

Diet Selection by Sheep and Goats on Upland Rangelands (North Alborz) Case Study: Javaherdeh Rangeland of Ramsar

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Abstract. To reach the desirable ecosystem management, determining the animal diet selection, which is one of the components of rangeland ecosystem, is important. Therefore, in order to determine the grazing behavior and diet selection of sheep and goat, the upland rangeland of northern part of Alborz was selected. In this study, the first weeks of July and August of 2009 were chosen for the grazing period of the animals. Range value and range trend method and the help of trend balance determined the range conditions and plant compositions in these two periods. Using the bite counting method, the grazing behavior of animals (sheep and goat) was observed from 0.5-2m via half an hour focus on each one and completing hundred records. Data collected and analyzed through the analysis of variance. Results showed that the bite counting method is a useful tool for determining the diet selection of sheep and goat. The animals have selected different layers of vegetation cover; therefore, range conditions have an effective role on the diet selection of animals within a grazing period. It has also shown that consumption rate was different in daily grazing in which sheep preferred to graze the forbs and goat browsed the bushy tree and shrub species if the grazing conditions were normal without any tension. Knowledge of the conditions of animals' diet selection in each area could have an effective role on the production of rehabilitation and development programs.

Keywords: Diet selection, Bite-count, Goat and sheep, Range, Northern Alborz, Javaherdeh.

Introduction

Rangeland ecosystems, as a dynamic system, has a special structure and function on the basis of its own indigenous discipline that is continuously changing under environment and living thing impacts. Grazing and browsing of herbivores are the most effective factors on these ecosystems. Herbivores affect vegetation community patterns and ecosystem functioning (Hobbs, 1996; Augustine and McNaughton, 1998; Austrheim and Eriksson, 2001) through selective grazing or browsing (Myserud, 2006). Diet selection of the herbivores is influenced by many different factors including quality and quantity of forages, rangeland and climate conditions, distance from water resources, conditions of the herbivore physiology and health, and livestock age and race (Arzani, 2009) that distinguishing of circumstance and nature of these effective factors lead to management of the livestock behavior and consumption. Wisdom regard on the herbivores and their diet selections, therefore, can help to sustainable management of rangeland ecosystem.

Growth stages of plants are the most important factor for the diet composition of rangeland forage (Volesky *et al.*, 2007) that changes with phenological stages. Seasonal palatability is the one tool to evaluate shrub plants for first, middle, and last winter of species growth stages (Holmgren and Hutching, 1972). Knowing of diet value in each plant organs (leaf, stem, and flower) in different phenological stages also helps the rangers to select desirable time of grazing in order to reach to worthwhile yield of animal without damaging to plants (Arzani *et al.*, 2004). Studying the diet quality of 11 range species has shown that progressing of phenological stages decreases the raw protein, metabolism energy, and total energy of digestible and increases the raw fibers and cellulose, hemi cellulose and lignin in species (Heshmati *et al.*, 2006).

The season is one of the effective factors on the diet selection and animal grazing (Schwartz and Ellis, 1981) in which short rainy season is caused that goats prefer to use 69% bushy trees and 19% grasses as their diet selection (Yayneshet *et al.*, 2008). Beck and Peek (2005) have reported that sheep prefer forbs in spring and summer seasons So that sheep compared to goats naturally prefer to graze in the open area (Poole *et al.*, 2009).

Rangeland conditions and plant composition also can influence on the diet selection and different kinds of animals (Van Niekerk and Abubaker, 2009). Forbes (1989) has known the rangeland condition as an effective factor on amount and size of bite-count. For example, Sanon (2007) has reported that cows prefer to spend more time on forbs whereas goats and sheep graze them when rangeland conditions are going to decrease the forb species. Spatial distribution of plant species in the different range conditions, therefore, prepares desirable situations to graze selection of different animals (Milne, 1991). Sheep prefer to graze the forbs in the normal and natural conditions. When grasses and shrubs dominate on rangeland, sheep prefer to use short grasses, especially in their favorite growth (Codron *et al.*, 2007). Although plural effects of herd can influence the diet selection of animal individually (Lane *et al.*, 1990; Ralph and Olsen, 1990), high intensity of livestock leads the sheep or goat to use any plant species including grasses, forbs, or shrubs. Askarizadeh *et al.* (2009) have reported that sheep use shrubs and bushy trees when weather is wet and Foggy and forbs or grasses were wet in ground surface at the same time.

There are many methods to study the diet selection of animal, but direct vision method that was used in this research has been applied to evaluate the diet selection of different animals. Number of bite-count can be limited by seeking of animals, amount of smash to plant species, munch timing, and devour (Spalinger and Hobbs,

1992; Bradbury, 1996). Small mammals, e.g. sheep and goat take more bite-count than bigger mammal such as elephants. Osmond *et al.* (2007) by using bite-count method have shown that studying of sheep grazing behavior in an entire day can be possible by this method. They also divided consumed species rate such as grass, forb, and shrub life forms. Parker and Bernard (2006) have pointed out that direct vision method is recommended to study of animal, which graze daily when habitat condition is open and unrestricted.

Materials and Methods

In order to do this research, the Javaherdeh rangeland (about 880 ha) from north part of Alborz was selected. The annual precipitation was 550-760 mm. The most precipitation occurs in fall and winter (Climate information, 2009). General features of this area show that dominated vegetation has been formed by grasses species along with shrubs, bushy trees, and forbs. The altitudinal range of the study area is located in 2300 to 3000 m, average slope of it is 55% and dominated aspect is western south (Fig. 1). Based on current grazing permission in this area, there are 660 animal units, which are formed by sheep and goats.

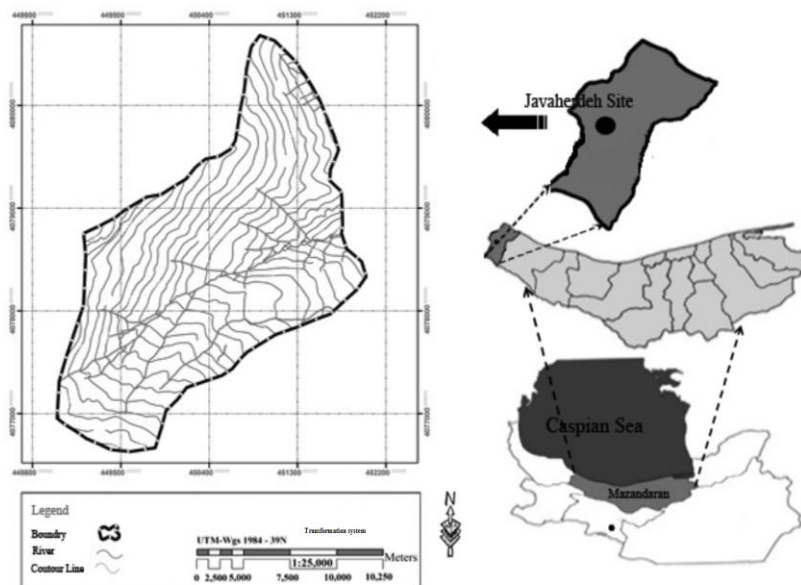


Fig. 1. Topographic map of the study area, the Javaherdeh rangeland (1:25000)

Research Approach

Time factor has an effective impact on daily and seasonal grazing. Hence, record time is learned by field monitoring and interviewing with ranchers between 6-10 a.m. and 4-8 p.m. The seasonal grazing period was also determined from June to August because of grazing period limitation in the upland rangeland. Vegetation type of the study area was *Onobrychis-Bromus*. The weather conditions for first and second recording

times were sunny-heat and sunny-foggy, respectively.

Range Value (Safaian and Shokri, 2003) obtained rangeland condition and Trend Balance determined plant combination and rangeland trend. Simplicity, minimum requirement tools for measuring, and easy use are the benefits of direct vision (bite-count) to study of animal diet selection (Holechek *et al.*, 1982). Hence, bite count method was employed to determine the sheep and goats' diet selection in the study

area. Grazing behavior of animals was followed from 0.5 to 2 m in each specified individual. In this method, percentage of consumed species is obtained via the amount of bite of each species by animal to whole bite counts (Shrestha and wegge, 2006; Forbes *et al.*, 2007; Yayenshet *et al.*, 2008). There are three kinds of grazer in each herd. Some of them like to graze end of herd and vice versa (Barani *et al.*, 2003). In this research, to cover the best situation of grazer, the auxiliary animal, therefore, was selected to concentrate on each animal and counts the bite in half an hour (Henley *et al.*, 2001). To record the bite, one expert concentrates on goal animal and counts the bites and another saves the records in a form. The age average of animals was 4 years in the natural conditions of grazing. The herd combination was 90% sheep and 10% goats.

Comparative analysis of mean bite counts from sheep and goats in two recording times was collected and analyzed by ANOVA method in SPSS₁₇ software.

Results and Discussion

The rangeland conditions in two recording times were good and excellent with progressive trend (Table 1). Comparison of plant combination percentage in the study area has shown that in first record duration, maximum plant combination was grasses and forbs (27.27%), and shrubs (26.5%) and minimum amount was for annual forbs (2.09%). In the second record period, shrubs (48.45%) and bushy trees (21.64%), and annual forbs (1.45%), respectively formed the plant combination of area (Fig. 2).

In two record periods, grazing behavior of sheep has shown that 1500 bite-counts have been recorded in morning and evening while it was 1000 bite-count record for goats (Table 2). The highest and lowest species consuming by sheep in the morning and evening time in the first record period were *Bromus tomentosus* Trin. (27.33 % and 35.47%), *Festuca rubra* L.(12.94% and 23.8%) and

Centaurea cyanus Roth. (0.13% in am), and *Cousinia habilitzlii* C.A. Mey. (0.06% in pm). *Onobrychis cornuta* (L.) Desv. was 19.9% and 36.6% for goats in am and pm, respectively. The lowest consumption for goats was occurred on *Centaurea cyanus* Roth. With 0.1%. In second record period, sheep highly preferred *Trifolium repens* L. with 36.6%, *Bromus tomentosus* Trin. With 35.26% in the morning. They, however, lowly grazed *Sedum album* L. with 0.06%. Based on the counted bite of sheep in evening, it has shown that the amount of bite has decreased in the morning and they preferred to graze *Lolium perenne* L. and *Trifolium repens* L. with 34.8% and 21.93%. Goats, however, have preferred to brows the shrubs species such as *Astragalus* sp. with 52.9 and 48.6% in same conditions as sheep were grazing.

The taken bites by sheep and goats have shown that both of them preferred the composed diet in grazing duration. Although based upon diet selection of sheep in the first and second record period, it has been cleared that perennial forbs were daily the most part of its diet (Fig. 3), presence of this vegetation forms in sheep diet selection is not the cause of its preference. Goats, however, have highly preferred forbs in the first record period, but in second stage, they preferred to brows the shrubs and bushy tree (Fig. 4). As it is seen in figure 5, sheep have preferred grasses in the daily grazing, considering that goats have same situation. However, goats have preferred shrubs and bushy trees in the daily grazing in both record periods (Fig. 6).

In the first record period, although grasses, forbs, and shrubs dominated the study area, sheep and goats preferred to graze legume family as their henpecked diet composition than the other families in grazing duration. The highest diet preference of sheep, however, was grasses. The reachable preferred forage and plant organ are the cause of mentioned situation. Moreover, dominating of grasses in the study area and

their easy digestibility compared to the other plants caused that sheep preferred to graze the grass plants more than the others. They are same results that Codron *et al.* (2007) mentioned. Since the goats prefer to brows the stems and leaves of bushy trees and shrubs in the same condition which sheep grazes (Arzani and Naseri, 2005), the results also emphasize that highest preference of goats are the shrubs and bushy trees.

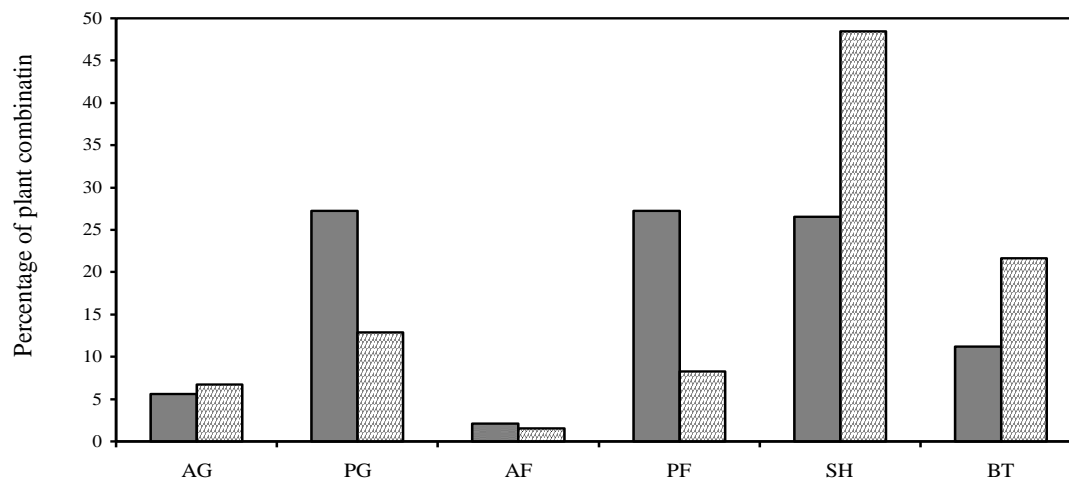
In the second record period, rangeland conditions and trend were excellent and positive, respectively. It was because of reduction of near to half amount of herd that was transited to other area. Hence, less grazing capacity caused to increase in the vigor of plants and also remaining of palatable plants in the plant composition in the study area in which the situation of diet selection of animal did not change. In this position, sheep have preferred to graze the perennial grasses and forbs in daily grazing duration. *Trifolium repens* L. and *Lolium perenne* L. were the dominated species in the diet selection of sheep in a.m. and p.m. because of excellent condition of rangeland with keeping the palatable and vigor species more than the past. Likewise the second record period, goats preferred to brows the bushy trees and shrubs including *Astragalus nurensis* Boiss and Bushe.

The results of one-way ANOVA show that taken bites by sheep and goats have

significantly different between each other in the daily and seasonal grazing (Table 3). Totally, the amount of bite counts in daily grazing period for goats and sheep were different from each other in this research as Baghestani *et al.* (2004) reported. The cause of it is that goats have more movements than the sheep and they are good selector to choose the best and highest rich plants (Arzani, 2009). Hence, they spend more time for moving and finding these kinds of plants. Goats, therefore, consume less plant in their diets. Sheep consumed more species than goats in the record period (season grazing). In the evening of first record period, both animals took more morsels, which were vice versa in the second record period. The cause of this difference is cool weather, requirement to the shadow that decreases the heat tension in day duration and increases the consumption of forage (Askarizadeh *et al.*, 2009). With going to end of summer, the mountain weather changes faster than the first and mid parts of summer. Hence, increasing the morning consumption of animal is agreeable with new weather conditions in the last record period. This result reported by Thomson *et al.* (1985) emphasized on non stop grazing of animal in the morning albeit its tripe was full in the suitable weather condition and they may be desist to grazing in the evening.

Table 1. The rangeland condition and trend in two recording times

Recording time	Vegetation type	Rangeland score	Rangeland class	Rangeland trend
First	<i>Onbrychis</i>	47.17	Good	Positive
Second	<i>Bromus</i>	55.2	Excellent	



AG: Annual Grass, PG: Perennial Grass, AF: Annual Forb, PF: Perennial Forbs, SH: Shrubs, BT: Bushy Trees

Fig. 2. Comparative percentage of plant combination in the first (left columns) and second (right columns) times in *Onobrychis-Bromus* type

Table 2. Average bite-count of sheep and goats in first and second record periods

Row	Species name	BT*	First record (End of Jun)				Second record (Mid of August)			
			Sheep -15 records		Goat -10 records		Sheep -15 records		Goat -10 records	
			A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1	<i>Carex stenophylla</i> Wahlenb.	AG	4.2	7.2	6	0.7	6.53		9.7	
2	<i>Bromus tomentosus</i> Trin.	PG	27.33	35.47	17.7	7.9	35.26	0.2	4.8	8.4
3	<i>Bromus tomentellus</i> Bioss.	PG	5.6	3.4	4.7	1.7	0.6	9.6	0.1	
4	<i>Dactylis glomerata</i> L.	PG					2	14		
5	<i>Festuca ovina</i> L.	PG	2.47		1	0.8		0.86		
6	<i>Festuca rubra</i> L.	PG	12.94	23.8	4.6	11.9			3.9	2.6
7	<i>Lolium perenne</i> L.	PG					5.2	34.8		
8	<i>Phleum pratense</i> L.	PG			0.5	0.4				
9	<i>Poa pratensis</i> L.	PG	1.8	3.4						
10	<i>Stellaria media</i> (L.) Vill.	AF	8.67	1.74	10.4	4.8	4.2	4.54		
11	<i>Achillea millefolium</i> L.	PF	1	1.6	1.5		0.13	6.74		
12	<i>Alchemilla persica</i> Rothm.	PF	0.93	2.34	2.3	1.3	0.6			
13	<i>Anthemis cotula</i> L.	PF		1.14	0.2	0.3				
14	<i>Borago</i> sp.	PF					0.4			
15	<i>Centaurea cyanus</i> Roth.	PF	0.13	0.73	0.1	0.1		1.2		
16	<i>Cousinia Habilitzlii</i> C.A. Mey.	PF	0.73	0.06	0.5		0.33			
17	<i>Hypochaeris radicata</i> L.	PF	1.93		3.1	0.3	0.6			
18	<i>Onobrychis michauxii</i> DC.	PF	0.6							
19	<i>Phlomis persica</i> Boiss.	PF			0.2	2				
20	<i>Pimpinella anisum</i> L.	PF	0.2	0.2	0.8					
21	<i>Plantago lanceolata</i> L.	PF	5.2	2.26	5		2.13	3.6		
22	<i>Potentilla reptans</i> L.	PF			0.5		0.26	0.54		
23	<i>Primulla vulgaris</i> L.	PF	0.53		1.6		0.2			
24	<i>Sedum album</i> L.	PF			0		0.06	1.13		
25	<i>Taraxacum officinalis</i> L.	PF	1.8	1.2	0.9	1.1	2.8			
26	<i>Trifolium repens</i> L.	PF	2.2	4.06	6.7	0.6	36.6	21.93		
27	<i>Turgenia latifolia</i> (L.) Hoffm.	PF	0.6		0.7					
28	<i>Vicia persica</i> Boiss.	PF							0.5	9.9
29	<i>Astaragalus nurensis</i> Boiss.	SH				2.4			52.9	48.6
30	<i>Onobrychis cornuta</i> (L.) Desv.	SH	7.01	11.4	19.9	36.6		0.66	0.7	4
31	<i>Thymus kotschyanus</i> Boiss.	SH	12		10.2	18	0.86	1.4		
32	<i>Berberis vulgaris</i> L.	BT	2.13		0.3	3.7			20.1	17.5
33	<i>Prunus domestica</i> L.	BT							7.3	9
34	<i>Rosa iberica</i> Stev.	BT			0.6	5.4				
Total bite count			100	100	100	100	100	100	100	100
Total amount of consumed species			22	22	22	25	16	19	22	13

* AG: Annual Grass, PG: Perennial Grass, AF: Annual Forb, PF: Perennial Forb, SH: Shrub, BT: Bushy Tree

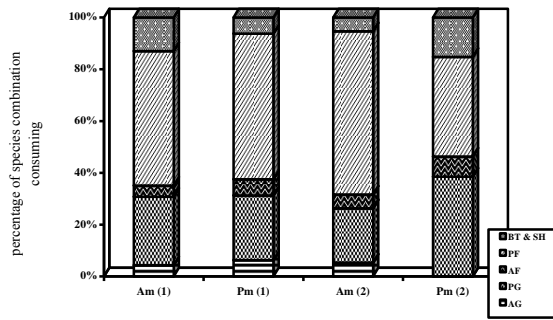


Fig. 3. Comparative percentage of species combination consuming by Sheep in the first and second times

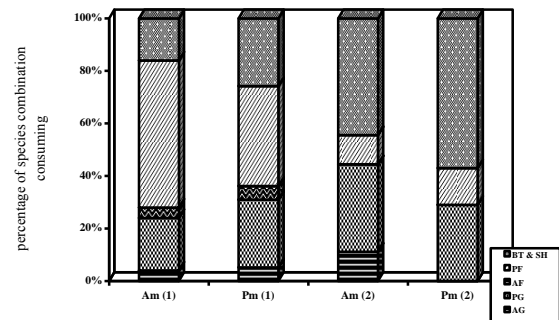


Fig. 4. Comparative percentage of species combination consuming by Goat in the first and second times

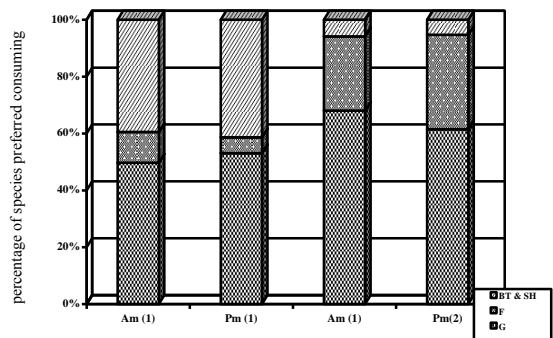


Fig. 5. Comparative percentage of species preferred consuming by Sheep in the first and second times

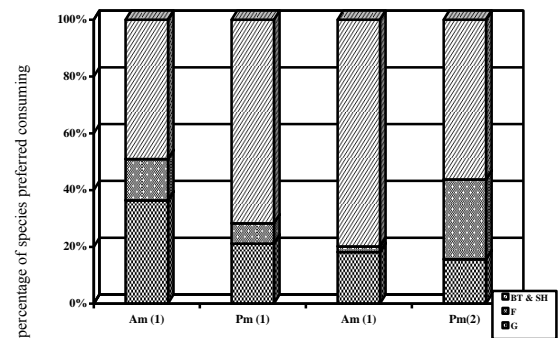


Fig. 6. Comparative percentage of species preferred consuming by Goat in the first and second times

Table 3. Result of ANOVA analysis for bites by sheep and goats in the daily and seasonal grazing period

Animal	periods	S.O.V	df	MSe	F
Sheep	First Time	Between Species	29	1007.55	21.17**
		Within Species	420	47.59	
		Total	449		
	Second Time	Between Species	21	2208.98	37.78**
		Within Species	308	56.46	
		Total	329		
Goat	First Time	Between Species	35	581.96	9.48**
		Within Species	324	61.38	
		Total	359		
	Second Time	Between Species	13	2808.64	9.30**
		Within Species	126	301.98	
		Total	139		

** : Significance Level 0.01

Conclusion

The current study has shown that direct vision (bite-count) is an uninjured approach to study the diet selection of animal on the basis of their natural environments. It also emphasizes on rangeland and weather conditions which impact the diet selection of animal. Upon the results, goats preferred to brows the shrubs and bushy trees and sheep also preferred to graze the grasses and forbs as

their grazing behavior. Hence, keeping the vegetation and species forms' positions and regulating the grazing program for plant vigor and keeping their vigor can increase the productivity of animal proportionate to the rangeland conditions. Therefore, knowing of animal diet selection in each area is a grazing management tool to design the rehabilitation and improvements program of rangelands.

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