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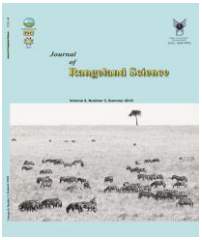

Research and Full Length Article:

Investigating Vegetation of Mowed and Grazed Areas in Tamdere Village Alpine Pastures in Turkey

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Abstract. Activities of transhumance ongoing have been mostly carried out in alpine pastures for centuries in Turkey. These pastures used unconsciously have faced to the danger of extinction. In order to implement improvement plans in the mentioned areas, qualitative and quantitative characteristics of pastures should be determined. This study was conducted in the mowed and grazed pastures in alpine zones in Anatolia, Turkey in 2013 and 2016. In the study, botanical compositions, quality degree, condition and healthy of areas, hay yield, grazing capacity and basal plant coverage of the pastures were investigated. Loop method was used for vegetation measurements concerning the blooming time of commanding plant species. According to the results obtained from the research, 146 taxa were identified involving 8 endemic from 30 families. In the mowed pastures, the average values of botanical composition were found as 31.61% grasses, 18.65% legumes and 49.74% other plant families and in the grazed pastures, the average of composition was estimated as 37.75% grasses, 14.25% legumes and 49.00% other plant families. Botanical compositions of grasses ($P\leq0.01$), legumes ($P\leq0.05$) and other families ($P\leq0.05$) were significantly different among the areas. Although all of the studied pastures were in the healthy quality degree and conditions ($P\leq0.05$) and danger of erosion has not been seen, quality of forage and grazing is not adequate in the study areas. Hay yield was given as 2869 kg ha^{-1}($P\leq0.01$) in the mowed areas and 1912 kg ha^{-1} ($P\leq0.01$) in the grazed areas. Grazing capacities in the mowed and grazing pastures were identified as 9.37 ($P\leq0.01$) and 6.87($P\leq0.01$) animal unit ha^{-1}, respectively and it was detected that the examined pastures were grazed over their capacity. According to situation of vegetation, it can be said that climax vegetation of pastures was perished and the management measures should be planned for grazing capacity. Pasture breeding studies should be paid attention. In addition, weed control, top seeding and fertilizing should be conducted.

Key words: Vegetation, Alpine, Pasture, Grazing, Mowing

Introduction

Alpine pastures consist of large grazing and mowing lands starting from forest upper boundary and reaching to the summit of mountains. Due to severe climatic conditions and generally steep terrain structure, the most productive usage of these areas is grazing or mowing. Besides animal husbandry production, alpine pastures also have vital ecosystem services functions like biodiversity maintaining, soil and water conservation and carbon storage (Zhao *et al.,* 2009; Dong *et al.,* 2010; Wen *et al.,* 2013; Luan *et al.,* 2014; Raiesi and Riahi, 2014).

Approximately 23% of the Turkey population lives in rural areas and their livelihood is from livestock. These people have practiced transhumance in subalpine or alpine pastures for many centuries and due to inadequate forage sector, animal husbandry usually depends on these areas. Many biotic and abiotic factors have adversely affected Turkey rangelands over the last 60 years. A rapidly growing population as well as the use of agricultural machinery is the steering wheel of this problem. Human population-dependant food and housing needs have increased and thus, pastures and meadows have been ploughed and turned into agricultural and housing zone lands. In the 1950s, Turkey had 44 million hectares of pasture; now, there is 14.6 million hectares of pasture (TSI, 2016); at the same time, increased number of livestock on the decreased pasture has led to overgrazing and deterioration in rangeland condition (Ünal *et al.,* 2010). These areas have been grazed too early and beyond their capacities; thus, the destruction of pastures is due to the fact that farmers violate the principles of pasture arrangements. As a result of mismanagement, climax vegetation of the rangelands became less effective (Avcioglu *et al.,* 2010), and the plant species with high feeding value started to disappear from the rangelands. Plant cover rates decreased and severe erosion problems have been seen at 90% of Turkey's rangelands (Koç *et al.,* 1994a).

In terms of biological diversity and ecological integrity, forest and alpine rangelands of Eastern Black Sea region are under threat due to investment projects, illegal cutting, road construction, enlargement of agricultural areas, tourism and plant picking with the aim of exportation and domestic use (Eminağaoğlu, 2004); also, the effects of grazing and mowed regime on vegetation characteristics of alpine pasture remain questionable. In the view of such information, rehabilitation and management should be first carried out in order to bring our pastures up to the demanded status. These works are based on determining the vegetation status of the said pastures, because vegetation research underlines implementation of rehabilitation and management.

Therefore, in this research, we investigated and compared the botanical composition, hay yield, quality degree, condition and healthy of pastures, grazing capacity, basal plant cover in the mowed and grazed areas. Thus, the effects of using our pastures by reaping and grazing will be found out and the data to be obtained at the end of the study will form a resource and basis to the researchers in pasture rehabilitation and management. The assessment of different usage patterns can help us to avoid negative effects and promote the utility efficiency of alpine pasture resources.

Materials and Methods

Study area

This study was carried out in 2013 and 2016 on the Alpine pastures in Giresun province. Tamdere village (40° 30' N latitude, 38° 20' E longitude, altitude of 1700-2300 m) in the Eastern Black Sea region of Turkey (Fig. 1). Native population mainly dealt with animal husbandry involving sheep, cow and horses; also, these pastures have been used by transhumant from other places in grazing season. The length of plant growing stage is about 180 days ranging between March and August. The mowed

pastures (150 ha slope 38-40%) are reaped about mid-July, opened for grazing afterwards and grazed until late autumn. Grazing has been started from early spring (mid-April) to late autumn (the end of October) in the grazing pastures (165 ha slope 38-40%). Black sea climate is with the distributed rainfall during the year, summer is warm and humid and winter is cool and damp in the area.

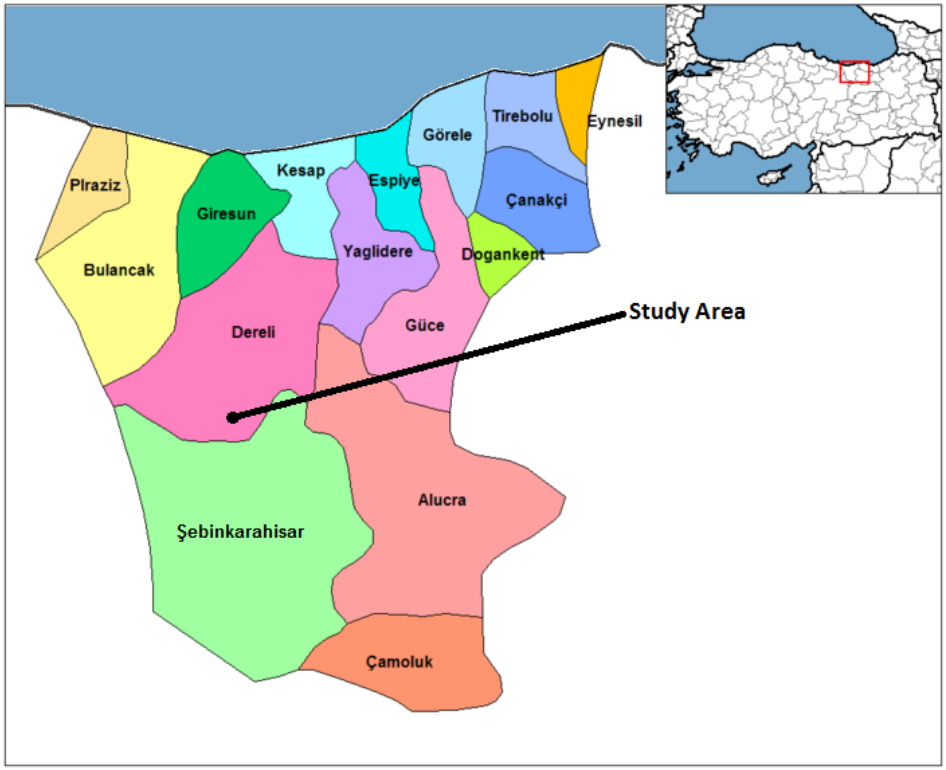

Fig. 1. Map of the study area Tamdere Village Alpine Pastures in Turkey

Due to the nearest meteorological station at 80 km distance, precipitation data were calculated with Schreiber Formula (Schreiber, 1904) and temperature data were calculated with Lapse Rate (Fairbridge *et al.*, 2005) for study area. The annual total precipitation is 1482.8 mm, 1761.9 mm, and 1564.8 mm and mean annual temperature is 7.5ºC, 8.3ºC, and 6.2ºC, respectively in 2013, 2016 and long period (1950-2015) (TSMS, 2016). Soil texture classes of the two pasture areas were the same (sandy-loamy) and organic matter quantity was higher in the mowed pastures (2.5%) than grazing pastures (1.4%). It was detected that the Nitrogen, Iron, Nickel and Copper quantities were higher in the mowed pastures than the grazing pastures.

Botanical composition

Botanical composition was surveyed at blooming time of commanding plant species. Loop method was used for vegetation measurements, which is a different way of point quadrate method and enables to easily monitor the changes in pasture vegetation. This method was developed by Parker and Harris (1959). Twenty meter long rope or steel wires have been used. This band is stretched out 20-25 cm above from the soil surface that is divided every 20 cm and 100 measuring points have been obtained. Encountered plant has been recorded with a ring of two cm diameter in every point.

Eighteen plots were surveyed in both mowed and grazed areas; totally, 3600 measurements were made in the manner representative areas. Identified plant species were grouped into the families of

Poaceae, Fabaceae and other families (Equation 1).

$$\text{Proportion of Y Family (\%)} = \frac{\text{Encountered Number of Y Species}}{\text{Total Number of Plants Encountered}} \times 100 \quad (1)$$

Where
Y is encountered any plant species.

In both pastures, plant species richness (*S*), Shannon Index of diversity (*H'*) and Evenness (*E'*) were determined (Equations 2 & 3).

$$H' = -\sum pi \times \ln pi \quad (2)$$

$$E' = H'/\ln S \quad (3)$$

Where
p_i is the proportion of total abundance of the $_i$th species.

To compare similarity between the mowed and grazed pastures for each plot, the Jaccard similarity index (Jaccard, 1912) was calculated (Equation 4).

$$J = \frac{a}{a+b+c} \quad (4)$$

Where
a is the number of species occurring both in the mowed and grazed areas,
b is the number of species occurring solely in the mowed area,
c is the number of species found exclusively in grazed area,
As the Jaccard similarity index increases from 0 to 1, the similarity increases between two different areas.

Quality degree, condition and health of pastures

Quality degree of range was estimated according to De Vries *et al.* (1951). For assessing pasture condition based on plant quality is the most suitable for use in Turkey. In accordance with plant species characteristics such as plant productivity, regrowth after defoliation, physical properties (e.g. hairy and spiny), palatability and poison content, each plant species is valued between -1 and +10 with the most desired plants +10 and poisonous plants -1.
Then, the Range Condition Score (RCS) can be calculated as follows (Equation 5):

$$RCS = \frac{\sum (Bcr \times Qv)}{100} \quad (5)$$

Where
Bcr is the ratio of the species within the botanical composition
Qv is the quality value of that species.
In a sampled site, the RCS of all species is summed up and divided by 100. Thus, it gives a range condition score value for this specific site. Range condition is divided into 5 classes: very poor (0.0-2.0), poor (2.1-4.0), fair (4.1-6.0), good (6.1-8.0), and excellent (8.1-10.0) (Fırıncıoğlu *et al.*, 2008).

The pasture condition (only cover of non-invasive and low-invasive used) and health (vegetation cover) of areas were calculated with the basal cover of rangeland vegetation (Koç *et al.*, 2003). All plant species were classified into three groups as non-invasive, low-invasive and invasive for different responses to grazing impact (Serin, 2005). Pasture condition was rated as poor (1-25 %). fair (26-50%). good (51-75%) and excellent (76-100%) (Koç *et al.*, 2003; Holechek *et al.*, 2004a). Pasture health was ranged in one of three categories: healthy (>40%), at risk (30%-40%) and unhealthy (<30%) (Koç *et al.*, 2003; Ünal *et al.*, 2010).

Grazing capacity

Grazing capacity was calculated using the formula below considering the average feed yield values of the pastures in order to determine the grazing capacities (Animal unit) in the period measured (Equation 6).

$$\text{Grazing Capacity} = \frac{(\text{Pasture area (ha)} \times \text{feed yield in unit area (kg ha}^{-1}) \times \text{utilization percentage(\%)} \times \text{Slope})}{(\text{Daily feed need of the animal to be grazed (kg day}^{-1}) \times \text{Grazing days})} \quad (6)$$

Where

- Pasture area (ha) = it is area of open and off grazing in field of research.
- Feed yield in unit area (kg ha^{-1}) = amount of hay yield in field of research.
- Utilization percent (%) = Bakır (1999) had said that in arid and semi-arid region, 50% of produced forage and rainy and irrigation region 80% of produced forage should be taken. This value was taken as 70 % in the study.
- Slope= in areas of 38-40% slope, this factor is taken as 0.7 for domestic and cross breed cattle (Altın *et al.*, 2011).
- Daily feed need of the animal to be grazed (kg day^{-1}) = daily need of an animal hay is 2.5% of weight for ruminants and 3% of weight for sheep and goats (Gökkuş and Koç, 2001).
- Grazing days= this period is between start date and finish date of grazing. In our study, this value was taken as 180 days.

Hay yield

Samples were taken with three 25×25cm^2 frames from everywhere to which loop measurement was applied in order to determine the hay yield in the pastures studied. Samples in the grazed area put under protection with enclosure. The hay within the 25×25cm^2 frames was reaped from 5 cm above ground level to represent the line measured. Three samples were taken from every loop line and 108 samples were taken in total. These samples were weighed separately after being dried for 48 hours in the cabinet drier set for 70°C and their total dry weight was calculated as hay yield. The average hay yield values of the total 108 samples taken from the measured areas were calculated separately for each area and then, these values were turned into the hay yield value per hectare.

Basal plant cover

Basal soil cover ratio of the plants was determined with the loop method. Ratio of Plant Cover (RPC) was calculated according to Gökkuş *et al.* (1995) (Equation 7).

$$RPC(\%) = \frac{\text{Number of Encounter ed Plant}}{\text{Total Number of Loop Measured}} \times 100 \quad (7)$$

As stated by Koç and Çakal (2004) "the measured values can be used for this purpose if measured by bottom covering strip method. "If measured by such methods as loop or wheeled loop, 55% measurement value should be considered for actual 30% covering and 70% measurement value should be considered for actual 49% covering". This suggestion was taken into consideration in the study.

Statistical assessment

The values were subjected to analysis of variance using MSTAT-C package program according to the randomized parcels experimental designs in order to compare the values obtained from four different sections in the study area. The data of the area covered with plants and botanical composition did not demonstrate a normal distribution since they were obtained by proportioning the data obtained by counting. Therefore, angle transformation was applied to these values before the analysis of variance. The statistically significant factor averages according to the results of variance analysis were compared with LSD test. Original data were used while making a diagram in LSD comparison tests. However, lettering was made according to the data to which angle transformation applied as in variance analysis.

Results

Vegetation characteristics

Hay yield, origin, life length, botanical composition, plant coverage and status of the identified species, the percentage of their distributions, the similarity between the mowed and grazed areas and Shannon and Evenness diversity index have been shown in Table 1.

At both the mowed and grazed areas, 146 taxa belonging to 30 families and 8 of which were endemic were determined in 2013 and 2016. 33.56% of the total

numbers of plant species were present at all sites. Families, origin, life length, quality level, status and number of presence in both areas have been shown in Table 3.

Shannon and Evenness index of diversity and number of family and taxon in mowed area was higher compared to grazed area. It had higher species than grazed areas in terms of species diversity and Jaccard similarity index had been determined as 0.31 and 0.34 for family and taxon, respectively. Result of analysis of variance showed significant differences between area for number of taxon ($P<0.05$) and number of family ($P<0.01$). On family basis, there were 30, 22, 16, 13, 7 and 58 taxon that belong to Poaceae, Fabaceae, Asteraceae, Lamiaceae, Rosaceae and other families, respectively. *Agrostis capillaris* L. (9.4%) and *Trisetum flavescens* (L.) P. BEAUV. (6.2%) in the mowed pasture, *Nardus stricta* L. (11.6%) and *Poa bulbosa* L.(%8.2) in the grazed pasture, *Agrostis capillaris* L., *Plantago lanceolata* L. and *Geranium sanguineum* L. were the most common species in non-invasive, low-invasive and invasive ones, respectively.

Both mowed and grazed areas showed significant differences for euro-siberian and unknown phytogeographic regions ($P<0.05$). Unknown phytogeographic region has the most species as compared to other regions and this is followed by the euro-siberian phytogeographic region. According to life length, except perennial ($P<0.05$), there were no significant differences among annual, biannual, Annual-Biennial species. For both areas, invasive species were higher than non-invasive species. There were significant differences ($P<0.05$) for invasive species and it showed the lowest similarity values. Also, non-invasive species had significant ($P<0.05$) differences between sites. Ratios of Poaceae, Fabaceae and other families were determined and there were significant differences ($P<0.01$, $P<0.05$ and $P<0.05$) between the areas, respectively. *Agrostis capillaris* L. and *Nardus stricta* L. in Poaceae family, *Medicago sativa* L. and *Trifolium repens* L. var. repens L. in Fabaceae family and *Plantago lanceolata* L. (Plantaginaceae), and *Origanum vulgare* L. subsp. gracile (C. KOCH) IETSWAART (Geraniaceae) in other families were determined in the mowed and grazed areas, respectively. Families showed no differences in terms of plant coverage. Sum of covering was 60.35% and 59.74% in the mowed and grazed areas, respectively.

Quality degree, condition and health of pastures and grazing capacity

Results of variance analyses were given for quality degree, condition and health of pastures, grazing capacity and required area (ha) (for 1 Animal Unit) in Table 2. Quality degrees and condition of pastures give status of nutritious forage considering non-invasive or low-invasive species. Health of pastures was calculated by the basal cover of rangeland vegetation that indicates state of health against such erosion.

According to results of variance analyses on quality degree, condition and health were significant differences ($P<0.05$) in both managements. Quality degrees were fair (4.17) and poor (3.50) and condition of pastures was good (53.12) and fair (37.64) in the mowed and grazed areas, respectively. Mowed area had better situation of pasture than other areas. But both areas had a similar health condition and there was no difference between areas. Grazing capacity had a crucial difference ($P<0.01$) that was determined as 9.37 animal unit in the mowed and 6.87 animal unit in the grazed area; also, there were significant differences ($P<0.01$) between areas for the required area (for 1 animal unit) that was determined as 11.20 ha for the mowed area and 16.81 for the grazed area (Table 2).

Table 1. Means of origin, life length, status, botanical composition of the identified species in the research areas

Variables	Mowed Area		Grazed Area		Jaccard Ind.
	Number	%	Number	%	
Shannon Ind.	4.067	-	3.354	-	-
Evenness	0.848	-	0.779	-	-
Family**	22	73.34	14	46.67	0.31
Taxon*	121	82.88	74	50.68	0.34
Hay Yield(kg ha^{-1})**	2869	-	1912	-	-
Origin					
Endemic	6	4.96	4	5.41	0.25
Euro-Siberian*	29	23.97	18	24.32	0.47
Irano-Turanian	4	3.31	3	4.05	0.40
Mediterranean	3	2.48	1	1.35	-
Unknown*	79	65.29	48	64.86	0.36
Life Length					
Annual-Biennial	1	0.83	-	-	-
Annual-Biennial-perennial	1	0.83	-	-	-
Annual	13	10.74	8	10.81	0.27
Biannual	1	0.83	1	1.35	-
Perennial*	105	86.78	65	87.84	0.37
Status					
Invasive*	73	60.33	40	54.05	0.29
Low-Invasive	20	16.53	20	27.03	0.43
Non.-Invasive*	28	23.14	14	18.92	0.45
Botanical Com.					
Poaceae**	24	31.61	20	36.75	0.47
Fabaceae*	20	18.65	10	14.25	0.36
Other families*	77	49.74	44	49.00	0.29
Plant Covering ratio					
Poaceae	-	19.13	-	23.57	-
Fabaceae	-	10.34	-	8.56	-
Other families	-	30.88	-	27.61	-
Sum of Covering	-	60.35	-	59.74	-

*, **= The differences between the percent values of two sites are significant at 5 and 1% probability levels, respectively

Table 2. Means of quality degree, pastures condition and health of pastures in the research areas

Variables	Mowed	Grazed
Quality Degrees*	Fair(4.17)	Poor(3.50)
Condition of Pastures*	Good(53.12)	Fair(37.64)
Health of Pastures	Healthy(60.35)	Healthy(59.74)
Grazing Capacity (Animal Unit ha^{-1})**	9.37	6.87
Required area (ha) (for 1 Animal Unit)**	11.20	16.81

*, **= The differences between the percent values of two sites are significant at 5 and 1% probability levels, respectively

Table 3. Identified species and their families, origin, life length, quality level, status, and number of presence in study areas

PLANTS	O	LL	QV	S	M	G
Apiaceae						
Astrantia maxima PALLAS subsp. maxima PALLAS	M	P	-1	I	22	-
Carum sp.	U	P	0	I	4	1
Chaerophyllum aureum L.	U	P	1	I	18	-
Heracleum humile SM.	M	P	0	I	4	-
Heracleum sphondylium L.	U	P	3	LI	4	-
Malabaila secacul BANKS ET SOL.	U	P	1	I	4	-
Asteraceae						
Achillea biserrata M.Bieb	IT	P	3	LI	14	44
Achillea kotschyi BOISS. subsp. kotschyi BOISS.	U	P	1	I	5	4
Anthemis marschalliana WILLD. subsp. pectinata (BOISS.) GRIERSON	U	P	2	I	2	-
Anthemis tinctoria L. var. tinctoria L.	U	P	2	I	8	-
Aster alpinus L.	U	P	2	I	1	-
Bellis perennis L.	ES	P	3	LI	1	7
Centaurea sp.	U	P	1	I	10	5
Centaurea triumfettii ALL.	U	P	1	I	25	-
Cirsium arvense (L.) SCOP. subsp. arvense (L.) SCOP.	U	P	0	I	1	2
Cirsium vulgare (SAVI) TEN.	U	B	0	I	5	1
Doronicum macrolepis FREYN ET SINT.*	E	P	1	I	1	-
Lapsana communis L. subsp. grandiflora (Bieb.)Sell.	ES	P	2	I	40	-
Pilosella cymosa (L.) C. H. ET F. W. SCHULTZ	ES	P	1	I	1	3
Pilosella hoppeana (Schultes) C H. Et F.W. Schultz subsp. Testimonials	ES	P	2	I	-	12
Taraxacum scaturiginosum G. Hagl.	U	P	5	LI	39	53
Tragopogon aureus BOISS.*	E	P	1	I	1	-
Boraginaceae						
Myosotis olympica Boiss.	U	P	1	I	-	9
Brassicaceae						
Campanula stricta L. var. stricta L.	U	P	1	I	2	-
Campanulaceae						
Asyneuma amplexicaule (Willd.) Hand.-Mazz. Subsp. Aucheri (A. Dc.) Born	IT	P	1	I	1	-
Campanula glomerata L. subsp. hispida (WITASEK) HAYEK	ES	P	1	I	1	-
Campanula latifolia L.	ES	P	1	I	2	-
Campanula sp.	U	P	1	I	3	7
Campanula stricta L. var. stricta L.	IT	P	1	I	4	-
Caryophyllaceae						
Arenaria gypsophiloides LMANT. var. gypsophiloides LMANT	M	P	2	I	-	2
Dianthus carmelitarum REUT. EX BOISS.*	E	P	2	I	9	10
Silene saxatilis SIMS	U	P	1	I	3	-
Silene vulgaris (MOENCH) GARCKE var. vulgaris (MOENCH) GARCKE	U	P	1	I	15	-
Cistaceae						
Dactylis glomerata L. subsp. glomerata L.	ES	P	7	NI	22	51
Convolvulaceae						
Calystegia sepium (L.) R. Br. Subsp. sepium R. Br.	U	P	1	I	4	-
Crassulaceae						
Sedum album L.	U	P	0	I	-	18
Cyperaceae						
Carex sp.	U	P	4	LI	1	-
Cyperus sp.	U	P	2	I	4	45
Dipsacaceae						
Scabiosa columbaria L. subsp. columbarium L. var. columbarium L.	U	P	1	I	9	-
Ericaceae						
Vaccinium arctostaphylos L.	U	P	1	I	1	-
Vaccinium uliginosum L.	U	P	1	I	-	2
Euphorbiaceae						
Euphorbia sp.	U	P	-1	I	5	-
Fabaceae						
Anthyllis vulneraria L. subsp. polyphylla (DC.) NYMAN	ES	ABP	7	NI	2	-
Astragalus sp.	U	P	2	I	-	10
Festuca valesiaca SCHLEICHER EX GAUDIN	U	P	6	LI	-	34
Lathyrus pratensis L.	ES	P	8	NI	6	-
Lathyrus tukhtensis CZECZ.*	U	P	5	LI	4	-
Lotus corniculatus L. var. tenuifolius L.	U	P	8	NI	12	22
Medicago sativa L.	U	P	8	NI	50	-

PLANTS	O	LL	QV	S	M	G
Medicago scutellata (L.) MILLER	U	A	8	NI	1	-
Onobrychis armena BOISS. ET HUET	U	P	8	NI	22	19
Trifolium arvense L. var. arvense L.	U	P	8	NI	8	8
Trifolium campestre SCHREB	U	A	9	NI	3	-
Trifolium canescens WILLD.	U	P	7	NI	3	-
Trifolium dubium SIBTH.	U	A	8	NI	26	26
Trifolium ochroleucum HUDS.	U	P	7	NI	14	7
Trifolium pratense L. var. pratense BOISS. ET BAL.	U	P	9	NI	47	28
Trifolium repens L. var. repens L.	U	P	9	NI	11	59
Trifolium rytidosemium BOISS. ET HOH var. rytidosemium BOISS. ET HOH.	U	P	8	NI	1	-
Trifolium spadiceum L.	ES	AB	7	NI	1	-
Vicia balansae BOISS.	U	P	8	NI	1	-
Vicia cracca L. subsp. caracca L.	ES	P	8	NI	37	-
Vicia freyniana BORNM.*	E	P	8	NI	26	1
Vicia narbonensis L. var. narbonensis L.	U	A	7	NI	10	-
Geraniaceae						
Geranium rotundifolium L.	U	A	3	LI	-	1
Geranium sanguineum L.	ES	P	1	I	49	6
Geranium sp.	U	P	1	I	7	-
Hypericaceae						
Hypericum calycinum L.	U	P	-1	I	1	-
Hypericum perforatum L.	U	A	-1	I	-	34
Lamiaceae						
Calamintha grandiflora (L.) Moench.	U	P	0	I	22	-
Clinopodium vulgare L. subsp. vulgare	ES	P	1	I	2	4
Lamiaceae sp.	U	P	2	I	9	-
Marrubium astracanicum JACQ. subsp. astracanicum JACQ.	U	P	2	I	1	-
Origanum vulgare L. subsp. gracile (C. KOCH) IETSWAART	IT	P	1	I	4	96
Prunella sp.	ES	P	1	I	-	1
Prunella vulgaris L.	ES	P	1	I	8	6
Salvia sp.	U	P	-1	I	-	4
Salvia verticillata L. subsp. verticillata L.	ES	P	0	I	29	-
Sideritis sp.	U	P	0	I	2	-
Stachys macrantha (C. KOCH) STEARN	U	P	1	I	3	-
Thymus pseudopulegioides KLOKOV VE DES.-SHOST.	U	P	3	I	-	49
Ziziphora sp.	U	P	1	I	-	4
Liliaceae						
Allium sp.	U	P	0	I	-	1
Lilium ciliatum P. H. DAVIS*	E	P	0	I	1	-
Muscari neglectum Guss.	U	P	0	I	1	32
Ornithogalum sp.	U	P	0	I	-	5
Veratrum album L.	ES	P	-1	I	10	-
Linaceae						
Linum hypericifolium SALISB.	U	P	2	I	4	-
Linum sp.	U	P	2	I	1	-
Orchidaceae						
Anacamptis pyramidalis (L) L. C. M. RICHARD	U	P	0	I	-	1
Plantaginaceae						
Plantago lenceolata L.	U	P	3	LI	66	50
Poaceae						
Agrostis capillaris L.	ES	P	8	NI	144	29
Alopecurus myosuroides Hudson var. myosuroides	ES	A	2	I	3	-
Alopecurus sp.	U	P	5	LI	-	10
Arrhenatherum sp.	U	P	6	LI	-	2
Brachypodium pinnatum (L.) P. BEAUV.	ES	P	5	LI	14	-
Briza media L.	U	P	5	LI	25	6
Bromus hordeaceus L. subsp. hordeaceus L.	U	A	7	NI	18	-
Bromus sp.	U	P	6	LI	2	2
Cynosurus cristatus L.	ES	P	5	LI	31	55
Cynosurus echinatus L.	M	A	4	LI	6	-
Dactylis glomerata L. subsp. glomerata L.	ES	P	7	NI	37	11
Deschampsia flexuosa (L.) TRIN.	ES	P	4	LI	-	1
Deschampsia sp.	U	P	4	LI	2	-
Eremopyrum orientale (L.) JAUB. ET SPACH	IT	A	4	LI	-	16
Festuca gigantea (L.) VILL	ES	P	6	LI	1	-

PLANTS	O	LL	QV	S	M	G
Festuca heterophylla L.	ES	P	6	LI	34	1
Festuca lazistanica subsp. giresunica*	E	P	6	LI	-	34
Festuca lazistanica ALEXEEV subsp. lazistanica ALEXEEV*	E	P	6	LI	12	-
Festuca pratensis HUDSON	U	A	6	LI	14	1
Festuca xenophontis MARGR.-DANNENB.*	E	P	6	LI	-	34
Koeleria cristata (L.) Pers.	U	P	7	NI	2	-
Nardus stricta L.	ES	P	2	I	3	174
Poa bulbosa L.	U	P	4	LI	1	123
Poa longifolia TRIN.	U	P	7	NI	1	20
Poa pratensis L.	U	P	9	NI	9	3
Poa sp.	U	P	7	NI	1	-
Poa trivialis L.	U	P	8	NI	10	-
Rostraria cristata (L.) Tzvelev var. cristata	U	A	2	I	3	5
Secale montanum GUSS.	U	P	2	I	15	2
Trisetum flavescens (L.) P. BEAUV.	ES	P	8	NI	95	23
Polygalaceae						
Polygala major JACQ.	ES	P	2	I	1	-
Polygonaceae						
Polygonum bistorta L. subsp. carneum (Koch) Coode Et Cullen.	ES	P	1	I	28	5
Rumex acetosella L.	U	P	2	I	13	10
Rumex sp.	U	P	1	I	1	-
Primulaceae						
Primula elatior (L.) Hill subsp. pallasii (Lehm.) W. W. Sm. Et Forrest.	ES	P	1	I	19	9
Ranunculaceae						
Anemone narcissiflora L. subsp. narcissiflora L.	ES	P	0	I	36	-
Ranunculus illyricus L. subsp. illyricus L.	U	P	-1	I	7	-
Ranunculus polyanthemos L.	U	P	-1	I	5	-
Ranunculus sp.	U	P	-1	I	-	7
Rosaceae					-	
Alchemilla pseudo cartalinica Juz.	U	P	2	I	39	78
Fragaria vesca L.	U	P	1	I	3	4
Potentilla recta L.	U	P	1	I	2	-
Potentilla sp.	U	P	1	I	1	-
Rosa canina L.	U	P	0	I	4	-
Sanguisorba minor SCOP. subsp. lasiocarpa (Boiss. Et Hausskn.) Nordb.	U	A	8	NI	-	12
Sibbaldia parviflora Willd. var. parviflora Willd.	U	P	0	I	-	13
Rubiaceae						
Galium album MILLER subsp. prusense (C. Koch) Behrend. Et Krendl	U	P	3	LI	12	3
Galium verum L. subsp. verum L.	ES	P	3	LI	2	13
Scrophulariaceae						
Euphrasia rostkoviana HAYNE subsp. rostkoviana HAYNE	ES	A	0	I	8	12
Rhinanthus angustifolius C.C.Gmelin subsp. grandiflorus (Wallr.) D.A. Webb	U	A	-1	I	14	-
Rhynchocorys stricta (C. KOCH) ALBOV	U	A	0	I	18	-
Veronica filiformis J. E. SMITH	U	P	1	I	1	-
Veronica gentianoides VAHL subsp. gentianoides	U	P	0	I	2	-
Veronica sp.	U	P	0	I	4	-
Valerianaceae						
Valeriana alliariifolia ADAMS	U	P	0	I	24	-
Number of Empty Point	-	-	-	-	272	298

M: number of presence in Mowed area
G: number of presence in Grazed area
QV: Quality Value
LL: Life Length
P: Perennial
A: Annual, B: Biennial
AB: Annual-Biennial
ABP: Annual-Biennial-Perennial
S: Status
I: Invasive
LI: Low-Invasive
NI: Non-Invasive
O: Origin
E: Endemic
ES: Euro-Siberian
IT: Irano-Turanian
M: Mediterranean
U: Unknown

Discussion

Botanical Composition

Our results showed that there were significant effects of grazing and mowing on the structure of vegetation in study areas. Both areas had lost climax vegetation as Altın *et al.* (2011) have shown that plants in pasture were divided into three groups as non-invasive, low-invasive and invasive. Non-invasive plants are natural member. There were low-invasive plants up to maximum 30% and there were no invasive plants in climax vegetation. Ratios of invasive plants were determined as 60.33% in the mowed area and 54.05% in the grazed area. The pastures in Turkey had generally lost their climax vegetations up to 90%. Low quality degree of the pastures in these places is an expected result (Gençkan *et al.*, 1990). Generally, in Turkey's pastures, invasive and low-invasive plants are encountered rather than non-invasive ones (Babalık, 2008; Altın *et al.*, 2011). Therefore, the above explanations support the result obtained from the current study.

The families with the most species are given in Fig.2. It was determined that Asteraceae, Fabaceae, Lamiaceae, Scrophulariaceae, Poaceae and Rosaceae families had a larger number of species in studies done in Black Sea (Kılınç, 1985; Terzioğlu, 1998; Özbucak *et al.*, 2006; Özbucak and Kutbay, 2008; Deveci *et al.*, 2012) as Davis (1965-1985) had shown that these families are quick-spread and increasing in Turkey's Flora.

Number of taxon in the mowed area was identified as the highest compared to the grazed area (Fig. 2). This situation can be explained with reaping time. The mowed pastures were used in parts as reaping areas by the villagers, and even two lands side by side may not be reaped at the same date because the villagers arrange the reaping time according to the climatic conditions, labor supply and available time. Because of this, unseasonably reaping has caused fall seed of plants.

Livestock grazing is one of the most essential means of grassland utilization worldwide (Dong *et al.*, 2011) but depending on early and overgrazing, firstly non-invasive species had abandoned the area and low-invasive species take over the location of these species. If misuses continue, low-invasive species have abandoned and invasive species take over the location of low-invasive species (Gökkuş, 1994; Holechek *et al.*, 2004b; Altın *et al.*, 2011; Çomaklı *et al.*, 2012). In the study areas, since grazing was made very early and intensely, many plants were plucked; in turn, these plants cannot go seed setting. Percentages of invasive, low-invasive and non-invasive species were 54.05%. 27.03% and 18.92% respectively; results of study well suit with the above explanations.

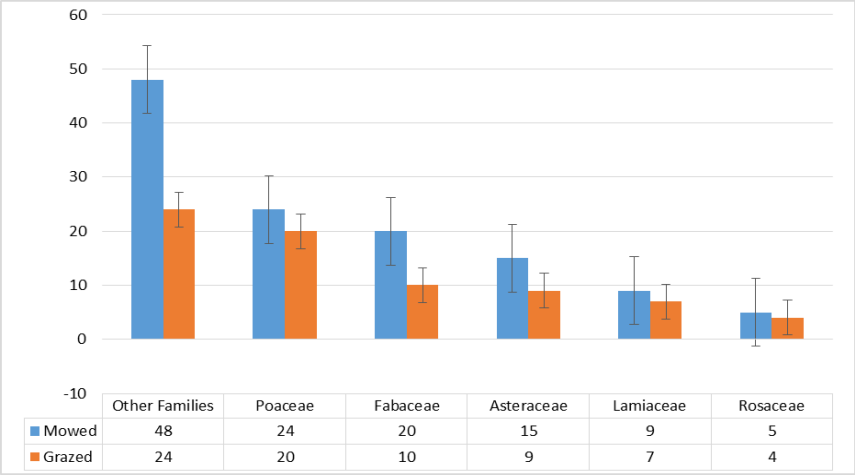

Fig. 2. The means of species number in families in two sites of study areas

Quality degree, condition and health of pastures

Quality degrees and condition of pastures are different between areas that were better in mowed areas than grazed areas. This variation is derived from the differences in quality grades of the species present in the composition. It can be said that mowing is less harmful as compared to grazing on pastures. Most of farmers are unconscious about grazing. An assessment of rangeland potential (Koç *et al.,* 1994b) showed that rangelands in Turkey are overgrazed 2-3 times more than their carrying capacity. High grazing pressure reduces diversity because only a few species are resistant to defoliation (Puerto *et al.,* 1990).

Health of both pastures was determined the same as healthy. It can be assumed that a healthy pasture may not be a good class pasture. This is a pleasing situation because erosion is a big problem in a poor rangeland condition. Restoration of pasture is immediately needed for achieving vegetation cover that intercepts raindrops, protects soil aggregates from raindrop impact, and reduces erosion (Carleton *et al.,* 2006). On the other hand, because study area's climate is very rainy, erosion is a threat for pastures. Based on the studies done in Italy and Austria, alpine pastures had erosion risk less than natural meadow. This situation depends on different plant species (Tasser *et al.,* 2003), because pastures can have more plant species than meadow.

Grazing capacity and hay yield

It can be said that the best useful method is grazing for alpine grassland and grazing regime has an important effect on grassland ecosystem (Mekuria and Aynekulu, 2013; Zhang *et al.,* 2015). However, the mechanisms show that alpine meadow vegetation responses to this management regime remain unclear (Li *et al.,* 2017). Grazing may transform community composition, therefore, influencing the plant allocation pattern (Semmartin *et al.,* 2008). Our study indicated that effect of mowed was better than grazing on grazing capacity. According to Table 1, number of taxon in the mowed area was higher than the grazed area; thus, grazing affected botanical composition in ill parts. Almost all of the farmers are unaware of importance of grazing capacity.

Grazing can increase or decrease biomass depending on the grazing intensity and history (Milchunas and Laurenroth, 1993). In the studies of Wang and Wang (1999) and Cao *et al.* (2004), it has been shown that different grazing intensities had significant effects on grass biomass with biomass decreasing under high grazing pressure. Our results suggested that grazing intensity markedly affected the above ground biomass of the pasture ecosystem.

Hay yield in a pasture depends on the reaping time, plant species in botanical composition, soil covering ratio of the plants, soil characteristics, climate and topography. In consequence of the statistical differences between the mowed and grazed pasture in terms of hay yield averages, it can be said that using the pasture as reaping area has more positive effects on hay yield than grazing.

Basal plant cover

In the study, plant coverage ratios of both areas were similar and there was no significant difference between two areas. Indeed, these results are pleasing because erosion has been seen everywhere in Turkey and it should not be regarded as the soil loss. Because with soil nutrients and valuable soil biota, species diversity of plants-animals and microbes are significantly reduced (Zuazo and Pleguezuelo, 2008).

In the six-year study in grazing and non-grazing pastures by Holechek *et al.,* (2006), they concluded that there were no differences in the botanic composition and basal soil covering ratio of the plants

for two pastures in long term. Our study complies with the study above. According to our results, there was a difference between botanic compositions but results of plant coverage were supported by above study.

Agrostis capillaris L. (9.4%) in the mowed area, and *Nardus stricta* L. (11.6%) in the grazed area were determined in terms of soil covering. *Agrostis capillaris* L. is perennial and high-value feed. It stands up to reaping and grazing after reaping. *Nardus stricta* L. is ball-shaped, perennial, low-value feed and belongs to group of invasive plants but it has been seen that it resists against intensity grazing and extreme environmental conditions. Alibegovic-Grbic *et al.* (2008) demonstrated that this species was not wanted in the pastures. On the other hand, for controlling erosion, *Nardus stricta* L. can be considered.

Conclusion

Considering the results obtained from the study, these implications can be made for the existing and similar pastures. Till agriculture cannot be performed in the Alpine pastures due to rough terrain and harsh climate conditions, these regions should be used in accordance with the pasture management principles without damaging the soil, water and the other natural resources. In order to ensure sustainability in the current areas, the critical periods of spring and autumn should be considered and the pastures should be grazed with animals in the appropriate number and type for their capacities and vegetation. Studies should be made on the determination of the most appropriate reaping time in the pastures used as reaping area. Invasive species should be controlled and overhead seeding should be applied with the decreasing and increasing species existing in the vegetation and preferred by the animals (such as *Agrostis capillaris* L., *Trisetum flavescens* (L.) P. Beauv., *Medicago sativa* L., *Lotus corniculatus* L. var. tenuifolius L., *Dactylis glomerata* L., *Festuca pratensis* L.) to the pastures to reach the secondary climax level.

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چکیده. فعالیت‌های پرورش گوسفند قرن‌ها است در ترکیه و عمدتا در مراتع آلپ انجام می‌شود. استفاده بی رویه از این مراتع، برخی از گیاهان را با خطر انقراض مواجه کرده است. برای بهبود پوشش گیاهی مناطقی که مورد استفاده می‌باشند، باید ویژگی‌های کمی و کیفی مرتع مشخص شود. این مطالعه در مراتع در حال چرا و چرا شده، در مناطق کوهستانی آناتولی، ترکیه در سال ۲۰۱۳ الی ۲۰۱۶ انجام شد. در این مطالعه؛ ترکیب گیاه‌شناسی، درجه کیفیت، وضعیت و سلامت مراتع، عملکرد علوفه خشک، ظرفیت چرا و پوشش گیاهی مراتع مورد بررسی قرار گرفت. برای بررسی درصد پوشش از ترانسکت حلقه‌ای و در زمان گلدهی گونه‌های گیاهی غالب منطقه استفاده شد. با توجه به نتایج به دست آمده از این پژوهش، ۱۴۶ گونه‌ی گیاهی که ۸ گیاه بومی بودند از ۳۰ خانواده شناسایی شدند. در مراتع در حال چرا، بطور متوسط از ترکیب گیاه‌شناسی ۳۱/۶۱٪ از خانواده گندمیان، ۱۸/۶۵٪ بقولات و ۴۹/۷۴٪ از خانواده‌های دیگر گیاه بودند. در مراتع چرا شده به طور متوسط از ترکیب گیاهان ۳۷/۷۵٪ گندمیان، ۱۴/۲۵٪ بقولات و ۴۹٪ دیگر خانواده‌های گیاهی را تشکیل می‌دادند. ترکیب گیاهان دارویی، حبوبات و سایر خانواده‌ها به طور معنی‌داری در سطوح یک و پنج درصد بین مناطق مختلف متفاوت بود. اگر چه همه مراتع مورد مطالعه در وضعیت سلامت به لحاظ کیفیت در سطح احتمال یک درصد بودند و در حال حاضر، خطر انقراضی در هیچ گونه گیاهی دیده نشده است اما کیفیت علوفه و ظرفیت چرا در مناطق مورد مطالعه کافی نیست. عملکرد علوفه خشک در مناطق در حال چرا ۲۸۶۹ کیلوگرم در هکتار و ۱۹۱۲ کیلوگرم در هکتار با احتمال یک درصد در مناطق چرا شده بود. ظرفیت چرای دام در مراتع در حال چرا و چرا شده، به ترتیب ۹/۳۷ و ۶/۸۷ واحد دامی در سطح یک درصد معنی‌داری بود و این موضوع نشان می‌دهد که مراتع مورد بررسی بیش از ظرفیت خود مورد استفاده قرار می‌گیرند. با توجه به وضعیت پوشش گیاهی، می‌توان گفت که پوشش گیاهان مراتع از بین رفته و باید برای مدیریت ظرفیت چراگاه برنامه‌ریزی شود. از طرف دیگر مطالعات اصلاح و بهبود مراتع، کنترل علف‌های هرز، کاشت بذر و بارور کردن باید مورد توجه قرار گیرد.

کلمات کلیدی: پوشش گیاهی، آلپ، چراگاه، چریدن، در حال چرا