Research paper

Plant diversity of Hyrcanian relict forests: An annotated checklist, chorology and threat categories of endemic and near endemic vascular plant species

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A B S T R A C T

In this paper a critical annotated checklist of 256 endemic and near endemic species belonging to 152 genera and 50 families of flowering plants known from Hyrcanian relict forests is presented. Distribution maps of taxa, elevational range, number of known records, chorotypes, life forms, IUCN threat categories and habitat types are also provided. The chorotypes are categorized into eight main patterns: 1) the Omni-Hyrcanian pattern (OH), 2) West Hyrcanian pattern (WH), 3) Manjil-Rudbar pattern (MR), 4) Central Hyrcanian pattern (CH), 5) Central and East Hyrcanian pattern (CEH), 6) East Hyrcanian pattern (EH), 7) Alborz-Hyrcanian pattern (AH), and 8) Euxino-Hyrcanian pattern (XH). The richness and distribution maps were generated based on 5408 records gained from herbarium specimens and literature records. The life form spectra show that the majority of taxa (54.7%) belong to hemicryptophytes, followed by the tuberous, bulbous and parasitic geophytes with 45 species (17.6%) and phanerophytes with 28 taxa (10.9%). The conservation status of species according to IUCN criteria indicates that 30 taxa are Critically Endangered, 52 taxa Endangered, 30 taxa Vulnerable, 25 taxa Near Threatened and 81 taxa are of Least Concern. Our present data were not sufficient to evaluate 38 taxa that are categorized here as Data Deficient. The new combination of Leutea translucens (= Peucedanum translucens) is validated with inclusion of Peucedanum hyrcanicum as its synonym. The disjunct occurrence of the Caucasian species Gentiana grossheimii is reported from the eastern parts of the Hyrcanian forests in Iran for the first time. We conclude that (i) the Hyrcanian forests and associated habitats in the northern slopes of the Alborz Mountains harbour tremendous floristic diversity of high conservation priority, and (ii) the Hyrcanian forest zone is an important and unique center of endemism within the Euro-Siberian region that should be considered a floristic province with a large number of relict species.

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1. Introduction

The Hyrcanian forests stretch as a green continuous arc from the Talish in Azerbaijan Republic, cover the northern slopes of the Alborz Mountains along three Iranian Provinces (Gilan, Mazandaran and Golestan) and end in Golestan National Park (GNP) (Fig. 1). There are some isolated outliers of the Hyrcanian forests in North Khorassan Province (Jowzak area) and East Azerbaijan Province in the Arasbaran Protected Area (APA) (Akhani et al., 2010 and references therein). The area is climatically and topographically very heterogeneous, with a unique flora and vegetation (Frey and Probst, 1986; Akhani et al., 2010). These forests have a surface area of about 1.9 mio ha in Iran and 0.1 mio ha in Azerbaijan (Anonymous, 2010). Although large parts of the mesic areas are covered by lowland and montane forests and wetlands, there are also transitional habitats in nearby areas produced by the presence of arid and semi-arid Irano-Turanian flora and the high elevations of the Alborz Mountains. The diversity of transition zones between
forests and adjacent Irano-Turanian vegetation is extremely high. For example, a total of 1362 species has been documented in GNP, which is almost 19% of the entire Iranian flora (Akhani, 1998, 2005). The Hyrcanian forests contain Arcto-Tertiary relict elements, which are of high phytogeographical interest. However, the intensification of human activity in this threatened forest zone has made conservation a major priority. Accordingly, in 2019, the Hyrcanian forests were designated a UNESCO World Heritage property (https://whc.unesco.org/en/list/1584).

In our first review paper we provided an overview of the flora, climate, major vegetation units, phytogeography, palaeoecology and conservation status of the Hyrcanian forests (Akhani et al., 2010). In this paper, an annotated critical checklist of endemic and near endemic species is provided, with plant chorology, conservation status and habitats. To evaluate phytogeographical status and threat categories, distribution maps are provided for all taxa. Further, we try to answer the following questions: (i) Is the Hyrcanian forest zone an autochthonous floristic province under the Euro-Siberian (boreal) region? (ii) Which species are endangered and require specific protection measures, and which taxa are Data Deficient based on IUCN threat categories?

2. Material and methods

2.1. Sources for taxonomic evaluation, literature and herbarium data

We searched for any floristic records from the northern provinces of Iran (Gilan, Mazandaran and Golestan), GNP, and the APA. The main sources of our data include 181 volumes of Flora Iranica (Rechinger, 1963–2015), 143 volumes of Flora of Iran (Research Institute of Forests and Rangeland: Assadi et al., 1992–2016), floristic records of the APA (Assadi, 1987, 1988; Hamzeh‘ee et al., 2010) and GNP (Akhani, 1998), and our own collections and field studies over the entire Hyrcanian forests over the last three decades.

We constructed a second database consisting of only endemic and near endemic species. Complete information, including location data, elevational range and any ecological information, have been added to the data base. The chorology data were expanded from reliably identified herbarium specimens held in the following herbaria: 1) Herbarium of Halophytes and C 4 Plant Research Laboratory (Hb. Akhani, School of Biology, University of Tehran); 2) Herbarium of Iranian Research Institute of Plant Protection (IRAN); 3) Herbarium of Research Institute of Forests and Rangelands (TARI) and 4) Herbarium of Botanical Garden and Botanical Museum of Berlin (B). Access to the Central Herbarium of University of Tehran (TUH) was not possible except for one specimen. For some critical taxa we checked either type specimens in mentioned herbaria or received photos from the herbarium of the Conservatoire botanique de la Ville de Genève (C), and through JSTOR, as well as some photos of specimens from Komarov Botanical Institute (LE).

All literature and herbarium data were georeferenced and converted into coordinates. Our access to reliable records outside of Iran, in particular the Caucasus, was limited. Therefore, we used point maps available in the monumental work, Flora Caucasus (Flora Kavkaza) (Grossheim, 1939, 1940, 1950, 1952, 1962, 1967), converting the points into coordinates. With the same method, we have extracted the point data of some arboreal species from Browicz’s chorology of trees and shrubs in SW Asia (Browicz, 1982, 1985–2016).
Appendix 1; otherwise, they have been stored in the herbarium of Specimens have been deposited in herbaria as indicated in Voucher specimens were given for many species we studied. Of these taxa, we were unable to check and ensure some of them because of restrictions we confronted with curators/staff. Therefore, these species are in the list of doubtful or excluded species. Voucher specimens were given for many species we studied. Specimens have been deposited in herbaria as indicated in Appendix 1; otherwise, they have been stored in the herbarium of Halophytes and C₄ Plants Laboratory, School of Biology, University of Tehran (Herbarium H. Akhani).

2.2. Criteria to include species as endemic or near endemic

Endemic taxa are attributed to those species that exclusively occur in mesic parts of the Hyrcanian forests. Near endemic taxa are species found in the Hyrcanian area as well as in the transitional zones between the Hyrcanian area and the Irano-Turanian region, and/or species distributed through the Hyrcanian area and that have expanded further in the Caucasus and Euxinian areas. Phytogeographic assessment of species occurring in transitional habitats with the neighboring Irano-Turanian flora is problematic. The South Caspian forests on the northern slopes of the Alborz Mountains connect with the Irano-Turanian vegetation on the southern slopes of these mountains, above the timberline and many rain shadow valleys in the northern slopes (Fig. 1). It is controversial to say whether a species growing in transition zone is a dry-adapted Hyrcanian species or a mesic-adapted Irano-Turanian species. In such cases we apply the following measures:

1) Those species growing in cliffs surrounded by forests and scrubs or occurring in coastal area with a distribution pattern within the Hyrcanian zone are accepted in our list as Hyrcanian species.
2) The endemic species of the Sefidrud Massif (Fig. 1), known in our paper as Manjil-Rudbar pattern, are included in the list of Hyrcanian plants, despite the fact that these species are xerophytes growing in a rain shadow Mediterranean semi-arid climate.
3) Species growing in moist transitional habitats such as meadows are considered Hyrcanian/Alborz transition species.

2.3. Distribution maps

All geographical coordinates were imported into DMAP (Morton, 2001) and distribution maps were generated for almost all taxa. The richness map of all species has been calculated using coincidence option for 30' x 30' grids. According to the inspection of 254 distribution maps and our own knowledge of the area, eight distribution patterns were defined for the Hyrcanian endemic and near endemic species. These patterns were determined based on the distribution range of each species along the study area. To identify the borders of each pattern, we generated multispecies maps of species that show similar distribution ranges.

2.4. Conservation status

The conservation status of all species has been assessed using IUCN criteria (IUCN, 2019). In some cases, we have only one old type collection. We preferred to classify such taxa as “Data Deficient” (DD) rather than considering them extinct.

We have presented two assessments for each species. In the first step we applied the assessment obtained by GeoCAT (a browser-based tool), which used the extent of occurrence (EOO) and the area of occupancy (AOO) according to criterion B of the IUCN Red List categories (http://geocat.kew.org; Moat, 2007; Bachman et al., 2011; Memariani et al., 2016; Pahlevani et al., 2020). The obtained categories have either been accepted or improved further, based on own field knowledge and field observations that support other IUCN criteria, i.e., A, C and D criteria (IUCN, 2019). The number of records gained from herbaria and literature provides useful information for evaluation of threat categories.

2.5. Habitat data

The Caspian forests and its transitional zones display high habitat heterogeneity (Akhani et al., 2010). The habitat types used in this paper are mostly based on our own field studies and available data in the literature. Our own extensive studies in GNP provide habitat information for a large number of species (Akhani, 1998).

3. Results and discussion

The number of genera and species (including subspecific taxa) of all plant families recorded from three Iranian northern provinces, Talish of Azerbaijan Republic, and two protected areas (GNP and APA) (Fig. 1) is provided in Table S1. A list of all endemic and near endemic taxa of the Hyrcanian area is provided in Appendix 1, with data on distribution, elevation range, number of records, chorotype, life form, threat category, habitat type, references, and one selected voucher specimen. Additional notes on the taxonomy of specific taxa are given in Appendix 2. A photographic selection of 37 representative endemic Hyrcanian species is depicted in Figs. 2—4. Distribution patterns of the Hyrcanian endemics and near endemics are shown in Fig. 5 and the percentage of these taxa within each distribution pattern is given in Fig. 6. The percentage of life forms of the Hyrcanian endemic and near endemic taxa is illustrated in Fig. 7. The numbers and percentages of these endemic and near endemic taxa in each threat category are summarized in Table 1. A richness map of all Hyrcanian endemics and near endemics is provided in Fig. 8. The distribution map of 254 Hyrcanian endemic and near endemic species is presented in Supplemental materials: Maps 1—254.

3.1. Alborz Mountains: Diversity hot spot in SW Asia

The total number of species recorded from three provinces (Gilan, Mazandaran and Golestan) and adjacent areas, including the APA and Talish, shows that 3855 vascular plant taxa (species and subspecies) belonging to 135 families and 893 genera are known from the area (Supplemental file 1: Table S1). There are only 55 species of Pteridophytes (ferns and fern allies) belonging to 15 families and 25 genera, and 10 species of Gymnosperms belonging to three families and five genera. In addition to 91 families, 681 genera and 3125 Dicot taxa and 23 families, 178
genera and 659 species of Monocots, these areas also contain basal Angiosperms, e.g., two species and two genera of Nymphaeales (Nymphaeaceae), and two species and one genus of Magnoliids (Aristolochiaceae); two species of Ceratophyllaceae, which is a sister family of Eudicots (Supplemental file 1: Table S1). The presence of at least 3855 species, which corresponds 52.8% of the total Iranian flora, in only three provinces of the northern Iran covering just 3.5% of the country's surface area is of great conservation importance. These provinces include the whole northern slopes of the Alborz Mountains and fragments of the southern slopes and parts of the Khorassan-Kopet Dagh Mountains (Fig. 1). This figure would increase if the whole Alborz area, i.e., the montane zones of Ardabil, Zanjan, Qazvin, Alborz, Tehran and Semnan provinces, is included. The presence of at least 1623

Fig. 2. Selected photos of Hyrcanian endemics and near endemics. A. Aristolochia hyrcana; B. Ruscus hyrcanus; C. Crocus caspius; D. Lilium ledebourii; E. Cephalanthera caucasica; F. Poa golestanensis; G. Leutea translucens; H. Rux spingera; I. Hedera pastuchovii; J. Centaurea hyrcanica; K. Epimedium pinnatum; L. Echium amoenum; M. Hesperis hyrcana; N. Buxus hyrcana. Photos: A, B, E-H, J-N by H. Akhani; C, I by A. Ghorbanalizadeh; D by A.R. Noormohammadi.
species in the area of Tehran and its vicinity to central Alborz is evidence of a hot spot center in the Irano-Turanian area. This is related to the complex lithological and elevational diversity, as well as the palaeoecological history of the area (Akhani et al., 2010, 2013) (Figs. 5G and 8).

Our floristic data support the hypothesis that the Alborz Mountains are an important diversity center in the Holarctic. The Irano-Turanian flora predominate the southern slopes and above timberline in the northern slopes and the Euro-Siberian flora dominate the northern slopes with higher precipitation. Parts of
the deep valleys, such as Manjil-Rudbar Massif, are characterized by a Mediterranean climate and vegetation. The climatic diversity, presence of many high peaks and rich mountains ridges result in a tremendous heterogeneity for the growth of a wide spectrum of mesophytes, chasmophytes, oreophytes, psammophytes, halophytes, xerophytes, alpine and nival plants (Klein, 1994; Noroozi et al., 2008; Akhani et al., 2010, 2013; Noroozi and Akhani, 2013).

3.2. Hyrcanian forests: A regional center of diversity

In total, 256 endemic and near endemic taxa belonging to 50 families and 152 genera of flowering plants have been identified in the Caspian forests (Appendix 1; Figs. 2–4). This is less than the ca. 280 species which we have previously noted in our previous paper (Akhani et al., 2010). The reason for this is that we have excluded several taxa with doubtful taxonomic status and endemic taxa that require re-evaluation. As 11 species of our list are indeed Euxino-Hyrcanian species, we can accept 245 species belonging to endemic and near endemic species of the Hyrcanian area and nearby Alborz Mountains. By excluding an additional 62 species of the Alborz-Hyrcanian pattern, only 183 species remain as exclusive endemic species of the Hyrcanian forests.

The largest families of the Hyrcanian endemic and near endemic species are Asteraceae (13.3%), Apiaceae (7.8%), Rosaceae (7%) and Lamiaceae (5.8%), comprising one third of these taxa. The most species-rich genera among the Hyrcanian endemics and near endemics are *Alchemilla* L. (with nine species), *Cousinia* Cass., *Dianthus* L., and *Veronica* L. (each with seven species), and *Astragalus* L. and *Leutea* Pimenov (each with six species). The life form spectra (Fig. 7) show noticeable number of phanerophytes within the Hyrcanian

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**Fig. 4.** Selected photos of Hyrcanian endemics and near endemics. A. *Primula heterochroma*; B. *Anemone caucasica*; C. D. *Pyrus boissieriana*; E. *Phuopsis stylosa*; F. *Populus caspica*; G. *Acer velutinum*; H. *Saxifraga wendelboi*; I. *Scrophularia vernalis* subsp. *clausii*; J. *Solanum kieseritzkii*. Photos: A, B by A. Ghorbanalizadeh; C-J by H. Akhani.
Fig. 5. Distribution patterns of the Hyrcanian endemic and near endemic species. A. Omni-Hyrcanian pattern; B. West Hyrcanian pattern; C. Manjil-Rudbar pattern; D. Central Hyrcanian pattern; E. Central and East Hyrcanian pattern; F. East Hyrcanian pattern; G. Alborz-Hyrcanian pattern; H. Euxino-Hyrcanian pattern.
endemic taxa. However, hemicryptophytes, with 140 species (54.7%), and geophytes, with 45 species (17.6%), are the most species-rich life forms in the area. The chamaephytes include only 12 species (4.7%), albeit, 10 further species (3.9%) could not well be classified as chamaephyte or hemicryptophyte.

There is consensus between most authors considering Hyrcanian forests as an autochthonous phytogeographical entity with a particular palaeoecological history, and particular flora and vegetation. However, its chorological position has fluctuated between province, subprovince and district. Zohary (1973) considered the area a district of the Pontic province belonging to the Euro-Siberian region. Takhtajan (1986) classified the area as the Hyrcanian province in the Irano-Turanian region. Frey et al. (1999) categorized the area as the Hyrcanian subprovince of the Euxino-Caucasian-Hyrcanian province, and Hedge and Wendelbo (1978) justified its position as the Hyrcanian subprovince of the Euro-Siberian region, supporting their view by the absence of Abies Mill., Picea A. Dietr., Pinus L. and Rhododendron L. in the area. The data in our paper confirms a regional center of diversity equivalent to a floristic province by the presence of 256 endemics and near endemics. The area is not only rich in isolated relicts but also harbors several vicariants with Euxinian and or northern and western Euro-Siberian areas, which probably evolved through allopatric speciation. All three important, widely distributed arboreal Hyrcanian species in the genera Ilex L., Buxus L. and Hedera L. have sister or related species in the Euxinian forests: Ilex spinigera (Loes.) Loes. (its Euxinian sister is Ilex colchica Pojark.) (Manen et al., 2010), Buxus hyrcana Pojark. (its Euxinian sister is B. colchica Pojark.) (Van Laere et al., 2011), Hedera pastuchovii Woron. ex Grossh. (its close affinity is H. colchica (K.Koch) K.Koch) (Vargas et al., 1999; Green et al., 2011).

The presence of 256 endemics and near endemics in a small area of forest zone, the presence of many relict species and a dozen of vicariant species with ecologically sister areas are justification for a floristic province. The Khorassan-Kopet Dagh floristic province located at the easternmost part of the Hyrcanian area is known with 356 endemics (Memariani et al., 2016).

There is some evidence that the Hyrcanian forests played a role in donating species to the Irano-Turanian region. The genus Leutea (Apiaceae) is an exclusively endemic genus in the Hyrcanian and Irano-Turanian region. Species of the arid parts of the Irano-Turanian are characterized by their cylindrical leaves (Pimenov, 1987). Discovery of a broad-leaved species (Leutea laseroideas Akhani = Laser rechingeri Akhani) (Supplemental file 2: Map 53) in the moist cliffs of the eastern parts of the Hyrcanian forests, which is phylogenetically sister to the cylindrical-leaved species, is

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**Table 1**

Number and percentage of the Hyrcanian endemic and near endemic species in each Red List category.

| Threat categories | No. of taxa | Percent (%) |
|-------------------|-------------|-------------|
| CR                | 30          | 11.7        |
| EN                | 52          | 20.3        |
| VU                | 30          | 11.7        |
| NT                | 25          | 9.8         |
| LC                | 81          | 31.6        |
| No category/DD    | 38          | 14.8        |
| **Total**         | **256**     | **99.9**    |

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![Richness map of all Hyrcanian endemic and near endemic taxa.](image-url)
evidence of its ancestral state (Akhani, 1996, 1998; Valiejo-Roman et al., 2006). Both rubiaceous species Phuopsis stylosa (Trin.) Hook. f. (an endemic Hyrcanian genus, Fig. 4E; Supplemental file 2: Map 236), and Crucianella platyphylla Ehrend. & Schön.-Tem. (Supplemental file 2: Map 230), show pleisiomorphic features (Schönbeck-Temesy and Ehrendorfer, 1989; Ehrendorfer and Schönbeck-Temesy, 2005). Alyssopsis Boiss. is also an isolated non-arboreal Hyrcanian endemic genus that phylogenetic studies show has an affinity with the Irano-Turanian genera Dielsiocharis O.E.Schulz and Calymmatium O.E.Schulz (Warwick et al., 2010; Toro-Nunez et al., 2015).

### 3.3. Distribution patterns and endemism

According to the distribution maps of 254 taxa (Supplemental file 2: Maps 1-254), eight geographical distribution patterns have been identified for the Hyrcanian endemic and near endemic species (Fig. 5).

1. **Omni-Hyrcanian pattern (OH, Fig. 5A)**

   This is the second largest group of species, including 61 species belonging to 34 families and 51 genera. The core range of most species lies in a continuous belt on the South Caspian forests. However, some more widespread species occur in proper surrounding areas such as isolated forests in the APA, East Caucasus up to South Dagestan, the Jowzak forest (in North Khorrassan Province in the eastern part of the Hyrcanian area) and even mesic valleys in Turkmenistan. Some prominent arboreal examples of this group are the Tertiary relict elements such as Parrotia persica (DC.) C.A. Mey. (Fig. 3F; Supplemental file 2: Map 150), Quercus castaneifolia C.A. Mey. (Fig. 3G; Supplemental file 2: Map 147), Alnus subcordata C.A. Mey. (Supplemental file 2: Map 98), Acer velutinum Boiss. (Fig. 4G; Supplemental file 2: Map 239), Pyrus boissieriana Buhse (Fig. 4C and D; Supplemental file 2: Map 216), Frangula grandifolia (Fisch. & C.A. Mey.) Grubov (Supplemental file 2: Map 204) and Ilex spinigera (Fig. 2H; Supplemental file 2: Map 60). Many herbaceous species are associated with forest zones and their distribution ranges perfectly overlap with arboreal species. Examples are Digitalis nervosa Steud. & Hochst. ex Benth. (Fig. 3N; Supplemental file 2: Map 180), Primula heterochroma Stapf (Fig. 4A; Supplemental file 2: Map 196), Scutellaria tournefortii Benth. (Fig. 3I; Supplemental file 2: Map 163), Alyssopsis mollis (Jacq.) O.E. Schulz (Supplemental file 2: Map 108), Echiium amoenum Fisch. & C.A. Mey. (Fig. 2I; Supplemental file 2: Map 100), and Centaurea hyrcana Bornm. (Fig. 2J; Supplemental file 2: Map 68).

2. **West Hyrcanian pattern (WH, Fig. 5B)**

   This group includes 39 species belonging to 21 families and 31 genera. They usually occur from the central Mazandaran westwards to the Talish forests on the border of Iran and Azerbaijan. This area matches with the “temperate oceanic” bioclimate (Djamali et al., 2011) and is the most humid part of the Hyrcanian zone, where the annual precipitation may reach or even exceed 2000 mm in some parts. Epimedium pinnatum Fisch. (Fig. 2K; Supplemental file 2: Map 97), Pyrus grossheimii Fedor. (Supplemental file 2: Map 217), P. stylosa (Fig. 4E; Supplemental file 2: Map 236), Scorpiularia rostrata Boiss. & Buhse (Supplemental file 2: Map 246) and Potentilla petraea Willd. ex Schlecht (Supplemental file 2: Map 215), are the most prominent species representing the West Hyrcanian pattern.

3. **Manjil-Rudbar pattern (MR, Fig. 5C)**

   Sefidrud Massif is a special area in the Hyrcanian lowlands, in which the climate is very dry and forms an island-like sub-desert in the moist zone of Iran. The low elevation and the strong winds create a rain shadow in this valley, forming sand dunes in parts of the area. The bioclimate of this zone is Mediterranean Xeric Oceanic (MZO) (Djamali et al., 2011). A total of 17 species belonging to 11 families and 16 genera are known to be endemic in this small area, including Cousinia erinacea Jaub. & Spach (Supplemental file 2: Map 76), Cousinia hypochionea Bornm. (Supplemental file 2: Map 78), Salvia oligophylla Auch. ex Benth. (Supplemental file 2: Map 158), Atrophanthis acheri Jaub. & Spach (Supplemental file 2: Map 189) and Asperula sherardiioides (Boiss.) Jaub. & Spach (Supplemental file 2: Map 226). A new undescribed species of Heliotropium is also known from this area (Supplemental file 2: Map 102). Most species of this pattern are either very rare, known only from type locality, e.g., Scorzoner a persica Boiss. & Buhse (Supplemental file 2: Map 91), or are endangered species such as Aristolochia hyrcana Davis & M.S. Khan (Fig. 2A; Supplemental file 2: Map 1).

4. **Central Hyrcanian pattern (CH, Fig. 5D)**

   This pattern includes 15 species belonging to 11 families and 15 genera, with a center of distribution in forest zone of Mazandaran Province. Most species occur in scrubs and cliff habitats. Satureja isophylla Rech. f. (Supplemental file 2: Map 161) and Galium wendelboi Ehrend. & Schön.-Tem. (Supplemental file 2: Map 235) are found in cliff habitats. Ophrys kojarenisis Göz (Supplemental file 2: Map 29), Hypericum fursei N. Robson (Supplemental file 2: Map 151), Pyrus mazanderanicum Schönbeck-Temesy (Supplemental file 2: Map 219), Spiraea sheikhii Zare (Supplemental file 2: Map 222), and Astragalus lacus-valashii Maassoumi, Podlech & Jallil (Supplemental file 2: Map 137) are examples of scrub habitats and Acer iranicum M. Mohtashamian & A. Rastegar/Acer mazanderanicum Amini, Zare & Assadi (Supplemental file 2: Map 238) a tree species of the forest zone.

5. **Central and East Hyrcanian pattern (CEH, Fig. 5E)**

   Species in this group occur from the central Hyrcanian forests and extend their range into the eastern parts up to Khorassan-Kopet Dagh area in some cases. This pattern includes 18 species belonging to 15 families and 18 genera. Except a few species such as Epipactis rechingeri Renz (Supplemental file 2: Map 26) and Heracleum gorganicum Rech. f. (Supplemental file 2: Map 48), which grow in shady forests, most other species, e.g., Berberis orthobotrys Bienert ex C.K. Schneider (Supplemental file 2: Map 96), Campanula lourica Boiss. (Fig. 3A; Supplemental file 2: Map 114), Alcea gar- ganica (Rech. f., Æll. & Esfand.) Zohary (Supplemental file 2: Map 169), Verbascum sublobatum Murb. (Supplemental file 2: Map 251) and Colutea bulsel (Boiss.) Shap. (Supplemental file 2: Map 142) are elements of cliffs, meadows and scrub.

6. **East Hyrcanian pattern (EH, Fig. 5F)**

   The range of the 33 species (belonging to 14 families and 29 genera) in this group is located from 52° E longitude to the east-ernmost extensions of the Hyrcanian forests. They usually occupy open scrubs and rocky outcrops, and grasslands adjacent to the forests. Some species of this group are taxonomically and phylogenetically very isolated, such as Leutea lasioides (Supplemental file 2: Map 53), Johrenia golestanica Rech. f. (Supplemental file 2: Map
Several mesophytic Irano-Turanian elements co-occur with the Hyrcanian species in the northern slopes of the Alborz Mountains, usually in deforested areas and rocky outcrops, or at the marginal and transitional parts in the timberline and nearby grasslands. One may consider these species, which constitute the largest group of endemics, as “xerophytic Hyrcanian” species or “mesophytic Irano-Turanian” elements, with 62 species, belonging to 21 families and 43 genera. In some cases, the range of some species extends to Talish in the west and Khorassan-Kopet Dagh Mountains in the east. Some prominent examples of the Alborz-Hyrcanian pattern are Phleum iranicum Bornm. & Gauba (Supplemental file 2: Map 35), Seseli elbursense Pimenov & Klijuykov (Supplemental file 2: Map 58), Dolichorchis persica (Boiss.) B. Nord. (Supplemental file 2: Map 84), Eritrichium gracillimum Reich. f. (Supplemental file 2: Map 101), Nepeta pagonospersma Jamzad & Assadi (Supplemental file 2: Map 156), Veronica paederota Boiss. (Supplemental file 2: Map 186), Dionysia aretioides (Lehm.) Boiss. (Supplemental file 2: Map 195), Paraquilegia caespitosa (Boiss. & Hohen.) Drumm. & Hutch. (Supplemental file 2: Map 201), and Galium aucheri Boiss. (Supplemental file 2: Map 231).

8) Euxino-Hyrcanian pattern (XH, Fig. 5H)

We have not included all Euxino-Hyrcanian species in this paper. The 11 selected species belong to 11 families and 11 genera. These species show an inconsistent pattern, ranging from the Euxinian species with some localities in the Hyrcanian forests [Erythronium caucasicum Woron. (Supplemental file 2: Map 20) and Polygonatum glaberrimum C. Koch (Supplemental file 2: Map 14)] or the Hyrcanian species with some localities in the Euxinian or Caucasus area [Forriea subpinata (Ledeb.) Baill. (Supplemental file 2: Map 47)], or widespread species occurring in both areas [Anemone caucasica Willd. ex Rupr. (Fig. 4B; Supplemental file 2: Map 198), Orchis adenocheila Czerniak. (Supplemental file 2: Map 31), Hesperis hyrcana Bornm. & Gauba (Fig. 2M; Supplemental file 2: Map 109), Teucrium hyrcanicum L. (Supplemental file 2: Map 166) and Lonicer a iberoica M. Bib. (Fig. 3B; Supplemental file 2: Map 116)].

Comparison of the species richness of different distribution patterns (Fig. 6) indicates that the Alborz-Hyrcanian (Fig. 5G) and Omni-Hyrcanian (Fig. 5A) patterns are the richest in the area.

In the Caspian forests the richness of endemics in lowlands and sub-montane zones is low whereas it increases remarkably in montane forests and above timberline towards the limits of the area. (Hedge and Wendelbo, 1978) (Fig. 9). This is a known phenomenon in Iran, explained by the geographical isolation in higher elevations (Noroozi et al., 2016). According to the results, the elevational distribution of Hyrcanian endemics and near endemics ranges between sea level in the Caspian lowlands and 4200 m in the alpine areas (Appendix 1). The largest numbers of Hyrcanian endemics and near endemics are found at elevations between 500 and 3000 m. Notably, many endemic and near endemic species, such as Poa masenderana Freyn & Sint. (75–2600 m), Centaurea hyrcanica (50–2810 m), C. zuvandica (Sosn.) Sosn. (0–3000 m), Crepis willemietioides Boiss. (50–2900 m), Echium amoenum (60–3000 m), Rhynchosorus maxima C. Richter (~26–2750 m), Polygala platypetra Bornm. & Gauba (0–2500 m) and Scrophularia rostrata (50–3010 m), have wide elevational distribution ranges in this area. The main reason for this extensive range is likely owed to favorable ecological conditions, including convenient temperature and humidity, from low to high elevations. Annual species become quite rare at high elevations (Mahdavi et al., 2013). These species are not common as endemics or near endemics in the Hyrcanian forests and mostly grow in the lowlands.

3.4. Hyrcanian forests: Irano-Turanian or Euro-Siberian?

Although the majority of phytogeographers have classified the Hyrcanian forests under the circumboreal or Euro-Siberian region (Zohary, 1973; Browicz, 1989; White and Léonard, 1991; Frey et al., 1999), a few, however, prefer to consider the area a mesophytic variant of the Irano-Turanian region (Takhtajan, 1986; Manafzadeh et al., 2017) or Sub-Mediterranean subregion (Meusel et al., 1965). The arguments in favour of the Euro-Siberian enclaves mostly refer to large number of arboreal species which are either circumboreal species such as Carpinus betulus L., Sorbus torminalis (L.) Crantz, Fraxinus excelsior L., Acer campestre L. and Berberis vulgaris L. (Browicz, 1989) or species having close affinity with some widely distributed boreal taxa belonging to Carpinus L., Quercus L., Fagus L., Castanea Mill., Acer L., Evonymus L., Zelkova Spach, and many more. The majority of Orchids and Pteridophytes growing in Iran are restricted to the Hyrcanian area as boreal or Euro-Siberian elements (Renz, 1978; Khoshraveh et al., 2009). Many Tertiary relict Hyrcanian endemic trees such as Parrotia persica (Fig. 3F; Supplemental file 2: Map 150), Quercus castaneifolia (Fig. 3G; Supplemental file 2: Map 147) and Acer velutinum (Fig. 4G; Supplemental file 2: Map 239) survived glaciations as refugees. The fossils of several species or their close affinities have been identified in Europe ([Bernsno in south France (Leroy and Roiron, 1996), the Mesovian Interglacial of Poland (Binka et al., 2003), and Willershausen in Germany (Ferguson and Knobloch, 1998)]. Twenty-nine of the species in Willershausen near Göttingen grow in the Hyrcanian forest zone and 16 further species are almost identical (Probst, 1981).
China in Jiangsu, Anhui and Zhejiang provinces (Li and Del Tredici, 2008). Despite very long distances (6500 km), the two regions share many woody plant genera, including Acer, Albizzia Durazz., Buxus, Castanea, Carpinus, Diospyros L., Fagus, Pterocarya Kunth, Quercus, Sorbus L., Taxus L., Zelkova and Hedera (Valcárcel et al., 2017).

From vegetation point of view, none of the syntaxa of the Hyrcanian forest correspond with Irano-Turanian region. All four classes recently known from the area (Alneta glutinosae Br.-Bl. et Tx. ex Westhoff et al., 1946, Alno glutinosae-Populetea albae P. Fukarek et Fabjanić 1968, Carpinio-Fagetea sylvaticae Jakucs ex Passarge 1968, and Quercetea pubescentis Doing-Kraft ex Scamoni et Passarge 1959) are indeed Euro-Siberian higher syntaxa (Mucina, 1968, and precipitation seasonality (Djamali et al., 2012).

The chorological analysis of the flora of Golestan National Park, the easternmost end of the Hyrcanian forests with the mixture of deciduous forests in the west and Irano-Turanian Juniper woodlands, Artemisia L. and montane steppes in southern, eastern and northern parts of the area shows that 15% of the species are Euro-Siberian plants (Akhani, 1998). The distribution of the Euro-Siberian species shows that 40% of the species are Omni-Euro-Siberian, 30% are Euxino-Hyrcanian sharing species and 30% are Euro-Siberian species dominate the mesic parts of the area and some interesting cases have been found as new records from that area, such as Carex pseudocyperus L., Hordeymus europaeus (L.) Harz and Alnepucus aequulis Sobol. (Akhani and Scholz, 1998; Akhani, 1999).

The Irano-Turanian region is characterized by its drought-adapted flora, which evolved under a particular climate differentiated from the Euro-Siberian region by continentality, winter temperature, and precipitation seasonality (Djamali et al., 2012). The climate of the Hyrcanian area has a characteristic temperate feature in the distribution of precipitation over the year, a very short dry period, and high air humidity (Akhani et al., 2010). However, the area deviates from the northern temperate forests by having an average minimum of temperatures in the coldest month above the freezing point. This provides not only support for growing thermophilous trees [such as deciduous species belonging to Parrotia, Pterocarya and Zelkova, and evergreen Buxus, Hedera and Ilex (Iversen, 1944)] but also the development of C4 grasslands in open areas (Akhani and Ziegler, 2002). The main argument that supports excluding the Hyrcanian forests from the Irano-Turanian region is the age difference of their endemics. The Irano-Turanian region harbors many neendemics, with large numbers of recently radiated lineages adapted to the arid conditions, mostly diversified after orogenic activities since the Oligocene (Manafzadeh et al., 2014). But the endemics of the Hyrcanian area are either paleoendemics that remained as refugees in the area or evolved from common ancestors of widely distributed temperate elements due to geographical vicariance (Tralau, 1963).

The Irano-Turanian elements in the Hyrcanian zones only occur in the marginal habitats of the forests, rain shadow areas, rocky outcrops, above the timberline and sometimes also in the deforested parts. None of the typical Irano-Turanian species and genera are associated with the forests. Therefore, considering Hyrcanian forests as Irano-Turanian is not justified.

3.5. Hyrcanian area with highly threatened species

The endemic and near endemic species of the Hyrcanian forests area have been evaluated using the IUCN Red List categories and criteria. We did not accept preliminary evaluations for several species suggested by Jamzad and Jalili (1999) or Naqinezhad et al. (2015), because of the poor methodological approach of these studies. Our checklist includes 30 taxa (11.7%) as Critically Endangered (CR), 52 taxa (20.3%) as Endangered (EN), 30 taxa (11.7%) as Vulnerable (VU), 25 taxa (9.8%) as Near Threatened (NT), 81 taxa (31.6%) as Least Concern (LC) and 38 taxa (14.8%) as Data Deficient (DD), lacking reliable data to be evaluated (Table 1). Assessment of 44% of the Hyrcanian endemic and near endemic species as threatened is alarming for national and international community. The distribution of different threatened categories among eight known distribution patterns clearly shows that except for the “Omn-Hyrcanian,” “Central and East Hyrcanian” and “Euxino-Hyrcanian” patterns, all other patterns harbor a considerable number of Critically Endangered, Endangered and Vulnerable species (Fig. 10). The Caspian forests are among the most highly threatened ecosystems in Iran. Some of the main factors responsible for threatening populations of indigenous species include urbanization and industrialization, clearing land areas for agricultural purposes, livestock overgrazing, road and dam construction, felling, intensive mining, disposal of waste, and pollution (Akhani et al., 2010).

Several threatened species of the Hyrcanian area, including Aristolochia hyrcana (Fig. 2A; Supplemental file 2: Map 1), Hyacinthella persica (Boiss. & Buhse) Chouard (Supplemental file 2: Map 10), Heliotropium sp. nov. (Supplemental file 2: Map 102), Nonea longiflora Wettst. ex Staf (Supplemental file 2: Map 106), Scabiosa schimperiana Boiss. & Buhse (Supplemental file 2: Map 117) and Atropaphis acharui (Supplemental file 2: Map 189), grow in special habitats around Sefidrud valley (MR pattern, Fig. 5C). The area has been heavily damaged by a variety of land use activities such as road and dam construction along with development of agricultural activities (olive plantations). Other species, such as Crocus almehensis Brickell & Mathew (Supplemental file 2: Map 17), Ophrys kojarenisis (Supplemental file 2: Map 29), Eriocycly gahaforiana Akhani (Supplemental file 2: Map 46), Leutza laseroides (Supplemental file 2: Map 53), Centaura golestanica (Supplemental file 2: Map 67), Plantago podlechii Akhani (Supplemental file 2: Map 181) and Saxifraga ramsarica Jamzad (Supplemental file 2: Map 242), are very local endemics with distributions restricted to small areas in the Hyrcanian zone. Additional endemics have suffered from habitat loss in coastal areas, as well as lowland and montane forests, e.g., Daucus littoralis Smith subsp. hyrcanicus Rech. f. (Supplemental file

![Fig. 10. Number of threatened endemic and near endemic species within distribution patterns of the Hyrcanian area.](image-url)
2. Typha caspica Pobed. (Supplemental file 2: Map 39), Dianthus hyrcanicus Rech. f. (Supplemental file 2: Map 120), Polygala platyptera (Supplemental file 2: Map 188), Scrophularia megalantha Rech. f (Supplemental file 2: Map 245), and Veronica francisepetae M.A. Fischer (Supplemental file 2: Map 183).

The Data Deficient category should be applied only in cases of unresolved taxonomy or uncertain locality information (Callmander et al., 2005). Many Hyrcanian endemics and near endemics designated as DD in the checklist (Appendix 1), including Tulipa harazensis Rech. f., Bunium scabrum Korov., Crepis alfredi Bornm., Campanula ghielianis Pall., Hypericum fursei, Phlomis ghilanensis C. Koch and Delphinium syncarpum Freyn, have incomplete locality information and other taxa require updated taxonomic assessments.

4. Conclusion

The Hyrcanian forests, a UNESCO World Heritage region, harbor highly valuable relics of Tertiary elements. The area is suffering from many degrading factors threatening the unique ecosystems that contains many rare and endangered species both in the mesic parts of the forests and surrounding highlands. Our studies support the hypothesis that the Hyrcanian forests are a regional center of endemism within the boreal (Euro-Siberian) floristic region. Implementation of protection measures to stop reduction of forest area and reduce destructive factors should be combined with documentation of the status of individual species, identification of unknown populations, census of rare species and in situ and ex situ programs to ensure the survival of rare, endemic and threatened species.

Author contribution

H.A. conceived of the research idea, A.Gh. collected and provided the data, tables and maps. The tables were critically reviewed by H.A., who wrote the manuscript jointly with A.Gh.

Declaration of competing interest

The authors declare no conflict of interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pld.2021.07.005.

Appendix 1

Annotated checklist of endemic and near endemic species of the Hyrcanian forests and marginal habitats including distribution along the Caspian forests, elevational range, number of records in surveyed references and herbarium data, chorotypes, life forms, threat categories, habitat types and references (with selected voucher). Threat categories are based on IUCN categories and criteria (IUCN, 2019). Superscript numbers are discussed in Appendix 2. Symbols and abbreviations.

1. Provinces and areas: Aras. = Arasbaran, Cauç. = Caucasia, E Azar. = East Azarbaijan, Gil. = Gilan, Gol. = Golestan, Maz. = Mazandaran, N Khor. = North Khorasan, Qazv. = Qazvin, R. Khor. = Razavi Khorasan, Sem. = Semnan, Tehr. = Tehran, Turk. = Turkmenistan, W Azar. = West Azarbaijan; 2. Chorotypes: AH = Alborz-Hyrcanian pattern, CEH = Central and East Hyrcanian pattern, CH = Central Hyrcanian pattern, EH = East Hyrcanian pattern, OH = Omni-Hyrcanian pattern, MR = Manjil-Rudbar pattern, WH = West Hyrcanian pattern, XU = Euhyrcino pattern; 3. Life forms: Cham. = Chamaephyte, Geo. = Geophyte, Hem. = Hemicryptophyte, Phan. = Phanerophyte, Ther. = Therophyte; 4. Table heading and threat categories: Elev. range = Elevation range, Rec. = Records, EOO = Extent of occupancy, max. dist. = Maximum distance, Imp. ass. = Improved assessment, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient; 5. Habitat types: AZ = Alpine zone, CSD = Coastal sand dune, DH = Disturbed habitat [around road, farm and garden], DV = Dry valley, FM = Forest margin, FO = Forest opening (clearing), GR = Grassland [SGR = Subalpine grassland], LF = Lowland forest [ALF = Alluvial lowland forest, CLF = Closed lowland forest, OLF = Open lowland forest], MF = Montane forest [CMF = Closed montane forest, OMF = Open montane forest], MH = Moist and Marshy habitat, MW = Meadow [AMW = Alpine meadow, LMW = Lowland meadow, MMW = Montane meadow, SMW = Subalpine meadow], MX = Mediterranean xeric enclave [PMX = Parphyry soil, SMX = Sandy soil, SEMX = Serpentine hill, SWMX = Shady woodland, STMX = Steppe, SAMX = Stony area], RH = Riverside (riparian) habitat, RO = Rocky outcrop (crevices of rock), CRO = Calcareous rock, MRO = Marl rock, SRO = Schistous rock, VRO = Volcanic rock, SC = Scrub and shrubland [GSC = Grassy scrub, LSC = Lowland scrub, MSC = Montane scrub, OSC = Open scrub, ASC = Subalpine scrub, SMC = Submontane scrub], SF = Submontane forest [CSF = Closed submontane forest, OSF = Open submontane forest], SP = Stony and pebble bed, ST = Steppe [LST = Lowland steppe, MST = Montane steppe, SAST = Subalpine steppe, SMST = Submontane steppe], SZ = Submontane zone, VC = Vertical cliff [LVC = Limestone vertical cliff], WO = Woodland [GWO = Grassy open woodland, JW = Juniper woodland, LWO = Lowland woodland, MWO = Montane woodland, SWO = Subalpine woodland]; 6. F. = Flora, Herb. = It means the number of those records that seen in herbarium, Inc. = It means that the distribution map of this species is incomplete in outside Iran (Caucasia); 7. Names: A. = Akhani, A.&Gh. = Akhani & Ghassakhani, As.a&M. = Assadi & Mozaffarian, For. = Foroughi, G.&M. = Ghaehman & Mozaffarian, Gho. = Ghobanaliizadeh, J. = Jalali, M. = Mozaffarian, Ma.&Sa. = Maasoumi & Safavi, Ma.Ea. = Maasoumi & Jalili, Man. = Manuchehri, Mo. = Moosavi Movahedi, N. = Noroozi, R.&Ma. = Runemark & Maasoumi, Re.kl. = Renz & Iranshahr, Sa.&Ga. = Sabeti & Gauba, Sh. = Shahsavari, T.&D. = Termeh & Darvayd, T. = Termeh, Z. = Zargani.
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | GeoCat | Imp. ass. | Habitat type | References and (selected voucher) |
|-----|----------------------------------|--------------------------|----------------|-------------|-----------|-----------|-----------|-----------|---------------------|----------------|--------|----------|-------------|----------------------------------|
| 1   | *Aristolochia hyrcana* Davis & M. S. Khan, (*Fig. 2A*) | Gil., (Map 1)           | 200–1100       | 7 (4)       | MR        | Geo.      | 406       | 150       | 4.8                 | EN B1+B2b (ii,iii) | EN     | SWMX     | EN          | Akhani (1998); F. Iranica 26: 1–2; F. Iran 29: 4–6; (A. e al. 20,943) |
| 2   | *Allium grande* Lipsky (← *A. chelotum* Wendelbo), (*Akhani, 2005: Figs. 171–172*) | Gol., Maz., Sem./Gol. (Map 2) | 1000–3100     | 19 (8)     | CEH       | Geo.      | 26,409    | 17,672    | 46.9                | NT             | VU C2b | MSC, SMSC | EN          | Akhani (1998); F. Iranica 76: 87–88; Fritsch and Abbasi (2013); (A. 11,305) |
| 3   | *Allium lenkoranicum* Miscz., (*Akhani, 2005: Fig. 180*) | Gol., Maz., Talish, Turk. (Map 3) | 600–1600       | 20 (5)      | OH        | Geo.      | 127,732   | 17,500    | 80.4                | LC             | LC     | CSF, LMW | LC          | Akhani (1998); F. Iranica 76: 61; Grossheim (1940); (A. 17,172) |
| 4   | *Allium subvineaee* Wendelbo, (*Akhani, 2005: Fig. 186*) | Gil., Gol., Maz., (Map 4) | 1900–2060      | 4 (2)       | AH        | Geo.      | 26,938    | 7500      | 54.8                | NT             | EN C2b | SMW     | RO          | Akhani (1998); F. Iranica 76:53; (A. 11,311) |
| 5   | *Allium talyschense* Miscz. | Talish, (Map 5) | 1800–2400      | 4          | WH        | Geo.      | 1817      | 3844      | 46.9                | NT             | EN     | RO       | LC          | Akhani (1998); F. Iranica 76: 56–57; Grossheim (1940) |
| 6   | *Danae racemosa* (L.) Moench, (*Akhani, 2005: Figs. 211–212*) | Gil., Gol., Maz., Talish, (Map 6) | 50–2300       | 65 (15)    | OH (disjunctly in East Mediterranean) | Phan. | 59,964   | 60,000   | 179.3               | LC             | NT     | CLF, CSF, RO, VC | Akhani (1998); Browicz (1988); F. Iranica 165: 177; (A. 13,387) |
| 7   | *Fessia gorganica* (Speta) Speta (*Scilla gorganica* Speta), (*Akhani, 2005: Fig. 225*) | Gol., Maz., (Map 7) | 100–2472       | 14 (5)      | EH        | Geo.      | 9657      | 13,690   | 36.6                | VU B1b (ii) | LC     | LF, MF, SC, SF | NT          | Akhani (1998); F. Iranica 165: 114–115; Speta (1998); (A. 13,393) |
| 8   | *Fessia greilhuberi* (Speta) Speta (*Scilla greilhuberi* Speta) | Gol., Maz., (Map 8) | 50–1150        | 13 (3)      | WH        | Geo.      | 36,896    | 26,411    | 48.7                | NT             | NT     | LF       | LC          | F. Iranica 165: 112–113; Grossheim (1940); Speta (1998) |
| 9   | *Fessia hohenackeri* (Fisch. & C.A.Mey.) Speta (*Scilla hohenackeri* Fisch. & C. A. Mey.) | Talish, (Map 9) | – | 9 | WH | Geo. | 3996 | 3087 | 21.3 | EN B1b (ii) | EN | LF (Possibly) | LF          | F. Iranica 165: 137–138 |
| 10  | *Hyacinthella persica* (Boiss. & Buhse) Chouard *Ornithogalum boissieri* Bidarlord & F. Ghahtreem. | Gil., Gil./Qazv., (Map 10) | 390–700        | 4          | MR        | Geo.      | 4,173     | 12       | 2.2                 | CR B1b (ii,iii) | CR     | SMX     | CR          | Bidarlord and Ghahtreeminejad (2016) |
| 11  | *Ornithogalum bungei* Boiss., (*Akhani, 2005: Figs. 221–223*) | Gol., Maz., Sem./Gol., Talish, (Map 12) | 150–2500      | 26 (5)      | OH        | Geo.      | 95,808    | 27,500    | 72.1                | LC             | LC     | CMF, FM | LF          | Akhani (1998); F. Iranica 165: 124–125; Grossheim (1940); (A. 14,470) |
| 12  | *Ornithogalum sintenisii* Freyn, (*Akhani, 2005: Fig. 224*) | Gil., Gol., Maz., Talish, (Map 13) | 50–2452 | 56 (8) | OH | Geo. | 294,976 | 60,000 | 97.2 | LC | LC | LF, MWO, RO | F. Iranica 165: 137–138 |
| 13  | *Polygonatum glaberrimum* C. Koch | Gol., Maz., (Map 14) | 800–2200       | 62 | XH | Geo. | 511,431 | 127,500 | 171.8 | LC | LC | LF, MF, SF | F. Iranica 165: 129; Grossheim (1940); (A. 13,943) |
| 14  | *Pseudomuscari chalusicum* (DC. Stuart) Garbari (*Muscari pseudomuscari* (Boiss. & Buhse) Wendelbo) | Gil. (without point in map), Gol., Maz., Sem./Gol., (Map 15) | 1100–1800 | 6 (1) | CEH | Geo. | 2953 | 3468 | 34.5 | EN B1b (ii) | EN | GSC, RO | RO          | F. Iranica 165: 179; Grossheim (1940) |
| 15  | *Ruscus hyrcanus* Woron., (*Fig. 2B*) | Gil., Gol., Maz., Talish, (Map 16) | 0–1200 | 70 (25) | OH | Cham. | 90,256 | 50,000 | 58.4 | LC | LC | LF, SF | F. Iranica 165: 178; (A. 14,139) |

(continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | GeoCat | Imp. ass. | Habitat type | References and (selected voucher) |
|-----|-----------------------------------|--------------------------|----------------|-----------------------|-----------|-----------|-----------|-------------------|----------------|--------|---------|-------------|----------------------------------|
| 17  | Iridaceae<br>
| 17  | Crocus almehensis Brickell & Mathew, (Akhani, 2005: Figs. 226) | Gol. (Golestan National Park), (Map 17) | 1470–2000 | 5 (2) | EH | Geo. | 79.127 | 3 | 1.5 | CR B1 + B2ab (iii) | CR | MMW, SAST | Akhani [1998]; F. Iranica 112: 5; F. Iran 31: 6–7; (A. & Sh. 6107) F. Iranica 112: 8 & 75; F. Iran 31: 9–10; (A. 13,774) F. Iranica 112: 11 & 75; F. Iran 31: 16 |
| 18  | Crocus caspius Fisch. & C. A. Mey. (Fig. 2C) | Gil., Gol., Maz., Talish, (Map 18) | –20–1300 | 50 (21) | OH | Geo. | 69,078 | 45,000 | 53.6 | LC | LC | LF | Akhani (1998); F. Iranica 165: 72; (A. 13,368) |
| 19  | Crocus gilanicus Mathew | Gil., Maz., (Map 19) | 1500–2400 | 4 | WH | Geo. | 4063 | 2352 | 27.9 | EN B1ab (iii) | EN | SZ | Akhani (1998); F. Iranica 165: 103; Grossheim (1940); Mathew (1992) |
| 20  | Liliaceae<br>
| 20  | Pyrrhontium caucasicum Woron. | Gil., Maz., (Map 20) | 600–1400 | 17 | XH | Geo. | 220,636 | 40,000 | 146.5 | LC | NT | LF, SF | Akhani (1998); F. Iranica 165: 72; (A. 13,368) |
| 21  | Fritillaria kotschyanë</br>Herbert [incl. subsp. kotschyanë & subsp. grandiflora (Grossh.) Rix], (Akhani, 2005: Figs. 279 –280) | E Azar., Gil., Gol., Maz., Talish, (Teh.), (Map 21) | 1000–3700 | 41 (19) | AH | Geo. | 129,527 | 25,000 | 77.8 | LC | LC | AMW, MF | Akhani (1998); F. Iranica 165: 72; (A. 13,368) |
| 22  | Lilium ledebouri (Baker) Boiss. (Fig. 2D) | Ardabil, Gil., Maz., Talish, (Map 22) | 1350–2250 | 9 (4) | WH | Geo. | 10,238 | 4900 | 34.6 | VU B1ab (iii,iii) | EN CI | FM, SGD | F. Iranica 165: 58–59; (T. & D. 30.061 (IRAN) Christenhusz et al., 2013) F. Iranica 165: 91–92 |
| 23  | Tulipa harazensis Rech. f. | Maz., (Map 23) | 700 | 1 | AH | Geo. | 1250 | 25 | CR B1b (iii,iii) | DD | SC | Akhani (1998); F. Iranica 165: 95–96 |
| 24  | Tulipa ulophylla Wendelbo | Gol., Sem., Maz., (Map 24) | 600–2500 | 3 | AH | Geo. | 1250 | 25 | CR B1b (iii,iii) | DD | SC | Akhani (1998); F. Iranica 126: 29–31; F. Iran 57: 15–16; Grossheim (1940); Hamzeh et al., 2010; (A. 11,253) Akhani (1998); F. Iranica 126: 36–37; F. Iran 57: 19–20; (A. 11,982) F. Iranica 126: 90–91; Grossheim (1940) F. Iranica 128: 86 |
| 25  | Orchidaceae<br>
| 25  | Cephalanthera caucasia KranzL. (Fig. 2E) | Aras., Gil., Gol., Maz., Talish, (Map 25) | 50–2003 | 48 (7) | OH | Geo. | 280,761 | 55,000 | 92.6 | LC | LC | CLF, CMF | Akhani (1998); F. Iranica 126: 29–31; F. Iran 57: 15–16; Grossheim (1940); Hamzeh et al., 2010; (A. 11,253) Akhani (1998); F. Iranica 126: 36–37; F. Iran 57: 19–20; (A. 11,982) F. Iranica 126: 90–91; Grossheim (1940) F. Iranica 128: 86 |
| 26  | Epipactis rechingeri Renz, (Akhani, 2005: Figs. 253 –254) | Gol., Maz., (Map 26) | 950–2200 | 15 (4) | CEH | Geo. | 27,703 | 14,175 | 45.5 | NT | VU CI | MF, SF | Akhani (1998); F. Iranica 126: 29–31; F. Iran 57: 15–16; Grossheim (1940); Hamzeh et al., 2010; (A. 11,253) Akhani (1998); F. Iranica 126: 36–37; F. Iran 57: 19–20; (A. 11,982) F. Iranica 126: 90–91; Grossheim (1940) F. Iranica 128: 86 |
| 27  | Himantoglossum formosum (Stev.) C. Koch | Talish, (Map 27) | 150 | 9 | WH | Geo. | 22,076 | 7776 | 35.6 | NT | EN CI | LF, MF | Akhani (1998); F. Iranica 126: 36–37; F. Iran 57: 19–20; (A. 11,982) F. Iranica 126: 90–91; Grossheim (1940) F. Iranica 128: 86 |
| 28  | Ophrys × aghemani Renz (Ophrys scolopax × transhyrcana) | Gol., (Map 28) | 1250 | 1 | EH | Geo. | 22,076 | 7776 | 35.6 | NT | EN CI | LF, MF | Akhani (1998); F. Iranica 126: 36–37; F. Iran 57: 19–20; (A. 11,982) F. Iranica 126: 90–91; Grossheim (1940) F. Iranica 128: 86 |
| 29  | Ophrys kojarenis Gölz | Maz., (Map 29) | 650–1020 | 7 | CH | Geo. | 50 | 5.4 | CR B1b (iii,iii) | CR | GSC | Golz et al. (2006); Golz et al. (2007) Golz et al. (2007) |
| 30  | Ophrys sintenisii Fleischm. & Bornm. Orchis adenocheila Czerniak. | Gol., Maz., (Map 30) | 70–650 | 6 | EH | Geo. | 310,946 | 900 | 15.5 | EN B1b (iii,iii) | EN | LMW | Akhani (1998); F. Iranica 126: 115–116; F. Iran 57: 57–58; Grossheim (1940); (A. 13,511) F. Iranica 126: 105 –106; Grossheim (1940) |
| 31  | — O. stevenii auct Fl. Iranica | Aras., Gil., Maz., Talish, Turk., (Map 31) | 150–2619 | 76 (12) | XH | Geo. | 359,593 | 67,500 | 146.1 | LC | LC | FM, LF, MF, SC | Akhani (1998); F. Iranica 126: 115–116; F. Iran 57: 57–58; Grossheim (1940); (A. 13,511) F. Iranica 126: 105 –106; Grossheim (1940) |
| 32  | Orchis caspia Trautv. | Gol., Talish, (Map 32) | – | 18 | OH | Geo. | 157,685 | 35,000 | 109.6 | LC | EN CI | MW, SC | Akhani (1998); F. Iranica 126: 115–116; F. Iran 57: 57–58; Grossheim (1940); (A. 13,511) F. Iranica 126: 105 –106; Grossheim (1940) |
| No. | Species Name | Author | Location | Elevation | Population | Phenology | Endangered Category | IUCN Category | Comments |
|-----|-------------|--------|----------|-----------|------------|------------|-------------------|---------------|----------|
| 33  | Poaceae     |        |          |           |            |            |                   |               |          |
| 34  | Agropyron bulbosum Boiss. |        | Maz., (Map 33) | 2300 | 2 (2) | AH | CEH | Hem. | 4050 | 44.8 | CR B1b(ii) | DD | GR | F. Iranica 70: 156–157 |
| 35  | Festuca akhanii Tzvelev |        | Gol., Maz., (Map 34) | 2130–2800 | 5 | AH | Hem. | 1368 | 1728 | 24.4 | EN B1ab (ii) | EN | MMW | F. Iranica 70: 289; Nath and Nielsen (1982) |
| 36  | Phleum iranicum Bornm. & Gauba |        | Maz., Maz./Qazv., Maz./Sem., Maz./Tehr., (Map 35) | 1250–2380 | 10 (10) | EH | Hem. | 2099 | 1444 | 18.7 | EN B1b(ii) | EN | MF, MMW, MSC | CLF, CMF, RH |
| 37  | Poa masenderana Freyn & Sint. |        | Gil., Gol., Iraq, Maz., Sem., Talish, Tehr., Turkey, (Map 36) | 75–2600 | 33 (8) | OH | (discontinuity it occurs in Zagros) | Hem. | 524,969 | 47,500 | 115.9 | LC | LC | B1b(i,ii) | EN |
| 38  | Trisetum bungei Boiss. |        | Gol., Sem., (Map 37) | 2600 | 3 | AH | Hem. | 653,836 | 450 | 14.6 | EN B1 + B2ab (ii) | DD | GR |
| 39  | Typhaceae    |        |          |           |            |            |                   |               |          |
| 40  | Typha caspica Pobed. |        | Gil., Talish, (Map 38) | – | 2 | WH | Hem. | 18 | 3.4 | CR B1b(ii) | DD | MH | F. Iranica 71: 3; F. Iran 42: 9 |
| 41  | Bunium scabrellum Korov. Talish, (Map 40) |        | – | 15 (7) | WH | OH | Geo. | Hem. | 52,699 | 22,500 | 56.6 | LC | LC | MF, RO |
| 42  | Bupleurum flavexile Bornm. & Gauba |        | Maz., (Map 41) | 1850–2950 | 3 (3) | CH | Hem. | 2 | 1.2 | CR B1 + B2b(ii) | CR | MF, SP |
| 43  | Cervaria cervariifolia (C. A. Mey.) M. Pimen. |        | F. Azar., Gil., Gol., Maz., Qazv., Talish, Tehr., Turk., (Map 42) | 500–3500 | 82 (8) | OH | Hem. | 223,063 | 60,000 | 95 | LC | LC | JWO, MF, SC |
| 44  | Daucus littoralis Smith subsp. hyrcanicus Rech. f. |        | Gil., Gil./Ardabil, Maz., (Map 43) | – | 16 (1) | WH | Hem. | 20,245 | 13,448 | 40.9 | NT | VU A1c | CSD |
| 45  | Dichoropetalum ramosissimum (Mozaff.) Pimenov & Klyuykov (¼ Johrenia ramosissima Mozaff.). |        | Maz., (Map 44) | 200–1700 | 5 (4) | CH | Hem. | 228,368 | 36 | 2.9 | EN B1 + B2ab (ii) | EN | LF, MF, SF |
| 46  | Eriocycla ghafooriana Akhani |        | Gol., (Map 45) | 550–1015 | 4 (3) | EH | Cham. | 392 | 13.8 | CR B1b(ii) | CR | LVC |
| 47  | Froriepia subpinnata (Ledeb.) Baill. |        | Gil., Gol., Maz., Talish, (Map 46) | 0–1650 | 41 (11) | XH | Hem. | 354,024 | 60,000 | 153.3 | LC | LC | FO, SC |
| 48  | Heracleum gorganicum Rech. f. |        | Gol., Maz., (Map 47) | 1220–2600 | 8 (4) | CEH | Hem. | 10,533 | 11,094 | 43.1 | VU B1ab (iii,iii) | LC | CMF |
| 49  | Heracleum rechingeri Manden |        | Gil., Maz., Talish, (Map 48) | 1250–2950 | 6 | WH | Hem. | 3760 | 2700 | 29.7 | EN B1b(ii) | VU A4 | MF |
| 50  | Johrenia golestanica Rech. f. |        | Gol., (Map 49) | 220–2000 | 21 (18) | EH | Hem. | 680,062 | 504 | 6.3 | EN B1b(ii) | EN | FO, RO, SC |
| 51  | Leutea glaucoptera (Rech.f.) Akhani & Salimian (¼ Peucedanum pimenovii Mozaff.). |        | Gol., Maz., (Map 50) | 1460–1890 | 6 (2) | CEH | Hem. | 447,061 | 2048 | 31.6 | EN B1b(ii) | EN | MF, RO |

(continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | GeoCat | Imp. ass. | Habitat type | References and (selected voucher) |
|-----|---------------------------------|--------------------------|----------------|-------------|-----------|-----------|-----------|-----------|---------------------|----------------|--------|----------|-------------|---------------------------------------------------|
| 52  | Leutea gracillima M. Pimenov     | Gol. (Golestan National Park), (Map 52) | 750–2080 | 3 (2) | EH | Hem. | 71,052 | 12 | 1.9 | CR B1b(ii) | EN A4a | CRO, JWO | Akhani (1998); F. Irаниca 162: 448–449; (A. 12,069) |
| 53  | Leutea laseroides Akhani         | Gol. (Golestan National Park), (Map 53) | 700–2010 | 6 (6) | EH | Hem. | 33,795 | 20 | 1.6 | CR B1b(ii) | EN A4a | LVC | Akhani (1998); (A. 12,361) |
| 54  | Leutea nematoloba (Rech. f.) M. Pimen. | Maz., Sem., (Map 54) | 1000–2400 | 7 (1) | AH | Hem. | 461,596 | 1764 | 20.6 | EN B1b(ii) | EN | CRO | F. Iraniča 162: 447; F. Iran 54: 445; (A. & Gh. 15,473) |
| 55  | Leutea polycis (Boiss.) M. Pimen. | Gil., Qazv., (Map 55) | 200–1650 | 16 (4) | MR | Hem. | 1409 | 700 | 10.2 | EN B1b(ii) | EN | VC | F. Iraniča 162: 444; (A. 15,359) |
| 56  | Leutea translucens (Rech.f.) Akhani & Salimian (– Peucedanum translucens Rech. f.)) | Maz., (Map 56) | 1750–2750 | 4 (3) | EH | Hem. | 687,362 | 768 | 15.8 | EN B1ab (ii) | CR C1 | JWO | F. Iraniča 162: 444; (A. 15,359) |
| 57  | Polylophium involucratum (Pall.) Boiss. | Maz., (Map 57) | 2000–3000 | 6 | AH | Hem. | 699,317 | 245 | 7.1 | EN B1 + B2b(ii) | VU A4 | AZ (MW, SMW) | F. Iraniča 162: 525; F. Iran 54: 507 |
| 58  | Seseli elbursense Pimenov & Kljuykov (–Trachydium eriocarpum Bornm. & Gauba) | Maz., (Map 58) | 3200–3400 | 2 | AH | Hem. | 8 | 2.4 | CR B1 + B2b(ii) | EN A4 | AZ, CRO | F. Iraniča 162: 444; (A. 15,359) |
| 59  | Seseli kiabii (Akhani) Akhani | Gol., Maz., (Map 59) | 300–2000 | 10 (8) | EH | Hem. | 7664 | 3600 | 30.1 | VU B1ab (ii) | VU | OSC, RO | Akhani (1998); Akhani et al. (2016); F. Iranica 162: 181–182 |
| 60  | Aquifoliaceae | | | | | | | | | | | | | |
| 61  | Ilex spinigera (Loes.) Loes., (Fig. 2H) | Gil., Gol., Maz., Talish, (Map 60) | 30–2018 | 68 (31) | OH | Phan. | 117,529 | 47,500 | 68.6 | LC | LF, MF, SF | Akhani (1998); Browicz (1984); F. Iranica 162: 349–350; (A. 12,370) |
| 62  | Araliaceae | | | | | | | | | | | | | |
| 63  | Hedera pastuchovii Woron. ex Grossh., (Fig. 2I) | Gil., Gol., Maz., Talish, (Map 61) | 50–1800m | 76 (16) | OH | Phan. (Liana) | 247,810 | 67,500 | 102.4 | LC | LF, MF, SF | Browicz (1986); F. Iranica 158: 26; F. Iran 59: 34 |
| 64  | Asteraceae | | | | | | | | | | | | | |
| 65  | Amblyocarpum inuloides Fisch. & C. A. Mey. | Gil., Gol., Maz., Talish, (Map 62) | Sea level–680m | 9 (2) | OH | Ther. | 53,038 | 12,500 | 57.6 | LC | VU A4c | MH, RH | F. Iraniča 145: 126; (Z. 7162 (IRAN)) |
| 66  | Anthemis mazandaranica Iranshahr | Gil., Maz., (Map 63) | 900–1520 | 5 | WH | Ther. | 4325 | 3888 | 36 | EN B1ab (ii) | EN | Unknown | F. Iraniča 158: 21; F. Iran 59: 26 |
| 67  | Anthemis talyschensis Fedor. | Gil., Gil./Ardabil, Maz., Talish, (Map 64) | 1250–4800 | 10 | WH | Hem. | 16,117 | 8000 | 40.1 | VU B1ab(i) | VU | AZ, MSC | F. Iranica 158: 26; F. Iran 59: 34 |
| 68  | Anthemis triumfettii (L.) All. subsp. khorasanica (Rech. f.) Iranshahr | Gil., Gol., Gol./N Khor., Gol./Semn, Maz., Turk., (Map 65) | 400–3000 | 29 (4) | CEH | Hem. | 83,123 | 16,000 | 64.2 | LC | LC | LSC, LWO, MSC, MWO | Akhani (1998); F. Iraniča 158: 20; F. Iran 59: 22–26; (A. 10,684) |
| 69  | Carduus transcaspicus Gandog. subsp. transcaspicus | Gol., Turkm., (Map 66) | 780–1700 | 7 (4) | EH | Ther. | 9961 | 4205 | 28.9 | VU B1ab (ii) | LC | DH, FM, RO | Akhani (1998); F. Iraniča 139a: 223; (A. 11,476) |
| 70  | Centaurea golestanica Akhani & Wagenitz | Gol., (Golestan National Park), (Map 67) | 1200–1550 | 4 (4) | EH | Hem. | 4094 | 1080 | 0.6 | CR B1 + B2b(iii) | CR | GOWO | Akhani (1998); (A. 11,704) |
| 71  | Centaurea hrycanica Bornm., (Fig. 2J) | Aras, Gil., Gil./Ardabil, Gol., Maz., Talish, (Map 68) | 50–2810 | 101 (57) | OH | Hem. | 130,026 | 65,000 | 81.5 | LC | LC | LF, MF, RO, SC | Akhani (1998); F. Iraniča 139b: 345–346; (A. & al. 21,281) |
| No. | Name                                      | Location | Elev. | Collect. | Status | Family | Genus | Subgenus | Section | Species | Pop. | Distribution |
|-----|-------------------------------------------|----------|-------|----------|--------|--------|-------|----------|---------|---------|------|--------------|
| 69  | Centaurea kandavaensis Wagenitz            | Alborz, Maz., (Map 69) | 270–2500 | 15 (3) | AH     | Hem.  | 3562 | 1296 | 12.3 | EN B1b(ii) | EN | RO, SC       | F. Iranica 139b: 392; (Gen. & sp. B182 [IRAN]) |
| 70  | Centaurea meyereana Tzvel.               | Talish, (Map 70) | 1200 | 2 | WH     | Hem. |        |       |       |          | DD | Unknown      | F. Iranica 139b: 404 |
| 71  | Centaurea zuvandica (Sosn.)              | Ardabil, Aras., Gil., Gol., Maz., Sem., Talish, Tehr., (Map 71) | 0–3000 | 90 (49) | OH     | Hem. | 143,494 | 50,000 | 81.1 | LC         | LC | CRO, VC      | Akhani (1998); F. Iranica 139b: 403–404; (A. & sp. 21,044) |
| 72  | Cephaloryynchus gorganicus (Rech. f. & Esfand.) Tuisl. | Gol., Maz., Talish, (Map 72) | 2700 | 3 | OH     | Hem. | 58,033 | 7500 | 62.5 | LC         | DD | SWO          | F. Iranica 122: 212–213 |
| 73  | Cirsium godzukense Petrak                  | Maz., (Map 73) | 2150 | 1 | AH     | Hem. | 98 | 6.8 | CR B1b(ii) | CR | MST, OSC, SF (Xeric slopes) AMW, JWO, MST, SC | F. Iranica 139a: 257 |
| 74  | Cirsium alfredii Borm. & Gauba             | Alborz, Maz., (Map 74) | 1300–1500 | 2 | AH     | Hem. |        |       |       |          | DD | MST, OSC, SF (Xeric slopes) AMW, JWO, MST, SC | F. Iranica 139a: 257 |
| 75  | Cirsium decipiens Boiss. & Bals.          | Gol., Gol./N Khor., Gol./Sem., Maz., (Map 75) | 1000–2810 | 18 (8) | EH     | Hem. | 5440 | 5103 | 27.4 | VU B1b(i) | LC | DDA          | F. Iranica 139a: 117; (A. 14,111) |
| 76  | Cirsium erinaceus Jaub. & Spach           | Gil., (Map 76) | 300–1000 | 6 | MR     | Hem. | 716,516 | 125 | 4.6 | EN B1 + B2b(ii,iii) | EN | STMX | F. Iranica 90: 307–308; F. Iranica 139a: 150; F. Iranica 139a: 121–122; F. Iranica 139a: 121 |
| 77  | Cirsium gmelini C. Winkl.                 | Gil., Maz., (Map 77) | 2600–3300 | 4 | AH     | Hem. | 1715 | 432 | 12.4 | EN B1 + B2ab (i) | EN | AMW, SMW | F. Iranica 139a: 121 |
| 78  | Cirsium hypochionea Borm.                 | Gil., (Map 78) | 400–450 | 1 | MR     | Hem. |        |       |       |          | DD | SEMX | F. Iranica 90: 316 |
| 79  | Cirsium rechingeriae Borm.                | Gol., N Khor., (Map 79) | 740–1300 | 11 (3) | EH     | Hem. | 2166 | 448 | 8.5 | EN B1 + B2b(ii,iii) | VU A4a | OSC | F. Iranica 90: 93–94; F. Iranica 139a: 117; (A. 14,111) |
| 80  | Cousinia wendelboi Rech. f.               | Maz., (Map 80) | 2000 | 1 | AH     | Hem. |        |       |       |          | DD | MSC | F. Iranica 90: 167 |
| 81  | Crepis alfredii Borm.                    | Gil., (Map 81) | 300 | 1 | MR     | Ther. |        |       |       |          | DD | Unknown | F. Iranica 122: 338 |
| 82  | Crepis papposissima Boiss.               | Gil., (Map 82) | – | 1 | EH     | Hem. |        |       |       |          | DD | Unknown | F. Iranica 122: 319 |
| 83  | Crepis willemetoides Boiss.              | Gol., Maz., Turk., (Map 83) | 50–2900 | 20 (10) | CEH   | Geo. | 43,886 | 15,000 | 54.5 | NT | LC | LF, MSC, MWO | Akhani (1998); F. Iranica 122: 302–303; (A. 16,667) F. Iranica 164: 52–53 |
| 84  | Dolichorhiza persica (Boiss.) B. Nord.    | Gil., Maz., (Map 84) | 2600–3400 | 4 | AH     | Hem. | 648 | 17.7 | CR B1b(ii) | CR | AZ | F. Iranica 164: 46 |
| 85  | Doronicum wendelboi Edmondson            | Gol., Maz., Sem., (Map 85) | 2000–2600 | 4 | EH     | Hem. | 2499 | 1296 | 18.1 | EN B1ab (ii) | EN | MF | F. Iranica 164: 46 |
| 86  | Echinops koelzii Rech. f.                 | Gol., Kho., Maz., Maz./ Tehr., Sem., W Azar., (Map 86) | 500–3000 | 19 (3) | AH     | Hem. | 153,766 | 27,500 | 74.8 | LC | LC | CMF, CSF, OMF, OSF, SC | Akhani (1998); F. Iranica 139a: 81; Jocharchi et al. (2007); (A. 9827) F. Iranica 122: 172–173 |
| 87  | Hieracium hoppeanum Schulites             | Aras., Gil., (Map 87) | 1200–2400 | 5 | WH     | Hem. | 6363 | 6480 | 35.7 | VU B1ab(i) | VU | MMW | F. Iranica 122: 172–173 |
| 88  | Hieracium kandavanicum (Rech. f. & Zahn) H. & Zahn | Maz./Alborz, (Map 88) | 2100–2700 | 3 | AH     | Hem. | 1.28 | 0.8 | CR B1 + B2b(ii,iii) | CR | SZ | F. Iranica 122: 173–174 |
| 89  | Klasea quinquefolia (Wild.)               | Aras., Ardabil/Gil., Gol., Maz., (Map 89) | 385–2200 | 36 (10) | XH     | Hem. | 647,246 | 57,500 | 172.2 | LC | LC | LF, MF, SF | Akhani (1998); F. Iranica 139b: 298–299; Martins (2006); (A. 13,726) F. Iranica 122: 128 |
| 90  | Leontodon stenocephalus Rech. f.          | Gol., Gol./Sem., (Map 90) | 2400–2600 | 2 | EH     | Hem. | 50 | 5.3 | CR B1b(ii) | CR | CRO | F. Iranica 122: 69; (Bulshe 984 [Photo-G]) |
| 91  | Scorzonera persica Boiss. & Bals.         | Gil., (Map 91) | – | 1 | MR     | Hem. |        |       |       |          | DD | STMX | F. Iranica 139b: 291–292 |
| 92  | Serratula gracilima Rech. f.              | Gol., (Map 92) | – | 1 | EH     | DD    | Unknown |          |       |          | DD | CRO | F. Iranica 158: 105 |

(continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | Habitat type | References and (selected voucher) GeoCat | Imp. ass. |
|-----|----------------------------------|--------------------------|---------------|-------------|-----------|-----------|-----------|-----------|-----------------|----------------|-------------|----------------------------------------|----------|
| 94  | Tragopogon gongylorrhizus Rech. f. | Gil., Gol., N Khor., Maz., (Map 94) | 450–1820 | 15 (5) | EH | Hem. | 7155 | 8214 | 36.7 | VU B1b(i) | VU | FO, CR, SC | Akhani [1998]; F. Iranica 122: 98; (A. 16,225) |
| 95  | Willemetia tuberosa DC. (Colycocorus tuberosus (DC.) Rauschert) | Gil., Gol., Maz., Talish, (Map 95) | 20–2000 | 48 (20) | OH | Geo. | 195,749 | 45,000 | 77.4 | LC | LC | LF, MH | Akhani [1998]; F. Iranica 122: 289–290; (A. 21,075) |
| 96  | Berberis orthobotrys Bienert ex K. Schneider | Gil., Gol., Maz., Turk., (Map 96) | 700–2800 | 43 (2) | CEH | Phan. | 93,383 | 37,500 | 59.3 | LC | LC | SC | Akhani [1998]; F. Iranica 111: 13; F. Iran 64: 9–12; (A. 11,625) |
| 97  | Epimedium pinnatum Fisch. | Gil., Maz., Talish, (Map 97) | 100–1700 | 47 (9) | WH | Geo. | 29,342 | 22,275 | 45 | NT | NT | LF, MF, SF | F. Iranica 101: 3; F. Iran 56: 4–7; (A. & al. 21,061) |
| 98  | Alnus subcordata C. A. Mey. [incl. var. subcordata & var. villosa (Regel) H. Winkl.] | Gil., Gol., Maz., Talish, (Map 98) | 100–1900 | 90 (19) | OH | Phan. | 103,886 | 37,500 | 59.3 | LC | LC | SC | Akhani [1998]; (Browicz, 1982); F. Iranica 96: 7 |
| 99  | Cynoglossum kandavanensis (Bornm. & Gauba) Akhani | Alborz, Aras., Gil., Gol., Maz., (Map 99) | Sea level–2360 | 16 (8) | OH | Hem. | 107,255 | 12,500 | 59.3 | LC | LC | FO, MMW | Akhani [1998]; F. Iranica 48: 141–142; F. Iran 39: 440–442; Hamze'ee et al., 2010; (A. 11,995) |
| 100 | Echium amoenum Fisch. & C. A. Mey., (Fig. 2L) | Gil., Gol., Maz., E Azar., (Map 100) | 60–3000 | 110 (42) | OH | Hem. | 172,439 | 57,500 | 71.6 | LC | LC | FO, MMW | Akhani [1998]; F. Iranica 48: 215; F. Iran 39: 184–185; Grossheim [1967]; (A. & al. 20,932) |
| 101 | Eritrichium gracillimum Rech. f. | Gil., (Map 101) | 3000 | 1 | AH | Hem. | DD | AZ | Unpublished |
| 102 | Helostroptum sp. nov.6 | Gil., Qazvin, (Map 102) | 150–850 | 6 (6) | MR | Ther. | 59,408 | 40 | 2.4 | CR B1b(i,ii,iii) | EN C2b | SMX | F. Iranica 48: 65–66 |
| 103 | Lepechiniella persica (Boiss.) H. Riedl | Gil., Maz., Tula., (Map 103) | 2400–3900 | 4 | AH | Hem. | 10,958 | 4563 | 38.9 | VU B1ab (ii) | DD | AZ | F. Iranica 48: 41–42; F. Iran 39: 335–336 |
| 104 | Lepechiniella wendelboi H. Riedl | Gil., Maz., Tula., (Map 104) | 1000–4100 | 8 | AH | Hem. | 12,330 | 5766 | 30.7 | VU B1ab (ii) | VU | AZ, SZ | F. Iranica 48: 266; F. Iran 39: 266–267; Joharchi et al. (2007) |
| 105 | Erysimopsis hyrcana Bornm. & Gauba, (Fig. 2K) | Aras, Ardabil 7, Gol., Maz., N Khor., (Map 105) | 250–2450 | 11 | OH | Hem. | 115,944 | 17,500 | 86.6 | LC | LC | LF, MF, MH | F. Iranica 48: 244; Nejad-Falatoury et al. (2011) |
| 106 | Elytria longiflora Wettst. ex Stapf | Gil., (Map 106) | 200–500 | 5 | MR | Ther. | 30,299 | 12 | 1.9 | CR B1b(i,ii,iii) | CR | SC, ST | F. Iranica 48: 127; F. Iran 39: 428 |
| 107 | Rinderia regia (Cmelin) Kuhn | Gil., Maz., Tula., (Map 107) | 2500–2750 | 2 | AH | Hem. | 0.18 | 0.3 | CR B1+B2b(i,ii) | CR | AZ | F. Iranica 48: 127; F. Iran 39: 428 |
| 108 | Alyssopsis mollis (Jacq.) O. E. Schulz | Ardabil, Gil., Maz., N Khor., Sem., Talish, Tshir., (Map 108) | 400–3200 | 87 (35) | OH | Hem. | 132,142 | 52,500 | 80 | LC | LC | LF, MF, RO, SC, VC | Akhani [1998]; F. Iranica 57: 268; F. Iran 143: 648–653; (A. 9349) |
| 109 | Hesperis hyrcana Bornm. & Gauba, (Fig. 2M) | Aras, Gil., Maz., Cau., (Map 109) | Sea level–2750 | 126 (33) | XH | Hem. | 497,196 | 147,500 | 169.9 | LC | LC | CLF, FM, MF, MH, SF | Akhani [1998]; (Dovrak 1964); F. Iranica 57: 268; F. Iran 143: 648–653; (A. 9349) |
| No. | Species Name | Authority | Location(s) | Elevation | Environment | Habitat | Notes |
|-----|--------------|-----------|-------------|-----------|-------------|---------|-------|
| 110 | Isatis gaubae | Bornmüller | Gol., N Khor., Maz., Sem., Tehr. | 570–3000 | CEH | Ther. | 57,432 | 37,500 | 68.9 | LC | LC | MSC | F. Iranica 57: 85; F. Iran 143: 541–543 |
| 111 | Noccaea umbellata (Steven ex DC) Al-Shehbaz | Gil, Gol, Maz., Talish | Sea level–1930 | 43 (2) | OH | Ther. | 158,756 | 50,000 | 80 | LC | LC | LF, MF, SF | F. Iranica 57: 113–114; F. Iran 143: 143; Grossheim (1950); (J. 1886) |
| 112 | Noccaea hastulata (Steven ex DC) Khosravi | Gil, Gol, Maz., Talish | 150–2500 | 54 (4) | OH | Ther. | 89,083 | 45,000 | 62.6 | LC | LC | FM, MF, MW | F. Iranica 57: 85; F. Iran 143: 148–151; Grossheim (1950); (A 13,746) |

**Buxaceae**

- 113 Buxus hyrcana Pojark. | Gil., Gol., Maz., Talish | 20 | WH | Ther. | 62,517 | 40,000 | 54.2 | LC | NT | ALF | F. Iranica 27: 4; F. Iran 66: 50–51; (A 11,396) |

**Campanulaceae**

- 114 Campanula ghilanensis Pall. | Gil., Maz., Talish, (Map 114) | 700–3400 | 41 (8) | CEH | Hem. | 34,716 | 35,000 | 52.7 | NT | LC | CRO | Akhani (1998); (A. 21,266) |

**Caprifoliaceae**

- 115 Lonicera florisobunda Boiss. & Buhse | Ardabil, Gol., Maz., Turk., Cauc., (Map 115) | 500–3000 | 136 (5) | XH | Phan. | 535,599 | 155,000 | 135.1 | LC | NT | MF, JWO, RO, SASC | Akhani (1998); Buhse (1988); F. Iranica 10: 13; F. Iran 13: 15; (A. 11,350) |

**Caryophyllaceae**

- 116 Scabiosa schimperiana Boiss. & Buhse | Gil., Maz., Talish, (Map 117) | 500–2400 | 7 | WH | Ther. | 2420 | 2704 | 26.2 | EN | B1+ B2b(i,ii,iii) | EN | MW | Akhani (1998); F. Iranica 163: 94 |

**Dianthus**

- 121 Dianthus mazanderanicus Rech. f. | Maz., (Map 121) | 1950–2700 | 2 | AH | Hem. | 50 | 4.6 | CR | B1b(ii) | EN | C1 | MST | F. Iranica 163: 154–155 |
- 122 Dianthus orientalis Agrostolepis Rech. f. | Ardabil/E Azar., Gil., Maz., Qazv., Sem., Talish, Tehr., Turkey, W Azar., (Map 116) | 200–2320 | 10 | AH | Cham. | 19,203 | 12,500 | 53.2 | VU | B1ab(i) | LC | LSC, MSC, ST | F. Iranica 163: 158–159 |
- 123 Dianthus orientalis Subsp. gilanicus Rech. f. | Gil., Maz., Sem./ Gol., (Map 122) | 350–2600 | 38 (15) | EH | Cham. | 14,298 | 10,890 | 33.4 | VU | B1b(i) | LC | RO, SC | Akhani (1998); F. Iranica 163: 162; (A. 13,700) |
- 124 Dianthus orientalis Subsp. gorganicus Rech. f. | Gil., Maz., Sem./ Gol., (Map 123) | 200 | 2 | MR | Hem. | 0.08 | 0.2 | CR | B1+ B2b(i,ii,iii) | DD | SAMX | F. Iranica 163: 188 |
- 125 Dianthus rudbaricus Assadi | Gil., (Map 124) | 200 | 2 | MR | Hem. | 200 | 0.2 | CR | B1+ B2b(i,ii,iii) | DD | LF | F. Iranica 163: 143–144; (Buhse 802 a (Photo-G)) |
- 126 Dianthus talyschensis Boiss. & Buhse | Talish, (Map 125) | 900 | 1 | WH | Hem. | 100 | 0.3 | CR | B1b(i,ii,iii) | CR | SMX | F. Iranica 163: 246 |

**Gypsophila modesta** Bornm. | Gil., (Map 126) | 400–500 | 2 | MR | Ther. | 32 | 3.9 | CR | B1b(i,ii,iii) | CR | SMX | (continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | Habitat type | References and (selected voucher) |
|-----|-----------------------------------|---------------------------|-----------------|-------------|-----------|-----------|-----------|-----------|---------------------|----------------|-------------|----------------------------------|
| 128 | *Saponaria bodeana* Boiss. (Fig. 3C) | Gol., Maz., (Map 127) | 400–2600 | 20 (12) | EH | Hem. | 11,741 | 13,689 | 39.3 | VU B1b(i) | VU | MF | Akhani (1998); F. Iranica 163: 198; Joharchi et al. (2007); (A. 11,052) |
| 129 | *Silene lineata* Boiss. & Buhse | Gil., (Map 128) | – | 1 | MR | Hem. | | | | DD | Unknown | | F. Iranica 163: 386; (Buhse 984 (Photo-G)) |
| 130 | *Silene schafta* Gmel. jun. ex Hohen. | Gil., Gol., Maz., Talish, (Map 129) | 820–2810 | 33 (12) | OH | Hem. | 68,790 | 32,500 | 59.2 | LC | LC | MSC, MST, RO | F. Iranica 163: 466–467; (A. 13,660) |
| 131 | *Silene sojakii* Melzh. | Gol. (Golestan National Park)?, Sem., (Map 130) | 2100–2800 | 4 | EH | Cham. | 2180 | 3072 | 31.8 | EN B1ab (iii) | EN | RO | Akhani (1998); F. Iranica 163: 462; Gholipour and Sheidai (2009) |
| 132 | *Celastraceae* | | | | | | | | | | | | |
| 134 | *Euphorbia mazandaranica* Pahlevani | Maz., (Map 134) | Sea level–1450 | 9 | CH | Hem. | 4289.5 | 4375 | 25 | EN B1b (iii) | VU | A4 | LF, SF | Grossheim (1962); Pahlevani and Rima (2014); Pahlevani et al. (2020) |
| 135 | *Euphorbia mazzandaranica* Pahlevani | Maz., (Map 134) | Sea level–620 | 44 (5) | OH (disjunctly occurs in SE Asia) | Phan. | 57,575 | 30,000 | 53.6 | LC | NT | LF | Browicz (1982); F. Iranica 161: 9; F. Iran 18: 30; (Gho. 4535) |
| 136 | *Albizia julibrissin* Durazz., (Fig. 3E) | Gil., Gol., Maz., Talish, (Map 135) | Sea level–620 | 7 (2) | MR | Cham. | 0.141 | 1.470 | 0.7 | CR B1+ B2b (iii) | CR | SMX | F. Iranica 178: 379; (Ma. d.s. 85,976 (TARI)) |
| 137 | *Astragalus acutifolius* Bunge (¼ *A. ammodendroides* Podlech & Zarre) | Gil., (Map 136) | 200–360 | 5 (1) | CH | Hem. | 94,112 | 80 | 4 | CR B1b (iii) | EN | C1 | MSC, SMSC, WO | F. Iranica 178: 342; (Ma. d.s. 82,422 (TARI)) |
| 138 | *Astragalus amaratus* Maassoumi, Podlech & Jalili | Maz., (Map 137) | 530–2268 | 37 (11) | AH | Hem. | 25,953 | 26,460 | 42 | NT | NT | MSC, MST, RO | F. Iranica 178: 44–45; (Ma. 75,471 (TARI)) |
| 139 | *Astragalus nurensis* Boiss. & Buhse | Alborz, Gol., Maz., Sem., (Map 138) | 150–3000 | 11 (2) | AH | Cham. | 17,825 | 10,086 | 41.2 | VU B1ab (i) | LC | SASC | F. Iranica 177: 103–104; (Fo. 453 (TARI)) |
| 140 | *Astragalus verissorotis* Sirj. & Rech. f. | Gil., Gol., Maz., Sem., (Map 139) | 1500–2750 | 33 (1) | AH | Hem. | 31,527 | 32,500 | 53.6 | NT | NT | LMW, LSC, LST, MMW, MSC, MST | F. Iranica 174: 236; 237; F. Iran 43: 185–186; (Klet 44,087 (IRAN)) |
| 141 | *Astragalus yushensis* T. Sabaii, Zarre & Podlech. (¼ *A. submitis* Boiss. & Hohen. subsp. maassoumii Tietz & Zarre) | Maz., (Map 140) | 500–2500 | 6 | AH | Cham. | 62,895 | 80 | 3.9 | CR B1b (ii) | EN | C1 | MSC, SMSC, SMST | F. Iranica 179: 120-121 |
143 Colutea buhsei (Boiss.) Schap. Alborz, Ardabil, Gol., Maz., N Khor., Qazv., R. Khor., Sem., Tehr., Turk., (Map 142) 320–3000 109 (9) CEH (also in Khorassan-Kopet Dagh) Phan. 201,475 65,000 97.5 LC LC DV, FM, OSC, RO Akhani (1998); Browicz (1986); F. Iranica 157: 72–73; (A. 16,616)

144 Gleditsia caspica Desf. Gil., Gol., Maz., Talish, (Map 143) 25–390 46 (8) OH Phan. 63,189 32,500 53.6 LC LC LF Browicz (1982); F. Iranica 160: 10–11; F. Iran 45: 20–21; (A. ã. al. 21,030)

145 Oxytropis heterophylla C. A. Mey. Talish, (Map 144) 900–1200 7 WH Hem. 3488 4500 29.8 EN B1b(ii) EN FO, SC F. Iranica 157: 437; Grossheim (1952) F. Iranica 157: 457; (A. 14,577)

146 Onobrychis mazanderanica Rech. f. Alborz, Gol., Maz., (Map 145) 500–2400 13 (1) AH Hem. 24,924 16,200 44.8 NT NT FO, SC F. Iranica 157: 313

147 Trifolium mazanderanicum Rech. f. Maz., (Map 146) 400 1 EH Hem. 1213 576 8 EN B1b(i,ii) EN MF, MSC, MST, F. Iranica 150: 498; F. Iran 76: 687 (continued on next page)

148 Quercus castaneifolia C. A. Mey., (Fig. 3G) Gil., Gol., Maz., Talish, (Map 147) Sea level–2400 119 (36) OH Phan. 225,250 67,500 77.5 LC LC CLF, OLF, CSF, OSF, CMF, OMF, SC Akhani (1998); Browicz (1982); F. Iranica 157: 7; 11; (A. 14,580)

149 Gentiana grossheimii Doluch., (Fig. 3H) Dagh. stan, Gol., (Map 148) 800–2300 13 (2) OH Hem. 9253 (for Dagh. stan records) VU B1b(ii) VU LVC, CRO, OSC Dolukhanof (1948); Grossheim (1967); (A. 23,291)

150 Erodium dimorphum Wendelbo Gil., Maz., (Map 149) 2600–3300 2 AH Hem. 18 3.5 CR B1b(iii) CR RO, AZ F. Iranica 69: 50; F. Iran 62: 89–91

151 Parrotia persica (DC.) C. A. Mey., (Fig. 3F) Gil., Gol., Maz., Talish, (Map 150) Sea level–1500 102 (36) OH Phan. 174,918 55,000 78.6 LC LC ALF, LF, RH Akhani (1998); Browicz (1982); F. Iranica 53: 1; F. Iran 136: 3; 5; (A. 14,579)

152 Hypericum fursei N. Robson Maz., (Map 151) 1200 1 CH Hem. 9776 7688 31 VU B1b(i) VU LSC, LWO, MSC, MWO, RH F. Iranica 49: 16

153 Ballota platyloma Rech. f. Gil., Maz., Sem., Tehr., (Map 152) 400–2500 17 (5) AH Hem. 9776 7688 31 VU B1b(i) VU LSC, LWO, MSC, MWO, RH F. Iranica 150: 399; (Mo. 14.7.2006, s.n.) Jamzad (1987); [As. A M. 33,028 (holotype-TARI)] Jamzad (1988); [As. A M. 33,030 (holotype-TARI)]

154 Phlomis ghilanensis C. Koch Gil., (Map 153) 2900–3600 6 (1) AH Hem. 4780 4500 30.3 EN B1b(ii) EN AZ, RO Jamzad and Assadi (1984); Jamzad (1991); [R.â.â. 21,689 (holotype-TARI)] F. Iranica 150: 301–302 (holotype-TARI) F. Iranica 150: 466; F. Iran 76: 915 Akhani et al. (2016)

155 Satureja intermedia C. A. Mey. Gil., (Map 154) 1900–2350 2 (1) AH Hem. 426.775 432 12.3 EN B1b(ii) EN RO F. Iranica 150: 498; F. Iran 76: 675 F. Iranica 150: 498; F. Iran 76: 687

156 Satureja isophylla Rech. f. Maz., (Map 155) 1900–2300 2 (1) AH Hem. 1213 576 8 EN B1b(ii) EN MF, MSC, MST, (continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | Habitat type | References and (selected voucher) |
|-----|----------------------------------|---------------------------|----------------|-------------|-----------|-----------|-----------|-----------|------------------|----------------|-------------|----------------------------------|
| 163 | *Satureja mutica* Fisch. & C. A. Mey. | Gil, Gol., Maz., N Khor., Talish, Turk., (Map 162) | 550–2080 | 21 (8) | OH | Hem. | 174,541 | 27,500 | 89 | LC | LC | RO, VC | Akhani (1998); F. Iranica 150: 499; F. Iran 76: 694; (A. 12,263) |
| 164 | *Scutellaria tournefortii* Bentham. (Fig. 3I) | Gil, Gol., Maz., Talish, (Map 163) | 20–2130 | 86 (11) | OH | Hem. | 124,962 | 70,000 | 68 | LC | LC | CLF, CMF | Akhani (1998); F. Iranica 150: 52–53; F. Iran 76: 92; Grossheim (1967); (A. 9,278) |
| 165 | *Stachys laca* Boiss. & Buhse | Gol., Maz., Sem., Tehr., (Map 164) | 500–2810 | 43 (8) | CEH | Hem. | 36,956 | 29,384 | 42.7 | NT | LC | RO | Akhani (1998); F. Iranica 150: 389–390; Salmaki et al. (2012); (A. 12,325) |
| 166 | *Stachys talyschensis* Kappler | Talish, (Map 165) | – | 1 | WH | Hem. | | | | | | | |
| 167 | *Tauricum hycnacium* L. | Gil, Gol., Maz., Talish, (Map 166) | –20–2000 | 97 (30) | XH | Hem. | 495,070 | 115,000 | 149.1 | LC | LC | LF, MF, OSC, WO | Grossheim (1967); (A. 11,960) |
| **Linaceae** | | | | | | | | | | | | | |
| 168 | *Linum bungeri* Boiss. | Gol., Maz., Sem., (Map 167) | 2100–3200 | 14 (3) | AH | Hem. | 27,044 | 15,129 | 41.1 | NT | NT | MMW, MSC, MST | Akhani (1998); F. Iran 34: 29; (Furse 2769 [IRAN]) |
| **Lythraceae** | | | | | | | | | | | | | |
| 169 | *Papilis hycrana* Soos. | Talish, (Map 168) | – | 1 | WH | Ther. | | | | | | | |
| **Malvaceae** | | | | | | | | | | | | | |
| 170 | *Alcea gorganica* (Rech. f., Aell. & Esfand.) Zohary [incl. A. popovi Iljin & A. sycophylla Iljin & Nikitin, A. mazandaranica Pakravan & Chahramej] | Gil, Maz., N Khor., W Azar?, Turk., (Map 169) | 100–2050 | 35 (12) | CEH | Hem. | 123,614 | 21,160 | 46.2 | LC | LC | FM, FO, OSC, WO | Akhani (1998); F. Iranica 120: 72, 76–77, 82; F. Iran 58: 77–80; (A. 11,197) |
| 171 | *Alcea hycrana* (Grossh.) Grossh. | Gil, Maz., Talish, (Map 170) | 100–2100 | 5 | WH | Hem. | 20,362 | 5445 | 33 | NT | NT | LF, MF | F. Iranica 120: 57; F. Iran 58: 108–110 Akhani (1998); F. Iranica 148: 6–7 |
| 172 | *Tilia platyphylla* Scop. subsp. caucasia (Rupr.) Loria², (Fig. 3J) | Gil, Maz., Talish, (Map 171) | 100–2400 | 141 (4) | XH | Phan. | 1,452,474 | 217,500 | 252.9 | LC | NT | CLF, CMF | |
| **Orobanchaceae** | | | | | | | | | | | | | |
| 173 | *Orobanche eriotheta* Bornm. & Gauba¹⁰ | Maz., (Map 172) | 2300 | 1 | AH | Geo. | | | | | | | |
| 174 | *Orobanche schwingenschussii* Gilli Grossh. | Maz/Alborz, (Map 173) | 2860 | 2 | AH | Geo. | 0.08 | 0.2 | CR B1 + B2b(ii,ii) | DD | MSC? | F. Iranica 5: 10 |
| 175 | *Rhynehochyrs maxima* C. Richter, (Fig. 3K) | Alborz, Gil, Gol., Maz., Talish, Tehr., (Map 174) | –26–2750 | 70 (35) | OH | Hem. | 185,771 | 62,500 | 88.8 | LC | LC | DH, FM, FO, LF, MF, | Akhani (1998); Burbridge and Richardson (1970); F. Iranica 147: 209; (A. & al. 20,929) |
| **Paoniacaeae** | | | | | | | | | | | | | |
| 176 | *Paonia tomentosa* (Lomak.) N. Busch¹¹, (Fig. 3L) | Gil, Gol., Maz., Talish, (Map 175) | 1000–3000 | 56 (6) | OH | Geo. | 119,308 | 40,000 | 68.8 | LC | LC | CMF, FM, FO, SC | Akhani (1998); F. Iranica 60: 4; F. Iran 86: 50–51 Akhani (1998); Burbridge and Richardson (2003); Rukišans and Zetterlund (2014); (A. 10,310) Rukišans and Zetterlund (2014) |
| 177 | *Paonia wendelboi* Rukišans & Zetterlund | Ardabil-Gil., (Map 176) | 2000–2300 | 5 | WH | Geo. | 9,727 | 3 | 1 | CR | CR | SMW, RO | |
Papaveraceae

178 Corydalis chionophila Czernjak.
   Gol., N Khor., R. Khor., Turk., (Map 177) 1650–2340 12 (11) EH KHORASSAN-KOPEK DAGH (Memariani) Geo. 32,757 12,943 43.3 NT NT MMW, WO Akhani (1998); F. Iranica 110: 20; (A. 10,203)

179 Corydalis hircana Wendelbo
   Ardabil ?, Gol., Maz., (Map 178) 1000–2450 5 (3) OH Geo. 32,704 7500 60 NT VU A4c MMW, WO F. Iranica 110: 14–15; (J. 1590) F. Iranica 34: 19; F. Iran 127: 99–102; (A. 5335)

180 Popeny chelidoniifolium Boiss. & Buhse, (Fig. 3M)
   Gil., Maz., Talish, (Map 179) –22–1800 49 (2) OH Ther. 57,919 39,762 47.2 LC LC FM, LF, SC, SF F. Iranica 110: 20; (A. 10,203)

Plantaginaceae

181 Digitalis nervosa Stud. & Hochst. ex Benth., (Fig. 3N)
   Aras, Ardabil/Gil., Gol., Maz., Sem., Talish, (Map 180) 2000 88 (32) OH Hem. 262,974 75,000 93.6 LC LC FM, FO, LF, MF, RO, SC Akhani (1998); F. Iranica 147: 97–98; (Bunge 15 (holotype-Photo-G-Boiss.)) F. Iranica 147: 174–176; (Wildenow 203 (type-B-Willd.)) F. Iranica 147: 104–105; Saedi-Mehrzar (1999) F. Iranica 147: 112–113; F. Iran 68: 115; (A. 12,036) F. Iranica 147: 78–79; Saedi-Mehrzar (1999); (J. 1779) F. Iranica 147: 144–145; Saedi-Mehrzar (1999); (N. 942) Akhani (1998); F. Iranica 147: 98–99; Saedi-Mehrzar (1999); (A. 10,403)

Polygalaceae

190 Polygala platystera Bornm. & Gauba
   Maz., (Map 188) Sea level–2500 42 (4) CH Hem. 19,833 11,760 28.4 VU B1b(i,ii) CR LMW, MMW, WO Akhani (1998); F. Iranica 110: 20; (A. 10,203)

Polygonaceae

191 Atropurasis eucheri Jaub. & Spach
   Gil., (Map 189) 300–600 4 MR Cham. 55,222 27 3.2 CR B1b(i,ii,iii) CR STMX F. Iranica 56: 35

192 Atropurasis radkanensis S.Tavakkoli, Kaz.Osaloo & Mozaff.
   Gol., (Map 190) 1400–1762 3 EH Cham. 11,359 3 1.1 CR B1 + B2b(i,ii) CR CRO, MRO Tavakkoli et al. (2013); (A. 23,283)

193 Polygonum hyrcanicum Rech. f., (Akhani, 2005: Figs. 747–748)
   Ardabil, Gil., Gol., Maz., N Khor., Qazv., Sem., (Map 191) 10–1750 33 (11) OH Hem. 179,483 40,000 90.3 LC LC DH, LMW, MMW Akhani (1998); F. Iranica 56: 64–65; (A. 12,307)

194 Rumex kandavanicus (Rech. f.) Rech. f.
   Maz./Alborz, (Map 192) 2800 1 AH Hem. DD MH, SZ F. Iranica 56: 9–10 (continued on next page)
| No. | Family and species (Figure number) | Distribution (Map number) | Elev. range (m) | Rec. (Herb.) | Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | Habitat type | GeoCat | Imp. ass. | References and (selected voucher) |
|-----|----------------------------------|---------------------------|----------------|-------------|-----------|-----------|-----------|-----------|---------------------|----------------|-------------|--------|---------|----------------------------------|
| 195 | Primula matthioli L. subsp. iranica Iranshahr & Wendelbo | Maz., (Map 193) | 2500–3000 | 2 (1) | AH | Hem. | 62,663 | 35,000 | 55.3 | LC | LC | CLF, CSF | F. Iran 25: 59; Iranshahr and Wendelbo (1976); (Re.&. Ir. 16,804 (type-IRAN)) |
| 196 | Cyclamen elegans Boiss. & Bubse (— C. coum auct. Flora Iranica 9: 30, 1965 non Miller) | Gil, Gol., Maz., Talish, (Map 194) | 50–1750 | 33 (7) | OH | Geo. | 2 (1) | AH | Hem. | CR | C2b | MF? | F. Iranica 9: 30–31; F. Iran 25: 67–69; Grossheim (1967); (A. 1.3,795) |
| 197 | Dionysia artemioides (Lehm.) Boiss. | Gil, Maz., Sem., Tehr., (Map 195) | 550–3200 | 28 (4) | AH | Cham./ Hem. | 96,444 | 10,800 | 29.7 | VU | B1b(i) | LC | VC | F. Iranica 9: 17; F. Iran 25: 25; (A. 13,757) |
| 198 | Primula heterochroma (Fig. 4A) | Gil., Gol., Maz., Sem., Talish, (Map 196) | 60–2400 | 55 (23) | OH | GeoCat | 115,748 | 50,000 | 66.9 | LC | LC | CLF, CMF, CSF | F. Iranica 171: 38; (Ir.&.Re. 16,765 (IRAN)) |
| 199 | Aconitum iranshahrii H. Riedl | Maz., (Map 197) | 2000–2500 | 1 (1) | CH | Geo. | 378,696 | 87,500 | 152.4 | LC | LC | GOWO, LF | F. Iranica 171: 224–225; Grossheim (1950); (A. 14,571) |
| 200 | Anemone caucasica Willd. ex Rupr., (Fig. 4B) | Cau., Central Alborz, E Anatolia, Gil., Gol., Maz., Sem., Talish, (Map 198) | 700–2900 | 53 (9) | XH | Geo. | 377,291 | 72,500 | 104.7 | LC | LC | FM, LF, MF, MH, OSC, SF | F. Iranica 171: 85–86 |
| 201 | Delphinium syncarpum Freyn | Maz., (Map 199) | — | 1 | CH | Ther. | 37,165 | 25,344 | 48.4 | NT | NT | AZ, FO, MWO | Akhani (1998); F. Iranica 171: 70–71; (A. 11,676) |
| 202 | Delphinium ursinum Rech. f., (Akhani, 2005: Figs. 519–520) | Gil, Gol., Maz., (Map 200) | 700–2200 | 16 (3) | CEH | Geo. | 37,165 | 25,344 | 48.4 | NT | NT | AZ, FO, MWO | Akhani (1998); F. Iranica 171: 70–71; (A. 11,676) |
| 203 | Pararuegula caespitosa (Boiss. & Hohen.) Drumm. & Hutch. | Maz., (Map 201) | 2500–4800 | 10 | AH | Hem. | 3096 | 2646 | 20.7 | EN | B1b(ii) | EN | AZ, RO | F. Iranica 171: 8 |
| 204 | Ranunculus cicutarius Schlechtend., (Akhani, 2005: Figs. 522–523) | Gil, Gol., Maz., Khor?, Sem., Talish, (Map 202) | — 26–2200 | 55 (4) | OH | GeoCat | 377,291 | 72,500 | 104.7 | LC | LC | FM, LF, MF, MH, OSC, SF | Akhani (1998); F. Iranica 171: 159–160; Grossheim (1950); (A. 10,347) |
| 205 | Ranunculus dolosus Fisch. & C. A. Mey. | Gil, Gol., Maz., (Map 203) | — 26–1200 | 13 (1) | OH | GeoCat | 92,641 | 27,500 | 64.3 | LC | LC | MH | F. Iranica 171: 137; Grossheim (1950); (A. 13,274) |
| 206 | Rhamnaceae | | | | | | | | | | | | | |
| 207 | Alchemilla amaricola Rothm. | | | | | | | | | | | | | |
| 208 | Alchemilla citrina Fr€ohner | Arasdil, Gil, Gol., Maz., (Map 206) | 2000–3200 | 10 | OH | Hem. | 43,814 | 12,500 | 60.2 | NT | NT | AMW, MF, SMW | F. Iranica 66: 142–143; F. Iran 6: 175; Naqinezhad et al. (2010) |
| 209 | Alchemilla condensa Fr€ohner | Gil, Maz., (Map 207) | 1800–2100 | 4 | OH | Hem. | 9899 | 6924 | 41.7 | VU | B1ab (ii) | VU | MMW | F. Iranica 66: 142–143; F. Iran 6: 175; Naqinezhad et al. (2010) |
| 210 | Alchemilla gigantodus Fr€ohner | Gil, Maz., (Map 208) | 1300–3400 | 9 | OH | Hem. | 57,831 | 12,500 | 72.7 | LC | LC | AZ, SZ | F. Iranica 66: 142–143; F. Iran 6: 175; Naqinezhad et al. (2010) |
| Page | Species Name | Authors | Map Numbers | Origin | Altitude | Flowering Season | Bloom Size | Bloom Color | Threat Status | Recovery Status | Conservation Status | Year | Map Numbers | Description |
|------|-------------|---------|-------------|--------|----------|-----------------|------------|-------------|--------------|----------------|-------------------|------|-------------|------------|
| 211  | Alchemilla hyrcana (Buser) Juz. | Aras, Gil, Maz., Talish, (Map 209) | 1200–3600 | 9 | WH | Hem. | 38,232 | 20,000 | 77.3 | NT | NT | AMW, SMW | F. Iranica 66: 137–138; F. Iran 6: 162–163; Grossheim (1952); Hamzehvve et al. (2010) Naqinezhad et al. (2017) |  |  |
| 212  | Alchemilla mazandarana Naqinezhad & S.E. Fröhner | Maz., (Map 210) | 2636–2950 | 7 | AH | Hem. | 303,290 | 75 | 5.4 | EN B1+B2b(ii) | EN | RO, MMW, COWO | MMW |  |  |
| 213  | Alchemilla microsperma Fröhner | Gil, Maz., (Map 211) | 1800–2300 | 4 | OH | Hem. | 20,958 | 6618 | 47 | NT | NT | AMW, SMW | F. Iranica 66: 138–139; F. Iran 6: 167–168 |  |  |
| 214  | Alchemilla pectiniloba Fröhner | Gil, Maz., (Map 212) | 1800–3200 | 5 | WH | Hem. | 1085 | 2352 | 28.4 | EN B1ab (ii) | EN | AZ, SZ |  |  |  |
| 215  | Alchemilla plicatissima Fröhner | Gil, Gol., Maz., (Map 213) | 1800–2600 | 4 | OH | Hem. | 5827 | 7500 | 52.3 | VU B1ab (ii) | VU | MMW |  |  |  |
| 216  | Cydonia oblonga Miller | Aras, Gil, Gol., Maz., Talish, Turk., (Map 214) | 40–1700 | 53 (2) | XH (widely cultivated in other parts) | Phan. | 2,350,436 | 107,500 | 123.5 | LC | VU A4ac | CLF, CSF, OLF, OSF |  |  |
| 217  | Potentilla petraea Wildl. ex Schlecht. | Alborz, Ardabil/Gil., Gil., Maz., Talish, (Map 215) | 2300–3100 | 10 | WH | Hem. | 12,196 | 7135 | 37.8 | VU B1ab(i) | NT | RO, SZ |  |  |  |
| 218  | Pyrus boissieriana Buhse | (Pro. Syn. P. ghahremanii Attar & Zamani, Plongipedicellata Zamani & Attar, P. kandevanica Ghahreman & Khatamsaz, P. cordifolia Zamani & Attar)(5), (Fig. 4C and D) |  |  |  |  |  |  |  |  |  |  |  |  |
| 219  | Pyrus grossheimii Fedor. | Gil, Maz., Talish, (Map 217) | 700–2400 | 8 | WH | Phan. | 9285 | 9507 | 39.9 | VU B1ab (ii) | NT | MF, MSC, SF, SMSC |  |  |  |
| 220  | Pyrus hyrcana Fedor. | Aras, Gil, Maz., Talish, (Map 218) | 40–2450 | 11 | WH | Phan. | 28,401 | 15,000 | 50.3 | NT | NT | LF, LSC, LWO, MF, MSC, MW |  |  |  |
| 221  | Pyrus mazanderanica Schönbeck-Temesy | Alborz, Maz., (Map 219) | 1900–2400 | 5 | CH | Phan. | 32 | 4.4 | CR B1b(ii) | DD | MSC |  |  |  |
| 222  | Rubus persicus Boiss. | Gil, Gol., Maz., Talish, (Map 220) | 30–1600 | 29 | OH | Phan. | 164,041 | 32,500 | 72.7 | LC | LC | DH, FM, LF, RH, SF |  |  |  |
| 223  | Rubus raddeanus Focke | Aras, Gil, Gol., Maz., Talish, (Map 221) | 50–2000 | 14 (1) | OH | Phan. | 97,308 | 22,500 | 79.1 | LC | LC | LF, RH |  |  |  |
| 224  | Spiraea sheikhii Zare | Maz., (Map 222) | 200–250 | 2 | CH | Phan. |  |  |  | DD | LF |  |  |  |  |
| 225  | Asperula gorgonica Schönb.-Tem. & Ehrend. | Gol., (Map 223) | 600–2080 | 15 (8) | EH | ±Cham. | 4136 | 2259 | 16.8 | EN B1b(ii) | VU A4a | CRO, SC, VC, WO |  |  |  |
| 226  | Asperula mazanderanica Ehrend. | Gil, Maz., (Map 224) | 650–2700 | 9 | EH | Cham./Hem. | 6015 | 2400 | 20.1 | VU B1ab (ii) | VU | MSC, RO, |  |  |  |
| 227  | Asperula microphylla Boiss. | Gil, Gol., Maz., (Map 225) | 300–3400 | 16 (1) | AH | Cham./Hem. | 14,584 | 10,086 | 41.4 | VU B1b(i) | VU | CRO, WO |  |  |  |
| 228  | Asperula sherardoides (Boiss.) Jaub. & Spach | Gil, (Map 226) | 400–600 | 2 | MR | Ther. |  |  |  | CR C2b | SMX |  |  |  |  |  |

Continued on next page
| No. | Family and species (Figure number) | Distribution Map (Map number) | Elev. range (m) | Rec. (Herb.) Chorotype | Life form | EOO (km²) | AOO (km²) | 10% max. dist. (km) | Threat category | Habitat type | References and selected voucher |
|-----|----------------------------------|-------------------------------|----------------|------------------------|-----------|----------|----------|------------------|----------------|-------------|----------------------------------|
| 229 | Crucianella gilanica Trin. subsp. hirsuta (Ehrend.) Ehrend. & Schönb.-Tem. | Alborz, Maz., Tehr. (Map 227) | 850–4100 | 19 | AH | Hem. | 489 | 128 | 4.4 | EN B1 + B2b (iii) | VU A4c | AZ, CRO, MF, MSC, SRO, VRO | F. Iranica 176: 85–86 |
| 230 | Crucianella gilanica Trin. subsp. nevensis Ehrend. & Schönb.-Tem. | Maz., Sem., (Map 228) | 2000–3200 | 5 | AH | Hem. | 202 | 36 | 2.7 | EN B1 + B2ab (iii) | EN | MF, RO, SASC, SZ | F. Iranica 176: 83–84 |
| 231 | Crucianella gilanica Trin. subsp. suleimanica Ehrend. & Schönb.-Tem. | Maz., (Map 229) | 2000–3520 | 2 | AH | Hem. | 8 | 1.8 | | CR B1 + B2b (iii) | EN A4c | AMW, RO | F. Iranica 176: 84 |
| 232 | Crucianella platyphylla Ehrend. & Schönb.-Tem. | Gol., Sem., (Map 230) | 1800–2500 | 6 (5) | EH | Cham./ Hem. | 3959 | 1620 | 17.6 | EN B1b (iii) | VU A4 | LVC, MWO | Akhani (1998); F. Iranica 176: 79; (A. 12,026) |
| 233 | Callium aucheri Boiss. | Gol., Maz., Sem., (Map 231) | 3000–4100 | 8 | AH | Hem. | 6971 | 6845 | 37.3 | VU B1ab (iii) | NT | AZ, CRO, SP | F. Iranica 176: 192 |
| 234 | Callium capsicum Steven | Gil., Maz., Tališ., (Map 232) | 700–1850 | 7 | WH | Hem. | 26,349 | 9216 | 48 | NT | NT | MH, SF | F. Iranica 176: 198 |
| 235 | Callium elbusense Bornm. & Gauba ex Bornm. | Gil., Maz., (Map 233) | 1700–1800 | 2 | AH | Cham./ Hem. | 26,349 | 9216 | 48 | NT | NT | MH, SF | F. Iranica 176: 229–230 |
| 236 | Callium kuetzingii Boiss. & Buhse | Gil., Tališ., (Map 234) | 250–400 | 5 | WH | Cham./ Hem. | 796,529 | 1728 | 24.5 | EN B1b (iii) | EN | SAMX | F. Iranica 176: 204–205 |
| 237 | Callium wendelboi Ehrend. & Schönb.-Tem. | Maz., (Map 235) | 450–1800 | 4 (1) | CH | | 2 | 1.1 | | CR B1 + B2b (iii) | CR | MF, RO | F. Iranica 176: 228–229; (A. 13,858) |
| 238 | Phuopsis stylosa (Trin.) Hook. f. | Gil., Gil./Ardabil, Maz., Tališ., (Map 236) | 200–2640 | 41 (19) | WH | Geo. | 34,779 | 24,299 | 46.8 | NT | LC | FO, MW, SC | F. Iranica 176: 73–74; (Glo. 4489) |

**Salicaceae**

| 239 | Populus caspica Bornm., (Fig. 4F) | Aras, Gil., Gol., Maz., N Khor., Tališ., Turk., (Map 237) | 300–1400 | 32 (15) | OH (widely cultivated outside of Caspian area) | Phan. | 1,852,142 | 85,000 | 85.1 | LC | LC | ALF, LF, RH | Akhani (1998); Browicz (1982); F. Iranica 65: 10–11; (A. 11,554) |

**Sapindaceae**

| 240 | Acer iranicum M. Mohrshahm. & A. Rastegar/A mazanderanicum Amini, Zare & Assadi 12 | Gil., (Map 238) | 950–1150 | 5 | WH | Phan. | 0.123 | 0.038 | 0.1 | CR B1 + B2b (iii) | DD | CSF | Amini et al. (2008); Mohrshahmian et al. (2020) |

**Saxifragaceae**

| 241 | Acer velutinum Boiss. [incl. var. velutinum & var. glabrescens (Boiss. & Buhse) E. Murray], (Fig. 4G) | Gil., Gol., Gol./N Khor., Maz., Tališ., (Map 239) | 0–2364 | 68 (31) | OH | Phan. | 235,494 | 62,500 | 100.4 | LC | LC | CLF, CMF, CSF, RH | Akhani (1998); Browicz (1982); F. Iranica 61: 4–5; (A. 16,614) |

| 242 | Saxifraga iranica Bornm. | Maz., (Map 240) | 2800–4200 | 8 | AH | Cham./ Hem. | 568,867 | 124,503 | 5 | EN B1 + B2b (iii) | EN | AZ, RO | F. Iranica 42: 13; F. Iran 12: 10–11 |
| 243 | Saxifraga mazanderanica Rech. f. | Gil., Maz., (Map 241) | 1100–3000 | 9 (1) | AH | Cham./ Hem. | 8482 | 5300 | 32.6 | VU B1ab (i) | EN C1 | RO | F. Iranica 42: 10; F. Iran 12: 16–18; (Ma. 38,628 [IRAN]) |
| 244 | Saxifraga ramsarica Jamzad | Maz., (Map 242) | 2750 | 2 (1) | AH | Cham./ Hem. | 0.72 | 0.6 | CR B1 + B2b (iii) | CR | CRO | F. Iran 12: 11–12; (R.AMu. 20,903 (holotype-TARI)) |
| 245 | Saxifraga wendelboi Schönb.-Tem., (Fig. 4H) | Gol., Maz., Sem., (Map 243) | 1900–3000 | 9 (4) | EH | Cham./ Hem. | 1879 | 1372 | 13.9 | EN B1b (iii) | VU A4 | VC | F. Iranica 42: 12; F. Iran 12: 9; (A. 13,611) |

**Scrophulariaceae**

| 246 | Scrophularia gauiae Bornm. | Gil., Gol., Maz., Khor., (Map 244) | 400–3000 | 29 (8) | CEH | Hem. | 54,119 | 32,500 | 64.1 | LC | LC | CLF, CMF, CSF, FO, RH SC | Akhani (1998); F. Iranica 147: 242–243; |
| No. | Species                                      | Distribution | Altitude (m) | Elevation | Presence | Source Code | Status   | Notes                                      |
|-----|---------------------------------------------|--------------|--------------|-----------|----------|-------------|----------|-------------------------------------------|
| 247 | Scrophularia megalantha Rech. f. Maz. (Map 245) | Gil., Gil. | 40–600       | 17        | CH       | Hem.        | 3459     | 1239 10.6 EN B1b (ii) EN LF                |
| 248 | Scrophularia rostrata Boiss. & Buhse Gil., Gil. Ardabil, Maz., Talish, (Map 246) | 50–3010      | 23 (1)       | WH        | Hem.     | 36,273      | 24,956   | 47.7 NT LC LF, MF, SC, SF, SZ              |
| 249 | Scrophularia vernalis L. subsp. clausii (Boiss. & Buhse) Gras. (Fig. 31) | Gil., Gil., Maz., Sem., Talish, W Azar. (Map 247) | 400–2640    | 41 (3)   | OH       | Hem.        | 220,922  | 45,000 78.5 LC LC MF, RO, SC              |
| 250 | Verbascum parsana Sotoodeh, Attar & Civeyrel Gil., (Map 248) | 1876         | 1            | WH        | Hem.     | (Bien.)     | DD OMF   | Sotoodeh et al. (2016); (Moazzem & Keshvari 34,341 (bolotype-TUH)) Sotoodeh et al. (2015) |
| 251 | Verbascum shahsavarensis Sotoodeh, Attar & Civeyrel Maz. (Map 249) | 1570         | 1            | CH        | Hem.     | (Bien. Peren.) | EN C2b OMF |                                           |
| 252 | Verbascum stachydiforme Boiss. & Buhse Gil./Ardabil, Maz., Talish, (Map 250) | 1200–2300    | 10 (1)       | WH        | Hem.     | 26,108      | 10,000   | 50.9 NT VU A4c MF, WO                     |
| 253 | Verbascum sublobatum Murb. Gil., Gil., Maz., N Khor. (Map 251) | 500–2100     | 15 (4)       | CEH       | Hem.     | 51,669      | 17,500   | 59 LC VU A4c FO, LF, MF, SC, SF, WO       |
|    | **Solanaceae**                               |              |              |           |          |             |          |                                           |
| 254 | Atropa pallidiflora Schönb. Liquid. German. Gil., Maz., (Map 252) | 35–2500      | 24           | CEH       | Hem.     | 30,200      | 23,040   | 48.1 NT LC LF, MF, SF, FO                  |
| 255 | Solanum kiesertzkii C. A. Mey., (Fig. 4J)    | Gil., Gil., Maz., Talish, (Map 253) | 90–2400      | 25 (8)   | OH       | Cham.       | 105,432  | 32,500 67.5 LC CLF, CMF, CSF              |
|    | **Thymelaeaceae**                            |              |              |           |          |             |          |                                           |
| 256 | Daphne mezereum L. subsp. rehingeri (Wendelbo) Halda Gil., Maz., (Map 254) | 500–1750     | 8 (1)        | WH        | Phan.    | 12,109      | 5710     | 33.8 VU B1ab (ii) VU LF, SC, SF           |

*F. Iranica 147: 231; F. Iran 68: 225; F. Iranica 147: 241–242; F. Iran 68: 289; Grossheim (1967); [A. al. 20,933] F. Iranica 147: 229–230; F. Iran 68: 219; Grossheim (1967); [A. 15,016] F. Iranica 147: 43; F. Iran 68: 62; (Manushehri 561) Akhani (1998); F. Iranica 147: 42; F. Iran 68: 59; (A. 16,323) F. Iranica 100: 41–42; F. Iran 24: 54–56 Akhani (1998); F. Iranica 100: 13; F. Iran 24: 15; Grossheim (1967); [A. al. 21,294] F. Iranica 95: 2–3; F. Iran 15: 4–6; (Sa.al.Ga. 42,162 IRAN)
Appendix 2

Taxonomic notes including doubtful or excluded species

**Apiaceae**

1. *Bupleurum gilanicum* Mozaff. Iran, J. Bot. 21 (1): 83. 2015. The type specimen was not available for evaluation. The original description shows its close affinity with the highly polymorphic complex *B. exaltatum* B. Bieb.

2. *Peucedanum pimenovii* Mozaff. Bot. Zhurn. 88 (4): 116. 2003. *Mozaffarian* (2003) described *P. pimenovii* from Gorgan: Between Tuskestan and Chaharbagh, at the beginning of Baghestan gorge of Pakotal, ca. 940 m, 30.09.1997, *V. Mozaffarian* 77,840 (TARI!). *Peucedanum glaucoprinus* Rech. f. was described from Mazandaran: Robate Qozloq (Gozlú), in silvis, *Koelz* 16,206 (Isotype W1) (Rechinger, 1952). Both localities are indeed the same place (http://www.iranvillage.ir/article-print-8957.html). Akhani’s study of the type specimens of both species showed that they are indeed the same place (http://www.iranvillage.ir/article-print-8957.html). Akhani’s study of the type specimens of both names and field studies in the area confirmed that there is no difference between them. *P. glaucoprinus* was transferred to the genus *Leutea* by Akhani and Salimian (Yassa et al., 2003).

3. *Leutea translucens* (Rech.f.) Akhani & Salimian comb. nov. Basionym: *Peucedanum translucens* Rech.f. Anz. Math.-Nat. Kl. Oestr. Akad. Wiss. 89: 243 (1952) = *P. hyrcanicum* Golizadeh, Naqinezhad & Mozaff. Ann. Bot. Fenn. 54: 292. 2017. syn. nov. Specimens examined: Golestan: In declivibus borealibus M. Shahvar prope Hajilang, 2400–2600 m, in juniperis saxosis, *K. H. Rechinger* 6154 (W); Shahvar mountain, between Tash and Siahmarzkhu, ca. 5 km S Siahmarzkhu, northern steep scree slope, with open *Juniperus sabina* community, 2750 m, 36°38′N, 54°44′E, 15.7.2001, *H. Akhani* & *M. Salimian* 15,359 (Hb. Akh.); Northern slopes of Shahvar mountain, ca. 2 km from Siahmarzkhu towards Kholidarreh, deep valley along the road, steep-cliffs, 1750 m, 36°39′27″N, 54°45′18″E, 15.7.2001. *H. Akhani* & *M. Salimian* 15,362 (Hb. Akh.); ca. 30 km SES of Gorgan, ca. 10 km NE Chaharbagh, Pir-Gerdeh Kuh, 36°39′19″N, 54°34′5″E, rocky steep to subvertical N-facing slopes, ca. 2500–2600 m, 10.9.1999, *H. Akhani* 13,711 (Hb. Akh.).

*L. translucens* was not accounted by Pimenov in Flora Iranica (Pimenov, 1987) and therefore was treated in its original description by Rechinger from the type locality. We were successful to rediscover this plant from area of its *locus classicus* (*Akhani & Salimian* 15,359). Information on fruit morphology, fruit anatomy and pollen morphology (*Salimian*, 2002) and ITS sequences (Akhani, unpublished data) clearly confirmed its position within the genus *Leutea* as recently accepted by Panahi et al. (2015). The mericarps in *L. translucens* are elliptic, 9–11 × 4–5 mm, rounded at apex and base having slightly prominent dorsal ribs, vittae solitary in valleculae occupying nearly whole of vallecular region, mesocarp cells above vittae absent, vittae in wings absent, commissural vittae 2, small, located between wing and raphe. The pollen grains are 3-zonocolporate and distinctly rhombic typical for the genus *Leutea* (*Salimian*, 2002).

The newly described *Peucedanum hyrcanicum* from Mazandaran: Sangdeh, Kheru-Neru mountain, 35°59′2.6″N, 53°12′48.4″E, 2700 m a.s.l., 10.08.2016, *H. Gholidzadeh* & A. Naqinezhad 7610 (holotype HUMZ; isotype TARI, n.v.) by Gholidzadeh et al. (2017) was collected from 155 km aerial distance. Although the type specimen was not seen by the authors, checking the description, illustration and data on habitat and locality remain no doubt that *P. hyrcanicum* is identical with *L. translucens*.

**Asteraceae**

4. *Artemisia kulbadica* Boiss. & Buhse. Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 120. 1860. This species was described from Gorgan: In pratis ad mare Caspium prope Kulbad non procul ab urbe, Buhse (Photo available in http://www.villege.ch/musinfo/bd/cjb/chg/adetail.php?id=274814&base=img&lang=en). The illustration of the type and own field observations in the type locality revealed that this is indeed a synonym of *A. absinthium* L., commonly growing in the area.

**Betulaceae**

5. *Alnus djavanshirii* Zare and A. dolichocarpa Zare, Amini & Assadi have been described from Mazandaran province as new species from N Iran (Zare and Amini, 2012). Both species are doubtful and require future studies.

**Boraginaceae**

6. *Heliotropium sp. nov.* This species is a local endemic belonging to *H. disstitorum* Boiss. complex. The species will be named and validated in an on-going publication.

**Gentianaceae**

7. *Gentiana grossheimii* Doluch. Zanetti Sist. Geogr. Rast. 14: 51. 1948. Fig. 3H. Examined specimen: Iran: Goletan province, Jahan Nama Protected Area, ca. 2–3 km E of Jahan Nama Protection Station, Chekele Shahpasand, uppermost parts of cliffs, 36°40′12″N, 54°19′54″E, 2044–2067 m a.s.l., *H. Akhani* 23,291 (Hb. Akh.). This is a new report from Iran. This chasmophytic species belongs to *Gentiana septemfida* Pall. complex but evidently differs not only by its habitat but also with a number of characters including smaller habit (up to 20 cm tall, not up to 40 cm), smaller leaves (8–15 mm, not 20–35 (–50) mm), shorter corolla (29–35 mm long, not 35–45 mm long), the presence of yellowish spots on corolla and flowering time in autumn (not in summer).

In spite of our intention to describe this as a new species, comparison of Iranian collection with the type specimen and other identical specimens of *G. grossheimii* in LE clearly proved their extreme similarity and an interesting disjunction between east Hyrcanian forests and Dagestan in the Caucasus (Supplemental file 2: Map 148).

**Geraniaceae**

8. *Geranium montanum* Hablitz ex Pall. in Neue Nord. Beytr. Phys. Geogr. Erd-Völkerbeschreib. 4: 51. 1784. was described from N Iran, “in alpib. Samamisib”, Aug, Hablitz (LE). This is recorded as a synonym of *G. ibericum* Cav. which its distribution concentrated on the eastern parts of the Black Sea and the Caucasus (Aedo, 2005).

**Malvaceae**

9. The genus *Tilia* in Iran was simultaneously reviewed by two working groups (Yousefzadeh et al., 2012; Zare et al., 2012). Rather surprising is that M. Assadi is the co-author of both papers and both papers have been accepted in less than a month of
interval (26.01.2012 and 21.02.2012). Following species are re-

10. The taxonomic status of species including Orobanchaceae

11. Paeania tomentosa & Hamdi & Assadi were recorded. We

12. Linaria golenosanensis Hamdi & Assadi and L. mazandaranensis

13. Polygonum lencoranicum Komar. is synonymous of P. litorale

14. Type specimen of Cotonester assadii Khatamsaz seen in TARI

15. Pyrus kandevanica Ghahreman & Khatamsaz, P. ghahremanii

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15. Pyrus kandevanica Ghahreman & Khatamsaz, P. ghahremanii

16. The diagnosis of Salix baladehensis Maassoumi, Moenei &

17. The synonymy of Acer iranicum M. Mohtashamian & A. Ras-

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