© by PSP Volume 28 – No. 8/2019 pages 5727-5733 Fresenius Environmental Bulletin

ANALYSIS OF THE FLORISTIC COMPOSITION OF MOUNTAIN BEECH FORESTS ON THE TERRITORY OF SERBIA AND MONTENEGRO

Rajko Milosevic[1,*], Milic Curovic[2], Marijana Novakovic-Vukovic[1]

[1]University of Belgrade, Faculty of Forestry, Belgrade, Serbia
[2]University of Montenegro, Biotechnical Faculty, Podgorica, Montenegro

ABSTRACT

The mountain beech forest represents a vast climate-regional belt of vegetation in Serbia, as well as the most economically important forest type, and takes up a significant area in Serbia and Montenegro. This paper focused on a comparison of the floristic composition of a typical mountain beech forest in Serbia and Montenegro in order to determine the differences between the investigated stands. A total of 12 phytocoenological relevés were analyzed; 7 on Jastrebac (Serbia) and 5 on Biogradska Gora (Montenegro). CCA analysis showed that significant differences are present among the studied stands. Phytocoenological relevés from Montenegro correlated with altitude and assembly, while relevés from Serbia have a correlation with slopes. Differences in floristic composition are mostly due to various tree layering. Stands on Mt. Jastrebac are dispersed, which allow the penetration of light on the terrestrial flora, leading to weed growth. The composition of tree layers is quite dense on Biogradska Gora, thus the shrub layer is poor, whereas terrestrial flora is mainly comprised of species that thrive in areas of little light (sciophytes). In the spectrum of floral elements, species of Central European areal type dominate both sites, which expressed extreme mesophilic characteristics of researched stands. In the spectrum of life forms on Mt. Jastrebac, phanerophytes are dominant due to the large number of species in the tree and shrub layer, while geophytes are dominant on Biogradska Gora as a result of dense tree layering, therefore, the ground flora consists of species that can complete the reproductive cycle before trees begin to bloom.

KEYWORDS:
beech forest, floristic composition, Serbia, Montenegro

INTRODUCTION

Beech forests cover large areas in South Eastern Europe and are on different geological substrates, soils, altitudes, grow in various macro and micro-climate conditions, thus they are very heterogeneous. There are many classifications of beech forests of Southeastern Europe. Horvat [1] first ranked all beech forests, ranging from the Alps to Albania and Greece, in alliance *Fagion sylvaticae illyricum*. However, within such a wide distribution, significant floristic differences exist within the researched stands, thus Soó [2, 3] ranked forests of Southeastern Serbia, Bulgaria and northern Greece in alliance *Fagion dacicum,* which were previously examined in the Carpathian region. Given that many diagnostic species of the alliance were not found in the mentioned areas, the author dubbed these forests 'Moesian Beech Forests' (Moesische-FagionWälder), marking Moesian beech (*Fagus moesiaca*) as a differential type of alliance [4]. All beech forests of Southeastern Europe have recently been classified into two alliances [5]: *Aremonio-Fagion* and *Fagion moesiacae*. Pure and mixed beech forests occupy significant areas in Serbia because beech (*Fagus sylvatica* L. *ssp. moesiaca*) is the most widespread tree species in Serbia; beech forests cover 660,400 ha (29.3%) of the total covered area, of which 64.7% is state-owned [6]. In syntaxonomic sense, beech forests in Serbia are classified into class *Querco- Fagetea* Br.-Bl. Vlieger & 1937, order *Fagetalia silvaticae* Pawlowski and Pawlowski, Sokolowski&Walisch 1928 and alliance *Fagion moesiacae* Blečić & R. Lakušić 1976. The affiliation of beech forest in the alliance *Fagion moesiacae* was confirmed on the area of Biogradska Gora in Montenegro [7] even though Illyrian beech forests *Fagetum montanum sylvaticae montenegrinum* Blečić 1958 were originally described [8] on the area of Piva (Montenegro). Within this alliance, due to a great variety, seven suballiances and a large number of associations were isolated where mountain beech forest has the largest distribution and is economically the most important type of beech forest, and forests in Serbia in general [9]. Mountain beech forest (*Asperulo odoratae-Fagetum moesiacae* B. Jovanović 1973, syn. *Fagetum moesiacae montanum* B. Jovanović 1973) presents a very well defined climate-regional belt of vegetation in Moesia and transitional Illyrian-Moesia Provinces. The community is mainly located on all exposures, at altitudes between 800-

1200 m, and is observed on most mountains of the mentioned areas. The aim of this research was to determine whether there are differences in the floristic composition of a typical mountain forests of beech in two localities in Serbia and Montenegro, given that it amounts to a considerable distance, and investigated sites with specific characteristics in terms of severity synergistic environmental impacts in which these two communities grow.

MATERIALS AND METHODS

Great Jastrebac mountain range stretches between 18 ° 59 'and 19 ° 05' east longitude and 43 ° 24 'and 43 ° 28' north latitude. It belongs to the Rhodope mountain system, and in morphological terms, belongs to the category of high and medium mountains with very expressed relief, locatedat altitudes between 300-1394 m (Figure 1). The average annual temperature is 9. 7^{O}C, the average temperature during the vegetation period is 15.8 ^{O}C. Geologically speaking, the area of Great Jastrebac consists of the highest percentage of granodiorite in its base. Corneits are present on the peaks of the mountain range, and phyllites at somewhat lower altitudes ranging from 950-1000 meters. Acidic brown soils prevail (dystric cambisol), typical acid brown soil, poor skeletal and typical acid brown soil of medium depth and skeletal. Podzolic acid brown soil is less common. Humus-silicate soils are present at higher altitudes: regosol, colluvial and podzolic [10]. Biogradska Gora, along with Mt. Bjelasnica, represent the unique geomorphological unit in Central Montenegro (Figure 1) with peaks over 2000 m, where glacier peaks and cirques with several glacial lakes are present. The average annual temperature is around 2^{0}C, while the mean air temperature in the vegetation period is around 6^{0}C (mountainous areas) to 12^{0}C (lower parts-valley of Tara). The dominant soil type is acid brown soil-dystric cambisol on volcanic surfaces. The geological foundation consists of various volcanic rocks that have effused in this area during volcanic activity in the Middle Triassic and Jurassic period [11].

DATA COLLECTION

For the analysis of floristic composition of the researched area, 12 phytocoenological relevés made using the standard method Braun-Blanquet [12] were done and were taken from literature [10,11]; 7 relevés on Jastrebac and 5 on Biogradska Gora. The stands at both sites, according to syntaxonomic origin, were classified as typical mountain beech forest (*Asperulo odoratae-Fagetum moesiacae* B. Jovanović 1973, syn. *Fagetum moesiacae montanum* B. Jovanović 1973 subass. *typicum*).

Statistical analysis. First, the transformation estimates of abundance and coverage for each species within the phytocoenological relevés were performed by the Van Der Maarel method [13]. CCA analysis of ecological-vegetation data was performed with the help of statistical software CANOCO 4.5 [14]. Monte Carlo permutation test was used to determine the significance of worth (eigenvalue) with appropriate CCA axes. The study calculated 499 randomly selected permutation of the described communities. Syntax names were given according to [15].

FIGURE 1
Geological location of researched sites

The spectrum of floral elements were produced on the basis of systematization of plant-geographic elements after [16], and the life-form spectrum after [17]. Indices of diversity and evenness (Shannon-Wiener diversity index and evenness) were calculated using the program JUICE 7.0 [18]. The Jaccard index of similarity between the investigated communities was also calculated [19] according to formula:

$$J = \frac{UV}{V + U - UV}$$ where

UV- is the number of common species, U, V- is the number of species in the beech and fir forest on Mt. Jastrebac and Mt. Biogradska Gora, respectively.

RESULTS

Statistical analysis. Stands of typical mountain beech forests (*Asperulo odoratae-Fagetum moesiacae* B. Jovanović 1973, syn. *Fagetum moesiacae montanum* subass. *typicum*) on Jastrebac (Serbia) appear at altitudes between 700-960 m, on slopes of 30-35 degrees, and exposure are mostly hidden- N, NW, NE. The stands at Biogradska Gora (Montenegro) are at slightly higher altitudes, between 1150 to 1270 m, on slopes of 20-25 degrees and different exposure-W, NW, S, SW. The graph (Fig. 2) shows that the relevés from Serbia accumulate on the right side, while relevés from Montenegro are on the left side of the chart, which shows that there are significant differences among them, although it is the same association and subassociations.

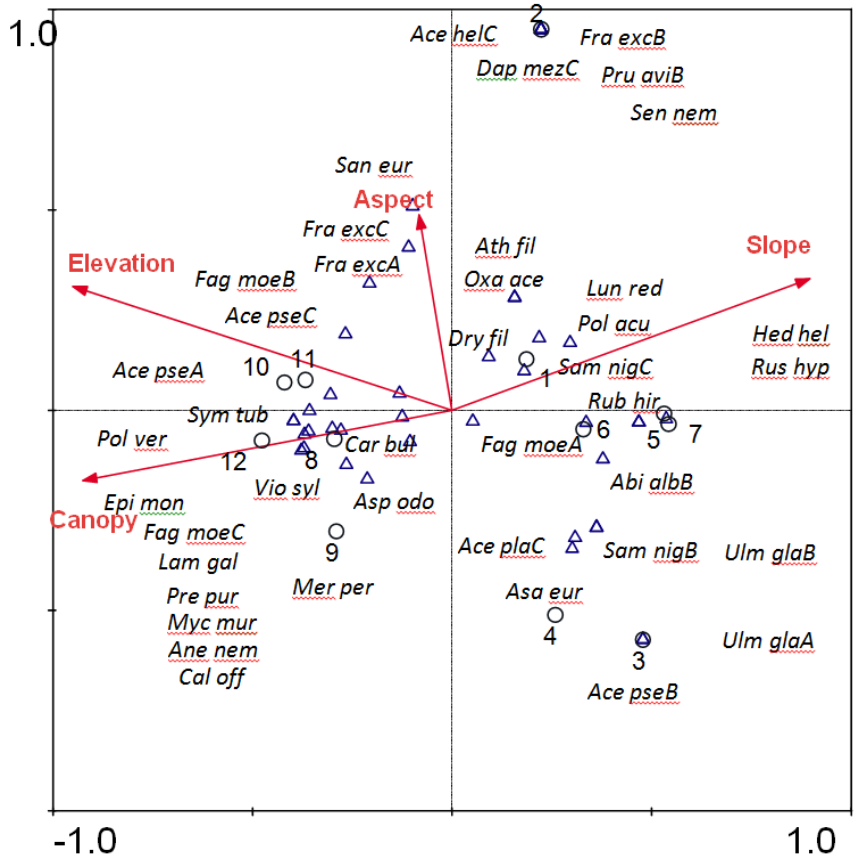

FIGURE 2
CCA ordination triplot, fit range for species 20-40%, 44 species

(○-relevé representation, Δ-species representation;(1-7) – phytocoenological relevés in the mountain beech forest on Mt. Jastrebac (Serbia); (8-12) –phytocoenological relevés of the mountain beech forest on Mt. Biogradska Gora (Montenegro)) Species abbreviations: *Ace hel-Acer heldreichii; Fra exc-Fraxinus excelsior; Dap mez-Daphne mezereum; Pru avi-Prunus avium; Sen nem-Senecio nemorensis; San eur-Sanicula europaea; Fag moe-Fagus moesiaca; Ath fil-Athyrium filix-femina; Oxa ace-Oxalis acetosella; Ace pse-Acer pseudoplatanus; Lun red-Lunaria rediviva; Pol acy-Polystichum aculeatum; Dry fil-Dryopteris fili-mas; Sam nig-Sambucus nigra; Hed hel-Hedera helix; Rus hyp-Ruscus hypoglossum; Rub hir-Rubus hirtus; Sym tub-Symphytum tuberosum; Pol ver-Polygonatum verticillatum; Car bul-Cardamine bulbifera; Abi alb-Abies alba; Vio syl-Viola sylvestris; Epi mon-Epilobium montanum; Asp odo-Asperula odorata; Lam gal-Lamium galeobdolon; Pre pur-Prenanthes purpurea; Mer per-Mercurialis perennis; Myc mur-Mycelis muralis; Ane nem-Anemone nemorosa; Cal off-Calamintha officinalis; Ace pla-Acer platanoides; Ulm gla-Ulmus glabra; Asa eur-Asarum europaeum;* (abbreviation after a species name denotes A- tree layer, B –shrub layer, C-ground flora layer)

Phytocoenological relevés from Montenegro correlated with altitude and assembly, while relevés from Serbia have a correlation with slopes. Exposure is the variable that has the least impact on the community, which isn't a surprise due to the fact that mountainous beech forests are located in all aspects within its areal. It is evident that mostly woody and shrub species are isolated when it comes to relevés from Serbia: *Abies alba, Fraxinus excelsior, Prunus avium, Ulmus glabra, Fagus moesiaca* and others. Due to more open tree layering (0.5-0.7) greater light penetration on the ground flora layer occurred, which led to weed growth and increase inquantity and coverage of blackberry (*Rubus hirtus*), which prevents the development of other species in this layer. On the other hand, a thick strand of tree layers in stands in Montenegro hinders the development of shrub species, however various sciophyt and semiscyophyte species are present in the ground flora layer: *Asperula odorata, Mercurialis perennis, Cardamine bulbifera, Mycelis muralis, Epilobium montanum* etc. Common to both sites is the absolute dominance of the beech trees in the tree and shrub layer, while the ground flora layer varies significantly as a result, primarily to, a different set of tree layers.

Jaccard's similarity index (0.38) shows that among the study stands there is not a great floristic similarity, even though it is the same subassociation.

The spectrum of floral elements. In both researched sites, the spectrum of floral elements (Fig. 3A) absolutely dominated species belonging to Central European floral element, which is an indicator that the community develops in mesophilic conditions of temperate zone. Other floral elements have a similar representation, apart from the elements of northern regions, which in Serbia amounts to 5%, while in Montenegro there are no records.

The spectrum of life forms. The spectrum of life forms (Fig 3B) reveals important differences between the mountain beech stands in Serbia and Montenegro. On the territory of Serbia, phanerophytes are significantly more numerous (41%: 25%) which is result of a large number of species of tree layers and shrubs. On the other hand, geophytes (early flourishing species) are more numerous in stands in Montenegro, nearly two fold compared to Serbia (39%: 18%). This is due to the dense layer of trees (0.9-1.0), where terrestrial plants have insufficient sunlight during the growing season, and therefore, have to complete their reproductive cycle before trees bloom.

Indices of diversity and evenness. The community of mountain beech on Biogradska Gora (Table 1) has a slightly higher diversity index (Shannon-Wiener index) when it comes to ground flora, compared to Jastrebac.However this value is not statistically significant. Evenness index (Evenness index) has approximately the same value at both sites. Blackberry (*Rubus hirtus*) can be labeled as a speciesthat reduces the evenness index value on Jastrebac, whereas *Asperula odorata* and *Lamium galeobdolon* do the same on Biogradska Gora.

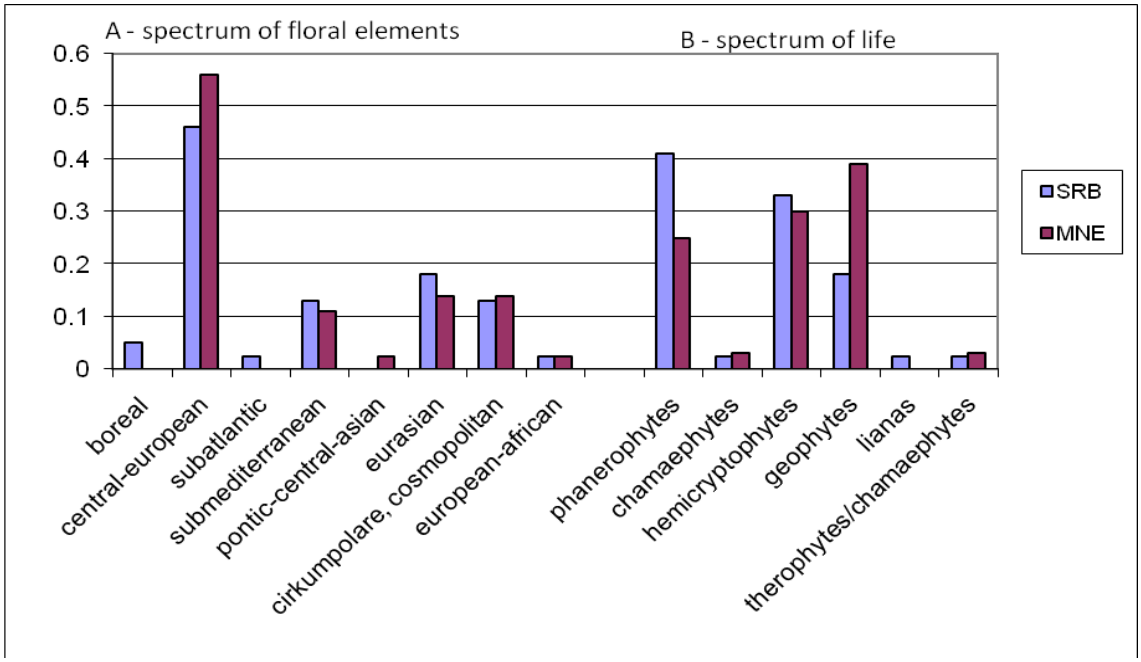

FIGURE 3
Spectrum of floral elements and spectrum of life forms in the mountain beech forests in Serbia and Montenegro

TABLE 1
Indices of diversity and evenness in researched stands

Locality	Average Shannon-Wiener index	Average Evenness index
Jastrebac (SRB)	1.42	0,54
Biogradska Gora (MNE)	1,76	0.60

DISCUSSION

At both researched sites (Jastrebac and Biogradska Gora) fir (*Abies alba*) was found in the shrub and ground flora layer. The presence of young fir is evidence that said community can not be regarded as a pure beech forest, but as a degraded deciduous-coniferous forest *Abieti-Fagetum*. On both mountain ranges forests of beech and fir were observed in the vicinity of pure beech forests, which confirms what was previously said, because over time man cut more fir than beech, thus beech, being biologically more resilient, prevailed. The origin of the secondary forests of mountain beech on some mountain ranges in Serbia was discussed in previous research [9, 15, 20, 21], as well as in Bosnia [22], on the Dinarides [23] and others.

Mountain beech forests occupies large areas on the Balkans. In the area of Galicica (Macedonia), the mountain beech forest (*Calamintha grandiflorae-Fagetum* (Em 1965) Rizovski& Jack's ex Matevski et al. Ass. Nova)) is present on altitudes between 1300-1700 m. This forest is of vast economical importance and has a lot of common species with the researched sites in terms of floristic composition. *Dryopteris filix-mas* (observed on Jastrebac and Biogradska Gora), *Neottia nidus-avis* (recorded on Biogradska Gora) and *Pulmonaria officinalis* (observed on Jastrebac) are all species labeled as diagnostics [24]. The mountain beech forest in Macedonia belongs to the alliance *Doronico columnae-Fagion* Dzwonki et al.1999, Macedonian fir (*Abies borisii-regis*) is a diagnostic type of alliance.

In the area of Mt. Jadovnik (BiH), the community *Fagetum montanum illyricum* Fuk. et Stef 1958. was described, with altitudes ranging from 700m (800m) -1100m (1200) m, on limestones and dolomites [25]. *Cardamine bulbifera, Cardamine enneaplhyllos, Paris quadrifolia, Polystichum aculeatum, Geranium robertianum* and *Oxalis acetosella* are differential types of the subassociation *cardaminetosum* (*typicum*). All of these species were recorded on the investigated localities Jastrebac and Biogradska Gora. The author also concludes that the forests of beech and beech-fir in Jadovnik have great sociological similarities, 55% of species are common to both characteristic sets, spatially very close, grow at the same exposures, slopes and soils, which supports the conclusion that the forests of secondary character beech, with anthropological origins, caused the degradation of beech-fir forests.

Mountain beech forests (*Fagetum montanum illyricum* subass. *typicum*) in Manjaca (BiH) also have great floristic similarities with mountain beech forests in Serbia and Montenegro. It was recorded at altitudes ranging from 920-1000 m. Fir and spruce [26] were introduced to this community via over-seeding. Due to a dense tree layer, ground flora is impoverished. Typical "fagetal" species represent a small coverage and quantity: *Asperula odorata, Dryopteris filix-mas, Mercurialis perennis, Festuca drymeia*. European beech (*Fagus sylvatica*) is an edificatory for this community.

The most common, and the most clearly defined, Illyrian beech forest in Croatia is the community *Lamia orvalae-Fagetum* (I. Horvat 1938) Borhidi 1963 classified in alliance *Aremon-Fagion* (I. Horvat 1938) Török, Podani et Borhidi 1989. It is found in the Dinaric area, between 400 -800 m above sea level, below the beech-fir belt [27]. By floristic composition, this community differs significantly from the mountain beech forests in the Moesia province, because it‘s floristic composition is comprised of a vast number of Illyrian species: *Lamium orvala, Rhamnus fallax, Cardamine enneaphyllos, Hacquetia epipactis*, but also a lot of species that occur in the mountainous beech forest in the Moesia Province: *Polystichum aculeatum, Lonicera nigra, Prenanthes purpurea, Senecio nemorensis, Lilium martagon* and others. The community *Lamia orvalae-Fagetum* in Slovenia represents the zonal vegetation mountainous belt at altitudes between 600-900 m [28]. It is mainly distributed in limestones and dolomites. In Slovenia, this community is of similar floristic composition compared to the mountain forests of beech in the Moesia Province, as can be seen from the combination of diagnostic species: *Acer pseudoplatanus, Ulmus glabra, Acer platanoides, Euonymus latifolia, Sambucus nigra, Athyrium filix-femina, Dentaria bulbifera, Dryopteris filix-mas Oxalis acetosella, Paris quadrifolia,* etc.

CONCLUSION

Mountain beech forests make up an eco-coenological and spatially differentiated whole in terms of developed and formed climate-regional belt. Typical forest community of mountain beech (*Fagetum moesiacae montanum* subass. *typicum*) is most widely spread and the most common within this belt.

There are significant differences in the floristic composition of the plant community between the forest communities typical mountain beech (*Fagetum moesiacae montanum* subass. *typicum*)

on Veliki Jastrebac (Serbia) and Biogradska Gora (Montenegro), although according to the classification they belong to the same association and subassociations.

Jaccard's similarity index (0.38) shows that among the studied stands there is great floristic similarity, even though it is the same subassociations.

It is evident that within the records from Serbia, mostly woody and shrub species are isolated: *Abies alba, Fraxinus excelsior, Prunus avium, Ulmus glabra, Fagus moesiaca* etc., while in the stands in Montenegro on the ground flora many sciophytes and semi-sciophyte species are present: *Asperula odorata, Mercurialis perennis, Cardamine bulbifera, Mycelis muralis, Epilobium montanum*, etc. Common to both sites is the absolute dominance of beech trees in the tree layer.

In the spectrum of floral elements on both studied sites, dominant species belong to Central European floral element, which is an indicator that the community develops in mesophilic conditions of temperate zone. Other floral elements have a similar representation, except for the elements of the northern regions, which in Serbia accounted for 5%, while in Montenegro they are not recorded.

In the spectrum of life forms significant differences between the mountain beech stands in Serbia and Montenegro were observed. On the territory of Serbia, phanerophytes are significantly more numerous (41%: 25%) as a result of a large number of species of trees and shrubs. On the other hand, in stands in Montenegro, geophytes are more numerous, early flourishing species, which is more than doubled compared to Serbia (39%: 18%).

The community of mountain beech on Biogradska Gora has a slightly higher diversity index (Shannon-Wiener index) of ground flora layer compared to Jastrebac, but this value is not statistically significant. Evenness index also has approximately the same value at both sites. Species that reduce the value of the evenness index in the area of in Biogradska Gora are *Asperula odorata* and *Lamium galeobdolon*, whereas in Jastrebac, blackberry (*Rubus hirtus*) is known to reduce the evenness index value.

ACKNOWLEDGEMENTS

This paper was done as a part of scientific project: Sustainable management of the total forest potential in Republic of Serbia" EVBR 37008, Ministry of education and science of Republic of Serbia.

REFERENCES

[1] Horvat, I. (1938) Phytosociological forest research in Croatia. Glas. Šum. pokuse. Zagreb. 6, 127-279 (in Serbocroatian).
[2] Soó, R. (1963) Bulgarian plant communities II. Ann. Univ. Sci. Budapest, Sect. Biol. 6, 175-186 8 (in German).
[3] Soó, R. (1964) The regional Fagion-alliance and associations of SE Europe. Stud. Biol. Acad. Sci. Hung. 1, 1-104 (in German).
[4] Tzonev, R., Dimitrov, M., Chytrý, M., Roussakova, V., Dimova, D., Gussev, C., Vulchev, V., Pavlov, D., Vitkova, A., Gogoushev, G., Nikolov, I., Borisova, D., Ganeva, A. (2006) Beech forest communities in Bulgaria. Phytocoenologia. 36(2), 247-79.
[5] Marinšek, A., Šilc, U., Čarni, A. (2013) Geographical and ecological differentiation of Fagus forests vegetation in SE Europe. Appl Veg Sci. 16, 131-47.
[6] Banković, S., Medarević, M., Pantić, D., Petrović, N. (2009) The national inventory of forests of Republic of Serbia-Republic of Serbia Fund of Forestry. Ministry of agriculture, forestry and water of Republic of Serbia-Forest management, Belgrade. 244p (in Serbian).
[7] Blečić, V., Lakušić, R. (1970) Der Urwald Biogradska gora in Gebirge Bjelasica in Montenegro. Akad. Nauka Umjet. Bosne Herceg, Poseb. Izd.15,131-9.
[8] Horvat, I., Glavač, V., Ellenberg, H. (1974) Vegetation of Southeast Europe. Geobotanica selec-ta. Gustav Fischer Verlag. Stuttgart. 767p (in German).
[9] Mišić, V. (1997) The suborder of beech forests in Serbia. In: Sarić, R.M. (ed.) The vegetation of Serbia II. Forest communities 1. Belgrade: Serbian Academy of sciences and arts. 159-270.
[10] Milošević, R. (2006) Definition of beech and beech-fir forest types in Mt. Veliki Jastrebac. PhD thesis. University of Belgrade, Faculty of Forestry. Belgrade. 333p (in Serbian).
[11] Čurović, M. (2010) Forest types in NP Biogradska Gora. [dissertation]. [Belgrade]: University of Belgrade, Faculty of Forestry. 121p (in Serbian).
[12] Braun-Blanquet, J. (1964) Phytosociology. Basics of Vegetation Science. 3rd ed. Springer, Wien. New York (in German).
[13] Van der Maarel, E. (1979) Transformation of cover-abundance values in phytosociology and its effects on community similarity. Vegetatio. 39(2), 97–114.
[14] Lepš, J., Šmilauer, P. (2002) Multivariate analysis of ecological data. Faculty of biological sciences, University of south Bohemia, České Budějovice.

[15] Tomić, Z., Rakonjac, L.j. (2013) Forest phytocenoses of Serbia. A manual for foresters, ecologists and biologists: University Singidunum, Faculty of Applied Ecology Futura, Institute of Forestry, Belgrade. 177p.
[16] Gajić, M. (1980) Synopsis of flora species of FS Serbia with phyto-geographical marks. The Herald of Faculty of forestry. Belgrade. 54(A), 111-41 (in Serbian).
[17] Kojić, M., Popović, R., Karadžić, B. (1997) Vascular plants of Serbia. Belgrade: Institute for agricultural research „Srbija“, Institute for biological research „Siniša Stanković“: 160p (in Serbian).
[18] Tichý, L. (2002) JUICE, software for vegetation classification. J. Veg. Sci.451-3.
[19] Chao, A., Chazdon, R.L., Colwell, R.K., Shen, J. (2005) A new statistical approach for assessing similarity of species composition with incidence and abundance data. Ecol. Lett. 8, 148-159.
[20] Jovanović, B. (1955) Forest phytocenoses and habitats of Mt. Suva planina. The Herald of Faculty of forestry. Belgrade. 9, 3-101 (in Serbian).
[21] Gajić, M. (1960) Present and past habitats of beech-fir forests (Abieto-Fagetum Jov.) in Šumadija. Šumarstvo. Belgrade. 13(1-2), 65-70 (in Serbian).
[22] Beus, V. (1984) Vertical analysis of forests in light of relation of real and primary vegetation in Yugoslavia. ANUBiH. Sarajevo. Radovi. LXXXVI(23), 23-32 (in Serbocroatian).
[23] Diaci, J., Roženbergar, D., Mikac, S., Anić, I., Hartman, T., Bončina, A. (2007-08) Long-term changes in tree species composition in old-growth Dinaric beech-fir forest. Glas. Šum. pokuse. Zagreb. 42(1), 13-27.
[24] Matevski, V., Čarni, A., Avramoski, O., Juvan, N., Kostadinovski, M., Košir, P., Marinšek, A., Paušič, A., Šilc, U. (2011) Forest Vegetation of Galičica Mountain Range in Macedonia. Biološki inštitut Jovana Hadžija ZRC SAZU, Makedonska akademija na naukite i umetnostite. 200p.
[25] Bucalo, V. (1994) Forest vegetation of mountain Jadovnik in western Bosnia. [dissertation]. [Belgrade]: University of Belgrade, Faculty of Forestry. 481P (in Serbian).
[26] Eremija, S. (2008) Phytocoenological characteristics of beech forests in Manjača. The Herald of Faculty of forestry. Belgrade. 98, 89-106 (in Serbian).
[27] Vukelić, J., Baričević, D. (2002) Recent phytocoenological findings of beech forests in Croatia. Sumar list. 9-10, 439-57 (in Croatian).
[28] Marinček, L., Čarni, A. (2002) Commentary to the vegetation map of forest communities of Slovenia in a scale of 1:400 000. Biološki inštitut Jovana Hadžija ZRC SAZU. Ljubljana. 120p.

Received: **31.10.2017**
Accepted: **01.05.2019**

CORRESPONDING AUTHOR

Rajko Milosevic
Faculty of Forestry,
University of Belgrade,
Kneza Višeslava 1,
11 000 Belgrade – Serbia

e-mail: rajko.milosevic@sfb.bg.ac.rs