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Checklist of Flora and Floristic Study of Wadi Al-Hamar Region in 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 Al-Hamar region north Middle Libya. . A survey of plant species of the Wadi was conducted between October 2017 to May 2018, with two trips per month at least. The plant specimens were collected in flowering or in fruiting stage. Data inventory has been documented in the form of family, Botanical name, vernacular name, life form, and habit. The study revealed the presence of 112 species within 93 genera of vascular plants belonging to 31 families, of which 13 species are belonging to monocotyledons and 99 belonging to dicotyledons. The family Asteraceae was the richest (21 species) followed by Fabaceae (19 species), then Poaceae and Brassicaceae (8 and 7 species respectively). In this study, two endemic species have been collected. The most dominant life form was therophytes having 72 species (64.28%) followed by chamaephyte having 16 species (14.28%), Hemicryptophytes 9 species (8.03%), Geophytes 8 species (7.14%), Phanerophytes 6 species (5.35%) and Parasites 1 species (0.89%). Finally, most of the species were herbs (87.5%).

1. Introduction

Libya is a huge arid desert with an area of about 1,760,000 square kilometers and covers the majority of North Africa. It is bordered by the Mediterranean Sea, Egypt, Sudan, Chad, Niger, Algeria, and Tunisia. It lies between 18°and 33°N and 9°and 25°E. Consisting mainly of desert and the Mediterranean coast. In Libya, about 94 to 96 % of the land is desert and it is one of the driest countries in the world [1]. Floristic studies gain increasing importance in recent years in response to the need for developing and under-developing countries to assess their plant wealth. Many floristic diversity studies have been conducted in different parts of the world. Thus, floristic studies are undertaken by many researchers worldwide at different levels [2].

A various floristic study has been conducted on the Flora of Libya, e. g. Lemaire in [3], reported some observations on Sylphium which was one of the most important extinct plant species in Cyrenaica. Della-Cella [4] had conducted the first taxonomic study on Flora of Libya and collected about 260 species from the coastal belt of Libya. Viviani [5] published Flora Libycae specimen and reported 1200 plant samples [6]. Rohlfs [7] provided the most comprehensive information on the vegetation of Tripolitania, Fezzan, Ghadames, Kufra, Aoujila, and Cirenaica as well as a list of vernacular names of plants. Durand and Barratte [8] had published Florae Libycae Prodromus and listed 1026 species. Pampanini [9] had published two books namely, Plantae Tripolitanae and Prodromo Della Flora Cirenaica, respectively. Keith [10] published A Preliminary Check List of the Flora of Libya, provided their local names and uses. Boulos [11] 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 between 1976 to1989. 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 Asker [12] on Wadi Al-Asrah, Al-Hamedi [6] on Wadi Al-Agar, Al-Habony [13] on Tobruk province, Alaib and Ihsaeen [14].

Moreover, floristic studies are not only important to know the variety of plants present in an area, but also their socio-economical significants. They provide shelter, food, medicine and everything for the human being and other species of that area [15]. The specific goals of the study were to analysis the vegetation, prepare preliminary list of the species of flowering plants, life-form and the diversity in the Wadi Al-Hamar.

2. Study Area

The study area is located about 90 Km east of Sitre City in the middle of northern Libya, bordered to the north by the Mediterranean Sea and from the south side at approximately 31˚ 01́ to 30˚ 59́ N latitude and 17˚ 28́ E longitudes. The area rises to about 11 m above sea level. Al-Wadi Al-Ahmar is one of the main and important valleys in the northern middle part of Libya (Figure 1). Where meet several valleys from the south, which originated from floodwaters in the rainy years, resulting in water drifts in the form of deep grooves that all gather together and take a downward slope towards the north, forming the delta of the valley ending in moving dunes.

Figure 1: Map of the study area

3. Soil

The soil in the study area is deep. The soil depth is more than 150 cm. Besides the soil is characterized by light texture, it is between sand and loamy sand. Therefore, it's characterized by high surface filtration with low water holding capacity. Electrical conductivity (EC) of the soil in the study area is about 1.2 mmhos/cm, which is very good in terms of, salts content. The coastal area of the Delta is characterized by sand dunes (Clay 2.69, Silt 2.21, Sand 95). The pH value is 9, the

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salt content is 2662 ppm and the calcium carbonate is 73% and the organic matter is 0.32%. The soil of central area of the valley mixed from sandy to loamy sand (Silt 4.64, Sand 89, Clay 5.36), pH8.59, salinity 480 ppm, calcium carbonate ratio 4.67%, organic matter 0.24%, whereas the southern interior areas at the beginning of the composition of the valley, which are characterized by the dark red soil pH 8.27.

4. Climate

The climate of the study area is subtropical semi-arid to arid [16]. It is chiefly characterized by its aridity and by its wide variation in temperatures. The temperatures are high and the rainfall is low. As a result, there can be an abrupt transition from one kind of weather to another, in summer it is extremely hot. The heat of summer is often aggravated by Ghibli winds. There is a hot dry season from May to October and a cold and rainy season from November to April.

5. Materials and methods

The study area was regularly visited from October 2017 to May 2018. 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 [17-19,10,20,21].

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.

6. Results and Discussion

6.1. Enumeration of species

Taxa collected from the study area are enumerated here. For the arrangement of families, Engler's syllabus der Pflanzen families, 12th edition [25] were used. The circumscription of the families is the same as in flora of Libya. The genera and species in each family are arranged alphabetically (Table 1and Table 2).

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, G. = Geophytes, and P. = Parasites) Dicotyledons**.**

Species.	Vernacular name	Family	Life form	Growth form
Emex spinosus (L). Campd	Dors el-azouz and el-henzab	Polygonaceae	Th.	Herb
Polygonum equisetiforme Sibth. And Sm.	Gurdab	Polygonaceae	H.	Subshrub
Rumex pictus Forssk.	Hommada	Polygonaceae	Th.	Herb
Mesembryanthemum crystallinum L.	Ghassoul	Aizoaceae	Th.	Herb
Silene cerastioides L.		Caryophyllaceae	Th.	Herb
Vaccaria pyramidata Medik.	Ful el Arab	Caryophyllaceae	Th.	Herb
Paronychia arabica (Linn.) Dc.	Tifun	Illecebraceae	H.	Herb
Atriplex halimus L.	Kataff	Chenopodiaceae	Ph.	Subshrub
Bassia muricata (L.) Aschers.	Chouleta, Ghabbir	Chenopodiaceae	Th.	Herb
Beta vulgaris L.	Seleg	Chenopodiaceae	Th.	Herb
Chenopodium murale L.	Effena	Chenopodiaceae	Th.	Herb
Halocnemum strobilaceum (Pall.) M.Bieb.	Hdidat, Rehsal, Shenin	Chenopodiaceae	Ch.	Subshrub
Salsola kali L.		Chenopodiaceae	Th.	Subshrub
Suaeda vera Forssk ex J.F.Gmel	Souida, Essabata	Chenopodiaceae	Ch.	Subshrub
Amarathus viridis L.	Buzinzir	Amaranthaceae	Th.	Herb
Adonis dentata Delile	Zeghalil	Ranunculaceae	Th.	Herb
Glaucium corniculatum (L.) Rud.	Gurn- aljadian	Papaveraceae	Th.	Herb
Papaver hybridum L.	Bugraun, Garaun	Papaveraceae	Th.	Herb
Hypecoum geslinii Coss.et kral		Hypecoaceae	Th.	subshrub
Brassica tournefortii Gouan	Shultam	Brassicaceae	Th.	Herb
Diplotaxis muralis (L.) Dc. ssp. Muralis		Brassicaceae	Th.	Herb
Enarthrocarpus clavatus Del.ex Goder.	Shultam	Brassicaceae	Th.	Herb
Hussonia pinnata (Viv.) Jafri		Brassicaceae	Th.	Herb
Lobularia libyca (Viv.) Meisner		Brassicaceae	Th.	Herb
Matthiola longipetala (Vent.) Dc. Ssp. Longipetala		Brassicaceae	Th.	Herb
Sisymbrium irio L.		Brassicaceae	Th.	Herb
Reseda alba L.spp. decursiva (Forsk.) Maire	m″sawiyah, Fattolet El Holi	Resedaceae	Th.	Herb
Argyrolobium uniflorum (Dence.) Jaub . & Sapach	Ergah, Kherta	Fabaceae	Ch.	Herb
Astragalus asterias Stev. ex Ledeb		Fabaceae	Th.	Herb
Astragalus boeticus L.	Grambushia	Fabaceae	Th.	Herb
Astragalus cabrinus L.	Shaewit Erraie	Fabaceae	H.	Herb
Astragalus peregrinus Vahl		Fabaceae	Th.	Herb
Hippocrepis multisiliquosa L.		Fabaceae	Th.	Herb
Lathyrus clymenum L.		Fabaceae	Th.	Herb
Lotus cytisoides L.		Fabaceae	Ch.	Herb
Lotus halophilus Boiss & Spruner.	Nafel , Gurn al – Ghazzal	Fabaceae	Th.	Herb
Medicago disciformis Dc.		Fabaceae	Th.	Herb
Medicago littoralis Rohde ex Lois	Nafal	Fabaceae	Th.	Herb
Medicago sativa L.	Gadb, safsafa,	Fabaceae	Th.	Herb
Medicago minima (L.) Bart.	Nafal	Fabaceae	Th.	Herb
Melilotus indicus (L.) All		Fabaceae	Th.	Herb
Ononis serrata Forsk.		Fabaceae	Th.	Herb
Retama raetam (Forsk.) webb.		Fabaceae	Ph.	subshrub
Trigonella marititma Delile ex Poiret	Kherta, Garat	Fabaceae	Th.	Herb
Vicia monantha Retz.		Fabaceae	Th.	Herb
Vicia sativa L.	Jilban.	Fabaceae	Th.	Herb
Vicia villosa Roth	Jelbana Hmam	Fabaceae	Th.	Herb

Species.	Vernacular name	Family	Life form	Growth form
Oxalis pes-caprae L.	Hummdha	Oxalidaceae	Th.	Herb
Erodium cicutarium (L.) L' Herit	Dahmiyet el-ghazl.	Geraniaceae	Th.	Herb
Euphorbia terracina L.	Lebbena	Euphorbiaceae	H.	Herb
Malva parviflora L. var parviflora	Khobaiz	Malvaceae	Th.	Herb
Malva sylvestris L.	Khobaiz	Malvaceae	H.	Herb
Thymelaea hirsuta (L.) Endl.	Metnan	Thymelaeaceae	Ph.	Subshrub
Helianthemum lippii var. sessiliflorum (Desf.) Murb.	Lerga.	Cistaceae	Ch.	Herb
Nitraria retusa (Forsk.) Asch		Zygophyllaceae	Ph.	Shrub
Daucus syrticus Murb		Apiaceae	Th.	Herb
Pituranthos tortuosus (Desf.) Benth.	Gazzah.	Apiaceae	Ch.	Subshrub
Pseudorlaya pumila (L.) Gramde		Apiaceae	Th.	Herb
Anagallis arvensis var. caerulea (L.) Gouan	Ain Algatuus	Primulaceae	Th.	Herb
Convolvulus althaeoides L.	Ullak	Convolvulaceae	G.	Herb
Convolvulus arvensis L.	Ullak	Convolvulaceae	G.	Herb
Convolvulus supinus Coss. et Kral	Ullak	Convolvulaceae	Th.	Herb
Echium angustifolium Mill.	Henna alagrab, abat elgula	Boraginaceae	Ch.	Subshrub
Echium horridum Batt		Boraginaceae	Ch.	Subshrub
Gastrocotyle hispida (Forsk) Bunge		Boraginaceae	Th.	Herb
Heliotropium ramosissimum (Lehm.) De.	Tahaunna, tahenna	Boraginaceae	Ch.	Herb
Ajuga iva (L.) Shreber	Shandgura	Lamiaceae	Th.	Herb
Salvia lanigera Poir.	Sag en naga	Lamiaceae	Ch.	Herb
Teucrium davaeanum Coss.		Lamiaceae	Ch.	Herb
Lycium europeaum L	Awesaj	Solanaceae	Ph.	Shrub
Solanum nigrum L. var. Nigrum	Anab ed. Deeb	Solanaceae	H.	Herb
Nicotiana glauca R.C. Graham	Akkuzemusa.	Solanaceae	Ph.	Shrub
Haplophyllum tuberculatum (Forsk) Juss.	Affia	Rutaceae	Ch.	Herb
Kickxia aegyptiaca (L.) Nabelek ssp. Aegyptiaca	Amekchin	Scrophulariaceae	Ch.	Herb
Linaria tarhunensis Pamp.		Scrophulariaceae	Th.	Herb
Linaria tenuis (Viv.) Spreng.		Scrophulariaceae	Th.	Herb
Orobanche schultzii Mutel.		Orobanchaceae	P.	Herb
Plantago albicans L.	Aenm.	Plantaginaceae	H.	Herb
Anacyclus monanthos (L.) Thell.	Tagrefta, Serat elkabesh.	Asteraceae	Th.	Herb
Artemisia momosperma Delile	Tguft	Asteraceae	Ch.	Herb
Anthemis secundiramea Biv.		Asteraceae	Th.	Herb
Calendula tripterocarpa Rupr.		Asteraceae	Th.	Herb
Carduus getulus Pomel		Asteraceae	Th.	Herb
Centurea alexandrina Delile	Mrrier.	Asteraceae	Th.	Herb
Centurea dimorpha Viv.	Bla ′ala	Asteraceae	Th.	Herb
Chrysanthemum coronarium L.	Gahwan	Asteraceae	Th.	Herb
Conyza aegyptiaca (L.) Dryander		Asteraceae	Th.	Herb
Conyza bonariensis (L.) Cornq.	Ashbet Zamora	Asteraceae	Th.	Herb
Crepis senecioides Delile		Asteraceae	Th.	Herb
Echinops galalensis Schweinf	Shembet Elgatoos	Asteraceae	H.	Herb
Hypochaeris achyrophorus L.		Asteraceae	Th.	Herb
Launaea resedifolia (L.) O. Kuntze	Adeeda.	Asteraceae	Th.	Herb
Onopordum arenarium (Desf.) Pomel	Libid	Asteraceae	H.	Herb
Reichardia tingitana (L.) Roth.	Sahani.	Asteraceae	Th.	Herb
Rhantterium suaveolens Desf.		Asteraceae	Ch.	Herb
Rhaponticum acaule (L.) DC.		Asteraceae	Ch.	Herb
Senecio gallicus Chiax	Daraita, Mourare.	Asteraceae	Th.	Herb
Senecio vulgaris L.	Kraa Eddjaja	Asteraceae	Th.	Herb
Sonchus oleraceus L.	Tefaf.	Asteraceae	Th.	Herb

Table 2: List of species recorded in the study area with their families, Vernacular name, life form and Growth form (Th. = Therophytes and G. = Geophytes) Monocotyledons

Asphodelus fistulosus L.	Lehiat ettaes	Liliaceae	G.	Herb
Muscari comosum (L.) Mill.	Keltout , Katout	Liliaceae	G.	Herb
Scilla Preuviana L.	Possaila	Liliaceae	G.	Herb
Allium subhirsutum L.	Ghazul.	Alliaceae	G.	Herb
Allium nigrum L.		Alliaceae	G.	Herb
Avena barbata Pott ex Link		Poaceae	Th.	Herb
Bromus rigidus Roth.		Poaceae	Th.	Herb
Cutandia dichotoma (Forsk.) Trabut	Zewahn , bu ′rukba	Poaceae	Th.	Herb
Cynodon dactylon (L.) Pers.	Najem, Najieel	Poaceae	G.	Herb
Hordeum murinm L. ssp. Leporinum (link.) Arcang.		Poaceae	Th.	Herb
Lolium rigidum Gaud.	Bomanjor.	Poaceae	Th.	Herb
Phalaris minor Retz.	Zewan	Poaceae	Th.	Herb
Stipa capensis Thunb.	Behma	Poaceae	Th.	Herb

At the end of the survey there was a total of 112 species of flowering plants, 93 representing genera belong to 31 families that have been collected and identified, of which 99 taxa belonging to 81 genera that belong to Dicotyledons which distributes in 28 families; whereas 13 taxa belonging to 12 genera and 3 families are belonging to monocotyledons (Table 3). The ratio of Dicotyledons to Monocotyledons is roughly 8: 1.

Table 3: Different taxonomic groups present in the study area.

Plant group	No. of families	No. of Genera	No. Species
Dicotyledons	28	81	99
Monocotyledons	3	12	13
Total	31	92	112

From floristic analysis were carried out which showed the most highly represented families were Asteraceae and Fabaceae being the richest with 21 and 19 species respectively. The next largest family was Poaceae with 8 species. Brassicaceae and Chenopodiaceae with 7 species followed by Boraginaceae represented by 4 species (Figure 2). Seven families namely, Convolvulaceae, Polygonaceae, Lamiaceae, Solanaceae, Liliaceae, Apiaceae and Scrophulariaceae, were represented by 3 species each. The families which include 2 species were Alliaceae and Caryophyllaceae, whereas the rest families were represented by only a single species occupying different habitats. A comparison of families in the largest number of species recorded in this study is similar to the studies in different regions of Libya, example studies of Asker [12], Al-Hamedi [6], Al-Habony [13], Alaib and Ihsaeen [14] (Table 3).

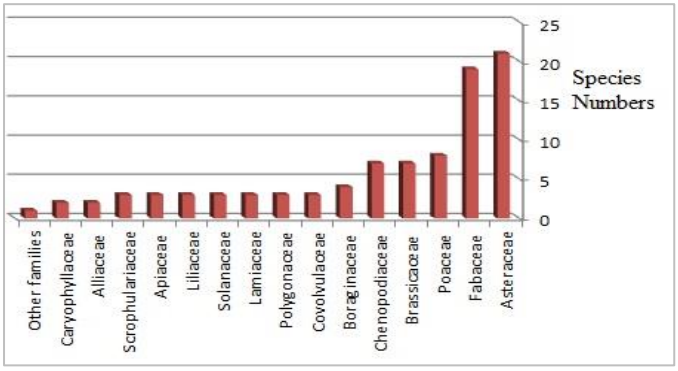

Figure 2: Floristic richness-Diversity-of the study area

According to the number of species in each genus in the study area, *Astragalus* and *Medicago* were the only two genera represented by four species each. Two genera, *Vicia* and *Convolvulus* have three species each. Six genera namely, *Lotus*, *Malva*, *Echium*, *Linaria*, *Centurea*, *Conyza* and *Allium* were represented by two species each in the study area.

In this study, two species considered as endemic species to Libya. These species namely, *Linara tarhunensis* and *Teucrium davaenum*.

Plant life forms were categorized as Therophytes with 72 species (64.28%), Chamaephytes with 16 species (14.28%), Hemicryptophytes with 9 species (8.03%), Geophytes with 8 species (7.14%), Phanerophytes with 6 species (5.35%), Parasites with 1 species (0.89%) (Figure 3). Therophytes and Chamaephytes were dominated in Wadi Al Hamar. These findings were in agreement with previous studies on different regions of Libya which have been recorded by many researchers such as Al-Habony [13], Ihsaeen [26], Mahklouf and Al Sghair [27], who reported that the dominancy of these two life forms may be due to hot dry climate, topography variations and biotic influence.

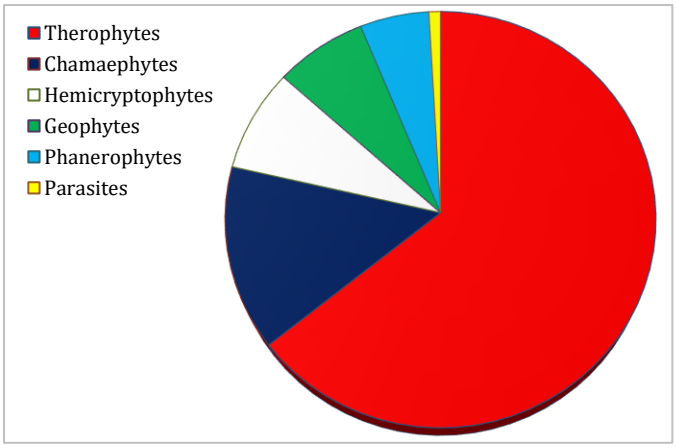

Figure 3: Biological spectrum of plant species in the flora of Libya**.**

The study showed that the growth habits of species were distributed as herbs 98 species (87.5%) and subshrubs to shrubs 14 species (12.5%). 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 [28].


Malva parviflora


Malva sylvestris


Orobanche schultzii


Atriplex halimus


Paronychia arabica


Phalaris minor


Anagallis arvensis


Oxalis pes-caprae


Asphodelus fistulosus


Convolvulus althaeoides


Papaver hybridum


Reichardia tingitana

Sonchus oleraceus

Centurea dimorpha

Anthemis secundiramea

Chrysanthemum coronarium

Astragalus cabrinus

Melilotus indicus

7. Conclusion

The findings of this study clearly show that the flora is poor floristically which may be attributed to its topography, edaphic factors, and climatic conditions**.**

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