



TAXONOMIC COMPOSITION OF RARE WOODY PLANTS DISTRIBUTED IN THE FLORA OF THE REPUBLIC OF AZERBAIJAN, THEIR CURRENT STATUS AND CONSERVATION MEASURES

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Abstract: Among the plant regions of the world, Azerbaijan stands out for the richness and diversity of its flora. Flowering plants native to the republic account for 70% of the higher plant species in the Caucasus region. However, in terms of land area, Azerbaijan covers only 16% of the entire Caucasus region. This rich flora can be explained by the diverse historical, natural, and geographical conditions of the Republic. The flora of Azerbaijan contains a large number of useful plants. More than 1,500 species of flowering plants native to Azerbaijan can be used in various sectors of the country's economy. The main goal is to effectively use this valuable natural resource and pass it on to future generations. Currently, with the accession of the Republic of Azerbaijan to the Convention on Biological Diversity, the Republic's flora is attracting the attention of researchers worldwide. Extensive projects and research are planned in this area. The article discusses the taxonomic composition of rare tree species distributed in the territory of the Republic, their current status, and the importance of conservation measures. The study also assessed the effects of conservation measures on the number of rare tree species. The study mainly notes the current status of 37 species of rare tree species included in the Angiosperms department, which are included in the "Red Book" of the Republic of Azerbaijan published in 2013, their taxonomy, and special conservation measures. As a result, rare tree species found in the territory of the Republic of Azerbaijan have been identified. The current status of these species has been analyzed based on the "Red Book" of the Republic of Azerbaijan. Finally, the positive effects of conservation measures and specially protected state territories on the current status of rare species have been identified.

Keywords: Red Book, Demiraghac, national park, sanctuary, nature reserve, conservation measures, endangered, rare species.

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Introduction

According to various studies, Azerbaijan currently has a large number of rare and endangered plant species in nature. Official measures are being taken to protect

and reproduce these plants. These measures include the creation of protected areas, the designation of nature reserves, and the establishment of national parks. One of the

most important measures is the creation of the Red Book of Azerbaijan. Published in 1989, this book lists 140 endangered plant species. It should be noted that the "National Strategy and Action Plan for the Conservation and Sustainable Use of Biodiversity in the Republic of Azerbaijan" was adopted by the Decree of the President of the Republic of Azerbaijan dated March 24, 2006, and Article 1.1.3 of the decree provided for the publication of the second edition of the Red Book in 2009. According to current information, 338 rare and endangered plant species are listed in Volume 2 of the Red Book. The latest edition of the Red Book was published in 2013. The book lists 460 plant species, including 383 higher plants, 15 spore plants, 6 mosses, 14 sphagnum mosses, and 5 algae. It also includes 37 fungal species ([The Red Book of the Republic of Azerbaijan, 2013](#)). According to the Red Book, there are 37 rare and endangered tree species in the angiosperms section.

In the study, belonging to the Angiosperms (Magnoliophyta) clade: oriental plane (*Platanus orientalis* L.), boxwoods (*Buxus colchica* Pojark., *B. hyrcana* Pojark, *B. sempervirens* L.), sweet chestnut (*Castanea sativa* Mill.), chestnut-leaved oak (*Quercus castaneifolia* C.A.Mey.), Aleppo oak (*Q. infectoria* Olivier), downy oak (*Q. pubescens* Willd.), birch (*Betula raddeana* Trautv), Caucasian alder (*Alnus subcordata* C.A.Mey.), hornbeam (*Carpinus schuschaensis* H.J.P. Winkl.), Hirkan poplar (*Populus hyrcana* Grossh.), Turan poplar (*P.euphratica* Olivier), Persian ironwood (*Parrotia persica* (DC.) CAMEy.), *Zelkova carpinifolia* (Pall.) Dippel, Caucasian hackberry (*Celtis caucasica* Willd.), Hyrcan fig (*Ficus carica* L.), mountain-ash (*Sorbus persica* Hedl., *S. roopiana* Bordz., *S. subfusca* Boiss.), pears (*Pyrus boissieriana* Buhse, *P. eldarica* Grossh., *P. georgica* Kuthath., *P.*

grossheimii Fed., *P. hyrcana* Fed., *P. medvedevil* Rubtz., *P. addeana* Woronow, *P. salicifolia* Balb., *P. voronovii* Rubtz., *P. vsevolodii* Heideman), thornapples (*Crataegus pontica* C.Koch.), cherry (*Prunus nachichevanica* Kudr., *Pprunus padus* L.), pomegranate (*Punica granatum* L.), Persian silk tree (*Albizia julibrissin* Durazz), Caucasian bladdernut (*Staphylea colchica* Steven), pistachio tree (*Pistacia atlantica* Desf.), holly tree (*Ilex hyrcana* Pojark.), and Gymnosperms (Pinophyta) clade includes foetid juniper (*Juniperus foetidissima* Willd.) and yew (*Taxus baccata* L.) trees ([The Red Book of the Republic of Azerbaijan, 2013](#)).

Information about trees common in the flora of the Republic of Azerbaijan

Trees are woody, evergreen plants with erect trunks and branches. The diversity of their size and appearance makes it difficult to define the morphology of this plant complex precisely. The term "tree" is sometimes used to describe the gradual development of the trunk into thinner branches or the presence of leaves. However, some perennial herbaceous plants, such as palms, do not branch, and giant cacti have lateral branches on their trunks, but they do not form an umbrella-shaped canopy. Some authors state that the minimum height of woody plants is generally 2–6 m. These figures may refer to all trees or to shrubs growing only in high mountains or certain Arctic regions; these plants are simply called "trees". Under suitable conditions, these plants have straight, slender trunks. Some species can reach a height of more than a few centimeters, but in other respects resemble trees. All mature trees naturally grow from seeds or small vegetative buds ([Təhməzov et al. 2004](#)).

The geographical structure and location of Azerbaijan, its unique geological history and rich natural environment have



led to the creation of numerous magnificent natural heritage sites. With approximately 3,000 natural heritage sites, the territory of this republic reflects almost all genetic and morphological diversity in the fields of biology, paleontology, geology, geomorphology, petrology, hydrology and landscape. According to experts, plant species found in Azerbaijan constitute 64% of the flora of the Caucasus region, 24% of the flora of the former Soviet Union and 11% of the world flora. Endemic and rare flora and fauna, paleontological flora and fauna museums (Binagadi, Eldar and Pila-Kashkur fauna), lakes, springs, waterfalls (Astara, Afurka and Iris), glaciers, natural landscapes and geological and geomorphological heritage make up our republic. The area is rich in relief monuments, including deposits, ores, rock formations, columnar basalt columns, lava flows, Rocky Mountains eruption domes, volcanic cones, craters and calderas, rocky mountains and mountain ranges (Besbarmag, Ilanridag, Goyazan, Khachagaya), avalanches, landslides, layered fractures, structural formations, ophiolite zones, protocave and depression valleys, caves and karst topography (shell karst, pseudokarst), exotic pyramids and wind sculptures formed in rocks and on the ground. In this context, Goyazan Mountain, Duzdag layered junction, Naftalan oil field, Eldar pine forest, ironwood forest and Basicay plain forests are particularly important (Məmmədov 2011; Shahin 2013).

Clade: Angiosperms

Family: Platanaceae

Species: *Platanus orientalis* L.
(Oriental plane)

International Assessment (according to IUCN Categories and Criteria): **DD**

National Assessment (according to IUCN Categories and Criteria): **VU A2c+3c**

Description: It is a deciduous tree with a rounded crown, 25–35 m tall (maximum 50 m) and a crown diameter of 1.5–3(–5) m. The leaves are simple, alternate, dense or papery, rounded or elliptical, with 3–5(–7) finger-like lobes. The fruit is a seed. Flowering occurs in April-May, and the fruit ripens in September-October (**Figure 1**). It grows naturally near water. It prefers hot summers but can be cultivated in most temperate regions. It is a very large and broad tree, with large, thick leaves that spread horizontally, making it particularly valuable for providing shade and coolness in hot seasons. It grows well in sunny locations. It grows well in nutrient-rich soil and is drought-resistant ([Missouri Botanical Garden](#)). It is also resistant to urban air pollution. Human activities such as grazing and logging are limiting factors.

Distribution: It was previously protected in the Basitchay National Nature Reserve, but private protection and inclusion in botanical gardens inside and outside the reserve are recommended ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 1. Oriental plane (*Platanus orientalis* L.).

Family: Fagaceae

Species: *Castanea sativa* Mill.
(chestnut)

International Assessment (according to IUCN categories and criteria): **LC**

National Assessment (according to IUCN categories and criteria): **VU A2c+3cd**

Description: This tree can reach a height of 38 m. The mature leaves are glabrous, green on the upper surface, star-shaped on the lower surface, with light green hairy and toothed edges. The male flowers bloom in yellow, spiny clusters. The fruit is a chestnut-like nut with a chestnut-colored shell, long, sharp spiny edges, and a single seed ([The Red Book of the Republic of Azerbaijan, 2013](#)). The average lifespan of a chestnut tree is 500–600 years. When cultivated, it can live for over 1,000 years ([Barstow & Khela 2018](#)). Flowering occurs

in June-July, and fruiting occurs in October-November. This species grows in rocky areas, stony slopes, and dry, sparsely wooded pastures in mid- and high-mountainous regions. It grows well on fertile soils in temperate climates (**Figure 2**). Human influences are limiting factors in its growth. Since wood is a valuable raw material for the furniture industry, wood decay is one of the factors limiting its growth. The presence of pathogens that cause diseases also limits its growth ([Hahn 2024](#)).

Distribution: This species is protected in the Zagatala National Nature Reserve and the Ilisu National Nature Reserve. Additional protection is needed in areas where it is more widely distributed ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 2. Chestnut (*Castanea sativa* Mill.).

Family: Salicaceae

Species: *Populus euphratica* Oliv.
(Turan poplar)

International assessment (according to IUCN categories and criteria): **LC**

National assessment (according to IUCN categories and criteria): **EN B2b(ii, iii)c(v)**

Description: The leaves are leathery, glabrous, blue-gray, lighter on the underside, wedge-shaped at the base, and the stems are 1–2.5 cm long. The fruit is glabrous and forms on a 3–6 mm long stem (**Figure 3**). Flowering and fruiting occur in June. It is usually found in low mountainous areas and along riverbanks ([The Red Book of the Republic of Azerbaijan, 2013](#)). In river basins of arid and semi-desert regions, Tugay is an important component of the alluvial plain ecosystem, forming dense thickets mixed with willow, fir, and mulberry trees. This species thrives in saline soil and brackish water and is resistant to

seasonal flooding. Once widely used as firewood, this forest has largely disappeared or been fragmented throughout its natural range ([Coombes 2012](#)).

Distribution: It is distributed in the mountainous regions of the Nakhchivan Autonomous Republic (Ordubad district, Gilanchay river basin; Julfa district, Alinjachay river basin and Araz river basin), in the coastal plain of the Caspian Sea (Khizi district, Dizarvachay river basin; Siyazan district, Gilgilchay river basin), in the Bozdag mountain plateau and in the southern mountains of the Lesser Caucasus (Zangilan district, Bartaz mountain). Natural, zoological and anthropogenic factors (agricultural and industrial development in the habitat, use of firewood, etc.) limit its population. The habitat is partially protected in the Ordubad National Nature Reserve and is the subject of conservation efforts ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 3. Turan poplar (*Populus euphratica* Oliv.).

Family: Hamamelidaceae

Species: *Parrotia persica* (DC.)
C.A.Mey. (Persian ironwood)

International classification based on IUCN categories and criteria: **None**

National classification based on IUCN categories and criteria: **NT**

Description: This species is a branched tree, reaching a height of 16–22(–25) m. The leaves are 4–10(–13) cm long and 3 cm wide, leathery or papery, alternate and lobed with 3–6 oval, obovate or elliptical lobes. The fruit is round to oval. The seeds are pointed, light brown and shiny (**Figure 4**). The species was named by Karl Anton von Meyer in honor of Georg Friedrich Parrott, a German naturalist and founder of Dolpat College, who studied botany in the Alborz Mountains during a mountaineering expedition in the 1830s ([San Miguel Ayanz 2016](#)). The flowering period is between February and March and the fruit

ripens between August and November. It reproduces by seeds and cuttings. It grows on heavy clay, yellowish silty soils or soils that form podzol. It is widespread in plains, hills and low mountains.

Distribution: It grows wild in the mountainous areas of the Lankaran region (Tangivan village, Khanbulanchay reservoir), in the Lankaran plains (Burjali village in Lankaran region, Mashkhan village in Astara region, Imanli village in Masalli region, Vilashchay valley) and in the Alazan Ayrichay valley (Chukhurgabala village in Gabala region). Human activities such as deforestation limit its spread. It is protected in Hirkan National Park. Some are also planted in Samur-Yarama National Park and the Central Botanical Garden. A protected area has been proposed within the Central Botanical Garden ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 4. Ironwood (*Parrotia persica* (DC.) C.A.Mey.).

Family: Rosaceae

Species: *Pyrus eldarica* Grossh.
(Eldar pear)

International Assessment (according to IUCN Categories and Criteria): **None**

National Assessment (according to IUCN Categories and Criteria): **CR A2abc+C1**

Description: It is a shrub or tree up to 1 m tall with densely branched umbel-shaped flower clusters. The opposite oblong-lanceolate leaves are 2–3.5 cm long and 0.8–1.3 cm wide. The leaves have fine, finely hairy or glabrous surfaces and sparsely hairy undersides. They are light green (**Figure 5**). The flowering period is April. The fruits ripen in August-September. Reproduction

occurs by seeds and shoots. It usually grows on dry, rocky slopes among sparse bushes, at altitudes of 300–600 m, along with Eldar pine and juniper trees.

Distribution: It is widespread in the pasture areas of the Bozdag massif (Samukh district, Eldar Oyun mountains and the right bank basin of the Gabri river). Its growth is limited by natural factors (its fruits are eaten by wild animals and birds). It is included in the Red List of the Azerbaijan SSR and is protected in the Eldar Shamy National Nature Reserve. It is recommended to promote natural regeneration and implement individual protection measures for trees growing outside the reserve ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 5. Eldar pear (*Pyrus eldarica* Grossh.).

Family: Rosaceae

Species: *Prunus padus* L. (Wild cherry)

International classification (according to IUCN categories and criteria): **LC**

National classification (according to IUCN categories and criteria): **EN B2b (ii, iii, v)**

Description: A tree or shrub, 2–5(–10) m tall, with a grayish black trunk and branches. The leaves are 4–12 cm long and 2–6 cm wide, oval-lanceolate, elliptical or obovate in shape. The upper surface is wrinkled and dark green, the lower surface is glabrous or hairy. The fruits are spherical, black, 5–7 mm in diameter. The seeds are oval (**Figure 6**). The flowering period is May–June, and the fruiting period is August–September. It grows on riverbanks, in forests and thickets, and is widely distributed from plains to mountain slopes ([The Red Book of the Republic of Azerbaijan, 2013](#)).

Distribution: It is native to Northern

Europe, Northern Asia and Northeast Asia, and is cultivated as an ornamental plant in North America, and is distributed in the Eastern Greater Caucasus Mountains (Gal Eybugud and Chukhuryurd villages in Shamakhi region, Talistan village and Garanohur Lake basin in Ismayilli region), in the Northern Lesser Caucasus Mountains (Goygol National Park), in the Central Lesser Caucasus Mountains and in the Guba region of the Greater Caucasus Mountains (Geray and Susay villages in Guba region). Their distribution is limited by human activities such as forest fires and deforestation, as well as the impact of the natural environment. There are currently no specific conservation measures. Area management, regular monitoring, and seed collection are recommended ([The Red Book of the Republic of Azerbaijan, 2013](#)).

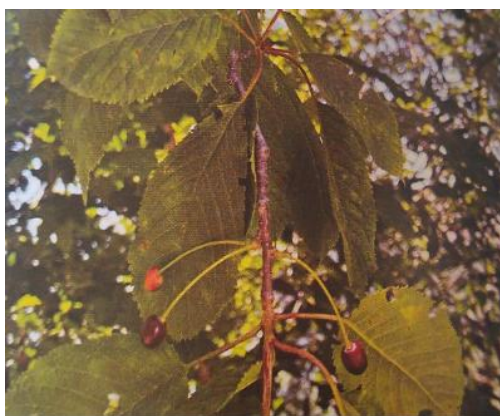


Figure 6. Wild cherry (*Prunus padus* L.).

Family: Lythraceae

Species: *Punica granatum* L. (pomegranate)

International assessment according to IUCN categories and criteria: **LC**

National assessment according to IUCN categories and criteria: **VU Blab (i, ii, iii)**

Description: It is a shrub or small tree, reaching a height of 1.5–5 m. Its leaves

are opposite or in groups, oblong or oblong-lanceolate, with a blunt or pointed tip, and leathery (**Figure 7**). The fruit is large and spherical, bright red or yellow in color. It contains numerous seeds and has a leathery surface ([The Red Book of the Republic of Azerbaijan, 2013](#)). The flowering period is June–July, and the fruiting period is October. It grows on dry slopes, river basins, and mountain slopes. Pomegranates are drought-



resistant and prefer sunny locations. Intermittent irrigation during the summer months can increase yield. In areas with high rainfall, they are susceptible to fungal root rot (Orwa et al. 2009).

Distribution: It is distributed in the Lankaran plains, Samur-Devachi and Kur-Araz lowlands, Mughan plain (Lankaran district), throughout the Greater and Lesser Caucasus mountains, the Gobustan region, the Kur plain, and the plains of the

Nakhchivan Autonomous Republic. Its distribution is limited by human factors (deforestation, intensive grazing, land use for agricultural and other purposes, and urbanization) and natural factors (sensitivity to the negative effects of climate change). It is protected in the Turyanchay National Nature Reserve. It has been proposed to conserve the population in situ (The Red Book of the Republic of Azerbaijan, 2013).



Figure 7. Pomegranate (*Punica granatum* L.)

Family: Anacardiaceae

Species: *Pistacia atlantica* Desf. (pistachio tree)

International Assessment (according to IUCN Categories and Criteria): **NT**

National Assessment (according to IUCN Categories and Criteria): **NT**

Description: This plant has a spherical or umbrella shape, reaching a height of 15 m. The leaves are compound, single-petiolate, aromatic, oval, sessile, with a blunt or slightly pointed tip, entire margins, shiny dark green upper surface, light green lower surface (Figure 8). The fruit is dry and inverted oval, consisting of green seeds covered with a thick purple-red shell. Flowering occurs in June, and fruit ripening occurs in August-September. It reproduces by seeds and cuttings. It is drought-resistant, prefers sunny places, and

requires special soil conditions.

Distribution: It is distributed in the Guba region of the Greater Caucasus Mountains, in the northern, southern, and central parts of the Lesser Caucasus Mountains, in the lowland and mountainous regions of the Nakhchivan Autonomous Republic, in the Kura-Araz plain and the Caspian Sea coastal plain, in the Kura plain, in the Gobustan region, and in the plateau region of the Bozdag Mountains. Its population has declined significantly due to human activities such as grazing and deforestation. It is protected in the Turyanchay National Nature Reserve. A protected area has also been proposed around the Sultanbud Hills in the Karabakh Plain (The Red Book of the Republic of Azerbaijan, 2013).

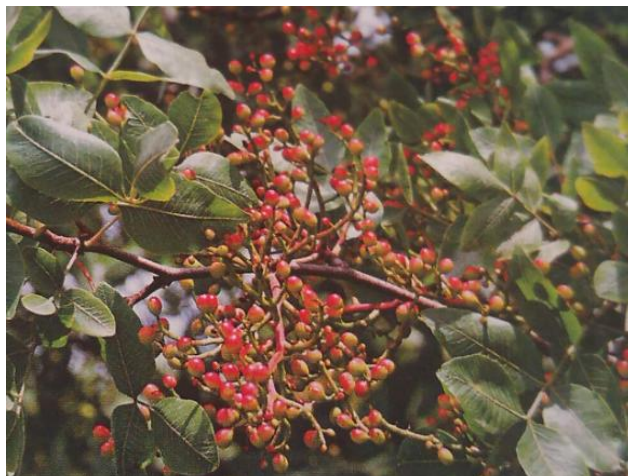


Figure 8. Pistachio tree (*Pistacia atlantica* Desf.).

Clade: Gymnosperms (Pinophyta)

Family: Cupressaceae

Species: *Juniperus foetidissima* Willd. (foetid juniper)

Description: The tree reaches a height of 5–9 m. It is either dioecious or monoecious, with the upper half of its leaves almost completely separated from the trunk. The cones are flattened and borne on short branches; they are large, spherical or oval, dark brown, reddish-black or black with dark blue spots, and 12–20 mm in diameter. When mature, the tips of the scales become almost invisible (**Figure 9**). The light brown, woody seeds contain 1–3, mostly 2 hemispherical or spherical seeds. This plant is heat-, drought-, and frost-resistant and adapts to a variety of soils. It can live for over 300 years. The root system is branched, dividing into numerous branches in the

topsoil. Its roots also extend very deep. The cones ripen between October and December. This plant reproduces by seeds. Its needles and seeds contain volatile oils. Its needles, shoots and seeds contain 5–8% of the inoculant, like those used in heart transplantation, and are useful for this purpose. They also contain 229.7 mg of vitamin C.

Distribution: The tree is widespread in the Crimean Peninsula, the Caucasus, Turkey, Syria, the Balkan Peninsula and the island of Cyprus. In Azerbaijan, it grows in the Lesser Caucasus Mountains, Nakhchivan Mountains, plateaus, plains and mid-altitude mountainous areas, as well as on dry, rocky slopes. It is a rare species included in the Red List of Azerbaijan ([Təhməzov et al. 2004](#)).



Figure 9. Foetid juniper (*Juniperus foetidissima* Willd.).

Family: Taxaceae

Species: *Taxus baccata* L. (yew)

Description: The berry-bearing blackthorn is a very ancient plant, dating back to the Carboniferous and Cretaceous periods. The berry-bearing blackthorn is an evergreen coniferous tree with dense, umbrella-shaped, dark green leaves, used as an ornamental tree or shrub (**Figure 10**). In Azerbaijan, it is also known as "European blackthorn", "eternal tree" or "red tree". It can still be found in some regions of Azerbaijan, but not in large quantities. The needle-shaped leaves are 3–4 cm long and 1.8–2 mm wide. They have a pointed and scaly, sometimes slightly sickle-shaped, dark green upper surface and a light green lower surface. The seeds are 6–8 mm long and 4–5 mm wide. The fruit is red, juicy, oval-shaped, pointed at the tip, and covered with a fibrous layer. The berry-bearing blackthorn is a shade-tolerant shrub that requires high humidity. It is picky about soil type, resistant to smoke, dust, and gas, but sensitive to direct sunlight. It blooms in

April-May, and the fruit ripens in October. It reproduces by seeds, shoots, and cuttings. It is long-lived, sometimes reaching 4000 years.

Distribution: It is found mainly in Europe, Africa, the Far East and the Kuril Islands. In Azerbaijan, blackthorn is widespread in the Ganja, Ismayilli, Shamakhi, Oghuz, Gabala, Sheki, Zagatala, Balaken, Gadabay, Dashkesan, Tovuz, Gusar, Kalbajar, Goygor and Talysh mountains. The coniferous tree is bitter and poisonous due to the presence of toxic glycosides. In traditional medicine, its leaves are used to treat heart diseases. Its wood, which comes in various shades, is used in furniture production, carpentry, and construction materials, especially in submarine and shipbuilding. The greatest advantage of this tree is its slow decomposition. It is on the list of endangered plants and is also included in the Red Book of Azerbaijan (Təhməzov et al. 2004).



Figure 10. Yew (*Taxus baccata* L.).

Specially protected state territories

Below are some examples of specially protected natural areas:

Nature Reserves: The creation of Nature Reserves aims to address some of the most pressing challenges facing the modern world. A Nature Reserve is an area where entire ecosystems are preserved in their natural state. Its main functions are to conserve biodiversity and to create a suitable environment for the study and application of sustainable development approaches at the local level (Mammadov & Khalilov 2005).

National Parks: National parks are a special form of protected area organization aimed at protecting ecosystems and promoting ecotourism. National parks balance the protection of natural, historical, and cultural heritage with the organization of recreational activities. Parks cover relatively large areas and allow the use of ecosystems (Babaşova 2020).

Sanctuaries: Sanctuaries are areas of special importance for the protection, restoration, and maintenance of the ecological balance of natural ecosystems and their components. Sanctuaries can be located on their own territory or on lands belonging to other users (Dolkhanov et al. 2012).

Conclusion

Finally, as a conclusion, we analyzed the number and taxonomic composition of rare and endangered forest plant species in the Republic of Azerbaijan. We also provided information about plant

communities based on viability indicators, population size, and influencing factors.

In this study, 467 tree and shrub species were identified in the flora of Azerbaijan. Of these, 43 rare and endangered woody plant species belonging to 24 families and 36 genera demonstrate ecological adaptation; 31 species are sun-tolerant, 12 species are shade-tolerant, 16 species are high-temperature tolerant, 23 species are moderately heat-tolerant, and 4 species are low-temperature tolerant. Depending on the type of aquatic vegetation, various groups were distinguished, including Mesozoic plants (26 species), arid plants (11 species), mesorax plants (2 species), arid Mesozoic plants (2 species), and marsh plants (2 species).

Conflict of Interest

The author declares that there is no conflict of interest.

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