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Floristic Diversity and Phytogeography of Mil steppe-Azerbaijan

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Abstract: Chorology and Phytogeography of Mil steppe and environs were studied. The results show that; 926 species belonging to 457 genera and 91 families were recorded. Five families: Poaceae, Asteraceae, Fabaceae, Brassicaceae and Chenopodiaceae contribute 42.51 % of the total plant species recorded in this study. Poaceae is represented by 59 genera (12.83 %) of the total observed plant species. Asteraceae carry 54 genera (11.83 %), while Brassicaceae, Fabaceae and Chenopodiaceae carry 39, 22 and 21 genera (8.48 %, 4.79 %, and 4.57 %) respectively. 40 endemic species belonging to 31 genera and 20 families were listed. Among them, 25 species are endemic to Caucasus, 11 species are endemic to Azerbaijan and 4 species are subendemics. The majority of the listed species in this study are annual represented by 440 species (47 %), the second most recorded life span was the perennial, which are represented by 404 species (44 %). Five life forms are observed in the current study. Therophytes are the most frequent life form with 475 species (51%), followed by hemicryptophytes with 314 species (34 %), Cryptophytes with 76 species (8 %), Phanerophytes with 26 species (4 %) and Chamephytes with 38 species (3 %). Chorological analysis revealed that the Mediterranean -Irano-Turanian is the most dominant phytochorion represented by 151 species (13.1 %), followed by Palearctic and Mediterranean phytochoria represented by 115 species (12.5 %) and 113 species (12.3 %) respectively.
Keywords: Chorology, Floristic composition, Kura-Araks lowland, Mil steppe, phytogeographical elements.

1 Introduction

The floristic composition of a region is a premium for any phytogeographical and ecological studies as well as conservation management activities. In studying any particular piece of vegetation, from an ecological point of view, the first step is to determine the facts, as they exist on the ground. These facts include the vegetation, on one hand and the habitat, on the other hand [1,2]. If there is any set of facts, which is more liable to direct study and precise characterization than the other is, it is the floristic composition of the vegetation [1].

The Caucasus region located between the Caspian and Black Seas covers approximately 600,000 km on the border between Europe and Asia. Due to presence of many high mountain chains and their location at the intersection of different climatic and biogeographic systems, this region hosts exceptional biological diversity with many endemic flora and fauna [3]. From a phytogeographical perspective, the southern part of the Caucasus is situated on the border between two major floristic units: the Euro -Siberian region to the north and the Irano-Turanian region to the south. At present-day regions of Azerbaijan, Georgia and Armenia have long been recognized as one of the Asian centers of crop diversity [5,6], as well as for hosting the wild ancestors of many plants that have been domesticated in Southwest Asia in the past [7]. The territory of Azerbaijan is part of the Alpine fold belt and consists of folded systems, embracing the eastern parts of the Greater and Lesser Caucasus Mountains. The Kura Intermountain Depression (Kura Lowland) separating them, and also separating the Middle and South Caspian basins [7].

In Mil steppe of Kura-Araks lowland of Azerbaijan, there are several rare, endemic, endangered and threatened species. On life forms, they are trees, shrubs, subshrubs, perennials and annuals [8]. The literature of compiling distribution data were numerous and heterogeneous [9–12]. Base chorological analysis, covering the entire range of species, was acquired principally from seminal monographs published in the second half of last century [9–12]. Along with systematical, geographical, biological and ecological analysis, endemics of certain area is also floristically important where, it allows the defining of rare and endangered species at the content of flora of concrete

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territory, and thereby, to evaluate its representativeness and conservation importance. Classification of geographical distribution and studying of contemporary plant areas allow determining their specific features and formation regularities [13, 14].

As flora and vegetation of Mil steppe of Kura-Araks lowland is yet not fully studied, this work addresses detailed floristic analysis of Mil steppe, and assesses its phytogeographic affinities. The results presented in this study contribute to the knowledge of the Mil steppe region and put a complete approch for flora and vegetation of Mil steppe of Kura-Araks lowland.

2 The Study Area

Kura-Araks lowland that covers 1/3 of Azerbaijan area consists of plains such as Shirvan, Mil, Garabakh, Mugan, and Salyan. Mil steppe is situated between 40º to 41º N and 46º to 49º E. Mil steppe (plain) covers southern-western

In this study, three regions in the Mil Steppe area were part of Kura-Araks lowland is placed between the rivers of Kura and Araks.

selected: 1. Imishli, 2. Aghjabadi and 3. Beylagan (figure1). From eastern and northern-eastern side Mil steppe is separated from Shirvan steppe by Kura River; but from southern and southern-eastern side is separated from Mugan by Araks River. From northern side Mil steppe is surrounded by Garabakh steppe.

In the study area, geo-botanical researches were conducted at desert, semi desert, hole-meadow and water-marshy phytocenosises, which distributed at grey-meadow, boggy-meadow, salty and saline soils. Climate of region is mainly temperate-hot semi desert and dry steppe types; middle annual temperature of air is 14°C to 20°C, annual quantity of precipitation is 309 mm. The surface of the Mil steppe, at first sight is exactly like the other plains of the Kura-Araks lowland, but it does not have full plains. The relief complexity of the area has led to the creation of such complex and diverse natural complexes in the plain, which is less than the sea level. This is because of its geological development. Past and modern rivers flowing flat in the area include various relief forms such as dry ditches, lakes and ponds [15-17].

2.1 Methods

The study area was thoroughly surveyed during November 2015 to April 2017, using stratified systematic random method [18]. Data was collected from 100 m^2 (10×10 m) sampling plots to sample the vegetation and floristic composition of the study area. In this study, 14 sample plots were surveyed in each of the three regions (Imishli, Aghjabadi and Beylagan) of Mil steppe territory based on different topographical features and different vegetation types (figure 1), distributed randomly to cover all possible variation in the vegetation. In each of the studied stands, ecological notes, presence of plant species and GPS position were recorded. Species life forms were determined depending upon the location of the regenerative buds and the shed parts through the unfavorable season [19]. The floristic categories of the investigated species were made to assign the registered species to world geographical groups according to Grossheim [22]. The collected plant specimens were identified and named using first to last available literature [20-24]. Specimens of each taxon were deposited at the Herbarium Fond of Baku State University.

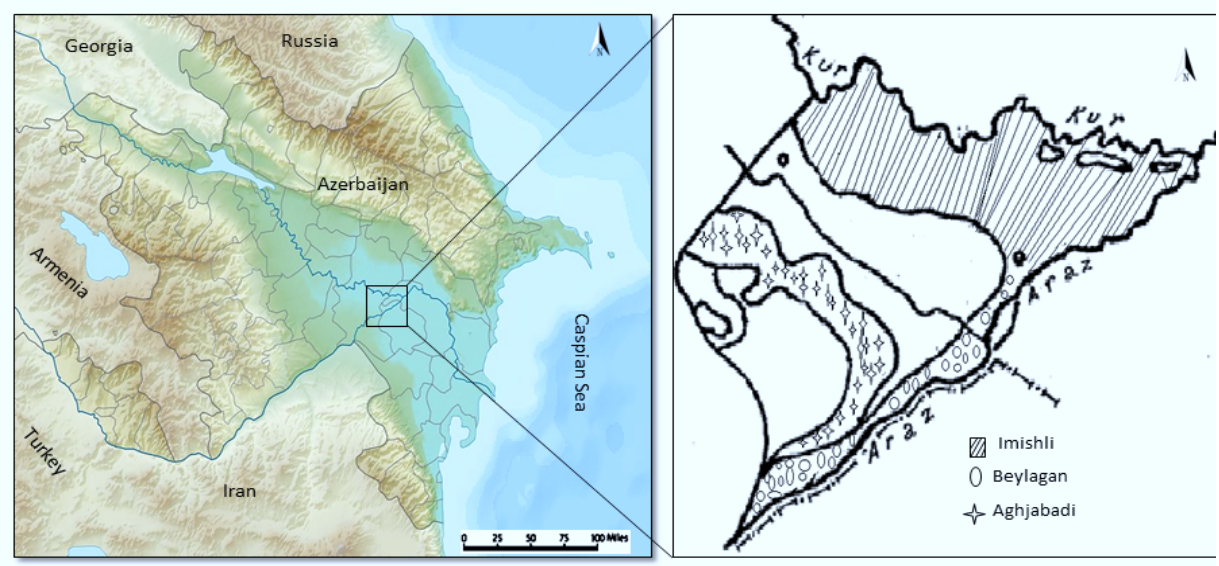


Fig. 1. Map of Mil Steppe region.

926 plant taxa belonging to 459 genera and 91 families Were recorded in the Mil steppe environs. The obtained

Table 1: Plant families in Mil steppe with its genera and species.

№	Family	Number		Percentage %	
		Genera	Species	Genera	Species
6	Apiaceae	20	25	4.35	2.,69
2	Asteraceae	54	93	11.83	10.03
7	Boraginaceae	19	30	4.13	3.24
3	Brassicaceae	39	58	8.48	6.28
8	Caryophyllaceae	18	33	3.92	3.56
5	Chenopodiaceae	21	52	4.57	5.61
11	Cyperaceae	12	34	2,61	3.67
4	Fabaceae	22	82	4.79	8.84
9	Lamiaceae	17	31	3.70	3.35
13	Liliaceae	9	23	1.97	2.48
15	Malvaceae	8	15	1.75	1.62
19	Orobanchaceae	5	14	1.11	1.52
18	Papaveraceae	5	15	1.11	1.62
1	Poaceae	59	113	12.84	12.18
17	Primulaceae	6	7	1.31	0.76
10	Ranunculaceae	12	28	2.61	3.02
12	Rosaceae	10	18	2.17	1.94
16	Rubiaceae	7	17	1.52	1.83
14	Scrophulariaceae	8	20	1.75	2.15
20	Tetradiclidaceae	5	5	1.11	0.54
	In 20 families totally	356	713	77.6	76.9
	71 families presented with 1-4 species	103	213	22.4	23.1
	Total: 91 families	**459**	**926**	**100**	**100**

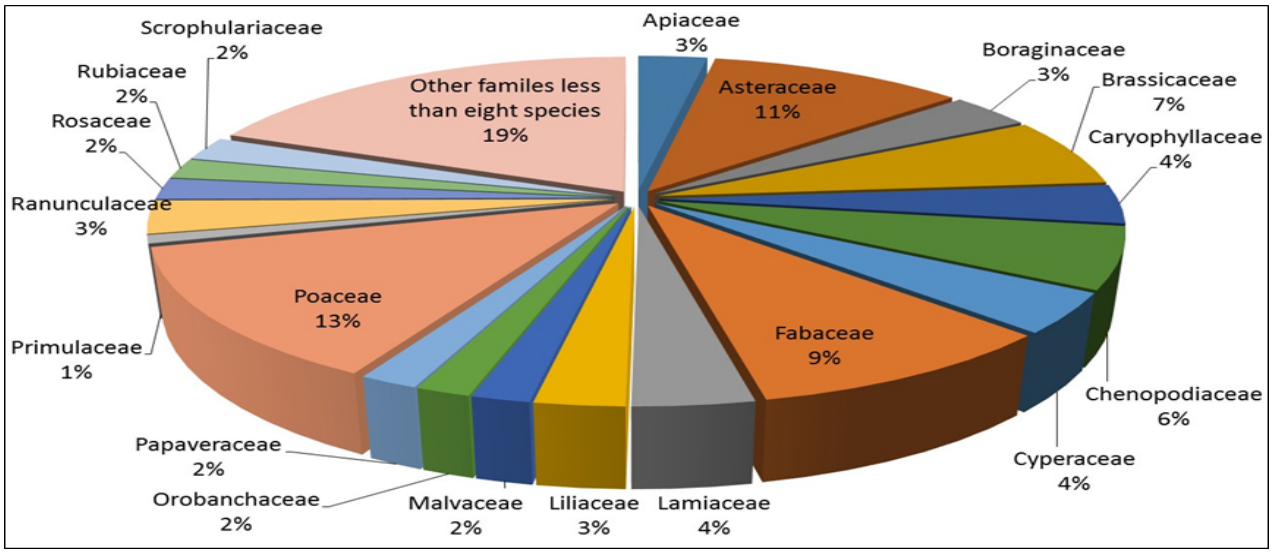


Fig. 2. Plant life form spectrum of the recorded taxa in the study area.

results represented in Table 1 and Figure 2 show the Plant families with their genera and species numbers recorded in different surveyed localities of Mil Steppe.

3.1 Floristic Composition and Life Span

Five families: Poaceae, Asteraceae, Fabaceae, Brassicaceae and Chenopodiaceae contribute 42.51 % of the total plant taxa recorded in this study. Poaceae is represented by 59

genera (12.83 %) of the total observed plant taxa. Asteraceae carries 54 genera (11.83 %), Brassicaceae, Fabaceae and Chenopodiaceae represented by 39, 22 and 21 genera (8.48 %, 4.79 %, 4.57 %) respectively. 15 families are represented by 20 to five genera, contributing (35.12 %) of total studied taxa (Apiaceae, Boraginaceae, Caryophyllaceae, Cyperaceae, Lamiaceae, Liliaceae, Malvaceae, Orobanchaceae, Papaveraceae, Primulaceae, Ranunculaceae, Rosaceae, Rubiaceae, Scrophulariaceae, Tetradiclidaceae); and 71 families are represented by less than 5 genera, contributing (22.44 %) of the total plant genera. In terms of species richness, Poaceae represented by113 taxa, Asteraceae 93, Fabaceae (82), Brassicaceae (58), Chenopodiaceae(52), Caryophyllaceae (33), Lamiaceae (31), Boraginaceae (30),Ranunculaceae (28), Apiaceae (25), Liliaceae (23), Scrophulariaceae (20),Rosaceae (18),Rubiaceae (17), Malvaceae (15), Papervaceae (15), Orbanchaceae (14), Primulaceae (7), Tetradiclidaceae (5). 71 families represented by less than five taxaAccording to life span, the recorded species can be classified into two main groups: the majority of the listed species in this study are annual plants represented by 440 species (47%). The second most recorded life span was the perennials, which are represented by 404 species (44%). Annuals to biennials, biennial and biennial to perennial life spans in the studied area are represented by (4%, 3%, 2%) respectively of the total recorded taxa for each category (Figure 3).

3.2 Life Form

Five life forms are observed in the current study according to the classification of Raunkiaer [18]. Therophytes are the most frequent life form of plants with 475 species followed by hemicryptophytes with 314 species, Cryptophytes with 76 species, Phanerophytes with 26 species and Chamephytes with 38 species with percentages of 51 %, 34 %, 8 %, 4 % and 3 % respectively (Figure 4).

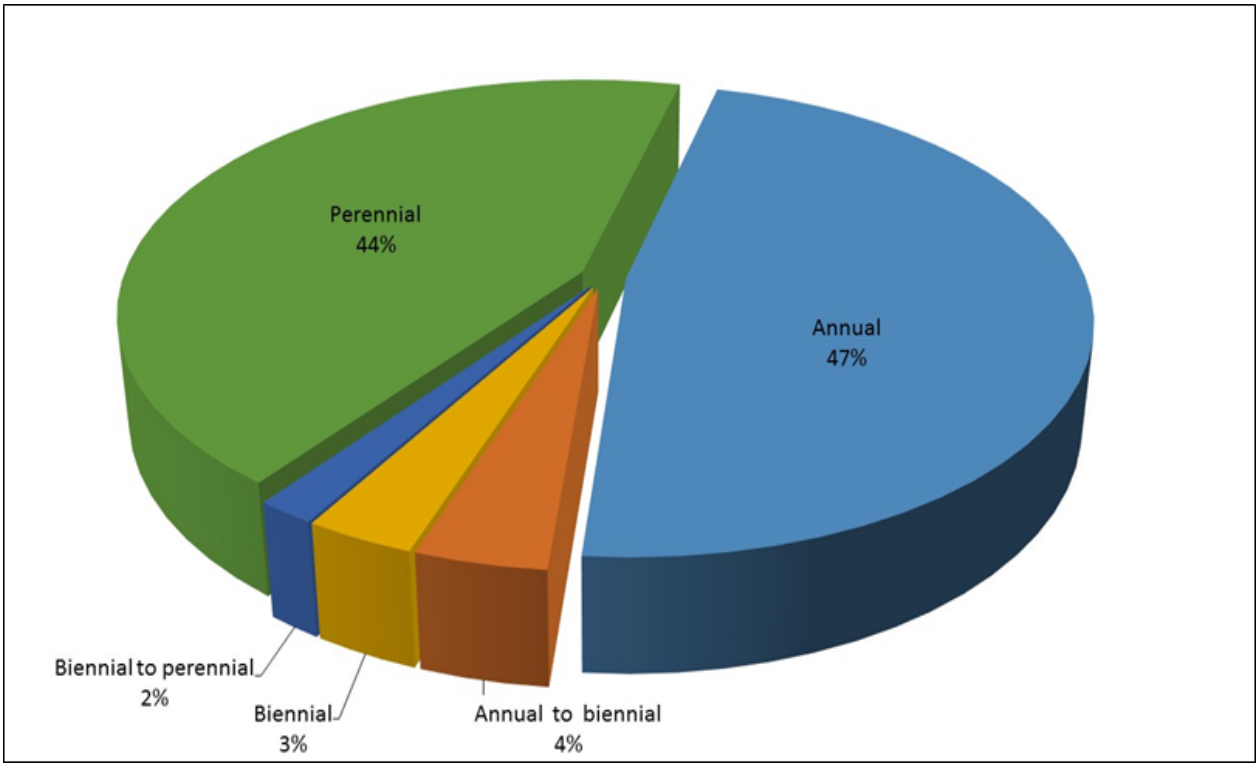
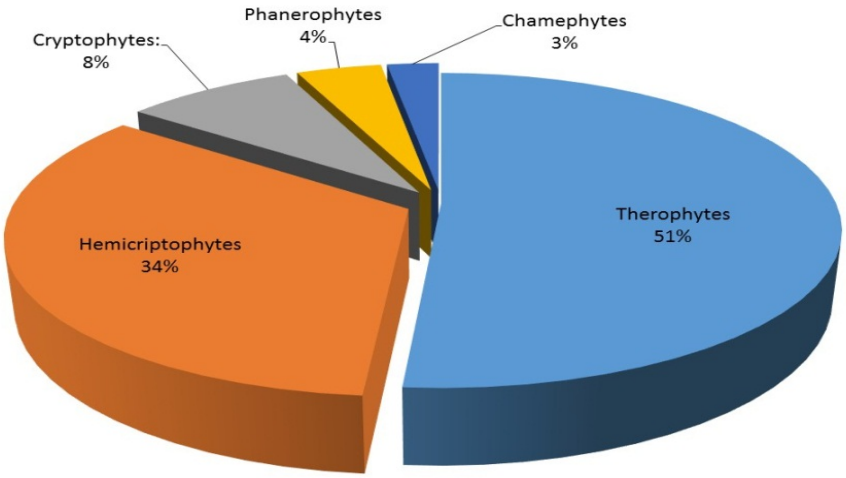


Fig. 3. The life-span of the recorded species in the study area.



3.3 Chorological Affinities

The results in table 2 and figure 5 show that, species belonging to Mediterranean -Irano-Turanian, Palearctic and Mediterranean chorotypes occupied 37.9 % of the total listed species. The Mediterranean -Irano-Turanian is the most dominant phytochorion represented by 151species (13.1 %), followed by Palearctic and Mediterranean phytochoria represented by 115 species (12.5 %) and 113 species (12.3 %) respectively. Both Holarctic and Irano-Turanian phytochoria elements represented by 54 species (5.8 %) for each, Eastern Mediterranean with 50 species (5.4 %).

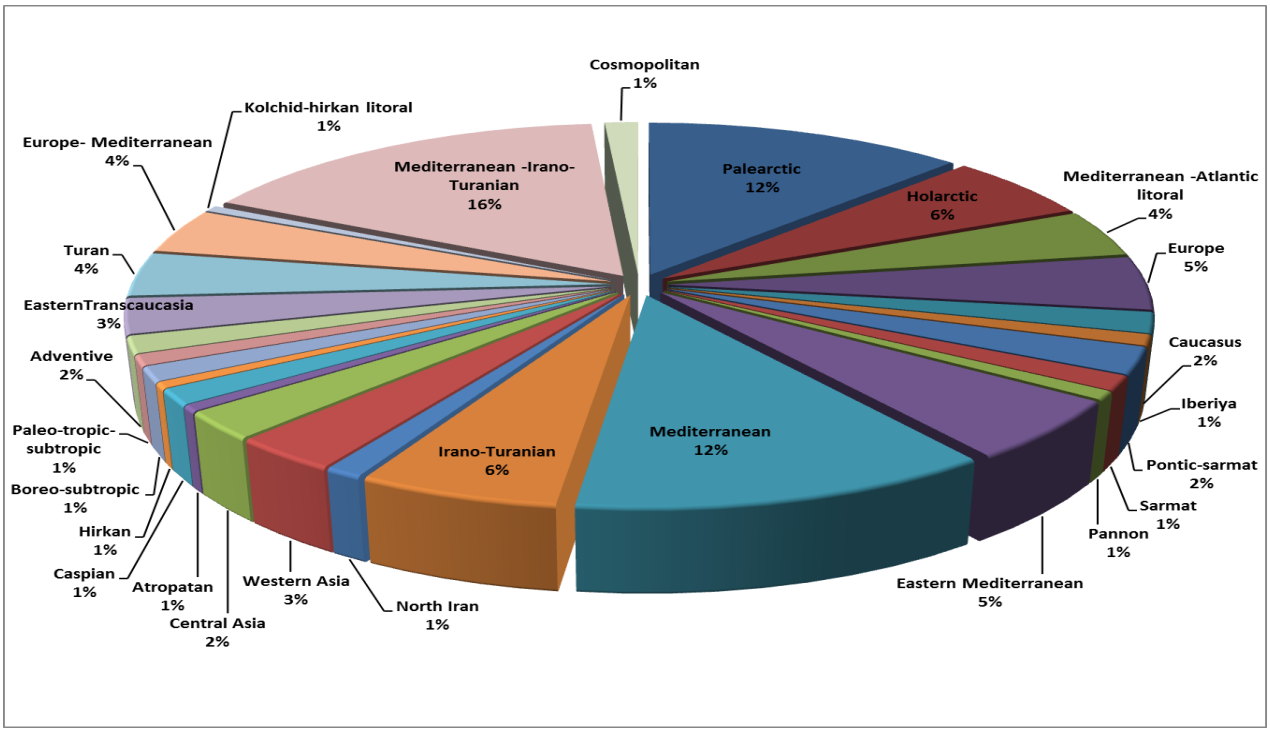


Fig. 5. Floristic category spectrum of Mil Seppe.

Table 2: The number of plant species belonging to the main floristic categories and their percentages (%), the Phytogeographical affinities according to the system of Grossheim (1936).

Chorotype	Number of species	Percentage %
Palearctic	**115**	**12.5**
Holarctic	54	5.8
Mediterranean -Atlantic litoral	39	3.1
Europe	44	3.6
Caucasus	17	1.8
Iberiya	9	1.0
Pontic-sarmat	22	2.4
Sarmat	12	1.3
Pannon	7	0.7
Eastern Mediterranean	50	5.4
Mediterranean	**113**	**12.3**
Irano-Turanian	54	5.8
NorthIran	10	1.1
Western Asia	29	3.1
Central Asia	23	2.5
Atropatan	5	0.5
Caspian	13	0.3
Hirkan	5	0.5
Boreo-subtropic	12	1.3
Paleo-tropic-subtropic	9	1.0
Adventive	14	1.5
EasternTranscaucasia	29	3.1
Turan	36	2.8
Europe- Mediterranean	37	4.0
Kolchid-hirkan litoral	5	0.5
Mediterranean -Irano-Turanian	**151**	**13.1**
Cosmopolitan	12	13
Total:	**926**	**100**

3.4 Endemic and Subendemic Taxa

In term of Endemism, 40 plant taxa belonging to 31 genera and 20 families were recorded. 25 of them are endemics to Caucasus, 11 species are endemics to Azerbaijan and four species are sub endemic. Families which are represented with endemic species are Asteraceae with seven taxa, Fabaceae five, Liliaceae four. Each Chenopodiaceae and Iridaceae was represented by three species, Orchidaceae, Scrophulariaceae, Plantaginaceae with 2 species (table 3)

'as represented by one species. In terms of genus richness *Astragalus*, *Tragopogon* and *Iris* were represented by three species; *Salsola*, *Taraxacum*, and *Bellevaliaeachare* represented by two species, the rest of listed genera were represented by one species. On the other hand, the studying of subendemics of Mil steppe revails the presenceof 4 species belonging to four genera in four families (Liliaceae, Fabaceae, Iridaceae and Hyacinthaceae) as shown in Table 3.

Table 3: Taxonomic content of endemic and subendemic species of Mil steppe.

Family	No. of genera	Percentage %	No. of species	Percentage %
Asteraceae	4	13.0	7	17.5
Fabaceae	3	9.7	5	12.5
Liliaceae	3	9.7	3	7.5
Chenopodiaceae	2	6.5	3	7.5
Scrophulariaceae	2	6.5	2	5.0
Orchidaceae	2	6.5	2	5.0
Plantaginaceae	2	6.5	2	5.0
Iridaceae	1	3.2	3	7.5
Hyacinthaceae	1	3.2	2	5.0
Santalaceae	1	3.2	1	2.5
Ranunculaceae	1	3.2	1	2.5
Papaveraceae	1	3.2	1	2.5
Malvaceae	1	3.2	1	2.5
Lythraceae	1	3.2	1	2.5
Salicaceae	1	3.2	1	2.5
Caryophyllaceae	1	3.2	1	2.5
Rutaceae	1	3.2	1	2.5
Polygalaceae	1	3.2	1	2.5
Apiaceae	1	3.2	1	2.5
Boraginaceae	1	3.2	1	2.5
Total: 20	**31**	**100**	**40**	**100**
subendemics				
Liliaceae	1	25	1	25
Fabaceae	1	25	1	25
Iridaceae	1	25	1	25
Hyacinthaceae	1	25	1	25
Total: 4	**4**	**100**	**4**	**100**

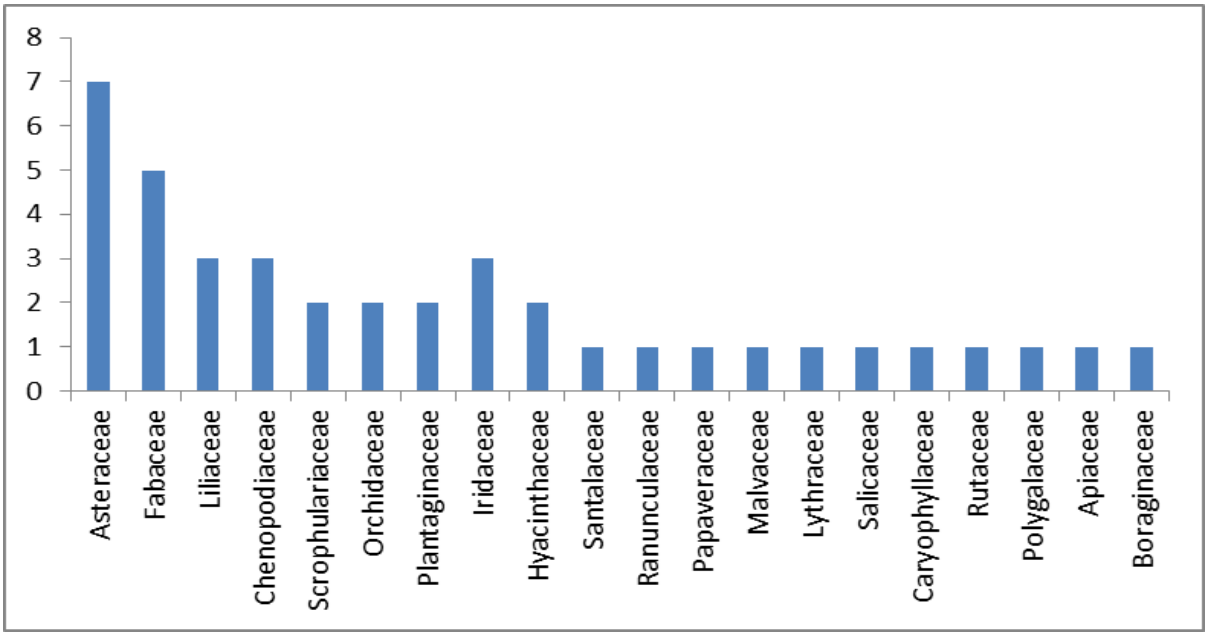


Fig.6. The number of endemic taxa with their related families in the study area.

Intensive agriculture, tourism, and other anthropogenic reasons effects all the components of nature in Azerbaijan. As a result, some plant species have diminished and endangered. All these Phenomenons are observed in the Kura-Araks lowland [45, 46]. Since the Mil is still suitable for agriculture, this natural landscape has been subject to intensive anthropogenic impacts. Irrigation works, meliorative measures, construction of roads, canals and collectors, and other communications have affected the natural landscape directly or indirectly [45,46]. Describing the floristic composition of a habitat is valuable to continuing ecological research, management and conservation of plants and animals [25]. Available resources for the conservation of species and ecosystems are in short supply relative to the needs for those resources. Targeting conservation and management actions toward both species and ecosystems require clearly established priorities such as the study of floristic composition as a principle tool in biodiversity, was considered in the current study [26]. The term of biodiversity refers to the totality of genes, species and ecosystem in a region [27]. Apart from natural disturbances, human induced impacts have caused a significant loss to biodiversity [27-29].

According to the current results, the occurrence of 926 plant species in Mil steppe area indicates considerable plant diversity in the study area. This high diversity of plants could be due to topographic and physiographic condition as well as the fertility and humidity of the site [30].

Life forms have close relationships with environmental factors [31], and can be considered as strategies for obtaining resources [32]. In addition, the life form classification is based essentially on plant reaction to climate; the individual spectrum should tell us much about macro climatic patterns at field sites [33]. Based on life form data of the study area, therophytes is the most abundant one (51%). Although, therophytes occur abundantly in desert areas [34], more or less high occurrence of this life form indicates some anthropogenic and overgrazing effects in the study areas [35-37]. A similar fraction of therophytes has been previously observed in some other lowland forest south of the Caspian Sea [38, 39]. Examination of the geographical distribution of plant species indicated that the total flora of Mil steppe was composed mostly of Mediterranean Irano-Turanian elements (13.1 %) followed by Palearctic elements (12.5%) and Mediterranean (12.3%). The Presence of these chorotypes reflects the phytogeographical link of the studied area with the Mediterranean region [4, 40, 41]. Also, and agreement with previous studies, pluriregional species constitute a remarkable fraction of the studied flora [37, 38, 42, 43, 44].

4 Conclusion

The current study provides an insight into the floristic diversity, life-form, chorological spectrum, and community structure of Mil steppe of Kura-Araks lowland. The results revealed the presence of 926 plant taxa, belonging to 457 genera and 91 families. Five families viz. Poaceae, Asteraceae, Fabaceae, Brassicaceae and Chenopodiaceae were dominant and contribute 42.51% of the total plant species recorded. 40 taxa belonging to 31 genera and 20 families were endemics while four taxa were subendemics. In term of life span, two major groups were recognized; the majority of the listed taxa were annuals and perennials. Five life-forms were observed in the current study. Therophytes were the most frequent with 475 species, followed by hemicryptophytes with 314 species, Cryptophytes with 76 species, Phanerophytes with 26 species and Chamephytes with 38 species. Chorological analysis revealed that the Mediterranean Irano-Turanian was the most dominant chorotype, exhibit 13.1%, followed by Palearctic and Mediterranean phytochoria represented by 12.5% and 12.3% respectively. These results can be contributed to future studies in order to put a complete picture for flora and vegetation of Mil steppe of Kura-Araks lowland.

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