

Phytosociological Survey on the Central Coastal Lowlands of Eastern Saudi Arabia

مسح المجتمعات النباتية والكساء الخضري Phytosociological في المنطقة الساحلية الوسطى، شرق المملكة العربية السعودية

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Abstract: The vegetation composition of the central coastal lowlands of Eastern Saudi Arabia was analysed. The appearance and distribution of the studied plant groupings were affected by atmospheric, edaphic conditions as well as topography. Eighty seven species belonging to (33) families of flowering plants were recorded in the following seven plant communities which are dominated and co-dominated by (*Zygophyllum qatarense*), (*Lasiurus scindicus* and *Lycium shawii*), (*Alhagi graecorum* and *Cynodon dactylon*), (*Phoenix dactylifera* and *Tamarix aphylla*), (*Aeluropus lagopoides* and *Sporobolus ioclados*), (*Halocnemum strobilaceum* and *Arthrocnemum macrostachyum*) and (*Avicennia marina*).

Keywords: East of Saudi Arabia, phytogeography, plants survey, biodiversity.

المستخلص: تستهدف الدراسة مسح وتحليل الكساء الخضري الطبيعي في الجزء الأوسط من الساحل الشرقي للمملكة العربية السعودية، باستخدام الطريقة المتبعة في مدرسة زيورخ ومونبيلية. (تم تسجيل عدد (87) نوعاً من النباتات، وتفصيلها إلى (33) فصيلة زهرية. كما أوضح جدول المجتمعات النباتية تصنيفها في (7) مجتمعات نباتية هي، مجتمع الرطريط (*Zygophyllum qatarense*)، مجتمع السماط والعوسج (*Lasiurus scindicus* and *Lycium shawii*)، مجتمع العاقول والنجيل (*Alhagi graecorum* and *Cynodon dactylon*)، مجتمع نخيل البلح والأثل (*Phoenix dactylifera* and *Tamarix aphylla*)، مجتمع المليح وأبو ركة (*Aeluropus lagopoides* and *Sporobolus ioclados*)، مجتمع السعدة والخريط (*Halocnemum strobilaceum* and *Arthrocnemum macrostachyum*)، ومجتمع الشورة (*Avicennia marina*) ولاسيما وأن منطقة المسح، تتمتع بالتنوع البيئي الذي يتنوع معه الغطاء النباتي بشكل واضح ومميز. ويتراوح هذا التنوع من الأراضي الصخرية المرتفعة إلى التربة المفككة الرملية والسلتية المنبسطة، وإلى ما يعرف بأرض السبخات اللزجة، والمستنقعات المحية وبيئة المانجروف حيث المد والجزر لمياه الخليج. برهنت الدراسة، أن التنوع في الكساء الخضري، رغم قلة كثافته، يعكس مدى تباين المناخ والبيئية للمنطقة، حيث بلغت نسبة الأشجار، مثل أشجار النخيل (*Phoenix dactylifera*)، والأثل (*Tamarix aphylla*)، والسدر (*Ziziphus spina-christi*) (4.3%) بينما بلغت نسبة الشجيرات وتحت الشجيرات، مثل العوسج (*Lycium shawii*) والمرخ (*Leptadenia pyrotechnica*) والقرص (*Ochradenus baccatus*) (30.7%)، أما الأعشاب فقد بلغت (65%) من جملة عدد النباتات. والنباتات الحولية قصيرة العمر التي تكمل دورة حياتها خلال فترة قصيرة (59.6%)، ويعتمد غطاء الحوليات على وجود كميات كافية من مياه الأمطار، والاعتدال النسبي في درجات الحرارة خلال فصلي الشتاء والربيع. يلاحظ أيضاً، أن ملوحة التربة تلعب دوراً كبيراً في تأخير إنبات البذور لهذه النباتات، ومن ثم فإن هطول الأمطار يتسبب في تخفيف درجة ملوحة الأرض، وبالتالي إلى إنبات البذور. تحتوي فلورة منطقة المسح، على مجموعة من النباتات ذات الأهمية الاقتصادية، كنباتات الرعي مثل الثيموم (*Lasiurus scindicus*)، والثمام (*Panicum turgidum*)، والشورة (*Avicennia marina*) التي جانب نباتات غذاء الإنسان، مثل الرجلة (*Portulaca oleracea*)، والخبيزة (*Malva parviflora*)، بالإضافة تلك المستخدمة في التداوي مثل العشار (*Calotropisprocera*)، والغبيشة (*Eremobium aegyptiacum*)، والارطى (*Calligonum comosum*). يلاحظ أيضاً، تداخل مجموعات الكساء الخضري بدرجة كبيرة وقلة تنوعه في الأرض المحية مقارنة بالصحراوية، فضلاً عن اختفاء الكثير من النباتات في بعض المناطق بسبب النشاط العمراني، أو نتيجة لعمليات الرعي الجائر، مما يعني كثير من التغيرات في التكوينات النباتية للمنطقة. من الجدير بالإشارة، أن بعض الأنواع لم يتم تسجيلها من قبل نبات اللصف (*Capparis aegyptiaca*)، رغم أن تسجيل الأنواع النباتية وعشائرها، كسجل يوثق الطبيعة، من الأهمية بمكان للملاحقة التغير الناتج عن ظروف البيئة، والنشاط البشري الضار في استدامة البيئة الطبيعية.

كلمات مدخلية: شرق السعودية، مسح نبات، نباتات زهرية، أشجار، شجيرات، حوليات، تنوع بيئة.

Area of Study

Phytogeographically, the central part of Eastern coastal region is one of the major sectors of Saudi Arabia. The biodiversity of vegetation and community types in the littoral salt marshes and coastal plains are associated with the type of soil and with the water resources in rocky grounds.

The vegetation of the Eastern part of Saudi

Arabia has been studied floristically and phytosociologically for many years. Among works dealing with the Eastern part of Saudi Arabia are: (Vesey-Fitzgerald 1957), (Mandaville 1965, 1990), (De Marco & Dinelli 1974), (Barth 1976), (Migahid & El-Sheikh 1977), (Migahid 1978), (Zahran 1983), (Batanouny & Baeshin 1983), (Batanouny 1987); (Shaltout & El-Halawany 1993), (Ghazanfar & Fisher 1998), (Barth & Ber 2002).

The present study aims to distinguish the plant communities existing in the Central Coastal Region of Eastern Saudi Arabia, which extends from the Northern coast of Ras as-Saffaniyah Southwards to Dhahran, and is bounded on the West by the escarpment of the Summan (Mandaville 1990).

Location and Climate

The surveyed area in Saudi Arabia lies between latitudes 26° and 28° North; and longitudes 48°:10' and 50°:13' East, (Fig. 1). The width of coastal plains vary from hundred meter in some areas to few kilometers in others, it also comprises the lands bordering the shore where the vegetation are of rocky grounds, salt marches and desert vegetation. The atmospheric and edaphic aridity plays a major role in the vegetation diversity and plant cover. The physiographic features of the region vary remarkably in terms of climatic conditions, soils and in consequence, the pattern of vegetational cover.

The study area has a surface exposures of tertiary sediments (Powers *et. al.*, 1966). These sediments were deposited during that period, covered by a regosol soils in the form of aeolian sands, beach deposits and late tertiary to Quaternary gravel sheets. The Dammam formation rocks are limestone, marl sandy shale and evaporites. The marine formation is continental deposits of conglomerate, sandstone, sandy limestone, sandy marl, sandy shale and evaporites. The soils of the Eastern region of Saudi Arabia is generally composed of saline loamy sand silts. A wide-spreading swamps are characterized by highly saline flat with crusted surfaces and proximity of water table to the soil surface.

Ecologically, the study area can be categorized into four habitats namely:-

- (1) Rocky ground which is a rising (5m to 15m.) limestone exposure with gentle or steep slopes. Sometimes, the slopes are covered by rocky fragments, however a thin layer of alluvial soil deposits on the rocky surfaces. The vegetation cover is mostly sparse due to limited water resources.
- (2) Non-saline inlands which are vast areas with sandy substratum mixed with silt and small proportion of gravels. Adequate water supply and relatively low salinity are supportable factors for the vegetation density.
- (3) Saline inlands which are extending along the littoral line, inland areas or around the sabkhas. In general, the high salinity prohibits the growth of most plants except the true halophytes.
- (4) Brackish, marshes and intertidal muddy soils

are characterized by water abundance and distributed in the shores of the studied regions, in swamps and in the depressions nearby the cultivated areas. The vegetation diversity is restricted by few species.

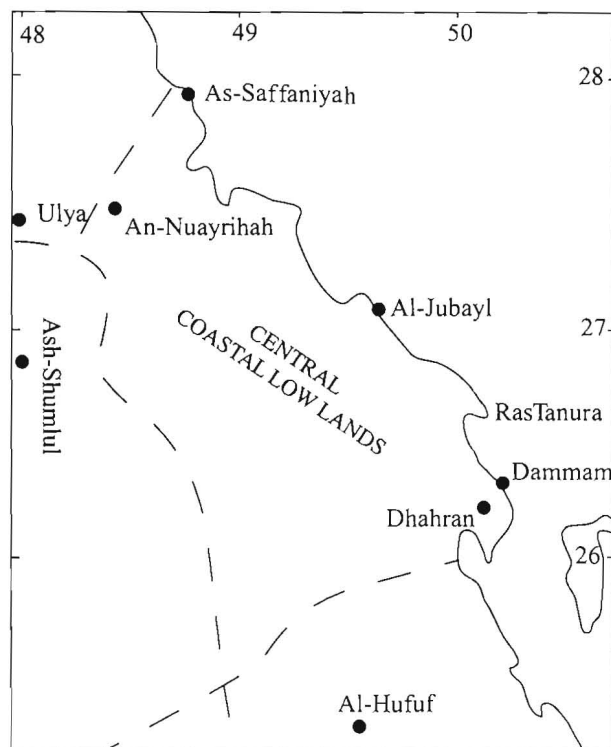


Fig.(1): Location area of the study area.

The climate of the Central Eastern coastal lowlands, where the study area is located, is characterized by low rainfall and relatively high temperatures. (Mandaville 1990) states that, the Eastern region of Saudi Arabia is arid and belongs to a subtropical desert climate. The average minimum temperature is (9.6°C) (absolute temp. = 4°C) in January, whereas the average maximum temperature reaches up to (44.5°C) (absolute temp. = 48°C) in June. The rainy period extends from November to April with mean annual rainfall up to (78.5 mm); Summer months are dry. The mean relative humidity ranges from (30 % in June) to (71% in February). Prevailing wind velocity becomes more active around the hot midday, it reaches (22.8 km/hr) in June.

The available climatic data were collected from the station of Dhahran after (Mandaville 1990). The following charts summarise the rainfall, temperature and relative humidity of the study area (Figs. 2 & 3).

Materials and Methods

Thirty five stands were randomly chosen where variations in plant cover were encountered. The observed species were rated according to Zurich-

Montpellier technique (Braun-Blanquet 1964). The presence value as percentage was calculated for the encountered species and the scales of combined abundance-dominance and sociability are used. The life forms of the recorded species is described according to (Raunkiaer's system 1934).

The collected specimens are identified according to (Migahid 1978), (Collenette 1985, 1998) and (Mandaville 1990) and checked with the specimens deposited in the Herbarium of Cairo University. The identified specimens are deposited at the Herbarium of Assiut University.

P = Presence value in (%)

AD = Combined abundance – dominance scale of six grades (+ to 5)

* = Species of negligible (AD values).

Results

The collected species in the surveyed area are belonging to (33) families and comprise (62.9 %) of ephemeral species. Furthermore, the life forms (Raunkiaer's system) are supported by phanerophytes (13.5%), chamaephytes (23.6%), cryptophytes (19.1%) and therophytes (43.8%). The diversity of vegetation composition reflect the variation of edaphic conditions and local topography. Therefore, the following seven plant communities are recognized (Table 1 & 2).

(1). *Zygophyllum qatarense* Community

It has a wide ecological amplitude and is distributed in sandy soils, gravelly slopes and shallow depressions with fine textured soils. The floristic composition of this community comprises only (6) species: (5) perennial and (1) annual. The presence of halophilous *Salsola tetrandra* is an indicative of a moderate saline habitat. The tree layer is missing and the presence value of the characteristic species

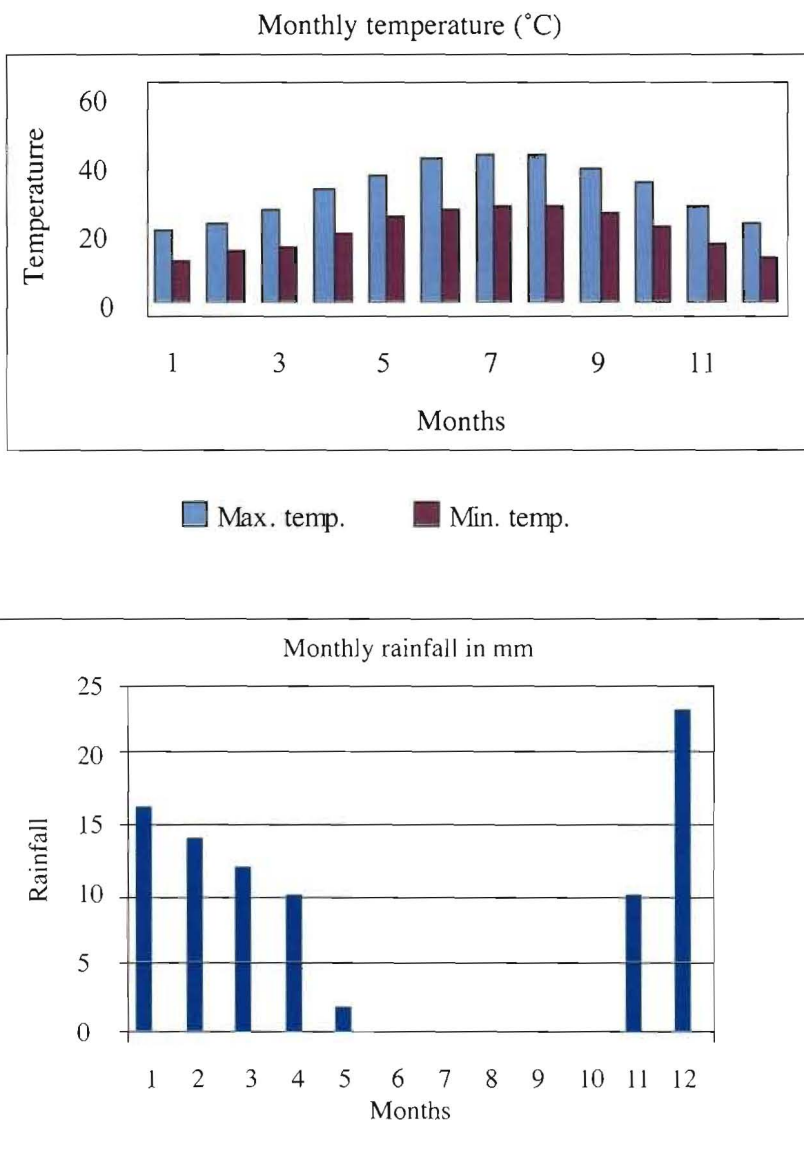


Fig. (2): Monthly temperature and rainfall, average of 10 years at Dhahran.

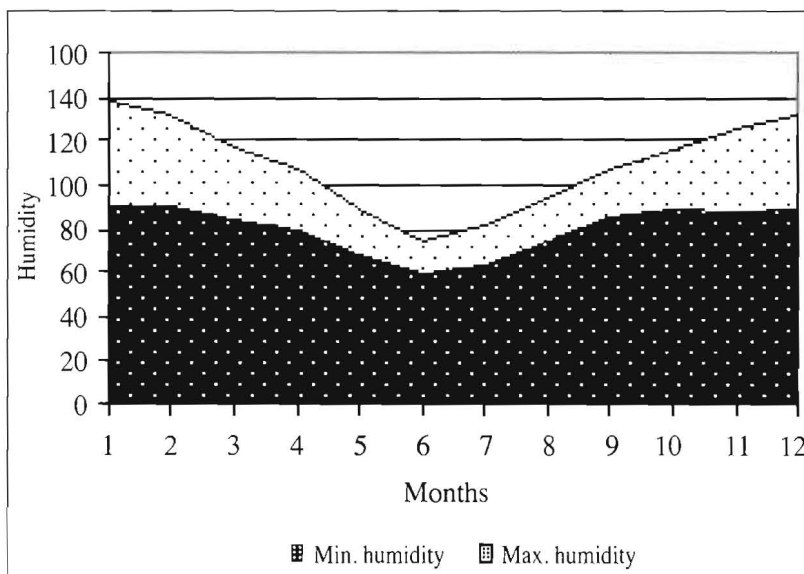


Fig. (3): Monthly relative humidity, average at 10 years at Dhahran.

Zygophyllum qatarense, *Heliotropium bacciferum* (Fig. 4.a) and *Salsola baryosma* ranges between (60% to 75%). *Cyperus conglomeratus*, *Fagonia indica* and *Launaea mucronata* (Fig. 4.d) are co-dominants with presence values ranging between

dated area are inhabited by the perennial associates such as *Atractylis carduus* and *Ochradenus baccatus* (See, Fig. 4.c). The annual plants, on the other hand, adapted the shallow alluvial soils present on the rockyhills and retaining limited water supply.



a. *Heliotropium bacciferum*



b. *Lycium shawii*



c. *Ochradenus baccatus*



d. *Launaea mucronata*

Fig. (4): Selected flowering plants from in Dammam region (KSA)

(31% to 57 %). The herbaceous layer is enriched during the rainy season by the annual grass *Schismus barbatus*.

(2). *Lasiurus scindicus*-*Lycium shawii* Community

Twenty one species are recorded in this community, of which eleven are perennials and the rest are (10) annuals. The characteristic species *Lasiurus scindicus*, *Lycium shawii* (See, Fig. 4.b) and *Moltkiopsis ciliata* dominated the elevated and steep rocky ground. The shallow sand-silts and consoli-

(3). *Alhagi graecorum*-*Cynodon dactylon* Community

This community includes five perennials and the rest are annuals, *Lactuca saligna* which is a biennial. The appearance of *Melilotus indicus*, *Melilotus albus*, *Senecio glaucus*, *Cutandia memphitica*, *Malva parviflora* and *Sonchus oleraceus* depends mainly on the rainfall abundance and low temperature, between January and March. On the otherhand, the characteristic species *Alhagi graecorum* and *Cynodon dactylon* tolerate a such environmental conditions as atmospheric aridity, salinity and grazing.

(4). *Phoenix dactylifera*-*Tamarix aphylla* Community

This community exists in deep sandy soils, where the dominant plants relatively form pure stands in some places. The plants of this group bearing a xero-

morphic characters. *Capparis aegyptiaca* is not previously recorded in the investigated area and is related to Tarut Island.

(5). *Aeluropus lagopoides* - *Sporobolus ioclados* Community

This community present in waste places, edges of swamps and in wet salinized habitats. It is a limited group of halophytic or saline tolerant species. Perennials are restricted by *Aeluropus lagopoides*, *Sporobolus ioclados*, *Phragmites australis* and *Cressa cretica*.

Table (1) : Floristic composition of the studied area Stands

Stands Species	12	21	14	13	18	10	16	9	8	17	2	5	3	4	1	15	20	22	P
1		++	1.1	2.4	++		++	1.2		3.3	++	++	++	1.3	++	1.2	2.4	1.2	75
2		++	2.2	1.2		2.2	1.1		2.2	1.1	2.3	++	1.1	++	1.1	++	++	++	69
3			1.1	1.2	1.+	++	++	2.3	1.1		2.1	+.1		++			2.4		60
4						++			++		1.2	1.2			1.+	++	++	++	57
5		++	++		1.2		1.1	++	1.+					1.+	++		++		31
6			++	++		++	++	++										++	31
7	++		1.3		++		++	1.+											26
8		++	+.1	1.2	2.3	++		1.1							++			++	26
9	3.2	1.+		++		1.1	++				++								17
10		1.2	++	++		2.4	1.+	++											17
11	++	1.1		++	++	+.1		++											14
12				++		++	++	1.1											14
13	++	++				++													9
14			++							++									6
15				++		+.1													6
16					++														6
17	++	1.2																	6
18		++					2.1												9
19				++							++								6
20		++			++			++											6
21							++	++											6
22		++																	3
23				++															3
24			++																3
25				++															3
26						++													3
27					++														3
28									++										3
29													1.3	++	2.3	++	++	2.3	17
30											+.1	+.1	1.3	++	++	+.1			14
31												1.3	++	++	++	2.3			14
32											++	++		++	1.2		++		14
33											+.2			2.3	+.2				9
34								++				++		++					9
35												++			++	++			9
36												++		++					9
37											++				++	++			9
38								1.3				1.2				1.3			9
39													++	++					6
40												1.3				+.1			6
41												++				++			6
42												++	++						6
43														++		++			6
44												++							3
45												++							3
46													1.3						3
47													++						3
48																++			3
49												++							3
50																++			3

(1). *Zygophyllum qatarense* Hadidi; (2). *Heliotropium bacciferum* Forssk.; (3). *Salsola tetrandra* Forssk.; (4). *Cyperus conglomeratus* Rottb.; (5). *Launaea mucronata* (Forssk.) Muschl.; (6). *Fagonia indica* Burm. f.; (7). *Schismus barbatus* (L.) Thell.; (8). *Lasiurus scindicus* Henrard; (9). *Lycium shawii* Roem. & Schult.; (10). *Moltkiopsis ciliata* (Forssk.) I. M. Johnst.; (11). *Emex spinosa* (L.) Campd.; (12). *Dipterygium glaucum* Decne.; (13). *Medicago laciniata* (L.) Mill.; (14). *Bassia muricata* (L.) Asch.; (15). *Hordeum murinum* L.; (16). *Neurada procumbens* L.; (17). *Herniaria hirsuta* L.; (18). *Convolvulus asyrensis* Kotschy; (19). *Lolium rigidum* Gaudin; (20). *Atractylis carduus* (Forssk.) C. Chr.; (21). *Paronychia arabica* (L.) DC.; (22). *Ochradenus baccatus* Delile; (23). *Ifloga spicata* (Forssk.) Sch.-Bip.; (24). *Stipagrostis plumosa* (L.) Munro ex T. Anderson; (25). *Avena barbata* Pott ex Link; (26). *Monsonia nivea* (Decne.) Webb; (27). *Lotus corniculatus* L.; (28). *Eremobium aegyptiacum* (Spreng.) Asch. & Schweinf.; (29). *Alhagi graecorum* Boiss.; (30). *Cynodon dactylon* (L.) Pers.; (31). *Melilotus indicus* (L.) All.; (32). *Senecio glaucus* L.; (33). *Cutandia memphitica* (Spreng.) Richt.; (34). *Portulaca oleracea* L.; (35). *Pluchea dioscoridis* DC.; (36). *Sonchus oleraceus* L.; (37). *Fagonia Olivieri* DC.; (38). *Malva parviflora* L.; (39). *Launaea nudicaulis* (L.) Hook. F.; (40). *Anagalis arvensis* L.; (41). *Melilotus albus* Medik.; (42). *Convolvulus arvensis* L.; (43). *Polypogon monspeliensis* (L.) Desf.; (44). *Amaranthus hybridus* L.; (45). *Linaria tenuis* (Viv.) Spreng.; (46). *Cuscuta campestris* Yunck.; (47). *Cucumis prophetarum* L.; (48). *Papaver rhoeas* L.; (49). *Cyperus rotundus* L.; (50). *Lactuca saligna* L.

Table (2) : Floristic composition of the studied area (cont.)

Stands Species	24	27	28	29	30	6	7	11	26	25	23	32	33	34	35	19	31	P
1	++	2.2	1.2		++		++	2.3	1.2	1.2	++	++	++					75
2	++		1.1	++	1.1	1.2	3.2		++		+1			++				69
3			+1		2.2	1.1	1.2	++		1.2	++	1.1	1.1	+1				60
4	++	++	++	++	++	1+	++		++	1.2		++	1.1	++				57
5	++		+1	++														31
6	++	++																31
7	1.3	1.3																26
51	1.2	1.1		2.2	++		1.2											20
52	++	+2	1.1	++	++	++		+1										20
53		++	++	1.1			++											11
54		++	++	++		++												11
55	++			1.1		++												9
56	++		++		++													9
57			++		++													6
58	++			++														6
59			++															3
60				++														3
61			++															3
62			++															3
63			++															3
64			++															3
65			++															3
66			++															3
67			++															3
68			++															3
69				1.3	1.3	++		1.3	++		++							17
70					++	1.1	++	+1		1.3	++							17
71	++					1.3		++	1.3			1.2	++					17
72			++		1.2			++	++		+1		++					17
73	++					++	++	++										11
74							++	++										6
75						++		++										6
76							++	++										6
77							++		++									6
78												3.4	++	2.2				9
79												1.2	1.2	3.2				9
80												++	++					6
81												++	++					6
82													1.1		++			6
83													1.3	++				6
84												++						3
85					++									++	2.3			9
86															1.3			3
87														++		3.3	4.4	9

(1). *Zygophyllum qatarense* Hadidi; (2). *Heliotropium bacciferum* Forssk.; (3). *Salsola tetrandra* Forssk.; (4). *Cyperus conglomeratus* Rottb.; (5). *Launaea mucronata* (Forssk.) Muschl.; (6). *Fagonia indica* Burm. f.; (7). *Schismus barbatus* (L.) Thell.; (51). *Phoenix dactylifera* L.; (52). *Tamarix aphylla* (L.) Karst.; (53). *Panicum turgidum* Forssk.; (54). *Leptadenia pyrotechnica* (Forssk.) Decne.; (55). *Calotropis procera* (Ait.) Ait.; (56). *Cenchrus ciliaris* L.; (57). *Caylusea hexagyna* (Forssk.) M. L. Green; (58). *Capparis aegyptiaca* Lam.; (59). *Flaveria trinervia* (Spreng.) Mohr.; (60). *Ziziphus spina-christi* (L.) Desf.; (61). *Phalaris minor* Retz.; (62). *Taverniera sparteae* (Burm. f.) DC.; (63). *Calligonum comosum* L'Her.; (64). *Cistanche tubulosa* (Schenk) Hook.; (65). *Indigofera intricata* Boiss.; (66). *Arnebia hispidissima* (Lehm.) DC.; (67). *Plantago boissieri* Hausskn. & Borm.; (68). *Aerva javanica* (Burm.f.) Juss. ex Schult.; (69). *Aeluropus lagopoides* (L.) Trin. ex Thwaites; (70). *Sporobolus ioclados* (Nees ex Trin.) Nees; (71). *Phragmites australis* (Cav.) Trin. ex Steud.; (72). *Suaeda aegyptiaca* (Hasselq.) Zohary; (73). *Tribulus pentandrus* Forssk.; (74). *Chenopodium album* L.; (75). *Tribulus terrestris* L.; (76). *Launaea capitata* (Spreng.) Dandy; (77). *Cressa cretica* L.; (78). *Halocnemum strobilaceum* (Pall.) M. Bieb.; (79). *Arthrocnemum macrostachyum* (Morice.) K. Koch; (80). *Suaeda monoica* Forssk. ex J. F. Gmel.; (81). *Haloplepis perfoliata* (Forssk.) Asch.; (82). *Limonium axillare* (Forssk.) Kuntze; (83). *Suaeda maritima* (L.) Dumort.; (84). *Tamarix macrocarpa* (Ehrenb.) Bunge; (85). *Juncus rigidus* Desf.; (86). *Cyperus laevigatus* L.; (87). *Avicennia marina* (Forssk.) Viern.

(6). *Halocnemum strobilaceum* and
Arthrocnemum macrostachyum
Community

This community occurs along the coastal line in salt marshes, on ground above the intertidal areas and sometimes near brackish water. *Halocnemum strobilaceum* and *Arthrocnemum macrostachyum* abundant on the soils affected hummocks of sabkhas.

(7) *Avicennia marina* Community

This is a monospecific community consists of pure population dominated by *Avicennia marina*, mangrove plant, which exhibits a tendency to grow in the first zone of the intertidal muddy soils, and shallow Gulf water.

Discussion

The study area is a part of an phytogeographical sector of the Eastern coastal lowlands of Saudi Arabia. Seven communities and eighty seven plant species are recorded. The study showed that the soil is the main factor affecting the variations of vegetation and community types.

Physiographically, the study area can be discriminated into three habitats:-

- (I) littoral salt marsh,
- (II) coastal desert plains and
- (III) rockyhills.

The mangrove is dominated by *Avicennia marina*, where the soil is highly saline and usually covered with water. Soil of mangal vegetation has been described previously by (Zahran *et. al.* 1983). The climatic conditions are the limiting factor in the distribution of the mangrove especially the temperature (Vesey-Fitzgerald 1956). The littoral salt marsh is dominated by two communities namely *Halocnemum strobilaceum* and *Arthrocnemum macrostachyum* and *Aeluropus lagopoides* and *Sporobolus ioclados*, where the soil was sandy, slippery and highly saline.

The coastal desert plains are dominated by *Phoenix dactylifera-Tamarix aphylla* and *Alhagi graecorum-Cynodon dactylon*, thirty nine species are recorded of which the trees layer is represented by *Phoenix dactylifera*, *Tamarix aphylla* and *Ziziphus spina-christi*. The rockyhills are dominated by *Lasiurus scindicus-Lycium shawii* and the wide-spread community of *Zygophyllum qatarense* which occurred in various habitats except the mangroves. *Medicago laciniata*, *Herniaria hirsuta* and *Neurada procumbens* inhabited the shallow alluvial soils

deposited on the elevated rockhills which have a limited water supply.

The poorly represented species in rocky and compact soils probably due to the conserve inadequate water supply required for the seed germination. On the other side, the germination of many annual's seeds is delayed by soil salinization and the dilution of soil solution during rainy season attenuate this problem.

Generally, the natural vegetation of the study area is gradually reduced, ephemerals are represented by (59.6%) of the vegetation, this agrees with (Freitag 1986) that, in such environments annuals show high percentage of species of the local flora. Also, the stratification of life forms includes layers of trees, (4.3 %), shrubs and subshrubs, (30.7%) and herbs, (65 %). The local flora exhibits a high percentage of ephemerals (62.9 % of gathered species), this is generally typical of hot deserts.

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