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THE COMPONENT PARTS OF THE FIRST NOMINATED NATURAL HERITAGE SITE FOR THE REPUBLIC OF SERBIA

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Abstract: Natural World Heritage site of the *Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe (Albania, Austria, Belgium, Bulgaria, Croatia, Germany, Italy, Romania, Slovakia, Slovenia, Spain and Ukraine)* aims to protect some of the last remnants of the natural and close-to-natural beech forests and to depict the beech post-glacial spread throughout Europe. The Republic of Serbia is among 10 European countries to nominate extension components of this Pan-European World Heritage property, enhancing the representation of the Outstanding Universal Value by adding significant values to the existing property. This paper presents the characteristics of the nominated Serbian components, which include some notable pure-stand and mixed beech forests of great scientific and conservation value, protected by the strict protection regime for several decades as the integral parts of the Kopaonik, Tara and Fruška gora National Parks. Prepared nomination was submitted in January 2020 and is to result with the first Natural World Heritage property for the Republic of Serbia, thus strengthening the protection of individual sites and increasing awareness on their natural values.

***Key words*:** World Heritage, beech forests, Kopaonik, Tara, Fruška gora, UNESCO.

Извод: Добро светске природне баштине под називом *Древне и нетакнуте букове шуме Карпата и других региона Европе (Албанија, Аустрија, Белгија, Бугарска, Хрватска, Немачка, Италија, Румунија, Словачка, Словенија, Шпанија, Украјина)* има за циљ да заштити последње остатке природних и готово природних букових шума у Европи и да представи њихово ширење након последњег леденог доба. Република Србија једна је од 10 европских држава које номинују компоненте за проширење овог пан-европског добра светске баштине, унапређујући тиме репрезентативност изузетне универзалне вредности добра значајним додатим вредностима. Овим радом се представљају карактеристике номинованих српских компоненти, којима су обухваћене неке од изузетних чистих и мешовитих букових шума од великог значаја за науку и заштиту природе, које су више деценија заштићене строгим режимом заштите у оквиру националних паркова „Копаоник", „Тара" и „Фрушка гора". Номинација предата јануара 2020. године треба да резултира проглашењем првог добра светске природне баштине у Републици Србији, доприносећи заштити појединачних локалитета и подизању свести о њиховим природним вредностима.

Кључне речи: светска баштина, букове шуме, Копаоник, Тара, Фрушка гора, UNESCO.

INTRODUCTION

There is no other tree species in the world to play such a dominant and unique role in the zone of nemoral deciduous forests as European beech (*Fagus sylvatica* L.), which has shaped an entire continent in a unique way (Britz *et al.*, 2009). Ancient and Primeval beech Forests of the Carpathians and Other Regions of Europe Natural World Heritage site protects the undisturbed biological and ecological processes of beech forests, their evolution, development and diversity as the most important autochthonous terrestrial ecosystems in Europe.

Ancient and Primeval beech Forests of the Carpathians and Other Regions of Europe (further on: AP BF CORE) World Heritage site tells a comprehensive tale of the post-glacial forest development in Europe, when the beech has re-colonized the continent across variety of environmental conditions, after having survived the alternating Ice Ages in the southern parts of the continent and spread from these refugia to eventually cover large parts of the European continent in a still ongoing expansion process. As such, this site spreads over 78 component parts hosting ancient and/or primeval beech forests on the territories of 12 European countries and 43 protected areas (WHC, 2017; Kirchmeir & Kovarovics, 2016).

This serial transnational property has grown to such complexity over the course of three nominations: the initial inscription in 2007, Slovakia and Ukraine - 10 component parts (Anonymous, 2006; IUCN, 2007; WHC, 2007), and the two inscribed extensions, in 2011: Slovakia, Ukraine and Germany - 15 component parts (Britz *et al.*, 2009; IUCN, 2011; WHC, 2011), and in 2017: Albania, Austria, Belgium, Bulgaria, Croatia, Germany, Italy, Romania, Slovakia, Slovenia, Spain, Ukraine - 78 component parts (Kirchmeir & Kovarovics, 2016; IUCN, 2017; WHC, 2017), but still the representation of the Outstanding Universal Value (further on: OUV) was not complete and the integrity of the site was insufficient in regard to several component parts, particularly in Slovakia.

From the perspective of the OUV of the AP BF CORE World Heritage site, which is aimed to represent the postglacial expansion process of undisturbed beech forests developing in highly diverse habitat conditions, it is important to adequately represent all the beech Forest Regions, which are in line with the climatic and the biogeographic regions, as these are the main factors influencing the development of different beech forest ecosystem types (Kirchmeir & Kovarovics, 2016, 2016a, 2020).

The third extension nomination was submitted to the World Heritage Centre in January 2020 aiming to enhance the integrity of the property and substantially contribute to the attributes which express the OUV of the property. The nomination proposes the extension of the existing property over the 30 additional component parts, as well as boundary modification of the five Slovakian component parts and two component parts from Italy. The extended AP BF CORE World Heritage site would represent a transnational serial property of 108 component parts across 20 countries and 61 protected areas (Kirchmeir & Kovarovics, 2020), and across 11 out of 12 Beech Forest Regions.

Besides preservation of these unique European forest ecosystems for future generations, the conservation of such complex transnational property protecting beech forests by the *Convention concerning the Protection of the World Cultural and Natural Heritage* (further on: World Heritage Convention) will support the related biodiversity conservation, as these forests contain an invaluable genetic reservoir of beech and many other species associated with and dependent on these forest habitats (Kirchmeir & Kovarovics, 2016a).

The 2020 extension nomination includes 8 European countries not represented in the existing property: Bosnia and Herzegovina, Czech Republic, France, Poland, Serbia, Switzerland, North Macedonia and Montenegro. This paper presents the characteristics of the nominated Serbian component parts and argues their significance in aspect to the OUV of the property.

The taxonomic divergence of beech – Moesian beech

During each glacial phase over the last 1 million years, the European beech (*Fagus sylvatica* L.) has survived the unfavorable climatic conditions in refuge areas in the southern parts of the European continent, mostly in secluded habitats of steep mountain areas, providing a high environmental heterogeneity (Kirchmeir & Kovarovics, 2016a). These different refugial populations show genetic differentiation resulting from hundreds of thousands of years of survival in isolation (Magri *et al.* 2006), which led to the formation of different beech ecotypes, varieties and even subspecies (Kirchmeir & Kovarovics, 2016a).

Taxonomic status of beech growing in the Moesian region of the Balkan Peninsula, covering central and southern Serbia, Montenegro, Albania, Bulgaria and Macedonia (Ibisch, 2014), is a controversial and still unresolved issue: some authors treat Moesian beech as a separate species (*Fagus moesiaca* (K. Maly) Czeczott), which is divergent from European beech (*Fagus sylvatica* L.) and Oriental beech (*Fagus orientalis* Lypski), while others treat it as a subspecies of

European beech (*Fagus sylvatica* L. ssp. *moesiaca* (K. Maly) Hjelmquist) (Karadžić, 2018). However, numerous recent genetic studies of beech in Europe challenge the species rank of the Moesian beech (Šijačić-Nikolić, 2018; Ivetić *et al*. 2018).

Mišić (1957) observes gradual change in traits of leaves, flowers and fruits from northwestern to southeastern Europe and considers Moesian beech a phylogenetical link between *F. sylvatica* and *F. orientalis*, as in many morphological and physiological features the Moesian beech is on the transition between European and Oriental beech (Karadžić, 2018; Šijačić-Nikolić *et al*., 2013). Some authors (Stajić *et al*. 2016) consider it a hybrid species, *Fagus* × *taurica* Popl., or even identical to the Crimean beech (*Fagus taurica* Popl.) (Šijačić-Nikolić *et al*, 2013).

The most recent multidisciplinary research done by Šiljačić-Nikolić (2018) using morphological, anatomical and molecular markers concluded that "*the genetic profiles of beech populations from Serbia do not significantly deviate from the genetic profiles of populations from Europe, which indicates that, based on the analyzed sample, beech in Serbia cannot be distinguished as a separate species*".

Characteristics of Serbian forests

Republic of Serbia is situated in the central part of the Balkan Peninsula, with north of the country lying on the rims of the great Pannonian Plain. Danube and Sava rivers split the country into two biogeographic regions: the Pannonian lowland region, forming also an administrative unit - Autonomous Province of Vojvodina, and the continental, predominantly mountainous region of central and southern Serbia.

Forests are dominant vegetation in Serbia, estimated to have covered about 80% of the country until the middle of XIX century (Stojanović, 2005). The current forest cover percentage in Serbia is considered medium level, with 29.1% of the country under forests. Forest coverage between two mentioned regions greatly differs, due to natural and anthropogenic influences - only 7.1% of Vojvodina Province is covered with forests while 37.6% of central Serbia is forested (Ranković, 2009). The dominant growing stock in Serbia are coppice forests, taking 64.7% of the total forest area, followed by natural high forests which cover 27.5%, and lastly, the artificially established stands at 7.8%. In regard to the forest naturalness, majority of Serbian forests are classified as semi-natural (92.1%), while forests with no human interventions account only for 0.1% of the forested area in Serbia (Statistical Office of the Republic of Serbia, 2018; Ranković, 2009).

The ownership structure of Serbian forests favors the state-owned forests at 53% of the forested area, while privately owned forests account for 47% (Ranković, 2009). Public Enterprise „Srbijašume" manages all state-owned forests and provides professional advisory service for the management of privately owned forests in central Serbia, while on the territory of Vojvodina Province the same responsibilities has PE "Vojvodinašume", according to the Law on Forestry ("Official Gazette of RS", No. 30/2010, 93/2012 and 89/2015).

The base of the growing stock are autochthonous tree species: broadleaves – F*agus sylvatica* ssp. moesiaca, Quercus spp., Carpinus spp., *Fraxinus angustifolia*, and conifers – *Picea abies*, *Abies alba*, *Pinus nigra* and *Pinus sylvestris*. The most dominant tree species in Serbia is the Moesian beech (*Fagus sylvatica* ssp. *moesiaca*), accounting for 40.5% intake of total wood volume (Statistical Office of the Republic of Serbia, 2018; Ivetić *et al*. 2018).

Forests in Serbia are classified by mixture into five categories, as follows: pure broadleaf stands (59.0% of the total forested area), mixed broadleaf stands (29.3%), pure coniferous stands (8.7%), mixed broadleaf and coniferous stands (2.4%) and mixed stands of conifers (0.6%) (Statistical Office of the Republic of Serbia, 2018; Ranković, 2009).

In the (semi)arid climate of the lowlands of the Pannonian plain and the Danube, Morava and Sava river valleys, the agricultural fields dominate the fertile lands of the Pannonian and alluvial plains. Alongside them grow the forests of the alliance *Aceri tatarici-Quercion*, as well as the riparian forests along the large rivers. The generally more humid climate of the hilly regions of Serbia, between 300 and 500 (800) m a.s.l., is dominated by the more mesic alliance *Quercion petraeae-cerris* and the more xeric alliance *Quercion confertae*, the latter more frequent in the eastern Serbia (Karadžić, 2018).

The mountainous region of Serbia is usually considered to be between (500) 800 and 1500 (2500) m a.s.l. and is characterized by a humid period in all seasons. Here the Moesian beech forests of the alliance *Fagion moesiace* dominate the lower altitudes up to 1000 m a.s.l. and coniferous forests the high-mountain habitats above 1000 m a.s.l. (Karadžić, 2018). The mixed beech and coniferous forests of the higher elevations in the mountainous regions shouldn't be regarded as a transitional vegetation type, as they represent the climax vegetation on most mountains of the Balkan peninsula, the result of specific climate conditions of the higher elevations in this region of Europe (Mišić, 1965).

Beech forests in Serbia

Beech forests have been spared from clearance and overuse in comparison to the oak forests, as they grow on higher altitudes where human activities are less pronounced, but also due to the long-standing belief that beech wood was of poor quality. Only since middle of XX century the wood processing techniques have discovered the value of the beech wood (Stojanović, 2005).

Beech forests in Serbia today cover 660.400 ha, i.e. 29.3% of total forested area, ranging in altitudes from 40 m a.s.l. at northeast to 2100 m a.s.l. at the southwest of the country (Ivetić *et al*. 2018). The beech dominates the mountain forests of central Serbia and Kosovo and Metohija Province, but is notably absent from Vojvodina Province, where the harsh continental climate of the Pannonian Plain does not allow its spread. The only orographically conditioned suitable habitats for beech forest development in Vojvodina are the northern exposed slopes of two low elevation ridges, Fruška gora Mt. and Vršačke planine Mt. (Mišić, 1965; Ostojić, 2002).

Cvjetićanin (2003) and Stojanović (2005) consider the beech forests in Serbia to belong to the alliance *Fagion moesiacae*, differentiated depending on the habitat conditions into 7 sub-alliances, out of which 4 according to the altitude and 3 according to the edaphic conditions. The first group consists of hilly beech forests (*Fagion moesiacae submontanum*), montane beech forests (*Fagion moesiacae montanum*), beech and fir forests (*Abieti-Fagion moesiacae*) and subalpine beech forests (*Fagion moesiacae subalpinum*), while the second group consists of basophilic beech and hornbeam forests (*Ostryo-Fagenion moesiacae*), basophilic beech and Turkish hazel forests (*Corylo colurnae-Fagenion moesiacum*) and acidophilic beech forests (*Luzulo-Fagenion moesiacae*).

Karadžić (2018) considers the beech forests in Serbia to belong to the *Fagetalia sylvaticae* order and distinguishes the following beech forest alliances in Serbia:

- Submontane beech forests (*Tilio tomentose-Fagion sylvaticae*), distributed mostly in the peri-Pannonian low mountains.
- Beech and hornbeam communities of the alliance *Ostryo carpinifoliae-Fagion sylvaticae*, distributed usually in canyons and gorges of western Serbia, on the ravine habitats and shallow, skeletal soil of colluvial deposits and screes.
- Acidophilic beech forests (*Luzulo-Fagion sylvaticae*) are considered floristically impoverished and occur on silicate acidic soils, in the montane and the high-montane belts.
- Beech forests on neutral or weakly acidic and nutrient-rich soils (*Galio (Asperulo) odorati-Fagion*) are found in the montane regions.
- Beech forests with the relict species *Corylus colurna* (*Fago-Colurnion colurnae*) are usually found in the ravine habitats in eastern Serbia, 700-1200 m a.s.l.
- Mixed forests of beech and conifers, *Abies alba* and/or *Picea abies*, form the *Abieto albae-Fagion sylvaticae* alliance which occurs in high-mountain habitats.
- Beech forests on the highest elevations form the alliance *Calamagrostio arundinaceae-Fagion sylvaticae* in the transitional zone followed by vegetation above the tree line.

According to Stojanović (2005), the total of 39 beech forest associations were recorded in Serbia, representing a great diversity, one of the most prominent in Europe. Although Tomić (2006) has revised this list according to the criteria of International Phytosociological Nomenclature, denominating only 20 basic syntaxonomic categories (associations) of beech forests in Serbia, their diversity is considerable nonetheless.

Karadžić (2018) concludes that beech forests in Serbia appear as more complex and more diverse compared to central-European beech forests, with more than 50 different species detected in the tree and shrub strata of the analyzed forests. Both species richness and entropy, i.e. forest naturalness, were greatest in beech forests of ravine habitats.

Forest management

Close-to-nature forestry has recently become one of the most important ways of ensuring sustainable management of European forests, which generally includes the continuous forest management. This management system foresees silvicultural measures imitating nature and improving its performance. One such system is the selective cutting system, which can be characterized by the natural regeneration, single-tree felling, indigenous tree species, etc. (Matović *et al*. 2019; Willim *et al*. 2019).

Most Balkan countries (Slovenia, Bosnia and Herzegovina, Serbia, Montenegro, North Macedonia, Albania and partially Croatia) have been practicing group selection and selection forest management systems and applying the continuous forest management principle which has preserved naturalness of their forests. Furthermore, Balkan countries have a higher percentage of virgin forests compared to other European countries. Some of these forests in Serbia are protected by certain protection regime, but significant areas of

virgin forests in the rugged mountainous terrains bear no formal protection (Matović *et al.* 2019) and are left undisturbed for their inaccessibility and the erosion control, thus excluded from all forestry planning documents.

Beech forests in Serbia are predominantly managed by the selection and group selection systems. At the beginning of the XX century, beech forests in Serbia were predominantly virgin forests, when the selection system was installed as the main form of beech forest management, until the 1960's, when it was substituted by group selection system. In the 1990's, the shelter-wood management system was installed, but rarely implemented in practice. Recent studies show that the managed beech forests in Serbia have substantially preserved their structural complexity (Matović *et al.* 2019).

MATERIALS AND METHODS

The Beech Forest Regions (further on: BFR) are regarded as delineated by the Screening Study (Ibisch, 2014) which identified 12 BFRs: Atlantic, Pyrenaic-Iberian, Subantlantic-Hercynic, Central Mediterranean, Illyric, Moesian-Balkanic, Alpic, Carpathian, Polonic-Podoloc-Moldovan, Pannonic and Euxinic. After the latest AP BF CORE extension in 2017, which has significantly contributed to the BFR representation in the property, 10 out of 12 BFRs are currently represented, with only the Euxinic and the Pannonian BFR left unrepresented (Kirchmeir & Kovarovics, 2016; WHC, 2017).

The Screening Study has also provided with the inventory of all potential candidate localities for future extensions of the WH property protecting beech forests (Ibisch, 2014), which considered Fruška gora National Park in Serbia as the only suitable component of future extensions in the Pannonian BFR, more specifically Papratski do Forest Reserve, established in 1955 and incorporated into Fruška gora NP upon its designation in 1960. By including this site, the prepared next extension nomination proposal significantly gained in value.

Moesian-Balkanic BFR is underrepresented by the existing property with only two components in the north Albania and one cluster component on the Central Balkan massif in Bulgaria, considering the fact that variability of beech forest communities within each of the BFR is conditioned by differences in the species pool, geological bedrock diversity, soil types, altitudinal zones, etc. (Kirchmeir & Kovarovics, 2016). Existing distribution gap in the current AP BF CORE component composition, as well as the historical significance and the contemporary distribution of beech forests in the Moesian-Balkanic BFR, urged the need to raise the representation of Moesian beech forests within the AP BF CORE series of component parts. As the Moesian region in Serbia holds some exceptional beech forests of great scientific and conservational value, the addition of several components from this region was proposed by the 2020 nomination, bringing the new attributes to further express the OUV of the property.

The criteria for all future extension components have originated from the protection and management sustaining the OUV in each component part and were developing since the initial inscription of the property protecting the European beech forests on the World Heritage list. After the last extension, however, they were clearly defined. In short summary, it is required that all the nominated component parts:

- belong to the larger protected area;
- have a long-standing strict protection regime in the core zone and an adequate protection regime in the buffer zone;
- have the beech comprising more than 30% of the forest, but not the entire core zone area, which can also include the non-forest ecosystems, providing the potential for beech to expand within the component driven by e.g. the climate change;
- be larger than the absolute minimum size reference of 50 ha (WHC, 2017), but preferably much larger;
- possess an "additional value", a characteristic not yet represented by the inscribed components in the same Beech Forest Region.

When setting the criteria, it was taken into account that the capacity of forests to maintain biodiversity may be measured by their coverage and naturalness (EEA, 2016). The long-lasting strict protection of the nominated component parts assures the high naturalness of the forest and its size minimum should ensure the gap dynamics regeneration, as well as the component resilience against the hazardous events. However, as the goal is to protect large, climax beech forest ecosystems, well over the minimum size, thus the nomination of components under 100 ha should be well reasoned.

The minimum size of the component parts of the AP BF CORE property was determined by the 2017 extension inscription Decision 41 COM 8B.7 of the WHC. As the extension nomination included some very small components, the smallest being from Belgium, in the Decision the WHC *„requests the States Parties to consider the future enlargement of components in consultation with IUCN and the World Heritage Centre, to at least the established minimum size of 50 ha, and to strengthen the protection level within buffer zones and the improvement of ecological connec-*

tivity especially between component parts, and further recommends interested States Parties to ensure that component parts included in any future extensions exceed minimum requirements to fully meet integrity, protection and management requirement" (WHC, 2017).

High forest ecosystem naturalness is primary prerequisite for the conservation of forest related biodiversity. Forest naturalness describes how similar a forest is to its natural state, correlates with forest structural diversity and numbers of specialized and often endangered plant and animal species (Winter, 2012), as well as the wood-inhabiting fungi (Abrego *et al*. 2017). Often the only forests of high naturalness are found in the unmanaged protected areas, often referred to as Strict Protection Reserves or Strict Forest Reserves, where only the minimum or no intervention are allowed. Legal protection can be through forest or nature protection legislation, or both, while the land is usually state-owned. Such areas are rare in the forest cover of Europe and vary in size between tens and thousands of hectares, which is largely influenced by the forest region, anthropogenic pressures and natural forest dynamics (Parviainen *et al*. 2000; Sabatini *et al*. 2018).

Beech forest reserves in south and central Europe are often of small sizes, as the dominant driving force of beech forest renewal dynamics are small canopy gaps of under 200 (250) m^2, while medium to large gaps are less frequent (Rugani *et al*. 2013, Glatthorn *et al*. 2018) and most of the canopy changes do not exceed 1200 m2 (Rugani *et al*. 2013). These Forest Reserves, established as early as the beginning of the XIX century, are more often situated on sites unsuitable for cultivation or where logging was unprofitable (Parviainen *et al*., 2000; Sabatini *et al*. 2018).

Natural, undisturbed forests are described as *primeval*, *virgin*, *near-virgin*, *ancient*, *old-growth*, *unmanaged* or *long-untouched*. The FAO uses the term *primary forests* to include all forests of a high naturalness, without implying that these forests were never neither cleared nor disturbed by man (FAO, 2015; Sabatini *et al*. 2018). However, the concept applied in the AP BF CORE property distinguishes beech forest naturalness on two levels, the ancient and the primeval forests (IUCN, 2011, 2017; Britz *et al*, 2009; Kirchmeir & Kovarovics, 2016, 2016a).

Primeval (*virgin*) *forests* are considered to be natural forests, developing throughout their history without human intervention, under natural processes and disturbance regime (Europarc-España, 2017). These forests were never logged and the natural forest dynamics shaped their structure, composition and ecological functions (EEA, 2016).

Ancient (old-growth) forests' state can be considered as "close-to-natural", originating from the undisturbed forest development over a long period of time, with a significant contribution of old trees and dead wood (Wirth *et al*. 2009; Vandekerkhove *et al*. 2009). In other words, the ancient forests have had some human influence in their history, but were able to develop naturally for the last several decades and have regained most of the natural forest characteristics, usually due to the enforcement of protective legislation. In absence of the anthropogenic disturbance, managed (seminatural) forests slowly recover the natural disturbance dynamics and develop those structural features typical for natural forests, although this process takes decades (Sabatini *et al*. 2018; Vandekerkhove *et al*. 2009).

Structural properties which characterize primeval and ancient forests, as well as their associated ecological functions, gradually appear over time as the result of the ecosystem dynamics in a constantly restarting cycle (Europarc-España, 2017; Vandekerkhove *et al*. 2009). Structural complexity of these forests offers variety of suitable habitats for a number of species, leading to ecological complexity of these ecosystems (Barbati *et al*., 2012). With the complex canopy structure influenced by the distribution and age structure of living trees, including large, senescent trees, with standing dead trees and the significant amount of coarse woody debris (CWD) on the forest floor, old-growth forests offer a range of microhabitats supporting rich biodiversity of fungi, lichens, ferns and invertebrates, as well as bird species inhabiting hollowed trees (Barbati *et al*., 2012; Europarc-España, 2017; Christensen *et al*. 2005; Harmon *et al*. 1986). Another indicative structural feature of primeval and ancient forests is the "pit-and-mound" microtopography, which forms when large trees are uprooted (Harmon *et al*. 1986; Wirth *et al*. 2009).

From a functional point of view, these forests are very productive ecosystems, capturing large amounts of solar energy with the stable production of biomass, stocking large amounts of carbon and retaining large quantities of nutrients in both living and dead organic material and lowering soil erosion levels (EEA, 2016; Harmon *et al*. 1986). Such forests provide an intricate horizontal and vertical pattern of ecological niches unavailable in managed forests, thus representing the limiting factor and playing a key role in biodiversity conservation (Barbati *et al*., 2012; Willim *et al*. 2019).

Management of the component parts and the buffer zone

The principles of World Heritage zonation were important criteria for the component parts selection on the basis of the existing national protection and management, while a key issue addressed while preparing the extension nomination proposal was achieving the adequate zonation of the component parts. Following the requirements for a transnational nomination laid down in the Operational Guidelines (UNESCO, 2017) and aiming to achieve the adequate protection of the OUV of the AP BR CORE World Heritage property, the previous nomination and management experience has defined the specific management requirements of the property and its buffer zone (Table 1). Both core and buffer zone need to be nationally protected, with the adequate management structure in place, while the national protection should be in line with the management requirements of the different zones.

Besides the designation of the core zone, i.e. the World Heritage site component part, two sub-zones of the buffer zone were to be delineated in nomination phase as well, as they require different management designed for a specific purpose, even though the nomination dossier regards them as one integral buffer zone. Each core zone of the property should be fully surrounded by the buffer zone, ideally one of a simple shape, evenly distributed around the component part. If multiple component parts are to be nominated within the same protected area, they are to be joined together by a mutual, i.e. shared buffer zone, thus forming a *component cluster*.

The core zone requires a no-intervention management for the protected ancient and/or primeval beech forest to be able to continue the undisturbed development under natural processes and dynamics. Only the core zones are regarded as parts of the World Heritage property.

Protective buffer sub-zone (further on: p-buffer zone) serves the protective function and requires a rather strict management, limited to very small-scale interventions, with no development or use of natural resources allowed. Single trees might be removed for phytosanitary purposes or infrastructure damage risks, but the gaps created must not exceed the size of the crown of an adult beech tree. The protective function is closely related to the threats affecting the component part and requires a present and potential threats analysis when determining its size and design. The p-buffer is in the most cases obligatory, fully surrounding the component, with at least 100 m in diameter. However, if no negative impacts are to be expected from adjacent areas, i.e. when the component border lies across a natural border – a river, lake or a mountain ridge, the designation of the buffer zone is not required as the negative impacts are unlikely to occur beyond these natural borders.

Landscape conservation and sustainable use buffer sub-zone (further on: l-buffer zone) serves to protect the component against the meso-climatic impacts and to provide connectivity between the component parts within the component cluster, as well as the surrounding ecosystems. In some cases, the l-buffer zone can cover entire protected area around the component parts. It is not obligatory for a component to have the l-buffer zone, but it is highly recommended. To achieve the connective function, the forest ecosystems in l-buffer zone need to be managed in a way to conserve natural forest structure, with selective forest management system. The management should aim to increase the forest biomass (living and dead), including the distribution of dead wood, uneven-age stands, natural gap structure, disturbance dynamics and natural regeneration of all tree species of the forest type. The more forest surrounding of the component parts and the higher the biomass of these forests, the higher their buffer capacity against the climate change. Additionally, the l-buffer prohibits the development of settlements, industrial zones, tourist, recreational and traffic infrastructure, extraction of minerals, development of the energetic sector infrastructure (wind parks, dams, pipelines etc.) and the intensification of agricultural land use.

Data and input sources

All data used for the description of nominated components from Tara NP and Kopaonik NP were taken from the Conservation Studies prepared by the Institute for Nature Conservation of Serbia elaborating the reasons behind the national protected area establishment and proposing the protection measures and the protection regimes. Namely, the Conservation Studies of Tara National Park (Ostojić *et al*. 2015) and of Kopaonik National Park (Šehovac *et al*. 2015) were used. However, the information concerning Fruška gora National Park was taken from the Scientific Documentation for Spatial Plan of the Special Purpose Area of Fruška gora National Park for the period up to 2022 (Stojčić *et al*. 2003). Since Fruška gora National Park is located on the territory of Vojvodina Province, the participation of the Institute for Nature Conservation of Vojvodina Province in the component parts selection was required, as this institution governs the nature conservation activities on the territory of Vojvodina Province by the Law on Nature Protection

("Official Gazette of RS", No. 36/09, 88/2010, 91/2010, 14/2016 and 95/2018). The managers of all of nominated protected areas from Serbia where involved in the nomination process as well, having the closest outlook on the state of natural values they are guarding.

The forest communities and alliances, i.e. the phytocoenoses given for these protected areas and the nominated component parts are provided as described in Janković *et al*. (1984), Jovanović *et al*. (1997) and Dinić *et al*. (2006).

Study area

Kopaonik National Park

Kopaonik Mt. is located in southern Serbia. About 40 km wide and stretching over 75 km in the NW-SE direction, it partially lies in Kosovo and Metohija Autonomous Province. Influenced by both continental and submediterranean climate, Kopaonik Mt. has a modified mountainous climate, with long but not so harsh winters. Geological substrate is quite diverse, with the main massif of granitoid rock intermitted with kornites, serpentinites, harzburgites, peridotites, marbles etc. Kopaonik Mt. is rich in metal and mineral ore, extracted here since Middle Ages. Past exploitation was so significant that it even influenced the mountain's name.

Kopaonik NP is located on the central plateau of Kopaonik Mt., surrounded by mountain peaks of over 1600 m a.s.l., including the highest - Pančić's Peak (2017 m a.s.l.). Forests take up 58% of Kopaonik NP total area of 11.969,04 ha and high forests dominate the Park, taking up 96.6% of the Park forests. The undisturbed, natural forests account for almost 12% of the Park area, predominately located on the steep mountain slopes, in and around deep river gorges, the sites which have never been exploited for their inaccessibility and for erosion prevention. Upon designation of Kopaonik NP in 1981, many of these intact natural habitats formed Lvl I PR localities by the adoption of the Spatial Plan of Kopaonik NP in 1989.

Out of 26 tree species recorded in Kopaonik NP, the prevailing are *Picea abies* (58%), *Fagus sylvatica* ssp. *moesiaca* (33%) and *Abies alba* (8%), which form the following pure-stand and mixed forests: spruce forests (37.89%), beech forests (25.35%), beech, spruce and fir forests (14.04%), beech and spruce forests (10.58%), spruce and fir forests (8.56%) and beech and fir forests (3.45%). Diverse natural habitats influenced the high floristic heterogeneity and diversity of 1603 plant and 155 moss species, 91 of which are endemic (3 stenoendemic) and 82 subendemic. Herbaceous vegetation takes 74% of 118 recorded plant associations and forest vegetation 26%.

Kopaonik Mt. is abundant in water, with 165 springs in the Park alone, sourcing a dense hydrographic network of 34 waterways. Samokovska River is the most important watercourse of the Park – 14.8 km long, it flows across the Park in almost all its length and forms several peat bogs and waterfalls on its course. Abundant in mountain rivers forming deep gorges, with dense hydrographic network of mountain springs and streams, large peat bogs, diverse forests, high-mountain meadows and grasslands, Kopaonik NP is a mosaic of well-preserved ecosystems, characterized by an orderly vegetation belt changeover and representing almost all types of central Balkan high-mountain ecosystems. Complex of microrefugia, mostly located in the high mountain peaks and deep gorges, provided Kopaonik NP as one of the hotspots of the endemic high-mountain flora of the Balkan Peninsula, hosting 12% of endemic high-mountain plant species of the Balkan Peninsula.

During the Ice Ages, the forest communities were preserved to a great extent in Kopaonik Mt., due to its geomorphological features and the position on the Balkan Peninsula. Gorges in the high mountains represent one of the most important refugia of Tertiary flora and fauna in the Balkan Peninsula, where microclimate did not change significantly as glacial and interglacial epochs went by and the glaciation impacts were much less pronounced.

High number of relict species distinguishes Kopaonik Mt. as a significant refugial area during the Ice Ages, while glacial relicts indicate that the glaciers once connected Kopaonik Mt. with other high-mountains of Europe and Asia. Tertiary relict species in Kopaonik NP include *Daphne blagayana*, *Acer heldreichii*, *Taxus baccata*, *Asyneuma trichocalycinum*, *Trolius europaeus*, *Jasione orbiculata*, *Cardamine glauca*, *Edrianthus termifolius*, *Ranunculus serbicus*, while the glacial relicts include *Vaccinium uliginosum*, *Eriophorum latifolium*, *E. angustifolium*, *E. vaginatum* and *Leontopodium alpinum*. All the floristic attributes define Kopaonik NP as an Important Plant Area (IPA).

Diverse fauna of Kopaonik NP granted the delineation of Prime Butterfly Area, with 138 butterfly species, including *Colias caucasica* ssp. *balcanica*, *Phengaris* (*Maculinea*) *arion*, *Lycaena dispar*, P*olyommatus eroides*, *Nymphalis vaualbum* and *Euphydryas aurinia*, and Important Bird Area, with 180 recorded bird species, out of which 115 nest in the Park. Other faunistic groups include 9 amphibian species, 11 reptile species and 39 mammal species, 5 of which are bats. Waterways of the Park are characterized by the presence of *Salmo trutta* and *Austropotamobius torrentium*.

Forests of Kopaonik NP form two forest elevation belts: beech forest belt (1000-1550 m a.s.l.), with

Fagetum montanum associations forming on serpentinites, limestones, granite or metamorphic rocks, and spruce forest belt (1550-2000 m a.s.l.), with *Picetum excelsae* associations forming mainly on granite substrate. Beech forests are also present within the spruce forest belt as *Fagetum subalpinum serbicum* and *Aceri heldreichi-Fagetum* forest associations.

Depending on the substrate, exposition and relief, four different types of beech forests are found in Kopaonik NP: *Fagetum montanum* is the dominant one, mostly on silicate or serpentinite substrate; *Luzulo-Fagetum montanum* and *Polytricho formosi-Fagetum* grow on similar, but moister habitats; *Seslerio rigidae-Fagetum* forms on limestone and is found in gorges of Duboka River and Brzećka River.

Spruce forests of *Piceetum excelsae* association form mainly on the granite substrate of the central Kopaonik Mt. plateau, and include *Piceetum excelsae oxalidetosum*, *Piceetum excelsae luzuletosum* and *Piceetum excelsae hylocomietosum* subassociations. However, the highest floristic diversity of spruce forests in Kopaonik NP is recorded on the limestone substrate, notably in the gorges of Gobeljska and Brzećka Rivers (*Arctostaphylleto-Picetum* and *Picetum excelsae daphnetosum blagayanae*). Subalpine spruce forests above 1400 m a.s.l. (*Picetum subalpinum*) represent quite productive old-growth forests.

Tara National Park

Tara Mt. (1591m a.s.l.) is located in western Serbia, on the right bank of the Drina River, bordering Bosnia and Herzegovina. Drina River forms a large bend around Tara Mt. complex, as well as over 1000 m deep canyon, one of the deepest in Europe.

Tara Mt. complex consists of Tara Mt. (sensu stricto) and Zvezda Mt., separated by the Derventa River gorge. These mountains are far-eastern parts of the Dinaric Alps mountain range, with limestone as the main geological substrate, many karst caves, pits and springs. Due to the karst characteristics, the river network is not dense. It should be also noted that the Rača River flows partly underground along its 14.2 km long course, except after a heavy rainfall.

Tara NP spreads over 24.991 ha of heavily forested mountain landscape (>60% of the total area), intermitted with several mountain peaks, plateaus and mountain rivers forming deep gorges. High forests dominate the Park (77.8% of the forests), while the main tree species are *Abies alba* (43.3%), *Fagus sylvatica* ssp. *moesiaca* (30.2%) and *Picea abies* (15.3%), forming *Piceto-Abieti-Fagetum* association which dominates the Park forests at 85%. Main tree species ratio slightly differs in the forests under strict protection regime, where beech is dominant (39.9%), followed by black pine (19.3%), silver fir (12.1%) and spruce (9.1%). Climate of Tara NP is modified humid mountain climate of relatively mild winters.

Tara Mt. has supported forest development throughout Quaternary Period, buffering the effects of the glacial periods by its geomorphological features, forming a complex of secluded microrefugia of favorable abiotic conditions, resulting in high diversity of endemic and relict flora and fauna. Tara NP holds some of the oldest forest ecosystems in Europe, with 4 relict forest communities out of total of 40 recorded in Tara NP. The Serbian spruce (*Picea omorika*), a Tertiary relict coniferous tree species and endemic of the Drina River valley, emphasizes the refugial character of Tara NP. The species was discovered in 1875 by Serbian botanist Josif Pančić, with Tara Mt. as *locus classicus*. All Serbian spruce populations in Tara NP are protected under strict protection regime. The status of Tara NP as Important Plant area is supported by the high floristic diversity of nearly 1200 plant species, 76 of which are endemic, which is partly due to its location on the Balkan Peninsula between Illyric and Moesian floristic provinces.

Fauna of Tara NP is also characterized by a number of relict and endemic species, the most prominent being a relict grasshopper species *Pyrgomorphulla serbica*, now endemic of the Drina River valley, discovered in 1881 by Josif Pančić on Tara Mt. With 115 butterfly species, 23 on the Red list of butterflies of Serbia, Tara NP is considered a Prime Butterfly Area. Ichthyofauna is represented by 28 species, batrachofauna by 10 and herpetofauna by 9 species. Ornithofauna counts 170 species, out of which 120 nests in the Park, which is considered Important Bird Area.

Out of 80 Mammal species, 24 species are bats and over 70% are forest dependent species. Characteristic Mammal species of the Park are *Ursus arctus* and *Rupicapra rupicapra* ssp. *balcanica*, recorded in both component parts. Characteristic bird species of the Tara NP are: *Tetrao urogallus*, *Glaucidium passerinum*, *Aegolius funereus*, *Nucifraga caryocatactes*, *Loxia curvirostra*, *Pyrrhula pyrrhula*, *Certhia familiaris*, *Parus cristatus*, *P. montanus*, *P. ater*, *Regulus regulus*, *Dryocopos martius*, *Accipiter nisus* and *Bonasa bonasia*. The rocky cliffs of canyons and gorges are characterized by the presence of *Aquila chrysaetos*, *Falco peregrinus*, *Alectoris graeca* and *Tichodroma muraria*.

Fruška gora National Park

Fruška gora Mt. (539 m a.s.l.) is a solitary mountain on the southern rim of the Pannonian Plain and the south-western part of Vojvodina Province of the Republic of Serbia, bordered by the Danube and Sava rivers. Located entirely within the Pannonian Plain,

Vojvodina Province is a major agricultural region of the country.

Fruška gora Mt. is a geological-tectonic unit in form of a horst - anticlinal massif raised amidst Pannonian plain and Syrmian lowlands, 85 km long (E-W) and 15 km wide (N-S), forming an outstanding relief feature. Central massif dates from the Paleozoic and Mesozoic Era, while the Tertiary and Quaternary sediments form the substrate of the outer layers. During the Pliocene Epoch, Fruška gora Mt. was an island in the shallow Pannonian Sea, which formed a large sediment deposit and caused the substrate to reveal almost all geological periods, along with the rich fossil fauna of the Pliocene Epoch.

Steppe is the dominant habitat type of the surrounding terrain of Pannonian Plain. However, the harsh, continental climate is altered by the position, altitude and stretch direction of Fruška gora Mt. As the less extreme abiotic conditions gave rise to forests, the cold northern winds are somewhat buffered by the thick forest vegetation of the northern slopes. Microclimatic conditions vary with altitude and topography, with the precipitation ranging 652-833 mm.

Mountain profile is slightly shifted, providing the gradual descent of the southern slopes onto Syrmian loess plateau, while northern slopes descend abruptly onto Danube alluvial plain, with steep inclinations, abrasive terraces and deep river valleys. With 44 permanent waterways and 187 registered springs, Fruška gora Mt. hydrographic network consists of streams and rivers descending down northern and southern slopes. Northern slopes are hydrologically richest, with longer but looser hydrographic network. Soil diversity includes the undeveloped soil (lithosols), pararendzina, rendzina, ranker and various types of chernozem, cambisol and acidic brown soil, as well as alluvial and deluvial soils.

The majority of the mountain has been protected since 1960 as the first designated national park in Serbia, the unique area of preserved unique natural values documented by the biodiversity research dating from XIX century. Forests are the predominant vegetation type of Fruška gora NP, with silver linden (*Tilia tomentosa*), sessile oak (*Quercus petraea*), European beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) as the dominant tree species. Diverse geological and pedological substrate, microclimatic conditions and relief, resulted in over 20 forest associations recorded within the Park. Mixed forests take around 75% of NP area, while around 24% are pure-stand forests. The centuries-long forest use influenced cca. 70% of coppice forests on Fruška gora Mt. The forests of Fruška gora Mt. are still used for wood, grazing and bee-keeping and the surrounding terrain as agricultural fields, orchards and vineyards, except for the strictly protected areas of Fruška gora NP.

Prevailing forests on Fruška gora Mt. are the oak and hornbeam forests (*Querceto-Carpinetum*) in the 300-500 m a.s.l. altitudinal belt, with prominent presence of Tertiary relict species. *Aculeato–Querco–Carpinetum serbicum* is rather xerothermic subassociation while *Hypoglosso–Querco–Carpinetum serbicum* is rather mesothermic. Other well distributed forests include *Quercetum cerris-virgilianae xerphyllum*, *Carpino-Quercetum roboris tilietesum* and *Tilio-Carpino-Quercetum robori-cerris pauperum*. Transitioning habitats between forest and steppe, composed of grasslands interspersed with forest, hedges and shrubs are particularly frequent on the sun-exposed eastern slopes and on the central massif of Fruška gora Mt. mainly as the *Chamaecytiso austriacae-Chrysopogonetum grylli* forest-steppe association.

Beech forests are widespread on the northern slopes of Fruška gora Mt., mainly mixed with linden (*Tilio–Fagetum submontanum*), while pure-stand beech forests (*Fagetum submontanum*) are rare. The cold and humid beech habitat is orographically conditioned on the steep north exposed slopes with deep ridged river valleys and supported by the deep, moist soil around rivers or streams, as well as the dense canopy reducing evaporation. Beech forests (*Fagetum submontanum*) form several forest associations in Fruška gora NP: a widespread *Tilio–Fagetum submontanum*; *Festuco montanae–Fagetum submontanum*, with a rather xerothermic sub-association - *petreae* and a rather mesothermic - *betuli; Musco–Fagetum submontanum*, on the very steep northern slopes with beech ecotype 'microcarpa'; *Festuco drymeiae–Fagetum submontanum*, a transitional forest type between beech and linden and the sessile oak forest; *Acereto–Fraxineto–Carpineto–Fagetum mixtum silicicolum*, a polydominant forest of the wet habitats.

In phytogeographic sense, vegetation of Fruška gora Mt. belongs to the Central-European phytogeographic region, Central-European Balkan-Illyrian sub-region and the Pannonian province. The relict steppe flora and the Pannonian endemic species are prominent floristic feature of Fruška gora Mt., with only few Balkanic endemics. Designation of Important Plant Area was influenced by the great floristic diversity cca. 1500 plants (cca. 1000 in the NP) and 150 moss taxa, as well as by the presence of endangered plant taxa, including 32 out of 64 Orchid species found in Serbia.

Fruška gora is a regional diversity hotspot for a number of animal groups and an important reproductive center of amphibians (13 taxa), reptiles (11 taxa) and mammals (60 taxa, including 17 bat spe-

cies). About 150 bird species was recorded in the Park and close to 220 in the whole mountain area, out of which around 140 are nesting species, which account for Important Bird Area status, while 113 butterfly species account for a Prime Butterfly Area status of Fruška gora Mt. Extensive entomofaunistic research of Fruška gora Mt. has covered different groups, recording around 200 species of conservation importance, including 24 Balkanic endemics (*Pocota personata*, *Cheilosia schnabli*, *Ch. griseifacies*, *Merodon recurves*, *Mallota cimbiciformis* etc.).

During the period of the Ottoman's Empire over 20 orthodox monasteries were raised on Fruška gora Mt., 16 out of which were preserved. For its numerous monasteries, Fruška gora Mt. is often referred to as Serbian Mount Athos, with religious tourism well developed. With 12 out of 16 monasteries located within the Park, the Serbian Orthodox Church owns approximately 1/3 of the National Park forests, while the majority of the rest is state-owned.

RESULTS AND DISCUSSION

The nominated AP BF CORE extension component parts from Serbia include the following strict protection regime, i.e. Level I Protection Regime localities:

- *Zvezda* and *Klisura Rače* in Tara National Park
- *Papratski do* and *Ravne* in Fruška gora NP
- *Kozje stene* in Kopaonik NP.

Component parts in Tara NP and Fruška gora NP form component clusters, while Kozje stene represents a single component within Kopaonik NP.

All the component parts comply with the elaborated selection criteria, all possessing certain additional value for the already inscribed AP BF CORE property, as well as great scientific and conservation values. Beech forests of Fruška gora component cluster will first represent the Pannonian Beech Forest Region within the property. Zvezda component part holds one of the few remaining populations of Serbian spruce (*Picea omorika* (Pančić) Purk.) on the Drina River canyon tops in relict forest association with beech, fir and spruce (*Omorikae-Piceto-Abieti-Fagetum mixtum* Čolić 1965). Rača component part holds relict forest sub-association of beech and walnut (*Fagetum submontanum juglandetosum* Mišić, 1963) on the lowest levels of the Rača River gorge. Kozje stene component will first represent Moesian beech forests on the serpentinite substrate, located in the Samokovska River gorge refuge area, which reflects the relict forest association of fir and spruce with winter heath (*Erico-Abieti-Piceetum* Mišić et Popović 1960), as well as the numerous relict and/or endemic taxa.

Zonation of the Serbian component parts

The management regulations required a p-buffer zone design within the strict regime (further on: inner p-buffer zone) to ensure adequate protection, although slightly diminishing component parts. Otherwise, the restraining requirements of the p-buffer zone (Table 1) would not be in contrast with the management and natural resource use allowed in the Level II and III Protection Regimes of the protected areas in Serbia, as set by the Law on Nature Protection (Official Gazette of RS, No. 36/09; 88/2010; 91/2010, 14/2016 and 95/2018) and the Decree on Protection Regimes (Official Gazette of RS, No. 31/2012), in particular the logging and grazing restrictions of the p-buffer zone, as there would be no legal basis to enforce such protection regime. Designing the inner p-buffer zone of different extent was needed for all five Serbian component parts, while the l-buffer zones incorporate the surrounding Level II and III Protection Regimes (Figures 1, 2 & 3).

The p-buffer zone around component parts in Tara NP is set almost entirely within the strict protection regime, due to the predictable conflicts regarding the use of natural resources in the adjacent areas on privately owned land under Level II and III Protection Regimes. These would include cattle grazing and forest exploitation by private land-owners, the latter also by the state-owned land users in immediate surroundings of the component parts - PE "Nacionalni park Tara" and Rača Orthodox Monastery. However, in the areas surrounding component parts' special values, i.e. Serbian spruce population in Zvezda and the relict forest association of beech and walnut in Rača component part, where these forest communities reach the outer strip of the Level I Protection Regime localities, the p-buffer zone was designed outside of the strict protection regime to provide adequate protection without excluding any part of these significant attributes of the component parts. As possible conflicts would include only these small areas, it is feasible to resolve them upon the inscription in favour of the World Heritage site protection.

The Fruška gora cluster component small sizes prevented additional reducing by the inner p-buffer design. Designing p-buffer zone outside the strict protection regime was possible for the surrounding state-owned forested land and the agreement between its user and the National Park manager, PE "Nacionalni park Fruška gora". However, as the southern borders of both Level I Protection Regime localities, Ravne and Papratski do, lay directly on the trans-mountain public road, with occasional management interventions in the strict protection regime for safety reasons,

the inner p-buffer zone design along the road was needed to protect the World Heritage property. For the sake of sparing the component parts sizes, a 50 m diameter p-buffer zone was designed along the road, the only exception from the p-buffer zone minimum standard of 100 m diameter in the zonation of Serbian component parts.

Kozje stene component in Kopaonik NP part is also surrounded by the state-owned forests used and managed by the PE "Nacionalni park Kopaonik", allowing the p-buffer zonation in the Level II Protection Regime. As the western border of Kozje stene Level I Protection Regime locality corresponds to the National Park border and follows no natural borders, the inner p-buffer zone was required to be designed along it.

Kozje stene component part

Kozje stene component (451.47 ha) largely corresponds to the largest (485.24 ha) and westernmost Level I Protection Regime locality of Kopaonik NP, entirely state-owned. The locality covers the Samokovska River gorge, spreading west to include Kozje stene reef (Figure 4), Kukavica peak and Jadovnik hill. Western border of the locality lies on the National Park border, on the grassland slopes of Jadovnik hill. The surrounding buffer zone (847.86 ha) includes a 100 m diameter patch of Kozje stene locality along its western border and the surrounding heavily forested Level II and III Protection Regime area of Kopaonik NP (Figure 1).

Kozje stene component part belongs to the Raška Municipality in the County of Raška. It was first protected in 1981 when Kopaonik NP was designated by the Law on Kopaonik National Park ("Official Gazette of SRS", No. 41/81). Unaffected by the ski-center development, the only significant human influence was the construction of Mijatovća jaz, an 18 km long irrigation canal traced by a primitive tool to determine the sufficient inclination gradient and constructed by hand tools across this inaccessible terrain in 1928 to supply the waterless land of Žutica village.

Kozje stene component covers steep inclinations, largely 26-35° with ranging altitude between 940 m a.s.l. (Samokovska River) and 1726 m a.s.l. (Kukavica peak). Diverse geological substrate of metamorphic rocks includes Paleozoic serpentinites and Mesozoic kornites, granitoides and marble. Main soli type is shallow and medium deep dystric cambisol, with up to 30% of soil skeleton.

Kozje stene locality has preserved primeval pure-stand and mixed beech forests (*Seslerio-Abieti-Fagetum*, *Piceo-Abieti-Fagetum*, *Fagetum montanum*, *Fagetum submontanum*) on lower elevations in the Samokovska River gorge. The higher elevations are covered by spruce and fir forests (*Piceo-Abietetum serpentinicum*), forming on some parts relict associations with *Erica carnea* (*Erico-Piceetum excelsae*, *Erico-Abieti-Piceetum*), which reflect refugial character of the site. Above spruce forests, the subalpine shrub vegetation of *Piceo subalpinae-Vaccinio Juniperetum* association is dominated by *Juniperus nana*, V*accinium myrtillus*, *V. uliginosum* and *V. vitis-idea*. Between these two belts, *Piceo subalpinae-Juniperetum sibiricae* and *Piceo-subalpinae-Vaccinio-Juniperetum* associations frequently form. Vegetation above the tree line, subalpine and alpine grasslands in the vegetation classes of *Juncetea trifidi* develop on the silicate substrate and *Festuco-Seslerietea* on limestone and serpentinite substrate.

Inaccessibility of these forests, along with long-lasting national protection, has prevented any exploitation works, contributing to high conservation value of Kozje stene locality, which is emphasized by the presence of three stenoendemic species in Kopaonik NP, *Sempervivum kopaonikensis* (syn. *Jovibarba heuffelii* var. *kopaonikensis*), *Cardamine pancicii* and *Viola kopaonikensis*. Other endemic plant taxa in Kozje stene component part include: *Edraianthus graminifolius* agg., *Stachys scardica*, *Cerastium decalvans*, *C. moesiacum*, *Silene parnassica ssp. serbica*, *Linum tauricum ssp. serbicum*, *Saxifraga adsendens ssp. blavi*, *Festuca panciciana*, *Thymus jankae*, *Aquillegia blecicii*, *Viola macedonica* and *Campanula abietina*.

Significant bird species for the component part include *Aquila chrysaetos*, *Circaetus gallicus*, *Pernis apivorus*, *Falco peregrinus*, *Bubo bubo*, *Eremophila alpestris ssp. balcanica*, *Alectoris graeca*, *Scolopax rusticola* etc. As the reintroduction feasibility study of Balkan chamois (*Rupicapra rupicapra* ssp. *balcanica*) in Kopaonik NP has determined the Kozje stene locality to possess the most suitable conditions for reintroduction, which is foreseen by the management plan, as well as the establishment of additional feeding places for carnivores and necrophagous bird species.

Two hiking trails lead through Kozje stene locality, reaching Kukavica peak and Kozje stene reef, the natural viewpoints. Kukavica peak is used regularly by paragliders as a takeoff point, along with other natural highpoints in the Park. Recently, an educational hiking route, Barska reka-Kukavica-Kadijevac was established with the appropriate visitor infrastructure (bridges, fences and resting points) and bilingual (Serbian and English) information boards. A picnic place Đorov most borders the locality, which is easily accessible and often visited by tourists.

Zvezda & Rača component cluster

Zvezda (1873.67 ha) and Rača (215.94 ha) component parts are situated in and around Drina River canyon and Rača River gorge, largely corresponding to the two Level I Protection Regime localities of Tara NP - the largest (2030.18 ha) and the westernmost called Zvezda, covering right slopes of the Drina River canyon and the adjacent parts of Zvezda (Zvijezda) Mt., and the one formed around the Rača River gorge in the far-eastern part of Tara NP, called Klisura Rače (301.80 ha). Rača River forms a valley further downstream, holding the XIII century Serbian orthodox monastery Rača.

Both component parts are within Bajina Bašta Municipality in the County of Zlatibor. Zvezda locality is entirely state owned, while the right bank of Rača River is monastery-owned land and the left bank is state-owned. The extensive buffer zone (4091.99 ha) of mostly heavily forested mountain landscape, with sparse human settlements, pastures and arable land protected under Level II and III Protection Regimes of Tara NP, includes also some the outer parts of the strictly protected localities (Figure 2).

Klisura Rače locality was first nationally protected in 1981 when the Tara NP was designated by the Law on Tara National Park ("Official Gazette of SRS", No. 41/81). Zvezda locality is one of the oldest protected parts of Tara NP. It was excluded from exploitation in all forestry planning documents since XIX century to prevent erosion. It was first nationally protected by the Decision No. 13126/49 of the Ministry of Forestry of the People's Republic of Serbia on permanent protection of forest complex Zvijezda, issued on 24.05.1949 for the conservation of the Serbian spruce population. The Zvezda Forest Reserve was established by the Decision of the Institute for Nature Protection and Scientific Research of Natural Rarities of the People's Republic of Serbia on the State Protection of Zvezda Reserve, issued on 14.10.1950.

Main soli types in the component parts are protorendzina, rendzina and terra fusca. On the steepest inclinations bedrock is uncovered and shallow protorendzina form, while milder inclinations and the ridges between large rocks hold deeper rendzina and terra fusca soil.

The great altitude range in Zvezda component part (220-1440 m a.s.l.) is related to the steep slopes (>35°) of the Drina River canyon (Figure 5). On the canyon slopes, beech inhabits gullies of the rugged slopes with deeper soils, while remaining rocky terrain is dominated by *Ostrya carpinifolia* and *Fraxinus ornus* in *Fraxineto-Carpinetum syringetum* association of low coverage (0.3-0.5), with the tree species frequently of the shrub form. The lower parts of the canyon have *Acer pseudoplatanus*, *Juglans regia* and *Tilia cordata* as accompanying species, with *Taxus baccata*, *Pinus nigra* and *Quercus petraea* around Neveljski Stream. The canyon tops provide the preferred habitat conditions for the Serbian spruce, found in a relict forest association *Omorikae-Piceto-Abieti-Fagetum mixtum*. The adjacent mountain terrain of milder inclinations (20-30°) is under *Fagetum montanum* and *Piceto-Abieti-Fagetum* forest associations of a thick coverage (0.7-1.0).

Rača River gorge is one of the rather deep river gorges of Tara NP, located in the eastern part of the Park. The predominantly inaccessible terrain of steep inclinations (15-35°) varies in altitude 600-1000 m a.s.l. On the lowest levels of the gorge (Figure 6) a relict beech and walnut forest sub-association *Fagetum submontanum juglandetosum* can be found, along with *Fagetum submontanum*, *Musco-Alnetum glutinosae*, *Ostryo-Pinetum nigrae* and *Aceri-Osryo-Fagetum* forest associations, the latter also of a relict character, with walnut as an accompanying species. The milder inclinations are dominated by *Fagetum submontanum* beech forest, with 35 m high beech trees with trunks of over 1m in diameter.

No paths or trails exist in Zvezda component part, but several lead up to the viewpoints above it, including Bilješka stena viewpoint, equipped with adequate safety infrastructure, from where the Serbian spruce population can be observed. Several more natural viewpoints exist atop of Zvezda component part: Drlije, Vidača, Vranovina and Mirzin vidikovac. Klisura Rače locality is also inaccessible for the most part, except for a hiking trail which leads from the Rača Monastery to the Lađevac thermal spring, upon the entering of Rača River gorge where the relict association of beech and walnut grows. The trail is equipped with visitor infrastructure (bridge, fence) and educational information boards. Two more hiking trails lead to the Sokolarica and Gradina fortress viewpoints.

Papratski do & Ravne component cluster

Papratski do (65.36 ha) and Ravne (93.43ha) component parts are located close together on the northern slopes of Fruška gora Mt. forming a cluster component. These are among the last preserved ancient beech forests in the Pannonian BFR, characterized by the unfavourable development conditions. Still, Fruška gora Mt. provides unique habitats where beech grows on deep and moist soils around springs and streams on the northern slopes. Component parts largely correspond to the two Level I Protection Regime localities of Fruška gora NP - Papratski do (71.35 ha) and Ravne (95.69 ha), on the state-owned land within Sremska Mitrovica Municipality in the County of Srem. The surrounding buffer zone of 847.86 ha in-

cludes a 50 m - diameter patch of both localities along their southern borders and the trans-mountain local road, while the rest consists of mixed beech, silver linden and sessile oak forest protected under Level II Protection Regime of Fruška gora NP (Figure 3). An XIX century mansion exists just outside Ravne locality, which was seldom used by the state officials and is currently abandoned.

Geological substrate of the component parts is made of phyllites and soils are loamy and sandy dystric cambisols, moderately deep to deep, structured and with high percent of humus. Papratski do altitudinal range is 400-460 m a.s.l., while in Ravne it is 350-450 m a.s.l.

The preserved natural characteristics of Papratski do locality (Figure 7) led to the establishment of Papratski do Forest Reserve by the Decision No. 345 of the Institute for Nature Protection and Scientific Research of Natural Rarities of the People's Republic of Serbia on the State Protection of Papratski do, issued on 15.11.1955, as the first nationally protected part of Fruška gora Mt. A monodominant beech forest (*Fagetum submontanum*) can be found in some parts of Papratski do component part, along with *Querco–Carpinetum*, *Querco–Fagetum* and *Tilio-Fagetum submontanum* forest associations, developing undisturbed under long-standing strict protection regime as the oldest preserved beech forests of the Pannonian Beech Forest Region, with estimated age of 160 years. Well-preserved beech and linden forest (*Tilio-Fagetum*) in Ravne locality (Figure 8) has been protected since 1960 as part of Fruška gora NP, but the strict protection regime was established in 2004, providing the younger forest, but an important addition to the Pannonian BFR adequate representation, given the lesser sizes of the component parts.

Papratski do is nesting habitat of the birds of prey, including the eagle species *Hieraaetus pennatus* and *Aquila pomarina*. Until recently it was one of the last nesting habitats of *Aquila heliaca* in Serbia, a globally vulnerable species (BirdLife International, 2019), critically endangered in Serbia (Radišić *et al*. 2019). Even though it ceased nesting, individuals were observed in the Park, so the search for active nests is ongoing, while maintaining the winter feeding stations. Reintroduction of the red deer (*Cervus elaphus*) in Fruška gora was carried out just outside Ravne locality in 2009, where the reintroduction of the European bison (*Bison bonasus*) is also intended.

Accessibility of this mountain and the vicinity of the large cities caused frequent tourist, recreational or educational visits and numerous hiking trails and picnic locations. However, there are no hiking routes in the nominated component parts. Visitors center of Fruška gora NP is located in Iriški venac locality, a main tourist spot on the central mountain ridge and the trans-mountain local road.

CONCLUSION

Beech forests represent one of the most significant terrestrial ecosystems in Europe, as well as in Serbia. The diversity and the characteristics of beech forests in Serbia are conditioned by the natural properties of its territory, such as central position on the Balkan Peninsula, a major European refuge area during the Ice Ages, a rich hydrographic network, with the large European rivers passing through, three biogeographic regions represented – Continental, Alpine and Pannonian, as well as the three great mountain chains - the Carpathian, the Rhodope and the Dinaric, with diverse relief and bedrock. Mountainous region of the country holds many refugial habitats, primarily within gorges and canyons, where forest cover was preserved during the glacial periods, providing survival of many forest dependent species.

The homogenous environmental conditions of these refugial habitats allowed the beech to persist, but also lowered the opportunities for its ecological differentiation, accumulating the latent genetic potentials in the beech genotype during the long evolution history of this species. When beech entered the expansion phase after the last Ice Age, its accumulated genetic potential had allowed spread from the refugial areas over a variety of habitats (Mišić, 1965).

The nominated Serbian component parts in the Moesian-Balkanic Beech Forest Region include several refugial ravine habitats in Kopaonik and Tara National Parks. Regardless of the long-standing strict protection regime, ravine forests had hardly ever suffered any significant human influence for their extreme inaccessibility. Surrounded by much more accessible forests, these areas have preserved virgin, primeval forests. Preserved relict beech forest communities of these component pats reflect the character of the beech forest vegetation of the past epochs, significant additional value of the World Heritage property dedicated to present and preserve evolution and diversity of these uniquely European ecosystems.

These selected primeval beech forests will provide better representation of the Moesian-Balkanic BFR, in accordance with its significant historic and present role in the conservation and development of the beech forest ecosystems in Europe. Beech forests in Kozje stene component grow on the serpentinite substrate, which is a characteristic not yet represented in the Moesian-Balkanic BFR, i.e. three already inscribed components in Albania and Bulgaria. It should be

noted that these habitats support great biodiversity, as beech forests show a decline in vascular plant species numbers from refugia in Southern Europe to the north and northwest (Vološčuk *et al*. 2014).

The component cluster of Fruška gora National Park will first represent the Pannonian Beech Forest Region within the property, therefore it represents an important addition to the property, as the only suitable extension candidate in the Pannonian BFR. Fruška gora Mt. was an important refuge area for its surroundings, with persisting forest vegetation on some parts during the glacial ages. The research of loess-paleosol sequences in Fruška gora NP confirmed that paleo-climatic and paleo-environmental oscillations in late Pleistocene were smaller compared to equivalent loess records in central Europe, with alternating steppe and woodland vegetation. Numerous relict species (*Daphne laureola*, *Orobanche hederae*, *Kitaibelia vitifolia*, *Campanula lingulata*), mostly Tertiary relicts, indicate the Ice Age refuge area.

Small component sizes coincide with the extrazonal beech distribution, where it does not form large climax forest ecosystems. Despite small sizes of the component parts, they are important for preserving genetic diversity of beech forest communities in Pannonian BFR environmental conditions. It should be underlined that often small, rear-edge populations are disproportionately important for the long-term survival and evolution of the species, providing an adaptive capacity in face of the climate change which might impact beech distribution in the next 200-500 years. These old-growth beech forest would mitigate the effects of global warming, enhancing the persistence of vulnerable species in mountainous ecosystems, heavily influenced by the global warming (Kirchmeir & Kovarovics, 2016a), as research shows that beech in Serbia will gravitate towards higher elevations in the XXI century (Stojanović *et al*. 2014; Pavlović *et al*. 2019).

Finally, it should be noted that all the participating State Parties are equally responsible for achieving the adequate protection and management of this complex NWH property, which represents a single inscribed entity comprised of many component parts, all contributing to the OUV of the property in their own way. No component part possesses higher significance and they all need to be adequately managed in a coordinated manner. If one component part would be unable to meet the requirements, the listing of a whole property and the rest of its components would be compromised. In order to facilitate the coordinated management, a management system is established with the joint management structure to oversee the management towards the preservation and promotion of the OUV of the property.

TABLES AND FIGURES

Table 1: Recommended management regulations for different zones of the WH property, as set by the Coordination Office of 2020 extension nomination proposal

Land use	Property (WH component part)	Protective buffer zone	Landscape conservation and sustainable use buffer zone
Agriculture			
fields	not allowed	not allowed	small plots (<5%) can be included
hay making, meadows	not allowed	not allowed	small plots (<5%) can be included
pastures, cattle grazing	not allowed	not allowed	small plots (<5%) can be included

sanitary cuts	not allowed	limited to single tree extraction	possible
cutting of firewood by locals (only dead or ill logs)	not allowed	not allowed	possible
sustainable forestry (selective logging, cuttings < 0.3 ha)	not allowed	not allowed	possible
clear cuts >0.3 ha, Shelterwood cuttings > 0.3 ha	not allowed	not allowed	[no joint decision found by now]
artificial restoration (regeneration)	not allowed	not allowed	possible
collecting mushrooms, berries, medical herbs	not allowed	possible	possible
security management along hiking trails (removal dead trees)	not allowed	possible	possible
Hunting and fishing			
game management by protected area management (as long as there is no harm on OUV)	reduced to minimum intervention	possible	possible
Fishing (as long as there is no harm on OUV)	reduced to minimum intervention	possible	possible
Infrastructure			
cellular phone tower, electrical power lines, pipelines	new constructions not allowed, maintenance of existing possible, but reduced to minimum intervention	possible	possible
forest huts, shelters	new constructions not allowed, existing ones shall be reclaimed in the mid term	possible	possible
trails (hiking, riding, biking)	possible	possible	possible
border control infrastructure	new constructions not allowed, maintenance of existing possible	possible	possible
hunting infrastructure	not allowed	possible	possible
hotels, motels, guest houses, restaurants	not allowed	not allowed	small sections can be included (<1%)

industrial buildings	not allowed	not allowed	new constructions not allowed, maintenance of existing possible
forest roads	new constructions not allowed, maintenance of existing possible	new constructions not allowed, maintenance of existing possible	possible
public roads, railway	new constructions not allowed, existing ones shall be reclaimed in the mid term	new constructions not allowed, maintenance of existing possible	small sections can be included (<1%)
settlements	not allowed	not allowed	possible
ski slopes, cable cars, snow machines	not allowed	not allowed	not allowed
watch towers, look-outs	new constructions not allowed, maintenance of existing possible	limited to small scale impact	possible
Natural Hazard Management (water management, protection from avalanches, rock fall …)	possible as long as natural processes in the beech forest are not disturbed	possible as long as natural processes in the beech forest of the component part are not disturbed	possible, as long as natural processes in the beech forest of the component part are not disturbed
Scientific research			
a) destructive (e.g. removing trees for measures)	not allowed	possible	possible
b) not destructive	possible	possible	possible
Tourism and recreation			
expedition to caves	possible	possible	possible
extreme sports (paragliding, climbing, rafting)	should be limited	should be limited	possible
hiking, riding, biking on terrain (not on trails)	should be limited	should be limited	possible
hiking, riding, biking on trails	possible	possible	possible

Figure 1: Zonation of the Kopaonik – Kozje stene component part

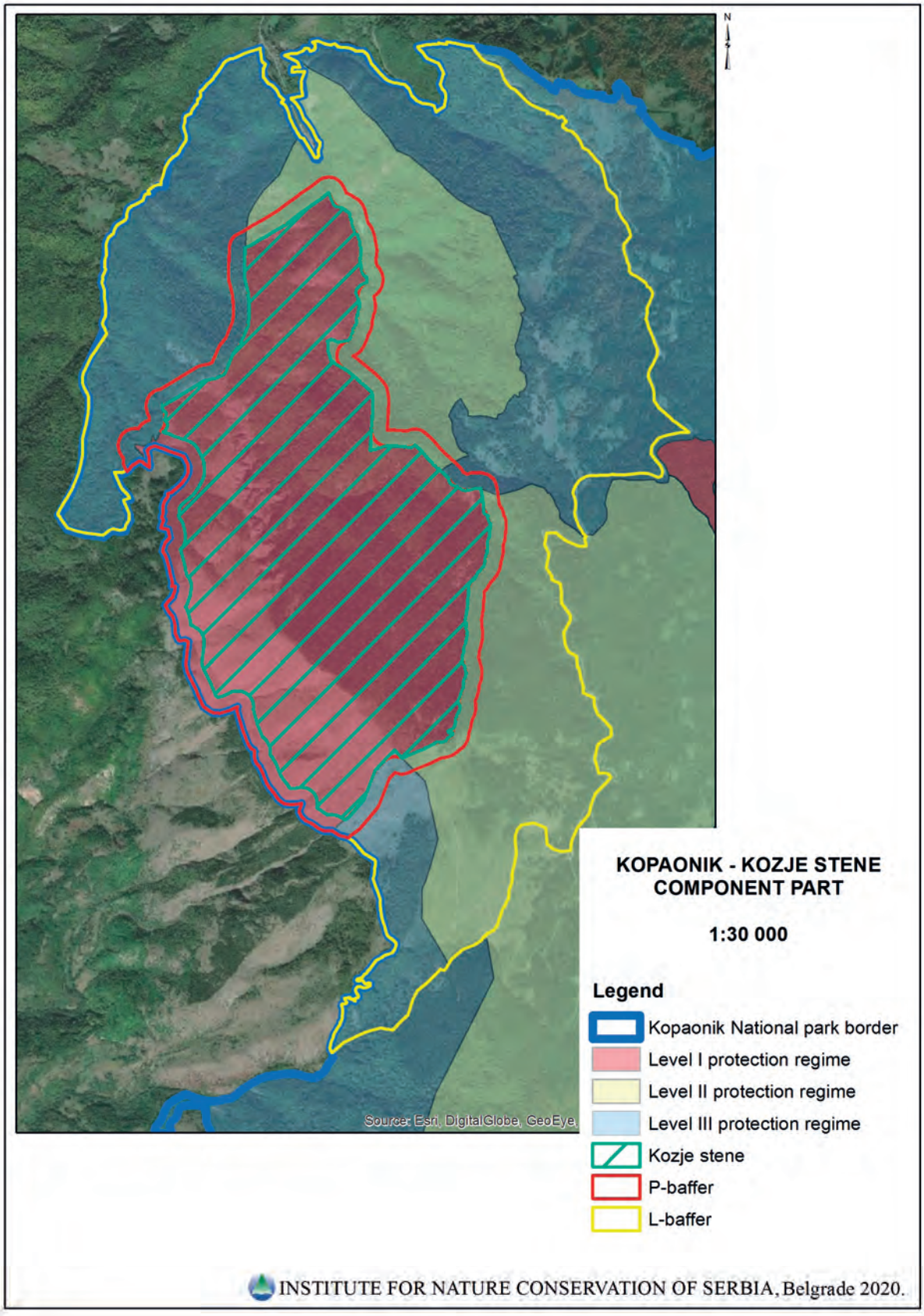

Figure 2: Zonation of the Tara – Zvezda & Rača component cluster

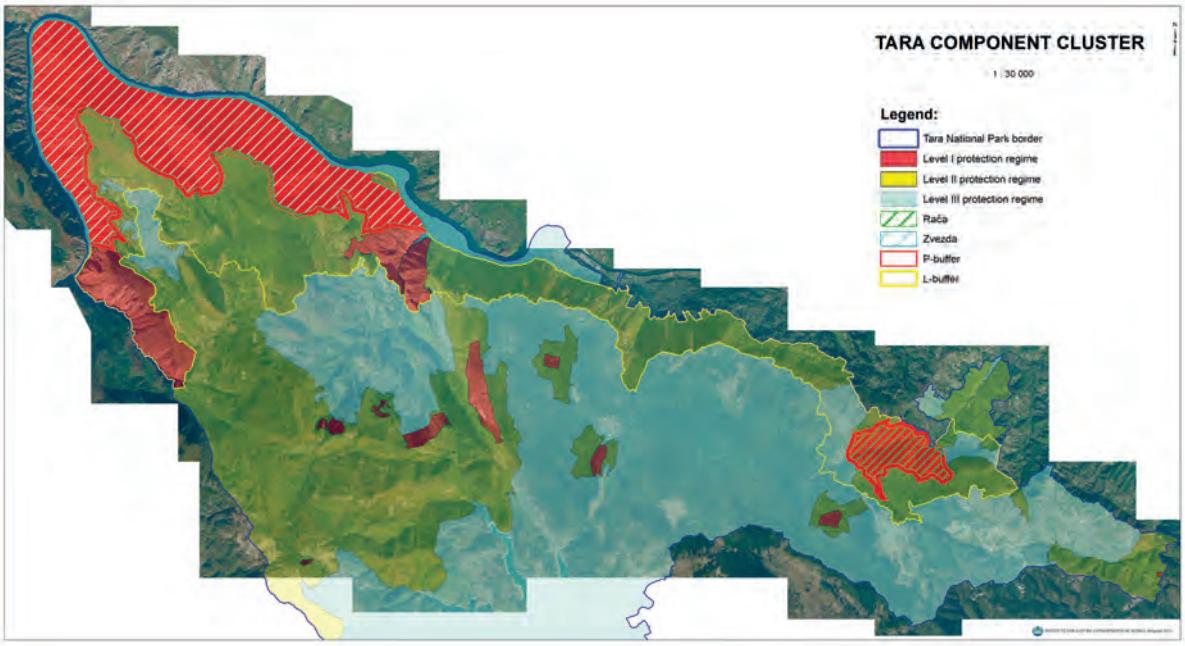

Figure 3: Zonation of the Fruška gora – Papratski do & Ravne component cluster

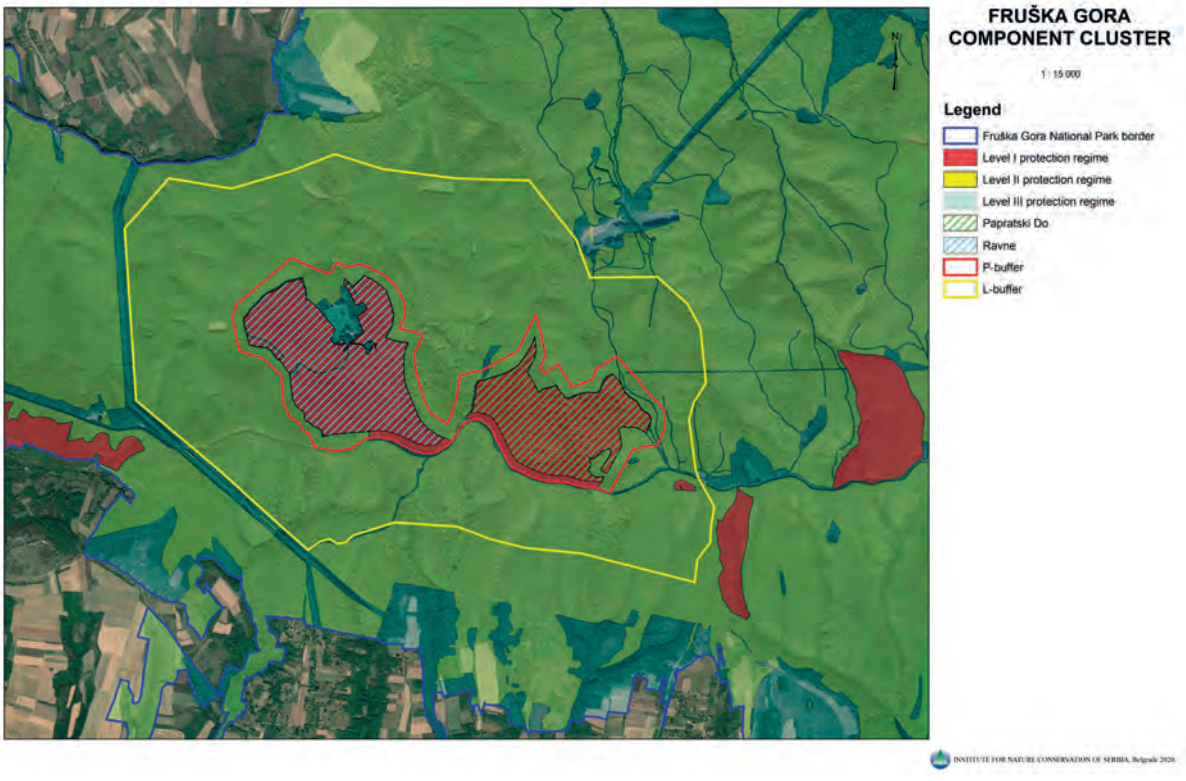

Figure 4: Level I Protection Regime locality of Kopaonik National Park - Kozje stene (Photo: PE "Nacionalni park Kopaonik")

Figure 5: Level I Protection Regime locality of Tara National Park - Zvezda (Photo: Vladimir Mijailović / PE "Nacionalni park Tara")

Figure 6: Level I Protection Regime locality of Tara National Park - Klisura Rače (Photo: Ivana Jovanović)

Figure 7: Level I Protection Regime locality of Fruška gora National Park - Papratski do (Photo: Ivana Jovanović)

Figure 8: Level I Protection Regime locality of Fruška gora National Park – Ravne (Photo: Ivana Jovanović)

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