MANSOURA JOURNAL OF BIOLOGY
Official Journal of Faculty of Science, Mansoura University, Egypt
E-mail: scimag@mans.edu.eg ISSN: 2974-492X

A Study on Floristic Characterization and Chorology of the Associated Flora with Three *Fagonia* Species in Egypt

Mustafa M. El-Zayat[a], El-Sayed F. El-Halawany[b] , Yasser A. El-Amier[b], Iman A. Abo Aisha[b,c]

[a]*Unit of Genetic Engineering and Biotechnology, Mansoura University*

[b]*Botany Department, Faculty of Science, Mansoura University, Mansoura, Egypt*

[c]*Botany Department, Faculty of Education, Sabha University, Tragan, Libya*

*** Correspondence to:** Email yasran@mans.edu.eg, Tel +201017229120)

Received:13/10/2019
Accepted: 3/11/2019

Abstract: This study, carried out on the associated flora with three species of the genus *Fagonia,* (*Fagonia arabica* L., *F. cretica* L. and *F. mollis* Delile) including the list of species, life-span and -form spectra as well as chorological analysis in the Western Mediterranean (Med.) coastal area and Wadi-Hagul of Egypt. In 63 survey sites, a total number of 122 plant species (59 annual, one biennial and 62 perennial species) belonging to 98 genera and 28 families formed their floristic composition. Asteraceae, Poaceae, Chenopodiaceae, Fabaceae, Brassicaceae and Zygophyllaceae are the largest families. Consistent with life-forms sorting the majority of the registered species are therophytes, chamaephytes and hemicryptophytes. Among the recorded species 46.72% and 24.59% of the total number are Mediterranean and Saharo-Sindian taxa, respectively. The obtained results will be useful for sustainable management of plant diversity in Egypt.

keywords: *Fagonia*, Zygophyllaceae, Duration, Chorotype, Mediterranean coast, Wadi Hagul .

1.Introduction

Desert plants in Egypt are by far the most important species and characteristics of natural plant life in ecosystem. Covering ≈95% of the total area of the country and is mainly composed of xerophytic shrubs and sub shrubs. The Egyptian ecosystem is wealthy in its natural fortune of flora particularly medicinal species in the location of comparatively rich rainfall such as, northern-Med. coast [1, 2]. On the other hand, the life of the botanical plant in Eastern-Desert (ED) is abundant than that of the Western-Desert. The wild-plant species of the northern mountains and wadis of ED west of Suez Gulf showed a close relationship with that of Pennisula of Sinai-Egypt [3]. The genus *Fagonia* belongs to the family: Zygophyllaceae according to Boulos [4], the species of this genus are low shrubs or perennial herbs, rarely annuals; characterized by palmate compound leaves, stiff stipules and purple flowers

Fagonia arabica L. (*F. arabica*) is a Low shrub 20-60 cm, entirely covered with sessile or stalked capitate glands, often with adhering sand grains, stems terete, striate, stipular spines to 4 cm; base leaves are three- foliolate, while the upper one-foliolate. It is spread in sandy plains and desert wadis. In Egypt, *F. arabica* occurs in Med. coastal strip, western-desert (oases and depression), all the deserts of Egypt and the entire Sinai Peninsula. *Fagonia cretica* L. Bright green glabrous perennial, 15-30 cm, with a woody base, stems many, prostrate, 4 angled, sulcate, internodes to 3.5 cm; stipular spines 2-4 (-8) mm; all leaves 3-foliate. The plant is distributed in calcareous coastal ridges, canary Islands, North Africa, Spain, Balearic Islands, Sicily, Malta and Greece. In Egypt, the plant presents in Med. coastal strip. *Fagonia mollis* Delile Low shrub 20-40 cm, or perennial with a woody base, glabrescent, hairy or glandular, hairy or glandular-hairy with sessile or stipulate glands, stems many, branched angular, striate, stipular, spines 0.5-1.2 (-1.8) cm leaves 3-foliolate, petiole 2-6 mm. The plant is distributed in sandy and stony desert wadis and plains. In Egypt, the plant presents in the desert east of the Nile and entire Sinai region [4].

Egypt has characterized by unparalleled biodiversity that contributes to its economy and supports human well-being, as well as provides regulating, and supporting services. Consequently, many kinds of research were conducted by Egyptian specialists, who were directed to introduce and cultivate some wild plants such as fodder and/or forage plants, building materials, furniture, agro-industrial, plant-fibres, bags, paper and others in Egypt [5-9].

The current study aims to shed light on the associated wild plant species with three *Fagonia* species

Study Area

The selected study area is located in the Western Mediterranean coastal belt and North Galalah Desert (Eastern Desert) regions in Egypt, which involves various habitats (Figure 1). The western section (Mariut coast) is the northern coast of the Western Desert, expands from El-Sallum to Abu-Qir for about 550 km. It is a thin strip of land parallel to Med. Sea that narrows or widens according to the position of its southern boundary Western Desert Plateau. Its average north-south width, from sea landward, is about 20 km and it is bordered by Lake Mariut on the east [10]. On the other hand, Wadi-Hagoul is situated in the northern sector of Eastern Desert (El-Galala Desert) which extends east of Nile Delta. Moreover, this valley occupies the depression among Gebel-Ataqa from the north and Kahaliya-ridge to south. Its main channel expands for approximately 35km, flowing on both sides and into Suez-Gulf [1].

The climate of the northern part of Egypt is fairly arid to semi-arid, as the rate of evaporation extremely exceeds the rate of rainfall [11, 12]. Wadi Hagoul is belonging to the arid mesothermal type of Thornthwaite [13]. Meteorological data of Suez-Province displays that, the climate of this area is dry and hot. The high temperature and low rainfall are the main reasons of aridity of the region.

MATERIALS AND METHODS

The sampled stands are distributed in Western Mediterranean coastal belt (Alexandria) of Egypt and Wadi Hagoul, which comprises different habitats. Regular visits were performed to the various locations of the study area, after that the sampled stands (sixty-three sites, range = 20 × 20 m for each) have been nominated for plant specimen [31 stands in Alexandria Governorate (Western Med. coast) and 32 stands in Wadi-Hagoul (inland desert)]. During all visits, plant specimens were harvested from different sites for identification. Harvested samples were kept in Herbarium of Botany Department, Faculty of Science, Mansoura University. Based on Raunkiaer [14, 15], the description and classification of life-forms were performed in this work. Whereas, identification (nomenclature), classification, and chorotype were made as stated by Tutin *et al*. [16], Davis [17], Zohary [18], Tackholm [19], Meikle [20], Feinbrun-Dothan [16-21] and advanced by Boulos [4].

Figure 1: Map of Egypt and the Nile Delta region showing different localities of the study area

RESULT AND DISCUSSION

1. Floristic composition (FC)

The listed plant species in current work are summed in terms of presence-values (P %). Table (1) showed FC in the different habitats in the area under study. The tabulated data reveal that the total number of plant species in the study area was 122 species. These species are classified as shown in Figure (2) into three major groups: 59 annual species (48.36%), one biennial species (0.82%) and 62 perennial species (50.82%). Out of the perennials, eight species namely: *Cyondon dactylon, Fagonia cretica, F. arabica, F. mollis, Haloxylon salicornicum, Launaea nudicaulis, Zygophyllum aegyptium* and *Z. decumbens* have a wide ecological distribution (P = 25.40, 30.16, 36.51, 31.75, 34.92, 42.86, 23.81 and 23.81%, respectively). The list of the recorded flora included only one biennial species, namely: *Centaurea aegyptiaca* (P= 15.87%).

Five annual species, being recorded in all stands, these species were: *Senecio glaucus*, *Emex spinosa*, *Bassia indica*, *Zygophyllum simplex* and *Malva parviflora*. These findings, were in agreement with those of El-Amier and Abdul-Kader [2] in the Eastern Desert and Al-Hadithy *et al*. [22] along with the sector of western Medi. coast.

The dominant perennial species (>50% of total recorded species) display the permanent character of the plant cover in each habitat. The high percentage of annuals (48.36% of total recorded flora) can be indorsed to the study time (March-May 2018) and short life-cycle that aids them to resist instability of agroecosystem [23, 24].

2. Life-forms of listed plant species

Based on the nomunculture and classification of life-forms [14], the life-forms of the species listed in the current work were categorised under 6 classes as follows: therophytes, chamaephytes, hemicryptophytes, nanophanerophytes, geophytes and helophytes (Figure 3). The common of the listed species are thero-phytes (47.97%), followed by chamae-phytes (24.39%), hemicryptophytes (16.26%), nanophanerophyes (7.32%) and geophytes (3.25%). The lowest value (0.81%) of life-forms is noted as helophytes. These findings came inconsistent with those of other reports [25-27]. Heneidy and Bidak [28], reported that the domination of thero-phytes over the other life- forms appears to be a response to climate of Med., edaphic factors and biological effects. In addition, the maximium values of hemicrypto-phytes and chamae-phytes may be due to the species ability to resisting dryness, electrical conductivity (salinity), sand accumulation and feeding [29].

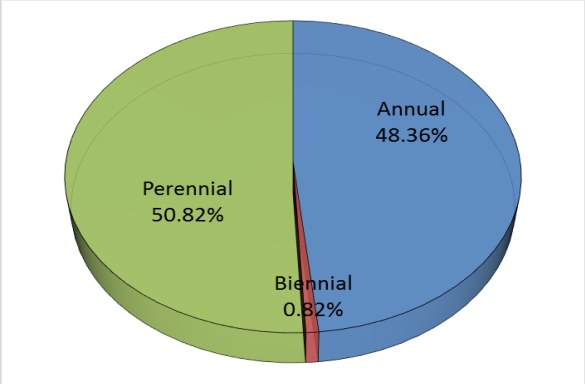

Figure 2. Plant life-span of the study area

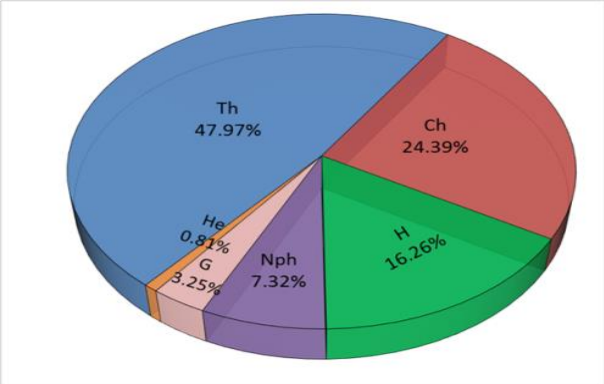

Figure 3. Plant life-form of study area. Abbreviations see table 1.

Table 1. Floristic characterization of the listed flora in the study region.

No.	Species	Family	Life span	Life form	Floristic Category	P%
1	*Atriplex portulacoides* L.	Chenopodiaceae	Per	Ch	IR-TR, ER-SR, ME	1.59
2	*Achillea santolina* L.	Asteraceae	Per	H	IR-TR, ME	14.29
3	*Achillea fragrantissima* (Forssk.) Sch.Bip.	Asteraceae	Per	Ch	IR-TR, SA-SI	4.76
4	*Aizoon canariense* L.	Aizoaceae	Ann	Th	SA-SI, S-Z	1.59
5	*Alkanna lehmanii* (Tin.) A.DC.	Aizoaceae	Ann	Th	SA-SI, S-Z	3.17
6	*Anabasis articulata* (Forssk.)	Chenopodiaceae	Per	Ch	IR-TR, SA-SI	6.35
7	*Avena fatua* L.	Poaceae	Ann	Th	PAL	15.87
8	*Artemisia monosperma* Delile.	Asteraceae	Per	Ch	SA-SI, ME	1.59
9	*Astragalus peregrinus* Vahl	Fabaceae	Ann	Th	SA-SI	6.35
10	*Artemisia judiaca* L.	Asteraceae	Per	Ch	SA-SI	3.17
11	*Anchusa humilis* (Desf.) I.M. Johnst.	Boraginaceae	Ann	Th	SA-SI, ME	3.17
12	*Atriplex halimus* L.	Chenopodiaceae	Per	Nph	SA-SI, ME	14.29
13	*Aegilops crassa* Boiss	Poaceae	Ann	Th	SA-SI, IR-TR	3.17
14	*Aegilops bicornis* (Forssk)	Poaceae	Ann	Th	SA-SI, ME	3.17
15	*Astragalus bombycinus* Boiss	Fabaceae	Ann	H	SA-SI, IR-TR	7.94
16	*Astragalus spinosus* (Forssk)	Fabaceae	Per	Ch	SA-SI,IR-TR	1.59
17	*Atractylis carduus* (Forssk) C.Chr.	Asteraceae	Per	H	ME, SA-SI	14.29
18	*Atriplex lindleyi* Moq.subsp. *inflata* (F.Muell.) Wilson.	Chenopodiaceae	Ann	Th	IR-TR, ER-SR, ME	6.35
9	*Anagallis arvensis* L.	Primulaceae	Ann	Th	COSM	4.76
20	*Atriplex semibaccata* R.Br.	Chenopodiaceae	Per	H.	AUST	3.17

21	*Bassia indica* (Wight) Scott.	Chenopodiaceae	Ann	Th	IR-TR, S-Z	23.81
22	*Bromus diandrus* Roth	Poaceae	Ann	Th	ME	19.05
23	*Bassia muricata* (L.) Asch.	Chenopodiaceae	Ann	Th	SA-SI, IR-TR	11.11
24	*Brassica tournefortii* Gouan.	Brassicaceae	Ann	Th	IR-TR, SA-SI, ME	11.14
25	*Carthamus tenuis* (Boiss & Blanche) Bornm	Asteraceae	Ann.	Th	ME	9.52
26	*Carduus pycnocephalus* L.	Asteraceae	Ann.	Th	SA-SI	4.76
27	*Centaurea aegyptiaca* L.	Asteraceae	Bi	Th	SA-SI	15.87
28	*Chenopodium murale* L.	Chenopodiaceae	Ann	Th	COSM	19.05
29	*Cakile maritima* Scop. subsp. *aegyptiaca*	Brassicaceae	Ann.	Th	ER-SR, ME	20.63
30	*Cleome amblyocarpa* Barratte & Murb.	Cleomaceae	Ann	Th	SA-SI	1.59
31	*Convolvulus arvensis* L.	Convolvulaceae	Per.	H	COSM	14.29
32	*Pluches dioscoridis* (L)	Asteraceae	Per.	Nph	S-Z, SA-SI	4.76
33	*Cenchrus cillaris* L.	Poaceae	Ann	H	S-Z,SA-SI	3.17
34	*Convolvulus lanatus* Vahl.	Convolvulaceae	Per.	Ch	SA-SI	1.59
35	*Crotalaria aegyptiaca* Benth	Fabaceae	per	Ch	SA-SI	1.59
36	*Cynanchum acutum* L.	Asclepiadaceae	Per.	H	IR-TR, ME	9.52
37	*Cyondon dactylon* (L.)Pers.	Poaceae	Per.	G	PAN	25.40
38	*Deverra tortuosa* (Desf.) DC.	Apiaceae	per	Ch	SA-SI	1.59
39	*Diplotaxis harra* (Forssk) Boiss	Brassicaceae	Per	Ch	SA-SI, ME	23.81
40	*Echinops spinosus* L.	Asteraceae	Per.	H	SA-SI, ME	17.46
41	*Echium angustifolium* Mill.	Boraginaceae	Per.	H	ME	6.35
42	*Euphorbia peplus* L.	Euphorbiaceae	Ann	Th	IR-TR, ER-SR, ME	3.17
43	*Emex spinosa* (L.) Campd.	Polygonaceae	Ann	Th	ME, SA-SI	25.40
44	*Erodium laciniatum* (Cav.) Wild.	Geraniaceae	Ann	Th	ME	20.63
45	*Euphorbia retusa* Forssk.	Euphorbiaceae	Ann	Th	SA-SI	9.52
46	*Enarthrocarpus lyrotus* (Boiss)	Brassicaceae	Ann	Th	SA-SI	3.17
47	*Fagonia arabica* L.	Zygophyllaceae	Per	Ch	SA-SI	36.51
48	*Fagonia cretica* L.	Zygophyllaceae	Per	H	SA-SI, ME	30.16
49	*Fagonia mollis* Delile	Zygophyllaceae	Per	Ch	SA- SI	31.75
50	*Filago desertorum* Pomel	Asteraceae	Ann	Th	SA-SI,IR-TR	3.17
51	*Farsetia aegyptia* Turra.	Brassicaceae	Per	Ch	SA-SI, S-Z	7.94
52	*Forsskaolea tenacissima* L.	Urticaceae	Per	H	S-Z, SA-SI	1.59
53	*Francouria crispa* (Forssk.) Cass.	Asteraceae	Per	Ch	SA-SI	1.59
54	*Gypsopila capillaris* (Forssk.) C.Chr.	Caryophyllaceae	Per	H	SA-SI,IR-TR	4.76
55	*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.	Chenopodiaceae	Per	Ch	SA-SI	34.92
56	*Haplophyllum tuberculatum* (Forssk.) Juss.	Rutaceae	Per	H	SA-SI	4.76
57	*Heliotropium curassavicum* L.	Boraginaceae	Per	Ch	NEO	1.59
58	*Hordeum spontaneum* K. Koch	Poaceae	Ann	Th	IR-TR, ME	1.59
59	*Hordeum leporinum* Link	Poaceae	Ann	Th	IR-TR, ME	3.17
60	*Halocnemum strobilaceum* (Palla.) M. Bieb.	Chenopodiaceae	Per	Ch	IR-TR, SA-SI, ME	4.76
61	*Hyoscyamus muticus* L.	Solanaceae	Per	Ch	SA-SI	7.94
62	*Ifloga spicata* (Forssk.) Sch. Bip.	Asteraceae	Ann	Th	SA-SI	1.59
63	*Imperata cylindrica* (L.) Raeusch.	Poaceae	Per	H	PAL, ME	6.35
64	*Kickxia aegyptiaca* (L.) Nábelek.	Scrophulariaceae	Per	Ch	SA-SI, ME	1.59
65	*Lactuca serriola* L.	Asteraceae	Ann	Th	IR-TR, ER-SR, ME	17.46
66	*Lasiurus scindicus* Henrard.	Poaceae	Per	G	S-Z, SA-SI	3.17
67	*Launaea mucronata* (Forssk.) Muschl.	Asteraceae	Per	H	SA-SI, ME	7.94
68	*Launaea nudicaulis* (L.) Hook. f.	Asteraceae	Per	H	SA-SI	42.86
69	*Lavatera cretica* L	Malvaceae	Ann	Th	ME	3.17
70	*Legousia speculum*-veneris (L.) Chaix	Campanulaceae	Ann	Th	IR-TR, ME	3.17
71	*Lotus polyphyllos* E. D. Clarke	Fabaceae	Per	TH	ME	9.52
72	*Limonium pruinosum* (L.) Chaz.	Plumbaginaceae	Per	H	SA-SI	4.76
73	*Lolium perenne* L	Poaceae	Per	Th	ME, IR-TR, ER-SR	12.70
74	*Lotus creticus* L.	Fabaceae	Per	H	ME	1.59
75	*Lycium shawii* Roem. & Schult.	Solanaceae	Per	Nph	S-Z, SA-SI	11.11
76	*Malva parvifolra* L.	Malvaceae	Ann	Th	IR-TR, ME	23.81
77	*Matthiola longipetala* (Vent.) DC.	Brassicaceae	Ann	Th	IR-TR, ME	15.87
78	*Medicago polymorpha* L.	Fabaceae	Ann	Th	IR-TR, ER-SR, ME	1.59
79	*Melilotus indicus* (L.) All.	Fabaceae	Ann	Th	IR-TR, SA-SI, ME	12.70
80	*Mesembryanthemum crystallinum* L.	Aizoaceae	Ann	Th	ER-SR, SA-SI, ME	17.46
81	*Mesembryanthemum forsskaolii* Hochst. ex Bioss.	Aizoaceae	Ann	Ph	SA-SI	3.17
82	*Mesembryanthimum nodiflorium* L.	Aizoaceae	Ann	Th	ER-SR, SA-SI, ME	19.05
83	*Moltkiopsis ciliata* (Forssk.) I. M. Jonst.	Boraginaceae	Per	Ch	SA-SI, S-Z, ME	6.35
84	*Nicotiana glauca* R. C. Graham	Solanaceae	Per	Ch	IR-TR, ER-SR,ME	6.35
85	*Ochradenus baccatus* Delile.	Resedaceae	per	Nph	SA-SI	9.52
86	*Ononis serrata* Forssk.	Fabaceae	Ann	Th	SA-SI, ME	3.17
87	*Parapholis incurva* (L.) C.E.Hubb.	Poaceae	Ann	Th	IR-TR, ER-SR, ME	1.59
88	*Pergularia tomentosa* L.	Asclepiadaceae	Per	Ch	SA-SI	1.59

89	*Phragmites australis* (Cav.) Trin.ex Steud.	Poaceae	Per	G, He	COSM	14.29
90	*Plantago lagopus* L.	Plantaginaceae	Ann	Th	IR-TR, ME	3.17
91	*Plantago notata* Lag.	Plantaginaceae	Ann	Th	SA-SI, IR-TR	1.59
92	*Poa annua* L.	Poaceae	Ann	Th	COSM	4.76
93	*Polypogon monspeliensis* (L.) Desf.	Poaceae	Ann	Th	COSM	3.17
94	*Paranochia argentea* L.	Caryophyllaceae	Ann	Th	SA-SI, S-Z, ME	3.17
95	*Polygonum equisetiforme* Sibthi & Sm.	Polygonaceae	Per.	G	IR-TR, ME	11.11
96	*Pulicaria undulata* (L.) C.A. Mey.	Asteraceae	Per	Ch	SA-SI, S-Z	6.35
97	*Reichardia tingitana* (L.) Roth.	Asteraceae	Ann	Th	IR-TR, ME	20.63
98	*Reseda decursiva* Forssk.	Resedaceae	Ann	Th	SA-SI	9.52
99	*Retama raetam* (Forssk.) Webb&Berthel.	Fabaceae	per	Nph	SA-SI	3.17
100	*Rumex vesicarius* L.	Polygonaceae	Ann	Th	ME, S-Z, SA-SI	14.29
101	*Salsola kali* L.	Chenopodiaceae	Ann	Th	COSM	9.52
102	*Suaeda monoica* Forssk.	Chenopodiaceae	Per	Ch	SA-SI, ME	1.59
103	*Senecio glaucus* L.	Asteraceae	Ann	Th	IR-TR, SA-SI, ME	34.92
104	*Spergularia media* (L.) Griseb.	Caryophyllaceae	Per	H	IR-TR, ER-SR, ME	4.76
105	*Suaeda pruinosa* Lange	Chenopodiaceae	Per	Ch	ME	6.35
106	*Solanum nigrum* L.	Solanaceae	Ann	Th	COSM	3.17
107	*Symphyotrichum squamatum* (Spreng.) Nesom.	Asteraceae	Per	Ch	NEO	3.17
108	*Sisymbrium irio* L.	Brassicaceae	Ann	Th	IR-TR, ER-SR, ME	4.76
109	*Stellaria pallida* (Dumort.) Murb.	Caryophyllaceae	Ann	Th	ER-SR, ME	1.59
110	*Silybum marianum* (L.) Gaertn.	Asteraceae	Per	H	IR-TR, ER-SR, ME	4.76
111	*Sonchus oleraceus* L.	Asteraceae	Ann	Th	COSM	3.17
112	*Tamarix aphylla* (L.) H. Karst.	Tamaricaceae	Per	Nph	S-Z, SA-SI	1.59
113	*Tamarix nilotica* (Ehrenb.) Bunge.	Tamaricaceae	Per	Nph	SA-SI	19.05
114	*Trigonella stellata* Forssk.	Fabaceae	Ann	Th	SA-SI, IR-TR	6.35
115	*Thymelaea hirsuta* (L.) Endl.	Thymelaeaceae	Per	NPh	ME	1.59
116	*Urospermum picroides* (L.) F. W. Schmidt	Asteraceae	Ann	Th	IR-TR, ME	7.94
117	*Volutaria lippii* (L.) Cass. Ex Maire	Asteraceae	Ann.	Th	SA-SI	9.52
118	*Zilla spinosa* (L.) Prantl.	Brassicaceae	Per	Ch	SA-SI	15.87
119	*Zygophyllum coccineum* L.	Zygophyllaceae	Per	Ch	SA-SI	14.29
120	*Zygophyllum aegyptium* Hosny	Zygophyllaceae	Per	Ch	ME	23.81
121	*Zygophyllum decumbens* Delile.	Zygophyllaceae	Per	Ch	SA- SI	23.81
122	*Zygophyllum simplex* L.	Zygophyllaceae	Ann	Th	SA-SI	25.40

Abbreviations: P: Presences, Ann: Annual, Per: Perennial, Bi: Bi-ennial, Th: Thero-phytes Ch: Chamae-phytes, Nph: Nanophanerophytes, H: Hemicryptophytes, He: Helophytes, G: Geophytes, P: Parasites, PAL: Palaeo-tropical, NEO: Neo-tropical, ME: Mediterranean, ER-SR: Euro/Siberian, SA-SI: Saharo/Sindian, IR-TR: Irano-Turanina, S-Z: Sudano/Zambezian, AUST: Australian, COSM: Cosmopolitan,

Table 2. The main chorotype of families in the studied region.

No.	Families	Genus	Spp.	Cosmopolitan	Neotropical	Palaeotropical	PAN	Pluri-regional	Bi-regional	Mediterranean	Sahro-Sindian	Australian
1	Asteraceae	21	24	1	1	-	-	3	11	1	7	-
2	Poaceae	13	15	2	-	1	1	2	7	1	1	-
3	Chenopodiaceae	8	13	2	-	-	-	3	5	1	1	1
4	Fabaceae	8	11	-	-	-	-	2	4	2	3	-
5	Brassicaceae	8	8	-	-	-	-	2	4	-	2	-
6	Zygophyllaceae	2	7	-	-	-	-	-	1	1	5	-
7	Aizoaceae	3	5	-	-	-	-	2	2	-	1	-
8	Boraginaceae	4	4	-	1	-	-	1	1	1	-	-
9	Caryophyllaceae	4	4	-	-	-	-	2	2	-	-	-
10	Solanaceae	4	4	1	-	-	-	1	1	-	1	-
11	Polygonaceae	3	3	-	-	-	-	1	2	-	-	-
12	Asclepiadaceae	2	2	-	-	-	-	-	1	-	1	-
13	Convolvulaceae	1	2	1	-	-	-	-	-	-	1	-
14	Euphorbiaceae	1	2		-	-	-	1	-	-	1	-
15	Malvaceae	2	2	1	-	-	-	-	1	-	-	-
16	Plantaginaceae	1	2	-	-	-	-	-	1	1	-	-
17	Resedaceae	2	2	-	-	-	-	-	-	-	2	-
18	Tamaricaceae	1	2	-	-	-	-	-	1	-	1	-

19	Apiaceae	1	1	-	-	-	-	-	-	-	1	-
20	Campanulaceae	1	1	-	-	-	-	-	1	-	-	-
21	Cleomaceae	1	1	-	-	-	-	-	-	-	1	-
22	Geraniaceae	1	1	-	-	-	-	-	-	1	-	-
23	Plumbaginaceae	1	1	-	-	-	-	-	1	-	-	-
24	Primulaceae	1	1	1	-	-	-	-	-	-	-	-
25	Rutaceae	1	1	-	-	-	-	-	-	-	1	-
26	Scrophulariaceae	1	1	-	-	-	-	-	1	-	-	-
27	Thymelaeaceae	1	1	-	-	-	-	-	-	1	-	-
28	Urticaceae	1	1	-	-	-	-	-	1	-	-	-
Total		98	122	9	2	1	1	20	48	10	30	1
Percentage				7.38	1.64	0.82	0.82	16.39	39.34	8.20	24.59	0.82

Table 3: No. of listed spp. and % of different floristic types of the studied region.

No.	chorotype	T. area		Geographical distribution
		No.	%	
1	Cosmoplitan	9	7.38	World wide
2	Neotropical	2	1.64	
3	Palaeotropical	1	0.82	
4	Pantropical	1	0.82	
5	IR-TR, SA-SI, ME	4	3.28	Pluri-regional elements
6	ER-SR, SA-SI, ME	2	1.64	
7	IR-TR, ER-SR, ME	11	9.02	
8	SA-SI, S-Z, ME	3	2.46	Bi-regional elements
9	IR-TR, ME	11	9.02	
10	ER-SR, ME	2	1.64	
11	SA-SI, ME	13	10.66	
12	PAL, ME	1	0.82	
13	SA-SI, IR-TR	10	8.20	
14	S-Z, SA-SI	10	8.20	
15	IR-TR, S-Z	1	0.82	
16	ME	10	8.20	Mono-regional elements
17	SA-SI	30	24.59	
18	AUST	1	0.82	
Total		122	100	

The floristic features

The overall number of registered plant species in the study region is 122 species of 98 genera and relates to 28 families. Figure (4) displayed that family Asteraceae includes 24 species (19.67%) of total recorded plant species, followed by the family of Poaceae, Chenopodiaceae, Fabaceae, Brassicaceae and Zygophyllaceae are 15, 13, 11, 8 and 7 species, respectively. Results obtained revealed that these six families are the prominent taxa as they represent the major bulk of the flora of study area, which came in agreement with many other researchers [2, 25, 26, 30] who reported that these families represent the most common in the Mediterranean North African flora.

Generally, the number of species in the family is small: 21 taxonomic families include < five species and only four families (Asteraceae, Poaceae, Chenopodiaceae and Fabaceae) > ten species. Obviously, unequal distribution of species richness among genera in the study area, where large genus included was *Atriplex* and *Zygophyllum* (4 species each). Another three genera including *Astragalus*, *Fagonia* and *Mesembryanthemum* were represented by three species, (Table 2).

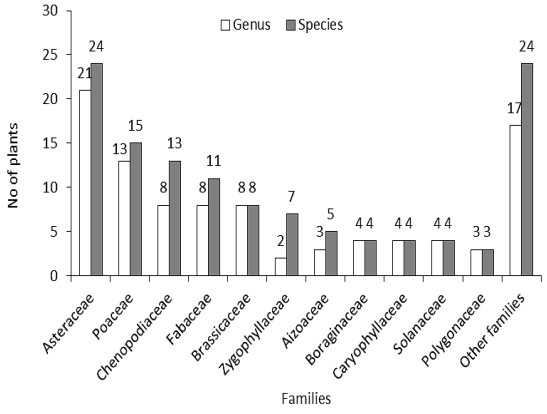

Figure 4: The overall number of listed plant genus and species inside the families.

The floristic types of plant life in the studied region are displayed in Table (2). The most noted chorotype of family Asteraceae are Bi-regional (11 spp.), SA-SI (7 spp.), Pluri-regional (3 spp.), while COSM, NEO and ME are signified by one species each. In Poaceae, the main appearance chorotypes are Biregional (7 spp.), COSM and Pluriregional (2 spp. each), while PAN, PAL, ME and SA-SI elements are denoted by one species each. The floristic composition of family Chenopodiaceae is Bi-regional (5 spp.), Pluri-regional (3 spp.), COSM (2 spp.), while ME, SA-SI and AUST chorotypes are represented by only one sp. each.

The most abundant floristic element in Fabaceae is Bi-regional (4 spp.), SA-SI (3 species), whereas Pluri-regional and ME chorotype are performed by one-species each. The floristic members in Brassicaceae are Bi-regional (4 spp.), Pluriregional and SA-SI (2 spp. each). The most common chorotype of family Zygophyllaceae are SA-SI (5 spp.), ME and Biregional elements are performed by one species each. In Aizoaceae, the most common chorotypes are Bi-regional and Pluri-regional (2 species each), a SA-SI element is represented by one species. The additional families include various types of floristic structure that were generally less than five species. Many researchers e.g. Sheded [31], El-Ameir et al. [26], El-Amier et al. [32], Salama et al. [25], and Al-Hadithy et al. [22] have described similar surveys.

Table (3) reveals also that, 57 species (about 46.72 % of the total number of recorded spp.) are Med. taxa (ME). These taxa are either Pluriregional (20 spp. =16.39 %), Biregional (27 spp. =22.13 %) or Monoregional (10 spp. = 8.20 %). It has been also found that 30 spp.(about 24.59 % of the total number of the recorded species) are Saharo-Sindian (SA-SI). These findings are consistent with those achieved by Danin and Plitman [33] on the phyto-geographical investigation of the flora of Sinai Pennsiula and Israel, and Salama *et al*. [25] on the floristic characterization of flora of valley El-Assiuty and valley-Habib in ED. A high percentage of the SA-SI chorotype may be explained by the fact that the listed plants of SA-SI spp. are good indicators for arid ecosystem conditions. It is worth noticing that spp. structure of area under study diverse significantly from those of Med. shoreline. This may be endorsed chiefly to the dissimilarities in nature of edaphic variables. The floristic components of Med. coastal girdle have better climatic conditions than those of the other regions in Egypt [34].

CONCLUSIONS

Egypt has characterized by unparalleled biodiversity that contributes to its economy and supports human well-being, as well as provides regulating, and supporting services. Egypt is part of the Sahara of North Africa and covers a total area of over one million km^2 in the hyper-arid region. Consequently, the flora of the desert is the most important and characteristic structure of a natural ecosystem. Also, the northern Med. coastline of Egypt is characterized by highly dissimilar edaphic, topographic and climatic characteristics and as a consequence, by different flora groups. Therefore, the listed flora in this region plays an essential role in sustainable management by keeping bio-diversity and protecting the environment.

Appendix 1. Photo of the studied *Fagonia* species.

Plate 1: General and close-up view of *Fagonia arabica* L

Plate 2: General and close-up view of *Fagonia cretica* L.

Plate 3: General close-up view of *Fagonia mollis* Delile

4. References

1. Zahran, M.A. and A.J. Willis, (2009). The Vegetation of Egypt. 2nd ed. Springer. Netherlands.
2. El-Amier Y.A. and O.M. Abdul-Kader, (2015). Vegetation and species diversity in the northern sector of Eastern Desert, Egypt. *West Afr. J. Appl*. Ecol., **23(1):** 75-95.
3. Boulos L. (2008). Flora and vegetation of the deserts of Egypt. Flora Mediterran. **1(8)**: 341 -359.
4. Boulos, L., (2000). Flora of Egypt, Al Hadara Publishing, Cairo. Vol. 2.
5. Hassan, F.A., (1980.) Prehistoric settlements along the Nile. Prehistoric settlements along the Nile. In: M.A.J. Williams and H. Faure (Ed.), The Sahara and the Nile, Quarternary Environments and Prehistoric Occupation in Northern Africa: Rotterdan, Balkema.
6. El-Hadidi, M. N., (1985) Food plants of prehistoric and predynastic Egypt. In: G.E. Wickens; J.R. Goodin and D.V. Field (Eds.), Plants for arid lands. London, Boston, Sydney: George Allen and Unwin.
7. Zahran, M. A. and Y. A. El-Amier, (2013). Non-traditional fodders from the halophytic vegetation of the Deltaic Mediterranean Coastal Desert, Egypt, *J. Biol. Sci*., **13**: 226-233.
8. Zahran, M. A. and Y. A. El-Amier, (2014). Ecology and establishment of fiber producing taxa naturally growing in the Egyptian deserts. Egypt. Egypt. *J. Basic App. Sci*., **1(3):** 144-150.
9. El-Amier, Y. A. and A. A Ejgholi, (2014). Fodder Potentialities of Three Halophytes Naturally Growing in Egypt. *J. Environ. Sci., Mansoura Univ*., **43 (4):** 647-662.
10. Zahran, M.A., M.A. EL-Demerdash, and I.A Mashaly. (1990). Vegetation types of Deltaic Mediterranean coast of Egypt and their environment. *J. Veget. Sci*., **1**: 305-310.
11. UNESCO (1977). Map of the World Distribution of Arid Regions. MAB Technical Notes, 7.
12. Ayyad, M.A., M. Abdel-Razik, and A. Mehanna, (1983). Climatic and

Vegetational Gradients in the Mediterranean Desert of Egypt. Pre-report of the Mediterranean Bioclimatology Symposium, Montpellier (France, 18-20 May).
13. Thornthwaite, C.W., 1948. An approach towards a national classification of climate. Geogr. Rev., **38**: 55 – 94.
14. Raunkiaer, C., 1934. The Life Forms of Plants and Statistical Plant Geography. Translated by Carter Fausboll and Tansley; Oxford Univ. Press, London.
15. Raunkiaer, C., (1937). Plant Life Forms. Clarendon, Oxford.
16. Tutin, T.G., V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb, 1964-1980, Flora Europaea, Cambridge Univ. Press. Vols. 1-5.
17. Davis, P. H. (ed.), 1965 – 1985. Flora of Turkey and the East Agean Islands. Vols. **1 – 9.** Edinburgh Univ. Press. Desert. Egypt. *J. Arid Env., ed. New Age Intern., Limited, New Delhi*, **66**: 210-217.
18. Zohary, M., (1966) and 1972. Flora Palaestina. Parts. 1 and 2. The Israel Academy of Sciences and Humanities, Jerusalem.
19. Tackholm, V., (1974). Students' Flora of Egypt. 2nd Edition, Cairo Univ. Press.
20. Meikle, R.D., (1977) and 1985. Flora of Cyprus, Bentham-Maxon Trust, Royal Botanic Gardens, Kew, Vols. 1 and 2.
21. Feinbrun-Dothan, N., 1978 and 1986. Flora Palaestina. Parts 3 and 4. The Israel Academy of Sciences and Humanities, Jerusalem.
22. Al-Hadithy, O.N., A.M. Youssef, R.A. Hassanein, and Y.A. El-Amier, (2018). Vegetation Composition Related to Environmental Factors along the International Highway-West Alexandria, Egypt. Ann. Res. Rev. Biol., **30(1):**1-15.
23. Alatar A, MA. El-Sheikh, J. Thomas, (2012). Vegetation analysis of Wadi Al-Jufair, a hyper-arid region in Najd, Saudi *Arabia. Saudi J. Biol. Sci*.; **19**: 357–68.
24. Abdel Khalik K, M. El-Sheikh and A. El-Aidarous. (2013) Floristic diversity and vegetation analysis of Wadi Al-Noman, Mecca, *Saudi Arabia. Turk. J. Bot*.; **37**: 894–907.
25. Salama, M., A. S. Sayed, and A. A. Abd El-Gelil, (2014), Plant communities and floristic composition of the vegetation of Wadi Al-Assiuty and Wadi Habib in the Eastern Desert, Egypt, Not. Sci. Biol., **6**: 196-206.
26. El-Amier Y. A., E. F. El-Halawany and T. J. Abdullah, (2014) .Composition and diversity of plant communities in sand formations along the northern coast of the Nile Delta in Egypt. Res. *J. Pharmaceut. Biol. Chem. Sci.* **5(4)**: 826–847.
27. El-Amier, Y.A., (2016). Vegetation structure and soil characteristics of five common geophytes in desert of Egypt. Egypt. *J. Basic Appl. Sci*. **3(2):**172-186.
28. Heneidy S. Z. and L. M. Bidak, (2001). Multipurpose plant species in Bisha, Asir region, southwestern *Saudi Arabia. J. King Saud Univ. Sci*. **13**: 11–26.
29. Danin A. and G. Orshan, (1990). The distribution of Raunkiaer life forms in Israel in relation to the environment, *J. Veg. Sci*. **1(1):** 41-48.
30. Walters DR, DJ. Keil, (1996). Vascular plant taxonomy. 4th ed. Dubuque, Iowa: Kendall/Hunt Publishing Co.
31. Sheded M. G., (1992),Environment and vegetation in the South Eastern Desert, Egypt, Ph.D. Thesis, Fac. Sci., Assiut Univ., Egypt.
32. El-Amier, Y. A., S. A. Haroun, O. A. El-Shehaby, and O. M. Abdulkader, (2015). Floristic features of Northern sector of the *Eastern Desert, J. Environ. Sci*., **44**: 387 – 401.
33. Danin A. and U. Plitman, (1987). Revision of the plant geographical territories of Israel and Sinai. Pl. Syst. Evol. **156**: 43–53.
34. Zahran, M.A. and A.J. Willis, (1992). The vegetation of Egypt. Chapman & Hall, London, U.K.