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The effect of grazing exclusion on some ecological factors of three important plants in the central steppe of Iran (case study: nodoushan rangelands)

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ABSTRACT

It is necessary to study the effect of different levels of utilization and Long-term exclusion grazing on the ecological structure in rangelands to better manage in the future. Therefore in this study, production, canopy cover, density, frequency and vitality of Artemisia sieberi, Stipa barbata and Eurotia ceratoides were considered (as important species in Irani Torani area) in grazing and grazing exclusion of Noudoshan rangelands in Yazd Province. Samples were 10 transfers and 40 1m2 quadrates randomly; and also 30 plants of each species were selected randomly and plant height, maximum and minimum diameter, canopy cover, vitality and weight of current year production by cut and weighted were measured. For determining distribution pattern, index of Dispersion (variance /mean ratio), Morisot's index of Dispersion and Standardized were used. There is no significant difference between factors of production, diameter, height and canopy cover of Ar.si in grazing and exclosure grazing area but vitality was different significantly. St ba has significant difference between production, canopy cover, density and vitality ($P<0.05$) in the two grazing conditions, and canopy cover, density, production and vitality of Eu ce were increased in the grazing rangelands, but there was no significant difference ($0.05< P$). Grazing on Ar.si and Eu ce partly increased vitality and productivity; but St ba has high palatability in this rangeland, that is due to heavy grazing on it; therefore St ba's power of life is reduced in the grazing area. Distribution pattern of Artemisia seiberi trends from random to uniform in long time grazing exclusion; but this trends from random to clump in the grazing. The distribution pattern of Eurotia ceratoides is clump based on the index of Dispersion and Morisita's index and it is uniform based on Moristia's Standardized Index and that doesn't change in the exclosure grazing area. Distribution pattern of Stipa barbata is uniform. Artemisia Seiberi is increaser and Stipa barbata is decreaser. Importance value of Eurotia ceratoides has no significant difference between grazing and grazing exclosure areas; therefore this is resistant grazing and it can be used to improve steppe rangelands.

Introduction

Livestock and plants always interact with each other in natural ecosystems. It is important to study different effects of rangeland plants on grazing and grazing exclusion for improving rangelands. Practices and efficient management is possible with accurate information of qualitative and quantitative characteristics of plants and plants' relationships with each other and environmental factors.

34 species have been known in Iran as Genus of Artemisia. Artemisia are the most important genus of plants of the flora iranica as extensive distribution. Among different species of this genus, Artemisia sieberi is an important specie of this genus in Iran, because this specie has dominant cover in Iran and Touran region and it is index of the steppe area (Mozaffarian, 2000). Different species of Stipa are growing in Iran. Habitats of Stipa barbata has been referred to slopes of mountain ranges and arid regions in Flora Iranica. In other words, Basically this plant belongs to the steppe fields. Stipa barbata is one of the most important forage grasses for reclamation of arid and semi-arid zones. Eurotia ceratoides is introduced as ingredient of plants adapted to arid and semiarid regions. High palatability, extensive distribution of pastures, very good adaptability and tolerance to environmental stresses and extensive amplitude of ecology, show us the importance of research on these species (Mozaffarian, 2000).

Cover, density and pattern of distribution can be used as valid indicators for assessing rangeland ecosystems and plants. Many researchers know canopy cover as the best criterion for measuring trend succession and the tendency by the management or other ecological changes (Holechek, 2004. Miguel et al 2011). Height of plant indicates life force and is a criterion for species' success and considered favorable conditions for plant growth and volume is important to demonstrate the vegetation structure (Holechek et al, 2004). The pattern of plants' distribution has an important role in evaluating uniformity and lack of uniformity of the environment, type of amplification and reproduction, publication, competition and behavior of plants; and determines appropriate and accurate methods for measuring characteristics quantitatively such as coverage and density of plants. Grazing exclusion is a method for pasture improvement. But experts' theoretical perspectives of range and results in a range site, Besides having their own value cannot be generalized to all regions. Therefore it is necessary to plan for better management in the future to conduct

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extensive researches on the effects of vegetation on specific grazing conditions and any plant in each region, and also to study the effect of different levels of operation and long-term grazing and different factors of plant species on the pasture. Therefore these factors have been considered in this study.

Landsberg et al (2002) and Riginos and Hoffman (2003) expressed that excessive grazing increase abundance of some species and many others have been reduced and that may change the structure and composition of plant communities. Heavy grazing leads to excessive defoliation of herbaceous and reduction of biomass, basal cover and plant species diversity (Bilotta et al., 2007).

Courtois et al (2004) studied 65 years non-grazing and concluded that non-grazing vegetation zone has slightly been developed and the reasons were considered as poor seed bank of soil, the unavailability of the important species and composition of vegetation. Wang et al (2002) investigated the spatial patterns of plants on different grazing intensities in semi-arid grasslands of China. The results demonstrated that Artemisia and Shyrsg species have been dominated; and uniformity of species' distribution and diversity is decreased as grazing increased. Also, Anderson and Hoffman (2011) and Mygval et al (2011) studied arid and semi-arid zones; The results indicated that production, cover, height, litter and vitality are increased in the non-grazing area. Overall changes in vegetation, plant and biomass are caused by interactions between grazing, soil and vegetation in arid zones (Brady 2012). The understanding of the responses of plants to different grazing intensities is crucial to facilitate the management of these arid and semi-arid zones for biological conservation and sustainable use (Hoshino et al., 2009). The objective of this study is to determine the effect of grazing on production, canopy cover, forage crops and the vitality of the three important species.

Methods and marital

The study area is steppe rangelands of Yazd Province in Nodoushan summer rangelands with 46000 hectares recognized as a center product livestock. Sadr Abad Nodoushan pasture is 4000 hectares with geographical area of '52 º 31 to '57 º 31 northern latitude and '30 º 53 to '36 º 53 eastern longitude. The average annual rainfall of this region is 168 mm and is considered as a dry steppe climate. The vegetation type of the study is shrub land. After the initial study on Nodoushan rangelands and, maps and survey on the land, the study area became distinct; then the target range was considered grazing and non-grazing. Both areas have almost similar factors such as: elevation, soil conditions, slope and aspect.

Samples were 10 transfers and 40 1m2 quadrates randomly; also 30 plants of each species ware selected randomly in each area and plant height, maximum and minimum diameter, canopy cover, vitality and weight of current year production and woody production by cut and weighted measured. They were measured on each transect number of each spaces and the canopy cover tangent with the transect.

The importance value of each sp was determined by this diagram:

Importance value = The Relative Density + Relative Dominance+ frequency

For determining distribution pattern, index of Dispersipon (variance /mean ratio), Morisita's index of Dispersion and Standardized Index of Moristia were used. In this study, EXCEL and MINITAB software were used for data analysis. Measured Factors such as production, height, diameter, cover, frequency and density of each species were compared by T-test and Mann-Whitney tests for the vitality in the grazing and grazing exclusion. In order to evaluate the correlation between production and conopy cover variables correlated were used relevant variables test.

Results

The studies on Artemisia sieberi showed that production, height, diameter and volume are increased in the exclosure grazing area; but didn't have significant difference ; however, the vitality of plants was different significantly and is reduced in the exclosure grazing. (Table 1)

The results on Stipa barbata indicated that non-grazing causes height, diameter, volume, vitality, abundance, canopy cover and density increase of Stipa barbata that all of them except height and volume are different significantly ($0.05>p$). In the Climax community, Stipa barbata has more canopy cover and density as the current status in this area (Table1).

The results of the study on Eu ce indicated that non-grazing increased production, height, diameter, volume, density and canopy cover of them. Factors are different significantly ($0.05>p$). Vitality has been decreased in the non-grazing area and had significant difference. In the climax community canopy cover, frequency and density of Eu ce were increased.

The effects of grazing has increased density, relative dominance and abundance of the species of Artemisia sieberi , Eurotia ceratoides and Stipa barbata (Table 1) . Ar. si has no significant difference between relative density and relative dominance in the two areas ($P>0.05$). But Frequency is significantly different between the grazing area non-grazed area ($P <0.05$). It can be concluded that Artemisia sieberi has middle and low class palatability that increases the plant in this pasture. It has been shown that grazing is affected by density, relative dominance and frequency increase. The importance value of Artemisia sieberi is increased in the grazing area. This factor also shows significant differences in the two areas. Eurotia ceratoides had no significant difference between indexes ($P>0.05$). It can be concluded that Eu ce has good palatability and high resistance to grazing in these rangelands. Also density and relative dominance of Stipa barbata were significantly different grazing and the grazing exclusion areas. It can be concluded from these results that Stipa barbata has high class palatability that degreased the plant in these rangelands. Comparison means are done with LSD test (Table 2).

In order to evaluate the correlation between production and percent cover, relevant variables test was used for correlated variables. The canopy cover was considered as the dependent variable and factors such as volume, height, vitality, density, percent cover as the independent variables (Table 2).

There is a negative correlation between canopy cover and volume-based of St ba in these rangelands. Means of Volume are reduced with increasing canopy cover (Table 2). The vitality and canopy cover show negative correlation in the grazing area. Due to around the base increased litter therefore plant vitality is reduced. There is a negative correlation between canopy cover and factors such as volume, height, vitality and production in each base of Ar si in these rangelands. Plant height had significant difference ($P< 0.05$). Density is positively correlated with the species' percentage of canopy cover (Table 2). Therefore, With the increasing number of plant-based and cover of Ar si, production and vitality of each base height decreases, because of the weakened basal activity which affects allelopathic in this plant and competition between species. There is a negative correlation between canopy cover and production of Er ce in each base plant in both grazing and grazing exclusion areas. It can be concluded that with canopy cover increase, production per plant basis decreases in the long grazing

Table 1. Estimated factors on three spices in the grazing and non-grazing areas

vitality	Density	Canopy cover	volume (m^2)	Big Diameter (cm)	Height (cm)	%Fresh forage weight	Production (gr)	area	
2.07	±0.01 11.4	4.91±0.62	0.076±0.25	72±7.1	55.4±4.4	31.7±5.1	113.6±12	exclosure grazing	*Artemisia sieberi*
2.7	±0.018 10.8	4.48±0.72	0.028± 0.15	±3.3 59.38	±2.3 48.13	36.1±2.4	±11.2 107.3	grazing	
0.004**	^{ns}0.776	0.673*	0.258 ^{Ns}	^{ns}0.133	^{Ns} 0.170	^{ns} 0.468	^{ns} 0.852	P value	
3.6	7.02±1.1	3.41±0.61	0.028±0.25	32.9±2.4	75.4±4.5	61.9±1.5	71.8±1.6	exclosure grazing	*Stipa barbata*
2.1	3.8±065	1.85±0.39	0.02± 0.15	24.5±3.3	66.7±5.2	83.1±1.2	57.3±7.4	grazing	
0.006**	**0.018	0.673*	0.078 ^{Ns}	**0.005	^{Ns} 0.170	** 0.004	** 0.002	P value	
2.8	0.78±0.1	1.01±0.4	0.026±0.04	69.1±6	45.6±2.7	39.5±2.9	124.3±15	exclosure grazing	*Eurotia ceratoides*
2	0.41±0. 6	0.49±0.24	0.005± 0.05	44.6±5.1	26.3±2.4	63.3±4.2	101.0±11	grazing	
0.046*	^{ns}0.319	^{ns}0.089	0.001**	**0.006	**0.001	** 0.001	^{ns} 0.683	P value	

Table 2. Importance value (IV) of three species by transect in the grazing and grazing exclusion areas

Factors				Study area	Species
Importance value	Ferecency	relative Dominance	Density		
131.78±4.3^{a}	65.88±2.85^{a}	33±1.21	32.9±0.69	exclosure grazing	*Artemisia Seiberi*
134.4±5.4^{b}	67.58±3.2^{b}	33.7±1.02	33.4±1.2	grazing	
69.8±2.5	55.6±1.4	7.2±0.17	6.3±0.19	exclosure grazing	*Eurotia ceratoides*
41.7±1.4	33.3±2.2	3.9±0.1	5.1±0.21	grazing	
135.3±11.4^{a}	77.8±6.3	28.89±4.5^{a}	28.6±4.6^{a}	exclosure grazing	*Stipa barbata*
86.9±8.7^{b}	58.3±7.85	16.8±3.3^{b}	11.82± 2.7^{b}	grazing	

Table 2. Correlation coefficients between various factors with the percent cover of the three species

Density	Vitality	Height	Volume	Production	(%)Canopy cover	
0.596	-0.206	-0.608	-0.448	-0.346	Correlation	*Artemisia sieberi*
0.009 **	0.413	0.007 **	0.062	0.159	P *value*	
0.041	-0.197	0.190	0.443	-0.192	Correlation	*Eurotia ceratoides*
0.931	0.404	0.423	0.050	0.419	P *value*	
0.838	-0.169	0.153	-0.169	0.051	Correlation	*Stipa barbata*
0.002 **	0.749	0.674	0.640	0.923	P *value*	

Table2. Distribution pattern of important species in the grazing and non-grazing areas.

grazing		exclosure grazing		Index	Species
Distribution pattern	value	Distribution pattern	value		
clamp ←random	1.27	uniform ← random	0.936	(variance /mean ratio)	*Artemisia Seiberi*
clamp ←random	1.04	uniform ←random	0.994	Morisita's index	
clamp←random	0.153	uniform ←random	-0.03	Standardized Index of Moristia	
clamp ←random	1.29	clamp ←random	1.15	(variance /mean ratio)	*Eurotia ceratoides*
clamp ←random	1.42	clamp ←random	1.33	Morisita's index	
uniform←random	-0.23	uniform ←random	-0.24	Standardized Index of Moristia	
uniform ←random	0.54	uniform ←random	0.48	(variance /mean ratio)	*Stipa barbata*
clamp ←random	1.02	clamp ←random	1.08	Morisita's index	
uniform←random	-0.07	uniform ←random	-0.47	Standardized Index of Moristia	

exclusion. grazing on plants is done through natural pruning and causes plant base to be young and increase production. Distribution pattern indices were estimated according to Transect (Table 2).

Distribution pattern of Ar.si trends from random to uniform, but in the grazing condition, distribution pattern trends from random to clump.

Distribution pattern of Eurotia ceratoides and Stipa barbata doesn't change in both grazing and grazing exclusion areas.

Conclusion

The study on the characteristics of Ar si and Eu ce indicate plants' response to grazing exclusion which is very slow in case where grazing exclusion is more than 20 years and there aren't any significant differences between plant basic vegetation in the grazing and exclusion grazing areas. It could be due to low rainfall in the area and several droughts in recent years. But St ba has significant differences between the studied factors.

Ar si, Eu ce and St ba are late to be at the end of their growth period in the grazing areas and have a longer growth period, so grazing causes their quality of species to maintain longer grazing season. However Ar si is not actively grazed in summer; therefore it is not important for shepherd in summer rangelands. With high canopy cover, volume of each plant is reduced in these rangelands. It could be due to competition between the species. Fresh forage growth has been reduced due to remaining dry leaves from years ago in the exclusion grazing area. Grazing has partly normal pruning on the plant that causes it to be young with more production.

Plant vitality of St ba and Eu ce are increased in the exclusion grazing, but Ar si is reduced due to increased litter around the base of the plant; therefore vitality has been increased in the grazing area. The importance value of the three species has been increased in the exclosure grazing rangelands. But Stipa barbata and Artemisia Seiberi had significant difference in the two conditions of grazing. The response of each plants was different against grazing, so Artemisia Seiberi is Increased, Stipa barbata is decreased and Eurotia ceratoides is resistant.

The distribution pattern of Ar se trends from random to uniform but this trends from random to clump in the grazing condition, because it has allelopathic properties; therefore these plants are in certain distances from each other. According to the results, composition percentage of Artemisia Sieberi in the climax community is less than the current community and other species with high palatability like Eurotia and Stipa will be more than the current time.

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