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Flora of Protected and Environmentally Sensitive Afforestation Area in Çankırı, Türkiye

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Abstract: The objective of this study was to examine the flora of Çankırı Karatekin University Faculty of Forestry Prof. Dr. Abdulreşit Brohi Research and Application Forest and to provide insights that could contribute to the conservation of biodiversity in the region. This afforestation area is a 25-year-old protected area that is sensitive to desertification. Despite the maintenance and restoration efforts undertaken in the region, its combination of protected status and high sensitivity to desertification underscores this study's importance. Plant specimens were systematically collected from designated areas, and identification procedures were carried out following established botanical methods. Between April and August 2021, 205 plant specimens were gathered from the area. The identification process recorded 192 taxa representing 153 genera and 47 families. Among these taxa, one belongs to the *Pteridophyta* division, while 191 are classified under the *Spermatophyta* division. Notably, no natural Gymnosperm specimens were found in the area. Among the identified taxa, 170 are *Dicotyledoneae*, and 22 are *Monocotyledoneae* species. The families with the highest representation are as follows: *Asteraceae*, with 31 species; *Brassicaceae*, with 19 species; *Fabaceae*, comprising 17 species; *Lamiaceae*, consisting of 16 species; and *Poaceae*, which includes 15 species. The most abundant genera, represented by three species, are *Centaurea, Crepis, Tragopogon, Silene, Convolvulus, Astragalus, Onobrychis, Salvia, Teucrium* and *Veronica*. The study identified ten endemic taxa, resulting in an endemism ratio of 5.21%. These endemic taxa play a crucial role in conserving biodiversity in the region. In terms of phytogeographic regions, the taxa can be categorized as follows: Irano-Turanian (46 taxa, 23.96%), Euro-Siberian (9 taxa, 4.69%), Mediterranean (4 taxa,

2.08%), Eastern Mediterranean (3 taxa, 1.56%), with the remaining 130 taxa (67.71%) classified as unknown or multiregional. The research findings provide essential insights into regional conservation and sustainable management.

Keywords: afforestation, desertification, flora, protected area, semiarid

Introduction

Preserving semi-arid and desertification-sensitive areas is essential for ensuring the sustainability of ecosystems. Turkey is endowed with a remarkable biodiversity, which can be attributed to the country's diverse climate and varied geological structures. This situation is critically essential for Turkey's ecosystem functions and contribution to global biodiversity. A total of 11,707 taxa from the classes of ferns and seed plants with conduction bundles have been identified in Turkey, with one-third of these (3,649) being endemic (Güner et al., 2012). Turkey is recognized as one of the richest regions in the world concerning endemic plant diversity, with 34.4% of its total endemic species (Ekim, 2009; Tekeli et al., 2006; Demir, 2013). It is crucial to identify the habitats of primarily narrowly distributed endemic species to protect them and highlight their significance to our country (Tuttu, 2024).

Turkey's geographical location and climate characteristics place it within a semi-arid climate zone, exacerbating the inadequacy of water resources and the frequency of drought events across a considerable portion of the country. A considerable proportion of the total area of 51 million hectares is classified as arid and semi-arid regions, which suggests that the risk of drought will increase in the future (Edis et al., 2022; Serkendiz & Tatlı, 2023; Erişmiş, 2023; Edis, 2024). In arid and semi-arid regions, a reduction in soil properties and water retention capacity harms agricultural production. This, in turn, exacerbates the degradation of natural vegetation and the phenomenon of desertification, which are further compounded by climate change (Akbaş Tetik et al., 2023).

The semi-arid regions in Turkey are mainly prone to erosion, highlighting the essential need for afforestation efforts (Edis et al. 2023). In afforestation projects conducted in semi-arid regions, choosing species that can withstand harsh climatic conditions and enhance soil properties is crucial (Edis et al., 2021). Afforestation is a crucial tool in the fight against desertification (Kar, 2018), enhancing carbon sequestration (Lal, 2004), and promoting

sustainable development. However, it is essential to highlight that afforestation initiatives can significantly change ecosystem functions. These changes may include shading, microclimate, nutrient cycling, and water balance alterations, which can ultimately affect biodiversity (Elmarsdottir et al., 2008).

The sustainability of ecosystems is contingent upon the continued viability of semi-arid and desertification-sensitive areas. In such areas, the ability of plants to withstand challenges such as climate change, wind erosion, and drought is critical for the sustainability of ecosystems. In arid areas such as Central Anatolia, it has been observed that vegetation cover has been significantly degraded over many years due to human and animal pressure (Fırıncıoğlu et al., 2007). It is, therefore, essential to identify suitable plant species to restore these ecosystems. It has been demonstrated that plant species in semi-arid regions demonstrate resilience to desertification processes and provide significant contributions to ecosystem services (Noy-Meir, 1973; Maestre et al., 2012). These species are notable for their capacity to utilize water efficiently and prevent soil erosion, which are critical factors in the success of afforestation efforts (López-Bermúdez et al., 1998). Plant species selection and adaptation are essential in semi-arid and desertification-sensitive afforestation areas.

The floristic composition of afforestation areas significantly influences biodiversity, determining the diversity and abundance of plant species. Urban and rural afforestation projects play a significant role in maintaining ecological balance. The objective of this study is to examine the plant species found in semi-arid and desertification-sensitive afforestation areas and to elucidate their impact on the ecosystem. Furthermore, evaluating these species' adaptation processes and their contribution to biodiversity will provide crucial data for developing effective ecosystem management and conservation policies in the region.

Material and Methods

Study area

The research and application forest at Çankırı Karatekin University (ÇAKÜ) Faculty of Forestry is 9.4 ha in size (Fig. 1). Since 1998, approximately 2,000 saplings of various species, including *Pinus nigra* J.F.Arnold subsp. *pallasiana* (Lamb.) Holmboe, *Cedrus libani* L., *Amygdalus communis* L., *Juniperus sabina* L., and *Robinia pseudoacacia* L., have been planted in the study

area. The climate of the study area can be described as follows. According to the meteorological data of Çankırı province (Anonymous, 2022), the average temperature is 11.1 ºC, the average annual precipitation is 393.9 mm, the highest precipitation is in May with 53.6 mm, and the lowest precipitation is in September with 16.4 mm. By the classification proposed by Thornthwaite (1949), the area is characterized by a semi-arid climate.

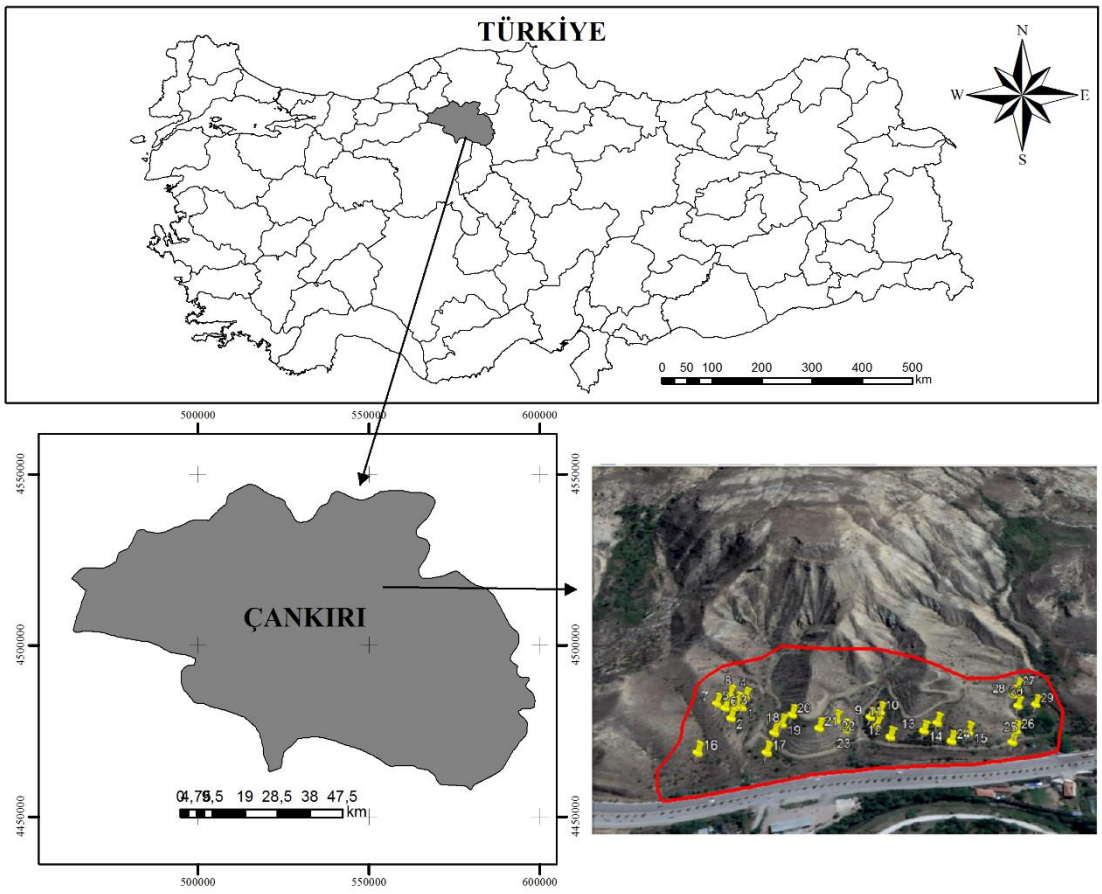

Figure 1. Location of the study area (Gül et al., 2019)

Desertification tendency of the study area

The desertification risk and environmental sensitivity of the study area were previously determined by Gül et al. (2019). This section provides general information on the area's desertification tendency (for detailed information, see Gül et al., 2019). Gül et al. (2019) used the Desertification Indicator System for Mediterranean Europe (DIS4ME) system to assess the desertification tendency of the afforested area. As a result of the calculations, it was found that the risk of desertification in the study area was evaluated in the low-risk class with the lowest

1.69 and in the medium-risk class with the highest 5.25. The desertification risk was lower in areas where the vegetation cover and soil properties improved due to afforestation activities. These results show that afforestation activities in the area effectively prevent desertification. Similarly, the Environmentally Sensitive Area (ESA) sensitivity index showed that the area's sensitivity varied between 1.35 and 1.52. These values indicate that the area falls into critical and fragile sensitivity classes. Fragile areas become more vulnerable to desertification, especially if not protected.

Collection and identification of plant samples

The material under investigation comprises plant samples gathered systematically between April and August 2021. During the collection of plant specimens, particular attention was paid to flowers, fruits, seeds, and other relevant plant parts. At least two specimens of each individual were collected, prioritizing undamaged ones and distributing them evenly throughout the area. The specimens were carefully placed in plastic bags and transported to the laboratory, where they were subjected to drying processes using the methodologies established by Yaltırık and Efe (1996). The identified specimens are stored in the Department of Forest Botany laboratory at Çankırı Karatekin University.

The series "Flora of Turkey and the East Aegean Islands," which includes volumes 1-9 (Davis, 1965-1985) and a supplement (Davis et al., 1988), served as the primary source for plant identification. "Flora Europaea" (Tutin, 1964-1993) was also referenced. The key resources for plant identification were Volume 11 (Güner et al., 2000) and "Flora Europaea" (Tutin, 1964-1993). The identification process utilized a Leica S6T stereo research microscope. The English-Turkish Botany Guide (Baytop, 1998) and Plant Identification Terminology (Harris and Harris, 2001) were consulted to understand the meanings of morphological terms.

The endangered status of endemic species was determined using the "Red Book of Plants of Turkey" (Ekim et al., 2000), while current names and authors were sourced from the WFO Plant List and IPNI databases (https://wfoplantlist.org/; http://www.ipni.org). The "List of Plants of Turkey (Vascular Plants)" (Güner et al., 2012) was also referenced. Furthermore, the Virtual Herbariums of the Van Lake Basin (http://www.vanherbaryum.yyu.edu.tr) and the Berlin

Museum of Natural History (http://ww2.bgbm.org/herbarium) were used for identifying seed plants.

Results

The 205 plant specimens were collected from the area in 2021 between April and August (Table 1). As a result of the identification of plant specimens, 192 taxa belonging to 153 genera and 47 families have been determined. One belongs to the Pteridophyta, and 191 taxa to the Spermatophyta division. All plant specimens are in the Angiosperme section in the area. The 170 taxa are Dicotyledoneae, and 22 taxa are Monocotyledoneae. Regarding distribution according to phytogeographic regions, Irano-Turanian 46 (23.96%) and Euro-Siberian 9 (4.69%) and Mediterranean-E.Mediterranean 7 (3.64%) phytogeographic region. The remaining 130 (67.71%) taxa are distributed unknown or multiregional (Table 2).

Table 2. Distribution of plant species in the study area by phytogeographic region

Phytogeographic Region	**Number of Taxa**	**Proportional Distribution (%)**
Irano-Turanian element	46	23.96
Euro-Siberian element	9	4.69
Mediterranean element	7	3.64
Unknown or multiregional	130	67.71
Total	**192**	**100**

According to the Flora of Turkey and the Eastern Aegean Islands findings, the five most prevalent families in terms of species diversity are Asteraceae, Fabaceae, Lamiaceae, Brassicaceae, and Poaceae. In our study, the initial five families are identical. As Erik and Tarıkahya (2004) state, Asteraceae, the most prominent family in Turkey, is represented by 1186 species, accounting for 13.1% of the country's flora. As illustrated in Table 3, the Asteraceae family is the most prevalent in the study area, comprising 31 taxa and accounting for 16.1% of the flora. Asteraceae is a cosmopolitan family exhibiting high ecological tolerance and the capacity for seed dispersal.

Table 3 The largest families

Family	Number of Taxa	Percentage of Total Number of Species
Asteraceae	31	16.1
Brassicaceae	19	9.9
Fabaceae	17	8.9
Lamiaceae	16	8.3
Poaceae	15	7.8
Other	94	49

Table 4 displays the taxon with the highest number of taxa in the research area. The largest genera include *Centaurea, Crepis, Tragopogon, Silene, Convolvulus, Astragalus, Onobrychis, Salvia, Teucrium,* and *Veronica*, with three examples from each. The largest genus of flora in Turkey, *Astragalus*, is distributed across the Irano-Turanian phytogeographic region and in habitats characterized by steppe. Despite its location in a transitional climate zone, the area is generally under the influence of the Iranian-Turanian Flora Region, which lends support to the conclusion that the genus *Astragalus* is the most prevalent (Erik and Tarıkahya, 2004).

Table 4: The taxon that includes the highest number of taxa in the research area

Genus	Taxa	Percent %
Astragalus	3	1.56
Centaurea	3	1.56
Convolvulus	3	1.56
Crepis	3	1.56
Onobrychis	3	1.56
Salvia	3	1.56
Silene	3	1.56
Teucrium	3	1.56
Tragopogon	3	1.56
Veronica	3	1.56

Ten endemic plant species have been identified in the study area (Table 5), resulting in an endemism rate of 5.21%. These plants belong to the Iran-Turan phytogeographic region 5.21%.

Table 5: Endemic taxa in the study area and their associated threat categories (LR(lc): Lover risk, Least Concern)

	Family	Taxa	Threat Categories
1	Asteraceae	*Cirsium pseudocreticum* (P.H.Davis & Parris) Yıldız, Dirmenci & Arabacı	LR(lc)
2	Asteraceae	*Jurinea pontica* Hausskn. & Freyn ex Hausskn.	LR(lc)
3	Asteraceae	*Tragopogon aureus* Boiss.	LR(lc)
4	Boraginaceae	*Mattiastrum leptophyllum* Brand	LR(lc)
5	Boraginaceae	*Onosma isaurica* Boiss. & Heldr.	LR(lc)
6	Brassicaceae	*Odontarrhena pateri* (Nyár.) Španiel, Al-Shehbaz, D.A.German & Marhold	LR(lc)
7	Caryophyllaceae	*Gypsophila eriocalyx* Boiss.	LR(lc)
8	Fabaceae	*Onobrychis ornata* Desv.	LR(lc)
9	Lamiaceae	*Salvia absconditiflora* Greuter & Burdet	LR(lc)
10	Rubiaceae	*Cynanchica bornmuelleri* (Velen. ex Bornm.) P.Caputo & Del Guacchio	LR(lc)

Discussion and Coclusion

This study presents the findings of a comprehensive survey conducted to evaluate the plant species composition in a protected afforestation site located in a semi-arid region facing potential desertification. The results emphasize the distribution of different plant species within the ecosystem. A total of 192 plant taxa were identified, including 10 local endemic species. The flora study revealed that the most dominant species in the study area belong to the Asteraceae, Brassicaceae, Fabaceae, Lamiaceae, and Poaceae families. These species are closely related to the local climatic conditions and soil characteristics.

To ascertain the floristic composition, it is essential to compare studies conducted in neighboring areas to identify similarities and differences in the plant species present. The families with the highest number of identified taxa in the studies conducted in the study area and nearby areas were compared and are presented in Table 6. Upon analysis of this table, it becomes evident that the Asteraceae family has the highest number of taxa. When the other families ranked in all study areas are examined, it is observed that there are some differences. This can be attributed to various factors, including the size of the areas, spatial differences, variability in climate and soil characteristics, vegetation types, and differences in vegetation layers.

Table 6. Comparison of Families with the Highest Number of Taxa

Family	Neighboring Studies								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)	Taxa (%)
Asteraceae	31 (16.1)	45 (14.8)	52 (14.6)	75 (11.9)	51 (14.1)	66 (15.8)	35 (15.0)	33 (14.0)	35 (14.0)
Brassicaceae	19 (9.9)	11 (3.62)	21 (5.88)	44 (6.98)	35 (9.6)	21 (5.03)	16 (6.87)	13 (5.5)	8 (3.2)
Fabaceae	17 (8.9)	29 (9.54)	33 (9.24)	48 (7.61)	39 (10.8)	44 (11.5)	32 (13.7)	28 (11.9)	26 (10.4)
Lamiaceae	16 (8.3)	24 (7.9)	34 (9.52)	43 (6.82)	29 (8.0)	41 (9.83)	25 (10.7)	31 (13.2)	24 (9.6)
Poaceae	15 (7.8)	9 (2.96)	12 (3.36)	56 (8.88)	30 (8.3)	18 (4.31)	9 (3.87)	11 (4.7)	15 (6.0)
Other	94 (49)	186(61.1)	205(57.4)	364(57.7)	181(49.6)	227(54.4)	116(49.8)	119 (50.6)	144 (57.1)
Total	192 (100)	304 (100)	357 (100)	630 (100)	365 (100)	417 (100)	233 (100)	235 (100)	252 (100)

1 ÇAKÜ Abdülreşit Brohi Ağaçlandırma Sahası (Tuttu and Gül, 2024), **2** Research and Application Forest (Eldivan) (Tuttu and Ursavaş, 2022), **3** Çankırı-Korubaşı Hill and its surroundings (Tuttu and Akkemik, 2017), **4** Ilgaz Mountain National Park (Pehlivan, 2007), **5** Karlıktepe (Çankırı) (Sağıroğlu and Duman, 2004), **6** Çankırı Yapraklı Forests (Mutlu, 2006), **7** Büyükyayla (Yapraklı) (Dölarslan and Gül, 2015), **8** Küçükyayla (Yapraklı) (Dölarslan and Gül, 2021), **9** Kabalı Dağı (Çerkeş) Florası (Erdoğan, Ketenoğlu and Bingöl, 2008)

The distribution of the taxa, according to phytogeographic regions; Irano-Turanian 46 (23.96%), Euro-Siberian 9 (4.69%), Mediterranean 4 (2.08%), E.Mediterranean 3 (1.56%) and unknown or multiregional taxa are 130 (67.71%), (Tablo7). As illustrated in Table 7, the greatest concentration of Irano-Turanian elements is observed within the study area. Except for the flora of Ilgaz Mountain National Park, the proportion of Irano-Turanian elements was notably elevated across all studies. Ilgaz Mountain National Park is situated at a higher elevation in the northern region than other areas, so there is a greater prevalence of Euro-Siberian elements.

Table 7: Distribution of other studies conducted in and around the research area, classified according to phytogeographical regions.

	Neighboring Studies								
Phytogeographic Regions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Irano-Turanian element (%)	23,96	16,77	27,20	12,00	27,70	20,60	24,03	20,00	14,80
Euro-Siberian element (%)	4,69	14,14	8,10	33,00	4,10	15,50	12,87	11,50	10,40
Mediterranean element (%)	3,64	2,96	5,30	6,00	3,60	3,80	3,87	5,10	4,00
Unknown or multiregional (%)	67,71	60,53	59,40	49,00	64,60	60,10	59,23	63,40	70,80
Taxa	192	304	357	630	365	417	233	235	252

1 ÇAKÜ Abdülreşit Brohi Ağaçlandırma Sahası (Tuttu and Gül, 2024), **2** Research and Application Forest (Eldivan) (Tuttu and Ursavaş, 2022), **3** Çankırı-Korubaşı Hill and its surroundings (Tuttu and Akkemik, 2017), **4** Ilgaz Mountain National Park (Pehlivan, 2007), **5** Karlıktepe (Çankırı) (Sağıroğlu and Duman, 2004), **6** Çankırı Yapraklı Forests (Mutlu, 2006), **7** Büyükyayla (Yapraklı) (Dölarslan and Gül, 2015), **8** Küçükyayla (Yapraklı) (Dölarslan and Gül, 2021), **9** Kabalı Dağı (Çerkeş) Florası (Erdoğan, Ketenoğlu and Bingöl, 2008)

In conclusion, this study provides a valuable resource for understanding semi-arid protected and environmentally sensitive afforestation areas' floristic composition and ecosystem dynamics. Flora studies are essential for understanding ecosystem functioning, conserving biodiversity, and ensuring environmental sustainability. These studies provide the necessary information to address environmental problems at both local and global scales and form a critical basis for maintaining ecosystem health.

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Table 1. Plant species distributed in the study area (LR(lc): Lover risk, Least Concern)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Amaryllidaceae	*Chenopodium album* L. subsp. *album* var. *album*	Unknown - multiregional	-
	Allium atroviolaceum Boiss.	Unknown - multiregional	-
	Allium pseudoflavum Vved.	Irano-Turanian	-
Apiaceae	*Bupleurum rotundifolium* L.	Unknown - multiregional	-
	Caucalis platycarpos L.	Unknown - multiregional	-
	Daucus carota L.	Unknown - multiregional	-
	Eryngium campestre L. var. *virens* Link.	Unknown - multiregional	-
	Malabaila secacul (Mill.) Boiss.	Unknown - multiregional	-
	Zosima absinthifolia Link	Unknown - multiregional	-
Apocynaceae	*Cynanchum acutum* L. subsp. *acutum*	Unknown - multiregional	-
Asparagaceae	*Muscari armeniacum* H.J.Veitch	Unknown - multiregional	-
	Ornithogalum oligophyllum E.D.Clarke	Unknown - multiregional	-
Asteraceae	*Achillea arabica* Kotschy.	Irano-Turanian	-
	Carduus pycnocephalus L. subsp. *albidus* (M.Bieb.)	Unknown - multiregional	-
	Carthamus lanatus L.	Unknown - multiregional	-
	Centaurea solstitialis L. subsp. *solstitialis*	Unknown - multiregional	-
	Centaurea urvillei DC. subsp. *armata* Wagenitz	East Mediterranean	-
	Centaurea virgata Lam.	Irano-Turanian	-
	Chondrilla juncea L.	Unknown - multiregional	-
	Cichorium intybus L.	Unknown - multiregional	-
	Cirsium arvense (L.) Scop. subsp. *vestitum* (Wimmer & Grab.) Petrak	Unknown - multiregional	-
	Cirsium pseudocreticum (P.H.Davis & Parris) Yıldız, Dirmenci & Arabacı	Irano-Turanian	Endemic LR (lc)
	Crepis foetida L. subsp. *rhoeadifolia* (M. Bieb.) Čelak.	Unknown - multiregional	-
	Crepis micrantha Czerep.	Unknown - multiregional	-
	Crepis pulchra L. subsp. *pulchra*	Unknown - multiregional	-
	Crupina crupinastrum (Moris) Vis.	Unknown - multiregional	-
	Echinops viscosus DC. subsp. *bithynicus* (Boiss.) Rech.f.	Unknown - multiregional	-
	Jurinea pontica Hausskn. & Freyn ex Hausskn.	Irano-Turanian	Endemic LR (lc)
	Lactuca serriola L.	Euro-Siberian	-
	Leontodon asperrimus (Willd.) Endl.	Irano-Turanian	-
	Leontodon biscutellifolius DC.		-

Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Asteraceae	*Onopordum tauricum* Willd.	Euro-Siberian	-
	Picris strigosa M.Bieb. subsp. *strigosa*	Irano-Turanian	-
	Pulicaria dysenterica (L.) Bernh.	Unknown - multiregional	-
	Rhaponticum repens (L.) Hidalgo	Irano-Turanian	-
	Senecio leucanthemifolius subsp. *vernalis* (Waldst. & Kit.) Greuter	Unknown - multiregional	-
	Sonchus asper (L.) Hill subsp. *glaucescens* (Jord.) Ball	Unknown - multiregional	-
	Taraxacum macrolepium Schischk.	Unknown - multiregional	-
	Tragopogon abbreviatus (Boiss.) Coşkunç. & Gültepe	Unknown - multiregional	-
	Tragopogon aureus Boiss.	Unknown - multiregional	Endemic LR (lc)
	Tragopogon latifolius Boiss. var. *angustifolius* Boiss.	Irano-Turanian	-
	Xanthium spinosum L.	Unknown - multiregional	-
	Xeranthemum annuum L.	Unknown - multiregional	-
Berberidaceae	*Berberis crataegina* DC.	Irano-Turanian	-
Boraginaceae	*Alkanna orientalis* Boiss. var. *orientalis*	Irano-Turanian	-
	Anchusa pusilla Guşul.	Unknown - multiregional	-
	Asperugo procumbens L.	Euro-Siberian	-
	Buglossoides arvensis (L.) I.M.Johnst.	Unknown - multiregional	-
	Cynoglossum montanum L.	Euro-Siberian	-
	Heliotropium dolosum De Not.	Unknown - multiregional	-
	Mattiastrum leptophyllum Brand	Irano-Turanian	Endemic LR (lc)
	Moltkia coerulea Lehm.	Irano-Turanian	-
	Myosotis lithospermifolia Hornem.	Unknown - multiregional	-
	Nonea caspica G.Don	Irano-Turanian	-
	Onosma isaurica Boiss. & Heldr.	Irano-Turanian	Endemic LR (lc)
Brassicaceae	*Aethionema arabicum* (L.) Andrz. ex DC.	Unknown – multiregional	-
	Alyssum desertorum Stapf	Unknown – multiregional	-
	Alyssum hirsutum M.Bieb.	Unknown – multiregional	-
	Boreava orientalis Jaub. & Spach	Unknown – multiregional	-
	Brassica elongata Ehrh.	Unknown – multiregional	-
	Capsella bursa-pastoris Medik	Unknown – multiregional	-
	Chorispora tenella DC.	Unknown – multiregional	-
	Crambe tataria Sebeók	Unknown - multiregional	-

Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Brassicaceae	*Descurainia sophia* (L.) Webb ex Prantl	Unknown - multiregional	-
	Isatis glauca Aucher ex Boiss. subsp. *exauriculata* (Bornm.) P.H.Davis	Irano-Turanian	-
	Lepidium draba L.	Unknown – multiregional	-
	Malcolmia africana (L.) W.T.Aiton	Unknown – multiregional	-
	Matthiola longipetala DC. subsp. *bicornis* Ball	Unknown – multiregional	-
	Noccaea perfoliata (L.) Al-Shehbaz	Unknown – multiregional	-
	Odontarrhena pateri (Nyár.) Španiel, Al-Shehbaz, D.A.German & Marhold	Irano-Turanian	Endemic LR (lc)
	Sinapis arvensis L.	Unknown – multiregional	-
	Sisymbrium altissimum L.	Unknown – multiregional	-
	Sisymbrium loeselii L.	Unknown – multiregional	-
	Turritis laxa Hayek	Unknown – multiregional	-
Caprifoliaceae	*Lomelosia argentea* (L.) Greuter & Burdet	Unknown – multiregional	-
	Lomelosia rotata (M.Bieb.) Greuter & Burdet	Irano-Turanian	-
Caryophyllaceae	*Cerastium perfoliatum* L.	Unknown – multiregional	-
	Dianthus nudiflorus Griff.	Unknown – multiregional	-
	Gypsophila eriocalyx Boiss.	Irano-Turanian	Endemic LR (lc)
	Minuartia anatolica Woronow var. *polymorpha* McNeill	Unknown – multiregional	-
	Minuartia hybrida (Vill.) Schischk. subsp. *hybrida*	Unknown – multiregional	-
	Silene cappadocica Boiss.& Heldr.	Irano-Turanian	-
	Silene pruinosa Boiss.	Unknown – multiregional	-
	Silene vulgaris (Moench) Garcke var. *vulgaris*	Unknown – multiregional	-
Cistaceae	*Helianthemum salicifolium* (L.) Mill.	Unknown – multiregional	-
Convolvulaceae	*Convolvulus arvensis* L.	Unknown – multiregional	-
	Convolvulus holosericeus M.Bieb. subsp. *holosericeus*	Unknown - multiregional	-
	Convolvulus lineatus L.	Unknown – multiregional	-
Cyperaceae	*Scirpoides holoschoenus* (L.) Soják	Unknown – multiregional	-
Elaeagnaceae	*Elaeagnus angustifolia* L.	Unknown – multiregional	-
Equisetaceae	*Equisetum palustre* L.	Unknown – multiregional	-
Euphorbiaceae	*Euphorbia macroclada* Boiss.	Irano-Turanian	-
	Euphorbia myrsinites L.	Unknown - multiregional	-
Fabaceae	*Alhagi pseudalhagi* (M.Bieb.) Desv. ex Shap.	Irano-Turanian	-
	Astragalus aduncus Willd.	Irano-Turanian	-

Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Fabaceae	*Astragalus microcephalus* Willd.	Irano-Turanian	-
	Astragalus spruneri Boiss.	Unknown – multiregional	-
	Colutea cilicica Boiss. & Balansa	Unknown – multiregional	-
	Genista sessilifolia DC.	Irano-Turanian	-
	Glycyrrhiza glabra L.	Unknown – multiregional	-
	Hedysarum varium Willd.	Irano-Turanian	-
	Lotus tenuis Waldst. & Kit. ex Willd.	Unknown – multiregional	-
	Medicago minima (L.) L.	Unknown – multiregional	-
	Medicago sativa L. subsp. *sativa*	Unknown – multiregional	-
	Melilotus officinalis (L.) Pall.	Unknown – multiregional	-
	Melilotus tauricus (M.Bieb.) Ser.	Unknown – multiregional	-
	Onobrychis hypargyrea Boiss.	Unknown - multiregional	-
	Onobrychis ornata Desv.	Irano-Turanian	Endemic LR (lc)
	Onobrychis oxyodonta Boiss.	Unknown – multiregional	-
	Vicia sativa subsp. *nigra* Ehrh.	Unknown – multiregional	-
Fagaceae	*Quercus robur* L. subsp. *robur*	Euro-Siberian	-
Gentianaceae	*Centaurium erythraea* Rafn subsp. *turcicum* (Velen.) Melderis	Unknown – multiregional	-
	Erodium cicutarium (L.) L'Hér. subsp. *cicutarium*	Unknown – multiregional	-
Hypericaceae	*Hypericum origanifolium* Willd.	Unknown – multiregional	-
Juncaceae	*Juncus inflexus* L.	Unknown - multiregional	-
Lamiaceae	*Ballota nigra* L. subsp. *anatolica* P.H. Davis	Irano-Turanian	-
	Lamium orientale (Fisch. & C.A.Mey.) E.H.L.Krause	Irano-Turanian	-
	Lamium purpureum L.	Euro-Siberian	-
	Marrubium parviflorum Fisch. & C.A. Mey. subsp. *oligodon* (Boiss.) Seybold	Unknown – multiregional	-
	Salvia absconditiflora Greuter & Burdet	Irano-Turanian	Endemic LR (lc)
	Salvia aethiopis L.	Unknown – multiregional	-
	Salvia sclarea L.	Unknown – multiregional	-
	Scutellaria orientalis L. subsp. *pinnatifida* J.R.Edm.	Unknown - multiregional	-
	Sideritis montana L. subsp. *remota* (d'Urv.) P.W.Ball	East Mediterranean	-
	Stachys annua (L.) L. subsp. *annua* (L.) L.	Unknown – multiregional	-
	Teucrium chamaedrys L. subsp. *syspirense* (K.Koch) Rech.f.	Irano-Turanian	-

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Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Lamiaceae	*Teucrium polium* L.	Unknown - multiregional	-
	Teucrium scordium L. subsp. *scordioides* (Schreb.) Arcang.	Euro-Siberian	-
	Thymus longicaulis C.Presl subsp. *chaubardii* (Rchb.f.) Jalas	Mediterranean	-
	Ziziphora taurica M.Bieb.	Irano-Turanian	-
	Ziziphora tenuior L.	Irano-Turanian	-
Linaceae	*Linum tenuifolium* L.	Unknown - multiregional	-
Malvaceae	*Alcea apterocarpa* Boiss.	Irano-Turanian	-
Nitrariaceae	*Peganum harmala* L.	Unknown - multiregional	-
Oleaceae	*Chrysojasminum fruticans* (L.) Banfi	Mediterranean	-
Papaveraceae	*Fumaria officinalis* L.	Unknown - multiregional	-
	Glaucium grandiflorum subsp. *refractum* (Nábělek) Mory	Irano-Turanian	-
	Hypecoum procumbens L.	Mediterranean	-
	Papaver laevigatum M.Bieb.	Unknown - multiregional	-
	Papaver rhoeas L.	Unknown - multiregional	-
Phyllanthaceae	*Andrachne telephioides* L.	Unknown - multiregional	-
Plantaginaceae	*Globularia orientalis* L. var. *orientalis*	Irano-Turanian	-
	Plantago lanceolata L.	Unknown - multiregional	-
	Plantago maritima L.	Unknown - multiregional	-
	Veronica hederifolia L.	Unknown - multiregional	-
	Veronica multifida L.	Irano-Turanian	-
	Veronica persica Poir.	Unknown – multiregional	-
Poaceae	*Aegilops speltoides* Tausch	Unknown – multiregional	-
	Aegilops triuncialis L. subsp. *triuncialis*	Unknown – multiregional	-
	Avena fatua L.	Unknown – multiregional	-
	Bothriochloa ischaemum (L.) Keng	Unknown – multiregional	-
	Cenchrus orientalis (Rich.) Morrone	Irano-Turanian	-
	Chrysopogon gryllus (L.) Trin.	Unknown – multiregional	-
	Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	Unknown - multiregional	-
	Melica ciliata L. subsp. *ciliata*	Unknown - multiregional	-
	Milium vernale M.Bieb.	Mediterranean	-

Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Poaceae	*Phleum subulatum* (Savi) Asch. & Graebn.	Unknown - multiregional	-
	Phragmites australis (Cav.) Trin. ex Steud.	Euro-Siberian	-
	Poa bulbosa L.	Unknown - multiregional	-
	Polypogon monspeliensis (L.) Desf.	Unknown - multiregional	-
	Stipa arabica Trin. & Rupr.	Irano-Turanian	-
	Triticum aestivum L.	Unknown - multiregional	-
Polygalaceae	*Polygala pruinosa* Boiss. subsp. *pruinosa*	Unknown - multiregional	-
	Polygonum bellardii All.	Unknown - multiregional	-
	Rumex dentatus L. subsp. *halacsyi* (Rech.) Rech.f.	Unknown - multiregional	-
Primulaceae	*Androsace maxima* L.	Unknown - multiregional	-
Ranunculaceae	*Clematis orientalis* L.	Unknown - multiregional	-
	Clematis vitalba L.	Unknown - multiregional	-
	Delphinium ajacis L.	Unknown - multiregional	-
Resedaceae	*Reseda lutea* L. var. *lutea*	Unknown - multiregional	-
Rhamnaceae	*Paliurus spina-christi* Mill.	Unknown - multiregional	-
Rosaceae	*Reseda lutea* L. var. *lutea*	Unknown - multiregional	-
	Paliurus spina-christi Mill.	Unknown - multiregional	-
	Potentilla recta L.	Unknown - multiregional	-
	Prunus argentea (Lam.) Rehder	Irano-Turanian	-
	Prunus mahaleb L.	Unknown - multiregional	-
	Rosa canina L.	Unknown - multiregional	-
	Rubus creticus Tourn. ex L.	Unknown - multiregional	-
	Sanguisorba minor Scop. subsp. *balearica* (Bourg. ex Nyman) Muñoz Garm. & C.Navarro	Unknown - multiregional	-
Rubiaceae	*Cruciata taurica* (Pall. ex Willd.) Ehrend.	Irano-Turanian	-
	Cynanchica bornmuelleri (Velen. ex Bornm.) P.Caputo & Del Guacchio	Irano-Turanian	Endemic LR (lc)
	Cynanchica tenella (Heuff. ex Degen) P.Caputo & Del Guacchio	Unknown - multiregional	-
	Galium incanum Sm. subsp. *elatius* (Boiss.) Ehrend.	Irano-Turanian	-
	Galium spurium L.	Euro-Siberian	-
	Rubia tinctorum L.	Irano-Turanian	-
Salicaceae	*Populus nigra* L. subsp. *nigra*	Unknown - multiregional	-
Santalaceae	*Thesium billardieri* Boiss.	Irano-Turanian	-

Table 1. (Continue)

Family	Taxon	Phytogeographic Region	Endemism and endangered status
Scrophulariaceae	*Scrophularia canina* L. subsp. *bicolor* (Sm.) Greuter	East Mediterranean	-
	Verbascum cheiranthifolium Boiss. var. *cheiranthifolium*	Unknown - multiregional	-
Tamaricaceae	*Tamarix smyrnensis* Bunge	Unknown - multiregional	-
Typhaceae	*Typha domingensis* Pers.	Unknown - multiregional	-
Violaceae	*Viola occulta* Lehm.	Unknown - multiregional	-
Zygophyllaceae	*Tribulus terrestris* L.	Unknown - multiregional	-
	Zygophyllum fabago L.	Irano-Turanian	-

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