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Wild plants diversity of Red Sea coastal region, Tabuk, Saudi Arabia

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ABSTRACT

Tabuk Red Sea coastal region; lies in the northern west part of Saudi Arabia with 500 Km length were regularly visited during 2015 for plants collection. Life forms and vegetation types were also recorded. This paper provides the first quantitative analysis of plant species diversity of Tabuk Red Sea coastal region. A total of 82 plant species belong to 66 genera and 30 families were recorded. The family Asteraceae is represented by the highest number of species (9 species) followed by Fabaceae (8 species); Brassicaceae & Zygophyllaceae (7 species); Chenopodiaceae & Poacea (6 species); Resedaceae (5 species); Boraginaceae (4 species) and Asclepediaceae & Caryophyllaceae (3 species). Four families are represented by two species while 16 families are represented only by one species each. The chamaephytes and therophytes are the dominating life form of the vegetation spectra, indicating typical desert spectrum vegetation. Chamaephytes represent by 32.92 % while therophytes represent 29.27% of the total species in the study area. The highest number of species (57.32%) was recorded for perennial, while annual species was recorded 42.68%. Chronological analysis of the vegetation in the area revealed the domination of Saharo-Arabian representing by 23 species (28.05%), followed by Irano -Turanian taxa by 6 species (7.32%) and Sudanian taxa by 5 species (6.10%). Mediterranean species were rarely represented with only two species (2.44%) while Saharo-Sindian, Tropical, American, Sudano-Zambezian and Sahelian Somali-Masai taxa are represented by one species (1.22%). Species of Saharo-Arabian- Sudano-Zambezian elements together have high share of species representing by 13 species (15.85%).

Key words: Plant flora, Floristic survey, vegetation types, Chorotype, Life form.

INTRODUCTION

Saudi Arabia, a part of the Arabian Peninsula, covers more than 2250,000 sq. kms. The climate of Saudi Arabia is affected by two climate types, namely: Monsoon and Mediterranean. The Monsoon climate affects the southern part while the northern part is affected by Mediterranean climate. The climate differs greatly between the coast and the interior. High humidity coupled with moderate temperature is prevalent along the coast, where as aridity and extreme temperature characterize the anterior. The climate of Saudi Arabia is generally hot and dry [1]. Plant distribution are determined by their responses to variation in environmental factors, such as water availability, topography and soil. Many studies showed that topography of the area and the climate are the main factors affecting the degree of speciation [2 & 3]. The importance of these factors were discussed in the vegetation along the nearest coastal mainland plains in the Jazan region [4].

Vegetation deterioration has received an increasing amount of attention in the last few decades. Floristic studies help us to assess the plant wealth and its potentiality of any given area and understanding the basic aspects of biology such as speciation, isolation, endemism and evolution. The flora of Saudi Arabia considers the richest biodiversity areas in the Arabian Peninsula. Several reports have been published on the Flora of Saudi Arabia [5, 6 & 7]. Besides its large number of endemic species, the components of the flora are the admixture of the elements of Asia, Africa and Mediterranean region. Many authors have studied limited areas in Saudi Arabia in the course of floral and taxonomical revision of some genera. Previous study [8] described the vegetation types in the Medina-Badr road across the Hijaz

Mountains. In the central part of Saudi Arabia, the Raudhas vegetation was analyzed by [9], while in the west part [10] who studied the vegetation along Makkah-Taif road. Plant diversity was studied by [11] on the natural vegetation in the Aseer region. In addition, vegetation analysis of wild legumes in Taif region was also conducted by [12]. According to [13]**,** the greatest species diversity in Saudi Arabia occurs in the western mountainous area of the kingdom that borders the Red Sea which can be attributed to a greater rainfall. Because of the wide area of Saudi Arabia and the change in climate. So, it is still more work is needed to fulfill gaps in Saudi flora.

Tabuk province is a region of Saudi Arabia, located along the northwest coast of the country, face Egypt across the red sea. The Red Sea has a unique environment with a wide range of habitats and outstanding biodiversity, which confers a great scientific and ecological importance [14]. It comprises diverse ecosystems that provide interesting aspects for vegetation and species diversity investigation. Therefore, the current study includes survey and identification of the wild plants growing in this region. Moreover, the vegetation types, life forms and diversity and floristic categories of the collected species were taken into consideration. This paper provides the first quantitative analysis of plant species diversity of Tabuk Red Sea coastal region.

EXPERIMENTAL SECTION

Tabuk Red Sea coastal region lies in the northern west part of Saudi Arabia with 500 km length, extending from Umluj in the south (24° 57' N) to Ras Hemaid in the north (53° 28' 09" E) punctuated by some valleys and coral and some plains. It has an area of 146.072 Km^2 (**Figure 1**). According to the records of Tabuk Province metrological station for the period 2014, the climate at Tabuk city is characterized by average temperature for the year is 21.2°C. The highest temperature is 45°C, which was recorded in July with an average temperature of 37.3°C. The lowest recorded temperature is -7°C, which was recorded in January with an average temperature of 10°C.

An extensive survey was carried out to this area from March 2015 to July 2015 during active plant growth period, when most species were expected to be present. The wild species were collected from Ras Hemaid - Umluj road across Al Wajh and Dhiba regions (**Figure 1**). The collected specimens were identified and named with the help of various Floras, [13, 5, 15, 16, 17 & 18]. For future reference, voucher herbarium specimens of different plant samples were pressed and deposited in the Herbarium of Biology Department, Faculty of Sciences, Tabuk University and Botany Department, Faculty of Science, Ain Shams University.

Figure 1: Map of Red Sea Coast region, Tabuk Province, KSA

Species life forms were determined according to [19] classification depending upon the location of the regenerative buds and the shed parts. The number of species within each life form was expressed as a percentage of the total number of species in the study area. The floristic categories of the investigated species were made according to [20].

RESULTS AND DISCUSSION

Appendix 1 shows the wild plant species recorded in different surveyed regions of Tabuk Red Sea coast. The list includes a total of 82 wild plant species belonging to 66 genera and 30 families. The major plant families present in these sites were Asteraceae (9 species); Fabaceae (8 species); followed by Brassicaceae and Zygophyllaceae (7 species); Chenopodiaceae & Poacea (6 species); Resedaceae (5 species); Boraginaceae (4 species) and Asclepediaceae & Caryophyllaceae (3 species). Finally, 4 families showed less number of species and represented by two species while 16 families are represented only by one species each **(Figure 2)**. Moreover, Asteraceae is represented by 7 genera, Brassicaceae and Fabaceae by 6 genera while, ten families are represented by 5 to 2 genera and 17 family are represented only by single genus. Six of collected families (Asteraceae, Fabaceae, Brassicaceae, Zygophyllaceae, Chenopodiaceae and Poaceae) comprise half of the recorded species (43 species) (**Figure 2**). With regard to the growth type (**Table 1**), 47 species were recorded in this study as perennial plants (57.32%) while annuals were represented by 35 species (42.68%).

Table 1. Total number of families, genera and species, vegetation types and life forms of the collected plants

Total number			Vegetation type			Life form		
Families	Genera	Species	Type	Number of species	%	Form	No. of species	%
30	66	82	Annual	35	42.68	Chamaephyte	27	32.92
			Perennial	47	57.32	Therophyte	24	29.27
						Phanerophyte	16	19.51
						Hemicryptophyte	10	12.2
						Geophyte	4	4.88
						Parasite	1	1.22
			Total No.	82	100%		82	100%

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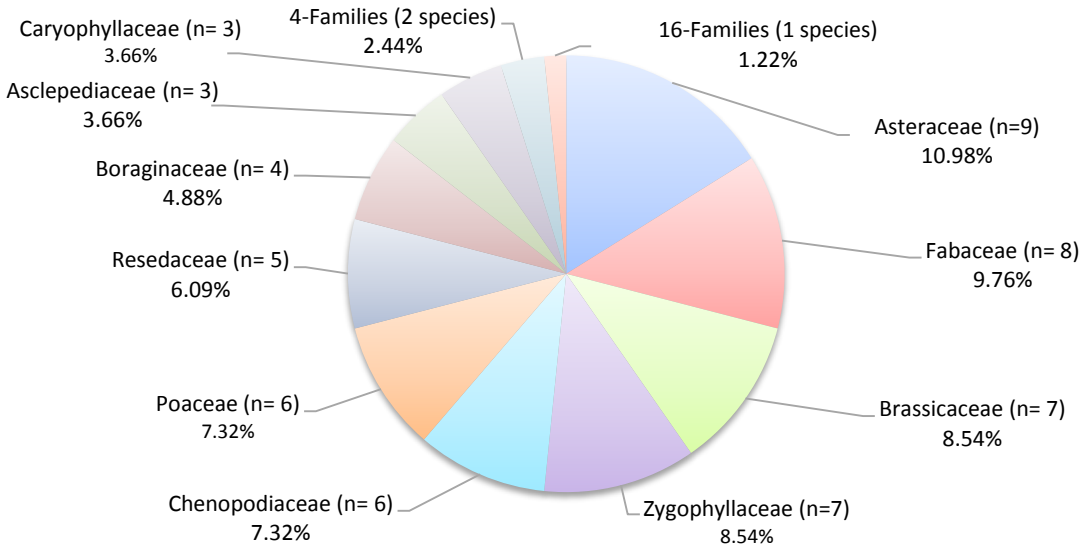

Figure 2: Floristic composition with the families of the studied area (n= number of species)

Life forms of the prevailing flora exhibited a great diversity and reflect a typical desert flora (**Table 1 & Figure 3**). The chamaephytes are the dominating life form in the study area amounting 32.92 % with a maximum number of species of 27, followed by therophytes with 24 species (29.27%). Phanerophytes were represented by 16 species (19.51%) while Hemicrytophytes were represented by 10 species (12.20%). Geophytes were represented by four species (4.88%). Finally Parasites were represented by only one species (*Orobanche cernua*) with a percentage of 1.22%.

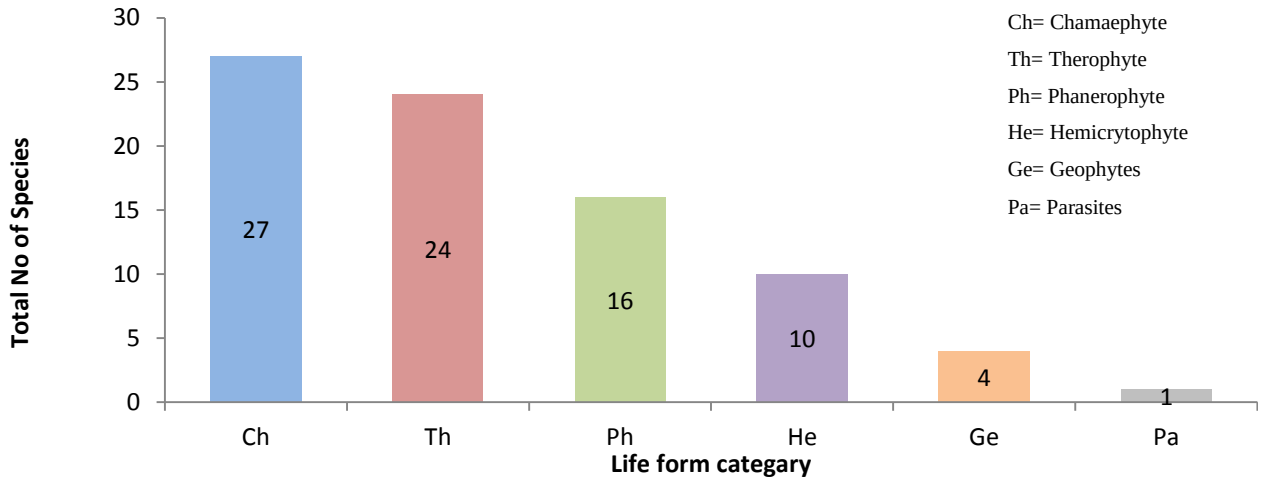

Figure 3: Life form spectrum of flora of Tabuk Red Sea coastal region

The life forms spectra of the recorded species according to **[19]**classification are shown in **Appendix 1** and represented as; Saharo-Arabian have the highest share of species representing by 23 species (28.05%), Irano -Turanian taxa by 6 species (7.32%), Sudanian taxa by 5 species (6.10%), Mediterranean species were rarely represented with only two species (2.44%) while Saharo-Sindian, Tropical, American, Sudano-Zambezian and Sahelian Somali-Masai taxa are represented by one species each (1.22%). Species of Saharo-Arabian-Sudano-Zambezian elements together have high share of species representing by 13 species (15.85%) (Figure 4).

For several decades the flora of Saudi Arabia was thought to be poor in terms of plant diversity based on various comparative floristic surveys [21, 22 & 23]. Nevertheless, towards the end of the previous century a significant amount of information pertaining to the flora of Saudi Arabia was revealed through extensive field work and elevated the plant species accounts for this country [24, 25 & 26]. These new additions to the flora of Saudi Arabia indicate that the country still has several under-collected areas or areas that have never been visited for plant collection. The present study is the first floristic study of Tabuk Red Sea coastal region that showing the importance of this region in term of plant diversity.

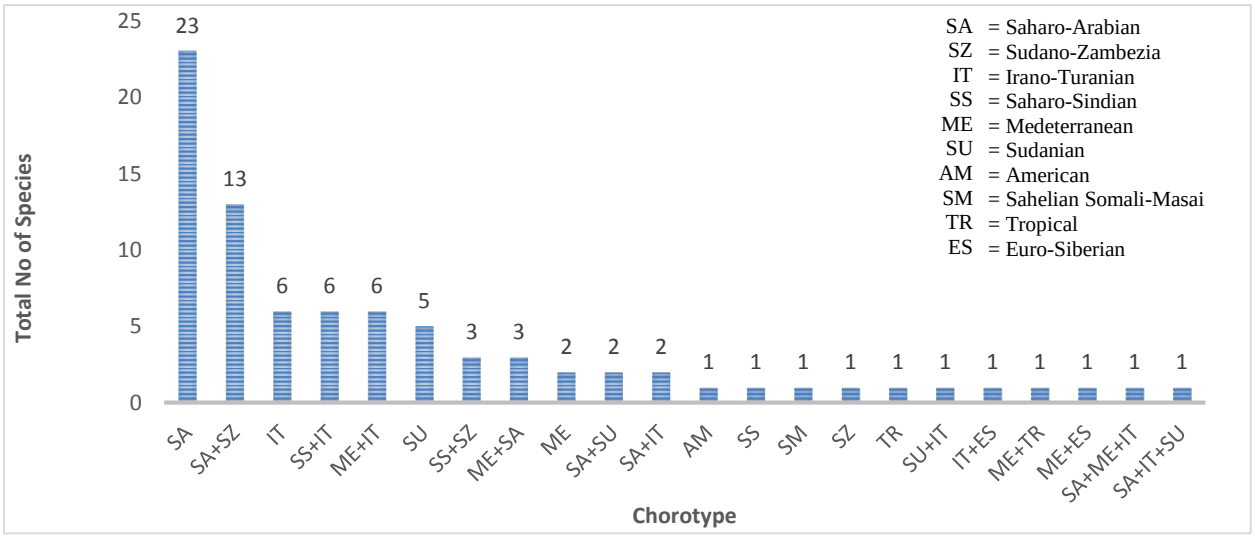

Figure 4: Chorological types of the recorded species in Tabuk Red sea coastal region

The floristic composition analysis in the studied area showed that the family Asteraceae is represented by the highest number of species followed by Fabaceae (8 species), Brassicaceae and Zygophyllaceae (7 species) then Poaceae (6 species). Poaceae, Fabaceae, Asteraceae constitute the main bulk of plant species in Saudi Arabia. Poaceae [27], the majority of which are grasses are characteristic of desert and semi-desert regions with high temperature and low rainfall [**8**]. The dominance of members of Asteraceae, Brassicaceae and Poaceae were reported on the flora of Hail region that lies in the northern part of Saudi Arabia [28].

In the present study among the 30 families, 16 families (about 50%) of the total number of families are represented by one species per families. This is a common feature of desert flora and consider an indication that only a few number of species that belong to these families have adapted and survived in this harsh environment, while other species that could not survive have become extinct [28 & 29]. The number of species per genus in this study is 1.24 (82/66), a ratio less than that recorded in total area of the kingdom which is 2.6 [27]. The most common genera are *Heliotropium* (Boraginaceae) with four species and Reseda (Resedaceae); Acacia (Fabaceae) with three species.
The relative frequency of life forms differs with habitat. The present study indicates the prevailing of both chaemophytes (32.92%) and therophytes (29.27%). The domination of chaemophytes and therophytes agree with the life form spectra in desert and semi-desert habitats in other parts of Saudi Arabia as described by some authors [11 & 29]. This life form is characteristic of an arid desert region. It is necessary to point out that the increase in therophytes can be considered a relative index of disturbance for Mediterranean ecosystems [30]. The high proportion of therophytes is also attributed to human activities according to [31]. This result was supported with the concept of [32] that dry climate tend to increase the percentage of therophytes through the spread of weedy grasses and forbs of this life form.

The life form spectra provide information that can help assess the effects of environmental factors on vegetation distribution. The importance of these factors in the vegetation along the nearest coastal mainland plains in the jazan region and Farasan Islands resprctively were discussed [4]. Chamaephytes was the main life forms in the saline and coastal sandy habitats, whereas therophytes and hemicryptophytes are dominated in the sandy formations and rocky habitats [**4**]. This could be related to soil salinity, drought conditions or topographic variations [33]. On the other hand, the low present of phanerophytes recorded in this study in agree with [29] who found that Khulais region, West Saudi Arabia are very poor in tree. Although the present study tried to record flora of different habitats of Tabuk Red Sea region yet it was a glimpse of the area. The results point out the need for further studies on the diverse and changing vegetation of Red Sea coastal region.

CONCLUSION

A total of 82 plant species belonging to 66 genera and 30 families were recorded. The family Asteraceae is represented by the highest number while 16 families are represented only by one species each. The chamaephytes and therophytes are the dominating life form of the vegetation spectra. The highest number of species was recorded as perennials. Chronological analysis of the vegetation in the area revealed the domination of Saharo-Arabian followed by Irano – Turanian, Sudanian, Mediterranean and finally Saharo-Sindian, Tropical, American, Sudano-Zambezian and Sahelian Somali-Masai.

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Appendix 1: list of plant species, families, vegetation type, life form and chorotype for studied area

No.	Family	Species	Vegetation type	Life form	Chorotype
1	Aizoaceae	*Aizoon canariense* L.	Perrennial	Th	SA+SZ
2	Arecaceae	*Hyphaene thebaica* (L.) Mart.	Perrennial	Ph	SA+SZ
3	Asclepediaceae	*Calotropis procera* (Aiton) W.T.Aiton	Perrennial	Ph	SA+SZ
		Leptadenia pyrotechnica Forssk.	Perrennial	Ph	SA+SU
		Pergularia tomentosa L.	Perrennial	Ch	SU
4	Asphodelaceae	*Asphodelus tenuifolius* (Cav.) Baker	Annual	Ge	SA+SZ
5	Asteraceae	*Anthemis melampodina* Delile	Annual	Th	SA
		Artemisia herba-alba Asso.	Perrennial	Ch	SA
		Artemisia judaica L.	Perrennial	Ch	SA
		Echinops viscosus DC.	Perrennial	He	IT
		Iphiona scabra DC.	Perrennial	Ch	SA
		Launaea procumbens (Roxb.) Ramayya & Rajagopal	Annual	Ch	SA+IT
		Picris cyanocarpa Boiss.	Annual	Th	SA
		Picris longirostris Sch.Bip.	Annual	Th	SU+IT
		Pulicaria incisa (Lam.) DC.	Annual	Th	SA
6	Avicenniaceae	*Avicennia marina* (Forssk.) Vierh.	Perrennial	Ph	TR
7	Boraginaceae	*Heliotropium crispum* Desf.	Perrennial	He	SS+IT
		Heliotropium curassavicum L.	Perrennial	Th	AM
		Heliotropium europaeum L.	Annual	Th	IT+ES
		Heliotropium ramosissimum (Lehm.) DC.	Annual	Ch	ME+TR
8	Brassicaceae	*Anastatica hierochuntica* L.	Annual	Th	SA
		Diplotaxis acris (Forssk.) Boiss.	Annual	Th	ME+IT
		Diplotaxis erucoides (L.) DC.	Annual	Th	ME+IT
		Farsetia burtoniae Oliv.	Perrennial	Ch	SM
		Morettia parviflora Boiss.	Perrennial	Th	SZ
		Malcolmia crenulata (DC.) Boiss.	Annual	Th	ME
		Zilla spinosa (L.) Prantl	Perrennial	Ch	SA
9	Capparaceae	*Cleome amblyocarpa* Barratte & Murb.	Annual	Ch	SA+SZ
10	Caryophyllaceae	*Polycarpaea robbairea* (Kunze) Greuter & Burdet.	Perrennial	Th	SA+SZ
		Sclerocephalus arabicus Boiss.	Annual	Ph	SA
		Spergularia bocconei (Scheele) Graebn.	Annual	Ph	ME+ES
11	Chenopodiaceae	*Anabasis setifera* Moq.	Perrennial	Ch	SA
		Halocnemum strobilaceum (Pall.) Bieb.	Perrennial	Ch	SS+IT
		Haloxylon persicum Bunge ex. Boss.	Perrennial	Ph	IT
		Haloxylon salicornicum (Moq.) Bunge ex Bioss.	Perrennial	Ch	SU
		Salsola cyclophylla Baker	Perrennial	Ch	SA
		Salsola villosa Schult.	Perrennial	Ch	SA
12	Convolvulaceae	*Convolvulus buschiricus* Bornm.	Perrennial	Ch	SS+IT
13	Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad.	Perrennial	He	ME+SA
		Cucumis prophetarum L.	Annual	Ph	SA+SZ

14	Euphorbiaceae	*Chrozophora tinctoria* (L.) A. Juss.	Annual	Ch	ME+IT
		Euphorbia retusa Forssk.	Perrennial	Th	SA
15	Fabaceae	*Acacia ehrenbergiana* Hayne	Perrennial	Ph	SS+SZ
		Acacia tortilis (Forssk.) Hayne subsp. raddiana (Savi) I	Perrennial	Ph	SS+SZ
		Acacia tortilis (Forssk.) Hayne subsp. tortilis (Savi) Br	Perrennial	Ph	SA
		Indigofera arabica Jaub. & Spach	Perrennial	Ch	SA
		Lotus lanuginosus Vent.	Perrennial	He	SA
		Prosopis farcta (Banks & Sol.) J.F. Macbr.	Perrennial	Ch	SS+IT
		Retama raetam subsp. raetam (Forssk.) Webb.	Perrennial	Ph	SA
		Senna italica Mill.	Perrennial	Ch	SS+SZ
16	Geraniaceae	*Erodium laciniatum* (Cav.) Willd.	Annual	Th	ME+IT
		Monsonia nivea (Decne.) Webb	Annual	Ge	SA+SZ
17	Hyacinthaceae	*Muscari tenuiflorum Tausch*	Annual	Ge	
18	Lamiaceae	*Lavandula coronopifolia* Poir.	Perrennial	Ch	SA+SZ
19	Liliaceae	*Asparagus horridus* L.	Perrennial	Ge	ME+SA
20	Orobanchaceae	*Orobanche cernua* Loefl.	Perrennial	Pa	SA+IT+ME
21	Papaveraceae	*Glaucium arabicum* Hebrew	Annual	He	IT
22	Plantaginaceae	*Linaria haelava* (Forskål) F.G. Dietr.	Annual	Th	SA
23	Poaceae	*Panicum turgidum* Forssk.	Annual	Ch	SA+SU
		Pennisetum divisum (Forssk. ex J.F.Gmel.) Henrard	Annual	Ch	SS
		Phragmites australis (Cav.) Trin. ex Steud.	Perrennial	He	ME
		Stipa hohenackeriana Trin. & Rupr.	Perrennial	He	IT
		Schismus arabicus Nees.	Annual	Th	ME+IT
		Schismus barbatus (Loefl. ex L.) Thell.	Annual	Th	ME+SA
24	Resedaceae	*Caylusea hexagyna* (Forssk.) M. L. Green	Annual	Th	SA
		Ochradenus baccatus Del.	Perrennial	Ph	SA+SZ
		Reseda arabica Boiss.	Annual	Th	SA
		Reseda decursiva Forssk.	Annual	Th	SA
		Reseda muricata C. Presl	Perrennial	Th	SS+IT
25	Salvadoraceae	*Salvadora persica* (L.) Garcin.	Annual	Ph	SU
26	Scrophulariaceae	*Kickxia scoparia* (Spreng.) kunkel.	Perrennial	Ch	SA+SZ
27	Solanaceae	*Hyoscyamus muticus* L.	Annual	Ch	SS+IT
		Lycium shawii Roem.	Perrennial	Ph	SA+SZ
28	Tamaricaceae	*Tamarix aphylla* (L.) Karsten	Perrennial	Ph	SU
29	Urticaceae	*Forsskaolea tenacissima* L.	Annual	Ch	SA+SZ
30	Zygophyllaceae	*Fagonia bruguieri* DC.	Perrennial	He	SA+IT
		Fagonia indica Burm.	Perrennial	He	SA+IT+SU
		Seetzenia lanata (Willd.) Bullock	Annual	Th	SU
		Tribulus terrestris L.	Annual	He	IT
		Tribulus macropterus Boiss.	Annual	Th	ME+IT
		Zygophyllum coccineum L.	Perrennial	Ch	SA
		Zygophyllum simplex L.	Perrennial	Ch	SA

***Life form**; **Ch:** Chamaephyte, Ge: Geophytes, **He:** Hemicrytophyte, Pa = Parasites, **Ph:** Phanerophyte, **Th:** Therophyte.*
***Chorotype**; **AM=** American, **ES** = Euro-Siberian, **IT** = Irano-Turanian, **ME** = Mediterranean, **SA** = Saharo-Arabian, **SM** = Sahelian-Somali-Masai, **SS** = Saharo-Sindian, **SU**= Sudanian, **SZ** = Sudano-Zambezian, **TR**= Tropical.*