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Full Length Research Paper

Impact of watering points on vegetation changes of a semi-arid natural pasture in Tekirdag Province, Turkey

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The research was carried out on natural pastures of Buzagici village of Tekirdag province, Turkey in 2005. The objective of this study was to determine effects of watering points on canopy cover, botanical composition, and hay yields of pastures using transect method. Data were collected from 4 different sites of natural pasture, two of which had watering points (sites 1 and 2), and two that had no watering points (sites 3 and 4). In sites 1 and 2, which had watering points, the percentage of botanical composition and percentage of canopy cover by grasses were less than in sites 3 and 4, which did not have watering points. The percentage of grasses in total vegetation increased with increasing distance from watering points. The highest total hay yield was obtained from site 4 (615.90 kg ha^{-1}); the lowest yield of total hay was obtained from site 2 (450.00 kg ha^{-1}). The periphery of watering points is always overgrazed by animals since they often visit watering points to drink water; therefore, those areas are generally covered by other families which have low feeding value.

Key words: Botanical composition, canopy cover, hay yield, pasture, watering point.

INTRODUCTION

Livestock products provide the major economic return from most range and pasture lands and compared with harvested or purchased feeds, pastures and pasture provide a relatively inexpensive and energy- efficient feed source for livestock (Valentine, 1990). The pasture are important components of agricultural production systems since plant canopy cover prevents soil erosion, increases soil organic matter and therefore restores soil fertility in addition to providing feed for livestock (Fageria et al., 1997). The pastures, characterized by different systems of grazing, resource usage, and management of communal grazing lands based on water resources, offer an opportunity to study changes in species composition and response of grasses to prolonged and intensive disturbance (Abule et al., 2005; Gemedo-Dalle et al., 2006). Ludwig et al. (2000) found that the cover of perennial plants increased whereas the area of bare soil decreased with increasing distance from watering points.

Similar studies have also substantiated that sites close to watering points are more intensively grazed, with negative consequences for vegetation cover and biodiversity (Ludwig et al., 2004; Johnson and Lewis, 1995). According to Whitford (2002), the soil-trampling effects on palatable species are severe in the vicinity of watering points. There was a clear increase in the proportion of palatable species with increasing distance from water (Friedel et al., 2003). Lange (1969) discussed that interactions between animals and watering points lead to the development of distinct ecological units, called piosphere. Pickup and Chewings (1994) defined that the term ‘grazing gradient’ as spatial patterns in soil or vegetation characteristics resulting from grazing activities and which are symptomatic of land degradation. Current grazing management causes overgrazing around the midday watering points. Therefore, developing new watering points and suitable grazing management plans are necessary to ensure more even distribution of grazing pressure (Comakli et al., 2008).

However, there is no information on what should be the minimum plant cover on pastures to maintain the pasture under excessive grazing conditions (Holechek et al., 2004).

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Table 1. Percentage of area canopy cover % (mean ±SD) of sites.

	Site			
	1	2	3	4
	Transect			
Grasses	48.65 ± 15.05	54.75 ± 12.93	66.75 ± 6.00	74.10 ± 13.46
Legumes	8.30 ± 1.17	7.25 ± 1.99	1.80 ± 0.37	1.35 ± 0.25
Other families	25.25 ± 2.12	9.90 ± 0.67	6.25 ± 0.71	5.50 ± 0.85
Total	82.20	71.90	74.80	80.95
Grasses, legumes, other families , F ratio:	Sites: 6.049** Sites:65.413 ** Sites: 383.15**			

P < 0.01** and P < 0.05* SD: Standart deviation.

Based on previous reports, the percentage of grass species in pasture vegetation was higher than species of legumes and species of other families (Kendir, 1999; Koc and Gokkus, 1996) . Lauenroth (1979) said that fundamental family of pasture vegetations are Poaceae and they are common especially in the districts in which the total rainfall is between 250 and 1000 mm and a lot of pastures around the world has an intense grass species and this is the reason they are called “Grassland”.

The objectives of this study were to determine effects of watering points on canopy cover, botanical composition, and hay yields of pastures.

MATERIALS AND METHODS

The study was carried out on natural pastures of Buzagici village (Latitude 41°13’ 60 N Longitude 27°10’60 E of Tekirdag, Turkey in 2005). Average annual temperature is 14.1°C; total annual precipitation was 522.3 mm in 2005, and long-term average precipitation and annual mean temperature were 462.4 mm and 10.50°C, respectively, in the area where the experiments were carried out. Measurements on pasture were made at 4 different sites, two of which had watering points (sites 1 and 2), two that did not have watering points (sites 3 and 4). Site 1 was close to the animals’ drinking water and living places. Site 2 was close to the animals’ drinking water and 400 m away from site 1and the living place. Site 3 did not have watering points 900 m away from site 1. Site 4 did not have water points 800 m away from site 1.

Based on analysis of soil sampled from the top 0 to 20 cm of pasture, the percentage of organic substance, phosphorus, lime, and total salt were determined to be 2.87, 5.42, 4.8 and 0.05%, respectively. Botanical composition and canopy cover were determined using transect (80 transects, 4×20 units) . Percentage of grasses, legumes and plant species from other families were determined with transect method (Altin et al., 2005). Measurements were made at the end of April. A total of 28 units were sampled at the four sites (seven units per site) to determine hay yield according to weight. For determination hay yield of the samples were harvested about 5 cm above the soil surface. All the plots in 0.25 m^2 were clipped from 28 units. Hay yield was determined by drying the samples at 78ëC for 24 h. All statistical analyses were performed using version 10.0 of the SPSS system.

RESULTS

The results of total canopy cover and botanical composition based on transect method is shown Tables 1 and 2, respectively. The results of our studies showed that the grazing and watering point lead to changes on botanical composition of pasture vegetation, where heavy grazing around watering points (site 1 and 2) changed percentage of canopy cover, botanical composition and hay yield. The percent total canopy cover was higher in site 1 than in the other sites. But, site 1 had the least grass canopy cover (Table 1). The percentage canopy cover of legumes was higher in sites 1 and 2 than in sites 3 and 4; however, in all four research regions, the percentage of legumes was less than the percentage of grass and other families. The percentage of species from other families was rather high in site 1 compared to the other sites. In this site, botanical composition can be changed by heavy grazing. Accordingly, annually legumes and other families ratio were increased. The percentage canopy cover of other families in site 1 was the highest. In sites 3 and 4, a larger decrease in the canopy cover of other families was determined with the transect method. Effects of differences between sites were highly significant for percentage botanical composition and canopy cover crops of grasses, legumes, and other families (P < 0.01). Botanical composition is shown in Table 2. Botanical composition of grasses and other species showed a trend among sites of 1 < 2 < 3 < 4; legumes and other families showed a trend among sites of 1 > 2 > 3 > 4 (Table 2). While the effect of differences between sites is highly significant for hay yields of total (P < 0.01), the effect of site differences was highly significant for percent composition of legumes (P < 0.01); and it was also significant for grasses, other families (P < 0.01) (Table 2).

The highest total hay yield was obtained from site 4(615.90 kg ha^{-1}); the lowest yield of total hay was obtained from site 2 (450.00 kg ha^{-1}) (Figure 1). Hay yield was less in sites 1 and 2 where watering points existed. For all sites of the pasture area, the average hay yield was 534.60 kg ha^{-1}. While the effects of differences between sites are highly significant for hay yields of grasses and legumes (P < 0.01), effects of sites on other families are highly also significant (P<0.01).

Table 2. Botanical composition % (mean ±SD) of sites.

	Site			
	1	2	3	4
Grasses	59.18±18.31	76.14±17.98	89.23±8.02	91.54±16.60
Legumes	10.09±1.43	10.08±2.77	2.40±0.50	1.67±0.32
Other families	30.73±2.58	13.78±0.93	8.37±0.95	6.79±1.05
Grasses,legumes, other families F ratio:		Sites:6.184**	Sites:60.074**	Sites:350.869**

P < 0.01** and P < 0.05* SD: Standart deviation.

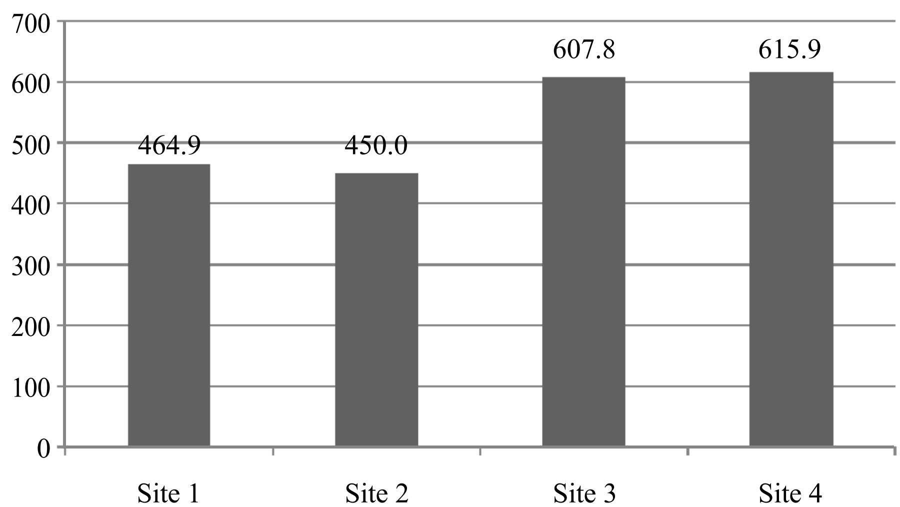

Figure 1. Total hay yield (kg ha^{-1}) of sites.

DISCUSSION AND CONCLUSIONS

The percentage of area covered by plants is an important feature in pasture improvement. The use of pasture, animal grazing pressure, and human activity can influence botanical composition and hay yield in watering point areas. In this study, we determined botanical composition and canopy coverage using transect. Our finding showed that watering points have significant effects on plant canopy cover and botanical composition. Hence, hay yield was less in the site closed to watering point compared to the other sites. Hart et al. (1989) stated that 77% grazing in a 1000 ha range occur within 400 m of the water sources. The lack of significant differences in most of the vegetation variables along the distance gradient from water could be ascribed to the fact that grazing disturbance has already exceeded a certain threshold of degradation (Solomon et al., 2007). Around watering points was always subjected to heavy grazing pressure compared to the area away from watering points. Heavy grazing is the most important factor causing the deterioration on botanical composition of rangelands. Overgrazing around the watering point not only has adverse affect on botanical composition but also decrease total hay yield. Hay yields obtained from sites 1 and 2 were low. A low percentage of grass botanical composition was one of the factors. Naveh and Whittaker (1979), stated that when grazing is either extensive or absent, the dominance of grasses eliminates other families and thus reduces diversity. Cattle and sheep prefer to graze in the vicinity of a watering point and vegetation is degradation in these areas, because, animals return regularly to drink to watering point two to three each day. According to Holechek et al. (2004), it is because the herds spent more time grazing around water resources during the dry season. Tuna (2000) indicated that, hay yield of grazed and ungrazed pastures were 357 to 1410 and 1830 to 2353 kg ha^{-1} in Trakya region.

The results of this study show that grasses were dominant in sites 3 and 4. We found grass canopy cover increased with the increase in distance from the watering point. Percentage of legume species decreased in the botanical composition as grasses percentage increased. The high density of grasses can caused a reduction in the percentage canopy cover of legumes. Site 4 does not have any watering point and is farther from a watering point; this area has been visited and grazed much less by animals compared to other sites. Solomon et al. (2007)

stated that species in the botanical composition varied with distance to watering point. In similar studies by Nangula and Oba (2004) and Gemedo-Dalle et al. (2006), grass canopy cover showed significant increases with increasing distance from watering points. Canopy cover of grasses was determined more likely to decline in abundance with proximity to watering point on the other hand, canopy cover of other families as determined increased since livestocks such as sheep, goat and cattle preferentially graze in the districts of watering points.

Besides, in this study, canopy cover and botanical composition of other families, were found in high percentage in watering point sites. However, based on the results of one recent study carried out in Turkey, plant species of other families were dominant in areas of pasture that were grazed excessively, although grasses were dominant in protected areas of pasture (Sılbır and Polat, 1996). Grasses formed dense communities in large areas of this pasture as in the local pastures, thereby increasing the area covered by vegetation. According to Adams et al. (1986), grasses are usually dominant in pastures all over the world (Arabaci and Yildiz, 2004; Ture et al., 2004), grasslands, which make up 20% of the world's vegetation coverage, are composed of Poaceae members. The most widely spread species on Buzagici pasture was scented grass *(Chrysopogon gryllus*). Scented grass (*C. gryllus) composes* 5% of densely covered areas which average is 15% in Trakya pastures, flowering to May from July (Uluocak, 1974; Davis, 1985). Todd (2006) stated that it has been shown that perennial plant cover increased rapidly away from watering points. Christiansen and Svejcar (1998) suggested that increased grazing pressure of animals put out to pasture resulted in weakness in developing plants, however, an increase in young shoots resulted in a greater covered area. Fusco et al. (1995) showed that even long term conservative cattle grazing cause a reduction in perennial grass phytomass in the sites closer to the water. Gemedo-Dalle et al. (2006) found that there is a highly significant positive correlation between the score of number of grass seedlings and distance from a watering point. Cattle and big game species often heavily graze forage plants near a water supply and neglect forage at long distances from water (Vallentine, 1990). From a livestock management stand point, the movement of drinking water to distant points in arid-land pastures is clearly the most effective tool affecting distribution of cattle; they shift location of their activities and remain near water (Ganskopp, 2001). Furthermore, gradients of utilization pressure develop around watering points, with the greatest impact near the watering point and decreasing pressure as distance away from the watering point increases (Tolsma et al. 1987, Brits et al., 2002). Over grazing in the vicinity of watering points is a world-wide phenomenon, but the current study was conducted in the pastures of a semiarid area in Turkey. Pasture vegetation is a plant community which is on a part of land and is affected by environmental factors and each other mutually and it consists of many kind of plants which grow up together. The percentage of area canopy covered by plant community is an important feature in land improvement. There is a powerful relationship between the area covered by plants and yield of vegetation.

Understanding the botanical composition, canopy cover and hay yield of natural pasture can lead to improvement of pastures and optimal use. Success in animal production depends on producing forage on pasture. Even when the yield of plant canopy cover is high, management of these fields must be done correctly. There were observed significant changes in canopy cover and botanical composition surrounding watering points on pasture. Together with this, hay yield of pasture is also affected from this changes a lot. Pasture management strategies change based on plant canopy cover and botanical compositions and, therefore, this information should be available to select the best management strategy. Management systems that decrease the percentage of other less desirable species and increase good quality legumes and grasses that are preferred by the animals should be developed in watering points areas. If number of watering point is increased on pasture, pressure of grazing can decrease in this area. Consequently, location of watering points in pasture affects grazing disturbance. Perfect distribution of livestock means that grazing pressure is spreading over rangeland areas. As a result, in the future, similar type more studies should be done to understand better the dynamics of the pasture ecosystem in natural areas.

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