

Study of effective ecological factors on distribution of vegetation types (Case study: Southern margin of Haj Aligholi Kavir, Damghan)

H. Azarnivand^a, H. Joneidi Jafari^b, Sh. Nikoo^c, M.A. Zare Chahouki^d, A. Malekian^e

^a Associate Professors, University of Tehran, Karaj, Iran

^b Assistant Professor, University of Kurdistan, Sanandaj, Iran

^c Ph.D. Student, University of Tehran, Karaj, Iran

^d Assistant Professor, University of Tehran, Karaj, Iran

^e Assistant Professor, University of Tehran, Tehran, Iran

Received: 8 December 2007; Received in revised form: 23 February 2008; Accepted: 21 April 2008

Abstract

The objective of current research is to investigate distribution patterns of vegetation types and its relation with environmental factors in southern margin of Haj Aligholi Kavir of Damghan. Three vegetation types including *Halecnemum strobilaceum*, *Sedlitzia rosmarinus* and *Artemisia sieberi* were studied in marginal arid regions and uplands of the study area. Firstly, geographic location of vegetation types was determined using GPS. Then the boundary of the region was delineated on the topographic map in scale 1:50000. Elevation, slope and aspect of vegetation types were determined as well. Ten plots were established in the field based on randomized – systematic approach. The area of each plot was determined according to the kind of plant species and distribution of plants. Floristic list, canopy cover and average percent of species canopy cover were determined in each plot. Finally, five soil samples were taken in each vegetation type. The characteristics of soil samples including texture, EC, pH, %CaCO₃, %CaSO₄, %OM, SAR and ESP were measured too. ANOVA and Duncan's test were used to analyze the collected data. The result of analysis of variance showed that F test of all studied characteristics except %CaCO₃, %CaSO₄, %OM and elevation is significant in %1. The results of Duncan's test showed that soil texture, EC, SAR, ESP and pH of *Halecnemum strobilaceum* type is significantly different from two other types. Also, SAR, ESP and slope in habitat of *Artemisia sieberi* and *Sedlitzia rosmarinus* types were significantly different.

Keywords: Vegetation type; Ecologic factors; Analysis of variance; Duncan's test; Haj Aligholi Kavir; Dameghan; Iran

1. Introduction

Vegetation type and its species composition is one of important components of rangeland ecosystems. Establishment of plant species depend on climatic, edaphic and biologic conditions which is not a random phenomenon.

Due to important role of plants in ecosystem equilibrium as well as direct and indirect utilization of plants by human, it is necessary to define the relation between plants and

environmental factors in order to improve natural resources. Rostami (1995) studied the ecological factors affecting variation of vegetation cover in Kabutar Khan playa and suggested soil humidity, texture and type of sediments as the most important factors in diversity of plant societies. Jafari (2004) studied edaphic factors affecting on index plant species in Qom province and found soil texture, EC and CaCO₃ content as the most important factors. Lents (1984) studied *Artemisia* sp. rangeland which showed that soil texture, depth of profiles, gravel content and type of soil structure are the factors that classify vegetation types.

* Corresponding author. Tel.: +98 261 2223044,
Fax: +98 261 2227765.

E-mail address: hazar@ut.ac.ir

The objective of current research is to study vegetation types distribution and its relation with environmental factors in order to provide manager approaches for optimum utilization of natural habitat to avoid soil salinization and desert expansion in the study area and other similar regions.

2. Materials and methods

The study area is part of southern margin of Haj Aligholi Kavir, Damghan in 35°51'28" latitudes and 54°26'51" - 54°26'56" longitudes. The climate based on revised De Martton method is cold dry and annual average temperature is 15.9°C. During the field studies, three vegetation types with apparent border and area of 3-4km extent were determined in the region. Therefore this research investigates the factors affecting distribution of three types including *Halecnemum strobilaceum*, *Sedlitzia rosmarinus* and *Artemisia sieberi* from marginal areas of playa toward uplands.

Since the region is a relatively small area, climatic and some ecologic factors do not show considerable change. Therefore, soil properties (texture, EC, pH, % CaCO₃, %CaSO₄, %OM, SAR and ESP), topographic factors (slope, aspect, elevation) and lithologic condition were considered as the most effective factors.

At the first, geographic location of the vegetation types were determined using GPS and consequently delineated on topographic map of scale 1:50000. Further more, slope, aspect and elevation of each type were determined based on the topographic map.

In each vegetation type, sampling was done in 10 plots. Method of sampling was randomized-systematic. The area of each plot was determined according to the kind of plant species and distribution of plants. The list of plant species in each plot, percent of canopy cover for each species and average percent of canopy cover were determined as well.

Also, in five plots of each vegetation type, soil samples were taken up to 50cm depth (root

zone and effective depth) and the samples were analyzed in the lab.

Analysis of data was conducted using one way ANOVA to compare the average of measured characteristic in the vegetation types and as the next stage paired comparison of means using Duncan's Test was considered.

3. Results

1. Description of soil and vegetation cover characteristics in the vegetation types of the study area:

1.1. *Halecnemum strobilaceum* type:

This type covers marginal area of Kavir in the wet surrounding area with average elevation of 1075m, average slope of 0.5%, northern aspects and lies on fine sediments with high salt content. The average canopy cover of the type is 15% and is lack of associate species, surface sand and gravel.

1.2. *Sedlitzia rosmarinus* type:

This type covers plain and shows sediment transport zone with average elevation of 1080m, average slope of 1%, northern aspect and locate on fine slaty sediments. Its only associate species is *Artemisia sieberi*. The average canopy cover is 8% and percent of surface gravel and sand is about 45%.

1.3. *Artemisia sieberi* type:

This type includes bare pediment (erosion pediment) geomorphological unit and Reg facies. The average elevation and slope are 1090m and 3%. It shows northern aspect and consist of alluvial and colluvial coarse sediment. The associate species are *Atraphaxis* sp. and *Sedlitzia rosmarinus*. The average canopy cover of the type is 3% while surface sand and gravel percent reaches to 10%.

The physico-chemical characteristics of soil in different vegetation type are summarized in Table 1.

Table 1. Soil physical and chemical properties in the studied vegetation types

Vegetation type	EC (ds/m)	pH	Clay (%)	Silt (%)	Sand (%)	Lime (%)	Gypsum (%)	OM (%)	SAR	ESP
<i>Halecnemum strobilaceum</i>	122.96	7.78	4.84	19.63	75.8	16.83	2.082	0.63	484.602	97.6
<i>Sedlitzia rosmarinus</i>	21.74	7.44	1.4	10.68	87.92	18.16	0.674	0.48	72.91	90
<i>Artemisia sieberi</i>	6.98	7.4	0.100	8	92	19.16	1.35	0.45	15.29	62.8

2. The result of analysis on the effect of ecological factors using one-way ANOVA and Duncan's Test:

Analysis of variance for the means of studied factors was conducted to find the reason of change in vegetation types. The results on F

test in 0.01 were significant for all of studied factors except %CaCO₃, % CaSO₄, %OM and elevation. Then a significant difference between at least one pair of the means was anticipated (Table 2).

Table 2. The result of analysis of variance of the studied ecological properties

SOV	df	EC (ds/m)	pH	Clay (%)	Silt (%)	Sand (%)	Lime (%)	Gypsum (%)	OM (%)	SAR	ESP	Slope (%)	Elevation (m)
Between Group	2	27.196	8.175	7.741	30.364	35.873	2.832	2.335	0.381	22.687	56.107	136.32	0.245
		**	**	**	**	**	ns	ns	ns	**	**	**	ns

n.s: not significant difference

** : Significant difference in 1% level

To find out the characteristics which are different in various types, Duncan's Test was considered. The result showed significant differences in 0.05 in many cases but *Artemisia sieberi* and *Sedlitzia rosmarinus* type showed

higher similarity while were considerably different with *Halecnemum strobilaceum* type (Table 3). In this table, in signification characteristics have similar alphabetic letters and vice versa.

Table 3: Classification of the studied properties in vegetation types using Duncan's Test

Vegetation type	EC (ds/m)	pH	Clay (%)	Silt (%)	Sand (%)	SAR	ESP	Slope (%)
<i>Halecnemum strobilaceum</i>	122.96 ^a	7.78 ^a	4.24 ^a	19.76 ^a	76.2 ^b	484.30 ^a	97.6 ^a	0.5 ^b
<i>Sedlitzia rosmarinus</i>	21.74 ^b	7.44 ^b	2 ^b	9.20 ^b	88.8 ^a	72.91 ^b	90 ^b	1.0 ^b
<i>Artemisia sieberi</i>	6.98 ^b	7.40 ^b	1 ^b	8.00 ^b	91.00 ^a	15.29 ^c	62.8 ^c	3.0 ^a

4. Discussion and Conclusion

The results showed that in the study area, among different environmental factors, the distribution of vegetation types was most strongly correlated with some soil characteristics such as salinity, texture, and pH. In arid and semi-arid regions, the relation between species distribution and salinity gradient has been reported by many investigators (Ungar, 1968; Flowers, 1975; Kassar, 1975; Jafari, 1989; Moghimi, 1989; Zahran et al., 1989; Asri, 1993; Caballero et al., 1994; Maryam et al., 1995). Abu-Ziada (1980) also showed strong relationships between vegetation pattern and soil moisture-salinity gradient in the Kharga and Dakhla Oases. Soil texture controls distribution of plant species by affecting moisture availability, ventilation and distribution of plant roots. The role of soil moisture, as a key element in the distribution of the plant species, is described by Zohary and Orshan (1949) in the Dead Sea region of Israel and El-Sheikh and Yousef (1981) in Al-Kharg springs.

The result of comparison among ecological characteristics of *Sedlitzia rosmarinus*, *Artemisia sieberi* and *Halecnemum strobilaceum* types showed similarities and differences. Some characteristics such as CaCO₃, CaSO₄, %OM and elevation have no role in distinguishing of different types. *Artemisia sieberi* and *Sedlitzia rosmarinus* types showed

no significant differences in soil EC, pH and texture while these factors distinguished the mentioned types from *Halecnemum strobilaceum*. Zareh Chahouki (2001) concluded that soil texture and EC are among the most effective factors in differentiating different vegetation types. ESP, SAR and slope were different in the types and led to distinguishing three types, but *Artemisia sieberi* type had difference based on slope compared to other types.

The overall results of the research indicates that *Halecnemum strobilaceum* has the highest resistance to soil salinity compared to other plant species surrounding the playa. This species disappears and replaced by *Sedlitzia rosmarinus* and then *Artemisia sieberi* with decrease of salinity. Another considerable issue is high capacity of ESP in *Sedlitzia rosmarinus* and *Halecnemum strobilaceum* types that increases alkalinity tolerance of the species. Jafari (1989) found *Halocnemum strobilaceum* as the highest resistant species in saline condition of Damghan region.

Among topographic factors, slope is an important parameter which affects on physico-chemical characteristics and distinguishes different vegetation types of the study area. Azarnivand (1990) implies that slope is an important factor in change of vegetation cover.

It is necessary to consider physico-chemical properties of soil as well as ecologic condition and resistance of the species for different

environmental factors in any remediation project planned for the study area.

References

- Abu-Ziada, M.E.A., 1980. Ecological studies on the flora of Kharga and Dakhla Oases of the Western Desert of Egypt. Ph.D. Thesis, Faculty of Science, Mansoura University, 342pp.
- Asri, Y., 1993. Some ecological characteristics of halophyte plant associations in western margin of Uromieh Lake. *Journal of Research and Construction* 18 (1): 21–25 (in Persian).
- Azarnivand, Hossein, 1990. Study of vegetation cover and soil in relation to geomorphologic units of Damghan, MSc. thesis, Tarbiat Modarres University.
- Caballero, J.M., Esteve, M.A., Calvo, J.F., Pujol, J.A., 1994. Structure of the vegetation of salt steppes of Guadalenitín (Murcia, Spain). *Studies in Oecologia* 10-11, 171–183.
- El-Sheikh, A.M., Yousef, M.M., 1981. Halophytic and xerophytic vegetation near Al-Kharg springs. *Journal of Colloid Science University Riyadh* 12 (1), 5–12.
- Flowers, T.J., 1975. Halophytes. In: Barker, D.A., Hall, J.L. (Eds.), *Ion Transport in Cells and Tissues*. North-Holland, Amsterdam, pp. 309–334.
- Jafari, M., 1989. Survey of relationship between salinity agents and distribution of plants in Damghan region. MSc. Thesis, Natural Resources College of Tarbiat modarres University (in Persian).
- Jafari, Mohammad, 2004. Study of the effective edaphic factors on distribution of index rangeland plant species, third National Conference on Range and Range Management, Karaj, Iran.
- Joneidi Hamed, Nikoo, Shima, 2005. Study of vegetation types of marginal region of Haj Aligholi playa, MSc. Seminar, University of Tehran.
- Lents, Ro, 1984. Correspondence of soil properties and classification units with sage brush communities in southeastern Oregon, MSc. thesis, Oregon State University.
- Maryam, H., Ismail, S., Alaa, F., Ahmed, R., 1995. Studies on growth and salt regulation in some halophytes as influenced by edaphic and climatic conditions. *Pakistani Journal of Botany* 27, 151–163.
- Moghimi, J., 1989. Survey of relationship between vegetation, salinity and water ground table in Hoz-e-Soltan playa in Qom province, MSc. Thesis, Natural Resources College of Tehran University (in Persian).
- Nikoo, Shima, 2006. Study of environmental effective factors on distribution of vegetation cover in Damghan Region, MSc. thesis University of Tehran.
- Rostami, Shahin, 1995. Study of environmental effective factors on vegetation cover change in Kabootar Khan Playa, MSc. thesis, University of Tehran.
- Teymourzadeh, Ali, 1981. Study of vegetation cover and its relation with geomorphologic units in Damghan, MSc. thesis, University of Tehran.
- Ungar, I., 1968. Species–soil relationships on the great salt plains of northern Oklahoma. *American Midland Naturalist* 80, 392–406.
- Yazdi Samadi, Rezaei, Abdolmajid, Valizadeh, 1998. *Statistical designs in Agricultural Research*, University of Tehran Press.
- Zahran, M.A., Abuziada, M.E., El-Demerdash, M.A., Khed, A.A., 1989. A note on the vegetation on lands in lake Manzala, Egypt. *Vegetation* 85, 83–88.
- Zare Chahouki Mohammad Ali, 2001. Study of the relation of some rangeland plants with physico-chemical properties of soil in Poshtkouh Rangelands of Yazd Province, MSc. thesis, University of Tehran.
- Zohary, M., Orshan, G., 1949. Structure and ecology of the vegetation in the a dead Sea region of Palestine. *Palestine Journal of Botany* 4, 177–206.