



FLORISTIC DIVERSITY, DISTRIBUTION AND CONSERVATION OF ENDEMIC PLANT SPECIES IN AZERBAIJAN

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Abstract: The territory of Azerbaijan is distinguished by its rich biodiversity, diverse natural and geographical landscapes, and rare and endemic species of flora and fauna. In order to protect these natural resources, ensure the sustainability of ecosystems, and preserve biological diversity, a system of specially protected natural areas has been formed throughout the country. The article analyzes the stages of development of specially protected natural areas in Azerbaijan, the main goals of the creation of national parks, state nature reserves and state nature sanctuaries, and their role in nature protection. It was noted that the creation of national parks created new opportunities for the protection of biodiversity, protection of rare and relict species, environmental education, scientific research, and development of ecotourism. It has been shown that state nature reserves and sanctuaries are of great importance in the protection and restoration of natural ecosystems and individual flora and fauna components. The study also considered the prospects for measures taken to expand specially protected natural areas, establish biosphere reserves and geological parks, and promote protected areas at the international level. As a result, effective management and scientifically based monitoring of specially protected natural areas have been assessed as one of the main conditions for the long-term protection of Azerbaijan's biological diversity and natural heritage.

Keywords: specially protected natural areas, national parks, state nature reserves, state nature sanctuaries, nature conservation, ecotourism, biosphere reserve.

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Introduction

Plants make up a significant portion of the Earth's surface. It is impossible to imagine the Earth without plants. Because plants are the source of oxygen for all living things - animals, humans, microorganisms, etc. and this oxygen is produced as a result of the process of photosynthesis.

Biodiversity refers to the total variety of life on Earth (plants, animals, fungi, and

microorganisms), as well as the communities they form and the habitats they inhabit. The living things that make up biodiversity are: (1) plants; (2) animals; (3) microorganisms; (4) fungi, and other living things ([Məmmədov 2011](#)). Biological diversity, or biodiversity, is the term given to the variety of life on Earth and the natural patterns it creates. The biodiversity we see

today is the result of billions of years of evolution and is shaped by natural processes and, increasingly, human influence. This forms the web of life of which we are an integral part and upon which we are completely dependent.

This diversity is often understood as a vast array of plants, animals, and microorganisms. Approximately 1.75 million species have been identified so far, most of which are small creatures like insects. Scientists believe that there are

about 13 million species, although estimates range from three million to 100 million.

There are 6 floristic regions on the Earth's surface, based on their origin, type, climatic conditions, etc., and other characteristics: (1) Holarctic; (2) Paleotropics; (3) Neotropics; (4) Australia; (5) Cape; (6) Antarctica. The flora of each region has a common historical origin. Each of these floras contains both endemic and relict plants (**Figure 1**).

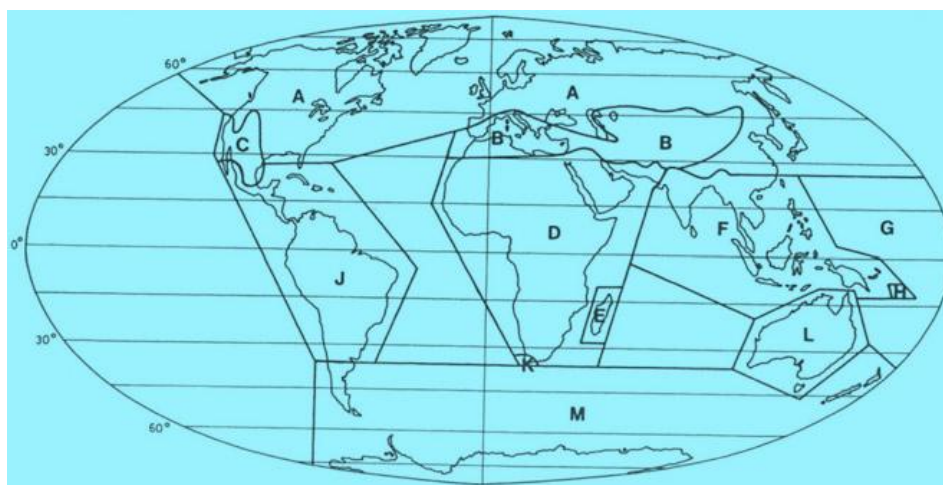


Figure 1. Floristic kingdoms and subkingdoms of the world, after Takhtajan. **A–C:** Holarctic kingdom (**A:** Boreal subkingdom; **B:** Tethyan subkingdom; **C:** Madrean subkingdom); **D–H:** Paleotropical kingdom (**D:** African subkingdom; **E:** Madagascan subkingdom; **F:** Indo-Malaysian subkingdom; **G:** Polynesian subkingdom; **H:** Neocaledonian subkingdom), **J:** Neotropical kingdom; **K:** Cape kingdom; **L:** Australian kingdom; **M:** Antarctic kingdom (Takhtajan 1986).

The Holarctic region is the largest floristic region, encompassing Europe, North America, a large part of Asia, northern Africa, and the Northern Islands. This vast area experiences all climatic conditions except tropical. The same climate during that period led to the emergence of the same type of flora. This floristic region is very rich in plant life. The Holarctic floristic region is divided into subregions such as the Arctic, Europe-Siberia, China-Japan, Caucasus, Mediterranean, North Africa-India, North America, Pacific, etc.

Paleotropical region covers tropical America, subtropical South Africa, southwestern Arabia, India, Indochina, New Zealand, the Philippines, the Malay Archipelago, New Guinea, etc. In terms of area, the Holarctic is second only to the plant world. Despite the highly fragmented terrain, the plant world is very close. Tropical evergreen forests predominate here.

Neotropical regions include Central and South America, the Antilles, and southern Florida. It is called neotropical because it covers the tropical areas of the



New World. The flora of this area is very diverse. Succulent plants, cacti, palms, species of ferns, and milkweeds predominate. It is divided into 3 hemispheres (Central American, tropical, and Andean).

Cape region covers the Cape Province of South Africa. Despite its very small area, it has up to 15,000 plant species, of which up to 3,000 are endemic. It is characteristic that the tree species are somewhat poor. It is very rich in evergreen shrubs and perennial grass species.

Australian floristic area covers Australia and the island of Tasmania. There are up to 10,000 plant species in this area, of which up to 8,000 are endemic plants. Plants from the myrtle, legume, Compositae, and aster families are more widespread. Xerophytic plants are also found in this floristic area. Evergreen, hard-leaved, multi-branched shrubs, mainly consisting of eucalyptus, have formed.

Antarctic floristic region covers the southern part of South America, Tierra del Fuego, and the Antarctic islands. Although the flora is very poor, endemic species make up 75%. The Antarctic islands are mainly inhabited by spore-bearing plants. Of course, just as there are plants in the lithosphere, the water area, i.e., the hydrosphere, also has its own vegetation. Mostly mosses and some flowering plants are common here. Both northern, tropical, and southern aquatic plants are found, each of which has its own unique species and forms.

Relief and distribution of vegetation of the Republic of Azerbaijan

The flora of Azerbaijan also has its own unique biodiversity, and this biodiversity is richer than that of other countries. In general, every region, city, and country has its own unique flora. The territory of the Republic of Azerbaijan is also one of the countries with the richest flora among these countries, with more than

4,500 flowering plant species of various varieties spread here.

In terms of the total number of species, the flora of Azerbaijan is much richer than that of other republics of the South Caucasus. Among these plants, both higher plants and primitive plants are very widespread. The higher plants found in the wild flora of our republic comprise 4,557 species, which constitutes more than 70% of the higher plant species found in the natural flora of the Caucasus as a whole. Although Azerbaijan is approximately 16% of the Caucasus in terms of area. This richness is explained by the diversity of the republic's natural, historical, and physical and geographical conditions. The plant species found in the republic account for 66% of the total number of plant species growing in the Caucasus. Of the 500,000 plant species in the world, 4.3 thousand grow in Azerbaijan. The richness of vegetation in Azerbaijan is primarily due to the diversity of relief and climatic conditions. 370 species of plants are endemic here, meaning they grow only in Azerbaijan. More than 1,500 species of plants found in the Republic of Azerbaijan are used in various fields of the national economy and in the treatment and prevention of various diseases ([The Red Book of Azerbaijan, 2013](#)). To date, 146 endemic higher plant species in 28 families and 75 genera, and 402 subendemic higher plant species in 53 families and 191 genera have been identified in the republic. This constitutes approximately 12% of the republic's flora. The natural dendroflora of Azerbaijan includes 435 species of trees and shrubs in 48 families and 135 genera, which constitutes approximately 10 percent of the republic's flora. Of these, 119 species are trees and 316 species are shrubs. Shrubs also include low shrubs commonly found in semi-desert and mountain xerophytic vegetation. Rare and endangered species have been studied. Of the more than 400

higher plant species discovered in the Azerbaijani flora, 140 are included in the "Red Book" of Azerbaijan. They are mainly relict and endemic species and include many plants such as boxwood, blackthorn, mountain ash, hard-branched ivy, wild pear, blackberry, eversmania, species of senna, etc. More than 125 species of rare and endangered plants have been planted in the Central Botanical Garden ([The Red Book of the Republic of Azerbaijan, 2013](#)).

The relief of the Republic of Azerbaijan is diverse. The relief of the Republic of Azerbaijan and the plants distributed there. All types of vegetation cover are found in the Republic of Azerbaijan - ancient forest, boreal, desert, xerophyte, steppe, Caucasian, and adventive vegetation ([The Red Book of the Republic of Azerbaijan, 2013, 2013](#); [Əsgərov 2005, 2006, 2008](#)). The most abundant examples of ancient forest types are found in Talysh, the boreal type in the mountain zones of the Greater and Lesser Caucasus, and in small quantities in the lower belts, while xerophilous, Caucasian, steppe, and desert types are found in the plain, foothill, and steppe summers of the republic, and most of them are found in the Kura-Araz lowland. The adventive areal type is somewhat less common. Rich and diverse vegetation has also developed in the lakes, ponds, streams, and swamps of the Kura-Araz lowland, Caspian Sea, and other plains ([Məmmədov 2016](#)). The reason for the spread of plants in different reliefs in the Republic of Azerbaijan is due to factors such as climatic conditions, soil composition, humidity, temperature, etc. Semi-desert, mountain steppe, and mountain xerophytic plants are widespread in the plains and low mountains ([Əsgərov 2005, 2006, 2008](#)).

Semi-desert plants

Semi-desert plants (wormwood, saltwort, davatikani, gavan, kengiz, etc.) are widespread in the Kur-Araz, Shirvan, Mil

and Karabakh steppes, as well as in the plains of Jeyranchol, Gobustan and Araz-side Salyan, Mughan, Samur-Devachi lowlands, Araz-side plains of Nakhchivan, Absheron-Gobustan. Semi-desert plants are winter pastures. Due to the increase in cultivated areas and settlements, the natural range of semi-desert plants is sharply decreasing ([Əsgərov 2005, 2006, 2008](#)). Dark salinity is widespread in deserts. The branches of the Garashora tree spread out on the ground, creating mounds, and are most common around Lokbatan, in Mughan, and Eastern Shirvan. Small hilly, saribash deserts are commonly found around the Caspian Sea, in the Kura-Araz lowland ([Məmmədov 2016](#)). Deserts of self-interest are also widespread in the Republic of Azerbaijan. There are 5–6 species of plants here. The Cheran desert also forms in Eastern Shirvan and some foothill regions ([Məmmədov 2016](#)). Semi-desert plants can also be easily seen.

Mountain Steppe Plants

Phytocenoses belonging to this vegetation type are distributed in mountain xerophytic forests and mountain steppe zones at altitudes of 700–900 m, 1500–1800 m, and 1700–2500 m above sea level in arid climates, on mountain gray-brown, mountain chestnut, and grassy mountain meadow soils emerging from the forest floor ([Qurbanov 2024](#)). According to researchers, steppe vegetation refers to mountain steppes formed by perennial xerophytic grasses that form dense turf.

Mountain steppe plant groups are formed in the middle mountain belts of the Greater and Lesser Caucasus, Nakhchivan and Talysh, spreading on mountain black soil, gray and chestnut soils. It is found in mountain steppes with cereals, cereals-mixed crops, or mixed grass-cereals. The dominant plants here include thyme (*Thymus* L.), grass (*Poa* L.), fescue (*Festuca* L.), astracantha (*Astracantha* Podlech),



wheatgrass (*Agropyron* Gaertn.), germander (*Teucrium* L.), sage (*Salvia* L.), and other genera (Qurbanov 2024).

Mountain steppe plants (velamer, thyme, etc.) are widespread in the northeastern part of the Lesser Caucasus, in the mountainous Shirvan part of the Greater Caucasus, and in the Nakhchivan Autonomous Republic (Əsgərov 2005, 2006, 2008). In the dry and hot regions of the republic (Nakhchivan Autonomous Republic, Jabrayil, Zangilan), on the steppe plateau of the Greater Caucasus, xerophytic vegetation is found, namely, phrygana, shiblak, prickly heath, tistist, and occasionally, stunted juniper and juniper-pistachio. In arid regions, kekotu and its species tumil-kekotu are found. For the Tumil fields, plants such as sedge, meadowsweet, caravan grass, etc. are very typical. Plants such as milkweed, sedge, and barberry are also found in these types of fields (Məmmədov 2016).

In Azerbaijan, the mountain steppes are very similar to the steppes spread across the open gray-brown montane plains, and their species composition consists mainly of xerophytes (Qurbanov & Cabbarov 2017). In the northern part of the Lesser Caucasus, mountain-steppe vegetation spreads at altitudes of 700–1200 m above sea level and has an intrazonal character. In particular, this type of vegetation is found in separate patches in the foothills, lower, middle and upper mountain belts, in areas where forest and subalpine vegetation are formed. Usually, the mountain-steppe vegetation of the high mountainous part includes fescue (*Festuca*) and herbaceous-fescue formations, which are distributed at an altitude of 1900–2400 m above sea level.

Mountain xerophytic plants

Mountain xerophytic plants are distributed in the Talysh Mountains and the Nakhchivan Autonomous Republic. Consists of sparse shrubs and herbs (Əsgərov 2005,

2006, 2008). In the foothill plains of the Greater Caucasus and the Lesser Caucasus, mainly annual and perennial xerophytic plants and shrubs are widespread at altitudes ranging from 200 m to 600–700 m, sometimes up to 1200 meters. Higher up, areas limited to 1800–2200 meters above sea level consist of forests (Əsgərov 2005, 2006, 2008).

Forest plants are also very widespread in the middle mountain regions of the Republic of Azerbaijan. Forests make up 11% of Azerbaijan. The total area of forests is 1.2 million ha. Although the area of Azerbaijani forests is small, their species composition (435 species) is very rich. There are 70 endemic tree and shrub species here. 90% of forests in Azerbaijan are in the mountains (especially in the middle highlands), and 10% are in the plains. Lowland forests are widespread in the Ganikh-Ayrichay valley, the Lankaran lowland, and the Shollar plain of the Samur-Devachi lowland (Əsgərov 2005, 2006, 2008). Azerbaijani forests are divided into several areas:

Broadleaf forests

Broad-leaved forests. Distributed in the low and middle highlands of the Greater and Lesser Caucasus, and the Talysh Mountains. 86% of Azerbaijani forests consist of 3 trees: oak, alder, and beech (Əsgərov 2005, 2006, 2008). These forests are in the mountainous zones of the Greater and Lesser Caucasus at an altitude of approximately 600–1800 m above sea level. The plants growing here are mostly Georgian oak, Eastern pistachio, and in the upper mountain belts, Eastern oak. In general, beech trees are very widespread in these areas and are very productive. At the same time, linden, alder, 5–6 species of birch, especially the Eastern oak, along with the Trautfetter birch, also grow in broadleaf forests. Many plants such as Georgian oak, currant, and gooseberry are also widespread

on the slopes of the mountains in broad-leaved forests.

Coniferous forests

Seven species of plants are found in coniferous forests in Azerbaijan. These include the Eldar pine, the hook pine, the multi-fruited, the heavy, the red and the long-stemmed juniper, and the European blackthorn (Əsgərov 2005, 2006, 2008). Locally, it has formed small forests in the Eldar Plain (Eldar pine), in the mountain regions of the Greater and Lesser Caucasus (Kok pine), especially in the Bulannig River basin of the Balakan region, and around Goygol (at an altitude of 1600 m). The Kokh pine, together with the birch, forms large cliffs around Lake Goygol, creating a forest. Among conifers, many species of fir and juniper are widespread in mountain-forest zones. In the northwestern zone of the Greater Caucasus, especially in the subalpine belt of the Zagatala-Balakan regions, small areas of Caucasian rhododendron forests are found.

Tugay forests

Tugay forests extend into a ribbon along riverbeds, especially along the Kura River. Located in semi-deserts, these forests moderate the climate, protect the soil, and strengthen the banks (Əsgərov 2005, 2006, 2008). Along the Kura, Araz, Ganikh, and Gabyrry rivers, there is a local Tugay forest in a ribbon-like form. The basis of these forests is formed by trees and shrubs such as poplar, willow, oak, elm, mulberry, sycamore, and pomegranate (Məmmədov 2016).

Sometimes, mixed, plain, and Talysh forests are found in the territory of the Republic of Azerbaijan. Mixed forests form along mountain rivers or in river valleys. Plants such as sea buckthorn, yude, willow, sumac, saragan, yulun, mulberry, immortal bush, pomegranate, rose hips, blackberries, etc. are widespread here.

The thorny trees are most common in

the valleys of the Shin, Kish, Demiraparag, Turyan, Goychay, Agsu, Velvə, and Tartar rivers (Məmmədov 2016). Plain forests are widespread in the Guba-Khachmaz and Karabakh zones of the Republic of Azerbaijan, as well as in the Alazan-Ayrichay depression. Plants such as oak, elm, hawthorn, elm, etc. are found in these forests. Dozens of different forms of long-stemmed oak also exist in plain forests (Məmmədov 2016). Typical tree species of the Talysh plain forests include ironwood and chestnut oak. In addition to these relict tree species, Hyrcanian-type forests consisting of Caucasian elm, two species of azat tree, elm, cherry poplar, and cherry thorn are also found here. On the sea-facing slopes of these forests, Lankaran acacia, linden, and many others create special mixed forests.

Subalpine and alpine meadows

In the high mountains, subalpine and alpine meadows exist. They are used as summer pastures and hayfields. At an altitude of 1800–3200 m above sea level, subalpine and alpine meadows of various compositions, with steppe and meadow plants prevailing.

True subalpine meadows take on various forms depending on the relief and character of the high mountains. The tall grassland in the subalpine zone also forms a special shape. Most tall grasses and subalpine plants are plants that have emerged from the forest floor. In tall grassy areas, the most common species are celandine, sedge, meadowsweet, soft broom, yarrow, nettle, sedge, and various representatives of the marigold family.

In the subalpine zone, grasslands of various compositions, low-moisture and mesophilous grasslands, dry xerophytes, and steppe grasslands are also widespread. The basis of the subalpine meadow is made up of white moustache, pink tongalotu, Caucasian thin-leaved, purple barley, alpine daisies,



wide varieties of lamellar and three-leaf clover, geranium, yarrow, primrose, and yarrow. Up to 1,000 plant species are distributed in the subalpine meadow. Alpine meadows are widespread on the peaks of high mountains, on steep slopes, and in saddle-shaped mountain passes. Although their diversity is less than that of subalpine meadows, their small plant types are very diverse and of great importance. Subnival areas are also widespread on high mountain peaks. The bare cliffs of the high mountain peaks of the Greater and Lesser Caucasus are almost devoid of vegetation.

The Republic of Azerbaijan is considered the homeland of many rare and endemic species of shrubs. Blackthorn is a rare gem of forests as a relict plant. This tree is more common in the southern (Gabala region) and southeastern (Pirgulu, Shamakhi regions) parts of the Greater Caucasus. The late-growing but long-lived black locust has never covered large areas. The homeland of the Eldar pine is Azerbaijan, and its distribution area is the Eldar hollow area of the Jeyranchol foothills. Among the relict and rare trees growing in the Talysh Mountains, ironwood, Lankaran acacia, chestnut-leaved oak, azat, Caucasian date, boxwood, sycamore, Hirkan fig, Hirkan birch, etc. are rare pearls of nature.

Wetlands are widespread in Azerbaijan. They are found in small areas around natural water bodies and in depressions. Swamps are observed in the Kur-Araz plain, the Lankaran plain, and the western regions of the republic.

Marsh plants in Azerbaijan, especially in Talysh, have been well studied. Reeds, Beckmania, paspalum, licorice, frogweed, sedges, lamellar iris, and other plants are common in those swamps. Although these plants grow in water, they are related to the soil. The second group of plants is related only to water conditions. These plants include water lilies, etc. Depending on the

growing conditions, these plants form different associations. Wetland plants are of great importance. The importance of reed beds in Azerbaijan is particularly great. They are used as a building material in hunting farms, for fencing, for building sheep pens, as masonry, and as raw materials for making cardboard, paper, and vitamins C and A.

Rare plants of Azerbaijan

The "Red Book" of the Republic of Azerbaijan is an official state document on rare and endangered species of wild animals and plants in the territory of the Republic of Azerbaijan. It provides information on animal and plant species, their distribution, and protection measures throughout the territory of the Republic, including the sector of the Caspian Sea (lake) belonging to the Republic of Azerbaijan. Several measures have been taken to preserve this type of animal and plant world, and sanctuaries, reserves, and national parks have been established for this purpose. Let's look at a few plants that are endangered or rare. These include Hyrcanian evergreen boxwood (*Buxus sempervirens*), Persian ironwood (*Parrotia persica*), Persian silk tree (*Albizia julibrissin*), Eldar pine (*Pinus eldarica*), water lily (*Nymphaea*), *Astragalus caraganae*, Hyrcanian pear (*Pyrus hyrcana*), chestnut-leaved oak (*Quercus castaneifolia*), and velvety euonymus (*Euonymus velutinus*).

Buxus sempervirens, or Hyrcanian boxwood, is a plant species belonging to the evergreen boxwood species (**Figure 2**). They are shrubs that are very common in nature. It can also take the form of a tree, reaching a height of 6–10 m. The bark of the trunk is thin and light grayish-yellow, smooth. It is multi-branched, densely umbellate. The leaf petiole is 2–5 mm long and stiffly hairy. The leaf has entire margins and rounded or slightly toothed tips. Its flowers are located in the axils of the leaves

and are greenish. The flower cluster is spike-shaped. It blooms in March-April, and its fruits ripen in July-August. Pollination is entomophilous. It is reproduced by seeds and vegetatively. It is more widespread in moist, shady valleys and in fresh, thick, humus-rich soils. It is distributed at an altitude of 400–800 m above sea level. It grows as a shrub in the second layer or in forests from the lower mountain belt (lowlands) to the middle mountain belt, in

oak-oak, mixed hyrcan and beech forests. It is also used for decorative purposes. The evergreen boxwood is relatively drought-resistant and suitable for planting singly or in groups. In the regions, it is distributed in the Lankaran lowland, the mountainous part of Lankaran, etc., and in other regions. Currently, it is protected in the Hirkan National Park ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 2. Hyrcanian boxwood (*Buxus sempervirens*).

Parrotia persica, or Persian ironwood, is a plant species belonging to the family Hamamelidaceae. This tree is native to the lower Alborz Mountains of northern Iran. It is widely cultivated in Europe and the United States (**Figure 3**). It is a highly branched tree, 12–22 m tall. The umbel is ovoid or broadly ovate. The shoots are 6–11 mm long. The leaves are 4–10 cm long and 3–6 cm wide. The leaves are alternate, ovate, or elliptical. The flowers are bisexual, have short stalks, and open before the

leaves. It blooms in February-March. Its fruits ripen in August-September. Pollination is anemophilous. It is reproduced by seeds and fruit. In the lowlands, in the foothill zone and lower mountain belt, at altitudes of 400–600 m above sea level, it forms mixed forests. Single trees are found at an altitude of 1000–1200 m above sea level. They form both pure and mixed forests consisting of two or three layers ([The Red Book of the Republic of Azerbaijan, 2013](#)).



Figure 3. Persian ironwood (*Parrotia persica*).

Albizia julibrissin, or Persian silk tree, is an endemic plant of Azerbaijan. It is also known as "Silk acacia", "Lankaran albissia", "Gulebrishin", and "Silk Flower" (Takhtajan 1986). Widely found in the Lankaran zone. This plant is also found in Europe, around the Mediterranean Sea, in Crimea, and on the Black Sea coast of the Caucasus (Figure 4). This plant is used in folk medicine for the treatment and prevention of several diseases. The average height of the tree is 1.2 m, and the diameter of its trunk is 4 cm. In fertile soil, it reaches a height of 10–12 m

within 10 years. The plant, which is considered drought-resistant, blooms after 4–5 years of age. It is a woody plant (Məmmədov 2003). In 1989, the this plant was included in the "Red Book" of Azerbaijan (Talışlı & Əhədov 2017). It is advisable to use the silk tree in single and group plantings, in landscaping, as well as in coastal areas, to reduce heat in the summer months, and as an ornamental plant in Absheron conditions. The seeds of the plant are fully resistant to the soil and climatic conditions of Absheron (Mehdiyeva 2011).



Figure 4. Persian silk tree (*Albizia julibrissin*).

Pinus eldarica or Eldar pine is a coniferous tree species belonging to the Pinaceae family. It is a relict plant of the III period of Azerbaijan and is a rare tree species that is naturally distributed only in the western part of the Eldar plain, on the right bank of the Gabyrrichay River, as well as in the Ellar hollow in Ganja. In 2004, nearly 2,000 hectares of Eldar pine forest were removed from the Goygol reserve, and

the Eldar Pine Reserve was established on its basis. The Eldar pine reaches a height of 20 meters and has a straight trunk and a wide canopy. Its leaves contain vitamin C and carotene. It is also a good building material. Eldar pine has high forestry potential in dry regions. Its rate of biomass accumulation rivals the fastest-growing conifer species. According to this feature in this article, we studied plantation

possibilities in new areas based on the data obtained by geoinformational technologies about the ecological limits of *Pinus brutia* var. *eldarica*. Eldar pine (**Figure 5**) is also used for landscaping purposes in regions where many other types of pine trees do not grow. The flowers are pollinated in April-

May. Its cones ripen in the second year, in August-September. However, it reproduces by seeds. Pollination is anemophilous. It is xerophytic. It is resistant to drought and heat (Məmmədov 2008; Mammadov et al. 2022; Farzaliyev & Afonin 2016).

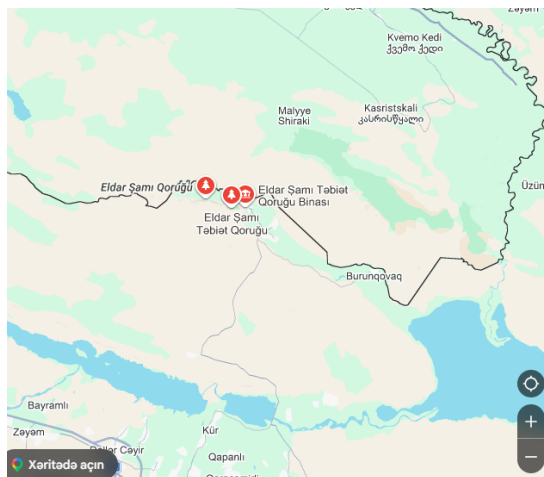


Figure 5. Eldar pine (*Pinus eldarica*).

Nymphaea, or water lily or Egyptian lotus, is a genus of plants from the lily family. It is a perennial aquatic plant with a strong root. The leaves are very large, solitary, on long, dense stalks; the leaf margins are heart-shaped to oval, sometimes rounded, and 10–25 cm wide. Its flowers are arranged singly, large, and 10–15 cm in diameter. The petals are numerous, white, oval-oblong. The fruit is spherical and green in color. The flowering and fruiting period occurs in May, August, and September. It is a water- and moisture-loving (hydrophilic) and light-loving plant. It is reproduced by seeds and vegetatively. In some water bodies, they have disappeared altogether. This plant is used as a food, medicine, and ornamental plant. The Kur-Araz lowland (Zardab district - around the Garasuchay River), the Lankaran lowland (Lankaran district - Liman settlement, in the northern part of Lake Mortso) are very widespread. It is protected in the Qizilaghac reserve (Flora Azerbaidjana, 1950-1961).

Astragalus caraganae, or Nakhchivan gavan, is a plant species from the legume family. It is a perennial plant with numerous erect stems, 20–50 cm tall. The leaflets are 16–27 pairs, oblong-oval, and covered with dense velvety hairs on the underside. The ovary is oblong and pedicelled. The raceme is short, with 4–6 sparse flowers (**Figure 6**). Flowering occurs in May, and fruiting occurs in June-July. It is a xerophytic plant. It is found in the middle mountain belt, on dry stony slopes, and in rocky areas. It is found in the mountainous part of Nakhchivan (Shahbuz region - around the villages of Garababa, Badamli, Kuku and Kechaldagh) and is widely distributed. As a species whose status in the wild has reached a critical point and is likely to become extinct, its distribution areas in Zangezur National Park and Arpachay State Nature Reserve should be placed under special control and its natural populations should be protected (Habel et al. 2010).



Figure 6. *Astragalus caragana*.

Pyrus hyrcana, or Hyrcanian pear, is a species of plant of the family Rosaceae. It is a tree up to 25 m tall. The leaves are ovate, with small margins. They are white, felty on the underside, and hairless on the upper side. The stem is long, thin, equal to the length of the leaf blade, and covered with fine hair. The fruits are cinnamon-colored, flattened, and spherical, and are found singly or in clusters on one-year-old shoots. It blooms in April-May. Its fruits ripen in August-September (**Figure 7**). Pollination is entomophilous. They reproduce by seeds and root suckers. It is distributed mixedly in

the foothill forests and forest glades of the mountain massif. It has a natural range in Azerbaijan and Iran. It is distributed in the Astara and Lankaran regions of Azerbaijan. Lankaran lowland (Astara-Shuvi, Anbabu, Duriya, Istisu, Astara villages; Lankaran district-Dashdatuk and Khanbulag villages) and the mountainous part of Lankaran (Yardımlı district - Pirembel village; Lerik district - Lerik village). It is widespread in the villages of Khanbulan and Dashdatuk in the Lankaran region and Anbabu village in the Astara region (Celka & Drapikowska 2008).



Figure 7. Hyrcanian pear (*Pyrus hyrcana*).

Quercus castaneifolia, or chestnut-leaved oak, reaches a height of 40–45 m, a

trunk diameter of 100–150 cm, and has a tent-like or broad-pyramidal canopy. The

bark of the branches is gray, and the bark of the trunk is dark gray. The stems are densely covered with hair, and the buds are small and egg-shaped. Its leaves are falling. The leaves are 19–20 cm long, 4–8 cm wide, with a toothed or lobed edge and a leathery surface. The upper side is shiny, dark green, and bare, while the lower side is light green and covered with hair. The leaf veins are 9–13 pairs. The flowers are unisexual. The male flowers are up to 10 cm long and are located singly in drooping earrings. The female flowers are arranged in clusters on the stem, 2–3 together. The stem is densely covered with hair and is 10 cm long. It blooms in April-May and is pollinated by the wind. The fruit is a seeded cone. The cone is 2.5–3.5 cm long, oblong, obovate, elliptical, or lanceolate. The cones ripen in September-October. It is warm, light-loving, very demanding on soil fertility, and has little resistance to frost and drought. It is found in the Ismayilli, Guba, Tartar, Shamkir, Shamakhi, and Barda regions of Azerbaijan, and in the Talysh zone. It is intended for use in single plantings and in the furniture industry. Its cones contain starch, and its bark and leaves contain antioxidants and tannins ([The Red Book of the Republic of Azerbaijan, 2013](#); [Əsgərov 2005, 2006, 2008](#)).

Euonymus velutinus, or Velvet spindle, is a plant species belonging to the family Celastraceae. It is a shrub 1.5–4 m tall. Shoots are ovate, 3–5 mm long. The leaves are oblong-elliptical or obovate, 2–8 mm long and 1–3.5 cm wide, blunt or acuminate, finely toothed along the edges, covered with small hairs along the veins; the petiole is short (1–6 mm) and hairy. The flower cluster is simple or umbel-shaped, located on a short axillary flower axis. The flowers are 4-membered, greenish, and small. The petals are oblong, rounded at the tip, and about 3 mm long. It blooms in May-June, and its fruits ripen in August. It is pollinated

by entomophiles. Being a microphanerophyte, it reproduces through seeds and vegetatively. It grows in light forests, on mountain slopes and along valleys, up to 1800 m above sea level, rising to the middle mountain belts. It is more commonly found scattered in sparse forests, on forest edges, among bushes, on mountain slopes, and in valleys. It is both an ornamental plant and used in landscaping. It is widely distributed in the Kur-Araz lowland, the central and southern part of the Lesser Caucasus (Khojavand), the western (Zagatala State Nature Reserve) and eastern part of the Greater Caucasus (Ismayilli region - Talistan village), the Lankaran Mugan, and the mountainous part of Lankaran.

Relict plants of Azerbaijan

Relict lat. *relictum* - remnant - relict plants and animals - plant and animal species of past geological periods that are part of the modern biocenosis, can occupy a small or large area ([Mirzəyev 2019](#)).

Azerbaijan is also rich in relict genera belonging to the Tertiary period, whose representatives are found more frequently in all zones, especially in the Talysh zone. Examples include ironwood, Persian silk tree, chestnut-leaved oak, bigavar, boxwood, etc. In other words, relict organisms are understood as the remnants of populations that inhabited and spread widely in the past. The causes of such changes and the emergence of relict plants may be due to factors such as climate change, competition between organisms, continental drift, or ice ages. Relict plants are used in food, medicine, dyeing, and other fields of application ([Maghradze et al. 2015](#)). Relict species are found in all countries of the world. Since the Republic of Azerbaijan has a very rich flora, relict species are widespread here. This includes pomegranate (*Punica granatum*), oriental plane (*Platanus orientalis*), wild grape (*Vitis sylvestris*),



Caucasian date palm (*Diospyros lotus*), and mountain thyme (*Thymus collinus*).

Punica granatum, commonly known as pomegranate, is a plant species belonging to the family Lythraceae. Its scientific name in Latin means "Punica" - dark or bright red, and "granatus" - grain. The pomegranate is a multi-stemmed, deciduous shrub or small tree, 3–5 m tall. Young branches are greenish gray, while older branches are brown and have thorns. The leaves are small, oblong or lanceolate, simple, shiny, and have short petioles. The fruit can contain 1000–1200 or more seeds. The seeds are covered in a juicy and edible coating. Pomegranate blooms in April, and its fruits ripen in September–October. The plant is propagated mainly by dividing the bush and cuttings. In Azerbaijan, the common pomegranate is naturally distributed in the Alazan-Ayrichay valley, the Kur-Araz and Lankaran-Astara lowlands, as well as in Absheron. Azerbaijan's favorable climatic conditions allow pomegranates to be grown in various regions of the country. Although pomegranates are mainly cultivated in semi-arid temperate and subtropical climates, they are well adapted to a variety of climatic conditions. Pomegranate, which holds a special place in the national and cultural heritage of Azerbaijan, is widely used in both the food and pharmaceutical industries. Its fruit, juice, and peel are used in the preparation of various food, medicine, cosmetics, and dye products. Pomegranate also has significant symbolic significance in Azerbaijani national culture, art, literature, and cuisine (Akparov et al. 2015).

Platanus orientalis, or oriental plane, is widely distributed in its natural state on

the Balkan Peninsula, the Aegean islands, the south and west of Asia Minor, the eastern coast of the Mediterranean Sea, and the islands of Cyprus and Crete. It is a large tree with a wide canopy, reaching a height of 40–50 m and a trunk diameter of 1.5–3 m. The bark of the trunk and branches is greenish, light gray, or yellowish green. The buds are broad-conical, swollen, and arranged alternately on long shoots. The leaves are alternate, round or ovate, 3–7-lobed, long-stalked, shiny green on the upper side, brownish green on the lower side, and glabrous or sparsely hairy (**Figure 8**). It is in the Sharvari flower group, with flowers of various sexes, ranging from 2 to 70 on long drooping stems. The fruit is a drupe, 2–2.5 cm in diameter and 4–7 mm long, with a widened and hairy top. The seed is thin and long. It is propagated by seeds, cuttings, layering, and stem cuttings. The oriental plane tree is a light- and heat-loving, soil-demanding plant. The Eastern plane tree is found naturally on the southern slopes of the Greater Caucasus, including in the regions of the Republic of Azerbaijan - Agstafa, Ganja, Goychay, Barda, Zangilan, Nakhchivan, Ordubad, Yardymli, Zagatala, Agdash, Sheki, Gabala, Baku and other places. Eastern plane trees are planted in parks, gardens, and orchards, singly or in groups, for landscaping purposes. Eastern plane trees are naturally planted along riverbanks, along with trees such as alder, willow, and poplar. The leaves and bark have been used for medicinal purposes. The branches and roots have also been used to make fabric dye (Huseynov et al. 2022; Mirzəyev 2019).



Figure 8. *Platanus orientalis*.

Vitis sylvestris, or wild grape, is widespread in the Caucasus, considered the center of origin of viticulture and included in the Vavilov Triangle (**Figure 9**). Although the phylogenetic resources of this species have been studied, research on micropropagation of wild grape forms of Caucasian origin is a new direction (Maghradze et al. 2020). The plant is a bushy liana with gray-brown bark. Its leaves have 3–5 lobes, its flowers are dioecious, and its fruits are blackish berries. It blooms in May-June and bears fruit in August-

September. It reproduces by seed and vegetatively and is distributed in the lowland and mid-mountain zones, mainly around wetlands. It grows in open forests in the South Caucasus, climbing various trees and shrubs (Ocete et al. 2018). It is important in medicine, agriculture, and the food industry. It is used to pollinate female grape varieties; the male flowers are used to flavor wines in Azerbaijan, and the unripe fruits are used to prepare marinades and special sauces (verjuice) (Maghradze et al. 2015).



Figure 9. Wild grape (*Vitis sylvestris*).

Thymus collinus is a plant species belonging to the family Lamiaceae. It is widespread in the Caucasus. It is a rare and relict species of Azerbaijan. Its range is narrow and it is found in the mountainous areas of Guba and Nakhchivan Autonomous

Republic in Azerbaijan. It grows more often in the middle and subalpine regions, on dry rocky slopes (**Figure 10**). It is a perennial plant with a branched stem at the bottom and hairy at the top. The height of the flower stalks is 7–12 cm. The leaves are petiolate,



oblong-ovate to ovate, 7–11 cm long, 3–5 mm wide, and dotted-veined. Its flowers are pink and clustered in small clusters. The fruit is a cone. In nature, it reproduces

mainly by seeds. It is widely used in ornamental gardening (Ganbarov et al. 2015).



Figure 10. Hill thyme (*Thymus collinus*).

Diospyros lotus L., or the Caucasian persimmon, is a plant species belonging to the Ebenaceae family. It is a tree 15–25 m tall, and up to 40 m in favorable conditions, with a diameter of up to 80 cm (Figure 11). Only one species, the Caucasian date palm, grows naturally in Azerbaijan. In Azerbaijan, this plant is widespread in the Lankaran region, in the Guba-Khachmaz zone, at an altitude of approximately 500 m above sea level. Currently, this plant is cultivated in almost all regions of Azerbaijan and is used for various purposes (Bakhshaliyeva 2023). Its lateral roots have penetrated deep into the soil, and the root system is divided into sections. The mild climate of the Lankaran-Astara region, the abundance of rain and sunny days, and the presence of humid air masses allow the Caucasian date palm to spread in different ecosystems. This species is distributed in mountainous and foothill areas up to 1500 m above sea level, mainly in mixed forests with oak (*Quercus* L.), ironwood (*Parrotia persica*), and hornbeam (*Carpinus* L.) trees.

It is a straight-stemmed tree, 15–20 m tall, and sometimes up to 30 m in forests, depending on its ecological conditions. It is a light-requiring plant (Huseynov et al. 2022). The Caucasian palm loves moist soils. It is used as an ornamental and medicinal plant. It can also be widely used in landscaping and afforestation. The common date palm or Caucasian date palm belongs to the ancient Mediterranean group of the Asia Minor - Mediterranean class of the ancient forest geographical type. It is distributed in the Mediterranean, the Balkans, Asia Minor, Iran, India, the Himalayas, Japan, China, Ukraine, Central Asia, and the Caucasus. In Azerbaijan, it is widespread in the eastern and western regions of the Greater Caucasus, the northern regions of the Lesser Caucasus, the mountainous part of Talysh, the Lankaran and Kur-Araz lowlands, the Alazan-Ayrichay valley, and the Bozgir plateau. It grows from the lowlands to the middle mountain belt (up to 1800 m above sea level).



Figure 11. Stem, leaf and fruit of the Caucasian date palm (*Diospyros lotus*).

Specially protected natural areas and national parks of Azerbaijan

Azerbaijan is a country distinguished by its rich biodiversity, diverse landscapes and climate zones, and rare and endemic flora and fauna. Especially protected natural areas have been established throughout the country to protect these natural resources, ensure the sustainability of ecosystems, and protect rare species. These areas include natural complexes of special ecological, scientific, cultural, aesthetic, and health-improving importance, as well as areas where rare and endangered plant and animal species are distributed.

Specially protected natural areas in Azerbaijan are divided into categories such as state nature reserves, national parks, nature and ecological parks, state nature reserves, natural monuments, zoological parks, botanical and dendrological parks, health resorts, and geological parks, depending on their purpose and protection regime.

The creation of protected areas is conventionally divided into three stages. The first stage began in 1910 with the creation of the Eldar Pine Botanical Reserve. In the second stage, especially in 1925–1936, the Goygol, Gizilaghac, Zagatala, and Hirkan state nature reserves were established. The third stage is characterized by the establishment of national parks since 2003. This stage, in addition to protecting biodiversity, has created opportunities for

the development of ecological tourism, scientific research, and environmental education.

National parks

National parks are specially protected areas created for the protection of natural complexes of special ecological, historical, and aesthetic importance, for environmental education, scientific research, and nature tourism. The first national parks in Azerbaijan were established in 2003. Currently, 12 national parks are operating in the country: Zangezur, Aggol, Shirvan, Hirkan, Altyaghaj, Absheron, Shahdag, Goygol, Samur-Yalama, Gizilaghaj, Ilisu, and Akhar-Bakhar national parks named after Academician Hasan Aliyev.

National parks make an important contribution to the preservation of biodiversity in various natural and geographical regions. Hirkan National Park plays an important role in protecting the Hirkan forests rich in relict and endemic plants, Gizilaghac National Park protects the Caspian coast and wetland ecosystems, Shahdag and Ilisu national parks protect the mountain ecosystems of the Greater Caucasus, and Zangezur National Park protects the rich natural complexes of Nakhchivan.

State Nature Reserves

State nature reserves are created to protect rare and characteristic natural complexes in their natural state, as well as to study natural processes. Maximum



protection of natural ecosystems is the main principle in reserves, and economic activity is strictly restricted. The first state nature reserve in Azerbaijan is considered to be the Goygol State Nature Reserve, established in 1925. In subsequent years, the Qizilaghaj, Zagatala and Hirkan reserves were established. The reserves operating in the country include Zagatala, Turyanchay, Shirvan, Basitchay, Garayazi, Garagol, Eldar Shamy, Mud Volcanoes Group and Korchay state nature reserves. (<https://www.eco.gov.az/az/tebii-servetlerimiz/qoruglar>)

State Nature Sanctuaries

State nature reserves are established to protect and restore natural complexes and their individual components, as well as to maintain ecological balance. Their main task is to ensure the protection of certain plant and animal species, habitats, and natural complexes. Sanctuaries can be established without taking land from owners and users. Activities that could harm nature are restricted or prohibited in these areas. The first state nature reserves in Azerbaijan began to be created in 1961. Korchay, Bandovan, Lachin, Garayazi-Aghstafa, Sheki, Shamkir, Gusar, Gubadli, Zuvand, Ordubad, Ismayilli, Dashalti, Gabala, Arazboyu, Hirkan, Zagatala, Arpachay and other state nature reserves operate in various regions of the country. (<https://www.eco.gov.az/az/tebii-servetlerimiz/yasaqliqlar>)

Development prospects of specially protected natural areas

The development of specially protected natural areas is of great importance for the protection of biodiversity as well as for the socio-economic development of regions. The creation of new protected areas and the development of existing ones allow for strengthening ecological security, developing ecotourism, increasing employment, and sustainable use

of natural resources. The creation of a biosphere reserve in the Zagatala-Balakan region, as well as the organization of geological parks, are promising directions in terms of protecting Azerbaijan's natural and geological heritage. The international recognition and protection of the Hyrcanian forests is also of particular importance. The inclusion of the Hyrcanian National Park on the UNESCO World Heritage List could make a significant contribution to the international recognition and protection of the biodiversity of this area. Thus, Azerbaijan's specially protected natural areas play an important role in preserving biodiversity and genetic resources, and in protecting rare and endangered species. National parks, state nature reserves, and sanctuaries are complementary protection mechanisms. Effective management of these areas, strengthening scientific monitoring, and applying ecotourism principles create important opportunities to preserve Azerbaijan's natural heritage for future generations.

Conclusion

Azerbaijan's specially protected natural areas are of great importance in preserving the country's rich biodiversity, rare and endemic species of flora and fauna, and valuable natural landscapes and ecosystems. The historical development of the system of protected areas in the country shows that measures taken to protect nature have become more extensive and complex over time, and the organization of national parks, along with the creation of reserves and sanctuaries, has become one of the priority areas.

The establishment of national parks, in addition to protecting natural ecosystems, has created new opportunities for environmental education, scientific research, ecotourism, and sustainable regional development. State nature reserves serve to

preserve natural complexes in their original state, while state nature reserves serve to protect and restore individual natural components and their habitats. The joint activity of these protection categories is one of the important guarantees of the country's ecological security and biodiversity protection.

In the future, it is of great importance to expand the scope of specially protected natural areas, improve their management based on modern scientific approaches, conduct regular monitoring of biodiversity, and create databases using digital technologies. In addition, involving local communities in the process, developing ecotourism based on sustainable principles, and strengthening environmental education among the population can contribute to the effective management of protected areas.

In particular, the work carried out towards the creation of biosphere reserves and geological parks, as well as the international promotion of Azerbaijan's natural areas, are considered promising directions in terms of protecting the country's natural heritage. In general, the development of specially protected natural areas serves not only to protect individual species and ecosystems, but also to maintain ecological balance, sustainable use of natural resources, and the preservation of Azerbaijan's rich natural heritage for future generations.

Conflict of Interest

The author declares that there is no conflict of interest.

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