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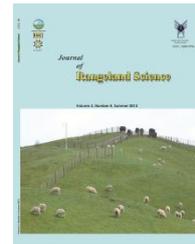
Full Length Article:

The Study of Preference Values of Forage Species and Grazing Behavior of Tali Goat in Chabahar Rangelands of Iran

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Abstract. In recent years, studying the dietary preferences and livestock grazing behavior has attracted lots of attention due to manage and improve the efficiency of rangelands. So, in this study the foraging behavior and diet selection of Tali goat was investigated in the Chabahar Rangeland during 2008-2010. Data were collected and analyzed for speeds of livestock, covered distance, time of grazing, resting, and walking for months of grazing (February to May) as replications over 3 years. To determine the preference value, time recorder method was used. Time of grazing of specific plant species by livestock was monthly recorded and analyzed, across February to April. Results showed that *Launaea mucronata* species of annual broad-leaved had the highest preference value while two species of *Sporobolus arabicus* and *Lotononis platycarpos* had the lowest ones. All the measured parameters of grazing behavior had no significant differences during the studied years. The resting time rates of various months had significant differences. Accordingly, the highest resting time rate could be attributed to May whereas this rate was likely to be reduced during February, March and April. The result of the study will therefore be useful in planning a grazing strategy and determination of carrying capacity for livestock grazing in the studied rangelands. Also the findings help us in rehabilitate Chabahar rangelands, with palatably species for the Tali goats.

Key words: Grazing behavior, Preference value, Tali goat, Chabahar

Introduction

Preference value means the selection of a specific species as compared to other ones by the livestock which can be defined as a behavioral reaction. Studying the grazing behavior of livestock can be applied as an index to specify the quality and quantity of available forage to be grazed in the given rangeland. Rutter (2006) defined the difference between the selection and preference of specific species and suggested that the livestock may be forced to choose species because of the limited environmental conditions; however, the livestock may prefer another species. In fact, in order to study the preference value of plant species, it is needed to remove all the environmental barriers of livestock grazing and the grazing should take place in a suitable rangeland where there is a mixture of a variety of plant species.

It is well known that animal behavior varies greatly among domesticated livestock species (Goetsch *et al.,* 2010). Goats are described in the literature as grazers or opportunistic feeders, since they adapt their selectivity in relation to seasonal changes of forage availability (Malechek and Provenza, 1983). Study of the behavior of freely moving goats on pastures and rangelands is useful for purposes such as determining the most appropriate stocking rate and physiological states and seasons of land use, the need for and types of supplemental feedstuffs, and the desirability of mono species grazing with goats (Animut and Goetsch, 2008). Animal tracking allows estimation of distances traveled with the use of Geographic Positioning System (GPS) equipment or geographical information system software (Ouédrago-Koné *et al.,* 2006). There has been a development of studies of the grazing behavior of goats in relation to forage availability under different management schemes with the goal of increasing forage and livestock production.

Papachristou (1994) investigated foraging behavior and nutrition of goats grazing on shrub lands of Greece. He suggested that the reduction of the shrubs by component down to cover resulted in an increased consumption of herbaceous species, which comprised of the diet during spring. He explained that in general, goats appear to be adaptive in their dietary habits. They browse more than graze whilst they can graze and utilize considerable quantities of grass and forbs during spring when their availability and quality is high.

Odo *et al.* (2001) monitored the grazing behaviors such as ingestion, walking, resting, rumination, playing of three goat ecotypes for a period of 18 weeks at Abakaliki, Nigeria. They were observed grasses, legumes and trees were the most preferred species. The most preferred species were not necessarily the most abundant on the ground, indicating that ease of accessibility and palatability may be important determinants for choice of a forage species.

Cisse *et al.* (2002) studied grazing behavior of Senegalese Sahel goat over 1 year while foraging in natural pasture. They reported that goats spent about 80% of their time eating, and time spent walking was higher in the dry season than in the rainy season (5-15% versus 0.6-2.6%). Contribution of ligneous species in the diet peaked in July (96.1 %) and January (95%), then decreased reaching 5% in September, corresponding to the peak intake of herbaceous species.

Ouédraogo-Koné *et al.* (2006) studied the behavior of sheep, goats and cattle on a shrub and tree savannah in the sub-humid zone of West Africa during the dry (February to May), rainy (June to September) and cool season (October to January). Their observation showed that during the dry season sheep, goats and cattle spent around 25% of their time browsing and there was no significant

difference between the number of browse species consumed per day by sheep, goats and cattle. During the cool season, goats (17%) browsed more than both sheep (7%) and cattle (5%).

Evangelou *et al.* (2010), examined the seasonal change of sheep and goat grazing behavior in communal Mediterranean rangelands. They find out that Sheep and goats spent more time feeding on grasses during spring (56.4%) and winter (45.4%) than summer (28.5%) whereas they spent more time feeding on forbs during summer compared to spring and winter.

Zare *et al.* (2012) studied preference value comparison in range species Anjedan-Arak, Iran. The results showed the preference value in different grazing months significantly differed and annual grasses and forbs showed maximum preference value.

Ferreira *et al.* (2013) compared foraging behavior and overlap in vegetation use between cattle, sheep and goats across the grazing season (May–December) in the Northwest of the Iberian Peninsula. They observed goats spent more time grazing on shrub lands. Herbaceous species were the main component in the diets of goat only during the spring. They suggested goats proved to be the best complement to the other animal species for an efficient use of natural vegetation.

Information on diet selection is essential to set the best management options to promote a more efficient utilization of the existing vegetation leading to an increase in the profitability of the production system. In other word, without the recognition of livestock grazing behavior and the preferences values of plant species during the grazing period, livestock planning and range management is difficult. This paper seeks to answer these questions which plant species are preferred by Tali goats than other species and how do Tali goats choose their diet? So, this research was aimed to investigation of grazing behavior of goats in order to determine the most consumed plants species and to assess how behavioral vary across the grazing season in Beris, Chabahar during 2008-2010.

Materials and Methods
Study area
The studied area was located in the south of Sistan and Balochestan province, Iran. In this area, existing lands include the mountains, plains and salt marsh. Height is varying from 2110 m in northern mountains to 0 m at the sea level. The experimental site (Beris) is situated in 30 km far from the eastern Chabahar in the central district and overlooking the sea of Oman between the 25° 13′ N and 60°57′ E (Fig. 1). The height of site was lower than 10 m from sea level.
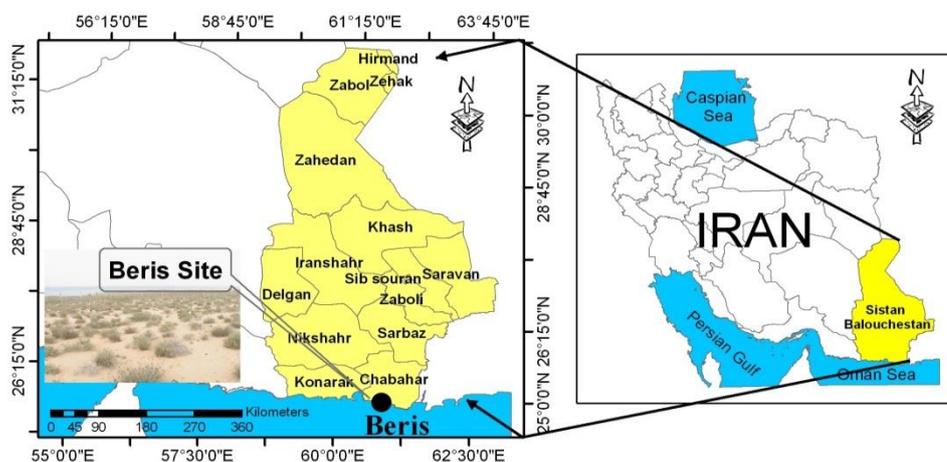

Fig. 1. The location of Beris site in the east of Chabahar

Climate and rainfall

This area according to De Martonne aridity index is regarded as a hyper arid part of southern Balochestan watershed. Average annual rainfall is varying from 96 to 250 mm at different height levels and its maximum is recorded in winter. Reviewing 20-year embrothermic curves of case study has shown that the dry season is dominant whole the year and precipitation is more likely to happen in the months of fall and winter from October to March. Moreover, precipitation may occur in July and August when the monsoon storm starts. Precipitation average, temperature maximum, minimum and average rates for a 20-year period have been calculated as 108.7 mm, 30.8 ℃, 20.6 ℃ and 26.1 ℃, respectively.

Vegetation

The southern Balochestan watershed is part of ecological region of the sea of Oman and Savannah-like subtropical. Site vegetation is shrubby and dominant species include *Sphaerocoma aucheri*, *Cyperus conglomeratus, Atriplex leucoclada* and *Salsola drummondii*. Grass species existing in the area are perennial. Among annual forbs in site were *Lotus halophilus, Trigonella stellata, Arnebia hispidissima, Blepharis persica, Launaea mucronata, Medicago minima* and *Lotononis platycarpos*.

To determine the preference value, time of grazing seven plant species (*Launaea mucronata*, *Sphaerocoma aucheri, Eremopogon foveolatus, Blepharis persica*, *Lotus halophilus, Lotononis platycarpos* and *Sporobolus arabicus*) by livestock were monthly computed and statistically analyzed.

Characterizations of Tali (Sahely) goat

The Tali goats are medium-sized and mostly are brown or light brown colored. Another local name of this breed is "Sahely". This breed can be found in South-western areas of Iran. Its main distribution areas are the coastal region of Hormozgan province along the Persian Gulf especially near the towns of Minab, Bandarabbas, Khamir, Bandar lengeh, and Qeshm Island in the Strait of Hormuz. The male and most of female have horns. Height at shoulder is 76 cm in adult male and 68 cm in adult female goat, respectively. The main use of this breed is for milk (Sadeghi *et al.,* 2009). Exploitation method of the rangelands in study area is rural and the livestock often is in the rangelands near the rural. Entrance and exit dates of livestock are from the beginning of February to the end of May based on the recommendations of Department of Natural Resources and Watershed Chabahar. Dominant regional livestock may be the goats of Tali race and rural livestock composition involves the goats and ewes computed as 80 and 20 percent, respectively.

Research methods

Direct observation methods have been, and are still, useful in studying animal behavior (Goetsch *et al.,* 2010). One mature female of goat were randomly chosen and was followed in 3 years (2008-2010). To determine the preference value, timing and filming methods were applied to record the livestock activities. In this method the time spent for grazing the plant species had been recorded by camera during February to April (3 months) in 3 years. It recorded the species grazing of goat for 30 minutes per month and the recorded videos were transferred to a computer for specifying the grazing time of each plant species. Then, a table of plant species was prepared on the basis of the spent time for grazing per month. Finally, the preference values of plant species were achieved. In addition, the livestock grazing behaviors were recorded regularly using a Geographic Positioning System (GPS) during February to May (4 months) in 3 years (2008-2010). In a given day, the GPS was regulated and then, fastened to the goat while leaving

the fold in every month of the grazing season. Recordings were made during the daytime varying from 9 to 13 h (05:30-7:00 to 16:15-18:00) each month. While livestock returning to the fold, the GPS was removed and the data were obtained through implementing Map Source software. Behavior activities such as average speed livestock, the covered distance length, the time spent grazing, resting and walking were recorded.

Statistical analysis

To evacuating of preference values, a split plot analysis was conducted between selected plant species over three years using months of grazing as replications.

For other traits as speeds of livestock, covered distance, time of grazing, resting, and walking, a two-way analysis of variance was conducted between months of grazing and years averaged over preference values. The SAS software was used statistical analysis and means comparisons were made using Duncan's multiple range test (P<0.01).

Results

Dietary preferences

The effects of year, month and interaction of year and month were not significant for preference value at 1% level. In other words, the preference value mean of species during 3-year and 3-month periods had no significant difference. Interaction of year and species was significant at (P<0.01), (Table 1).

Table 1. Analysis of variance the effects of year, month and species on preference value using time recording method

Source of Variation	df	Sum of Squares	Mean Squares	F Value	Pr>F
Month (replication)	2	25.93	12.96	0.05	0.9486[ns]
Year	2	144.49	72.24	0.29	0.7466[ns]
Error 1	4	440.55	110.13	0.45	0.7723[ns]
Species	6	5185.69	864.26	3.52	0.0076**
Species × year	12	7284.19	607.01	2.48	0.0177**
Error 2	36	8826.93	245.19		
Total	62	21907.7			

[ns] and ** = non significant and significant at 1% level

Duncan's multiple range tests on the species preference value indicated that *Launaea mucronata* as an annual broad-leaved forb species had the highest preference value followed by *Sphaerocoma aucheri* and *Eremopogon foveolatus*. The *Blepharis persica* and *Lotus halophilus* were placed in the intermediate group and *Lotononis platycarpos* and *Sporobolus arabicus* were in the lowest priorities (Fig. 2).
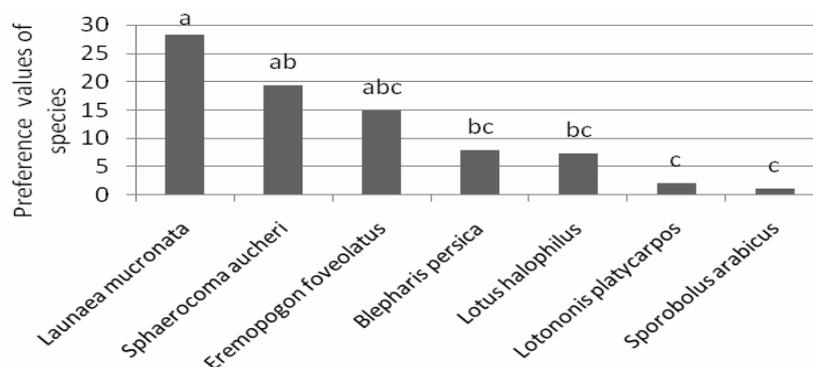

Fig. 2. Mean comparison of preference values of species and their classification using Duncan test

Behavior activities of goat

Results of studying the livestock grazing behaviors showed that in different months of grazing season, the goat averagely started grazing from 5:30 to 7:00 in the morning after leaving the fold and leave the rangelands from 4:15 to 6:00 in the afternoon. Spent grazing time

was ranged from 4 to 7 hours while the resting time was from 3 to 6 hours in different months. The covered distance varied from 15 to 20 km per day. Minimum and maximum livestock speed rates were ranged from 2.6 and 3.7 km/h in various months.

The impact of year for all of traits was not significant (Tables 2 and 3). The effect of month was significant only for time of resting (Table 2). Results showed that times of resting were significantly increased from February to May (Table 4).

Table 2. Analysis of variance the effects of year and month on different features of grazing behavior

Source of Variation	df	MS				
		Grazing Speed (Km/h)	Covered Distance (Km)	Grazing Time Spent (h)	Resting Time Spent (h)	Moving Time Spent (h)
Year	2	0.122	6.802	7319.25	3906.58	383.08
Month	3	0.055	9.289	5364.08	21854.75**	4234.75
Error	6	0.082	4.618	42.58	855.91	

** = significant at 1% level

Table 3. Duncan's multiple range tests for studying the effects of year on livestock behavioral parameters

Year	Speed	Covered Distance	Spent Grazing Time	Spent Resting Time	Spent Moving Time
2008	2.725 a	17.05 a	345.00 a	324.75 a	360 a
2009	3.075 a	19.00 a	429.75a	285.5 ab	342 a
2010	2.900 a	16.52 a	397.50a	263.0 b	345 a

Means with the same letter are not significantly different ($\rho<0.01$)

Table 4. Duncan's multiple range test for studying the effects of month on livestock behavioral parameters

Month	Speed	Covered Distance	Spent Grazing Time	Spent Resting Time	Spent Moving Time
February	2.80 a	18.20 a	378.67 a	198.33 c	388.33 a
March	3.10 a	19.40 a	414.67 a	251.67 c	368.33 ab
April	2.86 a	17.26 a	432.67 a	318.67 b	337.33 ab
May	2.83 a	15.23 a	337.00 a	395.67 a	302.33 b

Means with the same letter are not significantly different ($\rho<0.01$)

Discussion
The preference value
With respect to the findings of study, during the grazing season, the livestock (goats) had preferred the annual species such as *Launaea mucronata* compared than other ones. As a result, it can be stated that when the annual species grow in the rangelands, these plants mostly constitute the goat diets and livestock may graze them as their main feed. These results are in conformity with those reported by Evangelou *et al.* (2010) and Ferreira *et al.* (2013). Also, livestock considerably tend to graze the shrubs such as *Sphaerocoma aucheri* in March because after the start of fall rainfalls, this species is the first one which begins its vegetative growth and chlorophyll production in the region. It should be regarded that before the start of rainfalls at the end of fall, nearly all plant species are not green but rather they are dormant. Mentioned species will be grazed at the end of grazing season and in May due to the fact that the annual plants are likely to get dry. This agrees with Odo *et al.* (2001) reports that indicated the most preferred species were not necessarily the most abundant on the ground, also the ease of accessibility and palatability may be important determinants for choice of a forage species. Malechek and Provenza (1983) reported that the goat select a mixed diet and it has been confirmed in the current research so that the goats tend to graze a variety of species and if the goats graze one species for few minutes, they may move toward another species not to graze only one species. Ferreria *et al.* (2013) suggested that goats combine grazing activities spent on high quality pastures and woody vegetation even

when improved pasture availability was high, highlighting different diet preferences. Vallentine (2001) suggested that animals are attracted to vegetation communities where more preferred plants are found, and for that reason diet preferences are a major factor influencing grazing distribution patterns. It means that if there are several species in the rangelands, the livestock graze them in order based on their preferences. The results of this study showed that for a Tali goat, annual broad-leaved forbs such as *Launaea mucronata*, shrubs such as *Sphaerocoma aucheri* and perennial grasses such as *Eremopogon foveolatus* are respectively regarded as the palatable plants. So, rangelands with mentioned species above will a popular pasture for Tali goats in Chabahar rangelands.

Behavior activities of Tali goat

The amount of time spent grazing varied across the grazing season. The highest average time spent in Beris rangeland by livestock occurred in April and May (12 h/day) and the lowest average time spent, was in February and March (9h/day). A major factor influencing types and levels of vegetation available for use by goats is season, which moving time increases with decreasing forage availability. Goetsch *et al.* (2010) stated forage availability depends on the types of vegetation available largely. With respect to this study, during the grazing season, especially May, the goat spend more time to resting and grazing while in cold months such as February and March, they considerably tend to move. At the beginning of grazing season (February), the spent walking and grazing time varies between 4 to 7 hours a day while the spent resting time is from 3 to 6 hours. The high proportion of time spent walking for goat during the cool seasons was mainly due to the scarcity of feed which is in accordance with the observations of Ouédraogo-Koné *et al.* (2006). Based on the results, in the grazing season from February to May, the

distances covered rate was gradually reduced due to the increases in temperature and livestock resting time at the end of grazing season. Ferreira *et al.* (2013) explained that beside feed availability, weather conditions are also able to modify animals grazing behavior. In fact, animals seem to be reluctant to graze during the hot days and a reduction of mid-day grazing activities is expected. It has been confirmed in the present study. At the end of grazing season, the resting time is to be increased due to decrease the heat pressure on the livestock so that the moving time may be also reduced at the end of vegetative season. The impacts of month on the average speed livestock, covered distance and time spent grazing have no significant differences. The effect of month on the time spent resting is significant and on the basis of Duncan's test, May had the highest time spent resting and February and March, both had lower time spent resting. Also, the highest moving time was recorded in February and May had the lowest moving time. As it has been already stated, due to the increase in temperature at the end of grazing season, the goat resting time is more likely to be increased and the moving time is likely to be decreased due to reduce the heat pressure on the livestock. It should be stated that in the Beris rangelands, because of no watering place in the rangelands, less number of the livestock belonging to every rural family and the livestock ownership for lots of families, shepherds uniformly graze the livestock in the rangelands near the village whole the year without considering the grazing season of the region. It leads to significantly put pressure on the rangelands near the village, reduce the diversity of plant species in this area and increase the growth of invasive species. Due to above problems, it is expected that the livestock grazing behavior has a similar trend in the region during the months and years of

study implementation. In this study, analysis results of features of grazing behavior confirm the fact. According to the statistical results, grazing behavior has no differences in most of the studied months and years.

Conclusion

Examining the livestock grazing behavior may be used as a useful management tool to predict the plant selection of livestock, make management decisions and plan the desired grazing systems. Results from this study will be useful in planning a grazing strategy and determination of carrying capacity for livestock grazing in studied rangelands. It is felt that goats have to play an important role in future rangelands systems in south of Iran, since they have the ability to convert the vegetation of marginal ecosystems to useful product. So, the findings of this study help us in rehabilitate Chabahar rangelands, with palatably species for the Tali goats. Nevertheless, more studies should be carried out to assess the interactions between grazing behavior and goat's performance in these particular climate and vegetation conditions.

Acknowledgements

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مطالعه ارزش رجحانی گونه های گیاهی و رفتار چرایی بز تالی در مراتع چابهار

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چکیده. مطالعه رفتار چرایی دام در انتخاب و ترجیح گونه‌های گیاهی به منظور بهبود کارایی و دستیابی به یک رژیم غذایی مطلوب و درعین حال مدیریت مراتع، در سال‌های اخیر مورد توجه محققان قرار گرفته است. بنابراین در این مقاله رفتار چرایی و چگونگی ترجیح گونه ها توسط بز تالی درمنطقه مطالعاتی بریس چابهار درطول سالهای ۱۳۸۷ تا ۱۳۸۹ بررسی شده است. جهت مقایسه رفتار چرایی دام، صفات میانگین سرعت حرکت دام، طول مسافت پیموده شده، زمان‌های صرف شده جهت چرا، استراحت و حرکت در ماه‌های فصل چرا (بهمن تا اردیبهشت) طی ۳ سال مورد تجزیه و تحلیل آماری قرار گرفت. جهت تعیین ارزش رجحانی با استفاده از روش زمان سنجی، زمان توقف دام بر روی گونه‌های گیاهی در طول ماه‌های بهمن تا فروردین طی ۳ سال محاسبه گردید. نتایج نشان داد که در این منطقه گونه *Launaea mucronata* که از پهن‌برگان علفی یکساله می‌باشد، بیشترین ارزش رجحان و گونه‌های *Lotononis platycarpos* و *Sporobolus arabicus* کمترین ارزش رجحان را دارند. تمام پارامترهای اندازه‌گیری شده رفتار چرایی، اختلاف معناداری در طی سال‌های مختلف نداشته است. زمان صرف شده برای استراحت در ماه‌های مختلف، اختلاف معنی‌داری از نظر آماری باهم داشته و به علت افزایش گرمای هوا در اواخر فصل چرا بتدریج زمان استراحت دام بیشتر شده تا فشار گرما بر دام تقلیل یابد. بر این اساس دام در اردیبهشت ماه بیشترین زمان استراحت را داشته و در ماه‌های فروردین، بهمن و اسفند به ترتیب از زمان استراحت کاسته شده است. نتایج این مطالعه می‌تواند جهت برنامه‌ریزی استراتژی چرا در مراتع چابهار و همچنین احیا مراتع منطقه مورد مطالعه با گونه‌های گیاهی مطلوب بز تالی مورد استفاده قرار گیرد.

کلمات کلیدی: رفتار چرایی دام، ارزش رجحانی، بز تالی، چابهار