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Comparison of plant species indices under wildlife and livestock grazing site

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Abstract

Vegetation changes in terms of specific plant or family can determine vegetation composition, rangeland condition, grazing pressure and herbivores food preference. Therefore, it can be a base for ecosystem planning and rangelands management. This research tried to compares some of plant species indices between two regions under livestock and wildlife grazing in Kalmand-Bahadoran plain rangelands of Yazd province. For this purpose, in the first step two areas of Kalmand-Bahadoran plain rangelands of Yazd province were selected. Sampling was done using random-systematic method. In each plot and along each transect, species names, families, their presence and absence, canopy cover percentage, production and density for each species were noted. The results showed that in livestock grazing site, the dominant species (*Artemisia sieberi*), *Stipa barbata* ($p<0.01$) and *Scorzonera* sp. Canopy cover ($p<0.05$) increased significantly, while *Colchicum kotschyi*, *Iris songarica* ($p<0.05$) and *Stachys inflata* canopy cover ($p<0.01$) decreased. In deer grazing area, in terms of production and density, some species like *Stachys inflata*, *Colchicum kotschyi*, *Aegopordon berardioides* and *Boissiera squarrosa* ($p<0.01$) had significantly increased in comparison to livestock grazing area but *Stipa barbata* and *Scorzonera* sp. ($p<0.05$) raised significantly in livestock grazing site. According to results, it is necessary to recognize all vegetation aspects in rangelands specially plant species indices in order to proper grazing management and decide for future restoration planning.

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Introduction

Rangelands consist of different plant species with distinctive life forms and growth characteristics, which have a specific grazing value (Ahmadi *et al*., 2009). Plant species have different Strategies and this causes their more resistance to grazing. Changes in vegetation indices in terms of specific plant or family can determine vegetation composition, rangeland condition, grazing pressure and herbivores food preference. Therefore, it can be a base for ecosystem planning and rangelands management. There are several studies about grazing effects on plant species characteristics. Some researches revealed a significant increase about production and density of some species such as *Stipa barbata*, *Artemisia sieberi*, *Astragalus* sp. *salsola* sp. and also *Scorzonera* sp. canopy cover (Akbarzadeh, 2005; Aghajanlou & Moosavi, 2006; Akbarzadeh *et al*., 2007; Baghestani Meybodi *et al*., 2007) under livestock grazing. Other studies showed that canopy cover percentage, production and density of the species like *Echinops* sp. *Bromus* sp. *Boissiera squarrosa*, *Onobrychis* sp. and *Scariola orientalis* increased significantly in the regions with more livestock grazing pressure (Firinioglu *et al*., 2007; Jalilvand *et al*., 2007; Heidarian Aghakhani *et al*, 2010; Imani *et al*., 2010). Eftekhari *et al*. (2009) announced that the species *Stachys inflata* canopy cover and production has increased in deer grazing site.

In most parts of the world livestock grazing is the most common use of rangelands, and this is the main factor of rangelands degradation and extinction of wildlife (When *et al*., 2011; Pellerin *et al*., 2006). Wildlife and livestock cause changes on rangeland plant species and vegetation (Cesa & Paruelo, 2011; Jeddi & Chaieb, 2010). In arid rangelands in many parts of the world, identifying vegetation characteristics changes under wildlife and livestock grazing is the most important basic study to find a correct way for range management (Manier & Hobbs, 2007; Moser & Witmer, 2000; Hossein Jafari *et al*., 2013).

According to the literature reviews, there is a little information about wildlife and livestock grazing effects on plant species indices. Most studies have focused on vegetation characteristics totally but they didn't investigate particular plant species properties.

This study tries to find degradation effects of livestock on specific plant species characteristics in an arid ecosystem. So, the purpose of this study is to compare plant species indices such as canopy cover percentage, production and density between wildlife (deer) and livestock (sheep and goat) grazing sites. The results can be applied in restoration programs to choose particular plants in each kind of grazing management.

Materials and methods

Study site

Kalmand-Bahadoran plain is located southeast of Yazd province and at 31°20' north latitude and 54°30' east longitude. Plain areas cover most of the region and the rest composed of impassable height, mountains and hills. The average altitude is 1616 meters above sea level. Maximum and minimum heights in the region are 3290 m and 1400 m respectively. The averages of maximum and minimum temperatures are respectively 44.29°C and 22.5°C. The average annual precipitation is about 77 mm and the mean annual moisture is 30% (Karimian, 1999).

Methodology

After determining the study area using topographic maps (1:50000), during field investigation, two regions were chose, one in the protected area under wildlife grazing (deer) and the other outside that area under livestock grazing (sheep and goat).

The two regions are flat; their climatic and topographic conditions are the same (Consulting engineers of Iran, 2002; Alikhani & Ahmadi, 2012).

Sampling was done using random systematic method. Depending on vegetation type and condition (Mesdaghi, 2003), 10 transects of 100 m randomly and 3 plots of 2 m^2 were placed on each transect using systematic method in each site. In each plot and along each transect, species names, families, their presence and absence,

canopy cover percentage, production and density for each species were noted. Data processing and analysis related to plant species indices between the two study regions were performed using *SPSS16* software (independent sample t-test analysis).

Results

During sampling, 27 plant species of 10 families are found in the region under wildlife grazing. 25 species which belong to 10 families were identified in livestock grazing site. These species have different life and biologic forms (Table 1).

Table 1. Species presence and absence list in two wildlife and livestock grazing sites related to sampling.

Species name	Family	Longevity	Life form	Biologic form	Livestock	Wildlife
Acantholimon sp.	Plumbaginaceae	P	Shrub	Ch	-	+
Aegopordon berardioides	Compositeae	P	Forb	He	-	+
Aellenia subaphylla	Chenopodiaceae	P	Shrub	Ch	+	-
Artemisia sieberi	Compositeae	P	Shrub	Ch	+	+
Astragalus glauca canthus	Papilionaceae	P	Shrub	Ph	+	+
Astragalus microphysa	Papilionaceae	P	Shrub	Ch	-	+
Astragalus sp.	Papilionaceae	P	Shrub	Ch	+	+
Atraphaxis spinosa	Polygonaceae	P	Shrub	Ch	+	-
Boissiera squarrosa	Gramineae	A	Grass	Th	+	+
Centaurea sp.	Compositeae	A	Forb	Th	+	+
Cirsium sp.	Compositeae	P	Forb	He	+	+
Colchicum kotschyi	Liliaceae	P	Forb	Ge	+	+
Convolvulus virgatus	Convolvulaceae	P	Shrub	Ph	-	+
Cornulaca leucacantha	Chenopodiaceae	P	Shrub	Ch	-	+
Cornulaca monacantha	Chenopodiaceae	P	Shrub	Ch	+	-
Cousinia deserti	Compositeae	P	Shrub	Ch	+	+
Cyperus sp.	Cyperaceae	P	Forb	Ge	+	-
Echinops sp.	Compositeae	P	Shrub	He	+	-
Euphorbia helioscopia	Euphorbiaceae	A	Forb	He	+	-
Gymnocarpus decander	Caryophyllaceae	P	Bush-tree	Ph	+	-
Heliotropium sp.	Boraginaceae	P	Shrub	Ch	-	+
Iris songarica	Iridaceae	P	Forb	He	+	+
Jurinea radians	Compositeae	P	Shrub	Ch	-	+
Lactuca sp.	Compositeae	P	Shrub	Ch	+	+
Launea acantodes	Compositeae	P	Shrub	He	+	+
Lolium rigidum	Gramineae	A	Grass	Th	-	+
Noea mucronata	Chenopodiaceae	P	Shrub	Ch	-	+
Paracaryum persicum	Boraginaceae	A	Forb	Th	-	+
Peganum harmala	Zygophyllaceae	P	Forb	He	+	-
Salsola tomentosa	Chenopodiaceae	P	Shrub	Ch	+	-
Scariola orientalis	Compositeae	P	Shrub	Ch	+	+
Scorzonera sp.	Compositeae	P	Forb	Ge	+	+
Scrophularia steriata	Scrophulariaceae	P	Shrub	Ch	-	+
Stachys inflata	Lamiaceae	P	Shrub	Ch	-	+
Stipa barbata	Gramineae	P	Grass	He	+	+
Ziziphora tenuir	Lamiaceae	A	Forb	Th	+	+
Zygophyllum eurypterum	Zygophyllaceae	P	Bush-tree	Ph	+	-

(Ch= Chamophyt, He= Hemicriptophyt, Ph= Phanerophyt, Th= Therophyt).

Among 13 plant families in sampling plots, Scrophulariaceae, Boraginaceae and Convolvulaceae exist only in deer grazing site. On the other side,

families such as Zygophyllaceae, Polygonaceae and Euphorbiaceae were found in livestock grazing site and 7 plant families were in both sites. The results show that Lamiaceae ($p<0.01$), Liliaceae and Iridaceae ($p<0.05$) in wildlife grazing site and Compositeae ($p<0.01$) and Gramineae families ($p<0.05$) in livestock site increased significantly (table2).

Table 2. Comparing families with the most canopy cover percentages in study sites using independent sample t-test.

Families	Treatment	Average	Sd	df	t
Chenopodiaceae	wildlife	0.06	0.08	58	1.004^{ns}-
	Livestock	0.11	0.13		
Compositeae	wildlife	8.66	2.05	58	$^{**}4.119$-
	Livestock	12.10	1.67		
Gramineae	wildlife	0.34	0.18	58	$^{*}2.552$-
	Livestock	0.58	0.22		
Iridaceae	wildlife	0.66	0.34	58	$^{*}2.300$
	Livestock	0.25	0.45		
Lamiaceae	wildlife	2.05	1.06	58	$^{**}6.082$
	Livestock	0.02	0.03		
Liliaceae	wildlife	0.18	0.18	58	$^{*}2.229$
	Livestock	0.05	0.06		
Papilionaceae	wildlife	0.78	0.50	58	$^{ns}1.107$ns
	Livestock	0.59	0.21		

**: $p<0.01$), (**: $p<0.05$)(,)^{ns}: No significant.

The results of comparing the species with the most canopy cover percentage in sampling plots indicate that there is no difference.

Between the two regions in terms of species canopy cover percentage like *Noea mucronata*, *Aegopordon berardioides*, *Boissiera squarrosa*, *Astragalus* sp. and *Lactuca* sp. The species *Colchicum kotschyi*, *Iris songarica* ($p<0.05$) and *Stachys inflata* ($p<0.01$) reveal a significant increase in deer grazing site, but some species such as *Artemisia sieberi*, *Stipa barbata* ($p<0.01$) and *Scorzonera* sp. ($p<0.05$) indicate a significant reduction in deer grazing site compared to livestock grazing site (table3).

The results show a significant increase in relation to *Colchicum kotschyi*, *Stachys inflata* and *Boissiera squarrosa* in deer grazing site ($p<0.01$), while the species production like *Aegopordon berardioides* ($p<0.01$), *Stipa barbata* and *Scorzonera* sp. ($p<0.05$) has increased significantly in livestock grazing area. There is no difference between the two study areas related to the species production such as *Noea mucronata*, *Iris songarica*, *Artemisia sieberi*, *Astragalus* sp. and *Lactuca* sp. (Table 4).

Table 3. Comparing species with the most canopy cover percentages in study sites using independent sample t-test.

Species	Treatment	Canopy cover percentage	Sd	df	t
Noea mucronata	Wildlife	2.04	0.59	58	0.863^{ns}
	Livestock	1.79	0.68		
Colchicum kotschyi	Wildlife	0.185	0.181	58	$^{*}2.229$
	Livestock	0.050	0.062		
Iris songarica	Wildlife	0.660	0.336	58	$^{*}2.300$
	Livestock	0.250	0.453		
Artemisia sieberi	Wildlife	5.065	1.608	58	**- 4.729
	Livestock	7.915	1.022		
Stachys inflata	Wildlife	2.055	1.059	58	$^{**}6.135$

Species	Treatment	Canopy cover percentage	Sd	df	t
	Livestock	0.003	0.003		
Stipa barbata	Wildlife	0.020	0.042	58	**-4.405
	Livestock	0.185	0.111		
Aegopordon berardioides	Wildlife	0.003	0.004	58	- 1.964^{ns}
	Livestock	0.02	0.02		
Boissiera squarrosa	Wildlife	0.320	0.173	58	- 0.961^{ns}
	Livestock	0.395	0.175		
Astragalus sp.	Wildlife	0.240	0.227	58	0.915^{ns}
	Livestock	0.155	0.186		
Scorzonera sp.	Wildlife	0.270	0.111	58	*- 2.846
	Livestock	0.510	0.242		
Lactuca sp.	Wildlife	1.485	1.241	58	0.142^{ns}
	Livestock	1.420	0.740		

**: p<0.01), (**: p<0.05)(,)^{ns}: No significant.

Table 4. Comparing species with the most production in study sites using independent sample t-test.

Species	Treatment	Production	Sd	df	t
Noea mucronata	Wildlife	0.18	1.01	58	0.949^{ns}
	Livestock	0.01	0.04		
Colchicum kotschyi	Wildlife	0.39	0.41	58	3.639**
	Livestock	0.07	0.23		
Iris songarica	Wildlife	1.84	4.68	58	0.685^{ns}
	Livestock	0.96	5.19		
Artemisia sieberi	Wildlife	24.71	20.31	58	0.411^{ns}
	Livestock	22.73	16.92		
Stachys inflata	Wildlife	9.11	8.18	58	6.088**
	Livestock	0.02	0.06		
Stipa barbata	Wildlife	0.01	0.03	58	- 2.371*
	Livestock	0.23	0.52		
Aegopordon berardioides	Wildlife	0.01	0.06	58	-3.160**
	Livestock	0.23	0.37		
Boissiera squarrosa	Wildlife	0.74	0.53	58	4.748**
	Livestock	0.23	0.25		
Astragalus sp.	Wildlife	0.02	0.06	58	.987^{ns}
	Livestock	0.003	0.007		
Scorzonera sp.	Wildlife	1.00	1.10	58	- 2.109*
	Livestock	1.66	1.30		
Lactuca sp.	Wildlife	3.89	6.42	58	1.017^{ns}
	Livestock	2.45	4.37		

**: p<0.01), (**: p<0.05)(,)^{ns}: No significant.

Comparing the species with the most density in two regions indicate that the species density like *Colchicum kotschyi*, *Stachys inflata* and *Boissiera squarrosa* raise in deer grazing site (p<0.01), but *Aegopordon berardioides* (p<0.01). *Stipa barbata* and *Scorzonera* sp. (p<0.05) increase significantly in livestock grazing site. There is no significant difference between two sites in terms of species density such as *Noea mucronata*, *Iris songarica*, *Artemisia sieberi*, *Astragalus* sp. and *Lactuca* sp.

Table 5. Comparing species with the most density in study sites using independent sample t-test

Species	Treatment	Density	Sd	df	t
Noea mucronata	Wildlife	0.10	0.20	58	0.684^{ns}
	Livestock	0.07	0.17		
Colchicum kotschyi	Wildlife	0.47	0.54	58	3.762**
	Livestock	0.07	0.22		
Iris songarica	Wildlife	2.77	7.28	58	1.357^{ns}
	Livestock	0.72	3.92		
Artemisia sieberi	Wildlife	1.07	0.80	58	- 0.324^{ns}
	Livestock	1.13	0.80		
Stachys inflata	Wildlife	0.95	0.88	58	**5.494
	Livestock	0.05	0.15		
Stipa barbata	Wildlife	0.02	0.09	58	*- 2.397
	Livestock	0.23	0.49		
Aegopordon berardioides	Wildlife	0.03	0.13	58	**2.925-
	Livestock	0.40	0.67		
Boissiera squarrosa	Wildlife	12.97	8.75	58	5.500**
	Livestock	3.50	3.51		
Astragalus sp.	Wildlife	0.03	0.18	58	1.985^{ns}
	Livestock	0.002	0.01		
Scorzonera sp.	Wildlife	2.03	2.43	58	*2.346-
	Livestock	3.65	2.89		
Lactuca sp.	Wildlife	0.30	0.50	58	0.294^{ns}
	Livestock	0.27	0.36		

**: p<0.01), (**: p<0.05)(,)^{ns}: No significant.

Discussion and conclusions

The specie *Colchicum kotschyi* and *Stachys inflata* canopy cover, production and density from Liliaceae and Lamiaceae families and *Iris songarica* canopy cover (Iridaceae) increased in wildlife grazing site, but *Artemisia sieberi* and *Scorzonera* sp. canopy cover (Compositeae) raised in livestock grazing area. The reason of decreasing these shrub species and increasing all species belong to the mentioned families can be deer food preference in comparison to sheep and goat. Deer graze these species more than livestock and cause decreasing shrubs. According to some researches, deer prefer shrub species more than other life forms (Moser & Witmer, 2000; Pellerin *et al.*, 2006; Bagheri *et al.*, 2008). Livestock use forbs better than other life forms and it can be a reason for a significant reduction in *Stachys inflata* parameters in livestock site. Firinioglu *et al.* (2007) and Heidarian Aghakhani *et al.* (2010) studies results confirmed this issue. In addition, deer grazing site condition secure these species ecological requires, spreading and reproduction of the species increase (Akbarzadeh *et al.*, 2007). Raising *Artemisia sieberi* canopy cover percentage can also be an index to show more degradation of livestock grazing site and approximate resistance of this species to grazing (Jauffret & Lavorel, 2003; Navarro *et al.*, 2006).

The results showed that *Aegopordon berardioides*, *Scorzonera* sp. increase significantly in livestock grazing site. Some species like *Scorzonera* sp. and *Aegopordon berardioides* have different strategies as resistant species to grazing. For example, they partly protect themselves from grazing with expanding and sticking the leaves to the ground surface (Akbarzadeh *et al.*, 2007). This can be the reason for increasing them in livestock site. *Stipa barbata* canopy cover (Gramineae) also had a significant raise in livestock grazing area, because this species final bud is on the soil surface and grazing pressure injuries is less than other plants. This has been demonstrated through Louhaichi *et al.* (2012) research.

Most of species related to Compositeae family are thorny and non-palatable. Increasing the number of Compositeae family species in livestock grazing site can be the reason of more degradation and grazing pressure. Vakili *et al.* (2001) and Khosravi *et al.* (2010) announced that the presence of Compositeae family species can be related to the utilization conditions.

According to results, it is necessary to recognize all aspects and details about vegetation in rangelands specially the specific plant species in order to proper grazing management and decide for future restoration planning.

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