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The plant diversity and conservation status of the Taurus and Amanos mountains in the Eastern Mediterranean Region of Turkey

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ABSTRACT In this study, the Taurus and Amanos mountains of Turkey's eastern Mediterranean region offer an overview of the floristic features. A total of 1,259 vascular plant taxa belonging to 106 families and 469 genera were recorded from the research area as a result of various researches and field studies conducted between 1999–2017. The phytogeographic elements were represented in the study as follows: Mediterranean 328 (26.1%), Irano-Turanian 157 (12.5%), Euro-Siberian 87 (6.8%), cosmopolitan and unknown 687 (54.6%). The total number of endemic species was 195 and the endemism rate was 15.1%. According to the IUCN Red List Categories, 195 threatened plant species were found in the study area. As in all mountainous environments, climate, soil and vegetation characteristics change at short distances and are less exposed to anthropogenic activities. As a result, mountains are centers of high endemism and global biodiversity.

KEY WORDS Amanos; endemism; Taurus; flora; threatened species.

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INTRODUCTION

Very high parts of the earth's ridges (more than 500 m) are called mountain, spreading over a very wide area with a steep slope, very difficult to climb, covered with trees, shrubs, grasses or bare rocks. Just as mountains can be isolated, they can form mountain chains, mountain ranges or mountain masses in relation to each other. Mountains are the forms of the earth which are meters above the earth and which are not suitable for human life and agriculture due to the generally harsh weather conditions. There are many mountains in the world and their origin is different. While some mountains are formed by the compression of the earth, some mountains come out to the surface due to lava and freeze. The source of the lava of the volcanoes is a very warm mass called magma. 54% of Asia, 36% of North America, 25% of Europe, 22% of South America, 17% of Australia and 3% of Africa are covered with mountains. 24% of the Earth's terrestrial mass is entirely mountainous. Most of the world's rivers are fed by mountainous resources and are dependent on the mountains for more water than half of mankind. Mountains host approximately one quarter of all terrestrial biodiversity and half of the world's biodiversity hot spots (Anonymous, 2018; Barrow, 2018; Pariona, 2018).

Flatlands are generally uniform in vegetation. So a group of few plants can be seen. On the other hand, rugged terrain is rich in vegetation because it creates different environmental conditions. The forms of the earth especially affect the elevation, the direction of the mountain's extension, the unevenness, the spread of the plants and the formation of soil (Atalay, 2002, 2006; Özkan, 2008).

A large part of the forest areas in Turkey consists of natural forests. These areas, unspoilt by foreign species, have spread up to of mountainous masses. Turkey's mountains are also very rich in endemic plants at the same time.

In terms of genetic resources, mountain ecosystems have numerous important species, and, particularly, the mountains of Turkey have many endemic herbaceous species of the Anatolian Region (Öztürk et al., 2008). For this reason, mountainous areas have an extremely important function in agricultural biodiversity.

Anatolia is a geologically young mass. However, it is one of the most active centers in all geological periods. Due to intense volcanic and tectonic activity, different environmental conditions have led to the formation of high structures in different forms (single mountains, mountain ranges, and massive mountains) in the mountainous system. In ancient Western literature, Anatolia is referred to as Asia Minor because of its high altitude.

The Alpine-Himalayan mountain belt, which started about 65 million years ago (alpine period) and formed the youngest mountain formation zone in geological terms, is the rugged mountainous area (Anonymous, 2010). Mountain ranges in Turkey are also located in this mountain belt. Twenty-four percent of the Earth's land surface consists of mountainous areas. Approximately, 78% of Turkey's national area consists of mountain areas (Anonymous, 2010, 2011). In all mountain areas, elevation, climate, soil, and vegetation characteristics change at short distances. The climate varies depending on the latitude in the horizontal direction and the elevation in the vertical direction.

Turkey has, in general, the Mediterranean macro-climate. However, there are many different types of climate, depending on the shape of the ground (Erinç, 1993). Mountainous areas create isolated environments separating from the surrounding area, resulting in increased vegetative cover and locally distributed species.

Places with different bedrock, terrestrial and soil characteristics under the influence of the same climate type show distinct ecological characteristics (Kantarcı, 2005).

Differences in soil types play a crucial role in the diversity of plant communities and in the identification of their distribution area (Avcı, 2005).

Since the early ages, humans have been in close contact with plants (Baytop, 2000). Mankind has a wide variety of interventions directly and indirectly in the ecosystem they live in. Anthropogenic effects are sometimes more important than the sum of all other ecological factors (Duran, 2013).

Mountainous areas usually have low population density. Much of these areas are not suitable for human settlement. Plant communities in mountainous areas are also less exposed to anthropogenic effects. Plant diversity is uniform in flat areas where interaction is intensive (such as field opening, grazing, fire), open to human and animal interventions. The large increase in the world population has made an impact on vegetation in the natural environment.

Because of the high level of physical isolation in high mountain peaks, deep river valleys, closed basin lakes and karstic pits, only a few species are endemic to these areas (Atalay, 2002; Eken & Ataol, 2011). Across the European continent, Turkey is one of the forested country with the highest rate (21%) (Anonymous, 2010).

In high-altitude ecosystems, precipitation, wind, evaporation, and direct solar radiation increase. However, temperature, oxygen, atmospheric pressure, and nitrogen mineralization are reduced (Güleryüz et al., 2010). In addition, different ecological characteristics of the northern and southern slopes are very different from each other, so different plant breeds are formed (Atay et al., 2009). Mountain flora survive under different environmental conditions due to their adaptive properties (hairiness, dwarfness, needle leaflet, deep root, hard leaf, cluster formation, etc.) (Kılınç & Kutbay, 2004).

Geographical isolation in mountainous areas, tectonic movements, climate changes, glacialization, strong microhabitat facilites, and evolutions increase the taxonomic richness (Körner, 1999).

In mountainous regions, rainfall, wind, air humidity, and direct radiation increase as height increases, while temperature, water vapor, and air pressure decrease and vegetation duration shortens (Duran, 2013).

The micro-habitats that characterize the mountainous areas vary according to the roughness, elevation, and slopes of the land. Due to the interactions between soil, temperature and surface, which vary with the effect of the sun and wind, very large changes are observed at very short distances. With the effects of these changes in micro-habitats, the mountain belts contain a very rich biodiversity (Atay et al., 2009).

Many mountain ecosystems have higher species richness and endemism levels than adjacent plains. The mountains at lower altitudes can support an extraordinary biodiversity because a wide variety of ecosystems are compacted to a relatively short distance. The mountains also have suitable living areas isolated from unsuitable low plains.

Endemism levels are high, especially in the tropical regions and in the medium-height mountains in temperate regions. Mountains show environmental changes for some migratory species or represent refuge areas for other species. Mountain species with low habitat tolerance, especially those of high-altitud, are at a higher environmental risk to climate change.

Mountain environments cover 27% of the world's land surface and directly support 22% of the world’s people living in mountain regions. The people of the valley are also dependent on mountain environments for a wide range of products and services, including water, energy, timber, biodiversity care, recreation and spiritual renewal opportunities. The mountains satisfy the freshwater needs of more than half of mankind and are actually the world's water towers. The mountains of the world are made up of the most spectacular landscapes, from a wide variety of species and habitat types and from diverse human communities. Mountains all over the world, in all latitudes, from hyper-arid warm desert to tropical forests, support a wide variety of ecosystems. Mountain ecosystems are important for biodiversity, especially in tropical regions and warm temperate latitudes. Isolated mountain blocks are often rich in endemic species.

In this study, the Taurus and Amanos mountains in Turkey’s eastern Mediterranean region was chosen to determine the overall plant diversity and conservation status.

MATERIAL AND METHODS

Study area

The research area within the borders of Adana and Hatay province covers the geographical mountainous area within the boundaries of Erzin, Dörtyol and Iskenderun districts of the central Amanos mountains and the geographical mountainous area within the Kozan and Feke district borders of the central Taurus mountains (Fig. 1). Main settlements in the research area are Mansurlu, Burhaniye, Kalkumaç, Ergenuşağı, Bahçecik, Topaktaş, Karıncalı, Başlamış, and Üçkoz villages. Important rivers in the study area are the Zamantı and Göksu rivers, and there are İnderesi, Özerli, Deliçay and Payas creeks. The most important mountains in the study area are Tahtaflatan (2,495 m), Sarıpınar (2,081 m), Karakızoluğu (2,158 m), Sicimindağı (2,259 m), Görbeyaz (1,948 m), Mığır (2,240 m), and Harmankaya (2,208 m) (Fig. 2).

The Taurus and Amanos mountains, where the study area is located, constitute an important part of the Alpine orogenic belt that passes through the southern and eastern parts of Anatolia (Özgül, 1976). Geologically, the study area is formed from Mesozoic and Cretaceous limestone, upper Cretaceous ultrabasic rocks (Gabro and Serpentine), and Tertiary marls. Common soil formations distinguished in the area are as follows: brown calcareous soils, brown forest soils, terrarosa soils, reddish-brown Mediterranean soils, colluvial soils, and mixed land types (Akman, 1973; Türkmen & Düzenli, 1990; Karakuş & Türkmen, 2014; Türkmen et al., 2015a).

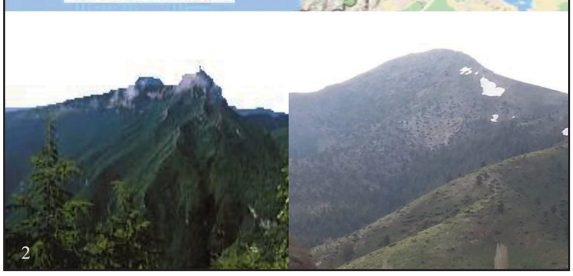

Figure 1, 2. Study area in Turkey’s eastern Mediterranean Region. Fig. 1: map. Fig. 2: general views of the study area.

Low altitude parts of the research area (up to 1,200 m) have a Mediterranean climate, with warm, dry summers and cool, wet winters. The high-altitude parts of the study area (between approximately 1,200 m and 2,495 m) experience a continental climate, with cold, snowy, and rainy winters and cool, dry summers. Annual rainfall varies between 400 and 1,500 mm, depending on the elevation and direction. Seasonal rainfall regime is as follows: winter, spring, autumn, and summer. From the beginning of December until the end of March, precipitation in the form of snow is seen at places above 1,000 m. The average annual temperature of the area is 19.3 °C. In August, average maximum temperature is 34.8 °C and the minimum average temperature of 4.8 °C is seen in January (Türkmen & Düzenli, 1990; Öztürk et al., 2008; Özkan, 2008; Türkmen et al., 2015b).

RESULTS AND DISCUSSION

Our investigations on the specimens collected from the area and identified with the help of Flora of Turkey (Davis, 1965–1985; Davis et al., 1988; Güner et al., 2000) have revealed that 1,259 vascular plant taxa belonging to 469 genera from 106 families (Türkmen & Düzenli, 1990; Türkmen & Düzenli, 1998; Türkmen, 2014; Türkmen et al., 2015a, b). Author citiations of plant names followed Brummitt & Powell (1992).

The phytogeographical distribution of these taxa is as follows (Table 1): Mediterranean: 328 (26.1%), Irano-Turanian: 157 (12.5%), Euro-Siberian: 87 (6.8%), cosmopolitan and unknown: 687 (54.6%). The total number of endemic species was 195 and the endemism rate was 15.1%.

As seen in Table 1, plains (low altitudes terrains) usually have a uniform vegetation, so there are few plant species. On the other hand, mountains (steep terrains) are rich in vegetation because they create different environmental conditions.

The Mediterranean elements are dominating the list simply due to the prevalence of Mediterranean climate here. The Euro-Siberian elements, which were widely distributed in the Pleistocene ice age, have progressed southwards along the Anatolian Diagonal, and due to the humid climatic conditions, they are still continuing to grow in the research area. The Euro-Siberian floristic region in Turkey is a very widespread area with typical *Fagus orientalis* Lipsky forest formation. In the Amanos mountains, large, frequent, and pure community is distributed on the northern slopes between 1600 and 1900 m (Davis et al., 1971; Yılmaz, 1993; Türkmen & Düzenli, 1998).

The dominating families and the number of taxa these embody are: Asteraceae: 163 (12.95%), Fabaceae: 132 (10.48%), Lamiaceae: 87 (6.91%), Brassicaceae: 85 (6.75%), Poaceae: 81 (6.35%), Liliaceae: 62 (4.92%), Caryophyllaceae: 59 (4.68%), Apiaceae: 50 (3.97%), Rosaceae: 45 (3.57%), Scrophulariaceae: 44 (3.49%), Boraginaceae: 35 (2.78%); Rubiaceae: 25 (1.99%); Polygonaceae: 17 (1.35%), Euphorbiaceae: 16 (1.27%), Hypericaceae: 16 (1.27%), Orchidaceae: 16 (1.27%), Ranunculaceae: 15 (1.19%), Crassulaceae: 12 (0.95%), and Geraniceae: 12 (0.95%).

The rare and endemic species and their International Union for Conservation of Nature (IUCN) categories are as follows: CR: 1, EN: 1, VU: 15, DD: 2, NT: 12, and LC: 22 (Table 2) (Ekim et al., 2000; IUCN, 2017).

The main types of vegetation observed in the research area are maquis, forest, steppe, and aquatic vegetations (Türkmen & Düzenli, 1990; Türkmen et al. 2015a, b):

Shrub-like vegetation (macchia) is the dominant vegetation between 300 m and 600 m, most of which are evergreen shrubs. Common species include *Quercus coccifera* L., *Erica manipuliflora* Salisb., *Myrtus communis* L. ssp. *communis* L., *Cotinus coggygria* Scop., *Calicotome villosa* (Poiret) Link., *Phillyrea latifolia* L., *Olea europaea* L. var. *sylvestris* (Mill.) Lehr, P*istacia terebinthus* L. ssp. *palaestina* (Boiss.) Engl., *Cistus creticus* L., *Rham-*

Floral parameters	Number of species			Percent of sample total		
	Mount 1	Plain 1	Plain 2	Mount 1	Plain 1	Plain 2
Mediterranean elements	328	151	73	26.1	36.4	17.5
Euro-Siberian elements	157	11	7	12.5	2.7	3.9
Irano-Turanian elements	87	13	6	6.8	3.1	3.4
Multiregional elements	687	240		54.6	57.8	51.7
Endemics	195	20	8	15.1	4.8	4.5
Total flora	1259	415	1178	-	-	-

Table 1. A comparison of the floral characteristics in the research area and lowland areas (Mount 1 (present study); Plain 1 (Türkmen & Düzenli, 1990); Plain 2 (Bulut, 2008).

Endangered plants	Conservation status
Acantholimon acerosum (Willd.) Boiss. var. *brachystachyum* Boiss.	VU (B1 a,b and B2 a,b)
Acanthus dioscoridis L. var. *laciniatus* Freyn	NT
Acanthus dioscoridis L. var. *perringii* (Siehe) E. Hossain	VU (B1 a,b and B2 a,b)
Achillea cappadocica Hauskn. et Bornm.	LC
Achillea monocephala Boiss. et Balansa	EN (B1 a,b and B2 a,b)
Aethionema capitatum Boiss. et Balansa	NT
Aethionema schistosum Boiss. et Kotschy	NT
Alcea apterocarpa (Fenzl) Boiss.	LC
Alkanna amana Rech. fil.	DD
Alkanna cappadocica Boiss. et Balansa	LC
Alkanna kotschyana DC.	LC
Allium brevicaule Boiss. et Balansa	NT
Allium cappadocicum Boiss.	NT
Allium glumaceum Boiss. et Hauskn.	NT
Allium tauricola Boiss.	NT
Allium tchihatschewii Boiss.	LC
Alnus glutinosa (L.) Gaertn. ssp. *antitaurica* Yalt.	NT
Alyssum argrophyllum Schott	NT
Alyssum callichroum Boiss. et Balansa	LC
Alyssum corningii Dudley	NT
Alyssum huetii Boiss.	LC
Alyssum masmenaeum Boiss.	LC
Alyssum murale Waldst. et Kit. var. *haradjianii* (Rech.) Dudley	VU (B1 a,b and B2 a,b)
Alyssum oxycarpum Boiss. et Balansa	NT
Alyssum peltarioides Boiss. ssp. *virgatiforme* (Nyar.) Dudley	LC
Alyssum praecox Boiss. et Balansa var. *praecox*	LC
Anchusa leptophylla Roemer et Schultes ssp. *incana*	LC
Anthemis aciphylla Boiss. var. *aciphylla*	LC
Arenaria ledebouriana Fenzl var. *pauciflora* McNeill	LC
Asperula cymulosa (Post) Post	VU (B1 a,b and B2 a,b)
Asperula stricta Boiss. ssp. *grandiflora* Schönb.-Tem.	NT
Asperula stricta Boiss. ssp. *monticola* Ehr	LC
Asphodeline cilicica Tuzlacı	VU (B1 a,b and B2 a,b)
Astragalus antiochinus Post	DD
Astragalus campylosema Boiss. ssp. *atropurpureus* (Boiss.) Chamb.	LC
Astragalus campylosema Boiss. ssp. *campylosema*	LC
Astragalus condensatus Ledeb.	LC
Astragalus globosus Vahl	LC
Aubrieta canescens (Boiss.) Bornm. ssp. *canescens*	LC
Aubretia canescens (Boiss.) Bornm. ssp. *macrostyla* Cullen et Huber-Morat	LC
Ballota macrodonta Boiss. et Balansa	VU (B1 a,b and B2 a,b)

Endangered plants	Conservation status
Bolanthus minuartioides (Jaub. et Spach) Hub.-Mor.	LC
Bupleurum lophocarpum Boiss. et Balansa	NT
Carduus olympicus Boiss. ssp. *hypoleucus* (Bornm.) Davis	LC
Carex divulsa Stokes ssp. *coriogyne* (Nelmes) Ö.Nilsson	LC
Centaurea aladaghensis Wagenitz	EN (B1 a,b and B2 a,b)
Centaurea antitauri Hayek	VU (B1 a,b and B2 a,b)
Centaurea calcitrapa L. ssp. *cilicica* (Boiss. et Balansa) Wagenitz	NT
Centaurea cataonica Boiss. et Hausskn.	NT
Centaurea haussknechtii Boiss.	CR (B1 a,b and B2 a,b)
Centaurea lycopifolia Boiss. et Kotschy	NT
Centaurea mucronifera DC.	LC
Centaurea ptosimopappoides Wagenitz	VU (B1 a,b and B2 a,b)
Cephalaria taurica Szabo	VU (B1 a,b and B2 a,b)
Chaenorhinum litorale (Bernh.) Fritsch ssp. *pterosporum* (Fisch. et C.A.Mey.) Davis	LC
Chamaecytisus drepanolobus (Boiss.) Rothman	NT
Cicer echinospermum P.H.Davis	LC
Cirsium ellenbergii Bornm.	VU (B1 a,b and B2 a,b)
Cochleria sempervivum Boiss. et Balansa	NT
Crepis armena DC.	LC
Crepis macropus Boiss. et Heldr.	LC
Crocus cancellatus Herb. ssp. *cancellatus*	LC
Crocus kotschyanus C. Koch ssp. *cappadocicus* Mathew	NT
Cyclamen pseud-ibericum Hildebr.	EN (B1 a,b and B2 a,b)
Dactylorhiza osmanica (L.) Soo' var. *osmanica*	LC
Dianthus balansae Boiss.	LC
Dianthus brevicaulis Fenzl ssp. *brevicaulis*	LC
Dianthus lactiflorus Fenzl	NT
Ebenus laguroides Boiss. var. *laguroides*	LC
Eryngium kotschyi Boiss.	LC
Erysimum alpestre Kotschy ex Boiss.	LC
Erysimum leptocarpum Gay	EN (B1 a,b and B2 a,b)
Erysimum sintenisianum Bornm.	LC
Euphorbia cardiophylla Boiss. et Heldr.	LC
Euphorbia rhytidosperma Boiss. et Balansa	VU (B1 a,b and B2 a,b)
Ferula drudeana Korovin	VU (B1 a,b and B2 a,b)
Ferulago pachyloba Fenzl	VU (B1 a,b and B2 a,b)
Festuca adanensis Markgr.-Dannenb.	NT
Fraxinus ornus L. ssp. *cilicica* (Lingelsh.) Yalt.	LC
Galatella amani (Post) Grierson	VU (B1 a,b and B2 a,b)
Galium cilicicum Boiss.	LC
Galium stepparum Ehrend. et Schönb.-Tem.	NT
Gladiolus anatolicus (Boiss.) Stapf	LC
Graellsia davisiana Poulter	EN (B1 a,b and B2 a,b)
Haplophyllum myrtifolium Boiss.	LC

Endangered plants	Conservation status
Helichrysum arenarium (L.) Moench ssp. *aucheri* (Boiss.) Davis et Kupicha	LC
Helleborus vesicarius Aucher	NT
Herniaria argaea Boiss.	VU (B1 a,b and B2 a,b)
Herniaria. saxatilis Brummitt	VU (B1 a,b and B2 a,b)
*Hieracium lasiochaetum (*Bornm. et Zahn) Sell et West	LC
Hyacinthella micrantha (Boiss.) Chouard	NT
Hyacinthus orientalis L. ssp. *chionophilus* Wendelbo	NT
Hypericum aviculariifolium Jaub. et Spach ssp. *aviculariifolium* var. *aviculariifolium*	NT
Hypericum aviculariifolium Jaub. et Spach ssp. *depilatum* (Freyn et Bornm.) Robson var. *depilatum*	LC
Hypericum kotschyanum Boiss.	NT
Hypericum. lanuginosum *Lam. var.* scabrellum (Boiss.) Robson	LC
Inula anatolica Boiss.	LC
Isatis candolleana Boiss.	LC
Isatis constricta P.H.Davis	EN (B1 a,b and B2 a,b)
Isatis floribunda Boiss. ex Bornm.	LC
Johrenia silenoides Boiss. et Balansa	NT
Juncus sparganiifolius Boiss. et Kotschy ex Buchenau	LC
Kundmannia syriaca Boiss	LC
Lamium microphyllum Boiss.	VU (B1 a,b and B2 a,b)
Lamium garganicum L. ssp. *nepetifolium* (Boiss.) R.R.Mill	LC
Lathyrus elongatus (Bornm.) Sirj.	NT
Lathyrus. laxiflorus (Desf.) Kuntze ssp. *angustifolius* (Post ex Dinsm.) Davis	VU (B1 a,b and B2 a,b)
Leucocyclus formosus Boiss. ssp. *amanicus* (Rech. fil.) Hub.-Mor. et Grierson	NT
Linaria genistifolia (L.) Mill. ssp. *confertiflora* (Boiss.) Davis	LC
Marrubium globosum Montbret et Aucher ex Benth, ssp. *globosum*	LC
Michauxia tchihatchewii Fisch. et C.A.Mey.	NT
Micromeria cilicica Hauskn. ex P.H.Davis	EN (B1 a,b and B2 a,b)
Micromeria cremnophila Boiss. et Heldr. ssp. *amana* (Rech..f.) P.H.Davis	LC
Micromeria cremnophila Boiss. et Heldr. ssp. *anatolica* P.H.Davis	LC
Minuartia tchihatchewii (Boiss.) Hand.-Mazz.	LC
Minuartia umbellulifera (Boiss.) McNeill ssp. *umbellulifera* var. *umbellulifera*	LC
Muscari aucheri (Boiss.) Baker	LC
Muscari azureum Fenzl	LC
Muscari bourgaei Baker	LC
Muscari microstomum Davis et Stuart	VU (B1 a,b and B2 a,b)

Endangered plants	Conservation status
Nepeta isaurica Boiss. et Heldr. apud Benth.	LC
Onobrychis armena Boiss. et A.Huet	LC
Onosma armenum DC.	LC
Onosma bracteosum Hauskn. et Bornm.	LC
Onosma inexspectatum Teppner	LC
Ornithogalum alpigenum Stapf	NT
Papaver triniifolium Boiss.	LC
Paronychia argyroloba Stapf	NT
Paronychia chionaea Boiss.	EN (B1 a,b and B2 a,b)
Paronychia mughlaei Chaudhuri	VU (B1 a,b and B2 a,b)
Phlomis armeniaca Willd.	LC
Phlomis longifolia Boiss. et Bal. var. *bailanica* (Vierh.) Hub.-Mor.	NT
Phryna ortegioides (Fisch. et C.A.Mey.) Pax. et Hoffm.	NT
Potentilla calycina Boiss. et Balansa	LC
Potentilla pulvinaris Fenzl	EN (B1 a,b and B2 a,b)
Pterocephalus pinardii Boiss.	LC
Ptilostemon afer (Jacq) Greuter ssp. *eburneus* Greuter	LC
Quercus petraea (Mat.) Liebl. ssp. *pinnatiloba* (C. Koch) Menitsby	LC
Rhamnus hirtellus Boiss.	LC
Rhamnus pichleri Schneider et Bornm. ex Bornm	NT
Ricotia sinuata Boiss. et Heldr.	LC
Rindera caespitosa (A. DC.) Bunge	LC
Rosularia chrysantha (Boiss.) Tahkt.	LC
Rosularia globulariifolia (Fenzl) Berge	LC
Rumex gracilescens Rech.	NT
Salvia cryptantha Montbret et Aucher ex Benth.	LC
Salvia recognita Fisch. et C.A.Mey.	LC
Saponaria prostrata Willd. ssp. *prostrata*	LC
Satureja amani P.H. Davis	CR (B1 a,b and B2 a,b)
Satureja cilicica P.H.Davis	NT
Scabiosa kurdica Post	VU (B1 a,b and B2 a,b)
Scorzonera semicana DC.	LC
Scorzonera tomentosa L.	LC
Scutulleria glaphyrostachys Rech. fil.	VU (B1 a,b and B2 a,b)
Scutulleria rubicunda Hormem ssp. *brevibracteata* (Stapf.) Edmond	LC
Scutellaria salviifolia Benth	LC
Senecio farfarifolius Boiss. et Kotschy	LC
Senecio jurineifolius Boiss. et Balansa	LC
Sideritis cilicica Boiss. et Bal.	EN (B1 a,b and B2 a,b)
Sideritis libanotica Labill. ssp. *linearis* (Benth.) Bornm.	LC
Sideritis phlomoides Boiss.et Balansa	NT
Silene delicatula Boiss. ssp. *delicatula*	LC
Stachys longiflora Boiss. et Balansa	DD
Stachys rupestris Montbret et Aucher ex Benth.	LC

Endangered plants	Conservation status
Stachys sparsipilosa Bhattacharjee et Hub.-Mor.	LC
Tanacetum argenteum (Lam.) Willd. ssp. *argenteum*	LC
Tanacetum densum (Labill.) Schultz Bip. ssp. *amani* Heywood	LC
Tanacetum densum (Labill.) Schultz Bip. ssp. *sivasicum* Hub.-Mor. et Grierson	VU (B1 a,b and B2 a,b)
Tanacetum haradjanii (Rech.f.) Grierson	NT
Teucrium chamaedrys L. ssp. *tauricolum* Rech.f.	LC
Thesium cilicicum Bornm.	NT
Thlaspi densiflorum Boiss. et Kotschy	NT
Thlaspi rosulare Boiss. et Balansa	CR (B1 a,b and B2 a,b)
Thlaspi violascens Boiss.	LC
Thymus sipyleus Boiss. ssp. *sipyleus* var. *sipyleus*	NT
Tordylium elegans (Boiss. et Balansa) Alava et Hub.-Mor.	NT
Trifolium davisii E.Hossain	VU (B1 a,b and B2 a,b)
Tripleurospermum fissurale (Sosn.) E.Hossain	NT
Tulipa armena Boiss. var. *lycica* (Baker) Marais	LC
Verbascum antitauricum Hub.-Mor.	VU (B1 a,b and B2 a,b)
Verbascum caesareum Boiss.	VU (B1 a,b and B2 a,b)
Verbascum cheiranthifolium Boiss. var. *asperilum* (Boiss.) Murb.	LC
Verbascum cilicicum Boiss.	VU (B1 a,b and B2 a,b)
Verbascum leianthoides Murb.	VU (B1 a,b and B2 a,b)
Verbascum leianthum Benth.	NT
Verbascum linearilobium (Boiss.) Hub.-Mor.	EN (B1 a,b and B2 a,b)
Verbascum lyratifolium Koch ex Benth.	NT
Verbascum protractum Fenzl ex Tchih.	NT
Veronica balansae Stroh	LC
Veronica cinerea Boiss. et Balansa	LC
Veronica cuneifolia Don ssp. Cuneifolia	LC
Veronica dichrus Schott et Kotschy	NT
Veronica hispidula Boiss. et A.Huet ssp. *ixodes* (Boiss.et Balansa) M.A.Fisch.	NT
Veronica orientalis Boiss. Miller ssp. *nimordi* (Reichter ex Stapf.) M.A. Fischer	LC
Vicia canescens Lab. ssp. *canescens*	NT

Table 3. The endangered species of the study area and their IUCN red data list categories. *CR (B1 a,b and B2 a,b) Critically endangered: Extent of occurrence less than 5000 km^2; area of occupancy less than 500 km^2; known no more than five locations; inferred decline in the area, extent and/or quality of habitat. EN (B1 a, b and B2 a, b) Endangered: Extent of occurrence less than 100 km^2; area of occupancy less than 10 km^2; known to exist at only a single location; inferred decline in the area, extent and/or quality of habitat. VU (B1 a, b and B2 a, b) Vulnerable: Extent of occurrence less than 20,000 km^2; area of occupancy less than 2000 km^2; known no more than ten locations; inferred decline in the area, extent, and/or quality of habitat. NT Near threatened. LC Least concern. DD Data deficient.

nus oleoides L. ssp. *graecus* (Boiss et Reut.) Holmboe, R. *punctatus* Boiss. var. *angustifolius* Post, *Arbutus andrachne* L., *Daphne sericea* Vahl, *Fontanesia philliraeoides* Labill. ssp. *philliraeoides* Labill., and *Styrax officinalis* L.

Forest vegetation, from 300 m to 1900 m, occupies different zones depending on local climate conditions, altitude, and topographic position. The common tree species in this belt are: *Pinus brutia* Ten., *P. nigra* Arn. ssp. *pallasiana* (Lamb.) Holmboe, *Cedrus libani* A. Rich., *Abies cilicica* (Ant. et Kotschy) Carr. ssp. *cilicica* (Ant. et Kotschy) Carr., *Fagus orientalis* Lipsky, *Quercus cerri*s L. var. *cerris* L., and *Carpinus orientalis* Mill.. These tree species occur in mono and mixed stands, as herbaceous and shrub layer cover is weak. Native forests of pine, cedar, and cilician fir have been overlogged and replaced with *Cistus laurifolius* L., *Juniperus excelsa* M. Bieb., *J. foetidissima* Willd., *J. drupaceae* Labill., and *J. oxycedru*s L. ssp. *oxycedrus* L.

Steppe vegetation consisting of perennial herbaceous and semi-woody dwarf plants dominate the elevation zone above 1900 m. These sparsely vegetated areas are covered by snow in winter until the middle of spring when herbaceous plants start emerging. The risk of landslides, floods, and avalanches increases due to overgrazing. The dominant species of this plant belt are: *Acantholimon libanoticum* Boiss., *Ac. armenum* Boiss. et A. Huet. var. *armenum*, *Ac. venustum* Boiss. et A. Huet var. *armenum, Allium tauricola* Boiss., *Asphodelina damascene* Boiss. et Baker ssp. *damascene* Boiss. et Baker, *Asperula stricta* Boiss. ssp. *monticola* Boiss., A*stragalus angustifolius* Lam. ssp. *angustifolius* Lam. var. *angustifolius* Lam., *As. globosus* Vahl, *As. gummife*r Labill., *As. macrourus* Fisch. et C.A.Mey., *Berberis crataegyna* DC., *Cerasus prostrate* (Labill.) Ser. var. *prostrata* (Labill.) *Ser., Convolvulus compactus* Boiss., *Cotoneaster nummularia* Fisch. et C.A.Mey., *Echinops ritro* L., *Daphne oleoides* Schreb. ssp. *kurdica* (Bornm.) Bornm., *Echinops ritro* L., *Eremurus spectabilis* Bieb., *Euphorbia kotschyana* Fenzl., *Ferula elaeochytris* Korovin, *Haplophyllum myrtifolium* Boiss., *Helichrysum arenarium* (L.) Moench ssp. *aucheri* (Boiss.) Davis et Kupicha, *Marrubium globosum* Montbret et Aucher ex Benth. ssp. *globosum*, *M. parviflorum* Fisch. et C.A. Mey. ssp. *parviflorum*, *Minuartia juniperina* (L.) Maire et Petitm., *Onobrychis cornuta* (L.) Desv, *Phlomis cap-*

itata Boiss., *Potentilla pulvinaris* Fenzl, *Pterocephalus pinardii* Boiss., *Rosa foetida* J. Herm., *R. pulverulenta* M. Bieb., *Thymus kotschyanus* Boiss et Hohen var. *glabrescens* Boiss. et Hohen., *Verbascum amanum* Boiss., and *Vincetoxicum tmoleum* Boiss.

Wetland vegetation is encountered only at creek banks and spring mouths and includes the herbaceous or woody aquatic plants such as *Alchemilla pseudocartilinica* Juz., *Alopecurus arundinaceus* Poir., *Alnus glutinosa* (L.) Gaertn. ssp. *antitaurica* Yalt., *Barbarea minor* C. Koch var. *eriopoda* Busch, *Carex divulsa* Stokes ssp. *divulsa* (Nelmes) O. Nilsson, *Cirsium arvense* (L.) Scop. ssp. *vestitum* (Wimmer et Grab.) Petrak, *Cyperus longus* L., *Datisca cannabina* L., *Equisetum arvense* L., *Hypericum venustum* Fenzl, *Juncus inflexus* L., *Lysimachia vulgaris* L., *Lythrum salicaria* L., *Nasturtium officinale* R.Br., *Orchis laxiflora* Lam., *Pedicularis comosa* L. var. *acmodonta* (Boiss.) Boiss., *Phragmites australis* (Cav.) Trin. ex Steudel, *Platanus orientalis* L., *Prunella vulgaris* L., *Ranunculus kotschyi* Boiss., *Rubus canescens* DC. var. *glabratus* (Godr.) Davis et Meikle, *Salix excelsa* J.F. Gmelin, *Scirpoides holoschoenus* (L.) Sojak, *Setaria viridis* (L.) P. Beauv., *Sium sisarum* L. var. lan*cifolium* (M. Bieb) Thell., and *Tamarix smyrnensis* Bunge.

Human activities such as dams, new road constructions, settlements, excessive grazing, illegal cutting, forest fires, mining, and summer camps are threats to the vegetation in the study area.

CONCLUSIONS

Geomorphological units are one of the most important elements limiting living habitats in nature. Areas of high biodiversity are concentrated on specific geomorphological units.

Rugged topography causes a wide variety of ecological conditions. The plant varieties that adapt themselves to these environmental conditions are also diversified. The research area is very important because it has biological diversity, pharmacological/industrial plant species, and recreation functions.

The high and rugged topography of the study area has contributed significantly to plant diversity and distribution. Large mountainous terrain leads to variability in climatic and lithological conditions. This is reflected in the plant cover. If the field investigated from the other side had formed a smoother physical surface, a plant richness could not be mentioned on this scale.

The Anatolian Diagonal, which forms the connection between the northern and southern Anatolian mountains in the formation of endemism and species richness, played an important role in the plant movement in the glacial periods and glacial warming periods by acting as a bridge for some species while creating physical obstacles for some other species (Türkmen & Düzenli, 1998; Atalay, 2006; Türkmen et al., 2015b)

In the near future, the climate change that will emerge in the region will undermine sustainable development efforts as well as affecting the phenological behaviors and living conditions of existing plant species, causing deterioration problems, especially in altitude along the Taurus and Amanos Mountains. These include the addition of anthropogenic activities such as illegal cutting, harvesting, settlement, land-clearing, overgrazing, and fire, which will inevitably change the largely preserved natural vegetation cover

Estimated climate scenarios for temperature increases will seriously threaten the life of the cryohygrophilous high-altitude plant taxon in the research area, interfering with hydrological conditions. Endemics will take full share of all these effects. Upward migrations due to warming temperatures will result in displacements in the vegetation belt here and drought-tolerant invaders from low altitudes will eventually lead to biodiversity losses (Öztürk et al., 2008; Güleryüz et al., 2010).

Mountain biodiversity faces serious and growing challenges.

The degradation of the habitat caused by nonsustainable land cleansment leads to the erosion of fertile soils and increases the avalanche, landslide, and flood threats. With this change in the habitat, rare plant and animal species can be depleted.

There are many challenges to overcome in order to use mountain biodiversity successfully and sustainably. The growing demand for water, the consequences of global climate change, tourism growth, and globalization are just a few of these challenges in the world, where the pressures of the industry and agriculture are on the rise.

Important threats of mountain ecosystems are: fire; climate change; land cover change, agricultural transformation, seismic hazards, infrastructure development, and armed conflict. These pressures disrupt mountain environments and affect the livelihoods of ecosystem services and people connected to them. In all mountain regions, natural risks are high and the effects of poor land-use practices are particularly intense. As ecosystems that represent the complex and integrated ecology of our planet, mountain environments are necessary for the survival of the global biosphere

Globalization is not only economic. It should also include the conservation and sustainable management of vegetation in all regions and other subregions around the world.

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