A SECOND LOOK ON BIOGEOGRAPHICAL PROVINCE OF MIANKALEH BIOSPHERE RESERVE

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Abstract. In Udvardy classification of introducing geographical biosphere provinces, the Miankaleh biosphere reserve of Iran, located in the southern coast of the Caspian Sea, has been expressed as mixed mountainous biome system. As the Udvardy classification, in large scale, is for national and regional use, it may not be able to separate the various kinds of existing habitats in a Biogeographical Province. That is why to prove the Udvardy classification theory and to investigate the probable disorder in it, by recognition of flora, the vegetation of the reserve has been studied, considering the ecological points of view. In the present research, the cluster analysis for classification of plant community and the ordination method for analysis of environmental (water table level and electrical conductivity of soil and water) relationships with plant communities have been used. The floras of the region, with over 200 species, with the origin of Euro- Siberian and Irano- Touranian, have been recognized and the presences of plant communities have been related to water table level and salinity of soil and water. In relation to Udvardy theory it seems that based on the existing and paleoecological documents of 1905, before fragmentation of Miankaleh winter and Alborz mountainous habitats, because of the urban developments, the place of the biosphere reserve of Miankaleh, as a unit, was a mixed mountainous biome.
Keywords: *Iran, biosphere reserve, Udvardy, Miankaleh, geographical province, Caspian Sea.*

Introduction

UNESCO, in its Man and Biosphere (M & B) program, tried to determine the main regions of the world and provide a classification of Biogeographical Province. Professor Micholos Udvardy made the classification in 1975. This system of classification determined 14 kinds of the biome types in one or eight bioclimate (realm) found throughout the world and separated them. Each climate is divided into geographical provinces, recognized by biome types, and all these units will be 193 Biogeographical Provinces all over the world.

In the above-mentioned classification system, the bioclimate of Iran has been determined as paleoarctic climate, the biome type as mixed mountainous system, and Miankaleh biosphere reserve, Golestan national park and Arasbaran protected region as indices for introducing Iran in mixed mountainous biome.

As the Udvardy classification system, in large scale, is for use in national and regional levels and is not able to separate types of existing habitats in Biogeographical Province and can not distinguish them, the present study is thought to be necessary to combine the regional ecological studies with the large scale worldwide standards in local units.

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Paleoecology of the region, considering the manuscripts of the king Zellolsoltan in 1905 [7] and native knowledge of old people showed that some animal species like red deer (*Ceruus elaphus*), tiger (*Panthera tigris*) and even Persian Wild Ass (*Equus hemionus* VU) were present. Presence of these animals shows the special ecological characteristics in that time and continuity of Miankaleh plain regions with Alborz mountainous high lands and steppe regions. At the present time, the presence of animal species in Miankaleh, due to fragmentation made up of urban development and fragmentation of ecosystems, is unbelievable.

Farrukh [8] classified and made a multi-variable analysis of vegetation in Swabi region. In his research, he found 3 main plant communities and their relationships with soil physical and chemical characteristics have been analyzed. He has concluded that elements like phosphorus, calcium and acidity of the soil were the most important factors controlling the vegetation.

Carnevale [5], by investigation of vegetation distribution along salinity gradient, showed that there is a special relationship between soil salt concentration and rehabilitation of plant species.

Roo-Zielinska [15] in 1996 has evaluated the role of soil in plant communities around the city of Pitcho. He found the acidity, moisture and soil nitrogen roles in rehabilitation of plant communities effective. Based on Frey and others studies [9, 10], four halophytic communities habitats were recognized in Iran and the region under investigation has been expressed as the halophytic community of southern Caspian Sea Coasts.

In this research, in order to prove the Udvardy theory, introducing the characteristics of Miankaleh Biogeography with vegetation analysis and understanding the causes of plant communities of the region, have been carried out. This biosphere reserve with mean sea level of -30 m, mean annual precipitation of 717.21 mm, warm semi - humid to temperate climates (16) latitude of 36° 50' North and longitude of 53° 17' East, is located in northern Iran and southern Caspian Sea Coasts (*Figure 1*).

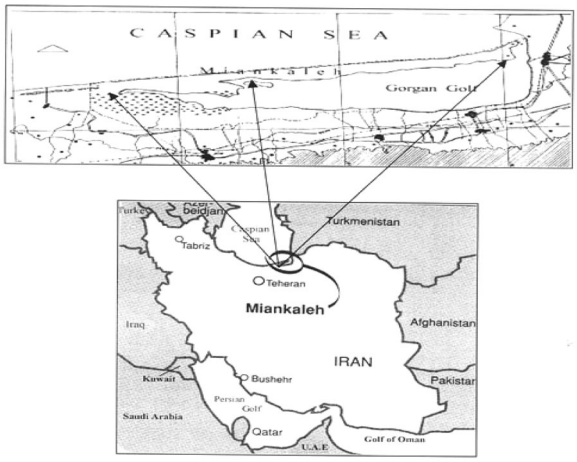

Figure 1. *The geografical position of Mienkaleh in Iran.*

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Materials and Methods

Considering the role of vegetation in introducing and separation of Biogeographical Provinces, the emphasis in this research was on studying the flora and plant ecology and recognition of environmental factors constituting the Miankaleh plant communities. With this in mind, to investigate the vegetation, using a map with a scale of 1:25000, and aerial photograph with a scale of 1:20000 along the transects and in the direction of sea to land in the West, Center and East of Miankaleh, inside the representative stand, by using plots whose area was determined by least square method, the relative vegetation cover has been evaluated. The sampling method was systematic -stochastic and the number of samples was determined using statistical method [13]. For recognition of plants the Flora of Turkey [6], Flora of USSR (11) and Flora Iranica [14] references were used. In each plant community, by digging a profile and taking samples from 0-30 cm and 30-60 cm, the soil texture has been determined. Water table levels and piezometric surfaces were determined, using auger-hole and piezometrs, respectively. The soil and water salinity was evaluated in each sample unit [1].

The classification of the sample units were performed by cluster least mean analysis and Euclidean dissimilarity criterion by statistical software of MVSP Ver. 3.2 [12].

n investigation of ecological similarity of sampling units with each other and correlation of sampling units (plant masses) with soil and water factors by PCO analysis and using the software MVSP Ver. 3.2 [12] were carried out.

Results and Discussions

Floristics

Flora of the region constitutes of 207 tree, shrub and herbaceous species. Out of these, 17 are tree and shrub species like: *Acre velutinum, Ulmus minor, Quercus castaneifoli*, and *Alnus glutinosa* are found in the western part of Miankaleh Penisula (*Table 1*). Among perennial and annual species, the halophytes such as *Aeuropus litoralis*, *Salicornia herbacea* and *Frankenia histrusta*, the hydrophyte species like *Lemna minor*, *Utricularia vulgaris*, *Myriophyllum spicatum* and *Ceratophyllum demersum* are observed (*Table 1*). The species (Juncus sp) is almost in all over the region and Rubus is in a vast part of the area.

The plant communities

The classification of vegetation by cluster analysis, showed the following plant communities:

Juncus Community

The dendrogram (*Figure 2*) shows that the masses of 10, 18, 24, 1 and 8, 16, 14, 21 are very similar to each other. These masses are combined with the masses of 27, 31, 29, and constitute the Juncus community. As it can be observed from *Table 1*, the Juncus is dominant in all above masses. This community with some variations of species composition is observed all over the southern Caspian Sea Coasts and north of Gorgan Gulf (before halophytes).

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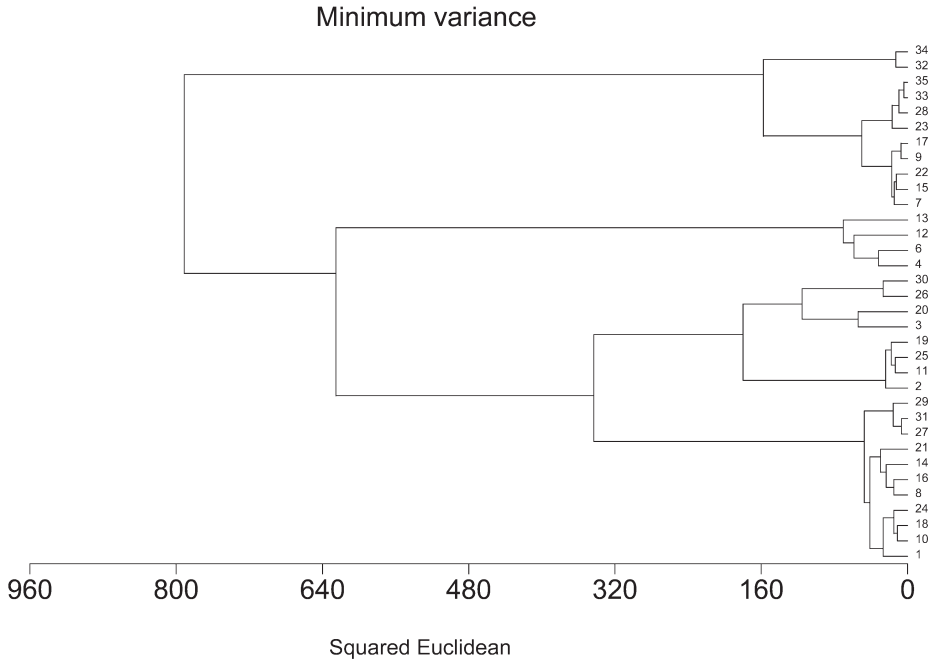

Figure 2. *Dendrogram from cluster analysis of representative stand of Miankaleh vegetation (34 Releves, Tab. 1)*

Rubus Community

The above dendrogram (*Figure 2*) shows that the masses of 3, 20, and 26, 30 are very similar (two by two). These masses are combined and constitute the Rubus community. This community with a change in floristic composition is scattered in all Miankaleh Penisula from West to East.

Punica Community

The above dendrogram (*Figure 2*) shows that the masses of 4, 6 with high similarity combines with masses of 12, 13 and constitutes Punica community. This community has been observed mainly in Western part of Miankaleh Penisula and at interface of the sea and the Gulf (in the most remote distance from the sea and the Gulf).

Sand Dune

The above dendrogram (*Figure 2*) shows that the masses 11, 25, 19, with high similarity to each other, combine with 2, and constitutes the Sand Dune. This community is observed as old and newly established Sand Dunes throughout the coast of the sea between Juncus and Rubus communities. In this community, based on performed evaluations, the mean non-vegetation is 87%; the canopy cover and litter area is 23%. The dominant species is Artemisia spp.

Halophyte Community

The above dendrogram (*Figure 2*) shows that the masses 7, 15, 22, 9, 17 and 23, 28, 33, 35 with high similarity to each other combine with masses 32, 34 and constitutes the Halophyte Community.

This community is located mainly in the northern, western, southern and eastern coasts of Gorgan Gulf. In this community the sub- community Schoenoplectus is observed.

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Table 1. *Floristic composition of Miankaleh Reserve Biosphere*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Acer velutinum				1*		1		1				1	1							1															
Achillea millefolium				1		2		1				1	1							1															
Aegilops tauchi	1	1	2	1		1		2		1			2	2		1				1						1									
Aeloropus spp.							6		8					1	9		8					8	4				2	8			3	3	6	7	8
Alhagi pseudalhagi																								1	1	3	1		2	3					
Alnus glutinosa			1	2		2		1				2	2	1						1						1									
Amaranthus blitoides	2	1	2	1		2		1				2	2							2	1				1	2									
Amaranthus retroflexus	1		1	2								2	1							1															
Ammi majus			1	2		1						1																							
Anagalis arvensis	1		1	2		1							2																						
Anthemis cotula	1			1																2															
Arabis nova			1			1							2																						
Arnebia decumbens	1			1																	2					2									
Artemisia annua		1		1				1																		1									
Artemisia kulbadica		4								1	3							1	2						2	2			1	2					
Artemisia turanica																		2	3	1					1	2	1		3	2					
Artemisia vulgaris	1									1	1	1																							
Arundo donax				2	3	1		1				2															2		2	2	2					
Asperula sp.				1		1						2	1																						
Aster tripolium	1						2	1	1					1	2	1	1				1						1									
Avena fatua			1	1							1	1			1				1					1	1										
Bolboscho maritimus					1																														
Brachypodium sylvaticum			2	2		1						1	1							1															
Briza minor			1	1		1							1							1															
Bromus tectorum		1	2	2		1						2	1							1						1									
Butamus umbellatus					1																														
Calamagrostis epigeios			1	1								1	1													1									
Calystegia sepium	1		2	1		3						2	1							1															
Campanula ranunculus			1	1		2						1																							
Capsella bursa-pastoris	1		1	1		1						1	1					1		1															
Cardamine hirsuta			1	1								1																							
Carex maritima					1	1						1		1							1															
Carpinus betulus			2	2		2						3	1							1						1									
Carthamus turkestanicus											1							1	2	1						2	1								
Catapodium rigidum	1		2	2		1	1						1																						
Celtis australis			1	2		2						1																							
Centaurea iberica	1		1										1								2					2				1					
Centaurea solstitialis								1						1		1					1														
Centaurium spicatum	1					1								1							1	1					1			1					

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Table 1. *(Continued)*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Ceratophyllum sp.					2																														
Chara sp.					4																														
Chelidonium majus			1	4		2						1																							
Chenopodium album	1	1						1				1				1			1																
Chenopodium murale			1										1							1															
Chrozophora tinctoria											1							1	1					1	1										
Cichorium intybus			1										1																						
Cirsium arvense		1	1								1	1								1															
Convolvulus arvensis	1	1	2	1		1						1	2							1															
Conyza canadensis			1			1							1							1															
Cornus australis				1		1							1																						
Crepis sp.	1		1			1						1	1																						
Crypsis aculeata			1							1				1																					
Cutandia memphitica			2										1	1																					
Cynanchium acutum			2										3							3						1									
Cynodon dactylon	2			2						3								2						2											
Cynoglossum creticum			1			1						1	1	1						1															
Cyperus spp.		2	1	1	1	1				1	1	1	1	1				1	1												2		2		
Dactylis glomerata			1	1		1						1	1	1						1															
Daucus littoralis	1	2	1	1		1					1	1	1						1	1															
Descurainia sophia	1			1						1			1							1				1											
Dittrichia graveolens		1	1								1	1	1							1															
Equisetum arvense	1			1		1						1	1																						
Eragrostis cilianensis			1	1		1						1																							
Eremopyrom bonaeopartis							1	1	4						2		4					1	2					1					1		
Erodium cicutarium		1	1	1		1					1	1	1							1															
Eryngium caucasicum				1		1						1								1															
Euphorbia chamasyce	1		1							1	1							1	1	1					1	1									
Euphorbia helioscopia	1	1				1					1							1	1						1										
Euphorbia prostrata		1	1							1								1	1																
Ficus carica			2											2		1										2			1						
Filago spp.		1	1									1							1																
Frankenia spp.							2		2						2		1					2	3					2				2	3	2	2
Fumaria parviflora			1	1		1						1	1																						
Galium spp.			1			1							1																						
Gastridium sp.				1		1						1																							
Geranium spp.			1	2		3						2	3																						
Glycyrrhiza echinata	1							2					1																						
Halocnemum strobilaceum															1							3	3					3					3	3	3

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Table 1. *(Continued)*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Halostachys belangeriana																																	1		
Heliotropium spp.			1								1									2					1	2				2					
Hibiscus trionum		1	1										1																						
Holosteum glutinosum			1	2		2						2	2							1															
Hordeum spp.		1	1	1							1	1							1	1	1														
Hypericum cabrum			1	1		1						1																							
Imperata cylindrica	1	1						1			1								1	1															
Inula britanica			1	2		2						2	1							2				1											
Iris pseudacorus					2																														
Juncus spp.	8		2	1	1	1		8		8		1	1	7		7		8		1	7	1		6		3	6		7	2	6	2		2	
Kichxia spuria	1	1	1								1	1							1	1															
Lactuca sp.																			2	1					2	1			1	1					
Lamium spp.			1	2		2						1	2							1															
Lappula spp.			1										1						1								1								
Lathyrus sphaericum		1	2	1		1						1								1										1					
Lemna minor					3																														
Limonium spp.							3			2					2		2					2	3				1	3					2		1
Lippa nodiflora				1	2	1						1	1								1										1		1		
Lolium spp.			1			1							1								1														
Lonicera floribunda			1	1		1							1																						
Lotus corniculatus		1	1			1															1														
Lycopus europaeus			2									1																							
Lythrum salicaria				1	2	1																													
Malcolmia turkestanica														1						1	1					1									
Malva spp.			1	2		3						2	2								2					1									
Marrubium vulgare			1											1						1	1					1									
Medicago lupulina	1		2	3		4						2	2						1	1						1									
Medicago minima		1	1	1		2					1	1	1						1	1															
Medicago polymorpha				1		1																													
Medicago sativa			1			1						1								1						1									
Melia azadrach				1		1						1																							
Melilotus officinalis		1										1	1							1	1					1									
Mentha spp.				1		1						1																							
Mespilus germanica																																			
Myosotis propinqua			1											1						1															
Myriophyllum					3																														
Nitella sp					2																														
Onopordon sp.			1										1							1						1									
Oxalis corniculata		1	1	1		1					1		1	1					1																

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Table 1. *(Continued)*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Paliurus spina-christi			1											1						1						1									
Papaver chelidonifolium			1	1									1							1															
Parapholis incurva																										1	1			1	1				
Parentucellia spp.				1									1							1															
Parietaria officinalis		1	1											1						1															
Parrotia persica				1		1							1																						
Paspalum paspaloides				1	3	1							1																						
Peganum harmala			1											1						1						1	1								
Phalaris paradoxa			1	1		1							1							1															
Phleum paniculatum				1		1						1								1															
Phragmites australis	1			1	4	2						1				2					2						3		2		3	3		3	
Pimpinella affinis			1										1							1															
Plantago psylium		1	3	2		2					2	4	2						2	2	1				1										
Plantago cronopus							1								3		1					1	2					2					2		2
Plantago lanceolata				1		1						1	1							1															
Poa bulbosa			3	1		1							2							2															
Polygonum aviculare			1	1		1						1																							
Polygonum hydropiper				1	1	1																													
Polypogon monspeliens				1		1						1																							
Populus caspica				1		1																													
Portulaca oleraceae			1									1	1							1															
Potamogeton crispus					1																														
Potamogeton pectinatus					1																											2		2	
Potentilla repens			1	2		2							2							1															
Psylotostacys spicatum							1		1						2		1					2	2				1	2					1		1
Pterocarya fraxinifolia				1		1																													
Pterohagia velutina							2		2						2	1	2				1	2	2					1							
Punica granatum			1	5		7		2				7	6	1						4						2									
Pyrus boissieri				1		1								1																					
Quercus castaneifolia						1																													
Ranunculus muricatus		1	1	1								1		1					1	1															
Ranunculus scleratus			1			1							1								1														
Ranunculs trichophylos					3																														
Rapistrum rugosum	1		1			1							1						1	1															
Rhamnus pallasii			1	7		6						6	7					1																	
Rhaphanus raphanistru			1								1		1						1																
Rhynchocorys elephas				1		1																													
Rubus spp.		1	7	2		2		2			1	5	4			1		1	1	7					1	8				7					
Rumex spp.			1	2		1						1								1															

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Table 1. *(Continued)*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Ruppia maritima																																2		2	
Saccharum spontareum	1	1								1	1							1	1																
Salicornia spp.							2		2					1	3		2				1	2	3				1	3			1		2		3
Salix alba			1	1		1						1								1															
Salsola baryosma															1		2						2					2							
Salsola kali	2	1						1		1						1			1	1							1								
Sambucus ebulus				1		1																													
Schoenoplectus spp.					2																		1					2				6		7	
Scrophularia vernalis				1		1																													
Sedum spp.			1										1							1															
Senecio vernalis	1	1	1									1				1				1						1									
Setaria viridis			1					1					1							1															
Silene spp.			1	1		1				1	1					1		1	1	1															
Silybium marinum			1								1		1							1	1														
Smilax excelsa				1		1						1																								
Solanum nigrum			1								1	1									1						1								
Sonchus palustris				1		1						1																								
Sorghum halepense		1	1								1									1															
Sparganium erectum					2																														
Spergularia spp.							1		2						2		2					2	2					1				2	1	2	1
Stachys byzantina			1										1							1															
Stellaria media				2		2						1	1																							
Suaeda maritima																							1					2					2		2
Sysimbrium irio		1						1					1						1	1															
Tamarix ramosissima							3		4						2		2					4						1					1		1
Taraxacum sp.			1	1		1						1								1															
Torilis arvensis				1									1						1	1															
Tournefortia sibirica																		1		1				2		3	2		1	2	1				
Tribulus terresteris			1																	1				1											
Trifolium arvense			1																	2						2				1					
Trifolium angustifolium												1							1	2						1									
Trifolium campestre				1		1							1																							
Trifolium fragiferum							2							2		1					1					2									
Trifolium subterraneum				3		3						2	3							2															
Typha spp.				1	4	1																													
Ulmus minor				1		2							2	1							2														
Urtica dioica				1		1							1	1							1														
Urticularia vulgaris					1																														
Vaccaria pyramidata			2							1								1								1									

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Table 1. *(Continued)*

Releve no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Verbascum songaricum																																			
Veronica spp.			1												1					1						1									
Vicia odorata			1			1							1							1															
Viscum album				1		1						1	1																						
Vitis sylvestris				1		1																													
Vulpia myuros			1									1						1																	
Xanthium spinosum		1	1								1	1							1	1					1	1									
Xanthium strumarius			1									1	1	1																					
Zanichellia palustris																																1		1	
Zelkova carpinifolia				1		1																													
Zostera noltii																																1		1	
EC(Soil)mmohs/cm(0-30cm)	7.5	3.1	3.2	1.8	0.7	0.9	23	8.3	23	8.5	4.5	1.9	0.9	9.8	22	8.2	24	7.3	5.1	1.1	9.6	25	27	9.8	7.1	6.5	9.8	32	8.5	6.8	12	21	40	19	32
pH (Soil)	8.2	7.8	7.9	7.3		7.2	8.4	7.9	8.4	7.3	7.6	7.1	7.1	8	8.3	8.1	8.4	7.9	7.9	7.4	8.2	8.4	8.4	8.3	7.9	7.4	8.4	8.4	8.3	8.1	8.4	8.4	8.4	8.4	8.4
Water table level (cm)	89	65	75	120		203	84	57	49	58	85	245	195	58	84	52	50	58	88	112	62	81	57	59	88	120	72	61	58	98	57	10	57	5	56
Soil texture *	S	S	SL	LS		LS	S	S	S	S	S	LS	LS	S	S	S	S	S	S	LS	S	S	S	S	S	LS	S	S	S	LS	S		S		S
Vegetation cover (%)*	63	19	75	85		89	42	59	43	57	14	87	86	50	40	46	36	52	14	79	51	41	25	37	11	71	45	38	41	65	44	42	39	54	59

* Vegetation cover %, Vander Mareel Scale

** S = Sand, L=Loam

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Schoenoplectus Sub- Community

This sub-community is located distinguishably in the eastern and southern coasts of Gorgan Gulf in a relatively narrow strip.

Hydrophytes Community

The mass 5 does not combine with any other masses. This mass belongs to the water ecosystem located in farthest western part of Gorgan Gulf. The following aquatic species are observed:

Ceratophyllum demersum, Myriophyllum spicatum, Potamogeton crispus, Potamogeton pectinantus, Ranunculus trichophyos, and *Lemna minor.*

Vegetation analysis

• The results of dissimilarity matrix analysis are shown in *Figure 3.*

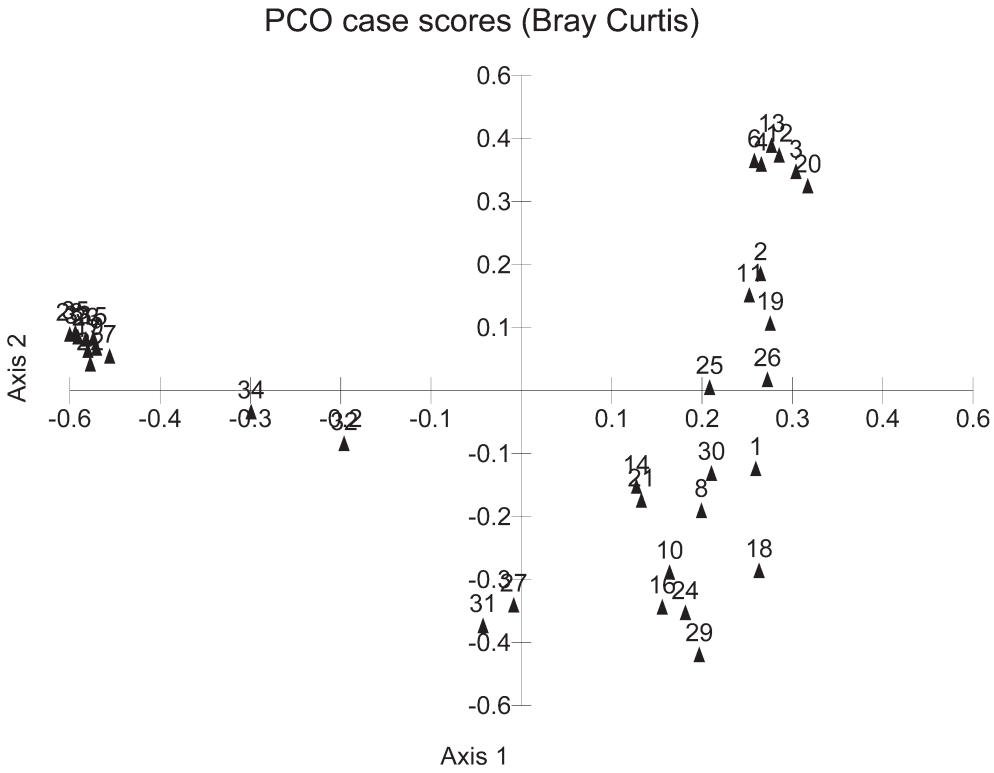

Figure 3. *Ordination of 34 representative stand of Miankaleh vegetation (based the data of Tab. 1)*

The percentage of dependence or the determining role of axis in the location of masses is depicted in *Table 2.* As it can be seen, the axes of 1 and 2 have the most determining roles.

• The masses related to Halophytes are in the farthest left end of axis 2.

• Masses related to Punica Communities are in the farthest right end of axis 2.

Considering the salinity of the soil of the above 2 communities (*Table 1*), the distribution of masses on axis 2 is affected by salinity.

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• The masses related to Punica are in the uppermost of axis 1 and the masses belonging to Juncus communities are in the lowest section of axis 1. Considering the water tables in the above two communities (*Table 1*), the distribution of masses are on axis 1 and are affected by water table level.

In general the locations of masses on 2 axes (*Figure 3*) indicate the relative correlation of masses and environmental factors. Correlation of these masses with environmental factors is in two gradients of salinity (axis 2) and water table (axis 1). The soil texture is generally sandy and sandy loam and as a result did not have any effect on distribution of plant communities.

Table 2. *The percentage of dependence of axis on the location of communities.*

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	4.122	2.264	1.334	0.914	0.794	0.56	0.405
Percentage	33.403	18.347	10.809	7.406	6.435	4.538	3.279
Cum. Percentage	33.403	51.75	62.56	69.966	76.401	80.939	84.218

Conclusions

The flora of the region, with over 200 species has the origin of Euro-Siberian and Irano-Touranian [16]. Out of these, over 90% of annual and perennial herbaceous species is specifically of a non-mountainous region, and the formation of the plant communities is more affected by water table and the salinity of soil and water, which as overall indicates coastal regions.

Udvardy has introduced Golestan National Park and Arasbaran protected region, in addition to Miankaleh biosphere reserve, in the mixed mountainous systems biome.

Based on the studies on Golestan national park [2] and protected Arasbaran region [3, 4], the two regions can be located in the Udvardy suggested system.

To express the relationship between upper mountainous region of Miankaleh in old times based on the results of this research and also paleoecologic investigation of the reserve, one can conclude:

Existence of red deer and Persian wild ass in winter seasons of very old days in Miankaleh shows a continuity of this region in the south with high lands of Alborz Mountains and in the East with steppe regions.

At present time, due to urban developments and road networks, there is not continuity between upper mountainous regions with Caspian Sea plains and coasts and from East between steppes with Miankaleh. That is why; nothing is heard about red deer, tiger and Persian Wild Ass in Miankaleh any more. The Udvardy classification in incarnation with landscape ecology in that time can be coincided, so if total Tajan river catchment (from -30 m to over 3000m mean sea levels) is considered as one unit, concerning the ideal form of a biosphere reserve in each geographical province, the Udvardy classification is acceptable. But it is better that at present time the Miankaleh reserve can be in the Littoral Classification system.

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