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COLLECTION  
TOM 67-68

ZBORNIK RADOVA  
TOM 67-68



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## TREE CROWN CONDITION AT LEVEL II SAMPLE PLOTS KOPAONIK, CRNI VRH AND MOKRA GORA IN 2013

*Radovan NEVENIĆ<sup>1</sup>, Svetlana BILIBAJKIĆ,  
Miroslava MARKOVIĆ, Goran ČEŠLJAR, Tomislav STEFANOVIĆ,  
Ilija ĐORĐEVIĆ, Zoran PODUŠKA*

**Abstract:** *Intensive monitoring at Level II sample plots represents a multipurpose research system. Evaluation criteria for intensive monitoring are all in compliance, so that upon recording and statistical analysis, the obtained data on forest condition are easy to compare analytically and logically, providing the basis for a variety of comparative studies. Dedicated sample plots for intensive monitoring and assessment of air pollution and its impact on forest ecosystems in Serbia – Level II sample plots were established on Mt. Fruška Gora in 2009, on Mt. Kopaonik in 2010, in Odžaci in 2011 and on Crni Vrh and Mokra Gora in 2013. Level II monitoring program encompasses the following groups of parameters: tree crown condition, foliar analyses, soil chemistry, soil solution chemistry, growth and yield, ground vegetation, atmospheric deposition, meteorology, phenology and forest litterfall. This paper presents the results of monitoring crown condition at Level II sample plots on Kopaonik, Crni Vrh and Mokra Gora in 2013.*

**Key words:** Level II sample plot Kopaonik, Crni Vrh, Mokra Gora, crown condition, defoliation, damage

## STANJE KRUNA STABALA NA OGLEDNIM POLJIMA BIT NIVO-a II KOPAONIK, CRNI VRH I MOKRA GORA U 2013.GODINI

**Abstract:** *Intenzivni monitoring na bioindikacijskim tačkama Nivo-a II, predstavlja višenamenski sistem istraživanja. Kriterijumi procene koje intenzivni monitoring podrazumeva, usaglašeni su i tako određeni da se dobijeni podaci o stanju šuma, nakon unosa u bazu podataka i statističke obrade analitički i logički lako porede,*

---

<sup>1</sup> Institute of Forestry, Belgrade, Serbia

dajući osnovu za različite komparativne studije. Ogledne parcele za praćenje i procenu uticaja vazdušnih zagađenja i njihovih efekata u šumskim ekosistemima na teritoriji Republike Srbije - bioindikacijske tačka Nivo-a II osnovane su 2009.godine na Fruškoj gori, 2010. godini na Kopaoniku, 2011. godine u Odžacima i 2013.godine na Crnom vrhu i Mokroj Gori. Programom monitoringa Nivo-a II obuhvaćene su sledeće grupe parametara: stanje kruna stabala, folijarne analize, hemizam zemljišta, hemizam zemljišnog rastvora, prirast, prizemna vegetacija, atmosferska depozicija, meteorologija, fenologija i šumska prostirka. U radu su dati rezultati praćenja stanja kruna stabala na oglednim parcelama BIT Nivo-a II na Kopaoniku, Crnom vrhu i Mokroj gori u 2013. godini.

**Ključne reči:** BIT Nivo II Kopaonik, Crni vrh, Mokra Gora, stanje kruna, defolijacija, oštećenja

## 1. INTRODUCTION

According to the uniform ICP Forests program methodology, sample plots have been installed all over the European continent for Level II intensive monitoring aiming at performing continuous measurements and collection of data on condition of forests featuring different specific ecological conditions. Evaluation criteria for intensive monitoring are all in compliance, so that upon recording and statistical analysis, the obtained data on forest condition are easy to compare analytically and logically, providing the basis for a variety of comparative studies.

By establishment of sample plots in Fruška Gora National Park, Kopaonik National Park, in Odžaci, Crni Vrh and Mokra Gora Serbia has joined the European network of more than 800 Level II sample plots.

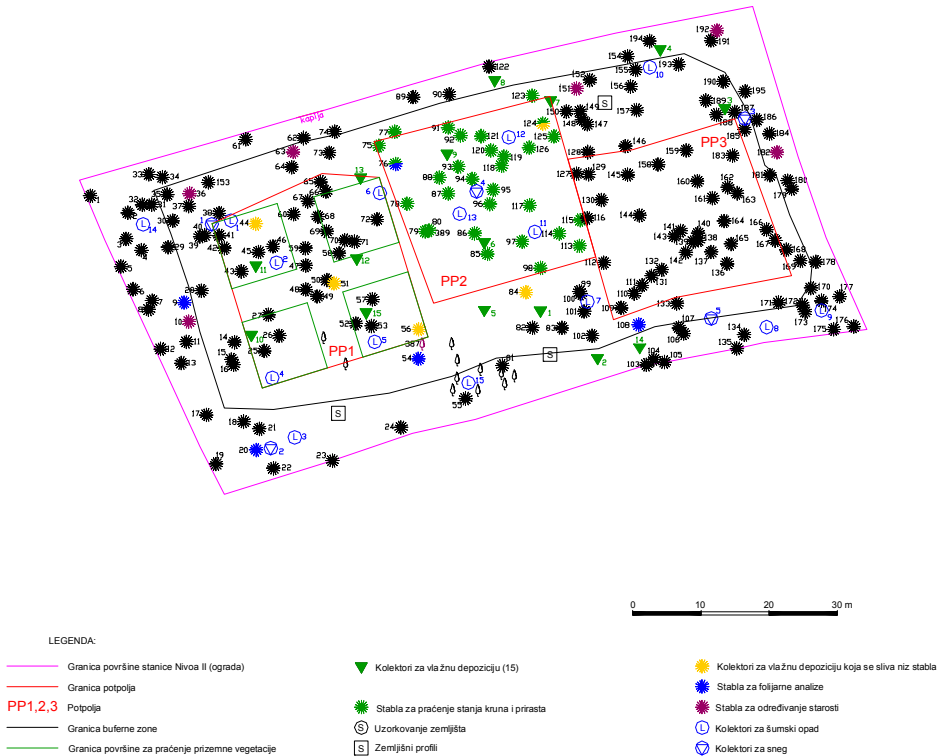
## 2. MATERIAL AND METHOD

Intensive monitoring sample plot - Level II sample plot on Kopaonik was established in 2010. The plot is situated in the 74th division of the "Samokovska reka" estate unit in Kopaonik National Park, within the pure stand of Norway spruce (*Picea abies* (L.) H.Karst.).

The area of the Level II sample plot covers 0.5 hectares (100x50m). There are three subplots within the sample plot, as follows: subplot for assessment of crown condition and growth and yield, subplot for assessing soil chemistry and subplot for assessment of ground vegetation. All the trees within the sample plot are designated with permanent bark marks, i.e. ordinal numbers from 1 to 195. The as-built site plan<sup>1</sup> of the sample plot is shown in Figure 1.

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<sup>1</sup> As-built site plan was prepared at the Institute of Forestry in Belgrade in digital form in accordance with the filed status and the blueprint of the basic setup of test subplots prepared by the Team of Faculty of Forestry in Belgrade in 2010.



**Figure 1.** *As-built site plan of sample plot Kopaonik*

During 2013 another two Level II sample plots were set up, one on Crni Vrh and the other in Mokra Gora.

The Level II sample plot on Crni Vrh is situated in the 17th division of the “Crni Vrh – Kupinovo” estate unit, within the pure beech stand (*Fagus moesiaca*).

The area of the Level II sample plot covers 0.5 hectares (100 x 50 m) at the altitude between 930m to 945m. Within the entire test plot, three subplots for customized sampling and a buffer zone are delineated. All the trees within the sample plot are designated with permanent bark marks, i.e. ordinal numbers from 1 to 150. The as-built site plan<sup>1</sup> of the Crni Vrh sample plot is shown in Figure 2.

<sup>1</sup> As-built site plan was prepared at the Institute of Forestry in Belgrade in digital form in accordance with the filed status and the blueprint of the basic setup of test subplots prepared by the Team of Faculty of Forestry in Belgrade in 2010.



**Figure 2.** Digital as-built site plan<sup>1</sup> of sample plot Crni Vrh

The Level II sample plot in Mokra Gora is situated in the 20th division of the “Mokra Gora – Panjak” estate unit within the artificially grown stand of the Scots pine (*Pinus silvestris*).

The area of the Level II sample plot covers 0.55 hectares (110 x 50 m) within the altitude zone between 580 m and 600 m.

Within the entire test plot, three subplots (25×25 m) for customized sampling and a buffer zone are delineated.

All the trees within the sample plot are designated with permanent bark marks, i.e. ordinal numbers from 1 to 450, and the position of each tree is defined by the coordinates of the kilometer grid (Figure 3).

<sup>1</sup> As-built site plan was prepared at the Institute of Forestry in Belgrade in digital form in accordance with the filed status.



**Table 1.** *Parameters, frequency of survey and monitoring intensity for Level II*

Parameter type	Frequency
Crown condition	At least annually
Foliar analyses	Every two years
Soil chemistry	Every ten years
Soil solution chemistry	Continuously
Growth and yield	Every five years
Ground vegetation	Every five years
Atmospheric deposition	Continuously
Air quality	Continuously
Ozone injuries	Annually
Meteorology	Continuously
Phenology	Several times a year
Forest litterfall	Continuously

For crown condition monitoring at the sample test plots on Kopaonik and Crni Vrh 30 trees were selected within subplot 2, and 32 trees were selected at the sample test plot on Mokra Gora.

### 3. RESULTS AND DISCUSSION

Parameters with annual and continuous monitoring frequency were monitored during 2013.

#### 3.1. Assessment of crown condition – intensive monitoring in 2013 – Level II sample plot Kopaonik

Crown condition of trees at the Level II sample plot on Kopaonik was assessed on October 17, 2013. The assessment was performed on 30 spruce trees selected for annual crown condition monitoring within subplot 2.

**Table 2.** *(PLT) Data on the sample plot dedicated for crown condition assessment, Level II – Kopaonik*

No.	Country code	Plot no.	Assessment date	Latitude	Longitude	Altitude /code	Team ID	Other findings
1	67	2	171013	+43°17'30"	+20°48'50"	35		

The crown condition assessment included determining the extent of defoliation, drying up – removal, tree status, crown shadow, crown visibility, foliage transparency and other findings (Table 3).

Tables 3 and 4 present parameters of crown condition and damage at the Level II sample plot on Kopaonik in 2013.

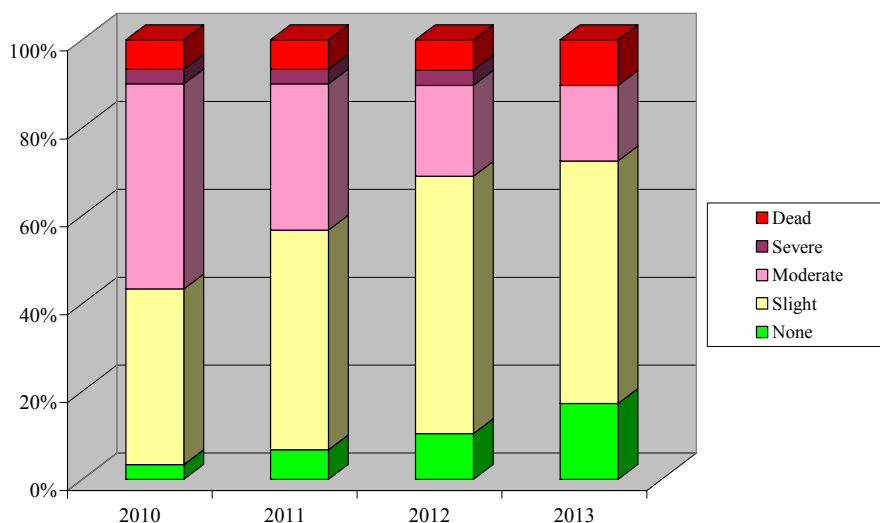
**Table 3.** *(TRC) Crown condition parameters, Level II - Kopaonik*

No.	Plot no.	Assessment date	Number of trees	Species	Drying – removal	Tree status	Crown shadow	Crown visibility	Defoliation	Foliage transparency	Other findings
1	2	171013	75	118	01	1	2	2	5	25	<i>U.b.*</i>
2	2	171013	76	118	01	1	1	2	15	20	<i>U.b.*</i>
3	2	171013	78	118	01	1	2	2	10	25	<i>U.b.*</i>
4	2	171013	79	118	01	1	1	2	15	25	<i>U.b.*</i>
5	2	171013	80	118	01	1	1	2	10	25	<i>U.b.*</i>

No.	Plot no.	Assessment date	Number of trees	Species	Drying – removal	Tree status	Crown shadow	Crown visibility	Defoliation	Foliage transparency	Other findings
6	2	171013	85	118	01	1	2	2	10	25	<i>U.b.*</i>
7	2	171013	86	118	01	1	3	3	10	30	<i>U.b.*</i>
8	2	171013	87	118	01	3	3	3	35	70	<i>U.b.*</i>
9	2	171013	88	118	38	5	6	2	100	99	<i>U.b.*</i>
10	2	171013	91	118	41						
11	2	171013	92	118	01	2	3	3	30	60	<i>U.b.*</i>
12	2	171013	93	118	01	1	3	3	30	60	<i>U.b.*</i>
13	2	171013	94	118	01	3	3	3	40	80	<i>U.b.*</i>
14	2	171013	95	118	01	2	3	3	20	30	<i>U.b.*</i>
15	2	171013	96	118	01	1	4	4	20	30	<i>U.b.*</i>
16	2	171013	97	118	01	1	3	3	15	50	<i>U.b.*</i>
17	2	171013	98	118	01	1	3	3	20	80	<i>U.b.*</i>
18	2	171013	113	118	01	1	2	2	20	60	<i>U.b.*</i>
19	2	171013	114	118	01	1	4	3	20	80	<i>U.b.*</i>
20	2	171013	115	118	01	1	3	3	25	50	<i>U.b.*</i>
21	2	171013	117	118	01	1	4	3	25	50	<i>U.b.*</i>
22	2	171013	118	118	01	1	3	2	20	65	<i>U.b.*</i>
23	2	171013	119	118	38	3	3	3	100	90	<i>U.b.*</i>
24	2	171013	120	118	01	1	1	2	30	40	<i>U.b.*</i>
25	2	171013	121	118	01	1	3	3	15	20	<i>U.b.*</i>
26	2	171013	124	118	01	1	2	2	20	60	<i>U.b.*</i>
27	2	171013	125	118	38	5	3	3	100	99	<i>U.b.*</i>
28	2	171013	126	118	01	1	2	2	15	40	<i>U.b.*</i>
29	2	171013	77	118	01	1	3	2	15	30	<i>U.b.*</i>
30	2	171013	123	118	01	1	1	1	15	20	<i>U.b.*</i>

*\*Usnea barbata*

The percentage of trees not suffering from defoliation increased at the sample plot Kopaonik in 2013 as compared to the previous three years. The percentage of dead trees increased slightly, while the percentage of trees exhibiting moderate defoliation decrease in comparison to the previous year. In 2013 severe defoliation was not observed in any of the trees selected for crown condition assessment.



**Graph 1.** Comparative overview of defoliation in the period from 2010 to 2013, Level II – Kopaonik

**Table 4. (TRD) Damage parameters, Level II - Kopaonik**

No.	Plot no.	Assessment date	Number of trees	Damaged tree portion	Symptom	Symptom designat.	Crown portion	Time of damage occurrence	Cause	Cause name	Damage intensity	Other findings
1	2	171013	75									U.b.*
2	2	171013	76									U.b.*
3	2	171013	78	11	11	56	3	3	301	Chrysomyxa	1	U.b.*
4	2	171013	79	11	11	56	3	3	301	Chrysomyxa	1	U.b.*
5	2	171013	80									U.b.*
6	2	171013	85									U.b.*
7	2	171013	86	11	11	56	3	3	301	Chrysomyxa	1	U.b.*
8	2	171013	87									U.b.*
9	2	171013	88									U.b.*
10	2	171013	91									
11	2	171013	92									U.b.*
12	2	171013	93									U.b.*
13	2	171013	94									U.b.*
14	2	171013	95									U.b.*
15	2	171013	96									U.b.*
16	2	171013	97									U.b.*
17	2	171013	98	33	11	60		3	390		1	U.b.*
18	2	171013	113									U.b.*
19	2	171013	114									U.b.*
20	2	171013	115									U.b.*
21	2	171013	117									U.b.*
22	2	171013	118									U.b.*
23	2	171013	119									U.b.*
24	2	171013	120									U.b.*
25	2	171013	121									U.b.*
26	2	171013	124									U.b.*
27	2	171013	125									U.b.*
28	2	171013	126									U.b.*
29	2	171013	77									U.b.*
30	2	171013	123									U.b.*

\**Usnea barbata*

On October 17, 2013, the selected 30 spruce trees were examined and assessed for health condition. During examination, it was determined that since 2010 4 trees had completely dried up. With regard to damage, only slight conifer needle chlorosis was identified in trees no. 78, 79, 86 and rot at the root collar in tree no. 98. Presence of lichen *Usnea barbata* all over the sample plot indicates a healthy habitat.



**Figure 4.** Slight chlorosis of spruce conifer needles

### 3.2. Assessment of crown condition – intensive monitoring in 2013 – Level II sample plot Crni Vrh

Crown condition of trees at the Level II sample plot on Crni Vrh was assessed on July 9, 2013. The assessment was performed on 30 beech trees selected for crown condition monitoring within subplot 2.

**Table 5. (PLT) Data on the sample plot dedicated for crown condition assessment, Level II – Crni Vrh**

No.	Country code	Plot no.	Assessment date	Latitude	Longitude	Altitude /code	Team ID	Other findings
1	67	4	090713	+44 <sup>0</sup> 07'55"	+21 <sup>0</sup> 58'38"	19		

**Table 6. (TRC) Crown condition parameters, Level II - Crni Vrh**

No.	Plot no.	Assessment date	Number of trees	Species	Drying – removal	Tree status	Crown shadow	Crown visibility	Defoliation	Foliage transparency	Other findings
1	4	090713	57	018	01	1	4	2	25	20	
2	4	090713	58	018	01	1	4	2	20	20	
3	4	090713	62	018	01	1	1	1	0	10	
4	4	090713	64	018	01	1	4	1	10	5	
5	4	090713	65	018	01	1	4	1	5	5	
6	4	090713	66	018	01	1	4	1	10	10	
7	4	090713	67	018	01	1	4	2	5	15	
8	4	090713	68	018	01	1	4	2	100	99	
9	4	090713	69	018	01	1	4	2	20	20	
10	4	090713	71	018	01	1	4	2	5	10	
11	4	090713	72	018	01	1	4	2	10	15	
12	4	090713	73	018	01	1	4	1	0	5	
13	4	090713	74	018	01	1	4	1	0	5	
14	4	090713	75	018	01	1	4	1	5	5	
15	4	090713	76	018	01	1	3	1	5	5	
16	4	090713	77	018	01	1	5	1	10	15	
17	4	090713	78	018	01	1	3	1	20	20	
18	4	090713	79	018	01	1	5	1	0	5	
19	4	090713	87	018	01	2	1	1	0	5	
20	4	090713	88	018	01	1	4	1	0	5	
21	4	090713	89	018	01	1	3	1	10	15	
22	4	090713	90	018	01	2	3	1	10	10	
23	4	090713	91	018	01	2	4	1	20	10	
24	4	090713	92	018	01	1	3	1	10	20	
25	4	090713	94	018	01	1	4	2	10	20	
26	4	090713	95	018	01	1	4	1	0	15	
27	4	090713	96	018	01	1	4	1	5	10	
28	4	090713	97	018	01	2	4	2	10	10	
29	4	090713	98	018	01	1	4	1	0	15	
30	4	090713	100	018	01	1	4	2	60	50	

In 2013, 76.67% of the trees selected for crown condition monitoring displayed no defoliation, whereas slight defoliation was detected in 16.67% and severe in 3.33% of the trees.

**Table 7. (TRD) Damage parameters, Level II - Crni Vrh**

No.	Plot no.	Assessment date	Number of trees	Damaged tree portion	Symptom	Symptom designat.	Crown portion	Time of damage occurrence	Cause	Cause name	Damage intensity	Other findings
1	4	181013	57	14	01	33	3	3	210	<i>Lymantria dispar</i>	2	
2	4	181013	58									
3	4	181013	62									
4	4	181013	64									
5	4	181013	65									
6	4	181013	66	14	01	33	3	3	210	<i>Lymantria dispar</i>	2	
7	4	181013	67									
8	4	181013	68									
9	4	181013	69									
10	4	181013	71									
11	4	181013	72									
12	4	181013	73									
13	4	181013	74									
14	4	181013	75									
15	4	181013	76									
16	4	181013	77									
17	4	181013	78									
18	4	181013	79									
19	4	181013	87									
20	4	181013	88									
21	4	181013	89									
22	4	181013	90									
23	4	181013	91									
24	4	181013	92									
25	4	181013	94									
26	4	181013	95									
27	4	181013	96									
28	4	181013	97									
29	4	181013	98									
30	4	181013	100	14	01	33	3	3	210	<i>Lymantria dispar</i>	2	

On October 18, 2013 the selected 30 beech trees were examined and assessed for health condition. With regard to the diseases and pests, a beech bark disease was identified – insect *Cryptococcus fagisuga* transferring fungus spores was observed in trees no. 38, 57 and 100. Pustulae of the fungus *Nectria coccinea* causing this disease were identified in trees no. 57 and 100. In addition, carpophores of the fungus *Trichaptum violaceum* and a fertilized brood of gypsy moth - *Lymantria dispar* were detected in tree no. 100. Beside the aforesaid tree, fertilized non-parasitized gypsy moth broods in the root collar or in the armpits of branches were identified in trees no. 2 (two broods), 57 and 66 (a brood each) and a non-fertilized damaged brood in tree no. 40. Bark beetle canals in a dry branch were perceived in tree no. 100. Rot in nodes and branches was observed in trees no. 57 and 72, while tree no. 14 suffered from severe central rot. Fungus *Diatrype stigma* was observed on the bark of tree no. 68. Mild bark inflammation resulting from intense insolation was recorded in trees no. 58 and 66.

On the whole, the damage to the trees within the sample plot may be regarded as not significant and not affecting a large number of trees; not many gypsy moth broods were observed although this year was the year of gypsy moth

gradation in the eastern region of Serbia. The presence of lichen is evidence of a healthy habitat. There is minor abiotic damage while out of biotic damage causes, in addition to the gypsy moth, the beech bark disease is the only harmful one as there is a possibility of its spreading although for the time being the infection is very mild.



**Figure 5.** Fertilized non-parasitized gypsy moth brood in the root collar of a beech tree

### 3.3. Assessment of crown condition – intensive monitoring in 2013 – Level II sample plot Mokra Gora

Crown condition of trees at the Level II sample plot on Mokra Gora was assessed on August 15, 2013. The assessment was performed on 32 Scots pine trees selected for crown condition monitoring within subplot 2.

**Table 8.** (PLT) Data on the sample plot dedicated for crown condition assessment, Level II –Mokra Gora

No.	Country code	Plot no.	Assessment date	Latitude	Longitude	Altitude /code	Team ID	Other findings
1	67	5	15.08.2013	+43°45'27"	+19°29'00"	12		

**Table 9.** (TRC) Crown condition parameters, Level II - Mokra Gora

No.	Plot no.	Assessment date	Number of trees	Species	Drying – removal	Tree status	Crown shadow	Crown visibility	Defoliation	Foliage transparency	Other findings
1	5	150813	82	018	1	2	2	1	0	30	C.I.*
2	5	150813	83	134	1	1	1	1	10	30	C.I.*
3	5	150813	84	134	1	2	2	1	10	30	C.I.*
4	5	150813	105	134	1	1	3	1	10	20	C.I.*
5	5	150813	106	134	1	1	2	1	15	30	C.I.*
6	5	150813	107	134	1	2	1	1	0	20	C.I.*
7	5	150813	113	134	1	1	1	1	0	25	C.I.*
8	5	150813	114	134	1	1	4	1	15	50	C.I.*
9	5	150813	140	134	1	2	2	1	5	25	C.I.*
10	5	150813	141	134	1	1	2	1	0	10	C.I.*
11	5	150813	142	134	1	2	2	1	0	20	C.I.*
12	5	150813	143	134	1	2	2	1	0	15	C.I.*
13	5	150813	144	134	1	2	2	1	5	20	C.I.*

No.	Plot no.	Assessment date	Number of trees	Species	Drying – removal	Tree status	Crown shadow	Crown visibility	Defoliation	Foliage transparency	Other findings
14	5	150813	165	134	1	2	1	1	0	15	<i>C.I.*</i>
15	5	150813	166	134	1	2	2	1	0	10	<i>C.I.*</i>
16	5	150813	167	134	1	2	2	1	5	15	<i>C.I.*</i>
17	5	150813	168	134	1	2	3	1	5	15	<i>C.I.*</i>
18	5	150813	183	134	1	1	1	1	10	15	<i>C.I.*</i>
19	5	150813	184	134	1	2	2	1	0	20	<i>C.I.*</i>
20	5	150813	185	134	1	3	3	2	5	25	<i>C.I.*</i>
21	5	150813	193	134	1	1	1	1	0	10	<i>C.I.*</i>
22	5	150813	194	134	1	1	2	1	0	10	<i>C.I.*</i>
23	5	150813	213	134	1	2	2	1	0	15	<i>C.I.*</i>
24	5	150813	214	134	1	3	3	1	0	10	<i>C.I.*</i>
25	5	150813	215	134	1	3	2	1	0	10	<i>C.I.*</i>
26	5	150813	223	134	1	1	2	1	0	10	<i>C.I.*</i>
27	5	150813	224	134	1	3	2	1	0	10	<i>C.I.*</i>
28	5	150813	320	134	1	2	2	1	10	20	<i>C.I.*</i>
29	5	150813	359	134	1	1	2	1	0	10	<i>C.I.*</i>
30	5	150813	407	134	1	1	2	1	0	5	<i>C.I.*</i>
31	5	150813	408	134	1	4	3	2	0	20	<i>C.I.*</i>
32	5	150813	412	134	1	1	2	1	0	5	<i>C.I.*</i>

\* *Crust-like lichen*

In 2013 93.75% of the selected trees within the Level II sample plot in Mokra Gora exhibited no signs of defoliation, whereas slight defoliation was detected in 6.25% of the trees. No severe defoliation was identified in the selected trees.

**Table 10. (TRD) Damage parameters, Level II - Mokra Gora**

No.	Plot no.	Assessment date	Number of trees	Damaged tree portion	Symptom	Symptom designat.	Crown portion	Time of damage occurrence	Cause	Cause name	Damage intensity	Other findings
1	5	101013	82	33	11	57		2	390	<i>Mycena sp.</i>		<i>C.I.*</i>
2	5	101013	83									<i>C.I.*</i>
3	5	101013	84									<i>C.I.*</i>
4	5	101013	105									<i>C.I.*</i>
5	5	101013	106									<i>C.I.*</i>
6	5	101013	107									<i>C.I.*</i>
7	5	101013	113									<i>C.I.*</i>
8	5	101013	114									<i>C.I.*</i>
9	5	101013	140									<i>C.I.*</i>
10	5	101013	141									<i>C.I.*</i>
11	5	101013	142	32	550			2			1	<i>C.I.*</i>
12	5	101013	143	32	550			2			1	<i>C.I.*</i>
13	5	101013	144									<i>C.I.*</i>
14	5	101013	165									<i>C.I.*</i>
15	5	101013	166									<i>C.I.*</i>
16	5	101013	167									<i>C.I.*</i>
17	5	101013	168									<i>C.I.*</i>
18	5	101013	183	33	11	57		2	390	<i>Mycena sp.</i>		<i>C.I.*</i>
19	5	101013	184									<i>C.I.*</i>
20	5	101013	185									<i>C.I.*</i>
21	5	101013	193									<i>C.I.*</i>
22	5	101013	194									<i>C.I.*</i>
23	5	101013	213									<i>C.I.*</i>
24	5	101013	214									<i>C.I.*</i>
25	5	101013	215									<i>C.I.*</i>

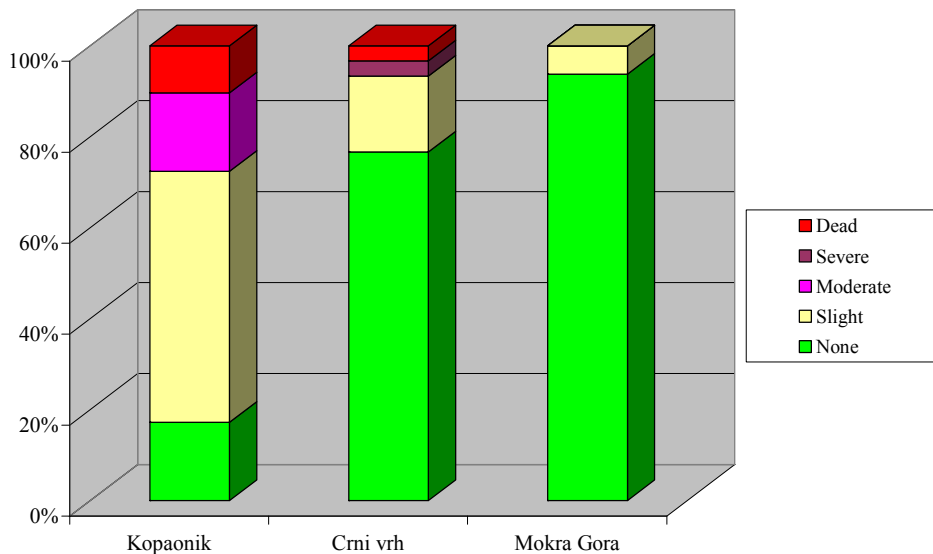
No.	Plot no.	Assessment date	Number of trees	Damaged tree portion	Symptom	Symptom designat.	Crown portion	Time of damage occurrence	Cause	Cause name	Damage intensity	Other findings
26	5	101013	223									C.l.*
27	5	101013	224									C.l.*
28	5	101013	320									C.l.*
29	5	101013	359	33	11	57		2	390	<i>Mycena sp.</i>		C.l.*
30	5	101013	407									C.l.*
31	5	150813	408									
32	5	150813	412									

\* *Crust-like lichen*

On October 10, 2013, the selected 32 trees at the level II sample plot Mokra Gora were examined in detail and assessed for health condition.

There is little damage on the tree trunks located at the root collar at the height of 1.2 m, which is slight and solely mechanical, caused by the anthropogenic factors, probably upon removal of trees or other materials or performance of other works in the forest. The only biotic damage recorded was in the form of a small number of carpophores of the saprophytic rot-causing fungus from the genus *Mycena sp.*, which appeared at the foot of a few trees close to the ground. No damage caused by insects, birds, game and the like was observed.

Presence of crust-like lichen at the lower portion of tree trunks, at the height of 2 m, indicates a healthy habitat.



**Graph 2.** Overview of defoliation at Level II sample plots in 2013

Among the three sites, the largest percentage of trees not suffering from defoliation was recorded in Mokra Gora; moreover, neither moderate nor severe defoliation was observed there.

### 3.4. GIS applications for forest condition monitoring in the Republic of Serbia in 2013

Geographic information system (GIS) is a digital tool for graphic and alpha-numeric presentation of real spatial phenomena, for manipulation with large numbers of spatial data and spatial analyses and models. GIS approach within the entire ICP Forests work of large-scale forest condition monitoring at the country level is an invaluable and irreplaceable procedure that allows adequate presentation of all data in the real coordinate system. The usage of GIS approach commences with the starting phase of determining the network of sample plot locations, continues through the field work when sample plots are marked by means of GPS manual devices to the entry of data into the GIS system, preparation of analyses, models and data archiving (Nevenić, 2011) according to the GIS procedure.

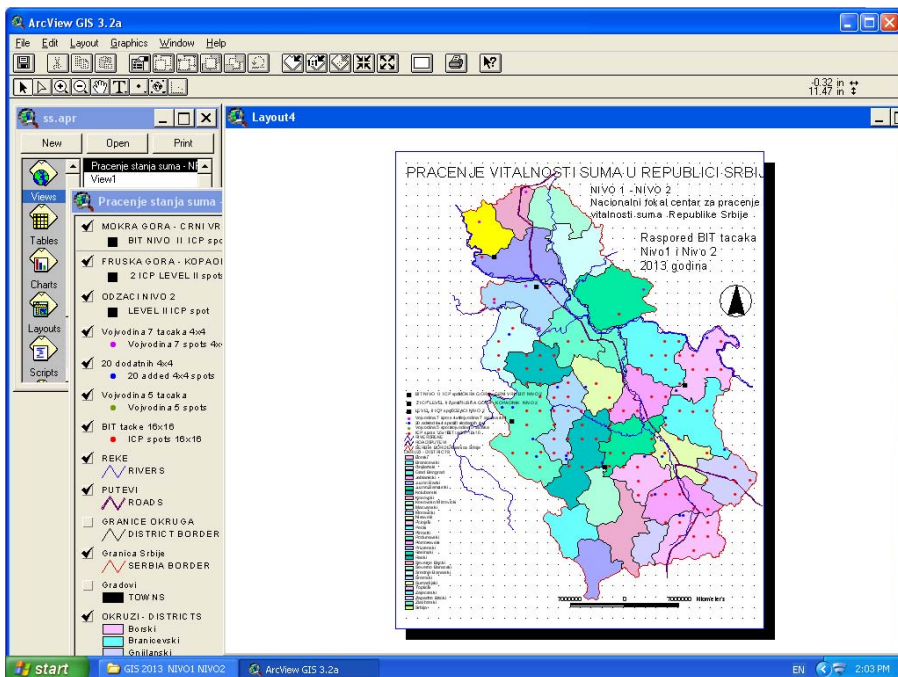


Figure 6. Distribution of Level I and Level II sample plots in the territory of the Republic of Serbia in 2013 – GIS application

For the purpose of practical implementation of GIS, the reference coordinate system (RCS) can be explained as the coordinate system linked to the Earth via the Geodetic Datum. The RCS may be a geodetic coordinate system where positions are defined by means of longitude and latitude. In most instances a projected coordinate system is used where the coordinates are transformed into plane using the Map Projection. This term, as well as other terms used here, is precisely defined by the international standards (ISO 19111:2003).

Trees in the Level II sample test plots in the territory of the Republic of Serbia are geodetically recorded and entered into the coordinate system. Figure 6 shows the distribution of the Level I and level II sample plots. Using the

manipulative approach within the appropriate GIS program, by selecting a certain topic or desired information, this application can provide clear presentation of all relevant alphanumeric and spatial data.

#### 4. CONCLUSION

In 2013, in addition to the existing Level II monitoring sample plot on Kopaonik, another two sample plots were set up – one on Crni Vrh and the other in Mokra Gora, where parameters with continuous and annual monitoring frequency were monitored.

The percentage of trees unaffected by defoliation at the sample plot Kopaonik increased in 2013 as compared to the previous three years, whereas the percentage of trees with moderate defoliation decreased in comparison the previous periods.

Examination and assessment of the health condition of the selected 30 spruce trees at the sample plot Kopaonik revealed that since the setup of the sample plot 4 trees had completely dried up; as for damage, only slight chlorosis of conifer needles was recorded.

In 2013, 76.67% of the trees within subplot 2 of the sample plot Crni Vrh showed no sign of defoliation, in 16.67 % of the trees slight defoliation and in 3.33% of the trees severe defoliation were detected.

Of diseases and pests, beech bark disease - insect *Cryptococcus fagisuga*, pustulae of the fungus *Nectria coccinea*, carpophores of the fungus *Trichaptum violaceum*, broods of gypsy moth - *Lymantria dispar* and fungus *Diatrype stigma* were identified. On the whole, the damage to the trees within the sample plot may be regarded as not significant and not affecting a large number of trees.

In 2013, 93.75% of the trees at the Level II sample plot Mokra Gora selected for crown condition monitoring displayed no indication of defoliation, while slight defoliation affected only 6.25% of the trees.

Of biotic damage, at the Level II sample plot Mokra Gora only a small number of carpophores of the saprophytic rot-causing fungus from the genus *Mycena sp.* was recorded, at the foot of several trees close to the ground.

In 2013, defoliation was the least present in trees at the Level II sample plot Mokra Gora.

A particular significance of the GIS digital approach is that it allows manipulating data obtained during field work, preparation of reports, exchange of data via the Internet network and continuous collaboration with the headquarters of ICP Forests in Hamburg.

Entries of new data into the GIS system of Serbia's NFC are regularly made on an annual basis, which will provide valuable archive for future scientific research in a few years' time, when multiannual analyses of the vitality of the Republic of Serbia's forests commence.

GIS methodology also provides great opportunities for preparation of simulation models for forecasting future condition of the ground cover vegetation and environment, where the work of collecting sample plot data performed up to date could have a significant role.

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\*\*\*\*\* Forms and Explanatory Items To be applied for data submission 2011 onwards Version n7 Last update: 3 December 2012. <http://www.icp-forests.org/page/data-submission>

Google 1 - <http://www.icp-forests.org/Manual.htm>

Google 2 - <http://www.icp-forests.org/>