



## Vascular flora of Zarrin-Kuh Protected Area in Central Kopet Dagh Mountains, NE Iran: An annotated checklist

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### Abstract

Zarrin-Kuh Protected Area (ZPA) is a part of the Khorassan-Kopet Dagh floristic province of the Irano-Turanian region. In this research, we present the first checklist of vascular plants of ZPA along with the life-form spectrum, phytogeography, and conservation status. We conducted field surveys through several random collection efforts and vegetation sampling during 2015–2017. A total of 549 species/infraspecific taxa belonging to 69 families and 318 genera are recorded as native and naturalized plants. The most prominent families are Asteraceae (43 genera/72 species), Poaceae (29/44), Brassicaceae (31/43), Fabaceae (15/43), and Chenopodiaceae (24/41). The richest genera are *Astragalus* (21 taxa), *Euphorbia* (10), *Acanthophyllum* (8), and *Allium* (8). The therophytes (47.2 %) and hemicryptophytes (25.2%) are dominant in the life-form spectrum. Irano-Turanian elements (347 taxa, 63.2%) are the most common plants; however, the area is inhabited by several Iranian and/or Khorassan-Kopet Dagh endemic, rare and narrow-range plants, among which 17 species are threatened. *Astragalus androssovianus* Gontsch. is also recorded as new to the flora of Iran. Over-grazing and exploiting valuable plants are the most critical threats to the area. The results support more effective protection practices to ensure the conservation of the unique flora of Central Kopet Dagh.

**Keywords:** biodiversity; chorology; conservation; endemism; floristics; Irano-Turanian; new record

### Introduction

The Iranian flora encompasses about 8000 vascular plant species making it the second most prosperous country of plant diversity in SW Asia after Turkey (Ghahremaninejad & Nejad Falatoury 2016, Davis *et al.* 1994). The diverse climatic conditions and geological features, and multiple phytogeographical positions in the meeting points of three main phytochoria regions of the Old World, *i.e.*, Irano-Turanian, Euro-Siberian, and Saharo-Sindian regions make a diverse flora in the country. The Iranian territory is also influenced by the Mediterranean and Somalia-Masaei species (Zohary 1973, Léonard 1988, 1993, Akhiani & Deil 2012). The mountain ridges dominate the Iranian landscapes which are composed of several significant systems, *i.e.*, Alborz, Zagros, Kopet Dagh, and Makran. About 75% of the Iranian vascular plant endemics are restricted to mountain ranges (Noroozi *et al.* 2008, 2019).

The mountainous areas of northeastern Iran belong to a separate floristic province of the Irano-Turanian region, named “Khorassan-Kopet Dagh”. This area is a transition zone and a corridor connecting different phytogeographical units of the Irano-Turanian region (Memariani *et al.* 2016a, 2016b, Memariani 2020). Several plant geographers have emphasized the separate biogeographic identity of the area (Kamelin 1970, Takhtajan 1986, Meusel *et al.* 1992, Fet 1994b). This area is also a part of the Irano-Anatolian mountain system, which is recognized as one of the thirty-five so-called hotspots of biodiversity in the World (Mittermeier *et al.* 2011).

Many efforts have been devoted to improving the understanding of the flora and vegetation of the Khorassan-Kopet Dagh province within Turkmenistan (Kamelin 1970, Kurbanov 1988, 1994, Fet 1994a, Popov 1994, Kamakhina 1994, Atamuradov *et al.* 1999, Ataev 2008) as well as in Iran (Ghahreman *et al.* 2006, Gholami *et al.* 2006, Amiri & Jabbarzadeh 2011, Memariani *et al.* 2016a, 2016b, 2016c, Nadaf *et al.* 2017, Atashgahi *et al.* 2018, 2022, Behroozian *et al.* 2022). However, there are still substantial gaps in our knowledge, especially for the protected regions in the lower mountain ranges and foothills of the Khorassan-Kopet Dagh. About 1.3 million ha of Khorassan-Kopet Dagh and surrounding transition zones (*ca.* 8% of its surface area) are protected officially under different protection schemes. Among 38 designated protected regions in the area there are four National Parks, 20 Protected Areas, five Wildlife Refuges, and six Natural Monuments in Iran (Memariani *et al.* 2016a).

Zarrin-Kuh Protected Area (ZPA) is one of the unexplored areas in the lower mountain ranges of Central Kopet Dagh, at the borders of Iran and Turkmenistan. The Central Kopet Dagh is one of the main hotspots with the highest magnitude of change in the endemic composition among the surrounding areas of the Khorassan-Kopet Dagh floristic province (Memariani *et al.* 2016b). However, the lower mountains and foothills are among the less explored parts of the Central Kopet Dagh. Our observations have revealed the occurrence of several local and narrow endemic plants as well as new floristic records in the area. Recently, the authors recorded four new and noteworthy species for the vascular flora of Iran from ZPA (Amiri *et al.* 2018a, 2018b, 2018c): *Crambe edentula* Fisch. & C.A.Mey. ex Korsch., *Galatella grimmii* (Regel & Schmalh.) Sennikov (under the name *Crinitaria grimmii* (Regel & Schmalh.) Grierson), *Plantago lagocephala* Bunge, and *Spryginia winkleri* (Regel) Popov. The area has been under protection only during the last decade. Its natural habitats have been disturbed mainly as vegetation overgrazing and overharvesting of the plants. Traditionally, the locals have used several threatened, endemic, and rare species as medicinal plants, food, and firewood. The knowledge of the floristic composition of the area is crucial for managing and protecting plant genetic resources. It provides a database to evaluate the conservation status and distribution patterns of the species. In this paper, we aim 1) to present the first checklist of the vascular plants in ZPA along with their life-forms and phytogeography, and 2) to document the occurrence of endemic and threatened species to reinforce the need for preservation of this precious natural heritage.

## Materials and methods

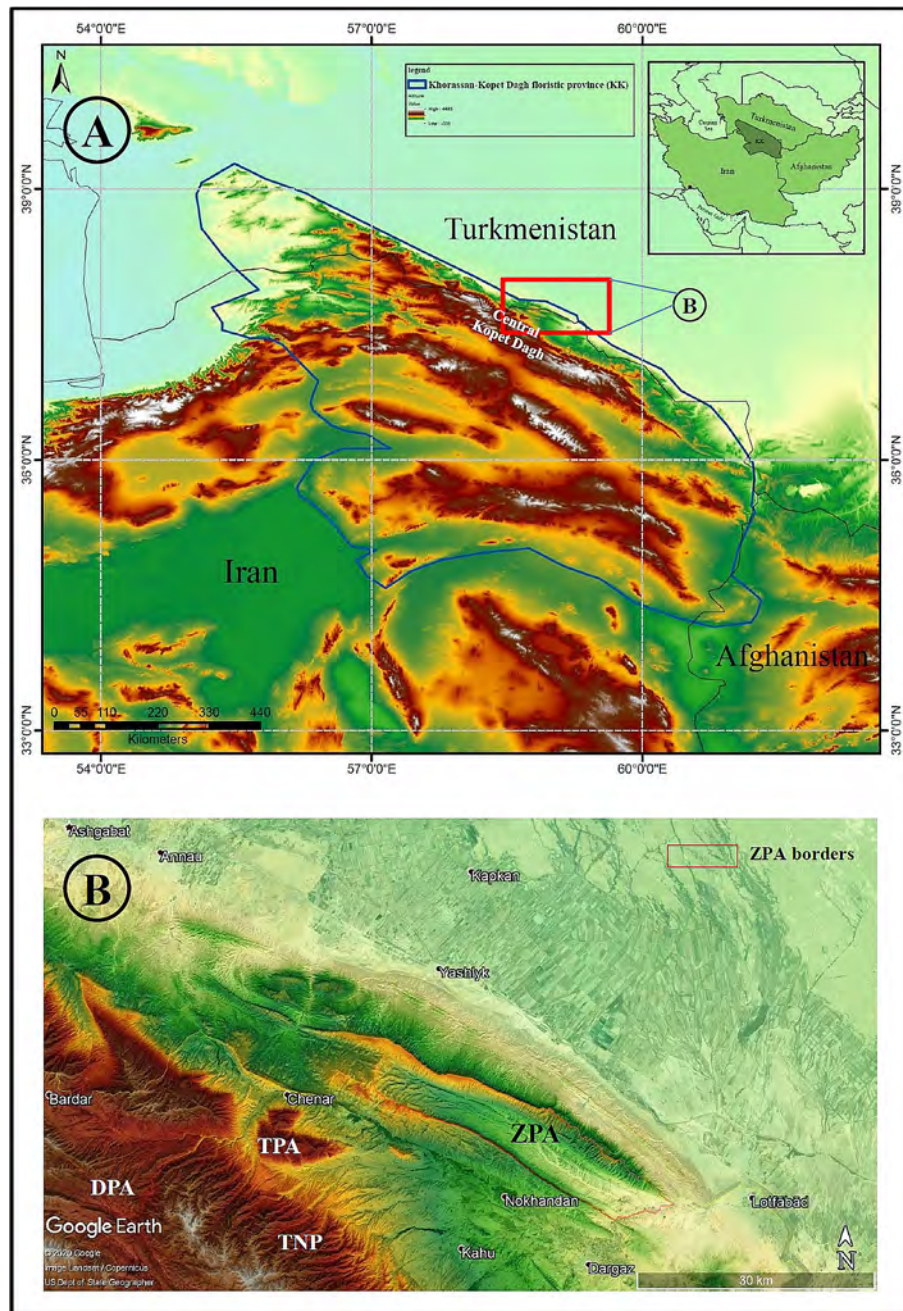
### Study area

Zarrin-Kuh Protected Area (ZPA) is located in the northwest of the city of Dargaz, Razavi Khorassan province, NE Iran, between 37°38'23" and 37°39'04" N latitude and 58°48'02" and 58°56'35" E longitude. The area is a part of the Central Kopet Dagh mountain ranges, oriented mainly NW-SE and extending for 40 km (Fig. 1). ZPA covers a surface area of 32852 ha with an elevational range from 356 in eastern plains up to 1320 m a.s.l. on the central peak of Zarrin-Kuh Mount. Two distinct mountain ranges run along the borders of Iran and Turkmenistan. There are also several foothills as well as flat plains in the area between these two mountain ranges. The main geomorphological feature of ZPA is the colorful foothills and mountains formed by the deposition of various mineral layers, which is named the hidden paradise or golden mountain (in Persian: Zarrin-Kuh) (Fig. 2). The study area has been legally under protection by the Iranian Department of Environment since 2012.

Geologically, the Kopet Dagh sedimentary basin was formed after the closure of the Paleo-Tethys Ocean and the convergence of the Iranian and Turanian plates by several continuous depositions, including the Jurassic, Cretaceous, Paleogene, Neogene, and Quaternary sediments (Berberian & King 1981, Afshar-Harb 1994). The ZPA is classified into three main parts based on the geological formations and their edaphic properties. The southern part of the study area includes the Neogene sediments, while the central and northern parts comprise the Paleogene sediments. The northern parts of the area are covered by the Chehel-Kaman formation, composed of cream, medium to thickly bedded limestone (partly dolomitized), marl, and calcareous shale with sandstones and gypsum as minor constituents. The central part includes the foothills characterized by the Khangiran formation, composed of green to gray silty and calcareous shale with medium bedded sub-mature sandstone. In the southern part of ZPA, the Neogene sediments consist of the Mio-Pliocene red formation and are composed of red to reddish-gray gypsiferous marl, siltstone, sandstone, and conglomerates (Fig. 2). A narrow belt at the central part is composed of Quaternary sediments; however, the flat plains in the eastern extension of ZPA covered by the alluvial younger terraces (Hosseinzadeh & Vahidinia 2012).

According to the available data from the nearest climatological station to the study area (the period of 10 years from 2008 to 2017 in the Dargaz climatological station), the lowest mean monthly temperature occurs in January and

February and the highest in July and August. The average annual precipitation is 285.6 mm, and the annual temperature is 16.4°C (IRIMO 2017). Based on the global bioclimatic classification of Iran, this area falls in the Mediterranean xeric-continental (Mxc) bioclimatic zone, which is the second largest bioclimate zone after the Mediterranean desertic-continental (Mdc) in Iran and occupies the main parts of the Kopet Dagh Mountains in NE Iran (Djamali *et al.* 2011).

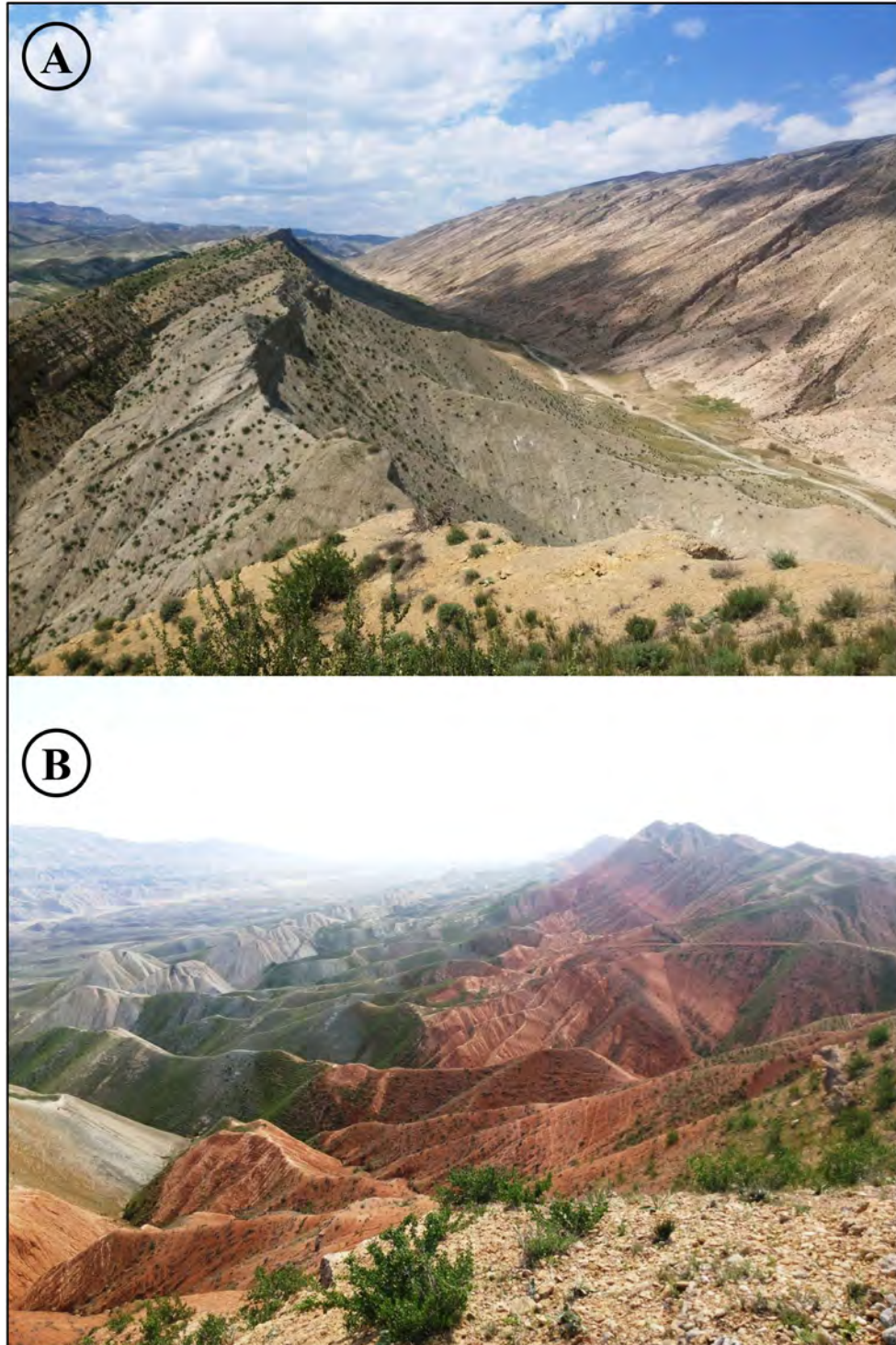


**FIGURE 1.** The geographical position of Zarrin-Kuh Protected Area (ZPA). **A:** Map of Khorassan-Kopet Dagh floristic province in northeastern Iran and partly in southern Turkmenistan; **B:** Topographic map of Central Kopet Dagh Mountains with the geographical position of ZPA in the northern lower mountains, and Tandooreh National Park (TNP), Tandooreh Protected Area (TPA), and Dorbadam Protected Area (DPA) in the higher mountains.

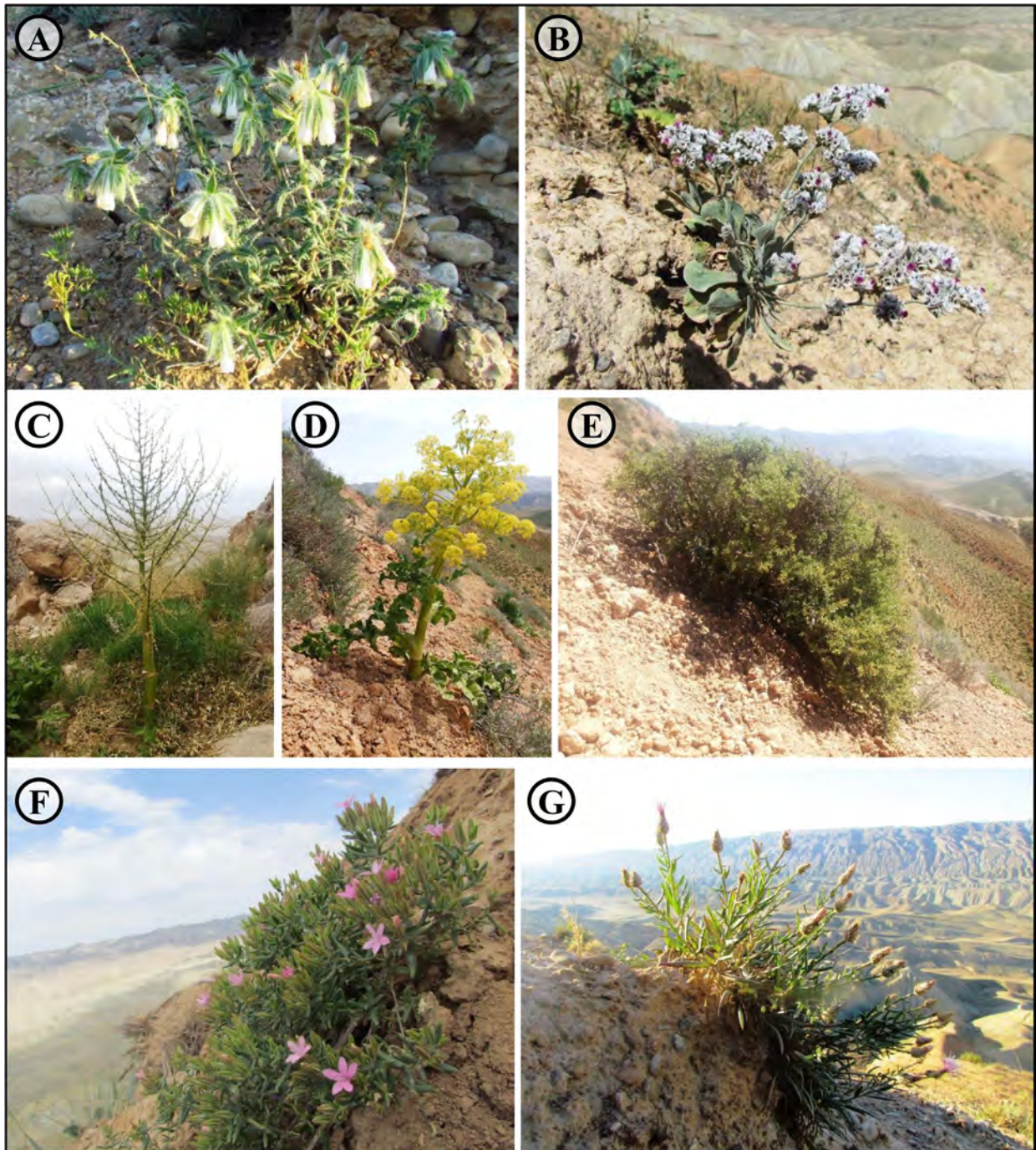
### Data collection and analysis

During the growing seasons of three successive years in 2015–2017, we collected about 1100 vascular plant specimens using several regular random collections and 160 vegetation samples (relèves) in different habitats and vegetation types. We recorded the elevation and geographical coordinates of the collection sites and relèves using a commercial GPS, with further notes on the vegetation and habitats. The collected specimens were identified using the relevant standard Floras for Iran and the adjacent countries, in particular Flora Iranica (Rechinger 1963–2015), Flora of Iran (Assadi *et al.* 1988–2019), Akhiani (1998, 2005) and Tzvelev (1976), and additional updated monographs and revisions

of individual genera. Nomenclature of plant families is based on APG IV (2016) for Angiosperms, Christenhusz *et al.* (2011) for Gymnosperms, and Christenhusz & Chase (2014) for Ferns. We checked all scientific and author names of the plant species according to the International Plant Name Index (IPNI: ipni.org). Using the distribution data in the relevant Floras and literature, we determined the chorology of the species based on phytogeographical groups defined by Akhani (1998) and Memariani *et al.* (2016a). The life-form of each species was defined according to Raunkiaer (1934). The threatened species were cited according to the “*Red Data Book of Iran*” (Jalili & Jamzad 1999) and Memariani *et al.* (2016b). The voucher specimens of all reported plants were deposited in the Herbarium of the University of Guilan (abbreviated here as GUH), and some duplicates were preserved in the Herbarium of Ferdowsi University of Mashhad (FUMH).



**FIGURE 2.** Characteristic landscapes in Zarrin-Kuh Protected Area. **A:** The steep stony slopes and rocky cliffs in the northern part of the area; **B:** The painted lower mountains in the southern part of the area mainly composed of marls and gypsum soils harbor mostly rare and endemic species of ZPA (Photos by M.S. Amiri).



**FIGURE 3.** Selected rare and threatened vascular plants of ZPA in their habitats: **A:** *Onosma khorassanica*, a critically endangered and endemic species restricted to a small habitat in the southern part of ZPA, **B:** *Cephalorhizum turcomanicum*, an endangered and rare species on marl hills, **C:** *Ferula hyrcana*, an endangered and medicinal plant found on stony substrates in the northern parts of the area, **d:** *Ferula latisecta*, an endangered and medicinal species growing on clay and marl hills, **E:** *Atraphaxis intricata*, a vulnerable and endemic species found on marl hills, **F:** *Acanthophyllum diaphanopterum*, a vulnerable and endemic plant on clay and marl hills of the southern parts, and **G:** *Jurinea catharinae*, a vulnerable and endemic species on southern foothills of the area (Photos by M.S. Amiri).

## Results

### *Floristic composition*

The final checklist of the flora of ZPA comprises 549 species / infraspecific taxa belonging to 318 genera in 69 families (Appendix). Angiosperms include Dicots with 466 species (267 genera/54 families), followed by Monocots with 78

species (47 genera/11 families), Gymnosperms include three species (2 genera/2 families), and Ferns represent two species (2 genera/2 families). The families with the highest number of genera and species are Asteraceae (43 genera/72 species), Poaceae (29/44), Brassicaceae (31/43), Fabaceae (15/43), Chenopodiaceae (24/41), Caryophyllaceae (15/35), and Boraginaceae (14/26). Fourteen families (each with more than or equal to 10 taxa) account for 74% (406 taxa) of the flora of ZPA (Table 1). The richest polymorphic genera are *Astragalus* (21 species), *Euphorbia* (10 species), *Acanthophyllum* (8 species), *Allium* (8 species), *Bromus* (7 species), *Cousinia* (7 species), and *Silene* (7 species). Table 2 indicates the list of 23 polymorphic genera, each with four or more species in the study area. The majority of genera (295) are monotypic or oligotypic ones. Figure 3 shows the selected rare and threatened plants and their habitats in the ZPA.

**TABLE 1.** List of the most represented families ( $\geq 10$  species) in the flora of Zarrin-Kuh Protected Area.

Families	Genera	Species/infraspecific taxa
Asteraceae	43	72
Poaceae	29	44
Brassicaceae	31	43
Fabaceae	15	43
Chenopodiaceae	24	41
Caryophyllaceae	15	35
Boraginaceae	14	26
Lamiaceae	15	24
Apiaceae	15	21
Ranunculaceae	8	13
Caprifoliaceae	4	12
Plantaginaceae	4	11
Euphorbiaceae	2	11
Rubiaceae	6	10

**TABLE 2.** List of the most represented genera ( $\geq 4$  species) in the flora of Zarrin-Kuh Protected Area.

Genera	Species/infraspecific taxa	Genera	Species/infraspecific taxa
<i>Astragalus</i>	21	<i>Gagea</i>	5
<i>Euphorbia</i>	10	<i>Galium</i>	5
<i>Acanthophyllum</i>	8	<i>Lappula</i>	5
<i>Allium</i>	8	<i>Medicago</i>	5
<i>Bromus</i>	7	<i>Salvia</i>	5
<i>Silene</i>	7	<i>Scorzonera</i>	5
<i>Alyssum</i>	6	<i>Erodium</i>	4
<i>Artemisia</i>	6	<i>Ferula</i>	4
<i>Atriplex</i>	6	<i>Linaria</i>	4
<i>Cousinia</i>	6	<i>Onobrychis</i>	4
<i>Valerianella</i>	6	<i>Tamarix</i>	4
<i>Caroxylon</i>	5	Other 295 genera (< 4 spp.)	403

## New record

*Astragalus androssovianus* Gontsch., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 10: 41 (1947), Fig. 4.

*Material examined.* IRAN: Razavi Khorassan province, Zarrin-Kuh Protected Area, 2 km west of Mash village, southern slope of Zarrin-Kuh Mnt., on marl hills, 37°32'59" N, 59°7'25" E, 568 m, 07.05.2016, *Amiri 45962* (FUMH).



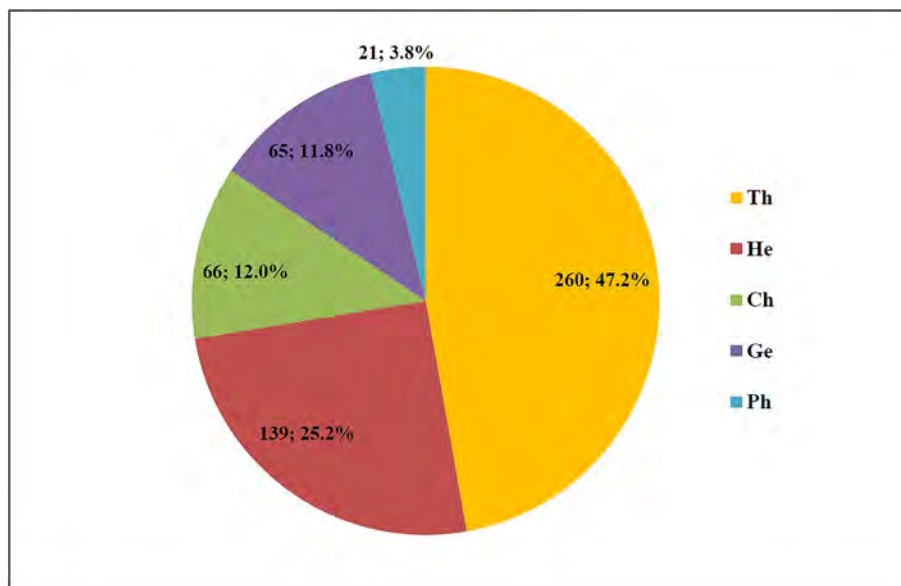
FIGURE 4. The voucher specimen of *Astragalus androssovianus* (45962 FUMH).

*Astragalus androssovianus* was originally described as an endemic species from Kyzyl-Arvat in SW Turkmenistan (Podlech & Zarre 2013). This newly recorded specimen from ZPA extends the species' distribution range to the NE of Iran. It belongs to the Irano-Turanian section *Ammodendron* Bunge characterized by bifurcating trichomes (Karamian & Ranjbar 2005). Morphologically, it is close to *A. nigricans* Barneby but differs from the latter by having 15–20 cm long (vs. 3–15 cm) inflorescence, free (vs. adnate) stipules, leaflets in 2–3 pairs (vs. 1–2 pairs), 15–25 mm long (vs. 10–20 mm), and standards 15–16 mm long (vs. 12–15 mm).

This species is very infrequent in the study area and is known only from one locality, where its habitat has recently been disturbed by road construction and over-grazing by sheep. Based on its very restricted extent of occurrence and low number of individuals in the area, *A. androssovianus* is evaluated as regionally Critically Endangered (CR) (IUCN 2016). The following taxa occur abundantly in the same locality: *Carduus pycnocephalus* L., *Nigella integrifolia* Regel, *Capparis spinosa* L., *Scrophularia striata* Boiss. and *Teucrium polium* L.

### Life-forms and phytogeography

Therophytes (260 taxa) and hemicryptophytes (139 taxa) dominate the life-form spectrum of the flora of ZPA, followed by chamaephytes (66 taxa), geophytes (65 taxa), and phanerophytes (21 taxa) (Fig. 5). Chorologically, Irano-Turanian elements (63.2%) dominate the flora of ZPA. Bi-regional elements make up a considerable proportion of the flora (15.7%), followed by widespread elements (10.9%), i.e., pluri-regional, sub-cosmopolitan, and cosmopolitan species. Tri-regional elements (10.2%) have the most minor frequency in the phytogeographical spectrum of the area. The main subdivisions of Irano-Turanian (IT) elements are widespread IT (30.4%), Central IT (7.5%), and IT elements endemic to Khorassan-Kopet Dagh (KK) floristic province (7.3%) (Table 3). Thirteen species are endemic to Iran; however, 64 sub-endemic or regional endemic taxa occur in the study area, distributed mainly in Iran and one or both neighboring countries, i.e., Turkmenistan and Afghanistan. *Onosma khorassanica* Attar & Joharchi is the only known species endemic to the study area (Fig. 3a). This area is also inhabited by 40 species endemic to the Khorassan-Kopet Dagh floristic province, such as *Atraphaxis intricata* Mozaff., *Ferula hyrcana* (Koso-Pol.) Puchalka, Spalik, Panahi & Piwczynski, *Ferula latisecta* Rech.f. & Aellen, *Linaria khorasanensis* Hamdi & Assadi, *Oxytropis suavis* Boriss. and *Zeravschania stricticaulis* (Rech.f.) Pimenov & Kljuykov.



**FIGURE 5.** The life-form spectrum in the flora of ZPA. Ch: chamaephytes, Ge: geophytes, He: hemicryptophytes, Ph: phanerophytes, and Th: therophytes.

## Discussion

### Floristic diversity

The checklist of the vascular flora of ZPA represents an area of exceptionally high floristic diversity (549 species/infraspecific taxa). In the previous studies, 404, 588, and 663 vascular plants have been recorded for the Tirgan watershed area (Amiri *et al.* 2009), Heydari Wildlife Refuge (Atashgahi *et al.* 2018) and Ghorkhod Protected Area



(Memariani *et al.* 2016c), respectively, which are mainly located in the higher mountains of the Khorassan-Kopet Dagh. Atashgahi *et al.* (2022) recorded 348 vascular plant species from the wild pistachio woodlands in the foothills of the Central Kopet Dagh. The biogeographical position of ZPA in the Central Kopet Dagh, which is known as one of the main biodiversity hotspots in the Khorassan-Kopet Dagh floristic province (Memariani *et al.* 2016b, Memariani 2020), as well as the complex geomorphology and topographic structure of the area, provide habitat heterogeneity and floristic diversity despite a relatively small surface area and elevation range (Fig. 1). These conditions support diverse vegetation types in the area, including semi-desert steppes, edaphic and halophytic vegetation, mountain steppe communities, cliff vegetation, and also anthropophilic flora in the disturbed areas.

**TABLE 3.** The number of taxa and proportion of different chorotypes in the flora of ZPA. Delimitation and abbreviation of phytogeographical groups are based on Akhiani (1998), and Memariani *et al.* (2016a). IT: Irano-Turanian; ES: Euro-Siberian; M: Mediterranean; SS: Sahara-Sindian; COS: Cosmopolitan; SCO: Sub-cosmopolitan; PL: Pluri-regional. The abbreviations of the IT subdivisions are as Omni: the widespread, W: western, C: central, E: eastern, KK: Khorassan-Kopet Dagh, Afgh.: Afghanistan, Turk.: Turkmenistan, and Cauc.: Caucasia.

Phytogeographical groups	Subdivisions	Taxa No.	Taxa (%)
Widespread 60 (10.9%)	PL	45	8.2
	COS	8	1.4
	SCO	7	1.3
<b>Tri-regional</b> 56 (10.2%)	IT- ES- M	41	7.5
	IT- M- SS	13	2.3
	IT- ES- SS	2	0.4
	IT- M	49	8.9
<b>Bi-regional</b> 86 (15.7%)	IT- SS	19	3.5
	IT- ES	15	2.7
	ES- M	2	0.4
	IT / IT <sup>Omni</sup>	167	30.4
	IT <sup>C</sup>	41	7.5
	IT <sup>KK</sup>	40	7.3
	IT <sup>C &amp; E</sup>	34	6.2
	IT <sup>W &amp; C</sup>	15	2.7
	IT <sup>KK - Afgh.</sup>	14	2.5
	IT <sup>KK - Alborz</sup>	11	2.0
	IT <sup>KK - E</sup>	11	2.0
	IT <sup>Cauc. - Turk.</sup>	5	0.9
	IT <sup>E</sup>	5	0.9
<b>Irano-Turanian</b> 347 (63.2%)	IT <sup>Aralo-Caspian</sup>	2	0.4
	IT <sup>Aralo-Caspian &amp; C</sup>	2	0.4
	IT <sup>E &amp; Aralo-Caspian</sup>	1	0.2
	<b>Total</b>	549	100.0

*Artemisia* steppe and different communities of xerophytic vegetation cover most of the semi-arid parts of ZPA. Saline soils cover the plains and foothills in the central and eastern parts of the area, which are suitable places for halophytes (mainly belonging to Chenopodiaceae). Additionally, marl, calcareous, and gypsophilous vegetation cover vast foothill areas and low mountain belts in the southern parts of ZPA inhabited by several endemic and edaphic plants (Figs. 2B and 3). The northern ranges of ZPA (Fig. 2A) are also dominated by mountain steppes which are characterized by thorn-cushion formations and grasslands. *Astragalus* spp., *Acanthophyllum* spp., *Acantholimon* spp. and *Onobrychis cornuta* (L.) Desv. are the most frequent thorn-cushion plants, together with some grasses like *Poa bulbosa* L. and *Stipa* spp. There is no tree line along the altitudinal gradient; however, some scattered trees and shrubs are formed in rocky places and mesic valleys, which are composed mainly of *Cotoneaster* spp., *Ephedra* spp. and *Ficus carica* L. Only some scattered trees of *Juniperus polycarpus* var. *turcomanica* (B.Fedtsch.) R.P.Adams occur in the northern parts of the area at elevations of 1100–1320 m a.s.l. Moreover, in the northern part of ZPA, rocky cliffs are one of the most fascinating landscapes that provide suitable habitats for chasmophytic species such as *Scrophularia*

spp., *Dionysia tapetodes* Bunge, *Campanula khorasanica* (Rech.f. & Aellen) Rech.f., *Valeriana sisymbriifolia* Vahl and *Vincetoxicum pumilum* Decne. There are also well-developed communities of *Zygophyllum atriplicolides* Fisch. & C.A.Mey. on foothills and in lower mountains in the northern part of the area.

Therophytes (annual plants), with nearly half of the life-form spectrum, dominate the flora of the ZPA, followed by hemicryptophytes (25%). Sokhanvar *et al.* (2013) recorded a similar life-form spectrum for the flora of Helali Protected Area located at the central Iranian desert margins in Khorassan. The dominance of therophytes reflects ecological adaptations of the flora to the arid climate and partly the disturbance history of the area compared to the prominence of hemicryptophytes in some protected regions located mainly in the higher mountains of the Khorassan-Kopet Dagh, such as Ghorkhod Protected Area (Memariani *et al.* 2016c) and Heydari Wildlife Refuge (Atashgahi *et al.* 2018). Hemicryptophyte species dominate in the northern borders of ZPA with a maximum elevation of 1320 m a. s. l. They are well-adapted to the cold semi-arid climate of the higher mountain steppes. Our unpublished data also indicate the dominance of hemicryptophytes (51%) in the nearby higher mountains of the Central Kopet Dagh in Tandooreh National Park (Fig. 1B).

### **Phytogeography and endemism**

The core flora of ZPA (ca. 64%) belongs to the Irano-Turanian (IT) regional center of endemism (*sensu* Léonard 1988, 1993). The IT region is one of the hotspots of the evolutionary and floristic diversity of the Old World, which is considered a significant center of endemism and radiation of several mega-genera, including *Astragalus*, *Acanthophyllum*, *Acantholimon*, *Cousinia*, *Eremurus*, and *Eremostachys* (Ghazanfar & McDaniel 2016, Manafzadeh *et al.* 2016). Most of these genera are well represented in the flora of ZPA. The area is also considerably affected by wide-range (bi-regional and tri-regional) and widespread (pluri-regional, cosmopolitan, and sub-cosmopolitan) elements (Table 3). Pan-Irano-Turanian or widespread IT plants (nearly one-third of the flora of ZPA) dominate the IT elements. However, Central IT species (7.5%) are less contributing elements in comparison with the whole flora of the Khorassan-Kopet Dagh (KK) floristic province (ca. 13%, Memariani *et al.* 2016a). The IT plant species endemic to the KK (7.3%) are also less presented in the study area compared to the whole flora of KK (ca. 14%, Memariani *et al.* 2016b). These findings indicate the reduction of plant endemism in lower mountains and foothills of KK, such as the landscapes and habitats in ZPA. Most KK endemic species (ca. 80%) occur in montane steppe communities from the mid-mountain belt to the subalpine zone (Memariani 2020). There is a similar pattern in the other Areas of Endemism within the Irano-Anatolian biodiversity hotspot, where high proportions of rare and endemic plants occur in alpine habitats (Noroozi *et al.* 2021).

### **Conservation and threats**

Although having a relatively lower endemism rate, the ZPA has essential conservation value, and makes a substantial contribution to the flora of the KK floristic province, especially in Central Kopet Dagh as a plant diversity hotspot. Habitat heterogeneity supports a diverse flora and vegetation in a small area at the northern peripheral of KK and the occurrence of 77 Iranian and regional endemics. Most of these endemic species are Red Listed and restricted to particular habitats, such as calcareous and gypsiferous marls in the painted lower mountains and foothills of the southern part of ZPA (Figs. 2B and 3). According to the Red List of the flora of KK by Memariani *et al.* (2016b), there are 23 threatened and near-threatened plant species in the area (Table 4), among which the locally endemic *Onosma khorasanica* and the newly recorded *Astragalus androssovianus* are critically endangered (CR). There are seven endangered (EN) and eight vulnerable (VU) species in the area. Six near-threatened (NT) species are also known, and they are more likely to become qualified for a threatened category in the near future.

There have been significant threats to the flora and vegetation of the area, mainly overgrazing, excessive harvesting of medicinal and other economically valuable plants, road construction, and overcutting of trees and shrubs for firewood and building material. Several parts of the area have been over-exploited by the nomads for a long time which is the primary reason for the domination of poisonous and ruderal species such as *Euphorbia* spp., *Peganum harmala* L. and *Zygophyllum fabago* L. in these parts. Traditionally, many people harvest rare and endangered medicinal species, especially *Allium* spp., *Astragalus* spp., *Ferula hircana*, *Ferula latisecta*, and *Thymus transcaspicus*, for selling in the local bazaars. Road constructions in the area make important habitats accessible for illegal exploitation. Although experiencing a disturbance history, the ZPA has been managed as a protected region during the last decade. The adequate protection of the natural habitats will guarantee the in situ conservation of the unique flora of Central Kopet Dagh and the rare and threatened species endemic to the KK. Additional *ex situ* conservation efforts such as in vitro propagation, cultivation in botanical gardens, and seed banking are highly recommended for the rare, endemic, and threatened plant species.

**TABLE 4.** Red List of the threatened (CR: critically endangered, EN: endangered, VU: vulnerable) and near-threatened (NT) species in the flora of Zarrin-Kuh Protected Area. The classification of the species is based on Memariani *et al.* (2016b), except for *Astragalus androssovianus* (the current study) and *Lagochilus khorassanicus* (Zeraatkar *et al.* 2017).

No.	Species	Red list categories
1	<i>Acanthophyllum diaphanopterum</i> (Rech.f.) A.Pirani & Moazzeni	VU
2	<i>Allium ellisii</i> J.D.Hook.	VU
3	<i>Anthochlamys turcomanica</i> Iljin	VU
4	<i>Astragalus androssovianus</i> Gontsch.	CR
5	<i>Astragalus jarmolenkoi</i> Gontsch.	EN
6	<i>Astragalus raddei</i> Basil.	NT
7	<i>Atraphaxis intricata</i> Mozaff.	VU
8	<i>Bromus turcomanicus</i> H.Scholz	EN
9	<i>Cephalorrhizum turcomanicum</i> M.Pop.	EN
10	<i>Cephalorrhynchus kossinskyi</i> (Krasch.) Kirp.	NT
11	<i>Cousinia komarowii</i> (O.Kuntze) C.Winkl.	VU
12	<i>Euphorbia kopetdaghi</i> (Prokh.) Prokh.	NT
13	<i>Ferula hircana</i> (Koso-Pol.) Puchalka, Spalik, Panahi & Piwczynski	EN
14	<i>Ferula latisecta</i> Rech.f. & Aellen	EN
15	<i>Heliotropium disciforme</i> Akhani	EN
16	<i>Jurinea catharinae</i> Iljin	VU
17	<i>Lagochilus khorassanicus</i> Zeraatkar, F.Ghahrem. & Joharchi	NT
18	<i>Linaria khorasanensis</i> Hamdi & Assadi	VU
19	<i>Onosma khorassanica</i> Attar & Joharchi	CR
20	<i>Oxytropis suavis</i> Boriss.	NT
21	<i>Peltaria turkemena</i> Lipsky	NT
22	<i>Rhammatophyllum gaudanense</i> (Litw.) Al-Shehbaz & O.Appel	VU
23	<i>Zeravschania stricticaulis</i> (Rech.f.) Pimenov & Kljuykov	EN

## Conclusion

Floristic inventories provide valuable data for plant diversity, biogeography, and ecology, which are essential to guide conservation decision-making. Biogeographically, Khorassan-Kopet Dagh, as a separate floristic province, is located at the crossroad between different phytogeographical units of the Irano-Turanian region and makes a unique mixture of the flora from the surrounding areas. The presence of a core Irano-Turanian flora, several widespread, wide-ranging elements, and many local and narrow endemic species are distinctive features of the plant diversity in this area. As a part of the Irano-Anatolian hotspot of plant diversity, the flora and vegetation of Khorassan-Kopet Dagh have been studied intensely during the last decades; however, there are still several gaps in the area, especially in the Central Kopet Dagh. For efficient conservation in the biodiversity hotspots, it has been recommended to expand the elevational gradients in Protected Areas and protect low and high-elevation plant species (Ludoviczy *et al.* 2022). Several poorly explored sites in the lower mountains and foothills support the edaphic endemism on calcareous, serpentine, and gypsum soils dating from Oligocene to Cretaceous substrates (Memariani 2018, 2020). These habitats are well known for the local endemics, most of them being rare and endangered plants at the edge of extinction. Therefore, the higher mountains of Central Kopet Dagh and their surrounding lower mountains merit simultaneous conservation attention. The results of this study are essential knowledge for the persistent monitoring of the flora and vegetation in dramatically changing environments.

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## References

- Afshar-Harb, A. (1994) Geology of Kopet Dagh. *In: Hushmandzadeh, A. (Ed.) Treatise on the Geology of Iran*, No. 11. Geological Survey of Iran, Tehran, pp. 1–275. [in Persian]
- Akhani, H. (1998) Plant Biodiversity of Golestan National Park, Iran. *Stapfia* 53: 1–411.
- Akhani, H. (2005) *The Illustrated Flora of Golestan National Park, Iran*, vol. 1. Tehran University Press, Tehran, 481 pp.
- Akhani, H. & Deil, U. (2012) First observations of the flora and vegetation of three islands in the NW Persian Gulf (Iran). *Phyton* 52: 73–99.
- Amiri, M.S. & Jabbarzadeh, P. (2011) Floristic study of Zangelanlo watershed (Khorassan, Iran). *Taxonomy and Biosystematics* 2: 1–16. [in Persian with English abstract]
- Amiri, M.S., Saeidi Mehrvarz, S., Moazzeni, H., Joharchi, M.R., Memariani, F. & German, D.A. (2018a) The genus *Spryginia* (Brassicaceae) in Iran and Afghanistan. *Phytotaxa* 334: 225–232.  
<https://doi.org/10.11646/phytotaxa.334.3.3>
- Amiri, M.S., Saeidi Mehrvarz, S. & Joharchi, M.R. (2018b) Two new records of vascular plants for the flora of Iran. *Phytologia Balcanica* 24: 243–247.
- Amiri, M.S., Saeidi Mehrvarz, S. & Memariani, F. (2018c) *Plantago lagocephala* (Plantaginaceae), a new record for the flora of Iran. *Nova Biologica Reperta* 4 (1): 74–99.
- Amiri, M.S., Zokaei, M., Joharchi, M.R., Ejtehadi, H. & Mozaffarian, V. (2009) An introduction to the flora, life-form and phytogeography of Tigran Watershed (Khorassan Province). *Journal of Science (Tarbiat Moallem Univ.)* 8 (2): 89–106. [in Persian]
- APG IV (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. *APG IV. Botanical Journal of the Linnian Society* 181: 1–20.  
<https://doi.org/10.1111/boj.12385>
- Assadi, M., Maassoumi, A.A., Khatamsaz, M. & Mozaffarian, V. (Eds.) (1988–2019) *Flora of Iran*, vols. 1–147. Research Institute of Forests and Rangelands Publications, Tehran. [in Persian]
- Ataev, A.C. (2008) Junipers phytocenosis significance of Kopetdagh. *Problems of Desert Development* 2008 (1): 48–50. [in Russian]
- Atamuradov, H.I., Fet, G.N., Fet, V., Valdez, R. & Feldman, W. (1999) Biodiversity, genetic diversity, and Protected Areas in Turkmenistan. *Journal of Sustainable Forestry* 9 (1): 73–88.  
[https://doi.org/10.1300/J091v09n01\\_06](https://doi.org/10.1300/J091v09n01_06)
- Atashgahi, Z., Ejtehadi, H., Mesdaghi, M. & Ghassemzadeh, Z. (2018) Plant diversity of the Heydari Wildlife Refuge in northeastern Iran, with a checklist of vascular plants. *Phytotaxa* 340: 101–127.  
<https://doi.org/10.11646/phytotaxa.340.2.1>
- Atashgahi, Z., Memariani, F., Jafari-Polgerd, V. & Joharchi, M.R. (2022) Floristic composition and phytogeographical spectrum of *Pistacia vera* L. woodland remnants in northeastern Iran. *Nordic Journal of Botany* 2022 (5): e03510.  
<https://doi.org/10.1111/njb.03510>
- Behroozian, M., Ejtehadi, H., Memariani, F., Joharchi, M.R. & Mesdaghi, M. (2022) Floristic diversity and vegetation of communities associated with two endemic *Dianthus* species in the montane steppes of northeastern Iran. *Nordic Journal of Botany* 2022: e03581.  
<https://doi.org/10.1111/njb.03581>
- Berberian, M. & King, G.C.P. (1981) Toward a palaeogeography and tectonic evolution of Iran. *Canadian Journal of Earth Science* 18: 210–265.  
<https://doi.org/10.1139/e81-019>
- Christenhusz, M.J.M. & Chase, M.W. (2014) Trends and concepts in fern classification. *Annals of Botany* 113: 571–594.  
<https://doi.org/10.1093/aob/mct299>
- Christenhusz, M.J.M., Reveal, J.L., Farjon, A., Gardner, M.F., Mill, R.R. & Chase, M.W. (2011) A new classification and linear sequence of extant gymnosperms. *Phytotaxa* 19: 55–70.  
<https://doi.org/10.11646/phytotaxa.19.1.3>
- Davis, S.D., Heywood, V.H. & Hamilton, A.C. (Eds.) (1994) *Centers of Plant Diversity: A guide and strategy for their Conservation*, vol. 1. Europe, Africa, South West Asia and the Middle East. IUCN Publications Unit, Cambridge.
- Djamali, M., Akhani, H., Khoshravesh, R., Andrieu-Ponel, V., Ponel, P. & Brewer, S. (2011) Application of the Global Bioclimatic

- Classification to Iran: implications for understanding the modern vegetation and biogeography. *Ecologia Mediterranea* 37: 91–114.  
<https://doi.org/10.3406/ecmed.2011.1350>
- Fet, G.N. (1994a) Vegetation of Southwest Kopetdagh. In: Fet, V. & Atamuradov, K.I. (Eds.) *Biogeography and Ecology of Turkmenistan*. Kluwer Academic Publisher, Dordrecht, pp. 149–172.  
[https://doi.org/10.1007/978-94-011-1116-4\\_9](https://doi.org/10.1007/978-94-011-1116-4_9)
- Fet, V. (1994b) Biogeographic position of Khorassan-Kopetdagh. In: Fet, V. & Atamuradov, K.I. (Eds.) *Biogeography and Ecology of Turkmenistan*. Kluwer Academic Publisher, Dordrecht, pp. 197–204.  
[https://doi.org/10.1007/978-94-011-1116-4\\_12](https://doi.org/10.1007/978-94-011-1116-4_12)
- Ghahreman, A., Heydari, J., Attar, F. & Hamzeh'ee, B. (2006) A floristic study of the southwestern slopes of Binaloud elevations (Iran: Khorassan Province). *Journal of Science (University of Tehran)* 32 (1): 1–12.
- Ghahremaninejad, F. & Nejad Falatoury, A. (2016) An update on the flora of Iran: Iranian angiosperm orders and families in accordance with APG IV. *Nova Biologica Reperta* 3: 80–107.  
<https://doi.org/10.21859/acadpub.nbr.3.1.80>
- Ghazanfar, S.A. & McDaniel, T. (2016) Floras of the Middle East: a quantitative analysis and biogeography of the flora of Iraq. *Edinburgh Journal of Botany* 73: 1–24.  
<https://doi.org/10.1017/S0960428615000244>
- Gholami, A., Ejtehadi, H., Ghassemzadeh, F. & Ghorashi-al-Hosseini, J. (2006) Study of plant biodiversity around protected area of the Bazangan Lake. *Iranian Journal of Biology* 19 (4): 398–407. [in Persian]
- Hosseinzadeh, F.M. & Vahidinia, M. (2012) Biostratigraphy of the base of Khangiran Formation based on planktonic Foraminifera at type section, Yaghol village, North of Dargaz city, west of Kopet-Dagh basin. *Sedimentary Facies* 4: 151–161.
- IRIMO (2017) Analytical reports & climatic data. I.R. of Iran Meteorological Organization. Available from: <http://www.irimo.ir/> (accessed 12 October 2017).
- IUCN (2016) *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 12. Prepared by the Standards and Petitions Subcommittee. Available from: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed 8 March 2017)
- Jalili, A. & Jamzad, Z. (1999) *Red Data Book of Iran*. Research Institute of Forests and Rangelands Publications, Tehran, 748 pp.
- Kamakhina, G.L. (1994) Kopetdagh-Khorassan flora: Regional features of Central Kopetdagh. In: Fet, V. & Atamuradov, K.I. (Eds.) *Biogeography and Ecology of Turkmenistan*. Kluwer Academic Publisher, Dordrecht, pp. 129–148.  
[https://doi.org/10.1007/978-94-011-1116-4\\_8](https://doi.org/10.1007/978-94-011-1116-4_8)
- Kamelin, R.V. (1970) Specific phyto-geographical features in the flora of the soviet part of the Kopet-Dag Range. *Botanicheskii Zhurnal* 55 (10): 1451–1462. [in Russian]
- Karamian, R. & Ranjbar, M. (2005) *Astragalus pendulipodus* (Fabaceae), a new species from Iran. *Annales Botanici Fennici* 42: 139–142.
- Kurbanov, D. (1988) *Summary on flora of western low-height and middle-height mountains of Kopetdagh (Northwest Kopetdagh and other low-height mountains of West Turkmenistan)*. Ylym, Ashkhabad, 260 pp. [in Russian]
- Kurbanov, D. (1994) Flora of Kopetdagh. In: Fet, V. & Atamuradov, K.I. (Eds.) *Biogeography and Ecology of Turkmenistan*. Kluwer Academic Publisher, Dordrecht, pp. 105–128.  
[https://doi.org/10.1007/978-94-011-1116-4\\_7](https://doi.org/10.1007/978-94-011-1116-4_7)
- Léonard, J. (1988) *Contribution à l'étude de la flore et de la végétation des desert d'Iran*, Fascicule 8. Étude des Aries de distribution, Les phytochories, Les chorotypes. Jardin Botanique National de Belgique, Meise, 190 pp.
- Léonard, J. (1993) Comparisons between the phytochorological spectra of three Iranian deserts and those of various surrounding regions. *Bulletin du Jardin Botanique National de Belgique* 62: 389–396.  
<https://doi.org/10.2307/3668284>
- Ludovicy, S., Noroozi, J., Semenchuk, P., Moser, D., Wessely, J., Talebi, A. & Dullinger, S. (2022) Protected area network insufficiently represents climatic niches of endemic plants in a Global Biodiversity Hotspot. *Biological Conservation* 275: 109768.  
<https://doi.org/10.1016/j.biocon.2022.109768>
- Manafzadeh, S., Staedler, Y.M. & Conti, E. (2016) Visions of the past and dreams of the future in the Orient: the Irano-Turanian region from classical botany to evolutionary studies. *Biological Reviews* 92: 1365–1388.  
<https://doi.org/10.1111/brv.12287>
- Memariani, F., Zarrinpour, V. & Akhiani, H. (2016a) A review of plant diversity, vegetation, and phytogeography of the Khorassan-Kopet Dagh floristic province in the Irano-Turanian region (northeastern Iran–southern Turkmenistan). *Phytotaxa* 249: 8–30.  
<https://doi.org/10.11646/phytotaxa.249.1.4>
- Memariani, F., Akhiani, H. & Joharchi, M.R. (2016b) Endemic plants of the Khorassan-Kopet Dagh floristic province in the Irano-Turanian region: diversity, distribution patterns and conservation status. *Phytotaxa* 249: 31–117.  
<https://doi.org/10.11646/phytotaxa.249.1.5>

- Memariani, F., Joharchi, M.R. & Akhiani, H. (2016c) Plant diversity of Ghorkhod Protected Area, NE Iran. *Phytotaxa* 249: 118–158.  
<https://doi.org/10.11646/phytotaxa.249.1.6>
- Memariani, F. (2018) Khorassan-Kopet Dagh Floristic Province (NE Iran, S Turkmenistan): an edaphic endemism hotspot in Irano-Turanian Region. In: Kurt, L. & Palacio, S. (Eds.) *GYPWORLD: a Global initiative to understand gypsum ecosystem ecology*, Abstract Book: 1st Gypsum Ecosystem Research Conference: Gypsum Ecosystems as Biodiversity Hotspots. 3rd–9th June, Ankara, Turkey.
- Memariani, F. (2020) The Khorassan-Kopet Dagh Mountains. In: Noroozi, J. (Ed.) *Plant Biogeography and Vegetation of High Mountains of Central and South-West Asia*. Cham: Springer, Cham, pp. 93–116.  
[https://doi.org/10.1007/978-3-030-45212-4\\_3](https://doi.org/10.1007/978-3-030-45212-4_3)
- Meusel, H., Jäger, E., Bräutigam, S., Knapp, H.D., Rauschert, S. & Weinert, E. (1992) *Vergleichende Chorologie der zentraleuropäischen Flora*, vol. 3. Gustav Fischer Verlag, Jena, 688 pp.
- Mittermeier, R.A., Turner, W.R., Larsen, F.W., Brooks, T.M. & Gascon, C. (2011) Global biodiversity conservation: the critical role of hotspots. In: Zachos, F.E. & Habel, J.C. (Eds.) *Biodiversity Hotspots: Distribution and Protection of Conservation Priority Areas*. Springer, Berlin, pp. 3–22.  
[https://doi.org/10.1007/978-3-642-20992-5\\_1](https://doi.org/10.1007/978-3-642-20992-5_1)
- Nadaf, M., Ejtehadi, H., Mesdaghi, M. & Farzam, M. (2017) Flora, life form and chorology of plants in Jozak–Chaminbid area, North Khorassan Province, Iran. *Taxonomy and Biosystematics* 32: 69–88. [in Persian with English abstract]
- Noroozi, J., Akhiani, H. & Breckle, S.W. (2008) Biodiversity and phytogeography of the alpine flora of Iran. *Biodiversity and Conservation* 17: 493–521.  
<https://doi.org/10.1007/s10531-007-9246-7>
- Noroozi, J., Talebi, A., Doostmohammadi, M., Manafzadeh, S., Asgarpour, Z. & Schneeweiss, G.M. (2019) Endemic diversity and distribution of the Iranian vascular flora across phytogeographical regions, biodiversity hotspots and areas of endemism. *Scientific Reports* 9: 12991.  
<https://doi.org/10.1038/s41598-019-49417-1>
- Noroozi, J., Khalvati, S., Nafisi, H., Kaveh, A., Nazari, B., Zare, G., Minaei, M., Vitek, E. & Schneeweiss, G.M. (2021) Endemics determine bioregionalization in the alpine zone of the Irano-Anatolian biodiversity hotspot (South-West Asia). *Alpine Botany* 131: 177–186.  
<https://doi.org/10.1007/s00035-021-00266-7>
- Podlech, D. & Zarre, S. (2013) *A taxonomic revision of the genus Astragalus L. (Leguminosae) in the Old World*. Verlag des Naturhistorischen Museums, Wien.
- Popov, K.P. (1994) Trees, shrubs and semishrubs in mountains of Turkmenistan. In: Fet, V. & Atamuradov, K.I. (Eds.) *Biogeography and Ecology of Turkmenistan*. Kluwer Academic Publisher, Dordrecht, pp. 173–186.  
[https://doi.org/10.1007/978-94-011-1116-4\\_10](https://doi.org/10.1007/978-94-011-1116-4_10)
- Raunkiaer, C. (1934) *The Life Form of Plants and Statistical Plant Geography*. Clarendon Press, Oxford.
- Rechinger, K.H. (ed.) (1963–2015) *Flora Iranica*, vols. 1–181. Akademische Druck- u. Verlagsanstalt, Graz; vol. 175. Akademische Verlagsgesellschaft, Salzburg; vols. 176–181. Verlag des Naturhistorischen Museums, Wien.
- Sokhanvar, F., Ejtehadi, H., Vaezi, J., Memariani, F., Joharchi, M.R. & Ranjbar, Z. (2013) Flora, life form and chorology of plants of the Helali protected area in Khorasan-e Razavi province. *Taxonomy and Biosystematics* 16: 85–100. [in Persian]
- Takhtajan, A. (1986) *Floristic Regions of the World*. Translated from Russian. University of California Press, California, 544 pp.
- Tzvelev, N.N. (1976) *Grasses of the Soviet Union*. Science Publishers, Leningrad, 788 pp. [In Russian]
- Zeraatkar, A., Ghahremaninejad, F. & Joharchi, M.R. (2017) A new species of *Lagochilus* (Lamiaceae) from Khorassan-Kopet Dagh floristic province. *Novon* 25: 497–502.  
<https://doi.org/10.3417/D-16-00010>
- Zohary, M. (1973) *Geobotanical Foundations of the Middle East*. 2 vols. Gustav Fischer Verlag, Stuttgart, 765 pp.

**APPENDIX.** Checklist of the vascular plants of Zarrin-Kuh Protected Area. Life-forms: Ch (chamaephyte), G.b (bulbous geophyte), G.c (cormous geophyte), G.t (tuberous geophyte), G.r (rhizomatous geophyte), G.p (parasitic geophyte), He (hemicyptophyte), Ph (phanerophyte), Th (therophyte). Chorotypes are according to Akhani (1998) and Memariani *et al.* (2016a, 2016b, 2016c). IT: Irano-Turanian (for chorological subdivisions of IT elements, refer to Table 3); ES: Euro- Siberian; M: Mediterranean; SS: Sahara-Sindian; COS: Cosmopolitan; SCO: Sub-cosmopolitan; PL: Pluri-regional. Regional endemics are marked by one, and Iranian endemics by two asterisks. All specimens are deposited in the Herbarium of the University of Guilan (GUH), and some duplicates are preserved in the Herbarium of Ferdowsi University of Mashhad (FUMH).

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
	<b>Amaranthaceae</b>			
1	<i>Amaranthus albus</i> L.	Th	PL	16495
2	<i>Amaranthus viridis</i> L.	Th	PL	16496
	<b>Amaryllidaceae</b>			
3	<i>Allium caspium</i> (Pall.) M.Bieb.	G.b	IT	16107
4	<i>Allium cristophii</i> Trautv.	G.b	IT <sup>KK*</sup>	16108
5	<i>Allium ellisii</i> Hook.f.	G.b	IT <sup>KK**</sup>	16109
6	<i>Allium giganteum</i> Regel	G.b	IT	16328
7	<i>Allium regelii</i> Trautv.	G.b	IT	16110
8	<i>Allium rubellum</i> M.Bieb.	G.b	IT <sup>Cauc. - Turk.</sup>	16111
9	<i>Allium umbilicatum</i> Boiss.	G.b	IT <sup>C</sup>	16112
10	<i>Allium xiphopetalum</i> Aitch. & Baker	G.b	IT <sup>C &amp; E</sup>	16329
11	<i>Ungernia trisphaera</i> Bunge	G.b	IT <sup>KK - Afgh. *</sup>	16330
	<b>Apiaceae</b>			
12	<i>Caucalis platycarpus</i> L.	Th	IT- M	16120
13	<i>Cuminum setifolium</i> (Boiss.) Kos.-pol.	Th	IT	16121
14	<i>Daucus carota</i> L.	He	PL	16122
15	<i>Elwendia afghanica</i> (Beauverd) Pimenov & Kljuykov (= <i>Bunium afghanicum</i> Beauverd)	G.t	IT	16123
16	<i>Elwendia cylindrica</i> (Boiss. & Hausskn.) Pimenov & Kljuykov (= <i>Bunium cylindricum</i> (Boiss. & Hohen.) Drude)	G.t	IT	16124
17	<i>Elwendia persica</i> (Boiss.) Pimenov & Kljuykov (= <i>Bunium persicum</i> (Boiss.) B.Fedtsch.)	G.t	IT	16125
18	<i>Eremodaucus lehmannii</i> Bunge	Th	IT	16126
19	<i>Eryngium bungei</i> Boiss.	He	IT <sup>C</sup>	16127
20	<i>Eryngium caeruleum</i> M.Bieb. (= <i>Eryngium caucasicum</i> Trautv.)	He	IT <sup>Ommi</sup>	16128
21	<i>Ferula gumosa</i> Boiss.	He	IT <sup>C*</sup>	16621
22	<i>Ferula hyrcana</i> (Koso-Pol.) Puchalka, Spalik, Panahi & Piwczynski (= <i>Dorema kopetdaghense</i> Pimenov)	He	IT <sup>KK*</sup>	16510
23	<i>Ferula latisecta</i> Rech.f. & Aellen	He	IT <sup>KK*</sup>	16331
24	<i>Ferula oopoda</i> (Boiss. & Buhse) Boiss.	He	IT <sup>C</sup>	16332
25	<i>Galagania tenuisecta</i> (Regel & Schmalh.) M.G.Vassiljeva & Pimenov (= <i>Korovinia tenuisecta</i> (Regel & Schmalh.) Nevski & Vved.	G.t	IT <sup>KK - E</sup>	16129, 16130
26	<i>Pimpinella puberula</i> (DC.) Boiss.	Th	IT	16131
27	<i>Prangos latiloba</i> Korov.	He	IT <sup>C*</sup>	16132
28	<i>Scandix stellata</i> Banks & Soland.	Th	IT- M	16133
29	<i>Seseli staurophyllum</i> Rech.f.	He	IT <sup>C**</sup>	16622
30	<i>Turgenia latifolia</i> (L.) Hoffm.	Th	IT- M	16134
31	<i>Zeravschania stricticaulis</i> (Rech.f.) Pimenov & Kljuykov	He	IT <sup>KK*</sup>	16333

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
32	<i>Zosima absinthifolia</i> (Vent.) Link	He	IT <sup>Omni</sup>	16334
	<b>Apocynaceae</b>			
33	<i>Cynanchum acutum</i> L.	He	IT- M- SS	16135
34	<i>Vincetoxicum pumilum</i> Decne.	He	IT <sup>KK*</sup>	16623
	<b>Araceae</b>			
35	<i>Arum korolkowii</i> Regel	G.t	IT	16587
	<b>Asparagaceae</b>			
36	<i>Asparagus verticillatus</i> L.	Ch	IT- ES	16335
37	<i>Bellevalia saviczii</i> Woronow	G.b	IT <sup>C</sup>	16101
38	<i>Hyacinthus transcaspicus</i> Litv.	G.b	IT <sup>KK - Alborz*</sup>	16102
39	<i>Muscari neglectum</i> Guss. ex Ten.	G.b	IT- ES- M	16135
	<b>Asphodelaceae</b>			
40	<i>Eremurus luteus</i> Baker	G.r	IT <sup>C</sup>	16136
41	<i>Eremurus olgae</i> Regel	G.r	IT <sup>KK - E</sup>	16624
	<b>Aspleniaceae</b>			
42	<i>Ceterach officinarum</i> Willd.	G.r	IT- ES- M	16137
	<b>Asteraceae</b>			
43	<i>Achillea biebersteinii</i> Afan.	He	IT	16138
44	<i>Achillea santolinoides</i> subsp. <i>wilhelmsii</i> (K.Koch) Greuter (= <i>Achillea wilhelmsii</i> K.Koch)	He	IT	16139
45	<i>Amberboa turanica</i> Iljin	Th	IT	16140
46	<i>Arctium umbrosum</i> Kuntze (= <i>Cousinia umbrosa</i> Bunge)	He	IT	16590
47	<i>Artemisia aucheri</i> Boiss.	Ch	IT	16650
48	<i>Artemisia diffusa</i> Krasch. ex Poljakov	Ch	IT	16651
49	<i>Artemisia khorassanica</i> Podl.	Ch	IT <sup>KK*</sup>	16652
50	<i>Artemisia kopetdaghensis</i> Krasch., M.Pop. & Lincz. ex Poljak.	Ch	IT <sup>KK - Afgh.*</sup>	16625
51	<i>Artemisia scoparia</i> Waldst. & Kitam.	Ch	PL	16626
52	<i>Artemisia turcomanica</i> Gand.	Ch	IT	16653
53	<i>Aster altaicus</i> Willd. (= <i>Heteropappus altaicus</i> (Willd.) Novopokr.)	He	IT- ES	16337
54	<i>Calendula arvensis</i> L.	Th	IT- ES- SS	16142, 16143
55	<i>Carduus pycnocephalus</i> L.	Th	IT- M	16511
56	<i>Carthamus oxyacanthus</i> M.Bieb.	Th	IT <sup>C &amp; E</sup>	16512
57	<i>Carthamus turkestanicus</i> Popov	Th	IT	16513
58	<i>Centaurea benedicta</i> (L.) L. (= <i>Cnicus benedictus</i> L.)	Th	IT- M	16147
59	<i>Centaurea bruguierana</i> (DC.) Hand.- Mzt. subsp. <i>belangerana</i> (DC.) Bornm.	Th	IT	16514
60	<i>Centaurea virgata</i> subsp. <i>squarrosa</i> (Willd.) Gugler	Ch	IT	16510
61	<i>Chardinia orientalis</i> (L.) O.Kuntze	Th	IT <sup>W &amp; C</sup>	16144
62	<i>Chondrilla juncea</i> L.	He	IT- ES- M	16145
63	<i>Cicerbita kossinskyi</i> Krasch. (= <i>Cephalorrhynchus kossinskyi</i> (Krasch.) Kirp.)	G.t	IT <sup>KK*</sup>	16588
64	<i>Cichorium intybus</i> L.	He	PL	16146
65	<i>Cota altissima</i> J.Gay (= <i>Anthemis altissima</i> L.)	Th	IT- ES- M	16141
66	<i>Cousinia arctotidifolia</i> Bunge	He	IT <sup>KK**</sup>	16627
67	<i>Cousinia eryngioides</i> Boiss.	He	IT <sup>C*</sup>	

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
68	<i>Cousinia komarowii</i> (O.Kuntze) C.Winkl.	He	IT <sup>KK*</sup>	16515
69	<i>Cousinia lyrata</i> Bunge	He	IT	16628
70	<i>Cousinia tenella</i> Fisch. & C.A.Mey.	Th	IT	16589
71	<i>Cousinia turkmenorum</i> Bornm.	He	IT <sup>KK-E</sup>	16516
72	<i>Cousiniopsis atractyloides</i> (C.Winkl.) Nevski	Th	IT <sup>KK-E</sup>	16591
73	<i>Crepis kotschyana</i> (Boiss.) Boiss.	Th	IT	16148
74	<i>Crepis pulchra</i> L. subsp. <i>turkestanica</i> Babcock	Th	IT	16149
75	<i>Crepis sancta</i> (L.) Babcock	Th	IT- M	16150
76	<i>Crupina vulgaris</i> Cass.	Th	IT- M	16517
77	<i>Dipterocome pusilla</i> Fisch. & C.A.Mey.	Th	IT	16152
78	<i>Echinops leiopolyceroides</i> Mozaff.	He	IT <sup>KK**</sup>	16592
79	<i>Echinops ritrodes</i> Bunge	He	IT <sup>C</sup>	16593
80	<i>Epilasia hemilasia</i> (Bunge) Clarke	Th	IT	16153
81	<i>Filago arvensis</i> L.	Th	IT- ES- M	16154
82	<i>Filago griffithii</i> (A.Gray) Andrés-Sánchez & Galbany (= <i>Cymbolaena griffithii</i> (A.Gay) Wagenitz)	Th	IT	16151
83	<i>Filago pyramidata</i> L.	Th	IT- ES- M	16155
84	<i>Galatella grimmi</i> (Regel & Schmalh.) Sennikov (= <i>Crinitaria grimmi</i> (Regel & Schmalh.) Grierson)	Ch	IT <sup>KK-E</sup>	16645, 45657(FUMH)
85	<i>Garhadiolus hedypnois</i> Jaub. & Spach (= <i>Garhadiolus angulosus</i> Jaub. & Spach)	Th	IT	16156
86	<i>Garhadiolus papposus</i> Boiss. & Buhse	Th	IT	16157
87	<i>Helichrysum oocephalum</i> Boiss.	He	IT <sup>C</sup>	16336
88	<i>Heteracia szovitsii</i> Fisch. & C.A.Mey. (= <i>Heteracia epapposa</i> (Regel & Schmalh.) M. pop.)	Th	IT	1658, 16159
89	<i>Jurinea catharinae</i> Iljin	Ch	IT <sup>KK**</sup>	16594
90	<i>Karelinia caspia</i> (Pall.) Less.	Ch	IT- ES	16160
91	<i>Serratula latifolia</i> Boiss.	He	IT <sup>C*</sup>	16523
92	<i>Koelpinia linearis</i> Pall.	Th	IT- SS	16161
93	<i>Lachnophyllum gossipinum</i> Bunge	Th	IT	16162
94	<i>Lactuca orientalis</i> (Boiss.) Boiss. (= <i>Scariola orientalis</i> Boiss.)	Ch	IT	16518
95	<i>Lactuca tuberosa</i> Jacq.	G.t	IT- M	16519
96	<i>Lactuca undulata</i> Ledeb.	Th	IT	16520
97	<i>Microcephala lamellata</i> (Bunge) Pobed.	Th	IT	16163
98	<i>Picnomon acarna</i> (L.) Cass.	Th	IT- M	16521
99	<i>Rhaponticum repens</i> (L.) Hidalgo (= <i>Acroptilon repens</i> (L.) DC.)	He	PL	16164
100	<i>Sclerorhachis platyrachis</i> (Boiss.) Podlech ex Rech.f.	He	IT <sup>KK*</sup>	16522
101	<i>Scorzonera leptophylla</i> (DC.) Krasch. & Lipsky	G.t	IT <sup>Cauc. - Turk.</sup>	16338
102	<i>Scorzonera litwinowii</i> Krasch. & Lipsky	G.t	IT <sup>E</sup>	16339
103	<i>Scorzonera mucida</i> Rech.f.	G.t	IT <sup>C**</sup>	16340
104	<i>Scorzonera ovata</i> Trautv.	G.t	IT	16341
105	<i>Scorzonera raddeana</i> C.Winkl.	G.t	IT <sup>C</sup>	16342
106	<i>Senecio paulsenii</i> subsp. <i>khorsanicus</i> (Rech.f. & Aell.) B.Nord.	G.r	IT <sup>C</sup>	16165
107	<i>Senecio vernalis</i> Waldst. & Kit.	Th	IT- ES	16166
108	<i>Sonchus oleraceus</i> L.	Th	PL	16167
109	<i>Tragopogon graminifolius</i> DC.	He	IT <sup>C</sup>	16168

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
110	<i>Tragopogon marginatus</i> Boiss. & Buhse	He	IT	16169
111	<i>Tussilago farfara</i> L.	G.t	IT- ES- M	16119
112	<i>Xanthium spinosum</i> L.	Th	COS	16524
113	<i>Xanthium strumarium</i> subsp. <i>brasilicum</i> (Vell.) O.Bolòs & Vigo	Th	COS	16525
114	<i>Zoegea purpurea</i> Fresen.	Th	IT- SS	16170
<b>Berberidaceae</b>				
115	<i>Bongardia chrysogonum</i> (L.) Spach	G.t	IT	16171
116	<i>Leontice leontopetalum</i> L. subsp. <i>ewersmannii</i> (Bunge) Coode	G.t	IT	16104
<b>Biebersteiniaceae</b>				
117	<i>Biebersteinia multifida</i> DC.	G.t	IT	16172
<b>Boraginaceae</b>				
118	<i>Arnebia decumbens</i> (Vent.) Coss.	Th	IT- SS	16343
119	<i>Arnebia grandiflora</i> (Trautv.) M. Pop.	Th	IT <sup>Aralo-Caspian</sup>	16344
120	<i>Asperugo procumbens</i> L.	Th	PL	16173
121	<i>Buglossoides arvensis</i> (L.) I. M. Johnst.	Th	IT- ES- M	16174
122	<i>Buglossoides tenuiflora</i> (L.f.) I. M. Johnst.	Th	IT- M	16175
123	<i>Caccinia macranthera</i> (Banks & Soland.) Brand	Th	IT	16345
124	<i>Heliotropium disciforme</i> Akhani	Th	IT <sup>KK**</sup>	16595
125	<i>Heliotropium chorassanicum</i> Bunge	Th	IT <sup>KK - Afgh. *</sup>	16629
126	<i>Heliotropium lasiocarpum</i> Fisch. & C.A.Mey.	Th	IT	16596
127	<i>Heterocaryum szovitsianum</i> (Fisch. & C.A.Mey.) A.DC. (= <i>Heterocaryum rigidum</i> DC.)	Th	IT	16597
128	<i>Lappula barbata</i> (M.Bieb.) Gurke	Th	IT- M	16176
129	<i>Lappula microcarpa</i> (Ledeb.) Gürke	Th	IT	16178
130	<i>Lappula sessiliflora</i> Gürke	Th	IT	16526
131	<i>Lappula sinaica</i> (A.DC.) Asch. & Schweinf.	Th	IT	16179
132	<i>Lappula spinocarpos</i> (Forssk.) Ascherson & O. Kuntze	Th	IT- SS	16177, 16180
133	<i>Nonea caspica</i> (Willd.) G.Don	Th	IT	16181
134	<i>Nonea turcomanica</i> Popov	Th	IT <sup>C*</sup>	16182
135	<i>Onosma dichroantha</i> Boiss.	He	IT <sup>W &amp; C</sup>	16346
136	<i>Onosma khorassanica</i> Attar & Joharchi	He	IT <sup>KK**</sup>	16598
137	<i>Onosma longiloba</i> Boiss.	He	IT <sup>KK - Alborz**</sup>	16527
138	<i>Paracaryum crista -galli</i> (Rech.f. & Riedl) Kamelin & Raenko	He	IT <sup>KK - Afgh. *</sup>	16347
139	<i>Rindera tetraspis</i> Pallas	He	IT <sup>KK - E</sup>	16630
140	<i>Rochelia bungei</i> Trautv.	Th	IT <sup>C &amp; E</sup>	16183
141	<i>Rochelia peduncularis</i> Boiss.	Th	IT	16184
142	<i>Solenanthes circinatus</i> Ledeb.	He	IT	16599
143	<i>Suchtelenia calycina</i> (C.A.Mey.) A.DC. var. <i>acanthocarpus</i> (Kar.) O. Kuntze	Th	IT	16185
<b>Brassicaceae</b>				
144	<i>Aethionema carneum</i> (Banks & Soland.) B.Fedtsch.	Th	IT	16186
145	<i>Alyssum dasycarpum</i> Steph. ex Willd.	Th	IT	16187
146	<i>Alyssum desertorum</i> Stapf	Th	IT- ES- M	16188
147	<i>Alyssum linifolium</i> Stephan ex Willd.	Th	IT- M	16189
148	<i>Alyssum muelleri</i> Boiss. & Buhse	Th	IT- ES	16190

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
149	<i>Alyssum stapfii</i> Vierh.	Th	IT	16191
150	<i>Alyssum szowitsianum</i> Fisch. & C.A.Mey.	Th	IT <sup>C</sup>	16192
151	<i>Arabis nova</i> Vill.	Th	IT- ES- M	16193
152	<i>Brassica elongata</i> Ehrh.	He	IT- ES- M	16348
153	<i>Camelina rumelica</i> Velen.	Th	IT- ES- M	16194
154	<i>Capsella bursa-pastoris</i> (L.) Medicus	Th	PL	16195
155	<i>Clypeola jonthlaspi</i> L.	Th	IT- M	16196
156	<i>Conringia perfoliata</i> (C.A.Mey.) Busch	Th	IT <sup>W &amp; C</sup>	16349
157	<i>Crambe cordifolia</i> subsp. <i>kotschyana</i> (Boiss.) Jafri (= <i>Crambe kotschyana</i> Boiss.)	He	IT	16350
158	<i>Crambe edentula</i> Fisch. & C.A.Mey. ex Korsch.	He	IT	16351, 45559 (FUMH)
159	<i>Cryptospora falcata</i> Kar. & Kir.	Th	IT	16197
160	<i>Cymatocarpus pilosissimus</i> (Trautv.) O.E.Schultz	Th	IT	16198
161	<i>Descurainia Sophia</i> (L.) Webb. & Berth	Th	PL	16199
162	<i>Diptychocarpus strictus</i> (Fisch.) Trautv.	Th	IT- ES	16200
163	<i>Eruca vesicaria</i> (L.) Cav. (= <i>Eruca sativa</i> Mill.)	Th	PL	16352
164	<i>Euclidium syriacum</i> (L.) R.Br.	Th	IT	16353
165	<i>Goldbachia laevigata</i> (M.Bieb.) DC.	Th	IT	16354
166	<i>Graellsia saxifragifolia</i> (DC.) Boiss.	He	IT <sup>C*</sup>	16528
167	<i>Isatis elegans</i> (Boiss.) Hadac & Chrtek (= <i>Sameraria elegans</i> Boiss.)	Th	IT	16206
168	<i>Isatis gymnocarpa</i> (Fisch. ex DC.) Al-Shehbaz, Moazzeni & Mumm. (= <i>Tauscheria lasiocarpa</i> Fisch. ex DC.)	Th	IT	16211
169	<i>Lepidium affghanum</i> Boiss. (= <i>Stroganowia affghana</i> (Boiss.) Pavlov)	He	IT <sup>KK - Afgh. *</sup>	16201
170	<i>Lepidium draba</i> L. (= <i>Cardaria draba</i> (L.) Desv.)	He	IT- ES	16202
171	<i>Leptaleum filifolium</i> (Willd.) DC.	Th	IT- SS	16355
172	<i>Matthiola afghanica</i> Rech. f. & Koeie	He	IT <sup>KK - Afgh. *</sup>	16356
173	<i>Matthiola alyssifolia</i> Bornm.	He	IT <sup>C &amp; E</sup>	16631
174	<i>Matthiola farinosa</i> Bunge ex Boiss.	Ch	IT <sup>C*</sup>	16357
175	<i>Neotorularia dentata</i> (Freyn & Sint.) Hedge & J.Leonard	Th	IT <sup>C</sup>	16204
176	<i>Neotorularia torulosa</i> (Desf.) Hedge & J.Leonard.	Th	IT- SS	16205
177	<i>Neslia apiculata</i> Fisch. & C.A.Mey. & Avé-Lall.	Th	IT- ES- M	16358
178	<i>Noccaea perfoliata</i> (L.) Al-Shehbaz (= <i>Thlaspi perfoliatum</i> L.)	Th	IT- ES- M	16203
179	<i>Olimarabidopsis pumila</i> (Stephan) Al -Shehbaz <i>et al.</i>	Th	IT <sup>Omi</sup>	16359
180	<i>Peltaria angustifolia</i> DC. (= <i>Peltaria turkmene</i> Lipsky)	Th	IT <sup>W &amp; C</sup>	16360
181	<i>Rapistrum rugosum</i> (L.) All.	Th	IT- ES- M	16361
182	<i>Rhammatophyllum gaudanense</i> (Litw.) Al-Shehbaz & O.Appel (= <i>Erysimum gaudanense</i> Litw.)	He	IT <sup>KK*</sup>	16632
183	<i>Sisymbrium septulatum</i> DC.	Th	IT	16207
184	<i>Spryginia winkleri</i> (Regel) Popov	Th	IT	16208, 45682 (FUMH)
185	<i>Strigosella africana</i> (L.) Botsch.	Th	IT- M- SS	16209
186	<i>Strigosella turkestanica</i> (Litv.) Botsch.	Th	IT	16210
	<b>Campanulaceae</b>			
187	<i>Campanula khorasanica</i> (Rech.f. & Aellen) Rech.f.	Th	IT <sup>KK*</sup>	16529
	<b>Cannabaceae</b>			

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
188	<i>Celtis australis</i> L. Capparidaceae	Ph	ES- M	16633
189	<i>Capparis spinosa</i> L. <b>Caprifoliaceae</b>	Ph	SCO	16366
190	<i>Lomelosia micrantha</i> (Desf.) Greuter & Burdet (= <i>Scabiosa micrantha</i> Desf.)	Th	IT- ES	16213
191	<i>Lomelosia olivieri</i> (Coulter.) Greuter & Burdet (= <i>Scabiosa olivieri</i> Coulter)	Th	IT	16212
192	<i>Lomelosia rotata</i> (M.Bieb.) Greuter & Burdet (= <i>Scabiosa rotata</i> M.Bieb.)	Th	IT	16214
193	<i>Pteroccephalus plumosus</i> (L.) Coulter	Th	IT	16215
194	<i>Valeriana ficariifolia</i> Boiss.	He	IT <sup>C &amp; E</sup>	16216
195	<i>Valeriana sisymbriifolia</i> Vahl	He	IT <sup>W &amp; C</sup>	16217
196	<i>Valerianella coronata</i> (L.) DC.	Th	IT- ES- M	16218
197	<i>Valerianella cymbocarpa</i> C.A.Mey.	Th	IT	16219
198	<i>Valerianella dufresnia</i> Bunge ex Boiss.	Th	IT	16220
199	<i>Valerianella oxyrrhyncha</i> Fisch. & C.A.Mey.	Th	IT	16221
200	<i>Valerianella platycarpa</i> Trautv.	Th	IT <sup>Cauc. - Turk.</sup>	16222
201	<i>Valerianella szovitsiana</i> Fisch. & C.A.Mey.	Th	IT <sup>Omni</sup>	16223
	<b>Caryophyllaceae</b>			
202	<i>Acanthophyllum adenophorum</i> Freyn	Ch	IT <sup>KK*</sup>	16367
203	<i>Acanthophyllum brevibracteatum</i> Lipsky	Ch	IT <sup>C*</sup>	16368
204	<i>Acanthophyllum diaphanopterum</i> (Rech.f.) A.Pirani & Moazzeni (= <i>Diaphanoptera khorasanica</i> Rech.f.)	Ch	IT <sup>KK**</sup>	16371
205	<i>Acanthophyllum glandulosum</i> Bunge ex Boiss.	Ch	IT <sup>C &amp; E</sup>	16530
206	<i>Acanthophyllum lilacinum</i> Schischk.	Ch	IT	16531
207	<i>Acanthophyllum microcephalum</i> Boiss.	Ch	IT <sup>C</sup>	16532
208	<i>Acanthophyllum pachystegium</i> Rech.f.	Ch	IT <sup>C</sup>	16533
209	<i>Acanthophyllum sordidum</i> Bunge ex Boiss.	Ch	IT	16369
210	<i>Arenaria serpyllifolia</i> L.	Th	PL	16224
211	<i>Cerastium dichotomum</i> subsp. <i>inflatum</i> Cullen (= <i>Cerastium inflatum</i> Link ex Desf.)	Th	IT	16225
212	<i>Dianthus crinitus</i> Sm. subsp. <i>turcomanicus</i> (Schischk.) Rech.f.	Ch	IT <sup>KK - Afgh.*</sup>	16370
213	<i>Dianthus polylepis</i> Bien. & Boiss.	Ch	IT <sup>KK*</sup>	16534
214	<i>Gypsophila heteropoda</i> Freyn	Th	IT	16372
215	<i>Gypsophila pilosa</i> Huds.	Th	IT	16373
216	<i>Herniaria cinerea</i> DC.	Th	PL	16226
217	<i>Herniaria hirsuta</i> L.	Th	PL	16227
218	<i>Holosteum umbellatum</i> L. subsp. <i>glutinosum</i> (M. Bieb.) Nyman	Th	IT	16228
219	<i>Lepyrodiclis holosteoides</i> (C.A.Mey.) Fenzl ex Fisch. & C.A.Mey.	Th	IT	16229
220	<i>Lepyrodiclis stellerioides</i> Schrenk ex Fisch. & C.A.Mey.	Th	IT <sup>C</sup>	16230
221	<i>Lepyrodiclis stellerioides x holosteoides</i>	Th	IT <sup>C &amp; E</sup>	16231
222	<i>Mesostemma kotschyana</i> (Fenzl ex Boiss.) Vved.	He	IT <sup>W &amp; C</sup>	16374
223	<i>Minuartia hamata</i> (Hausskn.) Matff.	Th	IT- M	16232
224	<i>Minuartia meyeri</i> (Boiss.) Bornm.	Th	IT	16233
225	<i>Silene apetala</i> Willd.	Th	IT- M	16234
226	<i>Silene brahuica</i> Boiss.	Ch	IT	16375

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
227	<i>Silene chaetodonta</i> Boiss.	Th	IT	16235
228	<i>Silene conica</i> L.	Th	ES- M	16236
229	<i>Silene conoidea</i> L.	Th	IT- M	16237
230	<i>Silene latifolia</i> Poir.	He	IT- ES- M	16376
231	<i>Silene swertiifolia</i> Boiss.	He	IT <sup>W &amp; C</sup>	16377
232	<i>Spergularia diandra</i> (Guss.) Heldr.	Th	PL	16238
233	<i>Spergularia marina</i> (L.) Besser	Th	SCO	16239
234	<i>Stellaria media</i> (L.) Vill.	Th	COS	16240
235	<i>Vaccaria hispanica</i> (Mill.) Reuschert subsp. <i>oxyodonta</i> (Boiss.) Greuter & Burdet	Th	IT	16241
236	<i>Velezia rigida</i> L.	Th	IT- M	16242
<b>Chenopodiaceae</b>				
237	<i>Anabasis aphylla</i> L.	Ch	IT <sup>C &amp; E</sup>	16610
238	<i>Anthochlamys turcomanica</i> Iljin	Th	IT <sup>KK*</sup>	16315
239	<i>Atriplex aucheri</i> Moq.	Th	IT- ES	16316
240	<i>Atriplex flabellum</i> Bunge ex Boiss.	Th	IT <sup>C &amp; E</sup>	16317
241	<i>Atriplex hortensis</i> L.	Th	PL	16318
242	<i>Atriplex leuocladia</i> Boiss.	Ch	IT- SS	16497
243	<i>Atriplex moneta</i> Bunge ex Boiss.	Th	IT	16319
244	<i>Atriplex tatarica</i> L.	Th	IT- ES- M	16320
245	<i>Bienertia cycloptera</i> Bunge	Th	IT	16646
246	<i>Blitum virgatum</i> L. (= <i>Chenopodium foliosum</i> Aschers.)	Th	PL	16498
247	<i>Caroxylon dendroides</i> (Pall.) Tzvelev. (= <i>Salsola dendroides</i> Pall.)	He	IT	16616
248	<i>Caroxylon gemmascens</i> (Pall.) Tzvelev (= <i>Salsola gemmascens</i> Pall.)	Ch	IT <sup>E</sup>	16507
249	<i>Caroxylon incanescens</i> (C.A.Mey.) Akhani & E.H.Roalson (= <i>Salsola incanescens</i> C.A.Mey.)	Th	IT	16326
250	<i>Caroxylon orientale</i> (S.G.Gmel.) Tzvelev (= <i>Salsola orientalis</i> S.G.Gmel.)	Ch	IT <sup>C &amp; E</sup>	16647
251	<i>Caroxylon scleranthum</i> (C.A.Mey.) Akhani & E.H.Roalson (= <i>Salsola sclerantha</i> C.A.Mey.)	Th	IT	16617
252	<i>Ceratocarpus arenarius</i> L.	Th	IT <sup>C &amp; E</sup>	16321
253	<i>Chenopodium album</i> L.	Th	COS	16322
254	<i>Climacoptera lanata</i> (Pall.) Botsch. (= <i>Salsola lanata</i> Pall.)	Th	IT	16509
255	<i>Climacoptera turcomanica</i> (Litv.) Botsch. (= <i>Salsola turcomanica</i> Litv.)	Ch	IT- SS	16649
256	<i>Dysphania botrys</i> (L.) Mosyakin & Clemants (= <i>Chenopodium botrys</i> L.)	Th	PL	16499
257	<i>Girgensohnia oppositiflora</i> (Pall.) Fenzl	Th	IT	16324
258	<i>Halimocnemis gamocarpa</i> Moq. (= <i>Gamanthus gamocarpus</i> (Moq.) Bunge)	Th	IT	16323
259	<i>Halimocnemis mollissima</i> Bunge	Th	IT	16500
260	<i>Halocharis hispida</i> (Schrenk) Bunge	Th	IT <sup>E &amp; Aralo-Caspian</sup>	16501
261	<i>Halocharis sulphurea</i> (Moq.) Moq.	Th	IT- SS	16502
262	<i>Halocnemum strobilaceum</i> (Pall.) M.Bieb.	Ch	IT- M- SS	16611
263	<i>Halostachys belangeriana</i> (Moq.) Botsch.	Ph	IT	16612
264	<i>Halothamnus glaucus</i> (M.Bieb.) Botsch.	Ch	IT	16613

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APPENDIX. (Continued)

No.	Families and species/infraspecific taxa	Life- form	Chorotype	Voucher No.
265	<i>Halothamnus oxianus</i> Botsch.	Ch	IT	16614
266	<i>Halothamnus subaphyllus</i> (C.A.Mey.) Botsch.	Ch	IT	16615
267	<i>Haloxylon ammodendron</i> (C.A.Mey.) Bunge ex Fenzl	Ph	IT <sup>Aralo-Caspian &amp; C</sup>	16503
268	<i>Kaviria gossypina</i> (Bunge) Akhani (= <i>Salsola gossypina</i> Bunge)	Th	IT	16325
269	<i>Kaviria tomentosa</i> (Moq.) Akhani (= <i>Salsola tomentosa</i> (Moq.) Spach)	Ch	IT	16648
270	<i>Krascheninnikowia ceratoides</i> (L.) Gueldenst.	Ch	IT- ES- M	16504
271	<i>Noaea mucronata</i> (Forssk.) Aschers. & Schweinf.	Ch	IT- ES- M	16505
272	<i>Salicornia europaea</i> L.	Th	IT- ES- M	16506
273	<i>Salsola kali</i> L. subsp. <i>tragus</i> (L.) Neyman	Th	IT	16508
274	<i>Spinacia turkestanica</i> Iljin	Th	IT <sup>C &amp; E</sup>	16327
275	<i>Suaeda altissima</i> (L.) Pall.	Th	IT- M	16618
276	<i>Suaeda microphylla</i> Pall.	Ch	IT	16619
277	<i>Suaeda microsperma</i> (C.A.Mey.) Fenzl	Th	IT <sup>Aralo-Caspian</sup>	16620
<b>Cistaceae</b>				
278	<i>Helianthemum ledifolium</i> (L.) Mill.	Th	IT- M	16378
279	<i>Helianthemum salicifolium</i> (L.) Mill.	Th	IT- M	16379
<b>Cleomaceae</b>				
280	<i>Cleome coluteoides</i> Boiss.	He	IT <sup>W &amp; C</sup>	16380
<b>Colchicaceae</b>				
281	<i>Colchicum robustum</i> (Bunge) Stefanov	G.c	IT <sup>C &amp; E</sup>	16100
<b>Convolvulaceae</b>				
282	<i>Convolvulus arvensis</i> L.	He	SCO	16381
283	<i>Convolvulus dorycnium</i> L. subsp. <i>subhirsutus</i> (Regel & Schmalh.) Saad	He	IT <sup>C &amp; E</sup>	16535
284	<i>Convolvulus fruticosus</i> Pall.	Ch	IT	16382
285	<i>Cressa cretica</i> L.	He	PL	16634
286	<i>Cuscuta campestris</i> Yunck.	Th	PL	16383
287	<i>Cuscuta europaea</i> L. (= <i>Cuscuta brevistyla</i> A.Braun ex A.Rich.)	Th	PL	16600
288	<i>Cuscuta epithimum</i> (L.) L. var. <i>kotschyi</i> (Des Moul.) Arcang.	Th	IT- ES- M	16601
<b>Crassulaceae</b>				
289	<i>Pseudosedum multicaule</i> (Boiss. & Buhse) Boiss.	He	IT <sup>C</sup>	16602
290	<i>Sedum hispanicum</i> L.	Th	IT- ES	16603
<b>Cucurbitaceae</b>				
291	<i>Bryonia aspera</i> Stev. ex Ledeb.	He	IT	16536
<b>Cupressaceae</b>				
292	<i>Juniperus polycarpus</i> K.Koch var. <i>turcomanica</i> (B.Fedtsch.) R.P.Adams	Ph	IT <sup>KK*</sup>	16537
<b>Cyperaceae</b>				
293	<i>Carex stenophylla</i> Wahlenb.	He	PL	16538
294	<i>Cyperus rotundus</i> L.	G.r	SCO	16539
<b>Ephedraceae</b>				
295	<i>Ephedra foliata</i> Boiss. ex C.A.Mey.	Ch	IT- SS	16540
296	<i>Ephedra intermedia</i> Schrenk & C.A.Mey.	Ph	IT <sup>C</sup>	16541
<b>Euphorbiaceae</b>				
297	<i>Chrozophora tinctoria</i> (L.) A.Juss.	Th	IT- M- SS	16635

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
298	<i>Euphorbia aucheri</i> Boiss.	Th	IT <sup>C</sup>	16384
299	<i>Euphorbia buhsei</i> Boiss.	He	IT	16385
300	<i>Euphorbia bungei</i> Boiss.	He	IT <sup>W &amp; C</sup>	16386
301	<i>Euphorbia densa</i> Schrenk	Th	IT	16387
302	<i>Euphorbia falcate</i> L.	Th	IT- ES- M	16388
303	<i>Euphorbia franchetii</i> B.Fedtsch.	Th	IT <sup>KK - E</sup>	16389
304	<i>Euphorbia granulata</i> Forssk.	Th	IT- SS	16390
305	<i>Euphorbia kopetdaghi</i> (Prokh.) Prokh.	He	IT <sup>KK*</sup>	16542
306	<i>Euphorbia microsciadia</i> Boiss.	He	IT <sup>C</sup>	16543
307	<i>Euphorbia szovitsii</i> Fisch. & C.A.Mey.	Th	IT	16391
<b>Fabaceae</b>				
308	<i>Alhagi maurorum</i> Medikus (= <i>Alhagi camelorum</i> DC.)	He	IT- M- SS	16392
309	<i>Astragalus (Ammodendron) androssovianus</i> Gontsch.	Ch	IT <sup>KK*</sup>	16604, 45962 (FUMH)
310	<i>Astragalus (Ammodendron) macrobotrys</i> Bunge	Ch	IT	16405
311	<i>Astragalus (Ankylotus) commixtus</i> Bunge	Th	IT	16398
312	<i>Astragalus (Annulares) campylorhynchus</i> Fisch. & C.A.Mey.	Th	IT <sup>C &amp; E</sup>	16394
313	<i>Astragalus (Annulares) crenatus</i> Schulte	Th	IT- SS	16399
314	<i>Astragalus (Anthylloidei) raddei</i> Basil.	Ch	IT <sup>KK*</sup>	16410
315	<i>Astragalus (Caprini) jarmolenkoi</i> Gontsch.	He	IT <sup>KK*</sup>	16403
316	<i>Astragalus (Caprini) nephtonensis</i> Freyn	He	IT <sup>KK - Afgh. *</sup>	16407
317	<i>Astragalus (Cremoceras) pendulinus</i> Popov & B.Fedtsch.	He	IT <sup>KK*</sup>	16409
318	<i>Astragalus (Dissitiflori) juratzkanus</i> Freyn & Sint.	He	IT	16404
319	<i>Astragalus (Erionotus) citrinus</i> Bunge subsp. <i>citrinus</i>	He	IT <sup>C</sup>	16396
320	<i>Astragalus (Erionotus) citrinus</i> subsp. <i>barrowianus</i> (Aitch. & Baker) Podlech	He	IT <sup>KK - Afgh. *</sup>	16397
321	<i>Astragalus (Erionotus) curvipes</i> Trautv.	He	IT <sup>KK*</sup>	16400
322	<i>Astragalus (Heterodontus) guttatus</i> Banks & Soland.	Th	IT	16402
323	<i>Astragalus (Incani) mercklinii</i> Boiss. & Buhse	He	IT <sup>C</sup>	16406
324	<i>Astragalus (Malacothrix) suluklensis</i> Freyn & Sint.	He	IT <sup>KK*</sup>	16411
325	<i>Astragalus (Oxyglottis) oxyglottis</i> M.Bieb.	Th	IT- M	16408
326	<i>Astragalus (Platonychium) verus</i> Olivier	Ch	IT <sup>C</sup>	16544
327	<i>Astragalus (Rhacophorus) cerasocrenus</i> Bunge	He	IT <sup>KK*</sup>	16395
328	<i>Astragalus (Sesamei) filicaulis</i> Kar. & Kir.	Th	IT <sup>C &amp; E</sup>	16401
329	<i>Astragalus (Sesamei) tribuloides</i> Del.	Th	IT- SS	16412
330	<i>Cercis griffithii</i> Boiss.	Ph	IT- M	16636
331	<i>Chesneya astragalina</i> Jaub. & Spach	He	IT	16413
332	<i>Colutea buhsei</i> (Boiss.) Shap.	Ph	IT <sup>KK - Alborz *</sup>	16414
333	<i>Cullen drupaceum</i> (Bunge) C.H.Strit. (= <i>Psoralea drupacea</i> Bunge)	He	IT <sup>C &amp; E</sup>	16549
334	<i>Glycyrrhiza glabra</i> L.	G.r	IT- ES- M	16415
335	<i>Hedysarum kalatense</i> Dehshiri	He	IT	16416
336	<i>Medicago lupulina</i> L.	Th	PL	16417
337	<i>Medicago minima</i> (L.) Bartalini	Th	PL	16248
338	<i>Medicago monantha</i> (C.A.Mey.) Trautv. (= <i>Trigonella monantha</i> C.A.Mey.)	Th	IT	16545
339	<i>Medicago radiata</i> L.	Th	IT	16249

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
340	<i>Medicago rigidula</i> (L.) All.	Th	IT- M	16250
341	<i>Onobrychis chorassanica</i> Boiss.	He	IT <sup>KK-E</sup>	16546
342	<i>Onobrychis cornuta</i> (L.) Desv.	Ch	IT <sup>Omni</sup>	16547
343	<i>Onobrychis micrantha</i> Schrenk	Th	IT	16251
344	<i>Onobrychis verae</i> Sirj.	He	IT <sup>KK-Afgh.*</sup>	16418
345	<i>Oxytropis suavis</i> Boriss. (= <i>Oxytropis kuchanensis</i> Vassilcz.; = <i>O. bicornis</i> Vassilcz.)	He	IT <sup>KK*</sup>	16419
346	<i>Prosopis farcta</i> (Sol. ex Russell) McBride	Ch	IT- SS	16548
347	<i>Sophora lehmannii</i> (Bunge) Yakovlev (= <i>Ammothamnus lehmannii</i> Bunge)	He	IT	16393
348	<i>Sophora pachycarpa</i> C.A.Mey.	He	IT <sup>C&amp;E</sup>	16420
349	<i>Trigonella coerulescens</i> (M.Bieb.) Halacsy	Th	IT	16550
350	<i>Vicia subvillosa</i> (Ledeb.) Boiss.	G.r	IT <sup>C&amp;E</sup>	16421
	<b>Frankeniaceae</b>			
351	<i>Frankenia pulverulenta</i> L.	Th	IT- ES- M	16637
	<b>Gentianaceae</b>			
352	<i>Gentiana olivieri</i> Griseb.	G.r	IT	16422
	<b>Geraniaceae</b>			
353	<i>Erodium ciconium</i> (Jusl.) L'Her. ex Aiton	Th	IT- M	16252
354	<i>Erodium cicutarium</i> (L.) L'Her. ex Aiton	Th	IT- ES- M	16253
355	<i>Erodium litwinowii</i> Woronow	Th	IT <sup>E</sup>	16423
356	<i>Erodium oxyrhynchum</i> M.Bieb.	Th	IT- SS	16424
357	<i>Geranium kotschyi</i> Boiss.	G.t	IT <sup>C*</sup>	16254
	<b>Hypericaceae</b>			
358	<i>Hypericum helianthemoides</i> (Spach) Boiss.	He	IT <sup>C</sup>	16425
359	<i>Hypericum perforatum</i> L.	He	PL	16426
	<b>Iridaceae</b>			
360	<i>Gladiolus atrovioleaceus</i> Boiss.	G.b	IT- M	16105
361	<i>Iris fosteriana</i> Aitch. & Baker	G.t	IT <sup>KK-Afgh.*</sup>	16244
362	<i>Iris kopetdagensis</i> (Vved.) Mathew & Wndelbo	G.t	IT <sup>KK-Afgh.*</sup>	16245
363	<i>Iris songarica</i> Schrenk	G.r	IT <sup>C&amp;E</sup>	16246
364	<i>Moraea sisyrrinchium</i> (L.) Ker Gawl.	G.b	IT- M	16106
	<b>Ixioliriaceae</b>			
365	<i>Ixiolirion tataricum</i> (Pall.) Herb.	G.b	IT	16243
	<b>Juncaceae</b>			
366	<i>Juncus inflexus</i> L.	He	PL	16427
367	<i>Juncus rigidus</i> Desf.	He	PL	16428
	<b>Lamiaceae</b>			
368	<i>Clinopodium graveolens</i> (M.Bieb.) Kuntze (= <i>Acinos graveolens</i> (M.Bieb.) Link)	Th	IT- ES- M	16255
369	<i>Hymenocrater bituminosus</i> Fisch. & C.A.Mey.	Ch	IT <sup>C</sup>	16429
370	<i>Hymenocrater calycinus</i> Benth.	Ch	IT <sup>KK-Alborz*</sup>	16430
371	<i>Lagochilus khorassanicus</i> Zeraatkar, F.Ghahrem. & Joharchi	Ch	IT <sup>KK*</sup>	16431
372	<i>Lallemantia iberica</i> (M.Bieb.) Fisch. & C.A.Mey.	Th	IT- M	16256
373	<i>Lallemantia royleana</i> (Benth.) Benth.	Th	IT <sup>Omni</sup>	16257
374	<i>Lamium amplexicaule</i> L.	Th	SCO	16258

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APPENDIX. (Continued)

No.	Families and species/infraspecific taxa	Life- form	Chorotype	Voucher No.
375	<i>Marrubium vulgare</i> L.	He	PL	16432
376	<i>Nepeta pungens</i> (Bunge) Benth.	Th	IT <sup>C &amp; E</sup>	16638
377	<i>Phlomis cancellata</i> Bunge	He	IT <sup>KK - Afgh. *</sup>	16433
378	<i>Phlomoides boissieriana</i> (Regel) Adylov, Kamelin & Makhm. (= <i>Eremostachys boissieriana</i> Regel)	He	IT <sup>E</sup>	16551
379	<i>Phlomoides labiosa</i> (Bunge) Adylov, Kamelin & Makhm. (= <i>Eremostachys labiosa</i> Bunge)	He	IT <sup>KK - E</sup>	16639
380	<i>Phlomoides molucelloides</i> (Bunge) Salmaki (= <i>Eremostachys molucelloides</i> Bunge)	G.t	IT <sup>W &amp; C</sup>	16640
381	<i>Salvia abrotanoides</i> (Kar.) Sytsma (= <i>Perovskia abrotanoides</i> Kar.)	Ch	IT <sup>C &amp; E</sup>	16552
382	<i>Salvia chlorolauca</i> Rech.f. & Aellen	He	IT <sup>KK - Alborz *</sup>	16434
383	<i>Salvia macrosiphon</i> Boiss.	He	IT	16435
384	<i>Salvia sclarea</i> L.	He	IT- M	16436
385	<i>Salvia virgata</i> Jacq.	He	IT- M	16437
386	<i>Scutellaria litwinowii</i> Bornm. & Sint.	Ch	IT <sup>C *</sup>	16438
387	<i>Siderites montana</i> L.	Th	IT- ES- M	16439
388	<i>Teucrium polium</i> L.	Ch	IT- M	16440
389	<i>Thymus transcaspicus</i> Klokov	Ch	IT <sup>KK *</sup>	16441
390	<i>Ziziphora clinopodioides</i> Lam.	Ch	IT- ES	16442
391	<i>Ziziphora tenuior</i> L.	Th	IT <sup>Omni</sup>	16259
<b>Liliaceae</b>				
392	<i>Gagea chomutovae</i> Pascher	G.b	IT <sup>C &amp; E</sup>	16113
393	<i>Gagea gageoides</i> (Zucc.) Vved.	G.b	IT <sup>W &amp; C</sup>	16114
394	<i>Gagea reticulata</i> (Pall.) Schult. & Schult.f.	G.b	IT	16115
395	<i>Gagea setifolia</i> Baker	G.b	IT	16116
396	<i>Gagea vegeta</i> Vved.	G.b	IT <sup>C &amp; E</sup>	16117
397	<i>Tulipa biflora</i> Pall.	G.b	IT <sup>C &amp; E</sup>	16118
398	<i>Tulipa undulatifolia</i> Boiss. var. <i>micheliana</i> (Hoog) Wilford (= <i>Tulipa micheliana</i> Hoog)	G.b	IT <sup>KK - Alborz *</sup>	16260
<b>Linaceae</b>				
399	<i>Linum corymbulosum</i> Reichenb.	Th	PL	16261
<b>Malvaceae</b>				
400	<i>Alcea rhyticarpa</i> (Trautv.) Iljin	He	IT <sup>KK - E</sup>	16443
401	<i>Malva neglecta</i> Wallr.	He	PL	16444
<b>Moraceae</b>				
402	<i>Ficus carica</i> L.	Ph	IT- M	16553
<b>Nitrariaceae</b>				
403	<i>Nitraria schoberi</i> L.	Ch	IT <sup>Omni</sup>	16605
404	<i>Peganum harmala</i> L.	He	IT- M- SS	16554
<b>Orobanchaceae</b>				
405	<i>Leptorhabdos parviflora</i> (Benth.) Benth.	Th	IT <sup>C &amp; E</sup>	16262
406	<i>Orobanche cernua</i> Loefl.	G.p	IT- M- SS	16445
407	<i>Orobanche kotschy</i> Reut.	G.p	IT	16446
408	<i>Orobanche oxyloba</i> (Reut.) G.Beck	G.p	IT	16447
409	<i>Parentucellia latifolia</i> Caruel	Th	IT- M	16263
<b>Papaveraceae</b>				

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
410	<i>Fumaria parviflora</i> Lam.	Th	IT- ES- M	16264
411	<i>Fumaria vaillantii</i> Loisel.	Th	IT- ES- M	16265
412	<i>Glaucium elegans</i> Fisch. & C.A.Mey.	Th	IT <sup>C&amp;E</sup>	16266
413	<i>Glaucium fimbrilligerum</i> Boiss.	Th	IT	16267
414	<i>Hypecoum pendulum</i> L.	Th	IT- M	16268
415	<i>Papaver dubium</i> L.	Th	PL	16269
416	<i>Papaver pavoninum</i> Fisch. & C.A.Mey.	Th	IT <sup>C&amp;E</sup>	16448
417	<i>Roemeria hybrida</i> (L.) DC. subsp. <i>dodecandra</i> (Forssk.) Maire	Th	IT- M- SS	16270
418	<i>Roemeria refracta</i> DC.	Th	IT	16271
<b>Phrymaceae</b>				
419	<i>Dodartia orientalis</i> L.	He	IT	16555
<b>Phyllanthaceae</b>				
420	<i>Andrachne telephioides</i> L.	He	IT- M- SS	16449
<b>Plantaginaceae</b>				
421	<i>Holzneria spicata</i> (Korovin) Speta	Th	IT	16272
422	<i>Linaria khorasanensis</i> Hamdi & Assadi	He	IT <sup>KK**</sup>	16641
423	<i>Linaria micrantha</i> (Cav.) Hoffmanns. & Link	Th	IT- M	16273
424	<i>Linaria simplex</i> DC.	Th	IT- M	16274
425	<i>Linaria striatella</i> Kuprian.	He	IT	16450
426	<i>Plantago lagocephala</i> Bunge	Th	IT	16642, 45716 (FUMH)
427	<i>Plantago lanceolata</i> L.	He	IT- ES- M	16451
428	<i>Plantago ovata</i> Forssk.	Th	IT- SS	16452
429	<i>Veronica campylopoda</i> Boiss. (= <i>Veronica capillipes</i> Nevski)	Th	IT <sup>Omni</sup>	16275
430	<i>Veronica intercedens</i> Bornm.	Th	IT <sup>C&amp;E</sup>	16276
431	<i>Veronica polita</i> Fr.	Th	PL	16277
<b>Plumbaginaceae</b>				
432	<i>Acantholimon bodeanum</i> Bunge	Ch	IT <sup>KK - Alborz**</sup>	16453
433	<i>Acantholimon pterostegium</i> Bunge	Ch	IT <sup>KK*</sup>	16454
434	<i>Cephalorhizum turcomanicum</i> M.Pop. ex Lincz.	He	IT <sup>KK*</sup>	16455
435	<i>Limonium gmelinii</i> (Willd.) Kuntze	He	IT- ES	16606
436	<i>Limonium reniforme</i> (Girard) Lincz.	He	IT	16607
<b>Poaceae</b>				
437	<i>Aegilops cylindrica</i> Host	Th	IT	16278
438	<i>Aegilops tauschii</i> Cosson	Th	IT <sup>C</sup>	16279
439	<i>Aegilops triuncialis</i> L.	Th	IT- M	16280
440	<i>Aeluropus littoralis</i> (Gouan) Parl.	He	IT- M- SS	16608
441	<i>Avena barbata</i> Pott ex Link	Th	IT- M- SS	16281
442	<i>Boissiera squarrosa</i> (Banks & Soland.) Nevski	Th	IT- M	16282
443	<i>Bromus briziformis</i> Fisch. & C.A.Mey.	Th	IT <sup>Cauc. - Turk.</sup>	16283
444	<i>Bromus danthoniae</i> Trin.	Th	PL	16284
445	<i>Bromus kopetdaghensis</i> Drobov	He	IT <sup>KK - Alborz*</sup>	16556
446	<i>Bromus oxyodon</i> Schrenk	Th	IT <sup>C&amp;E</sup>	16285
447	<i>Bromus pseudodanthoniae</i> Drobow	Th	IT	16286
448	<i>Bromus tectorum</i> L.	Th	PL	16287

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
449	<i>Bromus turcomanicus</i> H.Scholz	Th	IT <sup>KK*</sup>	16557
450	<i>Cynodon dactylon</i> (L.) Pers.	He	PL	16288
451	<i>Dactylis glomerata</i> L.	He	PL	16289
452	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Th	COS	16290
453	<i>Enneapogon persicus</i> Boiss.	He	IT	16558
454	<i>Eremopoa persica</i> (Trin.) Roshev.	Th	IT- M	16559
455	<i>Eremopyrum bonaepartis</i> (Spreng.) Nevski	Th	IT	16291
456	<i>Eremopyrum orientale</i> (L.) Jaub. & Spach	Th	IT- M	16292
457	<i>Heterantherium piliferum</i> (Banks & Soland.) Hochst.	Th	IT	16292
458	<i>Hordeum bulbosum</i> L.	He	IT- M	16456
459	<i>Hordeum murinum</i> L.	Th	IT- M	16293
460	<i>Lolium subulatum</i> (Banks & Soland.) Eig	He	IT	16457
461	<i>Lolium rigidum</i> Gaudin	Th	IT- M	16294
462	<i>Melica persica</i> Kunth	He	IT	16560
463	<i>Pennisetum orientale</i> Rich.	He	IT- SS	16561
464	<i>Phalaris minor</i> Retz.	Th	COS	16295
465	<i>Phleum paniculatum</i> Hudson	Th	IT <sup>W&amp;C</sup>	16458
466	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	He	SCO	16609
467	<i>Poa bulbosa</i> L.	He	IT- ES- M	16459
468	<i>Polypogon fugax</i> Nees ex Steud.	He	PL	16460
469	<i>Polypogon viridis</i> (Forssk.) Breistr.	Th	PL	16296
470	<i>Rostraria cristata</i> (L.) Tzvelev	Th	PL	16297
471	<i>Rostraria pumila</i> (Desf.) Tzvelev	Th	IT- M- SS	16298
472	<i>Schismus arabicus</i> Nees	Th	IT- M- SS	16299
473	<i>Sorghum halepense</i> (L.) Pers.	G.r	PL	16461
474	<i>Stipa arabica</i> Trin. & Rupr.	He	IT	16562
475	<i>Stipa caucasica</i> Schmalh.	He	IT	16462
476	<i>Stipa lessingiana</i> Trin. & Rupr.	He	IT- ES	16563
477	<i>Stipagrostis plumosa</i> (L.) Munro ex T.Anders.	He	IT- SS	16463
478	<i>Taenatherum caput-medosae</i> (L.) Nevski	Th	IT- ES- M	16300
479	<i>Vulpia myuros</i> (L.) C.C.Gmel.	Th	IT- M	16564
480	<i>Vulpia persica</i> (Boiss. & Buhse) V. Krecz. & Bobrov	Th	IT	16565
	<b>Portulacaceae</b>			
481	<i>Portulaca oleracea</i> L.	Th	IT- ES- M	16301
	<b>Polygonaceae</b>			
482	<i>Atraphaxis intricata</i> Mozaff.	Ch	IT <sup>KK**</sup>	16643
483	<i>Atraphaxis spinosa</i> L.	Ch	IT	16464
484	<i>Polygonum arenastrum</i> Bureau	Th	SCO	16566
485	<i>Polygonum argyrocoleon</i> Steud. ex Kunze	Th	IT	16567
486	<i>Polygonum aviculare</i> L.	Th	COS	16465
487	<i>Rheum turkestanicum</i> Janischew.	G.r	IT <sup>KK-E</sup>	16568
488	<i>Rumex tuberosus</i> L. subsp. <i>turcomanicus</i> (Rech.f.) Rech.f. (= <i>Rumex turcomanicus</i> Czerep.)	G.t	IT <sup>Cauc. - Turk.</sup>	16569
	<b>Primulaceae</b>			
489	<i>Androsace maxima</i> L.	Th	IT- ES- M	16303

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
490	<i>Dionysia tapetodes</i> Bunge	Ch	IT <sup>KK - Afgh. *</sup>	16103
491	<i>Lysimachia arvensis</i> var. <i>caerulea</i> (L.) Turland & Bergmeier (= <i>Anagallis arvensis</i> var. <i>caerulea</i> (L.) Gouan)	Th	PL	16302
<b>Pteridaceae</b>				
492	<i>Cheilanthes persica</i> (Bory) Mett. ex Kuhn	G.r	IT- M	16304
<b>Ranunculaceae</b>				
493	<i>Adonis aestivalis</i> L. subsp. <i>parviflora</i> Fisch. ex DC.	Th	IT- ES- M	16305
494	<i>Anemone biflora</i> var. <i>petiolulosa</i> (Juz.) Ziman (= <i>Anemone petiolulosa</i> Juz.)	G.t	IT <sup>C &amp; E</sup>	16306
495	<i>Ceratocephala falcata</i> (L.) Pers.	Th	IT- ES- M	16307
496	<i>Consolida leptocarpa</i> Nevski	Th	IT <sup>C</sup>	16466
497	<i>Consolida rugulosa</i> (Boiss.) Schrödinger	Th	IT <sup>C</sup>	16467
498	<i>Delphinium semibarbatum</i> Bienert ex Boiss.	He	IT	16570
499	<i>Delphinium turkmenum</i> Lipsky	G.r	IT <sup>KK *</sup>	16468
500	<i>Nigella integrifolia</i> Regel	Th	IT <sup>C &amp; E</sup>	16308
501	<i>Ranunculus oxyspermus</i> Willd.	G.r	IT <sup>W &amp; C</sup>	16469
502	<i>Ranunculus sewerzowii</i> Regel (= <i>Ranunculus leptorrhynchus</i> Aitch. & Hemsl.)	G.t	IT- ES	16470
503	<i>Thalictrum isopyroides</i> C.A.Mey.	G.r	IT <sup>Omni</sup>	16571
504	<i>Thalictrum minus</i> L.	He	PL	16572
505	<i>Thalictrum sultanabadense</i> Stapf	He	IT <sup>C</sup>	16573
<b>Resedaceae</b>				
506	<i>Ochradenus ochradeni</i> (Boiss.) Abdallak	Ch	IT	16471
507	<i>Reseda lutea</i> L.	He	IT- ES- M	16472
<b>Rhamnaceae</b>				
508	<i>Rhamnus pallasii</i> Fisch. & C.A.Mey. subsp. <i>sintenisii</i> (Rech.f.) Browicz & J.Zieliński	Ph	IT- ES	16574
<b>Rosaceae</b>				
509	<i>Cotoneaster nummularioides</i> Pojark.	Ph	IT	16575
510	<i>Cotoneaster ovatus</i> Pojark.	Ph	IT <sup>KK - Alborz *</sup>	16576
511	<i>Prunus microcarpa</i> C.A.Mey. (= <i>Cerasus microcarpa</i> (C.A.Mey.) Boiss.)	Ph	IT <sup>W &amp; C</sup>	16644
512	<i>Prunus turcomanica</i> (Lincz.) Kitam. (= <i>Amygdalus spinosissima</i> Bunge subsp. <i>turcomanica</i> (Lincz.) Browicz)	Ph	IT <sup>KK *</sup>	16473
513	<i>Rosa persica</i> Michx. ex Juss.	Ch	IT <sup>C &amp; E</sup>	16474
514	<i>Sanguisorba minor</i> Scop.	He	IT- ES- M	16475
<b>Rubiaceae</b>				
515	<i>Asperula glomerata</i> subsp. <i>turcomanica</i> (Pobed.) Ehrend. & Schonb. –Tem.	Ch	IT	16476
516	<i>Callipeltis cucullaria</i> (L.) Stev.	Th	IT- M	16309
517	<i>Crucianella gilanica</i> subsp. <i>transcaspica</i> (Ehrend.) Ehrend. & Schonb. –Tem.	He	IT	16477
518	<i>Galium setaceum</i> Lam.	Th	IT- M	16310
519	<i>Galium spurium</i> L.	Th	IT- ES- M	16311
520	<i>Galium tricornutum</i> Dandy	Th	IT- ES- SS	16478
521	<i>Galium verticillatum</i> Danth. ex Lam.	Th	IT- M	16479
522	<i>Galium verum</i> L.	He	PL	16480
523	<i>Plocama bruguieri</i> (A.Rich. ex DC.) M.Backlund & Thulin (= <i>Gaillonia bruguierii</i> A.Rich. ex DC.)	He	IT	16481

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APPENDIX. (Continued)

No.	Families and species/intraspecific taxa	Life- form	Chorotype	Voucher No.
524	<i>Rubia rechingeri</i> Ehrend. <b>Rutaceae</b>	Ch	IT <sup>KK - Alborz *</sup>	16482
525	<i>Haplophyllum obtusifolium</i> (Ledeb.) Ledeb.	He	IT <sup>Aralo-Caspian &amp; C</sup>	16483
526	<i>Haplophyllum pedicellatum</i> Bunge ex Boiss. (= <i>Haplophyllum pilosum</i> Stschegleev ex Turcz.) <b>Santalaceae</b>	He	IT <sup>C &amp; E</sup>	16484
527	<i>Thesium kotschyanum</i> Boiss. <b>Scrophulariaceae</b>	G.r	IT <sup>W &amp; C</sup>	16485
528	<i>Scrophularia striata</i> Boiss.	He	IT	16577
529	<i>Scrophularia variegata</i> M.Bieb.	He	IT <sup>C</sup>	16578
530	<i>Verbascum sinuatum</i> L.	He	IT- M	16486
531	<i>Verbascum speciosum</i> Schrad. <b>Solanaceae</b>	He	IT- M	16579
532	<i>Hyoscyamus pusillus</i> L.	Th	IT- SS	16312
533	<i>Hyoscyamus turcomanicus</i> Pojark.	He	IT <sup>E</sup>	16487
534	<i>Lycium depressum</i> Stocks	Ph	IT	16580
535	<i>Lycium ruthenicum</i> Murray	Ph	IT	16581
536	<i>Solanum nigrum</i> L. <b>Tamariaceae</b>	Th	COS	16488
537	<i>Reaumuria alternifolia</i> (Labill.) Britten var. <i>latifolia</i> (M.Bieb.) Trautv.	Ch	IT	16489
538	<i>Tamarix karakalensis</i> Freyn & Sint.	Ph	IT	16582
539	<i>Tamarix kotschyi</i> Bunge	Ph	IT	16490
540	<i>Tamarix meyeri</i> Boiss.	Ph	IT	16583
541	<i>Tamarix polystachya</i> Ledeb. <b>Thymelaeaceae</b>	Ph	IT	16491
542	<i>Diarthron antoninae</i> (Pobed.) Kit Tan (= <i>Stelleropsis antoninae</i> Pobed.)	Ch	IT <sup>KK - Alborz *</sup>	16492
543	<i>Diarthron vesiculosum</i> C.A.Mey. <b>Urticaceae</b>	Th	IT	16314
544	<i>Parietaria judaica</i> L. <b>Verbenaceae</b>	Ch	IT- ES- M	16584
545	<i>Verbena officinalis</i> L. <b>Violaceae</b>	He	PL	16493
546	<i>Viola occulta</i> Lehm. <b>Zygophyllaceae</b>	Th	IT <sup>Omni</sup>	16313
547	<i>Tribulus terrestris</i> L.	Th	PL	16585
548	<i>Zygophyllum atriplicoides</i> Fisch. & C.A.Mey.	Ph	IT	16494
549	<i>Zygophyllum fabago</i> L.	He	IT	16586