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Preference Value of Plant Species in Middle Alborz Region of Iran by Sheep

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ABSTRACT

Preference value means the animal preferring to eat a plant and different species do not have the same preference in different growth stages. Accordingly, by the use of preference value of forage plants in the rangeland management, grazing capacity of rangelands can be determined to achieve the optimum performance of livestock and to guarantee the stability of rangeland ecosystem. In this study, the plant preference value was determined by the preference index in semi-steppe rangelands of middle Alborz Mountains of Iran during the years of 2007- 2010. The results showed that during the studied years, the year of 2010 had the lowest preference value and also had a significant difference with the other years and we can say that the first month of these years had the highest value and there were significant differences among these months. Also, a fact about species is that there are significant differences among them and the highest value was related to *Thymus kotschyanus* and *Scariola orientalis.* Therefore, these two species have a complete preference value during the studied months and years.

KEYWORDS: Preference value, rangeland, species, Middle Alborz.

INTRODUCTION

Central Alborz mountain as a high bar separates Caspian Lake with unique topographic characteristics from the central Iran plateau and extends from East to West with a length of 600 km. Slopes and valleys of Alborz mountain are the major recreational places for the people of Tehran, Alborz, Qazvin and Semnan provinces. Qazvin is one of the most fertile areas of Iran located in the southern basin of the middle Alborz Mountain and its grasslands expand as a relatively narrow stripe in the slopes of middle Alborz Mountains. The annual precipitation of this natural environment is 400 mm. One of the most important characteristics of these ecosystems is to have a long dry season. The high quality Iranian rangelands are seen in North and West and also in the slopes of Alborz mountain. The rangelands of these ecosystems have a good grazing quality for sheep, goats and cattle. One of the basic principles of rangeland management is the determination of grazing capacity of rangelands to achieve the optimum performance of livestock and to guarantee the stability of rangeland ecosystem. Determination of grazing capacity depends on several factors such as forage production, preference values and permissible utilization limits (Abdollahi *et al*., 2009). Preference value means that an animal prefers eating a specific plant rather than the other plants; however, the animal is able to select the plants freely for grazing. The factors related to the livestock are age, type and race of livestock, hungry rate, health and stage of pregnancy and factors related to the plant include the growth rate, flowering, phonology, morphology, chemical compounds, dominant type and availability (Bashary *et al.*, 2002).

Malechek (1981) stated that when grasses are plentiful, goats do not graze all the parts of shrubs and select some parts with more nutritional value and also prefer a combined diet. Based on the study of plant compounds, Vallentine (1990) stated that the diet of sheep is composed of 2 to 23 percents of shoots, 9 to 62 percents of broad leaves and the remainder involves narrow leaves. He has shown high variation in the diet of sheep. The usage percentage, increasing need to the forage for livestock, the estimation of rangeland capacity and pasture management are the components related to the estimation of the dry matter consumption by livestock. A high forage consumption is estimated by the livestock factors (physical, physiological, psychological and behavioral) and environmental factors (diet, climate and management). Some factors increase the consumption of forage by the livestock or at least, they keep it in a high level. Some other factors decrease the consumption of forage and primarily forage consumption is associated with several factors (Baghestani *et al.*, 2003). Ngwa *et al.* (2000)

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followed the livestock 5 times for every flock and every time 10 minutes to determine the preference values for sheep and goats and recorded the grazed species to estimate the grazing period of each species in the grassland of northern Cameroon. They found that sheep spend two third of their time to graze the grasses and goats spend the most of their time to graze the branches. The results also showed that *Acacia seyal*, *Acacia sensegal*, *Pterocarpus lucens* and *Ziziphus mauritiana* have high preference values. Hussein and Durrani (2009) by investigating the preference value of country rangelands concluded that sheep spent 54% of grazing time for the forbs, 23% to the grasses, 22% to the shrubs and 1% to small trees. Also, goats spent 60, 27, 12 and 1percents of their grazing time to graze the forbs, grass, shrubs and small trees, respectively. Rogosica *et al.* (2006) studied the Mediterranean shrubbery to compare the preference values of sheep and goats and observed that goats eat more shrubs than sheep and also, goats gain much weight in the region; therefore, goats should be kept in this area.

Sanon *et al.* (2007) investigated the selection behavior of sheep, goats and cattle in natural pastures of coastal region of Burkina Faso. They recorded the behavior of cow, sheep and goats regularly in 15 minute intervals during the 3 consecutive days per month from May 2003 to April 2004. Their results showed a decline in the nutritional activities of all animal species from rainy season to dry season while the champing and resting activities increase contemporary during these seasons. The reduction of feeding time in cattle was higher than other animals (72 to 39% of the total time). Cows spend only about 4.5% of their grazing time to eat branches throughout the study period. Studying sheep and goats showed a peak in the behavior of grazing branches in dry season by 28% and 52%, respectively. During the study period, cows grazed 10 species from which *Guiera senegalensis* had the highest rates as 59, 54 and 84% respectively for rainy season, before rainfall and dry season. *Guiera senegalensis*, *Combretum micranthum* and *Balannites aegyptica* were the most important grazed species by sheep among the 20 grazed species. Also, goats grazed more than 20 species daily from which *Acacia Senegal*, *Balannites aegyptica* and *Pterocarpus lucens* were the most palatable species for goats. Mirdavoodi and Sanadgol (2008) investigated the preference value of rangeland species of Anjadan (Markazi province) using timing method and concluded that palatable species such as *Bromus tomentellus*, *As. Glomerata* and *Buffonia cf. koelzii* and annual grasses in the early grazing season were highly used by animals and during grazing, some species including *Bromus tomentellus*, *Artemisia aucheri* *As. glomerata*, and *Buffonia cf.koelzii* were used respectively with utilization rates of 74, 43, 59 and 56 percents. Rashtian *et al*. (2008) by determining a preference value of 7 important rangeland species in steppe areas of Yazd province concluded that sheep spend much of their grazing time to graze Teragopegon, Artemisia and other annual plants. Considering the preference value in the rangeland species in different months of grazing season and its important role in determining the rangeland grazing capacity, we can achieve the optimum performance of livestock. This study was carried out to determine the preference value of rangeland species in middle Alborz region by preference index and timing method.

MATERIAL AND METHODS

Study area

The study area is located in the middle of Alborz Mountain in 100 km of North-East of Qazvin and 27 km of South-East of the Moallem Kelayeh of Rudbar Alamut with the coordinates as: N 36° 21' E 50° 32', 2400m. Based on Dumarton coefficient, the climatic zone is semi-arid. According to the Embrothermic, the mean annual precipitation is 600 mm, the minimum and maximum mean annual temperature are 12.5 $^{\circ}$ ^{C} and 13.8° ^{C} and mean annual temperature is 15.3 $^{\circ}$ ^{C}. The study area has mountainous physiographic types and loamy soil. Its vegetation physiognomy is grass –shrubbery. The vegetation type of area is *Agropyron intermedium* - *Astragalus microcephalus* with 82 identified species in its floristic list. The main species are *Festuca ovina*, *Astragalus microcephalus*, *Bromus tomentellus*, *Dactylis glomerata*, *Thymus kotschyanus*, *Poa bulbosa*, *Agropyron trichophorum*, *Agropyron intermedium* and *Artemisia aucheri*,

The animal composition was 70% local, 20% Fashandi and 10% Ghomi. The herd is composed of 30% goats and 70% sheep. The utilization system of this rangeland is rural and traditional. Growing season begins from the late April to the second half of September (depending on climate). In the study area, grazing period is determined from 25 May to the end of October for 155 days based on rangeland grazing permission.

Methods

Sampling from vegetation were carried out in key area and rotation grazing system has been applied in this area. For each species, 1-5 similar stands inside and 1 to 5 stands outside of fence were selected and marked at the beginning of the grazing season. For each month of the grazing season, after the entry of livestock to rangeland, the first five stands of the inside and outside of the fence for the first month were harvested in the next month. The forage of each stand was separately weighed and recorded. The procedure was repeated for the grazing months. Data

were estimated based on non-cumulative production and consumption to calculate the selection index. Inside production is subtracted from outside fence production to calculate the cumulative consumption and non-cumulative consumption rate is computed with the subtraction of each month consumption from the month before consumption. Then, species ratio in forage is equal to the non-cumulative production of each species in the month divided by total production forage in the month multiplied by 100 and the diet ratio is equal to non-cumulative consumption of each species in the month divided by total consumed forage in the month multiplied by 100. Finally, species preference value was calculated based on the selection index according to the following equation (Becker, K. and J. Lohrmann, 1992 ; Van Dyne and Heady, 1965):

Preference index= species rate in ration / species rate in forage

Finally, the data obtained during the inventory years (2007-2010) were analyzed by the SAS software using split plot test in a completely randomized block design with a combined analytical test and the means were compared using a Duncan Multiple Range Test at P<0.01. Preference value index is determined based on the following classification:

Preference value based on PI

Class of preference value	Preference Index
Complete preference and complete palatability of species	I>2.1
Relative preference and relative palatability of species	1.4 -2
Middle preference and middle palatability of species	0.7-1.3
Relative avoiding and nearly non palatability of species	0.3-0.6
Complete avoiding and Complete non palatability of species	I<0.2

RESULTS

The mixed variance analysis of preference value in various species and studied years are shown in below table. According to the obtained information shown in the following table for Alamut- Qazvin area for 4 years (2007-2010), such factors as year, species and stage were statistically significant at 1% level and also, the interactions of year and species, species and stage, year and stage and interaction among year, species and stage were significant at 1% level.

Results of Duncan test (Table 3) for the species preference value in the studied years showed that the mean annual value was not significant for the first three years and these years have been placed in the same group (group A) and this mean is calculated as 1.07 (kg/ha) and they have significant differences in the level of 5% with the fourth year. Therefore, fourth year has the lowest value computed as 0.66 (kg/ha) and is located in the second group (group B).

According to average preference value obtained for the studied species using Duncan test (Table 4), it is concluded that *Scariola orientalis* and *Thymus kotschyanus* have the highest preference values (group A). Also, *Phlomis olivieri* has the lowest value that is placed in the last group (group H) and it has been shown in Table 2 that based on mixed analysis, the species factor is significant in the level of 1% and also, there is a significant difference among different species in terms of preference value leading to the classification of species in different groups.

Fig 1: Geographic position of study area

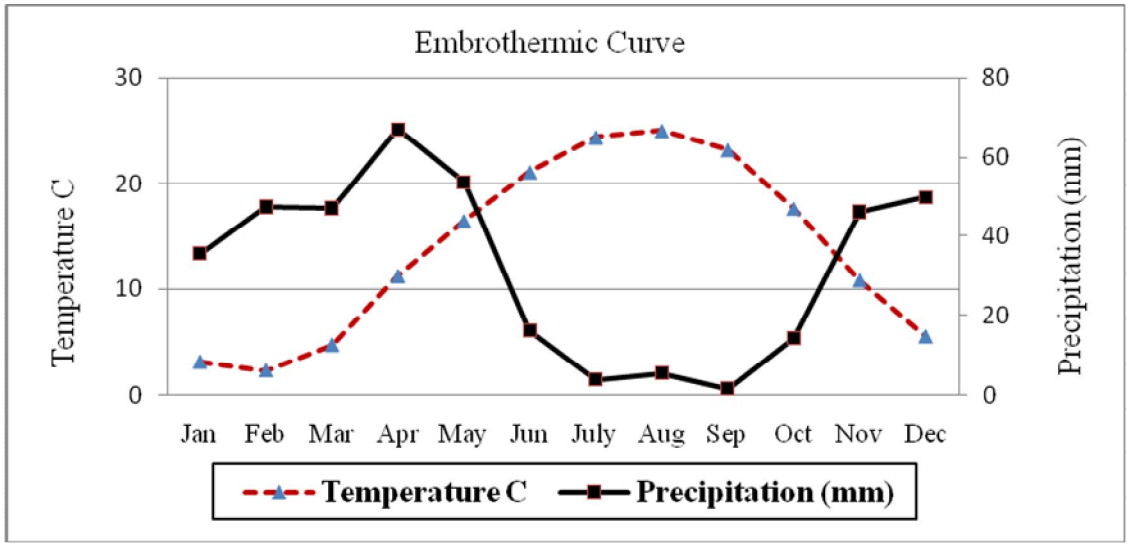

Fig. 2. Amberothermic curve from Bagh Kelayeh climatical station (ANONYMOUS 1977 – 2007)

Table1: Monthly and annual rainfall during study years in Alamut-Qazvin mountain

year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	average
2005-2006	64.1	71.4	13.5	15.0	33.5	119.5	163.2	86.0	15.5	0.0	2.7	0.0	584.4
2006-2007	4.8	0.5	72.4	22.0	38.0	13.7	7.0	5.5	5.0	15.5	0.6	5.9	190.9
2007-2008	6.0	108.5	35.5	26.5	93.0	20.5	87.1	48.0	12.5	0.0	0.0	32.0	469.6
2008-2009	9.0	76.9	27.5	10.0	49.7	61.8	71.5	135.0	1.0	0.0	2.0	1.0	445.4

Table 2: mixed variance analysis of species preference value based on preference index method

Source	DF	SS	MS	F	Prob
year	3	3.54	1.18	7.62	**0.0041
rep(year)	12	1.86	0.15	--	--
species	18	23.44	1.30	24.28	**<.0001
year*species	54	10.53	0.20	3.64	**<.0001
stage*rep(year)	164	8.80	0.05	--	--
stage	2	40.65	20.33	326.01	**<.0001
stage*species	36	37.97	1.05	16.92	**<.0001
year*stage	6	6.84	1.14	18.27	**<.0001
year*stage*species	108	27.31	0.25	4.06	**<.0001
Error	346	21.57	0.062	--	--

*P<0.05,**P<0.01,NS:Non-significant.

Table3: Mean comparison of year preference value based on preference index

year	mean
2006	1.11 A
2007	1.02 A
2008	1.09 A
2009	0.66 B

As seen in Table 5, during the first three months, first month has the highest mean preference value while the third month has the lowest value so that the highest preference value with a mean of 1.54 (kg/ha) is related to first month and set in the first group (A) and the lowest value is considered for the third month with an average of 0.15 (kg/ha).

Also, as shown in Table 2, it was known that the interactions between species and month, month and year and interaction among species, month and year have significant differences indicating that different species have different values in different months and different years and various species have different preference values in different months of different years.

Table4: mean comparison of the species preference value based on preference index

Row	species	mean	grouping	preference value index
1	*Scariola orientalis*	1.85	A	Comparatively palatable
2	*Thymus kotschyanus*	1.89	AB	Comparatively palatable
3	*Tanacetum polycephalum*	1.56	ABC	Comparatively palatable
4	*Astragalus citrinus*	1.51	BC	Comparatively palatable
5	*Astragalus demavandicus*	1.51	BC	Comparatively palatable
6	*Vinca herbacea*	1.43	C	Comparatively palatable
7	*Achillea millefolium*	1.02	D	Middle palatable
8	*Astragalus microcephalus*	0.99	D	Middle palatable
9	*Veronica orientalis*	1.03	ED	Middle palatable
10	*Eryngium billardieri*	0.76	ED	Middle palatable
11	*Acantholimon flexuosum*	0.77	EDF	Middle palatable
12	*Stachys lavandulifolia*	0.88	EDF	Middle palatable
13	*Artemisia aucheri*	0.59	EGDF	Nearly Non Palatable
14	*Cirsium haussknechtii*	0.48	EGHF	Nearly Non Palatable
15	*Cousinia esfandiarii*	0.42	GHF	Nearly Non Palatable
16	*Cousinia calocephala*	0.44	GH	Nearly Non Palatable
17	*Verbascum speciosum*	0.41	GH	Nearly Non Palatable
18	*Euphorbia denticulata*	0.50	GH	Nearly Non Palatable
19	*Phlomis olivieri*	0.3	H	Nearly Non Palatable

Table5: Mean comparison of month preference value based on preference index

stage	mean
June	1.54 A
July	1.22 B
August	0.15 C

DISCUSSION AND CONCLUSION

According to the mixed analysis table, all factors have a significant difference seen clearly in next tables. According to table 3, there are significant differences between the first three years and the fourth year while there are no significant differences among first three years of study. Also, according to the table, the highest preference value has been found in 2007 and then 2009 followed by 2008 and fourth year (2010) has the lowest value for the species grazed by livestock. In Table 5, it is found that there are significant differences between the different production months from the first to third months, respectively. It means that the highest and lowest preference values are seen in first and third months, respectively. Thus, we can say that the highest and lowest preference values are related to the first month of first studied year and third month in 2010, respectively. Notably, according to the results, it is concluded that the first month in all years has the highest preference value for plant when the plant has more freshness and vitality because of low temperatures and more rainfall in this month and the livestock is more willing to graze this species in the area. Livestock tendency for the consumption of species is declining as the temperature is increased in next months and precipitation decreases. In fact, the lowest preference value is observed in June or the third month of study. Also, the first year with the highest rainfall has had the highest preference value in different years and after 2007, the year of 2009 has had the highest rainfall that is also ranked as the second value in order to determine the preference value.

The important point is that according to Table 3, the first three years were not significantly different from each other and all of them were placed in the same group. It should be noted that although these three years are different in terms of rainfall, they have a same average temperature. Although the year of 2010 had a high rainfall, according to Table 3, this year had the lowest preference value among the studied years because of rain stopping in the early June and the increase of mean temperature monthly rather than long-term period which led to the heat stress for the rangeland plants. During this time, most of the rangeland plants had still been in the early stages of flowering and after a short period, there was a sharp drop in soil moisture and rangeland plants were deficient in moisture absorption and soon their reproductive stages finished. In this year, most species of the Poaceae and Apiaceae families do not produce seeds or they have produced hollow seeds without embryos. Therefore, it can be stated that the temperature effect is not less than the rainfall rate in order to determine the species preference value. So, after the years of 2007 and 2009 which have the highest rainfall, 2010 should have the third value but we see that 2008 has the third value despite less rain and the same temperature as two past years. The year of 2010 is placed in the range of fourth value despite more precipitation than 2008 and because of higher temperature than last year. In other

words, it is placed in the last rank due to species preference value in the area. Ahmadi *et al.* (2009) studying the grazing behavior and diet selection of Zandi sheep with different ages concluded that preference value varies based on grazing of each species by livestock during different months and this finding is consistent with this study.

It is noteworthy that according to Table 4, there were significant differences among different species in terms of preference values that in this case, among 19 species, *Thymus kotschyanus* and *Phlomis olivieri* has the highest and lowest values, respectively; in other words, it has the lowest value for the consumption by livestock and other species are placed within the range of these two obtained values. Abdullah *et al.* (2009) introduced low species distribution because of decreasing the consumption of species and many researchers including Springfield & Reynolds (1951), Holechek et al. (1984) , Malechek (1981) and Aregheore et al. (2006) mentioned that the availability of forage is one of the effective factors in selecting the plants and Phayaz *et al.* (2009) showed that *Festuca ovina* had a higher value than *Bromus tomentellus.* Therefore, we can divide the species into 4 groups by considering the preference value as follows: Group 1 includes such species with the preference value ranging from 1.5 to 2 as *Thymus kotschyanus, Scariola orientalis, Tanacetum Polycephalum, Astragalus citrinus and Astragalus Demavandicus.*

Group 2 has the value range of 1.5 to 2 including *Vinca herbacea,Veronica orientalis* and *Achillea millefolium* (range of 1 and 1.5), *Astragalus microcephalus, Stachys lavandulifolia, Acantholimon flexuosum, Eryngium billardieri, Artemisia aucheri* and *Euphorbia denticulate* (range of 0.5 to 1) and finally, *Cirsium haussknechtii,Cousinia calocephala, Cousinia esfandiarii, Verbascum speciosum* and *Phlomis olivieri* (less than 0.5).

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