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SOIL-VEGETATION RELATIONSHIPS IN EL-OMAYED ROSELT OBSERVATORY AREA (THE WESTERN MEDITERRANEAN COASTAL REGION OF EGYPT)

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The present study aims at monitoring and evaluating the edaphic features in relation to the distribution of plants communities for two years (1999 and 2000) along a permanent transect (about 15 km long) located perpendicular to the seashore in EL- Omayed area. The current study indicates that the local distribution of plant communities in different microsites is linked to physiographic variations, climatic zones, and soil characteristics. Two main groups of habitats are distinguished: (A) the coastal plain and (B) Plateau, local depressions and transitional zones. Each of which was classified into many microhabitats. Each microhabitat indicates the dominant plant species and main soil properties. High cover ratings were recorded in spring 2000 than in spring 1999 of different microhabitats for both perennial and annual species. Also, the life form spectrum illustrates big difference in the numbers of these life form between years 1999 and 2000. As a conclusion, ground cover and species composition changes (1999 – 2000) were a function of available soil water as reflected by the rainfall distribution pattern over the tow years. Finally, it may be concluded that the gradual modification in the plant cover proceeds in coincidence with the gradual accumulation of alluvial material and the gradual thickening of the soil. The relationship between the association in the area under study depending on the retrogressive changes due to erosion and building up of soil. On the other hand, soil depth and texture may support different and specific plant communities.

Keywords: Soil-vegetation relationship, biodiversity, Mediterranean coast, habitats.

An environmental management policy can be successful only if it is formulated with a basic understanding of the full complexity of the ecosystem, its structure and function (Ayyad and Le Floch, 1983). Small perturbations, natural or man-made, can trigger chains of physical and biological changes which could be sufficient to jerk ecosystem from its balanced position (Kohen, 1995). It is conceivable that the deterioration of some physical components of the environment may lead to considerable and quick changes in the biotic components (basically natural vegetation). Moreover, the standard pattern of plant community distribution in different habitats results from the interaction between physical constraints on plant growth (Bertness and Elligson, 1987), and chemical soil properties affecting plant growth (Howes *et al.*, 1981; Mendelssohn, Mekee and Patrick, 1981; Bakker, 1985).

The major constraint to soil formation as well as to plant growth is perennial or seasonal drought throughout the deserts of the world (Kehl *et al.*, 1984). The relief, the depth of the weathering and rooting zone, the supply and distribution of nutrients and salts, the action of wind or extremely high temperatures or frequency of frost are among features other than climate that differentiate the ecology of the desert landscapes (Blomel, 1982).

El-Omayed area (70 km west of Alexandria) on the western Mediterranean coastal land of Egypt is characterized by prominent physiographic variations which lead to a differentiation into different types of habitat: sand dunes, salt marshes, saline and non-saline depressions, rocky ridges, plains and inland plateau. These habitats differ regarding their exposure, microclimate, water supply, elevation above mean sea level, soil depth and other soil charecteristics. Each habitat supports, more or less, a special type of vegetation. In such an area with low rainfall (about 150 mm/year), the water relations of air and soil may be considered the factors of prime importance in the distribution of the different species as well as the plant communities. The physiography of this area is an important factor in the distribution of plant communities through its effect on the soil depth and other soil properties controlling the water supply to plants (Batanouny, 1973)

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MATERIALS AND METHODS

Study Area

Location

The collected data refer to a selected land sector to represent El-Omayed ROSELT observatory of about 14 km wide (longitude: 29° 05' 15"

E to 29° 14' 00" E) and 15 km long (latitude: 30° 41' 15" N to 30° 50' 00" N) starting from the Mediterranean shoreline (Fig. 1). This area covers about 210 km^2 (about 30% of the total area of the observatory). The sector is representative of the different landscape forms, ecosystems, habitats and human interventions and impacts in the area. A large part of the sector is rangeland, one half of which (south of the inland ridge) is under the traditional way of land-use (grazing and rain-fed barley production). The other half of the sector (north of the inland ridge) is exposed to high level of human interference with the presence of three human settlements (local villages). Of their inhabitants activities are arboricultural practices, herd raising, mining, local constructions, etc., especially with the newly constructed water canal prospected to bring Nile water to the western coastal strip to support governmental policy of increasing crop production.

The sampling transect crosses the selected sector (N/S direction) and extends for about 14.5 km, starting the southern slope of the coastal ridge, from latitude of 30° 49' 15" N to 30° 41' 25" N. It is centered on the longitude of 29° 10' 00" E with an average width of one kilometer.

Geology

Many workers have intensively studied the geology of the northern zone of the western desert of Egypt, examples of which are Shatla (1955), Said (1962), REGWA Company (1965) and El-Shazly and Attia (1994). Their studies revealed that the exposed rocks are exclusively of sedimentary origin that are dated back to the early Miocene and to the Holocene with maximum thickness of about 200 m.

Land forms

The study area has two main landforms as referred to by Harga (1967), Hammad (1969) and FAO (1970). The first main landform is the coastal plain recognized in several areas along the western coast, where the shoreline seems to be of emergence type developed by offshore bars and lagoons. Allied parallel bars and lagoons characterize the foreshore plain; the most conspicuous of which are the coastal bar and Abu Sir bar. There are several inland bars that can be also traced (Gebel Maryut, Ruweisat-Ben Gaber, Khashm El-Eish, Alam Halfa, Alam Shaltut). The swamps in between are thought to be lagoons or lagoonal depressions that were filled with materials brought by streams or wadis that are occasionally flooded after heavy rainfall.

The second main landform is tableland (plateau), which is bounded northwards by steep slopes at some localities leaving a wide or narrow coastal plain. In most of the headlands "Ras" there is wrapping of the land in a more or less northeastwards monocline. The tableland itself is almost featureless. A number of fans and fan convexities are forming along low scarp lines in the tableland. These scarp lines are most probably corresponding to fault lines. These are the only places where there are deep

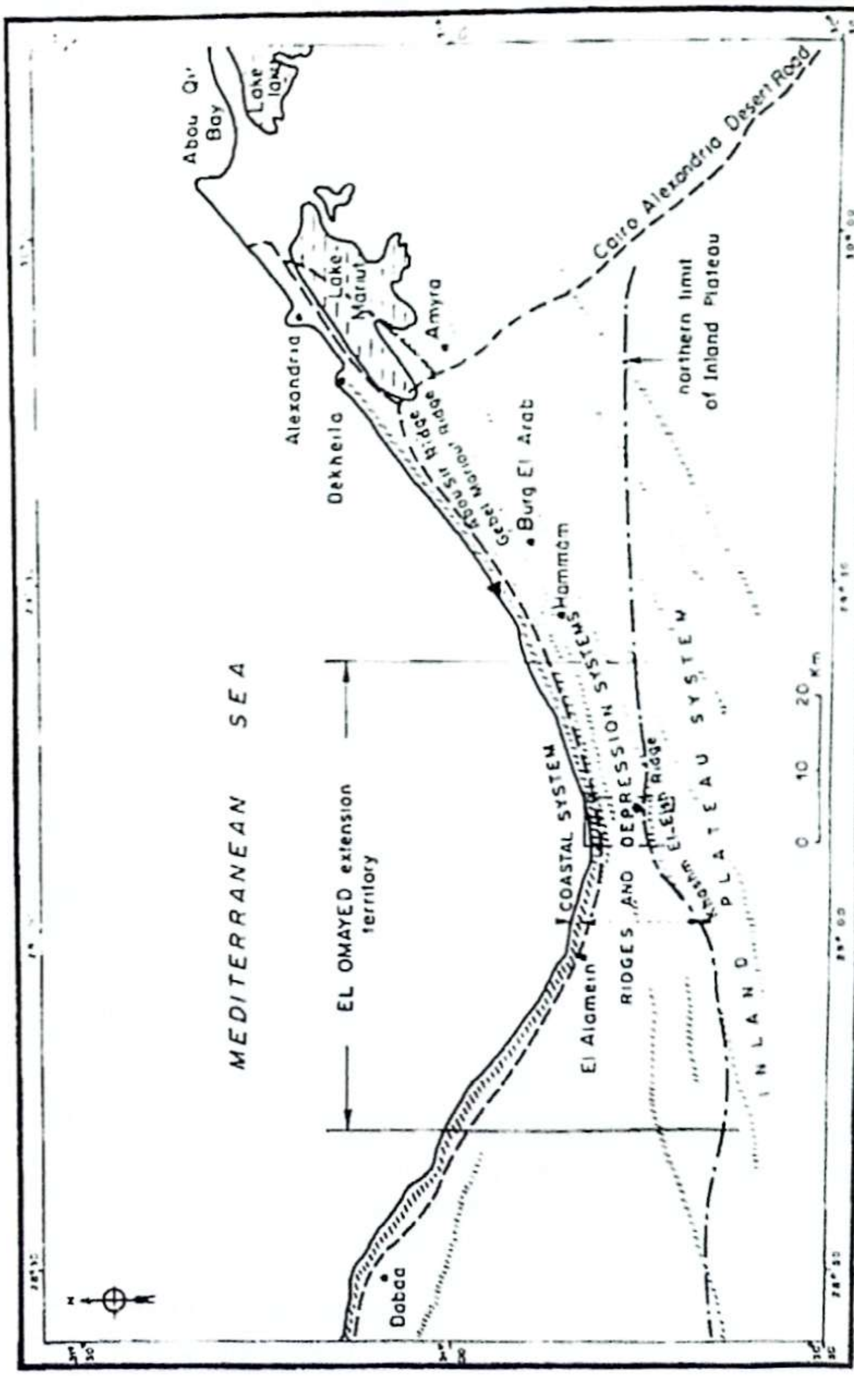


Fig. (1). Location map of El-Omayed ROSELT observatory.

soils with natural vegetation. The Wind-blown sand is common as hummocks around the scattered vegetation or as thin sand sheets. The composition of these.sand bodies is mainly oolitic and quartzitic sand grains. The sandy area in some locations obscures the boundary between the tableland and the coastal plain.

At El-Omayed area, five well-formed beach ridges are recognized. Discharging in former lagoon depression report the presence of lagoon facies characterized by mottled clays and gypsum crystals. Large gypsum quarries are located at these depressions. The lagoon facies appear at various depths in relation to the present sea level. The depressions between the dissected ridges or dunes within the coastal plain are filled with fine and coarse loamy materials brought to the area either from the tableland or from the oolitic ridges and dunes. At the foot-slopes of the escarpments in the coastal plain, alluvial fans are building thick deposits and extending around the dissected ridges in some areas. As the soil material in the coast are calcareous, partial leaching of carbonates occurred in the upper layers of the alluvial fans resulting in the formation of calcic horizons and caliche layers near the surface of the soils (Butzer, 1960).

Climate

The Mediterranean coastal land of Egypt belongs to the dry arid climatic zone of Koppen's classification system (Trewartha, 1954), the arid mesothermal province of Thornthwaite (1948). The region lies in Meig's "warm coastal desert" (Meigs, 1973) and in arid zone of the classification of the aridity zones map (UNEP, 1992). Annual rainfall varies from one location to the other along the western coast region of Egypt. In general, the region lies between isohytes 180 mm and 70 mm, with rapid decrease in the amount of rainfall from the shoreline to inland (Ayyad and El-Ghareeb, 1984). The aridity index (P/Etp, where P is the mean annual precipitation and Etp is the potential evapotranspiration) boundary between arid and hyperarid zones increased from 0.03 (UNESCO, 1977) to 0.05 (UNEP, 1992).

A large variation is noticed in the amount of rainfall between the two years. It was 52.1 mm in 1999 while 361.1 mm in 2000 (noticed there is one heavy storm with 146 mm in Sep. 2000). The same thing is noticeable for the wind speed where it was 12.5 in 1999 and 3.3 in 2000. Other climatic elements did not show a remarkable variation between the two years.

Field and Laboratory Work

Field work

Soil

Seven soil profiles samples considered to represent different geomorphic units were dug and morphologically described according to guidelines of soil survey (FAO, 1990). With the aid of the complementary laboratory analyses soils were pedologically classified according to the

American System of Soil classification (Soil Survey Staff, 1998). In addition, fifteen surface soil samples were taken from epipedon for the integrated chemical and physical analysis according to Richards (1954) and FAO (1970).

Vegetation

Twenty-four micro-sites along transect (Fig. 2) were selected in the study area during spring season (May 1999 and May 2000). The phytosociological survey method (Braun blanquet, 1964) was followed.

For each micro site a list of all species (perennials and annuals) was recorded, cover ratings were given for each species according to Braun blanquet's system and life form was assigned for each species in each pilot area according to Raunkaier's system (Kershaw, 1974). Taxonomic nomenclature is according to Tackholm (1974) and updated according to Boulos (1995). Species richness is considered as the count of species per unit area, which is the most commonly used measure of diversity and is specially favored by botanists (May, 1981).

Laboratory Work

Disturbed soil samples were air dried under laboratory conditions and crushed with a wooden pestle and passed through a 2-mm. sieve. Chemical analyses were carried out on soil samples after Richards (1954) and FAO (1970) including soil reaction (pH), electrical conductivity (E.C., ds/m), soluble cations and anions (meq/L), total carbonate (%), gypsum ($CaSO_4 .2H_2O$) and organic mater (O.M. %). The grain size distribution analysis was conducted by the dry-sieving pipette method according to Kilmer and Alexander (1949) and Piper (1950). According to Griffiths (1967), six soil fractions were separated into five for sand by sieves and one for each of silt and clay. The silt and clay fractions are those less than 62.5 microns. The textural class names were identified using the Textural Triangle (Soil Survey Staff, 1962).

Soil Surface Ranks Code Description

According to soil description form (FAO, 1990), the soil morphological surface features were ranked and coded leaning on our own specific field observations and the range of change in each feature. Then used for testing significant association among different years.

RESULTS AND DISCUSSION

Soil Properties, Plant Specificity and Vegetation Characteristics

The distribution of plant communities in the western Mediterranean coastal land is controlled by topography, the origin and nature of the parent material and the degree of degradation influenced by human activities. The local distribution of communities in different habitats and microhabitats is

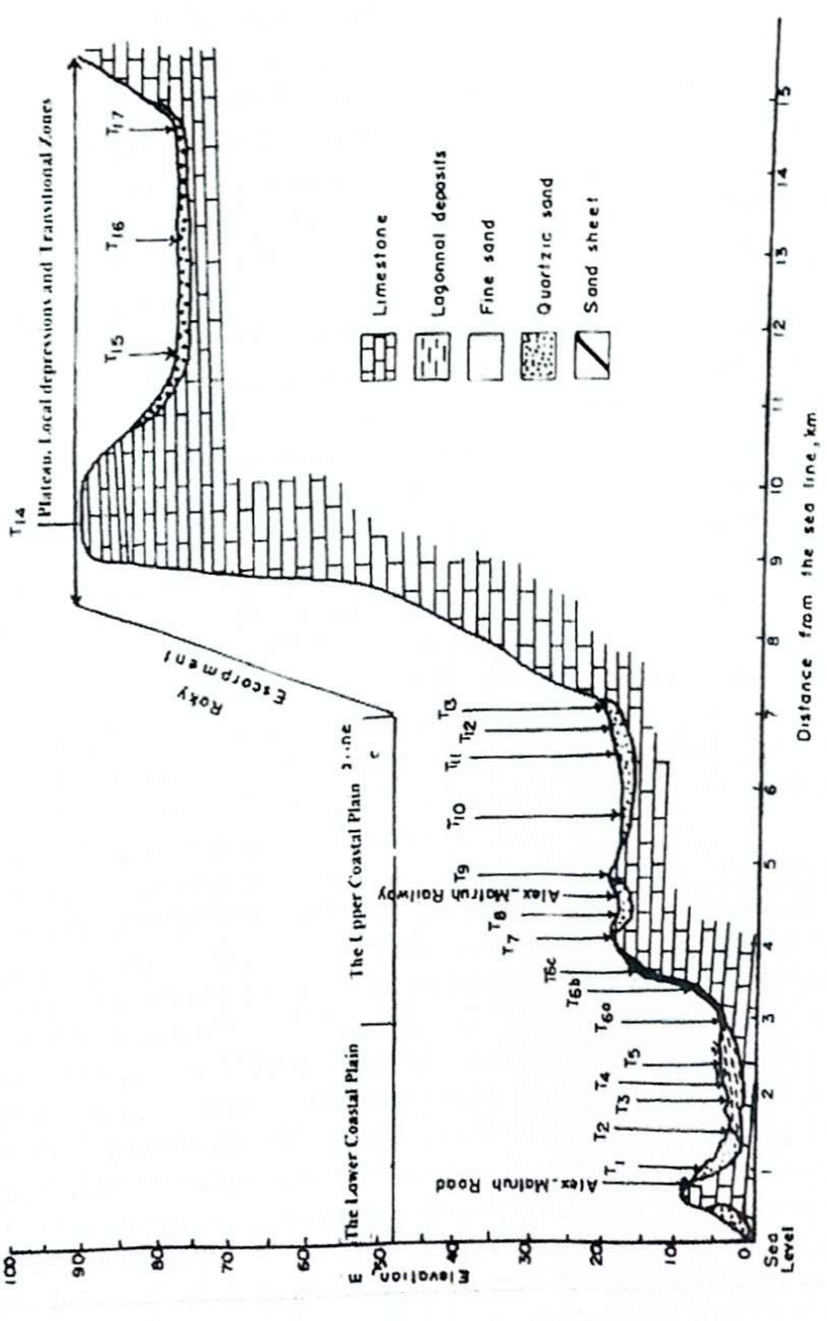


Fig. (2). Physiographic features of the selected pilot units distributed along El-Omayed transect.

linked to physiographic variations, climatic zones and soil properties (Batanouny, 1973 and Batanouny and Zaki, 1974).

According to the variations of plant communities in 10 microhabitats 24 micro-sites (Table 1), their soil characteristic (Tables 2 and 3) and plant specificity (Table 4), the relation between vegetation, physiographic features and soil properties could be distinguished as demonstrated in the following sections.

(A) The Coastal Plain

(A.1) ***The Lower Coastal Plain***

(A.1.1) ***Southern slope of the coastal oolitic dune (micro-site T1)***

It is formed of oolitic sand grains with low salinity (1.4 – 1.08 dS/m), low organic matter (0.51 – 0.63 %) and sandy texture (>90% sand). It is classified as Xeric Torripsamments. The landform of the microhabitat is characterized by straight slope form with slope gradient <25% and soil depth >100cm. The surface features description revealed that the deposition rate and area increased from 1999 to 2000 with change in deposition type from aeolian to alluvial. This may be related to increase of the rainfall in winter 2000. Fig trees are cultivated in this area where the farming operations promote the presence of specific wild species as *Convolvulus arvensis, Silene villosa and Atractylis cancellata.* The dominant and co-dominant perennial species for 1999 and 2000 are *Cynadon dactylon, Convolvulus arvensis,* and *Plantago albicans,* the most abundant associated annual species are *Schismus barbatus, Malva parviflora,* and *Plantago crypsoides.* The species richness increased from nine species in spring 1999 to 12 species in spring 2000 for perennial species associated with a remarkable increase in species richness of therophytes (13 in 1999 and 28 in 2000).

(A.1.2.) ***Salt marsh proper (micro-site T2a)***

It is originally lagoonal with a shallow water table, and when excluding the open water bodies the margins of these areas are wet and extremely saline. Soil surface appears as concave slope form with slope gradient < 2%, which promotes the accumulation of upward ground water on soil surface. Soils of this unit are permanently wet with salic horizons at the surface and with hard salt crust (110 dS/m in 1999 – 125 dS/m in 2000), or within 50 cm of the surface as shallow effective soil depth (Tables 2 and 3; Fig. 3). In addition, the subsurface horizon is characterized by clay texture, aquatic, anaerobic and glayzation conditions. The soluble calcium to magnesium ratio (<1) indicates that the soil could be referred to as magnesium affected soil due to sea water intrusion. The soil organic matter content increased from 0.77% in 1999 to 1.8% in 2000 associating more wet conditions, which could indicate a deficient decomposition of the organic matter, attributed mainly to the hydrmorphic conditions of the profile (Ortiz *et al.*, 1995), which is classified as Typical Aquisalids. This unit is covered by halophytic vegetation, which occupies the lower parts of the marsh with

TABLE (1). Description of different microhabitats distributed along the transect.

Microhabitat	Units represented	Dominant & Co-dominant perennial species	Most abundant associated annual species	Species richness				Species cover			
				Perennials		Annuals		Perennials		Annuals	
				1999	2000	1999	2000	1999	2000	1999	2000
Southern slope of the coastal oolitic dune	T1	*Plantago albicans* *Convolvulus arvensis* *Launaea resedifolia* *Cynodon dactylon*	*Schismus barbatus* *Plantago crypsoides* *Launaea tenuiloba* *Lobularia arabica* *Malva parviflora*	9	12	13	28	Few- 1-5%	Few-50-75%	Solitary -5-25%	Solitary -5-25%
Salt marsh proper	T2a	*Halocnemum strobilaceum* *Arthrocnemum macrophyllum* *Salicornia fruticosa* *Juncus arabicus*	*Sphenopus divaricatus* *Mesembryanthemum nodiflorum* *Mesembryanthemum crystallinum*	9	11	3	4	Solitary-5-25%	Few-25-50%	Few-1-5%	Solitary-5-25%
Saline-Depression	T2b-T4	*Arthrocnemum macrophyllum* *Limoniastrum monopetalum* *Halocnemum strobilaceum* *Cynodon dactylon* *Salsola tetrandra* *Launaea resedifolia* *Suaeda fruticosa*	*Sphenopus divaricatus* *Mesembryanthemum nodiflorum* *Schismus barbatus* *Hordeum leporinum* *Senecio glaucus* *Plantago crypsoides* *Bassia muricata* *Cutandia dichotoma* *Malva parviflora*	12	22	14	35	Solitary-5-25%	Solitary->75%	Solitary-5-25%	Solitary-25-50%

TABLE (1). Cont.

Inner saline depression	T5	*Limoniastrum Monopetalum* *Suaeda fruticosa* *Salsola tetrandra*	*Cutandia dichotoma* *Schismus barbatus* *Sphenopus divaricatus* *Plantago crypsoides*	11	12	8	12	Few-5-25%	Few->75%	Solitary-1-5%	Solitary-25-50%
Calcoreous coastal interridges, depressions and plains	$T_{6(a,b,c)}$-T8	*Centaurae calcitrapa* *Traganum nudatum* *Lotus creticus* *Plantago albicans* *Cynodon dactylon* *Echinops Spinosissimus* *Helianthemum Stipulatum* *Carduncellus eriocephalus* *Anabasis articulata*	*Launaea tenuiloba* *Malva parviflora* *Medicago laciniata* *Ifloga spicata* *Bassia muricata* *Plantago crypsoides* *Cutandia dichotoma* *Schismus barbatus* *Trigonella stellata* *Hordeum leporinum* *Rumex pictus* *Anchusa hispida* *Carthamus lanatus*	28	28	9	38	Solitary-25-50%	Few-> 75%	Solitary-1-5%	Solitary-5-25%

TABLE (1). Cont.

Dissected & wheathered ridges	$T_{9(a,b)}$	*Plantago albicans* *Thymelaea hirsuta* *Asphodelus ramosus* *Anabasis articulata* *Gymnocarpus Decander* *Scorzonera undulata*	*Launaea tenuiloba* *Bromus unioloides* *Cutandia dichotoma* *Plantago crypsoides* *Ifloga spicata* *Bassia muricata* *Malva parviflora*	20	28	8	25	Solitary-25-50%	Solitary-> 75%	Solitary –1-5%	Solitary-5-25%
Transition area between the rocky plain and non-saline depression	$T10_{(a,b)}$	*Launaea nudicaulis* *Atractylis carduus* *Asphodelus ramosus* *Artemisia monosperma* *Noaea mucronata* *Plantago albicans* *Carduncellus eriocephalus* *Echiochilon fruticosum* *Lotus creticus*	*Launaea tenuiloba* *Plantago crypsoides* *Malva parviflora* *Hordeum leporinum* *Cutandia dichotoma* *Schismus barbatus*	17	18	5	26	Solitary-25-50%	Few-> 75%	Solitary-1-5%	Solitary-5-25%
Non -saline.Depression	$T11.T12_{(a,b)}$	*Asphodelus Ramosus* *Helianthemum Stipulatum* *Echiochilon fruticosum* *Plantago albicans* *Carduncellus eriocephalus* *Artemisia monosperma* *Anabasis articulata* *Centaurae calcitrapa* *Atractylis carduus* *Convolvulus althoides*	*Schismus barbatus* *Malva parviflora* *Plantago crypsoides* *Bassia muricata* *Cutandia dichotoma* *Rumex pictus* *Adonis dentatus* *Launaea tenuiloba*	24	29	12	16	Solitary-5-25%	Solitary-25-50%	Solitary-1-5%	Solitary-25-50%

TABLE (1). Cont.

Escarpment and foot slope	T13$_{(a,b)}$, T14	*Plantago albicans* *Carduncellus eriocephalus* *Echiochilon fruticosum* *Anabasis articulata* *Deverra tortuosa* *Helianthemum lippii* *Scorzonera undulata* *Echinops spinosissimus* *Artemisia herba alba* *Gymnocarpus decander*	*Schismus barbatus* *Carthamus lanatus* *Bassia muricata* *Launaea tenuiloba* *Hordeum leporinum* *Plantago crypsoides* *Cutandia dichotoma* *Adonis dentatus* *Trigonella stellata* *Filago desertorum* *Ifloga spicata*	26	51	10	36	Solitary-5-25%	Solitary-25-50%	Solitary-1-5%	Solitary-5-25%
Highly dissected ridges of inland plateau	T15,T16	*Noaea mucronata* *Echiochilon fruticosum* *Asphodelus ramosus* *Gymnocarpus decander* *Thymelaea hirsuta* *Anabasis articulata* *Helianthemum lippii*	*Launaea tenuiloba* *Schismus barbatus* *Hordeum leporinum* *Plantago crypsoides* *Cutandia dichotoma* *Trachynaea distachyea*	20	27	8	20	Solitary-5-25%	Solitary-25-50%	Solitary-1-5%	Solitary 5-25%

high moisture content (Abdel Razik and Ismail, 1990). The dominant perennial species are *Arthrocnemum macrophyllum, Halocnemum strobilaceum* and *Salicorina fruticosa.* The most abundant associated annual species are *Sphenopus divaricatus, Mesembryanthemum nodiflorum* and *Mesembryanthemum cristallinum* (Table 1). The species with high specificity to this unit are *Cressa cretica, Juncus arabicus, Sprobolus pungens and Salicoronia fructicosa* that are clearly related to the edaphic conditions of this unit (Table 4). No temporal variations were detected in plant species richness between spring seasons of the years 1999 and 2000.

(A.1.3.) *Saline depression (micro-sites T2b, T3a, T3b and T4)*

The surface features are characterized by straight slope form with <2% slope gradient. Most of the soil has high salinity and referred to as magnesium affected soils (9.1 dS/m in T3, 55.8 dS/m in T4 and Ca/Mg <1) and contains gypsum crystals of variable sizes in subsurface layers (Tables 2 and 3). These soils are highly gleyed throughout the profile or, at least, within 75 cm of the surface. This microhabitat could be classified as Gypsic Haplosalids. In this depression, a heavy clay loam pan is found; little below the surface, preventing a rapid percolation and drainage of seawater and maintaining the surface saturated. The water table, derived mainly from the seawater, is relatively close to the surface resulting in salt accumulates in upper layer with proceeding evaporation while the soil solutions becomes more concentrated and makes soil wet and salinity is high (Bowman *et al.*, (1985). The wetness of soil surface in 2000 decreased the erosion activity from sever to slight erosion. The edaphic conditions of this unit favor the dominance and the habitat specificity of some plant species like *Halocnemum strobilaceum, Arthrocnemum macrostachyum, Limoniastrum monopetalum, and Frankenia revoulta* of perennials and *Sphenopus divaricatus* of annuals (Table 4). The most abundant associated annual species are *Sphenopus divaricatus, Mesembryanthemum nodilflorum,* and *Plantago crypsoides.* There was a remarkable increase in species richness of these micro-sites from 12 species in spring 1999 to 22 species in spring 2000 for perennials and from 14 species in spring 1999 to 35 species in spring 2000 for annuals (Table 1).

(A.1.4.). *Inner saline depression (micro-site T5)*

It is a transitional zone between the lower and upper coastal plain but it is characterized by a high soil salinity level (64.9 dS/m in 1999 and 71.3 dS/m in 2000) with gypsum segregation in different depths (Tables 2 and 3). The monitoring between 1999 and 2000 showed an increase in fine fraction (texture change from Silt-loam) that agrees with increasing of deposition area from 10% in 1999 to 50% in 2000. This may be due to heavy rainstorms and wet conditions in 2000 leading to the deposition of fine sediments under surface runoff processes (Fig. 4a). This unit is classified as Gypsic Haplosalids. *Salsola longfolia* and *Suaeda pruinosa* dominate the

TABLE (2). Main chemical and physical properties of the sampled soil profiles at different depths along the studied transect (1999).

Spring 1999	T1		T2a		T3		T5			T6	T7	T9		T11		T12	T13a	T13b	T14	T15	T16	
Depth	0 - 30	30-60	3- 45	0- 25	25-55	55-80	0-25	25-45	45-85	0- 25	0- 20	0-20	40-80	0-20	20-50	0- 20	0-20	0-20	0-20	0-20	0-15	15-65
pH	7.9	7.8	8.6	8.0	7.7	7.6	7.6	7.6	7.9	8.0	8.2	7.9	8.1	8.0	8.5	8.5	7.8	8.0	8.0	7.9	7.8	8.2
EC dS/m	1.08	1.33	110	8.3	7.3	6.6	64.9	62.0	60.0	2.8	0.8	1.2	2.0	0.71	0.80	0.46	0.66	0.68	0.82	0.97	9.5	7.5
HCO_3 meq/l	1.2	1.2	15.1	2.0	1.5	1.5	2.30	1.90	2.40	1.9	1.4	2.4	2.7	1.4	1.6	1.5	4.0	5.0	5.5	3.5	1.9	1.9
Cl^- meq/l	7.4	11.0	903.9	66.0	56.0	49.0	780	561	510	10.1	5.3	7.8	11.1	4.5	4.0	2.5	0.8	0.65	0.8	1.8	70.0	55.5
SO_4 meq/l	2.1	1.9	61.2	8.5	8.0	9.5	110	58.5	96.5	7.5	2.1	2.7	7.1	1.1	1.4	0.5	1.4	0.75	1.1	4.4	16	19
Ca^{++} meq/l	4.0	2.4	56.7	5.3	7.4	6.4	146	68.2	64.9	4.3	2.7	5.4	14.4	3.5	2.8	1.2	3.5	6.0	7.4	7.0	21.5	18
Mg^{++} meq/l	0.6	0.8	118.21	5.7	17.5	18.5	96.2	102	98.7	7.1	2.1	2.0	5.2	2.0	2.0	1.4	1.5	0.5	0.5	1.0	16.0	21.5
Na^+ meq/l	14.2	16.0	858.7	55.0	49.0	45.0	650	450	508	14.9	6.3	5.8	9.8	2.5	2.2	1.9	1.22	2.61	1.43	2.65	50	36
K^+ meq/l	1.3	1.8	23.27	1.8	1.9	1.4	3.0	4.0	4.0	1.1	0.9	1.1	1.5	0.01	0.01	0.01	0.33	0.21	0.21	0.56	0.2	0.1
Clay %	-	-	48.28	12	20	32	16	12	10	-	2.0	12	11	-	-	1.0	0	0	0	0	6.0	13.0
Silt %	5.8	5.0	35.12	20	30	28	48	55	52	0.6	8.0	4	6	3.2	2.2	3.0	4.4	2.3	2.8	11.4	4.0	7.0
FS %	64.4	67.0	13.2	40	28	20	23	27	28	37.2	40.0	57	50	35.4	38.8	45.0	-	-	-	-	40.0	35.0
MS %	23.8	26.0	6.1	20	14	10	10	5	8	50.6	30.0	25	20	23.0	46.8	35.0	-	-	-	-	30.0	15.0
CS %	6.0	2.0	1.6	8	8	10	3	1	1	11.6	20.0	2	13	38.4	12.2	16.0	-	-	-	-	10.0	10.0
Total Sand %	94.2	95.0	16.6	68	50	40	36	33	38	99.4	90.0	84	83	96.8	97.8	96.0	95.6	97.7	97.8	88.6	90	80
Texture	S	S	C	SL	L	CL	L	SiL	L	S	S.	LS	LS	S	S	S.	S	S	S	-	S	LS
$CaCO_3$%	10.7	28.2	70.26	45.6	33.6	37	19.2	20.0	12.0	40	55.0	31.3	26.8	16.5	14.8	25.0	-	-	-	-	45	49
O.M. %	0.63	0.44	0.77	0.95	-	-	0.88	0.66	0.66	0.44	0.66	0.68	0.44	0.72	-	0.44	-	-	-	-	0.96	0.68
Nitrogen ppm	88	62	112	108	-	-	64	58	48	56	56	88	64	66	-	56	-	-	-	-	112	78

S= Sandy L= Loamy C= Clay CL= Clay loamy SL= Sandy loamy Sil= Silty specific vegetation of this unit (Table 4). This community is usually present on the boarder of the dry saline beds of the marshy depressions (Dahlgren *et al.*, 1997). In addition, some weeds (e.g. *Phalaris minor*) appeared in this unit, which are related to cultivation practices and sandy soil (Zahran, 1992). The dominant perennial species are: *Limoniastrum monopetalum, Suaeda fruticosa,* and *Salsola tetrandra* while *Cutandia dichotoma, Schismus barbatus,* and *Plantago crypsoides* are among the most abundant associated annual species. No large variation in species richness between the years 1999 and 2000 for both perennials and annuals (Table 1).

(A.2) The Upper Coastal Plain

(A.2.1) Calcareous coastal inter-ridges depressions and plains (micro-sites T6 a, b, c, T7 and T8)

The coastal plains in most areas and the depressions between inland ridges are filled with calcareous loamy material mixed with sand brought down as alluvial, colluvial and wind blown deposits from the neighboring highlands, whether being the rocky ridges or the rocky tableland. The main differences between subdivisions of this broad group of mapping units are texture, depth, and presence of calcic horizon (Hammad, 1969). The soils belonging to this unit are characterized by low salinity and deep sandy soils and is classified as Typic Torripsamment. The main difference in soil characteristics between 1999 and 2000 is the increasing of coarse sand fraction from 11.6% to 51.0% in T6 and from 20.0% to 65.0% in T7 (Fig. 4b). The decreasing of fine fraction may explained as sever wind erosion from the surface horizon in year 2000. The previous result is in accordance with increasing erosion area from 25% in 1999 to 50% in 2000. Non-saline deep soil and loose coarse sand conditions are supporting the growing of *Argyrolobium uniflorum, Eryngium creticum* and *Polygoum equisetiforme* (Zahran, 1992). The increase of coarse sand fraction and decrease of fine fraction between spring 1999 and 2000 has a remarkable effect on perennial species richness along the slopes (T6b and T7). It was 23 for the two micro-sites in spring 1999 while declined to 11 and 14 in spring 2000, respectively. For the foot and top of the rocky plain no remarkable temporal variation in species richness was noticed between the years 1999 and 2000 (Table 3). However, there was a large variation in species richness of annual species throughout the micro-sites (T6, T7 and T8).

(A.2.2.) Dissected and weathered ridges (micro-sites T9a & T9b)

This unit occupies small areas and is situated at the northern slope of a rocky dune ridge. The soils are non-saline (1.2dS/m to 1.8 dS/m), calcareous loamy sand to sandy with low saturation percentage, probably weathered from oolitic sand deposits. The soils are classified as Typic Haplocalcidsc. In this rocky ridge, the slopes are usually steep and almost completely devoid of soil cover. These conditions support typical cliff vegetation dominated by *Kickxia aegyptiaca, Dactylis glomerata* and

TABLE (3). Main chemical and physical properties of the sampled soil profiles at different depths along the studied transect (2000).

Spring 2000	T1	T2a	T3	T4	T5	T6a	T6b	T6c	T7	T9	T11	T13a	T13b	T14	T15	T16
Depth	0 – 30	3 - 45	0 - 25	0 - 25	0 - 25	0 - 25	0 - 25	0 - 25	0 - 20	0 - 20	0 - 20	0 - 20	0 - 20	0 - 20	0-20	0 - 15
pH	8.1	8.6	8.3	8.0	8.0	7.8	8.1	8.0	8.0	8.2	8.1	7.8	7.9	8.0	7.8	8.1
EC mmhos/cm	1.4	125	9.1	55.8	71.3	2.4	2.2	1.9	0.87	1.8	0.9	0.66	0.61	0.81	0.88	8.8
HCO_3 meq/l	1.4	-	-	2.0	13.9	1.4	1.1	1.0	1.2	2.9	1.4	4.5	4.2	5.8	6.2	2.4
Cl^- meq/l	8.0	-	-	420.0	760.0	9.3	8.1	7.3	5.8	8.4	5.2	1.4	1.5	1.9	0.9	66.0
SO_4 meq/l	2.7	-	-	180.0	218.9	6.1	6.0	5.4	2.9	2.2	1.7	0.5	0.4	0.4	1.7	20.0
Ca^{++} meq/l	4.7	-	-	35.0	155.0	4.1	4.3	3.8	3.1	5.8	3.6	4.2	4.8	5.8	6.7	25.7
Mg^{++} meq/l	1.1	-	-	63.0	114.0	3.9	3.6	2.7	2.9	3.0	1.7	0.9	1.0	1.2	1.1	19.9
Na^+ meq/l	17.0	-	-	390.0	690.0	13.4	11.6	11.1	7.1	6.4	3.4	1.1	1.0	1.2	1.3	55.0
K^+ meq/l	1.5	-		4.5	6.0	1.0	1.0	0.9	0.8	0.9	0.3	0.18	0.12	0.28	0.2	0.7
Clay %	1.6	50.0	18.0	29.0	18.0	0.1	0.1	0.1	0.1	8.0	0.1	0	0	0	0	4.0
Silt %	7.2	37.0	22.0	23.0	51.0	4.0	3.0	2.0	5.0	11.0	5.0	3	1.8	2	2	8.0
FS %	70	13.0	36.0	32.0	20.0	20.0	18.0	13.0	15.0	54.0	14.0	-	-	-	-	35.0
MS %	16.8	-	16.0	14.0	8.0	25.0	22.0	18.0	15.0	20.0	22.0	-	-	-	-	30.0
CS %	4.4	-	8.0	2.0	3.0	51.0	57.0	67.0	65.0	7.0	59.0	-	-	-	-	23.0
Total Sand %	91.2	13.0	60.0	48.0	31.0	96.0	97.0	98.0	95.0	81.0	95.0	97	98.2	98	98	88.0
Texture	S	C	SL	SCL	L	S	S	S	S	LS	S	S	S	S	S	S
$CaCO_3$%	12.4	55.8	45.6	41.0	16.5	37.0	40.0	33.0	42.0	31.3	21.0	-	-		-	40.0
O.M. %	0.51	1.8	0.95	0.96	0.93	0.53	0.43	0.39	0.55	0.68	0.76	-	-	-	-	0.80

S= Sandy L= Loamy C= Clay CL= Clay loamy SL= Sandy loamy Sil= Silty

Globularia arabica (Table 4) These plants grow either in the cracks filled with soil or on residual and accumulated soil (Abd El-Rahman and Batanouny, 1965). The dominant perennial species are *Anabasis articulata, Gymnocarpus decander,* and *Scorzonera undulata. Cutandia dichotoma* and *Ifloga spicata* for annuals. No large variation was observed in species richness for perennials (Table 1), while there is a remarkable increase in the species richness of therophytes between the years of 1999 and 2000.

A.2.3 Transition soils between rocky plain and non-saline depression (micro-sites T10a and T10b)

The soils are mainly composed of quartz sand but have low lime contents. The texture of most of these soils is loamy sand to sand. Topography is generally hummocky but low dunes are present in some areas. The vegetation is generally shrubs of different heights and densities. The sand contains fractions of snail shells, which add to the lime content of the sand itself. The soils are classified as Typic Torripsamments (LMP/NWC, 1986). It is remarkable that this unit (of transition areas) has no habitat type specific species. Most of the species present in this unit have a wide ecological amplitude of tolerance. Of these species *Noaea mucronata, Echiochilon fruticosum* and *Plantago albicans* for perennials. *Malva parviflora, Hordeum liporinum* and *Schismus barbatus* for annuals (Table 1).

A.2.4 Non saline depression (micro-sites T11 and T 12 a, b)

The non-saline depression is the most fertile part of the western Mediterranean coastal belt. The soil of this depression is mainly non saline with sandy texture and is classified as Typic Torripsamments. Temporal variation in soil characteristics shows that the coarse sand texture increased from 38.4% in 1999 to 59.0% in 2000 due to erosion activity coinciding with increasing the erosion area from 25% in 1999 to 50% in 2000 (Tables 2 and 3; and Fig. 4 a and b). These variations could explain the difference in the dominant perennial species between spring 1999 and 2000, where in the micro-site T12b the first dominant species was *Plantago albicans* in spring 1999 while it was *Artemisia monosperma* in spring 2000 (Table 1). This result agrees with the same trend in sites T6 and T7. The micro-site T12b is characterized by *Medicago minima*. It occurs on deep non- saline sandy loam soil and some times with shallow sand sheet. This species dominates in most habitats (cultivated fields, ridges and plateau etc.)

(B) Plateau, Local Depressions and Transitional Zones

The plateau extends south between the northern coastal plain and southwest to the Qattara Depression. It has an elevation varying between 80 and 154m above the sea level. It is characterized by the following two micro-sites:

(B.1) Escarpment and Toe-Slopes (Micro-Sites T13 and T14)

The plateau is separated from the coastal plain by cliff rising +100 in facing north and oriented mostly in an east-west direction, but a little

TABLE (4). Species specificity in different micro sites (1999-2000).

Micro site	Species Specificity			
	Perennials		Annuals	
	Spring 1999	Spring 2000	Spring 1999	Spring 2000
T1	*Convolvulus arvensis*	*Convolvulus arvensis*	*Silene villosa*	*Atractylis cancellata*
T2a	*Cressa cretica* *Juncus arabicus* *Salicornia fruticosa* *Sprobolus pungens*	*Juncus arabicus* *Salicornia fruticosa* *Sprobolus pungens*		
T2b				
T3a				
T3b				
T4				
T5	*Salsola longifolia* *Suaeda pruinosa*	*Suaeda pruinosa*	*Phalaris minor*	
T6a				
T6b				
T6c		*Argyrolobium uniflorum* *Eryngium creticum* *Polygonum equisetiforme*		
T7				
T8				
T9a		*Kickxia aegyptiaca*		
T9b	*Dactylis glomerata* *Globularia arabica*			
T10a				
T10b				
T11				
T12a				
T12b			*Medicago minima*	
T13a			*Sisymbrium irio*	
T13b		*Colchicum ritchii* *Euphorbia bivonae* *Fumana thymifolia* *Thymus capitatus*		
T14	*Thymus capitatus*			
T15				
T16				

farther to the west and makes a rapid swing in the northwest direction. The soils have low salinity and deep calcareous sandy texture (LMP/NWC, 1986). It is classified as Typic Torripsamments. The micro site number 13a is characterized by *Sisymbrium irio* that is related to framing practices. In microsite T13b, *Colchicum rithil, Euphorbia bivonae, Fumana thymifolia* and *Thymus capitatus* are more favored in the steep slopes and gravel stony soil. *Colchicum rithil* and *Thymus capitatus* that grow more favorably in the inland rocky ridges and plateau dominate the micro site T14 (Batanouny and Zaki, 1974). The dominant perennial species are *Anabasis articulata, Helianthemum lippii* and *Deverra tortuosa*, while *Trigonella stellata and Cutandia dichotoma* are the most abundant associated annual species. Temporal variation declares that in the microsite T13b the dominant species were *Echiochilon fruticosum* and *Plantago albicans* in 1999 while they were replaced by *Artemisia herba-alba* and *Scorzonera undulata* in 2000. This difference may be attributed to the active wind and water erosion. There is a remarkable increase in species richness for these micro-sites. It was 26 in spring 1999 and increased to 51 in spring 2000. Similarly, annual species richness increased from 10 to 36 respectively (Table 1).

(B.2) Highly Dissected Ridges of Inland Plateau (Micro-Sites T15 and T16)

It is mainly composed of rocky ridges either highly dissected or not with moderately deep sandy to sandy loam over rock. The soil is characterized by undulating surface, hummocks and few scattered stones (Table 6). As mentioned before, the coarse sand fraction increased in year 2000 due to active erosion for fine fraction in this year. For this reason the dominant species were *Asphodelus ramosus and Thymelaea hirsuta* in 1999 for the microsite T16 while they were *Anabasis articulata and Helianthemum lippii* in spring 2000. Soils are classified as Lithic Torripssaments. No plants are specific to these micro-sites, which may be due to the homogeneity of surface features and soil properties.

Temporal Variation in Vegetation Characteristics

In general, from the listing of dominant and co-dominant perennial species in all pilot areas and within micro-sites for the two years, it is clear that certain species are characteristic for each microhabitat. For example, *Arthrocnemum macrostachymm, Halocnemum strobilaceum, Limoniastrum monopetalum* and *Suaeda fruticosa* are among the characteristic species for salt marshes and saline depression. *Deverra tortuosa, Artemisia herba-alba* and *Scorzonera undulata* are characteristic species for the inland ridges (rocky sites). Some species exhibit wide ecological amplitude of tolerance, so they recorded as dominants in more than one of the microhabitats (e.g. *Plantago albicans, Asphodelus microcarpus, Anabasis articulata* and *Thymeleae hirsute*). For annual species no characteristic species was found in the microhabitats except for *Mesembryanthemum nodiflorum, Mesembryanthemum crystallinum* and *Sphenopus divaricatus* which specify the salt marshes and saline depression. Other annual species are distributed in different microhabitats according to soil conditions (moisture content, sand % and $CaCO_3$) and human activities (ploughing, grazing and urbanization). Concerning the species richness of perennial species, two trends were noticed with the first one denoting the absence or less variation between spring 1999 and spring 2000. For example, in the microhabitat of calcareous coastal inter-ridges depressions and plains the species richness of perennials was similar in both years (28), while a narrow variation was noticed for the inner saline depression with species richness of 11 and 12 in spring 1999 and spring 2000, respectively. Concurrently, the second trend denoting a wide variation in species richness between the two years was observed in the microhabitat of the dissected and weathered ridge; it increased from 20 for spring 1999 to 28 for spring 2000. Similar trend was detected in the microhabitat of escarpment and foot slope where it increased from 26 in spring 1999 to 51 in spring 2000. Add to this that the annual species exhibit remarkable variation in the species richness for most of the microhabitats, except for the salt marsh proper and inner saline depression where it was 3 and 8 in spring 1999 while it was 4 and 12 in spring 2000, respectively. It is worthy mentioning that higher cover ratings were recorded in spring 2000 than in spring 1999 of different microhabitats for both perennial and annual species.

The life form spectrum illustrates the percentages of the different life forms in each of the selected units. It is noticeable that big difference in numbers of this life forms between year 1999 and year 2000. For example, the vegetation of micro-site T1, the number of therophyte was 13, and for hemicryptophyte was 3 in 1999 while these numbers were 28 and 7 respectively 2000 (Table 1). In the most of the selected micro-sites a remarkable increase in the number especially of therophytes was noticed between spring 1999 and spring 2000. For example, in T14 the number was 17 in spring 1999 while it was 61 in spring 2000. For other life forms no large variation was observed between spring 1999 and spring 2000. For example, in T9a the number of chamaephytes was 8 in spring 1999 while it was 9 in spring 2000. The same trend was noticed for the hemicryptophyte in the same unit since the number was 3 in spring 1999 while it was 4 in spring 2000. The annual species exhibit remarkable variation in the species richness for most of the microhabitats, except for the salt marsh proper and inner saline depression where was 3 and 8 in spring 1999 while it was 4 and 12 in spring 2000, respectively. It is worthy mentioned that higher cover ratings were recorded in spring 2000 than spring 1999 for most micro-sites and microhabitats of both pernnial and annual plant species.

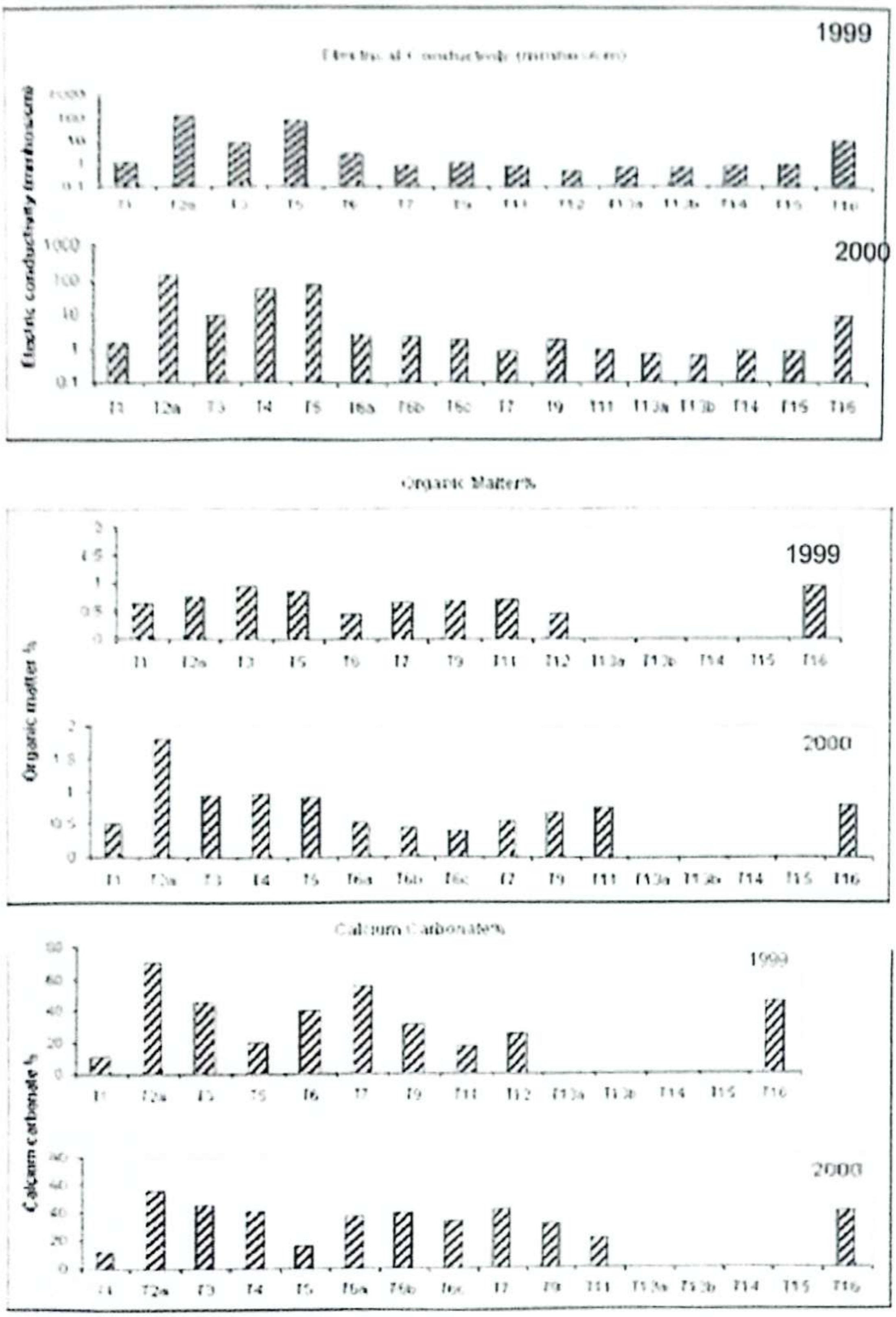


Fig. (3). Some physical properties of the sampled soil profiles along the studied transect (1999-2000).

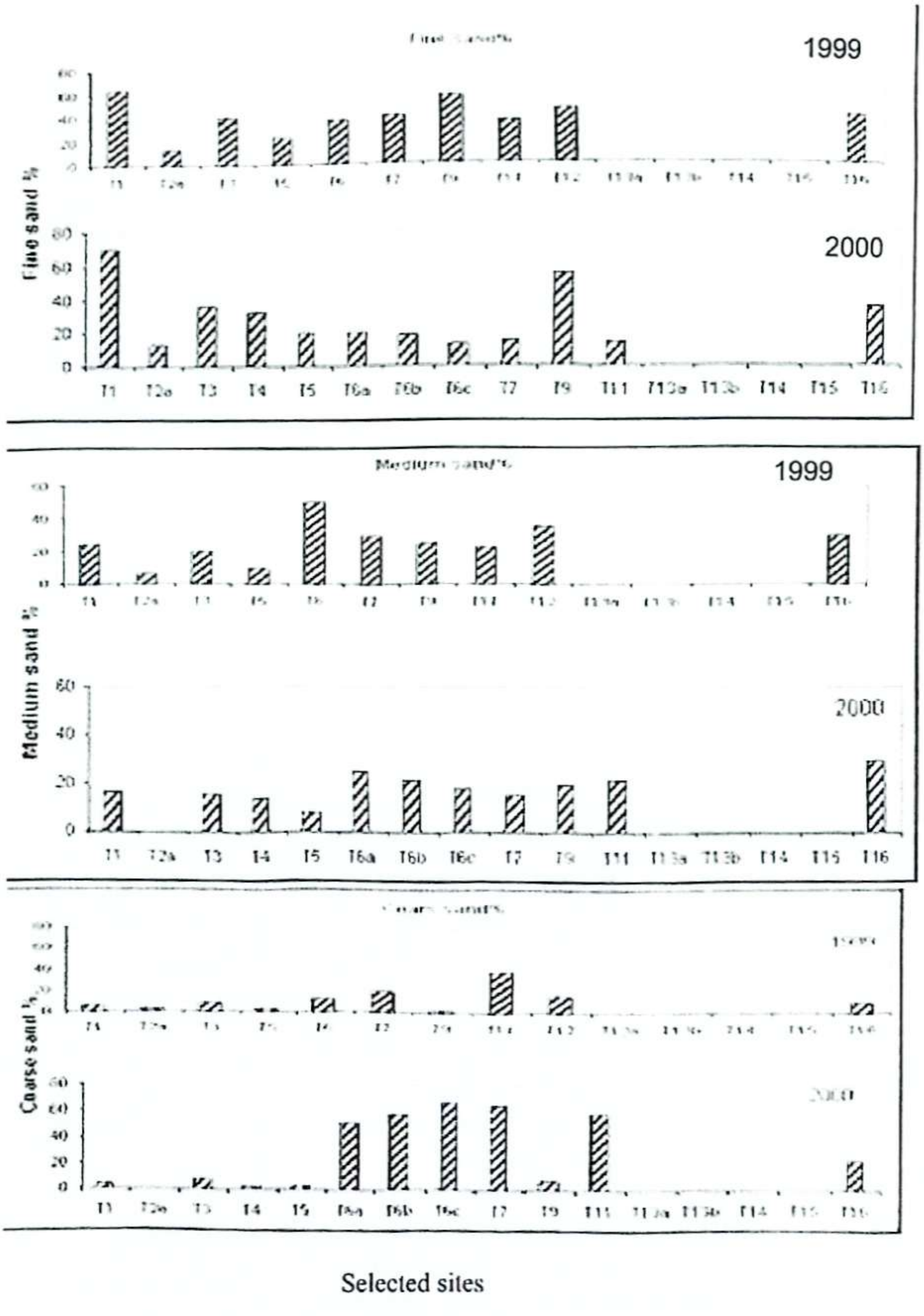
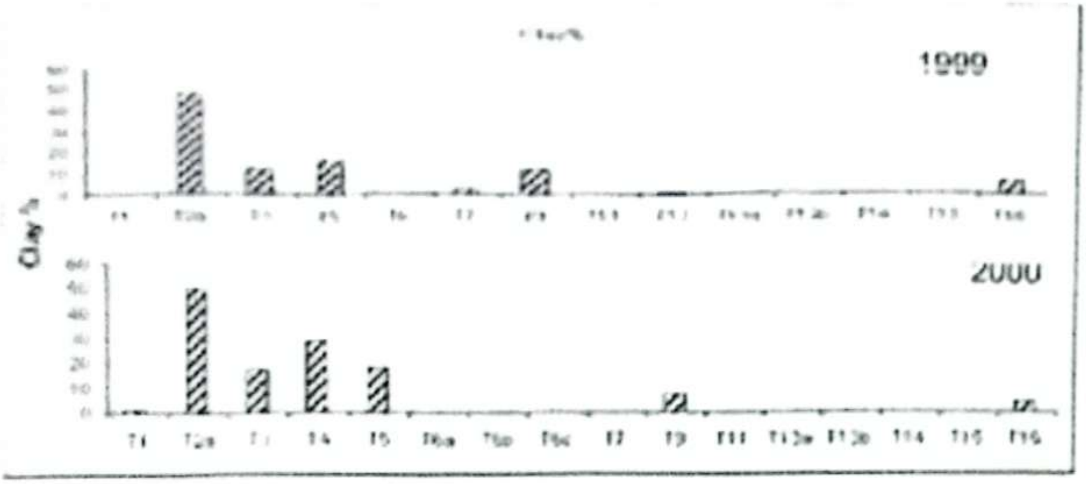
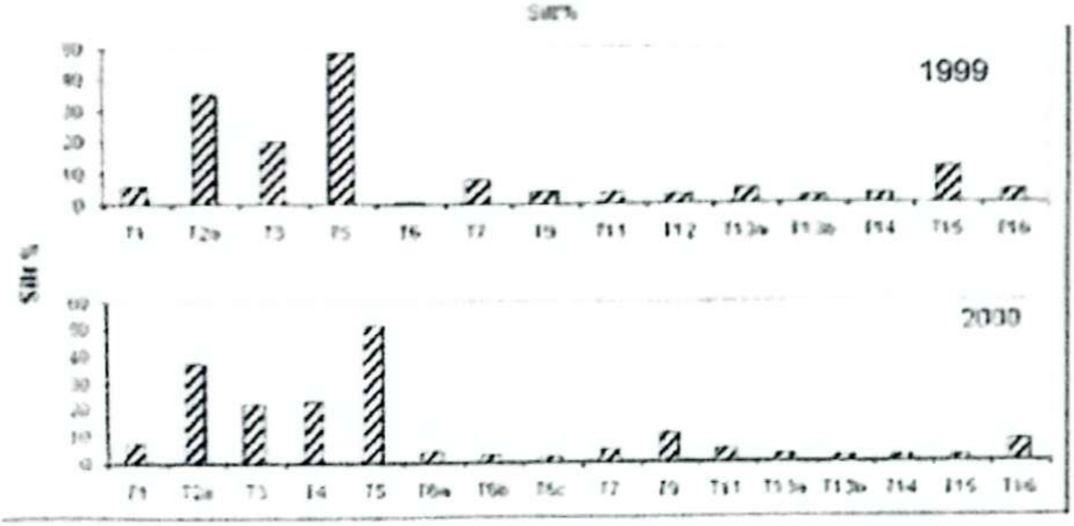


Fig. (4.a). Soil texture of the sampled soil profiles along the studied transect (1999-2000).





Selected sites

Fig. (4.b). Soil texture of the sampled soil profiles along the studied transect (1999-2000).

CONCLUSION

Different habitats are recognizable in the western coastal Mediterranean zone in Egypt. Each habitat supports a definite type of vegetation. Soils of these habitats vary widely as regards their physical and chemical properties. Physiography, through its effect on these properties, has a paramount effect on the distribution of plant associations.

The effect of relief on the distribution of plant communities is both direct and indirect. Elevated parts are more exposed to weathering factors than depressions. Soil is removed from elevated parts by wind and/or water actions, thus rendering the habitat unfavorable for the growth of many plants except those having the ability to extend their roots in the rock crevices (e.g. *Thymus capitatus, Globularia arabica and Colchicum rithii*). Moreover, such habitats receive less water than lowlands, which receive runoff water in addition to the local rain. The depressions receive not only water, but also the soil washed by runoff water. Ground cover and species composition changes between 1999 and 2000 were a function of available soil water as reflected by the rainfall distribution pattern over the 2 years. The wetter year (2000; average precipitation =360 mm) resulted in a large increase in cover and growth of specific plants.

The habitats that have deep soils favor more plant growth. Deep soils allow the storage of some water in the subsoil providing a continuous supply of moisture for the deeply seated roots of perennials. In contrast, shallow soils are moistened during the rainy season but dry in a short time. Water loss from deep layers is restricted to root absorption and transpiration, while evaporation from the soil ceases due to the presence of the upper protective dry layers (Abd El-Rahman and Batanouny, 1965). The water retained in deep layers represents the water supply for perennials in the dry season.

The gradual modification in the plant cover proceeds in coincidence with the gradual accumulation of alluvial material and the gradual thickening of the soil. The relationship between the associations in the area under study depending on the retrogressive changes due to erosion and building up of soil. On the other word, soil depth and texture may be supporting the different and specific plant communities.

Salinity in some sites is one of the indirect effect of varying elevation, where salts are dissolved in rainwater and washed down with runoff accumulating in depressions and low lands, thus causing increased salinity of these habitats. Near the seashore, low ground level renders the water table and particularly the saline water table very close to the surface. Saline water rises by capillary and salts accumulate in the surface soil as a result of intense evaporation in summer. In such a saline habitat, only halophytes can thrive as a specific habitat.

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دراسة العلاقة بين توزيع الكساء الخضري وعوامل التربة في منطقة الرصد البيئي بالعميد – الساحل الشمالي الغربي لمصر

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قسم الاراضى والمياه – كلية الزراعة – جامعة الاسكندرية – الاسكندرية – مصر
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تهدف الدراسة الحالية إلي رصد وتقدير التغيرات في العوامل البيئية وخاصة التربة وعلاقة هذا التغير بتوزيع المجتمعات النباتية وذلك من خلال قطاع عمودى علي البحر بعمق ١٥ كم جنوباً. ويغطي هذا القطاع عدد من الموائل البيئية موزعة من الشمال إلي الجنوب وقد تمت الدراسة في ربيع عامي ١٩٩٩ ، ٢٠٠٠.

خلصت الدراسة إلي إنه يوجد ارتباط وثيق بين توزيع المجتمعات النباتية وكلا من التغيرات الفيزيوغرافية والمناخية وكذلك خصائص التربة.

ميزت الدراسة بين مجموعتين أساسيتين من الموائل البيئية
أ- السهل الساحلي
ب- السهل الداخلي (ويشتمل علي المنخفضات الملحية والغير ملحية والمناطق الانتقالية) كما تم تقسيم بعض المواطن الرئيسية إلي موائل بيئية صغري (Microhabitats).

سجلت الأنواع النباتية غطاءاً عالياً في عام ٢٠٠٠ عنه في عام ١٩٩٩. كما أظهرت الدراسة أيضاً تباينا واضحا في طرز النمو لنفس عامي الدراسة.

كما خلصت النتائج إلي أن الغطاء النباتي وتركيب المجتمعات النباتية يتأثر تأثراً واضحاً بكمية الماء المتاحة في التربة والذي يعكسه كمية المطر وتوزيعه خلال عامي الدراسة، كما تم التوصل إلي أن هذا التغير يكون مسايراً للتراكم التدريجي في الرسوبيات المائية والذي يؤدي بدوره إلي زيادة في سمك التربة.

امكن استنتاج أن توزيع المجتمعات النباتية في منطقة الرصد البيئي بالعميد يرتبط ارتباطا وثيقا بالتغيرات التي تحدث نتيجة عوامل التعرية وبناء التربة من ناحية وكذلك عمق وقوام التربة من ناحية أخري.