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On the Ecology of the Deltaic Mediterranean Coastal Land, Egypt

III. The Habitat of Salt Marshes of Damietta - Port Said Coastal Region

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ABSTRACT. The present study provides estimates of the vegetation structure and its plant communities in the coastal salt marshes between Damietta and Port Said, to determine the factor or factors controlling the species distribution and to correlate the vegetational gradients with the edaphic factors. Five major communities constitute the major part of the natural vegetation of the study area and are dominated by five perennials:

Zygophyllum aegyptium A. Hosny, *Arthrocnemum macrostachyum* (Moric.) Moris and Delmonte, *Halocnemum strobilaceum* (Pallas) M. Bieb., *Juncus acutus* L. and *Juncus rigidus* Desf. Therophytes are the most frequent life-form in these communities. The results of this study confirm the presence of a Mediterranean floristic territory in Egypt. Analysis of the correlation between the vegetational gradients and the edaphic factors shows that calcium carbonate, organic carbon, sulfate, bicarbonate and potassium are the main operating edaphic factors in this habitat.

The vegetation of the Mediterranean coastal region of Egypt is considered one of its major natural resources. Its proper utilization plays a define role in the development of the region which is known to have enjoyed prosperity during the Greco-Roman times (Kassas 1972).

Massoud (1977) reported that the salt affected ecosytems covers about 7% of the world surface area. The developing countries, especially, those in the arid and semi-arid regions (*e.g.* Egypt), direct their efforts towards the renewable resources of these ecosystems to produce more food for people and forage for animals. Such efforts should be based on previous knowledge of climate, soil, vegetation and wild life as well as human activities (El-Demerdash 1984).

The present paper describes the vegetation composition of the salt marshes of the area between Damietta and Port Said in terms of spatial variation in species abundance by using the multivariate analysis. It also aims to analyse the spatial and temporal variation in environmental factors and to ascertain the correlation between these variations and the vegetation distribution.

Materials and Methods

Thirty six stands (13×13 m each) with a reasonable degree of physiographic and physiognomic homogeneity, were selected to represent the study area. The point centered quarter method was applied to provide estimates of relative frequency and density for each perennial species while, the relative cover was estimated using the line intercept method, these three values were then added to provide an importance value. Annual species were recorded in each stand. The presence percentage was calculated for each species (Ayyad 1970)..

The multivariate analysis were used in classifying and ordinating stands. The classification technique applied here is the agglomerative clustering using the mutual information as a measure of similarity between stands (Orloci 1969). The principal component analysis technique (PCA) was applied to achive two dimensional ordination of stands.

In each of the 36 stands, soil samples were taken at two depths: 0-25 and 25-50 cm. Samples were carried to the laboratory directly, air dried and sieved before analysis. Soil texture was determined by sieve method according to Jackson (1962). The maximum water holding capacity was estimated by Hilgard Pan box as described by Piper (1947). While, $CaCO_3$ percentage was estimated by titration against IN HCL as described by Jackson (1962). Oxidizable organic carbon was estimated using Walkely and Black rapid titration according to Black (1979). In the meantime estimation of soil pH, electrical conductance (E.C), HCO_3, Cl, SO_4 was carried out using soil: water extracts at ratio 1:5.

Extractable cations (Na^+, K^+, Ca^{++} and Mg^{++}) were extracted using ammonium acetate solution at pH 7 and estimated using flame photometer (Na^+, K^+, and Ca^{++}) and atomic adsorption (Mg^{++}) (Allen *et al.* 1974). Sodium and potassium adsorption ratios (SAR & PAR) were calculated according Mckell and Goodin (1984).

All statistical treatments applied are according to Snedecor and Cochran (1968). Identification, nomenclature and floristic categories were kindly carried out by Dr. I. Mashaly, Lecture of Plant Ecology, Faculty of Science, Mansoura University, in the herbaria of both the Faculty of Science University of Cairo and the Royal Botanical Gardens "Kew", England under supervision of both Dr. N. El-Hadidi, Professor of Botany, Botany Department, Cairo University and Dr. C.A. Stace, Professor of Plant Taxonomy, Botany Department, University of Leicester, U.K.

Ecological characteristics of the study area

The study area is a part of the deltaic Mediterranean coast of Egypt. It extends between Damietta and Port Said for about 65 km with a width ranging between 5-15 km. It covers an approximate area about 650 km^2 (Fig. 1).

The geomorphology of the study area is characterized by three shallow lakes occupying the northern part of the delta, Lake Manzala (east), Lake Borollus (middle) and Lake Idku (west). Many areas around these lakes are permanently covered with water as a result of flooding from these lakes and inland canals. Some areas are salt flats and others are marshes.

According to the climatic normals of Egypt (Anonymous 1960) and Ayyad *et al.* (1983) this area lies in the attenuated arid province characterized by a short dry period, annual rainfail ranging between 100-160 mm, warm summer (27-31°C), mild winter (8.2-24°C), and P/Etp below 0.03 (where P is the mean annual precipitation and Ept is the potential evapotranspiration). Means of 30 years of two meteorological stations: Damietta and Port Said indicate that air temperature varies from a maximum of 27.4°C to a minimum of 13.3°C. In the meantime the relative humidity varies from a minimum of 69% during summer to a maximum of 84% during winter. The mean annual rainfall at Damietta was 102.3 mm compared to 66.3 mm at Port Said. The mean evaporation rate varies between 2.6 mm/day and 8.1 mm/day.

Results

Species and Life-form spectrum

Thirty eight plant species related to 13 families are recorded in the study area: 25 perennials and 13 are annuals; Gramineae 20.0%, Chenopodiaceae 16.0%, Cyperaceae and Juncacease together 12.0%, Compositae 8.0% and the other 8 families 4.0% (Table 1). The most common perennials recorded are: *Arthrocnemum macrostachyum*, *Halocnemum strobilaceum* and *Phragmites australis*

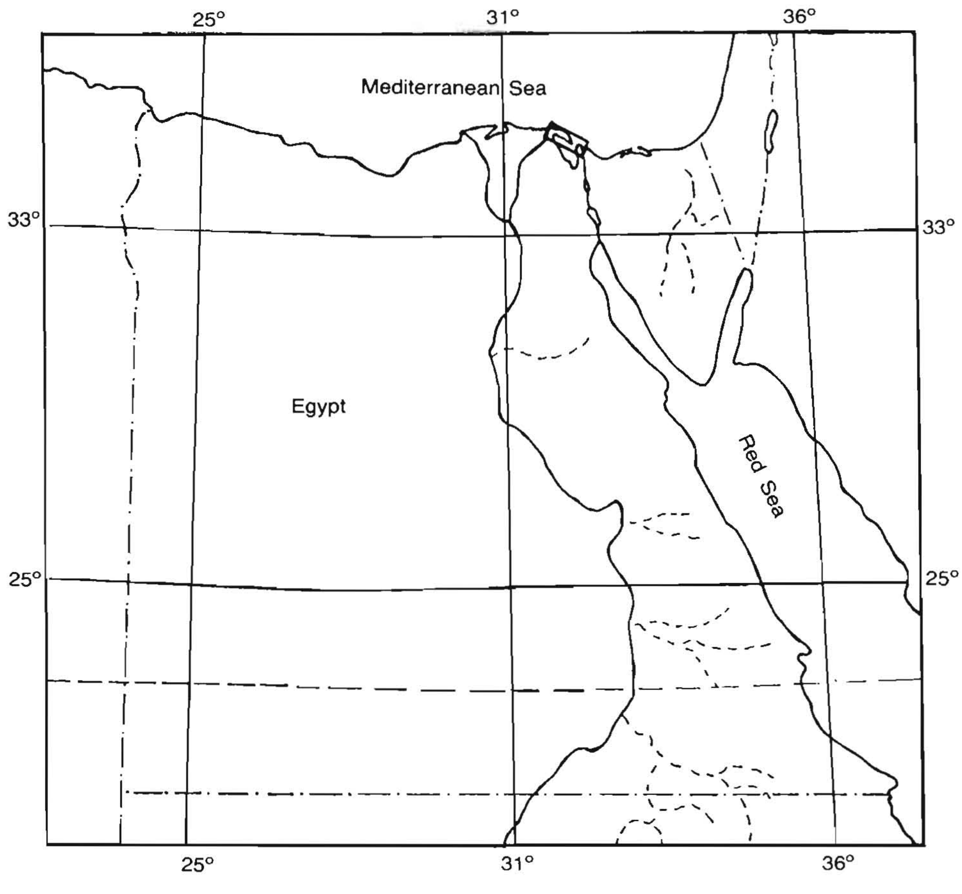

Fig. 1. Map of the Nile Delta showing the location of the study area.

(presence: 58.3-86.1%) *Inula crithmoides, Juncus rigidus, Zygophyllum aegyptium, Atriplex portulacoides* and *Suaeda vera* are of presence ranging between 32.2 and 52.8%. Less abundant species were recorded in a single stand only *e.g. Alhagi graecorum, Carex extensa* and *Cressa cretica*.

Thirty species or 76.9% of recorded species are Mediterranean floristic elements. These are either pluriregional (53.3%), biregional (33.3%) or monoregional (13.4%). Five species (12.8%) are either cosmopolitan (5.1%), pantropical (2.5%). The Saharo-Sindian elements comprise 5 species, including 1 monoregional, 1 pluriregional and 3 biregional species. The Sudano-Zambezian elements are represented only by 2 species (5.1%) of the total of species.

Table 1. Results of presence (%), floristic categories and life-form of species recorded in the salt marshes of the study area

Perennials	**Presence %**	**Floristic Category**	**Life-form**
Monocots:			
Aeluropus massauensis (L.)	2.8	ME,SA-SI,IR-TR	Cr,G
Trin. ex. Thwaites:			
Carex extensa Good.	2.8	ME,ER-SR	G
Cynodon dactylon (L.) Pers.	13.9	PAN	G
Cyperus laevigatus L.	19.4	PAN	G He
Imperata cylindrica (L.) Beauv.	2.4	PAL,ME	H
Juncus acutus L.	36.1	ME,IR-TR,ER-SR	He
Juncus rigidus Desf.	44.4	ME,SA-SI,IR-TR	He G
Juncus subulatus Forssk.	19.4	ME,IR-TR,SA-SI	He G
Phragmites australis (Cav.)	58.3	COSM	G He
Trin. ex. Steud.			
Sporobolus spicatus (Vahl) Kunth.	2.8	S-Z,SA-SI,ME	G
Dicots:			
Alhagi graecorum Boiss.	2.8	PAL	Ch
Arthrocnemum macrostacyum (Moric.)	66.1	ME,SA-SI	Ch
Moris et Delponte			
Atriplex portulacoids L.	33.3	ER-SR,ME,IR-TR	Ph
Cressa cretica L.	2.8	ME,PAL	H
Cynancum acutum L.	2.8	ME,IR-TR	Nph
Frankenia hirsuta L.	22.2	MR,ER-SR,IR-TR	Ch
Halocnemum strobilaceum (Pallas)	75.0	ME,IR-TR,SA-SI	Ch
M. Bieb.:			
Inula crithmoides L.	52.8	ME,ER-SR,SA-SI	Ch
Limonium pruinosum (L.) O. Kuntze	16.7	SA-SI	H
Plantago crassifolia Forssk.	13.9	ME	H
Pluchea dioscoridis (L.) DC.	2.8	S-Z,SA-SI	Nph
Polygonum equisetiforme Sibth. & Sm.	1.8	ME,IR-TR	G
Scorpoides holoschoenus (L.) Sojak	8.3	ME,IR-TR,ER-SR	G
Suaeda vera Forssk. ex. J.F. Gmelin	33.3	ME	Ch
Tamarix nilotica (Ehrenb.) Bge.	19.4	SA-SI,S-Z	Nph
Zygophyllum aegyptium A. Hosny	36.1	ME	Ch

Table 1. Results of presence (%), floristic categories and life-form of species recorded in the salt marshes of the study area

Annuals	Presence %	Floristic Category	Life-form
Monocots:			
Cutandia memphitica (Spreng.)		ME,IR-TR	Th
K. Richter:			
Parapholis incurva (L.) C.E.		ME,IR-TR,ER-SR	Th
Polypogon viridis (Gouan) Breistr.		ME,IR-TR	Th
Dicots:			
Cakile maritima Scop. Subsp. *aegyptiaca*		ME,ER-SR	Th
(Wild) Nyman:			
Frankenia pulverulenta L.		ME,ER-SR,IR-TR	Th
Ifloga spicata (Forssk) Sch. Bip.		SA-SI,ME	Th
Lotus halophilus Boiss. et Sprun		ME,SA-SI	Th
Mesembryanthemum crystallinum L.		ME,ER-SR	Th
Mesembryanthemum nodiflorum L.		ME,SA-SI,ER-SR	Th
Paronchyia arabica (L.) DC.		SA-SI,ME,S-Z	Th
Salsola kali L.		COSM	Th
Senecio glaucus Subsp. cronopigolius L.		ME,SA-SI,IR-TR	Th
Spergularia diandra (Guss.) Boiss.		ME,IR-TR,SA-SI	Th

COSM: Cosmopolitan, PAN: Pantropical, PAL: Palaeotropical, ME: Mediterranean, ER-SR: Euro-siberian, SA-SI: Sharo-Sindian, IR-TR: Irano-Turanian, S-Z: Sudano-Zambezian, Nph: Nanophanerophyte, Ch: Chamaephyte, G: Geophyte, He: Helophyte, TH: Therophyte.

The most frequent life-form in the study area is therophytes (36.1%), followed by cryptophytes (22.2%), chamaehytes (19.4%), hemicryptophytes and nanophytes (5.6%).

Multivariate analysis

The dendrogram resulting from the cluster analysis of stands representing the study area (Fig. 2 and Table 2), indicates 5 distinct clusters. Clusters "A" comprises 8 stands dominated by *Zygophyllum aegyptium* (IV = 161.2/300), "B" (6 stands) dominated by *Arthrocnemum macrostachyum* (IV = 180.9), "C" (7 stands) dominated by *Halocnemum strobilaceum* (IV = 142.4), "D" (9 stands) dominated by *Juncus acutus* (IV = 72.1) and "E" (6 stands) dominated by Juncus rigidus (IV = 121.1).

The ordination of stands by using the principal component analysis (PCA) indicates a clear distinction of the groups obtained by the agglomerative cluster analysis (Fig. 3). Groups A,B and C lie nearly on the negative side of axis II and occupies medium position on the positive side of axis I. Group C occupies a central position, while group D has an uppermost position on the negative left side of axis I and a medium position on the positive side of axis II.

Results of soil analysis demonstrate clear variations in the edaphic variables between groups of stands of the different vegetational clusters recognized in the study area (Table 3).

Contents of Sulfate, Calcium and Magnesium cations in the soil have high significant positive correlations with axis I along the two soil depths (Table 4). On the other hand, there are only few significant correlations present between axis II and the different soil variables (underground water level, maximum water holding capacity, chloride, bicarbonate, sulfate, sodium and potassium adsorption ratios).

Discussion

According to Zahran (1982) salt marsh ecosystems are associated with land which is liable to flooding with saline water; when this water evaporates it leaves its salt behind creating salt marsh habitat. In Egypt salt marshes are either littoral or inland. Littoral salt marshes located along of the Mediterranean and the Red Sea coasts are subjected to the maritime influence.

El-Demerdash (1984), reported that increased soil salinity in the Egyptian soil may be attributed to one of the following factors:

a) arid climate,
b) effect of the northern salty lakes *e.g.* Manzala, Borollus etc., through inundation of the surrounding areas,
c) conversion of the irrigation system from basin to perennial,
d) high water table associated with poor drainage,
e) use of brackish water from wells and/or drainage in irrigation,
f) high residual bicarbonate and carbonate in the Nile water used in irrigation.

The present study shows that the salt marsh ecosystems between Port Said and Damietta, in contrast to the sand formation ecosystems of the same region, host a relatively low number of perennial and annual species. Thirty nine species related to 13 families constitute the majority of its floristic composition.

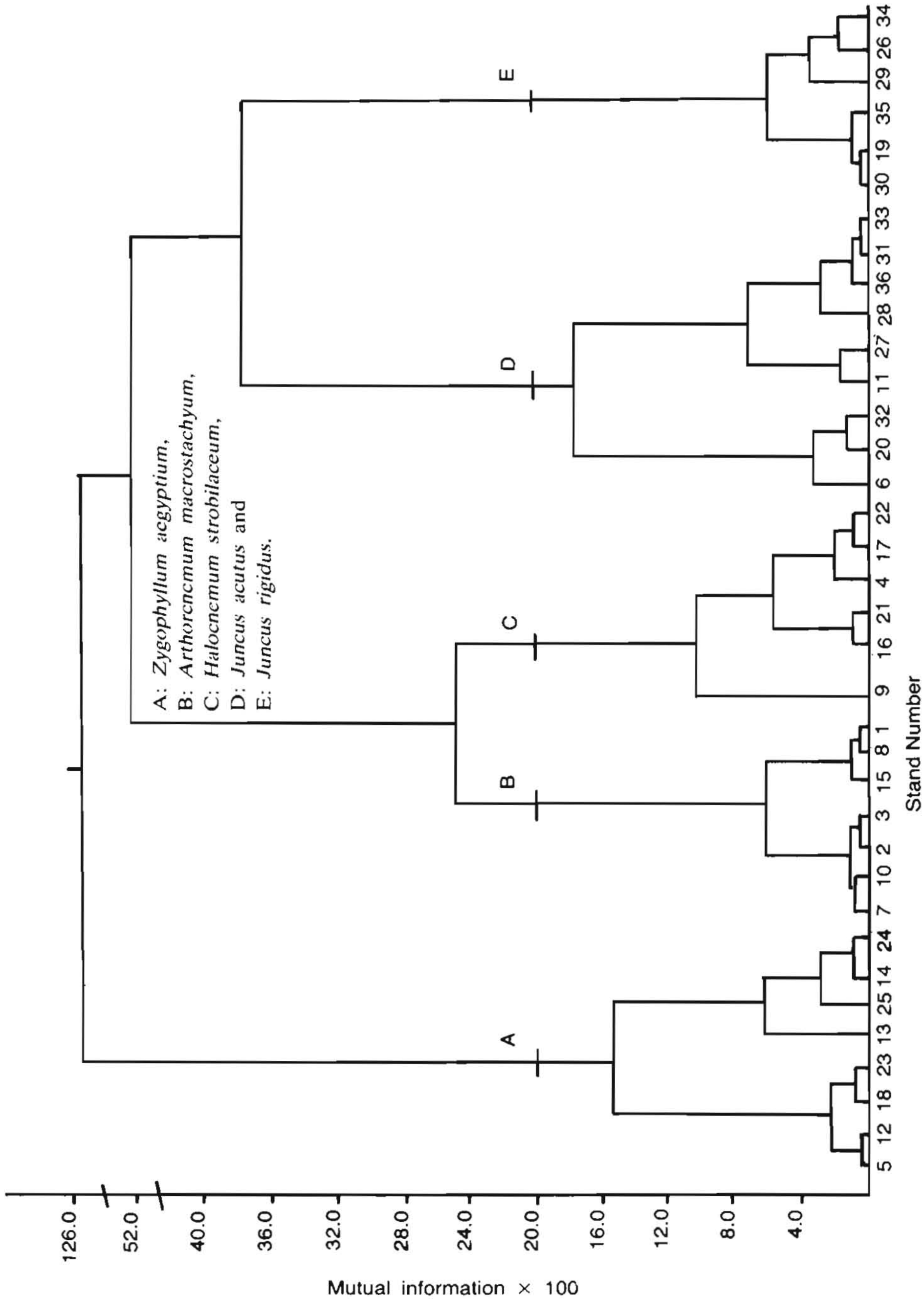

Fig. 2. The dedrogram resulting from the cluster analysis of stands. The dashed line denotes the level at which the denderogram yields five distinct clusters, dominated by the following species:

Table 2. Means and coefficient of variation (values between bracts) of the importance values (out of 300) of the perennial species in the different vegetational clusters

Plant Clusters	Clusters				
	A	B	C	D	E
A: Monocots					
Aeluropus massauensis	–	–	0.8 (2.6)	–	–
Carex extensa	–	–	–	0.1 (3.0)	–
Cynodon dactylon	–	–	1.2 (2.8)	5.1 (1.6)	–
Cyperus laevigatus	1.6 (2.8)	–	0.1 (3.0)	39.2 (1.7)	–
Imperata cylindrica	–	–	12.2 (2.7)	–	–
Juncus acutus	–	1.8 (1.6)	3.7 (2.6)	72.1 (1.0)	2.0 (1.5)
J. rigidus	–	–	11.1 (1.3)	11.3 (1.4)	11.1 (1.5)
J. subulatus	–	–	2.3 (1.3)	2.3 (2.6)	3.3 (1.8)
Phragmites australis	23.8 (2.1)	3.4 (1.3)	5.1 (1.3)	20.0 (1.0)	32.0 (1.1)
Scorpoides holoschoenus	–	–	1.5 (3.0)	1.5 (1.7)	–
Sporobolus spicatus	–	–	–	9.8 (3.0)	–
B: Dicots					
Alhagi graecorum	–	–	–	2.0 (3.0)	–
Arthrocnemum macrostachyum	33.4 (1.2)	180.9 (.1)	54.7 (.8)	29.9 (.6)	80.6 (.8)
Atriplex portulacoides	4.3 (2.7)	37.7 (1.5)	5.3 (2.6)	5.2 (1.4)	17.0 (1.6)
Cressa cretica	–	–	–	2.6 (3.0)	–
Cynanchum acutum	–	–	–	2.0 (1.4)	–
Frankenia hirsuta	30.0 (2.0)	13.9 (2.4)	1.0 (2.8)	3.5 (2.9)	6.2 (2.3)
Halocnemum strobilaceum	24.1 (1.3)	41.0 (1.1)	142.4 (.8)	9.0 (1.6)	4.3 (1.9)
Inula crithmoides	6.2 (2.0)	4.4 (2.4)	43.8 (1.5)	51.5 (1.0)	18.8 (.0)
Limonium pruinosum	1.9 (2.2)	0.3 (2.4)	–	0.9 (2.4)	5.4 (2.1)
Plantago crassifolia	0.3 (2.8)	–	–	8.0 (2.2)	0.3 (2.4)
Pluchea dioscoridis	–	–	–	0.1 (3.0)	–
Polygonum equisetiforme	1.7 (2.8)	–	–	–	–
Suaeda vera	–	11.6 (1.7)	0.2 (2.0)	22.9 (1.5)	0.1 (2.4)
Tamarix nilotica	5.3 (2.6)	–	7.4 (1.3)	3.7 (2.5)	–
Zygophyllum aegyptium	161.2 (0.7)	–	8.0 (2.0)	1.3 (2.1)	–

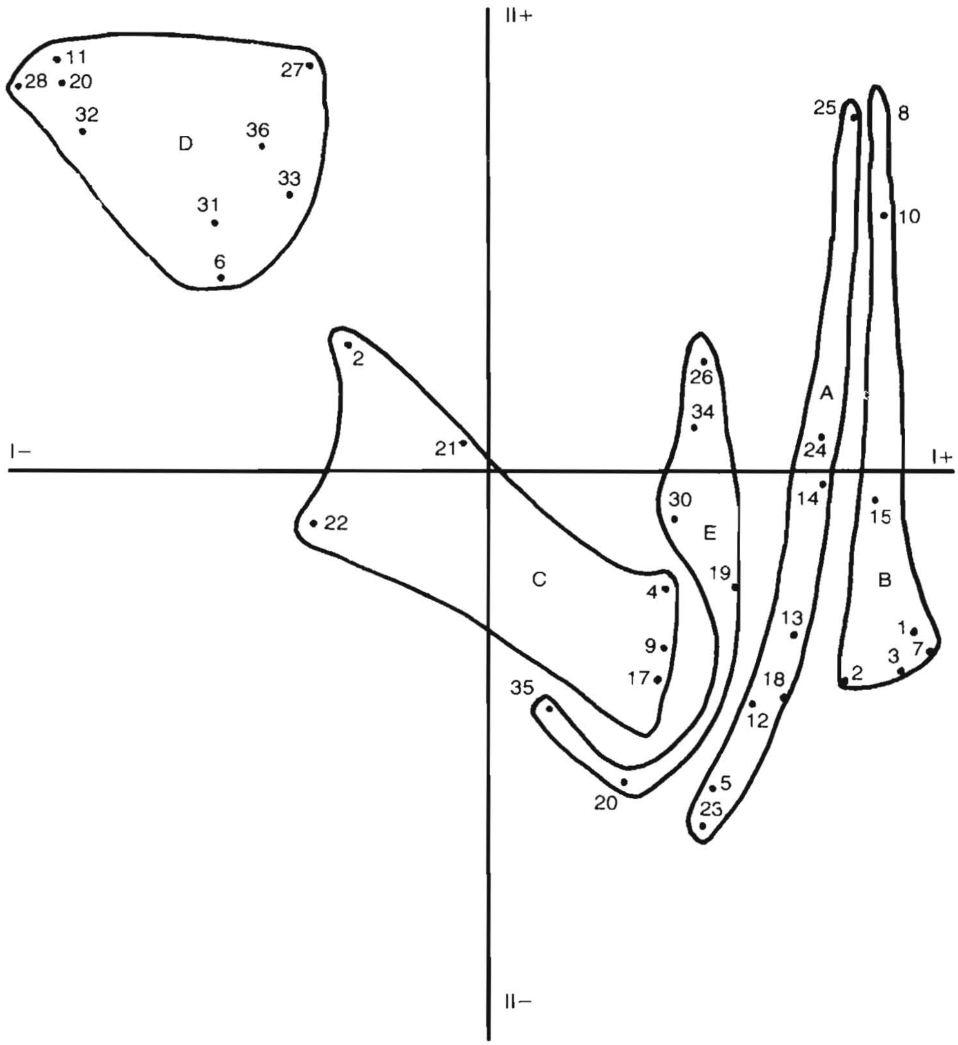

Fig. 3. Ordination of stands on the I & II axes derived from the PCA. Classification of stands by cluster analysis is superimposed.

Gramineae, Chenopodiaceae, Cyperaceae,and Juncaceae are highly represented in this area.

Cain and Castro (1959) as quoted Mashaly (1987) mentioned that life-form spectra have an important physiognomic attributes which have been widely used by ecologists in vegetation and floristic analyses. The life-form of a plant is thought

Table 3. Means and standard errors of the different soil factors in the stands representing the different vegetational clusters in the study area

Soil Factors	Clusters				
	A	B	C	D	E
W.H.C. (%)	30 + 1.8	56.5 + 10.3	33.2 + 3.4	38.7 + 4.7	39.8 + 4.3
pH	7.7 + 0.2	7.8 + 0.1	7.9 + 0.1	8.0 + 0.2	7.9 + 0.1
EC (mS/cm)	1.9 + 0.3	6.4 + 1.0	2.6 + 0.9	1.4 + 0.4	2.4 + 0.5
$CaCO_3$ (%)	1.3 + 0.6	13.0 + 4.0	2.6 + 1.0	8.8 + 4.8	5.7 + 2.0
O, C (%)	1.2 + 3.7	1.9 + 0.3	1.1 + 0.2	1.2 + 0.3	1.2 + 0.2
Cl^- (%)	0.3 + 0.1	1.5 + 2.5	0.5 + 0.7	0.2 + 0.2	0.1 + 0.2
SO_4^{--} (%)	1.5 + 1.5	0.5 + 0.2	0.4 + 0.1	0.3 + 0.1	0.5 + 0.2
HCO_3 (%)	0.1 + 0.1	0.1 + 0.1	0.1 + 0.1	0.1 + 0.1	0.1 + 0.1
Na^+	180.8 + 32	1099 + 448	498 + 154	232 + 100	242 + 45
K^+	0.5 + 0.1	1.3 + 0.7	0.5 + 0.3	0.5 + 0.1	0.6 + 0.1
Ca^{++}	131 + 88	1453 + 474	407 + 103	978 + 428	453 + 239
Mg^{++}	110 + 17	460 + 110	145 + 55	309 + 126	190 + 38
SAR	11.7 + 4.7	36.1 + 15.1	18.6 + 5.0	2.5 + 2.5	12.6 + 2.6
PAR	0.05 + .02	0.05 + .02	0.03 + 0.0	0.03 + 0.0	0.04 + 0.0
F.f. (%)	0.5 + 0.2	1.0 + 0.3	0.5 + 0.2	0.4 + 0.2	1.2 + 0.3

F.f. = silt + clay

to be an hereditary adjustment to environment (Mashaly 1987). In accordance with Ayyad and El-Ghareeb (1982), and Zahran (1982) the present study shows that therophytes are the major-life form in the study area (36.1%). Cryptophytes are the second frequent life-form with a value of 22.2%, followed by chamaephytes with 19.4% of the total life-form spectrum. The nature of the prevailing climate in the study area, water availability and the sandy nature of this habitat help therophytes to predominate during the favourable seasons. On the

Table 4. Simple linear correlation coefficients(r) between ordination (I & II) and soil factors in stands of the study area. A: surface layer (0-25 cm), B: subsurface layer (25-50 cm), *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$. UGW: underground water table, WHC: water holding capacity, OC: organic carbon, SAR: Sodium adsorption ratio, PAR: potassium adsorption ratio, F.F: fine fractions (Silt + Clay)

Axes	Soil depth	Edaphic Factors															
		UGW	WHC	pH	$CaCO_3$	OC	Cl^-	SO_4^{--}	CO_3^{--}	HCO_3^-	Na^+	K^+	Ca^{++}	Mg^{++}	SAR	PAR	F.F
I	A	+0.25	+0.23	−0.09	+0.31	+0.51**	+0.26	−0.34*	−0.63***	+0.22	+0.21	−0.16	+0.44**	+0.37*	+0.09	+0.12	+0.17
	B	+0.17	+0.27	−0.16	+0.42**	−0.24	+0.20	+0.50**	−0.45**	+0.42**	+0.09	−0.51**	+0.58***	+0.49**	+0.10	−0.03	−0.01
II	A	+0.45**	+0.76***	−0.6	+0.11	−0.28	−0.18	−0.67***	−0.12	+0.24	−0.05	−0.13	+0.26	+0.24	−0.21	−0.29	−0.29
	B	+0.26	−0.03	+0.15	+0.31	+0.29	−0.40*	−0.62***	+0.16	+0.37**	−0.17	−0.11	+0.14	+0.17	−0.33*	+0.34*	+0.05

other hand the high frequency of cryptophytes in the study area may be, according to Mckee and Seneca (1982), due to the resistance of their rhizomes to decomposition under constant sub-mergence.

In accordance with Barry *et al.* (1976), this study indicates the presence of a Mediterranean phytogeographical belt in Egypt, this belt represents a transition between the pure Mediterranean and the Saharo-Arabian territory. This conclusion is based on the richness of the Mediterranean taxa (76.9% or 30 spp.) in the study area, the bioclimatic features and the life-form spectrum, in contrast to Zohary (1975) who concluded that there is a gap in the Mediterranean territory between southern Palestine and Libya in which the Saharo-Arabian belt closely approaches the Mediterranean coast.

The phytosociological studies dealt with in the present work shows that the vegetation of the salt marshes of the deltaic Mediterranean coast could be recognized into five clusters. Named after their dominants these clusters are: *Z. aegyptium*, *A. macrostachyum*, *H. strobilaceum*, *J. acutus* and *J. rigidus*. Comparable groups have been described in the Mediterranean coastal land by many authors *e.g.* in north Africa by Quezel (1978), in Egypt by Ayyad and El-Ghareeb (1982), El-Demerdash (1984), and Zahran *et al.* (1985 & 1988). This may imply that the vegetation of salt marshes of the Mediterranean coast between Damietta and Port Said represents a continuation from the western communities in north Africa and those characteristic of the eastern Mediterranean. Kassas (1972), attributed the distribution of species in saline and marshy habitats to salinity, and that the plant communities are generally distributed according to its pattern of variation. In so far as salinity adds an osmotic component to the matric potential of the soil solution, it acts in the same direction as scanty rainfall or loss of moisture by run-of and/or excessive evaporation. Therefore, salinity may be considered as one of the factors controlling the moisture availability and consequently the distribution of vegetation. This could be applicable only in explaining the macro-distribution of species. Gates *et al.* (1956), related the local distribution of species to the concentration of the different ions. The marine sediments in the deltaic Mediterranean coast constitute a major source of sodium, calcium and other principal cations (Zahran *et al.* 1988).

Results obtained from correlation analysis between the different soil variables and the distribution of vegetational groups of the study area indicate that soil salinity (EC, Cl^- & Na^+), soil fertility (organic carbon % and potassium), and moisture availability (water holding capacity, water table level), are the most operating in this respect. The results obtained may be summarized as follows:

1. The vegetation in this habitat types is recognized into five groups dominated by *Zygophyllum aegyptium*, *Arthrocnemum macrostachyum*,

Halocnemum strobilaceum, Juncus acutus and *J. rigidus.*

2. Therophytes constitute the major part of the life-form in the salt marsh ecosystems between Damietta and Port Said.
3. These ecosystems constitute a part of a transitional Mediterranean territory in Egypt between the true Mediterranean and the Saharo Arabian territory.
4. Soil salinity, fertility and moisture availability are the most effective factors controlling species distribution.

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دراسات بيئية لمنطقة ساحل الدلتا بمصر
ثالثاً: بيئة المستنقعات الملحيـة في المنطقـة الساحليـة لدميـاط وبورسعيد

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يختص هذا البحث بإعطاء تقديرات كمّية لوفرة الأنواع النباتية بالعشائر المختلفة في منطقة الدراسة وتحديد العامل أو العوامل المتحكمة في توزيع الكساء الخضري فيها وكذلك ربط تلك العوامل مع متغيرات التربة.

اختير لهذه الدراسة ٣٦ موقعاً (كل منها ١٦٩م^{٢}). ووزعت تلك المواقع توزيعاً عشوائياً لتمثل جميع متغيرات البيئة الظاهرة بمنطقة الدراسة واستخدمت طريقة النقطة المتمركزة (Point-Centered Quarter Method) في تحليل الكساء الخضري. لتطبيق هذه الطريقة ثبتت شوكة حديدية في التربة عمودياً في أماكن أختيرت عشوائياً على إمتداد خطوط مستقيمة خلال الموقع. ثم قسمت المساحة حول كل نقطة إلى أربعة أجزاء بخطين متعامدين وقيست المسافة بين النقطة وأقرب نوع نباتي معمر يوجد في كل من هذه الأجزاء وباستخدام عدد النقط التي وجد عندها كل نوع نباتي معمر وعدد أفراده حسبت على التوالي نسبة تردده وكثافته وقد أضيفت نسبة التردد والكثافة والتغطية (قدرت بطريقة Line-Intercept) لكل نوع نباتي ثم جمعت لتعطي قيمة أهمية كما تم تسجيل الأنواع الحولية في كل موقع. طبقت طريقتي التصنيف والتسلسل (Classification and Ordination) لأعطاء صورة واضحة عن تركيب الكساء الخضري باستخدام قيم الأهمية لكل نوع

وبذلك يمكن تقسيم الكساء الخضري في منطقة الدراسة إلى خمس عشائر نباتية معمرة هي: العرقص، حطب عرقض، حطب ودينة، السمار المر نوع اكيوتس، حطب زيتي والسمار المر نوع ريجيداس.

تم جمع عينات تربة تمثل كل مواقع الدراسة ودرست الخصائص التالية: القوام، الاحتفاظية بالماء، نسبة الكربونات والبيكربونات، كربونات الجير، الكبريتات، الكلوريدات، الكربون العضوي، الملوحة، تركيز ايون الهيدروجين، مستوى الماء الأرضي وأيونات: الصوديوم، البوتاسيوم، الكالسيوم والماغنيسيوم.

وجد من خلال دراسة صفات التربة أنها متباينة في الصفات الكيميائية والفيزيائية لكل مجموعة من المجموعات الخمس النباتية. تشير نتائج الدراسة الحالية إلى أن الأنواع الحولية هي أكثر طرز الحياة النباتية شيوعاً في مختلف العشائر النباتية. كما تؤيد أن منطقة الدراسة تمثل جزء من اقليم البحر المتوسط النباتي بمصر. استخدمت بعض التحاليل الاحصائية للتوصل إلى أهم عوامل التربة الأكثر إرتباطاً بمحاور التسلسل حيث وجد أن احتفاظ التربة بالماء ودرجة ملوحتها ونسبة امتزاز الصوديوم وأيونات الماغنيسيوم وأيونات الكلوريدات والكبريتات ونسبة كربونات الجير هي أهم متغيرات التربة التي ترتبط بتوزيع الانواع النباتية المختلفة في منطقة الدراسة.