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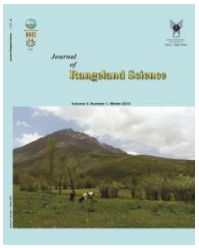

Research and Full Length Article:

Assessment of Fire Effects on Surface Cover Changes and Forage Production (Case Study: Delfan County, Lorestan Province, Iran)

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Abstract. The aim of this study was to assess the regional effects of fire on the surface cover and forage production of mountainous rangelands of Delfan County, Lorestan province, Iran. The fire took placed in June 2007 with significant effects on the vegetation characteristics in the study area. Four fire affected sites were selected for sampling and a close area without fire was considered as control. Sampling was carried out using a random systematic method and the size of plots was determined using the minimal area framework. The number of plots was determined using a statistical method. Totally, the data of eight sites including four fire affected sites and four control sites were measured during four consecutive years in early July of each year after fire. In each site, four transects of 50m length were selected in the direction of slope as well as perpendicular to the slope and five plots were established along each transect. The characteristics of canopy cover percent, litter percent, bare soil, density and forage production were recorded and compared to the fire affected and control sites. One-way analysis of variance and Duncan multiple range test were used to compare the mentioned characteristics over years in each region separately. According to the results, forage production, canopy cover percent, the density of grasses and forbs and litter cover percent increased significantly while the density and canopy cover percent of shrub species on the fire affected area has decreased significantly. On the other hand, fire had decreased bare soil cover percent significantly but it had no significant effects on the canopy cover of annual grasses.

Key words: Fire, Production, Density, Vegetation cover percent, Delfan, Lorestan

Introduction

Fire is one of the management tools in improving vegetation composition of rangelands in different ecosystems (Ghermandi *et al*., 2004). From the ecological point of view, fire is considered as one of the major factors in determining the diversity and distribution of plant species (Moghadam, 2004). Fire in many natural ecosystems is an effective factor in ecological succession, especially its acceleration (Harrod and Reichard, 2001; Dale *et al*., 2002; Kristofor, 2006). Moreover, some studies have considered it as a disturbing process in succession direction (Cassie *et al*., 2009). Changes in vegetation structure and composition caused by fire are inevitable (Guevara *et al*., 1999). Fire provides right conditions for the growth and development of plants which are mainly grasses in lower stratum through a significant reduction in woody plants and shrubs (Dale *et al*., 2002; Provencher *et al*., 2007; Haubensak *et al*., 2009); thus, in years after the fire, perennial grasses would be increased because they can resist after fire due to the position of bud growth on or below the soil surface (Provencher *et al*., 2007; Ortman and Beran, 2008). The importance and effects of fire vary with prevailing climatic conditions in each region (Moghadam, 2004). Due to the increase of grasses and annual species and the reduction of woody species, fire could be considered as a warning factor in the evolution of ecosystem towards the climax.

Studies have shown that normally after the third and fourth years of fire, shrubs will increase again (Shokri *et al*., 2002). Valentine (1989) indicated that fire could reduplicate the production of perennial grasses. Moreover, the production of perennial forbs can be increased up to 25% and total available forage showed an increase of 64 to 93%. Moghadam (2004) suggested this improvement method mainly for semi-humid regions. He introduced fire as an important factor in vegetation formation of arid and semi-arid regions (Moghadam, 2004). Due to the importance of fire for long-term sustainability of many natural ecosystems (Kristofor, 2006) and the effects of fire on soil and other resources controlling ecosystem sustainability (Cassie *et al*., 2009), it is used as a technique for management, fresh and palatable forage production (Korb *et al*., 2004; Parks *et al*., 2005) and rangeland conservation (Carleton and Loftin, 2000; Kristofor, 2006). Baghestani and Zare (2008) have studied the fire behavior on rangeland species and evaluated its effects on the improvement of steppe rangelands of Yazd province. They have concluded that the amount of forage production of *Salsola rigida* was affected by winter fire treatment with minimum negative effects in comparison with the other seasons and it had no significant differences with control treatment. Fire almost led to the elimination of *Artemisia sieberi* and *Stipa barbata* as well as two undesirable rangeland species including *Noaea mucronata* and *Cousinia deserti*. Fattahi and Tahmasebi (2010) in a study which was performed in Asad Abad, Iran concluded that forage production, canopy cover percent and the density of perennial grasses as well as bare soil percent were increased significantly under the fire effects. However, the percent of shrubs, annual grasses and litter cover were significantly decreased. Moreover, species diversity has decreased in the early years after fire but a significant increasing trend was observed in the latter years of their study. This study was aimed to investigate the behavior of vegetation cover of mountainous rangelands of Lorestan province in response to fire.

Materials and Methods

Case study

The study area with approximately 122 ha is located in northern slopes of the

Green Mountains; north east of Delfan County (34˚2'30" to 34˚3'00" northern latitude and 4816'15" to 48˚17'40" eastern longitude) (Fig. 1). Delfan County is located in Northwest of Lorestan province, Iran. The maximum and minimum altitudes of the study area are 2460 and 2220 m above sea level, respectively. Mean annual rainfall and temperature are around 490 mm and 11.8°C with mean annual minimum and maximum temperatures of 4.8 and 18.9°C, respectively. Delfan County has a Mediterranean climate based on De Martonne method while having a cold climate based on Emberger's classification (Planning Deputy Governor of Lorestan, 2008). Study region can be divided in two vegetation zones including forests (Southern half) and rangelands (Northern half). According to Takhtajan (1986), Delfan County is located in Irano-Turanian bio-climatic region with two sub-regions including semi-steppe and arid forests. Rangelands are mainly distributed in semi-steppe region. Delfan County with a semi-steppe flora includes rich species from Asteraceae, Lamiaceae, Apiaceae, Boraginaceae, Poaceae and Fabaceae families (i.e. Mozafarian, 1996; Ghahreman, 1978-2008). However, northern region of Delfan is not rich in terms of forest vegetation due to northern cold regions; on the contrary, the best rangelands are distributed specially on highlands of Green Mountains because of fertile soil and adequate moisture. Perennial grasses constitute the dominant vegetation type of the study area.

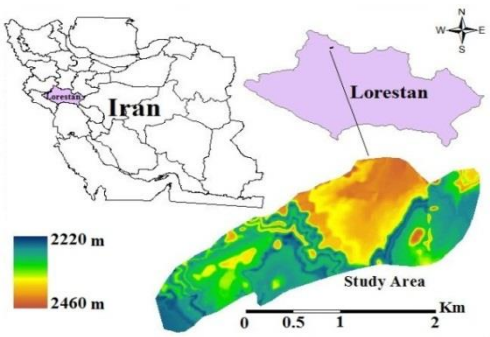

Fig. 1. Location of the study area in Iran and Lorestan province

Sampling method and data analysis

Fire which inadvertently occurred in 2007 caused burning as spots in an area of 122 ha. Data were collected during 2008 to 2011 to study the quantitative and qualitative changes of vegetation characteristics of the study area. The affected regions by fire with an area of 20 ha were selected from a large fire affected area of 122 ha. The fire occurred in the growing season (May). The map of fire affected sites was prepared by field survey using aerial photographs and satellite imagery and their boundaries were delineated on a topographic map. Finally, four fired affected areas were selected for sampling together with a control area (without fire) close to the selected fired sites. Totally, 8 sites were selected. In all sites, measurements were taken one year after fire in 2008 and continued until 2011. Samples were collected in both sites on 20^{th} to 30^{th} May in each year. It was attempted to select the sampling area with homogeneity and similarity in terms of environmental factors so that the environmental effects are reduced to minimum and only the effects of fire could be investigated. Vegetation sampling was performed using a random-systematic method. The size of plots was calculated $2m^2$ using the minimal area method on the bases of vegetation size and distribution (Cain, 1934). The number of plots was determined using a statistical method (Mesdaghi, 2004). In each site, four transects with 50m length were selected in the direction of slope as well as perpendicular to the slope and five plots of $2m^2$ were established along each transect. The characteristics of canopy cover percent, litter percent, bare soil, density and production were compared in the fire affected and control sites. Forage production was measured one year after fire coincided with the maximum growth of the studied species during July 2008-2011. Forage production was measured by the clipping and weighing method. Mean comparisons were made using t-test

between treatments and one-way ANOVA. Duncan's multiple range tests were also used for conducting mean comparisons between years using $SPSS_{16}$ software. Finally, the NDVI index was calculated for 2005 (a year before fire) and 2010 (four years after fire) using Landsat ETM^{+} satellite images of 2004/05/29 and 2010/05/30 and ERDAS Imagine9.2 software and the vegetation variations of the study area were investigated.

Results

The results of statistical analysis resulting from the comparisons of vegetation, litter, bare soil, forage production and density between the fire affected and control sites are presented in Table 1.

Fire caused the increased canopy cover percent of perennial grasses and forbs while the canopy cover percent of shrubs was decreased with no changes in the canopy cover percent of annual plants. Comparing these two sites (fire affected and control), significant differences were observed for shrubs in all studied years as well as for annuals in all years except the fourth year. Moreover, perennial grasses had no significant differences except in the second year. The canopy cover percent of forbs had also significant differences in the fire affected and control sites all the years except the second year (Table 1, Fig. 2).

Litter percent was changed significantly in the first and second years but there was no significant difference between the third and fourth years. Bare soil percent in the fire affected sites had significant differences in the studied years (Table 2). In the control sites, there were no significant differences for the production and the canopy cover percent of perennial grasses and live cover percent (perennial grasses, annual grasses, forbs and shrubs) over the studied years (Fig. 2). Eventually, fire had no significant effects and changes in litter percent between the fire affected and control sites in the fourth year. Although it showed an increase of 1% in comparison with the control site, it was not a significant difference but litter percent showed significant differences in the first and second years after fire in both sites (Table 1 and Fig. 3). Moreover, in the fire affected sites, litter percent showed a difference in the first and second years, but no significant difference was found between the third and fourth years (Table 2).

Bare soil percent differed significantly in the first, second and fourth years after fire in both fire and control sites at 1 and 5% probability levels. In the third year, this difference was at 5% level of probability. Generally, fire reduced bare soil percent in the fire site as compared to the control site (Table 1 and Fig. 4). In the fire affected sites, bare soil percent differed significantly in all the years after fire.

In the present study, the density of perennial grasses, forbs and shrubs were compared over the years in both control and fire sites. The density of perennial grasses over the years differed significantly in both sites and the density of forbs in the first, second and fourth years showed significant differences at 1 and 5% levels of probability. In the third year after fire, density did not differed significantly at fire and control sites. The density of shrubs showed significant differences over the years at 1 and 5% levels of probability except the first year after fire when density differed at 5% level of probability. The density of perennial grasses, forbs and shrubs at the fire affected sites differed significantly during four years after fire (Table 2 and Fig. 5).

According to the obtained results (Table 1), the amount of forage production increased under the effects of fire as compared to the control sites. In the fire site, forage production was lower than that of control site in the first and second years but in the third and fourth years after fire, the amount of forage produced in the fire affected sites was

higher. The amount of forage production in the control and fire affected sites over the years showed significant differences at 1 and 5% levels of probability (Table 1 and Fig. 6). Forage production differed significantly in the fire site over the years (Table 2).

Moreover, the results of the subsequent years after fire showed that there was a significant correlation between the number of years after fire and forage production. The results of regression analysis showed a linear relationship between the number of years after fire and the amount of forage production so that with taking distance from the time of fire, forage production has increased (Fig. 7).

The NDVI was calculated one year before fire (2005) and the fourth year after fire (2010) using Landsat TM imagery and the vegetation changes of the region were investigated. As it can be seen in Fig. 8, NDVI and vegetation in the fire affected sites have increased in comparison with the control sites.

Table 1. Comparison of the measured parameters in the control and fire affected sites

Treatments	Canopy Cover % Perennial Grasses			
	Year1	Year 2	Year 3	Year 4
Control	26 a	28 a	28 a	27 b
Fire	12 b	18 b	28 a	36 a
T values	25.56**	43.30**	0,00 ns	-12.72**

	Canopy cover % Annual grasses			
Treatments	Year1	Year 2	Year 3	Year 4
Control	3.0 a	5.0 a	3.0 a	3.0 a
Fire	1.0 b	1.0 b	2.0 b	3.0 a
T values	17.32**	21.90**	5.47**	0.00 ns

	Canopy cover % Shrubs			
Treatments	Year1	Year 2	Year 3	Year 4
Control	14 a	15 a	15 a	16 a
Fire	4 b	6 b	10 b	11 b
T values	61.23**	23.50**	14.85**	13.05**

	Canopy cover % Forbs			
Treatments	Year1	Year 2	Year 3	Year 4
Control	10 a	8 a	9 b	10 b
Fire	3 b	7 a	14 a	15 a
T values	27.11**	2.88 ns	-21.65**	-35.35**

	Litter %			
Treatments	Year1	Year 2	Year 3	Year 4
Control	12 a	10 a	12 a	11 a
Fire	3 b	3 b	12 a	12 a
T values	25.98**	10.60**	0.00 ns	-2.16 ns

	Bare soil %			
Treatments	Year1	Year 2	Year 3	Year 4
Control	21 b	20 b	19 a	19 a
Fire	63 a	47 a	20 a	10 b
T values	-58.62**	-45.00**	-2.73 ns	34.85**

	Forage Production (Kg/ha)			
Treatments	Year1	Year 2	Year 3	Year 4
Control	284.2 a	293.5 a	291.5 b	285.5 b
Fire	180.2 b	230.5 b	325.5 a	334.5 a
T values	82.78**	86.93**	-35.39**	-55.19**

	Perennial grasses Density			
Treatments	Year1	Year 2	Year 3	Year 4
Control	1.75 a	1.86 a	1.84 a	1.86 b

Fire	0.38 b	0.79 b	0.93 b	2.41 a
T values	29.54**	55.87**	4.02**	-30.12**

Forbs Density

Treatments	Year1	Year 2	Year 3	Year 4
Control	0.83 a	0.79 a	0.80 a	0.85 b
Fire	0.12 b	0.31 b	0.82 a	0.94 a
T values	52.43**	58.78**	-2.00 ns	-11.02**

Shrubs Density

Treatments	Year1	Year 2	Year 3	Year 4
Control	0.30 a	0.32 a	0.32 a	0.36 a
Fire	0.20 b	0.22 b	0.25 b	0.27 b
T values	3.46*	6.54**	8.57**	6.97**

* and **=Significant at 5 and 1% probability levels, respectively
Means of treatments with the same letters is not significant for each year
ns: Not Significant

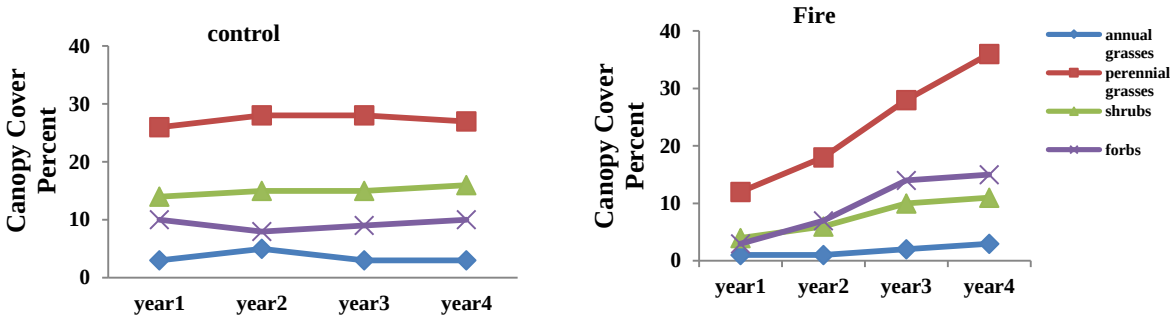

Fig. 2. Comparing canopy cover percentage in the control and fire site

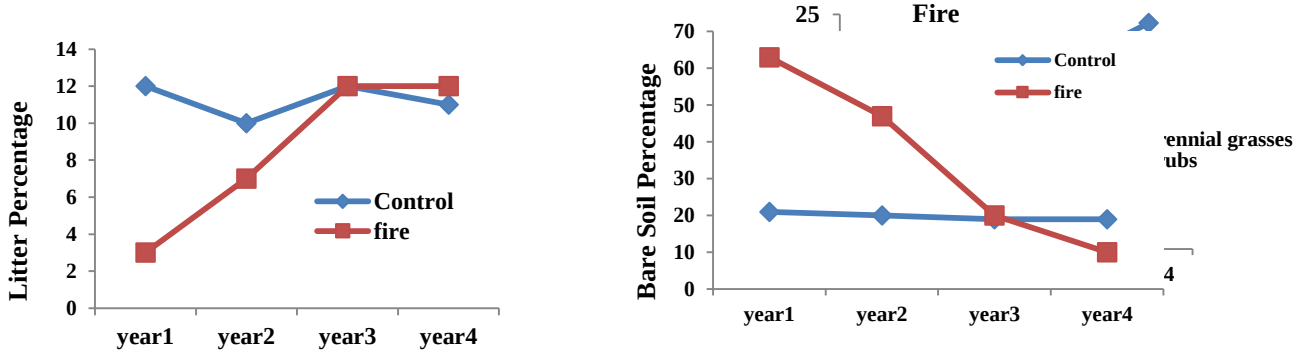

Fig. 3. Comparing bare litter percentage in the control and fire sites

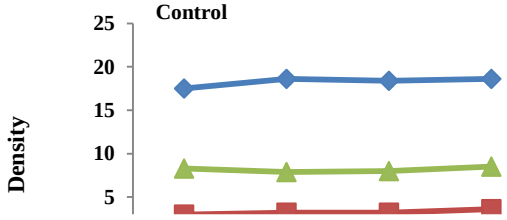

Fig. 5. Comparing density in the control and fire site during four years

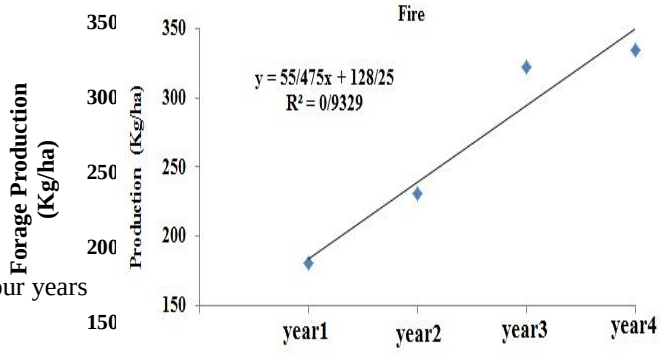

Fig. 4. Comparing bare soil percentage in the control and fire sites

Fig. 6. Comparing forage production in the control and fire affected sites

Table 2. Mean comparisons in the fire affected sites during the first to fourth years after fire

Parameters		Canopy Cover Percentage (the Years after Fire)				(Differences) Fire Site/ Control in Last Year
		Year1	Year 2	Year 3	Year 4	
Canopy cover %	Perennial grasses	12 ^{d}	18 ^{c}	28 ^{b}	36 ^{a}	+9 %
	Annual grasses	1 ^{c}	1 ^{c}	2 ^{b}	3 ^{a}	0 %
	Forbs	3 ^{d}	7 ^{c}	14^{b}	15 ^{a}	+5 %
	Shrubs	4 ^{d}	6 ^{c}	10^{b}	11 ^{a}	-5 %
	Litter	3 ^{c}	7 ^{b}	12^{a}	12 ^{a}	+1 %
	Bare soil	63 ^{a}	47 ^{b}	20^{c}	10 ^{d}	-9 %
Density	Perennial grasses	0.38^{d}	0.79 ^{c}	1.93^{b}	2.41 ^{a}	+0.55
	Forbs	0.12^{d}	0.31^{c}	0.82^{b}	0.94 ^{a}	+0.09
	Shrubs	0.20^{d}	0.22 ^{c}	0.25^{b}	0.27 ^{a}	-0.09
Production (Kg/ha)		180.2 ^{d}	230.5 ^{c}	322.2 ^{b}	334.8 ^{a}	+53.1 (Kg/ha)

The similar letters in rows indicate no significant difference between years (P<0.05)

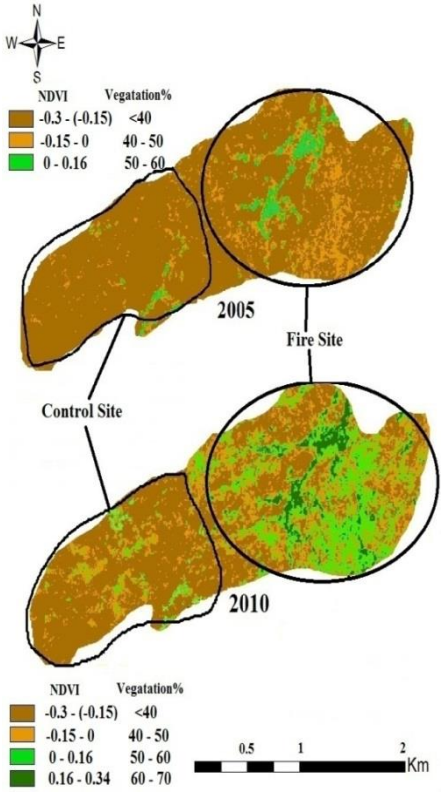

Fig. 8. Changes in NDVI values from 2005 to 2010

Discussion and Conclusion

Although fire creates changes, especially in plant compositions, most of the rangeland communities were flexible against fire (Guevara *et al.*, 1999; Kristofor, 2006; Haubensak *et al.*, 2009). The effects of fire depend on vegetation characteristics (plant moisture, bud height, plant yield at maturity stage, method of reproduction, etc.), climatic conditions (temperature, moisture, wind velocity) and fire characteristics (season, frequency, intensity and succession stage) (Brooks *et al.*, 2004). On the other hand, there were different environmental factors affecting the regeneration of plant species after fire of which relative frequency, the proximity of fire affected site to the seed sources of native species, species diversity, climatic conditions and fire intensity are of utmost importance (Brooks *et al.*, 2004). According to the obtained results, grasses were dominant species in the study area (in terms of both canopy cover percent and density) and forbs and shrubs are present as fraught species. In addition, lower percent was recorded for annuals. Data analysis showed that there were significant differences between control sites and fire affected sites as well as the fire years. There was no significant difference among the years in control sites indicating that in addition to the fire, other factors such as livestock grazing and climate factors affected vegetation.

Significant differences between the fire affected and control sites are related to the fire. As reported by previous studies such as Decastro and Kauffman (1998), Carleton and Loftin (2000), Kristofor (2006) and Provencher *et al.* (2007), fire reduces the ability of woody and shrubby species in competition with forbs for light,

moisture and soil nutrients and provides fertile ground for the growth of grasses. According to the results, the highest canopy cover percent was recorded for perennial grasses in comparison with the other species in the first year after fire in the fire affected sites. The canopy cover percent of perennial grasses has increased from the first year after fire by the end of the study period so that it showed an increase of 9% in comparison with the control site. Javadi and Mamoon (2011) have also concluded that the grasses percent has significantly increased in the burned rangelands in comparison with the unburned areas. Moreover, the results of some studies such as Decastro and Kauffman (1998), Kristofor (2006), Ortman and Beran (2008) and Fattahi and Tahmasebi (2011) supported our results. The canopy cover percent of annual grasses had decreased up to 70% in the first year after fire in comparison with the control sites. It is because that annual grasses are propagated only by seeds and fire has occurred in the growing season; therefore, they have been destroyed before seed production stage and also most of the seeds of previous years had burned in the fire event. Consequently, the canopy cover percent of annuals was reduced drastically until two years after the fire event. This result is consistence with previous studies' results such as Ortman and Beran (2008) and Fattahi and Tahmasebi (2010). In general, although the canopy cover percent of annual grasses showed an upward trend, it had no significant differences in comparison with the control site. The canopy cover percent of shrub species in the fire affected site showed an upward trend from the beginning to the end of the study period but it was lower than that of control sites in all the years so that during the study period, it was reduced up to 5% in comparison with the control site and it could not reach to the canopy cover percent of the year before fire event. Our results are confirmed by the findings of Guevara *et al*. (1999), Carleton and Loftin (2000), Dale *et al*. (2002) and Fattahi and Tahmasebi (2010). The main reason for the increased survival of perennial grasses is related to their resistance to fire event resulting from the position of growth buds at surface or underground (Ortman and Beran, 2008). In contrary, shrub species whose growth bud is above ground level were more injured by fire event and woody stems intensified the heat and made them more vulnerable. The canopy cover percent of forbs had increased from the beginning to the end of the study period so that it showed an increase of 5% in the fourth year in comparison with the control site and the highest canopy cover percent after perennial grasses was recorded for the forbs. Cook (1994) examined the response of herbaceous species to fire events and his results showed that fire had increased the production of herbaceous species and because these herbaceous species could be deployed quickly after the fire which corresponded with the results of this study.

Litter functions are a reservoir of organic matter and nutrients in the ecosystems (Debano *et al*., 1998; Ortman and Beran, 2008; Dale *et al*., 2002). Our results showed that initially, fire has reduced the litter percent extremely so that in the first year after fire event, litter percent was reduced up to 75% in comparison with the control site, but it showed a gradual upward trend so that in the fourth year after fire event, it has increased in comparison with the control site. The main reason for the increase of litter is related to the increase of canopy cover percent, density and yield (production) of grasses which is in agreement with the findings of Fattahi and Tahmasebi (2010). Fire has increased the bare soil extremely so that it has increased 3 times in the first year after fire event in comparison with the control site.

Similar results have reported by the other studies such as Certini (2005),

Cassie *et al*. (2009) and Fattahi and Tahmasebi (2010). However, bare soil has decreased in the subsequence years so that bare soil percent in the fire affected site was reduced up to 50% in comparison with the control sites in the fourth year after fire event. Reduced bare soil percent is due to the increased vegetation cover and litter in the fire site.

Forage production which is most relevant to grasses and forbs was also reduced extremely in the first year after fire event; however, it showed an upward trend from the third year onwards so that an increase of 53 Kg/ha was recorded in comparison with the control site. Results of Dale *et al.* (2002) have supported our results in this regard. Moreover, some other studies such as Snyman (2004) and Fattahi and Tahmasebi (2010) have also made similar conclusions. The increase of forage production can be affected by the reduction of litter and vegetation due to the fire event and the increase of bare soil which has increased the sunlight radiation to the soil surface and caused the rise of temperature. Increased temperature motivates and stimulates biological activities; therefore, organic matter is mineralized and plant available nutrients have increased. In addition, stem elongation as well as growth and production could be faster as it was highlighted by previous studies such as Fattahi and Tahmasebi (2010) and Richard and Hoffman (2012). Moreover, Bruhjell and Tegart (2001) had reported that fire event can affect the soil parameters such as organic matter. Released nutrients stored in litter and plant (equivalent to 58% canopy cover percent) and maximum NDVI for 2010 was 0.34 in the fire affected site (equivalent to 67% canopy cover percent). This increase in the NDVI value from the image of 2010 in comparison with the image of 2005 is due to the increase of vegetation cover in 2010 after fire event. In both images, minimum NDVI is related to the rocky areas as well as gravel and stones. To sum up, fire event has had significant effects on rangeland ecosystem through reducing shrubs and increasing perennial grasses and forbs. Although fire has caused a relative balance in vegetation composition in the region, woody species reduced and palatable species increased in the short-term period. This phenomenon may be considered from the feeding of livestock's perspective but the reduction of shrubby tissues which have caused soil enrichment providing a fertile field for plant growth in the fire affected sites. The same statement has been already stated by Fattahi and Tahmasebi (2010) in this regard. Moreover, by the removal of older organs and stems, it causes to increase the growth and forage quality in the fire affected areas. Morgan and Lunt (1999), Dale *et al*. (2002) and Ortman and Beran (2008) have reported the same results for their studies. Furthermore, Fire intensity can affect soil microbial population and available nutrients. Thus, these factors are influential on the development of species in the fire affected sites. Debano *et al*. (1998), Harrod and Reichard (2001) and Korb *et al*. (2004) have conceded the same results for their studies. Finally, fires rarely burn the area uniformly but normally, a mosaic of the areas with varying burn severity is created. This provides suitable conditions for competition, regeneration and utilization of environmental factors by grasses and dominance of them which have been concluded also by the results of this study. Sharifi and Emami (1999) by concluding the effects of fire on vegetation changes in the semi-steppe rangelands have stated that the fire caused a significant increase in the total canopy cover. Moreover, it has caused the reduction of shrub cover, but grass cover has increased according to their results. They reported that it is due to the grass revival in later years much faster after a fire event which supported the results of our study. Maximum NDVI for 2005 was calculated to be 0.16

plants with more soil conservation potential can cause severe degradation at the study area which was not considered by this study and it needs further investigation. This study has created some basic results for the study region for after fire understanding but still there is a requirement to continue data collection from the study area in 10, 20, 40, 80 and more years to conclude the real effects of fire on plant composition, cover, soil surface parameter and soil conservation issues to gain complete understating, particularly from the succession perspective and the selection of suitable management practices in the study region for range management of the burned areas.

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بررسی تأثیرآتش‌سوزی بر تغییرات پوشش سطحی و تولید علوفه (مطالعه موردی: شهرستان دلفان در استان لرستان)

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چکیده. هدف از این مطالعه بررسی اثرات منطقه‌ای آتش‌سوزی بر روی پوشش سطحی و تولید علوفه مراتع کوهستانی شهرستان دلفان، استان لرستان، ایران بود. آتش‌سوزی در خرداد سال ۱۳۸۵ صورت گرفت، که به نظر می‌رسد اثر قابل توجهی بر ویژگی‌های پوشش گیاهی در منطقه مورد مطالعه دارد. چهار منطقهٔ آتش‌سوزی شده برای نمونه‌برداری انتخاب و در نزدیک محل‌های آتش‌سوزی، منطقه‌ی شاهد (بدون آتش‌سوزی) تعیین گردید. نمونه‌برداری پوشش گیاهی به - روش تصادفی- سیستماتیک، اندازهٔ پلات به‌روش سطح حداقل و تعداد پلات به روش آماری تعیین شد. در مجموع داده‌های مربوط به ۸ سایت (۴ سایت آتش‌سوزی و ۴ سایت شاهد) مورد بررسی قرار گرفت. در هر سایت ۴ ترانسکت ۵۰ متری در جهت شیب و عمود بر شیب مستقر گردید و سپس در امتداد هر ترانسکت ۵ پلات مستقر شد. عوامل درصد پوشش گیاهی، درصد لاشبرگ، خاک لخت، تراکم و تولید در دو منطقهٔ شاهد و آتش‌سوزی مقایسه شد. برای مقایسه بین سال‌ها و میانگین صفات اندازه‌گیری شده در دو منطقه از آزمون تی مستقل و برای بررسی تغییرات عوامل مورد بررسی در هر منطقه به‌طور جداگانه، از تجزیه واریانس یک‌طرفه و آزمون دانکن استفاده شد. نتایج نشان داد که آتش‌سوزی منجر به افزایش معنی‌دار تولید علوفه، درصد پوشش، تراکم گراس‌های چند ساله و فورب‌ها و درصد پوشش لاشبرگ در منطقه دچار آتش- سوزی شده است در حالیکه تراکم و درصد پوشش بوته‌ای‌ها در منطقه دچار آتش‌سوزی شده را به‌طور معنی‌داری کاهش داد. از طرفی، آتش‌سوزی درصد پوشش خاک لخت را به‌طور چشم- گیری کاهش داد، اما تأثیری معنی‌دار روی درصد پوشش گراس‌های یکساله نداشت.

کلمات کلیدی: آتش‌سوزی، تولید، تراکم، درصد پوشش‌گیاهی، دلفان، لرستان

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