THE EFFECTS OF TOPOGRAPHICAL FACTORS ON FORAGE AND GRAZING PERIODS AND CARRYING CAPACITY IN EASTERN ANATOLIA REGION OF TURKEY

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ABSTRACT
In this study, natural pastures were selected for floristic and grazing measurement in toeslope, summit, footslope, and shoulder of four position with altitudes ranging between 2000-2500 m in 1992 and 1993. While the longest green forage periods were recorded for footslope, summit and northern faces, the longest dry forage periods were in the south and west sites. Duration of grazing period ranged between 120 and 140 days depending on climatic and topographical factors. Grazing period was the longest in the southern footslope whereas it was shortest in the summit and northern shoulder. Grazing area for a livestock unit (LU) needs to be at least 1.14 ha rangeland in the toeslope and the required range area for LU was highest with 3.20 ha in southern footslope.

KEYWORDS
Rangeland, Topography, Grazing Period, Animal Unit

INTRODUCTION
Eastern Anatolia occupies 19.6% of the total surface area in Turkey, and rangelands comprise 54.3% of total area in the region. The regional economy depends largely on animal husbandry, due to short and cool summer and extreme winter conditions which restrict the growth of many crops.

Rangeland dependent livestock production is mainly practiced by small scale family enterprises which try to benefit from the rangelands as much as possible. In traditional grazing management systems the misuse of communal rangelands has been continued for centuries. Grazing starts usually with melting of snow in early spring and continues until the period of permanent snow cover sets in autumn. Grazing capacity of the rangelands is not determined with respect to the rangeland production but available winter feed sources. These practices not only reduce production capacity of rangelands (Hart and Balla, 1982) but also are the main cause of deterioration of vegetation cover in the semi-arid climate (Holechek and Pieper, 1992).

Due to its fundamental impact on surface warming and water conservation, topography has a deep influence on the development of plant cover, hence, altering structure growth and the developmental course of plant cover. This in turn affects production period and carrying capacity of rangelands.

MATERIAL AND METHODS
Erzurum province (39^{o} 55$^{'}$ N and 41^{o} 61$^{'}$ E) has a semi-arid climate with an annual rainfall of 450 mm and with an average temperature of 6 ^{o}C. Altitude on the experimental site ranges from 2000-2500 m. On 10 sites representing toeslope, summit, and footslope and shoulder of four different expositions, grazing period, vegetation aspect and growing phase were investigated in 1992 and 1993 (Koç and Gökkus, 1996).

Initially, quality degree of range was estimated according to De Vries et al. (1951) to determine carrying capacity. Based on this study livestock unit (LU) (500 kg live weight) days per hectare were determined for each area using scales developed by Bakir (1965). The ratio of these values over the length of grazing period gave the required area for a LU. The means of two years are given in Figure 1 and Table 1.

RESULTS AND DISCUSSION
Growing Phases and Grazing Periods: The forage and grazing periods of the range plots were shown in Figure 1. Spring growth of plants in the experimental area began when snow melted and continued to the end of July or second half of August depending on climate. In this period, pasture regrowth started in the second half of September in 1992, but there was no regrowth in 1993 until snow cover in the first half of November. Although there were some differences in the initial spring growth and the beginning of summer dry periods of vegetation in plots, with regard to autumn regrowth no differences were observed among the sites. Both the initial spring growth and summer dry phase started the earliest in the south and west footslopes and the latest in the summit and shoulder positions of the north plots. The beginning of the summer dry phase was also very late in the toeslope position because of high soil moisture contents.

Depending on plant growth, the earliest grazing period started in the south footslope (May 20th) and it was followed by the west footslope and toeslope positions. However, it was the latest for summit and north shoulder positions (June 10th). On the other hand, because of high soil moisture content, grazing was delayed for about 20 days on toeslope plots. There was no difference in the closing time of grazing season in the plots because of similarities in autumn growth. Grazing season was ended at the end of September in the first year due to plant regrowth in autumn, but continued until the beginning of November in the second year since no autumn regrowth occurred. So, the longest grazing period was 140 days for southern footslope and the shortest grazing period was 120 days for the summit and northern shoulder positions.

Carrying Capacity: Required range area for LU varied between 1.14 ha (toeslope) and 3.20 ha (southern footslope) (Table 1), with an average of 2.76 ha including toeslope positions. Since the toeslope areas make up a small portion of total rangeland in the region, if the toeslope positions are excluded from the average figure, carrying capacity would change to 2.96 ha for LU.

The range quality degree in the region including study sites was between 4-5 (0: very poor; 10: excellent) (Koç and Gökkus, 1994). Bakir (1965) indicated that 1 ha range area with normal soil conditions in 400-500 mm rainfall zone (the majority of Eastern Anatoila is in this zone) can support grazing of LU for 43.75 days. Depending on the initial spring growth which is influenced by elevation and topographic differences, length of grazing seasons significantly varied. Therefore, in order to find out the required range area for LU for the whole grazing period, the length of grazing season in any part of Eastern Anatolia rangelands (with normal soil conditions) should be divided by 43.75 or multiplied by 0.023.

In conclusion, the start of spring growth and summer dry period depend on differences in topography and altitude of rangelands. Therefore, seasonal suitable grazing system should be selected for a profitable grazing management and animals should be supplemented

with feed after August 15th.

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Table 1
Required Range Area (ha) for an AU in a Grazing Period.

Range Plots	Required Range Area	Range Plots	Required Range Area
Toeslope	1.14	East Footslope	2.97
South Footslope	3.20	East Shoulder	2.97
South Shoulder	3.09	West Footslope	2.97
North Footslope	2.97	West Shoulder	2.97
North Shoulder	2.74	Summit	2.74
Range Sites Average:	2.76	Available Value:	2.96*

* Toeslope value was not included.

Figure 1
Forage Growing Phases and Grazing Periods in Relation to Plant Phenology.