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## CHANGE IN THE GROWING STOCK CONDITION OF THE MORAVIAN FOREST AREA AS A CONSEQUENCE OF ICE DISASTERS IN THE WINTER 2014

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**Abstract:** *The area of eastern Serbia was hit by a natural disaster, specifically an ice disaster, in the winter of 2014 which caused great damage to forest trees. The subject of this research is the state-owned natural forests and artificially raised stands within the Moravian Forest Area which are managed by Public Enterprise (PE) "Srbijašume" Belgrade. The data summarized as of December 31, 2013, and December 31, 2021, were parallelly analyzed to determine whether and to what extent the ice disaster affected the growing stock condition of the Moravian Forest Area. For that purpose, the comparative analysis of the following indicators was carried out: origin-based forest condition, preservation, diversity, tree species, stand affiliation, and coeno-ecological affiliation. Having in mind that the ice disaster highly damaged some parts of the Moravian Forest Area (Forest Management Unit (FMU) „Obla Glava”, FMU “Kamenički Vis I”, FMU “Kamenički Vis II”, FMU “Bukovik - Mratinja”, FMU “Rtanj”, FMU “Svrljiško - Gulijanske Planine” and FMU “Devica”) which consequently led to clean-cuttings at large areas (app.1000 hectares of forest stands), the research aim was to determine if the significant changes occurred in the growing stock at the whole area level.*

**Key words:** Moravian Forest Area, growing stock, natural disaster, ice disaster

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# PROMENA STANJA ŠUMSKOG FONDA U MORAVSKOM ŠUMSKOM PODRUČJU KAO POSLEDICA LEDOLOMA U ZIMU 2014. GODINE

**Izvod:** U zimu 2014. godine, područje istočne Srbije je pogodila elementarna vremenska nepogoda koja je prouzročila velike štete na šumskom drveću u vidu ledoloma i ledoizvala. Predmet ovog istraživanja su obrasle površine Moravskog šumskog područja (prirodne šume i veštački podignute sastojine) u državnom vlasništvu kojima gazduje JP „Srbijašume” Beograd. Uporedo su analizirani podaci svedeni na dan 31.12.2013. godine i podaci svedeni na dan 31.12.2021. godine, kako bi se utvrdilo da li su i u kojoj meri ledolomi uticali na stanje šumskog fonda Moravskog ŠP. U tu svrhu, vršena je uporedna analiza pojedinih pokazatelja stanja šumskog fonda Moravskog ŠP (stanje šuma po poreklu, očuvanosti, mešovitosti, vrstama drveća, sastojinskoj pripadnosti i cenoekološkoj pripadnosti). Obzirom da su elementarne vremenske nepogode u pojedinim delovima Moravskog ŠP (GJ “Obla Glava”, GJ “Kamenički Vis I”, GJ “Kamenički Vis II”, GJ “Bukovik – Mratinja”, GJ “Rtanj”, GJ “Svrljiško - Gulijanske Planine” i GJ “Devica”) prouzročile velike štete u vidu ledoloma i ledoizvala, usled čega su morale biti izvršene čiste seče na velikim površinama (oko 1000 ha šumskih sastojina), cilj istraživanja je da se utvrdi da li je došlo do bitnih promena u stanju šumskog fonda na nivou područja.

**Ključne reči:** Moravsko šumsko područje, šumski fond, elementarne vremenske nepogode, ledolomi.

## 1. INTRODUCTION

A Forest Area (FE) is an environmental and spatial geographical unit within which forest management is planned and functional sustainability is ensured (Jović et al., 1991). In the geographical sense, these are mainly clearly defined mountain massifs or macro-environmental units in the plain area which dominate the space. One forest area extends within the same macro-environmental (ecoclimatic) area. There are a total of thirteen macro-environmental (ecoclimatic) areas in Serbia, which, if each had the same degree of forest cover, could also represent organizational units (Medarević M., 2006).

The Moravian Forest Area was named after the Morava River that flows through this area. It covers the area of the Niško - Aleksinac basin from which rise the following mountains: Bukovik (part), Rtanj (part), Slemen (part), Devica, Ozren, Tresibaba (part), Svrljiške mountains, Belava (part), Šljivovački vis, Suva planina (part), Babička gora (part), Selicevica, Mali Jastrebac, and Veliki Jastrebac (Savić M., 2021).

The ice deposition on various objects and forest trees is a common phenomenon during the winter due to the continental climate which prevails in the Moravian Forest Area. In the winter of 2014, the extremely cold air masses penetrated from the east and the Carpathians, causing the appearance of large ice deposits on infrastructure facilities and forest trees in most parts of eastern Serbia. The ice disaster affected the entire area east of Morava River, and especially east of the Čestobrodica and Crni vrh pass. Practically, for a long period of time, this area was bound by ice. Forest trees could not withstand large amounts of ice (even

several tons per tree), so the ice made damage to large areas (Marković et al., 2018).

According to Baković et al., (2015), larger-scale damages occurred in the forest areas of Timok (FE Boljevac), Morava (FE Niš), Severnikučaj (FE Kučevo), Rasina (FE Kruševac), and Južnikučaj (FE Despotovac) based on data of “An action plan for the rehabilitation of state and privately-owned damaged forests for the period 2015-2018” published by PE “Srbijašume”. According to this action plan, the damage was recorded on an area of 43,305.78 ha, and 1,874,046 m<sup>3</sup> of damaged trees were recorded. The clear-cutting was planned on an area of 1,077.40 ha, and the vegetative and artificial regeneration is intended to be performed for most of the said area.

**Table 1.** Overview of damaged areas per forest area

Forest area	State-owned forests		Private-owned forests		Total for rehabilitation	
	ha	m <sup>3</sup>	ha	m <sup>3</sup>	ha	m <sup>3</sup>
Timok	10,060.72	979,682	21,588.00	219,869	31,648.72	1,199,551
Morava	6,744.22	569,775	1,818	41,946	8,562.22	611,721
Severnikučaj	1,612.60	7,868	460.00	3,850	2,072.60	11,718
Rasina	827.10	39,317	-	-	827.10	39,317
Južnikučaj	175.14	11,339	20.00	400.00	195.14	11,739
<b>Total</b>	<b>19,419.78</b>	<b>1,607,981</b>	<b>23,886.00</b>	<b>266,065</b>	<b>23,886.00</b>	<b>1,874,046.00</b>

Source: “An action plan for the rehabilitation of state and privately-owned damaged forests for the period 2015-2018” published by PE “Srbijašume”.

In the Moravian Forest Area, the following Forest Management Units (FMU) suffered the greatest damage: “Obla Glava”, “Kamenički Vis I”, “Kamenički Vis II”, “Bukovik - Mratinja”, “Rtanj”, “Svrlijško - Gulijanske Planine” and “Devica”.

## 2. THE RESEARCH SUBJECT, MATERIAL AND METHODS

According to “An action plan for the rehabilitation of state and privately-owned damaged forests for the period 2015-2018” the total area under forest and other land amounts to 329,333 ha of which 140,471 ha is the stocked forest land and 188,862 ha is non-stocked forest land with 30,872 ha of forest land which can be afforested taking into account the existing projections in the Spatial Plan of the Republic of Serbia and the Draft Forestry Development Program of the Republic of Serbia. The forest coverage of the Moravian Forest Area is 42.6%. The state-owned land in this forest area is 55,911 ha of which forest and forest land occupy 49,058 ha or 87.7%, and another land occupies 6,852 ha or 12.3%. Forests occupy an area of 47,726 ha, and artificially established stands occupy an area of 561 ha, i.e. the total stocked forest land owned by the state is 48,287 ha. The total non-stocked forest land owned by the state is 7,623 ha.

The subject of this research is only the stocked forest land of the Moravian Forest Area (natural forests and artificially established stands) state-owned and managed by PE “Srbijašume” Belgrade. For that purpose, the comparative analysis of the following forest condition indicators was carried out: origin-based forest

condition, preservation, diversity, tree species, stand affiliation, and coenological affiliation.

Given that natural disasters in the form of ice disasters, in some parts of the Moravian Forest Area (FMU “Obla Glava”, FMU “Kamenički Vis I”, FMU “Kamenički Vis II”, FMU “Bukovik - Mratinja”, FMU “Rtanj”, FMU “Svrljiško - Guljanske Planine” and FMU “Devica”) caused great damage, as a result of which clear cuttings had to be carried out on large areas (about 1000 ha of forest stands), the research aims to determine whether there have been significant changes in the growing stock condition at the area level.



**Picture 1.** *Ice break damage in natural beech stands*



**Picture 2.** *Ice break damage in artificially raised conifer stands*

The forest management data from the database of the Public Enterprise “Srbijašume” Belgrade for 20 forest management units managed by this enterprise were used for the analysis of certain parameters of the Moravian Forest Area growing stock (FMU “Veliki Jastrebac”, FMU “Mali Jastrebac II”, FMU “Suva Planina”, FMU “Šljivovački Vis”, FMU “Rinjska Planina”, FMU “Babička Gora”, FMU “Obla Glava”, FMU “Seličevica – Koritnik”, FMU “Kamenički Vis I”, FMU “Kamenički Vis II”, FMU “Suva Planina I – Rakoš”, FMU “Suva Planina III”, FMU “Bukovik – Aleksinački”, FMU “Bukovik – Mratinja”, FMU “Rtanj”, FMU “Svrljiško - Guljanske Planine”, FMU “Mali Jastrebac I”, FMU “Lipovačko - Crnobarske šume”, FMU “Ozren - Leskovik” and FMU “Devica”). The data summarized as of December 31, 2013, and December 31, 2021, was parallelly analyzed to determine whether and to what extent the ice disaster affected the growing stock condition of the Moravian Forest Area.

Some data on forest condition indicators (qualitative and quantitative) were obtained from the Development Plan of Moravian Forest Area (2012-2021) and available theoretical and professional sources related to this issue.

The most used methods in the research included the method of analysis and synthesis, the comparative method, as well as the method of induction and deduction.

### 3. RESEARCH RESULTS AND DISCUSSION

#### 3.1. Origin-based stand condition in the Moravian Forest Area

In the growing stock of the Moravian Forest Area according to data summarized as of December 31, 2013 (Tabela 2), high natural stands occupy 13.1% of the area, with a share in volume of 30.9% and a share in volume increment with 23.7%. The most represented are coppice stands which occupy 34.6% of the area, with a share in volume of 53.5% and a share in volume increment with 53.1%. Artificially raised conifer stands occupy 10.7% of the area, with a share in volume of 12.3% and a share in volume increment of 20.7%. Shrubs and thickets occupy 39.6% of the area, while other forms (mixed stands by origin, artificially established hardwood stands) occupy about 2% of the stocked area.

**Table 2.** *Origin-based stand condition in the Moravian Forest Area according to data summarized as of December 31, 2013*

Stand origin	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
High natural stands of hardwoods	6326.63	13.1	1905598.5	30.9	41936.8	23.7
Coppice natural stands of hardwoods	16651.08	34.6	3297207.9	53.5	93948.2	53.1
Origin-based mixed stands	871.53	1.8	193760.8	3.1	4080.8	2.3
Artificially raised hardwood stands	82.65	0.2	6324.6	0.1	184.1	0.1
Artificially raised stands of soft deciduous trees	5.37	0.0	1547.8	0.0	49.2	0.0
Artificially raised conifer stands	5171.48	10.7	756760.2	12.3	36667.2	20.7
<b>Total</b>	<b>29108.74</b>	<b>60.4</b>	<b>6161199.8</b>	<b>100.0</b>	<b>176866.4</b>	<b>100.0</b>
Shrubs	6155.50	12.8				
Thickets	12915.64	26.8				
<b>Total</b>	<b>19071.14</b>	<b>39.6</b>				
<b>Total</b>	<b>48179.88</b>	<b>100.0</b>				

Source: Database of PE "Srbijašume" as of December 31, 2013 and author's calculations

In the growing stock of the Moravian Forest Area according to data summarized as of December 31, 2021 (Table 3), high natural stands occupy 15.1% of the area, with a share in volume of 33.7% and a share in volume increment with 26.1%. The coppice stands occupy 35.5% of the area, with a share in volume of 53.0% and a share in volume increment with 53.9%. Artificially raised conifer stands occupy 8.2% of the area, with a share in volume of 13.2% and a share in volume increment with 19.8%. Shrubs and thickets occupy 40.8% of the area, while other forms (artificially established hardwood and soft deciduous trees stands) occupy about 0.5% of the stocked area.

**Table 3.** *Origin-based stand condition in the Moravian Forest Area according to data summarized as of December 31, 2021*

Stand origin	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
High natural stands of hardwoods	7279.00	15.1	2177650.76	33.74	48271.26	26.12
Artificially raised stands of soft deciduous trees	5.71	0.0	2044.21	0.03	65.79	0.04
Coppice natural stands of hardwoods	17135.32	35.5	3417750.87	52.95	99635.01	53.91
Coppice natural stands of soft deciduous trees	3.50	0.0	340.13	0.01	14.13	0.01
High natural stands of conifers	2.03	0.0	0.00	0.00	0.00	0.00
Artificially raised hardwood stands	178.83	0.4	4508.74	0.07	157.51	0.09
Artificially raised stands of soft deciduous trees	6.30	0.0	1962.38	0.03	49.53	0.03

Stand origin	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Artificially raised conifer stands	3936.45	8.2	850327.10	13.17	36633.82	19.82
<b>Total</b>	<b>28547.14</b>	<b>59.2</b>	<b>6454584.19</b>	<b>100.00</b>	<b>184827.05</b>	<b>100.00</b>
Shrubs	7366.98	15.3				
Thickets	12343.62	25.6				
<b>Total</b>	<b>19710.60</b>	<b>40.8</b>				
<b>Total</b>	<b>48257.74</b>	<b>100.0</b>				

Source: Database of PE "Srbijašume" as of December 31, 2021 and author's calculations

From tables 2 and 3 it can be seen that after the natural disaster in 2014, the share of artificially raised conifer stands significantly decreased. Exactly these stands suffered the most from the ice disaster and clear-cutting was carried out consequently. At the expense of artificially raised conifer stands, the share of artificially raised hardwood stands increased. This is a consequence of emphasizing artificial regeneration with deciduous trees after clear-cutting.

The share of thickets has also increased significantly (by about 500-600 ha) which could mean that certain areas after clear-cutting failed to be completely artificially restored so they turned into thickets. Apparently, according to the new Inventory, between 500 and 600 ha of shrubs was reclassified as thickets. However, these thickets are often composed of pioneer and autochthonous species of the parent stand of vegetative origin. As artificial restoration on these surfaces has partially succeeded it can be expected in the future to be raised the origin-based mixed stands if the cultivation measures of illuminating and cleaning as well as the thinning would be performed.

### 3.2. Preservation-based forest condition in the Moravian Forest Area

In the growing stock of the Moravian Forest Area according to data summarized as of December 31, 2013, the forest condition is unsatisfactory. The most represented are preserved stands that occupy 55.8% of the area, with a share of 97.1% in volume and 97.2% in volume increment. Insufficiently stocked stands occupy 3.1% of the area. 2.0% volume and 1.8% volume increment while unwanted forms (devastated stands, shrubs and thickets) occupy 41.1% of the area with a share of 0.9% in the total standing tree volume.

A large share of devastating stands, shrubs and thickets (41.1%) represents a potentially large work-site and a significant issue. It should be borne in mind that in this area a large share is occupied by shrubs which represent a permanent stage of vegetation in contrast to thickets which are a degradation stage.

**Table 4.** *Preservation-based forest condition in the Moravian Forest Area according to data summarized as of December 31, 2013*

Preservation	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Preserved stands	26896.82	55.83	5981551.77	97.08	171959.82	97.23
Insufficiently stocked stands	1479.42	3.07	124959.19	2.03	3268.32	1.85
Devastating stands	732.50	1.52	54688.85	0.89	1638.31	0.93
<b>Total</b>	<b>29108.74</b>	<b>60.42</b>	<b>6161199.81</b>	<b>100.00</b>	<b>176866.44</b>	<b>100.00</b>
Shrubs and thickets	19071.14	39.58				
<b>Total</b>	<b>19071.14</b>	<b>39.58</b>				
<b>Total</b>	<b>48179.88</b>	<b>100.00</b>				

Source: Database of PE "Srbijašume" as of December 31, 2013 and author's calculations

In the growing stock of the Moravian Forest Area according to data summarized as of December 31, 2021, the preserved stands are also the most represented with a share of 52.7% in the area, 93.3% in volume and 94.4% in volume increment. Insufficiently stocked stands occupy 2.4% of the area, with a share of 2.1% in volume and 2.0% in volume increment while devastating stands, shrubs and thickets occupy 44.9% of the area with a share of 4.6% in the total standing tree volume.

**Table 5.** *Preservation-based forest condition in the Moravian Forest Area according to data summarized as of December 31, 2021*

Preservation	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>		ha	%
Preserved stands	25449.20	52.74	6024564.73	93.29	175065.83	94.41
Insufficiently stocked stands	1149.60	2.38	136159.70	2.11	3635.55	1.96
Devastating stands	2116.23	4.39	296965.36	4.60	6725.42	3.63
<b>Total</b>	<b>28715.03</b>	<b>59.51</b>	<b>6457689.79</b>	<b>100.00</b>	<b>185426.79</b>	<b>100.00</b>
Shrubs and thickets	19541.28	40.49				
<b>Total</b>	<b>19541.28</b>	<b>40.49</b>				
<b>Total</b>	<b>48256.31</b>	<b>100.00</b>				

Source: Database of PE "Srbijašume" as of December 31, 2021 and author's calculations

Tables 4 and 5 show that after the ice disaster in 2014, the share of preserved stands decreased by approx. 1,450 ha and the share of devastating stands increased by the same amount and that between 500 and 600 ha became overgrown. Perhaps all this is not the result of the natural disaster, but according to existing records, clean-cutting was still carried out on approx. 1000 ha of forest stands damaged by ice.

The presence of insufficiently stocked and devastated stands, shrubs and thickets on almost half of the total stocked area with all the negative effects resulting from it (reduced ecological stability, insufficiently utilized habitat potential, reduced productivity concerning preserved stands, etc.) is one of the basic, long-term issues of forest management (Banković et al. 2009).

### 3.3. Diversity-based forest condition in the Moravian Forest Area

According to data summarized as of December 31, 2013, pure stands occupy 18,106.72 ha, namely 37.6% of the area. Their share in volume is 69.7% (4,292,169.6 m<sup>3</sup>) and in volume increment 66.8% (118,164.7 m<sup>3</sup>). The mixed stands occupy 11,002.02 ha (22.8%) with a share of 30.3% (1,869,030.2 m<sup>3</sup>) in volume and 33.2% (58,701.8 m<sup>3</sup>) in volume increment. The rest of the area of 19,071.14 ha (39.6%) is overgrown with shrubs and thickets where diversity, volume, and volume increment have not been determined (table 6).

The dominance of pure stands, as environmentally, functionally, and even productively inferior stand forms, is another strategic issue that burdens the forests of Serbia (Banković et al. 2009). The mixed stands represent more stable forest ecosystems and they are more resistant to negative abiotic and biotic influences, therefore the spread of monocultures should be limited.

**Table 6.** Diversity-based forest condition in the Moravian Forest Area according to data summarized as of December 31, 2013

Diversity	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Pure stand	18106.72	37.58	4292169.60	69.66	118164.67	66.81
Mixed stand	11002.02	22.84	1869030.21	30.34	58701.76	33.19
<b>Total</b>	<b>29108.74</b>	<b>60.42</b>	<b>6161199.81</b>	<b>100.00</b>	<b>176866.43</b>	<b>100.00</b>
Shrubs and thickets	19071.14	39.58				
<b>Total</b>	<b>19071.14</b>	<b>39.58</b>				
<b>Total</b>	<b>48179.88</b>	<b>100.00</b>				

Source: Database of PE “Srbijašume” as of December 31, 2013 and author's calculations

According to data summarized as of December 31, 2021, pure stands occupy 18,231.57 ha, namely 37.8% of the area. Their share in volume is 71.2% (4,597,510.5 m<sup>3</sup>) and in volume increment 67.0% (124,190.1 m<sup>3</sup>). The mixed stands occupy 10,483.46 ha (21.7%) with a share of 28.8% (1,860,179.3 m<sup>3</sup>) in volume and 33.0% (61,236.7 m<sup>3</sup>) in volume increment. The rest of the area of 19,541.28 ha (40.5%) is overgrown with shrubs and thickets where diversity, volume, and volume increment have not been determined (table 7).

**Table 7.** Diversity-based forest condition in the Moravian Forest Area according to data summarized as of December 31, 2021

Diversity	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Pure stand	18231.57	37.78	4597510.48	71.19	124190.14	66.98
Mixed stand	10483.46	21.72	1860179.31	28.81	61236.66	33.02
<b>Total</b>	<b>28715.03</b>	<b>59.51</b>	<b>6457689.79</b>	<b>100.00</b>	<b>185426.79</b>	<b>100.00</b>
Shrubs and thickets	19541.28	40.49				
<b>Total</b>	<b>19541.28</b>	<b>40.49</b>				
<b>Total</b>	<b>48256.31</b>	<b>100.00</b>				

Source: Database of PE “Srbijašume” as of December 31, 2021 and author's calculations

The reduced share of mixed stands and a slight increase in share of pure stands should certainly not be the result of the natural disaster, because mixed stands are more stable. This condition may occur as they were spatially more affected by this natural disaster, or that they were renamed into pure stands during another arrangement.

### 3.4. Forest condition based on the tree species in the Moravian Forest Area

In the stand inventory of forests managed by PE “Srbijašume”, 75 tree species were recorded (59 are deciduous and 16 coniferous species). The number of tree species is extremely important from the biodiversity conservation point of view (Banković et al. 2009).

From the following Table 8, it can be concluded that in the Moravian Forest Area before the natural disaster, the deciduous species dominated. They were represented by volume at 87.7% and by growth at 79.2%. Conifer stands were represented by volume only at 12.3% and by growth at 20.8%. These are exclusively artificial stands, established by the afforestation of bare forests and the reclamation of devastated deciduous forests with spruce and pine species, Douglas fir, and larch. The most common species is beech which participates in the total



standing tree volume with 66.9% and the current volume increment with 57.3%. A significant share in the standing tree volume also has the following deciduous tree species: Turkey oak (8.4%), Sessile oak (6.8%) hornbeam (1.5%), black locust (1.3%), Hungarian oak (0.7%), maple (0.4%). Other deciduous species are symbolically represented.

The most important conifer species are spruce with 6.7% share in volume and 10.1% in volume increment, Austrian pine with 3.3% volume and 6.7% volume increment, and Scots pine with 1.4% volume and 2.6% volume increment, Douglas fir (0.5% of volume, i.e. 0.9% of volume increment) and larch (0.3% of volume, i.e. 0.4% of volume increment).

The determined large number of tree species represents great biodiversity and biological wealth and has multiple importances for the environment.

**Table 8.** Forest condition based on the tree species in the Moravian Forest Area according to data summarized as of December 31, 2013

Tree species	Volume		Volume increment	
	m <sup>3</sup>	%	m <sup>3</sup>	%
Beech	4121314.5	66.9	101337.9	57.3
Turkey oak	520435.2	8.4	14760.6	8.3
Sessile oak	416615.2	6.8	12530.6	7.1
Common hornbeam	91585.1	1.5	2461.7	1.4
Black locust	82982.3	1.3	4591.3	2.6
Other hardwoods	46240.3	0.8	1064.5	0.6
Hungarian oak	40754.1	0.7	1462.6	0.8
Maple	27279.7	0.4	399.1	0.2
Black ash	10201.4	0.2	224.4	0.1
Large-leaved linden	9779.7	0.2	331.6	0.2
White ash	9217.2	0.1	207.1	0.1
Field maple	6989.4	0.1	175.1	0.1
Turkish hazel	5850.6	0.1	163.6	0.1
Norway maple	4492.1	0.1	122.0	0.1
Mountain maple	4476.3	0.1	44.5	0.0
Aspen	3045.4	0.0	126.7	0.1
American maple	2296.5	0.0	10.0	0.0
Silver linden	925.4	0.0	27.1	0.0
Black poplar	221.4	0.0	0.0	0.0
Other soft deciduous trees	160.0	0.0	0.2	0.0
<b>Hardwood trees</b>	<b>5404861.9</b>	<b>87.7</b>	<b>140040.5</b>	<b>79.2</b>
Norwaz spruce	413551.0	6.7	17803.0	10.1
Austrian pine	203826.2	3.3	11789.4	6.7
Scots pine	88494.4	1.4	4676.7	2.6
Douglas fir	30666.6	0.5	1587.7	0.9
European larch	15961.4	0.3	707.8	0.4
Eastern white pine	3278.1	0.1	241.4	0.1
Fir	560.3	0.0	20.0	0.0
<b>Conifers</b>	<b>756337.9</b>	<b>12.3</b>	<b>36825.9</b>	<b>20.8</b>
<b>Total</b>	<b>6161199.8</b>	<b>100.0</b>	<b>176866.4</b>	<b>100.0</b>

Source: Database of PE "Srbijašume" as of December 31, 2013 and author's calculations

The participation of species that have the status of relict, endemic, rare, and endangered species according to the IUCN - TBFRA 2000 category (International Union for Conservation of Nature – Temperate and Boreal Forest Resource Assessment), i.e. protected and strictly protected species according to the Rulebook on the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, animals, and fungi ("Official Gazette of RS" no. 5/10.

47/2011. 32/2016 and 98/2016) is of particularly great importance. In that sense, special attention should be paid to the Turkish hazel, mountain maple, various forest fruits such as walnut, wild service tree, true service tree, etc.; to bushy species such as species of the genus *Daphne*, and several herbaceous species such as sage, *Ramonda*, etc.

From the following Table 9 it can be concluded that the the growing stock condition by tree species is almost unchanged after a natural disaster. Deciduous species are represented by volume with 87.2% and by growth 80.5%. Conifer stands are represented by volume only 12.8% and by growth with 19.5%. The most abundant species is also beech which participates in the total standing tree volume with 65.5% and in the current volume increment with 55.7%.

Similarly as in the previous management period, from deciduous species, a significant share in the standing tree volume has the following species: Turkey oak (8.3%), Sessile oak (4.4%), hornbeam (1.6%), black locust (1.4%), and maple (0.6%) with the fact that a slightly higher share of Hungarian oak (3.1%) was recorded.

The share of the most important coniferous species as well as their representation by volume and volume increment has not changed significantly.

**Table 9.** *Forest condition based on the tree species in the Moravian Forest Area according to data summarized as of December 31, 2021*

Tree species	Volume		Volume increment	
	m <sup>3</sup>	%	m <sup>3</sup>	%
Beech	4229595.1	65.5	102857.0	55.7
Turkey oak	534588.1	8.3	15905.5	8.6
Sessile oak	281110.8	4.4	8426.3	4.6
Hungarian oak	199269.5	3.1	6664.8	3.6
Common hornbeam	104143.5	1.6	3561.1	1.9
Black locust	88355.6	1.4	5055.1	2.7
Other hardwoods	65322.0	1.0	2497.6	1.4
Maple	38957.3	0.6	1134.3	0.6
Black ash	18834.7	0.3	694.0	0.4
Field maple	16904.6	0.3	533.5	0.3
Large-leaved linden	12669.5	0.2	502.4	0.3
Turkish hazel	7880.7	0.1	225.1	0.1
White ash	6839.3	0.1	206.0	0.1
Aspen	5113.5	0.1	186.8	0.1
Norway maple	4563.3	0.1	119.5	0.1
Oriental hornbeam	2166.9	0.0	114.7	0.1
Cherry	1918.2	0.0	0.3	0.0
Silver linden	1557.7	0.0	55.6	0.0
Red oak	1454.6	0.0	61.7	0.0
Mountain maple	1110.8	0.0	30.4	0.0
American maple	891.9	0.0	1.8	0.0
Wild service tree	636.9	0.0	0.0	0.0
Bleck poplar	569.4	0.0	0.0	0.0
Black walnut	542.6	0.0	19.6	0.0
Other soft deciduous trees	401.0	0.0	6.6	0.0
<b>Hardwood trees</b>	<b>5625397.3</b>	<b>87.2</b>	<b>148859.8</b>	<b>80.5</b>
Norway spruce	451345.83	7.0	17409.5	9.4
Austrian pine	233875.61	3.6	12446.0	6.7
Scots pine	89615.94	1.4	3983.9	2.2
Douglas fir	32060.96	0.5	1377.6	0.7
European larch	14506.48	0.2	342.2	0.2
Fir	3948.46	0.1	115.4	0.1

Tree species	Volume		Volume increment	
	m <sup>3</sup>	%	m <sup>3</sup>	%
Eastern white pine	3833.59	0.1	292.7	0.2
<b>Conifers</b>	<b>829186.89</b>	<b>12.8</b>	<b>35967.3</b>	<b>19.5</b>
<b>Total</b>	<b>6454584.2</b>	<b>100.0</b>	<b>184827.1</b>	<b>100.0</b>

Source: Database of PE "Srbijašume" as of December 31, 2021 and author's calculations

### 3.5. Forest condition based on the stand affiliation in the Moravian Forest Area

In accordance with the instructions given in the framework of the National Forest Inventory (Banković et al. 2009) all forests are also differentiated by individual stand categories defined according to the main type of trees in the stand regardless of the participation of other species. In accordance with this criterion, the national inventory registered 20 stand categories in the forests of Serbia from the belt of willow forests along the banks of the rivers to the belt of spruce forests at the upper limit of the distribution of forest communities.

Based on data summarized as of December 31, 2013, the most represented category of forests based on the area coverage is thickets and thickets which occupy an area of 19,071.14 ha (39.6%) (Table 10).

The dominant category of forests in relation to this indicator is beech forests which cover 35.5% followed by spruce forests at 7.2%, Turkey oak forests at 6.1%, Sessile oak forests at 5.0%, pine forests at 3.0%, forests of black locust, aspen and birch at 2.4%, hornbeam forests at 0.3%, Hungarian oak forests at 0.2% of the total covered area to the linden forests, maple and ash forests, poplar forests, which are slightly present in the total forest area. The dominance of beech forests is even more pronounced if the participation in the total volume and volume increment is observed, which amounts to 70.2% for volume, that is, to 60.0% for volume increment followed by Turkey oak forests with a volume share of 9.2% and volume increment of 9.4%, spruce forests with 8.4% share in volume and 13.5% share in volume increment, Sessile oak forests with a volume share of 6.1% and volume increment of 6.3%, pine forests with 3.1% share in volume and 5.9% share in volume increment, forests of black locust, aspen and birch with 1.5% share in volume and 2.7% in volume increment. Forests of hornbeam, Hungarian oak, poplar, linden, willow, and forests of other broadleaves and conifers have an insignificant share in the volume and volume increment (Table 10).

**Table 10.** Forest condition based on the stand affiliation in the Moravian Forest Area according to data summarized as of December 31, 2013

Stand unit	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Beech forests	17087.04	35.5	4326327.3	70.2	106179.9	60.0
Turkey oak forests	2919.34	6.1	566201.7	9.2	16644.3	9.4
Sessile oak forests	2401.93	5.0	373977.6	6.1	11070.2	6.3
Hungarian oak forests	90.77	0.2	14996.5	0.2	513.2	0.3
Norway spruce forests	3486.31	7.2	520117.2	8.4	23831.4	13.5
Pine forests	1432.72	3.0	189693.7	3.1	10508.3	5.9
Black locust, aspen, and birch forests	1153.95	2.4	91702.4	1.5	4861.3	2.7
Hornbeam forests	162.77	0.3	18413.8	0.3	513.6	0.3
Fir forests	2.46	0.0	508.3	0.0	17.1	0.0
Poplar forests	4.46	0.0	377.6	0.0	3.1	0.0

Stand unit	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Linden forests	37.31	0.1	5890.7	0.1	216.1	0.1
Forests of other broadleaves	60.93	0.1	3744.1	0.1	95.2	0.1
White willow forests	0.96	0.0	188.2	0.0	2.2	0.0
Ash and maple forests	11.52	0.0	1033.0	0.0	30.2	0.0
Forests of other conifers	256.27	0.5	48027.9	0.8	2380.3	1.3
<b>Total (without shrubs and thickets)</b>	<b>29108.74</b>	<b>60.4</b>	<b>6161199.8</b>	<b>100.0</b>	<b>176866.4</b>	<b>100.0</b>
<b>Total (shrubs and thickets)</b>	<b>19071.14</b>	<b>39.6</b>				
<b>Total</b>	<b>48179.88</b>	<b>100.0</b>				

Source: Database of PE “Srbijašume” as of December 31, 2013 and author's calculations

Based on data summarized as of December 31, 2021, the most represented category of forests based on the area coverage is also thickets and thickets which occupy an area of 19.710.60 ha (40.8%) (Table 11).

The dominant category of forests in relation to this indicator is beech forests which cover 35.5% followed by spruce forests at 7.2%, Turkey oak forests at 6.1%, Sessile oak forests at 5.0%, pine forests at 3.0%, forests of black locust, aspen and birch at 2.4%, hornbeam forests at 0.3%, Hungarian oak forests at 0.2% of the total covered area to the linden forests, maple and ash forests, poplar forests, which are slightly present in the total forest area. The dominance of beech forests is even more pronounced if the participation in the total volume and volume increment is observed, which amounts to 70.2% for volume, that is, to 60.0% for volume increment followed by Turkey oak forests with a volume share of 9.2% and volume increment of 9.4%, spruce forests with 8.4% share in volume and 13.5% share in volume increment, Sessile oak forests with a volume share of 6.1% and volume increment of 6.3%, pine forests with 3.1% share in volume and 5.9% share in volume increment, forests of black locust, aspen and birch with 1.5% share in volume and 2.7% in volume increment. Forests of hornbeam, Hungarian oak, poplar, linden, willow, and forests of other broadleaves and conifers have an insignificant share in the volume and volume increment (Table 11).

**Table 11.** Forest condition based on the stand affiliation in the Moravian Forest Area according to data summarized as of December 31, 2021

Stand unit	Area		Volume		Volume increment	
	ha	%	m <sup>3</sup>	%	m <sup>3</sup>	%
Beech forests	17416.54	36.1	4428206.4	68.6	108694.0	58.8
Turkey oak forests	2839.35	5.9	560344.7	8.7	17573.0	9.5
Sessile oak forests	1606.23	3.3	287767.1	4.5	8936.3	4.8
Hungarian oak forests	1084.88	2.2	178558.9	2.8	5841.9	3.2
Norway spruce forests	2094.98	4.3	469212.9	7.3	18039.7	9.8
Pine forests	1635.49	3.4	324375.8	5.0	16312.5	8.8
Black locust, aspen, and birch forests	1196.18	2.5	103357.5	1.6	5567.2	3.0
Hornbeam forests	205.52	0.4	26137.0	0.4	903.2	0.5
Fir forests	15.00	0.0	4443.7	0.1	129.5	0.1
Poplar forests	3.79	0.0	660.5	0.0	1.1	0.0
Linden forests	46.94	0.1	8551.0	0.1	339.0	0.2
Forests of other broadleaves	52.22	0.1	188.2	0.0	2.2	0.0
White willow forests	107.06	0.2	2681.0	0.0	81.3	0.0
Ash and maple forests	49.95	0.1	7804.8	0.1	254.1	0.1
Forests of other conifers	193.01	0.4	52294.7	0.8	2152.2	1.2
<b>Total (without shrubs and thickets)</b>	<b>28547.14</b>	<b>59.2</b>	<b>6454584.2</b>	<b>100.0</b>	<b>184827.1</b>	<b>100.0</b>
<b>Total (shrubs and thickets)</b>	<b>19710.60</b>	<b>40.8</b>				
<b>Total</b>	<b>48257.74</b>	<b>100.0</b>				

Source: Database of PE “Srbijašume” as of December 31, 2021 and author's calculations

### **3.6. Forest condition based on coeno-ecological affiliation in the Moravian forest area**

The coeno-ecological affiliation is an ecological characteristic of forests that does not change significantly from one management period to another. It is defined by habitat and phytocenological affiliation. However, it should be said that this is not an unchangeable category but such changes require a much longer period. On the other hand, a change in the coeno-ecological unit can occur due to climate change. However, they are long-term and gradual, and this situation is about weather extremes that occur in certain years and as such cannot individually have much effect on the habitat and potential vegetation. Extreme climate disasters can only temporarily throw an ecosystem out of balance. If the habitat has not been significantly changed, it returns to balance through the succession of vegetation.

This process is not short though, so it is the task of the forest professionals to speed it up through artificial regeneration. In this way, some stages in the succession would be skipped and the end stages of climazonal and oroclimatic conditioned forest communities would be created more quickly. However, it should be noted that artificial restoration has failed in some cases, so we have the appearance of pioneer tree species or vegetative regeneration from stumps and shoots.

**Table 12.** Forest condition based on coeno-ecological affiliation in the Moravian Forest Area as of December 31, 2013

Coeno-ecological unit	Area	
	ha	%
Typical montane beech forest ( <i>Fagetum moesiace submontanum typicum</i> ) on medium to deep brown soils and diluvium	10894.94	22.6
Forest of Oriental hornbeam and oak ( <i>Carpino orientalis- Polyquercetum</i> ) on skeletal acidic brown soil	6948.05	14.4
Forests of Turkey and Sessile oak with a rich layer of shrubs ( <i>Quercetum petraeae-cerris galietosum</i> ) on the ridges, pararendzinas, browned pararendzinas, shallow eutric brown soils and alluvial soils - Total	6939.86	14.4
Forest of Oriental hornbeam and Pubescent oak with lilac ( <i>Carpinetum orientalis syringosum</i> ) on mottled rankers on andesite	5362.33	11.1
Alpine beech forests ( <i>Fagetum moesiace montanum typicum</i> ) on acidic brown soil	4131.75	8.6
Subalpine beech forests ( <i>Fagetum moesiace submontanum typicum</i> ) on acidic brown to lessive acid brown soil	3349.11	6.9
Subalpine beech forest with hammer sedge ( <i>Fagetum moesiace submontanum caricetosum pilosae</i> ) on skeletal acid brown soil	1910.48	4.0
Ecological unit of Turkey and Sessile oak forest with Oriental hornbeam ( <i>Quercetum frainetto-cerris carpinetosum orientalis</i> ) on shallow acid brown soils on schist	1697.43	3.5
Forest of Oriental hornbeam and oak ( <i>Carpino orientalis - Polyquercetum</i> ) on soils from pararendzina on loess to shallower (drier) cambisol	1155.16	2.4
Alpine beech forests ( <i>Fagetum moesiace montanum typicum</i> ) on distric and eutric brown soils	879.91	1.8
Forests of Sessile oak and Hungarian oak ( <i>Quercetum petraeae-cerris pauperum</i> ) on acidic brown soil	785.59	1.6
Forests of Sessile oak and hornbeam ( <i>Quercu-carpinetum montanum typicum</i> ) on eutric humus-silicate soil (mottled rankers)	751.38	1.6
Forests of Sessile oak and hornbeam on limestone ( <i>Hordelymo- Quercu-Carpinetum typicum</i> ) on humus and shallow brown soil on limestone	747.69	1.5
Forests of Sessile oak and hornbeam with black ash ( <i>Quercu- Carpinetum montanum ornetosum</i> ) on skeletal acid brown soil	521.48	1.1
Forests of Sessile oak with Poa annua L. ( <i>Quercetum montanum poetosum nemoralis</i> ) on humus-silicate and on skeletal acid brown soil	362.10	0.8
Turkey and Hungarian oak forest ( <i>Quercetum farnetto-cerris</i> ) on acidic brown soils on conglomerates and sandstones	353.16	0.7
Sessile oak and hornbeam forest ( <i>Quercu-Carpinetum moesiacum montanum</i> ) on medium deep eutric brown soils	199.88	0.4
Sessile and Turkey oak forest ( <i>Quercetum petraeae-cerris serpentinicum</i> ) on brown and loess brown soil on serpentinite	193.45	0.4
Typical Turkey and Sessile oak forest ( <i>Quercetum petraeae- cerris typicum</i> ) on distric and eutric brown soils	193.42	0.4
Alpine beech forest with drymetosum ( <i>Fagetum moesiace montanum drymetosum</i> ) on skeletal acid brown soils	165.64	0.3
Sessile oak and hornbeam forest ( <i>Quercu-Carpinetum serpentinicum</i> ) on loess brown soil on serpentinite	116.06	0.2
Sessile oak and hornbeam forest ( <i>Quercu-Carpinetum montanum typicum</i> ) on skeletal acid brown soil and acidic brown soil	96.26	0.2
Hungarian and Turkey oak forest with Sessile oak ( <i>Quercetum frainetto-cerris petraetosum</i> ) on medium deep brown soils	80.98	0.2
Environmental units of typical forest of Hungarian and Turkey oak ( <i>Quercetum frainetto-cerris typicum</i> ) on medium deep to deep brown soils	79.12	0.2
Sessile and Turkey oak forests with Hungarian oak ( <i>Quercetum petraeae-cerris frainetosum</i> ) on loess acid brown soil	45.03	0.1
Typical alpine beech forest ( <i>Fagetum moesiace submontanum typicum</i> ) on deep acidic brown soil	44.61	0.1
Sessile oak, hornbeam, and Turkey oak ( <i>Carpino-Quercetum petraeae - cerris pauperum</i> ) on lessive acid brown soil	38.92	0.1
Forest of Sessile oak with flowering ash ( <i>Quercetum montanum ornetosum</i> ) on loess pararendzina on loess	37.41	0.1
Mountain beech forest with noble deciduous trees ( <i>Fagetum moesiace submontanum ceretosum</i> ) on deep eutric brown soils	33.50	0.1
Sessile and Turkey oak forests ( <i>Quercetum petraeae-cerris typicum</i> ) on loess cambisol	28.25	0.1
Forest of different oak species and hornbeam ( <i>Carpino- Polyquercetum typicum</i> ) on soil interval from deep pararendzinas on loess to loess cambisol	24.83	0.1
Typical forest of Hungarian and Turkey oak ( <i>Quercetum farnetto- cerris aculeatosum</i> ) on lessive cambisol	22.26	0.0
Sessile and Turkey oak forests ( <i>Quercetum petraeae-cerris</i> ) on cambic pararendzina to humus cambisol	15.32	0.0

Coeno-ecological unit	Area	
	ha	%
Forest of Turkey, Hungarian and Sessile oak with Festuca ( <i>Quercetum frainetto-cerris petraetosum fac. festucetosum heterophyllae</i> ) on the medium-deep acidic brown soils	12.36	0.0
Forest of beech and hornbeam ( <i>Fagetum moesiacae montanum carpinetosum betuli</i> ) on rankers (humus silicate soils)	11.30	0.0
Sessile, Turkey oak and hornbeam forests ( <i>Quercetum petraeae-cerris calcicolum</i> ) lessive acid brown soil on limestone	9.54	0.0
Sessile and Turkey oak forests ( <i>Carpino-Quercetum petraeae-cerris</i> ) on pararendzinas on loess and marl	8.28	0.0
Forest of beech and Sessile oak ( <i>Querco-Fagetum typicum</i> ) on medium-deep eutric and distric brown soils	7.80	0.0
Typical forest of Sessile oak ( <i>Quercetum montanum typicum</i> ) on acidic brown soil	2.14	0.0
Forest of Sessile oak and hornbeam with European bladdernut ( <i>Querco- Carpinetum staphyletosum</i> ) on acidic brown soils	0.96	0.0
<b>Total</b>	<b>48257.74</b>	<b>100.0</b>

## 4. CONCLUSION

The natural disaster that happened in the winter of 2014 had an impact on the growing stock and the forest condition in certain parts of the Moravian Forest Area. The following forest management units were more affected by this disaster: FMU "Obla Glava", FMU "Kamenički Vis I", FMU "Kamenički Vis II", FMU "Bukovik – Mratinja", FMU "Rtanj", FMU "Svrljiško - Gulianske Planine" and FMU "Devica". It should be noted that the neighboring Timočka forest area which is located north of the Moravian Forest Area was affected to an even greater extent by this natural disaster.

On that occasion, the cooled-down air masses from the north, northeast, and east created an ice crust of greater thickness on the trunks of forest trees. Under the weight of the ice and the influence of the wind, there were breaks in different stand situations in the mentioned forest management units. The damages were of different intensity but on about 1,000 ha, they were so large that clear-cutting had to be carried out. This certainly led to a change in the growing stock condition in the mentioned forest management units.

Because of this climate disaster the artificially raised stands were almost completely destroyed. Natural stands that were on the way of this ice wave that moved in the direction Svrljiško - Guljanske Mountains - Tresibaba - Kamenički vis - Devica - Ozren - Obla glava also were destroyed. Parallel to this direction, the natural disaster also moved on the other side of Moravica River from Knjaževac via Slemen and mountain Rtanj towards mountain Bukovik. This natural disaster affected all stands and structural forms in the zone between 600 and 900 m above sea level.

In the research period, the share of the preserved forests decreased and the share of devastated forests and thickets increased. During artificial renewal in the areas where the clear-cutting was performed the emphasis was put on hardwoods. This increased the share of artificially raised hardwood stands and reduced the share of artificially raised conifer stands that suffered the most due to cold weather. The artificial restoration did not completely succeed in some parts of the destroyed area and thickets overgrown the surfaces. However, these thickets are often of vegetative origin, composed of pioneer and autochthonous species of the cut mother stand with some number of species of generative origin. Those areas will become autochthonous stands of mixed origin in the future through succession, cultivation measures of cleaning and illuminating, and thinning.

## REFERENCES

Baković. Z., Stajić. B., Janković. V., Janjatović Ž., Kazimirović. M. (2015): Activities of pe "Srbijašume" on remediation of the negative effects of the ice disaster in 2014 on forests and the environment in eastern Serbia. (Original Title in Serbian: Aktivnosti JP „Srbijašume“ na sanaciji negativnih efekata ledenog talasa u 2014. godini na šume i životnu sredinu u istočnoj Srbiji).

Babić B., Komazec N. (ed.). Proceedings: 1st International Scientific and Professional Conference "Crisis and Emergency Management - Theory and Practice". Kurjak Copy.



Crow (115-124). (Original Title in Serbian: Zbornik radova: 1. Međunarodna naučno-stručna konferencija „Upravljanje kriznim i vanrednim situacijama - teorija i praksa“. Kurjak Copy. Vranje (115-124)).

Banković S., Medarević M., Pantić D., Petrović N., Šljukić B., Obradović S. (2009): Forest Fund of the Republic of Serbia - Status and issues. Bulletin of the Faculty of Forestry, Belgrade No. 100. p. 7-30. (Original Title in Serbian: Šumski fond Republike Srbije – Stanje i problemi. Glasnik Šumarskog fakulteta Beograd. br. 100. str.7-30).

Jović D., Medarević M. (1991): Basic assumptions for modern management and management of forest areas. Expert gathering on the occasion of 70 years of the Faculty of Forestry - Bulletin of the Faculty of Forestry (387-392). (Original Title in Serbian: Osnovne pretpostavke za savremeno gazdovanje i upravljanje šumskim područjima. Stručni skup povodom 70 godina Šumarskog fakulteta– Glasnik Šumarskog fakulteta (387–392)).

Medarević M. (2006): Forest management planning- Faculty of Forestry, University of Belgrade. (Original Title in Serbian: Planiranje gazdovanja šumama. Šumarski fakultet Univerziteta u Beogradu).

Marković. N., Marković. M.. (2018): Disastrous ice breaks in eastern Serbia – gis analysis of their relationship with orographic characteristics. Sustainable Forestry. Collection 77-78. pp. 67-77

Savić M. (2021): Harmonization of forestry management and management in related sectors in the Moravian forest area. Master thesis. University of Belgrade, Faculty of Forestry- Forestry 2021 (Original Title in Serbian: Usklađivanje šumskog i gazdovanja u povezanim sektorima u Moravskom šumskom području. Master rad. Univerzitet u Beogradu. Šumarski fakultet. Šumarstvo. 2021).

\*\*\*An action plan for the rehabilitation of state and privately-owned damaged forests for the period 2015-2018 (“Official Gazzete of RS” No. 30 of March 27, 2015); (Original Title in Serbian: Akcioni plan sanacije oštećenih šuma u državnom i privatnom vlasništvu za period 2015 -2018. godinu (u skladu sa Naredbom „Sl. gl. RS“ broj 30 od 27. marta 2015. godine));

\*\*\*Rulebook on the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, animals, and fungi (“Official Gazette of RS” no. 5/2010. 47/2011. 32/2016 and 98/2016) (Original Title in Serbian: Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka. životinja i gljiva („Službeni glasnik RS“ br. 5/2010. 47/2011. 32/2016 i 98/2016)).

\*\*\*Development plan of the Moravian Forest Area (2012–2021), PE “Srbijašume”.

# CHANGE IN THE GROWING STOCK CONDITION OF THE MORAVIAN FOREST AREA AS A CONSEQUENCE OF ICE DISASTERS IN THE WINTER 2014

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## Summary

The area of eastern Serbia was hit in the winter of 2014 by natural disaster, specifically ice disaster, which caused great damage to forest trees. The subject of this research is the state-owned natural forests and artificially raised stands within the Moravian Forest Area which are managed by Public Enterprise (PE) "Srbijašume" Belgrade. Given that natural disasters in the form of ice disasters, in some parts of the Moravian Forest Area caused great damage, as a result of which clear-cuttings had to be carried out on large areas (about 1000 ha of forest stands), the research aims to determine whether there have been significant changes in the condition of the growing stock at the level of the area.

Natural stands that were on the way of this ice wave that moved in the direction Svrljiško - Guljanske Mountains - Tresibaba - Kamenički vis - Devica - Ozren - Obla glava also were destroyed. Parallel to this direction, the natural disaster also moved on the other side of Moravica River from Knjaževac via Slemen and mountain Rtanj towards mountain Bukovik. This natural disaster affected all natural stands and structural forms in the zone between 600 and 900 m above sea level. Artificially raised stands were almost completely destroyed.

In the research period, the share of the preserved forests decreased and the share of devastated forests and thickets increased. During artificial renewal in the areas where the clear-cutting was performed the emphasis was put on hardwoods. This increased the share of artificially raised hardwood stands and reduced the share of artificially raised conifer stands that suffered the most due to cold weather.

The artificial restoration did not completely succeed in some parts of the destroyed area and thickets overgrown the surfaces.

## PROMENA STANJA ŠUMSKOG FONDA U MORAVSKOM ŠUMSKOM PODRUČJU KAO POSLEDICA LEDOLOMA U ZIMU 2014. GODINE

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### Rezime

U zimu 2014. godine područje istočne Srbije je pogodila elementarna vremenska nepogoda u vidu ledene kiše koja je prčinila velike štete na šumskom drveću. Predmet ovog istraživanja su obrasle površine Moravskog ŠP (prirodne šume i veštački podignute sastojine) u državnom vlasništvu kojima gazduje JP „Srbijašume“ Beograd. Obzirom da su elementarne vremenske nepogode u pojedinim delovima Moravskog ŠP prčinile velike štete u vidu ledoloma i ledoizvala, usled čega su morale biti izvršene čiste seče na velikim površinama (oko 1000 ha šumskih sastojina). cilj istraživanja je da se utvrdi da li je došlo do bitnih promena u stanju šumskog fonda na nivou područja.

Od prirodnih sastojina stradale su one koje su se našle na udaru ove ledene stihije koja se kretala pravcem: Svrljiško - Guljanske planine Tresibaba - Kamenički vis - Devica - Ozren - Obla glava. Paralelno sa ovim pravcem, elementarna nepogoda se kretala i drugom stranom Moravice od Knjaževca preko Slemena i Rtnja ka Bukoviku. Od prirodnih šuma.

elementarnom nepogodom su zahvaćeni svi sastojinski i strukturni oblici u pojasu između 600 i 900 m nadmorske visine. Veštački podignute sastojine, zahvaćene vremenskom nepogodom stradale su gotovo u celosti.

U analiziranom periodu naročito se smanjilo učešće očuvanih, a povećalo učešće devastiranih šuma i šikara. Prilikom veštačkog obnavljanja, na mestima čiste seče, akcenat je stavljen na tvrde lišćare. Time se povećao udeo veštački podignutih sastojina tvrdih lišćara, a smanjio udeo veštački podignutih sastojina četinara koje su najviše stradale u vremenskoj nepogodi.

Na pojedinim mestima veštačko obnavljanje nije u potpunosti uspelo, te su se površine zašikarile.