

Improvement Possibilities and Effects of Vegetation Subjected to Long-Term Heavy Grazing in the Steppe Rangelands of Sivas

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Abstract

Rangelands are actually known as feed resources for animals. At the same time they have potential resources for multiple-uses such as water source, rich of flora and fauna, and recreation areas. They should be carefully used and conserved for their optimum benefits of long term. Deterioration and degradation process have still continued due to mismanagement of rangelands. Present range status should be reversed with good management practices. For this reason, field works were conducted on the rangelands of Sivas Province in years of 2008, 2009 and 2010. A modified wheel point method with loop was used for vegetation survey in the 103 representative study sites of rangelands in Sivas province. The results of this study indicated that vegetation cover was quantified as 60.68%. The cover rates of decrease and increase were 15.53% and 22.23%, respectively. The studied sites numbers were 6, 62, and 35 for good, fair, and poor conditions, respectively. The 97 sites of total sites were identified as fair and poor in condition based on the rangeland condition classes. On the other hand, 26 sites were found at healthy, 35 sites at risky and 42 sites at unhealthy in rangeland health categories. Total site number of the last two classes was 77. Study results indicate that rangelands are also in slow degradation trend and high potential for having been successively reversed to the climax situation with proper restoration and management practices for rangelands.

Keywords: Rangeland condition, health, restoration, management

Uzun Süre Ağır Otlatmanın Sivas Step Meralarında Vegetasyona Etkileri ve İslah İmkânları

Öz

Meralar gerçekte hayvanlar için yem kaynakları olarak bilinirler. Aynı zamanda meralar, su kaynağı, zengin flora ve fauna olma özelliği ve dinlenme alanı gibi çok yönlü kullanımlar için potansiyel kaynaklara sahiptir. Meralar uzun süreli optimum fayda sağlamak için dikkatli kullanılmalı ve muhafaza edilmelidirler. Bu alanlar hala kötü yönetim nedeniyle bozulmakta ve bu bozulma süreci devam etmektedir. Mevcut mera durumu iyi yönetim uygulamalarıyla tersine çevrilebilir. Bu sebeple Sivas ili meralarında 2008, 2009 ve 2010 yıllarında arazi çalışmaları yürütülmüştür. Vegetasyon etüt çalışmaları lup ile modifiye edilmiş tekerlek nokta yöntemi ile Sivas meralarını temsil eden 103 durakta yapılmıştır. Bu çalışmanın sonucunda bitkiyle kaplı alan % 60,68 olarak bulunmuştur. Azalıcı ve çoğaltıcı bitki türlerinin kaplama oranları sırayla % 15,53 ve % 22,23'tür. İncelenen mera duraklarında iyi, orta ve zayıf durumda olan duraklar sırayla 6, 62 ve 35 olarak bulunmuştur. Toplam durakların 97 adeti mera durumu orta ve zayıf sınıflamada yer almıştır. Diğer taraftan, mera sağlığı açısından yapılan sınıflamada 26 durak sağlıklı, 35 durak riskli, 42 durak sorunlu olarak bulunmuştur. Toplam 77 adet durak mera sağlığı açısından riskli ve sorunludur. Çalışma sonuçları, meraların yavaş olarak bozulma eğiliminde olduğunu ve bu alanların uygun ıslah ve yönetim uygulamaları ile başarılı olarak orijinal hallerine dönme potansiyeli taşıdığını, göstermiştir.

Anahtar Kelimeler: Mera durumu, sağlığı, yönetimi, ıslahı

Introduction

Rangelands are highly important for environmental aspects and ecosystem.

They are employed with multiple purposes as food, fiber, water resource, recreation function, wildlife (Holechek et al 2004).

Rangeland and relevant factors are monitored for following of change trend over time. Thus present management or use are automatically controlled and reorganized if necessary. The Central Anatolia Region consists

of 33% (TÜİK 2001) of total rangeland area which is 14.6 mil. ha (TÜİK 2012).

The rangelands have been converted to croplands in the result of the rapid development in agricultural mechanization since 1950's. Hence the total area of rangelands has been declined to 14.6 mil ha from approximately 46.4 mil. ha (Tosun 1996).

The balance between livestock and rangelands was changed by increased livestock and declined range production. The rangelands, basic animal feed resources, were misused and overgrazed for long time. As a result unfortunately they lost their quantity and quality (Büyükburç, 1983).

Plant species with perennial palatable and high preference are necessary for rangelands improvement of the Central Anatolia Region. These desired species are required to be expanded on vegetation community for rangeland condition and health.

These following species were detected as dominant plants for region rangelands such as *Festuca ovina*, *Andropogon gryllus*, *Hedysarum varium*, *Thymus squarrosus*, *Artemisia fragrans*, *Medicago sativa* (Bakır 1970; Özmen 1977; Uluocak 1977; Tokluoğlu 1979).

Moreover, some major important species for the rangelands of this region were also encountered such as *Poa bulbosa* var. *vivipara*, *Bromus erectus*, *Onobrychis armena*, *Cynodon dactylon*, *Stipa lagascae*, *Teucrium polium*, *Globularia orientalis* (Bakır 1970), and *Agrostis* sp., *Bromus erectus*, *Stipa pennata*, *Convolvulus compactus*, *Noaea spinosissima* (Özmen 1977). On the other hand, plant species as *Kochia prostrata* (Tokluoğlu 1979), and *Trifolium arvense*, *T. campestre*, *T. repens*, *Onobrychis sativa*, *O. alba*, *O. tenuifolia*, *Koeleria cristata*, *Agropyron intermedium*, *A. elongatum*, *A. trichophorum*, *Phleum pratense*, *P. phloides*, *P. exaratum*, *Dactylis glomerata*, *D. hispanica* (Uluocak 1977) were specified in the vegetation of rangelands.

Study area description contains botanical composition, climatic data and environmental features (Bakır 1969). After the assessment of current data is identified rangeland condition (excellent, good, fair, poor) and health (healthy, risky and unhealthy) (Bakır 1969; Koç et al. 2003). Moreover, the carrying capacity for rangeland should be also calculated by vegetation biomass or hay yield. Proper management systems should be easily applied for diverse status levels of rangelands with supporting all information given above.

Field study surveys were completed between 2007 and 2011 in the 9 provinces of the Central Anatolia Region. Both provinces, as namely Ankara and Çankırı, were found similar status for range condition and health in a fair and at risky, respectively (Ünal et al. 2012a; Ünal et al. 2012b).

Moreover, the percentage areas of plant cover and bare ground in Ankara and Çankırı were 60.55% and 39.45%; 65.19% and 34.81% at the same study, respectively. These field study results indicated that decrease and increase rates in Ankara and Çankırı provinces were measured ranging from 10.24% to 25.71% and from 14.72% to 24.80%, respectively.

These rangelands flora covered the 287 and 327 species in Ankara and Çankırı provinces, respectively. These decrease species were appeared in both provinces such as *Agropyron cristatum*, *Bromus tomentellus*, *Dactylis glomerata*, *Elymus repens*, *Koeleria cristata*, *Lotus aegaeus*, *L. corniculatus*, *O. armena*, *O. oxydonta*, *Trifolium pratense*, and *Vicia cracca*. These increase species as *Cynodon dactylon*, *Plantago lanceolata*, *P. bulbosa*, *Stipa holosericea*, and *Teucrium polium* were also existed in two locations. Other increase species such as *Hordeum bulbosum*, *Poa alpine*, *Dorycnium pentaphyllum*, *Ebenus hirsuta*, *Hedysarum cappadocicum* were also seemed. The aim of this study was to determine the condition and the health of rangelands which were relevant plant species cover in vegetation community of the 103 diverse sites. Another objective was to explain the management and improvement practices for various conditions of rangelands in this province.

Material and Method

Long term annual mean precipitation is 443 mm, precipitation means were 469 mm, 577 mm, and 548 mm in the study years of 2008, 2009 and 2010, respectively (GDSMS, 2010). Long term average temperature is 8.9°C but the recorded average temperatures were 8.3°C, 9.5°C, and 11.7°C in the years of 2008, 2009 and 2010, respectively. The coldest month is January with mean temperature of -3°C. The warmest months are July and August with mean temperature of 20°C. The average relative humidity for long term is about 65.4%, three study year means were lower than that such in 2008, 2009 and 2010, respectively.

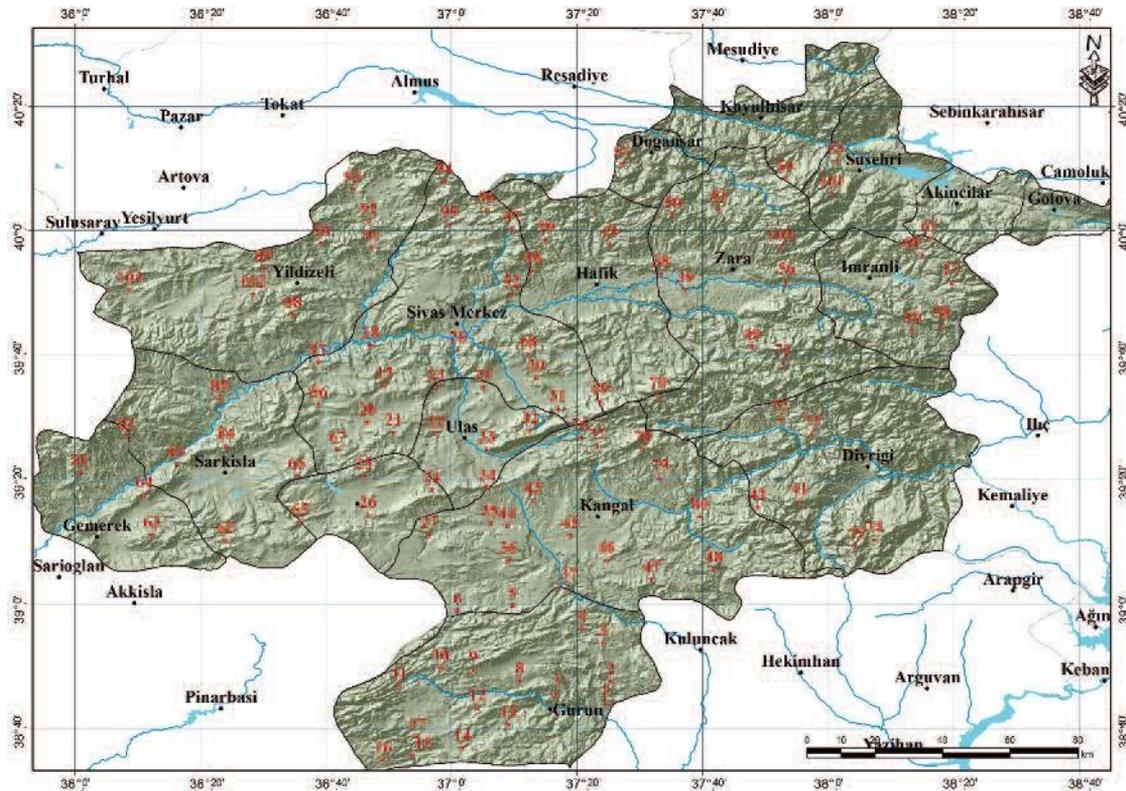


Figure 1. Study sites in the province of Sivas

Şekil 1. Sivas ilindeki çalışma yapılan duraklar

The study area is characterized by steep slopes (12-19%) and shallow soils (20-49 cm). The soil texture class of sites is clay – loam. The soil is neutral (pH 7.45), high lime content (15.76%), very low phosphorus amount (2.88 kg/da), rich potassium content (95.64 kg/da), and fair organic matter content (2.04%) (CSFWRRI, 2010).

The vegetation survey was carried out with a modified wheel point method with loop (Koç and Çakal, 2004) at the representative 103 sites of Sivas province in 2008, 2009, and 2010 (Figure 1).

Two transect lines having a 100 m long were performed at each site. The 200 reading points including 0.50 m intervals were written down along transects. Plant samples were carefully picked up and dried up for making herbarium. They all were specified according to flora books of Davis (1965-1985 and 1988) and Güner et al (2000).

Moreover, site habitat factors (altitude, aspect, slope, and distance to village) and effects of rangeland management (grazing intensity, erosion, and soil compactness) were written down.

The cover percentages of plant species, bare ground area and stoniness on rangeland vegetation were measured during field work. The rangeland condition (only cover of decrease and increase used) were categorized as excellent, good, fair, poor and health (vegetation cover) were also classified as healthy, at risky, and unhealthy based on the basal cover of rangeland vegetation (Koç et al. 2003).

Rangeland and meadow area is 1 207 916 ha. The total livestock numbers are 258.360, 207.510, and 268.372 Animal Unit (AU) in 2008, 2009 and 2010, respectively (PAED, 2010). Carrying capacity (CC) of total rangeland and meadow area in Sivas province is 214.741 AU. Livestock numbers are much more 20.3%, - 3.4%, and 24.9% in 2008, 2009, and 2010 than CC of Sivas rangelands. Annual hay requirement of livestock of the province is 1.178.768 tons, but rangeland and meadow production capacity are only 483.166 tons (40.9% of total requirement).

Results and Discussions

General assessment

The rangeland condition of Sivas province was identified and categorized into "fair" class (having the total values of decrease and

increasers as 37.76%) based on plant species (Table 1). In the same table, the proportions of decreaser, increaser and invader species in vegetation cover were 15.53%, 22.23% and 62.54%, respectively.

The Province rangeland health was found in a risky categorize having the percentages of botanical composition and bare ground as 60.68% and 39.32%, respectively (Table. 1).

Ankara and Çankırı provinces in the Central Anatolian Region had the same status for range condition and health, in a fair and at risky, respectively (Ünal et al. 2012a; Ünal et al. 2012b). Over - grazing may naturally cause unfavorable range status.

Rangeland health

Rangeland health values of the study sites were given in Table 2. The plant coverage area and bare ground were found as 80.90% and 19.10%; 62.15% and 37.85%; 46.94% and 53.06% at healthy (26 sites), risky (35 sites),

and unhealthy (42 sites) respectively (Table 2). In the same table, the 77 sites of total 103 sites were the worst health classes at risky and unhealthy.

In both provinces of Ankara and Çankırı, the percentages of vegetation cover and bare ground were found to be as 77.75% and 22.25%; 79.04% and 20.96%; 63.77% and 36.23%; 64.52% and 35.48%; 49.30% and 50.70%; 46.23% and 53.77% at healthy, risky, and unhealthy of the health classes, respectively (Ünal et al. 2012a; Ünal et al. 2012b).

These data showed that three provinces rangelands (Ankara, Çankırı and Sivas) a have similar declining trend on range health. It refers that rangeland health and management look like to each other in the regional provinces.

Healthy rangeland class in Table 2 had the highest vegetation cover with 99.75%. The lowest and the highest values of vegetation cover rates in the same consecutive classes for

Table 1. The values of vegetation cover and bare ground on rangeland (%)

Çizelge 1. Meradaki bitkiyle kaplı alan ve çıplak alan değerleri (%)

	VC	BG	D	IC	IV	ICURC	SURC
Minimum	35.50	0.25	1.38	0.63	18.44	0.63	6.29
Maximum	99.75	64.50	46.48	67.72	93.71	33.86	66.48
Average	60.68	39.32	15.53	22.23	62.54	16.33	31.56
Standard error	14.92	14.92	9.70	13.55	16.23	6.44	11.95
Coefficient variation (%)	24.58	37.94	62.47	60.94	25.95	39.45	37.85

Explanation

VC	Vegetation cover Bitkiyle kaplı alan	IV	Invaders çstilaclar
BG	Bare ground Çıplak alan	IURC	Increasesers Used for Range Condition
D	Decreasers Azalıclar	SURC	Species Used for Range Condition
IC	Increasesers Çoi)alıclar		Mera durumunun tespitinde kullanılan bitki türleri

Table 2. Vegetation cover, bare ground and rangeland health values

Çizelge 2. Bitkiyle kaplı alan, çıplak alan ve mera sağlık değerleri

Health values or health classes	Site numbers	Descriptive statistics	Vegetation cover (%)	Bare ground (%)
Healthy	26	Minimum	71.25	0.25
		Maximum	99.75	28.75
		Average	80.90	19.10
		Standard error	9.78	9.78
		Coefficient variations (%)	12.09	51.20
Risky	35	Minimum	56.25	30.25
		Maximum	69.75	43.75
		Average	62.15	37.85
		Standard error	4.08	4.08
		Coefficient variations (%)	6.56	10.78
Unhealthy	42	Minimum	35.50	44.25
		Maximum	55.75	64.50
		Average	46.94	53.06
		Standard error	5.55	5.55
		Coefficient variations (%)	11.83	10.47

these three health classes were determined as 71.25%, 99.75%; 56.25%, 69.75% and 35.50%, 55.75%, respectively. Consequently, regional rangelands have been misused such as early, late, and heavy grazing, so they appear in unfavorable trend.

Rangeland condition

The condition data of survey sites is presented in Table 3. Three different classes of rangeland conditions were found as good (6 sites), fair (62 sites), and poor (35 sites) in the province of Sivas.

The total number of fair and poor sites of conditions was 97 (Table 3). These data are early an indicator for slow degradation process of rangelands. But, it isn't sustainable for conservation and improvement of current status in the future.

The only 6 sites of the 103 sites were in a good rangeland condition and its decrease rates cover was found as 34.96% in botanical composition, but it had the percentages of 33.35% and 31.68% of increaser and invader species, respectively. Proper management techniques should be exerted for these sites to benefit at optimum level and to conserve its present status.

The cover rates of decrease rates and increase rates in Ankara and Çankırı good rangeland conditions were quantified as 43.09% and 32.87%; 49.36% and 13.33%, respectively (Ünal et al. 2012a; Ünal et al. 2012b).

The 62 sites of total 103 survey sites were in a fair class containing the percentages of decrease rates and increase rates in botanical composition of 17.92% and 25.83%, respectively (Table 3). When decrease rate and increase rate species rates lowered; on the contrary, invader species cover area enlarged on vegetation community.

Invader species also led to increase and dramatically reached to 56.53%. The cover rates of decrease rates and increase rates in Ankara and Çankırı fair rangeland conditions were quantified as 15.13% and 28.91%; 15.19% and 25.33%, respectively (Ünal et al. 2012a; Ünal et al. 2012b). In the fair condition, grazing impacts and habitat factors together cause spatial and temporal variation on vegetation community composition in long-term.

The 35 sites in a poor class of rangeland condition have the percentage of decrease rates and increase rates on botanical composition of 7.81% and 13.93%, respectively (Table 3). In the poor class, both decrease rates and increase rates in the community of vegetation were the lowest to other classes' data.

Invaders rate in the poor category was 78.49% which was the highest rate in the all three classes. In the poor sites, it is easily seen above percentage data, grazing intensity plays important role on plant cover and vegetation community composition.

The cover rates of decrease rates and increase rates in Ankara and Çankırı poor range

Table 3. Rangeland conditions of sites and the percentages (%) of decrease rates, increase rates and invaders on botanical composition

Çizelge 3. Durakların mera durumları ve bitkiyle kaplı alan içerisindeki azalıcı, çoğalıcı ve istilacı türlerin oranları (%)

Rangeland condition	Site numbers	Descriptive statistics	D*	IC	IV	IURC	SURC
Good	6	Minimum	23.75	23.80	18.44	20.00	51.33
		Maximum	46.48	57.81	44.88	28.91	66.48
		Average	34.96	33.35	31.68	21.48	56.45
		Standart error	7.50	12.56	10.39	3.64	5.44
		Coefficient variations (%)	21.46	37.67	32.78	16.92	9.64
Fair	62	Minimum	6.01	6.63	30.43	6.63	26.01
		Maximum	37.68	67.72	72.10	33.86	50.73
		Average	17.92	25.83	56.53	18.63	36.27
		Standart error	7.98	12.58	10.50	4.59	6.72
		Coefficient variations (%)	44.52	48.69	18.58	24.66	18.53
Poor	35	Minimum	1.38	0.63	53.85	0.63	6.29
		Maximum	18.54	46.15	93.71	23.08	25.50
		Average	7.81	13.93	78.49	11.38	18.96
		Standart error	4.49	11.27	8.99	6.72	5.46
		Coefficient variations (%)	57.53	80.87	11.45	59.05	28.77

* Explanation was given in Table 1.

conditions were measured as 4.21% and 22.66%; 3.13% and 27.13%, respectively (Ünal et al. 2012a; Ünal et al. 2012b). Decreasers cover value of poor condition in Sivas province was higher than those values in other provinces, but increasers data was too lower than Ankara and Çankırı's. In the poor sites, grazing intensity reaches at highest level on plant species especially containing good quality species (called as decreasers and increasers) but these desired plant species remarkably exist on vegetation community of rangelands.

Plant species

The floristic composition of vegetation has 422 species that refer to an indicator for a wide range diversity of plant species. Ankara, Çankırı and Kayseri provinces comprised the 287, 327 and 263 species in their rangeland vegetation, respectively (Ünal et al. 2012a; Ünal et al. 2012b; Ünal et al. 2013). These data mean that high species richness appears in regional range vegetation community composition.

The decreasers (32 species), increasers (34 species) and some invaders (356 species) on botanical composition were presented in Table 4 and Table 5.

Table 4. Decreaser (32) and increaser (34) plant species on the rangeland vegetation
Çizelge 4. Mera vejetasyonu içerisindeki azalıcı (32) ve çoğalıcı (34) bitki türleri

Decreasers		Increasers	
Grasses		Grasses	
Agrostis canina		Brachypodium pinnatum	
Agrostis stolonifera		Bromus cappadocicus	
Alopecurus arundinaceus		Bromus riparius	
Bromus inermis		Cynodon dactylon	
B. tomentellus		Festuca callieri	
B. variegatus		Festuca valesiaca	
Dactylis glomerata		Hordeum bulbosum	
Elymus lazicus		Hordeum violaceum	
E. hispidus E.		Phleum bertolonii	
repens Koeleria		Plantago lanceolata	
cristata Lolium		Poa alpina	
perenne		Poa bulbosa Poa	
Phleum montanum		trivialis Sesleria	
Poa angustifolia		phleoides	
P. densa		Stipa ehrenbergiana	
P. pratensis		Stipa holosericea	
		Stipa lessingiana	
		Trisetum turcicum	
Legumes		Legumes	
Lotus corniculatus		Anthyllis vulneraria	
Medicago falcata		Coronilla orientalis	
M. sativa		Coronilla varia	
M. varia		Dorycnium graecum	
Onobrychis albiflora		Dorycnium pentaphyllum	
O. armena		Ebenus laguroides	
O. hypargyrea		Hedysarum candidissimum	
O. oxydonta		Hedysarum pestalozzae	
O. paucijuga		Hedysarum pycnostachyum	
O. stenostachya		Hedysarum varium	
Trifolium ambiguum		Lathyrus czeczottianus	
T. pannonicum			
T. pratense			
T. repens			
Vicia cracca			
Other		Others	
Sanguisorba minör		Dianthus floribundus	
		Juncus gerardi	
		Teucrium polium	

Table 5. Invader plant species on the rangeland vegetation (82)-356
Çizelge 5. Mera vejetasyonu içerisindeki istilacı bitki türleri (82)-356

<i>Acantholimon acerosum</i>	<i>Daphne oleoides</i>	<i>Salvia caespitosa</i>
<i>Achillea biebersteinii</i>	<i>Dianthus anatolicus</i>	<i>Salvia cryptantha</i>
<i>Aegilops speltoides</i>	<i>Dianthus orientalis</i>	<i>Salvia vermifolia</i>
<i>Agrostis intermedia</i>	<i>Ebenus macrophylla</i>	<i>Salvia wiedemannii</i>
<i>Ajuga salicifolia</i>	<i>Eryngium campestre</i>	<i>Sedum album</i>
<i>Alyssum desertorum</i>	<i>Euphorbia macroclada</i>	<i>Sesleria alba</i>
<i>Alyssum murale</i>	<i>Galium incanum</i>	<i>Sideritis montana</i>
<i>Alyssum pateri</i>	<i>Galium verum</i>	<i>Silene caryophylloides</i>
<i>Androsace maxima</i>	<i>Genista alba</i>	<i>Taeniatherum caput-medusae</i>
<i>Artemisia santonicum</i>	<i>Genista sessilifolia</i>	<i>Tanacetum cadmeum</i>
<i>Astragalus angustifolius</i>	<i>Gypsophila eriocalyx</i>	<i>Tanacetum nitens</i>
<i>Astragalus lineatus</i>	<i>Gypsophila parva</i>	<i>Taraxacum crepidiforme</i>
<i>Astragalus plumosus</i>	<i>Helianthemum ledifolium</i>	<i>Teucrium chamaedrys</i>
<i>Astragalus wiedemannianus</i>	<i>Helianthemum nummularium</i>	<i>Teucrium parviflorum</i>
<i>Bromus japonicus</i>	<i>Herniaria incana</i>	<i>Thymus sipyleus</i>
<i>Bromus lanceolatus</i>	<i>Marrubium parviflorum</i>	<i>Trachynia distachya</i>
<i>Bromus sterilis</i>	<i>Minuartia hamata</i>	<i>Tragopogon dubius</i>
<i>Bromus tectorum</i>	<i>Minuartia hybrida</i>	<i>Trifolium arvense</i>
<i>Carduus nutans</i>	<i>Ononis spinosa</i>	<i>Trigonella fischeriana</i>
<i>Carex flacca</i>	<i>Onosma taurica</i>	<i>Trigonella monantha</i>
<i>Centaurea carduiformis</i>	<i>Paronychia argyroloba</i>	<i>Tripleurospermum tenuifolium</i>
<i>Centaurea urvillei</i>	<i>Paronychia kurdica</i>	<i>Veronica multifida</i>
<i>Centaurea virgata</i>	<i>Phleum exaratum</i>	<i>Xeranthemum annuum</i>
<i>Convolvulus holosericeus</i>	<i>Phlomis angustissima</i>	<i>Ziziphora clinopodioides</i>
<i>Convolvulus lineatus</i>	<i>Polygala anatolica</i>	<i>Ziziphora taurica</i>
<i>Crepis foetida</i>	<i>Potentilla recta</i>	<i>Ziziphora tenuior</i>
<i>Crepis sancta</i>	<i>Ranunculus arvensis</i>	
<i>Cruciata taurica</i>	<i>Reseda lutea</i>	

In this work, important decreaser grasses contained following species: *Agrostis stolonifera*, *Bromus tomentellus*, *Elymus hispidus*, *Koeleria cristata*, *Phleum montanum* and *Poa pratensis*.

Following decreaseers were encountered in Ankara and Çankırı provinces such as *Agropyron cristatum*, *Bromus tomentellus*, *Dactylis glomerata*, *Elymus repens*, *Koeleria cristata*, *Lotus aegaeus*, *L. corniculatus*, *Onobrychis armena*, *O. oxyodonta*, *Trifolium pratense*, and *Vicia cracca*. (Ünal et al. 2012a; Ünal et al. 2012b; Ünal et al. 2013).

Increaseer grasses were also detected *Cynodon dactylon*, *Festuca callieri*, *F. valesiaca*, *Hordeum bulbosum*, *Poa alpina*, *P. bulbosa*, *P. trivialis* and *Stipa holosericea*.

The following plant species became in the previous studies through The Central Anatolian Region: *Andropogon gryllus*, (Bakır 1970;

Tokluoğlu 1979) and *Festuca ovina*= *F. valesiaca*, *F.callieri* (Bakır 1970; Özmen 1977; Uluocak 1977; Ünal et al. 2010; Ünal et al. 2011; Ünal et al. 2013).

Dominant plant species of this region such as *Poa bulbosa* var. *vivipara*, *Cynodon dactylon* (Bakır 1970; Ünal et al. 2013), *Koeleria cristata*, *Agropyron intermedium*, *A. elongatum*, *A. trichophorum* were also detected in the previous field work and this survey.

Some decreaser legume species such as *Medicago sativa*, *Onobrychis albiflora*, *O. oxyodonta*, *Trifolium ambiguum*, and *T. pratense* were identified in the field work.

Some increaseer forage legumes such as *Coronilla orientalis*, *C. varia*, *Dorycinium pentaphyllum*, *Hedysarum pestalozzae* and *Hedysarum varium* were also found.

The similar species as *Hedysarum varium* were come across in the past surveys and this study (Bakır 1970; Tokluoğlu 1979), *Medicago sativa* (Bakır 1970; Uluocak 1977; Ünal et al. 2013), *Onobrychis armena* (Bakır 1970; Ünal et al. 2010; Ünal et al. 2013) and *Onobrychis sativa*, *O. alba*, *O. tenuifolia* (Uluocak 1977) that are exactly important to be improved and over-seeded for regional rangeland vegetation.

These increasars as *Cynodon dactylon*, *Plantago lanceolata*, *P. bulbosa*, *Stipa holosericea* and *Teucrium polium* also were come across in Ankara and Çankırı provinces (Ünal et al. 2012a; Ünal et al. 2012b). Other increasars such as *Hordeum bulbosum*, *Poa alpine*, *Dorycnium pentaphyllum*, *Ebenus hirsuta*, *Hedysarum cappadocicum* also appeared in vegetation of Ankara province (Ünal et al. 2012a).

Some invader species in the study area were *Alyssum desertorum*, *A. murale*, *Artemisia santonicum*, *Taeniatherum caput-medusae*, *Eryngium campestre*, *Euphorbia macroclada*, *Phlomis angustissima*, *Potentilla recta*, *Salvia cryptantha*, *Teucrium chamaedrys*, *Thymus sipyleus* and *Ziziphora taurica*.

Dominant species at the steppe vegetation existed as *Thymus squarrosus* (Bakır 1970; Özmen 1977; Tokluoğlu 1979; Ünal et al. 2010; Ünal et al. 2011), *Artemisia fragrans* (Özmen 1977; Tokluoğlu, 1979; Ünal et al. 2010; Ünal et al. 2011) which have synonyms with *Artemisia santonicum* and *Thymus sipyleus* occurring in this work.

Conclusions

Range condition and health classes were found as fair and risky. The rangelands of Sivas province were in a good condition at 6 sites, fair condition at 62 sites, and poor condition at 35 sites.

The status of total 97 sites, consisting of fair and poor sites, may be also accepted as an indicator of misused in the past of rangeland management.

As a result, rangelands have been mismanaged having early, late, and over grazing in a long term.

There appears three various range conditions in this work, so management and

rehabilitation practices should be immediately applied as given follows:

For good condition class, current status should be maintained with optimum benefit level and supported having fertilization and grazing system. Recommended fertilization rates are as 50 kg of nitrogen and phosphorous per hectare for yield and quality of rangeland vegetation (Büyükburç 1999). Range management is especially based upon grazing period and carrying capacity.

For fair condition category, this status is critical situation towards degradation and restoration of rangelands, for this reason management and improvement techniques may be finely found and carefully applied for its rehabilitation. Rangeland management based on grazing period and carrying capacity is vital important. At the same time, improvement methods such as fertilization (50 kg N+ 50 kg P2O5 per ha) (Büyükburç 1999), over-seeding and weed control should be applied together. Moreover, it is a big chance having a herbage production of forage crops for both rangeland improvement and livestock needs.

For poor condition class, all rehabilitation activities should be well designed. First, rangelands in this class must not be grazed for three year period. Second, over-seeding and weed control should be implemented together and correctly managed during this period. Third, plant cover should be expanded and the rate of palatable species on vegetation community should be also increased with sustainable management and rehabilitation strategies on these range sites.

Consequently, spatial and temporal changes on range vegetation should be monitored over time for new implements and improvements in the future.

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