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PLANT DIVERSITY, DISPERSION, COMMUNITY SIMILARITY AND VEGETATION DESCRIPTION IN UNITED ARAB EMIRATES. I. NORTH WESTERN AREA

By

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التنوع البيولوجي النباتي وطرز انتشار النباتات وتشابه العشائر ووصف الكساء الخضري في دولة الإمارات العربية المتحدة . (١) المنطقة الشمالية الغربية

ممدوح إبراهيم علي العامري

تمت دراسة طرز التجمعات في ستة عشائر طبيعية شمال دولة الامارات العربية المتحدة . شملت الدراسة قائمة بالأنواع النباتية ومدى تواجدها وانتشارها ، علاقة المساحة بتوزيع الأنواع ، الأثراء في التنوع البيولوجي النباتي والتباينية بين الأنواع ومدى التناظر في التوزيع للأنواع ، دراسة مؤشرات تشابه العشائر وتناسقها الترتيبي والتحليل الرياضي المجمع لهذه العشائر ووصف لبيئات ومواطن العشائر .

بلغ عدد الأنواع التي سجلت في الدراسة ٣٩ نوعاً في ٣٠ مربع بيئي دراسي وكان المتوسط ١,٥٩ . أوضحت مؤشرات الانتشار وجود انتشار متماثل وليس عشوائياً . كانت علاقة توزيع الأنواع النباتية بالمساحة مطابقة لتوزيعات النظم البيئية الصحراوية . دلت مؤشرات الأثراء على أن منطقة «أ» هي أكثرها ومنطقة «ف» هي أفقرها اثراءاً . كما أكدت الدراسة شدة التباين بين العشائر المختلفة في توزيعها . أوضحت نتائج دراسة تشابه العشائر والتي أكدتها نتائج التناسق الترتيبي والتحليل التجميعي عدم وجود تشابه بين بعض العشائر بشكل مطلق وأفتقار نسبي بشكل عام بين العشائر الأخرى .

Key Words : Plant diversity, Community similarity, UAE-North Western area

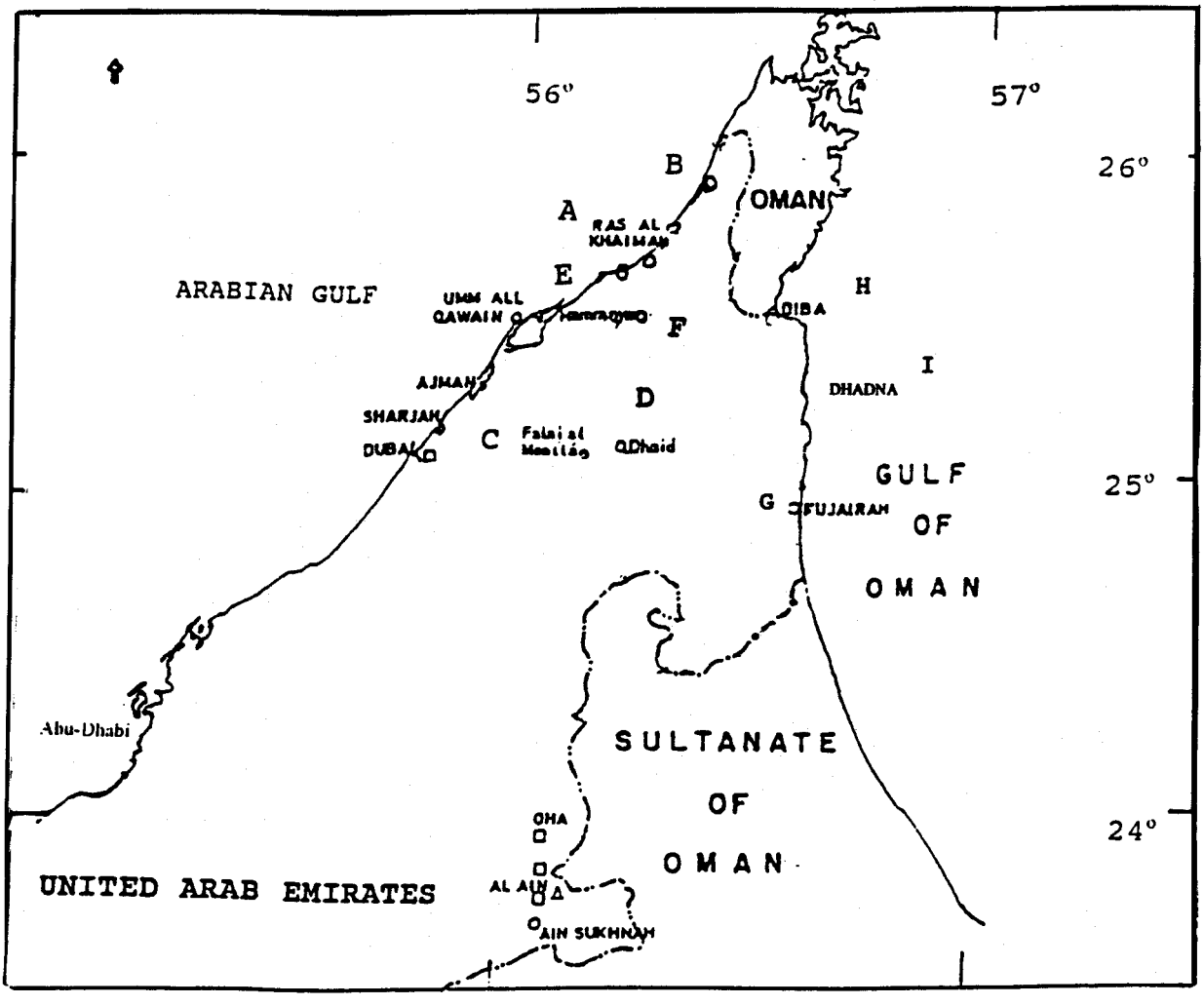
ABSTRACT

Plant population patterns in six natural communities (A-F) in the northern part of the UAE were studied. The study included: list of species and their frequencies; dispersion, species-area; diversity richness, heterogeneity, and evenness; community similarity indices; ordination; and cluster analysis. Recorded species were 39 with mean = 1.59, median = 1, variance = 0.77, and sd = 0.88. Dispersion index confirmed the presence of more uniform dispersion than random ($P<0.01$). Species-area varied among the six communities with a low proportion of variation (r^2) in A and high D. Diversity richness indices were 2.22, 2.02, 1.36. 3.05, 4.9 and 1.6 in communities A, B, C, D, E, and F respectively (Margalef) and from 1.15 to 2.45 (Menhinick); Heterogeneity indices were from 8.2 to 9.6 (Simpson), 1.6 to 3.1 (Shanon H'); Evenness indices were 0.99 to 0.95 (Pielou J'), 0.89 to 0.98 (Sheldon). Results of community similarity confirmed the ordination calculations and reflected 100% dissimilarity between B and D, B and F, and C and F; and an overall dissimilarity among all communities.

INTRODUCTION

Plants are not evenly distributed in nature. Distribution and patterns of growth reflect patterns of plant population diversity and dynamics. Morairty [1] stated that difference in the environmental conditions, resources, and disturbance are a few of many other factors that influence diversity and dynamics. Descriptive analysis with quantitative and numerical plant ecology, for areas that have not been explored or only partly earlier, is an additional stride towards better understanding of the nature of the vegetation. This concept was applied in studying vegetation ecology of the northern

part of the United Arab Emirates (UAE) between 56°05' - 56°20' N and 25°10' - 25°40' E. (Map 1., adopted from Ministry of Agriculture and Fisheries, Department of Soils and Water, UAE). The study was focused on vegetation sampling in six areas: A) Center of Ras Al-Khaimah, B) North Ras Al-Khaimah, C) Falaj A-Moalla, D) Dhaid, E) Al-Hamediah, and F) Al-Homranya. Areas A, B, E, and F represent the north western part of UAE while C and D represent central part of north UAE. The gradient analysis approach of Gleason [2] which is described by many plant ecologists [3-5] is adopted in this study, it includes: dispersion analysis, species-area relationship, plant diversity, community similarity, cluster analysis, and ordination analysis.



Map 1. The studied areas of part (a) and part (b) in the United Arab Emirates

MATERIAL AND METHODS

A short description for the western coast and central part of the North UAE was documented to provide a reasonable background for the vegetation ecology of the studied areas.

The plant species were identified with the helpful reference of Mandaville [6], Cornes [7], Batanouny [8], Migahed [9,10] and Täckholm [11]. Floristic composition together with the recurrence (occurrence of the species in the studied quadrats of one site, % and = R) and recurrence index (recurrence in quadrats of all the six sites, as a percentage of occurrence = R.I.) were calculated for each species.

Dispersion analysis based on the variance to mean ratio was compared with Morisita's index, where uniform <1, random = 1, contagious >1. Species-area relationship was studied in the six communities on log bases for each area vs species increments with determined r^2 values, provided with correlation equations.

The computed diversity indices for the areas were the following:

A) Richness

1 - Jackknife taxa number estimates = $S + \frac{(N-1)\ K}{N}$

where S = total number of species in all sampling units.
N = total number of sampling units
(In this study = Number of communities)
K = Number of species in only one sampling unit.

2 - Margalef's richness index = (S-1) / In N,
where S = total number of species in all sampling units.
N= total number of individuals.

3 - Menhinick's richness index $S/(N)^{0.5}$,
where S = total number of species in all sampling units.
N = total number of individuals.

B) Heterogeneity

1 - Simpson's index = $1 - R \frac{\{ ni(ni - 1) \}}{N (N-1)}$

where ni = number of individuals in species i,
N = total of all individuals = Rni

2 - Shannon-Wiener index H'

$$H' = R\ (pi)\ (\log pi)$$
$$i = 1$$

where s = number of different species
p = proportion of total in the i^{th} species

3- Hill's N1 index = log base $^{H'}$

4 - Hill's N2 index = 1/ (1 - Simpson diversity index)

C) Evenness

1 - Pielou's evenness index (J') = H'/log (s)
where H' = Shannon-Wiener index, s = total number of species.

2 - Sheldon's evenness index = log base$^{H'}$ / s,
where H' = Shannon-Wiener index, s = total number of species.

3 - Heip's evenness index = (log base$^{H'}$ -1) / (s - 1),
where H' = Shannon-Wiener index, s = total number of species

4 - Hill's evenness index N2/N1,
where N1 index = log base$^{H'}$, N2 index = 1/ (1 - Simpson diversity index)

5 - Hill's modified index = (N2 -1) / (N1 -1).
where N1 index = log base$^{H'}$, N2 index = 1/ (1 - Simpson diversity index)

In addition to percent similarity data as a major community similarity index, the quantitative cluster analysis of Moristita's and Horn's were calculated.

1) Morisita's Index = 2 RXiYi/ (S1 + S2) (N1 x N2)
where S1 = RXi (Xi - 1)/ N1(N1 - 1), S2 = RYi (Yi - 1)/ N2(N2 - 1)

Xi = number of individuals from Community 1 in taxa i
Yi = number of individuals from Community 2 in taxa i
N1 = RXi and N2 = RYi and range from zero = no similarity to 1 = identical taxa abundance.

2) Horn's index = (H4 - H3)/ (H4 - H5)
where H1 = (N1 log N1 - RXi log Xi) / N1

H2 = (N2 log N2 - RYi long Yi)/N2
H3 = {(N log N - R(Xi+Yi) log (Xi+Yi)}/N
H4 = (N log N - RXi log Xi - RYi log Yi)/N
H5 = (N1 H1 + N2 H2)/N.

Xi = number of individuals from Community 1 in taxa i
Yi = number of individuals from Community 2 in taxa i
N1 = RXi and N2 = RYi. N = N1+N2

3) Jaccard coefficient = C/(s1 + s2 - C)
where s1 = number of species in community 1
s2 = number of species in community 2
C = number of species in both communities.

Regression analysis was applied to find out to what extent a change can exist along the gradient.

Ordination analysis is commonly used to summarize sampling data in a simple and less space-consuming fashion. It usually goes with designation on a single axis, or two axis, or three dimension form, respectively which represent distances between the species in the related communities. However, in this study, the table summarizing different ordination analyses for the 6 communities included:

1 - Bray-Curtis IS = 100 - M_W %,
where M_W % = sum of smaller quantitative values of the species common in both communities.

2 - Euclidean distance = Dij = $\{ R\ (Xik - Xjk)^2 \}^{0.5}$ (k = 1 to m)

Dij = squared Euclidean distance between communities i and j.

m = number of species.
Xik = abundance of the k^{th} species in community i.
Xjk = abundance in the k^{th} species in community j.
3 - Relative Euclidean distance $=\sqrt{R}$ {(Xij/RXij) - (Xik/RXik}^{2}
Xij = abundance in the ith species in community j
Xik = abundance in the ith species in community k

Relative Euclidean distance measures differences in total community abundance and range from 0 to $\sqrt{2}$.
4 - Absolute Euclidean distance = R | Xij - Xik|
Xij = species i in community j., Xik = species i in community k.
It measures character difference as it sums the absolute difference between species abundance in communities and range from 0 to 100.
5 - Relative absolute Euclidean distance R | (Xij/Rxij) - (Xik/RXik)|
Xij = abundance of the i^{th} species in j^{th} community.
Xik = abundance of the i^{th} species in k^{th} community.

Relative absolute Euclidean distance measure standardized relative to difference in total community abundances and range from 0 to 2.

RESULTS AND DISCUSSION

Land: The studied areas A, B, E, and F are in the North-Western Coast of the UAE along the Arabian Gulf (Map 1) next to sea shore which lies between 40 to 80 meters from the high way bordering the extended mountainous formations and ridged elevations. The central part of North UAE areas (C and D) represents sandy to gravelly soils with background of sand dunes.

Climate: The area belongs to the desert belt extending from North Africa to Central Asia. The climate of this northern part of the western Coast is characterized by high temperature: averages during May to October frequently reaches >44°C, and moderate average (20-30°C) during November to April season. Scanty and variable rainfall is a common feature (Fig. 1. a and b). The highest rainfall

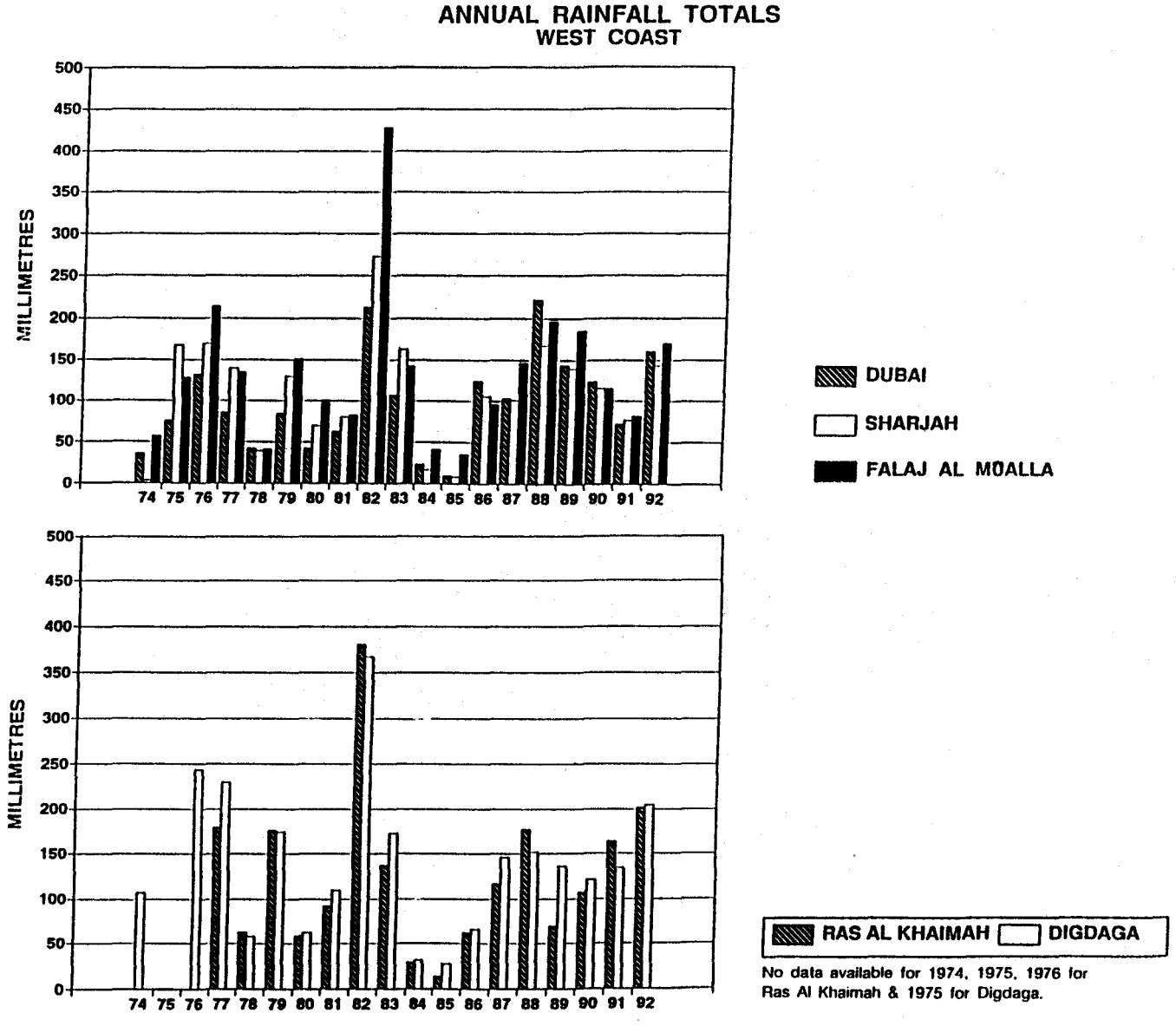


Fig. 1. The annual rainfall for the western Coast of UAE.

record of Falaj Al-Moalla was 428 mm in 1982 and of Ras Al-Khaimah was 380 mm in 1982. The lowest recorded was <10 mm in 1985 for Falaj Al-Moalla and about 15 mm in the same year for Ras Al-Khaimah. Running averages for 19 years do not exceed 100 mm in both rainfall stations. Relative humidity is high, especially during night and frequently reaches 100% from May to October. The wind component of the western Coast (Table 1) shows high speed from November to April, especially wind with duration of < 24 hours. Wind duration's >48 h are frequent from December to February.

Physiography and Geology: UAE has a total area of about 83,000 Km^2 lying at the southwestern tip of Arabian Peninsula. Although there are physiographic zones, their boundaries are indistinct. The landscape is dominated by recent sedimentation's of limestone, marls, shale deposits, and evoporites with few protruded sediments outcropping throughout the sand as isolated jebels and hills such as jebel Hafeet. Present-day scenery is a relict of Pleistocene and post-Pleistocene times.

Ecological and Habitat-Community description. The studied areas may be distinguished into two main ecosystems:

a) Coastal salt marsh, extended with recently formed saline flats known as sabkha, is bounded at the tidal zone by a narrow raised beechline of calcareous sand. On the inland side it is bounded by a low escarpment of Tertiary rocks. The true sabkha, with its impermeable substrate and evoporitic crust of gypsum, supports almost no vegetation. Eroded flat topped limestone and sandstone outcrops is a feature. The coastal highway never goes up to 30 m except in Ras Al-Khaimah studied areas (A, B, E, and F) where it becomes more constricted northwards by the mountain belt that provides a physical boundary between UAE and the northern tip of Oman. The northern and central of Ras Al-Khaimah are close geographically but different in the community types, the former is dominated by *Zygophyllum coccineum-Suaeda maritima,* and the co-dominant species are *Cyperus congalomeratus, Hyparrhenia hirta, Salsola arabica, Zygophyllum* sp., and the associated species are *Lolium regidum,* and *Spherocoma aucheri* while the associated spp. were *Seiditzia rosmainus, Haloxylon persicum, Zygophyllum simplex,* and *Aeloropus lagopoides.* Again, Al-Hamediah and Al-Homranya are close areas, yet different in community type where the former is dominated by *Cornulaca monacantha-Salsola impericata* and co-dominated by *Lolium regidum, L. perenne, Aeloropus lagopoides* and *Zygophyllum* spp. Al-Homranya community type is dominated by *Salsola impericata-Hyparrhenia hirta* with a few associated species.

b) Inland sites comprising part of the northern central desert region that extends north beyond Falaj Al-Moalla (c) where sand remains demarcated between the coastal oolitics and inland aeolian, while the gravel depressions are almost absent. The landscape is gently undulating, lacking in surface water and there are a few large outcrops in the area between Madam and Dhaid. (D) The community type of area (C) in Falaj Al-Moalla is *Zygophyllum coccineum - Cornulaca* monacantha with co-dominant *species Saueda* maritima in the brackish formations and *Heliotropium bacciferum subsp. tuberculosum.* The area of Dhaid is dominated by *Calotropis procera-Hyparrhenia hirta* and co-dominant species are *Imperata cylindrica, Lolium* spp., and *Sporobolus spicatus.* Further comparisons on communities levels are shown in tables 4, 5, and 6.

Floristic composition: 11 families were recorded in the six sites with 39 species (Table 2). Poaceae included 23.15% of the total species with modest R.I. except for *Hyparrhenia hirta* which was dominant in four communities

Table 1
Westerly component wind (> 20 knot) and seas (>4 Feet) for a 14-year period (1979-1992), Western Coast, UAE.

Item/Month	J	F	M	A	M	J	J	A	S	O	N	D
d* < 24 h	29	28	25	18	23	19	5	5	1	11	11	22
48 h>d< 24 h	20	14	19	11	4	2	1	1	0	4	0	16
d > 48 h	7	10	6	7	5	3	3	0	0	2	3	8
Seas > 4 feet	42	51	42	18	6	6	3	2	0	6	17	25

* d = duration

Table 2

List of families and their species, Recurrence (R) and Recurrence Index (R.I.) based on the record in 5 studied quadrates 2x2m^2 in each site of: A (Center of Ras-Al-Khaimah), B (North of Ras Al-Khaimah), C (Falaj Al-Moalla), D (Dhaid), E (Al-Hamediah), and F (Al-Homranya).

No	Family	Species	A	B	C	D	E	F	R	R.I.
1	Poaceae (Gramineae)									
	1- *Lolium rigidum* Guadin		-	5	-	4	5	-	14	46.7
	2- *Lolium perenne* L.		-	-	-	4	5	-	9	30.0
	3- *Hyparrhenia hirta* (L.) Stapf		4	-	-	5	4	5	18	60.0
	4- *Imperata cylindrica* L.		-	-	2	5	-	-	7	23.3
	5- *Aeloropus lagopoides* (L.) Trinex. Thwiates		-	1\-	-	-	5	-	6	20.0
	6- *Sporobolus spicatus* (vahl.) kunth		-	-	-	3	3	-	6	20.0
	7- *Cutandia dichotoma* (Forssk.) trabut		-	-	-	-	3	-	3	10.0
	8- *Schismus barbatus* (L.) Thell		-	-	-	-	2	-	2	6.7
	9- *Eleusine compressa* (Forssk.) Ascher et Schweinf		-	-	-	-	-	2	2	6.9
2	Chenopodiaceae									
	1- *Salsola imbricata Forssk.*		3	-	-	-	5	5	13	43.3
	2- *Salsola arabica Botsch*		4	-	-	-	-	-	6	20.0
	3- *Suaeda maritima* (L.) Dum.		5		5	-	-	-	10	33.3
	4- *Suaeda vermiculata* Forrsk.		-		-	-	4	-	9	30.0
	5- *Cornulaca monacantha* Del.		-		4	-	5	-	17	56.7
	6- *Haloxylon persicum Boiss.*		-		3	-	-	4	-	23.3
	7- *Seilditzia* rosmarinus Ehernb ex Bge		-		4	-	-	-	-	13.3
	8- *Halopeplis perfoliata* (Forssk.) Bge				-	-	-	-	-	6.7
3	Zygophyllaceae		5							
	1- *Zygophyllum* coccimeum L.		4		5	-	5	-	15	50.0
	2- *Z. sp. 2*		-		-	-	5	4	13	43.3
	3- *Z. simplex L.*		-		-	-	4	-	6	20.0
	4- *Z. qatarense* Hadidi		-		-	-	-	3	6	20.0
	5- *Fagonia ovalifolia Hadidi*		-		-	2	3	-	5	16.7
	6- *Fagonia indica Burm*		-		-	1	-	-	1	3.3
	7- *Nitraria retusa* (Forssk.) Ascher		-		-	-	4	-	4	13.3
4	Leguminosae									
	1- *Lotus gracinii* DC.		-		-	-	3	-	3	10.0
	2- *Indigofera spinosa Forssk.*		-		-	1	-	-	1	3.0
	3- *Acacia tortilis* (Forssk.) Hayne		-		-	-	1	-	1	3.0
	4- *A. ehrenbergiana* Hayne				-	-	2	-	2	6.7
5	Boraginaceae									
	1- *Heliotropium digynum* (Forssk.) Ascher ex C. Christen		4		3	-	-	-	4	13.3
	2- *H. bacciferum subsp.* tuberculosum(Boiss.) Riedl		-		-	3	-	-	3	10.0
	3- *Arnebia hispidissima* (Lehm) DC		-		-	-	4	-	4	13.3
6	Caryophllaceae		-				3	-		
	1- *Spherocoma aucheri Boiss.*		-		-	-	-	-	8	26.7
	2- *Paronychia arabica* (L.) Dc.		-		-	-	-	-	6	20.0
7	Asclepiadaceae									
	1- *Calotropis procera* (Ait.) Ait.		-		-	-	-	-	5	16.7
	2- *Leptadenia pyrotechnica* (Forssk.) Decne		-		-	2	-	-	2	6.7
8	Cyperaceae									
	1- *Cyperus conglomeratus* Rottb.		5		-	-	-	-	5	16.7
9	Euphorbiaceae									
	1- *Euphorbia larica* Boiss.		-		-	-	-	-	2	6.7
10	Asteraceae (Compositae)									
	1- *Pulicaria gnaphalodes* (Vent.) Boiss.		-		-	-	4	-	4	13.3
11	Plumbaginaceae									
	1- *Limonium axillare* (Forssk.) Kuntze		-		-	-	3	4	7	23.3

and *Lolium rigidum* as a co-dominant species with high R.I. Chenopodiaceae was represented as the second major family (20.5%) and the dominant species were *Salsola imbricata* and *Cornulaca monacantha.* Zygophyllaceae ranked the third and its species were about 18%. *Zygophyllum qatarense* was the common species in three communities with high R.I. Leguminosae and Boraginaceae species were 10.3% and 7.7% respectively. Caryophyllaceae and Asclepiadaceae were represented by two species each. There were four families represented by a single species each.

Dispersion: The data of dispersion indicated that dispersion is more uniform than random ($P<0.01$), where overall Morista's index of dispersion was about 0.7 (Table 3). The species areas recorded showed high correlation's on the log bases between the areas and the presented species (Fig. 2). The six studied sites reflected minimal areas of the desert ecosystems [3] where increase was not accompanied by an appreciable increase in species richness.

Table 3

Dispersion analysis for the communities of : A (Center of Ras Al-Khaimah), B (North of Ras Al-Khaimah), C (Ralaj Al-Moalla), D (Dhaid), E (Al-Hamrdiah), and F (Al-Homranya).
(<1 = random, 1 = uniform, and >1 contagious)

Parameter	Computer output
1- Number of samples	39
2- Mean per sample	1.58973
3- Median	1.00000
4- Variance	0.77463
5- Standard deviation	0.88013
6- variance to mean ratio	0.48727
7- Chi - Square	18.51620
8- Morisita index	0.68059
Conclusion: Dispersion is more uniform than random at $p<0.01$	

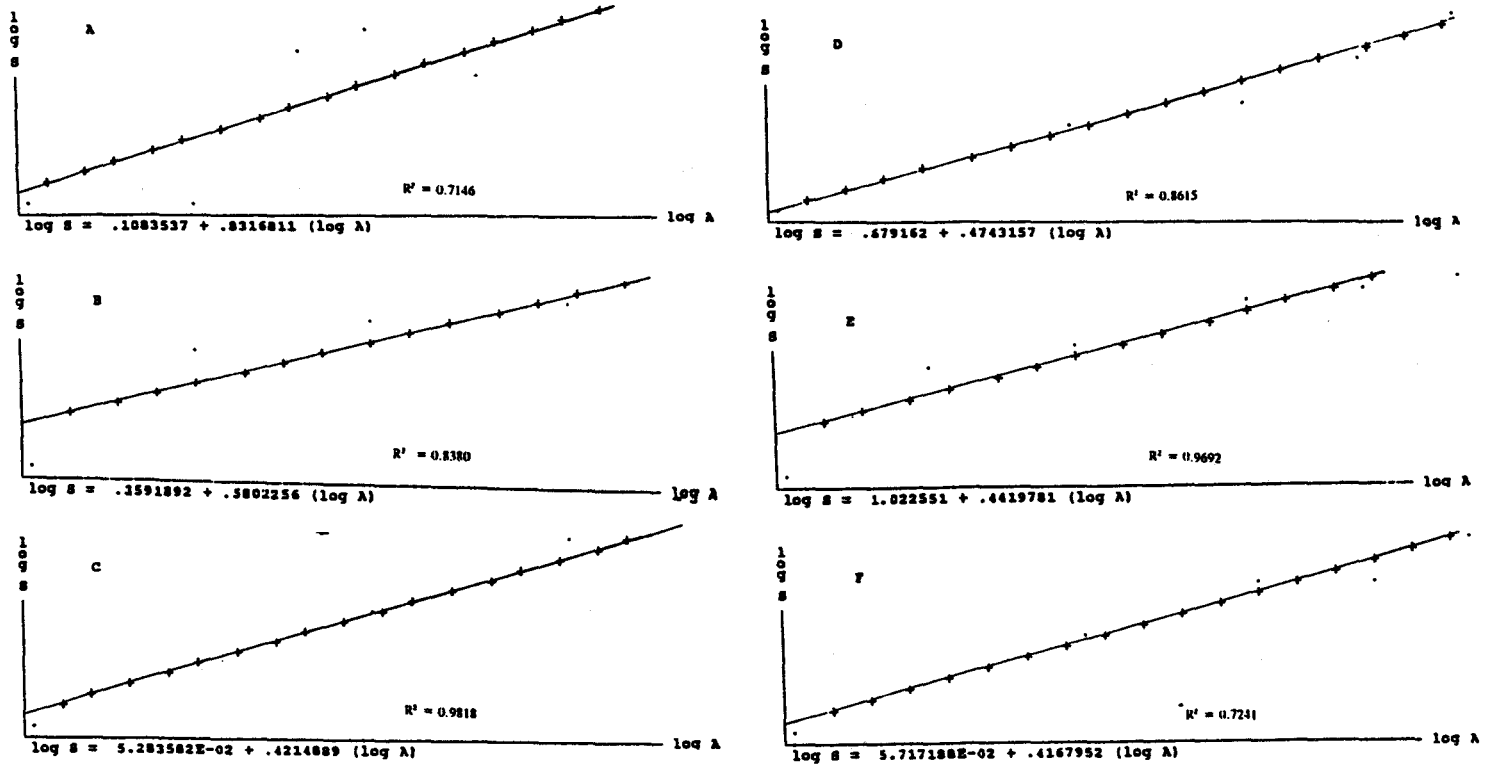


Fig. 2. Species-area relationships for A(Center of Ras Al-Khaimah), B (North of Ras Al-Khaimah), C (Falaj Al-Moalla), D (Dhaid), E (Al-Hamediah), and F (Al-Homranya), with r^2 values.

Diversity: The difference in species diversity (β) between areas or communities is indicated in Table 4. It is believed that choice of the suitable diversity index for best results in richness, heterogeneity, and evenness is still a difficult task [12,13]. The richness was calculated based on Margalef's index and its closely related index of Menhinick. They were selected here because of their simple straightforward measures for species abundance. Highest record was in area E followed by D, while the least recorded was in C. Heterogeneity indices take both evenness and richness with dominance in consideration such as Shannon's and Simpson's. Peet [14] suggested that they could be divided into type 1 (most affected by rate species, best choice is Shannon index) and type 2 (most effected by changes in abundance of most common species, best choice is Simpson's index). Simpson's index reflected high heterogeneity among the six studied sites, while Shannon's index showed high species richness in areas E and D, respectively and a poor one in area C. Hill's indices of heterogeneity reflected high uncertainity for species heterogeneity in the 6 studied communities, and the highest record was taken in area E. Diversity evenness indices of Pielou and Sheldon (the indices of evenness most common in ecological literature of population diversity) were used in this study because of their sensitivity towards species evenness distribution, especially in areas A and E. These data were confirmed by the calculated values of Heip's index for the very same areas. Hill's indices showed the highest evenness in areas E and A, respectively. In this study many diversity indices were applied because it would not be prudent if ecologists concentrated on one or a few indices.

Community similarity and cluster analysis. Community similarity and cluster analysis indices are recorded in Table 5. Results indicated complete dissimilarities between areas B-D, B-F, C-F and poor similarities between A-B, A-D, C-E. Morisita's index of similarity in the cluster analysis confirmed the results of % similarity, especially between B-D, B-F, C-F and showed a modest one between A-C, A-F. The same features appeared in cluster analysis, using Horn's index and coefficient of similarity for the same groups. The center of Ras Al-Khaimah and Falaj Al-Moalla are two different types of habitat as described before, yet they shared modest similarity.

Ordination. Again the ordination analysis proved that areas B-D, B-F, and C-F, have no similarity and the only modest similarity were between A-C, A-F, and E-F, (Table 6). Results of Euclidean distance and relative Euclidean distance reflected differences in total community abundance, especially for B-C (0.54) and B-F (0.564), C-F (0.631), and C-D (0.54). Absolute Euclidean distance confirmed the differences between species abundance, except for A-C, B-C, A-F and D-F. The relative absolute Euclidean distance showed complete difference in total community abundance between B-D, B-F, and C-F.

Table 4
Computed diversity indices in: (A) Center of Ras-Al-khaimah, B) North of Ras Al-Khaimah, C) Fakaj Al-Moalla, D) Dhaid, E) Al-Hamediah, and F) Al-Homranya

Index / community	A	B	C	D	E	F
A) Richness						
1- No of species	9	8	5	12	23	6
2- Margalef	2.216	2.020	1.359	3.046	4.914	1.595
3- Menhinick	1.480	1.414	1.147	1.973	2.452	1.251
B) Heterogeneity						
1- Simpson	0.910	0.889	0.825	0.925	0.965	0.858
2- Shannon (H')	2.181	2.010	1.559	2.368	3.102	1.750
3- Hill (NI)	8.854	7.465	4.754	10.678	22.252	5.754
4- Hill (N2)	11.100	9.018	5.700	13.059	28.335	7.028
C) Evenness						
1- Pielou (J')	0.993	0.967	0.969	0.953	0.989	0.977
2- Sheldon	0.984	0.933	0.951	0.890	0.967	0.959
3- Heip	0.982	0.924	0.939	0.880	0.966	0.951
4- Hill evenness	1.254	1.208	1.199	1.223	1.274	1.221
5- Hill modified	1.286	1.240	1.252	1.246	1.287	1.268

Table 5

Community simlarity indices, cluster analysis, and regression correlation of areas : A, B, C, D, E, F.

Item / community		A	B	C	D	E	F
A) No of species = 39 . B) No of Individuals = 208							
C) Proportion of y variation due to X, (R2) = 0.62499 (r) 0.24999							
c) Similarity	A	-	8.1	35.1	10.8	27.3	29.7
	B	-	-	15.6	0.0	21.3	0.0
	C	-	-	-	10.5	11.4	0.0
	D	-	-	-	-	22.7	24.3
	E	-	-	-	-	-	25.0
	F	-	-	-	-	-	-
d) Morisita Index	A	-	0.124	0.658	0.173	0.437	0.510
	B	-	-	0.227	0.000	0.365	0.000
	C	-	-	-	0.108	0.244	0.000
	D	-	-	-	-	0.404	0.436
	E	-	-	-	-	-	0.522
	F	-	-	-	-	-	-
e) Horn's Index	A	-	0.111	0.520	0.121	0.385	0.426
	B	-	-	0.184	0.000	0.372	0.000
	C	-	-	-	0.117	0.262	0.000
	D	-	-	-	-	0.343	0.312
	E	-	-	-	-	-	0.523
	F	-	-	-	-	-	-
F) Coef. of Similarity	A	-	0.063	0.273	0.050	0.185	0.250
	B	-	-	0.083	0.000	0.192	0.000
	C	-	-	-	0.063	0.077	0.000
	D	-	-	-	-	0.167	0.125
	E	-	-	-	-	-	0.208
	F	-	-	-	-	-	

Table 6

Community ordination analysis of: A) Center of Ras-Al-Khaimah, B) North of Ras Al-Khaimah, C) Falaj Al-Moalla, D) Dhaid, E) Al-Hamediah, and F) Al-Homranya.

Item / community		A	B	C	D	E	F
A) dissimilarity (Bray-Curtis)	A	-	91.3	53.6	89.2	69.6	63.3
	B	-	-	84.3	100.0	73.3	100.0
	C	-	-	-	92.9	83.2	100.0
	D	-	-	-	-	72.8	70.0
	E	-	-	-	-	-	64.0
	F	-	-	-	-	-	-
B) Euclidean distance	A	-	16.4	10.6	16.0	18.2	12.2
	B	-	-	13.5	16.8	18.2	15.2
	C	-	-	-	14.1	18.6	15.4
	D	-	-	-	-	18.6	13.2
	E	-	-	-	-	-	12.3
	F	-	-	-	-	-	16.3
C) Relative Euclidean distance	A	-	0.478	0.396	0.432	0.324	0.418
	B	-	-	0.540	0.490	0.361	0.564
	C	-	-	-	0.540	0.460	0.631
	D	-	-	-	-	0.319	0.430
	E	-	-	-	-	-	0.365
	F	-	-	-	-	-	-
D) Absolute Euclidean distance	A	-	63.0	30.0	66.0	87.0	38.0
	B	-	-	43.0	69.0	88.0	55.0
	C	-	-	-	52.0	89.0	42.0
	D	-	-	-	-	91.0	42.0
	E	-	-	-	-	-	71.0
	F	-	-	-	-	-	-
E) Relative Absolute Euclidean distance	A	-	1.8	1.3	1.8	1.5	1.4
	B	-	-	1.7	2.0	1.6	2.0
	C	-	-	-	1.8	1.8	1.5
	D	-	-	-	-	1.5	1.5
	E	-	-	-	-	-	-
	F	-	-	-	-	-	-

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REFERENCES

[1] **Morairty, F.,** 1988. Ecotoxicology. Academic Press. NY.

[2] **Gleason, H.A.,** 1926. The individualistic concept of the plant association. Bull. Torr. Bot. Club, 53: 6-26.

[3] **Mueller-Dombois, D. and H. Ellenberg,** 1974. Aims and Methods of Vegetation Ecology.) John Wiley & Sons. NY.

[4] **Pielou, E.C.,** 1984. The Interpretation of Ecological Data. Wiley. NY.

[5] **Kent, M. and P. Coker,** 1992. Vegetation Description and Analysis. CRC Press. London.

[6] **Mandaville, J.P.,** 1990. Flora of Eastern Saudi Arabia John Wiley & Sons. For KPI. Ltd. London.

[7] **Cornes, C.D. and M.D. Cornes,** 1989. The Wild Flowering Plants of Bahrain. Immel Publ. Ltd. London.

[8] **Batanouny, K.H.,** 1981. Ecology and Flora of Qatar. Scientific and Applied Research Centre, University of Qatar

[9] **Migahed, A.M.,** 1978. Flora of Saudi Arabia (2nd.) Vol. 2. Riyadh University Press, Riyadh.

[10] **Migahed, A.M.,** 1978. Flora of Saudi Arabia (2 nd.) Vol. 1. Riyadh University Press, Riyadh.

[11] **Täkholm, V.,** 1974. Student's Flora of Egypt. (ed.2). Cairo Univ. Press.

[12] **Magurran, A.E.,** 1988. Ecological Diversity and its Measurements Croom Helm. London-Sydney.

[13] **Burrows, C.J.,** 1990. Processes of Vegetation Changes. Unwin Hyman, London.

[14] **Peet, R.K.,** 1974. The measurement of species diversity. Ann. Rev. Ecol. Systems. 5: 285-307.

[15] **Bray, J.R. and J.T. Curtis,** 1957. An ordination of the upland forest communities of southern Wisconsin. Ecol. Monograph. 27: 325-349.