Study on Vegetation Changes of Natural Ranges in KhoyBilehvar Semi-Steppic Area of West Azarbaijan Province

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Abstract. The study of the exclosure effects on the vegetation changes under grazing and non-grazing conditions in the rangeland areas has particular importance in the rangeland improvement and revivification projects. The research was accomplished in semi-steppe KhoyBilehvar area, from 1999 to 2005. Vegetation cover was annually measured within fixed plots during transact. The results showed that during nine years of research, on KhoyBilehvar exclosure, the total canopy cover has increased inside the exclosure, and the highest increase was observed in the perennial grasses (more than 3.5) and perennial Forbs (more than 2.5). Outside the exclosure, the total vegetation cover was almost constant and changes were less in vegetation cover types. Within the exclosure, some desirable species appeared consisting almost 19% of vegetation composition. Medium species proportion in the plant composition increased to more than two times and undesirable species decreased by half. Whereas, outside the exclosure, scarce desirable species and medium species of vegetation ratio has increased a little. The vegetation average of annual species during the study within exclosure is more than outside and the vegetation average of forbs inside and outside the exclosure is more than annual grasses. Nine year research in Bilehvar exclosure showed that the correlation between precipitation changes and vegetation cover was significant in the most species.

Keywords: Exclosure, Canopy Cover, Species Changes and Species, Combination.

Introduction

The ranges are natural growing sites of our country. These sites that consist of different plant communities have been evolved under edaphic, climatic factors and living creatures over past years. The mutual effect of animals and plants or livestock and range has been in balance in the past, so this balance preserves plant resources and soil because of not being in man's reach and ecosystems are not damaged. By passing the time, the increased population and ever-increasing need for meat stuffs and dairy products, gradually man's reach in ecosystem has expanded and has created positive and negative effects. Whereas the irrational man's reach loses balance between livestock and rangeland leading to the consequences such as vegetation and soil cover damages. Exclosure is an index and useful way that defines short-term and long-term effects of grazing either domestic or wild animals. In addition, it is an ecological protection and shelter of desirable forage species which keeps them from overgrazing, definite extinction and causes propagation, and also preserves plants genetic reserves. The study results in Isfahan Firiden exclosure during 5 years Vahabi (1989) indicated that total canopy cover had increased only to 12.3 all over exclosure, class I, II species increased in composition and class III decreased. Baghestani Moybadi (1993) in the research of exclosure performance on vegetation composition over a period of seven years (1986-1993) in the Nodushan steppic ranges of Yazd province reported that the total canopy cover of exclosed area has increased about 6%. The most increase belongs to Stipa species. He also concluded that vast and fast changes in vegetation composition are not made in short-term.

Mosavi (2001) through a comparison of plant parameters in 13-year exclosure on Semnan semi-steppic ranges reported that total canopy cover increases a little within exclosure and decreases a little outside the exclosure. The increase observed inside the exclosure is related to Class II species and then Class I species. Akbarzadeh (2005) beginning a study of Radshor exclosure concluded that during 6 years (1968-1974) there is not significant changes in perennial species of canopy cover on the exclosure but during 26 years (1968-1994), the total canopy cover of perennial species increased significantly and became more than 2.5 increase in vegetation mainly resulted from considerable increase in perennial grasses and shrubs.

Fluctuation and precipitation annual changes are main factors that affect vegetation. Considering the effect of precipitation reduction on vegetation and rangeland forage production for 10 years in Plor exclosure with 2300m height Akbarzade *et al*. (2007), the obtained results showed that forage species mainly react to precipitation fluctuation. In arid years, vegetation decreases and between precipitation and canopy cover in most species appeared a significant correlation. The total canopy cover of species in humid year was two times than arid year. On the whole, sum of growing season precipitation affected the species vegetation and using this precipitation can, the vegetation changes and plant production can be predicted. Bock and Bock (1993) reported that in 22-year exclosure grasses canopy cover in the exclosed region was more than grazing regions. Only Bouteloua Eripopoda and Hilariabe Langeri species were abundant in the grazing conditions. Berndt and Tiedemann (1972) reported that 30-year exclosure had been kept from grazing by deers and gazelles, vegetation rate of total shrub and plant composition inside exclosure were significantly more than outside of it. Bock *et al*. (1984) realized that in an exclosed area in comparison with the opposite area in which the cattle are grazed permanently, covering grasses increased to 45% and covering shrubs to four times. Eragrostis intermedian and

Trichachne californica species increased inside the exclosure. According to Tylor *et al*. (1997), a 10-year exclosure in Texas in comparison with grazed opposite fields being grazed under alternative grazing system with different rest periods, Hilaria belangeri species decreased inside the exclosure and increased outside the exclosure and vice versa. Bouteloua curtipendula species along with other grasses inside the exclosure increased and decreased in outside the exclosure. Robertson (1971) reported that on an Artemisia-grasses eroded rangeland in Nevada, all growing types increased after 30 years. Perennial forbs vegetation increased 85% and Stipa thurberiana covering increased about seven times. Agropyron spicatum species appeared as spotty again.

Materials and Methods

The area of KhoyBilehvar exclosure is 50 hectares located in 20 km of east north of Khoy country, its latitude and longitude are 33'' 39' 38 till 9'' 40' eastern 38 and 45'' 7' 45 till 45''8' northern 45,respectively. The minimum height of studied area is 1050m and the maximum of that 1300 from free sea level. The general slope is 15-30 percent. Area climate is placed at mild semi-arid class in Klima Gram Amberge. According to 39-year statistics of Khoy weather station, the number of average frost days was 110 days in a year and annual precipitation average is 299 m. The maximum precipitation is in spring and the minimum of that is in summer. Annual temperature is 12.4 centigrade, the minimum temperature is -15 centigrade in January and the maximum of that is 32 centigrade in July. The dominant vegetation of inside the exclosure is Noaea maronata, Poa bulbosa, Stipa barbata and Atraphaxis spinosa and in the outside are Peganum harmala and Atraphaxis spinosa.

The soil of KhoyBilehvar station is classified to Eptisol soil. The surface soil is composed of sandy and clay texture and primary constituents such as cobblestone and sand. The soil acidity has been 7.2 without salinity (EC time's 43. D.Sm) that lime content is 30% and is poor in phosphorus, potash, carbon and nitrogen. The soil depth is medium and does not exceed 75cm and its permeability is well.

Vegetation changes were studied in the three sample units inside the exclosure and three sample units outside the exclosure. Each sample unit consists of two parallel transacts with 30m length. 10 fixed quadrats were placed on each of them in 1.1m dimentions and with 3m distances. Inside each quadrat, canopy cover percentage of species was estimated by shrubby growing types, perennial grasses, perennial broad-leaved forbs, annual grasses and annual broad-leaved forbs. For definition of changes in the different years, precipitation role was considered in canopy cover changes and the correlation between participation and canopy cover was calculated and used for the definition of available changes.

Results

Vegetation changes of inside and outside the exclosure over research period:

In 2005 compared to 1996 inside the exclosure, total canopy cover and total perennial species were increased (approximately total canopy cover is about 50% and perennial vegetation is about 40%). Whereas outside the exclosure total canopy cover as canopy cover total of perennial species was fixed. Canopy cover changes of growing types inside the exclosure were different. In 2005 compared to 1996, the most increase was observed in canopy cover growing types of perennial grasses (more than 3.5 times) and perennial broad-leaved forbs (more than 2.5 times). In this time, as compared with 1996, the shrubby canopy cover decreased considerably.

This change process exists for different canopy cover, growing typss outside the exclosure too. But increasing or decreasing was relatively little (Table1). In 1996, shrubby vegetation

was more than the rest of perennial growing types inside the exclosure and shrubby growing types, perennial grass and broad-leaved forbs rates were 72, 16 and 12 percent, respectively. In 2005, there was an increase in perennial grasses and broad-leaved forbs, so these rates varied to 43, 33 and 24 percent, respectively (Fig. 1). Although these rates were 66, 15 and 19 outside the exclosure, respectively in the first research year, they varied to 48, 28 and 24 percent (Fig. 2).

Table 1. Precipitation Statistics of Khoy Weather Station (mm) Over Research Years (1996-2005) and Long-term Average.

	Spring			Summer			Autumn			Winter			Annual
Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1995	22.0	36.1	2.0	8.5	2.1	13.0	10.3	10.1	15.1	16.6	9.3	51.5	196.7
1996	20.4	34.6	15.7	10.0	0.0	10.6	0.9	8.2	18.5	15.6	29.7	15.7	238.9
1997	35.6	84.5	11.5	1.3	1.0	1.5	6.0	0.5	14.7	7.9	4.4	17.9	186.8
1998	64.4	52.3	16.6	1.1	2.0	2.3	10.8	10.4	1.2	4.9	5.1	18.4	189.5
1999	59.3	53.9	24.3	0.0	8.0	6.0	6.2	16.9	1.2	4.5	7.2	17.1	204.3
2000	40.8	64.3	26.2	9.9	0.0	0.0	9.2	16.4	29.7	14.3	21.0	17.8	249.6
2001	63.9	65.7	29.8	5.7	4.1	0.6	13.3	12.7	28.3	21.1	25.3	15.6	286.1
2002	61.1	70.1	40.4	11.6	3.8	2.2	11.5	14.3	36.7	30.2	26.2	15.5	323.6
2003	46.6	92.5	35.1	16.2	4.6	0.0	18.3	16.9	35.9	28.5	35.4	17.2	345.9
2004	47.4	93.2	39.5	16.9	4.5	0.1	16.2	17.8	36.1	30.3	34.3	18.0	354.3
	45.2	61.8	27.6	8.7	5.0	7.4	19.9	27.5	21.0	20.7	20.3	34.0	299.0
Average		45.0			7.1			22.9			25.1		

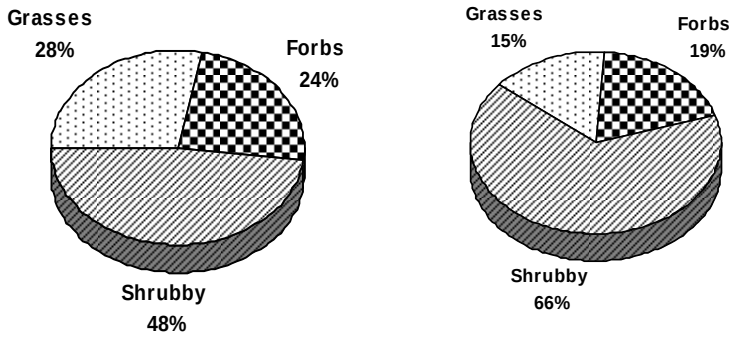

Fig. 1. Compare Canopy Cover Growing Types Rate in 1996 and 2005 khoy Bilehvar Exclosure

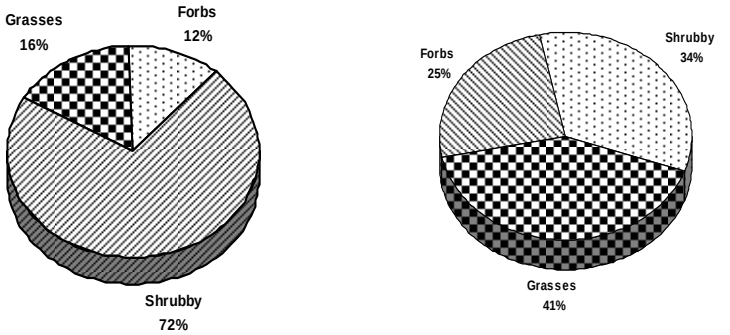

Fig. 2. Compare Canopy Cover Growing Types Rate in 1996 and 2005 outside khoy Bilehvar Exclosure

The annual average of spider plant and forb vegetation during searching inside the exclosure was more than the annual average of forb vegetation was both inside and outside the exclosure more than perennial annuals. In 1996, species vegetation rate of class I, II and III inside the exclosure were zero, 16 and 84 percent, respectively. Appearing class I species and their increase in the subsequent Years in the fixed plots, Composition was off balance and in last year (2005) changed to 19, 41, 40 percent, respectively (Fig. 3). Although outside the exclosure above mentioned rates remained unchanged in 1384 for some of class I species vegetation. The rate of class II species vegetation was added and changed to zero, 28, and 72 percent, respectively (Fig. 4).

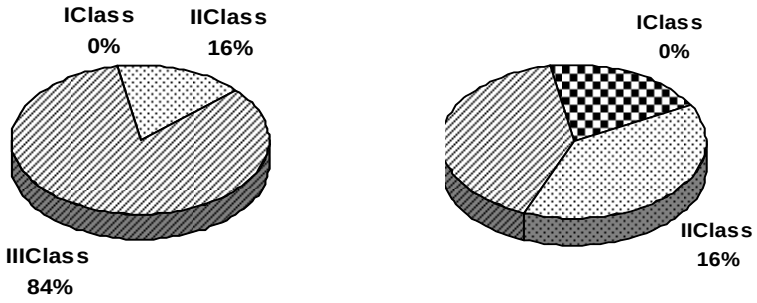

Fig. 3. A Comparison of Perennial Species Vegetation Rate of Palatability Classes in Plants Composition Inside KhoyBilehvar Exclosure in 1996 and 2005.

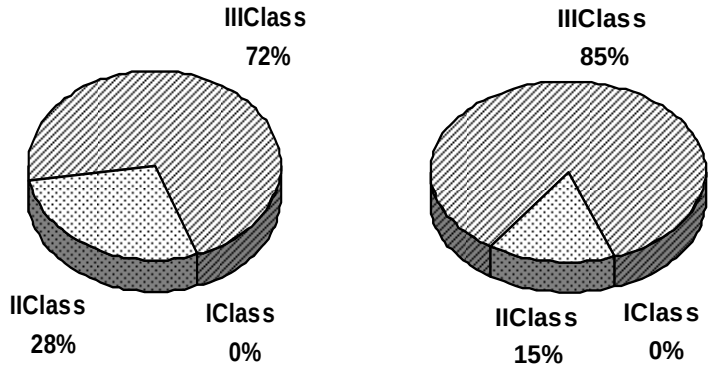

Fig. 4. A Comparison of Perennial Species Vegetation Rate of Palatability Classes in Plants Composition Qutside KhoyBilehvar Exclosure in 1998 and 2005

Table 2. Canopy Cover Changes Inside and Outside KhoyBilehvar Exclosure Cover in Researching Years(1998-2005).

Study years	1997		1998		1999		2000		2001		2002		2003		2004		2005	
Plant species	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**	**in**	**out**
Acantholimon bracteatus	0.2	0	0.5	0	0.5	0	0.5	0	0.5	00	0.5	0	0.2	00	0.15	00	0.18	00
Atraphaxis spinosa	6.2	5.5	6.2	5	5.8	5.5	5.6	5.5	5.1	4.5	5.7	3.5	4.5	4.25	4.3	4.2	3.9	4.15
Astragalus parrowianus	3.8	3	3.5	3.4	3.2	2.6	3	2.3	3.1	3.2	3.2	2.6	1.4	2.37	1.03	1.97	0.9	1.85
Noaea mucronata	2.3	3	2.8	2.6	3	2.9	3	3	2.4	2	3.1	3.5	3.8	3.5	4.15	3.63	4.2	3.87
Artemisia fragrans	3.7	2	3.5	3	3.5	3.5	3	3.5	3	3	2.4	2	1.57	0	1.45	00	1.5	0
Total shrubs	16	13.5	16	14	16	14.5	15	14.3	14	12.7	14	11.6	11	10	11	9.8	10	9.87
Stipa barbata	1.5	2	2	2.2	2.4	2	2.1	2	2.5	2	2.1	1.3	2.6	1.8	2.7	1.8	2.8	1.87
Poa bulbosa	2	1	2	2.3	2	2.1	2.2	2	2.5	2	2.35	1.8	4.5	2.8	4.78	3.3	5.1	3.5
Hordeum bulbosum	00	00	00	0	0.4	00	0.8	00	1.5	00	1.8	0.2	2.4	0.4	2.6	.32	2.65	.35
Agropyron cristatum	00	00	00	00	0.3	00	1	00	1	00	1.7	00	1.8	00	1.78	00	1.83	0
Festuca ovina	00	00	00	00	0	00	0.1	00	0.3	00	0.17	00	.28	00	0.3	00	.23	0
Total grasses	3.5	3	4	4.5	5	4.1	6.2	4	7.8	4	8.12	3.3	11	5	12	5.42	12.6	5.72
Achillea millefolium	0.1	0.2	0.2	0.5	0.3	0.8	0.2	0.5	0.4	0.5	0.4	00	0.83	00	0.87	00	1.2	00
Astragalus effusus	00	00	00	0	0	0	0	0	0	00	0.5	00	12	00	1.37	00	1.25	00
Polygonum sp.	0	0	0	0	0	0	0.1	00	0.8	00	0.57	0	0.53	00	0.58	00	0.7	00
Centaurea virgata	0.8	1	1	0.3	0.8	1	0.5	1	0.5	1	0.4	0.1	0.48	0.13	0.45	0.23	0.63	0.2
Lotus corniculatus	00	00	00	00	00	00	00	00	00	00	0.5	00	1.38	00	1.18	00	0.95	0
Paronychia sp.	00	0.2	00	0.8	00	00	0.2	0.3	0.2	0.2	0.23	00	0.12	00	0.8	00	0.5	0
Tragopogon sp.	0	0	0	0	00	00	00	00	00	00	00	00	0.73	00	0.62	00	0.57	00
Peganum harmala	1	1	1	1	0.8	1	0.5	0.5	0.5	0.7	0.47	2.4	0.42	2.1	0.3	2.5	0.2	2.8
Euphorbia macroclada	0.8	1.5	1	1	0.8	0.8	0.5	1	0.5	1	0.3	1.3	0.32	1.6	0.2	1.7	0.2	1.8
Medicago sativa	0	0	0	0	00	0	00	00	0.1	00	0.2	0	0.7	00	1	00	1.2	00
Gundelia tournefortii	0	0	0	0	00	0	0.5	00	00	00	00	0	0.4	00	0.3	00	0.35	00
Galium verum	0	0	0	0	00	0	00	0.2	0.4	00	0.38	0	0.27	00	0.45	00	0.5	00
Total perennial forbs	2.7	3.9	3.2	3.6	2.7	3.6	2.5	3.5	3.4	3.4	3.95	3.8	7.38	3.82	7.42	4.43	7.80	4.80
Bromus tectorum	2.3	2	2.5	0.7	2.8	1.8	2.5	2.5	2.7	2	2.4	1.4	2.3	2.7	2.1	2.17	2.8	2.2
Taeniatherum crinitum	1	1	1	0	1	1.8	1	1	1.3	2	1.8	1.2	1.9	1.98	1.75	2.42	2.1	2.3
Bromus japonicus	0	0.5	0	0	0	00	0	0	0	0	0.1	0	0.5	00	0.5	00	1.2	00
Total annual grasses	3.3	3.5	3.5	0.7	3.8	3.6	3.5	3.5	4	4	4.3	2.6	4.7	4.68	4.35	4.59	6.1	4.5
Alyssum sp.	2	1	2.6	0.9	2.5	1	3	0.8	2.5	2	2.77	1.2	2.98	2.2	2.53	2.18	2.7	1.7
Anthemis sp.	0.2	0	0.5	0	00	00	0.5	0.5	0.5	00	1.5	00	1.45	00	1.37	00	1.1	00
Ceratocarpus sp.	0.5	0	0.5	0	0.8	0.5	0.6	00	0.5	0.2	0.4	0	0.15	1.48	3.1	1.58	0.10	1.6
Senecio vernalis	1	2.4	1	1.2	1	1	1	1	2.1	1	2.17	1.3	1.78	1.7	1.9	1.77	1.7	1.2
Iris sp.	00	1	00	1	0	0	00	0.8	00	1	00	0.7	0.2	00	0.25	00	0.23	00
Total annual forbs	3.70	4.4	4.6	3.1	4.3	2.5	5.10	3.1	5.6	4.2	6.84	3.2	6.56	5.38	6.18	5.53	5.83	4.50
Total perennial	22.4	20.4	23.7	22.1	23.7	22.2	23.8	21.8	25.3	20.1	26.97	18.7	30.43	18.95	30.74	19.65	31.09	20.39
Total	29.4	38.3	31.8	25.9	31.8	28.3	32.4	28.4	34.9	28.3	38.11	24.5	41.69	29.01	41.27	29.77	43.02	29.39
Class I	00	00	00	00	0.2	00	1.2	00	2.2	00	3.64	00	5.89	00	6.21	0	6.16	00
Class II	3.5	3	4.0	4.50	4.80	4.10	5.60	4.20	6.9	4	6.63	3.30	10.92.92	5	11.47	5.42	12.97	5.72
Class III	18.9	17.4	18.8	17.6	18.7	18.10	17	17.60	16.20	16.10	16.70	15.40	13.62	13.95	13.06	14.23	12.96	14.67

Canopy covers changes and precipitation changes in different years in KhoyBilehvar exclosure. Precipitation statistics during the research and Khoy weather station long-term average are presented in (Table 1).

According to 39-year average, area precipitation is 299mm. Annual precipitation during the research in last four years was higher and in first five years was less than the long-term average of area. Spring precipitation (April, May and June) of growing season in last four years is more than spring long-term average, in first year was almost half of long-term average and in the next four years was as the average. Considering the importance of growing season precipitation in plant growth, correlation between canopy cover of species and growing types was measured by precipitation of March, April, May, June, spring precipitation and annual Precipitation, respectively. A good correlation based on the results of species calculations with June precipitation was observed between total spring precipitation and annual precipitation and sum of annual. and spring precipitation correlation was more with canopy cover changes of more species

So, the chart of canopy cover changes chart for species with annual and spring precipitation will be presented. The correlation between total canopy cover changes of species related to growing types was calculated. Canopy cover of all growing types except shrubs were under the positive effect of spring and annual precipitation and were increased due to the precipitation increase. The correlation coefficient between total precipitation of canopy cover, sum of perennial species vegetation, perennial grass vegetation and annual broad-leaved vegetation were 0.89, 0.87, 0.86 and 0.83, respectively and with the error surface of 0.01, in perennial broad-leaved and annual grass, they were o.77 and 0.76, respectively which was significant in the error surface of 0.05 statistically.

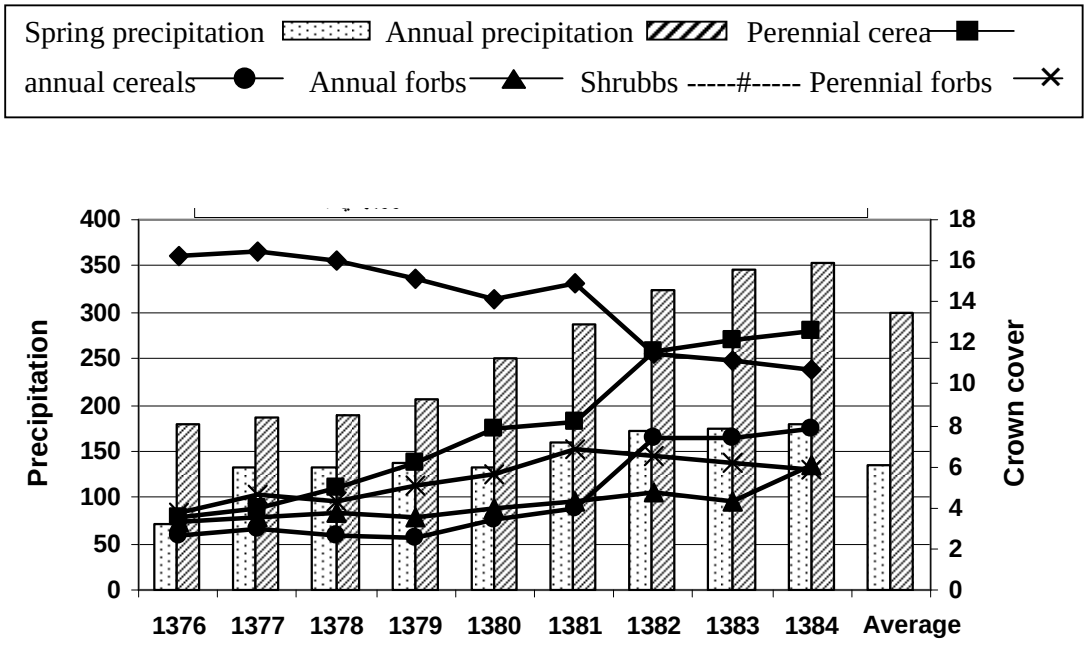

Fig. 5. Chart of canopy cover changes growing typss in the research years with precipitation changes in KhoyBilehvar exclosure

Also, the correlation coefficient between the total changes of canopy cover of species related to each palatability classes was computed. Canopy cover of classes I and II were under the effect of precipitation fluctuations (Fig. 6) and the correlation coefficient was high between them (more than o.84) and became significant statistically.($p<0.01$)

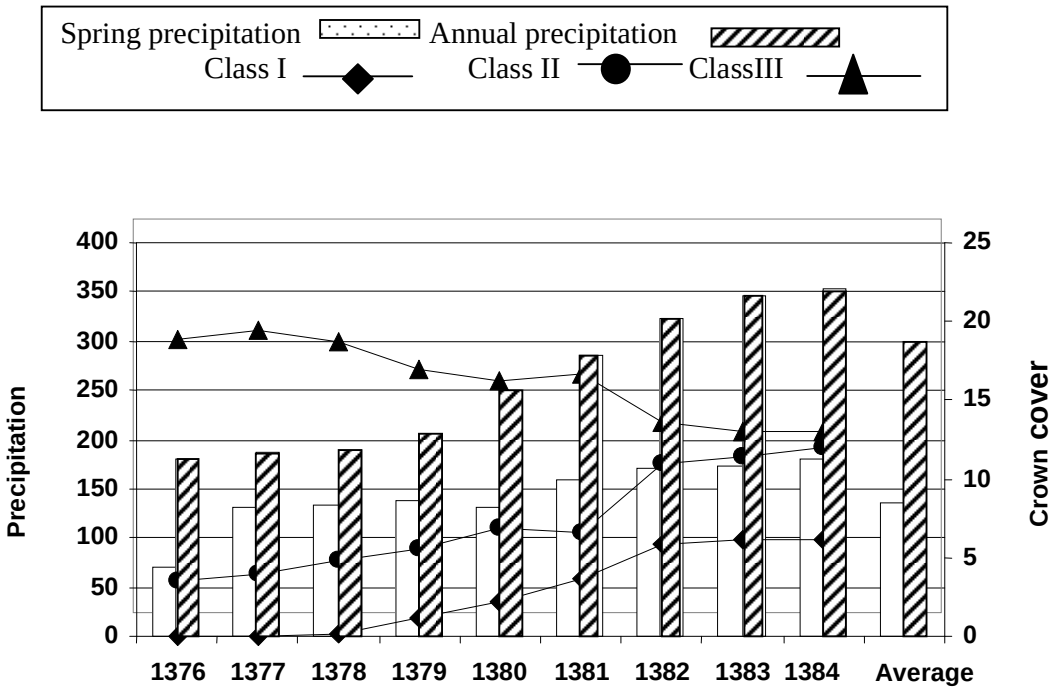

Fig. 6. Chart of Canopy Cover Changes of Palatability Classes in the Studying Years with Precipitation Changes in KhoyBilehvar Exclosure.

Conclusion

The survey of vegetation changes trend showed that during research period, the perennial species vegetation increased inside the exclosure but outside the exclosure, it was different. Considering the difference of annual vegetation for the total canopy cover and changes were similar to the perennial vegetation. It has been reported by many researchers that there was an increase in total canopy cover and perennial species vegetation due to the exclosure (Vahabi 1989; Mosavi 2001 and Akbarzade 2005). In KhoyBilehvar exclosure, the most increase of canopy cover was seen in perennial grasses (more than 3.5 times) and perennial broad-leaved forbs (>2.5 times), whereas the changes of growing types were less outside the exclosure. The results of vegetation changes of exclosure are as same as the results obtained by some researchers. The results of Akbarzade's research in 26-year exclosure of Roodshur show the increase of grass species by keeping them from grazing. The canopy cover increase of perennial grasses has been reported in the long-term exclosure by Bock (1993) Bork *et al*. (1984).

In Bilehvar exclosure, at the beginning of study, the desirable species did not have any covers inside the exclosure and through

treatment process, the desirable species appeared and in the end of research, they were about 20 percent of vegetation composition. The increasing proportion of intermediate species in composition was more than two times and the undesirable species decreased by half. Although the desirable species were rare outside exclosure and vegetation proportion of intermediate species increased. And this was a good effect of exclosure on the increase of grass forage average and broad-leaved plants inside the exclosure which is considerable in comparison with outside the exclosure being grazed permanently.

Relative increase of palatable species defines the improvement of rangeland in some researches. It is reported that the highest percentage of vegetation and the plant composition of Roodshur exclosure belongs to class II plants. The increase of class I plants also was happened in 26-year exclosure, whereas the changes were considerable in a long period and a little in a short time in this exclosure. (Akbarzade 2005) it is explained that the vegetation increase of class II and II species and decrease of class III species in Isfahan Firiden area are resulting from 5 year exclosure. The results of this research in the exclosure are as same as some mentioned resources. Area precipitation and humid rate that is provided for the plant growth in this way play an important role in the plant sort and composition. The rate of precipitation changes is important for the vegetation changes rate. In this survey, the correlation between precipitation changes in the different times was estimated which was associated with the canopy cover changes of species and different growing types.
However, the precipitation had a significant effect on the canopy cover changes of most species in Bilehvar exclosure.

The presence of annual plants in the composition of rangelands can be explained in different ways. The vegetation average of annual spider plant and forb in the research time inside the exclosure was more than outside and the annuals share was about 25 to 30 percent in total vegetation.

The changes made in the exclosure are because of different interactions which occur with keeping away the grazing livestock from the rangelands and due to the natural behavior of species in the environment. Apart from this view, physiological behavior of each species with regard to particular plant composition existing all over the area plays a role in these changes. In addition, the plant composition and its individuals are influenced by different rates of environment humidity which results from different precipitation dispersion of months and years of research and the competition between them for achieving better conditions should not be neglected. Differences in the soil environment increase the complexity. Although in this research, we understand the changes in vegetation through the increase or decrease of some species covering, these changes in natural period undergo some changes alternatively and annually which make the final conclusion difficult.

So in the exclosure survey, the comparison of numbers and increase or decrease of some plant elements may not lead us to a final result about the certain effects of exclosure. But the way of species changes in the condition that livestock factor are omitted and impressive factors of environment are also constant can be an important guide for the future management of the rangelands.

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