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Floristic Composition and Plant Diversity of Western Part of Wadi El- Enaghar, Libya

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ABSTRACT

The piece of work has been designed to study the present-day vegetation and document the flora of wild plants of the Wadi El- Enaghar region eastern part of Libya. The study was carried out in the period from October 2018 to June 2020, with two trips per month at least. The plant specimens were collected in flowering or in fruiting condition. Data inventory has been documented in the form of family, Botanical name, vernacular name, life form, and habit. The study revealed the presence of 207 species within 151 genera of vascular plants belonging to 46 families, of which 17 species are belonging to monocotyledons and 190 belonging to dicotyledons. The family Asteraceae was the richest (35 species) followed by Fabaceae (33 species), then Brassicaceae (17 species). In this study, there are four endemic species have been collected. The most dominant life form was Therophytes having 119 species (57.5%) followed by Hemicryptophytes having 34 species (16.4%) Chamaephytes 21 species (10.1%) Geophytes 18 species (8.69%) Phanerophytes 15 species (7.2%). Finally, most of the species were herbs (87.5%).

Keywords: Floristic diversity, life forms, Wadi El- Enaghar, Libya.

1. INTRODUCTION

A various floristic study has been conducted on the Flora of Libya, e. g. [1]. reported some observations on Sylphium which was one of the most important extinct plant species in Cyrenaica. [2]. had conducted the first taxonomic study on Flora of Libya and collected about 260 species from the coastal belt of Libya. [3] published Flora Libycae specimen and reported 1200 plant samples. [4] provided the most comprehensive information on the vegetation of Tripolitania, Fezzan, Ghadames, Kufra, Aoujila, and Cyrenaica as well as a list of vernacular names of plants. [5] had published Florae Libycae Prodromus and listed 1026 species. Floristically, Cyrenaica is relatively well known, and all records up to 1930 are contained in the comprehensive "Prodrmo Della Flora Cyrenaica" [6]. In his work Pampanini dealt with all plant groups of Libya. He described species and provided keys for their identification. [7] made observations on the pastures of Cyrenaica. The vegetation of these pastures is represented by 35 families of flowering

plants. The members of the family Poaceae most dominant followed by these of Asteraceae, Fabaceae and Apiaceae. [8] published A Preliminary Check List of the Flora of Libya, provided their local names and uses. [9] published a bibliography about the flora and vegetation of Libya. The University of Tripoli and the Arab Development Institute adopted the flora of Libya projects and have published [10-12] between 1976 to 1989. through last three decades, Numerous researchers have worked on floristic composition and ecological studies on regional or local floras of certain parts of the country; examples include the studies of [13] on Wadi Al-Asrah, [14] on Wadi Al-Agar, [15] on Tobruk province, [16] on Wadi Al-Hamar Region, [17] when studied weed flora of agriculture Project of Sirte.

Moreover, floristic studies are not only important to know the variety of plants present in an area, but also socio-economically significant. They provide shelter, food, medicine and everything for the human being and other species of that area [18]. The specific goals of the study were to analyse the vegetation, prepare preliminary list of the species of flowering plants, life-form and the diversity in the Wadi El- Enaghar.

Study Area

The study area lies south of Benghazi city and the eastern part of the study area is situated in the southwestern edge of Al-Jabal Al-Akhdar at about 200 m above the sea-level, whereas the western part is situated in Benghazi Plain at about 50 m (M asl). It extends approximately 30 Km. It lies between 20 24'49" and 20 08'45" E longitude and 31 54'09" and 31 47'08" N latitude (Figure 1).



Figure 1. A map of the study area

Climate

The climate of Libya is generally semi-arid to arid [19]. Within Libya, five different climatic zones have been recognized, but the dominant climatic influences are the Mediterranean and Saharan. The weather system in study area is general semi-arid. According to the records of Benghazi meteorological station for the period 1976- 2006, the study area is characterized by a mean minimum temperature of 8.8 °C in January and a mean maximum temperature of 32 °C in July with an annual mean temperature of 20 °C.

The rainfall in the study area is markedly seasonal and irregular in amount. The annual rainfall at the area varies considerably around the mean from one month to another, year to year. Most of the rainfall occurs in late autumn and early spring (during the period between October to March). The peak rainy months are December, January and February. In general the rainfall starts in the month of October sometime in September and extends up to March sometime up to April. It was low as 80 mm and as high as 240 mm. The average annual rainfall is 135 mm. The mean monthly relative humidity ranges between 55.3% in June and 75.4% in January. The average wind speed of the study area varies from 8.5 Km/h in November to 11 Km/h in April.

2. MATERIALS AND METHODS

The study area was regularly visited from October 2018 to June 2020. During this period at least one field trip per month was done for sample collection and vegetative observations. The plant specimens were collected in flowering or in fruiting condition. For drying, the presser containing the specimens was placed in the sun. After that, the specimens were examined individually, rearranged, transferred to a fresh sheet and again tightly bonded in the presser. The specimens were changed to dry sheet every 24 or 48 hours until they were completely dry.

When specimens were completely dry they were mounted on herbarium sheet with stander size (27 x 42 cm) with the aid of adhesives. On the lower right-hand corner of the herbarium sheet, a label was glued and all information from the field notebook was transferred to it. First, the family of the plant was determined by the use of an artificial key to the families. The genus and species were identified by the utilization of available taxonomic literature [8, 10-12, 20-21].

After drying, specimens were flooded with poisoning solution (Mercuric chloride 15 gm, Ammonium chloride 35 gm, in 1000 ml ethanol 96%) to protect them from fungi and pests [22]. Or placed in an oven at 60° C for 4-6 hours, which is enough to kill eggs of insects [23]. All plant species studied, were classified according to their growth habits, and Raunkiaer's life forms system [24] was used. The percentage composition of each of these life form categories was calculated. The generic coefficient was calculated following Jacord's Generic Coefficient [25] as under:-

$$\text{Generic Coefficient (G) \%} = \frac{\text{Total no. of genera}}{\text{Total no. of species}} \times 100$$

3. RESULTS AND DISCUSSION

Enumeration of species:

Taxa collected from the study area are enumerated here. The arrangement of families, genera, and species are alphabetical.

Table 1: List of species recorded in the study area with their families, Vernacular name, life form and Growth form (Th. = Therophytes, Ch. = Chaemophytes, H. = Hemi-cryptophytes, Ph. = Phanerophytes, and G. = Geophytes.)

Scientific name	Vernacular name	Life form	Growth form
Aizoaceae			
<i>Aizoon hispanicum</i> L .	Malha	Th.	Herb
Alliaceae			
<i>Allium erdelii</i> Zuec.	Korath	G.	Herb
<i>Allium subhirsutum</i> L.	Ghazul.	G.	Herb
<i>Allium nigrum</i> L.		G.	Herb
Amaranthaceae			
<i>Amaranthus viridis</i> L.	Buzinzir	Th.	Herb
Anacardiaceae			
<i>Rhus tripartita</i> (Ucria.) Grande .	Ijdari	Ph.	Shrub
Apiaceae			
<i>Ammi majus</i> L.	Sfinnari-Hameer, Khalla, Sfinnari el ma'iz	Th.	Herb
<i>Ammoides pusilla</i> (Brot.) Breist.		Th.	Herb
<i>Bupleurum lancifolium</i> Hornem.		Th.	Herb
<i>Bupleurum odontites</i> L.		Th.	Herb
<i>Ferula tingitana</i> L.	Kalakh	H.	Herb
<i>Foeniculum vulgare</i> Mill.	Kammun	H.	Herb
<i>Deverra tortuosa</i> (Desf.) DC. Syns. <i>Pituranthos tortuosus</i> (Desf.) Benth	Gazzah.	Ch.	Subshrub
<i>Pseudorlaya pumila</i> (L.) Gramde		Th.	Herb
Araceae			
<i>Arisarum vulgare</i> Targ.Tozz	Weden Essaloqi	G.	Herb
<i>Arum cyrenaicum</i> Hruby	Wednish, Gedri	G.	Herb
Asteraceae			
<i>Achillea santolina</i> L.	Zefrah, El Batharan	Th.	Herb
<i>Anacyclus monanthos</i> (L.) Thell.	Tagrefta, Serat elkabesh.	Th.	Herb
<i>Anthemis secundiramea</i> Biv.		Th.	Herb

<i>Atractylis cancellata</i> L.		Th.	Herb
<i>Bellis sylvestris</i> Cirillo. var. <i>cyrenaiaca</i> Beguinout		H.	Herb.
<i>Calendula arvensis</i> L.	Ain Al Baghra	Th.	Herb
<i>Calendula tripterocarpa</i> Rupr.		Th.	Herb
<i>Carduus getulus</i> Pomel		Th.	Herb
<i>Centurea alexandrina</i> Delile	Mrrier.	Th.	Herb
<i>Centurea dimorpha</i> Viv.	Bla 'ala	Th.	Herb
<i>Centaurea sphaerocephala</i> L.	Shebrem	Th.	Herb
<i>Chamomilla aurea</i> (Loefl.) Gay	Komilla	Th.	Herb
<i>Chrysanthemum coronarium</i> L.	Gahwan	Th.	Herb
<i>Cichorium spinosum</i> L.	Shikorea	Th.	Herb
<i>Conyza bonariensis</i> (L.) Cornq.	Ashbet Zamora	Th.	Herb
<i>Crepis senecioides</i> Delile		Th.	Herb
<i>Cynara cornigera</i> L.	Kharshofe, Gaamool	H.	Herb
<i>Echinops galalensis</i> Schweinf	Shembet Elgatoos	H.	Herb
<i>Filago contracta</i> (Boiss.) Chrtek & Holub Syns. <i>Evax contracta</i> Boiss		Th.	Herb
<i>Filago desertorum</i> Pomel		Th.	Herb
<i>Hypochaeris achyrophorus</i> L.		Th.	Herb
<i>Launaea nudicaulis</i> (L.) Hooker, fil.	Adeeda, Aara, Orreem	Th.	Herb
<i>Launaea resedifolia</i> (L.) O.Kuntze	Adeeda.	Th.	Herb
<i>Onopordum cyrenaicum</i> Maire & weiller	Libid	H.	Herb
<i>Onopordum espiniae</i> Cosson ex Bonnet	Libid	H.	Herb
<i>Pallenis spinosa</i> (L.) Cass.		H.	Herb
<i>Phagnalon rupestre</i> (L.) DC .		Ch.	Subshrub
<i>Reichardia tingitana</i> (L.) Roth.	Sahani.	Th.	Herb
<i>Rhantterium suaveolens</i> Desf.		Ch.	Herb
<i>Scorzonera undulata</i> vahl.	Dhabeeh, Tumare	H.	Herb
<i>Senecio gallicus</i> Chiaux	Daraita, Mourare.	Th.	Herb
<i>Senecio vulgaris</i> L.	Kraa Eddjaja	Th.	Herb
<i>Silybum marianum</i> (L.) Gaertner.	Shobrum	Th.	Herb
<i>Sonchus oleraceus</i> L.	Tefaf.	Th.	Herb
<i>Volutaria tubuliflora</i> (Murb.) Sennen: Syns. <i>Amberboa tubuliflora</i> Murb.		Th.	Herb
Boraginaceae			
<i>Echium angustifolium</i> Mill.	Henna alagrab, abat elgula	Ch.	Subshrub
<i>Echium horridum</i> Batt		Ch.	Subshrub
<i>Anchusa aegyptiaca</i> (L.) A.DC.		Th.	Herb
<i>Heliotropium bacciferum</i> Forssk.	Ramram	Ch.	Subshrub
<i>Heliotropium ramosissimum</i> (Lehm.) De.	Tahaunna, tahenna	Ch.	Herb
Brassicaceae			
<i>Biscutella didyma</i> L.	Ain Al Hanash	Th.	Herb
<i>Brassica tournefortii</i> Gouan	Shultam	Th.	Herb
<i>Capsella bursa-pastoris</i> var. <i>rubella</i> (Reut.) Rapin	Kees El Rai	Th.	Herb
<i>Cardaria draba</i> (L.) Desv.		Th.	Herb
<i>Carrichtera annua</i> (L.) DC .		Th.	Herb
<i>Didesmus bipinnatus</i> (Desv)DC.	Lessless	Th.	Herb

<i>Didesmus aegyptius</i> (L.) Desv .	Lessless	Th.	Herb
<i>Diploxys muralis</i> (L.) Dc. ssp. <i>Muralis</i>	Al – harra	Th.	Herb
<i>Enarthrocarpus clavatus</i> Del.ex Goder.	Shultam	Th.	Herb
<i>Enarthrocarpus pterocarpus</i> (Pers.) var. <i>pterocarpus</i> .	Shultam	Th.	Herb
<i>Eruca sativa</i> Mill.	Gargeer Barry	Th.	Herb
<i>Lobularia libyca</i> (Viv.) Meisner	Auinet El Hanash	Th.	Herb
<i>Matthiola fruticulosa</i> (L.) Maire	Eshegara	Th.	Herb
<i>Matthiola longipetala</i> (Vent.) Dc. ssp. <i>Longipetala</i>	Eshegara	Th.	Herb
<i>Sinapis alba</i> L.	Khardal, Harra	Th.	Herb
<i>Sinapis flexuosa</i> Poir.	Khardal, Harra	Th.	Herb
<i>Sisymbrium irio</i> L.	Fegeela	Th.	Herb
Caryophyllaceae			
<i>Silene apetala</i> Willd .		Th.	Herb
<i>Silene cerastioides</i> L.		Th.	Herb
<i>Spergula fallax</i> (Lowe.) Krause		Th.	Herb
<i>Vaccaria pyramidata</i> Medik.	Ful el Arab	Th.	Herb
Chenopodiaceae			
<i>Anabasis articulata</i> (Forssk.) Moq.	Ageram, Bagel	Ch.	Subshrub
<i>Atriplex glauca</i> L. Syns. <i>Atriplex stylosa</i> Viv.	Kataff	Ph.	Subshrub
<i>Atriplex halimus</i> L.	Kataff	Ph.	Subshrub
<i>Bassia muricata</i> (L.) Aschers.	Chouleta, Ghabbir	Th.	Herb
<i>Beta vulgaris</i> L .	Seleg	Th.	Herb
<i>Chenopodium murale</i> L.	Effena	Th.	Herb
<i>Haloxylon scoparium</i> Pomel. Syns. <i>Hammada scoparia</i> (Pomel) Iljin.	Hdidat, Rehsal, Shenin	Ch.	Subshrub
<i>Haloxylon scoparium</i> Pomel	Rimth	Ch.	Subshrub
<i>Suaeda vera</i> Forssk. ex J.F.Gmel.	Souida, Essabata	Ch.	Subshrub
Convolvulaceae			
<i>Convolvulus althaeoides</i> L.	Ullak	G.	Herb
<i>Convolvulus arvensis</i> L.	Ullak	G.	Herb
<i>Convolvulus dorycnium</i> L.	Ullak	H.	Herb
<i>Convolvulus humilis</i> Jacq .	Ullak	Th.	Herb
<i>Convolvulus althaeoides</i> L.	Ullak	G.	Herb
Crassulaceae			
<i>Umbilicus horizontalis</i> (Guss.) Dc.	Surrat Al'ard	G.	Herb
Cucurbitaceae			
<i>Bryonia cretica</i> L.	Fachira	H.	Herb
<i>Citrullus colocynthis</i> (L.) Schrad.	Handel	H.	Herb
<i>Ecballium elaterium</i> (L.) A.Rich.			
Cyperaceae			
<i>Cyper laevigatus</i> L.	Al Saad	H.	Herb
Euphorbiaceae			
<i>Euphorbia falcata</i> L	Lebbena	H.	Herb
<i>Euphorbia helioscopia</i> L .	Lebbena	H.	Herb
<i>Euphorbia peplus</i> L .	Lebbena	H.	Herb
<i>Ricinus communis</i> L.	Kharwa	Ph.	Shrub

Fabaceae			
<i>Alhagi graecorum</i> Boiss.	Agol	H.	subshrub
<i>Argyrolobium uniflorum</i> (Dence.) Jaub. & Sapach	Ergah, Kerta	Ch.	Herb
<i>Astragalus asterias</i> Hohen		Th.	Herb
<i>Astragalus boeticus</i> L.	Grambushia	Th.	Herb
<i>Astragalus cabrinus</i> L.	Shaewit Erraie	H.	Herb
<i>Astragalus hamosus</i> L.	Katai, kedad	H.	Herb
<i>Astragalus haurensis</i> Boiss		Th.	Herb
<i>Astragalus peregrinus</i> Vahl.		Th.	Herb
<i>Hippocrepis multisiliquosa</i> L.		Th.	Herb
<i>Hymenocarpus circinnatus</i> (L.) Savi.		Th.	Herb
<i>Lathyrus aphaca</i> L		Th.	Herb
<i>Lathyrus annuus</i> L.		Th.	Herb
<i>Lathyrus clymenum</i> L.		Th.	Herb
<i>Lotus cytisoides</i> L.	Qart	Ch.	Herb
<i>Lotus halophilus</i> Boiss & Spruner.	Nafel , Gurn al – Ghazzal	Th.	Herb
<i>Medicago disciformis</i> Dc.	Nafal	Th.	Herb
<i>Medicago littoralis</i> Rohde ex Lois	Nafal	Th.	Herb
<i>Medicago minima</i> (L.) Bart.	Nafal	Th.	Herb
<i>Medicago orbicularis</i> (L.) Bartal	Nafal	Th.	Herb
<i>Medicago sativa</i> L.	Gadb, safsa	Th.	Herb
<i>Medicago polymorpha</i> L.	Nafal	Th.	Herb
<i>Melilotus indicus</i> (L.) All	Handagog, Qart	Th.	Herb
<i>Onobrychis crista-galli</i> (L.) Lam		Th.	Herb
<i>Ononis serrata</i> Forsk.		Th.	Herb
<i>Retama raetam</i> (Forsk.) webb.	Ratam	Ph.	Subshrub
<i>Scorpiurus muricatus</i> L.		Th.	Herb
<i>Trigonella maritima</i> Delile ex poiret	Kherta, Garat	Th.	Herb
<i>Trifolium dasyurum</i> C.Presl		Th.	Herb
<i>Trifolium purpureum</i> Loisel.		Th.	Herb
<i>Trifolium tomentosum</i> L.		Th.	Herb
<i>Vicia monantha</i> Retz.		Th.	Herb
<i>Vicia sativa</i> L.	Jilban.	Th.	Herb
<i>Vicia villosa</i> Roth	Jelbana Hmam	Th.	Herb
Fumariaceae			
<i>Fumaria officinalis</i> L.	Sfinari el homar	Th.	Herb
Geraniaceae			
<i>Erodium cicutarium</i> (L.) L' Herit	Dahmiyet el-ghazl.	Th.	Herb
<i>Erodium crassifolium</i> L'Her	Khilala El-Gula, Temeer	G.	Herb
<i>Erodium malacoides</i> (L.) L'Her.	Rogma	Th.	Herb
<i>Erodium moschatum</i> (L.) L'Her.	Missaykah	Th.	Herb
<i>Geranium molle</i> L .		Th.	Herb
Illecebraceae			
<i>Paronychia arabica</i> (Linn .) Dc.	Tifun	H.	Herb
Iridaceae			
<i>Moraea sisyrinchium</i> (L.) Ker-Gawler Syns. <i>Iris sisyrinchium</i> L.	Sawsan	G.	Herb
Lamiaceae			

<i>Ajuga iva</i> (L.) Shreber	Shandgura	Th.	Herb
<i>Marrubium alysson</i> L.	Robia	Th.	Herb
<i>Phlomis floccosa</i> D.Don .	Zahira	Ch.	Subshrub
<i>Rosmarinus officinalis</i> L.	Kleel	Ch.	Subshrub
<i>Salvia lanigera</i> Poir.	Sag en naga	Ch.	Herb
<i>Stachys aegyptiaca</i> Pers.	Lahiat Alshshayib	H.	Subshrub
<i>Thymus capitatus</i> (L.) Hoffm.	Zater	Ch.	Subshrub
Liliaceae			
<i>Asphodelus fistulosus</i> L.	Lehiat ettaes	H.	Herb
<i>Asphodelus ramosus</i> L. Syns. <i>Asphodelus microcarpus</i> Salzm.	Onsail, Balloose	G.	Herb
<i>Bellevalia mauritanica</i> Pomel.		G.	Herb
<i>Urginea autumnalis</i> (L.) El-Gadi	Faraon	G.	Herb
Linaceae			
<i>Linum decumbens</i> Desf.	Khadd El Arous	Th.	Herb
Malvaceae			
<i>Malva aegyptia</i> L .	Khobaiz	Th.	Herb
<i>Malva parviflora</i> L. Var <i>microcarpa</i> (Pers.) Loscos	Khobaiz	Th.	Herb
<i>Malva parviflora</i> L. var <i>parviflora</i>	Khobaiz	Th.	Herb
<i>Malva sylvestris</i> L.	Khobaiz	H.	Herb
Mimosaceae			
* <i>Acacia cyanophylla</i> Lindley	Sunt	Ph.	Tree
* <i>Acacia karoo</i> Hayne	Sunt Shawki, Talha	Ph.	Tree
Myrtaceae			
* <i>Eucalyptus cosmophylla</i> F.	Serwel, Kafoor	Ph.	Tree
* <i>Eucalyptus camaldulensis</i> Dehnh.	Serwel, Kafoor	Ph.	Tree
Oleaceae			
<i>Olea europaea</i> L .	Zaitoon	Ph.	Tree
Orobanchaceae			
<i>Orobanche schultzei</i> Mutel.		P.	Herb
Oxalidaceae			
<i>Oxalis pes-caprae</i> L.	Hummdha	G.	Herb
Papaveraceae			
<i>Glaucium flavum</i> Crantz	Gurn- aljadian	H.	Herb
<i>Papaver hybridum</i> L.	Bugraun, Garaun	Th.	Herb
<i>Papaver rhoeas</i> L.	Bugraun	Th.	Herb
<i>Roemeria hybrid</i> (L) DC. var. <i>Hybrid</i>	Mungar el gharab	Th.	Herb
Plantaginaceae			
<i>Plantago albicans</i> L.	Aenm.	H.	Herb
<i>Plantago crypsoides</i> Boiss.		H.	Herb
<i>Plantago cyrenaica</i> Durand & Barratte	Degghis	H.	Herb
<i>Plantago lagopus</i> L .		H.	Herb
<i>Plantago ovata</i> Forssk.		H.	Herb
Plumbaginaceae			
<i>Limonium lobatum</i> (L.f.) .Syns. <i>Limonium thouinii</i> (Viv.) O.Kuntze	zita	Th.	Herb
Poaceae			
<i>Avena barbata</i> Pott ex Link	Shofan barry, Gussiba	Th.	Herb

<i>Bromus rigidus</i> Roth.	Summa	Th.	Herb
<i>Cutandia dichotoma</i> (Forssk.) Trabut	Zewahn , bu 'rukba	Th.	Herb
<i>Cynodon dactylon</i> (L.) Pers.	Najem, Najieel	G.	Herb
<i>Hordeum murinum</i> L. ssp. <i>Leporinum</i> (link.) Arcang.	Bu sharenta, Bu Shterta	Th.	Herb
<i>Lolium rigidum</i> Gaud.	Bomanjor.	Th.	Herb
<i>Phalaris minor</i> Retz.	Zewan	Th.	Herb
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Gaspa	G.	Subshrub
<i>Stipa capensis</i> Thunb.	Behma	Th.	Herb
Polygonaceae			
<i>Emex spinosus</i> (L). Campd	Dors el-azouz and el-henzab	Th.	Herb
<i>Polygonum aviculare</i> L.	Gurdab	H.	Subshrub
<i>Polygonum equisetiforme</i> Sibth. and Sm.	Gurdab	H.	Subshrub
<i>Rumex vesicarius</i> L .	Hommadet Hmam	Th.	Herb
Primulaceae			
<i>Anagallis arvensis</i> var. <i>caerulea</i> (L.) Gouan	Ain Algatuus	Th.	Herb
Ranunculaceae			
<i>Adonis dentata</i> Delile	Zeghalil	Th.	Herb
<i>Ranunculus paludosus</i> Poiret .		G.	Herb
Resedaceae			
<i>Reseda alba</i> L.spp. <i>decursiva</i> (Forssk.) Maire	m"sawiyah, Fattolet El Holi	Th.	Herb
Rhamnaceae			
<i>Ziziphus lotus</i> (L.) Lam .	Sedra	Ph.	Shrub
Rubiaceae			
<i>Galium aparine</i> L.	Dibbaykah	Th.	Herb
Rutaceae			
<i>Haplophyllum tuberculatum</i> (Forssk) Juss.	Sezeret er rih	Ch.	Herb
Scrophulariaceae			
<i>Kickxia aegyptiaca</i> (L.) Nabelek	Amekchin	Ch.	Herb
<i>Linaria laxiflora</i> Desf.		Th.	Herb
<i>Linaria virgata</i> (Poir) Desf .		Th.	Herb
Solanaceae			
<i>Hyoscyamus muticus</i> L.	Vathim, Flazlez, Sajran	Ch.	Herb
<i>Lycium europaeum</i> L .	Awsaj	Ph.	Shrub
<i>Nicotiana glauca</i> R.C. Graham	Akkuzemusa.	Ph.	Shrub
<i>Solanum elaeagnifolium</i> Cav.		Th.	Herb
<i>Solanum nigrum</i> L. var. <i>nigrum</i>	Anab ed. Deeb	H.	Herb
Thymelaeaceae			
<i>Thymelaea hirsuta</i> (L.) Endl.	Metnan	Ph.	Subshrub
Urticaceae			
<i>Urtica pilulifera</i> L .	Horregh	H.	Herb
Zygophyllaceae			
<i>Fagonia cretica</i> L	Tlaha, Zerga	Ch.	Shrub
<i>Nitraria retusa</i> (Forssk.) Asch	Atazzim, Dumuc, Rhordog	Ph.	Shrub
<i>Peganum harmala</i> L .	Harmal	H.	Shrub

(*) cultivated plant

At the end of the survey a total of 207 species of flowering plants 151 representing genera belong to 46 families have been collected and identified, of which 190 taxa belonging to 135 genera are belong to Dicotyledones which distributing in 42 families;

whereas 17 taxa belonging to 16 genera and 4 families are belonging to monocotyledons (Table 2). The ratio of Dicotyledons to Monocotyledons is roughly 10.5 : 1.

Table 2: Different taxonomic groups present in the study area.

Plant group	No. of families	No. of Genera	No. Species
Dicotyledons	42	135	190
Monocotyledons	4	16	17
Total	46	151	207

From floristic analysis were carried out which showed the most highly represented families were Asteraceae was the richest with (35 species, about 17% of the total species) followed by Fabaceae with 33 species (ca. 16%), Brassicaceae with 17 species (ca. 8.2%), Chenopodiaceae and Poaceae with 9 species each (ca. 4.3%). A comparison of families in term of the largest number of species recorded in this study is similar studies in different region of A comparison of families in term of the largest number of species recorded in this study is similar studies in different regions of Libya by [13, 15, 26] in different regions of Libya.

From the data of the present study, it was shown the Wadi El- Enaghar region had relatively high plant diversity (Table 3). The percentage of plant families reported in this study contributed to almost 30% of the total plant families recorded from Libya [27]. The recorded species represented about 10.1 % of the total flora recorded in the entire country, this cannot be considered a very rich flora as compared to the large area of the country [27]. A striking features in Libyan flora is a large number of genera in proportion to that of the species (about 2.5 species per genus). This is considered a very low figure compared with the global average, which amounts to 13.6 [28].

The present study indicated that the flora of the Wadi El- Enaghar region went below the average level of the Libyan flora where the number of species per genus was 1.37. That means that the flora of the study area is relatively rich as the region that has a certain number of species, each of which belongs to a different genus, is relatively more diverse than a region that has the same number of species but belongs to a few numbers of genera.

Table 3. Comparison of floristic diversity in Wadi El- Enaghar region in the present study to the floristic diversity in the entire country of Libya.

Location	Family	Genera	Species	Generic coefficient
Study area	46	151	207	1.37
Flora of libya [27]	168	818	2042	2.5
Percentage (%)	27.4	18.5	10.1	

According to the number of species in each genus in the study area, *Astragalus* and *Medicago* were the only two genera represented by six species each. Two genera, *Convolvulus* and *Plantago* have five species each. Two genera with four species namely, *Erodium* and *Malva*. Five genera were represented by three species each namely, *Allium*, *Centurea*, *Lathyrus*, *Trifolium* and *Vicia*.

Plant life forms were categorized as Therophytes with 118 species (57%), Hemicryptophytes with 35 species (17%), Chamaephytes with 21 species (10.1%), Geophytes with 18 species (8.69%), Phanerophytes with 15 species (7.2%) (Figure 2). Therophytes was dominated in Wadi El- Enaghar. The present findings are in the line with other related studies such as [15, 29-30], who reported the dominance of therophytes over the other life forms. Based on the study of [27], the dominance of therophytes is due to the long dry periods during the year in Libya.

The study showed that the growth habits of species were distributed as herbs 173 species (83.5%), subshrubs to shrubs 29 species (14%) and trees 5 species (2.4%). The dominance of herbs over the other growth habits can be attributed to the short life cycle that enables them to resist the instability of the ecosystem [31].

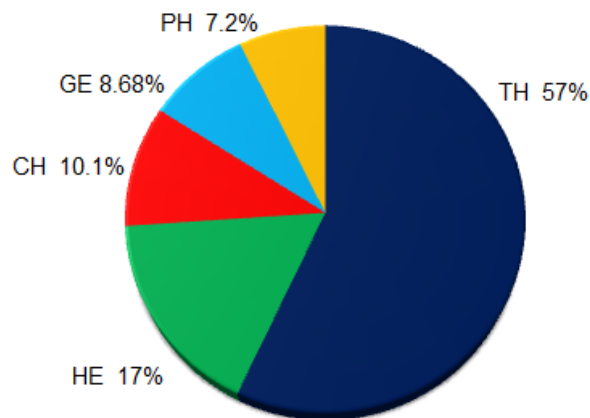
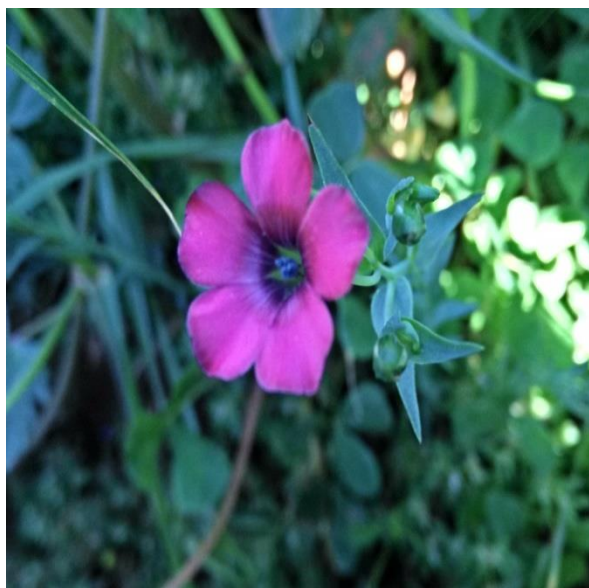


Figure 2. Life form spectrum of the recorded species in Wadi El- Enaghar. PH: Phanerophytes, CH: Chamaephytes, HE: Hemicryptophytes, GE: Geophytes, TH: Therophytes.

In this study only four taxa considered as endemic to Libya. These taxa namely, *Plantago cyrenaica*, *Bellis sylvestris* Cyr. var. *Cyrenaiaca*, *Onopordum cyrenaicum* and *Arum cyrenaicum*. This number is considered low (ca. 2 % of the recorded species in the study area) were recorded. These findings agree with [32] in their comprehensive analysis of the flora of Libya in which they reveal that number of endemic species in the flora of Libya not exceeding 4%. Only two species namely, *Centurea alexandrina* and *Echinops galalensis* considered as near-endemic where known only in Libya and Egypt, according to study of [27].

The study area as in all parts of the country suffers from the pressures of multiple forces, including extreme weather conditions, particularly drought. It is also caused by overgrazing, unorganized randomness, and human activities that pollute or reduce the quality of the soil and therefore, the impact on biological diversity. [33] pointed out that land degradation begins with a decrease in the palatable pastoral species completely removed from the vegetation cover, and with the continuous loss of species from the plant populations in these lands their productivity also decreases due to the imbalance which in turn the leading cause of a decrease in capacity.



Linum decumbens (Linaceae)



Erodium crassifolium (Geraniaceae)



Scorzonera undulata (Asteraceae)



Trifolium tomentosum (Fabaceae)



Chamomilla aurea (Asteraceae)



Volutaria tubuliflora (Asteraceae)



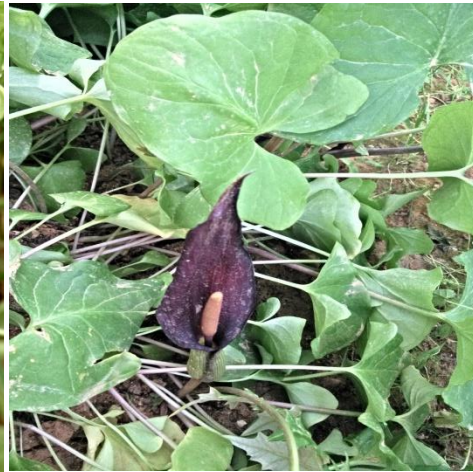
Allium nigrum (Alliaceae)



Geranium molle (Geraniaceae)



Biscutella didyma (Brassicaceae)



Arum cyrenaicum (Araceae)



Roemeria hybrida (Papaveraceae)



Glaucium flavum (Papaveraceae)



Convolvulus althaeoides (Convolvulaceae)



Convolvulus arvensis (Convolvulaceae)



Anchusa aegyptiaca (Boraginaceae)



Moraea sisyrinchium (Iridaceae)

4. CONCLUSION

The present study reported 207 species in this region which can be considered to be one of the relatively high diverse areas of Libya. This may be due to that the region is considered an ecotone between two plant communities, which are Al-Jabal Al-Akhdar and the Sahara. Further ecological studies should be carried out in the future to better understand the ecological interaction between plant species and environmental conditions variables in the Wadi. Moreover, conservation programs should be designed and implemented to protect the natural biodiversity of this region.

Ethical approval

The ethical guidelines for plants & plant materials are followed in the study for species collection & identification.

Conflict of interest

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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