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Relationship Between Environmental Factors and Plant Distribution in Arid and Semiarid Area (Case Study: Shahriyar Rangelands, Iran)

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Abstract: The main objective of this study was to investigate the relationship between some index plants of drylands and some different soil and environmental variables in Shahriyar rangelands, Iran. Principal Component Analysis (PCA) and SHAZAM 10 package were implied to determine the most effective soil parameters controlling the distribution of vegetation type and finding the logical relationship between each plant species and environmental variables. Analysis with PCA suggesting that there is a relatively high correspondence between vegetation and soil factors that explain 97% of the total variance in data set. PCA results showed that soil texture, salinity, effective soil depth, available nitrogen, potassium, organic matter, lime and soil moisture criteria were the major soil factors responsible for variations in the pattern of vegetation. Besides, results show that for *P. aucheri* sand in both depth, for *Z. eurypterum* saturated moisture in both depth, for *A. sieberi* lime and available water in the first depth and for *A. spinosa* effective soil depth in the second depth and organic matter in the first depth have the most important role in plant presence and absence probability.

Key words: Environmental · Vegetation · Relationships · PCA · Logic function and Shahriyar rangelands

INTRODUCTION

Arid and semiarid environments often support a low vegetation cover, which is thought to be responsible for fragile ecosystems and certain degree of desertification under human influences in arid and semiarid areas [1]. The distribution, pattern and abundance of plant species in arid and semiarid environments has most often been related to three groups of factors; physical environmental variables affecting water availability, soil chemistry and anthropogenic disturbance [2]. Most soil scientists and range managers hypothesize that percentage cover and plant species is function of landform, soil characteristic and that vegetation cover is a complex object but it is possible to make correlation between them, that is, between vegetation type, landform and kind of soil [3]. Although relationships between plant and both soil properties and environmental factors have been well developed for some plants, comparable understanding of how a variety of plant species in native rangelands respond to soil properties and environmental factors is poorly developed [4]. Debelis *et al*. [5] showed that the importance of topography in explaining the variation in soil properties and composition among different stretches of land, in its hydrological features and the distribution of plants. However, little research was on the comprehensive analysis of the vegetation–soil–topography relationship, which has been an important subject of ecological and geographic studies and can provide valuable information for such kind of degraded areas to have successful strategies in restoration and management [6, 7]. To better management of arid and semiarid environments and to offer a base line for restoration attempts, an understanding of the factors that determine the rangelands vegetation distribution and composition is needed. So this study tries to describe relationships between soil properties and plant vegetation in order to determine the most effective variables for some arid and semiarid index plants.

MATERIALS AND METHODS

Site Description: The study area was chosen in semiarid rangelands of Shahriyar, Iran (between 35° 35' 45″ to 35° 38' 57″ N and 50° 44' 03″ to 50° 52' 27″ E). The area is approximately 3748 hectares, with elevation ranging

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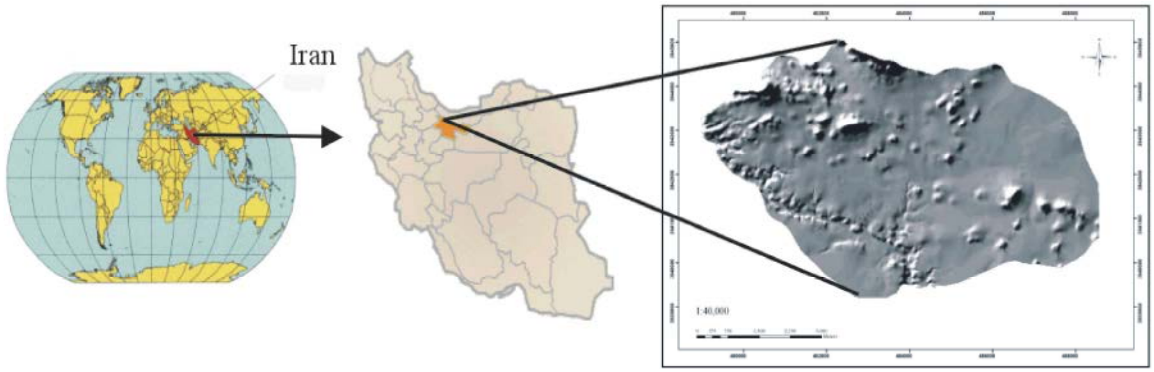

Fig. 1: Geographical situation of the study area

from 1120 m to 1290 meter (Fig. 1). The importance of the study area may be due to its position, which is located in the critical centers of wind erosion; therefore desertification has been identified as a major problem in this area in recent years. The climate is hot and dry Mediterranean via Gaussen's method. Estimated annual mean temperature and precipitation for a 20 year (1985–2005) were -2.3°C in January to 35°C in July and 142-339 mm, respectively. Most of precipitation falls during winter and spring seasons (March- April). The soils of study area based on U.S.D.A Soil Taxonomy method are classified into Aridisoils and four subgroups: Typic calciorthids, Calcic Gypsiorthids, Typic Gypsiorthids and Typic Natargids.

Methodology: Initially in order to general reorganization of study area and investigation of plant vegetation, a field survey was done. Then using ArcGIS 9.2 package the slop, aspect and hypsometry maps were prepared. Based on primary study, major plant types and species selected and sampling was done within them with systematically-randomized method. In each species site, 3-5 transects with a length of 200 meter each including 10 quaderat of 1 m^2 were established. Regarding the kind, distribution pattern and density of plant vegetation, the quaderat size determined with minimal area method. Presence and absence of plant species within quaderat was recorded. A total number of 32 soil samples were taken from 0-20 and 20-60 cm depth at the starting and ending point of each quaderat.

Laboratory Study: The soil samples were air dried at room temperature and passed through a 2mm sieve. The weight of fine fraction (<2 mm) in each soil sample was determined and was kept for laboratory analyses. Soil samples of each depth were mixed before analysis to reduce soil heterogeneity. Soil texture was determined by the hydrometer method [8]; pH and EC in a saturation extract by pH meter [9] and EC meter [10]; organic matter by the Walkley and Black's method [11]; the proportion of $CaCO_3$ by the Calsimeter method [12]; $CaSO_4$ by the ammonium acetate extraction method [13]; phosphorus by Olsen method [14]; Potassium (K) by flame photometry method [13]; Saturated moisture (SP) and effective soil depth (EP) determined by weighting method, PSS by U.S. Salinity laboratory formula and Total Nitrogen (N) by Kjeldahl method [15]. Hydraulic parameters such as field capacity (FC), wilting point (WP), available water (AW), saturation hydraulic conduct (Shc) and bulk density (Bd) estimated according to soil texture with application of CROPWAT 8.0 package.

Statistical Analyses: In the first step, principal component analysis (PCA) was conducted on vegetation and plant type-environmental variable matrix using the program PC-ORD. This ordination method is used to reduce the dimensionality of a data matrix by extracting axes [16]. Then SHAZAM 10.0 package was implied for finding the logical relationship between each plant species and environmental variables. The statistical pattern for this research was based on qualitative function, therefore logic function was evaluated. With appropriate pattern estimation, the efficiency of each variable will be determined. Thereby elasticity at mean and marginal effect is estimated. This analysis performed for all four species separately. Whereby two class of presence and absence and environmental variables were imported in analysis as independent and dependent variable, respectively. Finally a model that has the most percentage of right prediction is selected for each species and given that model the effectible variable or variables in presence and absence probability of each species with their quota are estimated.

RESULTS

Soil characteristics of each of the two major vegetation types are summarized in Table 2.

A brief description of each type is coming as follow:

Artemisia sieberi – Atraphaxis spinosa type. Soil texture in the first and the second layer was sandy clay loam and sandy loam, respectively. This type was found in the places with elevation from 1150 to 1290 meter. Increase in soil depth leads to increase in amount of sand, lime, gypsum, bulk density and soil hydraulic conductivity while EC, clay, silt, OM, PSS, FC, K, P and N decreased.

Pteropyrum aucheri – Zygophyllum eurypterum type. Soil texture in the first and the second layer was sandy loam and loamy sand, respectively. This type covered the area with elevation from 1200 to 1250 meter and east dominated aspect. Increase in soil depth leads to increase in amount of sand, gypsum, saturation moisture and soil hydraulic conductivity while pH, EC, clay, silt, OM, lime, EP, PSS, WP, FC, K, P and N decreased.

The Most Effective Environmental Variables Controlling the Distribution of Vegetation Type: Two plant types and 43 environmental factors were used in the principal component analysis (PCA) in order to determine the most effective soil parameters controlling the distribution of vegetation. The first three axes of the PCA ordination of soil samples accounted for 54.77%, 20.09% and 18.32% of the total variability, respectively. Therefore, the first three principal components together accounted for 97.19% of the total variance in data set (Table 1). The first axis was positively correlated with sand, saturated moisture and gypsum and negatively correlated with

Table 1: variance extracted, first 6 axes of PCA in the study area

Axes	1	2	3	4	5	6
Eigenvalue	25.273	8.639	7.880	1.208	0.00	0.00
Broken-stick	4.350	3.350	2.850	2.517	2.267	2.067
of Variance%	58.774	20.090	18.326	2.810	0.00	0.00
Cum.% of Var.	58.774	78.864	97.190	100	100	100

Table 2: PCA applied to the correlation matrix of the environmental factors and Soil characteristics of the two vegetation types of the study area

	Eigenvector						Soil Characteristics	
Factors	1	2	3	4	5	6	*P. au- Z. eu*	*A. se- A. sp*
pH 1	25.2730	0.0358	0.14220	-0.0489	-0.5284	-0.0053	7.70	7.79
Ph 2	4.3500	0.1099	-0.01130	-0.0962	0.7895	-0.0711	7.70	7.79
EC 1	58.7740	0.2129	0.07170	0.1524	-0.0026	0.0122	0.37	0.45
EC 2	58.7740	0.2086	0.11670	0.1775	0.0005	0.0605	0.32	0.31
OM 1	-0.1809	0.1462	-0.03380	-0.0912	-0.0589	-0.0912	0.43	0.55
OM 2	-0.1870	0.1293	-0.31580	-0.2229	-0.0445	0.1303	0.34	0.35
N 1	-0.1462	0.0849	0.11980	0.0999	0.0043	0.0580	0.02	0.03
N 2	-0.1376	-0.0097	0.06880	0.2011	0.0383	0.0203	0.01	0.02
P 1	-0.1775	-0.1668	0.19340	-0.2441	0.0305	0.0131	18.51	23.95
P 2	-0.0196	0.1106	-0.11160	-0.2323	-0.0585	-0.1746	16.57	20.90
K 1	-0.1793	0.0325	0.10830	0.0556	-0.0275	0.1240	8.07	12.62
K 2	-0.1901	0.2595	0.00040	0.3851	-0.0189	-0.1077	5.28	5.53
$CaCo_3$ 1	-0.1247	-0.0458	-0.20510	-0.0211	0.0051	-0.1322	8.66	12.55
$CaCo_3$ 2	-0.1701	-0.1023	-0.24460	0.1375	-0.0076	0.0751	7.75	13.59
$CaSo_4$ 1	-0.1882	0.2288	-0.00590	-0.0088	-0.0174	-0.0113	39.77	3.57
$CaSo_4$ 2	-0.0972	0.1606	0.10940	0.0006	-0.0138	0.0457	40.35	15.85
PSS 1	-0.1604	0.2173	0.07930	0.1622	-0.0140	0.1710	0.01	0.01
PSS 2	-0.1282	0.2290	0.11270	0.2203	-0.0111	0.1185	0.01	0.01
Gravel 1	0.1472	-0.0401	-0.18020	-0.1164	-0.0566	0.0809	29.60	50.88
Gravel 2	0.1644	0.0378	-0.25770	0.0581	-0.0098	-0.0995	36.98	61.82
EP 1	-0.1422	0.0401	0.18020	0.1164	-0.0152	0.0018	14.08	9.82
EP 2	-0.1240	-0.0378	0.25770	-0.0581	-0.0055	0.0101	25.21	15.27

Table 2: Continued

Sand 1	-0.1681	0.0857	-0.08630	0.1052	0.0693	0.0744	68.91	60.75
Sand 2	-0.1350	0.0847	-0.14070	-0.0523	-0.0751	-0.0614	76.13	70.50
Silt 1	0.1681	0.2203	0.18190	-0.1812	-0.0544	0.0806	22.53	17.50
Silt 2	0.1350	0.0244	0.28730	-0.3649	-0.0774	0.0624	17.19	16.00
Clay 1	0.1850	-0.2687	-0.05010	0.0289	0.0063	-0.0056	8.56	21.75
Clay 2	0.1755	-0.1088	0.07050	0.1848	0.0220	0.1016	6.69	13.50
Bb 1	-0.1054	0.1989	-0.04144	-0.0964	0.0114	0.0019	1.74	1.44
Bb 2	-0.0852	-0.1022	0.14680	0.0537	0.0133	-0.0145	1.78	1.54
WP 1	-0.1186	-0.2507	-0.04140	0.0379	0.0503	-0.0704	0.08	0.14
WP 2	-0.1798	0.0096	-0.12160	0.0999	0.0187	0.0121	0.07	0.23
FC 1	0.1583	-0.1941	0.02570	0.0465	-0.0313	-0.0387	0.16	0.24
FC 2	0.1707	0.0201	-0.08490	-0.7100	-0.7000	-0.0477	0.15	0.18
SP 1	-0.1322	-0.0724	0.17360	0.0237	0.0834	-0.1457	31.68	27.78
SP 2	-0.1856	0.0846	-0.11260	0.1502	0.0355	-0.0154	33.45	27.97
Shc 1	-0.1624	0.2848	0.00240	0.0522	-0.0145	-0.0145	3.01	0.88
Shc 2	-0.1922	0.1632	-0.18870	-0.0254	-0.0047	-0.0324	3.55	2.36
AW 1	0.1684	-0.0186	0.11840	0.0398	-0.0046	0.0305	0.09	0.10
AW 2	0.1791	0.0939	-0.16560	-0.0596	-0.0490	0.0136	0.08	0.11
Elevation	0.1082	-0.1887	-0.19190	0.3220	-0.1823	-0.2832	1158.00	1195.00
Slope	01391	0.0400	-0.29700	-0.1071	-0.0490	0.5716	7.53	6.93
Aspect	-0.1871	-0.2869	0.077100	0.19950	0.07210	0.56220	South west	South weast

Code 1and 2 are related to the soil properties were measured in the first layer (0-20 cm) and the second layer (20-60 cm), respectively

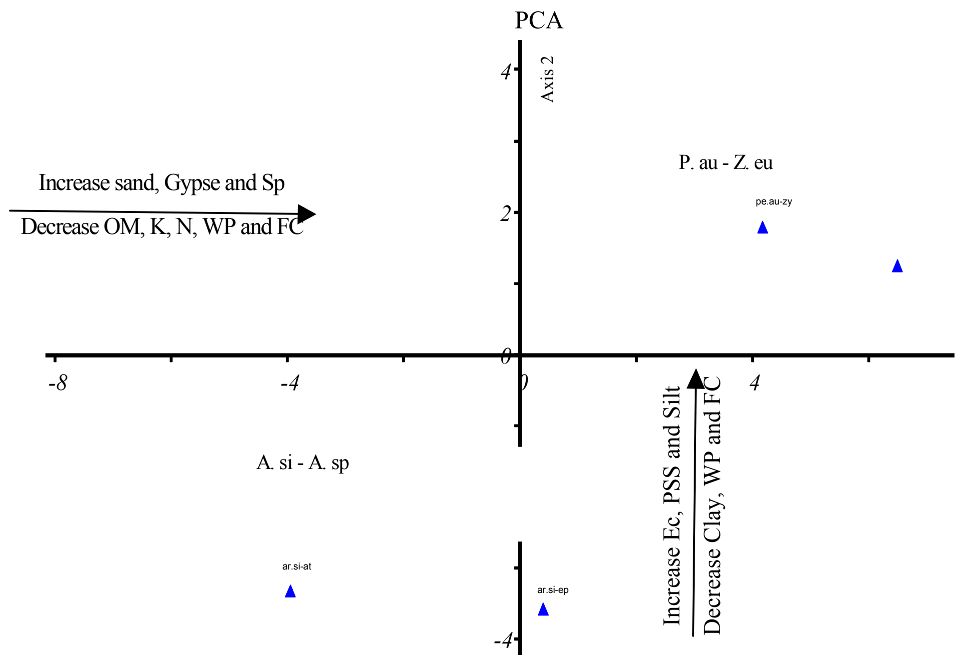

Fig. 2: Axis 1 and 2 of the PCA diagram of the vegetation types related to the environmental factors in the study area

organic matter and nitrogen. The second axis was positively correlated with electrical conductivity and silt and negatively with clay and moisture criteria. The third axis was positively correlated with effective soil depth, saturated moisture while negatively correlated with lime, organic matter and gravel.

P. aucheri – Z. eurypterum type comforted in the first quarter of the PCA axes 1 and 2. According to the Fig. 2, axis 1 factors have the most roles in distribution of this type, as it has a positive relationship with sand% of two layers, $CaSo_4$ and SP of the second layer and inverse relation with OM, K, N, WP and FC. With attention to

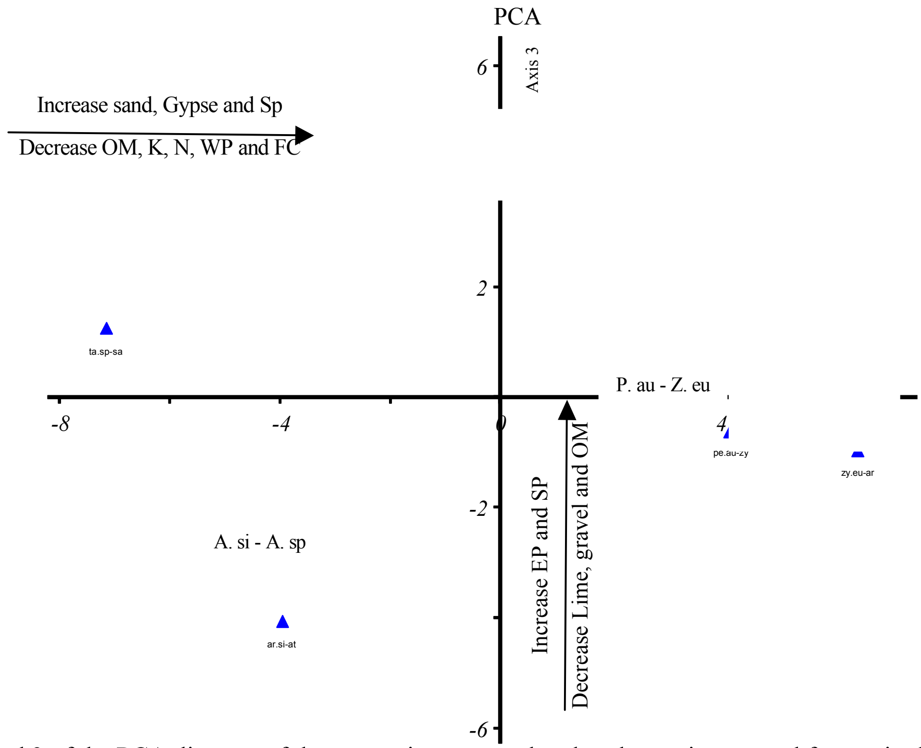

Fig. 3: Axis 1 and 3 of the PCA diagram of the vegetation types related to the environmental factors in the study area

the position of *A. sieberi – A. spinosa* type in the third quarter of the Fig. 2 and 3, it has a correlation approximately similar in negative part of axes 1 and 2 or 1 and 3. Therefore, this type has the most relation with variables such as OM, K, N and clay in first layer and WP and FC in two layers. This type has inverse position compare to *P. aucheri – Z. eurypterum* type, it means that decrease in factors which explain distribution of this type lead to present of *P. aucheri – Z. eurypterum* type.

The Logical Relationship Between Each Plant Species and Environmental Variables

Results Obtained of SHAZAM Analysis Are Shown as Below:

***P. aucheri*:**

The Best Model That Selected for this Species Is:

$$P(Pt.au) = \frac{1}{1+e^{-(0.278Sand_1+0.257Sand_2+0.288Silt_1+0.568Gypse_2+0.525)}}$$

According to the model, the most important factors that affect in distribution of this species are sand in both layer, silt in the first layer and lime in the second layer (Table 3). The presence probability of this species increases with increasing in these variables. With one percent increase in sand in the first and second layer, silt in the first layer and lime in the second layer, the presence probability increase 15.51, 15.70, 5.53 and 4.76 percent, respectively. Also with one unit increase in those variables the presence probability increase 0.316, 0.028, 0.032 and 0.064 unit, respectively. Results showed that the most elasticity at mean and the most marginal effect refer to sand in the first layer, so this variable has special importance in presence probability of *P. aucheri*. As Table 3 shows, Likelihood ratio test (LR) in this estimation significanted in 1 level as well as. Mcfadden R-square besides Maddala and Estrella R-square are representing that model defenititive variables described the model dependent variables changes as well as. Also according to present estimation percentage of right prediction is equal to 97.36%.

***Z. eurypterum*:**

The Best Model That Selected for this Species Is:

$$P(Zy.eu) = \frac{1}{1+e^{-(0.424SP_1+0.706SP_2+0.425Gravel_2+0.956Gypse_1+0.761Gypse_2-119.04)}}$$

According to the model, the most important factors that affect the distribution of this species are saturated moisture, gypsum and gravel (Table 4).

Table 3: The most important factors affecting the distribution of *P. aucheri*

Variable name	Mean of variable	Estimated Coefficient	Standard Error	t-ratio	Elasticity at Means	Marginal Effect
Sand1	68.33	0.278	0.120	2.303	15.511	0.316
Sand2	75.66	0.251	0.107	2.335	15.707	0.028
Silt1	24.33	0.288	0.159	1.811	5.537	0.032
$CaCo_3$2	7.70	0.568	0.241	2.356	4.760	0.064

Statistical coefficients

Statisti.	Log-Liklihood	Liklihood Ratio Test	t-ratio	Estrella	Maddala	CraggUhler	Mcfadden
Coeffi.	-64.802	65.430	0.00548	0.644	0.487	0.733	0.611

Percentage of right predictions = 97.36

Table 4: The most important factors affecting the distribution of *Z. eurypterum*

Variable name	Mean of variable	Estimated Coefficient	Standard Error	t-ratio	Elasticity at Means	Marginal Effect
Sa turation moisture1	32.81	0.424	0.228	1.855	3.728	0.0025
Saturation moisture 2	37.58	0.706	0.328	2.147	6.062	0.0042
Gravel2	36.38	0.825	0.181	4.542	3.432	0.0016
$CaSo_4$1	42.65	0.956	0.445	2.147	2.127	0.0019
$CaSo_4$2	42.84	0.761	0.400	1.900	2.311	00.0015

Statistical coefficients

Statisti.	Log-Liklihood	Liklihood Ratio Test	t-ratio	Estrella	Maddala	Cragg Uhler	Mcfadden
Coeffi.	-20.802	40.011	0.0049	0.9719	0.6510	0.9784	0.9617

Percentage of right predictions = 96.66

Table 5: The most important factors affecting the distribution of *A. sieberi*

Variable name	Mean of variable	Estimated Coefficient	Standard Error	t-ratio	Elasticity at Means	Marginal Effect
Nitrogen1	0.022	231.77	113.39	2.044	0.532	0.114
$CaCo_3$1	3.57	0.726	0.329	2.203	0.839	0.075
$CaCo_3$2	15.85	0.619	0.279	2.218	0.477	0.043
Potassium1	12.62	1.831	0.455	4.025	0.488	0.019
Potassium2	5.52	1.586	0.315	5.021	0.319	0.016
Availablewater1	0.103	33.638	12.518	2.687	0.393	0.499

Statistical coefficients

Statist.	Log-Liklihood	Liklihood Ratio Test	t-ratio	Estrella	Maddala	Cragg Uhler	Mcfadden
Coeffi.	-24.412	46.889	0.00724	0.9842	0.7085	0.9800	0.9602

Percentage of right predictions = 93.23

The presence probability of this species increases with increasing in saturated moisture and gypsum in both layer and gravel in the second layer. With one percent increase in saturated moisture and gypsum amount in the first and second layer and gravel in the second layer, the presence probability will be increased 3.72, 6.06, 3.43, 2.12 and 2.31 percent, respectively. Also with one unit increase in these variables the presence probability increase 0.002, 0.004, 0.0016, 0.0019 and 0.0015 unit, respectively. Results showed that the most elasticity at mean and the most marginal effect refer to saturated moisture in the second layer, so this variable has special importance in presence probability of *Z. eurypterum*. As Table 4 shows, Likelihood ratio test (LR) in this estimation significanted in 1 level as well as. Mcfadden R-square besides Maddala and Estrella R-square are representing that model defenititive variables described the model dependent variables changes as well as. Also according to present estimation percentage of right prediction is equal to 96.66%.

***A. sieberi*:**
The Best Model That Selected for this Species Is:

$$P(Ar.si) = \frac{1}{1+e^{-(231.77N_1+0.726Lime_1+0.619Lime_2+1.831K_1+1.586K_2 2+33.63AW_1-71.775)}}$$

According to the model, the most important factors affecting the distribution of this species are lime, potassium, available water and nitrogen (Table 5).

Table 6: The most important factors affecting the distribution of *A. spinosa*

Variable name	Mean of variable	Estimated Coefficient	Standard Error	t-ratio	Elasticity at Means	Marginal Effect
Effective depth 2	15.27	-0.674	0.116	-5.801	-1.365	-0.0070
Silt1	17.5	-0.390	0.107	-3.638	-0.759	-0.0041
Silt2	16	-0.578	0.258	-2.239	-0.870	-0.0060
Organic matter1	0.548	2.0753	1.108	1.872	0898	0.217
Organic matter2	0.353	2.219	1.260	1.760	0.256	0.107

Statistical coefficients

Statisti.	Log-Liklihood	Liklihood Ratio Test	t-ratio	Estrella	Maddala	Cragg Uhler	Mcfadden
Coeffi.	-63.802	73.622	0.00106	0.6004	0.4629	0.6957	0.5677

Percentage of right predictions = 97.36

The presence probability of this species increases with increasing in lime and potassium in both layer and available water and nitrogen in the first layer. With one percent increase in lime and potassium in the first and second layer and available water and nitrogen in the first layer the presence probability increase 0.83, 0.47, 0.48, 0.31, 0.39 and 0.53 percent, respectively. With one unit increase in these variables the presence probability increases 0.075, 0.43, 0.019, 0.016, 0.499 and 0.114 unit, respectively. Results showed that the most elasticity at mean and the most marginal effect refer to lime in the first layer and available water, so these variables have special importance in presence probability of *A. sieberi*. As Table 5 shows, Likelihood ratio test (LR) in this estimation significanted in 1 level as well as. Mcfadden R-square besides Maddala and Estrella R-square are representing that model defenititive variables described the model dependent variables changes as well as. Also according to present estimation percentage of right prediction is equal to 93.23%.

***A. spinosa*:**
The Best Model That Selected for this Species Is:

$$P(At.sp) = \frac{1}{1 + e^{-(-0.674EP_2 - 0.397Silt_1 - 0.578Silt_2 + 2.075OM_1 + 2.219OM_2 - 22.342)}}$$

According to the model, the most important factors affecting the distribution of this species are silt and organic matter in both layer and soil effective layer in the second layer (Table 6). The presence probability of this species increases with increasing in organic matter in both layers, while this probability will be decreased with increasing in silt in both layer and soil effective depth in the second layer. With one percent increase in organic matter in the first and second layers, the presence probability will be increased 0.89 and 0.25 percent, respectively. With one unit increase in these variables the presence probability increase 0.217 and 0.107 unit, respectively. Afterward with one percent increase in silt in the first and second layer and soil effective depth in the second layer the presence probability will be decreased 0.75, 0.87 and 1.36 percent respectively and with one unit increasing in those variables the presence probability increase 0.004, 0.006 and 0.007 unit, respectively. Results showed that the most elasticity at mean and the most marginal effect refer to, so these variables have special importance in presence probability of *A. spinosa*. As Table 6 shows, Likelihood ratio test (LR) in this estimation significanted in 1 level as well as. Mcfadden R-square besides Maddala and Estrella R-square are representing that model defenititive variables described the model dependent variables changes as well as. Also according to present estimation percentage of right prediction is equal to 97.36%.

DISCUSSION

The present study examined the relationship between environmental variables and plant distribution in a part of arid and semiarid ecosystem of Shahriyar rangelands, Iran. In our study area, the differences of climate and topographical features are relatively small, so plant distribution may be potentially affected by soil properties. Analysis with PCA confirms that there is a relatively high correspondence between vegetation and soil factors that explain 97% of the total variance in data set. The PCA results showed that soil texture, salinity, available nitrogen, potassium, organic matter, lime and soil moisture criteria are the most important factors for the distribution of the vegetation pattern (Table 2, Figs. 2 and 3).

Distribution of *P. aucheri – Z. eurypterum* and *A. sieberi – A. spinosa* types seems to be more influenced by soil texture, $CaSo_4$, organic matter and moisture criteria. Separately analysis for each four species with SHAZAM package verifies these findings.

Z. eurypterum is a gypsophyte plant that grows in the gypsious lands and indicates soils with high gypsum [7]; therefore increase of this species with increase in gypsum amount is expected. The water supply is another important factor affecting this plant type. Busygina *et al.* [18] and Tringham *et al*. [19] indicated that in arid and semiarid rangelands the water content is one of the most important factors affecting plant community composition and consequently plant production. Consequently, plant communities and rangelands production may be segregated on the basis of soil moisture content during the growing season [4]. Soil texture is one of the effective factors in the distribution of *Z. eurypterum*, *P. aucheri* and *A. spinosa* species.

Both three species have strong relationship with medium and coarse-textured, so that *A. spinosa* has adverse relationship with silt and effective soil depth. These findings agree with Davies *et al*. [20] who documented positive association of soil texture content with plant species composition in a semiarid environment. Maestre *et al*. [21] also documented the fine-textured soil as compared with the coarse-textured had higher soil water storage capacity, thereby facilitating seedling establishment and survival. He *et al*. [22] indicated that soil texture plays a significant role in regulating vegetation pattern, including vegetation composition, functional group and structure. Soil texture controls dynamics of soil organic matter in many simulation models or organic matter decomposition and formation [23, 24, 25] and influences infiltration and moisture retention and the availability of water and nutrients to plants [26]. Also, distribution of *A. sieberi* is controlled by potassium. Jafari *et al*. [17] recommended that potassium is one of the effective factors in the distribution of vegetation types in their study area. They mentioned that potassium indicates *A. sieberi* occurrence.

$CaCo_3$ for *A. sieberi* and *P. aucheri* and $CaSo_4$ for *Z. eurypterum* diagnosis as effective factors. These results were in conformity with the results reported by He *et al.* [22] Jafari *et al.* [12], they recommended that $CaSo_4$ controls distribution of plant species. They recommended that $CaSo_4$ controls distribution of plant species. Soil organic matter plays an important role in affecting A. spinosa appearance. Soil organic matter within the rangeland system provide more nutrients for plant growth, which results in a positive feedback as more plant biomass is likely to produce more soil organic matter [4]. Additionally, organic matter effect on soil chemical, physical and biological properties has been suggested as the single most important indicator of soil quality [27, 28, 29].

The present study addressed some aspects of relationships between soil properties and plant vegetation in native rangelands within arid and semiarid areas of Iran. It was anticipated that this finding could be used as a tool for prediction of presence and absence probability of these plant species in rangeland within similar ecosystems.

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