Studies on the Vegetation and Soil Seed Bank in Western Saudi Arabia. 2. East of Jeddah*

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Seed bank dynamics and vegetation analysis were undertaken in the eastern outskirts of Jeddah town. Seven plant communities are recorded namely *Lasiurus scindicus, Calotropis procera, Blyttia fruticulosum, Cappparis decidua, Panicum turgidum, Suaeda monoica-Tamarix aphylla* and *Zygophyllum simplex* community. Eighty eight species of vascular plants are recorded.

The study included also the evaluation of seed buried in the soil (seed bank). Relations between communities and their habitat types as well as the seed bank dynamics in the area are briefly discussed.

Key words: Soil Seed Bank, Vegetation, Western Saudi Arabia.

Introduction

The first paper of this series (El Karemy & Zayed, 1999) presents the vegetation and seed bank dynamics of Wadi Fatima. The present paper deals with another the eastern outskirts of Jeddah town which represent the alluvial coastal plain eco-geomorphological system as defined by Batanouny (1979), and has a width of about 12 km.

Earlier contributions to our knowledge of the area are those of Vesy-Fitzgerald (1955 & 1957), Batanouny (1978), Baeshin & El-Sahhar (1983 & 1987), Batanouny & Baeshin (1978) and Mahmoud & El-Tom (1985).

Climate

According to Walter *et al.* (1975) the study area lies within the subtropical dry zone of the deserts. The rainfall is characterised by scantiness, irregularity, and variability. The average annual rainfall is 71.3 mm. Air temperature is high, particularly in summer. Mean monthly temperature ranges from 24.3 ^{o}C in January to 31.8 ^{o}C in July. Mean maximum

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temperature reaches 41.6 ^{o}C in July and mean minimum temperature is 14.5 ^{o}C in January. The relative humidity is high, the mean maximum reaches 93% in January and 97.7% in June, while mean minimum ranges between 16.7% in January and 14.2% in June.

Materials and Methods

Seventy five stands were chosen where variations in vegetation were observed. In each stand, plant species were rated according to Braun-Blanquet (1964). Two scales are used, one combining the abundance and cover of species (abundance-dominance) and the second giving a measure of grouping (sociability). Features of habitat supporting each community were described.

Two complete sets of specimens collected are deposited in the Herbaria of Cairo University and Assiut University. The specimens were identified mainly according to Chaudhary (1989 & 1999), Collenette (1998), Migahid (1996) and Miller & Cope (1996).

From each habitat, 32 soil samples were collected, each of which from an area of 25x25 cm to a depth 2 cm. Soil samples collected from each habitat were thoroughly mixed, air-dried immediately after being brought to the laboratory. Soil samples then were sieved of rocks, roots and other plant remains. The weight of soil/m^2 was determined. Soil seed bank was estimated by two techniques: counting the number of germinating seeds under room temperature (Wang, 1997) and floating technique (Visser & Wentzel, 1980).

In this paper: P= presence value in %; AB= combined scale value, according to Braun-Blanquet (l.c.).

Results

A. Vegetation:

The vegetation exhibits recognizable units distinguished on the basis of their floristic composition (Table 1.a-g) and the prevailing habitat features into seven communities.

1. Lasiurus scindicus Community

The dominant species is a perennial desert grass, which grows in a large dense thickets. It is one of the important range grasses. The assemblage abounds on depressions receiving considerable water supply. The soil supporting this community is compact and fine-textured. Vegetation is luxuriant with a cover that may reach 80%.

Table 1.a. Floristic composition of *Lasiurus sindicus* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Acacia ehrenbergiana Hayne (Fig. 1)	50	+.1
Calotropis procera (Ait.) Ait. f. (Fig. 1)	50	+.1
Abutilon pannosum (G. Forst.) Schltdt.	30	1.1
Ochradenus baccatus Delile (Fig. 5)	20	+.1
b. Dwarf shrubs and perennial herbs		
Lasiurus scindicus Hern.	100	3.3
Cynodon dactylon (L.) Pers.	60	1.2
Pennisetum divisum (Gmel.) Hern.	60	1.1
Boerhavia coccinea Mill.	60	1.1
Heliotropium ramosissimum (Lehm.) Sieb. ex A.DC.	60	1.1
Panicum turgidum Forssk. (Fig. 1)	40	+.2
Citrullus colocynthis (L.) Schrad. (Fig. 1)	40	+.1
Convolvulus prostratus Forssk.	30	+.1
Cenchrus ciliaris L.	30	+.1
Senna holosericea (Fresen.) Greuter	30	+.1
Convolvulus hystrix Vahl	30	+.1
Tephrosia purpurea (L.) Pers. (Fig. 1)	20	+.1
Chrozophora oblongifolia (Delile) Spreng.	20	+.1
Salvia aegyptiaca L. (Fig. 1)	20	+.1
Farsetia longisiliqua Decne. (Fig. 1)	10	+.1
Corchorus depressus (L.) Stocks	10	+.1
Memordica balsamina L.	10	+.1
Convolvulus glomeratus Choisy	10	+.1
Pulicaria petiolaris Jaub. & Spach	10	+.1
Convolvulus arvensis L.	10	+.1
c. Annuals and ephemerals		
Zygophyllum simplex L.	90	1.1
Anastatica hierochuntica L.	60	1.1
Portulaca oleracea L.	50	1.1
Asphodelus tenuiflorus Cav.	40	1.1
Aizoon canariense L. (Fig. 3)	40	1.1
Launaea intybacea (Jacq.) Beauv.	20	+.1
Trianthema portulacastrum L.	10	+.1
Cleome amblyocarpa Barr. & Murb.	10	+.1
Setaria verticillata (L.) P. Beauv.	10	+.1

2. Calotropis procera Community

The dominant species is widespread in the study area. It is neither grazed by animals nor cut out for fuel. The community usually occurs on deep alluvial soils where the ground surface is covered by gravels. The plant cover ranges between 20 and 30%.

Table 1.b. Floristic composition of *Calotropis procera* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Calotropis procera (Ait.). Ait. f.	100	3.3
b. Dwarf shrubs and perennial herbs		
Cenchrus ciliaris L.	60	1.1
Cyperus conglomeratus Rottb. (Fig. 1)	60	+.1
Pennisteum divisum (Gmel.) Hern.	50	1.2
Lasiurus scindicus Hern.	50	+.1
Centropodia forsskaolii (Vahl) Cope	50	+.1
Senna holosericea (Fresen.) Greuter	40	1.1
Farsetia longisiliqua Decene.	40	+.1
Abutilon pannosum (G. Forst.) Schltdl.	40	+.1
Solanum coagulans Forssk. (Fig. 3)	40	+.1
Boerhavia coccinea Mill.	30	+.1
Citrullus colocynthis (L.) Schard	20	1.2
Dipterygium glaucum Decne.	20	1.1
Convolvulus prostratus Forssk.	20	+.1
Polycarpaea repens (Forssk.) Asch. & Schweinf.	20	+.1
Panicum turgidum Forssk.	10	1.1
Blepharis ciliaris (L.) B.L. Burtt	10	+.1
Aerva javanica (Burm. F.) Juss. Ex J.A. Schultes (Fig. 1)	10	+.1
Indigofera spinosa Forssk.	10	+.1
Tephrosia purpurea (L.) Pers.	10	+.1
Corchorus depressus (L.) Stocks	10	+.1
Odontanthera radians (Forssk.) D.V. Field (Fig. 2)	10	+.1
c. Annuals and ephemerals		
Polygala erioptera DC.	60	1.1
Euphorbia granulata Forssk.	40	1.1
Schismus barbatus (L.) Thell.	40	1.1
Reichardia tingitana (L.) Roth	40	1.1
Launaea capitata (Spreng.) Dandy.	30	1.1
Tribulus terrestris L.	20	1.1
Kohautia caespitosa Schinzl. (Fig. 1)	10	+.1
Schouwia purpurea (Forssk.) Schweinf.	10	+.1

3. Blyttia fruticulosum Community

This assemblage flourishes on the low rocky hills. The ground surface is covered by barren rocks and boulders of various sizes and shapes. The underneath and in crevices and pockets; fine sediments are traped. The plant cover is apparently thin not exceeds 10%.

Table 1.c. Floristic composition of *Blyttia fruticulosum* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Blyttia fruitculosum (Decne.) D.V. Field (Fig. 3)	100	2.1
Acacia ehrenbergiana Hayne	10	+.1
Calotropis procera (Ait.) Ait. f.	10	+.1
Cadaba glandulosa Forssk.	10	+.1
Maerua crassifolia Forssk.	10	+.1
b. Dwarf shrubs and perennial herbs		
Cenchrus ciliaris L.	70	1.1
Cyperus conglomeratus Rottb.	40	1.2
Pennisetum divisum (Gmel.) Henr.	40	+.1
Leucas inflata Benth. (Fig. 2)	40	+.1
Boerhavia coccinea Mill	30	+.1
Corchorus depressus (L.) Stocks	30	+.1
Heliotropium ramosissimum (Lehm.) Sieb. ex A.DC.	30	+.1
Chrozophora oblongifolia (Delile) Spreng.	20	+.1
Polycarpaea repens (Forssk.) Asch. & Schweinf.	20	+.1
Indigofera spinosa Forssk.	20	+.1
Tephrosia purpurea (L.) Pers.	20	+.1
Senna holosericea (Fresen.) Greuter	10	+.1
Cadaba longifolia DC.	10	+.1
Lindenbergia sinaica (Decne.) Benth. (Fig. 1)	10	+.1
Pergularia daemia (Forssk.) Chiov. (Fig. 1)	10	+.1
Cometes abyssinica R.Br. (Fig. 1)	10	+.1
c. Annuals and ephemerals		
Polygala erioptera DC.	40	+.1
Euphorbia granulata Forssk.	30	+.1
Tribulus terrestris L.	20	+.1
Astragalus eremophilus Boiss.	10	+.1

4. *Capparis decidua* Community

The community dominated by this species inhabits deep sand plains. Dunes of variable sizes are formed by the deposition of wind-blown sand around *Capparis decidua*. The plant cover is apparently rich, attaining 30%.

Table 1.d. Floristic composition of *Capparis decidua* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub laeyr		
Capparis decidua (Forssk.) Edgw. (Fig. 4)	100	2.2
Calotropis procera (Ait.) Ait. f.	30	+.1
b. Dwarf shrubs and perennial herbs		
Dipterygium glaucum Decene.	70	1.1
Senna italica Mill. (Fig. 4)	60	1.1
Boerhavia coccinea Mill.	40	+.1
Paronychia arabica (L.) DC.	40	+.1
Tephrosia purpurea (L.) Pers.	30	+.1
Chrozophora oblongifolia (Delile) Spreng.	10	+.1
Glossonema boveanum (Decne.) Decne.	10	+.1
Leptadenia arborea (Forssk.) Schweinf.	10	+.1
Anabasis setifera Moq.	10	+.1
Cucumis prophetarum L.	10	+.1
Withania somnifera (L.) Dunal	10	+.1
Pergularia daemia (Forssk.) Chiov.	10	+.1
c. Annuals and ephemerals		
Zygophyllum simplex L.	80	+.1
Tribulus terrestris L.	50	+.1
Astragalus eremophilus Boiss.	10	+.1

5. *Panicum turgidum* Community

The community dominated by this grassland species is confined to the sand plain areas in the study area. The soil is deep, compact and fine-textured. *Panicum turgidum* is a favourite fodder plant and hence subjected to destruction by grazing. Accordingly its growth is severely retarded. Plant cover not exceeding 10%.

Table 1.e. Floristic composition of *Panicum turgidum* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Calotropis procera (Ait.) Ait. f.	10	+.1
b. Dwarf shrubs and perennial herbs		
Panicum turgidum Forssk.	100	2.1
Cyperus conglomeratus Rottb.	80	1.1
Convolvulus hystrix Vahl	40	+.1
Fagonia indica Burm. f.	40	+.1
Capparis decidua (Forssk.) Edgw.	20	+.1
Abutilon pannosum (G. Forst.) Schltdl.	20	+.1
Convolvulus prostratus Forssk.	20	+.1
Lasiurus scindicus Hern.	10	+.1
Heliotropium arbainense Fresen.	10	+.1
Senna alexandrina Mill.	10	+.1
Morettia canescens Boiss.	10	+.1
Taverniera lappacea (Forssk.) DC.	10	+.1
c. Annuals and ephemerals		
Zygophyllum simplex L.	40	+.1
Arnebia hispidissima (Lehm.) DC.	10	+.1
Digera muricata (L.) Mart.	10	+.1
Dactyloctenium aegyptium (L.) P. Beauv. (Fig. 5)	10	+.1
Datura stramonium L.	10	+.1
Chloris virgata Sw.	10	+.1
Crotalaria microphylla Vahl.	10	+.1

6. Suaeda monoica-Tamarix aphylla Community

This plant assemblage prevail in saline habitats. The soil is compact, deep and fine-textured, while the ground surface is covered by aeolian sand. The few recorded associates were observed on the upper levels. Plant cover may reach 90 %.

Table 1.f. Floristic composition of *Suaeda monica-Tamarix aphylla* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Tamarix aphylla (L.) H. Karst.	100	3.2
b. Dwarf shrubs and perennial herbs		
Suaeda monoica Forssk.	100	3.3
Salsola imbricata Forssk.	60	1.2
Panicum turgidum Forssk.	20	1.1
Heliotropium curassavicum L. (Fig. 4)	10	1.1
Zygophyllum simplex L.	90	2.2
Sesuvium verrucosum Raf.	40	2.2

7. Zygophyllum simplex Community

The community dominated by this annual herb, was widely spread on the sandy plains with considerable water resources. Soils supporting the community are relatively shallow and formed mainly of fine sand. Plant cover ranges from 40 to 75%, where *Zygophyllum simplex* contributes to most of it.

Table 1.g. Floristic composition of *Zygophyllum simplex* community. P= presence value, AB= combined scale value (Braun-Blanquet, 1964).

Species	P (%)	AB
a. Shrub layer		
Not represented		
b. Dwarf shrubs and perennial herbs		
Dipterygium glaucum Decene.	50	1.1
Polycarpaea repens (Forssk.) Asch. & Schweinf.	50	1.1
Cynodon dactylon (L.) Pers.	40	1.2
Senna italica Mill.	40	1.1
Cenchrus ciliaris L.	40	+.1
Boerhavia coccinea Mill.	30	+.1
Pennisetum divisum (Gmel.) Henr.	10	+.1
Indigofera spinosa Forssk.	10	+.1
Maerua oblongifolia (Forssk.) A. Rich. (Fig. 2)	10	+.1
Forsskalea tenacissima L.	10	+.1
c. Annuals and ephemerals		
Zygophyllum simplex L.	100	3.3
Malva parviflora L.	80	1.1
Tribulus terrestris L.	60	1.1
Amaranthus graecizans L. (Fig. 1)	40	+.1
Reichardia tingitana (L.) Roth.	10	+.1
Vernonia cinerea (L.) Less.	10	+.1
Euphorbia granulata Forssk.	10	+.1
Convolvulus fatmensis Kunze	10	+.1

B. Seed bank

Seed bank studies showed that the total number of burried seeds varied greatly among the studied habitats (Table 2).

A total of 7544 seeds/m^2 was recorded in the soil collected from the deep sand plains inhabited by *Panicum turgidum* community, whereas the samples collected from the depressions occupied by *Lasiurus scindicus* contained 114576 seed/m^2.

The number of emerged seeds vary also greatly ranging from 105 in the low rocky hill habitat, occupied by *Blyttia fruticulosum* to 2110 in the habitat supporting *Lasiurus scindicus.*

Table 1: Soil characteristics and seed bank of the uppermost 2 cm of samples collected from different habitats.

Community	Soil texture			pH	Organic Matter (%)	Total Sol. Salts (%)	CO_3 (%)	Seed bank	
	Coarse Sand	Fine sand	Silt+ clay (%)					Total Seeds/m^2	Emerged Seedlings/m^2
Lasiurus scindicus	64.2	30.1	5.7	8.8	1.09	1.1	1.9	114576	2110
Calotropis procera	81.6	14.8	3.6	8.5	0.35	1.4	1.3	11520	318
Blyttia fruticulosum	88.5	8.8	2.7	9.3	0.34	2.5	1.5	10632	105
Capparis decidua	64.3	24.8	10.9	8.1	2.05	2.8	2.1	45008	400
Panicum turgidum	72.7	22.5	4.8	8.4	0.96	4.2	2.8	7544	180
Suaeda monoica - Tamarix aphylla	56.2	39.2	4.0	8.8	1.02	3.3	1.7	61920	720
Zygophyllum simplex	77.6	20.9	7.5	8.2	0.86	0.9	2.3	34800	1014

Discussion

The distribution of the recognized plant communities in the surveyed area is mainly controlled by factors affecting the soil water availability. Other factors such as woodfuel cutting play an additional role in this respect. Since soil texture, pH and organic matter content (Table 2) are not very different in the habitats of the different communities, they do not seem to play a decisive role in the zonation of these communities.

Depressions receive, relatively, high water revenue and support a plant growth dominated by shrubs or small trees (*Calotropis procera* and *Capparis decidua*). Wadis and wide runnels, where alluvial soil is deposited, support a plant growth dominated by the grassland species *Panicum turgidum* and *Lasiurus scindicus* with shrubs as associates. In shallow depressions with thin soil and rock fragments, the plant growth is dominated by *Zygophyllum simplex.* In narrow runnels crossing the low rocky hills, the soil is restricted to small pockets among the rock fragments. In this habitat abounds the *Blyttia fruticulosum* community. The halophytic vegetation is confined to the salt-affected land, hence the occurrence of *Suaeda monoica-Tamarix aphylla* community. It has been clear that the halophytic vegetation is homogenous with low number of associates compared with the xerophytic vegetation.

Local topography and grazing seem to be the main factors affecting the diversity of the soil seed bank. High values of seed bank was observed in the depressions which is

attributed to the continuous enrichment of such habitats by water-borne seeds. On the otherhand, dense grazing observed in some communities as that of *Panicum turgidum* which community was accompanied by remarkably low values of seed bank, since grazing reduces the reproductive capacity of the plants.

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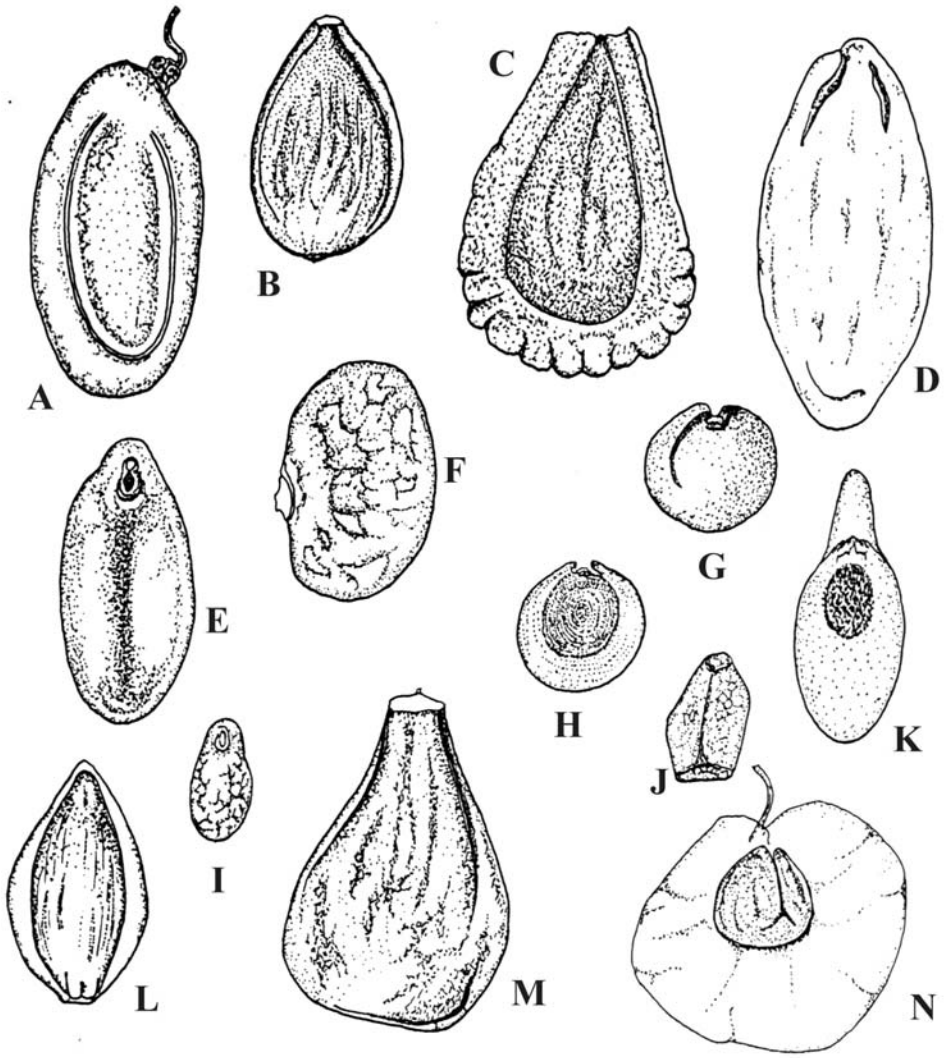

Fig. 1: Seeds of some plants growing in the area studied: A, *Acacia ehrenbergiana* (x5), B, *Cyperus conglomeratus* (x16), C, *Pergularia daemia* (x5), D, *Citrullus colocynthis* (x3), E, *Salvia aegyptiaca* (x16), F, *Tephrosia purpurea* (x6), G, *Aerva javanica* (x16), H, *Amaranthus graecizans* (x16), I, *Lindenbergia sinaica* (x16), J, *Kohautia caespitosa* (x16), K, *Cometes abyssinica* (x14), L, *Panicum turgidum* (x8), M, *Calotropis procera* (x5) and N, *Farsetia longisiliqua* (x6).

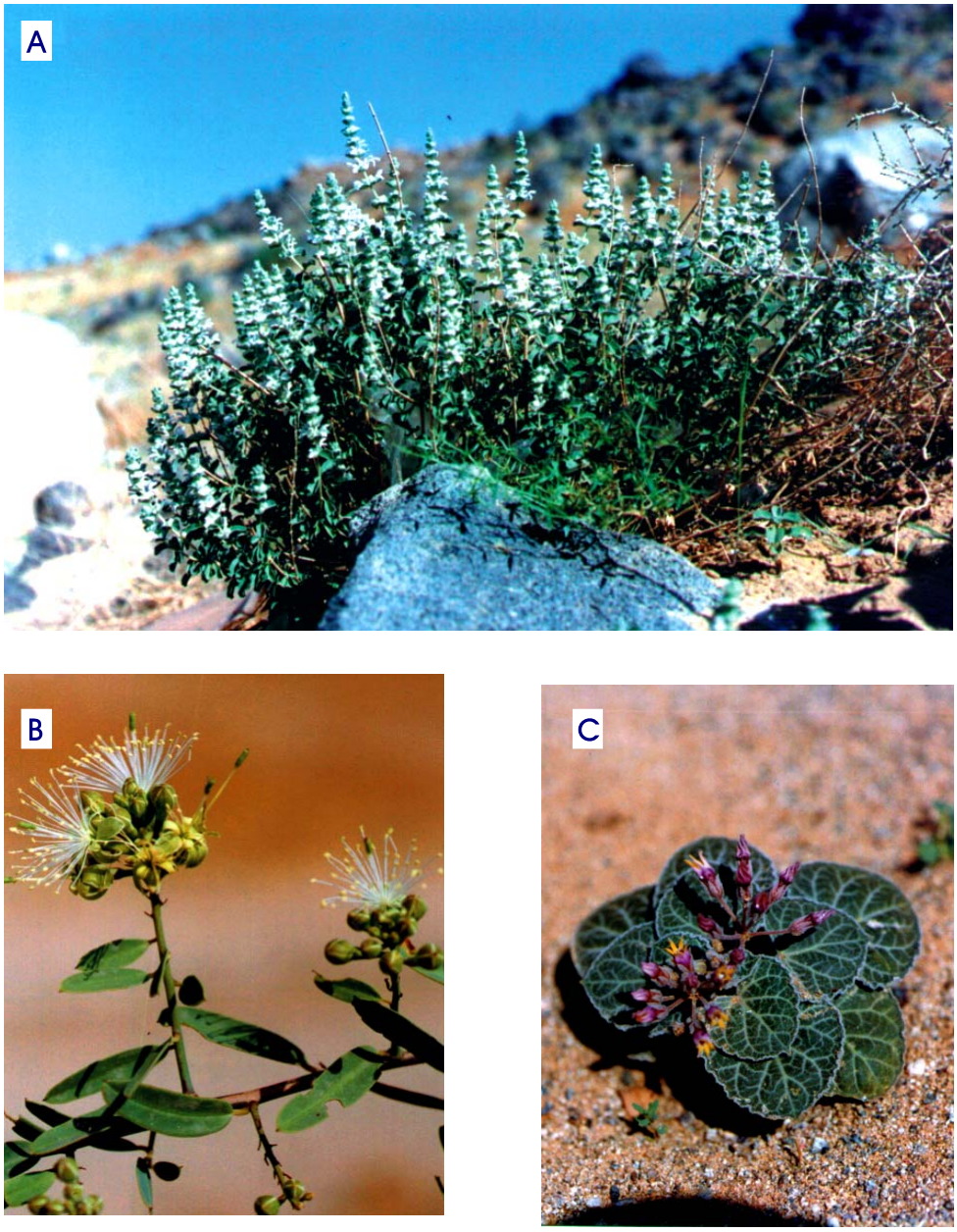

Fig. 2: Some plants were encountered in bloom: (A) *Leucas inflata*, (B) *Maerua oblongifolia*, (C) *Odontanthera radians*.

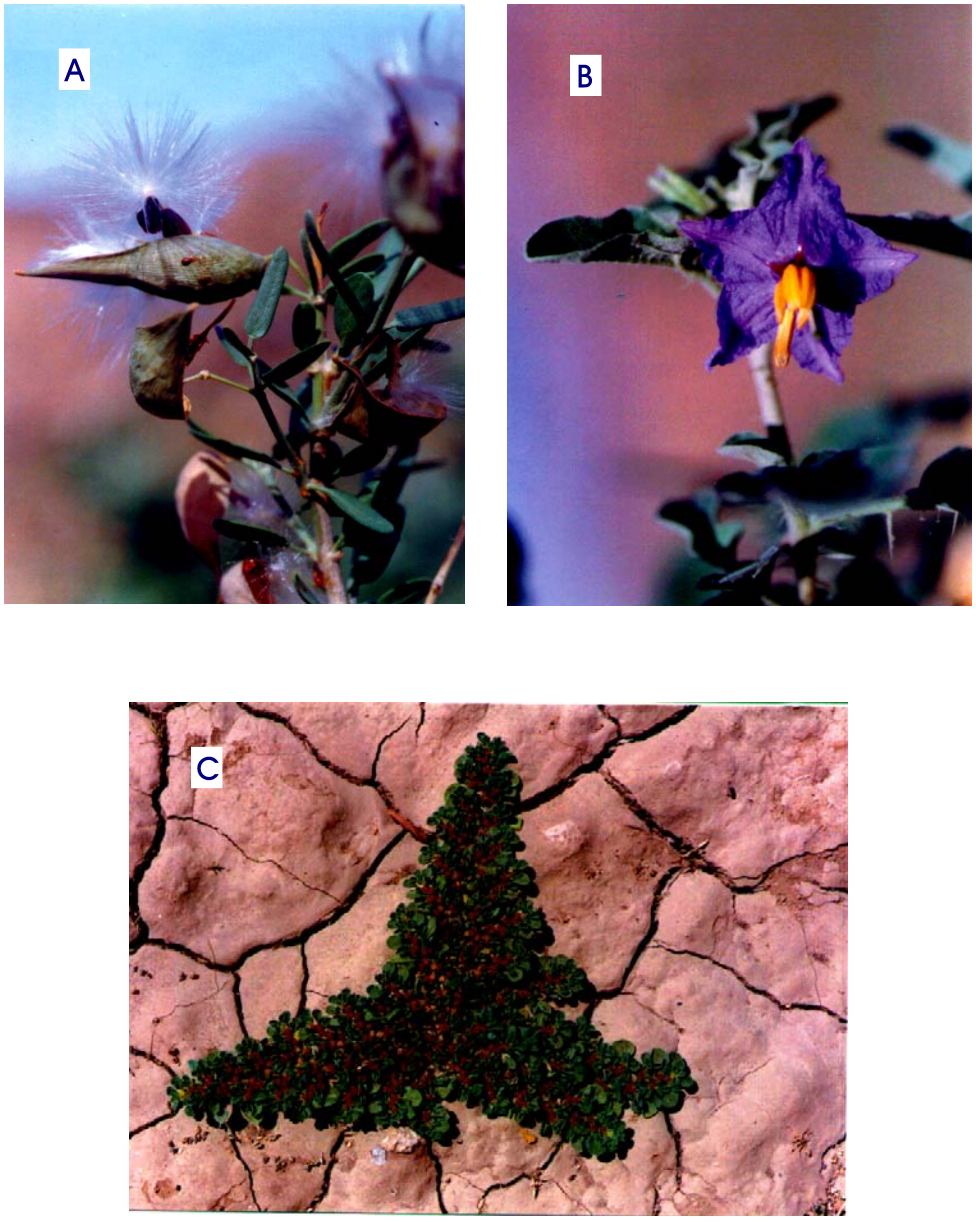

Fig. 3: Blooming or fruiting plants: A. *Blyttia fruticulosum*, B. *Solanum coagulans*, C. *Aizoon canariense* .

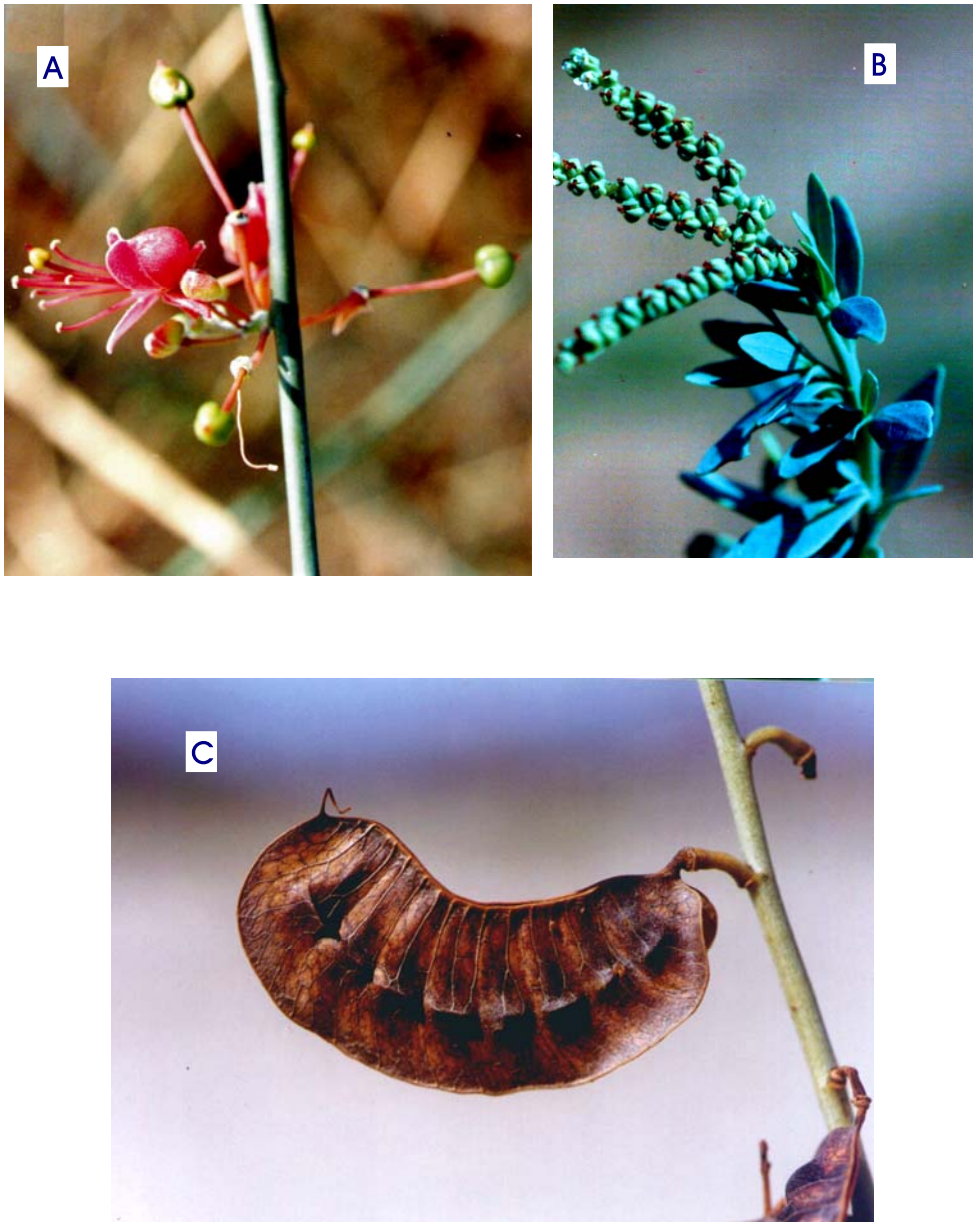

Fig. 4: Plants in full growth (flowering or fruiting): A. *Capparis decidua*, B. *Heliotropium curassavicum*, C. *Senna italica*.

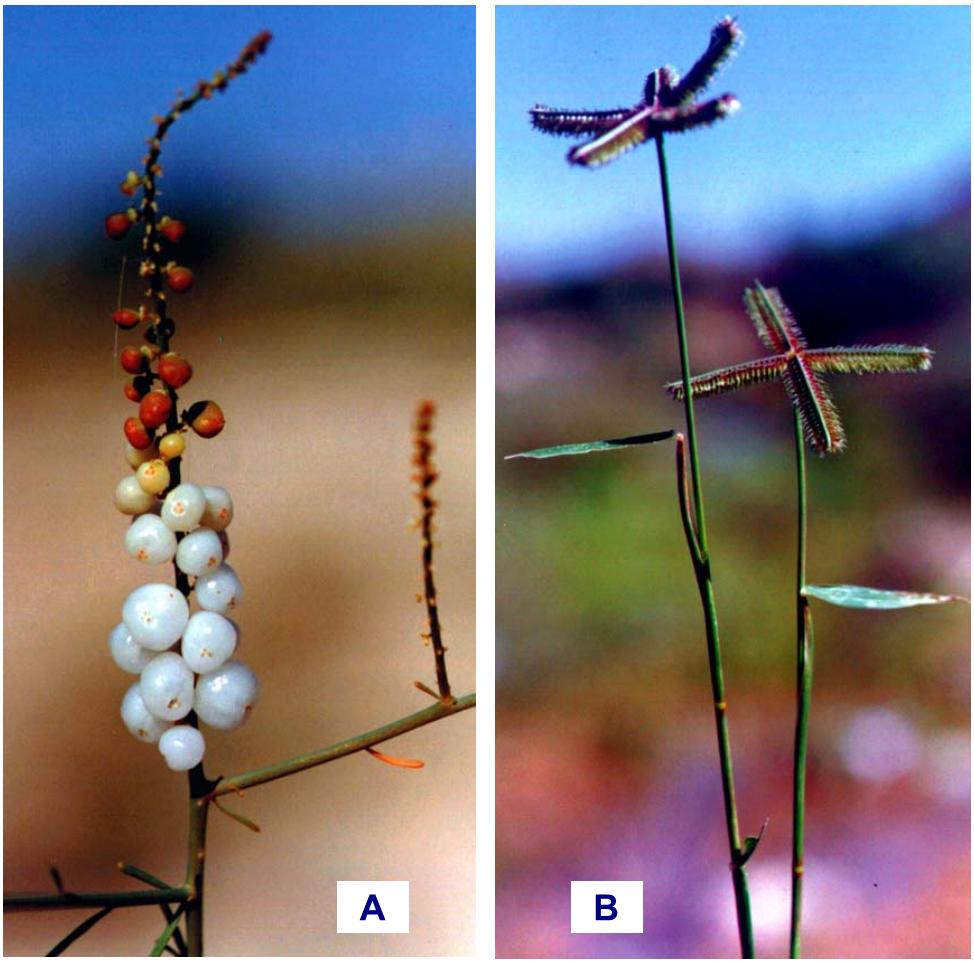

Fig. 5: Flourishing species in the vegetation of the area studied: A. *Ochradenus baccatus*, female, B. *Dactyloctenium aegyptium*.