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Floristic Composition and Vegetation Analysis in Suez Governorate, Egypt

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ABSTRACT

The present study provides a detailed depiction of the floristic composition and vegetation analysis of four habitats in Suez Governorate, Egypt. The investigated habitats include desert, waste lands, crop fields and orchards. A total of 107 species (56 annuals, 2 biennials and 49 perennials) belonging to 93 genera and 33 families were recorded in the study area. The most represented families were Asteraceae, Poaecae, Brassicaceae, Fabaceae and Chenopodiaceae. Therophytes were the most prevailing life-forms. Chorological analysis revealed that the Saharo-Sindian and Mediterranean chorotypes either pure or extended into other regions form the major component of the floristic structure. The application of TWINSPAN classification technique on the importance values of 107 plant species recorded in 40 stands representing the studied habitats produced four vegetation groups named after their dominant species. Group A: dominated by *Zygophyllum coccineum*, group B: dominated by *Tamarix nilotica*, group C: dominated by *Beta vulgaris*, *Chenopodium murale* and *Melilotus messanensis* and group D: dominated by *Oxalis corniculata.* Species richness, Shannon-Wiener and Simpson indices measurements indicated that vegetation groups D and C were the most diverse ones, followed by groups A and B. Detrended Correspondence Analysis (DCA) results indicated a reasonable segregation among these groups along the first and second axes. Linear correlation of soil variables with the importance values of some dominant species and the application of Canonical Correspondence Analysis (CCA- biplot) indicated significant correlation between species distribution of the studied habitats and the soil variables such as, soil texture, organic matter, $CaCo_3$, pH, electrical conductivity, bicarbonates, chlorides, sodium, magnesium, potassium and calcium.

Keywords: Flora, chorology, classification, ordination, soil-vegetation relationships.

INTRODUCTION

Suez Governorate is located in the northern part of the Eastern Desert of Egypt**.**The Eastern desert of Egypt occupies the area extending from the Nile Valley eastward to the Gulf of Suez and Red Sea which is about 223000 km^2 (21%) of the total area of Egypt. The Eastern desert consists essentially of a backbone of high, rugged mountains running parallel to the Red Sea coast. These mountains are flanked to the north and west by an intensively dissected sedimentary plateau (Said, 1962). It is traversed by numerous wadis running to the Red Sea or to the Nile Valley. The flora of the northern wadis and mountains of the Eastern desert, west of the Gulf of Suez, have strong relations with that of the Sinai Peninsula (Bolous, 2008). Two major phytgeographical regions are usually recognized within the Eastern desert; the Red Sea coastal region and the inland desert. The Red Sea coastal land extends from Suez to Mersa Halaib at the Sudano-Egyptian border, while the inland part lies between the range of the Red Sea coastal land in the east and the Nile Valley in the west (Hassib, 1951).

The natural plant communities in the Red Sea coastal land and Eastern desert of Egypt were studied by several workers e.g. Mashaly *et al.* (1995); Dahmash (2001), Zahran and Willis (2009); Galal (2011); Galal and Fahmy (2012); Salama *et al.* (2013; 2014 a and b); Abd El-Ghani *et al.* (2013 and 2014) and El-Amier and Abdulkader (2015).

Despite the various studies carried out on the desert vegetation in Eastern desert, little was known about the vegetation of the Suez Governorate. Suez Governorate supports many types of habitats, some of which are natural such as salt marshes and desert and others are man-made such as field crops and orchards.

Vegetation is an indicator of considerable reliability of the environmental gradient (Whittaker, 1956), where the number of population and community composition are related to the environmental patterns. It has long been established that patterns in vegetation are correlated with gradients in environmental parameters (Smith and Huston, 1989; Gauch, 1982). The most critical gradients in abiotic factors may be related to water availability, including annual precipitation, soil properties and topography (Parker, 1991).

The plant community plays an important role in sustainable management by maintaining biodiversity and conserving the environment (Kandi *et al.*, 2011). Weeds are an integral component of agro-ecosystems and play an important role in diversifying the land. Evidence from field experiments shows that weeds can be used to increase the species diversity of an ecosystem, reduce pest density and maintain soil fertility (Chen *et al.*, 2004). Weed communities are affected by many factors, such as farm management practices (Andersson and Milberg, 1998), the crop type (Andereasen and Skovgaard, 2009) and soil characteristics (Pinke *et al.*, 2010).

Understanding the relationship between the prevailing environmental condition and the responses of the existed plants are important for most investigations of plant habitats. Multivariate analysis including classify-

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cation and ordination techniques has been used widely to indicate the ecological relationships between vegetation and the environment (Zhang and Zhang, 2000). Moreover, floristic studies are not only important in order to know the variety of plants that are present in an area, but because plants are socioeconomically signifycant. They provide shelter, food, medicine and everything for the human being and other species of that area. The present study aims to investigate the floristic features, quantitative analysis of the vegetation structure and factors controlling the distribution of the plant communities in the different habitats of Suez Governorate.

MATERIALS AND METHODS

Study area

Suez Governorate is one of the Canal Region's urban governorates. It is located in the east Delta, northwest of the Gulf of Suez and south of the Suez Canal, between longitudes 32^0 25´ E - 32^0 40´ E and latitudes 29^0 50´N - $30^0$15´N (Fig. 1). The total area of Suez Governorate is approximately 9000 km^2. It is bounded by the Governorates of Ismailia and North Sinai at North, Red Sea Governorate at South, South Sinai Governorate at East and the Governorates of Cairo and Giza at West.

The soil surface in the study area is nearly flat with ripple marks. It is covered by an extensive sedimentary clastics and non-clastic accumulation, alluvial deposits ranging from Oligocene to Quaternary age (El Shazly *et al.,* 1975). The Quaternary deposits exhibit more than 200 meters covering of braided river sediments to the north and fan type deposits to the east at valley mouths (Ramadan, 1984). The subsurface geological and geophysical studies for the deeper horizons at the study area show two distinct sedimentary units; lower are clay free sand unit, while the upper sediments show clay intercalations with fine sands and silt sized grains (Abdallah, 1998)

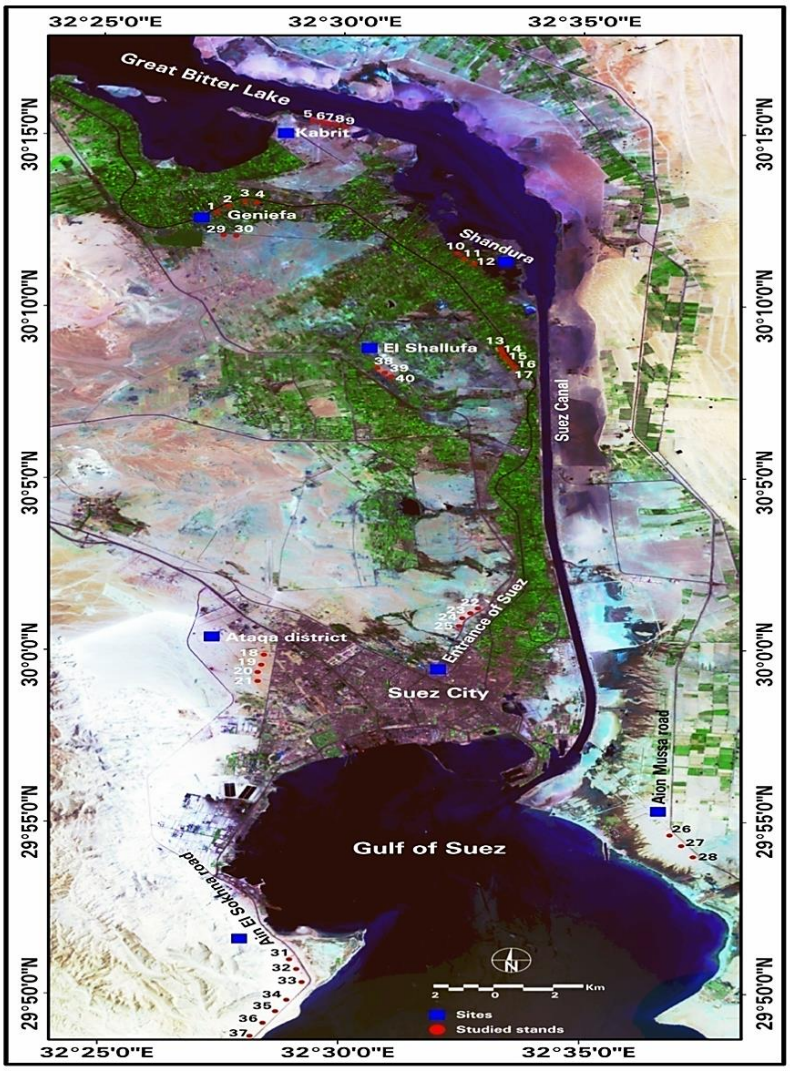

Figure (1): Location map of the study area showing the studied sites and stands

According to the map of the world distribution of arid regions (UNESCO, 1977), the study area belongs to arid climate. Meteorological data of Suez Governorate shows that the climate of this region is obviously hot and dry. The low rainfall and high temperature are the main aspects of its aridity (El-Amier and Abdulkader, 2015). The mean maximum temperature ranged between 18.54°C in January and 36.21°C in August, while the mean minimum temp-erature was 7.5°C in January and 20.75°C in August. The relative humidity varied between 55.45% in March and 64.68% in December. Evaporation rate ranged between 5.25 mm/day in December and 13.10 mm/day in June. Most of the rainfall occurs during November to March. Summer is nearly dry. The mean maximum value was 6.73 mm in January while the mean minimum was 2.15 mm in March (Dah-mash, 2001).

Vegetation analysis

Forty stands (area =10 × 10 m each) were selected for sampling vegetation in the study area during two successive years 2014-2015. The stands covered four habitat types in eight sites of the study area namely; desert (11 stands), waste lands (12 stands), crop fields (12 stands) and orchards (5 stands). The density and plant cover of each species have been estimated in each stand. The density was measured by counting the number of individuals of species within each stand (Shukla and Chandel, 1989). The estimation of plant cover was carried out by using the line-intercept method (Canfield, 1941). The relative values of density and cover of each species were calculated and summed up to give an estimate of its importance value (IV out of 200). The taxonomic nomenclature of the species in the study area was given according to Täckholm (1974) and Boulos (1999; 2000; 2002; 2005 and 2009). Life form of each species was listed according to Raunkiaer (1934). The phytogeographycal range of species distribution was carried out according to Good (1974); Wickens (1976) and Abd El-Ghani (1981 and 1985).

Soil analysis

Three soil samples were collected from each stand at a depth of 0-50 cm, mixed, air-dried and passed through 2 mm sieve to separate gravel and debris. Soil texture was analyzed using the Bouyoucos hydrometer method (Bouyoucos, 1962), by which the percentages of sand, silt and clay were calculated. Organic matter content was estimated by ignition method according to Allen *et al*. (1974). Calcium carbonate content was determined in the dry soil samples using Collin's Calcimeter (Allen *et al*., 1974). Soil salinity (EC) and soil reaction (pH) were estimated in (1:5) soil water extract using a digital conductivity meter (Model 76, ES D, Inc. USA, and a digital pH-meter (Model 201, Orion research, USA) respectively. Carbonates (CO_3^{--}) and bicarbonates (HCO_3^-) were determined volumetrically by titration against 0.1N HCl using phenolphthalein and methyl orange as indicators (Pierce *et al*., 1958). Chlorides (Cl^-) were estimated by direct titration against 0.01 silver nitrate solution using 5% potassium chromate as an indicator (Baruah and Barthakur, 1997). Sulphates were determined by the gravimetric method in which sulphates were precipitated as barium sulphate by using barium chloride (Piper, 1947). Calcium and magnesium were estimated by titrating against 0.01 versenate solution using ammonium purpurate and Eriochrome black T as indicators (Baruah and Barthakur, 1997). Estimations of sodium and potassium cations were carried out on a soil extract prepared by a 2.5% glacial acetic acid using a flame photometer (Model 410, Corning, England) as described by Allen *et al*. (1974).

Data treatment

Two-Way Indicator Species Analysis (TWINSPAN), as a classification technique and Detrended Correspondence Analysis (DCA), as an ordination technique (Hill, 1979 a and b) were applied to the matrix of importance values of the 107 species in the 40 stands in the study area. The relationship between the vegetation and the soil gradients was assessed using Canonical Correspondence Analysis (Ter Braak, 1986 and 1994). The analyses were carried out by using two computer programs: CAP, Community Analysis Package, version 1.3.1 (Henderson and Seaby, 1999) and CANOCO for windows, version 4.5 (Ter Braak and Smilauer, 2002).The species richness for each vegetation group was calculated as the average number of species per stand. The relative evenness or equitability of the importance value of species was expressed by Shannon diversity index (H') according to the following formula:

$$H' = -\sum_{i=1}^{s} pi\, ln(pi)$$

Where, s= number of species and pi= the relative importance value of the i^{th} species. The relative concentration of dominance was expressed by the Simpson's diversity index (C) according to the following formula:

$$C = \sum_{i=1}^{s} pi^2$$

Where, s = number of species and pi= the relative importance value of the i^{th}species (Pielou, 1975; Magurran, 1988).

Linear correlation coefficient (r) was calculated for assessing the relationship between the estimated soil variables and the common species. The variation in the soil variables in relation to the vegetation groups was assessed by using a one-way ANOVA. The obtained data were statistically analyzed using SPSS version 16.0 for windows software.

RESULTS

Floristic characteristics

A total of 107 species (56 annuals, 2 biennials and 49 perennials) belonging to 93 genera and related to 33 families were recorded in the study area. The most represented families were Asteraceae and Poaecae (14% each), Brassicaceae and Fabaceae (9.3% each), Chenopodiaceae (6.5%), Polygonaceae (4.7%), Asclepiadaceae and Zygophyllaceae (3.7% each). Sixteen families were represented only by one species (Table1).

The life form spectrum analysis indicated that the therophytes were highly represented (53.3%) followed by chamaephytes (16.8%), then hemicryptophytes and nanophanerophytes (9.3% each), geophytes (8.4%), helophytes (1.9%) and parasites represented only by one species (Table 1 and Fig. 2).

The chorological analysis of the species in the study area (Table 1 and Fig.3) revealed that 41 species (38.2% of the total number of the recorded species) were Saharo-Sindian taxa; these taxa are either monoregional (8.4%), biregional (18.6%) or pluriregional (11.2%).While, Mediterranean elements were represented by 38 species (35.5% of the total number of the recorded species), these taxa are either monoregional (1.9%), biregional (14.9%) or pluriregional (18.7%). The other well represented chorotypes were cosmopolitan (16.8%), palaeotropical (9.3%) and pantropical (8.4%).

Table(1): Floristic composition, life forms and chorological affinities of the recorded species in Suez Governorate, Egypt**.**

Species	Duration	Life form	Chorology
Amaranthaceae			
Aerva javonica (Burm. f.) Juss. ex Schult.	Per	Ch	SA-SI+S-Z
Amaranthus hybridus L.	Ann	Th	COSM
Apiaceae (Umbiliferae)			
Ammi majus L	Ann	Th	ME+IR-TR
Apium graveolens (L.) Log.	Bi	Th	ME+ IR-TR+ ER-SR
Deverra tortuosa (Desf.) DC.	Per	Ch	SA-SI
Asclepiadaceae (Apocynaceae)			
Calotropis procera (Aiton) W.T. Aiton	Per	N. Ph	SA-SI+S-Z
Cynanchum acutum L.	Per	H	ME+ IR-TR+ ER-SR
Leptadenia pyrotechnica (Forssk.) Decne.	Per	N. Ph	SA-SI+S-Z
Oxystelma esculentum (L. f.) R. Br.	Per	H	S-Z
Asteraceae (Compositae)			
Artemisia judaica L.	Per	Ch	SA-SI
Bidens pilosa L.	Ann	Th	PAN
Cichorium endivia L.	Ann	Th	ME+IR-TR
Conyza bonariensis (L.) Cronquist	Ann	Th	PAN
Echinops galalensis Schweinf.	Per	Ch	ME+SA-SI
Eclipta prostrata L.	Ann	Th	PAN
Launaea nudicaulis (L.) Hook. f.	Per	H	SA-SI+S-Z+IR-TR
Pluchea dioscoridis (L.) DC.	Per	N. Ph	SA-SI+S-Z
Pseudognaphilum leuto- album (L.) Hilliard & B. L. Burtt	Ann	Th	COSM
Pulicaria incisa (Lam.) DC.	Per	Ch	SA-SI+S-Z
P. undulata (L.) C. A. Mey.ssp. *undulata*	Per	Ch	SA-SI+S-Z
Reichardia tingitana (L.) Roth	Ann	Th	ME+SA-SI+IR-TR
Senecio glaucus L. ssp. *coronopifolius* (Maire) C. Alexander	Ann	Th	ME+SA-SI+IR-TR
Sonchus oleraceus L.	Ann	Th	COSM
Urospermum picroides (L.) F.W. Schmidt	Ann	Th	ME+IR-TR
Boraginaceae			
Heliotropium bacciferum Forssk.	Per	Ch	SA-SI+S-Z
Brassicaceae (Cruciferae)			
Brassica nigra (L.) Koch	Ann	Th	COSM
B. tournefortii Gouan.	Ann	Th	ME+SA-SI+IR-TR
Capsella bursa-pastoris (L.) Medik	Ann	Th	COSM
Coronopus didymus (L.) Sm	Ann	Th	COSM
Eruca sativa Mill.	Ann	Th	Cult. & Nat.
Erucaria crassifolia (Forssk.) Delile	Ann	Th	ME+SA-SI
Farsetia aegyptia Turra	Per	Ch	SA-SI+S-Z
Raphanus raphanistrum L.	Ann	Th	ME+ ER-SR
Sisymbrium irio L.	Ann	Th	PAL
Zilla spinosa (L.) Prantl	Per	Ch	SA-SI
Caryophyllaceae			
Loeflingia hispanica L.	Ann	Th	ME+SA-SI
Spergularia marina (L.) Bessler	Ann	H	ME+ IR-TR+ ER-SR
Stellaria pallida (Dumort.) Murb.	Ann	Th	PAL

Table 1 (Cont.)

Chenopodiaceae			
Anabasis setifera Moq.	Per	Ch	SA-SI
Atriplex lindlyi Moq. ssp. *inflata* (F. Muell.) P. G. Wilson	Ann	Th	ME+ IR-TR+ ER-SR
Beta vulgaris L.	Ann	Th	ME+ IR-TR+ ER-SR
Chenopodium album L.	Ann	Th	COSM
Ch. glaucum L.	Bi	Th	ME+ ER-SR
Ch. murale L.	Ann	Th	ER-SR+IR-TR+SA-SI
Haloxylon salicornicum Pomel	Per	Ch	SA-SI+IR-TR
Convolvulaceae			
Convolvulus arvensis L.	Per	H	PAL
C. hystrix Vahl	Per	Ch	SA-SI+S-Z
Cuscuta pedicellata Ledeb.	Ann	P	SA-SI+S-Z+IR-TR
Cyperaceae			
Cyperus laevigatus L.	Per	G	PAN
C. rotundus L.	Per	G	PAN
Euphorbiaceae			
Euphorbia helioscopia L.	Ann	Th	ME+ IR-TR+ ER-SR
E. peplus L.	Ann	Th	ME+ IR-TR+ ER-SR
Fabaceae(Leguminosae)			
Acacia tortilis (Forssk.) Hayne ssp. *tortilis*	Per	N-Ph	SA-SI+S-Z
Alhagi graecorum Boiss.	Per	Ch	PAL
Lotus glaber Mill.	Per	H	ME+ IR-TR+ ER-SR
Medicago polymorpha L.	Ann	Th	COSM
Melilotus indicus (L.) All.	Ann	Th	ME+ IR-TR+ ER-SR
M. messanensis (L.) All.	Ann	Th	ME
Sesbania sesban (L.) Merr.	Per	N. Ph	S-Z
Taverniera aegyptiaca Boiss.	Per	Ch	SA-SI+S-Z
Trifolium resupinatum L.	Ann	Th	ME+ IR-TR+ ER-SR
Trigonella hamosa L.	Ann	Th	ME+SA-SI
Geraniaceae			
Erodium glaucophyllum (L.) L'Hér.	Per	H	ME+SA-SI+IR-TR
Lamiaceae (Labiatae)			
Lamium amplexicaule L.	Ann	Th	PAL
Mentha longifolia (L.) Huds. ssp. *typhoides* (Briq.) Harley	Per	H	PAL
Juncaceae			
Juncus rigidus Desf.	Per	G	ME+IR-TR
Malvaceae			
Malva parviflora L.	Ann	Th	ME+ ER-SR
Nitrariaceae			
Nitraria retusa (Forssk.) Aschers.	Per	N. Ph	SA-SI
Oxalidaceae			
Oxalis corniculata L.	Per	G	COSM
Plantaginaceae			
Plantago major L.	Per	H	COSM
Poaceae (Gramineae)			
Avena fatua L.	Ann	Th	PAL
Crypsis alopecuroides (Piller&Mitterp.)Schrad.	Ann	Th	ME+IR-TR
Cynodon dactylon (L.) Pers.	Per	G	COSM
Echinochloa colona (L.) Link	Ann	Th	PAN
Imperata cylindrica (L.) Raeusch.	Per	G	PAL
Leptochloa fusca (L.) Kunth	Per	G	PAN
Lolium multiflorum Lam.	Ann	Th	ME+ ER-SR
L. perenne L.	Ann	Th	ME+ IR-TR+ ER-SR
L. rigidum Gaudin	Ann	Th	ME+IR-TR
Phalaris minor Retz.	Ann	Th	PAL
Phragmites australis (Cav.) Trin.ex.Steud	Per	He, G	COSM
Polypogon monspeliensis (L.) Desf.	Ann	Th	COSM
Rostraria rohlfsii (Asch.) Holub	Ann	Th	COSM
Sporobolus spicatus (Vahl) Kunth	Per	G	ME+SA-SI+S-Z
Stipagrostis plumosa (L.) Munro ex T. Anderson	Per	H	ME+SA-SI+IR-TR
Polygonaceae			
Calligonum polygonoides L.	Per	N. Ph	SA-SI
Emex spinosa (L.) Campd.	Ann	Th	PAN
Polygonum equisetiforme Sm.	Per	G	ME+IR-TR
Rumex dentatus L.	Ann	Th	ME+ IR-TR+ ER-SR
R. vesicarius L.	Ann	Th	PAL
Portulacaceae			
Portulaca oleracea L.	Ann	Th	COSM
Primulaceae			
Anagallis arvensis L.	Ann	Th	COSM

Table 1 (Cont.)

Resedaceae			
Ochradenus baccatus Delile	Per	N.Ph	SA-SI+S-Z
Oligomeris linifolia (Vahl ex Hornem.) J. F. Macbr.	Ann	Th	ME+SA-SI+S-Z
Rutaceae			
Haplophyllum tuberculatum (Forssk.) Juss.	Per	H	SA-SI+IR-TR
Salixaceae			
Salix mucronata Thurb.	Per	N.Ph	S-Z+ER-SR+SA-SI
Santalaceae			
Thesium humile Vahl var. *humile*	Ann	Th	ME
Scrophulariaceae			
Kickxia aegyptiaca (L.) Nábelek	Per	Ch	ME+ ER-SR
Solanaceae			
Solanum nigrum L.	Ann	Th	COSM
S. villosum Mill.	Ann	Th	SA-SI
Tamaricaceae			
Tamarix nilotica (Ehrenb.) Bunge.	Per	N.Ph	SA-SI+S-Z
Typhaceae			
Typha domingensis (Pers.) Poir. ex Steud.	Per	He	PAN
Urticaceae			
Urtica urens L.	Ann	Th	COSM
Zygophyllaceae			
Fagonia arabica L.	Per	Ch	SA-SI
Zygophyllum album L. f.	Per	Ch	ME+SA-SI+IR-TR
Z. coccineum L.	Per	Ch	SA-SI
Z. simplex L.	Ann	Th	SA-SI+S-Z

Chorotype: COSM= cosmopolitan, PAL= Palaeotropical, PAN= Pantropical, S-Z= Sudano-Zambezian, ME=Mediterranean, SA-SI=Saharo-Sindian, IR-TR=Irano-Turanian, ER-SR= Euro-Siberian, Cult. & Nat. = Cultivated and Naturalized.
Life form: Th=Therophytes, H= Hemicryptophytes, N. Ph= Nanophanerophytes, Ch= chamaephytes, He=Helophytes, G=Geophytes, P=Parasites
Duration: Ann=annual, Bi =biennial, Per = perennial.
Duration: Ann=annual, Bi =biennial, Per = perennial.

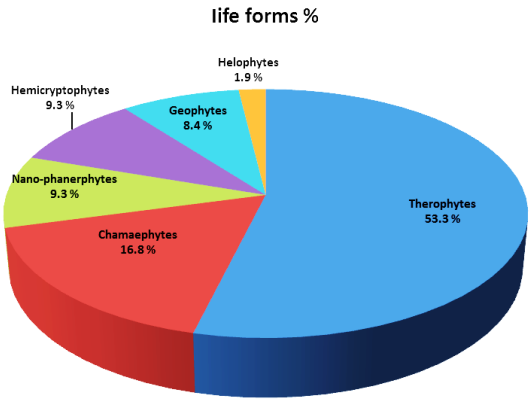

Figure (2): Life forms spectrum of the recorded species in the study area.

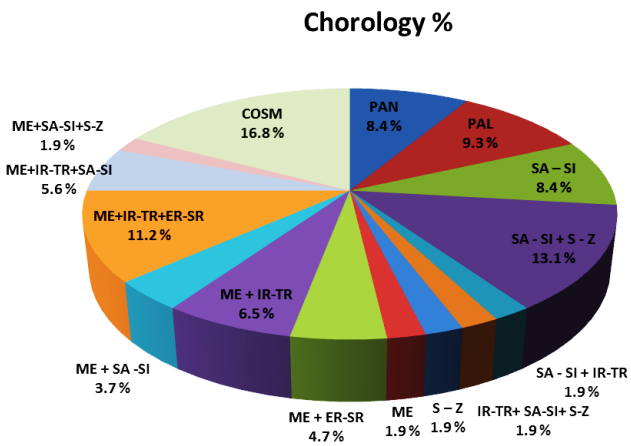

Figure (3): Chorological analysis of the recorded species in the study area.

Classification of stands

The application of TWINSPAN classification technique on the importance values of 107 plant species recorded in 40 stands representing the different habitats of the study area yielded four vegetation groups (Fig. 4). The vegetational composition of these groups is presented in table (2). The vegetation groups were named after the dominant species.

Group (A): *Zygophyllum coccineum* group

This vegetation group comprised of 37 species recorded from 9 stands most of them represent desert habitat, with average species richness of 8.44 species /stand, Shannon-Wiener diversity index of 1.86 and Simpson index of 0.8. The stands of this group were characterized by soil with the highest levels of pH and Ca^{++} cation, relatively high levels of sand fraction and lowest levels of organic matter and bicarbonates (Table 3). The most common associated species which attained relatively high importance value in this group are *Ochradenus baccatus* (IV=20.46), *Pulicaria incisa* (IV= 14.47), *Convolvulus hystrix* (IV= 13.97) and *Haloxylon salicornicum* (IV= 12.04). The indicator species identified by TWINSPAN classification in this group is *Convolvulus arvensis.* This group includes 16 consistent species (recorded only in this group), of which *Farsetia aegyptia, Haplophyllum tuberculatum, Leptadenia pyrotechnica, Echinops galalensis* and *Fagonia ara-bica.*

Group (B): *Tamarix nilotica* group

It is the largest among the separated vegetation groups. It included 33 species recorded from 13 stands most of them represent waste lands habitat. This group had the lowest average species richness with 5.46 species/stand, Shannon-Wiener diversity index of 1.29 and Simpson index of 0.63. The soil of this group was characterized by the highest levels of sand fraction, EC, anions (HCO_3^-, Cl^- and SO_4^{--}) and cations (Mg^{++} and Na^+) and lowest levels of clay fraction (Table 3). The most common species in this group are *Phragmites australis* (IV= 48.31), *Zygophyllum coccineum* (IV= 23.39) and *Anabasis setifera* (IV= 15.99). *Malva parviflora* is the indicator species of this group. Twelve species restricted only in this group, among of these species are *Anabasis setifera, Zygophyllum album* and *Typha domingensis.*

Group (C): *Beta vulgaris* - *Chenopodium murale* – *Melilotus messanensis* group

This group embraced the highest number of weed species (50) species recorded from 12 stands representing field crops habitat, with average species richness of 11.25 species/stand, Shannon-Wiener diversity index of 2.12 and Simpson index of 0.81. The stands of this group were characterized by soil with high content of clay and organic matter and low content of sand, EC, Cl^-, Ca^{++}, Na^+ and K^+ (Table 3).Other important common species in this group are *Lolium rigidum* (IV=11.95), *Convolvulus arvensis* (IV=11.13) and *Malva parviflora* (IV=10.16). Another indicator species in this group are *Rumex dentatus* and *Plantago major*. This group includes 18 exclusive species, of which *Raphanus raphenistrum, Spergularia marina* and *Brassica nigra*.

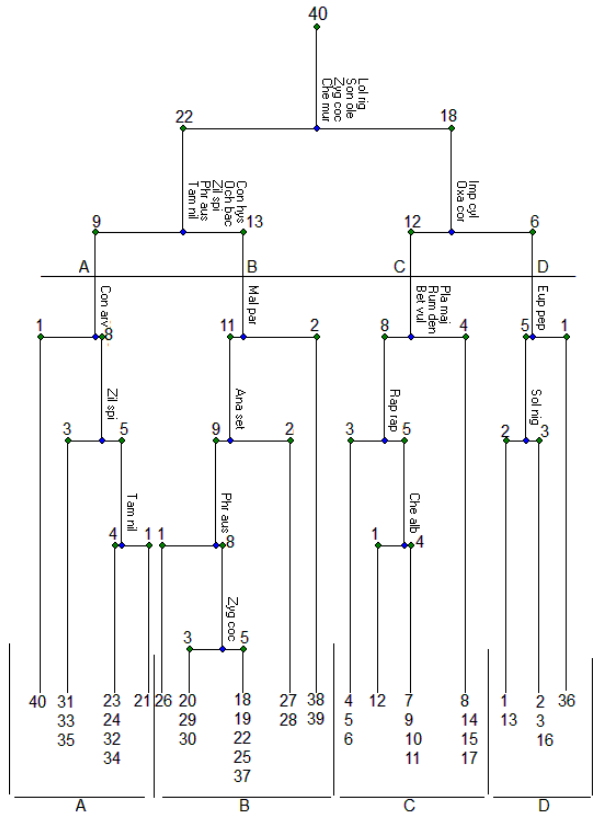

Figure (4): TWINSPAN dendrogram of 40 sampled stands based on the importance values of 107 species. The indicator species names are abbreviated to the first three letters of both genus and species, respectively**.**

Group (D): *Oxalis corniculata* group

It comprised 41 species recorded from 6 stands, most of them occur in orchards habitat. This group had the highest average species richness of 14.17 species/stand, Shannon-Wiener diversity index of 2.28 and Simpson index of 0.81. The soil of this group attained the highest levels of silt and K^+ cation and the lowest of $CaCO_3$, sulphates and magnesium. *Sonchus oleraceus* (IV=15), *Cynodon dactylon* (IV=14.15) and *Rumex dentatus* (IV=10.78) are the most common species in this group, while *Euphorbia peplus* is the indicator species identified by TWINSPAN classification. Thirteen species show consistency in this group, of which *Imperata cylindrica, Sisymbrium irio* and *Lotus glaber.*

Table (2): Mean of the importance values (out of 200) of the recorded species in the four vegetation groups (A - D) resulting from TWINSPAN classification of the sampling stands in the different habitats of the study area.

Vegetation groups	**A**	**B**	**C**	**D**
Total number of stands	**9**	**13**	**12**	**6**
Total number of species	**37**	**33**	**50**	**41**
Phragmites australis (Cav.) Trin.ex.Steud.	3.250	48.31	3.120	1.570
Tamarix nilotica (Ehrenb.) Bunge.	6.640	65.45	3.520	–
Alhagi graecorum Boiss.	0.910	7.580	0.800	–
Zygophyllum simplex L.	5.110	3.920	0.810	–
Senecio glaucus L. ssp. *coronopifolius* (Maire) C. Alexander	0.660	0.840	0.760	–
Pluchea dioscoridis (L.) DC.	8.260	1.510	–	6.380
Sonchus oleraceus L.	2.560	–	9.740	15.00
Convolvulus arvensis L.	0.700	–	11.13	5.640
Lolium rigidum Gaudin	–	0.440	11.95	2.250
Malva parviflora L.	–	0.610	10.16	4.020
Chenopodium murale L.	–	1.480	17.63	5.010
Zygophyllum coccineum L.	34.85	23.39	–	–
Nitraria retusa (Forssk.) Aschers.	2.370	4.650	–	–
Ochradenus baccatus Delile	20.46	2.500	–	–
Oligomeris linifolia(Vahl ex Hornem.) J.F. Macbr.	0.380	0.720	–	–
Launaea nudicaulis (L.) Hook. f.	4.360	0.620	–	–
Erucaria crassifolia (Forssk.) Delile	0.690	1.290	–	–
Reichardia tingitana (L.) Roth	6.500	0.340	–	–
Rumex vesicarius L.	4.970	1.270	–	–
Haloxylon salicornicum Pomel	12.04	3.160	–	–
Conyza bonariensis (L.) Cronquist	1.370	–	–	2.380
Calotropis procera (Aiton) W.T. Aiton	2.710	–	–	10.10
Atriplex lindlyi Moq. subsp. *inflata* (F. Muell.) P. G. Wilson	–	0.390	1.330	–
Avena fatua L.	–	0.680	1.380	–
Cynanchum acutum L.	–	0.670	–	0.760
Ammi majus L	–	–	2.090	1.800
Stellaria pallida (Dumort.) Murb.	–	–	0.670	2.720
Anagallis arvensis L.	–	–	3.790	5.130
Trifolium resupinatum L.	–	–	2.520	1.610
Urtica urens L.	–	–	5.830	0.820
Solanum nigrum L.	–	–	0.760	1.850
Melilotus indicus (L.) All.	–	–	1.380	0.430
M.messanensis (L.) All.	–	–	16.78	0.710
Beta vulgaris L.	–	–	19.56	0.590
Bidens pilosa L.	–	–	0.780	4.310
Chenopodium album L.	–	–	4.400	1.780
Euphorbia helioscopia L.	–	–	1.540	3.340
Rumex dentatus L.	–	–	4.310	10.78
Plantago major L.	–	–	1.240	3.330
Euphorbia peplus L.	–	–	1.470	5.750
Cynodon dactylon (L.) Pers.	–	–	0.880	14.15
Cichorium endivia L.	–	–	9.410	4.960
Convolvulus hystrix Vahl	13.97	–	–	–
Acacia tortilis (Forssk.) Hayne subsp. *tortilis*	4.260	–	–	–
Artemisia judaica L.	1.200	–	–	–
Calligonum polygonoides L.	2.260	–	–	–
Deverra tortuosa (Desf.) DC.	1.240	–	–	–
Echinops galalensis Schweinf.	3.120	–	–	–
Erodium glaucophyllum (L.) L'Hér.	0.710	–	–	–
Fagonia arabica L.	4.120	–	–	–
Farsetia aegyptia Turra	9.400	–	–	–
Haplophyllum tuberculatum (Forssk.) Juss.	7.260	–	–	–
Heliotropium bacciferum Forssk.	1.000	–	–	–
Leptadenia pyrotechnica (Forssk.) Decne.	4.480	–	–	–
Loeflingia hispanica L.	0.340	–	–	–
Polypogon monspeliensis (L.) Desf.	1.680	–	–	–
Pulicaria incisa (Lam.) DC.	14.47	–	–	–
Sporobolus spicatus (Vahl) Kunth	1.160	–	–	–
Taverniera aegyptiaca Boiss.	0.390	–	–	–
Zilla spinosa (L.) Prantl	10.90	–	–	–
Stipagrostis plumosa (L.) Munro ex T. Anderson	–	1.920	–	–
Trigonella hamosa L.	–	1.150	–	–
Typha domingensis (Pers.) Poir. ex Steud.	–	2.350	–	–
Pulicaria undulata (L.) C.A. Mey.subsp. *undulata*	–	0.520	–	–
Polygonum equisetiforme Sm.	–	2.100	–	–
Kickxia aegyptiaca (L.) Nábelek	–	1.870	–	–
Crypsis alopecuroides (Piller & Mitterp.)Schrad.	–	0.840	–	–

Table 2 (Cont.)

Aerva javonica (Burm. f.) Juss. ex Schult.	–	1.150	–	–
Anabasis setifera Moq.	–	15.99	–	–
*Brassica tournefortii*Gouan	–	0.750	–	–
Cyperus laevigatus L.	–	2.690	–	–
Zygophyllum album L. f.	–	3.870	–	–
Cuscuta pedicellata Ledeb.	–	–	2.54	–
Chenopodium glaucum L.	–	–	0.80	–
Apium graveolens (L.) Log.	–	–	0.57	–
Brassica nigra (L.) Koch	–	–	3.13	–
Coronopus didymus (L.) Sm	–	–	2.37	–
Cyperus rotundus L.	–	–	1.22	–
Echinochloa colona (L.) Link	–	–	2.02	–
Emex spinosa (L.) Campd.	–	–	0.57	–
Eruca sativa Mill.	–	–	0.76	–
Juncus rigidus Desf.	–	–	0.80	–
Lamium amplexicaule L.	–	–	0.67	–
Lolium multiflorum Lam.	–	–	4.99	–
Lolium perenne L.	–	–	0.81	–
Medicago polymorpha L.	–	–	1.75	–
Phalaris minor Retz.	–	–	0.76	–
Portulaca oleracea L.	–	–	1.96	–
Raphanus raphanistrum L.	–	–	6.63	–
Rostraria rohlfsii (Asch.) Holub	–	–	1.36	–
*Solanumvillosum*Mill.	–	–	0.67	–
Spergularia marina (L.) Bessler	–	–	7.87	–
Thesium humile Vahl var. *humile*	–	–	1.54	–
Oxalis corniculata L.	–	–	–	45.64
Amaranthus hybridus L.	–	–	–	0.650
Capsella bursa-pastoris (L.) Medik	–	–	–	1.100
Eclipta prostrata L.	–	–	–	2.250
Imperata cylindrica (L.) Raeusch.	–	–	–	9.140
Leptochloa fusca (L.) Kunth	–	–	–	1.100
Lotus glaber Mill.	–	–	–	3.850
Mentha longifolia (L.) Huds.	–	–	–	1.610
Oxystelma esculentum (L. f.) R. Br.	–	–	–	1.680
Pseudognaphilum leuto-album (L.) Hilliard & B. L. Burtt	–	–	–	3.230
Salix mucronata Thurb.	–	–	–	0.910
Sesbania sesban (L.) Merr.	–	–	–	2.400
Sisymbrium irio L.	–	–	–	4.980
Urospermum picroides (L.) F.W. Schmidt	–	–	–	2.550

Ordination of stands

The ordination of sampled stands in the different habitats of the study area, were given by using Detrended Correspondence Analysis (DCA) (Fig. 5). It is obvious that, the vegetation groups yielded by TWINSPAN classification are clearly separated on the ordination plane of axes (1) and (2). Groups A (desert habitat) and B (waste lands habitat) separated at the left-side of the DCA diagram, while stands of groups C (crop fields habitat) and D (mango orchards) occupied the right-side of the DCA diagram.

Soil characteristics of the vegetation groups

The soil variables of the four vegetation groups of stands resulted from TWINSPAN classification indicated considerable variations among the stands of the different groups (Table 3). Sand, silt, clay, organic matter, calcium carbonates, bicarbonates, pH and Ca^{++} cation showed significant correlations ($p \leq 0.05$) among vegetation groups. Soil texture of all vegetation groups is formed mainly of sand. The sand fraction attained more than 70% in the four groups. Its values varied between 71.43% in soil of group C and 83.04% in soil of group B. The highest percentage of silt fraction (17.6%%) was recorded in soil of group D, while the highest percentage of clay fraction (12.32%) was recorded in soil of group C. Organic matter content attained the highest mean value (1.79%) in soil of group C, while the lowest value (0.64%) in the group A. pH values ranged between 7.32 in group C to 8.62 in group A.

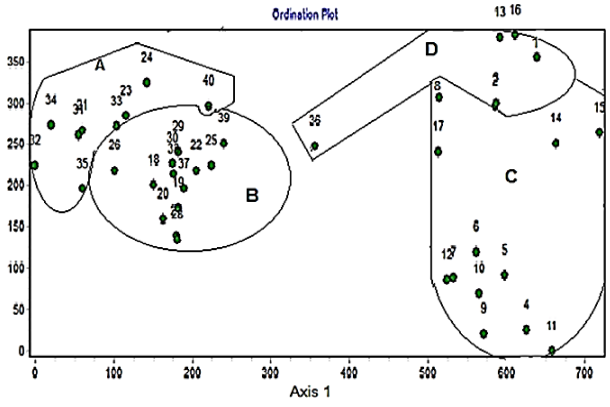

Figure (5): Detrended Correspondence Analysis (DCA) ordination diagram of the 40 sampled stands with the four identified vegetation groups using TWINSPAN technique.

The soil of group B attained the highest mean values of electrical conductivity (15.08 mmohs/cm), bicarbonates (0.6 meq/100g dry soil), calcium carbonates (17.71%), chlorides (51.04 meq/100g dry soil), sulphates (29.13 meq/100g dry soil), magnesium (12.02 meq/100g dry soil) and sodium (49.3 meq/100g dry soil).The highest mean value of calcium (34.0 meq/100g dry soil) was recorded in the soil of groups A, while the highest mean value of potassium (0.6 meq/100g dry soil) was recorded in group D.

Table (3): Mean values and standard errors of the different soil variables and species diversity indices in the stands representing the different vegetation groups (A- D) obtained by TWINSPAN classification in the study area. EC: electrical conductivity; O.M.: organic matter.

Variable	Vegetation group				F-ratio	*p*-value
	A	B	C	D		
Sand (%)	82.59 ^{a} ± 0.67	83.04 ^{b} ± 0.59	71.43 ^{b} ± 4.08	74.70 ^{ab} ± 5.14	4.28	0.011*
Silt (%)	11.24 ^{a} ± 0.48	11.88 ^{ab} ± 0.53	16.33 ^{bc} ± 2.01	17.60 ^{c} ± 2.95	3.78	0.018*
Clay (%)	06.17 ^{a} ± 0.40	05.08 ^{a} ± 0.39	12.32 ^{b} ± 2.50	07.70 ^{ab} ± 2.44	4.20	0.012*
O.M. (%)	00.64^{a} ± 0.18	0.780^{ab} ± 0.16	01.79 ^{b} ± 0.46	01.66 ^{ab} ± 0.33	3.39	0.028*
$CaCO_3$ (%)	14.85 ^{b} ± 2.94	17.71 ^{b} ± 3.37	06.19 ^{a} ± 1.29	05.76 ^{a} ± 1.45	5.09	0.005**
pH	08.62 ^{b} ± 0.20	08.41 ^{b} ± 0.13	07.32 ^{a} ± 0.09	07.66 ^{a} ± 0.25	16.33	<0.001***
EC (mmhos/cm)	07.09 ^{a} ± 4.20	15.08 ^{a} ± 5.21	03.53 ^{a} ± 0.96	03.59 ^{a} ± 1.34	2.14	0.112 ^{ns}
HCO_3^- meq/100 g dry soil	00.17 ^{a} ± 0.05	00.60 ^{b} ± 0.11	0.38 ^{ab} ± 0.05	00.25 ^{a} ± 0.10	5.25	0.004**
Cl^- meq/100 g dry soil	18.34 ^{a} ± 14.73	51.04 ^{a} ± 21.50	07.01 ^{a} ± 2.81	08.90 ^{a} ± 4.55	1.96	0.137 ^{ns}
SO_4^{--} meq/100 g dry soil	18.96 ^{a} ± 14.65	29.12 ^{a} ± 11.42	10.36 ^{a} ± 2.37	05.81 ^{a} ± 2.51	1.05	0.383 ^{ns}
Ca^{++} meq/100 g dry soil	34.00 ^{c} ± 6.76	28.73 ^{bc} ± 7.16	08.60 ^{a} ± 2.23	12.26 ^{ab} ± 7.75	4.01	0.015 *
Mg^{++} meq/100 g dry soil	07.69 ^{a} ± 5.47	12.01 ^{a} ± 4.65	02.32 ^{a} ± 0.57	00.97 ^{a} ± 0.11	1.73	0.179 ^{ns}
Na^+ meq/100 g dry soil	17.38 ^{a} ± 10.91	49.25 ^{a} ± 20.48	06.56 ^{a} ± 2.64	10.04 ^{a} ± 4.85	2.14	0.112 ^{ns}
K^+ meq/100 g dry soil	00.55 ^{a} ± 0.15	00.48 ^{a} ± 0.10	00.27 ^{a} ± 0.04	00.60 ^{a} ± 0.16	1.80	0.165 ^{ns}
Species richness	08.44 ^{ab} ± 0.84	05.46 ^{a} ± 1.00	11.25 ^{bc} ± 1.35	14.17 ^{c} ± 1.89	8.34	<0.001***
Shannon's index	01.86 ^{b} ± 0.09	01.29 ^{a} ± 0.16	02.12 ^{b} ± 0.16	02.28 ^{b} ± 0.22	7.87	<0.001***
Simpson's index	00.80 ^{b} ± 0.01	00.63 ^{a} ± 0.05	00.81 ^{b} ± 0.03	00.81 ^{b} ± 0.04	6.01	0.002**

ns = non- significant at $p \leq 0.05$,
* : Values are significant at $p \leq 0.05$,
** : values are significant at $p \leq 0.01$,
***: values are significant at $p \leq 0.001$.
Means in every row with different superscript letters are significantly different according to Duncan's multiple comparisons (DMRTS).

Soil–vegetation relationships

Correlations of edaphic variables with the importance values of the dominant, common and indicator species are shown in table (4). It has been found that some soil variables showed significant positive correlations with plant species, such as sand showed significant positive correlation with *Zygophyllum coccineum* (*r* = 0.33), silt with *Plantago major* (*r* = 0.44), *Rumex dentatus* (r = 0.37) and *Convolvulus arvensis* (*r* = 0.33), clay fraction with *Beta vulgaris* (*r* = 0.66), organic matter correlated significantly with *Euphorbia peplus* (*r* = 0.67). Calcium carbonates exhibited significant positive correlation with *Tamarix nilotica* (*r* = 0.72), *Anabasis setifera* (*r* = 0.45) and *Convolvulus hystrix* (*r* = 0.39), while pH correlated significantly with *Ochradenus baccatus* (*r* = 0.46) and *Zygophyllum coccineum* (*r*= 0.55). *Phragmites australis* and *Tamarix nilotica* exhibited high signifycant positive correlation with electrical conductivity (*r* = 0.52 and 0.4, respectively), chlorides (*r* = 0.52 and 0.36, respectively), magnesium (*r* = 0.42and 0.41, respecttively) and sodium (*r* = 0.53and 0.37, respecttively).Calcium cation correlated significantly with *Zygophyllum coccineum* (*r* = 0.35), while potassium cation correlated with *Cynodon dactylon* (*r* = 0.33). On the other hand, some soil variables indicated significant negative correlations with plant species, such as sand with *Beta vulgaris* (*r* = - 0.5), pH with *Malva parviflora* (*r* = -0.44), *Beta vulgaris* (*r* = - 0.41) and *Euphorbia peplus* (*r* = -0.43), bicarbonates and calcium cation with *Sonchus oleraceus* (*r* = -0.48 and -0.41, respectively).

The relationship between the vegetation and soil variables is shown on the ordination diagram produced by Canonical Correspondence Analysis (CCA) of the biplot of species and soil variables. Inspection of the CCA diagram (Fig. 6) revealed that the percentages of soil texture (sand, silt and clay), organic matter, $CaCO_3$, pH, electrical conductivity, bicarbonates, chlorides, sodium, magnesium, potassium and calcium are the most effective soil variables. The dominant and the common species of group B (*Tamarix nilotica*, *Phragmites australis* and *Anabasis setifera*) are separated at the upper left side of CCA biplot diagram and showed strong relationship with $CaCO_3$, electrical conductivity, bicarbonates, sulphates, chlorides and cations (sodium, magnesium and calcium). While, the dominant and the common species (*Zygophyllum coccineum*, *Ochradenus baccatus*, *Pulicaria incisa*, *Convolvulus hystrix* and *Haloxylon salicornicum*) in group A and *Cynodon dactylon* which was the common species in group D are separated at the lower left side of CCA biplot diagram and closely associated with pH, sand and potassium cation. Species of group C (*Beta vulgaris, Lolium rigidum*, *Melilotus messanensis* and *Chenopodium murale*) are separated at the upper right side of CCA biplot diagram and showed strong correlation with clay fraction. On the other hand, the dominant species (*Oxalis corniculata*), the common species (*Sonchus oleraceus* and *Rumex dentatus*), the indicator species (*Euphorbia*

peplus) in group D and the common species (*Malva parviflora*) in group C are separated at the lower right side of CCA diagram. These species showed a close relationship with organic matter and silt fraction.

The correlation between environmental variables and the first two CCA axes is given in table (5). CCA axis 1 was positively correlated with silt, clay and organic matter and negatively correlated with pH, HCO_3^-, $CaCO_3$, sand, Ca^{++}, EC, Cl^-, SO_4^{--}, Mg^{++} and Na^+. So this axis can be interpreted as silt- pH gradient. CCA axis 2 was positively correlated with sodium, EC, Chlorides, clay and magnesium and negatively correlated with potassium and pH. This axis can be interpreted as sodium-potassium gradient. A test for significance with an unrestricted Monte Carlo permutation Test (499 permutation) for the eigenvalue of axis 1 found to be significant (p=0.02), indicating that the observed patterns did not arise by chance.

DISCUSSION

The floristic analysis of the present study revealed the record of 107 species belonging to 93 genera and 33 families. The most common families were Asteraceae and Poacae followed by Brassicaceae, Fabaceae and Chenopodiaceae, which contributed collectively about 54.1% of the total number of recorded plant species**.** Similar results were also reported by other researchers (Abd El Hamid, 2005; Abd El Hamid and Kamel, 2010; El-Halawany *et al*., 2010; Mashaly *et al*., 2012; Abd El-Ghani *et al*., 2013; El-Amier *et al*., 2014 and 2015). The results of this study indicated that, 56 species of the total recorded species are annuals, 2 biennials and 49 perennials. The dominance of annuals could be attributed to the fact that they have a higher reproductive capacity and ecological, morphological and genetic plasticity under high levels of disturbance such as agricultural practices (Frenkel, 1970; Harper, 1977; Grime, 1979).

The biological spectrum of the study area indicates the prevailing of therophytes followed by chamaephytes and hemicryptophytes. These results coincide with the findings of Abd El- Ghani *el al*. (2013); Salama *et al*. (2013); El-Amier *et al*. (2014 and 2015). The dominance of therophytes in the study area seems to be a response to Mediterranean climate and biotic influence (Mashaly *et al*., 2013), while the highest values of chamaephytes and hemicryptophytes may be due to the ability of species to adapt against drought, salinity, sand accumulation and grazing (Danin and Orshan, 1990; Danin, 1996).

The surveyed area is considered as a meeting point of several phytogeographical regions. Therefore, the flora of it embraces a mixture from elements of most worlds' floras. Chorological analysis of the floristic data revealed that the Saharo-Sindian and Mediterranean chorotypes (monoregional, biregional and pluriregional) forms the major component of the floristic structure. This may reflect the effect of both Mediterranean and Saharo -Sindian climates on the flora of the study area. The dominance of the Saharo-Sindian chorotype may be attributed to the selection of some stands of desert habitat, which embraces numerous shrubs and trees belong to this chorotype. The Saharo-Sindian species are considered as good indicators for desert environmental conditions (Danin and Plitman, 1987; Salama *et al*., 2013; El-Amier and Abdul Kader, 2015). The high contribution of Mediterranean taxa in the study area agreed with the most current of weed flora of Egypt that has a Mediterranean origin or distribution (Kosinova`, 1974 and El-Hadidi, 1993). The application of TWINSPAN classification technique on the vegetation data produced four vegetation groups distributed in the different habitats. Groups A and B may represent the desert and waste land habitats. Group A was dominated by *Zygophyllum coccineum* and group B was dominated by *Tamarix nilotica*. They inhabited soil with the highest values of sand, calcium carbonates, pH, salinity and most of the estimated anions and cations. These results are in line with those of Dahmash (2001) who reported that *Z. Coccineum* and *T. nilotica* abounds on soil with high values of medium and fine sand, calcium carbonate, potassium and calcium cations.

Shehata (1992) showed that *Z.coccineum* community is one of the commonest types in the Egyptian desert. *Z. Coccineum* and *T. nilotica* species can tolerate a wide range of drought and salinity (halo-xerophytes) (Aronson *et al*., 1988; Zahran *et al*., 1996; El-Amier *et al*., 2016). These two species have been recorded as dominant or common species in other studies by Mashaly *et al*. (1995) in the vegetation of Ismailia-Suez desert road, Dahmash (2001) in Eastern desert (from fayed to Ain El-Sokhna), Abd El Ghani *et al*. (2013) in the desert-roadside vegetation in Eastern Desert and El- Amier and Abdul Kader (2015) in the northern sector of Eastern Desert. The other two groups C and D may represent field crops and orchard habitats. They inhabited soil with the highest values of fine particles (silt and clay), organic matter and potassium cation and contained the highest number of species (50) and (41), respectively. Moreover, group D has the highest average species richness of 14.17 species/stand, Shanon-Wiener diversity index of 2.28 and Simpson index of 0.81. The highest species richness and biodiversity indices in group D which characterize mango orchards may be attributed to the irregular weeding process in mango orchards, wider spacing between trees rows, and constant irrigation system, which might have created favourable conditions for the growth of weeds. Similar conclusions were reported by Abd El- Ghani *et al*. (2013) in olive orchards in the northern sector of the Nile Valley in Egypt. Moreover, the sites with fine substrates act as refuges for vegetation during the agricultural practices (Khedr and Hegazy, 1998).

Table (4): Pearson-moment correlation (*r*) between the soil variables and importance values of the dominant and most common species. EC = Electrical conductivity, O.M. = Organic matter. * = significant at $p \leq 0.05$, ** = significant at $p \leq 0.01$.

Species	Soil variables													
	Sand	**Silt**	**Clay**	**O.M.**	**$CaCO_3$**	**pH**	**EC**	**Cl^-**	**SO_4^{--}**	**Ca^{++}**	**Mg^{++}**	**Na^+**	**K^+**	**HCO_3^-**
Sonchus oleraceus	-0.1940	0.309	0.077	0.089	-0.372*	-0.378*	-0.220	-0.240	-0.279	-0.405**	-0.186	-0.201	-0.187	-0.480**
Oxalis corniculata	-0.1760	0.276	0.055	0.285	-0.156	-0.337*	-0.159	-0.151	-0.200	-0.283	-0.139	-0.131	-0.101	-0.277
Malva parviflora	-0.0950	0.021	0.158	0.322*	-0.284	-0.444**	-0.233	-0.253	-0.214	-0.295	-0.217	-0.231	-0.222	-0.373*
Beta vulgaris	-0.499*	0.223	0.660**	0.307	-0.122	-0.413**	-0.146	-0.178	-0.141	-0.215	-0.133	-0.152	-0.278	-0.297
Rumex dentatus	-0.1510	0.367*	-0.069	0.093	-0.306	-0.106	0.005	-0.178	-0.141	-0.215	-0.133	-0.152	-0.278	-0.297*
Lolium rigidum	-0.1810	0.052	0.266	0.174	-0.335*	-0.398*	-0.180	-0.216	-0.163	-0.250	-0.190	-0.183	-0.237	-0.393*
Convolvulus arvensis	-0.2490	0.329*	0.137	0.128	-0.234	-0.361*	-0.172	-0.183	-0.183	-0.268	-0.149	-0.158	-0.182	-0.238
Phragmites australis	0.1900	-0.146	-0.198	-0.076	0.155	0.150	0.520**	0.518**	0.325*	0.327	0.418**	0.534**	-0.124	0.131
Cynodon dactylon	0.1240	-0.152	-0.078	-0.140	-0.069	0.142	-0.051	-0.013	0.054	0.198	-0.074	-0.062	0.327*	0.182
Tamarix nilotica	0.1850	-0.159	-0.179	-0.123	0.715**	0.190	0.396*	0.355*	0.290	0.182	0.408**	0.370	0.007	0.217
Ochradinus baccatus	0.1950	-0.232	-0.130	-0.310	-0.055	0.463**	-0.131	-0.097	-0.013	0.214	-0.105	-0.110	0.216	0.193
Zygophyllum coccineum	0.326*	-0.352*	-0.251	-0.320*	0.124	0.554**	0.039	0.069	0.245	0.354*	0.090	0.005	0.292	0.370*
Convolvulus hystrix	0.1180	-0.154	-0.068	0.014	0.386*	0.012	0.235	0.206	0.415**	0.220	0.378*	0.149	-0.055	-0.151
Anabasis setifera	0.1700	-0.099	-0.206	-0.187	0.446**	0.032	-0.074	-0.087	-0.046	-0.069	-0.049	-0.089	0.064	0.260
Euphorbia peplus	-0.1610	0.334*	-0.022	0.674**	-0.227	-0.431	-0.198	-0.190	-0.264	-0.378*	-0.197	-0.157	-0.029	-0.343*
Plantago major	-0.368*	0.440**	0.251	0.344*	-0.170	-0.278	-0.143	-0.141	-0.179	-0.267	-0.116	0.119	0.015	-0.325*

Soil texture may affect soil or productivity via influence on the soil water holding capacity, infiltration rate, moisture availability for plants and consequently plant nutrition (Sperry and Hake, 2002). Organic matter content is an essential soil fertility factor can affect phytodiversity (Zhang *et al.*, 2010). Group C was dominated by *Beta vulgaris*, *Chenopodium murale* and *Melilotus messanensis*. These species were recorded as dominant or common weeds by Shaltout *et al*. (1992) in the common crops in the Nile Delta region and Abd El Hamid (2005) in the field crops in Ismailia Governorate. Moreover, *Ch. murale* showed very wide ecological amplitude in the orchards in the Nile Delta (Mashaly and Awad, 2003). Group D was dominated by *Oxalis corniculata*. This species was reported as dominant or co-dominant weeds in orchards and canal bank habitats in Egypt. El-Halawany *et al.* (2010) reported *O. Corniculata* among the dominant species in the canal bank vegetation in El-Dakahlyia Governorate and Abd El Hamid (2005) recorded it as dominant species in Orchards in Ismailia Ggovernorate. In this study, it is evident that most of the dominant and common species of the identified groups were salt and drought tolerant species such as *Tamarix nilotica, Phragmites australis, Zygophyllum coccineum, Beta vulgaris* and *Melilotus messanensis*. The dominance of the salt tolerant species indicates the saline nature of the study area. This is could be attributed to the proximity of the studied stands to the Suez Canal and Gulf of Suez. Salinity is the most prominent factor having major significances on plant life in arid regions (Chapman 1966).

The vegetation groups yielded by TWINSPAN classification are clearly separated on the ordination plane. It is obvious that groups A and B are closely related to each other, also and groups C and D are related to each other. The relationships between the above mentioned pairs of groups may be owing to the close similarities of their floristic composition and natural habitats.

Table (5): Correlations of the first three CCA ordination axes with the soil variables, eigenvalues and species-environment correlations.

Variable		Axis 1	Axis 2	Axis 3
Sand	(%)	-0.5475	-0.0733	0.0032
Silt	(%)	0.5196	-0.1397	0.3148
Clay	(%)	0.4769	0.2453	-0.2785
OM	(%)	0.4891	-0.0556	0.1838
$CaCO_3$	(%)	-0.5941	0.1472	0.3109
pH		-0.7669	-0.2014	-0.1826
EC	(mmhos/cm)	-0.3289	0.2830	0.2768
HCO_3^-	meq/100 g soil	-0.6057	0.1324	-0.0698
Cl^-	meq/100 g soil	-0.3427	0.2614	0.2316
SO_4^-	meq/100 g soil	-0.3785	0.1122	0.0637
Ca^{++}	meq/100 g soil	-0.5108	0.0727	-0.1125
Mg^{++}	meq/100 g soil	-0.3485	0.2075	0.1920
Na^+	meq/100 g soil	-0.3021	0.2872	0.2818
K^+	meq/100 g soil	-0.2588	-0.2451	-0.0478
Eigenvalues		0.8350	0.4920	0.4420
Species-environment correlations		0.9740	0.8700	0.8450

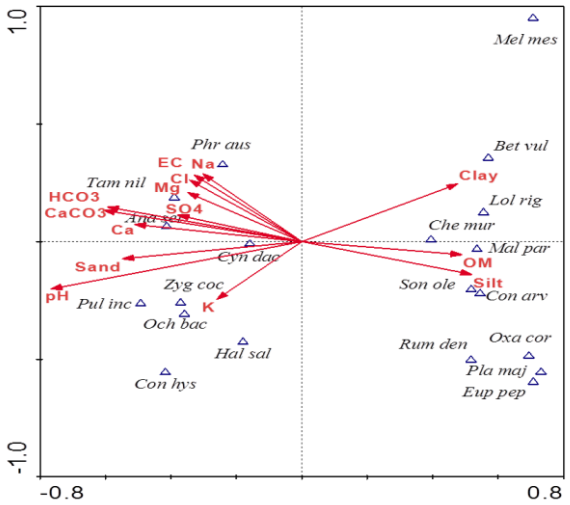

Figure (6): Biplot of Canonical Correspondence Analysis (CCA) showing the relationships between the plant species and the correlated soil variables. The indicator and preferential species are abbreviated to the first three letters of the genus and species, respectively

Soil texture, salinity and organic matter are the main acting factors controlling the composition and species richness of weed communities (Fried *et al*., 2008; Andersson and Skovgaard, 2009; Pinke *et al.*, 2010). In the present study, Linear correlation of soil variables with the importance values of some dominant species showed significant correlation between the floristic composition of the study area and the soil variables such as sand, silt, clay, organic matter, calcium carbonates, pH, electrical conductivity, chlorides, magnesium, sodium, calcium and potassium. Also, the application of Canonical Correspondence Analysis (CCA biplot) indicated that the distribution of vegetation in this area is controlled by a wide range of soil variables including soil texture, organic matter, $CaCO_3$, pH, electrical conductivity, bicarbonates, chlorides, sodium, magnesium, potassium and calcium. This was reported in other studies (Dahmash, 2001; Mashaly *et al.*, 2012; El-Amier and Abdulkader, 2015). Mashaly *et al.* (1995) pointed out that moisture content, porosity, water holding capacity, calcium carbonate, pH, EC, sulphate, carbonate, sodium, potassium, calcium and magnesium were the most effective soil variables controlled the distribution of vegetation in the Ismailia-Suez desert road, while soil texture, organic carbon, chloride and bicarbonate content showed little effect on the vegetation distribution.

CONCLUSION

In conclusion, the floristic composition analysis of the present study revealed the record of 107 species belonging to 93 genera and 33 families. Therophytes and chamaephytes were the most prevailing life-forms. Saharo-Sindian and Mediterranean chorotypes forms the major component of the floristic structure in the study area. *Zygophyllum coccineum* dominated the desert habitat; *Tamarix nilotica* dominated waste land habitat, while *Beta vulgaris*, *Chenopodium murale*, *Melilotus messanensis* and *Oxalis corniculata* dominated the crop fields and mango orchard habitats. In this study, it is evident that most of the dominant and common species of the identified groups were salt tolerant and drought species which reflect the saline nature of the study area. It can be concluded that the species diversity and dominance may be related to soil physical and/or chemical characteristics and variation of habitat types.

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REFERENCES

ABDALLAH, A., M. ABDEL AAL, AND M. HUSSSIN. 1998. “Integrated Surface and Subsurface Structural Study of the Area between Mediterranean and Eastern Desert, Egypt,” EGPC’s Exploration and Production Conference, Cairo, pp. 1-12.

ABD EL-GHANI, M. M. 1981. Preliminary Studies on the Vegetation of Bahariya Oasis Egypt.M. Sc. Thesis, Cairo University, Egypt.

ABD EL-GHANI, M. M. 1985. Comparative Study of the Vegetation of Bahariya and Farafra Oases and the Faiyum region,Egypt. Unpublished Ph. D. Thesis, Cairo University, Egypt.

ABD EL-GHANI, M. M., F. M. SALAMA, AND N. A. EL-TAYEH. 2013. Desert roadside vegetation in Eastern Egypt and environmental determinants for its distribution. Phytologia Balcanica, 19 (2): 233 – 242.

ABD EL-GHANI, M. M., A. SOLIMAN, R. HAMDY, AND E. BENNOBA. 2013. Weed flora in the reclaimed lands along the northern sector of the

NileValley in Egypt. Turkish Journal of Botany, 37(3): 464-488.

ABD EL-GHANI, M.M., F.M. SALAMA, B.SALEM, A. EL-HADIDY, AND M. ABDELL-ALEEM. 2014. Biogeographical relations of a hyper arid desert flora in eastern Egypt. African Journal of Ecology, 52(2): 173-191.

ABD EL-HAMID, H. A. 2005. Ecological Study of Weed Vegetation and local Environment in Ismailia Governorate, Egypt. Ph.D. Thesis, Faculty of Science, Suez Canal University.

ABD EL-HAMID, H. A., AND K. A. KAMEL. 2010. Weed communities of field crops at El-Tina Plain, Egypt .CATRINA, 5 (1): 77-86

ALLEN, S. E., H. M. GRIMSHAW, J. A. PARKINSON, AND C. QUARMBY. 1974. Chemical Analysis of Ecological materials. Black-well Scientific Publicatins. Osney, Oxford, London.

ANDERSSON, T. N., AND P. MILBERG. 1998. Weed flora and the relative importance of site, crop, crop rotation, and nitrogen. Weed Science. 46: 30–38.

ANDERSSON, T. N., AND I. M.SKOVGAARD. 2009. Crop and soil factors of importance for the distribution of plant species on arable fields in Denmark. Agriculture, Ecosystems and Environment, 133: 61-67.

ARONSON, J. A., D. PASTERNK, AND A. DANON. 1988. Introduction and First Evaluation of 120 Halophytes under Sea Water Irrigation. In Arid lands Today and Tomorrow: Proceedings of an international Research and Development Conference. Whitehead, E.E. Hutchinson, Timmerman, B.N., and varady, R.G.. (Eds), Wesrtview Press, Boulder., 737-746.

BARUAH, T.C., AND H. P. BARTHAKUR. 1997. A Textbook of Soil Analysis. Vikas Publishing House, PVT, LTD, New Delhi.

BOULOS, L. 1999. Flora of Egypt.Vol. 1. Azollaceae-Oxalidaceae.AL-Hadara Publishing, Cairo, Egypt.

BOULOS, L. 2000. Flora of Egypt.Vol. 2. Geraniaceae-Boraginaceae. AL-Hadara Publishing , Cairo, Egypt.

BOULOS, L. 2002. Flora of Egypt.Vol.3.Verbenaceae-Compositae.AL-Hadara Publishing, Cairo, Egypt.

BOULOS, L. 2005.Flora of Egypt.Vol. 4. Monocotyledons (Alismataceae- Orchiaceae). AL-Hadara Publishing , Cairo, Egypt.

BOULOS, L. (2008). Flora and vegetation of the deserts of Egypt. *Flora Mediterran*. 1 (8): 341-359.

BOULOS, L. (2009). Flora of Egypt Check list Revised Annotated Edition. AL Hadara Puplishing, Cairo, Egypt .pp.287.

BOUYOUCOS, G.J. 1962. Hydrometer method improved for making particle size analysis of soils. Agronomy Journal, 54: 464-465.

CANFIELD, R. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry, 39: 288-394.

CHAPMAN, V.J. 1966. Vegetation and Salinity. In Salinity and Aridity Monographiae Biological XVI. (ed. H. Bayko.) Dr. W. Junk Publishers .The Hague.

CHEN X., J. TANG, Z. FANG, AND K.SHIMIZU. 2004. Effects of weed communities with various species numbers on soil features in a subtropical orchard ecosystem. Agriculture, Ecosystems and Environment, 102: 377-388.

DAHMASH, A. A. 2001. Ecological and Phytosociological Studies on Plant Communities in the Eastern desert of Egypt. Ph. D. Thesis, Faculty of Science, Zagazig University, Egypt.

DANIN, A. 1996. Plants of Desert Dunes. Springer-Verlag.

DANIN, A., AND G.ORSHAN. 1990. The distribution of Raunkiaer life forms in Israel in relation to the environment. Journal of Vegetation Science, 1(1): 41-48.

DANIN, A., AND U. PLITMAN. 1987. Revision of the plant geographical territories of Israel and Sinai. Plant Systematic Evolution, 156: 43-53.

EL-AMIER, Y.A., AND O. M. ABDULKADER. 2015. Vegetation and species diversity in the Northern Sector of Eastern Desert, Egypt. West African Journal of Applied Ecology, 23: 75-99.

EL-AMIER, Y. A., E. F. EL-HALAWANY, AND T. J. ABDULLAH. 2014. Composition and diversity of plant communities in sand formations along the Northern coast of the Nile Delta in Egypt. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 5: 826-847.

EL-AMIER, Y.A., E. F. EL-HALAWANY, S. A. HAROUN, AND S. G. MOHAMUD. 2015. Vegetation analysis and soil characteristics on two species of genus *Achillea* growing in Egyptian Desert. Open Journal of Ecology, **5**: 420-433.

EL-AMIER**,** Y.A., H. EL-SHORA, AND M. HESHAM. 2016. Ecological study on *Zygophyllum coccineum* L. in coastal inland desert of Egypt. Journal of Agriculture and Ecology Research, 6 (4): 1-17.

EL-HADIDI, M.N. 1993. Natural Vegetation. In "The Agriculture of Egypt".(Graig, G.M.cd.), Oxford University Press 3: 39-62.

EL-HALAWANY, E.F., I. A. MASHALY, AND G. OMAR. 2002. On the ecology of weed communities of the principal crops in Damietta area, Egypt. Bull. Faculty of Science, Assiut University. 31 (2-D): 159 -174.

EL-HALAWANY, E.F., I. A. MASHALY, M. E. ABU-ZIADA, AND M. ABD EL-AAL. 2010. Habitat and Plant Life in El-Dakahlyia Governorate, Egypt, M., Journal of Environmental Sciences, Mansoura University, 39 (1): 83-108.

EL-SHAZLY, E.M., M.A. ABDEL HADY, M. A. EL-GHAWABY, I.A., EL-KASSAS, A.B. SALMAN, AND M.A. MORSI. 1975. Geology and ground water potential of EL-Ismailia master plan study area. Remote Sensing Center. Academy of Scientific Research and Technology, Cairo, Egypt, pp.45.

FRIED G., L. R. NORTON, AND X. REBOUD. 2008. Environmental and management factors determining

weed species composition and diversity in France. Agriculture, Ecosystems and Environment, 128: 68 –76.

FRENKEL, R. E. 1970. Ruderal Vegetation Along Some California Roadsides. Berkeley. Univ. of California Press. pp. 163.

GALAL, T. M. 2011. Size structure and dynamics of some woody perennials along elevation gradient in Wadi Gimal, Red Sea coast of Egypt. Ecologia, 1(1): 56-67.

GALAL, T. M., AND A.G. FAHMY. 2012. Plant diversity and community structure of Wadi Gimal protected area, Red Sea coast of Egypt. African Journal of Ecology, 50 (3): 266-276.

GAUCH, H. 1982. Multivariate Analysis in Community Ecology. Cambridge University Press, Cambridge.

GRIME, J. P. 1979. Plant Strategies and Vegetation Processes. Chichester: John Wiley and Sons. pp. 222.

GOOD, R. 1974. The Geography of the Flowering Plants. Longman, London. pp. 557.

HARPER, J. L. 1977.Population Biology of Plants. London: Academic Press.

HASSIB, M. 1951. Distribution of plant communities in Egypt. Bulletin de l'Institut du Desert d'Egypte, 29: 60-261.

HENDERSON, P. A., AND R. M. SEABY 1999. Community Analysis. Package Version 1.3.1. PISCES Conservation Ltd, IRC House, UK.

HILL, M.O. 1979 A. TWINSPAN-A fortran Program for Arranging Multivariated data in an Ordered Two-Way Table by Classification of the Individuals and Attributes. Ithaca, New York.

HILL, M. O. 1979 B. DECORANA-A fortran Program of Deterended Correspondence AnalysisReciprocal Averaging. Ithaca. New York.

KHEDR, A. A. AND A. K. HEGAZY. 1998. Ecology of the rampant weed *Nymphaea lotus* L.Willdenow in natural and rice field habitats of the Nile delta, Egypt-Kluner Academic Publishers prints in the Netherland, Hydrobiologia, 386: 119-129.

KOSINOVA, J. 1974. Studies on the weed flora of cultivated land in Egypt. 4: Mediterranean and Tropical elements. Candollea, 29: 281-295.

KANDI, B., S. C. SAHU, N.K. DHAL, AND R. C. MOHANTY. 2011. Species diversity of vascular plants of Sunabeda wildlife sanctuary, Odisha, India. New York Science Journal 4: 1-9.

MAGURRAN A.E. 1988.Ecological Diversity and Its Measurements. Croom Helm, London.

MASHALY, I.A, E.F. EL-HALAWANY, AND M.A. EL-BEHEIRY. 1995. Ecological and phytosociological studies in the Ismailia-Suez Desert Road of Egypt. Journal of Environmental Sciences, Mansoura University, 10 (1): 1-18.

MASHALY, I. A., AND E.R. AWAD. 2003. Ecological perspectives on the weed flora of orchards in the Nile Delta, Egypt. Journal of Environmental Sciences, Mansoura University, 25: 1-37.

MASHALY, I. A., E.F. EL-HALAWANY, M. E. ABU-ZIADA, AND M.L. ABDEL-AAL. 2013. Vegetation – soil relationship in the cultivated land habitat in El-Behira Governorate, Egypt. Journal of Environmental Sciences, Mansoura University, 42 (4): 607 – 623.

MASHALY, I. A., I. E. EL-HABASHY, E. F. EL-HALAWANY, AND G.OMAR. 2012. Weed plant communities in the Nile Delta of Egypt. III – Cultivated land habitat. Egyptian Journal of Botany, 52 (1) : 1- 26.

PARKER, K. 1991.Topography, substrate, and vegetation patterns in the northern Sonoran Desert. Journal of Biogeography, 18: 151-163.

PIELOU, E.C. 1975. Ecological Diversity. Wiley, Inter science, New York (pp. 165).

PIERCE, W. C., HAENISCH, E.L., AND D. T. SAWYER. 1958. Quantitative Analysis. Wiley Toppen, Tokyo.

PINKE, G., R. PAL, AND Z. BOTTA-DUKAT. 2010. Effects of environmental factors on weed species composition of cereal and stubble fields in western Hungary. Central European Journal of Biology, 5: 283-292.

PIPER, C. S. 1947. Soil and Plant Analysis. Intersience Publishers, Inc. New York.

RAMADAN, F. 1984. "Sedimentological Studies on the Bottom Sediments of the Suez Canal," M.Sc. Thesis, Faculty of Science, Zagazig University, Zagazig, 185p.

RAUNKIAER, C. 1934. The Life Forms of Plants and Statistical Plant Geography. Translated by Carter Fausboll and Tansley, Oxford Univ. Press, London.

SAID, R. 1962. Geology of Egypt. Elsevier. Amesterdam, 378 pp.

SALAMA F. M, M. M. ABD EL-GHANI, M. A. GADALLAH, S. M. EL-NAGGAR, AND A. AMRO. 2014B. Variations in vegetation structure, species dominance and plant communities in south of the Eastern Desert-Egypt. Notulae Scientia Biologicae., 6(1): 41-58.

SALAMA, F. M, A. S. SUZAN, AND A. A. ABD EL-GELIL. 2014A. Plant communities and floristic composition of the vegetation of Wadi Al-Assiuty and Wadi Habib in the Eastern Desert, Egypt. Notulae Scientia Biologicae., 6(2): 196-206.

SALAMA, F.M., M.M. ABD EL-GHANI, AND N. EL-TAYEH. 2013. Vegetation and soil relationships in the inland wadi ecosystem of central Eastern Desert, Egypt. Turkish Journal of Botany, 37(3): 489-498.

SHALTOUT, K.H., A. SHARAF EL-DIN, AND R.A. EL-FAHAR. 1992. Weed communities of the common crops in the Nile Delta region. Flora 187: 329-339.

SHEHATA, M.N. 1992. Ecological Studies on Some Desert Plants. Ph. D. Thesis, Faculty of Science,

Zagazig University, Egypt.
SHUKLA, R. S., AND P. S. CHANDEL. 1989. Plant Ecology and Soil Science. Chand S, Company LTD. Ram Nagar, New Delhi, India.
SMITH, T., AND M. HUSTON. 1989. A theory ofspatial and temporal dynamics of plant communities. Vegetatio, 83: 49-69.
SPERRY, J. S., AND U. G. HACKE. 2002. Desert shrub water relations with respect to soil characteristics and plant functional type. Function Ecology, 16: 367– 378.
TÄCKHOLM, V. 1974. Students' Flora of Egypt. 2nd. Ed. Cairo University, Egypt.multivariate direct gradient analysis. Ecology, 67: 1167-1179.
TER BRAAK, C.J.F. 1994. Canonical community ordination. Part 1: Basic theory and linear methods Ecoscience 1: 127-140.
TER BRAAK, C., AND P. SMILAUER. 2002. CANOCO Reference Manual and Cano Draw for Windows User's Guide: Software for Canonical Community Ordination Version (4.5). Microcomputer Power, Ithaca, New York.
UNESCO. 1977. Map of the World Distribution of Arid Regions, MAB Technical Notes 7.
WICKENS, G. E. 1976. The Flora of Jebel Morra (Sudan Republic) and its Geographical Affinities. Kew Bull, Add. Ser.,V. HMSO, London.
WHITTAKER, R. H. 1956. Vegetation of Great Smoky Mountains, Ecological Monographs, 26 (1): 1-80
ZAHRAN, M. A., K. J. MURPHY, I. A. MASHALY, AND A. A. KHEDR. 1996. On the ecology of some halophytes and psammophytes in the Mediterranean coast of Egypt. Verhandungen der Gesellschaft fur Okologie, Band, 25: 133-146
ZAHRAN, M. A., AND A. J. WILLIS. 2009. The Vegetation of Egypt 2nd ed. Springer. Netherlands.
ZHANG, F., AND J. T. ZHANG. 2000. [Research progress of numericalclassification and ordination of vegetation in China.] J. Shanxi Univ.(Nat. Sci. Educ.) 23: 278-282 (in Chinese with English abstract).
ZHANG, K.,H. DANG, S. H. TAN, Z. H. WANG, AND Q. ZHANG. 2010. Vegetation community and soil characteristics of abandoned agricultural land and pine plantation in the Qingling Mountains, China. Forest Ecology, 259: 2036-2047.

التركيب الفلورى وتحليل الغطاء النباتى لمحافظة السويس بمصر

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الملخص العربى

إستهدفت هذه الدراسة تقديم وصفا تفصيليا للتركيب الفلورى وتحليل الغطاء النباتي لمحافظة السويس وقد تم دراسة أربعة بيئات مختلفة وهى البيئة الصحراوية وبيئة الاراضى المهملة وبيئةالمحاصيل الحقلية وبيئة حدائق المانجو.تم تسجيل ١٠٧ نوعا من النباتات الزهرية تنتمي إلى ٩٣ جنسا تتبع ٣٣ فصيلة نباتية، صنفت هذه النباتات إلى ٥٦ نوعا من النباتات الحولية و نوعان من النباتات ثنائية الحول و ٤٩ نوعا من النباتات المعمرة. وجد أن أكثرالفصائل تمثيلا هى العائلة المركبة، النجيلية، الصليبية، البقولية والرمرامية. كما تم وصف طرزالحياةالنباتية فى منطقة الدراسة، حيث وجد ان طرازالحوليات كان الأكثر تمثيلا بالمنطقة. وأوضح التحليل الفلورى أن عناصر الصحارى-السندانية وعناصر البحرالأبيض المتوسط إما نقية أو ممتدة إلى مناطق أخرى تشكل العناصر الرئيسية للتركيب الفلورى.باستخدام برنامج التصنيف ثنائى الإتجاه أمكن التعرف على اربعة مجموعات نباتية سميت تبعا للأنواع السائدة بهاإلى: الرطريط (مجموعة أ)، الطرفة (مجموعة ب)، السلق- الزربيح- الحندقوق الحلو (مجموعة ج) والحمض (مجموعة د)، كما أوضحت قياسات التنوع البيولوجى أن المجموعتان د و ج كانتا أكثرتنوعا من المجموعتان أ و ب. وبإستخدام برنامج التطابقى العكسى (DCA) امكن فصل المجموعات النباتية الناتجة عن إستخدام برنامج التصنيف ثنائى الإتجاه على إمتدادالمحورين الأول والثاني.اوضح إستخدام برنامج التوزيع التطابقى الكنسي والتحاليل الإحصائية أن أهم عوامل التربة إرتباطا بتوزيع العشائرالنباتية في منطقة الدراسة هىقوام التربة،المادة العضوية،كربونات الكالسيوم، الرقم الهيدروجينى، التوصيل الكهربى، الأنيونات (البيكربونات و الكلوريدات) و الكاتيونات (الصوديوم، الماغنيسيوم، البوتاسيوم والكالسيوم).