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Review Article

Review on biodiversity of tree and shrub communities in desert regions (Case study: Khorasan province in Iran)

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Abstract

At present, although there is good information about Iran flora, but the body of information about the level of knowledge on the ecology and recognition of plant communities in dry land region is poor. Vegetation covers were identified as trees, shrubs, psamophyle and halophyte. Results showed that the grown trees in the geographic domain of desert territory of Khorasan was composed of three different communities within an area of 70,602 hectares which is about 0.6 % of the vegetation cover in the study an area of 2125480 hectares equal to 17.6% of the vegetation were covered by shrubs with seven communities (except psamophyle and halophyte species).

Keywords: *Plant communities, ecological criteria, physiognomy, Desert areas, Khorasan province*

INTRODUCTION

Study of plant ecology and plant geographical analysis has been conducted in an extensive region by Westoby [1998], Braun-Blanquet[1932] and Harper[1967]. Zohari[1999], regarding the structure and evolution of flora and vegetation of the Middle East has done extensive the research.The first comprehensive data on formation of woody vegetation and other vegetation units have been conducted by Mobayin[1976]. Zohari[1973] has investigated geobotanical foundation of the Middle East [including Iran vegetation] once again in detail. Heshmati[2007],conduced a reasearch concerning emissions, climate and flora of Iran and Afghanistan and sandy deserts.In other regions of the world many studies were conducted regarding phytosociology and plant diversity by different scientists such as the phyto-geographical territories of Israel and Sinai that They were revised using a large mass of species distribution data with the help of chorotype frequencies for 25 km^2 squares in Israel. Territories were defined on the basis of the first two most frequent chorotypes. The similarity of boundaries in the resulting phytogeographical map with a physiognomic map suggests that the latter may be used in preliminary stages of the preparation of plant geographical maps[Danin and Plitmann 1987].

The present study focuses on plant species richness, taxonomic diversity, and endemism of the Sinai peninsula as a whole and Saint Catherine area in particular. Beta diversity was also measured using β T to represent the biotic change between different landforms in the St. Catherine area. The peninsula supports about 1285 species including the infraspecific taxa of which about 800 species [also including the infraspecific taxa] are recorded in the southern Sinai south; of El-Tih Desert. The present study reveals that southern Sinai is more diverse as compared with the Sinai peninsula as a whole. Southern Sinai also supports more than the expected numbers of rare and very rare species [about 62%] and about 4.3% endemic species. Beta diversity between different landforms in the St. Catherine area reflects a large biotic change between slopes and terraces on the one hand and between terraces and ridges on the other. Finally, the study recommends appropriate management of the peninsula and more research for the management requirements of the numerous endemic and rare species in the Sinai peninsula[Ayyad, Fakhry et al. 2000]. A biome classification for China was established based on plant functional types [PFTs] using the BIOME3

model to include 16 biomes. In the eastern part of China, the PFTs of trees determine mostly the physiognomy of landscape. It is a comprehensive classification which using multivariables and expresses more vividly the vegetation distribution which them can be compared with world biome classifications. It can be easily used in the response study of Chinese biomes to global change, regionally and globally[Ni 2001].

Through tabular and average linkage cluster analyses, 737 phytosociologicalrelevés were classified. Based on these relevés, we described and typified the associations, alliances, orders, and classes grouping the coastal plant communities of the Baja California peninsula. Diagnostic tables, classification by average linkage clustering, and climatic, edaphic, and biogeographical data were used to establish floristic affinities among these syntaxa and to interpret their distributions. Syntaxa were characterized by their floristic composition, physiognomy, and biogeographical distribution, along with their positions in halophilous and psammophilous gradients. Thirty-three associations were identified, out of which 22 are described here for the first time. Our syntaxonomical proposal includes descriptions of nine new alliances, seven new orders and four new classes: Allenrolfeeteaoccidentalis, Atriplicijulaceae–Frankenieteapalmeri, Euphorbioleucophyllae–Sporoboletea virginici and Achyronichiocooperi–Abronieteavillosae. [Davies and Holcombe 2009]

A survey of natural vegetation along Hanna Lake, Baluchistan was undertaken. The study was conducted within two distinct zones for clear communities' demarcation. The vegetation data was analyzed using TWINSPAN and DECORANA, to classify the vegetation into plant communities. Thirty eight species belonging to 16 families were recorded from 20 quadrats of Zone 1 and 36 species belonging to 16 families were recorded from 20 quadrats of Zone 2. Two major and four sub-communities were demarcated by TWINSPAN in both zones. DCA results showed three distinct plant communities in both Zones. Mostly the TWINSPAN and DCA results were similar and the plant communities classified by TWINSPAN were confirmed by DCA. The study provided base line data, information and importance of native plant communities.[Ahmad and Yasmin]

Here we present a habitat-classification method developed specifically for mapping and the steps of its development. Habitat categories and descriptions reflect site conditions, physiognomy and species composition as well. However, for species composition much lower role was given deliberately than in the phytosociological systems. Recognition and mapping of vegetation types in the field is highly supported by a definition- list of subtypes and list of 'types not belonging to this habitat category'. Our system is two-dimensional: the first dimension is habitat type; the other is naturalnessbased habitat quality. The development of the system was conducted in two steps. over 200 mappers already tested it over 7000 field days in different projects.[Boloni, Molnar et al. 2011]

Goals

1-To identify different kinds of vegetation indices in desert regions of Khorasan province[Fig.1].

2 To determine the scope and extent of plant communities in desert areas.

3-To identify different kinds of environmental parameters including soil, climate, geology and within each plant type.

4 - Preparation and presentation of vegetation maps.

Characteristics of the study area

Geographical coordinates

Khorasan province with an area equivalent to 296,189 sq km in in the *east* and *north-east* of Iran.The geographical alignment of Khorasan suggests latitude of 30-38º08-13' N and longitude of 55-61º18-30' E. The definite latitude of Khorasan signifies its position in Northern Hemisphere and its moderate distance from the equator. The province of Khorasan is bordered by Turkmenistan in the north and the north east,by Afghanistan from the east, Sistan and Baluchestan in the south east, Kerman province in the south, by Yazd province, Esfahan and Semnan province in the west, and finaly from the northwest to Golestan Provinces. Maximum and minimum altitude is Binalud mountain with a height of 3211 meter and the lowest height in the north of Sarakhs city of 300 meters. 80% of Khorasan province is covered by desert in an area of approximately 23653950 ha[Map 1].

Weather

Khorasan province is located in the North Temperate Zone and has changeable weather as a whole. The maximum and minimum air temperatures reported by the weather stations in Halvan [Tabas] and Emamqoli read 50 and -32 ° C, respectively. Average maximum temperature in the hottest month sfluctuates between 26/7 ° C in Emamqoli to 42/3 ° C in Dastgerdan[Tabas]. The mean minimum temperatures of the coldest month

is -8/8°C to 2.2°C in Torbateheydarieh and in Boshruyeh, respectively. January and July are the hottest month of the year.The temperatures of the province increases from north to south, but annual precipitation decreases.

Thehigh regions of the province, Aladagh and Binalood heights, have cold mountainous weather. Bojnoord, Ghoochan and Shirvan regions and southern parts of Binalood, Kopeh-Dagh heights, Hezarmasjed and some parts of Mashhad townships have temperate mountainous climate, Ghaenat and mountain side of the province have mild semi-arid weather and southern areas have warm, dry and arid climate.

The distribution of precipitation has been reported on the basis of the maximum rainfall with 900-1000 mm in the northwest province-based stations in the forest area of Golestan and the minimum amount of rainfall in Dyhuvk with 76/3 mm. Average precipitation in the province were recorded by the weather stations between 180-200 mm showing a 50% precipitation falls over the three-months from span Marchto May.

Evapotranspiration rate also changes in neighbouring temperatures, but it is lowin the northern province and high in the southern provinces. The maximum and minimum capacity of evaporation was taken in the weather station Halvan[Tabas] and Emamgholi 4075 and 913 mm, respectively.

Khorsan Climatic diversity was classified into seven 7 major divisions based on the developed method of Diomarton's classification. The division of the seven climates is as follows: Hyper arid, arid, semi arid, semi-humid, humid, and very humid and Mediterranean. Three sub divisions [usually cold and hyper cold and sometimes mild] were also included. A total of 15 different climatic categories were identified in Khorasan Province. The desert region is one of the seven devision of climatic areas.

MATERIAL & METHODS

Data Collection Phase

At this stage, the necessary information was collected from internal and external sources. Major activities carried out in this context, it has to be mentioned as:

1. Literature review: Collecting and studying reports, articles and maps of vegetation on Iran, Khorasan Province, especially vegetation.
2. Collecting maps and studying weather reports, including climatic classifications, isohyte, and isothermal and evaporation rates in Khorasan.
3. Collecting and studying of geological reports and maps of soils, land resource evaluation and geological features related to the study area.
4. Field visits and field measuring in desert areas of Khorasan province.

Integrating the Second Stage of Data

A comparative analysis was done on the acquired information for the vegetation cover from different sources and finally the desired objectives results were extracted and presented here. The major activities carried are the following stages:

1. The identification of plant species using flora and botanist professionals guide.
2. Determination of the range of desert and semi-desert areas, based on two main climatic factors [using expanded Diomarton method], edaphic and topography factors as influenced by the distribution and adaptation of plants with their environment.
3. Classification, and introduction of plant communities and units based on the vegetation classification Frey and Probst [1986].This classification shows the highest compatibility and harmony with nature in the region.
4. Vegetation mapping using Geographic Information System [GIS].
5. Mapping was done in all vegetation units separately.

RESULTS & DISCUSSION

Vegetation units were identified in an area of12089394 ha. Some details of the tree and shrub have been already identificatoin Khorasan desert areas is n described in this study [Figure 1].

Although comprehensive and detailed studies of the floristic composition and distribution trees wide range of mountain areas has been reported by others in history, but instead referred to ecological studies in these areas is still empty. A tree habitat in the Khorasan which is composed of several sub area is 70,602 hectares of which about 6.0 percent of total vegetation cover the study area.

Sparseevergreen trees with needle leaf resistance to cold [juniperus]

The structure of needle-leaf forests continues Juniperusor Juniperus excelsa in Iran or the Kopetdag mountains along the basin of Qarehgum extended to Mashhad in North East Bazngan. Its area is 2113 hectares of which about 3 percent of forest vegetation in the study area forms. Altitudinal range from 1500-2000 meters above

sea level, at least 250 mm annual precipitation and the semi-arid climate is cold.
The climate of Juniperus habitats is continental that the distinctive features of particular hard frost of winter [-25 degrees] without decreasing summer temperatures and humidity is low. [Frey and Probst, 1986].
This growth is widespread in land types, including mountains with peaks extracted consists of dolomitic limestone rocks and soils lithic lepthosols. This plant structure consists of a plan type named Ar.kopetdaghensis-Juniperus excelsa which the important species associated with it are: Lonicera nummularifolia, Pistacia vera, Amygdalus spinosissima, Agropyron trichophorum, Crataegus sp., Cotoneaster, Astragalus spp., Acantholimon spp., Eremurus spp., Prunus, Colutea buhsei, Berberis integrrima, Ferula spp.

Sparse Erymuphyte edible pistachio [pistaciavera]

Although pistachio trees can be seen in the form of physiognomy, but most of these shrubs are the association and hence Frey&Probst classified them in units of eremophytes plant that widely located margins of forests [Fig. 3].
Bubak [1951] is called open and sparse erymuphyteforests of pistachio and almond. Zohary[1973]has been named them asSteppianjuniper, pistachio and almond [Junipero-pistacietea]. They are divided them into three categories[Gul and ur Rahman 2003]:

1. Amygdalus spinossisima & a. lysioides
2. Amygdalusscoparia
3. Loniceranummularifolia.

Pistachio trees in Irandisterbuted in Khorasan province on the Garehgum basin. Dry violent climate on the current point in such a way as the dry hot summer and very cold in winter. Its area is 27,079 ha, equivalent to 38.4 percent tree cover in the study area makes. The plant Artemisia diffusa and often dominant Poabulbosa covers form the basis and scattered around the line, Kalat, and along it towards the East in the Saraks region and is extended to the East Saleh- Abad. Elevation changes 600-1500 m from sea level, slope lands in it ranges 1-100 percent and generally to 40 percent, average annual precipitation over the general structure of 200 mm and semi-arid climate of the cold.

Khinjuk communities [pistacia atlantica and P. khinjuk]

Area of this vegetation is 41,410 ha equivalent 58.6 percent of tree cover is included which is located in Torbate-jam and Cain regions. But this community plant dominated with Artemisiain the region Torbate-jam and be seen with the dominant form of Astragalus in Gaien. Habitat characteristics of the plant unit area in Torbat included: Average annual precipitation 100 to 200 mm. cold semi-arid climates, elevation 900-1300 meters above sea
level, slope lands to 30 percent.Habitat characteristics of the vegetation units in the region of Ghaen is: Average annual precipitation 250 mm, semi-arid climate, elevation 1800-2800 m above sea level and slope land more than 30 percent. In mountain and hill lands and calcareous soils and Lptvsol Rigosol rock is spread.

Very sparse erymophytes [semi-desert shrubs]

In areas of low rainfall sparse erymophyte moorland to the very popular open land into which species represents the highly drought-resistant plant can be named Amygdalus spp. and Zygophyllum eurypterum. This structure of the study area is an area of 2125488 hectares of which about 17.6 percent of the total vegetation forms and is composed of several floor.

community of Hammadasalicornica

The area of this community is about 866,471 hectares that is about 40.8 percent of the shrub vegetation are included. Thisplant community scatteredon the southern provinces such as Khour of Birjand, Birjand&Tabas.Besides, this unit plant has expanded on lands with pure sand or salty and calcareous and gypsum lands. Amount of precipitationwhere typically less than 50 to 150 mm.Land sources mainly contained hillside land, plateau, and sanddunes.Slope is less than 30 percent, elevation is 600 to 1500 m above sea level, hyper arid [cold] and hyper arid[temperate] provides favorable conditions for growth of this unit plant. J. Leonard [1989] knowsspecies [Hammada salicornica] as an exclusive species for sahara-syndion Arabic –Syndihabitates.
Important species associated with this community is:
Artemisia sieberi, Ephedra, Haloxylon ammodendron, Fortuyniabungei, Calligonum, Cornulacamonacantha, Pteropyrumaucheri, Zygophyllumatriplicoides.

Community of Ephedra spp.

Its area is 531,636 ha, is equivalent to 25 percent shrub vegetation. This unit plant distributed in Kashmar, Gonabad,Gzyk, Caein, Khoor and Birjand.Dominant Species areEphedra strobilacea, E. intermedia and E. major. This type of vegetation has expanded on the mountains, hills and plateau withLitosol, calcareous and HaplicRigosol.Land slope changes from 10 to 50 percent, elevation range is 1400 to 2600 m above sea level, dry desert climate with cold and hyper arid cold, average rainfall 150-250 mm per year. Important species along the main species are seen in areas including

Artemisia sieberi, A. diffusa, Astragalus spp., Cousinia spp.

saxual community [Haloxylon ammodenderon]

Total Area is about 476,545 hectares, which occupies 22.4 percent of the shrub vegetation. Distribution of this unit plant is central areas ofIranlike this Sabzevar and around Taibad and southern parts like Ferdows, Gonabad, Gaein, Madne, Birjand, khoor, Gezik and Tabas regions. Average annual precipitation in this unit is less than 50 mm to 250 mm is fluctuating.

This type of vegetation can be seen in the land of salt and sand that separately in this report will be named. Endemic and planted Haloxylon species are seen above regions. Important species associated with include:

Salsola tomentosa.Astragalus squarrosus, Zygophyllum atriplicoides, Seidlitzia rosmarinus, Hammada salicornica, Convolvulus

Almond Community [Amygdalus spp.] & [Amygdalus scoparia]

The area of this community is about165,225 hectares that contained about 7.8 percentage of shrub vegetation formed. The dominant species in this community in Ferdows, Tabas, Chahsorb, Khoor and Birjand located southern provinceis Amygdalus scoparia. Habitat characteristics include:

Mountain and hillside land, the general slope of 15 to 50 percent, Rigosol, calcareous soil and rock Litosol, average annual precipitation changes from 75 to 200 mm, height range 850-2150 m above sea level with dry desert, arid cold and Hyper arid cold climate.

Associated species include:

Gymnocarpus decander, Artemisia sieberi, Zygophyllum atriplicoides, Pistacia atlantica, Ephedra intermedia.

But in other areas A. Spinosissima or A.lycioides or sometimes A. ebornea is the dominant species. Beside, Artemisia is the maincompaining plant as well A.sieberi A.deserti species is the most abundant in this community. Distribution of this vegetation across the Khorasanarea including Torbate-jam, Caein, Gyzik and Taibad. Habitat characteristics that include:

Mountain and hillside land, the general slope of 10 to more than 30 percent, rock and Riggosol, Litosol calcareous soil, average annual precipitation of 100-160 mm, height range 900-2200 m above sea level and the dry cold desert.

Community of Seidlitzia rosmarinus

The area of this type is 52,252 hectares and about 2.5 percent shrub vegetation forms. In addition to salt and gypsic lands habitates, this community has also spread on pure sand and salted sands. This unit plant mainly is Arabic-syndi interface elements as well as consideredIrano-Tourani vegetation. Thus the community in several plant units was introduced. Mnjlmh in land salinity and Birjand with Sabzevar Astragalus squarrosus and Hammada salicornica are seen. General slope of land less than one percent elevation range 1200-840 m above sea level, dry desert climate cold and mean annual precipitation from 200 to 50 mm of the specifications of this unit is growing in these areas. Also, fan type and plateau lands Varyz•hRygvsvl soils with gypsum and limestone are expanding.

Community of Zygophyllum atriplicoides

Area of this community plant is about 24,070 ha that includes1.1 percent of sparsetrees in dry lands. This unit plant which scattered in Gonabad & Geainregions is composed two different types. Zygophyllum atriplicoides as a unique species in theIrano–tourani vegetative region which grows on plains rubble mixed with sand, significantly. In Gonabad region, Astragalus squarrosus and Salsola tommentosa areas two associated species.In the region of Gaein two different vegetative types include:

Zygophyllum atriplicoides, Astragalus squarrosus, Z.atria plicoides, Salsola sp. A. squarrosus

Rainfall amounts in this habitatchanges between 100 to 150 mm, public slope 3 to 30 percent, the arid climate, cold expression, heights range from 960 to 1200 meters above sea level and the type of growth soils calcareous and Gypsic Rigosol temporary Haplic Calcisol and calcareous Flovisol.

Community of Pteropyrum aucheri

The area of this community plant is about 9289 hectares which is 0.4 percent shrub lands

vegetation forms. This is only connector genus between Oman's – syndic and Irano –Tourani vegetative unit. Expanding of this community plant in the study area is Kashmar region, along with Artemisia sieberi on the hills, plateau and plains with calcareous and Gypsic Rigosol. The other characteristics of this community are changes in land elevation range 1100-1300 meters above sea level, slope 1-15 percent, dry& cold desert climate, and mean annual precipitation is 200 mm settlement.

This study reports on an ecological survey of the main parts of the Eastern Desert of Egypt. This is divided on geographical [climate, lithology, latitude, etc.] bases into three regions. The general attributes of desert vegetation as represented in the surveyed area are given. Eighteen community types are recognized. Some are confined to one of the three regions; others are recorded in two or three regions. Widespread community types show regional variations in their floristic composition that allow for recognition of regional faces of these types. Classification of vegetational units on grounds of structure and growth form of dominant species shows close relationships between these characters and the habitat complex.[Kassas and Girgis 1970]

CONCLUSION

The present study reveals vegetation diversity and species richness along the altitudinal gradient ranged from 900 to 3000 m at GarhiDopatta Hills. Species diversity and richness values were high in the tree layer in the middle part of the altitudinal gradient. It decreases both towards upper and lower altitude, which was due to deforestation, human interaction, encroachment pressure, low number of species and soil erosion. There is great need of reforestation in the area. Alternate sources of fuel must be provided to local inhabitants to minimize the pressure on wealth of wild plants.[Habib, Malik et al.]

The distribution and abundance of desert plant communities were examined in the lower reaches of the Tarim River, southern Xinjiang. Eighteen plant species were collected at 18 sites along a sequence of increasing ground-water depths in six transects. Except for Tamarix ramosissima and Populus euphratica, which were distributed across nearly all sites, most of the investigated species had low frequency of occurrence. Correspondence analysis [CA] of the 18 species revealed a separation of growth forms into distinct groups corresponding to different ground-water levels. Canonical correspondence analysis [CCA] of the 18 species and seven environmental variables would suggest a major botanical gradient exists relating to ground-water depth and secondary gradients exists that include soil moisture, pH and to a lesser extent alkalinity and mineralization[Zhang, Chen et al. 2005].

Ephemeral plants are a special type of plants living in an environment which is rainy in early spring and xerothermic in summer. In Gurbantunggut Desert, they are mainly distributed in the southern part, playing an important role in the maintenance of desert ecosystem stability and in sand-fixation By adopting stratification sampling, this paper investigated the diversity feature of ephemeral plants at 35 sites covering a total area of 3.86×104 m2 in the southern Gurbantunggut Desert. A total of 93 ephemeral species were recorded, belonging to 24 families and 74 genera, among which, Chen opodiaceae, Compositae,Cruciferae, and Leguminosae were the dominant families, accounting for 19.35%,17.20%,11.83%,and 9.68% of the total species, respectively. In terms of life form, ephemeral plants, annuals with long period of nourishment, and trees and shrubs accounted for 53.76%, 22.58%, and 16.13%, respectively. In terms of importance value, ephemeral plants accounted for 45.73%, while trees and shrubs accounted for 30.93%. [Liu, Liu et al. 2011].

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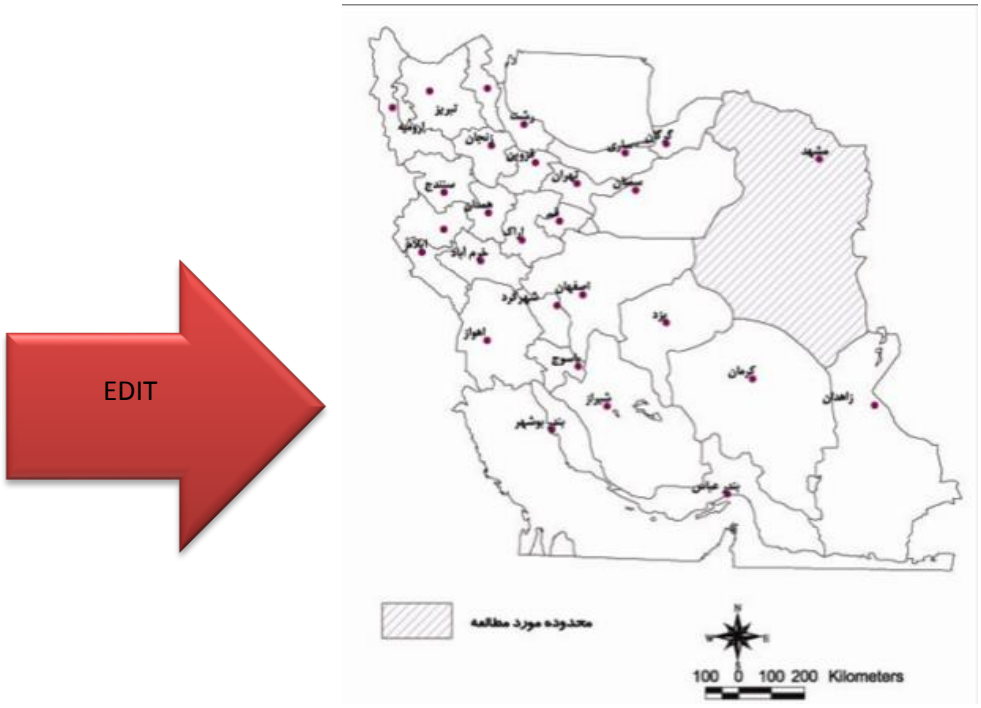

Fig (1): Map of study area

Fig (3): Community of *pistachiovera*

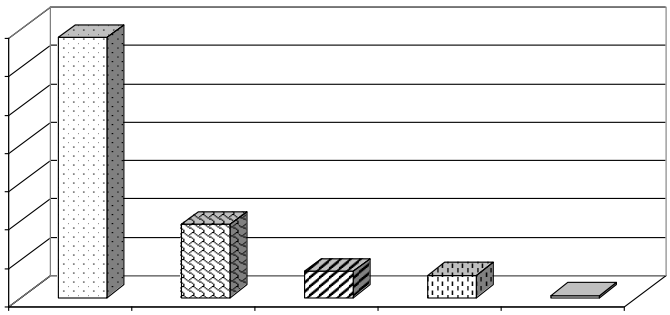

Chart 1: Comparison of frequency of vegetation units in desert regions of Khorasan