Species

22(70), 2021

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

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To Cite:
Naser OI Omar, Naser G El-Mghrbi, Raheel RO, Mohamed A Alaib, Abdul Hamid K Alzerbi. Floristic Composition and Plant Diversity of Western Part of Wadi El- Enaghar, Libya. *Species*, 2021, 22(70), 204-217

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Peer-Review History
Received: 27 May 2021
Reviewed & Revised: 29/May/2021 to 03/July/2021
Accepted: 04 July 2021
Published: July 2021

Peer-Review Model
External peer-review was done through double-blind method.

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).

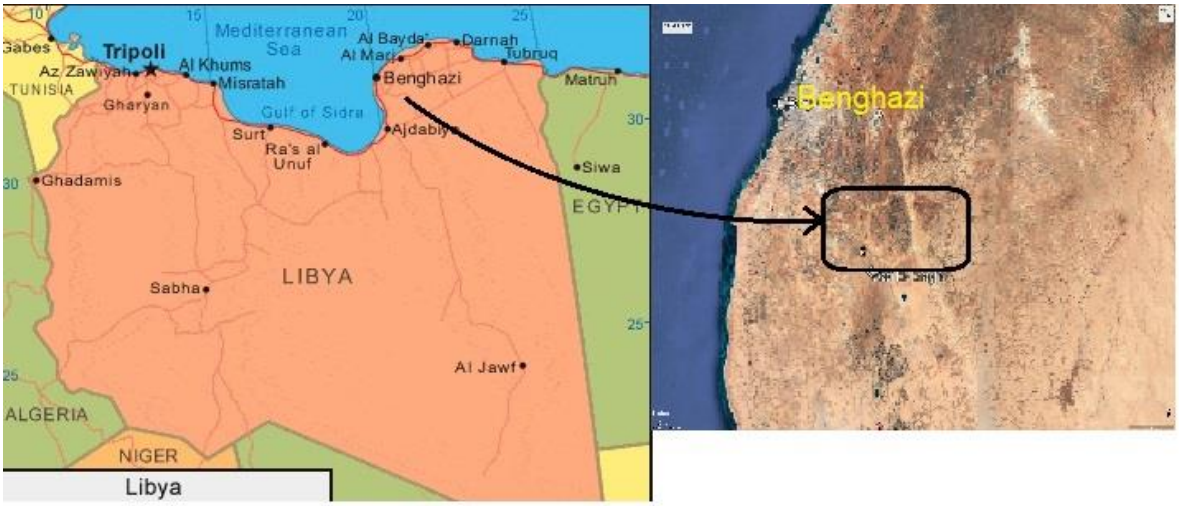


Figure 1. A map of the study area

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 ºC in January and a mean maximum temperature of 32 ºC in July with an annual mean temperature of 20 ºC.

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 Octobers a 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 60º 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			
Aizoon hispanicum L .	Malha	Th.	Herb
Alliaceae			
Allium erdelii Zuec.	Korath	G.	Herb
Allium subhirsutum L.	Ghazul.	G.	Herb
Allium nigrum L.		G.	Herb
Amaranthaceae			
Amaranthus viridis L.	Buzinzir	Th.	Herb
Anacardiaceae			
Rhus tripartita (Ucria.) Grande .	Ijdari	Ph.	Shrub
Apiaceae			
Ammi majus L.	Sfinnari-Hameer, Khalla, Sfinnari el ma'iz	Th.	Herb
Ammoides pusilla (Brot.) Breist.		Th.	Herb
Bupleurum lanciofolium Hornem.		Th.	Herb
Bupleurum odontites L.		Th.	Herb
Ferula tingitana L.	Kalakh	H.	Herb
Foeniculum vulgare Mill.	Kammun	H.	Herb
Deverra tortuosa (Desf.) DC. Syns. *Pituranthos tortuosus* (Desf.) Benth	Gazzah.	Ch.	Subshrub
Pseudorlaya pumila (L.) Gramde		Th.	Herb
Araceae			
Arisarum vulgare Targ.Tozz	Weden Essaloqi	G.	Herb
Arum cyrenaicum Hruby	Wednish, Gedri	G.	Herb
Asteraceae			
Achillea santolina L.	Zefrah, El Batharan	Th.	Herb
Anacyclus monanthos (L.) Thell.	Tagrefta, Serat elkabesh.	Th.	Herb
Anthemis secundiramea Biv.		Th.	Herb

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

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

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

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

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

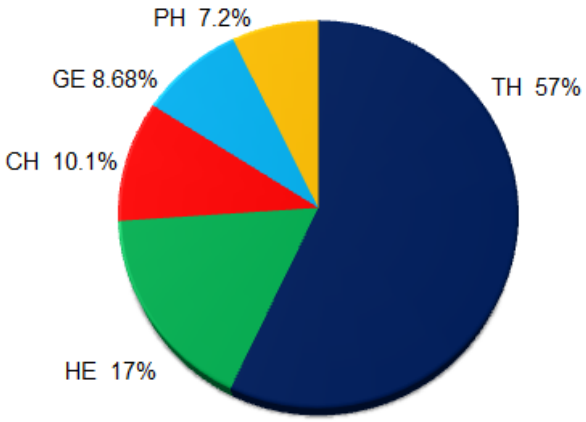


Figure 2. Life form spectrum of the recorded species in Wadi El- Enaghar. PH: Phanerophytes, CH: Chamaephytes, HE: Hemicryptophytes, GE: Geophytes, TH: Therophytes.

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)

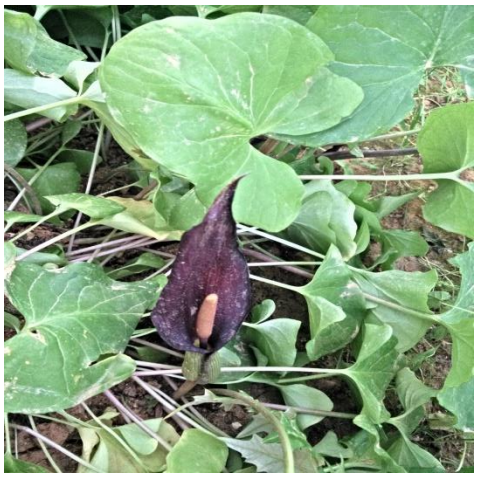
Chamomilla aurea (Asteraceae)

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)

 ISSN 2319–5746 EISSN 2319–5754 I OPEN ACCESS

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.

Data and materials availability

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

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