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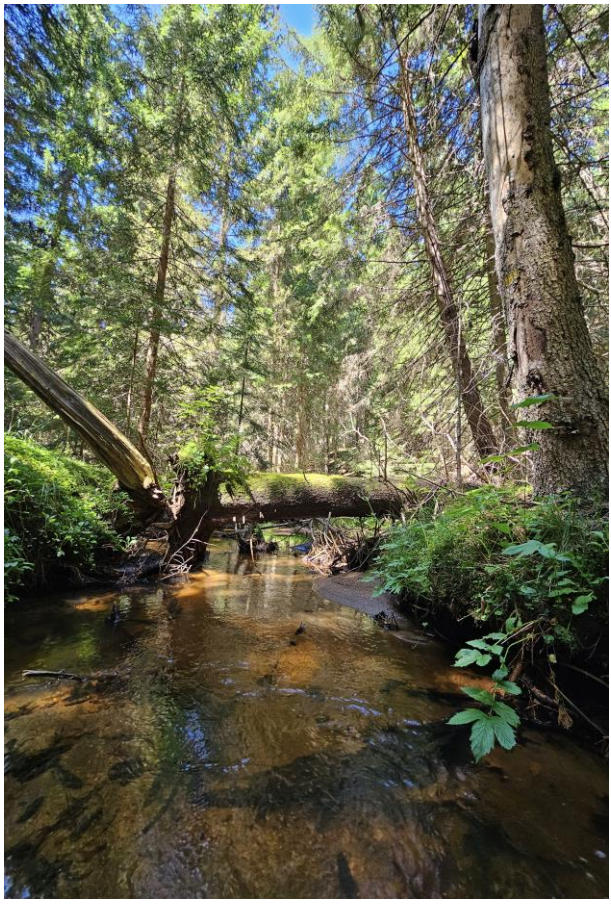

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PLANT SPECIES AS HABITAT INDICATORS IN BEECH FORESTS FOLLOWING CLEARCUTTING

Branka PAVLOVIĆ[1], Vlado ČOKEŠA[1], Snežana STAJIĆ[1],Violeta BABIĆ[2], Zoran PODUŠKA[1], Nikola MARTAĆ[1], Branko KANJEVAC[2]*

Abstract: *In the winter of 2015, extensive damage affected forest ecosystems in eastern Serbia due to severe ice-induced tree breakage and falls. As a result, clearcutting was necessary in certain forest stands. This study evaluates the ecological characteristics of plant species that emerged on clearcut sites five years after clearcutting. The research was conducted within the Timok Forest Region, encompassing both natural beech stands and artificially established conifer plantations on beech sites (Helleboro odori-Fagetum moesiacae Soó & Borhidi 1960). This investigation focuses only on the stocked areas within the Timok Forest Region (natural forests and artificially established stands) managed by the state-owned company "Srbijašume" in Belgrade. Vascular flora was categorised based on their affiliation with specific ecological plant groups according to the following key environmental parameters: soil moisture (V), soil acidity (K), nitrogen availability (N), light (S), and temperature (T). Spontaneously colonised plants, serving as bioindicators, reflect changes in ecological (particularly microclimatic and edaphic) conditions. Additionally, these bioindicators reveal the degradation of forest habitats post-clearcutting, which manifests as increased light penetration, xerothermic microclimatic shifts, surface soil acidification, and diminished nutrient availability.*

Keywords: Timok Forest Region, beech habitat, phytodindicators, ecological factors, forest degradation.

BILJNE VRSTE KAO INDIKATORI STANIŠTA BUKOVIH ŠUMA NAKON ČISTE SEČE

Apstrakt: *Na području istočne Srbije u zimu 2015. godine, u šumskim ekosistemima nastale su štete velikih razmera u vidu ledoloma i ledoizvala. U pojedinim satojinanama morala je biti izvedena čista seča. U radu su analizirane ekološke karakteristike biljnih vrsta koje su se pojavile na sečinama pet godina nakon izvršene čiste seče. Istraživanja su vršena u Timočkom šumskom području, u prirodnim bukovim i veštački podignutim sastojinama četinara na bukovom staništu (Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960.*). Predmet ovog istraživanja su samo obrasle površine Timočkog ŠP (prirodne šume i veštački podignute sastojine) u državnom vlasništvu kojima gazduje JP „Srbijašume“Beograd. Izvršeno je diferenciranje vaskularne flore na osnovu pripadnosti određenoj ekološkoj grupi*

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biljaka, prema najvažnijim ekološkim faktorima: vlažnost zemljišta (V), kiselost zemljišta (K), količini azota u zemljištu (N), svetlosti (S) i temperaturi (T). Spontano naseljene biljke, kao indikatori ukazuju na promene ekoloških (pre svega mikroklimatskih i edafskih) uslova. Takođe ukazuju i na degradaciju šumskih staništa nakon čiste seče koja se manifestuje kroz veći priliv svetlosti, kserotermizaciju mikroklime, zakišeljavanje zemljišta u površinskim slojevima i slabiju obezbeđenost hranljivim materijama.

Ključne reči: Timočko šumsko područje, bukovo stanište, fitoindikatori, ekološki faktori.

1. INTRODUCTION

The continental climate in the Timok Krajina region of eastern Serbia frequently results in ice formation. In the winter of 2015, an influx of extremely cold air masses from the east and the Carpathians led to substantial ice accumulation on infrastructure and forest trees (Pavlović et al., 2022). The large quantities of ice (weighing several tons per tree in some cases) exceeded the structural resilience of the trees, resulting in widespread ice breakage and tree falls (Marković et al., 2018). The most severely impacted forest management units (FMUs) in the Timok Forest Region included: MU Rtanj, MU Tupižnica, MU Šaška – Studena – Selačka Reka, MU Zaglava I, MU Tresibaba, MU Vrška Čuka – Babajona – Treći Vrh, MU Markov Kamen – Mečji Vrh, MU Čestobrodica, MU Dubašnica, MU Zaglavak II, and MU Stol (Pavlović et al., 2023). The severe weather events in certain parts of the Timok Forest Region caused extensive damage, necessitating clearcutting on more than 1,200 hectares of forest stands (Pavlović et al., 2023).

Knowledge of the ecological conditions specific to each habitat is crucial for selecting appropriate tree species when restoring degraded forest sites and reforesting cleared areas (Krstić, 2000). The more closely the ecological requirements of selected species align with site conditions, the more successful the reforestation and rehabilitation of degraded areas will be (Kojić et al., 1997). It is well-established that each plant species thrives only within specific habitat parameters, making it a reliable ecological indicator of environmental conditions. Therefore, by analysing the floristic composition of a plant community and the bioindicator values of the species it comprises, it is possible to determine the ecological conditions of a given habitat.

Numerous researchers have investigated the relationship between plants and environmental conditions, as well as the indicator role of plants and plant cover. The foundations of bioindicator ecology were laid by Linnaeus (1751), who, in his seminal work *Philosophia Botanica*, classified several groups of indicator plants. The term bioindicator was first introduced by Clements (1920) to denote organisms that, through their presence in a specific habitat, clearly reflect its ecological characteristics. Raunkiaer (1934) emphasised plant life forms as significant indicators of habitat conditions, especially climatic factors. The phytogeographical analysis and spectra of plant life forms discussed in this paper have been previously conducted. (Pavlović et al., 2024). Ellenberg made a profound impact on the field of indicator geobotany by introducing ecological indices as quantitative indicators of individual plant species' ecological relationships with habitat conditions (Kojić et

al., 1997). Building on this, Swiss phytoecologist Landolt (1977) developed ecological indices for ten specific factors as indicators of ecological conditions. Hungarian phytoecologist Soó (1980) also made considerable contributions to the field. Ecological indices for the native flora of Serbia were established by Kojić et al. (1994, 1997).

This study focuses on natural stands of submontane beech forests (*Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960) and artificially established stands within sites of this community. It also investigates the ecological changes in beech habitats five years following clearcutting in the Timok Forest Region. The primary aim is to identify the ecological characteristics of plant species, which serve as bioindicators of habitat conditions in these stands. According to Tomić and Rakonjac (2013), the *Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960 subassociation encompasses sub-Pannonian beech forests found at lower altitudes across sites ranging from Gučevo and Cer, through Šumadija, Avala, Fruška Gora, and Đerdap, reaching into the Timok Krajina.

2. MATERIALS AND METHODS

To assess ecological changes in stands affected by clearcutting, eight sample plots of 1,000 square meters each were established at various sites within the Timok Forest Region. These plots were placed in forests managed by "Srbijašume" State Enterprise from Belgrade, specifically within the FE "Timok Forests" Boljevac. The plots covered altitudes ranging from 580 to 830 meters, predominantly on cool, north-facing slopes typical of beech forests, with slopes varying from 5° to 32°. The bedrock included carbonate and silicate formations; on carbonate substrates, soils were classified as eutric brown (Calcaric Cambisol), while on silicates, they were acidic brown (Dystric Cambisol). All plots were within the submontane beech forest community (*Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960). Four plots were located in areas previously occupied by natural beech stands (within the Tresibaba, Šaška-Studena-Selačka Reka, and Čestobrodica Forest Management Units). The remaining four plots were established in areas where artificial coniferous stands had been planted on beech habitats (within the Zaglavak I, Šaška-Studena-Selačka Reka, and Rtanj Management Units).

For each plot, baseline ecological conditions were recorded, and a survey of vascular flora was conducted based on sample methods to systematise the floristic composition in areas subjected to clearcutting. Species identification was conducted using the keys provided in *Flora of the Socialist Republic of Serbia*, Volumes I-IX, Josifović, ed. (1970-1977). Plant species were then categorised into ecological groups based on critical environmental factors: soil moisture, soil acidity, soil nitrogen content, light requirements, and temperature preferences. This classification utilised the ecological indices for Serbian flora developed by Kojić et al. (1997).

3. RESULTS AND DISCUSSION

Table 1 presents the forest management units (FMUs), compartments, and subcompartments (C/SC) where sample plots (SPs) were established. Key ecological conditions include altitude (ALT), aspect, average slope, bedrock, and soil type.

Stand characteristics are represented by origin classification—either natural beech stands or artificially established stands (AES) on beech sites.

Table 1. *Spatial Data and Basic Ecological Conditions at Sample Plots (SP)*

SP	MU	C/SC	Alt.	Aspect	Slope (°)	Origin	Bedrock	Soil type
1	Zaglavak I	28b	695	W-WS	20	AES	amphibole-biotite plagiogranites	Dystric Cambisol
2	Tresibaba	46b	714	N	10	natural	limestone	Calcaric Cambisol
3	Šaška-Studena-Selačka reka	40c	761	SW	30	AES	amphibole-biotite plagiogranites	Dystric Cambisol
4	Šaška-Studena-Selačka reka	25a	823	NW	25	natural	phyllitoids and greenstones	Dystric Cambisol
5	Čestobrodica	90g	582	N-NE	12	natural	organogenic limestone	Calcaric Cambisol
6	Rtanj	29a	779	N	25	AES	limestones	Calcaric Cambisol
7	Rtanj	28c	675	NE	5	AES	limestone breccia	Calcaric Cambisol
8	Čestobrodica	100/1	575	E	32	natural	conglomerates and sandstones	Dystric Cambisol

Source: *author*

Table 1 indicates that the stands most affected by ice-induced tree breakage and falls are situated at elevations between 580 and 830 meters, with cold exposures, primarily north-facing, typical of submontane beech forests. Slopes in these areas range from 5° to 32°. The bedrock across the study area varies from carbonate to silicate. On carbonate bedrocks, the soil type is eutric brown (Calcaric Cambisol), whereas on silicate bedrocks, it is acidic brown (Dystric Cambisol).

A survey of vascular flora on clearings recorded 176 taxa of vascular plants (Pavlović et al., 2023). Typical of submontane beech forests, the site supports mesophilic species from lower elevations as well as xerophytic elements from neighbouring oak forests. In addition to beech young growth (*Fagus sylvatica* ssp. *moesiaca* (Maly) Czeczott), characteristic species include *Lamium galeobdolon* (L.) Crantz, *Cardamine bulbifera* (L.) Crantz, *Acer campestre* L., *Helleborus odorus* Waldst. & Kit., *Mycelis muralis* (L.) Dum., *Circaea lutetiana* L., *Stachys sylvatica* L., *Carex sylvatica* Huds., and *Moehringia trinervia* (L.) Clairv.

Among the accessory species observed, many are characteristic of beech forests, such as *Dryopteris filix-mas* (L.) Schott, *Alliaria officinalis* (M. Bieb.) Cavara & Grande, *Tamus communis* L., *Viola odorata* L., *Geranium robertianum* L., *Hedera helix* L., *Euphorbia amygdaloides* L., *Sambucus nigra* L., *Viola sylvestris* Lam., *Ruscus aculeatus* L., *Prunus avium* L., *Bilderdykia convolvulus* (L.) Dumort., and *Polygonatum odoratum* (Mill.) Druce (Stajić et al., 2018).

3.1. Species affiliation and relationships with ecological factors

Understanding the ecology, or the relationship of forest trees to environmental conditions, as well as the biological characteristics of species, is of great importance in forest cultivation. This knowledge forms a solid foundation for selecting appropriate silvicultural approaches, treatment methods, and strategies for natural regeneration and forest care (Krstić, 2003). As previously noted, species classification into specific ecological plant groups was determined based on their indicator values for the analysed factors, as outlined by Kojić et al. (1997).

Table 2. *Ecological Factors and Plant Ecological Groups*

Ecological factor	Plant Ecological Group (index and classification)
Soil moisture	1. Xerophytes
	2. Subxerophytes
	3. Submesophytes
	4. Mesophytes
Soil Acidity	1. Acidophiles
	2. Acidophilic-Neutrophiles
	3. Neutrophiles
	4. Neutrophilic-Basophiles
	5. Basophiles
Soil Nitrogen Content	1. Oligotrophs
	2. Oligotrophic-Mesotrophs
	3. Mesotrophs
	4. Mesotrophic-Eutrophs
	5. Eutrophs
Light Requirements	1. Sciophytes
	2. Sciophytes-Partial Sciophytes
	3. Partial Sciophytes
	4. Partial Sciophytes-Heliophytes
	5. Heliophytes
Temperature Preferences	1. Frigoriphiles
	2. Frigoriphiles-Mesophiles
	3. Mesophile
	4. Mesophile-Thermophile
	5. Thermophile

Source: *author*

3.1.1. Plant Distribution by Soil Moisture Levels

The moisture index indicates the average soil moisture during the growing season, with low values representing dry conditions and high values indicating increased moisture (Landolt, 1977). Analysis of the ecological moisture index values reveals that in the submontane beech forest community (*Helleboro odori-Fagetum moesiacae*, Soó & Borhidi, 1960), submesophytes dominate at 63.07%. These are plants commonly found in mesophytic habitats, though they also occur in some xerophytic communities. Mesophytes account for 6.82% of species, while subxerophytes, found in both extremely dry and somewhat mesophytic habitats, make up 26.70%. Xerophytes – plants specifically adapted to extreme drought conditions – constitute approximately 3.41% of the sampled stands (Figure 1).

A comparable pattern can be observed in the submontane beech forest community (*Helleboro odori-Fagetum moesiacae*, Soó & Borhidi, 1960) in the

Kosmaj area, where submesophytes similarly prevail, comprising 71% of species (Stajić et al., 2018). Here, however, subxerophytes represent a smaller proportion at 15%, and xerophytes are absent. Research in the "Vinatovača" beech primeval forest further confirms this pattern: submesophytes dominate across all ecological units with an average of 64.5%, while subxerophytes are present at 9%, and xerophytes at only 0.5% (Čokeša et al., 2022).

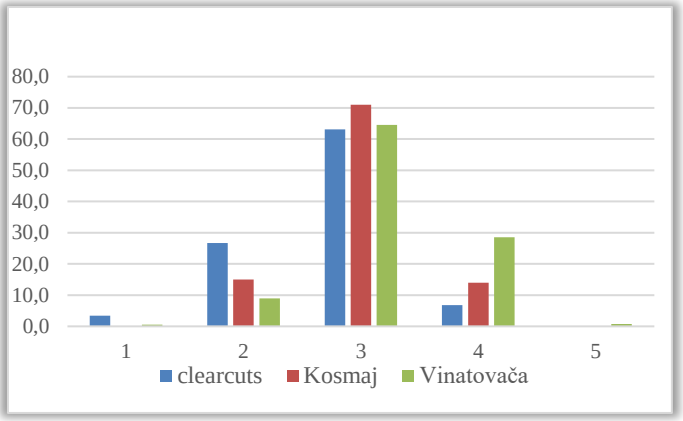

Figure 1. *Plant Distribution by Soil Moisture Levels*

The preceding analysis indicates that submesophytes are characteristic of submontane beech forests, occurring both across barren areas five years post-clearcutting and in managed beech forests, as well as in undisturbed primeval forests, with minimal variation between these environments. However, subxerophytes were the most responsive to the drastic ecological changes following clearcutting, showing their highest abundance in clearcut areas and lowest presence in pristine primeval forests. The reverse trend is observed with mesophytes. As anticipated, their numbers decline significantly in clearcut areas compared to managed forests, with the lowest presence in primeval forest ecosystems.

Additionally, typical xerophytes have been observed to colonise clearcut areas yet are nearly absent in both managed and unmanaged forests. Hygrophilous plants are entirely absent from clearcut areas. These findings suggest a xerothermic shift in the microclimate of clearcut areas relative to managed forests, and even more so when compared to untouched, fully natural primeval forest ecosystems.

3.1.2. Plant Distribution by Soil Acidity

Beech trees belong to the ecological group of neutrophilic plants in terms of soil acidity, as they thrive best in neutral to slightly acidic soils (Stajić et al., 2018). In Figure 2, the distribution of plants based on soil acidity shows that neutrophilic plants are predominant, occurring primarily on neutral to slightly acidic soils (64.20%), followed by neutrophilic-basophilic plants (26.70%). Basophilic plants are the least represented (0.57%). Transitional acidophilic-neutrophilic species make up 6.82%, while acidophilic plants, which are confined to acidic soils, account for only 1.70%. Similar findings have been reported in the submontane beech forest community (*Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960.) in the

Kosmaj region (Stajić et al., 2018) and in "Vinatovača" beech forest reserve (Čokeša et al., 2022).

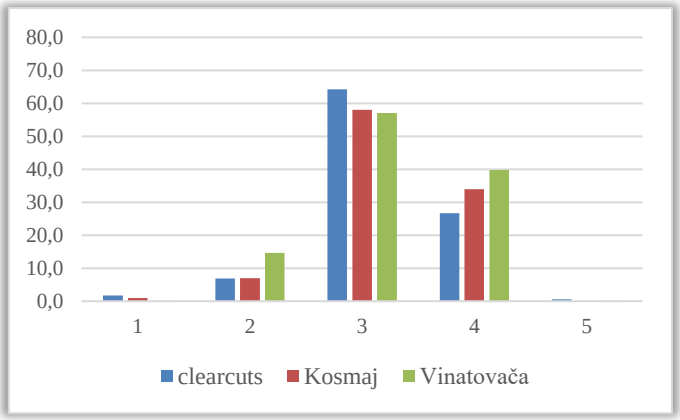

Figure 2. *Plant Distribution by Soil Acidity*

Soil acidity indicators are influenced by bedrock and soil type. In the study area, different bedrock and soil types are present, making direct comparisons challenging. However, when results are averaged and viewed on a broader scale, the highest concentrations of plants indicating neutral to slightly acidic and acidic soil reactions appear in clearcut areas, while indicators of slightly alkaline reactions are most prevalent in primeval forests. Managed natural forests fall somewhere in between. This pattern may suggest increased leaching of base cations from surface soil layers in exposed areas, leading to soil acidification. To draw valid conclusions, it would be beneficial to analyse these changes individually for each soil type, though this is beyond the scope of the present study. Five years is still a relatively short timeframe to detect substantial shifts in soil properties. The spontaneous growth of natural vegetation in these habitats also slows down such soil evolution.

3.1.3. Plant Distribution by Soil Nitrogen Content

As shown in Figure 3, mesotrophic plants – species that thrive in soils moderately rich in mineral nutrients – are the most prevalent, comprising 49.43% of the total. These are followed by transitional groups: plants between oligotrophic and mesotrophic conditions (27.27%) and those between mesotrophic and eutrophic conditions (18.75%). True eutrophic (nitrophilic) plants, which require soils exceptionally high in mineral content, and oligotrophic (nitrophobic) plants, adapted to nutrient-poor soils, are both rare, each representing just 2.27% of the total. In terms of soil nitrogen content, the submontane beech forest community in the Kosmaj Region also demonstrates a predominantly mesotrophic profile (Stajić et al., 2018). Similarly, mesotrophic plants are dominant across all ecological units within the beech forest reserve “Vinatovača” (Čokeša et al., 2022).

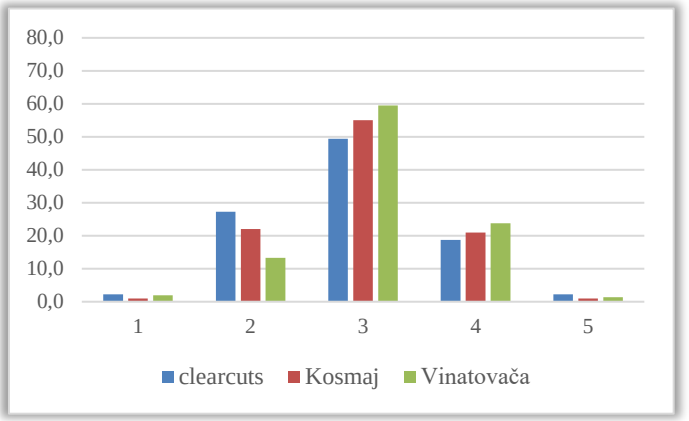

Figure 3. *Plant Distribution by Soil Nitrogen Content*

The preceding analysis reveals that beech habitats, irrespective of their preservation status, have moderate mineral nutrient levels. However, some differences are evident. Mesotrophic plants are least represented in clearcut areas and most abundant in primeval forests. The relative proportion of transitional oligotrophic-mesotrophic species further suggests that soils in clearcuts are nutrient-poor, with clearcuts showing the highest relative share of these species, while primeval forests have the lowest. Conversely, within the transitional group of mesotrophic-eutrophic plants, their presence is most prominent in primeval forests and least in clearcut areas. Managed natural forests fall in between these three habitat types. Overall, these findings support the conclusion that "the more ecosystems are disrupted, the poorer their soils become in mineral nutrients."

3.1.4. Plant Distribution by Light Requirements

The light index reflects the average light intensity during the growing season under which plants develop (Landolt E., 1977).

Figure 4 shows that the most prevalent plant types are the ones with semi-sciophytic (49.43%) and semi-sciophytic-heliophytic (28.98%) characteristics. The transitional category, comprising sciophytes and semi-sciophytes, represents 19.32%. True sciophytes—plants adapted to conditions of extreme shade (up to 3% of full daylight)—account for only 1.70%, while typical heliophytes, or plants adapted to full sunlight, constitute just 0.57%. In the investigated community of submontane beech forest in the Kosmaj Region, the transitional category of semi-sciophytes-heliophytes is represented by only 8%, while in the beech primeval forest, it is even lower at 3%. However, there is a significantly higher share of the transitional category of sciophytes-semi-sciophytes, with 41% in the submontane beech forest on Kosmaj and as much as 66.9% in the beech primeval forest. Additionally, a higher presence of true sciophytes is also recorded.

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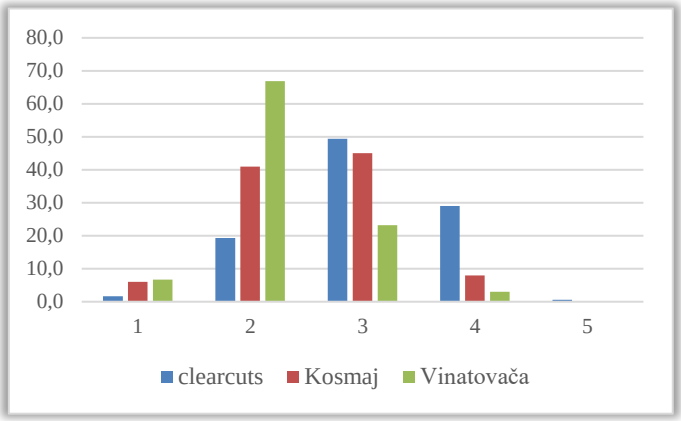

Figure 4. *Plant Distribution by Light Requirements*

As expected, increased ecosystem disturbance results in a greater influx of light, leading to a higher prevalence of light-demanding plant species. In the primeval forest, the category of sciophytes-semi-sciophytes is the most dominant. In contrast, clearcut areas are characterised by a predominance of semi-sciophytes and semi-sciophyte-heliophytes. Managed beech forests consistently occupy an intermediate position. True sciophytes are relatively rare in the primeval forest due to the abundance of canopy gaps and light penetration, coupled with a significant number of fallen trees. Conversely, clearcut areas also lack a substantial presence of true heliophytes because spontaneous woody vegetation has already closed the canopy within five years. It is likely that heliophytes were present during the first and second years after clearing but have since disappeared.

3.1.5. Plant Distribution by Temperature Preferences

The distribution of plants by temperature preferences (Figure 5) reveals that in the submontane beech forest community (*Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960) in the Timok Forest Region, mesothermic species—those that thrive in moderate heat—predominate, representing 65.91% of the total. Transitional mesothermic-thermophilic plants make up 30.11%, while strictly thermophilic species account for 2.84%. The least represented are frigophilic-mesothermic species, at 1.14%.

Regarding temperature as an ecological factor, the *Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960 community displays a predominantly mesothermic character, with an increase in presence of plants tending towards thermophilicity, likely due to the influence of oak forest species in the area. A similar pattern is observed in the Kosmaj Region (Stajić et al., 2018).

In the beech primeval forest, mesothermic (Central European) species are dominant across all ecological units, occupying mountainous zones of southern Europe and comprising about 73.7% of the total plant species. On average, these plants represent nearly three-quarters of the overall flora. The next largest group consists of transitional species between mesothermic and thermophilic types, at

23.65%, including many sub-Mediterranean species. On limestone, strictly thermophilic and transitional frigophilic-mesothermic species are scarce.

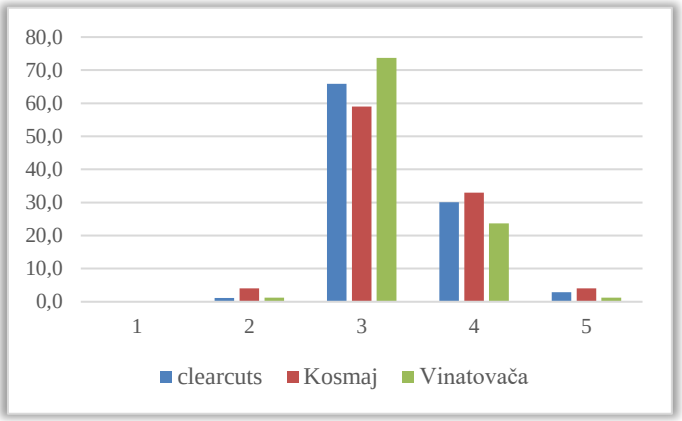

Figure 5. *Plant Distribution by Temperature Preferences*

The previous analysis indicates no major differences in temperature preferences across the three stand types. While mesothermic plants are the most dominant in all three types, there is a marked presence of mesothermic-thermophilic species from the oak belt in each stand. Importantly, despite ecosystem disturbances, there has been no significant increase in thermophilic species, and especially not in frigophilic species, within these habitats.

4. CONCLUSIONS

The severe ice storm that hit eastern Serbia in the winter of 2015 caused extensive damage to forest ecosystems, resulting in widespread ice-induced tree breakage and falls. This phenomenon is becoming increasingly common in Serbia, posing a significant threat to forest ecosystem stability. In the Timok Forest Region, certain beech stands were completely devastated, necessitating clearcutting. Five years after this intervention, substantial ecological changes were observed, with plants in these areas serving as indicators of the degradation level of natural beech habitats.

In terms of soil moisture preferences, sub-mesophytic plants dominate the submontane beech forest community (*Helleboro odori-Fagetum moesiacae* Soó & Borhidi 1960), whether in clearcut areas, managed forests, or untouched primeval forest. However, clearcut areas display a trend toward xerothermic microclimate conditions, marked by an increase in subxerophytes and xerophytes and a reduction in mesophytes compared to managed and primeval forests.

Regarding soil acidity, neutrophilic and neutrophilic-basophilic plants are predominant across all three stand types. Despite differences in bedrocks and soil types, clearcut areas tend to favour plants that indicate a neutral to slightly acidic reaction in the surface soil layers. This is due to intensified leaching of base cations from surface to deeper soil layers on degraded sites. In contrast, managed and

primeval forests have a higher prevalence of plants associated with a slightly more alkaline soil reaction.

With respect to soil nitrogen content, mesotrophic species dominate across all three stand types. However, as phytocenosis degradation progresses, the share of oligotrophic-mesotrophic species increases, pointing to a certain depletion in nutrient availability. The more preserved an ecosystem is, the greater the proportion of mesotrophic-eutrophic species, reflecting richer soil nutrient availability.

In all three stand types, the presence of indicators showing the amount of light on the soil surface is binary. As expected, with increasing phytocenosis degradation, there is a greater influx of light and a rise in heliophilic species. Conversely, more preserved phytocenoses support a higher presence of sciophilic species.

Finally, mesothermic plants dominate in all three stand types, a fundamental characteristic of submontane beech forests. The increased presence of mesothermic-thermophilic species reflects the influence of nearby oak forests. They have not been significantly impacted by phytocenosis degradation.

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PLANT SPECIES AS HABITAT INDICATORS IN BEECH FORESTS FOLLOWING CLEARCUTTING

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Summary

Research was conducted in the Timok Forest Region, which was hit by a severe ice storm in the winter of 2015. The storm caused extensive damage to forest ecosystems,

resulting in ice-induced tree breakage and falls. In some stands, clear-cutting was necessary. Five years after the clear-cutting, significant ecological changes, primarily microclimatic and edaphic, were observed. In these conditions, plants served as indicators of the degradation level of natural beech habitats.

Regarding soil moisture, sub-mesophytic plants dominated in all stand types. However, in clearcut areas, a trend of microclimate xerothermisation emerged, with an increase in subxerophytic and xerophytic species and a decrease in mesophytic species compared to managed forests and primeval forest.

In terms of soil acidity, plants that indicate a neutral to slightly acidic reaction in the surface soil layers were predominant in clearcut areas. In managed forests and the primeval forest, plants indicative of a slightly more alkaline soil reaction were more common.

With respect to soil nitrogen content, mesotrophic species were the most represented in all three stand types. However, as phytocenosis degradation increased, the proportion of oligotrophic-mesotrophic species rose, indicating some depletion in soil nutrient availability.

As expected, with increased phytocenosis degradation, there was a greater influx of light and a higher proportion of heliophilic species. In more preserved phytocenoses, the share of sciophilic species increased.

In all three stand types, mesothermic plants dominated, a fundamental characteristic of submontane beech forests.

BILJNE VRSTE KAO INDIKATORI STANIŠTA BUKOVIH ŠUMA NAKON ČISTE SEČE

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Rezime

Istraživanja su vršena u Timočkom šumskom području, koje je u zimu 2015. bilo pogođeno ledenim talasom. Došlo je do veoma ozbiljnih šteta u šumskim ekosistemima u vidu ledoloma i ledoizvala. U pojedinim satojinanama morala je biti izvedena čista seča. Pet godina nakon čiste seče je došlo do značajnih ekoloških promena (pre svega mikroklimatskih i edafskih). Biljke su u ovakvoj situaciji poslužile kao indikatori stepena degradacije prirodnih bukovih staništa.

U odnosu prema vlažnosti zemljišta, u svim satojinskim oblicima preovlađuju submezofite. Na sečinama je ipak došlo do kserotermizacije mikroklime i povećanog učešća subkserofita i kserofita, a smanjenog učešća mezofita u odnosu na gazdovane šume i prašumu.

Prema kiselosti zemljišta, na sečinama preovlađuju biljke koje ukazuju na neutralnu do slano kiselu reakciju površinskih slojeva zemljišta. U gazdovanim šumama i u prašumi preovlađuju biljke koje ukazuju na nešto alkalniju reakciju zemljišta.

U odnosu na količinu azota u zemljištu, u sva tri sastojinaska oblika su najzastupljenije mezotrofne vrste. Međutim, sa porastom degradacije fitocenoze, povećava se učešće oligotrofno-mezotrofnih vrsta, što ukazuje na izvesno osiromašenje u pogledu obezbeđenosti hranljivim elementima.

Kao što se i očekivalo, sa povećanjem degradacije fitocenoze, veći je priliv svetlosti i učešće heliofilnijih vrsta. Što je fitocenoza više očuvana povećava se učešće sciofilnijih vrsta.

U sva tri sastojinska oblika dominiraju mezotermne biljke, što je osnovna karakteristika submontanih bukovih šuma.

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