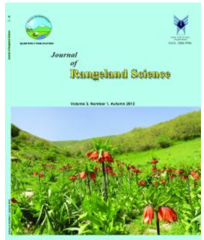
Contents available at ISC and SID

Journal homepage: www.rangeland.ir



Full Length Article:

Investigation on Effects of Environmental and Soil Factors on Establishment of Vegetation Types (Case Study: Sabzdasht, Bafgh)

Majid Sadeghinia[A], Mohammad Jafari[B], Ghavamodin Zahedi Amiri[C], Naser Baghestani Maybodi[D], Ali Tavili[C]

[A]Ph.D Student of Range Management, Faculty of Natural Resources, University of Tehran, Iran.
[B]Professor, Faculty of Natural Resources, University of Tehran, Iran. (Corresponding Author). Email: jafary@ut.ac.ir
[C]Associate Prof., Faculty of Natural Resources, University of Tehran, Iran.
[D]Associate Prof., Agricultural and Natural Resources Research Center of Yazd, Iran.

Received on: 11/09/2012
Accepted on: 29/12/2012

Abstract. This research was conducted to investigate the relationships between soil (organic matter, potassium, phosphorous, sodium, fine gravel, soil texture, EC, lime, gypsum, nitrogen) and environmental (elevation, slope) factors with distribution of vegetation types in rangelands of Sabzdasht, located in Bafgh, Yazd province at 2012. For this purpose, four vegetation types were selected as follows: *Artemisia sieberi*; *Artemisia sieberi*, *Stipa barbata*, *Eurotia ceratoides*; *Dorema ammoniacum*, *Artemisia sieberi*, *Eurotia ceratoides*; and *Hammada salicornica*. Minimal area was determined using nested plots. Afterward, vegetation factors were measured and five soil profiles were dug randomly in minimal area. In each profile, data for depths of 0-10 and 10-80 cm were recorded. Principal component analysis was applied to analyze the data. Results showed that soil texture, potassium, phosphorous, EC and lime had the most impact on variation and distribution of vegetation types.

Key words: Soil properties, Environmental factors, Principal component analysis, Minimal area, Bafgh, Yazd.

Introduction

In natural resource management, it should be considered that soil, plant and water are important environmental components which affect vegetative biomass as the final product. Vegetation is greatly influenced by environmental factors such as climate, soil, topography and geology (Holechek *et al.*, 2001). Given the important role of plants in balance of ecosystems, recognizing relationships between plants and environmental factors is inevitable to maintain their consistency and stability (Asri, 1995). It is noticeable that there is a clear relationship between vegetation and soil conditions and this is not a one-way relationship but is interaction (Atri, 1997) and change of vegetation composition in an area indicates a change in factors that directly or indirectly affect the species (Ludwig and Reynolds, 1988). Given the close relationship between ecosystem components and the importance of soil, the relationship between vegetation and soil arises among the climate factors, organisms, relief, rock and time. For this reasons, study on relationship between environmental factors and species is one of the main topics of ecology and natural resource management (Jafari, 1988).

On the other hand, it should be noted that in sensitive, fragile and vulnerable ecosystems of arid and semi-arid regions reduction of biological production resulting from degradation of resources (vegetation, wildlife, water and soil) is not an easily reversible phenomenon and production and the land may lose its production potential and supplying human life needs permanently. Population growth coupled with mismanagement has led to degradation of these fragile ecosystems (Jafari *et al.*, 2006).

Since human life depends on preservation and restoration of these areas, paying attention to management and revegetation is of utmost importance in these regions. Vegetation of arid, semi-arid and desert areas is mostly affected by soil and climatic characteristics.

Factors such as rainfall (He *et al.*, 2007), soil texture (El- Demerdash *et al.*, 1994), physiography of the area, specially elevation, slope, topography, land form and latitude (Yair and Danin, 1980), salinity, pH, organic matter and lime have influence on species composition. Soils with high salinity and high lime content have low species diversity (Mabbutt, 1977). Low rainfall and frequent drought periods are of climatic characteristics in arid and semi-arid regions (Mabbutt, 1977), consequently in the most studies, moisture availability is considered to be of the most important factors in controlling vegetation of these areas (Noy- Meir, 1973; Yair and Danin, 1980). Also, several studies have been conducted on relationships between vegetation and environmental factors in arid and semi-arid regions of different countries (Abd El- Ghanei, 1998; Abd El-Ghani and Amer, 2003; Monier and Wafaa, 2003; Parker, 1991; Yair and Danin, 1980; Zare Chahouki, 2006).

There are some publications for relationship between environmental and soil factors on distribution of vegetation type in Iran. Jafari *et al.* (2006) investigated the relationship between soil properties and distribution of plant species at 14 rangeland sites in Qom. The results showed that soil texture, EC and lime were the most important soil properties effective in separation of vegetation types. Zare Chahouki *et al.* (2007), introduced lime, gravel, saturation percentage, gypsum and EC as the most important soil properties effective in separation of vegetation types in the study area. Zare Chahoki and Safizade (2008) stated that gravel percentage, saturation percentage, lime, pH and EC were the most effective factors influencing the distribution of vegetation in Chah Beiki desert at Yaz province. Zare (2009) showed that soil texture, soil salinity, effective soil depth, potassium and soil moisture were the most effective factors influencing the distribution of vegetation in Chahar Bagh, Shahriar. Abd El-Ghani *et al*. (2011) with the aid of canonical correspondence analysis and unbiased comparative analysis expressed that some soil properties such as gravel percentage, sand, sodium, solphat, chloride and nitrate were the most important factors influencing the distribution of vegetation in desert regions of Egypt. El- Bana and Al- Mathnani (2009) showed that vegetation of Al- Hayat desert in Libya is associated with salinity, moisture, organic matter, elevation and soil texture. According to the results of the mentioned researches, it is obvious that distribution of vegetation types and species in each region is affected by one or more environmental factors. Understanding the factors affecting vegetation is crucial for vegetation management. Consequently with regard to the important role of plant species in ecosystem balance, the necessity of understanding the relationships between species and environmental factors to maintain their consistency and stability is inevitable.

Materials and Methods

In Bafgh protected area, physical and biological diversity has resulted in considerable diversity and density of vegetation. Minimum altitude in the north-west of the protected area is 1060 m and maximum altitude is 2860 m (Bajgan Mountain) in the south-east (Fig. 1). Elevation range of 1800 to 2860, diversity of topography and deep valleys and high mountains and relatively broad plains have caused various and considerable habitats in the region. The region stretches from the north-west to south east with a greater height in central parts of the region. Geographical aspect is very important in terms of effectiveness on type of climate, rainfall, water reserves, soil and vegetation and also the amount of solar energy intake (Sarhangzadeh, 2012). The aspect of the region is west and east. Altitudes of the region, in the center of the protected area, extend from north to south and most of the area is covered with the east and west sides. Most of the plains have extended from north to south near the eastern and western borders and Giberi and Shitur are the most important plains. Average annual rainfall is over 97 mm, mean annual temperature is 14.26 °C, warmest month is July and the coldest month is January. The minimum and maximum temperatures were recorded -24 °C and 45.7 °C, respectively.

To investigate the relationship between vegetation and environmental factors (topography and soil factors), after a preliminary visit, four vegetation types determine with Physiognomic- Floristic System. First of all, a floristic list was prepared for each vegetation type. Then, minimal area was determined in each vegetation type using nested plots technique. Canopy cover percentage, density and frequency of the species were recorded in $2m^2$ plots. Finally, the minimal area was divided into four equal segments and a point was randomly selected and a soil profile was dug in each segment. Also, a profile was dug in the center of the minimal area and soil samples were taken from two depths of 0-10 and 10-80 cm given the effective depth of the species (Mousaei Sanjerehei, 2010). Geographical coordinates of each of the profiles and altitude were recorded using GPS (Fig. 2).

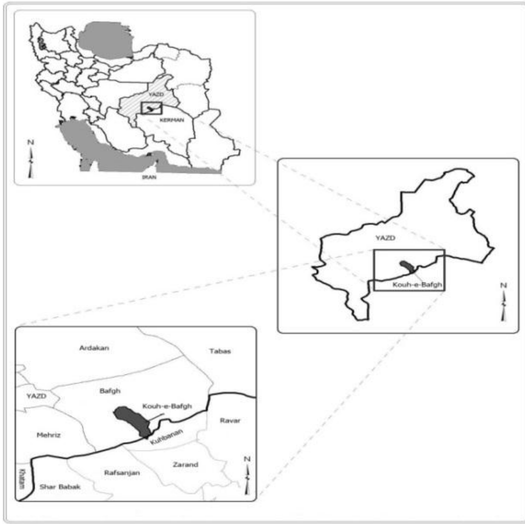


Fig. 1. Situation of Sabzdasht in Iran and Yazd and map of Baghedar

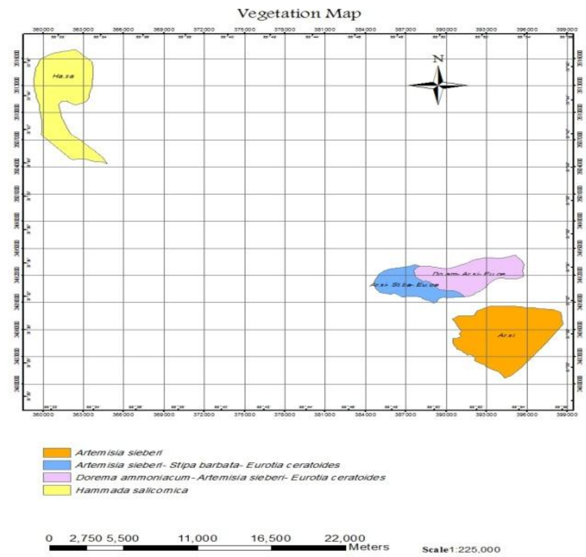


Fig. 2. Map of vegetation in Sabzdasht

The samples were collected and transported to the laboratory. Afterward, all soil samples were weighed and sifted through a 2 mm sieve and the percentage of gravel was calculated. Organic carbon was measured using Walkley-Black method and then percentage of soil organic matter was obtained by multiplying the percentage of carbon by 1.72. Sodium and potassium by flame photometry; phosphorous by using Olsen's method and spectrophotometer; soil texture by hydrometer method (Bouyoucos, 1962), and soil acidity by a pH meter were determined (Mousaei Sanjerehei, 2010). Analysis of relationship between environmental and soil factors with vegetation changes was perform by Principal Component Analysis (PCA) using PC-ORD software (McCune and Mefford, 1999). The aim of the PCA is to analyze the variance of the multivariate data in few components. The first component should have the highest variance in the data as far as possible and then the second component comes (is added) due to a lower variance. In this method, each component is independent from the other ones. It means that there is no correlation between each component and the other ones and each component is on the right side of the other components. In PCA method, the data should be normalized (Zare Chahouki, 2006).

Results

Four major vegetation types including *Artemisia sieberi*; *Artemisia sieberi- Stipa barbata- Eurotia ceratoides*; *Dorema ammoniacum- Artemisia sieberi- Eurotia ceratoides*; and *Hammada salicornica* were selected and the factors affecting the distribution of these vegetation types were studied. (Table 1), shows the results of PCA including eigenvalues and variance percentage accounted for each component for vegetation types at two depths of 0-10 and 10-80 cm.

Table 1. Eigenvalues of the variance of the components in PCA

Axis	Eigenvalue	% of Variance	Cum. % of Var.	Broken-Stick Eigenvalue
1	18.936	70.135	70.135	3.891
2	5.713	21.159	91.294	2.891
3	2.351	8.706	100	2.391

According to (Table 1), Eigen values of the first and second components are greater than Broken-stick Eigen values consequently, the first and second components were identified as the components affecting the changes of vegetation types. Results of the percentage of variance of the components showed that the first and second components could justify 70.13 and 21.16% of vegetation changes, respectively. In general, the first and second components justified 91.29 % of vegetation changes. (Table 2), shows eigen vectors of environmental and soilfactors.

Table 2. Eigen vectors of soil and environmental factors of PCA

Factors	Eigen Vector 1	Eigen Vector 2
K 1	**0.2083**	-0.1532
K 2	**0.2202**	-0.0740
Na 2	**0.2284**	-0.0326
Fine Gravel 2	**0.2167**	0.1377
Sand 1	**0.2203**	-0.1038
Sand 2	**0.2091**	-0.1713
Silt 1	**-0.2269**	0.0398
Silt 2	**-0.2216**	-0.0205
EC 2	**0.2283**	-0.0378
Lime 1	**-0.2042**	-0.1861
Slope	-0.1071	**-0.3427**
OM 2	-0.1863	**0.2439**
Na 1	0.1409	**0.3302**
P 1	-0.1066	**-0.3571**
P 2	-0.1345	**-0.3045**
Clay 1	-0.1939	**0.2149**
Clay 2	-0.1487	**0.3140**
EC 1	0.1744	**0.2724**
Elevation	-0.2290	-0.0137
OM 1	-0.1012	-0.1351
Fine Gravel 1	0.1457	0.1008
pH 1	0.1867	-0.2438
pH 2	-0.2146	-0.0977
Lime 2	-0.2281	-0.0509
Gypsum 2	0.2274	-0.0537
N 1	-0.1612	-0.0982
N 2	-0.2055	0.1872

1: the first soil depth (0-10 cm) 2: the second soil depth (10-80 cm)

According to (Table 2), the first component included K (top and low layer), Na (lower layer), fine Gravel (top layer), sand (top and low layer) and EC (lower layer) had positive effects and silt (top and low layer) and lime had negative effects on separation of vegetation types. In other word, as shown in (Fig. 3) *Hammada salicornica* was associated with the positive coefficients. The second component included organic matter (low layer), clay (top and low layer) and EC had positive effects and slope and phosphorous (top and low layer) had negative effects on separation of vegetation types. Other components included the factors as follows: The third component: organic matter and gravel percentage of the first soil depth; the forth component: pH of the both soil depths; the fifth component: height and nitrogen of the first soil depth, gypsum and nitrogen of the second soil depth.

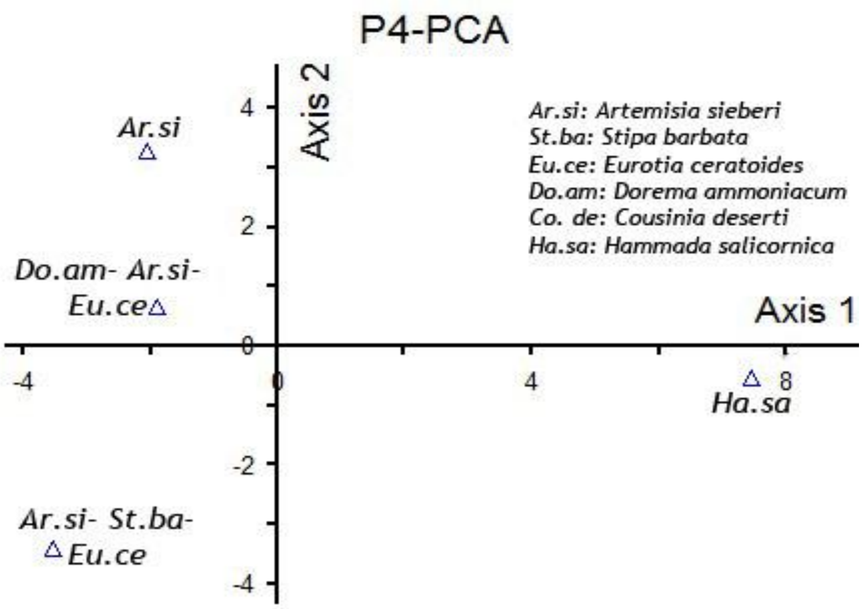


Fig. 3. Ordination of vegetation types in principal components analysis (the first and second components)

According to the results, vegetation types were classified into the following groups: The first group: *A. si* and *D. am- A. si- E. ce.* The second group: *A. si-S. ba- E. ce.* The third group: *H. sa.* (Table 3), show the correlation of environmental factors with the first and second components.

Table 3. Correlation of soil and environmental factors with the first and second components in vegetation types

Factors	Eigenvector 1	Eigenvector 2	Factors	Eigenvector 1	Eigenvector 2
Elevation	-0.996	-0.033	Clay 1	-0.844	0.514
Slope	-0.466	-0.819	Clay 2	-0.647	0.750
OM 1	-0.440	-0.323	Sand 1	0.959	-0.248
OM 2	-0.811	0.583	Sand 2	0.910	-0.409
K 1	0.906	-0.366	Silt 1	-0.988	0.095
K 2	0.958	-0.177	Silt 2	-0.964	-0.049
Na 1	0.613	0.789	pH 1	0.813	-0.583
Na 2	0.994	-0.078	pH 2	-0.934	-0.234
P 1	-0.464	-0.854	EC 1	0.759	0.651
P 2	-0.585	-0.728	EC 2	0.994	-0.090
Fine Gravel 1	0.634	0.241	Lime 1	-0.888	-0.445
Fine Gravel 2	0.943	0.329	Lime 2	-0.993	-0.122
Gypsum 2	0.989	-0.128	N 1	-0.701	-0.235
			N 2	-0.894	0.447

1: first soil depth (0-10 cm) 2: second soil depth (10-80 cm)

According to (Table 3), in the first Eigenvector the negative factors are involved in *Artemisia sieberi*; *Dorema ammoniacum- Artemisia sieberi- Eurotia ceratoides* types and the positive factors are involved *Hammada salicornica* type. In the second eigenvector the positive factors are involved in *Artemisia sieberi* and *Dorema ammoniacum- Artemisia sieberi- Eurotia ceratoides* types and the negative factors are involved *Artemisia sieberi- Stipa barbata- Eurotia ceratoides* type.

Discussion and Conclusion

Results showed that among the factors studied, soil texture, potassium, phosphorus, EC and lime had the most effect on changes and distribution of the vegetation types. According to (Table 2), changes in soil texture have caused the changes in vegetation types. Soil texture affects the moisture content and the amount of nutrients available to plants and light textured soils with good depth easily provide plant available water. Noy-Meir (1973) studied the vegetation of arid regions of Australia and their relationship with environmental factors. His results showed that precipitation and soil texture had the most correlation. In present study, changes in clay content caused the changes in vegetation types. For example, sand content increased in vegetation type of *H. sa* while it decreased in vegetation type of *D. am- A. si- E. ce* and clay content increased in vegetation type of *A. si*. Phosphorous was the other factor influenced the separation of vegetation types and had the maximum content in vegetation type of *A. si- S. ba- E. ce*. *Stipa barbata* was the only species of Gramineae with relatively good canopy cover among vegetation types so it is an important species and with regard to the obtained results it could be said that there was a direct relationship between the presence of the mentioned species with factors of slope, and phosphorous while it had an inverse relationship with EC, organic matter and sodium. Organic matter was also the other factor influenced the separation of vegetation types. Maximum amount of organic matter was obtained for the vegetation type of *A. si*. Organic matter improves soil structure and increases field capacity and causes some changes in soil pH. Organic matter also plays an important role in plant nutrition due to the richness of N and adsorption properties (Ahmadi *et al.*, 2010). EC was another influential factor in distribution of vegetation types. Vegetation type of *H. sa* showed high correlation with increasing of EC, sodium and potassium content. In this vegetation type, high salinity limited the presence and establishment of other species as there were a few species of *Salsola yazdiana* except. The results of the studies performed by Carneval and Torres (1990), Jafari (1988), Roger *et al.* (2001) and Abd El- Ghani (2003) also showed that soil salinity is one of the most important factors in establishment of vegetation communities of arid lands. Soil salinity changes ion balance and consequently reduces availability of water for plants. Lime was the other influential factor in distribution of vegetation types. Minimum lime content was observed in vegetation type of *H. sa* compared to other vegetation types. The *D. am- A. si- E. ce*. *D. am* are calciphyte species and their presence could be justified in areas with high lime content. Lime improves soil structure and causes changes in soil pH but if it increases too much, some problems will be created for plant species due to the hardpan and an increase in acidity and salts in the root zone. In conclusion, results of the current study, performed in arid and semi arid regions, showed that soil texture, potassium, phosphorous, EC and lime had the most impact on changes and distribution of vegetation types. It is also important to note that soil factors did not have similar effect on plant species and there was a strong relationship between some factors with some plant species. In general, a relationship was found between each plant species and some soil factors with regard to the habitat characteristics, ecological requirements and tolerance of the species; therefore, the results could be generalized to similar situations. With the knowledge of soil properties representing each species, improvement of the regions with similar ecological conditions would be possible through suggesting compatible species to the soil conditions and if native species do not have forage quality, some other species with similar ecological requirement could be replaced.

References

Abd EI-Ghani, M. M., 1998. Environmental correlations of species distribution in arid desert ecosystems of eastern Egypt. *Jour. Arid Environment*, No. **38:** 297–313.

Abd El-Ghani, M. M., Abo El-Kheir, M., Abdel-Dayem, M. and Abd El-Hamidand, M., 2011. Vegetation analysis and soil characteristics of the fire common desert climbing plants in Egypt. *Turk Jour. Botany*, No. **35:** 561-580.

Abd El-Ghani, M. M. and Amer, W., 2003. Soil-Vegetation relationships in a coastal desert plain of southern Sinai, Egypt. *Jour. Arid Environments*, No. **55:** 607-628.

Ahmadi, H., Kamali, N., Salajeghe, A., Jafari, M. and Sadeghipour, A., 2010. Investigation on some environmental factors influencing distribution of plant species (Case study: Ghara Aghach watershed, Semirom, Iran). *Watershed Management Researches Jour. (Pajouhesh & Sazandegi)*, No. **88:** 55-63. (In Persian).

Asri, Y., 1995. Phytosociology. Research Institute of Forest and Rangelands of Iran. (In Persian).

Atri, M., 1997. Phytosociology (Translated). Research Institute of Forest and Rangelands of Iran. (In Persian).

Bouyoucos, G. J., 1962. Hydrometer method improved for making particle size analysis of soils. *Agronomy Jour*. No. **54:** 446-465.

Carneval, N. J. and Torres, P. S., 1990. The relevance of physical factors on species distribution in inland salt marshes (Argentina). No. **5:** 113-120.

El-Bana, M. I. and Al-Mathnani, A. S., 2009. Vegetation- Soil relationships in the wadi Al-Hayat area of the Libyan Sahara. *Australian Jour. Basic and Applied Science*, No. **3(2):** 740-747.

El-Demerdash, M. A., Hegazy, A. K. and Zilay, A. M., 1994. Distribution of the plant communities in Tihamah coastal plains of Jazan region, Saudi Arabia. Vegetatio, No. **112:** 141–151.

He, M. Z., Zheng, J. G., Li, X. R. and Qian, Y. L., 2007. Environmental factors affecting vegetation composition in the Alxa Plateau, China. *Jour. Arid Environments*, No. **69:** 473–489.

Holechek, J. L., Pieper, R. D. and Herbel, C. H., 2001. Range Management, Principles and Practices. Prentice-Hall. New Jersey.

Jafari, M., 1988. Investigation on relationships between salinity and vegetation in Damghan kavir. M.Sc. Thesis, Faculty of Natural Resources, University of Tarbiat Modarres, Iran. (In Persian).

Jafari, M., Zare Chahouki, M. A., Tavili, A. and Kohandel, A., 2006. Soil-vegetation relationships in rangelands of Qom province. Pajouhesh & Sazandegi, **73:** 110-116. (In Persian).

Ludwig, J. A. and Reynolds, J. F., 1988. Statistical Ecology- A primer on methods and computing. A Wiley- Interscience Publication.

Mabbutt, J. A., 1977. Desert Landforms. MIT Press, Cambridge, MA.

McCune, B. and Mefford, M. J., 1999. PC-ORD. Multivariate Analysis of Ecological Data, Version 4. MjM Software Design, Gleneden Beach, OR, USA.

Monier, M. A. and Wafaa, M. A., 2003. Soil–vegetation relationships in coastal desert plain of southern Sinai, Egypt. *Jour. Arid Environments*, **55:** 607-628.

Mousaei Sanjerehei, M., 2010. The Study of Habitat Conditions, Distribution Pattern and Spatial Structure of Plant Species in Arid and Semi Arid Rangelands of Nodushan, Yazd. Ph.D Thesis, Science and Research Branch, Islamic Azad University, Tehran, Iran. (In Persian).

Noy-Meir, I., 1973. Desert ecosystem: environment and producers. Annual Review of Ecology and Systematic, No. 4: 25-51.

Parker, K., 1991. Topography, substrate, and vegetation patterns in the northern Sonoran Desert. *Jour. Biogeography*, No. **18:** 151–163.

Rogel, J. A. Silla, R. O. and Ariza, F. A., 2001. Edaphic characterization and soil ionic composition influencing plant zonation in a semiarid Mediterranean salt marsh, Geoderma, No. 99: 81-98.

Sarhangzadeh, J., 2012. Habitat suitability modeling for wildlife, Case Study: wild goat (*Capra aegagrus*) and wild sheep (*Ovis orientalis*) in Kouh-e-Bafgh Protected Area. Ph.D. Thesis in Environmental Planning. Faculty of Environment. University of Tehran, Iran. (In Persian).

Yair, A. and Danin, A., 1980. Spatial variation as related to the soil moisture regime over an arid limestone hillside, northern Negev, Israel. Oecologia, No. **47:** 83–88.

Zare Chahoki, M. A. and Safizade, M., 2008. Environmental effective factors on distribution of arid plants (Case study: Chahbyki region of Yazd province). *Iranian Jour. Range and Desert Reseach*, 15(3). (In Persian).

Zare Chahouki, M. A., 2006. Modeling the spatial distribution of plant species in arid and semi-arid rangelands. Ph.D Thesis in Range management, Faculty of Natural Resources, University of Tehran, Iran. (In Persian).

Zare Chahouki, M. A., Jafari, M., Azarnivand, H., Moghaddam, M. R., Farahpour, M. and Shafizadeh NasrAbadi, M., 2007. Application of logistic regression to study the relationship between presence of plant species and environmental factors. Pajouhesh & Sazandegi, No. **76:** 136- 143. (In Persian).

Zare, S., 2009. An investigation of plant-environment relationship in some arid and semiarid lands indicator plants (Case Study: Chaharbagh Shahriyar Rangelands, Iran). M.Sc. Thesis, Faculty of Natural Resources, University of Tehran, Iran. (In Persian).

بررسی تاثیر برخی عوامل محیطی و خاکی بر استقرار تیپ‌های گیاهی در منطقه سبزدشت بافق

مجید صادقی‌نیا، دانشجوی دکترای مرتعداری دانشگاه تهران و عضو هیات دانشگاه اردکان (نویسنده مسئول)
محمد جعفری، استاد دانشکده منابع طبیعی دانشگاه تهران
قوام‌الدین زاهدی امیری، دانشیار دانشکده منابع طبیعی دانشگاه تهران
ناصر باغستانی، دانشیار پژوهش مرکز تحقیقات کشاورزی و منابع طبیعی استان یزد
علی طویلی، دانشیار دانشکده منابع طبیعی دانشگاه تهران

چکیده

این پژوهش در مراتع سبزدشت شهرستان بافق واقع در استان یزد به منظور بررسی روابط بین عوامل خاکی و محیطی با پراکنش تیپ‌های گیاهی منطقه انجام شده است. به این منظور چهار تیپ گیاهی شامل تیپ گیاهی ***Artemisia sieberi***، تیپ گیاهی ***Artemisia sieberi, Stipa barbata***، ***Eurotia ceratoides***، تیپ گیاهی ***Dorema ammoniacum,Artemisia sieberi, Eurotia ceratoides*** و تیپ گیاهی ***Hammada salicornica*** در منطقه حفاظت شده انتخاب و سپس با استفاده از روش پلات‌های تو در تو سطح حداقل مشخص گردید. در مرحله بعد در سطح حداقل فاکتورهای مربوط به پوشش گیاهی اندازه گیری شده و در نهایت در داخل سطح حداقل پنج پروفیل به صورت تصادفی در داخل سطح حداقل حفر شده و در هر یک از پروفیل‌ها اطلاعات مربوط به عمق صفر تا ۱۰ سانتی‌متری و ۱۰ تا ۸۰ سانتی‌متری خاک برداشت گردید. به منظور تجزیه و تحلیل داده‌ها نیز از روش تجزیه مولفه‌های اصلی استفاده گردید. نتایج نشان داد که از بین فاکتورهای مورد بررسی عوامل بافت خاک، پتاسیم، فسفر، هدایت الکتریکی و آهک بیشترین تاثیر را بر روی تغییرات و پراکنش تیپ‌های گیاهی منطقه داشته است.

کلمات کلیدی: خصوصیات خاک، عوامل محیطی، تجزیه مولفه‌های اصلی، سطح حداقل، بافق، یزد