

## Plant Life in the Digla Conserved Area, Hyperarid Desert, Egypt

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**Abstract:** Wadi Digla was declared as a conserved area in 1999, it characterized by Digla Canyon structure. Seventy five species were recorded in the study area. Chamaephytes and therophytes are the dominating life forms. The Sahro-Sindian element was prevailing represented by 28 species (37.3%) of the total species. *Atriplex halimus*, *Zilla spinosa* and *Zygophyllum coccineum* are the dominating species of the wadi. *Iphiaea mucronata*, *Gymnocarpus decandrus*, *Deverra tortosa* and *Farsetia aegyptia* are the co-dominant species. Accidental vegetation (empherals) were recorded after winter rainfall in 2001. Upstream of the wadi have 28 species while 41 species were recorded in the downstream. Human impact is clearly appear in the upstream physiogeographic of the wadi.

**Key words:** Digla, desert, flora, Egypt

### Introduction

Wadi Digla (North Eastern Desert) was declared a protected area in 1999. The wadi is located east of Maadi district, belonging to the limestone desert wadis. It extends along 30 km from east to west. The channel receives a number of main tributaries which in turn receives runoff drainage from branched runnel.

Wadi Digla is a limestone desert which comprises massive Eocene age conveniently, classified into upper Eocene and middle Eocene (Said, 1990). The middle Eocene series includes various limestone which is the main quarrying beds for building stones and for cement industry. According to Hume (1907), the wide plateau of the wadi owes its origin to hard band of siliceous limestone which extends to the feet of the higher hills. The erosion affects the successive steps of the waterfall like cliffs at different rates being greatest at the top step and least at foot-step, the result of this differential rate of action causes the whole form becomes stepped course of a runnel. The floor is partly covered by blocks which are boulders of dolomite limestone. Fossil of *Nummulites* sp. and *Gastropoda* sp. in the middle Eocene and *Ostrea* sp. in the Upper limestone.

The soil is usually composed of rock waste varying in texture from silt to gravels and boulders. It is often noticed that the wadi bed is covered with layers of fine material alternating with layers of coarse gravels. The alteration of layers of different textures has a substantial influences on the water available for utilization by plants.

According to Ayyad and Ghabbour (1986), the study area is belong to hyperarid province with hot summer and mild winter (mean temperature of the hottest month; 20-30 °C ) with winter rainfall. The rain in this province is less than 30 mm/year and occasional and unpredictable.

The aim of the work is to study the habitats and species diversity in the Digla protected area and distributions of plants in the different landform.

### Materials and Methods

The conserved area is located between latitude (29 57' 49 & 29 56' 22) and longitude (31 19' 18 and 31 30' 00). Twenty six stands were chosen in the study area so as to represent the different habitats and the micro variation in this area. The area were visited during 1999-2001 in different seasons.

Each stand comprised 3-5 quadrats (10X10m<sup>2</sup>) and a list of species was made for each stand. Species cover-abundance was determined according to Braun-Blanquet (1964). The locations in the wadi were made using Magellan Gps Tracks Satellite Navigator (1960 overland. San Dimas, CA, 91773). Stands are classified into vegetation groups according to the tabular comparison technique as described by Muller-Dombois and Ellenberg (1974).

Species diversity was determined using Simpson's index (Magurran, 1988). Species were identified according to Tackholm (1974), El Hadidi and Fayed (1994,1995), Boulos (1995) and Boulos

(1999, 2000). Voucher specimens were deposited in Helwan Faculty of Science Herbarium, Helwan University.

### Results and Discussion

**Floristic presentation:** Seventy five species were collected during the period of the study (1999-2001) (Table 1), belonging to twenty eight families. The most representative families are Gramineae, Compositae, Chenopodiaceae, Cruciferae and Zygophyllaceae. Twenty seven species are collected once in the rainy season (2001), represent 36 % of the total species (Table 3). *Alhagi graecum* is collected once near Bir Digla after heavy rainfall. The most common ephemerals are *Pseuderucaria clavata*, *Diptaxis acris*, *Mesembryanthemum forsskaei*, *Zygophyllum simplex* and *Rumex vesicarius*.

Sahro-Sindian is the dominating element, represent 37.3 % of the total species. The result is coincide with Fossatil et al. (1998), El Hadidi (1993) and Ozenda (1958). The biregional elements have 26 species of which Sahro-Sindian + Sudano-Zambezian elements are prevailing (Table 1). Pluri-regional is represented by 15 species. Paleotropic element have one species (*Amaranthus graecizans*). *Imperata cylindrica* and *Phragmites australis* are pantropic elements while *Polypogon monosplensis*, *Chenopodium murale* and *Sonchus oleraceus* are cosmopolitan elements. Following are the life form of spices in the wadi according to Raunkiaer (1934) and Hassib (1951):

Phanerophytes	Parasites
4	3
Nano-Phanerophytes	Hemi-Cryptophytes
6	14
Chamaephytes	Cryptophytes
23	Geophytes 3
Therophytes	Helophytes 1
21	

The dominating life forms were therophytes represented by 28% of total recorded species and chamaephytes have 30.63% of total life forms in the study area (Hassib, 1951; Danin and Orchan, 1990; El Adawy, 2001). Parasites have three species; *Cistanche phelypaea*, *Orobancha cernua* and *Cuscuta pedicellata*.

**Description of habitats:** According to Kassas and Imam (1954) and Batanouny (1973), the mature wadi bed ecosystem may be subdivided into a number of habitats describe on grounds of sediment thickness and plant cover. In the study area the main habitats are:

- **Rocky habitat:** *Gymnocarpus decandrus*, *Farsetia aegyptia* and *Iphiaea mucronata* are the dominating species in this habitat. The main associated species are *Anabasis setifera*, *Reamurea hirtella*, *Erodium glaucophyllum*, *Diptaxis hrra* and *Stachys*



Loutfy M. Hassan: Digla, desert, flora, Egypt

Table 3: Monitoring of the species collected in the area of wadi Digla (1999-2001)

List of species	1999	2000	2001	Life form
<b>Ephedraceae</b>				
<i>Ephedra alata</i> Decne	+	+	+	N.ph.
<b>Polygonaceae</b>				
<i>Rumex vesicarius</i> L.	-	-	+	Th.
<b>Aizoaceae</b>				
<i>Mesembryanthemum forsskaei</i> Hockst. ex Boiss	-	-	+	Th.
<b>Caryophyllaceae</b>				
<i>Gypsophylla capillaris</i> (Forsskal) C. Chr.	-	+	+	H.
<i>Gymnocarpus decandrus</i> Forsskal	+	+	+	Ch.
<b>Chenopodiaceae</b>				
<i>Chenopodium murale</i> L.	-	-	+	Th.
<i>Atriplex leucoclada</i> Boiss	-	+	+	Ch.
<i>Atriplex halimus</i> L.	+	+	+	N.ph.
<i>Bassia muricata</i> (L.) Asch.	-	+	+	Th.
<i>Anabasis setifera</i> Moq.	+	+	+	Ch.
<i>Anabasis articulata</i> (Forsskal) Moq.	+	+	+	Ch.
<i>Agathophora alopecuroides</i> (Del.) Moq.	+	+	+	Ch.
<b>Amaranthaceae</b>				
<i>Amaranthus graecizans</i> L.	-	-	+	Th.
<b>Menispermaceae</b>				
<i>Cocculus pendulus</i> (J.R. & Forst.) Diels	+	+	+	Ph.
<b>Capparidaceae</b>				
<i>Capparis spinosa</i> L. var. <i>Spinosa</i>	+	+	+	N.ph.
<b>Cruciferae</b>				
<i>Sisymbrium irio</i> L.	-	-	+	Th.
<i>Farsetia aegyptia</i> Turra	+	+	+	Ch.
<i>Diplotaxis harra</i> (Forsskal) Boiss.	-	+	+	H.
<i>Diplotaxis acris</i> (Forsskal) Boiss.	-	-	+	Th.
<i>Zilla spinosa</i> (Turra) Prantl	+	+	+	Ch.
<i>Pseuderucaria clavata</i> Boiss.	-	-	+	Th.
<b>Resedaceae</b>				
<i>Ochradenus baccatus</i> Del.	+	+	+	N.ph.
<b>Leguminosae</b>				
<i>Retama raetum</i> (Forsskal) Webb et Berth	+	+	+	N.ph.
<i>Trigonella stellata</i> Forsskal	-	-	+	Th.
<i>Alhagi graecorum</i> Boiss.	-	-	+	H.
<b>Geraniaceae</b>				
<i>Erodium oxycorymbium</i> M. Bieb				
ssp. <i>Bryoniifolium</i> (Boiss) Schonb.- Tem	-	-	+	H.
<i>Erodium glaucophyllum</i> (L.) L' He'rit	+	-	+	H.
<i>Erodium cicutarium</i> (L.) L' He'rit	-	-	+	Th.
<b>Zygophyllaceae</b>				
<i>Fagonia arabica</i> L.	+	+	+	Ch.
<i>Fagonia bruguieri</i> DC.	-	+	+	H.
<i>Fagonia mollis</i> Del.	-	-	+	Ch.
<i>Zygophyllum simplex</i> L.	-	-	+	Th.
<i>Zygophyllum album</i> L.f.	+	-	-	Ch.
<i>Zygophyllum coccineum</i>	+	+	+	Ch.
<i>Nitraria retusa</i> (Forsskal) Asch.	+	+	+	Ph.
<b>Malvaceae</b>				
<i>Malva parviflora</i> L.	-	-	+	Th.
<b>Tamaricaceae</b>				
<i>Tamarix nilotica</i> (Ehrenb.) Decne	+	+	+	N.ph.
<i>Reamuria hirtella</i> Jaub. et Spach	+	+	+	Ch.
<b>Umbelliferae</b>				
<i>Deverra tortuosa</i> (Desf.) DC.	+	+	+	Ch.
<i>Deverra triradiatus</i> Hockst. ex Boiss.	+	+	+	Ch.
<b>Plumbaginaceae</b>				
<i>Limonium pruinosum</i> (L.) Kuntze	+	+	+	H.
<b>Asclepiadaceae</b>				
<i>Pergularia tomentosa</i> L.	+	+	+	Ch.
<b>Cuscutaceae</b>				
<i>Cuscuta pedicellata</i> Ledeb.	-	-	+	P
<b>Boraginaceae</b>				
<i>Heliotropium digynum</i> (Forsskal) Asch. ex Christensen	+	-	+	Ch.
<i>Heliotropium baccifarum</i> Forsskal	-	+	+	Ch.
<b>Labiatae</b>				

Loutfy M. Hassan: Digla, desert, flora, Egypt

Table 3: Continued

List of species	1999	2000	2001	Life form
<i>Stachys aegyptiaca</i> Pers.	+	+	+	H.
<b>Solanaceae</b>				
<i>Lycium shawii</i> Roemer. et Schultes	+	+	+	Ph.
<b>Scrophulariaceae</b>				
<i>Kickxia aegyptiaca</i> (L.) Nabelek	-	+	+	Ch.
<i>Scrophularia deserti</i> Del.	+	+	+	H.
<b>Orobanchaceae</b>				
<i>Orobanche cernua</i> Loeff.	-	-	+	P
<i>Cistanche phelypaea</i> (L.) Cout. -	+	+	P	
<b>Cistaceae</b>				
<i>Helianthemum kahiricum</i> Del.	-	+	+	Ch.
<b>Plantaginaceae</b>				
<i>Plantago ovata</i> Forsskal	-	-	+	Th.
<b>Compositae</b>				
<i>Echinops spinosissimum</i> Turra	+	+	+	Ch.
<i>Centaurea aegyptiaca</i> L.	-	-	+	H.
<i>Pluchea dioscoridis</i> (L.) DC.	-	-	+	Ph.
<i>Iphiona mucronata</i> (Forsskal) Asch. et Schwenf	+	+	+	Ch.
<i>Pulicaria incisa</i> (Lam.) DC.	+	-	-	H.
<i>Nauplius graveolens</i> (Forsskal) Wilkhud & Nord	+	-	-	H.
<i>Achillea fragrantissima</i> (Forsskal) Schultz-Bip	+	+	+	Ch.
<i>Artemisia judaica</i> L.	+	+	+	Ch.
<i>Senecio glaucus</i> spp. <i>Coronopifolia druce</i>	-	-	+	Th.
<i>Launaea nudicaulis</i> (L.) Hook. F.	-	+	+	H.
<i>Sonchus oleraceus</i> L.	-	-	+	Th.
<i>Picris asplenoides</i> L.	-	-	+	Th.
<i>Reichardia tingitiata</i> (L.) Roth.	-	-	+	Th.
<b>Gramineae</b>				
<i>Bromus madritensis</i> L.	-	-	+	Th.
<i>Desmostachya bipinnata</i> (L.) Stapf	-	+	+	G.
<i>Phragmites australis</i> (Cav.) Trin. ex Steud	-	+	+	H.H.
<i>Schismus arabicus</i> Nees	-	-	+	Th.
<i>Polypogon monspiliensis</i> (L.) Desf.	-	-	+	Th.
<i>Stipa capensis</i> Thunb.	-	-	+	Th.
<i>Cynodon dactylon</i> (L.) Pers.	-	-	+	G.
<i>Pennisetum divisum</i> (J.Gmelin) Henrard	+	+	+	G.
<i>Imperata cylindrica</i> (L.) Rauschel	-	+	+	H.

Th = Therophytes, Ch = Chamaephytes, G = Geophytes, Ph = Phanerophytes, N.ph = Nano-phanerophytes, H = Hemicryptophytes, P = Parasites, H.H = Helophytes and Hydrophytes, + = Species collected, - = Species not collected

*aegyptiaca*.

- **Cliffs:** It is dominated by *Capparis spinosa*, *Limonium pruinosum* and *Cocculus pendulus*.
- **Terraces:** *Lycium shwaili*, *Atriplex halimus*, *Nitraria retusa* and *Pennisetum divisum* are the dominating species. The associated species includes *Zygophyllum coccineum*, *Achillea fragrantissima*, *Pergularia tomentosa*, *Echinops spinosus*, *Zilla spinosa*, *Agatophora alopecuroides*, *Ochradenus baccatus* and *Anabasis setifera*.
- **Digla Canyon:** It is characterized by *Capparis spinosa* and *Phragmites australis*. The Bir (latitude 29 56` 22 N and 31 25` 23 E) which located near the Canyon is characterized by *Tamarix nilotica*, *Atriplex halimus*, *Zygophyllum coccineum* and *Gymnocarpos decandrus*.
- **The main wadi bed channels:** *Zilla spinsa*, *Zygophyllum coccineum*, *Devera tortuosa* and *Iphiona mucronata* are dominated species. The main associated species; *Retama raetam*, *Echinops spinosus*, *Anabasis articulata*, *Launaea nudicaulis*, *Anabasis setifera*, *Achillea fragrantissima*, *Ephedra alata*, *Heliotropium bacciferum* and *Centaurea aegyptiaca*.

**Vegetation analysis:** Vegetation of the wadis in the eastern desert is distinguished into plant communities where the dominant perennial species give the permanent character of plant cover in

each habitat. This may be attribute to the rather scanty rainfall which is not adequate for appearance of many annual. The accidental vegetation type (Kassas, 1966, 1970) is recorded in the wadi after winter rainfall in 2001.

The most characteristic group includes *Atriplex halimus* (88.5% of presence), *Zilla spinosa* (80.8%) and *Zygophyllum coccineum* (73.1%). These species are characteristic to the different physiographic of the wadi (downstream, middle of the wadi and the upstream) (Table 2).

*Iphiona mucronata* (65.4%), *Gymnocarpos decandrus* (65.4%), *Devera tortuosa* (61.5 %) and *Farsetia aegyptia* (61.5 %) are codominate species.

The differential species includes *Ochradenus baccatus* (57.7%), *Anabasis setifera* (57.7%), *Lycium shwaili* (50%), *Echinops spinosissimus* (46.2%) and *Achillea fragrantissima* (46.2%) which are the main associated species. *Stachys aegyptia* (19.2 %) which recorded in this study as differential species was considered as the characteristic community to Helwan desert according to Kassas and Imam (1954).

In this study *Devera trirdiatus* is a new record specie in the Helwan desert. It recorded in stands 7, 12 and 17 (downstream and middle of the wadi).

The rare species includes emperals species; *Rumex vesicarius*, *Plantago ciliata*, *Sisymbrium irio*, *Zygophyllum simplex*, *Bassia muricata*, *Schismus arabicus*, *Polypogon monospliensis*, *Orobanche cernua*, *Plantago ovata* and *Senecio glaucus* ssp. *coronopifolius*. Perennials species includes *Artemisia judica* (3.8%) and *Scrophularia deserti* (3.8%) which were recorded once in

stand 15 (middle of the wadi, 29 56` 43 N and 31 24` 41 E). *Pergularia tomentosa* (3.8%), *Gypsophilla capillaris* (3.8%) were recorded only in stands 1 and 2 respectively (lat. 29 57` 37 N and 31 19` 53 E, Downstream) while *Heliotropium bacciferum* (3.8%) only in stand 18 (29 56` 21 N and 31 25` 25 E, middle of the wadi). According to Kassas and Imam (1954), the mature wadi bed ecosystem may be subdivided into a number of habitats discernible on the grounds of the soil thickness and plant cover. The vegetation is distinguished into associations where the dominant perennial species give the permanent character of plant cover in each habitat. This may be attributed to the rather scanty rainfall which is not adequate for the appearance of many annuals. Accidental vegetation forms a temporary adjunct to the above perennial communities. The rainy winter season (2001) allowed the appearance of the accidental vegetation (Ephemerals) in wadi Digla (Table 3).

In this study 41 species were recorded in the downstream, 44 species in the middle of the wadi and 28 species in the upstream of wadi Digla. The small number of species in the downstream and upstream is due to the human impact on the vegetation of the wadi. Batanouny (1983) described the human impact on the Egyptian deserts vegetation.

The effects of man on desert vegetation may be direct on the vegetation cover itself or indirect through their influence on the other components of the ecosystem.

Human activities affecting the plant cover directly, resulting in the deterioration of desert vegetation; includes intensive collection of medicinal plants and removal of plants during the construction of roads and building of new cities.

Kassas and Imam (1954), recorded only thirty species in wadi Digla (4 km from Maadi railway station). This area now is a building area (personal communication with prof. Kassas). In their survey, *Euphorbia retusa*, *Panicum turgidum*, *Haloxylon salicornicum* and *Lisurus hirsutus* were recorded. The previous species were not recorded in the conserved area.

Species diversity were calculated for the different physiographic of the wadi. In the upstream,

Simpson's index  $D = 0.136$   $1/D = 7.35$   
 Lowstream, Simpson's index  $D = 0.263$   $1/D = 3.802$   
 Middle part, Simpson's index  $D = 0.340$   $1/D = 2.94$

The reciprocal form of Simpson's index is usually adopted. This ensure that the value of the index increase with increasing diversity. The high species diversity value was determined in the upper stream of wadi Digla while the low value in the middle of the wadi.

Followings are the main threats to the conserved area:

- Area of collecting garbage near the upstream of the wadi which attract insets and animals
- Activities of quarries of building stones and cement industry
- Remains of contractors and buses companies
- Burning of tyres in the area adjacent to the wadi
- Area of metallurgical industry which will be located near the east part of the wadi.

The most dangerous activity is the quarries of building stones will increase the erosion of the geological structure of the wadi.

In this study, wadi Digla is classified according to the physiographic into; downstream, middle part and upstream. The main dominating species are *Atriplex halimus*, *Zygophyllum coccineum* and *Zilla spinosa*. Accidental vegetation was appear after winter rainfall in 2001. This vegetation is apart of wadi vegetation which exposed to remove after construction of the main traffic road. The new cities; Zahra el Maadi, Digla and Amal were built near the downstream. The declaration of the wadi as conserved area is to protect the wild life in the desert wadi after the highly human activities.

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