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Rare and endangered species of Shahdag National Park (Azerbaijan) with special status

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ABSTRACT This work presents information about the geographical ranges of the vegetation of the Shahdag National Park (NP) belonging to the Greater Caucasus (within the borders of Azerbaijan) range, the current status of endemic, relict and rare species. The geographic-areological analysis of the region shows that the flora of the Shahdag area is formed by the predominance of Boreal and Xerophile types. From the studies, it was found that the spread of endemic taxa in NP to neighboring areas reduced them to the subendemic level. In total, 7 species of Azerbaijan endemic and 88 subendemic species are distributed in the territory of Shahdag NP, of which 69 are described only from the Caucasus and are considered endemic to the Caucasus, while others are distributed as far as the borders of Dagestan, Turkey and Iran. In terms of determining the development history of the local flora, 24 relict species have been determined. In general, 14 species were evaluated as vulnerable (VU), 10 species as Near Threatened (NT), and 5 species as endangered (EN) in the Shahdag area.

KEY WORDS National Park; endemic; relict; rare species; geographical range.

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INTRODUCTION

Without studying the flora of certain territories, it is difficult to ensure the protection of its plants that have a special status, their rational use, and the implementation of improvement measures in territories affected by the negative impact of environmental, anthropogenic and zoogenic factors. Also in botanical geography, the study of the endemic specie is of great importance. The endemic or relict species distributed in a certain area is the main indicator of the specificity and originality of that flora. As a result of studying the composition of endemic taxa, the regularity of flora formation, phylogenetic condition, chorological and eco-phytocenological characteristics, as well as genesis, become clear. Endemics are understood as taxa the distribution of which is limited to a certain territory (Tolmachev, 1986). The geographic distribution of endemic taxa may vary. Species, the range of which goes beyond the boundaries of the area under study and is not limited to a certain area, are called subendemic. Endemic and relict plants of the vegetation of Azerbaijan and the Caucasus have been studied by many authors (Askerov, 2006–2008; Salimov et al., 2021; Babakishiyeva, Ibadullayeva, 2021). Information on 240 endemic species for the flora of Azerbaijan has been provided by Akhundov

(1973). Subsequently, Grossheim (1939) recorded the presence of 1153 endemic species in Caucasus and Asgarov (2016) provided information on 146 endemic and 402 subendemic plants that make up the gene pool of the flora of Azerbaijan. As a result of the research towards the study of the endemic plants of Azerbaijan in recent years, some of the endemic species have been assessed as subendemic (Yusifov et al., 2022).

Floristic research is extremely important in terms of studying the vegetation of the region. As a result of the analysis of the research conducted in this direction and the identification of the plant samples obtained during the expeditions, the flora of the territory of the Shahdag National Park has been fully studied and systematically analyzed (Ibadullayeva et al., 2014). During the research period, a schematic description of higher plants consisting of 1603 species in the flora of the Shahdag National Park area has been developed. It was determined that 31 species of spore and 1572 species of seed (12 species of gymnosperms, 1560 species of angiosperms, including 294 species of monocotyledons, 1266 species of dicotyledons) are distributed in the local flora (Mustafayev, 2019).

In recent years, in order to protect the biodiversity of rare species that have a limited range and are on the verge of extinction, extensive research work is being carried out (Musayev, 2005; Talibov et al., 2010; Mursel et al., 2019; Ibadullayeva et al., 2021; Mehdiyeva et al., 2022). The assessment of rare and endangered species is first carried out at the regional level, then at the national level, and finally at the international level. For this purpose, the International Union for Conservation of Nature (IUCN) was developed, and in Azerbaijan, according to the criteria of the Red List of this Union, the protection status of rare species was determined (IUCN, 2001).

Taking all this into account, the goal was to study the origin of plants with a special status of the Shahdag NP, including the geographic ranges and the reasons for their decline.

MATERIAL AND METHODS

During the research, attention was paid to the latest nomenclatures data following Portenier (2000) and its methods based on phytochorions in botanical-geographical zoning. The flora of the region was geographically analyzed using the works of Grossheim (1939; 1939–1967). The protection status of rare species is given according to the IUCN "Red Data Book" (2003) criteria and the "Red Books" of the Republic of Azerbaijan (1989, 2013, 2023). In addition, attention was paid to the publications on rare and endemic species (Asgarov, 2016; Ibadullayeva et al., 2021).

RESULTS AND DISCUSSION

Floristic geographical studies, which provide information on the geographic location of the intraspecific smallest taxa and the center of distribution of rare species (relict, endemic), play a key role in the protection of vegetation, the genetic origin of species, on the physical-geographical conditions, modern and past, of the area where it is inhabited, for determining the geographical element and the areal types to which they belong, and determining the distribution and centers of formation of the species.

Based on the herbarium materials and literature sources collected during the research years, for the flora of Shahdag area, zonal areal type were determined. The types, classes and groups of all species distributed in the area's flora according to their geographical range are defined and reflected in Table 1. The geographic analysis of the region shows that the flora of the Shahdag is formed by the predominance of boreal and xerophilous types. Species with xerophilic areal type constitute almost the majority of the region flora with 571 species (35.5%), the boreal areal type with 538 species (33.6%) and the Caucasian areal type with 329 species (20.5%). Steppe areal type is represented by 48 species (3%). Indeterminate areal type is represented by 41 species (2.5%), ancient areal type by 24 species (1.5%), adventive areal type by 21 species (1.3%), desert areal type by 17 species (1.1%), and cosmopolitan areal type by 14 species (0.9%).

There are 24 species - *Anizantha tectorum* (L.) Nevski, *Chenopodium foliosum* Aschers, *Ch. vulvaria* L., *Krascheninnikovia ceratoides* (L.)

№	Areal types	Species	%	Classes	%	Groups	%
1	Ancient	24	1.5	2	13.3	6	14
2	Boreal	538	33.6	3	20	7	16.3
3	Steppe	48	3	3	20	8	18.6
4	Xerophile	571	35.6	3	20	16	37.2
5	Desert	17	1.1	2	13.3	3	7
6	Caucasus	329	20.5	1	6.7	2	4.7
7	Adventive	21	1.3	1	6.7	1	2.2
8	Cosmopolitan	14	0.9	-	-	-	-
9	Undeterminate	41	2.5	-	-	-	-
Total		1603	100	15	100	43	100

Table 1. Composition of species in the flora of Shahdag NP according to geographical areal types, classes and groups.

Gueldents., *Rumex scutatus* L., *Platanus orientalis* L., *Juglans regia* L., *Viola sicheana* W.Beck., *Datisca cannabina* L., *Thymelaea passerina* (L.) Coss. et Germ., etc - of relict plants in the ancient areal type in the area.

There are 9 main and 7 transition groups in 3 classes of the xerophilic areal type (Mediterranean, Western Asia, Central Asia) represented by more species. Most species are distributed in Western Asia (69 species), Mediterranean (74 species), Irano-Turanian (53 species), Azerbaijan endemics (38 species), Iran (34 species) and Mediterranean-Irano-Turanian (33 species) groups. Turanian group of desert areal type is represented by the species *Lonicera iberica* Bieb., *Viburnum opulus* L., *Adonis bienertii* Butk., Eastern Transcaucasian group by the species *Nonnea rosea* (Bieb.) Link, *Acer laetum* C.A.Mey., *A. hyrcanum* Fisch. et C.A.Mey., *Lonicera iberica* Bieb., *Papaver arenarium* Bieb., *Melandrium latifolium* (Poir.) Maire, *Sclerochloa dura* (L.) Beauv, Sacharo-Iranian group by the species *Lepidium sativum* L. The Caucasian areal type includes 329 species in one class and 2 groups, of which *Callicephalus nitens, Xeranthemum longepapposum, X. cylindraceum, Centaurea behen, Achillea tenuifolia* species are more common. Cosmopolitan areal type is represented by only 41 species - *Cerastium glomeratum* Thuill., *Triglochin palustre* L., *Botrychium lunaria* (L.) Sw., *Ophioglossum vulgatum* L., *Poa palustris* L., *P. caucasica* Trin., *P. annua* L., *Sonchus oleraceus* L., *Veronica biloba* Schreb., *Lemna minor* L., *L. trisulea* L., etc.

The species *Sisymbrium altissimum* belonging to steppe areal type of the region is included in Pontic-Sarmatian group, *Stipa lessingiana* species to Pannon-Sarmatian, *Phlomis pungens* species to Eastern Mediterranean–Pontic transition group, *Eremopyrum triticeum, Catabrosella humilis, Ceratocarpus arenarius, Atriplex cana* species to Sarmatian main group.

In the boreal areal type, which takes the second place by the number of species, the main place is occupied by Palearctic with 142 species and European areal elements with 176 species. In the flora of the region, the Holarctic is represented by 87 species, and the Western Palearctic by 65 species.

Thus, the vegetation of the Shahdag area was formed due to the Western Asia, the Mediterranean Sea, Irano, Turanian xerophilic elements, on the one hand, and Palearctic, European, Holarctic boreal elements on the other hand. Local oborogenic species with Atropathan and Caucasian elements also play an important role in the formation of the area's flora.

Endemic and relict plants belonging to various floristic elements are found in the composition of

Status	Species	Areal
Endemics	*Astragalus kubensis* Grossh.	GC
	Erodium schemachense Grossh.	GC
	Euphrasia karjaginii Kem. - Nath.	GC
	Rosa azerbaidzhanica Novopokr. et Rzazade	GC, LC, Nakh.AR
	Rosa abutalybovii Gadzhieva	GC
	Seseli cuneifolium Bieb.	GC
	Silene caespitosa Stev.	GC
Subendemics	*Allium saxatile* Bieb.	Caucasus
	A. szovitsii Regel	Caucasus, Iran, Turkey
	Angelica sachokiana (Karjag.) M. Pimen.et V. Tichomirov	Caucasus
	Anthemis fruticulose Bieb.	Caucasus
	Alchemilla amicta Juz.	Caucasus
	Asperula hirsutiuscula Pobed.	Caucasus
	Astragalus biebersteinii Bunge	Caucasus
	Astragalus eugenii Grossh.	Caucasus
	A. humilis subsp. *thedodori* (Grossh.) Hashim.	Caucasus
	A. caspicus Bieb.	Caucasus
	A. cuscutae Bunge	Caucasus
	A. onobrychioides Bieb.	Caucasus
	A. denudatus Stev.	Caucasus
	A. macrocephalus Willd.	Caucasus
	A. polyphyllus Bunge.	Caucasus
	A. sanguinolentus Bieb.	Caucasus
	Campanula meyeriana Rupr.	Caucasus
	C. stevenii Bieb.	Caucasus
	C. caucasica Bieb.	Caucasus
	C. ciliata Stev.	Caucasus
	Carex caucasica Stev.	Caucasus
	Carex phyllostachys C.A. Mey.	Caucasus
	*C. acrifolia*V.Krecz.	Caucasus
	Cirsium macrocephalum C.A. Mey.	Caucasus, Iran, Turkey
	C. szovitsii (C. Koch.) Boiss.	Caucasus, Iran, Turkey
	C. strigosum (Bieb.) Fisch.	Caucasus, Iran, Turkey
	C. lappaceum (Bieb.) Fisch.	Caucasus
	Cladochaeta candidissima (Bieb.) DC.	Caucasus
	Cousinia macrocephala C.A. Mey.	Caucasus
	Centaurea kobstanica Tzvel.	Caucasus
	Hypericum theodorii Woronow	Caucasus, Iran, Turkey
	Beta macrorrhiza Stev.	Caucasus
	Betonica nivea Stev.	Caucasus
	Delphinium tomentellum N. Busch	Caucasus
	Draba mollissima Stev.	Caucasus
	D. incompta Stev.	Caucasus, Iran, Turkey
	Dracocephalum botryoides Stev.	Caucasus, Iran, Turkey
	Haplophyllum villosum (Bieb.) G. Don fil.	Caucasus, Iran, Turkey
	Hedera pastuchowii Woron.	Caucasus
	Erodium fumaroides Stev.	Caucasus
	*Kemulariella rosea (*Stev. ex Bieb.*)* Tamamsch.	Caucasus
	İsatis latisiliqua Stev.	Caucasus, Iran, Turkey
	Iris lycotis Woronow	Caucasus
	Gypsophila capitata Bieb.	Caucasus
	G. szovitsii Fisch. et C.A. Mey. ex Fenzl	Caucasus, Iran, Turkey
	Gagea alexeenkoana Micz.	Caucasus

Subendemics	*Galium brachyphyllum* Roem. et Schult.	Caucasus, Iran, Turkey
	Quercus macranthera Fisch. et C.A. Mey. ex Hohen.	Caucasus
	Malabaila sulcata Boiss.	Caucasus
	Merendera eichleri (Regel) Boiss.	Caucasus
	Medicago caucasica Vass.	Caucasus
	M. glutinosa Bieb.	Caucasus
	Nonea alpestris (Stev.) G. Don. f.	Caucasus, Iran
	Nepeta supina Stev.	Caucasus
	N. cyanea Stev.	Caucasus, Turkey
	Ornithogalum sintenisii Freyn	Caucasus
	Onosma levinii T.N. Pop.	Caucasus, Turkey
	Pimpinella aromatica Bieb.	Caucasus, Iran
	Poa meyeri Trin. ex Roshev.	Caucasus
	Pseudovesicaria digitata (C.A.Mey.) Rupr.	Caucasus, Iran, Turkey
	Pulsatilla albana (Stev.) Bercht. et J. Presl.	Caucasus, Turkey
	Ranunculus crassifolius (Rupr.) Grossh.	Caucasus
	Rosa alexeenkoi Crep. ex Juz.	Caucasus
	R. sachokiana P. Jarosch.	Caucasus
	R. sosnowskyi Chrshan.	Caucasus
	R. komarovii Sosn.	Caucasus
	Salix kuznetzowii Laksch. ex Goerz	Caucasus
	Salvia verbascifolia Bieb.	Caucasus
	Saxifraga pseudolaevis Oetting.	Caucasus
	Scutellaria oreophila Grossh.	Caucasus
	Silene caucasica Boiss.	Caucasus
	S. lacera (Stev.) Sims	Caucasus
	Symphyoloma graveolens C.A. Mey.	Caucasus
	Senecio grandidentatus Ledeb.	Caucasus
	S. kubensis Grossh.	Caucasus
	Serratula caucasica Boiss.	Caucasus
	Sedum obtusifolium C.A. Mey.	Caucasus
	S. subulatum (C.A. Mey.) Boiss.	Caucasus
	S. stevenianum Rouy et Camus	Caucasus, Iran
	Stemmacantha pulchra (Fisch. et C.A. Mey.) Dittrich	Caucasus, Turkey
	Sorbus caucasica Zinserl.	Caucasus
	Scrophularia variegate Bieb.	Caucasus
	Stachys pauli Grossh.	Caucasus
	Trigonocaryum involucratum (Stev.) Kusn.	Caucasus
	Tanasetum meyerianum Sosn. (*Pyrethrum meyerianum* Sosn.)	Caucasus
	Valerianella amblyotis Fisch. et C.A. Mey.	Caucasus, Iran
	Valeriana cardamines Bieb.	Caucasus
	Veronica peduncularis Bieb.	Caucasus,Iran
	V. petraea (Bieb.) Stev.	Caucasus
	V. minuta C.A.Mey.	Caucasus
	Vicia loiseleurii (Bieb.) Litv.	Caucasus, Iran
	Vavilovia formosa (Stev.) Fed.	Caucasus, Iran, Turkey

Table 2. Endemic and subendemic species of flora of Shahdag NP.

vegetation of Shahdag area. Previously, there was information about the existence of 277 species of endemic plants in the flora of the territory (Flora of Azerbaijan, 1950-1961), of which 252 species (91%) are endemic to the Caucasus, and 25 species endemic to Azerbaijan. This makes up 17.28% of the area's flora.

Endemism can be characterized by a relatively small area. Among the endemics of Azerbaijan, elements of the Caucasian group dominate with 9

species, elements of Palearctic, Iranian-Turanian, Atropatan and Mediterranean with 2 species each, elements of adventive, Armenian, Holarctic, Asia Minor, Pontic, Caucasus-Central Asia, North Iranian are very few (1 species each), and the range of one species is unknown. They are mainly distributed in the forest, forest edge cenoses, subalpine, alpine and subnival zones of Shahdag NP. Caucasian endemics are distributed on the Caucasus, Western Asia, Asia Minor, Palearctic, Atropathan, Irano, Mediterranean, and European elements.

The analysis of recent studies towards the analysis of the flora of Azerbaijan and neighboring countries shows that some species mentioned in the flora of Azerbaijan have already been brought to the subendemic level. These subendemics are also considered Caucasian endemics and are species described for the first time from Azerbaijan (Table 2).

Since some of the sub-endemic species distributed in the Shahdag area have a wide range, their status should be upgraded: *Veronika cristagalli* Stev., *Thesium procumbens* C.A. Mey., *Podospermum canum* C.A. Mey., *Gentianella umbellata* (Bieb.) Holub, *Euphorbia iberica* Boiss., *Cousinia cynaroides* (Bieb.) C.A. Mey., *Cirsium rhizocephalum* C.A. Mey., *Carex caucasica* Stev. and *Cachrys microcarpa* Bieb.

Based on the study of literature sources and our own research, it was determined that 7 species of Azerbaijani endemic and 88 subendemic species are distributed in the territory of Shahdag NP, of which 69 are described only from the Caucasus and are considered endemic to the Caucasus, while others are distributed as far as the borders of Türkiye and Iran (Figs. 1-6).

Relict species are plants preserved in a limited area belonging to the Tertiary and Quarternary periods. In terms of determining the development history of the area flora, the analysis of the relict species and their distribution on different geographical elements was carried out. It was determined that there are 24 relict species in Shahdag flora. In the area, relict species *Mespilus germanica* L., *Parietaria elliptica* C. Koch, *Datisca cannabina* L., *Viola sicheana* W. Beck., *Platanus orientalis* L., *Juglans regia* L., *Rumex scutatus* L., *Kraschenninikovia ceratoides* (L.) Gueldents., *Chenopodium foliosum* Aschers., *Phelipanche purpurea* (Jacq.) Sojak, *Juncus effusus* L., *Thymus nummularius* Bieb., *Rhynchocorys elephas* (L.) Griseb, etc. are found in the composition of various botanical groupings. In general, endemic and relict species in the vegetation of Shahdag area are distributed mainly in meadow vegetation, floodplain and watery meadows, sedge-grass-legume-forb alpine meadows, scree vegetation and shrubby forb vegetation.

There are also some species in the area that have a very narrow range and are in danger of disappearing. Assessment of rare plants according to criteria can be done according to the smallest taxonomic unit. At this time, taking into account the geographic or political area, the condition of populations should be assessed based on the distribution range of the assessed taxon in the wild flora. Each taxon should be assessed against all criteria and assigned an appropriate level of threat. In general, assessment on criteria should be carried out not only by personal expeditions, but also by matching existing scientific materials, clarifying flora and consulting with other specialists. Thus, during the floristic research conducted in the area, the ranges and bioecological characteristics of rare and endangered species were determined, taxa that are few in number, narrowing in ranges and facing the threat of extinction were selected, as well as herbarium materials were collected from different areas of the territory.

In general, 14 species were evaluated as vulnerable (VU), 10 species as Near Threatened (NT), and 5 species as endangered (EN) in the Shahdag area.

The species with special status from the II edition of the Red Book (2013), such as *Dactylorhiza flavescens* (C. Koch) Holub, *Limodorum abortivum* (L.) Sw., *Orchis ustulata* L., *Gladiolus imbricatus* L., *Colchicum speciosum* Stev., *Primula algida* Adams., *Alcea kusariensis* (İljin) İljin, are not included in the III edition of the Red Book (2023), as they are widespread in other area. Currently, the following species in the Shahdag NP have the status of rarity not only in the NP, but also in the biodiversity of Azerbaijan as a whole.

Thus, 23 species identified as rare or endangered in the area under study were evaluated in 3 categories according to IUCN criteria and sub-criteria (Table 3).

Figures 1–6. Endemic and subendemic species of Shahdag National Park (Azerbaijan). Fig. 1: *Angelica sachokiana* (Karjag.) M. Pimen. et V. Tichomirov. Fig. 2: *Astragalus humilis* subsp. *thedodori* (Grossh.) Hashim. Fig. 3. *Campanula meyeriana* Rupr. Fig. 4: *Cirsium macrocephalum* C.A. Mey. Fig. 5: *Betonica nivea* Stev. Fig. 6: *Pseudovesicaria digitata* (C.A. Mey.) Rupr.

Species	IUCN	IUCN	Limiting factors
Woodsia alpina (Bolt) S.F. Gray	NT	In small numbers, in limited areas	Rare species. Anthropogenic factors, sensitivity to environmental factors, very limited range.
Juniperus foetidissima Willd.	NT	Wide distribution areas that are more susceptible to adverse effects.	Rare species. Cattle grazing, fires, unsystematic felling, weak natural regeneration.
Gagea glacialis C. Koch	NT	In small number	Rare species. Decorative plant. In danger of decreasing under the influence of anthropogenic and zoogenic factors.
Herminium monorchis (L.) R. Br.	VU D2	In small number in the only distribution area (Shahdag).	Rare species. Climate change, grazing and trampling.
Himantoglossum formosum (Stev.) C. Koch	EN A2acd+3bc; C1	They are few in number and are in danger of disappearing completely.	Rare, relict species and endemic to the Caucasus. Grazing, trampling and being demanding to a special habitat.
Crocus adami J. Gay	VU B1ab (iii,iv) + 2ab(iii)	A continuous decrease is observed.	Rare species. Decorative plant. Anthropogenic factors, being demanding to a special habitat.
Crocus speciosus Bieb.	VU B1ab(iii) + 2ab(iii)	Decrease of fragmented area quality.	Rare species. Gathering as a decorative, spicy and medicinal plant.
İris caucasica Stev.	NT	Intensive gathering.	Rare species. Decorative plant. Endemic to the Caucasus. The main limiting factor is anthropogenic influence.
Galanthus caucasicus (Baker) Grossh.	EN B1ab (i,ii,v)c(i,ii,iii) + 2b(i)c	It does not create population.	Rare species. Decorative plant. Endemic to the Caucasus. Gathering as decorative plants, mowing of grass, grazing of cattle.
Aquilegia olympica Boiss.	NT	The population tends to decline.	Rare species. Gathering by the population as an ornamental plant, trampling, grazing and sensitivity to climatic factors
Ranunculus arachnoideus C.A. Mey	VU A2c+3c	Natural reserves are low.	Rare species. Sensitive to environmental factors, short vegetative period, and weak self-regeneration.
Corydalis alpestris C.A. Mey	VU D2	Dependence on anthropogenic influences is observed	Rare species. Anthropogenic factors and climate changes.
Dianthus ruprechtii Schischk	VU D2	The population is small.	Rare species. Endemic to the Caucasus. Habitat is limited, anthropogenic factors, grazing, trampling and mowing.
Gypsophila capitata Bieb.	EN B1ab (iii) + 2ab(iii)	The number of individuals decreases, the distribution area is limited.	Rare species. Endemic to the Caucasus. Climate and anthropogenic factors have caused habitat degradation.
Betula raddeana Trautv.	VU C2a(ii)	A decreasing trend is observed in the population.	Rare species. Endemic to the Caucasus. Decorative plant. Anthropogenic and natural factors are the main limiting factors.

Saxifraga exsarata Vill.	EN B2 ab(i,ii,iii,iv)	Range is narrowing	Rare species. Habitat degradation, weak population regeneration and anthropogenic factors.
Rosa azerbaidzhanica Novop. et Rzazade	EN B2ab (ii,iii, iv,v)	The habitat is limited, it is completely endangered.	Azerbaijan endemic and rare species. Collection of its flowers and fruits by the population as a medicinal plant.
Astragalus kubensis Grossh.	VU D2	Population decline has accelerated.	Azerbaijan endemic and rare species. The number has decreased due to anthropogenic effects and soil erosion.
Parnassia palustris L.	NT	It tends to decrease.	Rare species. Anthropogenic factors and sensitivity to climatic factors.
Carum caucasicum (Bieb.) Boiss.	NT	It has small populations in limited areas.	Rare species. Sensitivity to adverse climate is observed.
Symphyoloma graveolens C.A.Mey.	NT	The dependence of natural regeneration on the negative effects of climate is observed.	Rare species. Endemic to the Caucasus. Sensitivity to environmental factors, grazing and degradation of distribution areas.
Cladochaeta candidissima (Bieb.)	VU A2c+3c; B1ab(i,iii,iv)	Anthropogenic factors have caused rapid population decline.	Rare species. Endemic to the Caucasus. Spontaneous grazing, medicinal plant, distribution mainly in the flood river beds.
Cynoglossum holosericeum Stev.	VU A2c + 3c	Distributed in limited areas, the population is decreasing due to the influence of changing climate.	Rare species. Endemic to the Caucasus. Medicinal plant. Small number and presence of their ranges in areas with extreme climatic conditions.
Trigonocaryum involucratum (Stev.) Kusn.	VU A2c + 3c	Weak natural regeneration of populations.	Rare species. Anthropogenic factors, floods, and strong erosion processes.
Scrophularia minima Bieb.	NT	Their population is found in small numbers.	Rare species. Endemic to the Caucasus. Anthropogenic factors, distribution in extreme climatic conditions, sensitivity to acute climate change
Veronica minuta C.A. Mey.	NT	Natural recovery in their populations is weak.	Rare species. Endemic to the Caucasus. Since it has a short vegetative period, self-regeneration is weak.
Cetraria islandica (L.) Ach. (= *Lichen islandicus* L.)	VU A2c +3c	Number is small, the amount and range are about to be exhausted.	Rare species. Used as a medicinal plant in folk medicine since ancient times. Anthropogenic factors (intensive grazing and trampling) and use of mountain meadows.
Usnea florida (L.) F.M. Wigg.	VU D2	Their population is decreasing.	Rare species. It is used as a medicinal plant in folk medicine and medicine. Anthropogenic factors and climatic effects may threaten the extinction of the species.
Lobaria pulmonaria (L.) Hoffm.	VU D2	Their population is decreasing.	Rare species. Medicinal plant. Anthropogenic factors and climatic effects may threaten the extinction of the species.

Table 3. Regional assessment of rare and endangered species of Shahdag area according to IUCN criteria.

There are also some species that are considered rare for Shahdag NP but relatively widespread in other areas: *Aconitum nasutum* Fisch. ex Reichenb., *Pulsatilla albana* (Stev.) Bercht. et Persl., *Pterocarya fraxinifolia* (Poir) Spach. (= *P. pterocarpa* (Michx.) Kunth. ex İljinsk), *Pyrola rotundifolia* L., *Primula ruprechtii* Kusn., *Viola caucasica* Kolen., *Salix kuznetzowii* Laksch. ex Goerz, *Alchemilla grossheimii* Juz., *Pyracantha coccinea* M.Roem. *Asyneuma campanuloides* (Bieb. ex Sims.) Bornm., *Pyrethrum carneum* Bieb., *Atropa bella-donna* L. (= *A. caucasica* Kreyer). Care should be taken to protect these species as well.

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