

The Conservation of Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe, a transnational composite nature UNESCO World Heritage site

Europe is the only continent where pure and mixed beech forests (*Fagus sylvatica*) grow and dominate. The spread of European beech in the post-glacial period (after the end of the last ice age) is a process that has been going on for over 10,000 years. The diversity of glacial sanctuaries (Pyrenees, Apennines, Illyrian region and Southern Carpathians) has led to the genetic diversity of European beech trees and the adaptation of regional fauna and flora to the specific ecosystem of beech forests. Due to the different flora and fauna, climatic and soil conditions, the post-glacial beech propagation process has led to the development of more than 80 different types of pure and mixed beech forests that are present in most bio-geographical regions of Europe.

Beech reaches a height of about 30 m, trunk diameter up to 2 m and age over 200 years. Beech forests are dark and the beech itself is a shade-loving species (sciophyte), and as such reaches maturity very late, at about 40 years of age if it grows in solitude, and in the closed stand about 20 years later. After ripening, it bears fruit every 3 to 4 years, and the fruit is called beechnuts or mast, which is brown in color and up to 2 cm long. Beech can also propagate vegetatively by shoots growing from the stump. Beech growing at lower altitudes produces leaves by the end of April, and even later at higher altitudes.

The main native range of European beech is located in the moderately humid climate of central Europe. Beech-dominated forest communities are mainly distributed in central and western Europe, as well as in the southern European mountain range. These forests have the widest amplitude in terms of soil type and altitude of all deciduous forests of Europe, and potentially occupy the largest area. Unfortunately, beech forests share the fate of all deciduous forests of the northern hemisphere, especially on the European continent, since these forests have for centuries been subject to enormous development pressure, that is, the settlement and expansion of human communities, as well as their needs, which entailed deforestation or use of these forests so that natural, primeval beech forests became rare.

Beech forests of the Balkans, that is Moesian beech forests - *Fagus sylvatica* ssp. *moesiaca* are distributed in Serbia, representing autochthonous forests growing at different altitudes, ranging from (70) 100 to 1800 (2500) m a.s.l. but most commonly in the mountain belt at 800–1500 m a.s.l. Beech forests in Serbia are distributed from the lowland to the subalpine belt, on typical forest soil, cooler terrain aspects and humid habitats. Due to its great ability to adapt to different climatic and habitat conditions, beech forms a large number of communities in our country, building pure or mixed stands with deciduous trees or conifers. Beech is the largest part of the timber mass of our forests, which is why it is considered the most economically important species of trees, which due to its high quality of wood also has great economic importance. Until the mid-nineteenth century, Serbia was overgrown with dense forests, according to some estimates, in about 80% of the territory. However, as early as the second half of the nineteenth century, deforestation and use of forests in Serbia struck, first of all, oak forests as the most accessible and dominating the mountain belt, while at higher altitudes beech forests were somewhat spared, especially since the beech wood was little appreciated until the second half of the twentieth century when with the development of technology of protection (steaming, impregnation) became an important raw material.

Institutional protection of the remaining primeval beech forests in Serbia begins with the establishment of the Institute for Nature Conservation of Serbia and the establishment of protection categories such as nature reserves and strict nature reserves. Thus, the first protected natural area in Serbia, the Strict

Nature Reserve "Zeleničje" designated in 1948, is precisely the primeval beech forest with cherry laurel (*Prunus laurocerasus*), and besides this one, the oldest protected beech forests in Serbia are the Felješana Strict Nature Reserve and Danilova kosa Nature Reserve, where a strict protection regime has been in place for seven decades.

A unique aspect of the international protection of Europe's natural and primeval beech forests is their protection under the Convention on the Protection of World Cultural and Natural Heritage, which is implemented through the UNESCO World Heritage Program. The World Heritage List includes the transnational composite nature site "Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe", which currently comprises almost 80 components, i.e. beech forests in 12 European countries (Ukraine, Slovakia, Germany, Belgium, Spain, Italy, Slovenia, Austria, Romania, Bulgaria, Croatia and Albania). These beech forests are exceptional examples of natural beech forest complexes protected with the aim of preserving the beech forest ecosystems for future generations, as one of the most important deciduous forest ecosystems of the northern hemispheres, and certainly the most important for the European continent, for which it is endemic. This World Heritage Site consists of unaltered ancient beech forests that present all the processes and phenomena that are a characteristic of natural pure and mixed beech ecosystems in different environmental conditions, in order to ensure, as gene pools, the survival of beech trees, as well as a large number of species that depend on these ecosystems.

Following the last extension of this World Heritage Site in 2017, in January 2020, a nomination was submitted for a new extension of this extremely complex World Heritage Site involving 10 countries: Serbia, Bosnia and Herzegovina, Montenegro, Northern Macedonia, Switzerland, Czech Republic, Poland, Slovakia, Italy and France, which proposed the inscription of another 30 reserves as part of this composite site on the list of World Heritage Sites. Nominated beech reserves in Serbia are located in the Fruška Gora National Park - sites in the level I protection regime "Papratski do" and "Ravne", in the National Park Kopaonik - site in the level I protection regime "Kozje stene", and in Tara National Park - sites in the level I protection regime "Zvezda" and "Rača Gorge", which are mostly covered with conserved mixed beech forests.

National Park "Fruška Gora"

The forest in Papratski do Reserve that has been under strict protection since 1955, is about 160 years old and mostly of natural, seedlings origin. In some parts the beech builds pure stands, while the rest of the site is under mixed beech and linden forests. Beech trees are well regenerated here and dominate among trees of rather large trunk diameter, while linden trees are more numerous, though trees of rather small trunk diameter dominate. The Ravne Reserve is located near the Papratski do Reserve, on a gently inclined plateau that is sheltered by a mountain ridge in the upper part. This well-preserved mixed beech forest of significant productivity has been protected by the establishment of Fruška Gora National Park in 1960, with the level I protection regime being established in 2004. These are perhaps the only remaining preserved beech forests in the Pannonian region where the harsh climate contributes to the dominance of grassland ecosystems. However, the climate of the northern slopes of Fruška Gora, a gentle elevation on the southern edge of the Pannonian Plain, was conducive to the development of beech forests which preserved their natural character despite their accessibility and centuries-old use, and due to their long-standing national protection.

National Park "Kopaonik"

The naturalness of the forests in the Kozje stene Reserve is a consequence of their inaccessibility, but also of national protection since 1981 when the National Park was established in this area. When protection regimes were introduced in 1989, the site was granted level I protection regime. Located in the northwestern part of Kopaonik National Park, this site of pronounced refugial character includes the slopes of Samokovska River Gorge, Kozje stene ridge and Jadovnik hill with Kukavica peak. Beech forests are formed here on serpentinitic bedrock in the Samokovska River Gorge, while the rest of the site is dominated by spruce forests, including the relict community with winter heath (*Erica carnea*). Three stenoendemic plant species, *Sempervivum kopaonikensis* (synonymous with *Jovibarba heuffelii* var. *kopaonikensis*), *Cardamine pancicii* and *Viola kopaonikensis*, which grow only in the Kopaonik National Park area, can be found at this site.

National Park "Tara"

The Zvezda Reserve is one of the oldest protected areas designated in 1950 to become part of the Tara National Park in 1981, also under a strict regime of protection. This site includes the slopes of Zvezda (Zvijezda) in the Drina Gorge, one of the deepest in Europe, at a part of its course that is at a sharp angle, so that the northern and western boundaries of the site lie on the Drina River. The vertical slopes facing the river are dominated by European hop-hornbeam and South European flowering ash, while beech grows in parts where deeper soil is formed. Accompanying species are maple, walnut, linden, yew, black pine, sessile oak, etc. At the top of the cliffs there is a population of relict conifer species, which is endemic to the Drina River basin. This species was discovered in 1875 by the famous Serbian naturalist Josif Pančić in the very area of the Tara National Park, and was named after him Pancic's spruce (*Picea omorika*). In the Zvezda Reserve *Picea omorika* builds a relict community with beech, spruce, fir and pine trees. The terrain of milder slopes is occupied by the natural mixed beech-fir-spruce forest, a characteristic forest community for this National Park. The Rača Gorge Reserve consists of the gorge of Rača River, located in the eastern part of the Park. At the bottom of the gorge, near the spring Ladjevac, beech forms a relict community with walnut, thus reflecting the refugial character of the site.