

Floristic diversity and vegetation analysis of Wadi Arar: a typical desert Wadi of the Northern Region of Saudi Arabia

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Wadi Arar in the northern region of Saudi Arabia is one of the most important Wadis of the Kingdom. The present study provides an analysis of vegetation types, life forms, as well as **floristic** categories and species distribution. A total of 194 species representing 30 families of vascular plants were recorded. Compositae, Gramineae and Leguminosae were the most common recorded families. Therophytes and Chamaephytes are the most frequent life forms, indicating typical desert spectrum vegetation. The distribution of **species** in the different sectors of the Wadi as well as the phytochoria for the recorded species is provided. Eighty nine species (45.88%) are typically bi-regional. Furthermore, about 105 species (53.5%) are **mono- and** pluriregional taxa. The highest number of species (135 or 69.59%) was recorded for annual plants, while the lowest number of species (59 or 30.41%) was recorded for perennial, short perennial or annual to biennial species.

Key words: Kingdom of Saudi Arabia; Northern region; floristic survey; flora; Wadi Arar; floristic diversity.

Introduction

The Kingdom of Saudi Arabia is a huge arid land with an area of about 2,250,000 km² covering the major part of the Arabian Peninsula, characterized by different ecosystems and diversity of plant species (Abdel Khalik *et al.*, 2013).

The topography of Saudi Arabia, as well as that of the Arabian Peninsula, is an ancient massif in which geologic structure developed concurrently with the Alps (Country Profile: Saudi Arabia, 2006). The climate in Saudi Arabia differs greatly between the coast and the interior. High humidity coupled with more moderate temperatures is prevalent along the coast, whereas aridity and extreme temperatures characterize the interior (Country Profile: Saudi Arabia, 2006).

The word “Wadi” in this article will be used to designate a temporary river, which its runoff is dependent to rain. In the dry lands, Wadis represent one of the most prominent desert landforms, which exhibit physiographies irregularities that lead to parallel variations in distribution of plant species (Kassas and Girgis, 1964). Wadi “Arar” is considered one of the most important wadis in the northern region.

The flora of Saudi Arabia is one of the richest biodiversity in the Arabian Peninsula and comprises very important genetic resources of crops and medicinal plants (Atiqur Rahman, *et al.*, 2004). The components of this flora are an admixture of Asia, Africa and Mediterranean region's plants. According to Collenete (1999), this flora comprises 2,250 species belonging to 835 genera and about 142 families: 147 species are “endemic”, 721 species are “endangered” and about 22 species are nearly extinct.

The number of wild species occurring in a square kilometer area of Saudi Arabia is less significant, especially in areas such as central, eastern and northern regions. Areas along the northwestern and southwestern regions are densely vegetated and contain the highest number of species. Approximately 70% of the country's species are reported in these areas. Endemism in Saudi Arabia is relatively insignificant in comparison with some of the neighboring countries such as Yemen and Oman (<http://plantdiversityofsaudi-arabia.info/index.htm>).

Wild plants of Saudi Arabia were studied by many authors (Chaudhary, 1999-2001; Chaudhary and Al Jowaid, 1999; Collenete, 1999; Migahid, 1996; Miller and Cope, 1996) as general floral studies. Furthermore, many authors have studied more limited areas in the course of floral and

taxonomical revision of some genera (Aleem, 1979; Batanouny and Ismail, 1985; Fayed and Zayed, 1989; El Karemy and Zayed, 1992; Hajar *et al.*, 1998; Hegazy *et al.*, 1998; Al Wadie, 2002; Al-Turki and Al-Olayan, 2003; Atiqur Rahman *et al.*, 2004; Alfarhan *et al.*, 2005; Mosallam, 2007; Alshammari and Sharawy, 2010; El-Ghanim *et al.*, 2010; Al-Sodany *et al.*, 2011; Alatar *et al.*, 2012; Alsherif *et al.*, 2012; Farrag, 2012; Gomaa, 2012; Ihsanullah Daur, 2012; Waly *et al.*, 2012 and Abdel Khalik *et al.*, 2013).

The distribution of life form is closely related to topography and landform (Kassas and Girgis, 1965; Zohary, 1973; Orshan, 1986; Fakhireh *et al.*, 2012). In Wadis, the composition of life forms expresses a typical desert flora, the majority of species being therophytes and chamaephytes. Vegetation of wadis in general is not constant; it varies from year to year, depending upon the moisture level (Siddiqui and Al-Harbi, 1995). The establishment, growth, regeneration and distribution of the plant communities in the wadis are controlled by many factors, such as geographical position, physiographies features and human impacts (Shaltout and El-Sheikh, 2003; Kürschner and Neef, 2011; Alatar *et al.*, 2012 and Korkmaz and Ozcelik, 2013).

The current study aims to surveying and identification of the wild plant species growing in Wadi Arar and the surrounding areas in the northern region of Saudi Arabia. Moreover, the vegetation types, life forms and floristic categories of the collected species were taken into consideration. For the future reference, voucher herbarium specimens of different plant samples were deposited in the herbarium of the College of Sciences in Arar (Northern Border University).

The Study Area

The area of the present study is located in the Northern region of Saudi Arabia (30° 55' 13" N, 41° 0' 3" E). Wadi Arar (Wadi of the Anizah tribe) is one of the main Wadis which existed in the northeast of Saudi Arabia (Figure 1). It covers an area of about 9500 km square and extends next to Arar city (Map 1). According to the Worldwide Bioclimatic Classification System (<http://www.globalbioclimatics.org>), this region falls within the Mediterranean desert continental climate. This area is dry zone, characterized by hot, arid, desert climate and an average annual temperature of 21.5°C (Figure 2). Precipitation is scanty, with an average annual of 20.2 mm, which usually falls during the winter months, the extreme rainfall

occurring in January and May with more than 90 mm (<http://www.globalbioclimatics.org>).

Material and methods

This study was performed in Wadi Arar from November 2011 to April 2013 during active plant growth period, when most species were expected to be present. The wild vegetation was sampled in 25 localities including the different Wadi tributaries.

The collected plant specimens were identified according to Collenette (1999), Cope (1985), Megahid (1996), and Chaudhary (1999-2001); and deposited in the Herbarium of Biology Department, College of Sciences, Northern Border University.

Life forms of the traced species were determined according to Raunkier (1934). The floristic categories of the investigated species were made according to Wickens (1978) and Zohary (1973).

Results

Table (1) showed the plant species recorded in the different surveyed sectors of Wadi Arar. The list includes 194 species belonging to 30 families of phanerogams. Their generic representation is quite variable. Compositae, Gramineae and Cruciferae were represented with the highest number of genera as 29, 19 and 14; respectively. Five families are represented by four to eight genera (Caryophyllaceae and Leguminosae with 8 genera; Umbelliferae with 7 genera and Zygophyllaceae with 4 genera). Furthermore, eight families were represented by 2 or 3 genera and 14 families are represented by a single genus (Table 1).

From the standpoint of species richness within the described families of the region, only one family exceeded 30 species (Compositae: 48), one family was represented by 26 species (Gramineae), the third family contained 22 species (Leguminosae), two families had more than 10 species (Caryophyllaceae: 12 and Cruciferae: 17). Moreover, seven families showed eight to five species (Boraginaceae: 5, Labiatae and Zygophyllaceae: 6 each, Plantaginaceae: 7, Umbelliferae and Chenopodiaceae: 8 genera each, 2 families were represented by three species, five possessed two species only and 11 families were represented by a single species as shown in Table (1).

With regard to the growth type, the majority of the recorded species in the present study were annual plants 135 species (69.59%) of the total

recorded species. The second most recorded growth types were the perennials, which were represented by 52 species (26.80%) of the total species. The remaining growth types (biennial, annual or short-perennial and annual or biennial) in the investigated area not exceeding two species and ultimately only one species was recorded as a short-perennial (*Launaea mucronata* sp. *mucronata* Table 2 and Figure 3).

Table (2) showed the life form spectra of the recorded species according to the classification of Raunkiaer (1937). Therophytes were the most frequent life form represented by 139 species, followed by chamaephytes with 33 species and hemicryptophytes with 16 species, with a percentage of 71.65%, 17.01% and 8.24% of the total recorded species respectively. Two species were geophytes (*Cynodon dactylon* and *Polypogon maritimus*) and both cryptophytes and phanerophytes were represented only by a single species (*Reichardia tingitana* and *Calotropis procera*; respectively). Parasitic species were represented by two species from two different families (*Cuscuta campestris* and *Cistanche phelypaea*; Table (2) and Figure 4).

From a phytogeographical point of view, the recorded species in the different sectors of Wadi Arar may be classified as monoregional, biregional or pluriregional taxa. A total of 46 species representing 23.71% of the total number of recorded species were monoregional taxa of different affinities. The recorded monoregional species fall under three main phytochoria: Irano-Turanian taxa (15 species forming 7.73% of recorded species), Saharo-Sindian taxa (13 species forming 6.70% of recorded species) and Saharo-Arabian taxa (10 species forming 5.16% of recorded species). Among these, six species were typical Mediterranean species (*Atractylis carduus*, *Helichrysum conglobatum*, *Astragalus schemperenniali*, *Hippocrepis cyclocarpa*, *Plantago crassifolia* and *Ammi majus*). Mediterranean species were rarely represented in the different sectors of the Wadi. The phytochoria Sudano-Zambezian was rarely represented in the different sectors of the Wadi with only two species (*Haloxylon salicornicum* and *Eragrostis aegyptiaca*) forming 1.03% of the total number of recorded species (Table 3, Figures 5, 6).

The other 89 species (45.88 %) were biregional taxa. Both the two phytochorial regions Mediterranean-Saharo-Sindian and Mediterranean-Irano-Turanian were represented by 19 species (9.79%). Saharo-Sindian-Irano-Turanian region was represented by 17 species (8.77%). Saharo-Sindian-Sudano-Zambezian region was represented by 16 species (8.25%).

Both Mediterranean-Saharo-Arabian and Saharo-Arabian-Irano-Turanian two regions were represented by eight species (4.12%) and six species (3.09%); respectively. Irano-Turanian-Euro-Siberian region was represented by two species (*Artemisia scoparia* and *Centaurea sinaica*). Only one species was recorded in both Saharo-Arabian-Sudano-Zambezi region (*Calotropis procera*) and Mediterranean-Sudano-Zambezi region (*Hippocrepis areolata*; Table (3) and Figures 5 & 6).

Thirty nine species representing 20.10% of the recorded species were pluriregional taxa of different affinities. The recorded pluriregional species represented in three main phytochoria: Mediterranean-Saharo-Sindian-Irano-Turanian phytochorion (14 species forming 7.20% of recorded species) and both Mediterranean-Saharo-Arabian-Irano-Turanian and Mediterranean-Irano-Turanian-Euro-Siberian two phytochoria (six species for each phytochorion forming 3.09% of recorded species). Mediterranean-Irano-Turanian-Sudano-Zambezi, Mediterranean-Saharo-Sindian-Irano-Turanian-Euro-Siberian, Mediterranean-Saharo-Sindian-Irano-Turanian-Sudano-Zambezi and Saharo-Arabian-Irano-Turanian-Sudanian regions were represented by two species (1.03%) which were *Lamarckia aurea*, *Setaria pumila*; *Sisymbrium irio*, *Zilla spinosa*; *Citrullus colocynthis*, *Cistanche phelypaea* and *Stipagrostis ciliata*, *Triticum aestivum*; respectively. Only one species (0.52% of the recorded species) occurred in the following regions: Mediterranean-Saharo-Arabian-Irano-Turanian-Euro-Siberian (*Eruca sativa*), Mediterranean-Saharo-Arabian-Irano-Turanian-Sudanian (*Alhagi graecorum*), Mediterranean-Saharo-Arabian-Sudano-Zambezi (*Oligomeris linifolia*), Mediterranean-Saharo-Sindian-Sudano-Zambezi (*Rumex vesicarius*) and Saharo-Sindian-Irano-Turanian-Sudano-Zambezi (*Launaea nudicaulis*). The remaining twenty species were distributed as follows: 12 species are Cosmopolitan, followed by four Palaeotropical species and four Pantropical species (Table (3) and Figures 5 & 6).

Discussion and conclusions

In the present study, which focused on the flora of the Wadi Arar area, five of recorded families (Compositae, Gramineae, Leguminosae, Caryophyllaceae and Cruciferae) represent nearly two thirds of the total flora. The most representative families of this region were corresponded to a typical Mediterranean-North African floristic structure and this agrees with the results of study carried out by Quézel (1978).

According to Al-Hassan (2006), about 458 species which belong to these floristic structures were represented in the northern sector of the Kingdom of Saudi Arabia. In Wadi Arar area, the present survey recorded 194 species, and this represented over one third of the checklist recorded before in the whole northern region of the Kingdom. The total number of recorded genera was 129, indicating a high generic index of 1.5 (194/129). These results were conforming to those of Pielou (1975) and Magurran (1988), where the taxonomic diversity is higher in an area in which the species were belonging to many genera. Species diversity in Wadi Arar is 1.5 for species/genera ratio and 6.3 for genera/families. This indicates higher species diversity in the studied region than in other areas (Tables 1& 2). This high diversity was due to the abundance of water sources, soil fertility and the diversity of relief (open shallow valleys, mountains and sand dunes) as mentioned by Al-Shammari (2010) and Al-Shammari and Sharawy (2010).

The natural vegetation in the study area comprised 194 plant species, including 135 annuals (69.59%) and 52 perennials (26.80%). The highest contribution of annuals can be attributed to their short life cycle that enables them to resist the instability of the ecosystem (Gomaa, 2012). Moreover, they were generally characterized by a high allocation of resources to the reproductive organs (Harper, 1977) and the production of flowers early in their lifespan to ensure some seed production even in a year when the growing season is cut short (Sans and Masalles, 1995). These results corroborated previous studies focusing on a Hail province (Al-Turki and Al-Olayan, 2003; Sharawy and Al-Shammari, 2009 and Al-Shammari and Sharawy, 2010).

The vegetation of northern region has no appreciable contribution to the flora of Saudi Arabia with regard to other parts of the country (Al-Turki and Al-Olayan 2003). It is also dominated by annual species. The studied area was widely regarded as a transition zone between the floristic regions of the Mediterranean, Irano-Turanian and Saharo-Sindian, Saharo-Arabian or

Sudano-Zambezian regions. The influences of these phytogeographical zones were very much reflected in the flora of the Northern region. The other floristic elements such as cosmopolitan, pantropical, palaeotropical, Euro-Siberian and Sudanian elements were represented by a variable number of species reflecting their differential capability to penetrate the region (AI-Turki and AI-Olayan 2003).

Among the recorded species from this region, some were extremely rare and poorly known and their results reveal that some of these plants had been collected from a single locality (*Calotropis procera*, *Gypsophila* sp. and *Cistanche phelypaea*), while others have been collected in the studied area only once or twice (*Aerva javonica*, *Anthemis* sp., *Koelpinia linearis*, *Solanum nigrum* and *Anagallis arvensis*), this results supported by the earlier one on the same area carried out by AI-Turki and AI-Olayan (2003).

Regarding the life forms spectra, therophytes had the highest contribution, followed by chamaephytes, hemicryptophytes, parasites, geophytes and finally both phanerophytes and cryptophytes (Tables 1, 2 and Figure 4). The life form of desert plants is closely linked with rainfall, topography and land form (Kassas and Girgis, 1965; Zohary, 1973; Orshan, 1986). Therophytes (which had a lifespan as short as few weeks) as *Amaranthus viridis*, *Cleome amblyocarpa*, *Calendula arvensis* species recorded in this area, are characteristic of desert regions (Gomaa, 2012).

Considering the florists categories in the study area, the results indicate that Irano-Turanian elements predominate the studied area (97 species, 49.5%), and were represented as mono-regional (15 species, 7.73%), bi-regional under the influence of Mediterranean, Saharo-Arabian, Euro-Siberian and Saharo-Sindian regions (44 species, 22.68%) and Pleuriregionals under the influence of Mediterranean, Saharo-Sindian, SaharoArabian, Euro-Siberian, Sudano-Zambezian and Sudanian regions (37 species, 19.07 %). Mediterranean region was represented by 89 species (or 45.88%), followed by Saharo-Sindian region (85 species, 43.81%), followed by Sudano-Zambezian region (45 species, 23.20%) and at last SaharoArabian region (36 species, 18.56%). Taxa of wide geographical range, like Cosmopolitan (12 species, 6.18%), Palaeotropical (4 species, 2.06%) and Pantropical (4 species, 2.06%), has apparently lower presence value (Table 3).

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http://sa.geoview.info/sha_ib_ushbah,408372



Figure 1. Location map of Saudi Arabia showing the Northern Region.

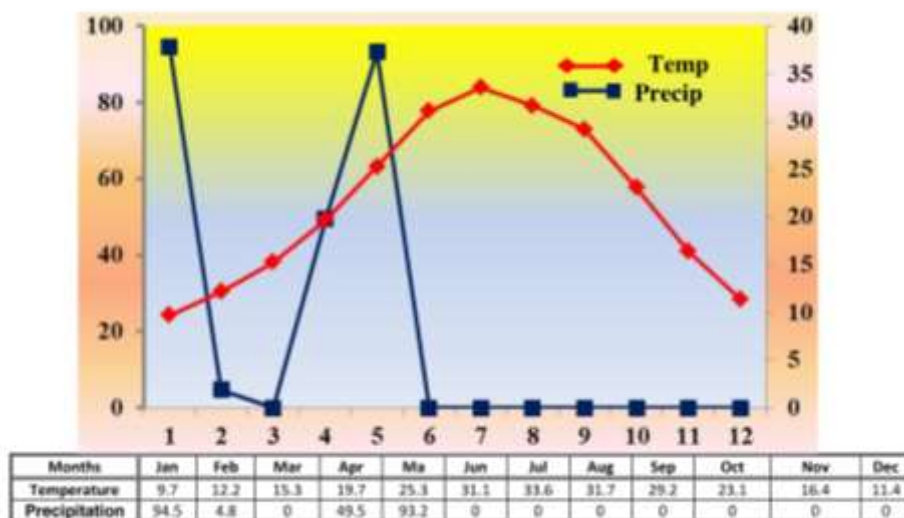


Figure 2. Climate diagram for Arar, Northern Border Region, Saudi Arabia.

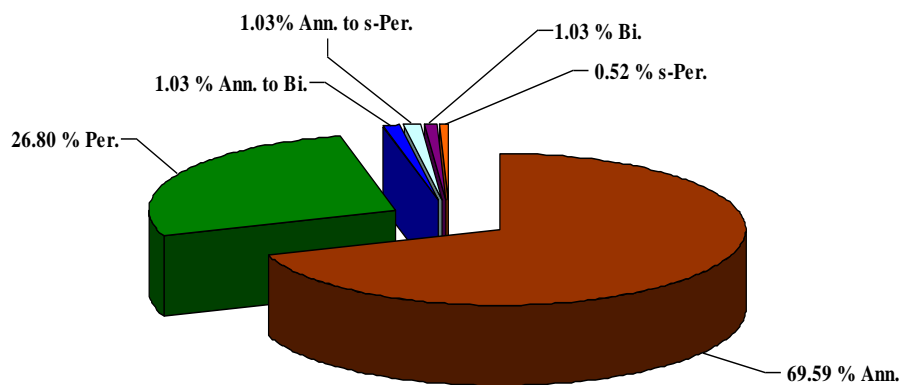


Figure 3. Vegetation type relative spectrum of Wadi Arar vegetation: A. = annual; Bi. = Biennial; P. = Perennial; s-P. = short Perennial.

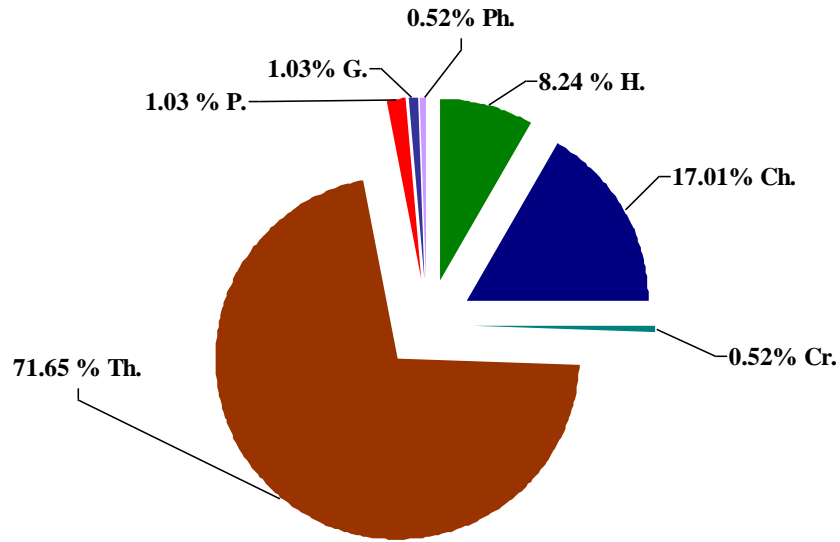


Figure 4. Life form relative spectrum of Northern region vegetation of Saudi Arabia. Th. = Therophyte, Ph. = Phanerophyte, H. = Hemicryptophyte, P. = Parasite and G. = Geophyte.

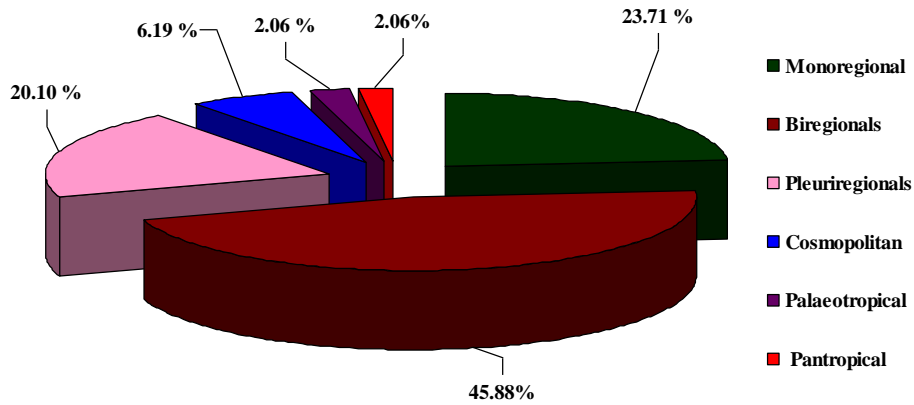


Figure 5. Floristic category spectrum of Wadi Arar according to number of vegetation regions.

Table (1). List of recorded species in the study area with their families, vegetation type, life form and floristic categories.

- **Vegetation type (V. t.):** **A.** = annual; **Bi.** = Biennial; **P.** = Perennial; **s-P.** = short Perennial.
- **Life form (L. f.):** **Ch** = Chamaephytes; **Cr** = Cryptophytes; **G** = Geophytes; **H** = Hemicryptophytes; **P** = Parasites; **Ph** = Phanerophytes; **Th** = Therophytes.
- **Floristic categories (the Chorotypes):** **COSM** = Cosmopolitan; **EU-SI** = Euro-Siberian; **IR-TR** = Irano-Turanian; **ME** = Mediterranean; **PAL** = Palaeotropical; **PAN** = Pantropical; **S-Z** = Sudano-Zambeian; **SA** = SaharoArabian; **SA-SI** = Saharo-Sindian; **SU** = Sudanian; **TR** = Tropical.

Family	Species	V. t.	L. f.	Floristic Categories
Aizoaceae	<i>Aizoon canariense</i> L.	P.	H	SA-SI + S-Z
Amaranthaceae	<i>Aerva javonica</i> (Burm. f.) Juss. ex Scult.	P.	Ch	SA-SI + S-Z
	<i>Amaranthus graecizans</i> L.	A.	Th	PAL
	<i>Amaranthus viridis</i> L.	A.	Th	COSM
Asclepiadaceae	<i>Calotropis procera</i> (Aiton) W. T. Aiton	P.	Ph	SA + S-Z
	<i>Pergularia tomentosa</i> L.	P.	Ch	SA-SI + S-Z
Boraginaceae	<i>Arnebia decumbens</i> (Vent.) Coss. & Kralik var. <i>decumbens</i>	A.	Th	SA-SI + S-Z
	<i>Arnebia decumbens</i> (Vent.) Coss. & Kralik var. <i>macrocalyx</i> Coss. & Kralik	A.	Th	SA-SI + S-Z
	<i>Arnebia linearifolia</i> A. DC.	A.	Th	SA-SI + S-Z
	<i>Heliotropium bacciferum</i> Forssk. subsp. <i>bacciferum</i> var. <i>bacciferum</i>	P.	Ch	SA-SI + S-Z
Caryophyllaceae	<i>Gypsophila capillaris</i> (Forssk.) C. Chr.	A.	Th	SA
	<i>Gypsophila linearifolia</i> (Fisch. & C. A. Mey.) Boiss.	A.	Th	IR-TR
	<i>Gypsophila viscosa</i> Murray	A.	Th	IR-TR
	<i>Herniaria hemistemon</i> J. Gay	P.	Th	ME + SA-SI
	<i>Herniaria hirsuta</i> L.	A.	Th	ME + SA-SI
	<i>Paronychia arabica</i> (L.) DC.	A.	Th	ME + SA-SI + IR-TR
	<i>Polycarpaea robbairea</i> (Kuntze) Greuter & Burdet	P.	H	SA-SI + S-Z
	<i>Polycarpon tetraphyllum</i> (L.) L.	A.	Th	ME + SA-SI + IR-TR
	<i>Pteranthus dichotomus</i> Forssk.	A.	Th	ME + SA + IR-TR
	<i>Silene arabica</i> Boiss.	A.	Th	SA-SI
	<i>Spergularia diandra</i> (Guss.) Boiss.	A.	Th	ME + SA + IR-TR
	<i>Spergularia marina</i> (L.) Griseb.	A.	Th	ME + IR-TR
Chenopodiaceae	<i>Atriplex leucoclada</i> Boiss. var. <i>turcomanica</i> (Moq.) Zohary.	P.	Ch	ME + SA-SI
	<i>Bassia eriophora</i> (Schrud.) Asch.	A.	Th	SA + IR-TR
	<i>Chenopodium ambrosioides</i> L.	Bi.	Th	COSM
	<i>Chenopodium murale</i> L.	A.	Th	COSM
	<i>Haloxylon salicornicum</i> (Moq.) Bunge ex Boiss.	P.	Ch	S-Z
	<i>Salsola villosa</i> Delile ex Schult.	P.	Ch	ME+ SA-SI + IR-TR
	<i>Salsola volkensii</i> Schweinf. & Asch.	P.	Ch	COSM
	<i>Suaeda pruinosa</i> Lange	P.	Ch	ME + SA
Cistaceae	<i>Helianthemum lippii</i> (L.) Dum. Cours.	P.	Ch	SA-SI + S-Z

	<i>Helianthemum vesicarium</i> Boiss.	P.	Ch	SA
Cleomaceae	<i>Cleome amblyocarpa</i> Barratte & Murb.	A.	Th	SA-SI + S-Z
Compositae	<i>Anthemis arvensis</i> L.	A.	Th	SA
	<i>Anthemis cotula</i> L.	A.	Th	SA
	<i>Anthemis deserti</i> Boiss.	A.	Th	ME + SA
	<i>Anthemis melampodina</i> Delile.	A.	Th	ME + SA
	<i>Anthemis pseudocotula</i> Boiss.	A.	Th	ME + SA
	<i>Anthemis scrobicularis</i> Yavin.	A.	Th	ME+ SA-SI + IR-TR
	<i>Artemisia judaica</i> L.	P.	Ch	SA
	<i>Artemisia monosperma</i> Delile.	P.	Ch	ME + SA
	<i>Artemisia scoparia</i> Waldst. & Kit.	P.	Ch	IR-TR + EU-SI
	<i>Atractylis carduus</i> (Forssk.) C. Chr. var. <i>angustifolia</i> Täckh. & Boulos.	P.	Th	ME
	<i>Calendula arvensis</i> L.	A.	Th	ME+ SA-SI + IR-TR
	<i>Calendula tripterocarpa</i> Rupr.	A.	Th	PAN
	<i>Carthamus nitidus</i> Boiss.	A.	Th	SA + IR-TR
	<i>Carthamus oxyacantha</i> M. Bieb.	A.	Th	ME + IR-TR
	<i>Centaurea pseudosinaica</i> Czerp.	A.	Th	IR-TR
	<i>Centaurea sinaica</i> DC.	A.	Th	IR-TR+ EU-SI
	<i>Chamaemelum mixtum</i> (L.) All.	A.	Th	ME + SA
	<i>Cotula anthemoides</i> L.	A.	Th	SA
	<i>Cotula cinerea</i> Delile.	A.	Th	SA- SI
	<i>Crepis nigricans</i> Viv.	A.	Th	SA
	<i>Filago desertorum</i> Pomel	A.	Th	SA-SI + IR-TR
	<i>Garhadiolus angulosus</i> Jaub. & Spach.	A.	Th	ME + IR-TR
	<i>Glebionis coronaria</i> (L.) Tzvelv. (= <i>Chrysanthemum coronarium</i> L.)	A.	H	ME + SA-SI
	<i>Gymnarrhena micrantha</i> Desf.	A.	Th	ME + SA-SI
	<i>Helichrysum conglobatum</i> (Viv.) Steud.	P.	Th	ME
	<i>Homognaphalium pulvinatum</i> (Delile.) Fayed & Zareh.	A.	Th	SA-SI+ IR-TR
	<i>Ifloga spicata</i> (Forssk.) Sch. Bip. subsp. <i>albescens</i> Chrtk.	A.	Th	ME + SA-SI
	<i>Koelpinia linearis</i> Pall.	A.	Th	ME + SA + IR-TR
	<i>Lactuca serriola</i> L.	A./Bi.	Th	IR-TR
	<i>Lasiopogon muscoides</i> (Desf.) DC.	A.	Th	ME+SA-SI
	<i>Launaea capitata</i> (Spreng.) Dandy	A.	Th	ME+SA-SI
	<i>Launaea fragilis</i> (Asso) Pau subsp. <i>fragilis</i> (= <i>L. tenuiloba</i> (Boiss.) Kuntze)	A.	Th	ME+SA-SI
	<i>Launaea mucronata</i> (Forssk.) Muschl. subsp. <i>mucronata</i>	s-P.	Th	SA-SI + IR-TR
	<i>Launaea nudicaulis</i> (L.) Hook.f.	P.	Th	SA-SI + IR-TR + S-Z
	<i>Leontodon hispidulus</i> (Delile.) Boiss.	A.	Th	ME + SA-SI
	<i>Leontodon laciniatus</i> (Bertol.) Widder.	A.	Th	ME + SA-SI
	<i>Matricaria aurea</i> (Loefl.) Sch. Bip.	A.	Th	SA-SI
	<i>Nauplius graveolens</i> (Forssk.) Wiklund. (= <i>Asteriscus graveolens</i> (Forssk.) Less.)	P.	Ch	ME + SA-SI
	<i>Picris altissima</i> Delile.	A.	Th	ME + SA
	<i>Picris asplenioides</i> L.	A.	Th	ME + IR-TR
	<i>Picris cyanocarpa</i> Boiss.	A.	Th	SA
	<i>Pseudognaphalium luteoalbum</i> (L.) Hilliard & B. L. Burt	A.	Th	ME + SA + IR-TR
	<i>Reichardia tingitana</i> (L.) Roth	P.	Cr	ME+ SA-SI + IR-TR
	<i>Senecio belbeysius</i> Delile.	A.	Th	ME+ IR-TR + EU-SI

	<i>Senecio glaucus</i> L. subsp. <i>coronipifolius</i> (Maire) C. Alexander (= <i>S. desfontainei</i> Druce)	A.	Ch	SA-SI + IR-TR
	<i>Sonchus oleraceus</i> L.	A.	Th	COSM
	<i>Sonchus tenerrimus</i> L.	A.	Th	COSM
	<i>Urospermum picroides</i> (L.) F.W. Schmidt	A.	Th	ME + IR-TR
Convolvulaceae	<i>Convolvulus arvensis</i> L.	P.	H	PAL
	<i>Cuscuta campestris</i> Yunck.	P.	P	SA-SI + S-Z
Cruciferae	<i>Arabidopsis kneuckeri</i> (Bornm.) O. E. Schulz	A.	Th	SA-SI
	<i>Carrichtera annua</i> (L.) DC.	A.	Th	ME + SA-SI
	<i>Coronopus didymus</i> (L.) Sm.	A./Bi.	Th	SA
	<i>Diptotaxis acris</i> (Forssk.) Boiss.	A.	Th	ME + IR-TR
	<i>Enarthrocarpus strangulatus</i> Boiss.	A.	Th	SA-SI
	<i>Eruca sativa</i> Mill.	A.	Th	ME + SA+ IR-TR + EU-SI
	<i>Erucaria crassifolia</i> (Forssk.) Delile	A.	Th	ME + SA-SI
	<i>Erucaria hispanica</i> (L.) Druce	A.	Th	ME + SA-SI
	<i>Farsetia aegyptia</i> Turra	P.	Ch	SA-SI+S-Z
	<i>Farsetia stylosa</i> R. Br.	A./s-P.	Th	SA-SI
	<i>Horwoodia dicksoniae</i> Turril	A.	Th	SA-SI
	<i>Matthiola arabica</i> Boiss.	A.	Th	SA
	<i>Matthiola longipetala</i> (Vent.) DC.	A.	Th	ME + IR-TR
	<i>Savignya praviflora</i> (Delile) Webb	A.	Th	SA-SI + IR-TR
	<i>Schimpera arabica</i> Hochst. & Steud. ex Endl.	A.	Th	SA-SI
	<i>Sisymbrium irio</i> L.	A.	Th	ME + SA-SI + IR-TR + EU-SI
	<i>Zilla spinosa</i> (L.) Prantl subsp. <i>spinosa</i>	P.	Ch	ME + SA-SI + IR-TR + EU-SI
Cucurbitaceae	<i>Citrullus colocynthis</i> (L.) Schrad.	P.	H	ME+SA-SI + IR-TR+ S-Z
Euphorbiaceae	<i>Euphorbia peplus</i> L.	A.	Th	COSM
	<i>Euphorbia prostrata</i> Aiton	A.	Th	ME + SA-SI + IR-TR
	<i>Euphorbia serpens</i> Kunth.	A.	Th	SA-SI + IR-TR
Fumariaceae	<i>Hypecoum pendulum</i> L.	A.	Th	ME + IR-TR
Geraniaceae	<i>Erodium crassifolium</i> L'Hér. (= <i>E. hirtum</i> (Forssk.) Willd.).	P.	Th	SA-SI
Gramineae	<i>Agropyron cristatum</i> (L.) Gaertn.	P.	H	IR-TR
	<i>Bromus scoparius</i> L.	A.	Th	ME + SA-SI + IR-TR
	<i>Bromus tectorum</i> L.	A.	Th	COSM
	<i>Cutandia memphitica</i> (Spreng.) Benth.	A.	Th	ME + IR-TR
	<i>Cynodon dactylon</i> (L.) Pers.	P.	G	PAN
	<i>Enneapogon lophotrichus</i> Chiov. ex H. Scholz & P. König	A.	Th	IR-TR
	<i>Eragrostis aegyptiaca</i> (Willd) Delile.	A.	Th	S-Z
	<i>Eremopyrum bonaepartis</i> (Spreng.) Nevski	A.	Th	IR-TR
	<i>Eremopyrum distans</i> (K. Koch) Nevski	A.	Th	IR-TR
	<i>Hordeum murinum</i> L. subsp. <i>glaucum</i> (Steud.) Tzvelev	A.	Th	ME + IR-TR
	<i>Hordeum murinum</i> L. subsp. <i>leporinum</i> (Link.) Arcang.	A.	Th	ME + IR-TR
	<i>Lamarckia aurea</i> (L.) Moench	A.	Th	ME + IR-TR + S-Z
	<i>Lolium multiflorum</i> Lam.	A.	Th	ME+ IR-TR + EU-SI
	<i>Lolium perenne</i> L.	A.	Th	COSM
	<i>Lolium rigidum</i> Gaudin	A.	Th	ME + IR-TR
	<i>Parapholis incurva</i> (L.) C.E. Hubb	A.	Th	ME+ IR-TR + EU-SI
	<i>Phalaris paradoxa</i> L.	A.	Th	ME + IR-TR

	<i>Poa annua</i> L.	A./s-P.	Th	ME+ IR-TR + EU-SI
	<i>Polypogon maritimus</i> Willd.	A.	G	COSM
	<i>Polypogon monspeliensis</i> (L.) Desf.	A.	Th	ME + SA-SI + IR-TR
	<i>Rostraria pumila</i> (Desf.) Tzvelev.	A.	Th	ME + SA-SI
	<i>Schismus arabicus</i> Nees.	A.	Th	ME + SA + IR-TR
	<i>Schismus barbatus</i> (L.) Thell.	A.	Th	ME + SA-SI + IR-TR
	<i>Setaria pumila</i> (Poir.) Roem. & Schutt.	A.	Th	ME + IR-TR + S-Z
	<i>Stipagrostis ciliata</i> (Desf.) De Winter	P.	H	SA + IR-TR + SU
	<i>Triticum aestivum</i> L.	A.	Th	SA + IR-TR + SU
Labiatae	<i>Phlomis brachyodon</i> (Boiss.) Zoh.	P.	H	IR-TR
	<i>Salvia aegyptiaca</i> L.	P.	Ch	SA-SI + S-Z
	<i>Salvia lanigera</i> Poir.	P.	Ch	ME + SA-SI
	<i>Salvia spinosa</i> L.	P.	H	ME + IR-TR
	<i>Teucrium oliverianum</i> Ging. ex. Benth.	P.	Ch	COSM
	<i>Teucrium polium</i> L.	P.	Ch	ME + IR-TR
Leguminosae	<i>Alhagi graecorum</i> Boiss.	P.	Ch	ME + SA + IR-TR + SU
	<i>Astragalus bombycinus</i> Boiss.	A.	H	SA-SI+ IR-TR
	<i>Astragalus corrugatus</i> Bertol. subsp. <i>corrugatus</i>	A.	Th	IR-TR
	<i>Astragalus hauarensis</i> Boiss.	A.	H	IR-TR
	<i>Astragalus schimperi</i> Boiss. var. <i>subsessilis</i>	A.	Th	ME
	<i>Astragalus sieberi</i> DC.	P.	Ch	SA + IR-TR
	<i>Astragalus spinosus</i> (Forssk.) Muschl.	P.	Ch	SA-SI + IR-TR
	<i>Astragalus tribuloides</i> Delile var. <i>tribuloides</i>	A.	Th	SA-SI + IR-TR
	<i>Hippocrepis areolata</i> Desv.	A.	Th	ME + S-Z
	<i>Hippocrepis cyclocarpa</i> Murb.	A.	Th	ME
	<i>Hippocrepis multisiliquosa</i> L.	A.	Th	IR-TR
	<i>Medicago laciniata</i> (L.) Mill. var. <i>brachyacantha</i> Boiss.	A.	Th	SA-SI
	<i>Medicago laciniata</i> (L.) Mill. var. <i>laciniata</i>	A.	Th	SA-SI
	<i>Medicago monspeliaca</i> (L.) Trautv.	A.	Th	ME + IR-TR
	<i>Medicago polymorpha</i> L.	A.	Th	ME+ IR-TR + EU-SI
	<i>Melilotus albus</i> Medik.	A.	Th	ME + SA + IR-TR
	<i>Melilotus indicus</i> (L.) All.	A.	Th	PAL
	<i>Onobrychis ptolemaica</i> (Delile.) DC.	P.	H	IR-TR
	<i>Tephrosia purpurea</i> (L.) Pers. subsp. <i>Leptostachya</i> (DC.) Brummitt, Bol.	P.	Ch	SA-SI + S-Z
	<i>Trigonella hamosa</i> L.	A.	Th	ME + SA-SI
	<i>Trigonella laciniata</i> L.	A.	Th	ME + SA-SI + IR-TR
	<i>Trigonella stellata</i> Forssk.	A.	Th	SA-SI + IR-TR
Malvaceae	<i>Malva parviflora</i> L.	A.	Th	PAN
Orobanchaceae	<i>Cistanche phelypaea</i> (L.) Cout.	P.	P	ME+SA-SI + IR-TR+ S-Z
Plantaginaceae	<i>Plantago amplexicaulis</i> Cav. subsp. <i>Bauphula</i> (Edgew.) Rech. f.	A.	Th	SA-SI + IR-TR
	<i>Plantago ciliata</i> Desf.	A.	Th	ME + SA-SI + IR-TR
	<i>Plantago crassifolia</i> Forssk.	A.	H	ME
	<i>Plantago lagopus</i> L.	A.	Th	ME + IR-TR
	<i>Plantago lanceolata</i> L.	A.	Th	ME + SA-SI+ IR-TR
	<i>Plantago ovata</i> Forssk.	A.	Th	SA + IR-TR
	<i>Plantago psammophila</i> Agnew & Chalibi-Ka, bi.	A.	Th	SA-SI + IR-TR
Polygonaceae	<i>Emex spinosa</i> (L.) Campd.	A.	Th	PAN
	<i>Polygonum equisetiforme</i> Sm.	A.	Ch	M + IR-TR
	<i>Rumex vesicarius</i> L.	P.	Th	ME + SA-SI + S-Z
Portulacaceae	<i>Portulaca oleracea</i> L.	A.	Th	ME + SA-SI
Primulaceae	<i>Anagallis arvensis</i> L. var. <i>arvensis</i>	A.	Th	ME+ IR-TR + EU-SI

Resedaceae	<i>Oligomeris linifolia</i> (Vahl ex Hornem.) J. F. Macbr. (= <i>Reseda linifolia</i> Vahl ex Hornem.)	A.	Th	ME + SA + S-Z
	<i>Reseda muricata</i> C. Presl.	A.	Th	SA-SI + IR-TR
Scrophulariaceae	<i>Veronica polita</i> Fr. (= <i>V. didyma</i> sensu auct)	A.	Th	M + IR-TR
Solanaceae	<i>Hyoscyamus muticus</i> L.	P.	Ch	SA-SI + IR-TR
	<i>Solanum nigrum</i> L.	P.	Ch	COSM
Umbelliferae	<i>Ammi majus</i> L.	A.	Th	ME
	<i>Anisosciadium isosciadium</i> Bornm.	A.	Th	SA + IR-TR
	<i>Anisosciadium lanatum</i> Boiss.	A.	Th	SA + IR-TR
	<i>Deverra tortuosa</i> (Desf.) DC.	P.	Ch	SA-SI
	<i>Ducrosia anethifolia</i> (DC.) Boiss.	P.	Th	IR-TR
	<i>Ferula ovina</i> (Boiss.) Boiss.	P.	Ch	IR-TR
	<i>Petroselinum crispum</i> (Mill.) A. W. Hill. = <i>P. Sativum</i> (L.) P. Hoffm.	Bi.	Th	PAL
	<i>Tordylium aegyptiacum</i> (L.) Poir.	A.	Th	ME + SA
Urticaceae	<i>Forsskaolea tenacissima</i> L.	A.	H	SA-SI + S-Z
Zygophyllaceae	<i>Fagonia bruguieri</i> DC.	P.	H	SA-SI + IR-TR
	<i>Fagonia glutinosa</i> Delile	P.	H	SA-SI
	<i>Peganum harmala</i> L.	P.	H	ME + SA-SI + IR-TR
	<i>Tribulus macropterus</i> Boiss.	A.	Ch	SA-SI + IR-TR
	<i>Tribulus megistopterus</i> Kralik.	A.	Ch	SA-SI + IR-TR
	<i>Zygophyllum simplex</i> L.	A.	Th	SA-SI + S-Z

Table (2). Summary table showing the total number of families, genera and species, growth types and life forms of collected plants.

Total number of			Growth type			Life forms		
Families	Genera	Species	Type	Number of species	Percentage (%)	Form	Number of species	Percentage (%)
30	129	194	Annual	135	69.59	H	16	8.24
			Perennial	52	26.80	Ch	33	17.01
			Biennial	2	1.03	Ph	1	0.52
			Annual or short-Perennial	2	1.03	Th	139	71.65
						P	2	1.03
			Annual or Biennial	2	1.03	G	2	1.03
						Cr	1	0.52
			short-Perennial	1	0.52			
Total Number	194	100%	Total Number	194	100%			

Table (3). The number of recorded species belonging to the main floristic categories and their relevant percent (%) abbreviations.

Phytochoria	Number of species	Percentage (%)
Monoregional		
ME	06	3.09
SA-SI	13	6.70
IR-TR	15	7.73
SA	10	5.16
S-Z	02	1.03
Total	46	23.71
Biregionals		
SA-SI + S-Z	16	8.25
SA + S-Z	01	0.52
ME + SA-SI	19	9.79
ME + IR-TR	19	9.79
SA + IR-TR	06	3.09
ME + SA	08	4.12
IR-TR + EU-SI	02	1.03
SA-SI + IR-TR	17	8.77
ME + S-Z	01	0.52
Total	89	45.88
Pleuriregionals		
ME + SA-SI + IR-TR	14	7.20
ME + SA + IR-TR	06	3.09
ME+ IR-TR + EU-SI	06	3.09
ME + IR-TR + S-Z	02	1.03
ME + SA-SI + IR-TR + EU-SI	02	1.03
ME+SA-SI + IR-TR+ S-Z	02	1.03
ME + SA+ IR-TR + EU-SI	01	0.52
ME + SA + IR-TR + SU	01	0.52
ME + SA + S-Z	01	0.52
ME + SA-SI + S-Z	01	0.52
SA-SI + IR-TR + S-Z	01	0.52
SA + IR-TR + SU	02	1.03
Total	39	20.10
Cosm	12	6.19
Pal	04	2.06
Pan	04	2.06
Total	20	10.31