


## ALPINE FLORISTIC DIVERSITY OF TOCHAL MOUNTAINS

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### Abstract

In recent decades, the synergistic effects of climate change and anthropogenic activities have placed numerous plant species, particularly those inhabiting alpine and subalpine zones, as well as endemic and rare taxa, under significant threat of extinction. Safeguarding these species requires detailed habitat investigations and the establishment of long-term monitoring programs to mitigate genetic erosion and biodiversity loss. The present study focuses on the alpine flora of the Tochal Mountains, where plant collections conducted in 2022-2023 documented 225 taxa across 132 genera and 34 families. The most prominent families included Asteraceae (17.3%), Fabaceae and Poaceae (10.2% each), Brassicaceae (8.5%), Caryophyllaceae (7.1%), and Lamiaceae (6.2%). Analysis of life-form composition revealed hemicryptophytes (44.4%), cryptophytes (24.4%), and chamaephytes (19.6%) as the dominant categories. Of these, 187 (83.1%) were restricted to the Irano-Turanian region, comprising 51 endemic and 17 regional endemic taxa in Iran. However, intensive human pressures, including overgrazing, infrastructure development such as cable cars and ski facilities, expansion of resorts and residential complexes, construction of shelters, and the establishment of mountaineering routes, combined with prolonged drought conditions, have inflicted severe and often irreversible damage on the vegetation.

**Keywords:** Alborz Mountains; alpine ecosystem; climate change; elevational gradient; genetic resources

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### تنوع فلورستیکی آلبی کوهستان توچال

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چکیده: در دهه‌های اخیر تغییرات اقلیمی و اثرات مخرب انسانی باعث شده است که گونه‌های گیاهی به‌ویژه گیاهان آلبی، نیمه‌آلبی، اندمیک و نادر در معرض خطر انقراض قرار گیرند. از این رو، بررسی رویشگاه‌های این گونه‌ها و پایش مستمر آنها به‌منظور پیش‌گیری از فرسایش ژنتیکی و انقراض آنها بسیار ضروری است. در مطالعه حاضر فلور آلبی کوهستان توجال مورد بررسی قرار گرفت. براساس جمع‌آوری گیاهان طی سال‌های ۱۴۰۲-۱۴۰۱، تعداد ۲۲۵ تاکسون تشخیص داده شد که به ۱۳۲ جنس و ۳۴ تیره تعلق دارند. تیره‌های Asteraceae (۱۷/۳٪)، Fabaceae و Poaceae (هر یک با ۱۰/۲٪)، Brassicaceae (۸/۵٪)، Caryophyllaceae (۷/۱٪) و Lamiaceae (۶/۲٪) سهم بیشتری را در فلور منطقه داشتند. در میان گیاهان این کوهستان، همی‌کریبتوفیت‌ها، کریبتوفیت‌ها و کامفیت‌ها به ترتیب با ۴۴/۴، ۲۴/۴ و ۱۹/۶ درصد، فراوان‌ترین شکل‌های زیستی منطقه بودند. پراکنش ۱۸۷ گونه (۸۳/۱٪) به ناحیه رویشی ایران - تورانی منحصر می‌گردد که از این تعداد ۵۱ گونه اندمیک ایران و ۱۷ گونه اندمیک منطقه‌ای هستند. چرای مفرط دام، احداث مسیرهای تله‌کابین، تله‌اسکی، هتل توجال و مناطق اقامتی، پناهگاه‌ها و مسیرهای مختلف کوهنوردی، و به‌ویژه خشکسالی، ضربات جبران‌ناپذیری را بر پوشش گیاهی و تنوع گونه‌ای کوهستان توجال وارد نموده است.

## INTRODUCTION

Alpine regions cover about 3.56 million km<sup>2</sup>, which is 2.64% of Earth's land. Most of this area around 2.59 million km<sup>2</sup> is found in Asia (Testolin & al., 2020). These high-altitude zones are habitat to roughly 4% of the world's plants, estimated at 10,000 and 12,800 species (Körner, 1995). Survival in such environments requires adaptation to extreme conditions, including freezing temperatures, low oxygen, aridity, nutrient-poor soils, intense UV radiation, short growing seasons, and limited pollination due to reduced insect activity (Grabherr & al., 2010; Ebrahimnezhad, 2014).

Alpine ecosystems and their plants are highly vulnerable to both direct and indirect impacts of climate change, land use, and tourism (Mondoni & al., 2011; Dainese & al., 2024). Over the past century, global mean temperature has risen by 0.85 °C, with projections indicating an increase of 1.4–8 °C during the 21st century (Fan & al., 2011). Climate-driven changes such as rising temperatures, earlier snowmelt, and hotter, drier summers (Pickering, 2014) have triggered upward species migration, shifts in flowering phenology, and increased frost damage (Trunschke & al., 2024). Many alpine plants move upslope to seek favorable conditions (Kavousi & al., 2016; Zhao & al., 2024), altering species composition and biodiversity of alpine communities (Wang & al., 2019). However, summit-restricted taxa face extinction risks, as no higher habitats remain for migration (Müller & al., 2017; Zhou & al., 2023).

The primary environmental variables influencing the zoning of mountainous areas and the distribution of plant species include latitude, elevation, temperature, humidity, soil properties, and solar exposure (Majumdar, 2018). The different regions of the world are divided into four elevational zones: the nival zone, beginning at approximately 4000 m a.s.l. and higher;

the alpine zone, ranging from about 2800 to 4400 m a.s.l.; the montane zone, spanning 1500 to 2800 m a.s.l.; and the lowland zone, extending from sea level up to 1500 m a.s.l. However, there is no universal agreement among botanists on the precise definition of the alpine zone, as diverse environmental factors, such as latitude, prevent the establishment of a single global model. In general, the alpine zone is described as the elevational belt located above the treeline ecotone and below the nival zone (Körner, 2021).

Iran is a mountainous and semi-arid country, with an average altitude exceeding 1200 m a.s.l., and nearly 54% of its territory covered by mountain ranges. Geographically, the country lies at the confluence of three major phytogeographic regions: The Irano-Turanian, Saharo-Sindian, and Euro-Siberian. It also encompasses portions of two global biodiversity hotspots, the Irano-Anatolian and the Caucasus, and contains five areas of endemism (Noroozi & al., 2019). Extensive floristic investigations have been undertaken across the subalpine, alpine, and nival zones of various Iranian regions, including Golestanak Mountain (Naderi & al., 2012), Khersan glacier and Alamkuh Mountain (Kavousi & al., 2016), Oshtrankooch (Mehrnia & al., 2020), Azadkouh Mountain (Saber Amoli & al., 2021), Takhte-Sartashtak (Malekpourzadeh & al., 2024), Keyno Mountain (Dinarvand & al., 2025), and Nizwa Mountain (Rabizadeh & al., 2025). Complementary floristic and phytosociological studies have also been conducted in the Central Alborz by Klein (1982–1991) and Klein & Lacoste (1989–1999), as well as in Tochal, Sahand, Sabalan, and Bozqush mountains by Noroozi & al. (2010–2017), and more recently in Damavand Mountain by Talebi & al. (2024). Comparable research in alpine ecosystems across Asia includes studies of the Cambasi High Plateau (Karakaya & Kiling, 1996),

Korean alpine flora (Kong, 2002; Kim & al., 2015), the Northwest Caucasus (Onipchenko, 2004), Armenia (Baloyan, 2005), Altindere Valley (Palabaş Uzun & Anşin, 2006), Jaya Mountain (Utteridge & Edwards, 2009), Khangchendzonga in the Himalaya (Tambe & Rawat, 2010), Giresum Mountain (Hüseyinoğlu & al., 2017), the Taisetsu Mountains (Amagai & al., 2018), South Siberia, Kamchatka Peninsula, Sakhalin, and the Kuril Islands (Brianskaia & al., 2021), the Georgian Caucasus (Nakhutsrishvili & al., 2022), the Tian Shan Mountains (Swacha & al., 2023), and the Pamir-Alai and western Tian Shan ranges (Nowak & al., 2024).

The principal aims of this research are fourfold: first, to compile a comprehensive inventory of plant species inhabiting the alpine zones of Tochal Mountains; second, to conduct a comparative evaluation of species composition, biological spectra, and chorological attributes across the mountain's two alpine belts; third, to identify and document endemic and rare taxa within the region while assessing their conservation status; and fourth, to examine the anthropogenic and environmental drivers of vegetation degradation and propose measures to mitigate biodiversity loss and safeguard the mountain's valuable flora.

## MATERIALS AND METHODS

### Study Area

#### Geography and Climate

The Alborz Mountain range is located along the southern Caspian Sea, between the Ararat range on the Turkey–Armenia border and Afghanistan's Hindu Kush. Recognized as a major center of endemism in Iran, it harbors numerous species unique to the country. The Tochal Mountains lie in the southern Central

Alborz, directly north of Tehran, with elevations of 1800–3966 m a.s.l. (Fig. 1). Its summit is located at 35°53'04"N, 51°51'09"E. The high mountainous regions of Iran have a continental climate with a Mediterranean precipitation pattern. In the alpine and subalpine belts of the Alborz, precipitation increases with elevation. Summers are hot, dry, and exposed to strong solar radiation, while winters bring heavy snowfall. The main precipitation period extends from late autumn through early spring, with higher elevations further affected by northwesterly polar air masses (Noroozi & al., 2010). Climatic records over the past three decades ([www.meteoblue.com](http://www.meteoblue.com)) indicate that the Tochal Mountains receive an average annual precipitation of 603 mm, with a mean annual temperature of 6.3 °C (Fig. 2). The maximum average temperature recorded on the hottest day reaches 29 °C, while the minimum on the coldest night falls to –22 °C. Over these 30 years, precipitation has declined slightly by 2 mm, while mean annual temperature has risen from 5.4 °C to 7.1 °C.

#### Vegetation

In the lower elevational belt of the Tochal Mountains, vegetation is primarily characterized by thorny cushion formations, especially on windward slopes (Fig. 3). Dominant plant communities include *Prangos uloptera*–*Cousinia adenosticta*, *Prangos uloptera*–*Psathyrostachys fragilis*, *Onobrychis cornuta*, *Thymus kotschyanus*, *Tanacetum polycephalum*–*Silene commelinifolia*, *Nepeta racemosa*–*Eryngium billardieri*, *Arabis caucasica*–*Silene odontopetala*, and *Bufonia kotschyana*–*Cousinia multiloba* (Akhani & al., 2013).



Fig. 1. Location of Tochal Mts in the Alborz mountain range (red triangle).

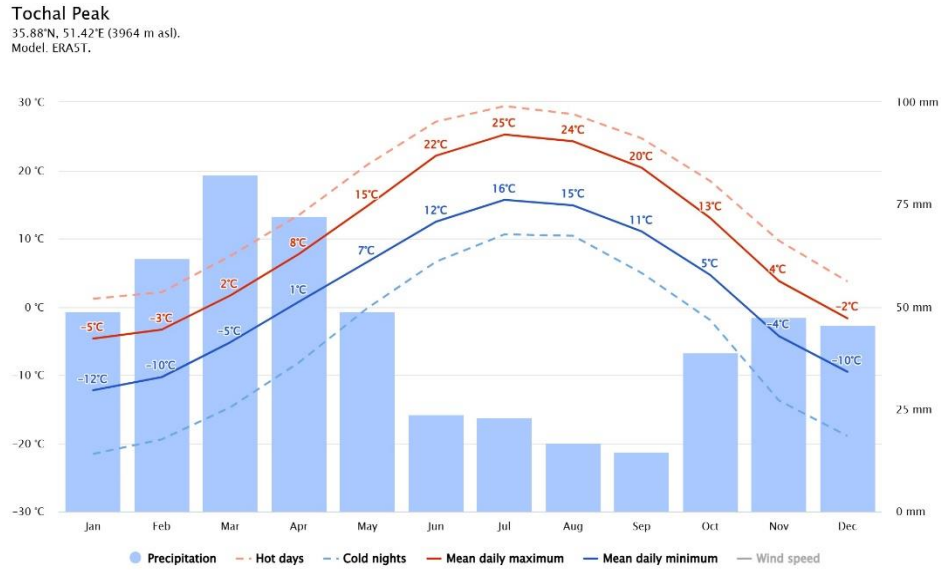


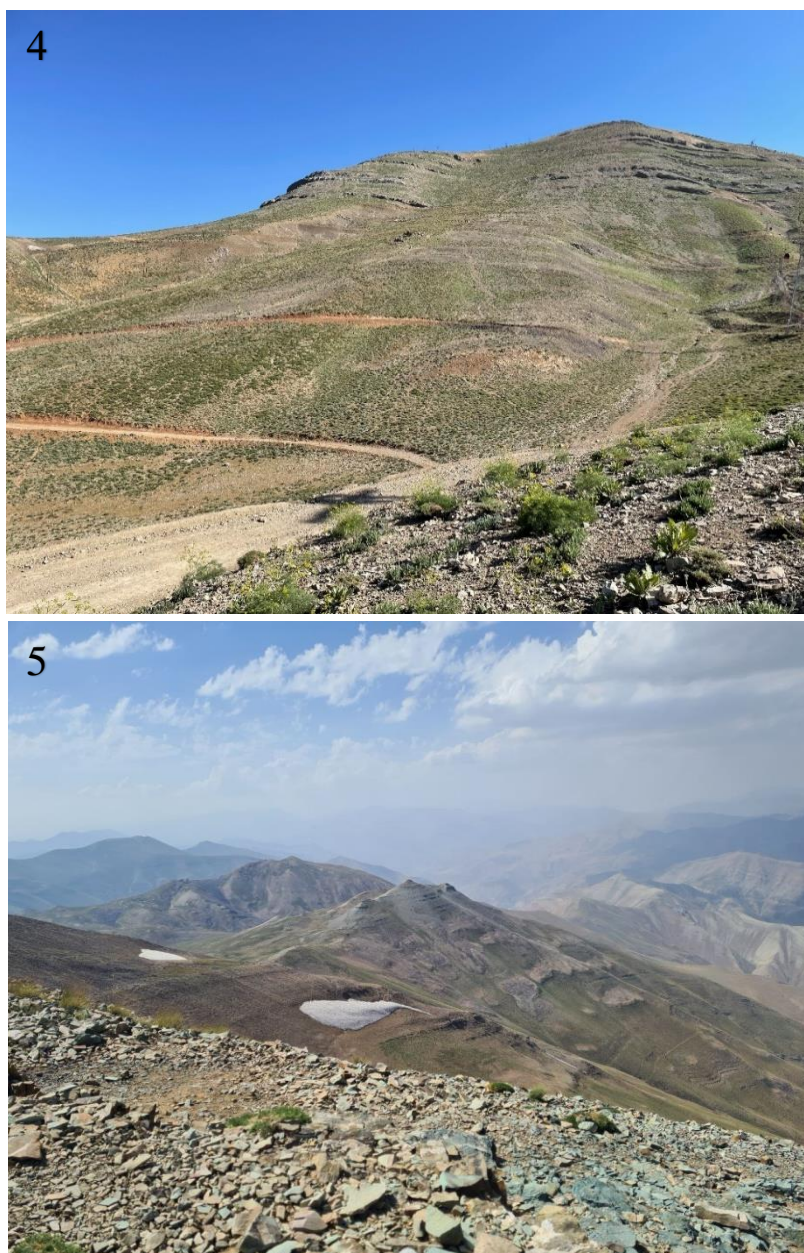
Fig. 2. Climatic characteristics of the Tochal Peak based on 30 years (1995-2024).

At the upper elevational belt, vegetation shifts to alpine steppes and pastures (Fig. 4), with communities such as *Astragalus iodotropis*, *Galium decumbens*–*Thymus pubescens*, *Vicia ciceroidea*, *Rumex elbursensis*, *Bufonia kotschyana*–*Cousinia multiloba*, *Hordeum violaceum*–*Cousinia multiloba*, *Astragalus chrysanthus*–*Cousinia multiloba*, *Oxytropis persica*–

*Cousinia multiloba*, *Acantholimon demawendicum*, and *Acantholimon demawendicum*–*Onobrychis cornuta* (Noroozi & al., 2010). These habitats occur along slope gradients ranging from gentle (5–15°) to steep (30–40°), with scree slopes forming a significant part of the area (Fig. 5).



Fig. 3. A view of the lower elevational belt vegetation of the alpine zone on Tochal Mts.



Figs. 4 & 5. 4, A view of the upper elevational belt vegetation of the alpine zone on Tochal Mts. 5, A view of the northern slopes of Tochal Mts in the central Alborz.

#### **Data Collection and Sampling Method**

The alpine zone of the Tochal Mountains was divided into two elevation belts: 2900–3400 m a.s.l. (lower zone) and 3400–3900 m a.s.l. (upper zone). Plant specimens were collected during the growing season, from mid-spring through mid-summer, in 2022 and 2023. A total of 25 field excursions were conducted, encompassing all major slope aspects and elevation levels within the study area. A systematic design was applied, with each belt subdivided into three sites. At

each site, 200m transects were established perpendicular to slopes on both sides of the main trail. Plant specimens collected along these transects were dried, labeled as herbarium vouchers, and deposited in the TARI herbarium. In addition, earlier collections from the Tochal Mountains made by other botanists and preserved at TARI were incorporated into the dataset. These are coded as numbers marked with a T letter in Table 1. Species without herbarium specimens are indicated with the letters NA.

**Identification, life form, and chorotype of species**

Plant specimens were identified using authoritative botanical references, including Flora Iranica (Rechinger, 1963–2015), and Flora of Iran (Assadi & al., 1988–2024). Taxonomic data and species distribution were verified through the Global Biodiversity Information Facility (GBIF, 2026). Life forms were classified according to Raunkiaer’s system (Raunkiaer, 1934). Geographical distribution was determined using the World Plants database (Hassler, 1994–2026), and Plants of the World Online (POWO, 2026). Chorotype assignment considered only native plant regions, excluding areas of introduction. Terminology and delimitation of phytogeographical units followed Zohary (1973) and White & Leonard (1991).

**Conservation status**

The conservation status of endemic and regional endemic alpine species of Tochal Mountains was evaluated based on prior studies (Asri, 2024; Mahmoudi, 2024; Safavi, 2024). Given that these assessments were conducted at the provincial scale, a more precise evaluation was undertaken using IUCN guidelines (2024) and population data from Flora of Iran (Assadi & al., 1988–2024). Species were classified into four categories: Critically Endangered (CR),

Endangered (EN), Vulnerable (VU), and Lower Risk (LR).

**RESULTS**

**Floristic composition**

A total of 225 plant taxa were documented from the alpine zone of Tochal Mountains, representing 132 genera across 34 families (Table 1). Asteraceae was the most dominant family (39 taxa, 17.3%), followed by Poaceae and Fabaceae (23 species each, 10.2%). Brassicaceae (8.5%), Caryophyllaceae (7.1%), and Lamiaceae (6.2%) ranked third to fifth (Fig. 6). The most species-rich genera included *Astragalus* (14 species), *Allium*, *Bromus*, and *Cousinia* (6 species each), *Silene* (5 species), and *Carex*, *Gagea*, *Polygonum*, and *Ranunculus* (4 species each).

**Altitudinal distribution**

Altitudinal analysis revealed that 56% of species were distributed throughout the alpine zone (2900–3900 m a.s.l.), while 39.6% were confined to the lower belt (2900–3400 m a.s.l.). Only 10 species *Aethionema stenopterum*, *Crepis heterotricha* subsp. *lobata*, *Epilobium confusum*, *Herniaria caucasica*, *Oxytropis persica*, *Papaver armeniacum* subsp. *microstigma*, *Physoptychis gnaphalodes*, *Scutellaria glechomoides*, *Senecio vulcanicus*, and *Taraxacum crepidiforme* were restricted to the upper belt (3400–3900 m a.s.l.)

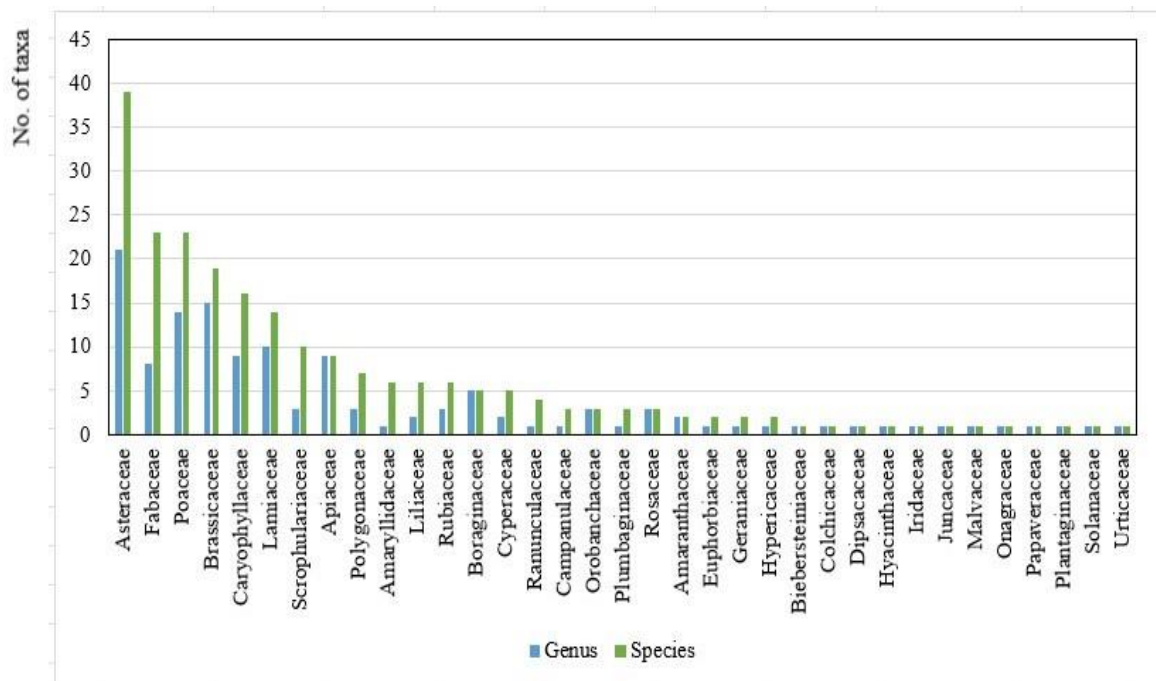


Fig. 6. The number of genera and species of each family in the alpine zone of Tochal Mts.

### Life form spectrum

Life forms were classified into hemicryptophytes (100 species, 44.4%), cryptophytes (55 species, 24.4%), chamaephytes (44 species, 19.6%), therophytes (24 species, 10.7%), and phanerophytes (2 species, 0.9%). The biological spectrum differed between the entire alpine zone (Z1 and Z2) and the lower belt (Z1). In the alpine zone, hemicryptophytes (29.8%), chamaephytes (12.9%), and cryptophytes (9.8%) predominated, whereas in the lower belt hemicryptophytes and cryptophytes (13.3% each) were most abundant, followed by chamaephytes and therophytes at nearly equal proportions (Fig. 7).

### Chorological analysis

Irano-Turanian elements constituted the predominant chorotype, representing 83.1% of the taxa (187 species). Their distribution included 51.6% across the alpine zone, 28.5% confined to the lower belt, and 3.1% restricted to the upper belt. Other chorotypes exhibited only minor representation (Fig. 8). Representative taxa are illustrated in Figures 9 and 10.

### Endemism

A total of 67 endemic and regional endemic (in addition to Iran, it is also distributed in one of the neighboring countries including Afghanistan, Armenia, Azerbaijan, Iraq, Turkey, and Turkmenistan) species of Iran (29.8%) were recorded, of which 40 are restricted to the Alborz range (Table 1). *Carex decaulescens* subsp. *brunneola*, *Cousinia adenosticta*, *Dichodon scaturiginellum*, and *Vicia sojakii* are confined exclusively to the Tochal Mountains. Also, two species, *Linaria lineolata* and *Veronica paederotae* are distributed in Gachsar and Darbandsar, respectively, in addition to Tochal. Additionally, *Allium tuchalense*, *Astragalus macrosemius*, *Carex decaulescens* subsp. *brunneola*, *Cousinia adenosticta*, *Dichodon scaturiginellum*, *Scutellaria glechomoides*, *Senecio vulcanicus*, and *Vicia sojakii* are recognized as rare taxa of the Alborz Mountains. Asteraceae, Fabaceae, and

Brassicaceae exhibited the highest representation of endemic species (18, 13, and 9 species, respectively). The most species-rich genera were *Astragalus* (10 species), *Cousinia* (5 species), and *Allium*, *Ranunculus*, and *Tragopogon* (3 species each). Among endemic and regional endemic taxa, 68.6% were distributed across the alpine zone, 26.4% confined to the lower belt, and 6% restricted to the upper belt. Hemicryptophytes predominated (49.2%), followed by chamaephytes (25.4%), cryptophytes (20.9%), and therophytes (4.5%).

### Conservation

Endemic and regional endemic alpine species were categorized into four conservation groups (Table 1). The largest proportion (34.3%) was assessed as Lower Risk (LR), followed by Endangered (EN, 29.9%), Vulnerable (VU, 23.9%), and Critically Endangered (CR, 11.9%).

### Invasive species

Weedy, invasive, and increaser species accounted for 15.1% of the alpine flora, reflecting anthropogenic disturbance and competitive expansion. These species include *Alyssum simplex*, *Asperugo procumbens*, *Asperula setosa*, *Barbarea plantaginea*, *Blitum virgatum* subsp. *montanum*, *Bothriochloa ischaemum*, *Bromus danthoniae* subsp. *danthoniae*, *B. gracillimus*, *B. lanceolatus*, *B. tectorum*, *Chondrilla juncea*, *Coronilla varia* subsp. *varia*, *Cousinia pinarocephala*, *Erigeron acris* subsp. *pycnotrichus*, *Euphorbia aucheri*, *E. cheiradenia*, *Hypericum scabrum*, *Hyoscyamus senecionis*, *Juncus inflexus* subsp. *inflexus*, *Lophiolepis lappacea*, *Malva neglecta*, *Picnomon acarna*, *Plantago lanceolata*, *Poa bulbosa*, *Polygonum molliiforme*, *P. rottboellioides*, *Potentilla argyroloma*, *Psathyrostachys fragilis* subsp. *fragilis*, *Rumex elbursensis*, *Scorzonera laciniata*, *Stellaria alsinoides*, *Tragopogon graminifolius*, *Urtica dioica* subsp. *dioica*, and *Veronica biloba*.

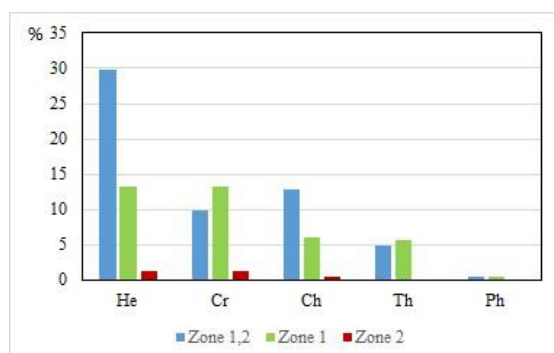


Fig. 7. Relative abundance of life forms of alpine plants in Tochal Mts according to elevational zones; Life forms: Ch (Chamaephyte), Cr (Cryptophyte), He (Hemicryptophyte), Ph (Phanerophyte), Th (Therophyte).

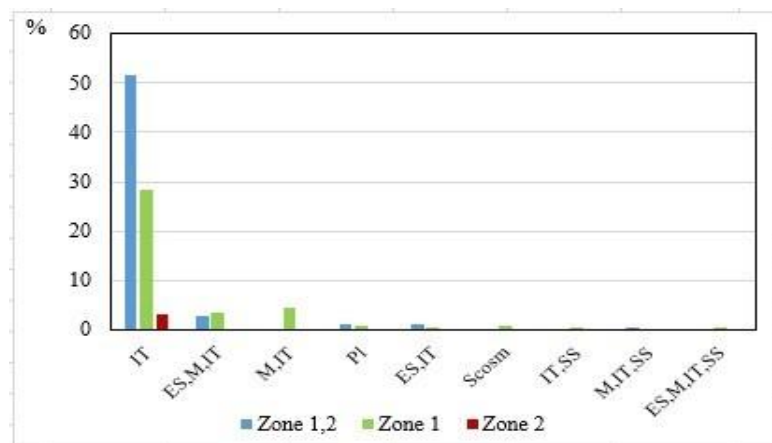


Fig. 8. Relative abundance of chorotypes of alpine plants in Tochal Mountains according to elevational zones; Chorotypes: ES (Euro-Siberian), IT (Irano-Turanian), M (Mediterranean), Pl (Pluriregional), SS (Saharo-Sindian), Scosm (Subcosmopolitan).

## DISCUSSION

The present investigation recorded 225 plant species belonging to 34 families within the alpine zone of Tochal Mountains. Species richness observed is comparatively high when compared with the alpine floras of the Alborz, Zagros, Azerbaijan, North Khorasan, and central regions of Iran, which collectively encompass 682 species across 39 families (Norouzi & al., 2008). Floristic analysis identified Asteraceae, Fabaceae, Poaceae, Brassicaceae, and Caryophyllaceae as the dominant families in the alpine flora of Tochal. Similar patterns of dominance by these families have been documented in other alpine regions, supporting our findings (Rajaei & al., 2011; Palabaş Uzun & Uzun, 2017; Moradi & Attar, 2019; Ibadullayeva & Yusifov, 2022). When alpine regions are examined on a broader geographic scale, considerable variation in floristic composition becomes apparent. In the mountain ranges of Azerbaijan, Armenia, and Turkey, as well as in southeastern Asian regions such as the Himalayas and China, the dominant plant families include Asteraceae, Poaceae, Rosaceae, Polygonaceae, and Ranunculaceae (Shen & al., 2017; Shaheen & al., 2023; Ahmad & al., 2024; Rasray & Showkeen, 2025). These differences are mainly influenced by climatic variables such as annual precipitation, annual temperature, and mean daily minimum and maximum temperatures.

According to our findings, Asteraceae was the most dominant family, aligning with observations from previous studies in other alpine environments (Jiménez-Alfaro & al., 2021; Rasray & al., 2026). The prevalence of Asteraceae in such habitats is frequently linked to several morphological and physiological

adaptations, including rosette growth forms, hairy (tomentose) surfaces, thick cuticles, efficient seed dispersal, varied pollination mechanisms, and resilience against herbivores due to structural features (such as thorns and spines) as well as chemical defenses (secondary metabolites). These adaptive traits, which enable members of the Asteraceae family to thrive across diverse environments—particularly alpine zones—have also been highlighted by Nagy & Grabherr (2009), Körner (2021), and Prameela & al. (2026).

The biological spectrum of the alpine flora in Tochal Mountain demonstrated that hemicryptophytes represent the predominant life form in this area—a characteristic that, according to Archibold (1995), points to a cold, mountainous climate. Our findings on the superiority of hemicryptophytes are further corroborated by research conducted across other alpine ranges in West Asia (Ghelichnia, 2014; Hüseyinoğlu & al., 2017; Moradi & Attar, 2019). The success of these plants is due to their ecological adaptations, notably the ability to store carbon in underground organs to endure prolonged and severe environmental stress, alongside vegetative and clonal reproductive strategies that facilitate their colonization and expansion. These observations are in agreement with those reported by Gulzar & al. (2022) and Islam & al. (2023). The contribution of hemicryptophytes to the region's flora increases progressively from the lower altitudinal zones to the higher, reflecting their ability to grow under the increasingly harsh conditions encountered at greater elevations. This pattern is in line with the results of Mahdavi & al. (2013) and Mehta & al. (2023).



Fig. 9. Some Vascular plants recorded from the alpine zone of Tochal Mountains: A, *Ranunculus elbursensis*; B, *Allium elbursense*; C, *Physoptychis capsica*; D, *Onobrychis cornuta*; E, *Astragalus iodotropis*; F, *Astragalus ochrochlorus*; G, *Campanula stevenii*; H, *Tulipa biflora*.



Fig. 10. Some Vascular plants recorded from the alpine zone of Tochal Mountains: I, *Scorzonera mucida*; J, *Ornithogalum montanum*; K, *Graellsia stylosa*; L, *Hypericum scabrum*; M, *Tanacetum parthenium*; N, *Geranium kotschyi*; O, *Tragopogon caricifolius*; P, *Veronica kurdica* subsp. *kurdi*

In the alpine zone of Tochal, cryptophytes and chamaephytes rank next in abundance after hemicryptophytes. By contrast, in East Asian alpine environments—where climatic conditions are more favorable, particularly regarding higher rainfall—phanerophytes and therophytes become the dominant following hemicryptophytes (Ahmad & al., 2024; Rasray & Showkeen, 2025). In cold, freezing alpine regions such as Tochal Mountain, annual plants are primarily hindered by low temperatures and restricted water availability. Meanwhile, tree and shrub species face challenges due to frost, elevated ultraviolet radiation, diminished levels of oxygen and carbon dioxide, and limited access to water.

Irano-Turanian elements were more abundant in the alpine flora of Tochal Mountain due to their resilience to harsh environmental conditions, including extreme cold, drought, and constant cold winds. These elements gradually increased from the lower altitudinal belt to the higher belt of the alpine zone. Following the Irano-Turanian elements, Mediterranean and Euro-Siberian elements had a significant share in the alpine flora of this mountain. Similar results have also been obtained in other alpine regions of West Asia and Central Asia (Asri & al., 2016; Hüseyinoğlu & al., 2017; Mehrnia & al., 2020; Breckle & Rafiqpoor, 2020; Nowak & al., 2020; Akhavan Roofgar & al., 2024). The abundance of these elements gradually decreases toward East Asia, where Sino-Japanese and Eastern Asiatic elements become dominant (Nakamura & Krestov, 2012; Xu & al., 2014; Welk, 2015; Sun & al., 2017; Tiwari & al., 2019). The differences in species distribution patterns across these regions arise from their distinct climatic and geological conditions, although continental connections and separations have also played an important role as floristic exchange routes between landmasses.

Due to climate change and overexploitation of natural resource areas, Iran is among the countries facing a high loss of genetic diversity and the risk of species extinction. In Tochal Mountains, 67 endemic and regional endemic species are present as plant genetic reserves, of which 24 species are critically endangered and threatened. Species diversity at higher altitudes was favorable compared to lower altitudes, where continuous direct human activities and higher grazing pressure prevail. Studies conducted in other mountain ecosystems also support a species distribution pattern similar to that of the Tochal Mountains (Tomar & al., 2022; Javid & al., 2024). Overall, with increasing altitude, anthropogenic species have declined due to the increasing harshness of

climatic conditions. Furthermore, many of these species cannot tolerate the effects of frost and snow at alpine altitudes, and the shorter growing season of these regions may prevent their establishment, growth, and development. The highest number of anthropogenic species was observed in the Asteraceae and Poaceae families. Similar results were obtained in other alpine and mountainous regions. (Bear & al., 2006; Asri & al., 2016; Zhumadina & al., 2023).

The vegetation of Tochal Mountain has been severely degraded due to various factors, including the presence of villages, the construction of telecabin lines, telesiege lifts, ski lifts, the Tochal Hotel, accommodation areas, shelters, and various mountaineering routes. Additionally, Tochal Mountain has traditionally been used as summer rangeland for livestock grazing by villagers. However, in recent years, due to drought and a shortage of forage caused by the very poor growth of palatable plants, irreparable damage has been inflicted on its vegetation and species diversity. The area has a relatively rich flora, and more than one-quarter of its species are endemic or regional endemics. Therefore, it is suggested that Tochal Mountain be added to the Central Alborz Protected Area.

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## CONFLICTS INTEREST

The authors declare that they have no conflicts of interest.

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Table 1. Checklist of plant species in the alpine zone of the Tochal Mountain. Life forms: Ch (Chamaephyte), Cr (Cryptophyte), He (Hemicryptophyte), Ph (Phanerophyte), Th (Therophyte). Chorotypes: ES (Euro-Siberian), IT (Irano-Turanian), M (Mediterranean), Pl (Pluriregional), SS (Saharo-Sindian), Scosm (Subcosmopolitan), En (Endemic), Re. en (Regional endemic); Elevational zones: 1 (2900-3400 m), 2 (3400-3900 m); Conservation status of endemic and regional endemic taxa: CR (Critically Endangered), EN (Endangered), LR (Lower Risk), VU (Vulnerable), Alborz endemic (\*); T (Herbarium specimen added); NS (No herbarium specimen).

Families/ Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
<b>Amaranthaceae</b>							
1. <i>Chenopodium foliosum</i> subsp. <i>montanum</i> Uotila	Th	IT	2925, 3763	1, 2	NS	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	
2. <i>Salsola canescens</i> (Moq.) Boiss.	Ch	IT	3006	1	NS	35 51 34 N, 51 24 01 E	
<b>Amaryllidaceae</b>							
3. <i>Allium ampeloprasum</i> L. subsp. <i>ampeloprasum</i>	Cr	M, IT	2950, 3300	1	NS	35 51 30 N, 51 23 60 E	
4. <i>Allium derderianum</i> Regel	Cr	IT (Re. en)	2900	1	48350T		LR*
5. <i>Allium elbursense</i> Wendelbo	Cr	IT (En)	2925, 2950 3006, 3250	1	111950	35 51 27 N, 51 23 55 E 35 51 30 N, 51 23 60 E 35 51 34 N, 51 24 01 E 35 52 16 N, 51 22 35 E	VU*
6. <i>Allium schoenoprasum</i> L.	Cr	Scosm	3150	1	12289T		
7. <i>Allium tuchalense</i> F.O.Khass. & Noroozi	Cr	IT (En)	2950, 3763	1, 2	NS	35 51 30 N, 51 23 60 E 35 52 58 N, 51 24 31 E	CR (rare)*
8. <i>Allium xiphopetalum</i> Aitch. & Baker	Cr	IT	2900, 3600	1, 2	12294T		
<b>Apiaceae</b>							
9. <i>Bupleurum exaltatum</i> M.Bieb.	Ch	ES, M, IT	2950	1	NS	35 51 30 N, 51 23 60 E 35 51 36 N, 51 24 03 E	
10. <i>Eryngium billardierei</i> F.Delaroche	He	IT	2970, 3006 3763	1, 2	110103	35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	
11. <i>Ferula ovina</i> (Boiss.) Boiss.	He	IT	2950, 3560	1, 2	NS	35 51 30 N, 51 23 60 E 35 52 35 N, 51 25 06 E	
12. <i>Grammosciadium platycarpum</i> Boiss. & Hausskn.	He	IT	2900, 3503	1, 2	NS	35 52 27 N, 51 25 06 E	
13. <i>Leutea petiolaris</i> (DC.) Pimenov	He	IT	2700, 3500	1, 2	49122T		
14. <i>Pimpinella affinis</i> Ledeb.	He	IT	2958, 3250	1	111945	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	
15. <i>Prangos uloptera</i> DC.	He	IT	2950, 3006 3750	1, 2	NS	35 51 30 N, 51 23 60 E 35 51 34 N, 51 24 01 E	
16. <i>Pseudotrachydium depressum</i> (Boiss.) Pimenov & Kljuykov	He	IT	2900, 3790	1, 2	49190T		
17. <i>Semenovia tragioides</i> (Boiss.) Manden.	He	IT (Re. en)	2700, 3550	1, 2	49131T		VU
<b>Asteraceae</b>							
18. <i>Achillea millefolium</i> subsp. <i>elbursensis</i> Hub.-Mor.	He	IT	3006, 3763	1, 2	111901	35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	
19. <i>Achillea vermicularis</i> Trin.	He	IT	2950, 3006	1	110104	35 51 30 N, 51 23 60 E 35 51 34 N, 51 24 01 E	
20. <i>Centaurea aucheri</i> subsp. <i>elbursensis</i> Wagenitz	Cr	IT (En)	2958, 3250	1	111947	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	LR
21. <i>Centaurea virgata</i> subsp. <i>squarrosa</i> (Willd.) Gugler	He	IT	2995	1	111927	35 51 37 N, 51 25 23 E	
22. <i>Chondrilla juncea</i> subsp. <i>acantholepis</i> (Boiss.) Takht.	He	M, IT	3006	1	NS	35 51 34 N, 51 24 01 E	
23. <i>Cirsium lappaceum</i> var. <i>tomentosum</i> Boiss.	He	IT	2958, 3650 3763	1, 2	110105	35 51 29 N, 51 23 57 E 35 52 58 N, 51 24 31 E	

Families and Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
24. <i>Cousinia adenosticta</i> Bornm.	He	IT (En)	2900, 3650	1, 2	78281T		CR (rare)*
25. <i>Cousinia calocephala</i> Jaub. & Spach subsp. <i>calocephala</i>	He	IT (Re. en)	2900, 3650	1, 2	78285T		LR
26. <i>Cousinia crispa</i> Jaub. & Spach	He	IT (En)	3006, 3790	1, 2	NS	35 51 34 N, 51 24 01 E	LR*
27. <i>Cousinia hypoleuca</i> Boiss.	He	IT (En)	2958	1	NS	35 51 29 N, 51 23 57 E	EN
28. <i>Cousinia multiloba</i> DC.	He	IT	2958, 3006 3650, 3763	1, 2	110107 111928	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E 35 53 23 N, 51 24 28 E 35 52 58 N, 51 24 31 E	
29. <i>Cousinia pinarocephala</i> Boiss.	He	IT (En)	2950, 3006 3763	1, 2	111906	35 51 30 N, 51 23 60 E 35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	VU*
30. <i>Crepis elbursensis</i> Boiss.	Cr	IT (Re. en)	2950, 3763	1, 2	NS	35 51 30 N, 51 23 60 E 35 52 58 N, 51 24 31 E	EN*
31. <i>Crepis heterotricha</i> subsp. <i>lobata</i> Babcock	Cr	IT (En)	3763	2	NS	35 52 58 N, 51 24 31 E 35 51 29 N, 51 23 57 E	EN*
32. <i>Echinops elbursensis</i> Rech.f.	He	IT (En)	2958, 2970 3006, 3763	1, 2	111912	35 51 36 N, 51 24 03 E 35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	VU*
33. <i>Erigeron acris</i> subsp. <i>pycnotrichus</i> (F.Vierh.) Grierson	He	IT	3000	1	78285T		
34. <i>Erigeron uniflorus</i> subsp. <i>elbursensis</i> (Boiss.) Rech.f.	He	IT (En)	3006, 3763	1, 2	NS	35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	EN*
35. <i>Filago arvensis</i> L.	Th	ES, M, IT	2950	1	NS	35 51 30 N, 51 23 60 E	
36. <i>Helichrysum oligocephalum</i> DC.	Ch	IT (En)	2958, 3006 3750	1, 2	NS	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E	LR
37. <i>Helichrysum psychrophilum</i> Boiss.	Ch	IT	2958, 3763	1, 2	110108	35 51 29 N, 51 23 57 E 35 52 58 N, 51 24 31 E	
38. <i>Jurinella frigida</i> (Boiss.) Wagenitz	Ch	IT (En)	3000, 3750	1, 2	14497T		VU*
39. <i>Leontodon hispidus</i> L. var. <i>hispidus</i>	He	ES, M, IT	3006	1	NS	35 51 34 N, 51 24 01 E	
40. <i>Picnomon acarna</i> (L.) Cass.	Th (He)	M, IT	2958	1	NS	35 51 29 N, 51 23 57 E	
41. <i>Picris strigosa</i> M.Bieb. subsp. <i>strigosa</i>	He	IT	2750	1	33893T		
42. <i>Psychrogeton amorphoglossus</i> (Boiss.) Novopokr.	Ch	IT	2925, 3000	1	111896	35 51 27 N, 51 23 55 E 35 51 34 N, 51 24 01 E	
43. <i>Scorzonera laciniata</i> L.	He	ES, M, IT	3006, 3690 3763	1, 2	110110	35 53 13 N, 51 24 32 E 35 52 58 N, 51 24 31 E	
44. <i>Scorzonera meyeri</i> (K.Koch) Lipsch.	He	IT	2958, 3763	1, 2	NS	35 51 29 N, 51 23 57 E 35 52 58 N, 51 24 31 E	
45. <i>Scorzonera mucida</i> Rech.f., Aellen & Esfand.	He	IT (Re. en)	2925, 3250	1	111943	35 51 27 N, 51 23 55 E 35 52 16 N, 51 22 35 E	LR
46. <i>Senecio glaucus</i> L. subsp. <i>glaucus</i>	Th	M, IT, SS	2950, 3006 3763	1, 2	110109	35 51 30 N, 51 23 60 E 35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	
47. <i>Senecio vulcanicus</i> Boiss.	Cr	IT (En)	3763	2	NS	35 52 58 N, 51 24 31 E	CR (rare)*
48. <i>Tanacetum parthenium</i> (L.) Sch.Bip.	He	ES, IT	2958, 3250 3750	1, 2	111948	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	
49. <i>Tanacetum polycephalum</i> subsp. <i>duderanum</i> (Boiss.) Podlech	He	IT (En)	2900, 3650	1, 2	78295T		LR*

Families and Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
50. <i>Taraxacum brevirostre</i> Hand.-Mazz.	He	IT	2990, 3850	1, 2	NS	35 51 36 N, 51 24 04 E	
51. <i>Taraxacum crepidiforme</i> DC.	He	IT	3690	2	NS	35 53 13 N, 51 24 32 E	
52. <i>Tragopogon acanthocarpus</i> Boiss.	He	IT (Re. en)	2970, 3690	1, 2	111923	35 51 36 N, 51 24 03 E 35 53 13 N, 51 24 32 E	LR
53. <i>Tragopogon caricifolius</i> Boiss.	He	IT (En)	2950, 3650	1, 2	111944	35 51 30 N, 51 23 60 E 35 53 23 N, 51 24 28 E	LR
54. <i>Tragopogon graminifolius</i> DC.	He	IT	3400	1	14489T		
55. <i>Tragopogon kotschyi</i> Boiss.	He	IT (En)	2970, 3790	1, 2	110111	35 51 36 N, 51 24 03 E	EN*
56. <i>Varthemia persica</i> DC.	Ch	IT	2958, 3763	1, 2	NS	35 51 29 N, 51 23 57 E 35 52 58 N, 51 24 31 E	
<b>Boraginaceae</b>							
57. <i>Alkanna bracteosa</i> Boiss.	Cr	IT (Re. en)	2950	1	NS	35 51 30 N, 51 23 60 E	VU
58. <i>Asperugo procumbens</i> L.	Th	ES, M, IT	2925	1	NS	35 51 27 N, 51 23 55 E	
59. <i>Lappula microcarpa</i> (Ledeb.) Gürke	Th (He)	IT	2958, 3006 3250, 3750	1, 2	110112 111945	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E 35 52 16 N, 51 22 35 E	
60. <i>Onosma microcarpa</i> Steven ex A.DC.	He	IT	2958	1	NS	35 51 29 N, 51 23 57 E	
61. <i>Solenanthus circinnatus</i> Ledeb.	He	IT	2990, 3650	1, 2	NS	35 51 36 N, 51 24 04 E 35 53 23 N, 51 24 28 E	
<b>Brassicaceae</b>							
62. <i>Aethionema stenopterum</i> Boiss.	Ch	IT (En)	3500	2	45415T		LR
63. <i>Alyssum minus</i> var. <i>micranthum</i> (C.A.Mey.) T.R.Dudley	Th	M, IT	2925	1	NS	35 51 27 N, 51 23 55 E	
64. <i>Alyssum murale</i> Waldst. & Kit.	Ch	ES, IT	2925, 3763	1, 2	NS	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	
65. <i>Anchonium elichrysofolium</i> (DC.) Boiss.	He	IT	2925	1	111907	35 51 27 N, 51 23 55 E	
66. <i>Arabis caucasica</i> Willd.	Cr	M, IT	2925	1	111904	35 51 27 N, 51 23 55 E	
67. <i>Barbarea plantaginea</i> DC.	He	IT	2958, 2995	1	111921 111929	35 51 29 N, 51 23 57 E 35 51 37 N, 51 25 23 E	
68. <i>Chalcanthus renifolius</i> (Boiss. & Hohen.) Boiss.	He	IT	2900, 3600	1, 2	14510T		
69. <i>Clastopus vestitus</i> (Desv.) Boiss.	Ch	IT (En)	3006, 3763	1, 2	NS	35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	VU
70. <i>Draba pulchella</i> Willd.	He	IT (Re. en)	2990, 3790	1, 2	110113	35 51 36 N, 51 24 04 E	LR
71. <i>Erysimum caespitosum</i> DC.	He	IT (Re. en)	2900, 3500	1, 2	49126T		LR
72. <i>Erysimum elbrusense</i> Boiss.	He	IT (Re. en)	2958, 3750	1, 2	NS	35 51 29 N, 51 23 57 E	LR
73. <i>Fibigia multicaulis</i> (Boiss. & Hohen.) Boiss.	Ch	IT (Re. en)	3000, 3750	1, 2	12299T		EN
74. <i>Fibigia suffruticosa</i> (Vent.) Sweet	Ch	IT	2925, 3503	1, 2	NS	35 51 27 N, 51 23 55 E 35 52 27 N, 51 25 06 E	
75. <i>Graellsia saxiragifolia</i> Boiss.	Ch	IT	2958	1	111916	35 51 29 N, 51 23 57 E	
76. <i>Graellsia stylosa</i> (Boiss. & Hohen) Poulter	Ch	IT (En)	2925, 3250	1	111895 111949	35 51 27 N, 51 23 55 E 35 52 16 N, 51 22 35 E	VU
77. <i>Noccaea trinervia</i> (DC.) Steud.	Ch	IT	3006, 3250	1	NS	35 51 34 N, 51 24 01 E 35 52 16 N, 51 22 35 E	
78. <i>Parlatoria rostrata</i> Boiss.	Th (He)	IT (En)	2925, 2995 3763	1, 2	111934 110114	35 51 27 N, 51 23 55 E 35 51 37 N, 51 25 23 E 35 52 58 N, 51 24 31 E	EN

Families and Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
79. <i>Physoptychis gnaphalodes</i> (DC.) Boiss.	Ch	IT	3690, 3763	2	110115	35 53 13 N, 51 24 32 E 35 52 58 N, 51 24 31 E	
80. <i>Pseudocamelina glaucophylla</i> (DC.) N.Busch	He	IT (En)	2958, 3250	1	111941	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	LR
<b>Campanulaceae</b>							
81. <i>Campanula glomerata</i> subsp. <i>hispida</i> (Witasek) Hayek	He	ES, IT	2900, 3600	1, 2	3512T		
82. <i>Campanula ruprechtii</i> Boiss.	Cr	IT	2990, 3650	1, 2	NS	35 51 36 N, 51 24 04 E 35 53 23 N, 51 24 28 E	
83. <i>Campanula stevenii</i> subsp. <i>beauverdiana</i> (Fomin) Rech.f. & Schiman-Czeika	Cr	IT	3250, 3763	1, 2	110119	35 52 16 N, 51 22 35 E 35 52 58 N, 51 24 31 E	
<b>Caryophyllaceae</b>							
84. <i>Arenaria insignis</i> Litv.	He	IT	3250, 3763	1, 2	110116	35 52 16 N, 51 22 35 E 35 52 58 N, 51 24 31 E	
85. <i>Arenaria polycnemifolia</i> Boiss.	Ch	IT (En)	2925, 3763	1, 2	110117	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	LR*
86. <i>Arenaria rotundifolia</i> M.Bieb. subsp. <i>rotundifolia</i>	He	M, IT	3006	1	NS	35 51 34 N, 51 24 01 E	
87. <i>Bufonia kotschyana</i> Boiss. subsp. <i>kotschyana</i>	He	IT (En)	3250	1	NS	35 52 16 N, 51 22 35 E	LR
88. <i>Dianthus orientalis</i> Adams	Ch	IT	2700, 3500	1, 2	49149T		
89. <i>Dichodon scaturiginellum</i> (Rech.fil.) Assadi	Th	IT (En)	3000, 3700	1, 2	47422T		CR (rare)*
90. <i>Herniaria caucasica</i> Rupr.	He	IT	3763	2	NS	35 52 58 N, 51 24 31 E	
91. <i>Mesostemma kotschyanum</i> (Fenzl ex Boiss.) Vved. subsp. <i>kotschyanum</i>	He	IT	2958, 3650	1, 2	NS	35 51 29 N, 51 23 57 E 35 53 23 N, 51 24 28 E	
92. <i>Minuartia lineata</i> (Boiss.) Bornm. subsp. <i>lineata</i>	He	IT	2950, 3650	1, 2	NS	35 51 30 N, 51 23 60 E 35 53 23 N, 51 24 28 E	
93. <i>Minuartia mesogitana</i> (Boiss.) Hand.-Mzt.	Th	IT	2950, 3650	1, 2	NS		
94. <i>Silene aucheriana</i> Boiss.	Ch	IT	2950, 3763	1, 2	110118	35 51 30 N, 51 23 60 E 35 52 58 N, 51 24 31 E	
95. <i>Silene commelinifolia</i> Boiss.	Ch	IT	2995, 3250	1	111926	35 51 37 N, 51 25 23 E 35 52 16 N, 51 22 35 E	
96. <i>Silene marschallii</i> C.A.Mey. subsp. <i>marschallii</i>	He	IT	2958, 3790	1, 2		35 51 29 N, 51 23 57 E	
97. <i>Silene odontopetala</i> Fenzl var. <i>odontopetala</i>	Ch	IT	2900 3650	1, 2	78296T		
98. <i>Silene spergulifolia</i> (Willd.) M.Bieb.	Ch	ES, IT	2925	1	111924	35 51 27 N, 51 23 55 E	
99. <i>Tythostemma alsinoides</i> (Boiss. & Buhse) Nevski	Th	IT	2925	1	NS	35 51 27 N, 51 23 55 E	
<b>Colchicaceae</b>							
100. <i>Colchicum kotschyi</i> Boiss.	Cr	IT	2925	1		35 51 27 N, 51 23 55 E	
<b>Cyperaceae</b>							
101. <i>Carex decaulescens</i> subsp. <i>brunneola</i> Kukkonen	Cr	IT (En)	2600, 3790	1, 2	43411T		CR (rare)*
102. <i>Carex demissa</i> subsp. <i>iranica</i> Kukkonen	Cr	IT (Re. en)	2600	1	43445T		EN*
103. <i>Carex orbicularis</i> subsp. <i>kotschyana</i> (Boiss. & Hohen.) Kukkonen	Cr	IT	2600	1	43439T		
104. <i>Carex pseudofoetida</i> subsp. <i>acrifolia</i> (V.I.Krecz.) Kukkonen	Cr	IT	2600	1	49932T		
105. <i>Eleocharis quinqueflora</i> (Hartmann) O.Schwarz	Cr	Scosm	2600	1	43453T		
<b>Dipsacaceae</b>							
106. <i>Cephalaria microcephala</i> Boiss.	He	IT	3006	1	NS	35 51 34 N, 51 24 01 E	
<b>Euphorbiaceae</b>							
107. <i>Euphorbia aucheri</i> Boiss.	He	IT	2970, 3790	1, 2	NS	35 51 36 N, 51 24 03 E	

Families and Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
108. <i>Euphorbia cheiradenia</i> Boiss. & Hohen.	He	IT	2950, 3650	1, 2	NS	35 51 30 N, 51 23 60 E 35 53 23 N, 51 24 28 E	
<b>Fabaceae</b>							
109. <i>Astragalus aegobromus</i> Boiss. & Hohen.	He	IT	3300, 3650	1, 2	NS	35 53 23 N, 51 24 28 E	
110. <i>Astragalus aureus</i> Willd.	Ch	IT	3100,3500	1, 2	49102T		
111. <i>Astragalus capito</i> Boiss. & Hohen.	He	IT (En)	2990, 3763	1, 2	NS	35 51 36 N, 51 24 04 E 35 52 58 N, 51 24 31 E	EN*
112. <i>Astragalus chrysanthus</i> Boiss. & Hohen.	He	IT (En)	3300, 3600	1, 2	76797T		EN*
113. <i>Astragalus compactus</i> Lam.	Ch (Ph)	IT	2958, 3006 3795	1, 2	111939 110123	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E 35 52 49 N, 51 25 12 E	
114. <i>Astragalus iodotropis</i> Boiss. & Hohen.	Ch	IT (En)	3006, 3763	1, 2	111925 110121	35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	VU*
115. <i>Astragalus leptynticus</i> Maassoumi	Ch	IT (En)	2925, 3750	1, 2	NS	35 51 27 N, 51 23 55 E	EN
116. <i>Astragalus macrosemius</i> Boiss. & Hohen.	Ch	IT (En)	2950, 3860	1, 2	110122	35 51 30 N, 51 23 60 E	CR (rare)*
117. <i>Astragalus microcephalus</i> Willd. subsp. <i>microcephalus</i>	Ph (Ch)	IT	2900, 3650	1, 2	78274T		
118. <i>Astragalus ochrochlorus</i> Boiss. & Hohen.	Ch	IT (En)	2990	1	110120	35 51 36 N, 51 24 04 E	LR*
119. <i>Astragalus rubriflorus</i> Bunge	Ch	IT (En)	2900, 3650	1, 2	78289T		LR*
120. <i>Astragalus sciureus</i> Boiss. & Hohen.	Ch	IT (En)	2925, 3750	1, 2	NS	35 51 27 N, 51 23 55 E	VU*
121. <i>Astragalus submitis</i> Boiss. & Hohen.	Ch	IT (En)	2780	1	NS	35 51 01 N, 51 24 24 E	LR
122. <i>Astragalus subsecundus</i> Boiss. & Hohen.	He	IT (Re. en)	2700, 3500	1, 2	49100T		VU
123. <i>Cicer tragacanthoides</i> Jaub. & Speech var. <i>tragacanthoides</i>	He	IT (En)	2925, 3750	1, 2	NS	35 51 27 N, 51 23 55 E	VU
124. <i>Coronilla varia</i> L. subsp. <i>varia</i>	He	ES, M, IT	2780	1	NS	35 51 01 N, 51 24 24 E	
125. <i>Lotus corniculatus</i> L. subsp. <i>corniculatus</i>	He	ES, M, IT, SS	2958	1	NS	35 51 29 N, 51 23 57 E	
126. <i>Onobrychis cornuta</i> (L.) Desv. subsp. <i>cornuta</i>	Ch (Ph)	IT	2925, 3750	1, 2	111909	35 51 27 N, 51 23 55 E	
127. <i>Oxytropis persica</i> Boiss.	He	IT	3763	2	NS	35 52 58 N, 51 24 31 E	
128. <i>Trifolium nigrescens</i> subsp. <i>petrisavii</i> (Clem.) Holmboe	Th	M, IT	3200	1	6315T		
129. <i>Trifolium radicosum</i> Boiss. & Hohen.	Cr	IT (En)	2950, 3795	1, 2	111937	35 51 30 N, 51 23 60 E 35 52 49 N, 51 25 12 E	EN*
130. <i>Trifolium repens</i> L.	Cr	ES, M, IT	2958, 3620	1, 2	111931	35 51 29 N, 51 23 57 E	
131. <i>Vicia sojakii</i> Chrtková	Th	IT (En)	2700, 3600	1, 2	6327T		CR (rare)*
<b>Geraniaceae</b>							
132. <i>Biebersteinia multifida</i> DC.	Cr	IT	3006	1	NS	35 51 34 N, 51 24 01 E	
133. <i>Geranium kotschyi</i> Boiss.	Cr	IT	2970, 3763	1, 2	NS	35 51 36 N, 51 24 03 E 35 52 58 N, 51 24 31 E	
134. <i>Geranium tuberosum</i> L.	Cr	M, IT	2925	1	111919	35 51 27 N, 51 23 55 E	
<b>Hyacinthaceae</b>							
135. <i>Ornithogalum montanum</i> Cirillo	Cr	M, IT	2990	1	NS	35 51 36 N, 51 24 04 E	
<b>Hypericaceae</b>							
136. <i>Hypericum scabrum</i> L.	Ch	IT	2958, 3006 3763	1, 2	111893 110124	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	
137. <i>Hypericum vermiculare</i> Boiss. & Hausskn.	Ch	IT (Re. en)	3150	1	5263T		LR
<b>Iridaceae</b>							

Families and Species	Life form	Chorotype	Altitude (m a.s.l.)	Elevational zones	Voucher No.	Coordinate	Conservation status
138. <i>Iris barnumiae</i> subsp. <i>demawendica</i> (Bornm.) B.Mathew & Wendelbo	Cr	IT (En)	2970, 3750	1, 2	NS	35 51 36 N, 51 24 03 E	EN*
<b>Juncaceae</b>							
139. <i>Juncus inflexus</i> L.	Cr	PI	2995	1	111936	35 51 37 N, 51 25 23 E	
<b>Lamiaceae</b>							
140. <i>Dracocephalum aucheri</i> Boiss.	Ch	IT	2900, 3700	1, 2	78280T		
141. <i>Lamium album</i> subsp. <i>crinitum</i> (Montbret & Sucher ex Benth.) Mennema	Cr	IT	2958, 3006	1	NS	35 51 29 N, 51 23 57 E 35 51 34 N, 51 24 01 E	
142. <i>Leonurus cardia</i> subsp. <i>persicus</i> (Boiss.) Rech.f.	Cr	IT (En)	2800, 3700	1, 2	5591T	35 51 30 N, 51 23 60 E	EN*
143. <i>Marrubium astracanicum</i> Jacq.	He	IT	2970, 3763	1, 2	110126	35 51 36 N, 51 24 03 E 35 52 58 N, 51 24 31 E	
144. <i>Nepeta fissa</i> C.A.Mey.	Ch	IT	2900, 3900	1, 2	76867T		
145. <i>Nepeta racemosa</i> Lam.	He	IT	2925, 2970 3006, 3763	1, 2	111900 111910 110127	35 51 27 N, 51 23 55 E 35 51 36 N, 51 24 03 E 35 51 34 N, 51 24 01 E 35 52 58 N, 51 24 31 E	
146. <i>Salvia microstegia</i> Boiss. & Balansa	He	IT	3000	1	5585T		
147. <i>Salvia verticillata</i> L.	He	ES, M, IT	3006, 3650	1, 2	NS	35 51 34 N, 51 24 01 E 35 53 23 N, 51 24 28 E	
148. <i>Scutellaria glechomoides</i> Boiss. ex Benth.	He	IT (En)	3763	2	NS	35 52 58 N, 51 24 31 E	CR (rare)*
149. <i>Scutellaria pinnatifida</i> subsp. <i>viridis</i> (Bornm.) Rech.f.	Ch	IT	2970, 3250 3500	1, 2	110128	35 51 36 N, 51 24 03 E 35 52 16 N, 51 22 35 E	
150. <i>Stachys lavandulifolia</i> Vahl	Ch	IT	2950	1	NS	35 51 30 N, 51 23 60 E	
151. <i>Thymus kotschyanus</i> Boiss. & Hohen. var. <i>kotschyanus</i>	Ch	IT	2925, 3650	1, 2	110129	35 51 27 N, 51 23 55 E 35 53 23 N, 51 24 28 E	
152. <i>Thymus pubescens</i> Boiss. & Kotschy ex Čelak.	Ch	IT	2970, 3763 3850	1, 2	111905	35 51 36 N, 51 24 03 E 35 52 58 N, 51 24 31 E	
153. <i>Ziziphora clinopodioides</i> subsp. <i>elbursensis</i> (Rech.f.) Rech.f.	Ch	IT (En)	3350, 3730 3960	1, 2	110130	35 52 58 N, 51 24 31 E	VU*
<b>Liliaceae</b>							
154. <i>Gagea alexeenkoana</i> Misch.	Cr	IT	2925, 3763	1, 2	NS	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	
155. <i>Gagea confusa</i> A.Terracc	Cr	IT	3150, 3400	1	12290T		
156. <i>Gagea dschungarica</i> Regel	Cr	IT	3150	1	12291T		
157. <i>Gagea gageoides</i> (Zucc.) Vved.	Cr	IT	3006	1	111917	35 51 34 N, 51 24 01 E	
158. <i>Tulipa humilis</i> Herb.	Cr	IT	2925	1	111894	35 51 27 N, 51 23 55 E	
159. <i>Tulipa montana</i> Lindl.	Cr	IT	2950	1	NS	35 51 30 N, 51 23 60 E	
<b>Malvaceae</b>							
160. <i>Malva neglecta</i> Wallr.	Th (He)	ES, M, IT	2995	1	111930	35 51 37 N, 51 25 23 E	
<b>Onagraceae</b>							
161. <i>Epilobium confusum</i> Hausskn.	Cr	IT	3650	2	NS	35 53 23 N, 51 24 28 E	
<b>Papaveraceae</b>							
162. <i>Papaver armeniacum</i> subsp. <i>microstigmum</i> (Boiss.) Kadereit	He	IT	3763	2	NS	35 52 58 N, 51 24 31 E	
<b>Plantaginaceae</b>							
163. <i>Plantago lanceolata</i> L.	Cr	PI	2958	1	111920	35 51 29 N, 51 23 57 E	

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<b>Plumbaginaceae</b>							
164. <i>Acantholimon demawendicum</i> Bornm.	Ch	IT (En)	3400, 3763	1, 2	110131	35 52 58 N, 51 24 31 E	VU*
165. <i>Acantholimon erinaceum</i> (Jaub. & Spach) Lincz.	Ch	IT	3100, 3500	1, 2	14493T		
166. <i>Acantholimon hohenackeri</i> (Jaub. & Spach) Boiss.	Ch	IT	2700, 3400	1	NS	35 52 16 N, 51 22 35 E	
<b>Poaceae</b>							
167. <i>Alopecurus textilis</i> Boiss.	Cr	IT	3006, 3800	1, 2	110132	35 51 34 N, 51 24 01 E	
168. <i>Arrhenatherum kotschyi</i> Boiss.	Cr	IT	2925	1	NS	35 51 27 N, 51 23 55 E	
169. <i>Bothriochloa ischaemum</i> (L.) Keng)	He	PI	2995, 3650	1, 2	111933	35 51 37 N, 51 25 23 E 35 53 23 N, 51 24 28 E	
170. <i>Bromus danthoniae</i> Trin. subsp. <i>danthoniae</i>	Th	IT, SS	3006	1	NS	35 51 34 N, 51 24 01 E	
171. <i>Bromus gracillimus</i> Bunge	Th	IT	2925	1	NS	35 51 27 N, 51 23 55 E	
172. <i>Bromus lanceolatus</i> Roth	Th	M, IT	2958	1	NS	35 51 29 N, 51 23 57 E	
173. <i>Bromus tectorum</i> L.	Th	ES, M, IT	2925	1	NS	35 51 27 N, 51 23 55 E	
174. <i>Bromus tomentellus</i> Boiss.	He	IT	2990, 3763	1, 2	NS	35 51 36 N, 51 24 04 E 35 52 58 N, 51 24 31 E	
175. <i>Bromus trinianus</i> Schult.	He	IT	2950, 3860	1, 2	NS	35 51 30 N, 51 23 60 E	
176. <i>Catabrosella parviflora</i> (Boiss. & Buhse) Alexeev ex Mill.	Cr	IT	3180, 3600	1, 2	12295T	35 52 16 N, 51 22 35 E	
177. <i>Dactylis glomerata</i> L. subsp. <i>glomerata</i>	He	PI	2958, 3750	1, 2	111903	35 51 29 N, 51 23 57 E	
178. <i>Elymus longearistatus</i> (Boiss.) Tzvelev	Cr	IT	2958, 3250 3860	1, 2	111942	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	
179. <i>Festuca alaica</i> Drobow	He	IT	3250, 3750	1, 2	NS	35 52 16 N, 51 22 35 E	
180. <i>Festuca arundinacea</i> Schreb.	He	ES, M, IT	2950, 3700	1, 2	110133	35 51 30 N, 51 23 60 E	
181. <i>Festuca sclerophylla</i> Boiss. ex Bisch.	He	IT	2958, 2995 3763	1, 2	111932 110143	35 51 29 N, 51 23 57 E 35 51 37 N, 51 25 23 E 35 52 58 N, 51 24 31 E	
182. <i>Hordeum brevisubulatum</i> subsp. <i>violaceum</i> (Boiss. & Hohen.) Tzvelev	Cr	IT	2950	1	NS	35 51 30 N, 51 23 60 E	
183. <i>Melica persica</i> Kunth subsp. <i>persica</i>	Cr	IT	3006, 3750	1, 2	NS	35 51 34 N, 51 24 01 E	
184. <i>Piptatherum laterale</i> (Regel) Nevski	He	IT	3000, 3750	1, 2	5226T		
185. <i>Poa bulbosa</i> L.	Cr	ES, M, IT	2958, 3750	1, 2	111918 110142	35 51 29 N, 51 23 57 E	
186. <i>Poa versicolor</i> subsp. <i>araratica</i> (Trautv.) Tzvelev	Cr	IT	3250, 3850	1, 2	NS	35 52 16 N, 51 22 35 E	
187. <i>Psathyrostachys fragilis</i> (Boiss.) Nevski subsp. <i>fragilis</i>	Cr	IT	2950	1	111898	35 51 30 N, 51 23 60 E	
188. <i>Stipa arabica</i> Trin. & Rupr.	He	IT	2958, 3250	1	111940	35 51 29 N, 51 23 57 E 35 52 16 N, 51 22 35 E	
189. <i>Stipa hohenackeriana</i> Trin. & Rupr.	He	IT	2950, 3763	1, 2	NS	35 51 30 N, 51 23 60 E 35 52 58 N, 51 24 31 E	
<b>Polygonaceae</b>							
190. <i>Polygonum alpestre</i> C.A.Mey.	He (Ch)	IT	2958, 3750	1, 2	111915	35 51 29 N, 51 23 57 E	
191. <i>Polygonum serpyllaceum</i> Jaub. & Spach	He (Ch)	IT	3006, 3690 3795	1, 2	111935 110135	35 51 34 N, 51 24 01 E 35 53 13 N, 51 24 32 E 35 52 49 N, 51 25 12 E	
192. <i>Polygonum molliiforme</i> Boiss.	Th	IT	2950, 3750	1, 2	110136	35 51 30 N, 51 23 60 E	
193. <i>Polygonum rotthoellioides</i> Jaub. & Spach	Th	IT	2950	1	110134	35 51 30 N, 51 23 60 E	
194. <i>Rheum ribes</i> L.	He	IT	2950	1	NS	35 51 30 N, 51 23 60 E	

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195. <i>Rumex elbursensis</i> Boiss.	Cr	IT (En)	2958, 3763	1, 2	110137	35 51 29 N, 51 23 57 E 35 52 58 N, 51 24 31 E	LR
196. <i>Rumex scutatus</i> L. subsp. <i>scutatus</i>	Cr	ES, M, IT	3006	1	111902	35 51 34 N, 51 24 01 E	
<b>Ranunculaceae</b>							
197. <i>Ranunculus amblyolobus</i> Boiss. & Hohen.	He	IT (En)	3000	1	12303T		VU
198. <i>Ranunculus aucheri</i> Boiss.	Cr	IT	2925, 3250 3800	1, 2	111922	35 51 27 N, 51 23 55 E 35 52 16 N, 51 22 35 E	
199. <i>Ranunculus bulbifer</i> Boiss. & Hohen.	He	IT (Re. en)	3150	1	12304T		EN
200. <i>Ranunculus crymophilus</i> Boiss. & Hohen.	He	IT	2958, 3850	1, 2	NS	35 51 29 N, 51 23 57 E	
<b>Rosaceae</b>							
201. <i>Geum kokanicum</i> Regel & Schmalh. ex RegelL.	Cr	IT	2925, 3600	1	111897	35 51 27 N, 51 23 55 E	
202. <i>Potentilla argyroloma</i> Boiss. & Hohen.	He	IT (En)	3000, 3763	1, 2	NS	35 52 58 N, 51 24 31 E	EN*
203. <i>Rosa beggeriana</i> Schrenk	Ph	IT	2958	1	111899	35 51 29 N, 51 23 57 E	
<b>Rubiaceae</b>							
204. <i>Asperula glomerata</i> subsp. <i>bracteata</i> (Boiss.) Ehrend.	He	IT (En)	3250, 3763	1, 2	110139	35 52 16 N, 51 22 35 E 35 52 58 N, 51 24 31 E	VU*
205. <i>Asperula glomerata</i> subsp. <i>eriantha</i> (Hausskn. ex Bornm.) Ehrend.	He	IT	3006	1	110140	35 51 34 N, 51 24 01 E	
206. <i>Asperula setosa</i> Jaub. & Sp.	Th	IT	2925, 3750	1, 2	NS	35 51 27 N, 51 23 55 E	
207. <i>Cruciata taurica</i> subsp. <i>persica</i> (DC.) Ehrend.	He	IT	2970, 3500	1, 2	111911	35 51 36 N, 51 24 03 E	
208. <i>Galium decumbens</i> (Ehrend.) Ehrend. & Schönb.-Tem.	He	IT (En)	2925, 3500 3850	1, 2	NS	35 51 27 N, 51 23 55 E	EN*
209. <i>Galium hyrcanicum</i> C.A.Mey.	He	IT	3000	1	12298T		
<b>Scrophulariaceae</b>							
210. <i>Euphrasia pectinata</i> Ten. subsp. <i>pectinata</i>	Th	ES, M, IT	3000	1	14487T		
211. <i>Linaria karajensis</i> Hamdi & Assadi	He	IT (En)	3150	1	8470T		EN*
212. <i>Linaria lineolata</i> Boiss. & Kotschy	He	IT (En)	2990, 3500	1, 2	NS	35 51 36 N, 51 24 04 E	LR*
213. <i>Odontites aucheri</i> Boiss.	Th	IT	2700, 3500	1, 2	49148T		
214. <i>Pedicularis pycnantha</i> Boiss. subsp. <i>pycnantha</i>	He	IT	2925, 3763	1, 2	NS	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	
215. <i>Scrophularia amplexicaulis</i> Benth.	He	IT	3350	1	8466T		
216. <i>Scrophularia frigida</i> Boiss. subsp. <i>frigida</i>	He	IT (Re. en)	2958, 3900	1, 2	NS	35 51 29 N, 51 23 57 E	LR
217. <i>Scrophularia variegata</i> subsp. <i>cinerascens</i> (Boiss.) Grau	He	IT	3006	1	111914	35 51 34 N, 51 24 01 E	
218. <i>Veronica anagallis-aquatica</i> L. subsp. <i>michauxii</i> (Lam.) A.Jelen	He (IT)	IT	2995	1	111938	35 51 37 N, 51 25 23 E	
219. <i>Veronica beccabunga</i> subsp. <i>abscondita</i> M.A.Fisch.	Cr	IT	3006	1	NS	35 51 34 N, 51 24 01 E	
220. <i>Veronica biloba</i> Schreb. ex L.	Th	IT	3000, 3650	1, 2	NS	35 53 23 N, 51 24 28 E	
221. <i>Veronica kurdica</i> Benth. subsp. <i>kurdica</i>	He	IT (En)	2925, 3763 3850	1, 2	111913 110138	35 51 27 N, 51 23 55 E 35 52 58 N, 51 24 31 E	EN*
222. <i>Veronica paederotae</i> Boiss.	He	IT (En)	2700, 3400	1	49185T		EN*
<b>Solanaceae</b>							
223. <i>Hyoscyamus senecionis</i> Willd. var. <i>senecionis</i>	Cr	IT	3200	1	3390T		
<b>Urticaceae</b>							
224. <i>Urtica dioica</i> L. subsp. <i>dioica</i>	Cr	Pl	2958, 3650	1, 2	NS	35 51 29 N, 51 23 57 E 35 53 23 N, 51 24 28 E	
<b>Valerianaceae</b>							
225. <i>Valeriana sisymbriifolia</i> Vahl	Cr	IT	2925	1	111908	35 51 27 N, 51 23 55 E	