Scientific Papers. Series A. Agronomy, Vol. LIX, 2016
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

IMPACT OF SETTLEMENT POINTS ON SOME PROPERTIES OF A HIGHLAND RANGELAND VEGETATION OF EASTERN ANATOLIA REGION OF TURKEY

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Abstract

In this study, three different rangeland sites were examined according to their attitude and usage degree in Kümbet village of Erzurum province during the year of 2004. Vegetation properties such as botanic composition, canopy coverage ratio, rangeland quality degree and health, carrying capacity, and similarity index were determined. Total 81 plants species were found in the experimental rangeland sites and sheep fescue (Festucaovina) was the dominant plant species at all sites. In botanic composition, the ratio of grasses, legumes and the other plant families were determined as 42.33%, 19.19% and 38.59% in average, respectively. Agropyron intermedium, Koeleria cristata and Bromus tomentollus from grasses; Astragallus microcephalus and Astragallus lagunus from legumes and Thymus parviflorus from the other families were the common plant species. Plant canopy coverage ratio was determined as 32.11%, 36.06%, and 58.24% at the I, II, and III rangeland sites, respectively. Rangeland site which has 35.47% quality score was evaluated as "Fair - at Risk Condition and health" class. In our study, rangeland site I was evaluated as "Poor –at Risk" condition and health class with 24.99% quality score, rangeland site II was evaluated as "Fair – at risk" condition and health class, and rangeland site III was evaluated as "fair - Healthy" condition and health class. In grazing season, rangeland carrying capacity was determined as 0.5 in I. site, 1.0 in II. site and 1.1 in III. site for Animal Unit.(AU) According to these results, 10 ha in site I, 5 ha in site II, and 3.18 ha in site III area were necessary for one AU during grazing season. Similarity index of rangeland plant canopy differed between 43 and 64. Current grazing management practices leads to overgrazing pressure especially around the permanent settlement; therefore, developing a suitable grazing management plan are necessary to provide sustainable use of the rangelands.

Key words*:Rangeland, botanical composition, canopy ratio, carrying capacity, similarity index.*

INTRODUCTION

Today, many countries in Africa, Northwestern and Southeastern Asia and Middle America come across insufficient feed sources and hunger problem in the world (Eswaren, 1996). Basic condition of meeting feed supply for increasing population is to increase production and keep sustainability of field crops and rangelands. The only way to overcome this problem is to increase production in a per unit area as agricultural lands are extremely limited.
Rangelands are highly important as they are enormous energy sources compared to agricultural lands (Lauenroth, 1979). They also play role on preventing erosion and protection of water resources, besides they are significant and cheap feed supplies. In addition, they maintain biological diversity since they are gene resources of plants and animals. Sustainability of the rangelands is important to challenge global warming. They are inevitable complements of country-life and wildlife (Holechek et al., 2004).
Sedentary husbandry system is common in the Eastern Anatolia, one of the important livestock region of Turkey. In summers, these rangelands are overgrazed; however, livestock are kept under shelter over harsh winters and fed on forage.
Overgrazing and over utilization of rangelands are main problems in Turkey. As a complementary damage of heavy grazing, erosion and deterioration of plant vegetation have been observed in many regions of the country. It was stated that Turkish rangelands have lost approximately 90% of their original vegetation (Gençkan et al., 1990). Therefore, losing plant vegetation of rangelands has accelerated erosion problem (Koç et al., 2000).

The rangelands which have been exposed to overgrazing are the close area to settling centers (Erkovan, 2000). After snow melts, livestock are grazed in close rangelands by owners until forming large flocks. After that, herders control and graze the herds in further rangelands. However, it does not mean that close rangelands are far from grazing pressure.
Overall these concept, this paper aimed to figure out the variation of rangeland vegetation under grazing concerning altitudes and distance to settling centers in Palandoken mountain ranges in Erzurum province of Turkey.

MATERIALS AND METHODS

The research was conducted in three rangeland sites (41º03' long and 40º22' lat), 18 km to Kumbet Village, in Erzurum province during the year of 2004. The altitude in the study area was between 1890 and 2100 m.
The rangeland was divided into 3 sites considering distance to settling area, altitude and utilization style. First site had 1820 m altitude, 200 m distance to settling center and 32% slope. This site was the closest to village and firstly grazed in early spring Therefore, this site was under heavy grazing during the season-long. The second site had about 1860 m altitude, 2 km distance to settling center and 13% slope. This site was grazed later than first site. So, it was hypothesized that grazing pressure in the second site would be less than first site because there is no grazing pressure upto the settlement's animals combined into herds. The third site was the furthest zone to settling center (8 km distance to settling center) and had alpine characteristics with its high altitude (2100 m). It had slight slope (8%) and was mostly grazed by pre-milked heifers. First and second sites were under season-long grazing (no limitation), but grazing began in the middle of June and ended in the middle of September in third site.
Erzurum province located in Eastern Anatolia mainly has typical harsh continental climate. Mean of long term temperature and mean of long term precipitation of Erzurum are 5.7°C and 435.6 mm, respectively (Anonimous, 2005). In the research year, climatic conditions were similar to long terms in temperature and precipitation.
Analysis for soil characters such as pH, organic matter, lime and salt content, available phosphor and potassium were done at the Laboratory of Directorate of Horticultural Research Institute. Results are presented in Table 1.
Concerning physical analysis; soil of the first range site was loamy, but the soil of the second and third range sites were clay loam.
The highest organic matter rate was found in the third range site with 4.94%, however; the lowest organic matter rate (0.87%) was found in the first range site. The second range site had 4.06%.
Soil pH of the range sites changed between 6.61 and 7.27. Lime contents of the first, second and third sites were 2.33%, 2.16% and 1.67%, respectively. Available phosphor was the lowest in the first site (41.1 kg ha^{-1}), highest in the second site 211.3 kg ha^{-1} and found 143.5 kg ha^{-1} in the third site. Available phosphor situations were sufficient in all sites according to Sezen (1991).

Table 1. Some physical and chemical properties of Rangeland sites

Soil characters	Rangeland sites		
	I	II	III
pH	7.27	6.61	6.91
Organic matter (%)	0.87	4.06	4.94
Lime (%)	2.33	2.16	1.67
Salt (%)	0.011	0.025	0.012
Phosphor (kg/da)	4.11	21.13	14.35
Potassium (kg/da)	136.97	140.33	143.16
Sand (%)	52.68	38.04	36.76
Silt (%)	31.84	36.52	36.65
Clay (%)	15.48	25.44	26.59
Texture class	loam	Clay loam	Clay loam

Botanical composition of the range sites were determined using the line-intercept method developed by Canfield (1941) in July of the year. Measurements were performed using 8 line intercept transects (for 10 m interval over a fixed 80 m length) considering the base area. The range condition score, condition and health classification were determined for each range site using the average botanical composition values according to Koc et al., (2003) criteria, consisting of a combination of (Dyksterhius, 1949) range condition classification and rangeland health methods of the Committee on

Rangeland Classification (National Research Council, 1994).

The percentage of vegetation cover-area was determined using the data used for determination of botanical composition (Gokkus et al., 2000).

In assessment of rangeland carrying capacity, the data of rangeland class and health based on grazing severity and particularly ecological factors were used, since rangeland feed was not able to be determined (Koc et al., 2003). In rangeland carrying capacity, 500 kg live weight was based for livestock.

Grazing period in Erzurum location is about 5 months (Koc, 1991). Therefore, grazing periods for the first and the second range sites regarded as 150 days; and 105 days for the third days regarding villagers' declarations.

Similarity indexes of the vegetation were calculated in the direction of Bakir (1970) and Okatan (1987) as follows:

$$(SI) = \frac{2W}{a+b} \times 100$$

SI: Similarity index

W: sum of least common values in the vegetation belonging to compared rangelands.

a: sum of botanical composition rates of common plant species which exist in the first location

b: sum of botanical composition rates of common plant species which exist in the second location

In order to compare the data obtained from 3 different sites of the experimental areas, arc sine transformation was applied to relative values (Cox 2002) after that, data were analyzed of variance at $p \leq 0.05$ and 0.01 levels of significance and means were compared using the least significant difference test at $p \leq 0.05$.

RESULTS AND DISCUSSIONS

Totally 81 plant species including 15 grasses, 11 legumes and 55 other families were determined in the three sites of the experimental area. In the botanical composition considering families, it was figured out that almost half of the plant species (42.23%) belonged to grass family. The other species followed the grasses (38.59%). Legumes had the lowest rate of the botanical compositions (19.19%) (Table 2).

Table 2. Botanical compositions of Rangeland sites

Plant species	I	II	III	Means	F	The mean square error
Agropyron intermedium	0.74 **B**	6.87 **A**	11.50 **A**	6.37	18.77**	12.41
Bromus tomentollus	0.64	4.27	2.63	2.51	3.20	8.23
Festuca ovina	21.06	30.30	28.62	26.66	1.67	116.23
Koeleria cristata	0.51 **b**	5.97 **a**	4.59 **a**	3.69	4.88*	43.31
Other grasses [11]	7.62 **A**	0.42 **B**	0.95 **B**	3.00	13.89**	9.27
Total	30.58 **B**	47.82 **A**	48.29 **A**	42.23	10.33**	78.88
[11]*Bromus erectus, Bromus inermis, Bromus japonicus, Bromus tectorum, Catabrocella parviflora, Dactylis glomerata, Elymus hispata, Poa bulbosa, Poa pratensis, Poa trivialis, Stipa lagascae*						
Astragalus lagurus	1.55	0.75	3.24	1.85	0.58	22.31
Astragalus microcephalus Other legumes[22]	6.81 **a**	3.44 **ab**	0.88 **b**	3.71	5.34*	52.11
Total	8.78 **b**	10.51 **b**	21.62 **a**	13.64	4.86*	79.85
	17.14	14.69	25.74	19.19	3.69	72.92
[22]*Astragalus lineatus, Astragalus ornitopodoides, Astragalus pinoterum, Medicago lupiluna, Medicago papillosa, Medicago varia, Onobrychis* spp., *Trifolium hybridum, Trigonella* spp.						
Thymus parviflorus	14.43 **A**	8.37 **AB**	1.38 **B**	8.86	9.57**	35.65
Other familes[33]	37.86	29.13	24.59	30.53	3.68	98.74
Total other families	52.29 **a**	37.50 **b**	25.97 **b**	38.59	21.01*	66.26
[33]*Acantalimon caryophila, Achilla biebersteyni, Achilla millefolium, Acinos rotundifolius, Alchemmilla* spp., *Allium* spp., *Alysum desertorum, Alysum minus, Anthemis cretica, Arenaria gypsophoides, Artemisia austriaca, Artemisia spisigera, Campanula* spp., *Carex* spp., *Carum carvi, Cenecio* spp., *Centaurea carduiformis, Centaurea sessilis, Chenepodium* spp., *Convolvulus lineatus, Eriyngium campestre, Erysimum leptocarpum, Euphorbia esula, Falcaria vulgris, Ferula* spp., *Galium* spp., *Gerenium* spp., *Gundellia* spp., *Herniaria incana, Lagotis stolonifera, Marrubium* spp., *Minuartia* spp,.*Muscari* spp., *Ornitogalum* spp., *Polygonum auculare, Potentilla argea, Potentilla bifurca, Rumex* spp., *Salvia* spp., *Salvia verticillata, Scariola wiminea, Scleranthus annuus, Scorzonera* spp., *Sessilis* spp., *Slene* spp., *Tanacetum abrotanifolium, Tanacetum absinthifolium, Tanacetum balsamita, Tanacetum* spp., *Taraxacum* spp., *Teucrium polium, Thesium* spp., , *Veronica oriemtalis, Xeranthemum annuum*						

According to analysis of variance, significant differences were found among the rangeland sites in both family groups and species ratios concerning botanical compositions (Table 2). The ratios of *Agropyron intermedium* and *Koeleria cristata* in the botanical composition showed s tatistically significant differences in

experiment area ($p<0.01$ and $p<0.05$, respectively).

Average ratio of *Festuca ovina* which was the dominant species in range sites was found 26.66% and it did not show any statistically significant differences regarding botanical homogeneity in the range sites.

There was no statistically significant difference among the plant species belonging to legumes which are extremely important for animal feeding and fixing nitrogen. The most common legume species in three range sites were *Astragalus* spp. which has no feeding value. *Astragalus microcephalus* was common in first and second range sites; however, *Astragalus lagurus* was common in third site. The botanical composition ratios of these legume species were over 1%. Botanical variation of *Astragalus lagurus* was insignificant but it was statistically significant for *Astragalus microcephalus* regarding range sites ($p<0.05$).

Thymus parviflorus, belonging neither legumes nor grasses and one of the most common species after grasses, showed statistically significant variation in the sites ($p<0.01$).

Among the range sites, plant coverage rates showed statistically significant difference ($p<0.01$) (Table 3). The highest and the lowest coverage rates were found in the third range site (58.24%) and first range site (32.11%), respectively. The second range site had 36.06% plant coverage rate but no statistically significant difference was determined between the first site and second site.

Table 3. Plant covering percentages of Rangeland sites (%)

	Rangeland sites					
	I	II	III	Means	F	The mean square error
Plant Coverage Rates	32.11 B	36.06 B	58.24 A	42.14	26.07**	60.86
Rangeland Score	24.99	43.01	38.94	35.47		
Classification of Rangeland condition and health	Poor - At Risk	Fair – at Risk	Fair - Healthy	Fair - Healthy e		
Stocking Rate (Animal Unit (AU))	0.5	1.0	1.1	0.86		
The area for a cattle unit (ha)	10	5	3.18	6.06		

As an average experimental range sites had 35.47 quality score and were placed in Fair- at Risk condition and health class. Comparing range sites, the first site was in Poor – at Risk with 24.99 quality score, the second site was in Fair at Risk, and finally the third site was located in the group of Fair - Healthy condition and health class.

Table 3 shows that the first site provides feed for 0.5 AU per month, the second site supplies feed for 1.0 AU per month, and the third site meets the feed requirement for 1.1 AU per month. Considering grazing periods (5 months for I. and II. sites; 3.5 months for III. Site); for an AU, 10, 5 and 3.18 ha rangelands should be allocated in the first, second and third range sites, respectively.

While the lowest similarity percentage among the range sites was found between the first and third sites (43%), it was determined between the first and second range sites with (64%) (Table 4).

Table 4. Similarity indexes of different rangeland sites(%)

Rangeland sites	I-II		I-III	II-III
Similarity index	64		43	62

Results from the experiment show that rangeland have lost more than half of their potential performance. This is an indication that they have been misused for long time. So far, none of range site have got half of total rangeland score at the researches which were conducted in the region concerning De Vries et al. (1951) and the calculations on range classification.

Deterioration in the rangelands close to settling areas were higher than further rangelands as closer rangeland to settling areas are started to graze, as soon as snow melts and they are grazed until next snowing without any control. In addition to heavy grazing, early grazing is

also serious problem on rangelands, especially the rangelands close to permanent settlements. . The basic dilemma on rangelands far from settling areas is heavy grazing. Therefore, precautions should be taken to heavy and early grazing and proper grazing systems should be established.

Plant covering percentage of the rangelands close to settling areas was around the critical value. Even the data below the critical value was obtained in some experiments. This situation is a rather handicap for erosion concept. Taking preventive measures are essential so as to keep the soil in rangeland and increase the yield.

CONCLUSIONS

Rangeland classification is closely dependent on the ratios of desired species in botanical composition. It is only possible with the precautions which activate the growth of desired species and suppress undesired species such as controlling livestock rate and grazing severity etc. If not possible, weed control (undesired species) should not be considered. Even though these plants are not preferred by livestock, these plants take extremely efficient role to protect soil against erosion. However, rangeland improvement systems and grazing management should be applied in all rangelands of Turkey.

REFERENCES

Anonymous, 2003. Erzurum Rural Services Research Institute Reliable Datas, Erzurum.

Bakir O., 1970. Middle East Technical University in a study of pasture land.Ankara University.Agr.Fac. Scientific Research and Development. No: 232, Ankara, 123.

Canfield R.H., 1941. Application of the interception method in sample range vegetation. J. Forest, 39, 388-394.

Cox G.W., 2002. General Ecology Laboratory Manual (8th ed) McGraw Hill Comp., New York, 312 p.

De Viries D.M., De Boer T.A., Dirver J.P.P., 1951. Evalation of grassland by botanical research in the Netherlands. In Proc. United National Sci. Conf. On The Conservation and Utilization Of Resources, 6, 522-524.

Dyksterhuis E.J., 1949. Condition and management of range land based on quantitative ecology. J. Range Manage., 2: 104-115

Eswaren H., 1996. Land degradation, International Conference on Land Degradation: Programme Abstracts and Excursions 10-14 June, 1996, Adana-Turkey.

Erkovan H.I., 2000. Çigdemlik Village (Bayburt) Current Status of rangeland vegetation. Atatürk University.Science Inst. Field Crops Department (M.Sc.) Erzurum.

Gokkus A., Koc A., 1996. Agricultural structure in Eastern Anatolia.Turkey III.Meadow and Forage Crops Congress.June 17 to 19, Erzurum.

Gokkus A., Koc A., Comaklı B., 2000. Meadow Implementation Guide. Atatürk University. Faculty of Agriculture. No: 142, Erzurum, p. 139.

Genckan M.S., Avcıoglu R., Soya H., Dogan O.O., 1990. The use of Turkey pasture, preservation and problems and solutions related to the development. Turkey Agricultural Engineering III.Technical Congress. January 8 to 12, Ankara, 53-61.

Holechek J.L., Pieper R.D., Herbel C.H., 2004. Range Management: Principles and Practices. Prentice Hall, New Jersey 607 p.

Koc A., 1991. Güzelyurtvillage (Erzurum) in Grazing Pasture and Termination Time of Starting Over Biomass of Soil and Grass Determination of the Year In A Study on the Change of Chemical Composition. Atatürk University.Science Inst. Department of Agronomy (Unpublished Master Thesis), Erzurum.

Koc A., Oztas T., Tahtacıoglu L., 2000. Rangeland-livestock Interaction in Our Near History Problems and Recommendations. Proc. Int. Symp. Desertification. 13-17 June Konya, Turkey, 293-297.

Koc A., Gokkus A., Altin M., 2003. Comparison of the world-widely used methods in definition of range condition and a suggestion for Turkey. Turkey 5. Field Crop Cong. 13-17 October 2003, Diyarbakır. p. 36-42.

Laurenroth W.K., 1979. Grassland Primary Production: North American Grassland in Perspective. In perspectives in Grasslands Ecology (Ed. N. French). Sprenger-Verlag New York, Inc., 3-24.

National Research Council, 1994. Rangeland Health, New Methods to Classify, Inventory and Monitor Rangelands. Washington, D. C.: National Academy Press, p. 180.

Okatan A., 1987. A ResearchTrabzon Virgin Mary River Watershed in Alpine pastures of some physical and hydrological soil properties with vegetation on the Structure. T. C. Ministry of Agriculture and Rural Affairs General Directorate of Forestry. No: 664, Serial No: 62, Ankara, 290.

Sezen Y., 1991. Fertilizers and fertilization. Atatürk University. No: 679, Agr. Fac. No: 323, Lesson Kit. No: 55, Erzurum, 251.