

## Conservation and Landscape Evaluation of Some Endangered Species in Türkiye

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### ABSTRACT

In addition to *in-situ* conservation activities related to endangered taxa, it has a great importance to provide *ex-situ* conservation activities to increase awareness and to determine their usage areas by examining reproduction methods. In the line with, the aim of the study is to prevent the extinction of some endangered endemic taxa in Ayaş, Beypazarı and Nallıhan regions of Ankara province in Türkiye, to evaluate the taxa within the framework of sustainable conservation and use principles by raising awareness, and thus to protect the biodiversity in the region. For these purposes, during their vegetation periods throughout the years 2020-2022, some observations were recorded in landscape point of view from the habitats of 9 Critically Endangered (CR) and 3 Vulnerable (VU) taxa. Moreover, all the taxa are photographed and have been archived in the Collections of National Botanical Garden of Türkiye as National Herbarium (TC), DNA and Tissue Banks. Also, samples have been kept in 70% EtOH for Microscopic Slide Collection of National Botanical Garden of Türkiye. In addition, the possibilities of using taxa in the landscape area were evaluated. The results of the habitat observations for years serve as a basis for future conservation and landscape gain efforts for the taxa.

**Keywords:** Botanical garden, conservation, endangered species, landscape

### Türkiye’de Nesli Tehlikede Olan Bazı Türlerin Korunması ve Peyzaj Değerlendirmesi

#### ÖZ

Nesli tükenmekte olan taksonlarla ilgili *in-situ* koruma faaliyetlerinin yanı sıra, farkındalığı artırmaya yönelik *ex-situ* koruma faaliyetlerinin sağlanması ve üreme yöntemlerinin incelenerek kullanım alanlarının belirlenmesi büyük önem taşımaktadır. Bu doğrultuda çalışmanın amacı, Türkiye’de Ankara ili Ayaş, Beypazarı ve Nallıhan bölgelerinde nesli tükenmekte olan bazı endemik taksonların neslinin tükenmesini önlemek, taksonları sürdürülebilir koruma ve kullanım ilkeleri çerçevesinde bilinçlendirerek değerlendirmek ve böylece bölgedeki biyoçeşitliliğin korumasını sağlamaktır. Bu amaçla, 2020-2022 yılları boyunca vejetasyon dönemlerinde, 9 Kritik Tehlike Altında (CR) ve 3 Hassas (VU) taksonun habitatlarından peyzaj açısından bazı gözlemler kaydedilmiştir. Ayrıca tüm taksonların fotoğrafları çekilmiş ve Milli Herbarium (TC), DNA ve Doku Bankaları olarak Türkiye Milli Botanik Bahçesi Koleksiyonlarında arşivlenmiştir. Ayrıca örnekler Türkiye Milli Botanik Bahçesi’nin Mikroskopik Slayt Koleksiyonu için %70 EtOH’de saklanmıştır. Buna ek olarak taksonların peyzaj alanında kullanım olanakları değerlendirilmiştir. Yıllardır yapılan habitat gözlemlerinin sonuçları, taksonlar için gelecekteki koruma ve peyzaj kullanım çalışmalarının veri altyapısını güçlendirmektedir.

**Anahtar Kelimeler:** Botanik bahçesi, koruma, tehlike altındaki türler, peyzaj

### INTRODUCTION

The geographical structure of Türkiye, which has a rich biological diversity, provides high endemism rate and genetic diversity. However, biodiversity is under threat due to traditional and unsustainable agricultural techniques, rapid urbanization, increasing population and needs, unconscious use of resources and climate change etc. With the Convention on Biological Diversity [1], conservation biology studies of species have increased in the

world. Conservation and population revitalization studies for many endemic and endangered taxa in Türkiye are supported by many governmental agencies. However, despite the conservation efforts, the danger of extinction of the taxa continues with the effect of biotic and abiotic factors. Conservation of narrow endemic species that grow in certain ecological conditions and are less likely to be seen elsewhere requires species-specific planning decisions [1]. Focusing on integrated conservation in botanical gardens, Newton and Oldfield [2]

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emphasized that the optimal conservation practice is the integrated application of *ex-situ* and *in-situ* procedures for species recovery, reproduction and ecological restoration. However, *ex situ* conservation is especially essential to prevent the extinction of rare or threatened plant species when habitat is severely degraded or fragmented [3]. Especially in anthropogenic pressures and situations such as unconscious agricultural activities, habitat change and climate change, *ex situ* conservation can be seen as the only way to prevent species extinction [4, 5, 6]. Botanical gardens play a central role in *ex situ* conservation and are well placed to host species of conservation concern [7]. Working with data from the International Botanical Gardens Conservation Union (BGCI), Mounce et al. [8] stated that botanical gardens have at least 105,634 species and 41% of these species are classified as threatened. Abeli et al. [9] and Smith and Pence [5] provided information that botanical gardens create *ex-situ* collections of various types, characterized by different advantages and limitations. For conservation of endemic plants with narrow and limited distribution, first of all, it is determined which of the global risk categories they belong to, and in the measures to be taken accordingly, priority is given to those under pressure and facing the threat of extinction [10]. In order to determine the right conservation strategies and to implement sustainable effective conservation practices, it is necessary to monitor the plants in their natural habitats and to provide some data systematically. Data obtained from field observations are important for determining conservation strategies [11, 12].

Grassland and steppe ecosystems, in which herbaceous plants are in the majority, are of great importance in terms of biological diversity [13]. These ecosystems, which make important contributions to many sectors from agriculture to industry, are also remarkable in terms of endemic species diversity. In the city of Ankara, the endemism rate is quite high in the widespread gypsum steppe ecosystem, especially in Ayaş, Nallıhan and Beypazarı regions. In these regions, important places in terms of biological diversity, there are endemic taxa have risk categories as Vulnerable (VU) and Critically Endangered (CR) of the International Union for Conservation of Nature (IUCN). There are also other endangered taxa as *Acantholimon anatolicum* Doğan & Akaydın, *Anabasis aphylla* L., *Astragalus kochakii* Aytaç & H.Duman, *Centaurea nallihanense* Uysal & Hamzaoğlu, *Ornithogalum nallihanense* Yıld. & Doğru-Koca, *Scutellaria yildirimlii* M.Çiçek & Yaprak, *Sideritis gulendamii* H.Duman & Karaveliogullari, *Muscari adilii*

M.B.Güner & H.Duman distributed in the studied area [14]. In all of the studies on the taxa that are the subject of this study, it has been stated that their generations are endangered and that they should be conserved in botanical gardens and seed gene banks. *Aethionema dumanii* Vural & Adigüzel was reported by Ayyıldız [15] that it spreads in Ankara, Afyon and Eskişehir and it was also detected by Hamzaoğlu and Koç [16] in Sivas. The data of *Aethionema turcica* H.Duman & Aytaç, which is in the IUCN Risk Category of Least Concern (LC) in the Red Book of Plants of Türkiye [10], was re-evaluated by Ayyıldız [15, 17] that, it has been stated that the species is in the CR category in terms of its narrow distribution and fragmented populations, and in the Endangered (EN) category in terms of the number of individuals. In the General Directorate of Nature Conservation and National Parks (DKMP) study [18], it was stated that *Salsola grandis* Freitag, Vural & Adigüzel is faced with the problems due to the field expansion for farming, problems of intervention in the habitat of the plant because of the infrastructure issues and the foreign material coming with the erosion flow in the seasons with heavy rainfall. For these reasons, it was emphasized that the habitat of the taxon should be constantly monitored. It has been stated that the population of *Astragalus beypazaricus* Podlech & Aytaç is also being damaged by field expansion for farming, erosion and road widening works [19]. In addition, it was emphasized that the role of climatic factors in the flowering of the plant is great and its flowering is low when the spring season passes without precipitation. It is indicated in some studies [17, 20] that *Campanula damboldtiana* P.H.Davis & Sorger is in the "Plant Species Under Strictly Protection" group according to Annex List I of the Bern Convention (Convention on the Conservation of European Wildlife and Habitats) and the habitat of the species is under threat due to farming and tree planting activities, solution mining, and road paving activities [21]. During the observations made by *Cytisus acutangulus* Jaub. & Spach by Vural [22] about 70 individuals were counted in an area of approximately two decares. The taxon, which was observed to be adversely affected by the increasing urban pressure, was urgently included in the conservation and monitoring study within the scope of the DKMP 'Ankara Province Biological Diversity Inventory and Monitoring Project'. The habitat and distribution of *Verbascum gypsicola* Vural & Aydoğdu are endangered due to afforestation, road widening and thermal reactor activities and its IUCN category is CR [14, 23] However, according to Keser et al. [24] the risk category of the taxon is EN

(Endangered) and conservation precautions should be taken for it.

In Türkiye, the General Directorate of Agricultural Research and Policies (TAGEM), DKMP and the General Directorate of Forestry (OGM), that are affiliated to the Ministry of Agriculture and Forestry; also, the General Directorate of Conservation of Natural Assets (TVKGM) affiliated to the Ministry of Environment, Urbanization and Climate Change, Botanical gardens affiliated to institutions such as universities, municipalities and foundations carry out many studies for the conservation of plant biological diversity. However, despite the studies on taxa, especially in universities, the danger of extinction of the taxa still continues.

Within the scope of the research, it is aimed to provide the data infrastructure of 12 endemic plants (*Achillea ketenoglui* H.Duman, *Aethionema dumanii*, *Aethionema turcica*, *Astragalus densifolius* subsp. *ayashensis* Aytaç & Ekim, *Astragalus beypazaricus*, *Astragalus yildirimlii* Aytaç & Ekici, *Asyneuma linifolium* Bornm. subsp. *nallihanicum* Kit Tan & Yıldız, *Campanula damboldtiana*, *Cytisus acutangulus*, *Salsola grandis*, *Salvia aytachii* Vural & Adigüzel, *Verbascum gypsicola*) that grow in the ecological conditions of Ayaş, Nallıhan and Beypazarı surroundings and enter the process of extinction rapidly, and to conserve these taxa in the Directorate of National Botanical Garden of Türkiye, in order to slow down the extinction process. This study is compiled with the outputs of a project supported by TAGEM.

## MATERIALS AND METHOD

Within the scope of the study, the information, observations and photographs recorded about the habitats of endemic taxa listed in Table 1 were used as material in the field studies carried out between 01.03.2020-01.03.2022 around Ayaş, Nallıhan and Beypazarı (Ankara).

During the field studies, locality information, coordinates, habitat characteristics, altitude, habitus, life form, flowering time, leaf characteristics, stem structure, reproduction material, photo number, observations and landscape value were evaluated and noted for each taxon. Herbarium samples were delivered to the National Herbarium (TC) to be pressed and prepared. Moreover, leaf samples from taxa were taken into bags containing silica gels for Tissue and DNA Bank. Furthermore, for the Microscopic Slide Collection, samples were put in 70% EtOH and brought to Anatomy Laboratory of the

Botanical Garden. Also, for propagation studies seeds of the taxa were collected and more than enough of the seeds were given to the Türkiye Seed Gene Bank. During the field studies, care was taken not to harm the population due to the low number of individuals of these taxa. Additionally, within the scope of the study, evaluations were made regarding the landscape characteristics of the taxa. These evaluations, unlike the stages in ornamental plant breeding [25], are limited to data on flowering time, flower color, form, and growing environment conditions.

Table 1. The list of studied taxa

No	Family	Taxon	IUCN Risk Category
1	Asteraceae	<i>Achillea ketenoglui</i> H.Duman	VU
2	Brassicaceae	<i>Aethionema dumanii</i> Vural & Adigüzel	VU
3	Brassicaceae	<i>Aethionema turcica</i> H.Duman & Aytaç	CR
4	Fabaceae	<i>Astragalus densifolius</i> subsp. <i>ayashensis</i> Aytaç & Ekim	CR
5	Fabaceae	<i>Astragalus beypazaricus</i> Podlech & Aytaç	CR
6	Fabaceae	<i>Astragalus yildirimlii</i> Aytaç & Ekici	CR
7	Campanulaceae	<i>Asyneuma linifolium</i> Bornm. subsp. <i>nallihanicum</i> Kit Tan & Yıldız	CR
8	Campanulaceae	<i>Campanula damboldtiana</i> P.H.Davis & Sorger	CR
9	Fabaceae	<i>Cytisus acutangulus</i> Jaub. & Spach	CR
10	Chenopodiaceae	<i>Salsola grandis</i> Freitag, Vural & Adigüzel	CR
11	Lamiaceae	<i>Salvia aytachii</i> Vural & Adigüzel	VU
12	Scrophulariaceae	<i>Verbascum gypsicola</i> Vural & Aydoğdu	CR

## RESULTS

*Achillea ketenoglui* (Fig.1A) is a perennial herbaceous species that lives in gypsum, marn stony areas and blooms between June and July. Within the scope of the research, observations were made in its habitat located on the Ayaş-Beypazarı road. The species does not have a dense distribution in its habitat, and its individuals are sparsely distributed. The flowers of the taxon reaching a diameter of 10-15 cm in its habitat were recorded as white, small and unpretentious. The species was collected from Beypazarı within the scope of the project supported by TAGEM. However, according to the literature, it is distributed around Kırbaşı, Çayırhan, Polatlı Acıkır, Şereflikoçhisar, Sivrihisar Kepen village, Kırıkkale-Kesikköprü [26] and Bursa Uludağ [27].

*Astragalus densifolius* subsp. *ayashensis* (Fig.1B) is an Iranian-Turanian element that grows only in Ayaş. It was collected from 1192 m height in Ayaş-Aysanti. The plant, which draws attention with its feathery purple flowers and leaf arrangement, blooms in June-July. It has been observed in the studies that the seed yield is very low. The other species of the genus, *Astragalus yildirimlii* (Fig.1C) collected from

Gürsöğüt village, 30 km southwest of Beypazarı, lives on rocky dune slopes. It has showy pinkish purple flowers and a deep, solid root. It has a showy structure with its leaves, form and flowers. The taxon that blooms in June is valuable for landscaping. *Campanula damboldtiana* (Fig.1D) is a perennial herb with many stems. The roots are thick, cylindrical and twisted. Flowering stems are hard, erect and 5-22 cm. tall. Base leaves are absent. The plant collected from Orhaniye village within the scope of the study is spectacular with its purple bell-shaped flowers. *Campanula damboldtiana* is distributed in Aysanti, Ayaş, Kahramankazan Orhaniye neighborhood, Dağyaka, İmrendi and İncirlik neighborhoods [17]. The flowering period is long and flower, fruit and seed structures can be observed together in one individual (Figure 1).



Figure 1. Pictures of the species. A) *Achillea ketenoglui*, B) *Astragalus densifolius* subsp. *ayashensis*, C) *Astragalus yildirimlii*, D) *Campanula damboldtiana*. Photos were taken by M.Yılmaz.

*Aethionema turcica* (Fig.2A) was collected from Aysanti-Ayaş. However, the taxon is also distributed in Sivrihisar, between Ertuğrul village and Çaykoz village, in Polatlı Acıkır locality. [28, 29, 14]. Although there is a wire fenced protection area made by General Directorate of Nature Conservation and National Parks in this area, the population is under pressure due to farming activities and construction piles. The taxon, which has a radially extending branch structure, has pink showy flowers. It has

formed small communities in its habitat. It flowers between May and June and can be used in landscaping considering its flower structure, flowering time and form. Another *Aethionema* species located in Aysanti-Ayaş region is *Aethionema dumanii* (Fig.2B). It is distributed in Ankara, Ayaş; Acıkır location between Polatlı and Sivrihisar; Afyon, Dazkırı-Kepez Hill; Eskişehir, Sivrihisar-Aşağıkepen village; Mihaliçcik-Alpu, Doğanoğlu village; Haymana and İkizce localities [15]. Additionally, the taxon was also detected between Sivas: Şarkışla and Pınarbaşı [16]. The individuals of the taxon, which make 10-15 cm in diameter in its habitat, are sparsely distributed. These two *Aethionema* species share the same habitat in the same wire fenced protection area. The striking features that distinguish the two species in the habitat are the leaf shapes and plant forms.



Figure 2. Pictures of the species. A) *Aethionema turcica*, B) *Aethionema dumanii*, C) *Astragalus beypazaricus*, D) *Salsola grandis*. Photos were taken by M.Yılmaz.

*Astragalus beypazaricus* (Fig.2C) is another endangered endemic species belonging to the Leguminosae family. It has purple flowers and grows rarely in the steppes of Beypazarı-Nallıhan highway and blooms in May-June. It has been observed that the population of the plant, which was taken under protection by the DKMP, continues to be under pressure due to field opening and road widening works. Also, the species was taken under *ex situ* conservation in Nezahat Gökyiğit Botanical Garden

in 2009 [30]. In the field studies conducted in 2020, it was observed that the seed yield was quite low but high in 2021. *Salsola grandis* (Fig.2D) is an annual species, having erect, very hard, greyish green (in live condition), slightly shiny, hairless and small unpretentious yellow flowers. The species was collected from clay hills located near Ankara Nallıhan Bird Sanctuary. The taxon is distributed in Ankara, Çorum, Çankırı and Kırıkkale provinces [31]. Although it is an annual plant, it has a very showy form. It reaches the most interesting form especially in October, which is its fruiting period. *Asyneuma linifolium* subsp. *nallihanicum* (Fig.3A) is distributed in the rocky oak areas of Nallıhan. There are very few individuals in its population, it has a perennial herbaceous structure with purple flowers and a length of 80 cm with weak roots. It is determined that *Asyneuma linifolium* subsp. *nallihanicum*, which is located at the entrance of Nallıhan district and has an information signboard, is very rare in its population. It is necessary to develop the existing knowledge about this locally endemic plant, to determine the population limits and to make individual counts.

*Cytisus acutangulus* (Fig.3B) was collected from Davutoğlan village. The plant is a bushy plant with yellow flowers, which can be up to 40 cm tall, with an upright stance, frequent and forked branching. It has been noted that the flowering period of the plant that blooms in April is very short and it starts to bear fruit in May. Its population suffers from the ongoing road widening works between Beypazarı and Nallıhan. In addition, it has been observed that the seed yield of the plant is very low in the field studies carried out in the protection area. The reason of this is thought to be a pest that seems to be feed by the seeds of the plant. *Salvia aytachii* (Fig.3C) is a perennial, spreading herbaceous plant. The plant, which prefers marly and gypsum soils, was collected from its habitat located on the Ayaş-Beypazarı road at an altitude of 642 m. It is also widespread in Polatlı-Sivrihisar regions [32]. The showy flowers stalks are 30-40 cm long. The spreading plant can cover large areas. It has high landscape value. Another taxon, *Verbascum gypsicola* (Fig.3D) reaching 20-40 cm in length with dense white hairs, can live in arid environments with its woody base. It spreads on gypsum soils on the Beypazarı-Nallıhan road. In addition, *V.gypsicola* has distribution areas in the Solta Strait, Kösebükü, Beypazarı-Nallıhan 15<sup>th</sup> km and in the Yeşilköy neighborhood of Sivrihisar district. The taxon, which is under protection by DKMP, has showy yellow flowers. It does not shed its leaves throughout the year and gives new shoots in spring.



Figure 3. Pictures of the species. A) *Asyneuma linifolium* subsp. *nallihanicum*, B) *Cytisus acutangulus*, C) *Salvia aytachii*, D) *Verbascum gypsicola*. Photos were taken by M.Yılmaz.

Among the factors affecting the vital activities of taxa, there are biological factors besides human effects. In field studies, it was observed that there are pests that feed on the seeds of *Astragalus densifolius* subsp. *ayashensis*, *Cytisus acutangulus* and *Campanula damboldtiana*. Conservation biology studies are urgently recommended especially for these taxa. Moreover, *Aethionema turcica*, *Aethionema dumanii*, *Campanula damboldtiana*, *Salvia aytachii*, *Salsola grandis*, *Verbascum gypsicola* have the potential to be used as ornamental plants. Plant forms, flower structures, visual fruit and seed structures, length of flowering periods and easy reproduction possibilities are thought to be suitable taxa for scientific studies on this subject. *Salvia aytachii*, *Astragalus beypazaricus*, *Astragalus densifolius* subsp. *ayashensis*, *Astragalus yildirimlii*, *Cytisus acutangulus*, *Achillea ketenoglui* have possibilities to be used in rock gardens and large ground cover areas. Especially, *Verbascum gypsicola*, *Salvia aytachii*, *Achillea ketenoglui* have the potential to be used as groundcovers in landscaping studies, since they do not disappear in winter, their leaves continue to exist and they form a dense cover on the soil surface.

One of the most important factors determining the habitats of taxa is climate. In their studies, Ayyıldız [17] and Keser [33] made the bioclimatic interpretation of Ayaş, Beypazarı and Nallıhan districts according to the Emberger Method and reported that the habitats of the taxa were under the

influence of the Mediterranean semi-arid bioclimate. In the semi-arid Mediterranean bioclimatic layer of Türkiye, steppe vegetation is dominant, and the

research areas have steppe vegetation that is sometimes treed, sometimes treeless, or covered by shrub formations [17].

Table 2. Some field observations

	Name	Habitat	Altitude and aspect	Life time and form	Flowering period and color	Landscape value
1	<i>Achillea ketenoglui</i>	Stony and rocky areas	599 m Northwest	Perennial, herbaceous, hemicryptophyte	June-July / white	Ground cover
2	<i>Aethionema turcica</i>	Stony and rocky areas with marl soil	1192 m Northwest	Perennial, herbaceous, hemicryptophyte	May-June / pinkish-lilac	ornamental
3	<i>Aethionema dumanii</i>	Stony and rocky areas with marl soil	1192 m Northwest	Perennial, herbaceous, hemicryptophyte	May-June / Pink	ornamental
4	<i>Astragalus beypazaricus</i>	Sandy soil areas	642 m West	Perennial, herbaceous, kamephyte	May-June / bluish violet	ornamental
5	<i>Astragalus densifolius</i> subsp. <i>ayashensis</i>	Stony and rocky areas with marl soil	1192 m Northwest	Perennial, herbaceous, hemicryptophyte	June-July / white, light purple or magenta	Ground cover and ornamental
6	<i>Astragalus yildirimii</i>	Stony and rocky, steppe meadows	960 m West	Perennial, herbaceous, hemicryptophyte	June-July / pinkish purple	ornamental
7	<i>Asyneuma linifolium</i> subsp. <i>nallihanicum</i>	Rocky oak groves	610 m West	Perennial, herbaceous, hemicryptophyte	July / purple	
8	<i>Campanula damboldtiana</i>	Stony and rocky areas with marl soil	1192 m Northwest	Perennial, herbaceous, hemicryptophyte	June-July / purple	ornamental
9	<i>Cytisus acutangulus</i>	Sandy stony areas	487 m West	Perennial, semi woody, kamephyte	April / yellow	Border plant
10	<i>Salsola grandis</i>	Clay soil	487 m West	Annual, herbaceous, therophyte	August / yellow	ornamental
11	<i>Salvia aytachii</i>	Sandy soil	642 m West	Perennial, herbaceous, hemicryptophyte	May / pinkish purple	Ground cover and ornamental
12	<i>Verbascum gypsicola</i>	Gypsum rocks	581 m West	Perennial, herbaceous, hemicryptophyte	May-July / yellow	Ground cover and ornamental

## DISCUSSION

Alternative *ex situ* conservation methods for the conservation of living collections in botanical gardens containing documented *ex situ* collections of herbaceous and woody plants [5]. In the carried-out studies, habitat information of all taxa was recorded (Table 2) and herbarium samples were taken and brought to the National Herbarium (TC). Thus, well-documented collections of taxa were created. Moreover, beyond conserving exceptional species [7], it contributes to the conservation of rare and endangered plants by providing stock for living collections, breeding programs, and research into the growing needs of individual species [34]. *Ex-situ* populations can serve as a safeguard against rapid environmental change [35] and provide essential support for stakeholder engagement, education, habitat rehabilitation, and *in situ* conservation [9]. Also, Thomas et al. [36] stated in their study that *ex-situ* populations can provide plant stock by strengthening the reproduction of the species. As stated in all these studies, seeds were collected from all of the studied taxa and the studies were started by taking them into the propagation programs. In addition, these seeds are under protection in Türkiye Seed Gene Bank.

The observations for the habitats of taxa supports all the previous studies [14, 16, 17, 18, 20, 22, 23, 24] that, these taxa are under threat due to human

activities such as field opening, road widening works, mining activities, excavation dumping. Moreover, the *in-situ* conservation activities carried out by the DKMP have been successful in the protected areas for *Verbascum gypsicola*, *Aethionema dumanii*, *Aethionema turcica*, *Salvia aytachii*, *Astragalus beypazaricus* whose borders are determined by wire fence. However, in the habitats of *Astragalus densifolius* subsp. *ayashensis*, *Campanula damboldtiana*, the excavation dumping and field expansion activities still continue and threaten the distribution area of the taxa.

In studies on the use potential of taxa, Bozdoğan [37] stated that soil bacteria living in the root regions of *Salsola grandis* grown in salty soils are used as biofertilizers. Moreover, Güzel Vardar [38] reported that *Verbascum gypsicola* has antioxidant properties. Dilaver [39] showed in her study that *Aethionema dumanii* and *Astragalus densifolius* subsp. *ayashensis* are among the suitable species to be used in landscape architecture applications when evaluated with their phenological, ecological and sociological characteristics. In this context, it has been seen that the evaluations of usage possibilities in the landscape architecture studies conducted within the scope of the study overlap with the literature. This study provided data for preliminary breeding studies. However, in order to introduce taxa to the ornamental plants sector, Alp et al. [25] the breeding stages reported in their study need to be completed. Moreover, one of

the potential economic uses of plants is their medicinal properties. Many species from the genera *Achillea*, *Verbascum*, *Astragalus*, *Salvia* are currently used for medicinal purposes [38, 40, 41, 42]. In this direction, it is important to determine the medical contents of the taxa that are the subject of the study and to investigate the possibilities of their use for the benefit of humanity in the future. Many scientific studies and methods can be developed with the priority of protecting these plants in order to spread their use in the field of medicine.

In the studies carried out, taxa that could adapt to the Botanical Garden were determined. Among the taxa that were successful as a result of propagation efforts, *Aethionema dumanii*, *Aethionema turcica*, *Salvia aytachii*, *Verbascum gypsicola*, *Astragalus beypazaricus*, *Achillea ketenoglui* and *Salsola grandis* were taken under *ex-situ* conservation in the collection garden. Thus, the taxa that were able to adapt to the collection garden continue their vitality as stock material for future studies. However, first of all, it is seen that *in-situ* and *ex-situ* conservation conditions should be fully provided for the endangered taxa. In future studies, it will be appropriate to determine the reproduction methods of taxa and to conduct scientific studies on their usage areas. In addition, it is important to gather institutions and organizations that carry out *in-situ* conservation and monitoring activities on an integrated and common ground with the work of other institutions and organizations that carry out *ex-situ* conservation activities.

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