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Investigation of site conditions of *Astragalus eriostylus* in South of Iran (case study: Bushehr province)

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Abstract

The main goal of this research is to study the effect of soil characteristics and land form on dispersion of *Astragalus eriostylus* in Southwest of Iran. 22 habitats of plant species have been identified as appropriate for study of vegetation in the view of area, density and mass dispersion and then soil sampling was done. Study of vegetation in various habitats, subject of study, has revealed that 49 plant species are grown in the region. In order to choose an optimized cluster analysis method of indicating species has been used. According to diagram of changes in number of indicating species at each stage of clustering, when four clusters are chosen, 46 species enjoys meaningful indicating value, which have been considered as optimized numbers of groups. *Astragalus eriostylus* species is located on positive side of the first axle and there is the highest positive correlation between the same and such elements as elevation from sea level, aspect, slope to some extent, C/N and moisture of surface soil and a negative correlation between the same and Loam in surface soil. Results show that presence of *Astragalus eriostylus* and accompanying species in designated ecological groups, are influenced by elevation from sea level, slope and aspect. Concerning the fact that in Bushehr Province, upon increase of elevation from sea level, temperature is decreased and annual precipitation is increased, one may say that the species, subject of study and accompanying species at higher elevations shall indicate more competition with other species and be extended more.

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Introduction

In plant communities, plant species are grown, reproduced and survived under certain ecological conditions. Thus, the presence of a certain kind species of plant in a habitat means it needs in the view of temperature, light, food, and access of water and moisture (Zahedi Amiri, 1998).

Amplitude of such conditions designates ecological amplitude of the respective species. When ecological amplitude of one species is recognized, its presence in a particular habitat can be predicted by designating habitat conditions (climate and soil) and/or vice versa i.e. upon presence of a kind of species in a habitat, one can find out habitat conditions of the said species indirectly (Hardtle, 2004).

Any plant species enjoy particular habitat and dispersion area and within this limit of dispersion, they enjoy habitat needs and/or particular ecological characteristics (Braun-Blanquet, 1983). A few species enjoys a more extensive dispersion range. However, some other species do need special habitat conditions and eventually, they have limited dispersion range. In management planning for natural resources, recognition of species, their needs and reactions to climate changes and human interventions are significant points, which must be taken into consideration.

The main goal of this research is to study the effect of soil characteristics and land form on dispersion of *Astraagalus eriostylus* in Bushehr province, in Southern parts of Iran, which enjoy the hot and dry climate.

Materials and methods

Bushehr Province is located in the southwest parts of Iran, beside Persian Gulf and the climate in the said region, according to Emberger climatogram, is from slight hot desert to severe hot desert on coastal and low elevation areas and semi-dry climate in mild winter in high mountainous areas. According to the map for evaluation of resources and potential of lands in Bushehr Province and considering studies conducted by other researchers, 55% of the total area of Bushehr Province consists of mountains and hills, 34% comprises Plateaus, plains and Debris, and 11% consists of lowlands and salt marshes. Soil of Bushehr Province, which is formed due to interaction of soil development elements such as home materials, climate, ups and downs, time, beings and human, finds special characteristics in each area in consideration of intensity and weakness of these elements.

Study of vegetation

In many ecological studies of plant communities, classified sampling has been used, optionally or compulsorily. The more variety and changes of vegetation in certain intervals exist in the region, the more intensified sampling will be (Atri, 1997). In this research, upon general survey across Bushehr Province, and benefiting from experts' comments, 22 habitats of plant species have been identified as appropriate for study of vegetation in the view of area, density and mass dispersion. In the regions, minimum area of plots has been designated using Nested plots. Then, vector statistical network dimensions (considering the results obtained from the researches of others and experiences of the authors) have been given as 100*100 m. Thus, 430 square-shape sample lots of 250 m2 have been implemented in the respective habitat and then, information on vegetation has been extracted accordingly.

After implementation of the sample plots in a desirable location, first, general characteristics of the habitat including elevation from sea level, percentage of slope and Azimuth for taking notes, and then, qualitative and quantitative characteristics of species in the sample lots have been studied accordingly.

After extraction of information on vegetation in each region, soil sampling was done. In each region, for the study of general characteristics of soils and designation of depths of sample layers, a few profiles were dug and explained accordingly. In consideration of the changes observed among the profiles and

across the region, the number of soil samples of each region has been designated and sampling was done on determined horizons. On a whole, in 22 habitats, subject of study, 136 soil samples were taken from two separate horizons (surface and subsurface horizons) at a certain depth in each region and respective tests for designation of tissue, pH, total lime, relative moisture, EC, organic carbon, total phosphorus and absorbable potassium have been conducted as well.

Recognized ecological groups have exclusively been separated based on the frequency and presence or absence of various species in sample lots. Using variance analysis and Tukey Test, average of environmental variables (soil variables and physiographical conditions) of sample lots of various ecological groups has been compared in statistical view and according to several comparisons of this test shall indicate in which variable/s ecologic groups enjoy meaningful difference. Thus, one may come up with this conclusion that floristic difference among groups rose from difference in which environmental variables.

Results

Study of vegetation in various habitats, subject of study, has revealed that 49 plant species are grown in the region of which names have been given in Table 1.

In order to simplify the consistency of vegetation structure and in order to assist with better perception of the relationship between vegetation and habitat and environmental elements of the region, subject of study, vegetation has been classified using cluster analysis. Thus, sample plots have been put together under similar floristic conditions and separated from other sample plots.

Table 1. Observed species in sample plots

Scientific name of species	
Amygdalus lycioedes	*Calendula persica*
Anthemis brachistephana	*Tragus racemosus*
Anvilia garcini	*Cleome oxypetela*
Astragalus eriostylus	*Nepta glomerolosa*
Astragalus mollis	*Paronichia arabica*
Capparis cartiloginia	*Schismus arabicus*
Capparis spinosa	*Aizon canariense*
Chardinia xerantemoeides	*Vulpa myorus*
Dodonaea viscosa	*Biebersteinia multifida*
Ebenus stellata	*Bromus danthoniae*
Echinops cephalotus	*Poa sinaica*
Echinops kotschi	*Centurea brugoerana*
Echinops ritrodes	*Crypsis schoenoeides*
Ephedra paciclada	*Papaver orintalis*
Gundelia tournefortii	*Descorena Sophia*
Gymnocarpus decander	
Haplophylum canaliculatum	*Malva silvester*
Lycium shawii	*Parapholis incurva*
Prosopis koelziana	*Fagonia indica*
Prosopis spicigera	*Acantolymon festicum*
Rhamnus cathartica	*Moltkiopsis ciliata*
Zataria mutiflora	*Steppa capensis*
Ziziphus lotus	*Ochradenus baccatus*
Ziziphus numolaria	*Alhaji camelorum*
Ziziphusspina-christi	*Salsola drumondi*

In order to choose an optimized cluster analysis method of indicating species has been used. According to diagram of changes in number of indicating species at each stage of clustering (Fig. 1), when four clusters are chosen, 46 species enjoys meaningful indicating value, which have been considered as optimized numbers of groups.

After execution of cluster analysis and classification of sample lots, and after analysis of indicating species, indicating the value of various species of each group has been calculated. After calculation of indicating the

value of species in different groups, indicating the maximum value of each species has been tested in statistical view using Mont Carlo Method. The results of this test have been given in table 2 for study of meaningfulness of maximum indicating value of species.

Table 2. Results of Monte Carlo test

P	Maximum indicator value of random data	Maximum of observed indicator value	Number of group represents the highest indicator value	Species
0.0010	14.3	61.9	2	*Acantolymon festicum*
0.0010	8.9	100.0	2	*Aizon canariense*
0.0010	12.6	80.1	3	*Alhaji camelorum*
0.0010	10.3	43.9	1	*Amygdalus lycioedes*
0.0010	14.4	47.0	1	*Anthemis brachistephana*
0.0010	13.3	60.5	2	*Anvilia garcini*
0.0010	10.4	44.6	2	*Astragalus eriostylus*
0.0010	12.7	38.9	2	*Astragalus mollis*
0.0010	12.3	38.5	2	*Biebersteinia multifida*
0.0010	18.6	47.4	2	*Bromus danthoniae*
0.0010	8.9	100.0	2	*Calendula persica*
0.0010	9.2	36.1	1	*Capparis cartiloginia*
0.0010	8.1	50.8	1	*Capparis spinosa*
0.0010	17.1	43.7	2	*Centurea brugoerana*
0.0010	13.8	48.7	2	*Chardinia xerantemoeides*
0.0010	7.3	78.7	2	*Cleome oxypetela*
0.0010	4.8	25.0	2	*Crypsis schoenoeides*
0.0010	10.0	45.7	2	*Descorena Sophia*
0.0010	11.1	42.8	1	*Dodona viscose*
0.0010	8.8	73.2	2	*Ebenus stellata*
0.0010	13.9	54.4	2	*Echinops cephalotus*
0.0010	11.8	24.8	2	*Echinops kotschi*
0.0010	14.2	43.9	2	*Echinops ritrodes*
0.0010	8.8	41.3	2	*Ephedra paciclada*
0.0010	11.9	64.7	2	*Fagonia indica*
0.0010	12.2	66.4	2	*Gundelia tournefortii*
0.0010	12.4	67.3	2	*Gymnocarpus decander*
0.0010	3.4	21.4	2	*Haplophylum canaliculatum*
0.0010	13.0	58.9	3	*Lycium shawii*
0.0010	3.8	20.9	4	*Malva silvester*
0.0010	12.1	61.2	2	*Moltkiopsis ciliata*

P	Maximum indicator value of random data	Maximum of observed indicator value	Number of group represents the highest indicator value	Species
0.0010	19.4	49.9	2	*Nepta glomerolosa*
0.0010	6.3	59.0	2	*Ochradenus baccatus*
0.0010	11.5	32.1	1	*Papaver orintalis*
0.0010	6.4	42.2	2	*Parapholis incurva*
0.0010	12.0	29.4	3	*Paronichia arabica*
0.0010	18.0	26.4	3	*Poa sinaica*
0.0010	17.2	67.1	3	*Prosopis koelziana*
0.0010	21.2	36.5	3	*Prosopis spicigera*
0.0010	17.6	46.5	2	*Rhamnus cathartica*
0.0010	12.9	76.5	3	*Salsola drumondi*
0.0010	7.5	24.6	3	*Schismus arabicus*
0.0010	24.9	29.8	1	*Steppa capensis*
0.0010	8.1	89.4	2	*Tragus racemosus*
0.0010	10.0	43.4	2	*Vulpa myorus*
0.0010	18.8	43.2	2	*Zataria mutiflora*
0.0010	24.8	27.9	4	*Ziziphus lotus*
0.0010	11.5	49.5	1	*Ziziphus numolaria*
0.0010	25.4	29.6	4	*Ziziphus spina-christi*

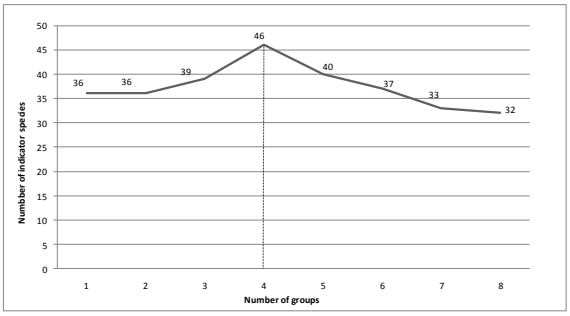

Fig. 1. Number of indicator species in each level of clustering

In the first column on the right side of this table, generic names of plants have been inserted. The second column indicates in which group each species of plant enjoys the most indicating value and the third column indicates maximum indicating value of each species. The last column shows whether there is a meaningful difference between the maximum indicating value of each species, obtained from real data and the maximum value, obtained from random data or not.

Such species as *Ziziphus spina-christii* enjoy an extensive dispersion and are present in most sample lots accordingly and they enjoy equal vegetation percentage average in sample lots of various groups. They, however, have no meaningful indicating value. On the other hand, such species as *Halophylum canaliculatum* are present only in a few sample lots and have no meaningful indicating value. This case is logically from an ecological point of view because in a certain region, certain species, which are present as rare or extensively in sample lots, can't indicate special environmental conditions.

Analysis of the relationship between vegetation and environmental variables

Results of CCA (Canonical Correspondence Analysis)

The first and second axles of CCA categorization have been chosen for display and further analyses since they have the most Eigen Value (0.359 and 0.123 respectively). Eigen value for the third axle was given as 0.074. Then, upon designation of quantity and number of sample lots, ecological groups have been determined on the said diagram (Fig. 2). Value of sample plots in this diagram is obtained from multivariable regression between frequency of species and habitat elements.

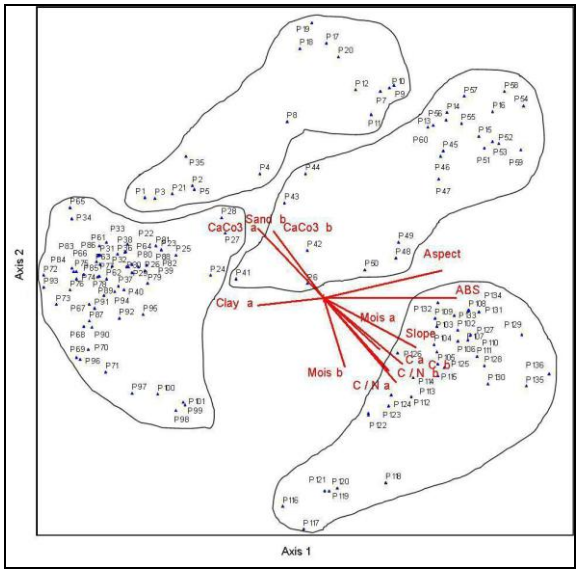

Fig. 2. *Ecological* groups of ordination analysis

Considering Figure 2, and axles obtained from CCA Analysis, it is observed that then there is a high positive correlation between the first axle and such elements as elevation from sea level and geographical directions. Moreover, there is a relatively high correlation between the said axle and Loam on the surface soil horizon. There is a high positive correlation between the second axle and quantity of lime in both soil horizons and quantity of the sand particle subsurface horizon. Moreover, there is a high negative correlation between the said axle and such elements as Carbon and ratio of Carbon to nitrogen in both soil horizon and there is a low correlation between the said axle and moisture in both soil horizons (Table 3).

Table 3. Correlation between site conditions and CCA axles

Site conditions	First axle	Second axle	Third axle
Moisture in layer a	0/348	**-0/451**	-0/210
Moisture in layer b	0/125	**-0/594**	-0/226
pH in layer a	0/252	-0/096	0/252
pH in layer b	-0/069	0/214	0/203
Carbon in layer a	0/448	**-0/726**	-0/029
Carbon in layer b	0/489	**-0/572**	-0/070
CaCo3 in layer a	-0/413	**0/597**	0/068
CaCo3 in layer b	-0/292	**0/430**	0/241
Nitrogen in layer a	-0/041	0/033	-0/161
Nitrogen in layer b	0/006	0/404	0/023
Phosphor in layer a	0/427	0/039	-0/012
Phosphor in layer b	0/360	0/215	-0/057
KOH in layer a	-0/032	-0/179	-0/420

Site conditions	First axle	Second axle	Third axle
KOH in layer b	-0/007	-0/006	-0/431
EC in layer a	0/155	0/479	-0/156
EC in layer b	0/253	0/273	-0/179
Lay in layer a	0/282	-0/363	-0/212
Lay in layer b	0/062	-0/235	0/040
Clay in layer a	**-0/412**	-0/064	-0/222
Clay in layer b	0/281	-0/372	-0/217
Sand in layer a	0/091	0/309	0/319
Sand in layer b	-0/310	**0/576**	0/144
Carbon/Nitrogen in layer a	0/396	**-0/629**	0/110
Carbon/Nitrogen in layer b	0/387	**-0/630**	-0/009
Elevation(ABS)	**0/824**	0/001	0/017
Aspect Geographical	**0/736**	0/240	-0/142
Slope	**0/575**	-0/430	0/055

Respective species, with trivial value in both axles, located around the central area of the coordinates are the species that have no tendency toward existing gradients. In other words, they are regarded as non-preferable species. The most value of one kind of species on an axle is increased; the more preference of the said species, compared to the gradients of the elements, associated with the said axle will be increased. In fact, one may say that if there is a less distance between one kind of species and one vector (vectors obtained from correlation between habitat elements and categorization axles), it indicates that due to increase of respective variable, presence and frequency of the said species will be increased accordingly.

Astragalus eriostylus Species is located on positive side of the first axle and there is the highest positive correlation between the same and such elements as elevation from sea level, aspect, slope to some extent, ratio of Carbon to Nitrogen(C/N) and moisture of surface soil and a negative correlation between the same and Loam in surface soil, more consistent with such species as *Echinops ritrodes*, *Chardinia xerantemoeides*, *Anthemis brachistephana*, *Echinops cephalotus*, *Crypsis schoenoeides* and *Astragalus mollis*.

Discussion

Corresponding results of correlation between habitat factors, subject of study and extent of changes of the factors in connection with vegetation changes show that presence of such species as *Astragalus eriostylus* and accompanying species in designated ecological groups, are influenced by physiographic element such as elevation from sea level, slope and aspect. Concerning the fact that in Bushehr Province, upon increase of elevation from sea level, temperature is decreased and annual precipitation is increased, one may say that the species, subject of study and accompanying species at higher elevations shall indicate more competition with other species and be extended more. Moreover, considering form of growth of the said species, which is stack, it shall have desirable adaptability with seasonal winds, reserve more moisture under its crown, arriving in soil. According to results obtained from Kouhgardi et al (2004) in mountainous habitats in Bushehr Province, the aforesaid result is confirmed accordingly. Considering results obtained, thanks to its sack form

of growth, the said species is appropriately resided in high slopes and there is a negative correlation between the said species and quantity of Loam in surface soil horizon due to high slopes because on high slopes and due to severe rain, Loam is washed on surface soil horizon, deposited in valleys. Thus, soil of habitat for the said species is poor in surface horizon considering quantity of Loam. Considering characteristics of soil of habitats, one may say that results obtained by Sadeghi et al (1996), who studied *Ziziphus spina-chritii* species in the study area, stated that Lotus species is present on lands with Loamy, Loamy-sandy and Loamy-Silt texture and habitat soil of the said species is appropriate considering Carbon and Nitrogen and weak in the view of Phosphorus and organic materials, conforming to the results obtained from this research.

According to research results, there is a meaningful positive correlation between *Astragalus eriostylus* species in habitats, subject of study and aspect parameter because in north and east directions, achieving more moisture and evaporation occurs less, this species in sub-layer of such species as *Dodona viscosa* and *Amygdalus lycioedes* covers an extensive area and in south and west directions with high evaporation, the same reserves moisture under its crown, which is very close to ground surface and sometimes is located on soil surface, promoting conditions for its growth accordingly. Results obtained by Frank Klotzli et al (2001) also indicate that the two factors of soil depth and environmental moisture are effective in residing and the dispersion of plant species, conforming to the results obtained from this research.

On upper elevation of the habitats of the study area, various seasonal grassy species grow due to desirable conditions in winter and spring. They die after a few months at the beginning of hot season and remainders of their body are analyzed and added to organic materials of soil and during mining process, they increase ratio of Carbon to Nitrogen and fortify soil fertilization. According to results obtained from this research, there is a positive and meaningful correlation between the same and extension of the species, subject of study.

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