



Plant Communities and Floristic Composition of the Vegetation of Wadi Al-Assiuty and Wadi Habib in the Eastern Desert, Egypt

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Abstract

Torrential rains (in January 2011) that have swept a limited area in the Eastern Desert, facing Assiut Province (Upper Egypt), resulted in enriching the vegetation in Wadi Al-Assiuty and its tributary Wadi Habib. Vegetation survey carried out shortly after this event (in May) revealed the prevalence of annuals which are hardly recognizable in such usually dry habitats. The normally scarce perennial vegetation has flourished. A total of 66 plant species, 33 perennials and 33 annuals, belonging to 53 genera from 22 different families were recorded. Therophytes are the predominant life form (50%) followed by chamaephytes (21%), phanerophytes (15%), hemicryptophytes (11%) and geophytes (3%). Chorological analysis revealed that Saharo-Arabian (81.8%) constitute the main bulk of the total flora of the studied area. The majority of the perennial species behave similarly to each other in their phenology, and usually perennials sprout at the end of February, become leafy in March, flower in April and produce fruits between April and July. The investigation revealed that the wadis studied are potential shelters of four vegetation groups. Twenty two of the recorded species (33.3%) are omnipresent and had a dominant degree of occurrence (Q-value ≥ 0.2). The highest among others were *Zilla spinosa* and *Zygophyllum coccineum* which recorded in 86% and 88% respectively of the studied stands and spread their dominancy all over the Eastern Desert of Egypt.

Keywords: chorology, cluster analysis, life forms, phenology, phytosociology

Introduction

The Eastern Desert of Egypt extends between the Nile Valley and the Red Sea. It is traversed by numerous canyonlike depressions (wadis) running to the Red Sea or to the Nile Valley. Wadi Al-Assiuty is one of the most notable features of the Egyptian Eastern Desert. It is the largest and greatest dry valley which runs in Sahara desert for a distance of about 115 km. Its width varies from 5 to 25 km. Although this wadi is generally dry all over the year, some seasonal rainfall is experienced in winter time, which may occasionally become torrential in autumn and spring times.

From the early beginnings of the last century, the Eastern Desert was studied botanically by different researchers: Schweinfurth (1901), Montasir (1938), Hassib (1951), Girgis (1965), Kassas (1953 a,b), Hassan (1987), Salama and Fayed (1989, 1990), Salama and El-Naggar (1991), Abd El-Ghani (1998) and Hassan (2003), Salama *et al.* (2012, 2013). Except that of Hassan (1987), most of the previous studies dealt with the different ecological aspect, with less attention to the floristic features of this desert.

The main trunk of wadi Al-Assiuty has an east-west orientation extending between latitude $27^{\circ}10'$ and $27^{\circ}20'$ N. Its tributaries cover an area between longitudes $31^{\circ}16'$ and $31^{\circ}50'$ E (Fig. 1). The main wadis, which debouch their water in wadi Al-Assiuty are: wadi Hubara, wadi Qird El-Farr from north and wadi Marahil, wadi Habib from the south (Said, 1962; Abu Al-Izz, 1971). Due to the variety of chances of water feeding of the tributaries of Wadi Al-

Assiuty originating in the mountain range of Red Sea and pouring their flood waters into its principle channels, difference in floral characteristics and vegetation composition are something expectable. Kassas and Girgis (1972) studied the ecology of Wadi Al-Assiuty among other wadis in the region between latitude 27°30' and 25°30' N. Abd El-Wahab (1963) studied the Autecology of *Leptadenia pyrotechnica* in wadi Al-Assiuty. Migahid *et al.* (1972) and Batanouny (1973) investigated Eco-Phsiological characters of desert plants in Wadi Al-Assiuty. El-Khatib (1993) studied the ecophysiology and palynology of the vegetation of wadi Al-Assiuty and Wadi Qena based on recent floristic investigations by the author.

Phenological studies provide information on functional rhythms of plants and plant communities (Ralhan *et al.*, 1985). Moreover, various phenological events may be timed to biotic and/or abiotic environmental conditions (Estabrook *et al.*, 1982; Lee, 1971). It was also reported by Nilsen (1981) that desert plants exhibit phenologies that are closely related to moisture availability and temperature, as well as photoperiod and nutrient input (Abdel- Razik, 1980). The phenological cycles may represent physiological and morphological adaptations by species to utilize resources (Kemp and Gardetto, 1982; Salama *et al.*, 2012).

In last decades, Wadi Al-Assiuty was affected by human activities including; cultivation of the deltaic part, the intensive collection of plant species for its values (medicinal, fuel, fiber etc.), establishment of new Assiut city, new high ways, farms and others. These activities affect the natural flora and changing the distribution of plants in Wadi Al-Assiuty. This means great changes in the distribution, species richness and extinction of the floristic composition of Wadi Al-Assiuty.

Torrential rains (in January 2011) that had suddenly swept a limited area in the Eastern Desert facing Assiut Province (Upper Egypt) resulted in enriching the vegetation of some extremely dry wadis at this location. This leads to the prevalence of annuals and the flourishing of the scarced perennial vegetation (El-Sharkawi *et al.*, 1982 a, b; Salama *et al.*, 2013). It is worthy to mention that the last torrent sudden in this wadi was at 1994. This reflects the high aridity in the studied wadis.

Such an event was the inspiration to carry out this study with the aim of recognizing the potential of natural vegetation in the wadis as a result of an unexpected water supply. The plant communities and its associated species were investigated. This study deals with analyses of floristic composition, life forms, phenology, chorological spectrum, and analyses the vegetation inhabiting the deltaic part and the principal channel of Wadi Al-Assiuty and Wadi Habib.

Materials and methods

Wadi Al-Assiuty is easily traversable by vehicle. The study was carried on two successive years: 2011-2012. The studied stands were randomly chosen at locations where considerable vegetation cover was encountered. Based on presence/absence of each species, 50 stands were studied in the deltaic part, and along the main trunk of the Wadi Al-Assiuty and Wadi Habib, and geo-referenced using GPS technique (Fig. 1). Meteorological data obtained from the Assiut University station at Assiut, through the last ten years (2003 to 2012) showed the temperature is regular in its seasonality. The average lowest minimum temperature through the last ten years is 8 °C recorded in January and the average highest maximum temperature is 39 °C recorded in June. The highest mean relative humidity in the study area is 50% recorded in December and the lowest mean is 24% recorded in May.

Ten species were selected randomly to study their phenological characteristics through one year, from January

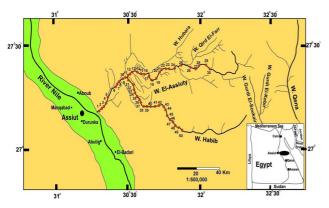


Fig. 1. Location map of Wadi Al-Assiuty and Wadi Habib in the Eastern Desert of Egypt; the stands are given by their numbers

2012 to December 2012. The species were Acacia niotica, Acacia raddiana, Calotropis procera, Datura innoxia, Leptadenia pyrotechnica, Ochradinus baccatus, Tamarix aphylla, Tamarix nilotica, Zizyphus spina-christi and Zygophyllum coccineum. Four phenophases were distinguished: vegetative, flowering, fruiting and seed dispersal and were recorded monthly. The recorded species are classified according to their life forms (Hassib, 1951; Raunkiaer, 1937). The number of species within each life form is expressed as a percentage of the total number of species in the study area. Plant specimens collected were identified and deposited at the herbarium of the Botany Department of Assiut University. Identifications were done according to Täckholm (1974) and Boulos (1995, 1999, 2000). Duplicates were checked for identification and deposited at the Cairo University Herbarium. Analysis of phytogeographical ranges was carried out according to Zohary (1966, 1972, 1973), Abd El-Ghani (1981) and Hassan (1987). A floristic data matrix of 50 stands and 66 species was subjected to classification by cluster analysis of the program Community Analysis Package (CAP) version 1.2 (Henderson and Seaby, 1999) using squared Euclidean distance dissimilarity matrix with minimum variance (also called Ward's method) as agglomeration criterion (Orlóci, 1978).

Results and discussion

Floristic composition

The floristic composition of the species showed that 66 plant species were recorded in Wadi El-Assiuty and Wadi Habib. They include 33 perennials and 33 annuals, belonging to 53 genera from 22 different families (Tab. 1). The largest family was Asteraceae, which included 11 genera and 14 species. Six of them were perennials and the others were annuals (Tab. 1). The second family was Chenopodiaceae with six genera and eight species. Four of them were annuals and four were perennials. Brassicaceae, Boraginaceae and Zygophyllaceae had the same number of the recorded species (five for each). Family Brassicaceae included one perennial and four annuals. Family Boraginaceae have two perennial and three annuals. Family Zygophyllaceae included four perennials and one annual. Two genera and four species were recorded for family Fabaceae. Three of them were annuals and one was perennial. Four species were recorded as members of the Poaceae family. They were included in four genera. All of them were perennials except Avena sterilis, which was annual. For each of the Malvaceae, Polygonaceae, Resedaceae, Solanaceae, Mimosaceae, Tamaricaceae families two (for each) species were recorded. One genera belonged to family Tamaricaceae, was represented by two perennial species, Tamarix aphylla and Tamarix nilotica. One genera belonged to Mimosaceae family represented by two perennial species: Acacia nilotica and Acacia tortilis. The other families were represented by only one species, each. The largest genera were: Astragalus, Fagonia and Pulicaria, which include three species. Six genera, represented by two species: Launaea, Helliotropium, Chenopodium, Bassia, Acacia and Zygophyllum. Other genera were represented by one species, each (Tab. 1).

198 Life

Life form

Fig. 2 shows the life forms of the recorded plant species according to Raunkiaer (1937). The total number of species in the study area was 66, which belong to five different life forms. Therophytes (50%) constitute the largest number of species (33 species). Chamaephytes had 21% including 14 species. Phanerophytes have 10 species represent about 15% of the flora. Hemicryptophytes represent about 7 % of the flora including 11 species. Geophytes (3%) are represented by two species; *Cynodon dactylon* and *Panicum turgidum*.

Chorological affinities

Results of the total chorological analysis of the surveyed flora presented in Fig. 2 revealed that 28 species belonging to monoregional region representing 42.4% of the total recorded species. There were 26 species recorded as Saharo-Arabian species (39%); while Hibiscus trionum belonging to Irano-Turanian region (2%) and Ammi majus belonging to Mediterranian region (2%). A total of 28 species are biregional elements representing 42.4% of the recorded species. It comprises the following four regions as followes: nine species belonging to the Saharo-Arabian, Sudano-Zambezian regions representing 14% of the recorded species. Mediterranian, Irano-Turanian regions, represented by five species, formed 8 % of the recorded species. Ten species, belonging to the Saharo-Arabian, Irano-Turanian regions represented 15% of the recorded species. Four species belonging to the Saharo-Arabian, Mediterranian region consist 6% of the recorded species. A total of five species (7.6% of the recorded species) are Pluri-regional taxa of wide geographical range. They were as follows: Centaurea calcitrapa, Imperata cylinderica, Matthiola longipetala, Tamarix aphyllaand Tamarix nilotica. Cynodon dactlyon is the only species representing pantropic floristic region. Four species were recorded as cosmopolitan taxa comprising 6.1% of the recorded species.

Species distribution pattern

Data of Tab. 1 revealed that four of the recorded species are omnipresent. Zygophyllum coccineum has presence value equal 88% and recorded in 44 studied stands in the study area. Zilla spinosa was recorded in 43 stands of 50 studied stands giving presence value 86%. Calligonum polygonoides has presence value 74% and recorded in 37 stands. Cornulaca monacantha was recorded in 35 stands giving presence value 70%. On the other hand, Matthiola longipetala, Atriplex halimus and Cotula cinarea showed the highest presence estimated among annuals (P=68%, 60% and 56%) respectively. Matthiola longipetala appeared in 34 stands, where Atriplex halimus appeared in 30 stands and Cotula cinarea was detected in 28 stands. Artemisia judaica and Eremobium aegyptiacum appeared in 27 stands giving P=54%. Diplotaxis acris and Tamarix nilotica recorded in 26 stands (P=52%). Fagonia arabica and Bassia indica presented in 23 stands (P=46%). 33 species or about 50% of the total recorded species are perennials, demonstrated a constant degree of constancy, while the other 33 species, 50% of the total recorded species, are annuals most of them recorded after 2011 rainfall. The presence of Tamarix aphylla, Tamarix nilotica, Salsola imbricata and Atriplex halimus refers to salinization.

Phenological pattern

As shown in Fig. 3, *Acacia nilotica* started the vegetative growth from July to October. Flowering is in October to December period. The plant began fruiting in January to 'May. In about six months from January to June, *Tamarix aphylla* completes its vegetative growth. Flowering occurs in two months; July and August. Fruiting takes two months also; September and October. Finally seed dispersal occurs in November and December. *Tamarix nilotica* grows vegetatively from March to August. Flowering occurs in two months; November and December, seed dispersal in January and February. *Zizyphus spina-christi* grows vegetative from August to September. Flowering starts in October to mid of November. Fruiting starts in late of

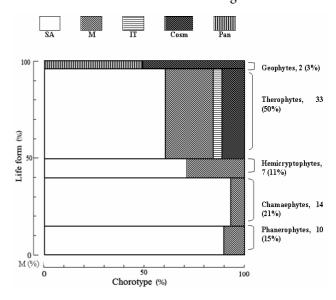


Fig. 2. Chorotype spectrum and life forms diagram of the study area. SA=Saharo Arabian, M= Mediterranean, IT= Irano Toranian, Cosm = Cosmopolitan, Pan= Pantropic (Kürschner, 1986)

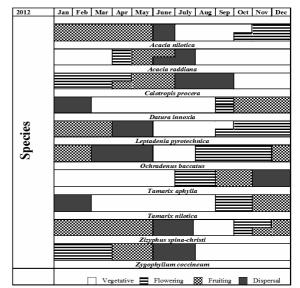


Fig. 3. Phenological spectrum of selected ten species from the study area of wadi El-Assuity during 2012

November to May. Seed dispersal occurs in June and July. *Zygophyllum coccineum* starts its vegetative growth from August to December. Flowering occurs from January to March. Fruiting takes two months, from April to May. Seed dispersal occurs after fruiting and lasts to July.

Species Occurrence

The recorded plants were categorized according to the Q values (Tab. 1) as dominant species: twenty two of the recorded species (33.3%) are omnipresent had a dominant degree of occurrence (Q-value ≥ 0.2). Q values ranged between 0.88 - 0.20. Very common species: the very common species generally had Q values ranged between 0.1-0.199. In this study, twelve species were recorded belonging to this range (17.9% of the recorded species Q=0.10-0.18). Common species: according to Q value calculation (Q value ranged between 0.05–0.099) there were 5 common species. Helliotropium bacciferum, Kickxia aegyptiaca, Schouwia purpurea and Trigonella stellata were collected from four stands (Q=0.08), while Astragalus vogelii were collected from three stands (Q=0.06). Q value ranged between 0.08-0.06. Occasional species: most of the recorded species (28 species, 41.8% of total species number) were represented according to Q value as occasional (Q value ranged between 0.01-0.05). These plants had presence value was about 4% (Q=0.04), while Acacia nilotica, Achillea fragrantissima, Amberboa lippii, Ammi majus, Arnebia hispidissima, Astragalus hamosus, Astragalus sieberi, Avena sterilis, Calotropis procera, Chenopodium ambrosioides, Cynodon dactylon, Datura innoxia, Echium rauwolfii, Hibiscus trionum, Hyoscyamus muticus, Ifloga spicata, Imperata cylinderica, Lactuca serriola, Panicum turgidum and Zizyphus spina-christi were recorded in one stands (P=2% and Q=0.02). The sporadic species (Q-value ≤ 0.01) were not represented in this work.

Vegetation structure (Classification of vegetation)

Application of classification using cluster analysis to the floristic data of Wadi El-Assuity yielded four vegetation groups (Fig. 4). Most of the groups (A) and (B) stands were confined to the main trunk of Wadi El-Assuity, while those of groups (C) and (D) were belonging to the Wadi El-Assuity tributary (Wadi Habib). The Artemisia judaica, Bassia indica, Cotula cinerea, Diplotaxis acris, Eremobium Fagonia arabic, Launaea nudicaulis, aegyptiacum, Leptadenia pyrotechnica, Matthiola longipetala, Pulicaria undulate, Salsola imbricate, Senecio glaucus, Tamarix Zilla *spinosa*and nilotica, Trichodesma africanum, Zygophyllum coccineum were recorded with variable presence values in the four groups.

Group (A): Senecio glaucus-Zygophyllum coccineum group; this vegetation group comprised of 39 species recorded from 6 stands (Tab. 2). Sporadic species (species recorded in one stand only; P (presence value)=17%) were represented by 18 species or about 46.2% of the recorded species in this group and they were; Acacia nilotica, Achillea fragrantissima, Ammi majus, Anabasis setifera, Artemisia judaica, Calotropis procera, Cynodon dactylon, Datura innoxia, Fagonia arabica, Hibiscus trionum, Hyoscyamus muticus, Imperata cylinderica, Launaea amal-aminae, Ochradinus baccatus, Oligomeris linifolia, Rumex vesicarius, Trichodesma africanum and Zizyphus spina-christi. While Launaea nudicaulis and Tamarix nilotica show codominance with a presence value 67% (were represented by two species or about 5.1% of the recorded species in this group) (Tab. 2). The 12 species represent 30.8% of this group plants: Acacia nilotica, Achillea fragrantissima, Ammi majus, Calotropis procera, Chenopodium murale, Cynodon dactylon, Datura innoxia, Hibiscus trionum, Hyoscyamus muticus, Imperata cylinderica, Zizyphus spina-christi and Zygophyllum simplex had a degree of fidelity to this community.

Group (B): Zilla spinosa-Zygophyllum coccineum group. It comprised of 49 species recorded in 14stands (Tab. 2). The 24 sporadic species (49% of the recorded species in this group; P=7-14%) were: Acacia tortilis, Amberboa lippii,, Anabasis setifera, Arnebia hispidissima, Astragalus hamosus, Avena sterilis, Centaurea calcitrapa, Chenopodium ambrosioides, Cleome amblyocera, Echium rauwolfii, Helliotropium bacciferum, Ifloga spicat, Kickxia aegyptiaca, Lactuca serriola, Leptadenia pyrotechnica, Pulicaria incis, Schouwia purpurea, Artemisia judaica, Fagonia bruguieri,

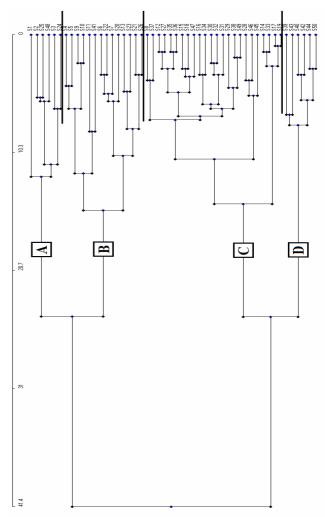


Fig. 4. Dendrogram showing cluster analysis of the studied 50 stands with the 4 vegetation groups (A-D) in Wadi El-Assuity and Wadi Habib

Sonchus Launaea nudicaulis, Monsonia nivea, oleraceus, Tamarix aphylla Tamarix nilotica. and WhileDiplotaxis acris (P=93%), Fagonia arabica (P=86%), Atriplex halimus (P=86%), Cornulaca monacantha (P=86%), Cotula cinerea (P=71%), Matthiola longipetala (P=71%), Senecio glaucus (P=71%), Rumex vesicarius (P=71%), Salsola imbricate (P=64%) represented as codominance species (18.4% of this group species). The following 10 species (20.4% of plants in this group) showed a degree of fidelity to this community and they were; Amberboa lippii, Arnebia hispidissima, Astragalus hamosus, Astragalus vogelii, Avena sterilis, Chenopodium ambrosioides, Echium rauwolfii, Ifloga spicata, Lactuca serriola and Monsonia nivea.

Group (C): Calligonum polygonoides-Zilla spinosa group. The species belonging to this group were 33 species in 24 stands (Tab. 2) with $1\overline{7}$ sporadic species (about $\overline{5}1.5\%$ of the recorded species in this group; \hat{P} =4-17%) and they were Bassia muricata, Pulicaria arabica, Trichodesma africanum, Centaurea calcitrapa, Helliotropium bacciferum, Tamarix aphylla, Senecio glaucus, Pulicaria incise, Launaea nudicaulis, Launaea amal-aminae, Salsola imbricate, Malva parviflora, Oligomeris linifolia, Ochradinus baccatus, Acacia tortilis, Paronychia arabica, and Panicum turgidum. The codominance species were 7 species represent 21.2% of plant in this group (P=63-88%). They were Zilla spinosa, Zygophyllum coccineum, Eremobium aegyptiacum, Artemisia judaica, Cornulaca monacantha, Matthiola longipetala and Tamarix nilotica. Only Panicum turgidum showed a degree of fidelity.

Group (D): Artemisia judaica-Matthiola longipetala group. This vegetation group comprised of 31 species recorded from six stands (Tab. 2). This group included five characteristic species: Zilla spinosa, Atriplex halimus, Calligonum polygonoides and Pulicaria incisahad the dominance degree (P=100%) with Artemisia judaica and Matthiola longipetala. Sporadic species (species recorded in one stand only; P=17%) were represented by six species or about 19.4% of the recorded species in this group: Astragalus sieberi, Cleome amblyocera, Fagonia arabica, Launaea nudicaulis, Trichodesma africanum and Trigonella stellate. The co-dominant species were represented by 11 species with 35.5% of plant in this group. Seven species had presence value of 83% (Bassia indica, Centaurea calcitrapa, Cornulaca monacantha, Fagonia bruguieri, Leptadenia pyrotechnica, *Tamarix nilotica* and *Zygophyllum coccineum*); four species had presence value 67% (Diplotaxis acris, Pulicaria undulate, Rumx vesicarius and Salsola imbricate). Two species Astragalus sieberi and Helliotropium digynum had a presence value of 17%, 33% with fidelity of degree.

The present study comprises an ecological survey in Wadi Al-Assiuty and its tributary Wadi Habib in the Eastern Desert of Egypt. The impact of extreme aridity and the scanty rains in Wadi Al-Assiuty and its tributaries is quite clear from the poverty of species encountered. The plant species collected from the study area of Wadi Al-Assiuty included 66 species, 33 perennials and 33 annuals, belonging to 53 genera from 22 different families. Most of the collected annuals were recorded after 2011 rainfalls. The largest family was Asteraceae which represented by 14 species (21.2% of the recorded species), followed by family Chenopodiaceae which represented by eight species (12.1%). It may be noted that the deltaic part of Wadi Al-Assiuty and a great part of its main course are parts of a great bay fringing the Nile Valley. The near of underground water reservoir from the surface in this area, at depth 2-5 m (Kassas and Girgis, 1972) is obviously an important source of water for plants with deep roots (perennials).

Taking into account the Q-values of the recorded species, twenty two of the recorded species (33.3%) are omnipresent and had a dominant degree of occurrence (Qvalue ≥ 0.2). Q values ranged between 0.88-0.20 (Tab. 1). The highest among others were Zilla spinosa and Zygophyllum coccineum which recorded in 86% and 88% respectively of the studied stands and spread their dominancy all over the Eastern Desert of Egypt. Their dominance over the communities of the Eastern Desert was documented by many scientists: Montasir (1938), Hassib (1951), Kassas and İmam (1954), Kassas and El-Abyad (1962), Kassas and Girgis (1964), Salama and El-Naggar (1991), Abd El-Ghani (1998) and Galal and Fahmy (2012). Fossati et al. (1998) recorded Zilla spinosa and Zygophyllum coccineum and indicated their wide range of distribution, often on fine calcareous neutral or alkaline substratum. The remaining dominant species showed a regional dominancy over certain sectors. The very common species generally had Q values ranged between 0.1-0.199. In this study, twelve species were recorded belonging to this range (17.9% of the recorded species Q=0.10-0.18). According to Q value calculation (Q value ranged between 0.05-0.099) there were five common species. Helliotropium bacciferum, Kickxia aegyptiaca, Schouwia purpurea and Trigonella stellata were collected from four stands (P=8%; Q=0.08), while Astragalus vogelii were collected from three stands (P=6%; Q=0.06). Q value ranged between 0.08-0.06. Occasional species were represented by 28 species such as Acacia nilotica, Achillea fragrantissima, Amberboa lippii, Ammi majus, Arnebia hispidissima, Astragalus hamosus, Astragalus sieberi, sterilis, Calotropis procera, Chenopodium Avena ambrosioides, Cynodon dactylon, Datura innoxia, Echium rauwolfii, Hibiscus trionum, Hyoscyamus muticus, Ifloga spicata, Imperata cylinderica, Lactuca serriola, Panicum turgidum and Zizyphus spina-christi were in one stands (P=2% and Q=0.02). The sporadic species (Q-value ≤ 0.01) were not represented in this work. Zygophyllum coccineum, Zilla spinosa and Calligonum polygonoides have the highest presence values in Wadi Al-Assiuty. The same species were identified in other wadis in the Eastern Desert as members of the alliance Zygophyllaeion (Salama and Fayed, 1990). Calligonum polygonoides has an analogue and previously recognized in Wadi El-Miyah (El-Sharkawi et al., 1982b). Salama and Fayed (1989) recognized Zilla spinosa and Salsola imbricata in one community in Wadi Barramiya. Zilla spinosa has also been recorded in the wadi system west of Qusseir province (Salama and El-Naggar, 1991); Wadi El-Matuli, Wadi Gimal, Wadi Qassab (El-Sharkawi et al., 1982a, 1982b, 1984) Wadi Kherit and Wadi El-Ghuza (El-Sharkawi et al., 1987, 1988). The 33 collected annual species (50% of total flora) in the present study may be

200

Tab. 1. Species composition of the study area classified according to the different families, together with their presence values (P%), chorology and occurrences. Choro=Chorology (SA=Saharo-Arabian, SZ=Sudano-Zambezian, M=Mediterranean, IT=Irano-Turanian, Cosm=Cosmopolitan, Pan=Pantropical). Q=Occurrence (D=Dominant, VC=Very common, C=Common, O=Occasional, S=Sporadic); L.F.=Life forms (Th: Therophytes, He: Hemicryptophytes, Ch: Chamaephytes, G=Geophytes and Ph: Phanerophytes; Dur.=Duration (Ann.=Annual and Per.=Perennial)

Families and species	Dur.	L.F	Choro.	Р%	Q
Apiaceae	Ann.	Th	М	2	0
Ammi majus L.				-	Ũ
Apocynaceae					
Leptadenia pyrotechnica (Forssk.) Decne.	Per	Ph	SA+SZ	40	D
Asclepiadaceae					
Calotropis procera(Aiton) W. T. Aiton	Per	Ph	SA+SZ	2	0
Asteraceae					
Achillea fragrantissima(Forssk.) Sch. Bip	Per	Ch	SA+IT	2	0
Amberboa lippii (L.)DC	Ann	Th	SA+SZ	2	0
Artemisia judaica L.	Per	Ch	SA	54	D
Centaurea calcitrapa L.	Per	He	M+SA+IT	18	VC
Cotula cinerea Delile	Ann	Th	SA	56	D
Ifloga spicata (Frossk.) Sch. Bip.	Ann	Th	SA+SZ	2	0
Lactuca serriola L.	Ann	Th	M+IT	2	О
Launaea amal-aminae (Boiss.) Kuntze	Ann	Th	SA	20	D
	Per	He	SA+IT	16	VC
Launaea nudicaulis (L.) Hook. f.	Ann	Th	M+SA	12	VC
Pulicaria arabica (L.) Cass.	Per	He	SA	44	D
Pulicaria undulata(L.) C. A. My.	Per	He	SA	18	VC
Pulicaria incisa (Lam.) DC.	Ann	Th	SA+IT	40	D
Senecio glaucus L. subsp. coropifolius (Maire) C. Alexander					
Sonchus oleraceus L.	Ann	Th	Cosm	10	VC
Boraginaceae		771	6.4	2	0
Arnebia hispidissima (Lehm.) DC.	Ann	Th	SA	2	0
Echium rauwolfii Delile	Ann	Th	SA	2	0
Helliotropium bacciferum Fross	Per	Ch Ch	SA SA	8	C
Helliotropium digynum (Forssk.) C.Chr.	Per Ann	Th	SA SA+SZ	4 22	O D
Trichodesma africanum (L.) R. Br.	Ailli	111	3AT32	22	D
Brassicaceae	Ann	Th	M+IT	52	D
Diplotaxis acris (Forssk.) Boiss.	Ann	Th	SA	54	D
Eremobiuma egyptiacum (Spreng.) Asch. & Schweinf. ex Bioss					
Matthiola longipetala (Vent) DC.	Ann	Th	M+SA+IT	68	D
Schouwia purpurea (Forssk.) Schweinf.	Ann	Th	SA	8	С
Zilla spinosa (L.) Prantl.	Per	Ch	SA	86	D
Caryophyllaceae					
Paronychia arabica (L.) DC.	Ann	Th	SA	10	VC
Chenopodiaceae					
Anabasis setifera Moq.	Per	Ch	SA	4	0
Atriplex halimus L.	Per	Ph	M+SA	60	D
Bassia indica (Wight) A.J.Scott	Ann	Th	SA+IT	46	D
Bassia muricata (L.) Asch	Ann	Th	SA+IT	28	D
Chenopodium ambrosioides L.	Ann	Th	Cosm	2	0
Chenopodium murale L.	Ann	Th	Cosm	4	0
Cornulaca monacantha Delile	Per	Ch	SA	70	D
Salsola imbricate Forssk. sub sp. imbricate	Per	Ch	SA+IT	32	D
Cleomaceae					
Cleom amblyocera Barratte & Murb.	Ann	Th	SA	4	0

Fabaceae					
Astragalus hamosus L.	Ann	Th	M+IT	2	0
Astragalus sieberi DC.	Per	Ch	SA	2	0
Astragalus vogelii (Webb) Bornm.	Ann	Th Th	SA SA	6 8	C
Trigonella stellata Forssk.	Ann	In	3A	δ	С
Geraniaceae					
Monsonia nivea (Decne.) Webb	Per	He	SA	4	0
Malvaceae					
Hibiscus trionum L.	Ann	Th	IT	2	О
Malva parviflora L.	Ann	Th	M+IT	12	VC
Mimosaceae	_				-
Acacia nilotica (L.) Delile	Per	Ph	SA	2	0
<i>Acacia tortilis</i> (Forssk.) Hayne subsp. <i>raddiana</i> (Savi) Brenan	Per	Ph	SA+SZ	4	0
Plantaginaceae					
Plantago ciliate Desf.	Ann	Th	SA+IT	12	VC
Poaceae					
Avena sterilis L.	Ann	Th	M+IT	2	0
Cynodon dactylon (L.) Pers.	Per	G	Pan	2	О
Imperata cylinderica (L.) Raeusch.	Per	He	M+SA+IT	2	0
Panicum turgidum Frossk.	Per	G	M+SA	2	0
Polygonaceae					
Calligonum polygonoides L`Hèr.	Per	Ph	SA+IT	74	D
Rumx vesicarius L.	Ann	Th	SA+IT	30	D
Resedaceae					
Ochradinus baccatus Delile	Per	Ph	SA+SZ	4	0
Oligomris linifolia (Hornew) J. F. Macbr.	Ann	Th	SA+SZ	18	VC
Rhamnaceae	D	DI	C 4	2	0
Zizyphus spina-christi (L.)Desf.	Per	Ph	SA	2	0
Scrophulariaceae <i>Kickxia aegyptiaca</i> (L.)Na`belek	Per	Ch	M+SA	8	С
Solanaceae	Per	Cli	M+3A	0	C
Datura innoxia Mill.	Ann	Th	Cosm	2	0
Hyoscyamus muticus L.	Per	Ch	SA	2	0
Tamaricaceae	101	Chi	011	2	U
<i>Tamarix aphylla</i> (L.) H. Karst.	Per	Ph	SA+SZ+IT	14	VC
Tamarix nilotica (Ehreub.) Bunge	Per	Ph	SA+SZ+M	52	D
Zygophyllaceae	10		of the the	2	2
Fagonia arabica L.	Per	Ch	SA	46	D
Fagonia bruguieri DC.	Per	He	SA SA+IT	40	VC
Fagonia indica Burm. f.	Per	Ch	SA	18 34	D
Zygophyllum coccineum L.	Per	Ch	SA+SZ	88	D
Zygophyllum simplex L.	Ann	Th	SA	4	0
-JSor Junio surplus El					

attributed to a heavy rainfall in January 2011.

Plant life forms resulted from evolved adaptation to environment and climate (Kassas, 1955). The life form spectrum of Wadi El-Assiuty (Fig. 2) showed that the proportion of therophytes (50%) is higher than that of other life forms, while the proportion of chamaephytes (21%) and phanerophytes (15%) are not worthy. High percentages of therophytes and chamaephytes coincide with the floristic characters of the arid zones and semi-arid zones (Bornkamm and Kehl, 1985; Migahid *et al.*, 1971; Pignatti and Pignatti, 1989). Danin and Orshan (1990) pointed out that the life form pattern of the desert plants correlates mainly with rainfall. Life form distribution of the desert plants is also correlated with topography and land form (Kassas and Girgis, 1965; Orshan, 1986; Zohary, 1973).

Results of the total chorological analysis of the surveyed flora (Fig. 2) revealed that 28 species (42.4% of the total flora) are mono-regional, of which 26 species (39.4%) are native to the Saharo-Arabian chorotype. Cosmopolitan ranked second with 3.1%. About 50% of the recorded species are 33 bioregional and pluri-regional, extending their distribution all over the Saharo-ArabianSudano-Zambezian, Irano-Turanian and Mediterranean regions. The Saharo-Arabian chorotype (bi- and pluri-), part of the Saharo-Arabian region, constitutes 34.8% and 7.6%, respectively, of the recorded species (total 81.8%) and it forms the major component of the floristic composition of this study. These results coincide with Hassan (1987), Sheded (1992) and Tab. 2. Floristic composition in the vegetation groups of Wadi El-Assuity and Wadi Habib. Figures in bold are species with highest presence values

Naoárandaé,i.e.i.e.i.e.Noof speciai.e.i.e.i.e.i.e.i.e.Ravis tandos (Neph M Sorei.e.i.e.i.e.i.e.i.e.Diplotes: arie (norsk) Nois.i.e. <t< th=""><th>Groups</th><th>А</th><th>В</th><th>С</th><th>D</th></t<>	Groups	А	В	С	D
Basis indica (Wight) A.J.Sort 50 413 38 83 Conduct intered Delle Ann 50 7.1 54 33 Diplotacia aeri (nonck) Boiss. 33 36 75 33 Equator and and in L 17 86 38 17 Landard and in L) 167 16 47 16 Leptadonic protechnic (Forsk) Decne. 50 7.1 46 83 Mathibal longipestal (Vent) DC. 50 7.1 46 83 Tamaré nolisita Korsk. 33 36 46 67 Saded induritate L) C.A.My. 33 36 47 83 Tamaré nolisita (Kink) C.A.My. 33 36 67 83 13 13 13 13 13 13 14 83 14 83 14 83 14 83 14 16 16 17 14 16 16 17 14 16 16 17 14 16 16 17<	No.of stands	6	14	24	6
Catala cinese Dedle Ann 50 71 54 33 Diplocati arri (Forsk.) Doks. 33 93 62 57 Ermonibium aggritatum (Sperce) Ach. &Schwind ex Biosn 33 56 75 33 Figmita archiva L. 17 86 38 17 Lamanea muldeatili (L). Hook f. 67 14 4 17 Lapadotin protechnik (Corsk.) Decne. 50 71 63 100 Palizaria muldeatili (L). C.A. My. 33 36 46 67 Subda timbritata Ebrosk. 33 160 48 33 Tamaria muldeatili (Naice) C. Alexandee Ann 100 71 8 33 Tamaria muldeatili Ebrosh. 17 43 13 17 Zille ginnas (L). Pland. 33 100 88 100 Zigophyllum accinama L. 100 100 101 101 Artemiti phale (Mait) Ebrosh. 100 102 17 14 Zigophyllum accinama L. 100 101 101	No.of species	39	49	33	31
Diplotaxis acris (Forsk.) Biois.3393932967Ergonia ardis (Spreng). Axch. & Schweint ex Bios33367533Ergonia ardis (L)6714417Lannaea mudiandis (L) Hook. f.6714417Laptadonia pyratchnia (Forsk.) Dence.50714683Mathibial langingradus (Vant) OC.30646733Saladis inbritatis (Cork.) Dence.33364667Saladis inbritatis (L) C.A. My.33364663Stanaia pricana giraama (Vant) OC.714583100Stanaia functian (Vant) C.A. Kacnder Ana30007383Tamaric midnicia (Ehrenb.) Bange67146383Tamaric midnicia (L) C.A. My.301007983Artis miticia (L) Parad.171475100Zilla ginsei (L.) Parad.17147510Artis miticia (L) Nexh Ann1750417Mala paradifor (L) Asch Ann17501714Oligameri lanigdia Unsuer J. F. Machr.17714Oligameri lanigdia Unsuer J. F. Machr.17714Artis indiza Barcia L. Della171414Oligameri lanigdia Unsuer J. F. Machr.171414Oligameri lanigdia (L) Della171414Artis indiza Barcia Della171414Artis indiza Barcia Della<	Bassia indica (Wight) A.J.Scott	50	43	38	83
Bremobium aggritacom (Sprcug) Asch & Schweinf, ex Bios 33 36 75 33 Fagonia arabica L. 17 86 38 17 Lannare mulciantik (L, Hook, f. 67 14 4 17 Laptadenia protechnica (Forsk) Decne. 50 7 46 83 Mathibal bangpeade (Vero) DC. 50 7 46 83 Mathibal bangpeade (Vero) DC. 50 7 46 67 Scarcio glacaru L. subg. corojfiliu (Mairo C. Alesander Ann 100 7 8 33 Treidodoma africansen (L.) R. Br. 17 43 13 17 Zalle opinos (L.) Paruh. 33 64 4 67 Statiantristis (L.) Asch Ann 50 50 17 100 Rasis antristis (L.) Asch Ann 50 57 25 100 Rasis antristis (L.) Asch Ann 50 57 4 100 Rasis antristis (L.) Asch Ann 50 17 4 10 Mathing paryflora L. 33 14 4 10 Charabasin strigtins Mog. 17 17 <	<i>Cotula cinerea</i> Delile <i>Ann</i>	50	71	54	33
Figuria arabica L. 17 86 38 17 Launate mulicatik (L) Hook, f. 67 14 4 17 Laptadnia protechnic (Porsk) Dece. 50 7 63 100 Paltaria unduktur (L) C. Aly, 33 36 46 67 Sidole individar Forsk. 33 64 46 67 Sidole individar Forsk. 33 64 46 63 Tamaric individa (Encell) Bange 67 43 13 100 Zilla spinosa (L) Pand. 33 100 88 100 Ziggelyllim cecineam L. 100 100 79 83 Artemitis judicia L 17 14 75 100 Egginia indicia Urah. 17 50 4 100 Launaea unal-minia vikina Ura. 50 57 25 Launaea unal-minia vikina Ura. 17 71 6 Moleo paryllen L 33 14 4 Oligomeria lingida (Yahl) et Hornew J.F. Mache. 17 71	Diplotaxis acris (Forssk.) Boiss.	33	93	29	67
Launaee andicaulis (L.) Hook f.6714417Leptadenia protechnica (Forsk.) Decne.5074683Matthiala langipetak (Vern) DC.50716667Saloka indrivatar. Forsk.33364667Sencio glacea L. subpe. compifisions (Maire, C. Alexander Ann10071883Trichodean africanum (L.) R. Br.17431317Zille apinos (L.) Pand.3310088100Speghp Jilm accinanu T.1001007983Artenitis judaica L.171475100Batta muricata (L.) Ach Ann505725Launaes and-oninae N. Kilan17574Launaes and-oninae N. Kilan17574Change aprilora L.331483Rums voitarius L.177167Andala partifora L.177167Andalas partifora L.17	Eremobium aegyptiacum (Spreng.) Asch. & Schweinf. ex Bioss	33	36	75	33
Leptadenia protechnica (Forsak.) Decne.5074683Mattribula longipedia (Verol. DC.506763100Albelaria undrikal longipedia (Narlo I) DC.33644467Schecia glancer L. subs., compifilus (Maire) C. Alexander Ann100718.833Transrix milaria (Elexen.) Bunge6714468100Zilla spinosa (L.) Panel.331008.88100Zigaphyllum receineau L.100701475100Arrennis indikta L.5050771475100Ressi municata (L.) Asch Ann50501711475100Ressi municata (L.) Asch Ann50501711415100 </td <td>Fagonia arabica L.</td> <td>17</td> <td>86</td> <td>38</td> <td>17</td>	Fagonia arabica L.	17	86	38	17
Matrihiad longiperada (Venu) DC. 50 71 63 100 Pallacini andudata[.]. C. A. My. 33 36 46 67 Saloda inhiritat Forsk. 33 64 4 67 Senetio glauna L. subp. compifdins (Maire) C. Alexander Ann 100 71 8 33 Tamaris inhitic (Threub.) Bunge 67 14 63 85 Trichodenna africanum (L) R Br. 17 43 100 88 100 Zigophyllam concineam L. 100 100 79 83 100 Artemisia judiata L. 17 14 75 10 Sensita muricata (L) Asch Ann 50 57 25 12 Lanuace annal-anniae N. Kilan 17 57 4 12 Malas parujfara I. 33 14 12 67 Malas parujfara I. 33 14 12 67 Malas parujfara I. 33 14 14 13 Obligomeris Inglika L. Orekanoni senaconal. 17 71	Launaea nudicaulis (L.) Hook. f.	67	14	4	17
Pulicaria undulata (L) C. A. My. 33 36 46 47 Senecia glacies Lsubsp. comp (dim) (Mairs) C. Alexander Ann 100 71 83 33 Transmix initiari (Ehreub, Dunge 67 14 63 83 Trichodoma africanum (L.) R. Br. 17 43 13 17 Zigo phyllim cocineum L. 30 100 88 100 Artonoitis judicia L. 17 43 13 17 Zigo phyllim cocineum L. 10 100 79 83 Artonoitis judicia L. 17 14 75 100 Resia maricata (L.) Ach Ann 50 50 17 1 Lananas anal-aminar N. Klinn 17 7 4 83 Malva parviflora L. 33 14 83 Rome vesioarina L. 17 70 14 67 Malva parviflora L. 33 14 83 Malva parviflora L. 33 14 83 Rome vesioarina L. 7 17 7 Scholaria barceare L. 50 67 84 <td>Leptadenia pyrotechnica (Forssk.) Decne.</td> <td>50</td> <td>7</td> <td>46</td> <td>83</td>	Leptadenia pyrotechnica (Forssk.) Decne.	50	7	46	83
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Zilla spinos (L) Prand.3310088100Zygophyllen occineum L.1001007983Artenisia judaica L.505017Basis muricata (L.) Asch Ann505025Latuneae amal-aminae N. Kilian17574Charlen age armidjorn L.33214Malay partifora L.331483Charlen age armid-aminae N. Kilian17574Charlen age armid-aminae N. Kilian17574Charlen age armid-aminae N. Kilian17574Charlen age armid-aminae N. Kilian17574Charlen age armid-aminae N. Kilian175767Faigonia Imguieri Dir.331483Rumx resicariue L.177157Schouid purpure (Drssk) Schweinf.50717Schouid purpure (Drssk) Schweinf.501414Chardinui baccatus Delile17414Advilla fageantismia (Icrosk) Sch. Bip17415Advilla fageantismia (Icrosk) Sch. Bip171414Chardinui majus L.33141415Chardinui majus L.17141415Chardinui majus L.17141416Chardinui aniou L.17141416Chardinui aniou L.17141714Chardinui aniou L.17141714Chardinui aniou L. <td></td> <td>17</td> <td>43</td> <td>13</td> <td>17</td>		17	43	13	17
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Heliotropium bacciferum Fross	7	13	
Paronychia arabica (L.) DC.	29	4	
Cleom amblyocera Barratte & Murb.	7		17
<i>Kickxia aegyptiaca</i> (L.)Na`belek	7		50
Plantago ciliata Desf.	21		50
<i>Trigonella stellata</i> Forssk.	21		17
Arnebia hispidissima (Lehm.) DC.	7		
Amberboa lippii (L.)DC	7		
Astragalus hamosus L.	7		
Astragalus vogelii (Webb) Bornm.	21		
Avena sterilis L.	7		
Chenopodium ambrosioides L.	7		
Echium rauwolfii Delile	7		
Ifloga spicata (Frossk.) Sch. Bip.	7		
Lactuca serriola L.	7		
Monsonia nivea (Decne.) Webb	14		
Pulicaria arabica (L.) Cass.		17	33
Panicum turgidum Frossk.		4	
Astragalus sieberi DC.			17
Heliotropium digynum (Forssk.) C.Chr.			33

Fossati et al. (1998).

The phenological events of perennials are fairly constant regardless of the rainfall. This is because these plants depend on a permanent source of the underground water. The majority of perennial species behave similarly to each other in their phenology. Usually perennials sprouted in the end of the month of February and become leafy in March, flowered in April and produced fruits between April and July (Abd El-Rahman and Batanouny, 1959; El-Adawy, 2001; Salama *et al.*, 2013).

Classification of the presence/absence data set of 66 species recorded in 50 stands using cluster analysis yielded four vegetation groups at level two of the hierarchy (Fig. 5; Tab. 2). Most of the groups (A) and (B) stands were confined to the Main trunk of Wadi El-Assuity, while those of groups (C) and (D) were belonging to the Wadi El-Assuity tributary (Wadi Habib). These groups are named after the first and second dominant species as follows: (A) Senecio glaucus-Zygophyllum coccineum, (B) Zilla spinosa-Zygophyllum coccineum, (C) Calligonum polygonoides, and (D) Artemisia judaica-Matthiola longipetala. Group B was the largest (14 stands) group, including 49 species, followed by Group A (6 stands, 39 species). Some species showed a certain degree of fidelity, e.g. Acacia nilotica, Achillea procera. fragrantissima, Ammi magus, Calotropis Chenopodium murale, Cynodon dactylon and Datura innoxia was confined to Group A; Arnebia hispidissima, Amberboa lippii, Astragalus hamosus, Astragalus vogelii, Avena sterilis, Chenopodium ambrosioides, Echium rauwolfii, Ifloga spicata, Lactuca serriola and Monsonia niveato to Group B; Panicum turgidum to Group C; and Astragalus sieberi and Heliotropium digynum to Group D. Sixteen species were recorded in all groups, including Bassia indica, Diplotaxis acris, Eremobium aegyptiacum, Matthiola longipetala, Trichodesma africanumas annuals and Cotula

cinerea, Fagonia arabica, Launaea nudicaulis, Leptadenia pyrotechnica, Pulicaria undulata, Salsola imbricata, Senecio glaucus, Tamarix nilotica, Zilla spinosa, Zygophyllum coccineum, Artemisia judaica as woody perennials (Tab. 2).

In their detailed study on the plant communities in the vicinity of this study area, El-Sharkawi *et al.* (1982a) described three major community types. The first included Zilla spinosa, Zygophyllum coccineum, Schouwia thebaica, Zygophyllum simplex, Cotula cinerea, Salsola baryosma, Pulicaria undulata, Tribulus pentandrus, and Launaea capitata. Certainly, the identified vegetation group B belongs to these community type. Kassas and Girgis (1972) stated that the plant growth in WAdi Al-Assiuty and Wadi Habib differes in obvious relations to the size of the catchment area. They recognized also Zilla spinosa, Zygophyllum coccineum, and Leptadenia pyrotechnica community types among other communities recorded in the studied wadis.

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206

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