CURRENT STATUS OF FLORISTIC STRUCTURE IN WADI EL ZEKR, ZLITEN CITY, LIBYA

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Abstract

The current study addressed the current floristic composition in Wadi El Zekr, Zliten City, Libya. Through six field trips, a total of 30 randomly-located stands each of 10 m^2 were sampled. In each stand, a complete list of all species with their updated taxonomic families and life-span were recorded. A total of 86 species belonging to 80 genera and 35 families were recorded in Wadi El-Zekr, Zliten City, Libya. Four families (Asteraceae, Fabaceae, Lamiaceae and Poaceae) were the leading families, collectively contributing by 44.19% of the total number of surveyed species. The surveyed species were distributed into 47 annuals and 39 perennials. Concerning life-forms, the surveyed species are distinguished into 45 therophytes (52.33% of the total recorded species), 12 hemicryptophytes (13.95%), 11 phanerophytes (12.79%), 10 chamaephytes (11.63%) and 8 geophytes (9.30%). The bi-regional elements had attained the highest contribution by 31.40% (27 species), followed by mono-regional elements (26 species = 30.23%), worldwide taxa (18 species = 20.93%) and pluri-regional taxa (13 species = 15.12%). Furthermore, the Mediterranean chorotypes are represented by 55 species (64% of the total recorded species in the study area), while Saharo-Sindian, Irano-Turanian and Euro-Siberian elements are represented by 29, 20 and 9 species, respectively.

Keywords: Flora, Wadi El-Zekr, Libya, chorotypes, Mediterranean taxa.

الوضع الحالي للتركيب الفلوري في وادي الذكر, بمدينة زليتن, ليبيا

الملخص

تناولت الدراسة الحالية التركيب الفلوري الحالي في وادي الذكر، مدينة زليتن، ليبيا. من خلال ست رحلات ميدانية، وتم أخذ عينات من إجمالي 30 موقعا عشوائيًا تبلغ مساحة كلا منها 10 متر مربع في كل موقع. تم تسجيل قائمة كاملة بجميع الأنواع مع عائلاتها التصنيفية المحدثة وفترة النمو. وحيث سجل 86 نوعاً يتبع 80 جنساً و35 عائلة. ووجد أن الفصائل: (المركبة, القرنية, الشفوية والنجيلية) هي أكثر العائلات وفرة حيث حققت مجتمعةً حوالي (44.19 %) من إجمالي الأنواع المسجلة. وتم توزيع الأنواع التي تم تسجيلها على 47 نبات حولي و39 نبات معمر. فيما يتعلق بطرز الحياة، تم تمييز الأنواع النباتية المسجلة إلى 45 طراز من الحوليات (52.33 %), يليه 12 طراز شبه المختفيات (13.95 %)، و11 طراز من النباتات الشجيرية (12.79 %)، و10 من طراز السطحيات (11.63 %) و8 من طراز المختفيات (9.30 %). فيما يخص التحليل الفلوري للنباتات المسجلة حققت العناصر ثنائية المناطق أعلى مساهمة بنسبة (27 نوعًا = 31.40 %)، تليها العناصر أحادية المنطقة (26 نوعًا = 30.23 %)، والأصناف العالمية (18 نوعًا = 20.93 %), والأصناف متعددة المناطق (13 نوعًا = 15.12 %). علاوة على ذلك، تم تمثيل أنماط البحر الأبيض المتوسط بـ 55 نوعًا = 64 % من إجمالي الأنواع المسجلة في منطقة الدراسة، بينما تم تمثيل العناصر الصحراوية السندية والإيرانية والأوروبية بـ 29 , 20 و 9 نوعًا على التوالي.

الكلمات المفتاحية: الفلورة، وادي الذكر, ليبيا, التوزيع الجغرافي, نباتات البحر الأبيض المتوسط

INTRODUCTION

The purpose of nature conservation is to safeguard earth's capacity to endure development and support biodiversity. Disturbances by natural factors and human activities are the main drivers for shaping and distribution of ecological communities **[1]**. Habitat loss due to land use changes is considered as one of the main drivers of biodiversity depletion and can push native populations to local/regional extinction and enable invasion of alien species **[2]**. Human being in their quest for economic development and enjoyment of the riches of nature must come to term with the reality of the limited resources and the absorptive capacities of ecosystems and must take account of the needs of future generations, especially in arid region. Recently, nearly half of the plant species in the world, especially in highly biodiversity regions may be categorized as threatened as a result of degraded and altered habitats **[3]**. For a foreseeable future, expanding demands for natural resources will proceed to change in habitat conditions with local extinction native species **[4]**.

Desert occupies approximately 95% of Libya's total area and the southern part of Libya is amongst the driest region in the world. This ecosystem has its unique and characteristic xerophytic vegetation that sustain human population with essential goods and services. Despite these benefits, threats to its species and habitats are noted in the latest history. Actually, all threats are caused by human mismanagement for biological resources in addition to the aridity of climate. Desert degradation and fragmentation caused by human misuse and sever environmental changes are one of the major causes of decline in global biodiversity and have become a critical environmental problem **[5]**. Therefore, in many areas, reconstruction of disturbed ecosystems is being taken up on a priority basis for biodiversity conservation and maintaining landscape productivity **[6]**.

Libya is located at the north of Africa and south of the Mediterranean Sea and occupies approximately 1.75 million km^2. Desert and narrow sector of coastal Mediterranean area are the main phytogeographic regions in Libya **[7]**. Similar to the Mediterranean areas, the northern coast strip is featured by high rainfall and rich-fertile soil which consequently increase the plant diversity and endemism in this area as compared with the rest desert region of the country **[8]**. **[9]** reported that, among other habitats, the Libyan northern coast is exposed to biodiversity loss due to recent and excessive human impacts and land degradation. For examples, over-grazing, over-cutting, overcollection for wood, medicinal and economic uses.

From the biogeographical perspective, one may distinguish four main zones in Libya with different ecotypes:(1) the coastal plains include El-Jafarah Plain, Sirte Plain and Benghazi Plain, which are considered as rangeland areas; (2) the northern highlands include Nafosa Mountain, Al-Jabal Al-Akhdar Mountain and Marmarica Plateau, which contain the highest abundance and diversity of biota species (fauna and flora); (3) the desert includes most of the southern part of the country and is dotted with many oases – this desert is very poor in biota species, and agriculture has been the primary land use for centuries in many oases due to the abundance of underground water; (4) the southern mountains include several mountain chains such as Al-Uweinat, Tibesti, Tassili, Arqueno, Al-Heroj and *Acacus*, which have geographical isolation for thousands of years– these mountains are considered to be a transitional zone between the Sahara Desert in the north and the Sahel Bioclimatic Zone in the south.

The desert climate (hot and dry) dominates the Libyan land, except for the northern coastal strip which is characterised by a Mediterranean climate. The ultra- hyper-arid ombrotype dominates over 75% of the southern territory of the country and hyper-arid, arid and semi-arid

prevail over the rest of the land, mostly in the north, and the sub-humid ombrotype only exists in a small area in Al-Jabal Alakhdar Mountain in the north-eastern part of Libya **[7]**.

The variation in floristic composition all over the country may attributed to soil conditions, topography, land-forms, climate and degree of human impacts **[9]**. The flora of Libya consists of ca. 2118 species with 864 genera and 161 families **[10]**. The vascular plants in Libya constitute higher numbers of annual and perennial herbs than woody shrubs and trees. However, there is a further need of research to investigate and update the flora and floristic composition in different habitats in Libya. The floristic and vegetation study in Libya has attract the interest of many researchers. For example, the broadest floristic study was offered as an earliest checklist of the flora of Libya by **[11]**, and Flora of Libya by **[12]**. Furthermore, to the best of our knowledge, up to date, no previous study has addressed the flora and floristic composition in Zliten City and in particular Wadi El-Zekr. Therefore, the main objective of this study is to address the floristic composition in this wadi to document and update the plant life in the flora of Libya and outline the required conservation actions.

MATERIALS AND METHODS

STUDY AREA

Wadi El-Zekr is among wadis of Zliten City. Zliten is a coastal city located along the Mediterranean region of Libya, east of the capital Tripoli with an area of ca. 30,000 km^2 **(Figure 1)**. It is located within the coordinates of 32°27′50″N and 14°34′21″E. It is regarded as a semi-arid region. The Mediterranean climate data of Zliten displayed that, the average temperature is ranged between 20.1°C in winter to 38.2°C in summer, the average rainfall is fluctuated between 60 and 75 mm per year.

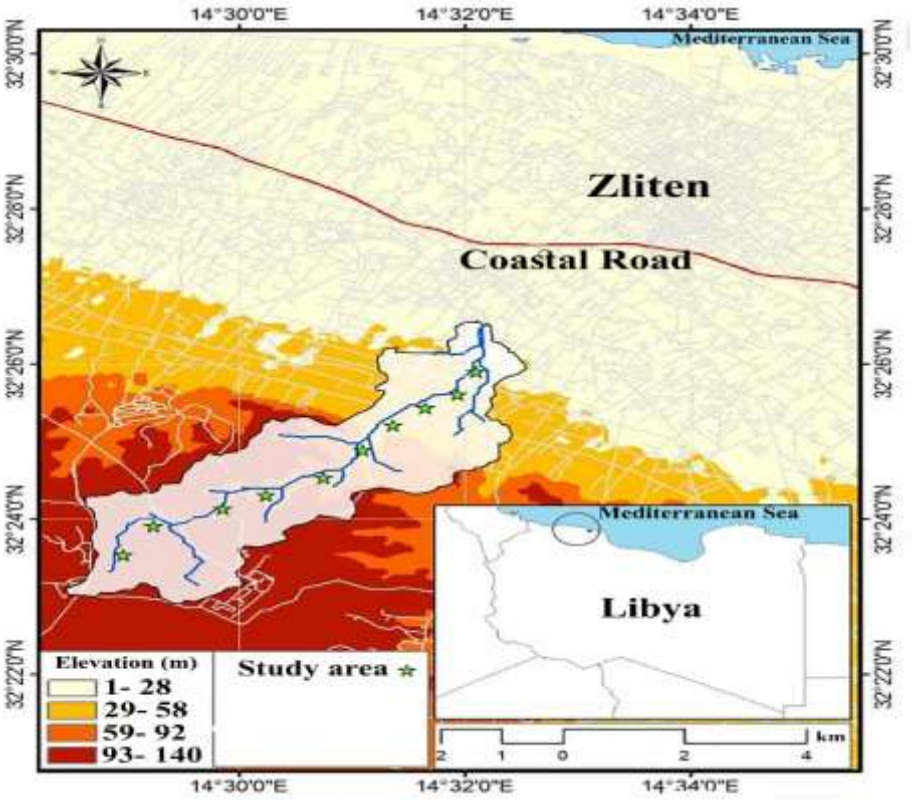

Figure (1). Map of Libya showing the study area with in Zliten City.

FLORISTIC SAMPLIG

During Spring 2020, six field trips were carried out along Wadi El-Zekr to investigate and assess its current floristic composition. A total of 30 randomly-located stands, each of 10 m^2 were sampled. In each stand, a complete list of all species with their updated taxonomic families and life-span were recorded. Nomenclature of plant species was informed according to **[13]** and updated after the World Flora Online **[14]**. Life-forms and floristic category of the surveyed species were established according to **[15]**, **[16]** and **[17]**. Voucher plant specimens were preserved at the Herbarium of Botany Department, Faculty of Science, Al-Asmarya Islamic University.

RESULTS AND DISCUSSION

To date, no study has focused on the floristic composition of Wadi El-Zekr in Libya. A total of 86 species belonging to 80 genera and 35 families were recorded in Wadi El-Zekr, Zliten City, Libya **(Table 1)**. The recorded species represented ca. 4% of the total flora of Libya (2103-2118 species) **[18]; [10]**. This species number is lower as compared with **[19]** who recorded 231 species in sand dunes and salt marshes along the coastal area of the Surt region in Libya. The low number of species in the present work may be due to the fact that our study area has concerned with only one habitat (wadis) that was a little far from the sea and highly dependent on rainfall compared to other habitats very close to the sea such as sand dunes and salt marshes. *Atractylis*, *Carduus*, *Mesembryanthemum*, *Plantago*, *Salvia* and *Urtica* are the dominant genera with two species each. Out of the recorded families, Asteraceae comprises 15 species, followed by Fabaceae with 11 species, Poaceae with 7 species, Lamiaceae with 5 species, Aizoaceae, Brassicaceae, Plantaginaceae and Solanaceae with 3 species each, Apiaceae, Asparagaceae, Boraginaceae, Caryophyllaceae, Chenopodiaceae, Euphorbiaceae, Polygonaceae and Rubiaceae with 2 species each, while the other 20 families are represented by only one species each. Thus, four families were the leading families collectively contributing by 44.19% of the total number of surveyed species (38 species). This finding is agreed with **[8]** who reported that, Asteraceae, Fabaceae and Brassicaceae are the dominant families for dicotyledons while Poaceae is the most prevalent family for monocotyledons. Regarding life-span, the surveyed species were distributed into 47 annuals and 39 perennials **(Figure 2)**. In contrast to our findings, **[19]** attained higher perennials (123 species) than annuals (108 species), while **[20]** recorded only 64 perennial species in Al-Heroj Mountain, in central desert of Libya. This confirm the hypothesis, the plant life and wealth in the studied wadi are rainfall-independent. Moreover, the high contribution of annuals may be attributed to their high reproductive and ecological features under anthropogenic disturbances. In addition, annuals are preferred to emerge during the rainy-season in desert wadis, oases and depressions **[21]**.

Table (1). Global floristic composition of the study area with their families, life-span, life-forms and floristic category.

Species	Family	Life- span	Life-form	Floristic category
Acacia nilotica (L.) Delile	Fabaceae	Per	Ph	SA-SI
Achillea biebersteinii Afan.	Asteraceae	Per	H	ME+ IR-TR+ ER-SR
Adonis dentata Delile	Ranunculaceae	Ann	Th	ME+ IR-TR
Aizoanthemum hispanicum (L.) H.E.K.Hartmann	Aizoaceae	Ann	Th	ME+ IR-TR
Alhagi maurorum Medik.	Fabaceae	Ann	H	ME+ IR-TR+ SA-SI
Anacyclus monanthos (L.) Thell.	Asteraceae	Ann	Th	SA-SI
Anagallis arvensis L.	Primulaceae	Ann	Th	COSM
Androcymbium gramineum (Cav.) J.F.Macbr.	Colchicaceae	Per	G	ME+ SA-SI
Asparagus stipularis Forssk.	Asparagaceae	Per	G	ME+ SA-SI
Asphodelus tenuifolius Cav.	Xanthorrhoeaceae	Ann	G	SA-SI
Atractylis carduus (Forssk.) C.Chr.	Asteraceae	Per	H	ME+ SA-SI

Atractylis serratuloides (Cass.) DC.	Asteraceae	Per	H	ME+ SA-SI
Atriplex halimus L.	Chenopodiaceae	Per	Ph	ME+ SA-SI
Biscutella didyma L.	Brassicaceae	Ann	Th	ME+ IR-TR
Bituminaria bituminosa (L.) C.H.Stirt.	Fabaceae	Per	Ch	ME
Bromus rigidus Roth	Poaceae	Ann	Th	ME
Calicotome villosa (Poir.) Link	Fabaceae	Per	Ph	ME
Carduus getulus Pomel	Asteraceae	Ann	Th	SA-SI
Carduus pycnocephalus L.	Asteraceae	Ann	Th	SA-SI
Carthamus tenuis (Boiss. & Blanche) Bornm.	Asteraceae	Ann	Th	ME
Cenchrus ciliaris L.	Poaceae	Per	H	COSM
Centaurea glomerata Vahl	Asteraceae	Ann	Th	ME+ IR-TR
Chenopodium murale L.	Chenopodiaceae	Ann	Th	COSM
Convolvulus althaeoides L.	Convolvulaceae	Per	H	COSM
Cynodon dactylon (L.) Pers.	Poaceae	Per	G	PAN
Deverra tortuosa (Desf.) DC.	Apiaceae	Per	Ch	SA-SI
Echinops spinosus L.	Asteraceae	Per	H	ME+ SA-SI
Echium angustifolium Mill.	Boraginaceae	Per	H	ME
Emex spinosa (L.) Campd.	Polygonaceae	Ann	Th	ME+ SA-SI
Erigeron bonariensis L.	Asteraceae	Ann	Th	COSM
Erodium laciniatum (Cav.) Willd.	Geraniaceae	Ann	Th	ME
Euphorbia pterococca Brot.	Euphorbiaceae	Ann	Th	ME
Fagonia cretica L.	Zygophyllaceae	Per	Ch	ME+ SA-SI
Filago argentea (Pomel) Chrtek & Holub	Asteraceae	Ann	Th	SA-SI
Fumana thymifolia (L.) Spach	Cistaceae	Per	Ch	ME
Galium verrucosum Huds.	Rubiaceae	Ann	Th	ME
Haloxylon scoparium Pomel	Amaranthaceae	Per	Ch	SA-SI
Heliotropium europaeum L.	Boraginaceae	Ann	Th	ME+ IR-TR+ IR-TR
Hordium marinum Huds.	Poaceae	Ann	Th	ME+ IR-TR
Kickxia aegyptiaca (L.) Nabelek	Plantaginaceae	Per	Ch	SA-SI
Lathyrus cicera L.	Fabaceae	Ann	Th	ME+ IR-TR
Lavandula multifida L.	Lamiaceae	Per	Ph	SA-SI
Leontice loentopetalum L.	Berberidaceae	Per	G	ME+ IR-TR
Lycium schweinfurthii Dammer	Solanaceae	Per	Ph	ME
Lygeum spartum Loefl. ex L.	Poaceae	Per	G	ME
Malva parviflora L.	Malvaceae	Ann	Th	ME+IR-TR
Marrubium vulgare L.	Lamiaceae	Per	G	COSM
Matthiola longipetala (Vent.) DC.	Brassicaceae	Ann	Th	ME+ER-SR+SA-SI
Medicago minima (L.) L.	Fabaceae	Ann	Th	COSM
Mesembryanthemum crystallinum L.	Aizoaceae	Ann	Th	ME+ ER-SR
Mesembryanthemum nodiflorum L.	Aizoaceae	Ann	Th	ME+ ER-SR+SA-SI
Nicotiana glauca Graham	Solanaceae	Per	Ph	COSM
Olea europaea L.	Oleaceae	Per	Ph	COSM
Papaver rhoeas L.	Papaveraceae	Ann	Th	COSM
Paronychia arabica (L.) DC.	Caryophyllaceae	Ann	Th	ME+ SA-SI+ S-Z
Peganum harmala L.	Nitrariaceae	Per	H	ME+ IR-TR+SA-SI
Phalaris minor Retz.	Poaceae	Ann	Th	ME+ IR-TR
Phoenix dactylifera L.	Arecaceae	Per	Ph	CULT and NAT
Plantago albicans L.	Plantaginaceae	Per	H	ME+ SA-SI
Plantago lagopus L.	Plantaginaceae	Ann	Th	ME+ IR-TR
Polygonum equisetiforme Sm.	Polygonaceae	Per	H	ME+ IR-TR
Prasium majus L.	Lamiaceae	Per	Ch	ME
Reichardia tingitana (L.) Roth	Asteraceae	Ann	Th	ME+ IR-TR
Retama raetam (Forssk.) Webb & Berthel.	Fabaceae	Per	Ph	ME+ IR-TR+ SA-SI
Ricinus communis L.	Euphorbiaceae	Per	Ph	CULT and NAT
Salvia aegyptiaca L.	Lamiaceae	Per	H	SA-SI+ S-Z
Salvia verbenaca L.	Lamiaceae	Per	Ch	COSM
Scabiosa arenaria Forssk.	Caprifoliaceae	Ann	Th	ME+ SA-SI
Scilla peruviana L.	Asparagaceae	Per	G	ME
Scorpiurus muricatus L.	Fabaceae	Ann	Th	ME
Scorzonera undulate Vahl	Asteraceae	Per	Ch	ME
Scrophularia canina L.	Scrophulariaceae	Per	Ch	ME+ ER-SR

Sherardia arvensis L.	Rubiaceae	Ann	Th	COSM
Silybum marianum (L.) Gaertn.	Asteraceae	Ann	Th	ME+ IR-TR+ ER-SR
Sisymbrium irio L.	Brassicaceae	Ann	Th	ME+ IR-TR+ER-SR
Solanum nigrum L.	Solanaceae	Ann	Th	COSM
Sonchus oleraceus L.	Asteraceae	Ann	Th	COSM
Spergula fallax (Lowe) E. H. L. Krause	Caryophyllaceae	Ann	Th	ME+ SA-SI+ S-Z
Stipa capensis Thunb.	Poaceae	Ann	Th	ME+ TR-TR
Torilis nodosa (L.) Gaertn.	Apiaceae	Ann	Th	COSM
Trifolium tomentosum L.	Fabaceae	Ann	Th	COSM
Tripodion tetraphyllum (L.) Fourr.	Fabaceae	Ann	Th	ME
Urtica pilulifera L.	Urticaceae	Ann	Th	ME+ ER-SR
Urtica urens L.	Urticaceae	Ann	Th	ME+ IR-TR+ ER-SR
Vicia sativa L.	Fabaceae	Ann	Th	COSM
Ziziphus lotus (L.) Lam.	Rhamnaceae	Per	Ph	ME+ SA-SI+ S-Z

Per: perennial, Ann: annual, Th: therophyte, Ch: chamaephyte, H: hemicryptophyte, Ph: phanerophyte, G: geophyte, ME: Mediterranean, SA-SI: Saharo-Sindian, IR-TR: Irano-Turanian, S-Z: Sudano-Zambezian, ER-SR: Euro-Siberian, COSM: Cosmopolitan, PAN: Pantropical, CULT and NAT: Cultivated and Naturalized.

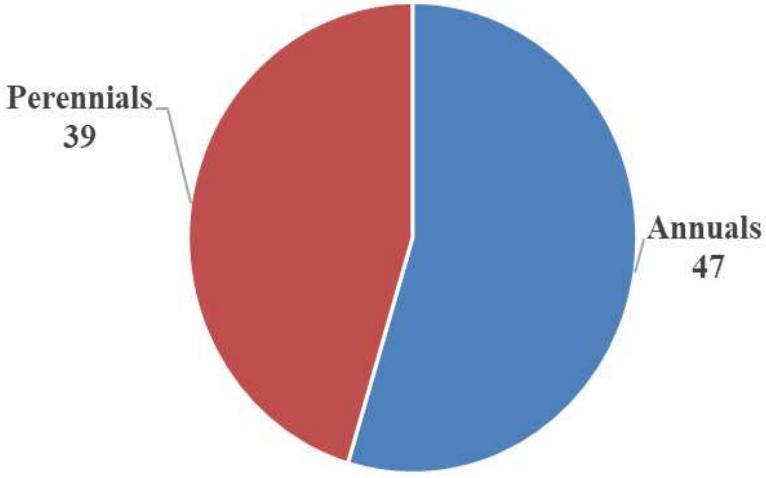

Figure (2). Life span (in number) for the surveyed species in the study area.

Concerning life-forms, the surveyed species are distinguished into 45 therophytes (52.33% of the total recorded species), 12 hemicryptophytes (13.95%), 11 phanerophytes (12.79% of the total recorded species), 10 chamaephytes (11.63% of the total recorded species) and 8 geophytes (9.30% of the total recorded species) **(Figure 3)**. This is in accordance with the studies of **[19]** and **[21]** on relevant study areas and they confirmed the predominance of therophytes over other life-forms. The dominance of therophytes is a response to the Mediterranean-climate, topography and biotic impact **[22]**. This result is similar to floristic spectra in other desert arid regions for example, **[23]; [18]; [24]; [10]**.

On the other hand, the highest numbers of hemicryptophytes, geophytes and chamaephytes in the study area may attributed to the capacity of these species to withstand drought, salinity, sand deposites and over-grazing.

Except for the two cultivated and naturalized plant species, the global floristic categories (chorotypes) of the surveyed species are displayed in **(Table 1)** and **(Figure 4)**. The bi-regional elements had attained the highest contribution by 31.40% of the total recorded species (27 species), followed by mono-regional elements (26 species = 30.23% of the total recorded species), worldwide taxa (18 species = 20.93% of the total recorded species) and plur-regional taxa (13 species = 15.12% of the total recorded species). Furthermore, the Mediterranean chorotypes are represented by 55 species (64% of the total recorded species in the study area), while Saharo-Sindian, Irano-Turanian and Euro-Siberian elements are represnetd by 29, 20 and 9 species, respectively. Cosmpolitan elements are reprsented by 17 species (19.77% of the total flora in the study area). The present study comprises a mixture of floristic categories such as Mediterranean, Saharo-Sindian, Sudano-Zambezian, Irano-Turanian, Euro-Siberian, Cosmopolitans, Palaeotropical elements with variable number of species.This finding assure the capability of certain floristic elements to penetrate the study area from other neighboring phytogeographic regions **[25]**.

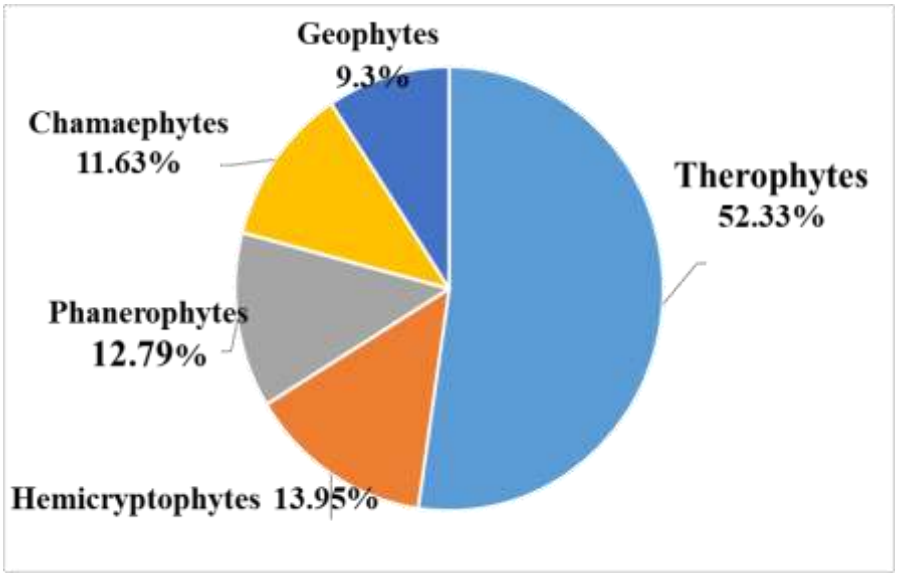

Figure (3). Life-forms spectra of the surveyed species in Wadi El-Zekr, Zliten region, Libya.

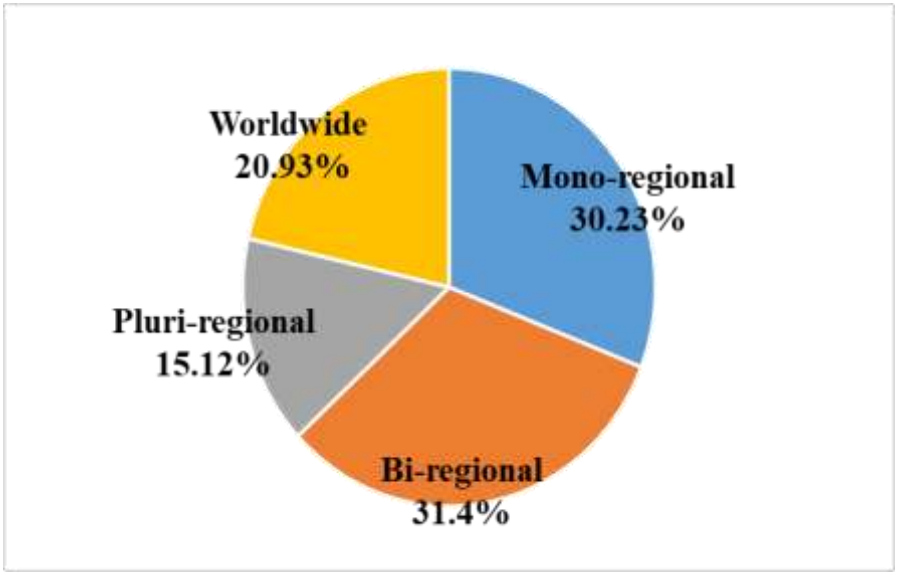

Figure (4). Global floristic analysis of the surveyed species in Wadi El-Zekr, Zliten region, Libya.

The current study area is chiefly regarded as a mixture of different chorotypes including Mediterranean, Saharo- Arabian, Irano-Turanian and cosmopolitan taxa. This result agreed with the fact that, these species are indicators for the desert-arid zone **[26]; [10]**. According to Qaiser and **[27]**, the natural vegetation in Libya is classified into 5 types. The 1st type represents 46.1% and includes plants of the Mediterranean area, sited in Al-Jabal Al-Akhdar. The 2nd type represents 4.5% of the Mauritanian Plains area plants, located in the northern coastal belt. The 3rd type contains 12.7% of annual plants of the Arab Sahara area. The 4th type consists of 4.1% including steppes plants of the Sudan area. The 5th type consists of 32.6% including numerous types of plants from different parts of the world.

CONCLUSION

A total of 86 species including 47 annuals and 39 perennials; 45 therophytes, 12 hemicryptophytes, 11 phanerophytes, 10 chamaephytes and 8 geophytes were recorded in Wadi El-Zekr, Zliten City, Libya. The knowledge about the current status of floristic composition and diversity, spatial distribution of plant communities and types of threats enable us to establish an effective conservation strategy to prevent further losses of floristic inventory and attempt for recovery and restoration of threatened plants and endangered ecosystems and habitats.

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