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FLORISTIC STUDY AND PLANT DIVERSITY OF FARWA ISLAND-LIBYA

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ABSTRACT

The aim of the present study is to assess the floristic composition and plant diversity of Farwa Island one of the most important Libyan wetlands. The results showed that 130 plant species belonging to 53 families of which 40 dicots, 10 monocots and 3 Gymnosperms were recorded. The most highly represented families are the Asteraceae with 16 species, followed by Amaranthaceae and Fabaceae with 10 species. Floristic analysis was conducted to determine life forms and chorotypes, the highest life forms recorded were Therophytes with 47 species, followed by Hemicryptophytes and Chamaephytes with 25 species for each, then Geophytes with 17 species which the Mediterranean Therophytes are dominating. Chorotype analysis revealed the dominance of Mediterranean plants with 57 species, then Mediterranean / Iranu-Turanean plants with 18 species.

دراسة التنوع الحيوي و فلورا جزيرة فروة – ليبيا

محمد مخلوف فتحي الصغير خالد التاب

أجريت هذه الدراسة بهدف دراسة الفلورا و التنوع النباتي في جزيرة فروة. أظهرت النتائج تسجيل130نوعاً نباتياً تنتمي إلى53فصيلة منها 40 ثنائيات الفلقة و10 أحاديات الفلقة و3عاريات البذور. أظهرت النتائج أن أكثر الفصائل تمثيلاً هي فصيلة Asteraceae التي ضمت 16نوعًا ، تليها Amaranthaceae و Fabaceaeبعدد 10 أنواع .تم إجراء التحليل الفلوري لتحديد أشكال الحياة وأنماطها ،أظهرت النتائج سيادة النباتات العشبية الحولية بعدد 47نوعًا ، تليها النباتات العشبية المعمرة وتحت الشجيرات (الجنبات) بعدد 25 نوعًا لكل منهما،ثم النباتات البصلية و الريزومية بعدد 17 نوعًا .أظهرت دراسة التوزيع الجغرافي سيادة نباتات البحر الأبيض المتوسطية 57 نوعًا،ثم النباتات ثنائية المنطقة (النباتات المتوسطية الأيراني قبـ 18 نوعًا.أظهرت نتيجة تحليل الغنى النوعي باستخدام index Simpson أن جزيرة فروة تتمتع بتنوع نباتي عالي .

INTRODUCTION

Farwa island is one of the most important Libyan wetlands (Defos *et al*, 2003), it is located in the Mediterranean north western part of Libya about 150 km west to Tripoli city between 11º15 E and 11º45 E, and 33º05 N and 33º08 N (11°44'40" E, 33°05'20" N; Fig. 1), the length of the island is about 12 Km with maximum width of about 1.5 km, and the total area is about 31 Km² (Fig 1) (Pergent *et al*, 2002; Etayeb and Essghaier, 2007). The island is characterized by sandy to clayey loam soils in southern region towards the mainland, sandy soil in eastern region and western region is dominated by marshes, water logged puddles and elevated Posidonia crust near to the sea(Pergent *et al*, 2002; Etayeb, 2012), and with diverse habitats of sand dunes, trees, mud flat, marshes, drying salt lakes, and beaches, these different conditions provide a good habitat for many plant species, it falls under Mediterranean climatic condition, with the mean annual temperature is 19ºC and the mean annual rainfall reaches 200 mm, (Jadidi *et al*, 2017). Botanically, Farwa Island is poorly explored with scarce fragmented floristic studies (Keith, 1965; Jafri and El-Gadi, 1976 – 1989; Erteeb and Kikli, 2012). The aim of this study is to conduct a comprehensive floristic survey to evaluate the floral status and biodiversity of the island, as well as, to provide sufficient data of the plant diversity for future studies.

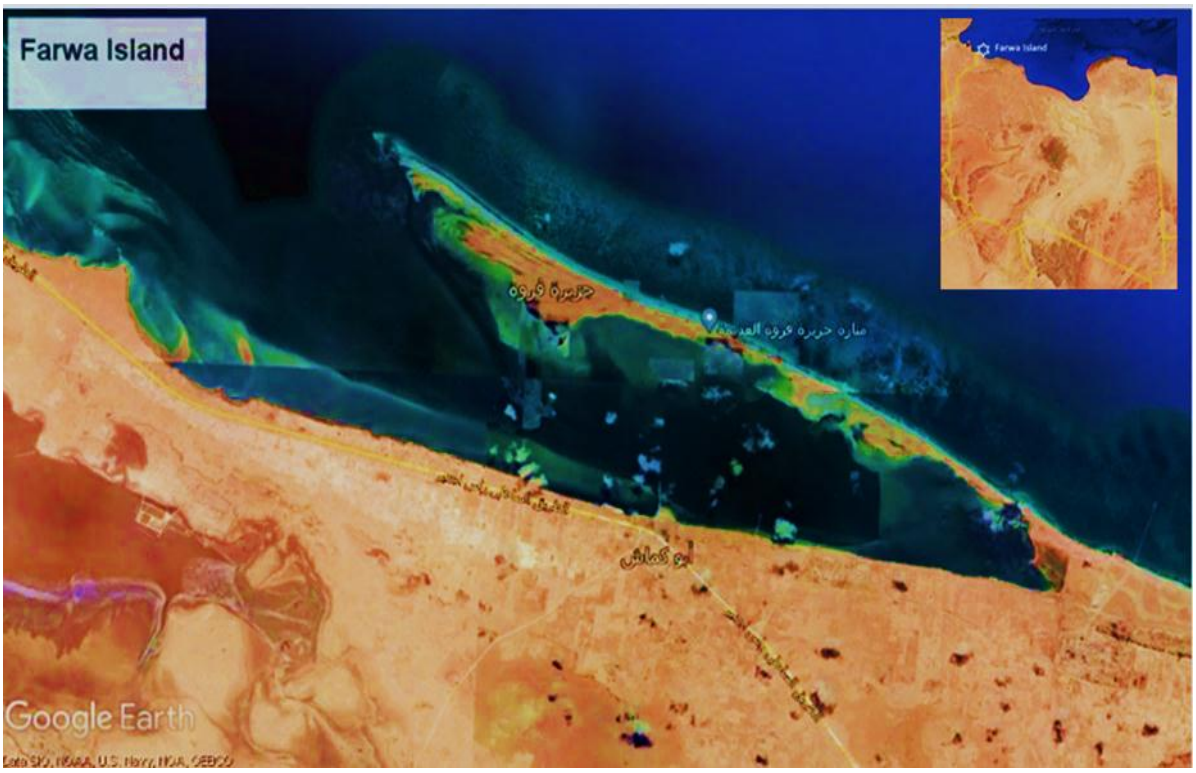


Figure 1. Location of Farwa Island.

METHODOLOGY

Due to the drought of the region, this study lasted for one completeyear from (1/1/2022 to 1/1/2023) to investigate the status of plant diversity in the study area. During this period, a total of 130 plant species were collected upon various field trips, the collected plant specimens were brought into the herbarium for further treatments. Identification of plant specimens was authenticated by the authors and confirmed by using dichotomous keys, plant description, illustrations, and photographs, provided by manuals and floras of the region, such as Flora of Libya (Jafri and El-Gadi, 1976 – 1989), Flora Palaestina (Zohary, 1966 & 1972; Feinbrun-Dutan, 1976-1986). Flora of Egypt (Täckholm, 1974). Flora of Syria, Palestine and Sinai (Post, 1932-1933). Key to The Families of Flora of Libya (Erteeb, 1994).The Grasses of Libya (Sherif, 1995). Finally the plant specimens were deposited at the National herbarium of the botany department, faculty of sciences, University of Tripoli (ULT).

RESULTS AND DESCUSSION

A survey of the study area has conducted in the period between January 2022 and January 2023, to investigate the status of plant diversity of the study area. This survey has led to collection and identification of 130 plant species, 106 are belonging to dicotyledons, 21 species belong to monocotyledons and 3 species belonging to Gymnosperms. The collected plant species represented by 53 families where 40 families belong to Dicotyledons, 10 belong to Monocotyledons and 3 families belong to gymnosperms (Table 1). In term of calculation of the of families percentages in relation to the total number recorded, the result showed predominance of the family Asteraceae with a total of 16 speciesand percentage of 12.3%, followed by the families Amaranthaceae and Fabaceae with a number of 10 species each and a percentage of 7.8 %, and the family Poaceae was represented by nine species which comprise 6.9 % (Fig 2).

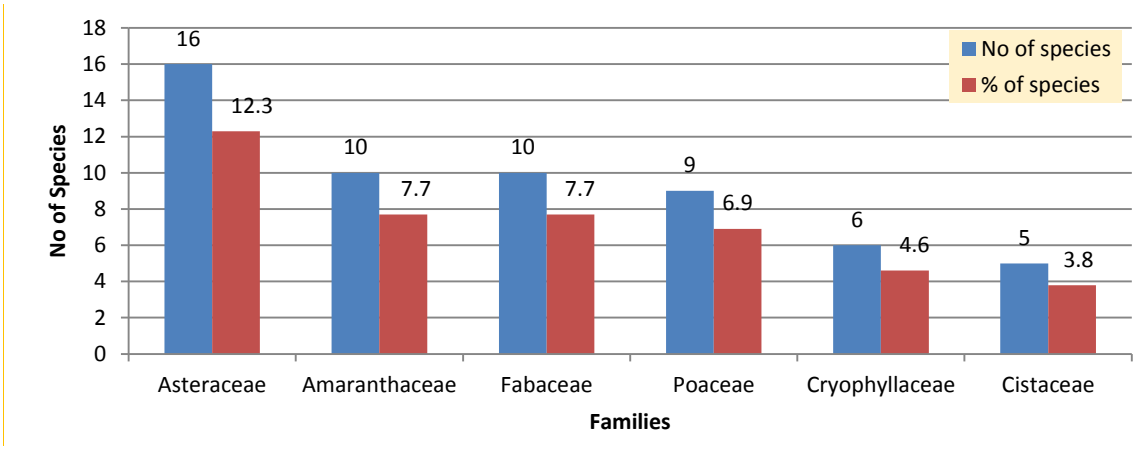
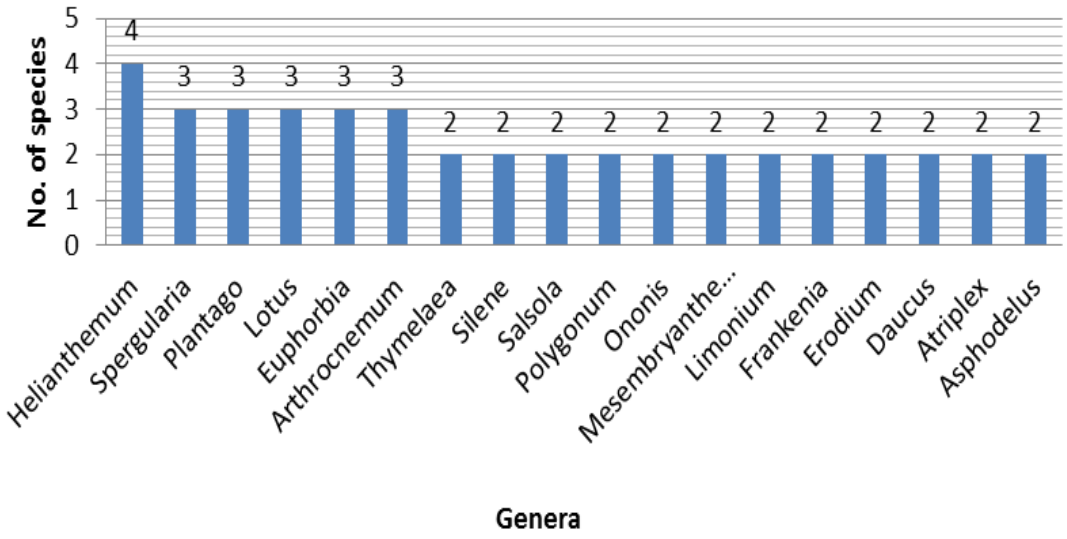


Figure 2: The dominant families

in the study area.

The dominant genera recorded in this study were *Helianthemum* represented by 4 species, followed by *Euphorbia*, *Arthrocnemum*, *Plantago*, *Spergularia* and *Lotus* which represented by 3 species each, while the genera *Silene*, *Salsola*, *Ploygonum*, *Erodium*, *Mesembryanthemum*, *Ononis*, *Limonium*, *Frankenia*, *Asphodelus*, *Atriplex* and *Daucus* were represented by 2 species for each. Such results indicate that most recorded genera in this study 85 genera are represented by one species for each (Fig 3).



3: The dominant genera in the study area.

The dominance of the family Asteraceae is reasonably expectable because most members of this family are Therophytes which are dominating the Mediterranean region (Al-Sghair and Makhlouf, 2017) that characterizes the study area, in addition, it is one of the largest families among the vascular plants and with cosmopolitan distribution, so it is expected that it will occupy highest ratio (Bessada *et al*, 2015). A floristic list is also presented in this study which provides life forms and chorotypes of collected species (Table 1).

Table 1. Check list of recorded plant species with lifeforms and corotypes.

	Family	Scientific Name	Life form	Chorotype
		Gymnospermis		
1	Cupressaceae	*Cupressus sempervirens* L.	Ph	Med.
2	Ephedraceae	*Ephedra alata* Decna.	NP	Sah-Ara.
3	Pinaceae	*Pinus halepensis* Mill.	Ph	Med.
		Angiospermis (Dicots)		
4	Aizoaceae	*Mesembryanthemum crystallinum* L.	Th	Med./ Eru-Si.
5	Aizoaceae	*Mesembryanthemum nodiflorum* L.	Th	Med. /Eru-Si./ Sah-Ara
6	Amaranthaceae	*Arthrocnemum fruticosum* (L.) Moq.	Ch	Med.
7	Amaranthaceae	*Arthrocnemum macrostachium* (Moric) Moric	Ch	Med./ Sah-Ar.
8	Amaranthaceae	*Arthrocnemum perene* (Mill.) Moss	Ch	Med.
9	Amaranthaceae	*Atriplex halimus* L.	Ch	Med.
10	Amaranthaceae	*Atriplex mollis* Desf.	Ch	Med.
11	Amaranthaceae	*Bassia muricata* (L.) AShers.	Th	Sah-Ar./ Ir-Tu.
12	Amaranthaceae	*Chenopodium murale* L.	Th	Plu.
13	Amaranthaceae	*Halocnemum strobilacium* (Pall.) M	Ch	Med./ Ir-Tu./ Sah-Ar.
14	Amaranthaceae	*Salsola kali* L.	Th	Plu.
15	Amaranthaceae	*Salsola vermiculata* Forsk.	Ch	Ir-Tu./ Sah-Ar.
16	Apiaceae	*Daucus pumilus* (L.) Hoffmanns. & Link.	Th	Med./ Sah-Ar.
17	Apiaceae	*Daucus syrticus* Mub.	Th	Med.
18	Apiaceae	*Deverra tortuosa* (Desf.) DC.	Ch	Med.
19	Asteraceae	*Artemisia campestris* L.	H	Med./ Ir-Tu.
20	Asteraceae	*Calendula arvensis* L.	Th	.Med./ Ir-Tu
21	Asteraceae	*Carthamus lanatus* L.	Th	Med./ Ir-Tu./ Eur-Si.
22	Asteraceae	*Centaurea dimorpha* Viv.	H	Med./ Ir-Tu.
23	Asteraceae	*Chrysanthoglossum trifurcatum* (Desf.) Wilcox, Bremer & Humphries	H	Med.
24	Asteraceae	*Echinops spinosissimus*Turra.	H	Med.
25	Asteraceae	*Helichrysum stoechas* (L.) Moench	Th	Med.
26	Asteraceae	*Ifloga spicata* (Forsk.) Sch-Bip.	Th	Med./ Ir-Tu.
27	Asteraceae	*Launaea fragilis* (Asso) Pau.	H	Med.
28	Asteraceae	*Limbarda crithmoides* (L.) Dumort.	Ch	Med./ Eur-Si./ Sah-Ar.
29	Asteraceae	*Onopordum arenarium* (Desf.)Pomel.	H	Med.
30	Asteraceae	*Phagnalon rupestre* (L.) DC.	H	Med./ Ir-Tu.
31	Asteraceae	*Phonus lanatus* (L.) Hill.	Th	Med./ Ir-Tu./ Eur-Si.
32	Asteraceae	*Reichardia tingitana* (L.) Roth.	Th	Ir-Tu./ Sah-Ar.
33	Asteraceae	*Senecio gallicus* Chiax	Th	Med.
34	Asteraceae	*Sonchus bulbosus* (L.) N.Kilian & Greuter.	H	Med.
35	Boraginaceae	*Echiochilon fruticosum* Desf.	Ch	Med.
36	Boraginaceae	*Echium angustifolium* Mill.	H	Med.
37	Brassicaceae	*Brassica tournifortii* Gouan	Th	Med./ Sah-Ar.
38	Brassicaceae	*Cakile aegyptica* (L.) Willd.	Th	Med./ Eur-Si.
39	Brassicaceae	*Enarthrocarpus clavatus* (Desf.) Del. Ex Godr.	Th	Med.
40	Brassicaceae	*Hussunia pinnata* (Viv.) Jafri	Th	Med./ Sah-Ar.
41	Caryophyllaceae	*Minurtia geniculata (*Poiret) Thell.	H	Med.
42	Caryophyllaceae	*Silene colorata* Poiret	Th	Med.
43	Caryophyllaceae	*Silene succulenta* Forsk.	H	Med.
44	Caryophyllaceae	*Spergularia diandra (*Guss.) Heldr. & Sart.	Th	Med./ Ir-Tu./ Eur-Si.

45	Caryophyllaceae	*Spergularia media (*L.) C. Presl.	H	Med./ Ir-Tu./ Eur-Si.
46	Caryophyllaceae	*Spergularia rubra* (L.) C. Presl	Th	Med./ Eur-Si.
47	Casuarinaceae	*Casuarina equisetifolia* Forsk.	Ph	Astralian
48	Cistaceae	*Fumana arabica* L.	Ch	Med.
49	Cistaceae	*Helianthemum kahirichum* Delile	Ch	Med.
50	Cistaceae	*Helianthemum lippii* (L.) Dum.	Ch	Med.
51	Cistaceae	*Helianthemum stipulatum* (Forsk.) C. Chr.	Ch	Sah-Ar.
52	Cistaceae	*Helianthemum virgatum* (Desf.) Pers.	Ch	Med.
53	Convolvulaceae	*Ipomoea imperati* (Vahl) Griseb(Cyr.) Gmelin.	Geo	Med.
54	Coridaceae	*Coris monspeliensis* L.	Th	Med.
55	Cuscutaceae	*Cuscuta planiflora* Ten	Th	Med./ Ir-Tu.
56	Cynomoriaceae	*Cynomorium coccineum* L.	H	Med./ Ir-Tu./ Sah-Ar.
57	Euphorbiaceae	*Euphorbia peplus* L.	Th	Sud.
58	Euphorbiaceae	*Euphorbia terracina* L.	H	Med.
59	Euphorbiaceae	*Euphorbia paralias* L.	Th	Med./ Eur-Si.
60	Fabaceae	*Astragalus hamosus* L.	Th	Med./ Ir-Tu.
61	Fabaceae	*Calicotome villosa* (Forsk.) Webb. & Berth	NP	Med.
62	Fabaceae	*Hippcrepis bicontorta* Lois.	Th	Sah-Ar.
63	Fabaceae	*Lotus cytisoides* L.	H	Med.
64	Fabaceae	*Lotus edulis* L.	Th	Med.
65	Fabaceae	*Lotus polyphyllos* Clarke	H	Med.
66	Fabaceae	*Ononis natrix* L.	Ch	Med.
67	Fabaceae	*Ononis vaginalis* Vahl.	Ch	Med.
68	Fabaceae	*Retama raetam* ((Forsk.)	NP	Sah-Ar.
69	Fabaceae	*Trigonella maritima* Delile ex Poiret	Th	Med./ Ir-Tu.
70	Frankeniaceae	*Frankenia hirsuta* L.	H	Med./ Eur-Si.
71	Frankeniaceae	*Frankenia pulverulenta* L.	Th	Eur-Si./Med./Ir-Tu.
72	Gentianaceae	*Centaurium pulchellum* (Swartz) Druce	Th	Med.
73	Geraniaceae	*Erodium glaucophyllum* (L.) L. Herit	H	Sah-Ar.
74	Geraniaceae	*Erodium laciniatum* (Cav.) Willd.	Th	Med.
75	Hypeocaceae	*Hypecoum procumbens* L.	Th	Med.
76	Illecebraceae	*Herniaria ericifolia* Townsend	Ch	Med./ Sah-Ar.
77	Illecebraceae	*Pteranthus dichotomus* Forsk.	Th	Sah-Ar.
78	Lamiaceae	*Salvia lanigera* Poir.	Th	Med./ Ir-Tu.
79	Lamiaceae	*Teucrium polium* L.	Ch	Med./ Ir-Tu./ Eur-Si.
80	Mimosaceae	*Acacia cyanophylla* Lindley.	Ph	Ir-Tu.
81	Moraceae	*Ficus carica* L.	P	Ir-Tu.
82	Myrtaceae	*Eucalyptus gomocephala* (DC.) Prodr.	Ph	Australian
83	Neuradaceae	*Neurada procumbens* L.	Th	Med./Ir-Tu./ Eru-Si.
84	Oleaceae	*Olea europaea* L.	Ph	Med.
85	Orobanchaceae	*Orobanche lavandulacea* Recheb.	Th	Med./ Ir-Tu.
86	Plantaginaceae	*Plantago afra* L.	Th	Med./ Ir-Tu.
87	Plantaginaceae	*Plantago coronopus* L.	Th	Med./ Ir-Tu.
88	Plantaginaceae	*Plantago crassifolia* Forsk.	H	Med.
89	Plumbaginaceae	*Limoniastrum monopetalum* (L.) Boiss.	Ch	Med.
90	Plumbaginaceae	*Limonium pruinosum* (L.) O. Kutze.	H	Med.
91	Plumbaginaceae	*Limonium sibthropianum* (Guss.) Mo. Kuntze	Th	Med.
92	Polygonaceae	*Polygonum equisetiforme* Sibth. & Sm.	Plu	Plu.
93	Polygonaceae	*Polygonum maritimum* L.	H	Med.
94	Polygonaceae	*Rumex vesicarius* L.	Th	Sah-Ar.

95	Ranunculaceae	*Delphinium halteratum* Sibth.	Th	Med.
96	Resedaceae	*Reseda alba* L.	Th	Med./ Ir-Tu./ Eur-Si.
97	Rhamnaceae	*Ziziphus lotus* (L.) Desf.	NP	Med./ Sah-Ar.
98	Rubiaceae	*Crucianella maritima* L.	Th	Med.
99	Scrophulariaceae	*Kickxia aegyptica* (L.) Nabelek	H	Med./ Sah-Ar.
100	Scrophulariaceae	*Scrophularia canina* L.	H	Med.
101	Solanaceae	*Lycium europaeum* L.	NP	Med.
102	Solanaceae	*Nicotiana glauca* R. C. Graham.	NP	Plu.
103	Tamaricaceae	*Reaumaria vermiculata* L.	Ch	Med.
104	Tamaricaceae	*Tamarix aphylla* (L.) Karst.	NP	Sah-Ar./ Sud.
105	Thymeleaceae	*Thymelaea hirsuta* (L.) Endl.	Ch	Med.
106	Thymeleaceae	*Thymelaea microphylla* Coss. Et Dr.	Ch	Med./ Sah-Ar.
107	Vitaceae	*Vitis vinifera*	Ch	Plu.
108	Zygophyllaceae	*Nitraria retusa (*Forsk.) Ashers.	NP	Med./ Ir-Tu.
109	Zygophyllaceae	*Zygophyllum album* L.	Ch	Med.
Angiosperms (Monocots)				
110	Amaryllidaceae	*Pancratium maritimum* L.	Geo	Med./ Ir-Tu.
111	Arecaceae	*Phoenix dactylifera* L.	NP	Sah-Ar.
112	Asparagaceae	*Agave sisalana* Perrine ex Engelam	Geo	American
113	Cymodoceaceae	*Cymodocea nodosa* (Ucria) Asch	Geo	Med./ Eur-Si
114	Cyperaceae	*Cyperus kalli* (Forsk.) Murb.	Geo	Med./ Canaries.
115	Iridaceae	*Iris sisrynchium* L.	Geo	Med.
116	Juncaceae	*Juncus maritimus* Lam.	Geo	Med./ Eur-Si
117	Liliaceae	*Asparagus stipularis* Forsk.	Geo	Med.
118	Liliaceae	*Asphodelus microcarpus* Salzm. & Viv.	Geo	Med.
119	Liliaceae	*Asphodelus refractus* Boiss.	Th	Sah-Ar.
120	Liliaceae	*Bellevailia sessiliflora* (Viv.) Kunth.	Geo	Med.
121	Poaceae	*Aeluropus lagopsoides* (L.) Trin. ex Thwaites	Geo	Med./ Ir-Tu.
122	Poaceae	*Ammophila australis* L.	Geo	Med.
123	Poaceae	*Bromus rigidus* Roth.	Th	Med./ Eur-Si
124	Poaceae	*Imperata cylindrica* (L.) Raeushel	H	Med./ Ir-Tu./ Sah-Ar.
125	Poaceae	*Lygeum spartum* Loefl	Geo	Med.
126	Poaceae	*Phragmites australis* (Cav.) Trin. ex steud	Geo	Cos.
127	Poaceae	*Stipa barbata* Desf.	Geo	Med./ Ir-Tu.
128	Poaceae	*Stipagrostis pungens* Desf.	Geo	Sah-Ar.
129	Poaceae	*Trachynia distachya* (L.) Link.	Th	Med./ Ir-Tu.
130	Posidoniaceae	*Posidonia oceanica* (L.) Delile	Geo	Med.

Abbreviations

***Lifeforms*:** Therophytes: Annual herbs, Hemicryptophytes: Perennial herbs, Chaemephytes: Subshrubs, Nanophanerophytes: Shrubs, Phanerophytes: Trees, Geophytes: Perennial herbs with bulbs , corms, tubers, rhizomes

***Chorotypes*:** Cos: Cosmopolitan, Eur-Si: Eurosiberian, Ir-Tu: Iranutuanean, Med: Mediterranean Plu: Pluriregional, Sah-Ar: Saharabian, Temp: Temperate, Trop: Tropical

according to Raunkiaer system of life forms of plants (1934) as modified by Govaerts *et al*. (2000) showed a predominance of Therophytes with a total of 47 species which comprise 36.2 %, followed by Hmicryptophytes and Chaemephytes with 26 species each which comprise 19.2 %, then the Geophytes with a number of 17 species which comprise 13.0 %. (Fig 4)

As expected Therophytes have a clear dominance on other life forms, apparently because of their wider ecological amplitude, greater plasticity in size, and their small growth requirements. In addition, according to the result in (Fig 5

& 6), there is a clear positive correlation between Therophytes and Mediterranean chorotype, this explain why Therophytes dominating the study area which falls within the Mediterranean region (Makhlouf & Al-Eisawi, 2005).

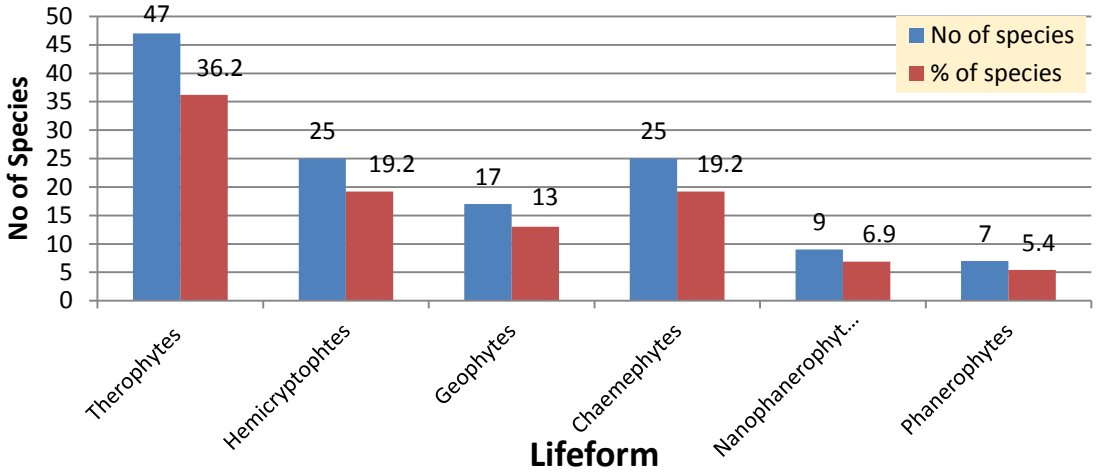


Figure 4: Life-forms of recorded plants in Farwa Island.

Analysis of chorological spectrum of collected plant species showed a predominance of Mediterranean chorotypes with the number of 57 species which is comprise 43.8 %, followed by Mediterranean / Irano-Turanean chorotypes with 18 species which comprise 13.9 % (Fig 5).

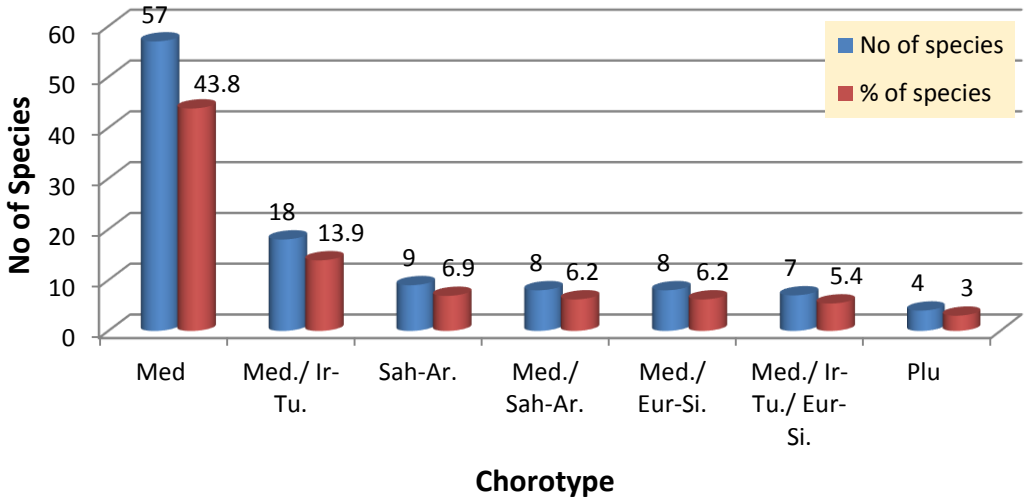


Figure 5: The most dominant chorotypes in the study area.

The dominance of Mediterranean chorotype is expected because the study area falls within the Mediterranean region which characterized by sub humid bioclimate, where the sun is not very strong and the moisture remained longer (Makhlouf and Al-Sghair, 2016). The presence of Mediterranean / Irano-Turanean chorotype with respected ratio because the Iranu-Turanean region is overlapped with the Mediterranean region especially in the east Mediterranean and extend to north Africa because both with more or less similar climate conditions, instead other chorological types were poorly represented, this may have been due to having been transported or introduced.

One of the most important indices to assess ecosystems at different scales is species diversity (Ardakani, 2004). Local diversity can be evaluated using a variety of indices, such as species richness or Simpson's index, which are frequently used to assess distinct trends in plant diversity. Biodiversity measurement mainly focuses on the species level (Eshaghi *et al*, 2009). Simpson's index of diversity

values varies from 0 to 1; closer values to 1 indicate greater diversity, while closer values to 0 indicate decreased diversity (Reich et al, 2001; Ket, 2012). Based on the number of families as well as the number of individuals present for each family (Table 2), the Simpson's Diversity Index was used to determine the Species Diversity score in this study by using this formula:

$$D = 1 - C$$

$$C = \Sigma (pi)^2$$

Where pi = the number of species in each family divided the total number of all species in the families.

$\Sigma (pi)^2 = (15/128)^2 + 2(10/128)^2 + (9/128)^2 + (6/128)^2 + (5/128)^2 + 2(4/128)^2 + 6(3/128)^2 + 10(2/128)^2 + 27(1/128)^2$

= (0.013733) + (0.012207) + (0.004944) + (0.002197) + (0.001526) + (0.001953) + (0.003296) + (0.002441) + (0.001648) = 0.043945

Simpson's Diversity Index (D) = 1-0.043945 = 1- 0.044 = 0.956

Depending on the value obtained from the Simpson Diversity Index, Farwa Island has a high diversity. This is due to the presence of 53 families on the island out of 161 families in the Libyan flora, representing 32.9%.

Table 2: Number of species depending on families.

Family	Number of species	$(pi)^2$
Asteraceae	16	0.013733
Amaranthaceae	10	0.012207
Fabaceae	10	
Poaceae	9	0.004944
Caryophyllaceae	6	0.002197
Cistaceae	5	0.001526
Brassicaceae	4	0.001953
Liliaceae	4	
Euphorbiaceae	3	0.003296
Gentianaceae	3	
Geraniaceae	3	
Polygonaceae	3	
Plantaginaceae	3	
Plumbaginaceae	3	
Aizoaceae	2	0.002441
Boraginaceae	2	
Frankeniaceae	2	
Illecebraceae	2	
Lamiaceae	2	
Scrophulariaceae	2	
Solanaceae	2	
Tamaricaceae	2	
Thymeleaceae	2	
Zygophyllaceae	2	
Other 27 familes	1	0.001648

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REFERENCES

Al-Sghair, F. & Mahklouf, M. H. 2017. Floristic Analysis of the Family Asteraceae in Libya Depending on Flora of Libya. Tripoli–Libya. American Journal of Life Science Researches. 5(4): 170-183. www.diili.org/ojs-2..6/index.php/ajlsr/index.

Ardakani, M. R. (2004) Ecology. Tehran University Press, p. 340. Colinvaux P (1993). Ecology. John Wiley and Sons Inc. New York, pp. 648-684.

Bessada, S.M.F; Barreira, J.C.M; M.Beatriz P.P. Oliveira, M.P.P. 2015. Asteraceae species with most prominent bioactivity and their potential

applications: A review. Industrial Crops and Products Vol 76. 604–615

Defos P., Essghaier, M.F.A. and Etayeb, K. (2003). Inventaire preliminaire des zonehumides cotieres de Libya. Faune. Sauvage. (ONCFS). 259, 44–48.

Etayeb, K.S. and Essghaier, M.F.A., (2007). Breeding of marine birds on Farwa Island, western Libya. Ostrich, 78: 419e bir

Etayeb, K. S., Taboni, E. and Essghaier, M. F. A. (2012). Aspects on Libyan Legislation for Biodiversity conservation and propose Farwa complex as protected area. (2nd Djerba International Mediterranean Environment Sustainability Conference, 22-25 April 2012) Atti E Memorie Dell'ente Fauna Siciliana – Volume XI-81-90

Erteeb, F. B. (1994). A key to the Families of the Flora of Libya. Dept of Botany. Faculty of Science. Al Fateh University. Tripoli-Libya.

Erteeb, F. B. and A. R. Kikli, A. R. (2012). A Taxonomic and Ecological Study of Farwa Island. (2nd Djerba International Mediterranean Environment Sustainability Conference, 22-25 April 2012) Atti E Memorie Dell'ente Fauna Siciliana – Volume XI-81-90.

Eshaghi, R. J; Manthey, M; Mataji, A. (2009) Comparison of plant species diversity with different plant communities in deciduous forests. Int. J. Environ. Sci. Tech., 6 (3), 389-394.

Feinbrun-Dothan, N. (1978). Flora Palaestina, Vol. 3. The Israel Academy of Science and

Humanities. Jerusalem.Feinbrun-Dothan, N. (1986). Flora Palaestina, Vol. 4. The Israel Academy of Science and Humanities. Jerusalem.

Govaerts R, Frodin DG and Radcliffe-Smith. (2000). A. World Checklist and Bibliography of Euphorbiaceae (with Pandanaceae). Kew: The Royal Botanic Gardens; 2000.

Jdeidi, T. B; Saed, F. A; Elhosk, M, A. (2017). The Main Fauna And Flora Of Farwa Island, Lybia. Atti E Memorie Dell'ente Fauna Siciliana, 2018, Volume Xii: 171-176. 3rd International Congress "Biodiversity, Mediterranean, Society", September 4th-6th 2015, Noto-Vendicari (Italy).

Jafri, S. M. and El – Gadi, A. A. (1977 – 1989). Flora of Libya, AlFaateh.University. Faculty of Sciences. Tripoli, Libya: Deparment of Botany. Vol 1- 150.

Keith, H. G. (1965). A Preliminary Checklist of Libya Flora. Ministry of Agriculture Publication, Libya. 1 & II, 1-1047: 1-528.

Ket, M. (2012) Vegetation Description and Data Analysis a Practical Approach (2nd edn), John Wiley and Sons Ltd.

Makhlouf, M.H; Al-Eisawi, D.M. 2005. Plant diversity and flora of Dibbeen National park, Jordon. Msc thesis, Department of biology, Faculty of Science, University of Jordan.

Mahklouf, M. H. & Al-Sghair, F. 2016. Floristic and Inventory Study of Mallaha Wetland. Tripoli – Libya. American Journal of Life Science Researches. 4:(4). 119 – 123. DOI: 10.21859/ajlsr-040401.

Post, G E. (1932-1933). Flora of Syria, Palestine & Sinai, Vol (1&2). 2nd edition. American University of Beirut.

Pergent, G; Djellouli, A; Hamza, A.A; Ettayeb, K.S; El Mansouri, A.A; Talha, F.M; Hamza, M.A; Pergent-Martini, C; Platini, F. 2002. Journal of Coastal Conservation 8: 119-126.

Raunkiaer C. The Life Forms of Plants and Statistical Plant Geography. Oxford: The Clarendon Press; 1934.

Reich, P. B; Bakken, P; Carlson, D; Frelich, L; Friedman, S. K; Grigal, D. (2001) Influence of logging, fire and forest type on biodiversity and productivity in southern boreal forests. Ecology, 82 (10), pp. 2731-2748.

Sherif, A. S. (1995). The Grasses of Libya. Faculty of science. Al-Fateh University. Tripoli- Libya.

Täckholm, V. (1974). Students flora of Egypt, (2nd edition). Faculty of science. Cairo University.

Zohary, M. (1966). Flora of Palestine,Vol 1. The Israel Academy of Science and Humanities, Jerusalem.

Zohary, M. (1972). Flora of Palestine, Vol 2. The Israel Academy of science and Humanities, Jerusalem.

Zohary, (1973). Geobotanical foundation of the Middle East. Amsterdam: Swets and Zeitlinger.