OnLine Journal of Biological Sciences 2(9): 573-581, 2002
ISSN 1608-4127

Vegetation Analysis in the South Eastern Part in the Southern Eastern Desert of Egypt

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Abstract: The floristic elements of the study area comprises 240 species. The majority of these species (238) belong to Angiospermae, the other two species (Mushroom and Chara) are belonging to Gymnospermae. A total number of species 238 Angiospermae belonging to 54 families and 155 genera. The most represented families were Graminae (4.29%), Leguminosae (11.76%), Compositae (9.2%), Cruciferae (4.6%), Zygophyllaceae (4.2%), Euphorbiaceae (3.4%), Boraginaceae (3.4%) and Asclepidaceae (2.9%). Vegetation analysis in the south eastern part of the southern eastern desert of Egypt indicates the dominance of *Polycarpea repens, Zygophyllum simplex, Triraphis pumilio, Astragalus eremophilus, Fagonia indica, Aizoon canariense, Caylusea hexagyna, Acacia tortilis* subsp. *tortilis, Aerva javanica, Aristida mutabilis, Asphodelus tenuifolius* and *Panicum turgidum*. Seven vegetation clusters are recognized after the application of the two-way indicator species analysis (Twinspan). These clusters are named after the dominant species as follows: *Indigofera spinosa-Cocculus pendulus- Peristrophe paniculata-Cucumis prophetarum-Convolvulus hystrix, Chenopodium murale, Zygophyllum simplex, Coelachyrum brevifolium-Cleome amblyocarpa, Salsola imbricata, Polycarpea robbairea* and *Heliotropium bacciferum*. Among the estimated soil variables in this study, pH and HCO_3 are important in characterizing the vegetation clusters.

Key words: Multivariate analysis, Decorana, Twinspan, Eastern desert, Egypt

Introduction

The harsh climate, absence of roads and remoteness from the main cities are the main characteristics of the study area in the southern eastern desert of Egypt. Little is known about the plant life in this part of the eastern desert, but see Kassas and Girgis (1969), Springuel *et al*. (1986) and Sheded (1992,1998).

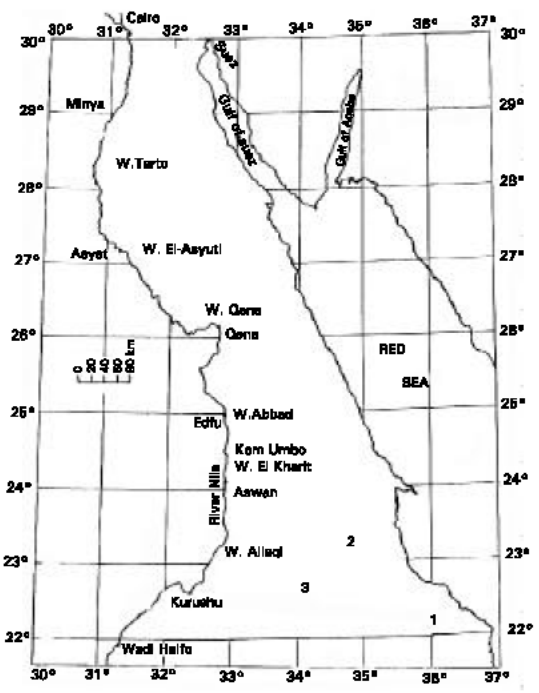
The eastern desert of Egypt extends between the Nile Valley in the west and the Red Sea in the east. It is traversed by numerous wadis running to the Red Sea or the Nile Valley. The study area is a triangular in the southern part of the southern eastern desert of Egypt with its apex in the north at Abraq area. Its base in the south is along the Egyptian Sudanese border that extends between upstream parts of Wadi Allaqi in the west and Gebel Elba group in the east. The area is located between latitudes 22°N to 23° 30′ N and longitudes 34° 30′ to 37°E.

Gebel Elba group is an extensive group of granite mountains situated in the Sudano- Egyptian border (Lat.22°N) and comprises Gebel Elba (1428m), Gebel Shindeib (1911m), Gebel Shindodai (1526m), Gebel Shillal (1409m), Gebel Makim and Gebel Asotriba (2217m). The eastward drainage is much more complex, the principle trunk wadis such as Ibib, Da·ib and Serimtai, being separated by very numerous minor wadis draining independently to the Red Sea. Gebal Elba and Shandib (1912m) is a mountain block located close to the Red Sea in the southeastern corner of Egypt between Wadi Da·ib and its coast.

Wadi Allaqi is the most extensive wadi of the eastern desert. The east section of the mountain region is not far from the maritime influence of the Red Sea. In this part, Wadi Allaqi receives a few tributaries from the south (Wadi Nasari) and numerous tributaries from the north (Wadi Mitikwan, Wadi Eqat, Wadi Suhin and Wadi Hadai-Bur).

Wadi Hoddein is the most important wadi going to the Red Sea. It has an important tributary known as Wadi Al-Naam, entering it from the northwest. Wadi Abraq famous for its excellent springs, is a tributary of Wadi Al-Naam. These springs give water all the year round, although due to the sandiness of the valley bottom they are not surrounded by greenery. Nubia-Red Sea has enclaves of Nubia sandstone which appear to the east of the Red Sea-Nile basin water divide (Abraq area). The main wadis are wadis Abraq, Wadi Al-Naam, Wadi Abu-Safa and downstream part of Wadi Al-Hawdayan. Abraq, Daff, Aqab Al-Nugum and Mashbah; their elevation is 1353m and they form the main water divide between Wadis Kharit, Shait and Al-Allaqi in the west and Wadi Al-Hawdayan in the east.

Among these groups of high peaks as located sandy plains. Some of the mountains between the outliers of the sandstone plateaus



Map. 1: Location map of the study area 1, Elba area; 2, Abraq and Hoddein area and 3, upstream part of Allaqi

(such as Gabal Abraq) Others are rounded, serrated peaks of granite (Such as the mountains of Gabal Elba) (Map 1).

The southern part of the Egyptian desert is one of the extremely arid areas of the world. Table 1 shows that the mean minimum temperature (11.4°C) has been recorded in January and the mean maximum (38.7°C) in July. The area is almost rainless. In the period from 1964 to 1981, only 12.49 mm annual rainfall was recorded (Ayyad and Ghabbour, 1986). The relative humidity shows that the atmosphere is dry throughout the year (RH = 47.2%), but seasonal variation is evident; it is drier in summer than in winter. (Egyptian Meteorological Authority; personal communication). The present study aims at analysing the

Table 1: Meterological data of Ras Benas station. Averages of 17 years (1964 -1981)

Months	Temperature (°C) Min.	Max.	Rainfall (mm)	Relative humidity (%)	Evaporation (mm/day)
January	11.4	24.5	0.8	59.5	7.8
February	12.5	26.0	0.01	57.2	8.3
March	14.5	28.4	0.1	51.2	11.8
April	18.3	32.3	0.2	39.6	15.5
May	21.4	35.0	0.3	34.8	20.8
June	23.7	38.5	-	34.7	23.7
July	24.8	38.7	-	40.8	20.4
August	24.4	38.4	-	35.0	20.6
September	23.9	37.1	tr	40.0	20.7
October	21.4	34.7	7.4	49.7	13.5
November	17.7	29.3	4.1	61.7	8.58
December	14.8	26.4	0.03	62.4	7.6
Mean			12.49/12	47.2	

vegetation of the southern part of the south eastern desert of Egypt in order to depict the main vegetation types and assess the role of soil factors and human interference that influence the vegetation.

Materials and Methods

Thirty four stands were selected in the study area during March 97 to April 1997. In selecting each stand, a reasonable degree of habitat uniformity and plant cover homogeneity were ensured. In each stand, the list of species were recorded (Mueller-Dombois and Ellenberg, 1974). Nomenclature follows Tackholm (1974) and updated according to Boulos (1995) and El-Hadidi *et al.* (1994/1995).

Soil samples were collected from each stand. Soil samples were screened through a 2mm sieve and the gravel was discarded. The remainder was kept for chemical and mechanical analysis. Different soil sizes of particles were separated using the pipette method (Kilmer and Alexander, 1949), whereby the percentages of sand, silt and clay were calculated.

Soil water extracts (1:5) were prepared for determination of EC and soil reaction (pH) using conductivity and pH meters, chlorides by direct titration against silver nitrate using potassium chromate as an indicator, carbonates and bicarbonates by direct titration against HCl using phenolphthalein and methyl orange as indicators and calcium and magnesium by titration against EDTA (ethylenediamine dihydrogen tetraacetic acid) using ammonium purpurate and Eriochrome black T as indicators (Jackson, 1977). Two-way indicator species analysis (Twinspan), as a classification technique and detrended correspondence analysis (DCA), as an ordination technique, were applied to the presence estimates of 238 species in 34 stands according to the computer programs of Hill (1979a, b). Species richness (alpha-diversity) of each vegetation cluster was calculated as the average number of species per stand and species turnover (beta-diversity) as the ratio between the total species recorded in a certain vegetation cluster and its alpha-diversity (Pielou, 1975; Shaltout, 1985).

Results

The number of perennial species encountered in this study is 149, and that of annuals is 89 (Table 2). Of the perennials, *Acacia tortilis* subsp. *raddiana, Aerva javanica, Panicum turgidum, Acacia tortilis* subsp. *tortilis, Polycarpaea repens, Fagonia indica, Launaea cassiniana, Forsskaolea tenacissima, Lycium shawii, Senna italica,* are considered the most common species (the presence percentage≥ 50%). Other common perennials are *Crotalaria aegyptiaca, Zilla spinosa, Acacia ehrenbergiana, Stipagrostis plumosa, Launaea capitata, Pulicaria incisa, Pulicaria crispa, Heliotropium bacciferum, Trichodesma africanum, Centropodia forsskaolii, Stipagrostis raddiana, Citrullus colocynthis, Calotropis procera, Ochradenus baccatus, Polycarpaea robbairea, Leptadenia pyrotechnica, Salsola villosa, Maerua crassifolia, Chrozophora oblongifolia, Heliotropium pterocarpum, Farsetia longisiliqua,*

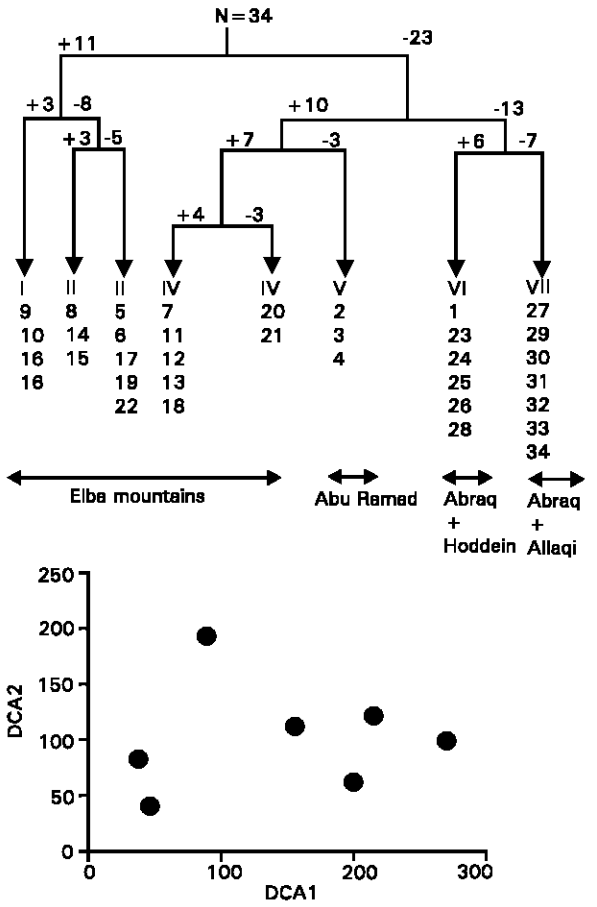


Fig. 1: The relationship between the seven vegetation clusters identified according to the Twinspan and the ordination of the clusters along DCA1 and DCA2.
The seven clusters are I, *Indigofera spinosa-Cocculus pendulus-Peristrophe paniculata-Cucumis prophetarum-Convolvulus hystrix;* II, *Chenopodium murale;* III, *Zygophyllum simplex;* IV, *Coelachyrum brevifolium-Cleome amblyocarpa;* V, *Salsola imbricata;* VI, *Polycarpea robbairea* and VII, *Heliotropium bacciferm.*

Balanites aegyptiaca, Convolvulus hystrix, Abutilon pannosum, Tephrosia purpurea subsp. *apollinea, Indigofera argentea, Cucumis prophetarum, Lavandula coronopifolia, Cocculus pendulus* (the presence percentage is 25-50). The most common annuals species

Table 2: Life form, presence percentage (%) of the recorded species in the seven vegetation clusters identified after the application of Twinspan classification and floristic categories (FC)

				Vegetation clusters						
Species	Life form	FC	T. P. %	I	II	III	IV	V	VI	VII
Abutilon bidentatum A. Rich.	Ch	Ssz	5.9	33.3	33.3	-	-	-	-	-
Abutilon fruticosum Guill.& Perr.	Ch	Ssz	2.9	-	33.3	-	-	-	-	-
Abutilon pannosum (G. Forst) Schltdl	Ch	Ssz	32.4	33.3	66.6	100	28.6	33.3	-	-
Acacia asak (Forssk.) Willd.	Ph	Ssz	5.9	33.3	33.3	-	-	-	-	-
Acacia ehrenbergiana Hayne	Ph	Ssz	35.3	-	-	-	-	-	83.3	100
Acacia etbaica Schweinf.	Ph	Ssz	8.8	66.6	-	20	-	-	-	-
Acacia millifera (Vahl.) Benth.	Ph	Ssz	14.7	33.3	66.6	20	14.3	-	-	-
Acacia oerfota (Forssk.) Schweinf	Ph	Ssz	2.9	33.3	-	-	-	-	-	-
Acacia tortilis(Forssk) Hayne subsp. *raddiana* (Savi) Bernan	Ph	Ssz	64.7	100	100	40	85.7	-	66.6	57.1
Acacia tortilis (Forssk) Hayne. subsp *tortilis*	Ph	Ssz	85.3	100	100	100	100	33.3	83.3	71.4
Aerva javanica (Burm.f.) Juss.ex Schult.	Ch	Ssz	76.5	33.3	100	100	85.7	66.6	66.6	71.4
Aerva lanata (L.) Juss. ex Schult.	Ch	Pan	5.9	66.6	-	-	-	-	-	-
Aizoon canariense L.	Th	Ssz	55.9	33.3	100	40	85.7	100	16.7	42.9
Amaranthus graecizans L.	Th	Pal	55.9	66.6	100	80	57.1	100	50	-
Amberboa leucantha Coiss. ex.A. Chev.	Th	Pal	5.9	33.3	33.3	-	-	-	-	-
Anabasis setifera Moq.	Ch	Ssi	2.9	-	-	-	-	33.3	-	-
Andrachne aspera Spreng.	Ch	Ssz	8.8	66.6	33.3	-	-	-	-	-
Anticharis glandulosa Asch.	Th	Ssz	5.9	-	-	-	-	-	33.3	-
Anticharis linearis (Benth.) Hochst.ex Asch.	Th	Ssz	5.9	-	-	40	-	-	-	-
Aristida adscensionis L.	Th	Pan	5.9	-	33.3	-	-	-	16.7	-
Aristida funiculata Trin.&Rupr.	Th	Ssz	29.4	33.3	33.3	-	28.6	33.3	66.6	14.3
Aristida meccana Hochst.	Th	Ssz	23.5	33.3	-	-	42.9	-	50	14.3
Aristida mutabilis Trin. &Rupr.	Th	Ssz	67.6	100	100	80	57.1	33.3	83.3	42.9
Arnebia hispidissima (Lehm.) DC.	Th	Ssz	52.9	33.3	100	80	28.6	-	66.6	57.1
Asphodelus tenuifolius Cav.	Th	Mits	64.7	66.6	100	80	71.4	100	33.3	42.4
Astragalus eremophilus Boiss.	Th	Ssz	47.1	33.3	-	-	28.6	66.6	100	71.4
Astragalus spinosus (Forssk.) Muschl.	Ch	Ssi	2.9	-	-	-	14.3	-	-	-
Astragalus vogelii (Webb) Bornm	Th	Ssz	35.3	-	-	-	-	33.3	100	71.4
Balanites aegyptiaca (L.) Delile	Ph	Ssz	29.4	100	100	20	14.3	-	-	28.6
Barleria hochstetteri Nees	Ph	Pal	2.9	33.3	-	-	-	-	-	-
Belpharis ciliaris (L.) B. L. Burtt	H	Ssz	20.7	-	66.6	60	14.3	-	-	14.3
Bidens pilosa L.	Th	Pan	11.8	66.6	33.3	-	-	-	-	-
Boerhavia elegans Choisy, DC.	H	Szi	11.8	-	-	-	14.3	-	33.3	14.3
Cadaba farinosa Forssk.	Ph	Szi	2.9	-	-	20	-	-	-	-
Cadaba glandulosa Forrsk.	Ph	Sz	2.9	-	-	20	-	-	-	-
Calligonum polygonoides L.	Ph	Ssi	20.6	66.6	66.6	20	14.3	-	-	14.3
Calotropis procera (Aiton) W.T.Aiton	Ph	Ssz	32.4	-	33.3	60	42.9	33.3	16.7	28.6
Capparis decidua (Forssk.) Edgew	Ph	Ssz	20.6	66.6	-	40	-	33.3	16.7	14.3
Caralluma retrospiciens (Ehren.) N. E. Br.	S	Sz	2.9	-	-	-	14.3	-	-	-
Caylusea hexagyna (Forssk.) M. L. Green	Th	Ssz	64.7	66.6	100	60	71.4	33.3	83.3	42.9
Cenchrus ciliaris L.	H	Sszm	5.9	-	-	-	-	33.3	16.7	-
Cenchrus pennisetiformis Steud.	H	Sszm	20.7	33.3	66.6	-	28.6	-	66.6	-
Centropodia forsskaolii (Vahl.) Cope	G	Ssi	26.5	-	66.6	20	42.9	66.6	-	14.3
Chenopodium murale L.	Th	Cosm	29.4	33.3	100	-	42.9	66.6	16.7	-
Chrozophora oblongifolia (Delile) Spreng	Ch	Ssm	41.2	33.3	66.6	60	57.1	-	50	14.3
Chrozophora tinctoria (L.) Raf.	Ch	Mit	11.8	-	-	-	14.3	-	16.7	28.6
Cistanche phelypaea (L.) Cout.	P	Sszm	5.9	-	-	-	-	33.3	16.7	-
Citrullus colocynthis (L.) Schard.	H	Sszm	35.3	-	100	20	28.6	33.3	50	28.6
Cleome amblyocarpa Barratte & Murb.	Th	Ssz	38.2	-	-	20	57.1	-	83.3	42.6
Cleome droserifolia (Forssk.) Delile	H	Ssz	5.9	-	-	-	-	-	-	28.6
Cleome paradoxa DC.	H	Sz	5.9	-	-	40	-	-	-	-
Coelachyrum brevifolium Hochst.& Nees	Th	Ss	35.5	-	66.6	60	71.4	66.6	-	-
Coccinia grandis (L.) Voigt	G	Pan	5.9	33.3	-	-	-	33.3	-	-
Cocculus pendulus (J.R.& G. Frost) Diels	Ph	Ssz	29.4	66.6	100	80	14.3	-	-	-
Cometes abyssinica Wall.	Ch	Ssz	17.6	33.3	66.6	40	14.3	-	-	-
Commelina forsskaolii Vahl	Ch	Sz	8.8	66.6	33.3	-	-	-	-	-
Commicarpus plumbagineus (Cav.) Standl.	Ph	Sz	14.7	66.6	33.3	40	-	-	-	-
Commiphora opobalsamum (L.) Engl.	Ph	Sz	2.9	-	-	20	-	-	-	-
Convolvulus austro-aegyptiacus Abdallah&Saad	H	End	5.9	33.3	-	-	-	-	16.7	-
Convolvulus arvensis L.	H	Pan	2.9	-	33.3	-	-	-	-	-
Convolvulus fatmensis Kunze	Th	Ssz	5.9	-	33.3	-	-	-	16.7	-
Convolvulus deserti Hochst.& Steud.	Ch	Ssi	5.9	-	-	-	-	-	33.3	-
Convolvulus hystrix Vahl	Ch	Ssz	29.4	100	66.6	60	14.3	-	16.7	-
Cotula cinerea Delile	Th	Ss	32.4	-	-	-	-	66.6	50	85.7

Table 2: Continued

Species	Life form	FC	T. P.%	Vegetation clusters I	II	III	IV	V	VI	VII
Crotalaria aegyptiaca Benth.	H	Ssz	35.3	-	33.3	-	14.3	-	83.3	71.4
Crotalaria microphylla Vahl	Th	Sz	17.6	-	66.6	20	14.3	66.6	-	-
Crucianella maritima L.	Th	Med	2.9	-	33.3	-	-	-	-	-
Crypsis schoenoides (L.) Lam.	Th	Cosm	2.9	-	-	-	-	-	16.7	-
Cucumis prophetarum L.	H	Ssz	47.1	66.6	100	100	71.4	-	-	-
Cullen plicatum (Delile) C.H.Stirt.	Ch	Ssz	5.9	-	-	-	-	-	16.7	14.3
Cuscuta pedicellata Ledeb.	P	Ssz	2.9	-	33.3	-	-	-	-	-
Cymbopogon schoenanthus (L.) Spreng.	G	Ssz	8.8	33.3	-	-	-	-	-	28.6
Cyperus conglomeratus Rottb	G	Sszi	20.6	-	-	-	57.1	100	-	-
Cyperus laevigatus L.	G	Pan	5.9	-	-	-	-	-	33.3	-
Dactyloctenium scindicum Boiss.	H	Ssz	5.9	-	33.3	20	-	-	-	-
Deverra tortuosa (Desf.) DC.	Ch	Ss	2.9	-	-	20	-	-	-	-
Dichanthium foveolatum (Delile) Roberty	H	Sszi	23.5	33.3	-	60	42.9	-	16.7	-
Dieeratella elliptica (DC.) Jonsell.	H	Ss	2.9	33.3	-	-	-	-	-	-
Dinebra retroflexa (Vahl.)Panz	H	Ssz	2.9	-	-	20	-	-	-	-
Dipterygium glaucum Decne.	Ch	Sz	14.7	-	-	-	28.6	-	16.7	28.6
Dodonaea viscosa (L.) Jacq.	Ph	Ss	5.9	33.3	33.3	-	-	-	-	-
Draceana ombet Kotschy & Peyr.	Ph	Sz	8.8	33.3	33.3	-	14.3	-	-	-
Echinochloa colona (L.) Link.	Th	Pan	2.9	-	-	-	14.3	-	-	-
Echinochloa colona subsp leianthum	Th	Pan	2.9	-	33.3	-	-	-	-	-
Echinopus spinosus	H	Ssi	14.7	66.6	66.6	-	-	-	-	14.3
Echiochilon fruticosum Desf.	Ch	Ss	2.9	-	-	20	-	-	-	-
Elionurus royleanus Nees ex A Rich.	H	Ssz	8.8	-	33.3	40	-	-	-	-
Eragrostis aegyptiaca (Willd.) Delile	Th	Sz	2.9	33.3	-	-	-	-	-	-
Eragrostis cilianensis (All.) F.T. Hubb.	Th	Pan	41.2	66.6	100	80	42.9	-	16.7	14.3
Eragrostis ciliaris (L.) R.Br.	Th	Ss	5.9	-	-	-	-	-	33.3	-
Eragrostis pilosa (L.) P. Beauv.	Th	Ssz	2.9	-	33.3	-	-	-	-	-
Eremobium aegyptiacum (Spreng.) Asch. & Schweinf.	Th	Ss	2.9	-	-	-	-	-	16.7	-
Euphorbia cuneata Vahl.	S	Ssz	17.6	66.6	66.6	40	-	-	-	-
Euphorbia granulata Forssk.	Th	Ssz	50	-	66.6	80	71.4	100	33.3	14.7
Euphorbia schimperi C.Presl. B.	H	Ssz	14.7	100	66.6	-	-	-	-	-
Euphorbia scordifolia Jacq.	H	Ssz	2.9	33.3	-	-	-	-	-	-
Fagonia bruguieri D C.	H	Ssi	11.8	-	-	-	-	-	66.6	-
Fagonia glutinosa Delile	H	Ss	8.8	-	-	20	-	-	16.7	14.3
Fagonia indica Burm.	Ch	Ssz	50	-	-	80	42.9	-	83.3	71.4
Farsetia longisiliqua Decne	Ch	Ssz	32.4	66.6	100	40	28.6	-	-	28.6
Farsetia ramosissima E.Fourn	Th	Ssz	11.8	33.3	33.3	20	-	-	16.7	-
Farsetia stylosa L.	Ch	Ssz	20.6	-	-	-	-	-	66.6	42.9
Ficus palmata Forssk.	Ph	Ss	8.8	100	-	-	-	-	-	-
Filago desertorum Pomel	Th	Ssi	2.9	33.3	-	-	-	-	-	-
Forsskaolea tenacissima L.	H	Ssz	55.9	66.6	100	60	57.1	-	66.6	42.9
Forsskaolea viridis Ehr.ex Webb ap.Hoo.k.	Th	Ssz	14.7	66.6	66.6	-	-	-	-	14.3
Gisekia pharnaceoides L.	Th	Sz	23.5	-	66.6	20	71.4	-	-	-
Glossonema boveanum subsp. *nubicum* (Decne.) Bullock.	Th	Sz	8.8	-	-	20	-	-	33.3	-
Gnaphalium luteo- album L.	Th	Cosm	5.9	66.6	-	-	-	-	-	-
Gnaphilum pulvinatum Delile	Th	Cosm	2.9	-	-	-	-	-	16.7	-
Geigeria alata Benth.& Hook. ex Olive.&Hiern.	Th	Sz	11.8	33.3	33.3	40	-	-	-	-
Grewia tenax (Forssk.) Fiori	Ch	Sz	11.8	66.6	-	40	-	-	-	-
Halopeplis perfoliata (Forssk.) Asch.	Ch	Ssz	2.9	-	-	-	-	-	16.7	-
Heliotropium arbainense Fresen.	Ch	Ssz	5.9	33.3	-	-	14.3	-	-	-
Heliotropium bacciferum Forssk.	Ch	Ssz	29.4	-	33.3	20	28.6	-	-	85.7
Heliotropium pterocarpum (DC.) Hochst. & Steud& Bunge	Th	Ssz	35.4	33.3	100	40	57.1	66.6	-	-
Heliotropium zeylanicum (Burm.f) Lam.	H	Sz	14.7	66.6	33.3	20	14.3	-	-	-
Hippocrepis constricta Kunze	Th	Mits	5.9	-	33.3	-	-	33.3	-	-
Hyoscyamus desertorum (Asch. ex Boiss) Tackh.	Th	Ss	2.9	-	-	-	-	-	16.7	-
Hyoscyamus muticus L.	H	Ssi	5.9	-	-	-	-	66.6	-	-
Hyperrhenia hirta (L.) Stapf	H	Sszm	23.8	33.3	-	40	28.6	33.3	-	28.6
Hphaene thebaica (L.) Mart.	Ph	Ssz	5.9	-	-	-	-	-	33.3	-
Ifloga spicata (Forssk.) Sch.Bip.	Th	Mits	35.3	66.6	100	20	57.1	-	33.3	-
Imperata cylindrica L.	H	Pan	2.9	-	-	-	-	-	16.7	-
Indigofera argentea Burm. f.	H	Ssz	2.9	-	-	-	14.3	-	-	-
Indigofera hochstetteri Baker	Th	Ssz	2.9	-	33.3	-	-	-	-	-
Indigofera spinosa Forssk.	Ch	Ssi	35.3	100	66.6	80	42.9	-	-	-

Table 2: Continued

Species	Life form	FC	T. P. %	Vegetation clusters I	II	III	IV	V	VI	VII
Iphiona scabra DC.	Ch	Ssz	23.8	-	66.6	60	42.9	-	-	-
Kickxia aegytiaca (L.) Nabelek	Ch	Ss	2.9	-	-	20	-	-	-	-
Kickxia acerbiana (Boiss.)Tackh *ex* Boulos	Ch	Ss	2.9	33.3	-	-	-	-	-	-
Kickxia hastata (R.Br.*ex*Benth.) Dandy	Th	Sz	8.8	33.3	-	40	-	-	-	-
Kickxia heterophylla (Schousb.) Dandy	Ch	Ssz	2.9	-	-	-	14.3	-	-	-
Kickxia nubica (Skan) Dandy	Th	Ss	11.8	33.3	-	-	14.3	-	16.7	14.3
Kickxia spartioides(Brouss. *ex* Buch) Janch.	Ch	Ssz	2.9	-	33.3	-	-	-	-	-
Kohautia caespitosa Schinzl.	Th	Ssz	32.4	33.3	66.6	60	57.1	-	-	14.3
Launaea capitata (Spreng.) Dandy	Th	Ssz	35.3	-	66.6	-	14.3	100	50	42.9
Launaea cassiniana (Boiss.) Kuntze.	H	Ss	50	-	100	-	28.6	100	83.3	57.1
Launaea massauensis (Fresen.) Sch.Bip&Kuntze	Th	Ssz	23.5	66.6	66.6	60	14.3	-	-	-
Launaea tenuiloba (Boiss.) Kuntze	Th	Ssm	11.8	66.6	33.3	-	-	33.3	-	-
Lavandula coronopifolia Poir	Ch	Ssz	29.4	66.6	66.6	60	28.6	33.3	-	-
Lawsonia inermis L.	Ph	Pal	2.9	-	-	-	-	-	16.7	-
Leptadenia pyrotechnica (Forssk.) Decne.	Ph	Ssz	41.2	33.3	66.6	40	85.7	-	16.7	28.6
Lindenbergia sinaica (Decne.) Benth.	Ch	Ss	5.9	33.3	-	20	-	-	-	-
Lotus arabicus L.	Th	Ssz	2.9	-	-	-	-	-	16.7	-
Lotus deserti Tackh & Boulos	H	Ss	20.6	-	-	-	-	-	66.6	42.9
Lotus glinoides Delile	Th	Ssz	26.5	-	-	-	42.9	100	50	-
Lotononis platycarpa (Viv.) Pic. Serm.	Th	Ssz	50	-	-	40	14.3	66.6	83.3	71.4
Lupinus digitatus Forssk.	Th	Med	17.6	-	-	-	-	-	16.7	71.4
Lycum shawii Roem.& Schult.	Ph	Ssz	50	100	100	80	71.4	33.3	-	14.3
Malva parviflora L.	Th	Mits	14.7	-	66.6	-	-	33.3	33.3	-
Dieeratella elliptica (DC.) Jonsell.	H	Ss	2.9	33.3	-	-	-	-	-	-
Maerua crassifolia Forssk.	Ph	Sz	38.2	-	66.6	80	42.9	33.3	-	42.9
Monsonia nivea (Decne.) Webb.	H	Ssz	11.8	-	33.3	-	14.3	-	16.7	14.3
Morettia canescens Boiss.	H	Ssz	2.9	33.3	-	-	-	-	-	-
Morettia philaeana (Delile) DC	H	Ssz	20.6	-	-	-	14.3	-	50	42.9
Moringa peregrina (Forssk.)Fiori	Ph	Ssz	5.9	66.6	-	-	-	-	-	-
Neurada procumbens L.	Th	Mits	23.5	-	66.6	-	14.3	66.6	16.7	28.6
Ochradenus baccatus Delile	Ph	Ssz	32.4	100	66.6	20	42.9	-	-	28.6
Olea europea L.	Ph	Ssz	5.9	66.6	-	-	-	-	-	-
Orobanche ramosa L.	P	Mits	2.9	-	-	-	-	-	16.7	-
Otostegia fruticosa (Forssk.) Penz.	Ch	Sz	14.7	100	66.6	-	-	-	-	-
Pancratium sickenbergi Asch.& Schweinf.	G	Ss	8.8	66.6	-	-	-	-	-	14.3
Panicum turgidum Forssk.	G	Sszm	76.5	33.3	100	80	71.4	100	83.3	71.4
Parietaria alsinifolia (Delile)	Th	Ssi	2.9	-	33.3	-	-	-	-	-
Peristrophe paniculata (Forss.) Burmmitt	Th	Sz	29.4	66.6	100	80	-	-	16.7	-
Pergularia daemia (Forssk.) Chiov	Ch	Ssz	5.9	66.6	-	-	-	-	-	-
Pergularia tomentosa L.	Ch	Ssz	23.5	-	-	-	-	-	33.3	86.7
Phoenix dactylifera L.	Ph	Ssz	8.8	-	-	-	-	-	50	-
Phragmites australis (Cav.) Trin. *ex* Steud.	Hy&H	Pan	5.9	-	-	-	-	-	33.3	-
Pimpinella etbaica Schweinf.	Th	Med	5.9	33.3	33.3	-	-	-	-	-
Plantago afra L.	Th	Mits	14.7	33.3	100	-	14.3	-	-	-
Plantago ovata Forssk.	Th	Mits	2.9	-	33.3	-	-	-	-	-
Plectranthus hadiensis (Forssk.) Spreng.	Ch	Pal	2.9	33.3	-	-	-	-	-	-
Pluchea dioscorides (L.) DC.	Ph	Ssz	2.9	-	-	-	-	-	16.7	-
Polycarpaea repens (Forssk.) Asch. & Schweinf.	H	Ssz	67.6	-	66.6	60	71.4	100	66.6	85.7
Polycarpaea robbairea (Kunze) Greuter & Burdet.	H	Ssz	47.1	33.3	100	40	57.1	100	50	-
Polycarpon succulentum (Delile) J. Gay	Th	Ssm	2.9	-	-	-	-	-	16.7	-
Polygala erioptera DC.	Th	Sz	14.7	33.3	-	40	-	-	33.3	-
Polygala irregularis Boiss.	Th	Cosm	2.9	-	-	-	-	20	-	-
Portulaca oleracea L.	Th	Pal	5.9	33.3	33.3	-	-	-	-	-
Pulicaria arabica (L.) Cass.	Ch	Mit	2.9	-	33.3	-	-	-	-	-
Pulicaria crispa (Forssk.) Oliv.	Ch	Ssz	38.2	66.6	33.3	-	14.3	33.3	50	71.4
Pulicaria incisa (Lam.) DC.	H	Ssz	44.1	33.3	-	40	42.9	-	66.6	71.4
Reichardia tingitana (L.) Roth.	Th	Sszm	17.6	33.3	33.3	20	-	-	50	-
Reseda pruinosa Delile	Th	Ss	8.8	-	-	20	-	-	33.3	-
Ricinus communis L.	Ch	Pan	5.9	-	-	-	-	-	-	28.6
Rhynchosia minima (L.)DC.	Ph	Sz	8.8	33.3	-	20	14.3	-	-	-
Rhus abyssinica Hochst.*ex* Oliv.	Ph	Ssz	2.9	33.3	-	-	-	-	-	-
Rhus tripartita (Ucria) Grande	Ph	Mits	2.9	33.3	-	-	-	-	-	-
Rumex cyprius Murb.	Th	Ss	14.7	66.6	33.3	-	14.3	-	16.7	-
Salsola imbricata Forssk.	Ch	Ssz	14.7	-	-	-	-	100	16.7	14.3
Salsola villosa Schult.. in Roem.&Schult.	Ch	Mits	26.5	33.3	66.6	20	71.4	-	-	-
Salvadora persica L.	Ph	Ssz	14.7	33.3	-	-	14.3	-	-	42.9

Table 2: Continued

Species	Life form	FC	T. P.%	Vegetation clusters I	II	III	IV	V	VI	VII
Salvia aegyptiaca L.	Ch	Sszi	23.5	33.3	66.6	80	-	33.3	-	-
Schouwia thebaica Webb.	Th	Ssz	20.6	-	-	20	28.6	-	66.6	-
Sclerocephalus arabicus Boiss.	Th	Ssz	8.8	-	66.6	-	14.3	-	-	-
Seddra latifolia Hochst.& Steud.	Ch	Sz	5.9	-	-	20	14.3	-	-	-
Seetzenia lanata (Willd.) Bullock.	H	Ssz	2.9	-	-	-	-	-	16.7	-
Senecio aegyptius L.	Th	End	2.9	33.3	-	-	-	-	-	-
Senecio flavus (Decne.) Sch. Bip.	Th	Ssm	11.8	-	-	40	-	-	33.3	-
Senecio hoggariensis Batt.& Trab.	Th	Ss	2.9	-	33.3	-	-	-	-	-
Senna alexandrina Mill.	Ch	Ssz	14.7	-	-	40	-	-	50	-
Senna italica Mill.	Ch	Ssz	52.9	100	100	80	14.3		66.6	42.9
Setaria verticillata (L.) P. Beauv.	Th	Med	8.8	100	-	-	-	-	-	-
Sida ovata Forssk	Ch	Pal	11.8	100	33.3	-	-	-	-	-
Silene linearis Decne.	Th	Ss	17.6	66.6	33.3	-	42.9	-	-	-
Silene villosa Forssk.	Th	Ss	5.9	33.3	-	-	14.3	-	-	-
Sisymbrium irio L.	Th	Cosm	17.6	33.3	66.6	40	14.3	-	-	-
Solanum forsskaolii Kotschy ex Dunel	Ch	Sz	14.7	66.6	33.3	40	-	-	-	-
Solanum incanum L.	Ch	Sz	2.9	-	33.3	-	-	-	-	-
Solanum nigrum L.	Ch	Cosm	5.9	66.6	-	-	-	-	-	-
Solanum unguiculatum A. Rich.	Th	Sz	8.8	100	-	-	-	-	-	-
Solenostemma arghel (Delile) Hayne	Ph	Ssz	8.8	-	-	-	-	-	33.3	14.3
Sorghum halepense (L.) Pers.	Th	Pan	5.9	-	33.3	-	-	-	16.7	-
Spergula fallaxa (Lowe) E. H. L. Krause	Th	Ssi	11.8	33.3	66.6	-	14.3	-	-	-
Stipagrostis ciliata (Desf.) de Winter	H	Ssz	2.9	-	-	-	-	-	-	14.3
Stipagrostis hirtgluma (Steud.ex Trin&Rupr.) de Winter	Th	Ssz	2.9	-	33.3	-	-	-	-	-
Stipagrostis plumosa (L.)Munro ex T. Anderson	H	Sszm	35.3	-	33.3	-	57.1	-	50	57.1
Stipagrostis raddiana (Savi) de Winter	H	Ssi	38.2	33.3	33.3	60	28.6	-	50	42.9
Tamarix aphylla (L.) H. Karst	Ph	Sszi	2.9	-	-	-	-	-	16.7	-
Tamarix nilotica (Ehrenb.) Bunge	Ph	Sszi	5.9	-	-	-	-	-	33.3	-
Tephrosia purpurea (L.) Pers subsp. *apollinea*	Ch	Ssz	41.2	100	100	80	28.6	-	33.3	-
Tephrosia purpurea (L.) Pers subsp. *purpurea*	Th	Ssz	2.9	-	-	20	-	-	-	-
Tephrosia nubica (Boiss.) Baker	Ch	Sz	8.8	66.6	-	20	-	-	-	-
Tragus berteronianus Schult.	Th	Ssz	35.3	33.3	100	40	85.7	-	-	-
Tribulus ochroleucus (Maire) Ozenda & Quezel	Th	Pan	14.7	-	-	-	14.3	-	50	14.3
Tribulus parvispinus Presl	Th	Ssz	5.9	-	-	-	28.6	-	-	-
Tribulus pentandrus Forssk.	Th	Ssz	23.5	-	33.3	-	14.3	33.3	33.3	14.3
Tribulus terrestris L.	Th	Pan	20.6	-	100	40	28.6	-	-	-
Trichodesma africanum (L.) R. Br.	Ch	Ssz	26.5	-	33.3	40	-	-	50	42.9
Trichodesma ehrenbergii Schweinf.	Th	Sz	32.4	66.6	66.6	60	28.6	-	16.7	14.3
Tricholaena teneriffae (L.f.) Link.	G	Sszm	8.8	100	-	-	-	-	-	-
Triraphis pumilio R.Br.	Th	Ssz	58.8	-	100	40	100	100	50	28.6
Triumfetta flavescens Hochst.ex A. Rich.	Ph	Ssz	14.7	100	33.3	20	-	-	-	-
Typha domingensis (Pers.) Poir & Steud.	Hy&H	Pan	2.9	-	-	-	-	-	16.7	-
Zilla spinosa (L.) Prantl	Ch	Ss	38.2	-	-	-	-	-	100	100
Ziziphus spina- christi (L.) Des.F.	Ph	Ssz	11.8	-	33.3	-	-	-	16.7	28.6
Zygophyllum coccineum L.	Ch	Ssz	5.9	-	-	-	-	33.3	16.7	-
Zygophyllum simplex L.	Th	Ssz	82.4	-	100	100	100	100	83.3	71.4

{Ph} = Phanerophytes, {Ch} = Chamaeophytes, {H} = Hemicryptophytes, {G} = Geophytes, {P} = Parasites, {S} = Succulents, {He} = Helophytes, {Hy} = Hydrophytes and {Th} = Therophytes. FC = Floristic Categories, Cosm = cosmopolitan, Pal = palaeotropical, Pan = pantropical, Med = Mediterreanean, Mit = Med + Irano-Turanian, Ss = Saharo-Sindian, Ssi = Saharo-Sindian + Irano-Turanian, Ssz = Saharo-Sindian + Sudano-Zambezian, Sszm = Saharo-Sindian + Sudano-Zambezian + Med + Irano-Turanian, Sz = Sudano-Zambezian, Misz = Med + Irano-Turanian + Sudano-Zambezian, Mits = Med + Irano-Turanian + Saharo-Sindian, Mssz = Med + Saharo-Sindian + Sudano-Zambezian, Ssm = Saharo-Sindian + Med, Szi = Sudano-Zambezian + Irano-Turanian and End = Endemic.

Table 3: Life spectra (%), species richness and species turnover of the seven vegetation clusters identified after application of TWINSPAN

Characters	Vegetation culsters(%) I	II	III	IV	V	VI	VII	Total
Phanerophytes	21.6	14.3	20.4	14.0	10.0	12.9	18.2	16.4
Chamaeophytes	24.1	22.7	25.5	22.0	16.0	18.5	22.1	23.9
Hemicryptophytes	12.9	14.3	16.3	18.0	14.0	18.5	22.1	15.9
Geophytes	4.3	1.7	2.0	3.0	8.0	1.8	5.2	3.4
Succulent	1.7	1.7	1.0	1.0	0.0	0.0	0.0	0.8
Hydrophytes & Helophytes	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.8
Parasites	0.0	0.8	0.0	0.0	2.0	1.8	0.0	1.3
Therophytes	35.3	44.5	34.7	42.0	50.0	44.4	32.5	37.4
Total species	116.0	119.0	98.0	100.0	50.0	108.0	77.0	238.0
Species richness	68.7	72.0	44.2	37.3	29.7	49.5	39.6	46.1
Species turnover	1.69	1.65	2.2	2.7	1.68	2.18	1.49	5.16

Table 4: The mean ± standard deviation of the soil variables of stands supporting the seven resulting after the application of Twinspan classification

Soil variables	Vegetation clusters I	II	III	IV	V	VI	VII	Total
Sand	85.9±3.4	88.0±2.7	88.3±1.0	88.0±3.6	87.3±2.2	85.7±1.3	88.5±1.0	87.40±1.15
Silt	2.4±2.3	0.8±0.4	1.0±0.6	1.0±1.2	0.4±0.4	1.8±1.3	1.3±0.5	1.24±0.67
Clay	11.4±1.3	10.3± 2.4	10.7±1.0	10.8±2.6	11.6±1.7	12.1±1.4	9.8±0.9	10.95±0.79
pH	7.6±0.2	7.7±0.2	7.5±0.3	7.6±0.1	7.7±0.3	7.5±0.3	7.7±0.3	7.60±0.09
EC (μmoh/cm)	195.0±210	137.7±53.5	134.2±53	118.7±49.8	179.0±120.6	423.0±675	122.6±19.2	187.2±107.9
Cl (mg/100gm)	7.9±6.1	4.1±0.2	4.9±2.4	4.5±0.6	8.8±9.5	28.7±58.6	4.6±0.6	9.07±8.85
HCO3 (mg/100gm)	14.1±10.5	12.4±3.9	11.4±2.3	10.3±2.4	17.8±0.8	14.0±6.8	12.7±1.2	13.24±2.4
Ca (mg/100gm)	7.5±8.4	5.9±2.3	5.1±2.1	4.4±2.0	5.7±2.1	6.1±2.8	5.2±0.9	5.70±0.98
Mg (mg/100gm)	2.5±2.3	1.4±0.3	1.3±0.8	1.4±0.9	1.7±0.8	1.1±0.8	1.4±0.7	1.54±0.46
Organic matter (%)	1.3±1.1	0.4±0.2	0.5±0.2	0.7±0.7	0.4±0.2	0.5±0.1	0.5±0.1	0.61±0.32

Table 5: Correlations coefficients between soil variables and DCA axes 1 and axes 2

Soil variables	Axis1	Axis2
Sand	-0.024	-0.144
Silt	0.474	-0.357
Clay	-0.366	0.238
Organic matter (%)	0.481	-0.344
pH	-0.013	0.863**
EC(μ moh/cm)	-0.390	-0.004
Cl (mg/100gm)	-0.501	-0.037
HCO3 (mg/100gm)	-0.233	0.684*
Ca (mg/100gm)	0.269	-0.016
Mg (mg/100gm)	0.599	0.201

* = P < 0.05; ** = P < 0.01; *** = P < 0.001

(the presence percentage≥ 50%) are *Zygophyllum simplex, Aristida mutabilis, Lotononis platycarpa, Aizoon canariense, Caylusea hexagyna, Triraphis pumilio, Euphorbia granulata* and *Amaranthus graecizans*. Other common annuals species *Astragalus vogelii, Tribulus pentandrus, Tragus berteronianus, Eragrostis cilianensis, Peristrophe paniculata, Trichodesma ehrenbergii, Kohautia caespitosa, Chenopodium murale, Aristida funiculata, Coelachyrum brevifolium, Cleome amblyocarpa, Astragalus eremophilus, Cotula cinerea, Lotus glinoides, Ifloga spicata* and *Arnebia hispidissima* (the presence percentage is 25-50).

The classification of stands according to the Twinspan technique resulted in 8 vegetation clusters at level 4 and 7 clusters at level 3 of the hierarchy. The 7 clusters of level 3 are named after the dominant species as follows: *Indigofera spinosa-Cocculus pendulus-Peristrophe paniculata-Cucumis prophetarum-Convolulus hystrix* (I) *Chenopodium murale* (II) *Zygpohyllum simplex* (III) *Coelachyrum brevifolium-Cleome amblyocarpa* (IV) on the Elba mountains. *Salsola imbricata* (V) along the sides of Abu Ramad. *Robbairea delileana* (VI) in northern parts of Abraq and Hoddein while *Heliotropium bacciferum* (VII) in upstream parts of wadi Allaqi (Wadi Nassari) and southern part of Abraq area (Fig. 1).

The application of the detrended correspondance analysis (DCA) to the same set of stands indicated clear gradients of soil moisture along axis 1(Fig. 1). The stands of clusters I, II, III and IV occupy the right part of axis 1 and the stands of cluster V, VI and VII occupy the left part of the same axis.

The most frequent life forms are the chamaephytes (23.9%) and therophytes (37.4%) (Table 3). The percentages of these two life forms vary considerably from one cluster to the other. The chamaephytes attains a maximum of 25.5% in the cluster III and a minimum of 16 % in cluster V. On the other hand, the therophytes have the highest value in cluster V (50%) and the lowest in the cluster III (34.7%). *Orobanche ramosa* and *Cistanche phyleapea* are the only parasitic species recorded in this study.

The highest species richness is that of cluster II (72 species/stand), followed by cluster I (68.7 species/stand). On the other hand, cluster V has the lowest species richness (29.7 species/stand).

The soil variables that correlate positively with axis 2 are pH (r = 0.863) and HCO_3 (r = 0.684). The sand is highest in cluster VII (88.51%) and lowest in cluster VI (85.73%) (Table 5). The silt attains highest averages in cluster I (2.4 %) and lowest in cluster V (0.41%). The clay attains highest values in cluster VI (12.1) and lowest in cluster VII (9.84). pH value attains a minimum in cluster VI (7.5) and a maximum in cluster VII (7.74). EC has a maximum in cluster VII (423μmohs/cm) and a minimum in cluster IV (118.7μmohs/cm). The chloride concentration attains highest in cluster VI (28.7mg/100gm) and lowest in cluster II (4.09mg/100mg). The HCO_3 concentration attains highest values in clusters V (17.83mg/100gm) and lowest in cluster IV (10.27mg/100gm). The high content of Ca has a maximum in cluster I (7.52mg/100mg) a minimum in cluster IV (4.4mg/100gm). The Mg content attains highest concentration in cluster I (2.53mg/100mg) and lowest in cluster VI (1.1mg/100gm). The percentage values of organic matter attains highest in cluster I (1.34%) and lowest in cluster VI (0.35%) (Table 4).

Discussion

According to Takhtajan (1969), northern Egypt belongs to the Mediterranean region of the Holarctic kingdom and middle and southern Egypt belong to the Saharo-Sindian region of the Palaeotropical kingdom. Momad (1939,1957); Quezel (1965,1978); Wickens (1984) and Shmida (1985), consider the Saharo-Sindian region to be partially belonging to the Holarctic and Palaetropical kingdoms. Eig (1931), Zohary (1962); Davis and Hedge (1971) and Wickens (1976,1984) believe that the Saharo-Sindian flora has been derived from Mediterranean, Sudanian and to a lesser extent Irano-Turanian elements. The flora of the present study lies in the Saharo-Sindian region and is bounded by the Sudano-Zambezian region. In this study the area was found to be 61.3% dominated by Saharo-Sindian species, 12.2% Sudano-Zambezian, 10.5% Pluri-regional, 2.5% Mediterranean, 6.7% Pantropical, 2.9% Palaeotropical, 2.9% Cosmopolitan and 0.8% Endemic. This is more or less in agreement with Ozenda (1958) who found that 47% of the species in central Sahara are Saharo-Sindian species, 29.5% Sudano-Zambezian, 4% Mediterranean, 13.3% Pluriregional, 3% Cosmopolitan, 3.6% Palaeotropical, 4.8% Pantropical and 1.8% Endemic species.

The floristic elements of the study area comprises 240 species. The majority of these species (238) belong to Angiospermae, the other two species(Mushroom and Chara) are belonging to Gymnospermae. A total number of species 238 Angiospermae belonging to 54 families and 155 genera. The most represented families were Graminae (14.29%), Leguminosae (11.76%), Compositae (9.2%), Cruciferae (4.6%), Zygophyllaceae (4.2%), Euphorbiaceae (3.4%), Boraginaceae (3.4%) and Asclepidaceae (2.9%).

This study distinguishes seven clusters at level 3 of the 30 hierarchy that are named after the dominant species as follows: *Indigofera spinosa--Cocculus pendulus-Peristrophe paniculata-Cucumis prophetarum Convolulus hystrix-Chenopodium murale-Zygpohyllum simplex-Coelachyrum brevifolium-Cleome amblyocarpa-Salsola imbricata-Robbairea delileana* and *Heliotropium bacciferum*. All these clusters have analogues in the southern eastern desert (Kassas and Girgis, 1969; El- Sharkawi *et al.*, 1982, 1987; Salama *et al.*, 1989; Ali *et al.*, 1998; Springuel *et al.*, 1991, 1997).

The list of species recorded in the present study indicates that the

common perennials are *Acacia tortilis* subsp. *raddiana, Aerva javanica, Panicum turgidum, Acacia tortilis* subsp. *tortilis, Polycarpaea repens, Fagonia indica, Launaea cassiniana, Forsskaolea tenacissima, Lycium shawii, Senna italica,* are considered the most common species. Other common perennials are *Crotalaria aegyptiaca, Zilla spinosa, Acacia ehrenbergiana, Stipagrostis plumosa, Launaea capitata, Pulicaria incisa, Pulicaria crispa, Stipagrostis raddiana, Citrullus colocynthis, Calotropis procera, Ochradenus baccatus, Polycarpaea robbairea, Leptadenia pyrotechnica, Maerua crassifolia, Chrozophora oblongifolia, Heliotropium pterocarpum, Farsetia longisiliqua, Abutilon pannosum, Tephrosia purpurea* subsp. *apollinea, Indigofera spinosa, Cucumis prophetarum.* The most common annuals species are *Zygophyllum simplex, Aristida mutabilis, Lotononis platycarpa, Aizoon canariense, Caylusea hexagyna, Triraphis pumilio, Euphorbia granulata* and *Amaranthus graecizans.* Other common annuals species *Astragalus vogelii, Tragus berteronianus, Eragrostis cilianensis, Trichodesma ehrenbergii, Kohautia caespitosa, Coelachyrum brevifolium, Cleome amblyocarpa, Astragalus eremophilus, Cotula cinerea, Ifloga spicata* and *Arnebia hispidissima.*

These species were recorded by Kassas and Girgis (1964) and Springuel *et al.* (1991,1997), Sheded (1992,1998) as abundant members of many communities in the wadis of eastern desert.

The most frequent life forms are the chamaephytes (23.9%) and therophytes (37.4%) (Table 3). The percentages of these two life forms vary considerably from one cluster to the other. The chamaephytes attains a maximum of 25.5% in the cluster III and a minimum of 16% in cluster V. On the other hand, the therophytes have the highest value in cluster V (50%) and the lowest in the cluster III (34.7%). *Orobanche ramosa* and *Cistanche phyleapea* are the only parasitic species recorded in the present study. The highest species richness is that of cluster II (72 species/stand), followed by cluster I (68.7 species/stand). On the other hand, cluster V has the lowest species richness (29.7 species/stand).

The life form spectra in the study area express a typical desert flora, the majority of species are therophytes and chamaephytes. The life form of desert plants is closely related with rainfall, topography and landform (Kassas and Girgis, 1965; Zohary, 1973; Orshan, 1986).

The species richness is higher in clusters I, II, III and IV than clusters V, VI and VII may be because the habitat of former clusters characterized by orographic precipitation which predominates in the study clusters and supplies the summits, cliffs and the mountains and is then transported to the upstream tributaries of the wadi systems (Kassas, 1953 a, b, 1956, 1960. Kassas and Girgis, 1964, 1970). Precipitation is correlated with elevations (Migahid *et al.*, 1959; Danin, 1983) or bounded by basement rocks and is characterized high properties of coarse and fine particles between the boulders and soil pockets where water collects (Danin, 1983).

Danin and Orshan (1990) pointed out that the life-form patterns of desert plants correlates mainly with rainfall. Life-form distribution of desert plants is also very closely correlated with topography and landform (Kassas and Girgis, 1965; Orshan, 1986; Zohary, 1973). The present study distinguishes five life-forms in the study area: phanerophytes, chamaeophytes, hemicryptophytes, parasites and theropytes . The habitat of the mountains is the richest in floristic composition, followed by northern slopes of Abraq and Hoddein. This is because the mountains are characterized by more orographic precipitation, wadifilling materials, sediments and high proportion of gravel and fine grains between the boulders and soil pockets. These conditions support the growth of some annual species in pockets, of semishrubs in the downstream parts and of trees on the top.

The slope habitats especially those resulted from gullies on the tops of mountains or the slopes of depressions, in favourable for the growth of subshrubs and annual species. The depressions play a great role in regulating moisture availability to plants (Kassas and Girgis, 1965, 1970). On the other hand, the ridge at low elevations is the driest. It is dominated by only two types of life-forms, chamaeophytes and hemicryptophytes. The habitat of smooth faced granite outcrops and terraces with rocky surface support a sparse vegetation composed mainly of a very few number of annuals. This is due to the shallow soil cover inadequate to support plant growth. Phanerophytes occur in gorges especially in elevated and shaded crevices, where it can receive more rainfall (Danin and Orshan, 1990).

Acknowledgment

The author wishes to express his thanks to Prof. Dr. K. H. Shaltout, Botany Department, Faculty of Science, Tanta University for reading and revising the manuscript.

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