ISSN 1821-1046
UDK 630

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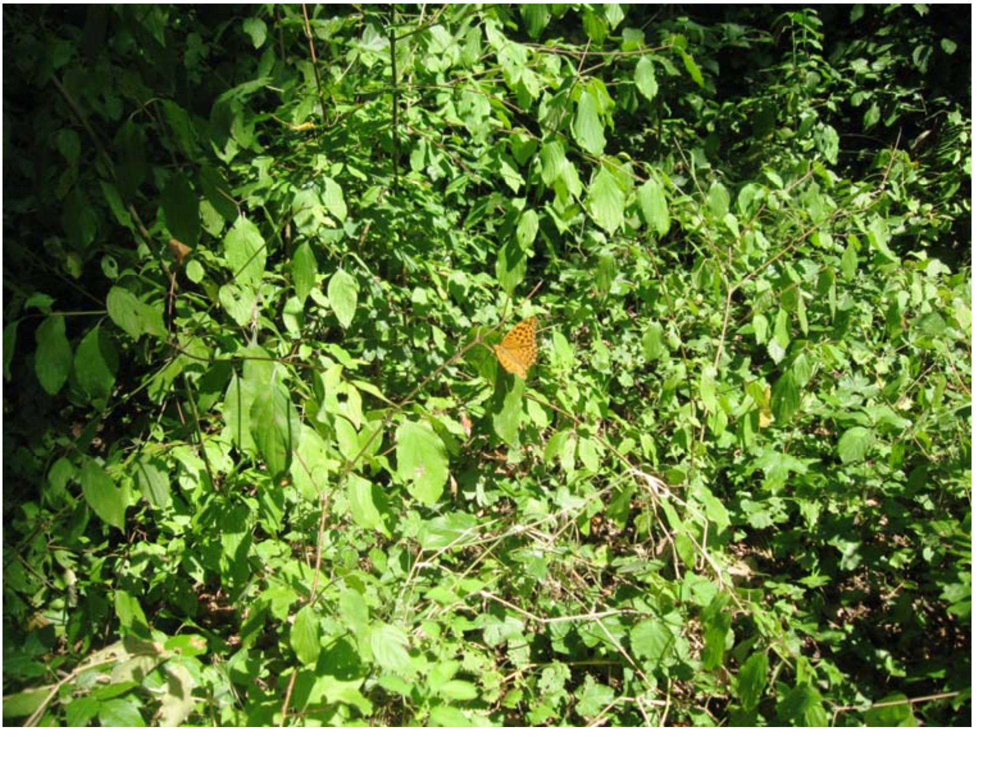

BELGRADE BEOGRAD
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INSTITUTE OF FORESTRY BELGRADE	**INSTITUT ZA ŠUMARSTVO BEOGRAD**
PROCEEDINGS	**ZBORNIK RADOVA**
Publisher	**Izdavač**
Institute of Forestry Belgrade, Serbia	Institut za šumarstvo Beograd, Srbija
For Publisher	**Za izdavača**
Ljubinko Rakonjac, Ph.D.	Dr Ljubinko Rakonjac

Printed in	**Tiraž**
100 copies	100 primeraka
Printed by	**Štampa**
Black and White Beograd	Black and White Beograd

Cover Page: Author of the Photos Tatjana Ćirković-Mitrović, M.Sc.
Naslovna strana: Autor fotografije mr Tatjana Ćirković-Mitrović

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

630

SUSTAINABLE Forestry : collection = Održivo šumarstvo = zbornik radova / chief
editor = glavni i odgovorni urednik Snežana
Rajković. - 2008, T. 57/58- . - Belgrade (Kneza Višeslava 3) : Institute of forestry, 2008- (Beograd : Black and White). - 24 cm

Godišnje. - Je nastavak: Zbornik radova - Institut za šumarstvo = ISSN 0354-1894
ISSN 1821-1046 = Sustainable Forestry
COBISS.SR-ID 157148172

CONTENT SADRŽAJ
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INSTITUTE OF FORESTRY • BELGRADE
INSTITUT ZA ŠUMARSTVO • BEOGRAD

SUSTAINABLE FORESTRY **ODRŽIVO ŠUMARSTVO**
COLLECTION 65-66, 2012 ZBORNIK RADOVA 65-66, 2012

UDK 630*181.45+630*425(497.11)(23.03 Kopaonik)=111
Original scientific paper

INTENSIVE MONITORING AT LEVEL II TEST PLOT KOPAONIK IN 2012

Svetlana BILIBAJKIĆ, Tomislav STEFANOVIĆ, Radovan NEVENIĆ, Zoran PODUŠKA, Renata GAGIĆ SERDAR, Ilija ĐORĐEVIĆ, Goran ČEŠLJAR, Zoran MILETIĆ[1]

Abstract: *Level II intensive monitoring of forest vitality represents a multi-purpose research system. Forest ecosystems are highly complex entities characterized by numerous different parameters subject to continuous variation due to constant and mutually inseparable effects of both biotic and abiotic factors. Evaluation criteria applied in intensive monitoring are compatible and defined in such a manner that, subsequent to their recording and statistical processing, data obtained on the condition of forests are easy to compare both analytically and logically, thus providing the basis for a variety of comparative studies. Dedicated test plot for intensive monitoring of trans-boundary air pollution impact on forest ecosystems in Serbia, a Level II test plot, was established in Kopaonik in 2010, with ten panels – from 10 separate forestry research areas, grouped according to the research subjects, which methodology is prescribed by ICP Forests Manual. This paper presents the results of intensive monitoring of parameters under review at Level II test plot Kopaonik in 2012.*

Key words: Level II test plot Kopaonik, intensive monitoring, crown condition, defoliation, deposition, litterfall.

INTENZIVNI MONITORING NA OGLEDNOM POLJU NIVO-a II „KOPAONIK“ U 2012.GODINI

Abstract: *Intenzivni monitoring vitalnosti šuma Nivo-a II, predstavlja višenamenski sistem predmetnih istraživanja. Šumski ekosistem, kao izuzetno složen entitet, odlikuju različiti parametri podložni konstatnim varijacijama usled neprestanog i*

[1]Institute of Forestry, Belgrade, Kneza Viseslava No 3, Serbia

neodvojivog delovanja abiotičkih i biotičkih činilaca. Kriterijumi procene koje intenzivni monitoring podrazumeva, usaglašeni su i tako određeni da se dobijeni podaci o stanju šuma, nakon unosa i statističke obrade analitički i logički lako porede, dajući osnovu za različite komparativne studije. Namenska ogledna površina za intenzivni monitoring uticaja prekograničnog vazdušnog zagađenja na šumske ekosisteme u Srbiji - bioindikacijska tačka Nivo-a II osnovana je u 2010. godini na Kopaoniku, sa deset radnih panela – iz 10 zasebnih stručnih oblasti šumarstva, grupisanih prema predmetu istraživanja, a metodološki propisanim Manual-om ICP-a za šume. U radu su dati rezultati intenzivnog monotoringa praćenih parametara u 2012.godini na BIT Nivo-a II na Kopaoniku

Ključne reči: BIT Nivo II Kopaonik, intenzivni monitoring, stanje krošnji, defolijacija, depozicija, lisni opad.

1. INTRODUCTION

Level II monitoring of forest vitality is a versatile system of comparative research of many different forestry disciplines. Scientific research in forest condition monitoring is characterized by a multi-disciplinary and studious approach. Level II monitoring test stations have been installed all over the European continent according to the uniform ICP Forests methodology in order to enable continuous measurement and collection of data on condition of forests with various specific environmental circumstances. Such forest biocenoses belong to different taxonomic groups with a wide range of differences in species diversity and extent of man's impact in terms of intensifying their productive function; there are also forests where explicit management mechanisms of habitat maintenance are applied with strict protection and conservation regimes in effect. The objective of such research approach is to enable analyses performed over several years to allow observing patterns and drawing conclusions on the phenomenon of forest drying in Europe as well as clearer defining the cause–effect system for all changes monitored. Evaluation criteria applied in intensive monitoring are compatible and defined in such a manner that, subsequent to their recording and statistical processing, data obtained on the condition of forests are easy to compare both analytically and logically, thus providing the basis for a variety of comparative studies. By perceiving similarities and dissimilarities, assumptions on the primary causes of the disturbed natural equilibrium in the forest biocenoses are rejected or accepted, further progress of the changes is anticipated and further degradation of forests as invaluable natural entities is prevented strategically, from the aspects of multiple applied forestry disciplines.

By setting up test stations in Kopaonik National Park (2010), Fruška Gora (2009) and Odžaci (2011), Serbia joined the European network of over 800 Level II test plots.

2. MATERIALS AND METHODS

A Level II test plot, a dedicated test plot for intensive monitoring of trans-boundary air pollution impact on forest ecosystems in Serbia, was established in Kopaonik in 2010. The test plot is situated in the 74th division of the estate

“Samokovska reka” in Kopaonik National Park, within pure spruce stand, *Picea abies* (L.) H.Karst., which forms thick forest complexes in such altitude (1,720 m).

Level II sample plot covers an area of 0.5 ha (100 x50 m). Within its area there are three subplots for customized sampling and a buffer zone. The trees are marked with permanent bark markings, i.e. numbers from 1 to 195. Current status situation plan[1] of the test plot is provided in Figure 1.

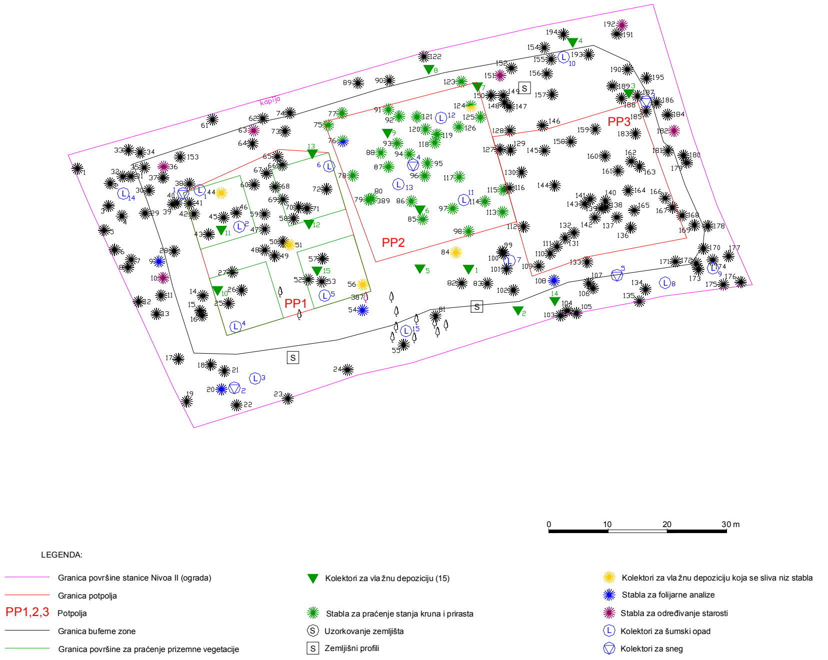


Figure 1. *Current status situation plan of the test plot area*

Level II monitoring program comprised the following parameter groups: crown condition, foliar analyses, soil chemistry, soil solution chemistry, growth and yield, ground vegetation, atmospheric deposition, air quality, meteorology, phenology and forest litterfall. Frequency of monitoring individual parameters is shown in Table 1.

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

Parameter type	Frequency of monitoring
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

[1] Current status situation plan was prepared at the Forestry Institute in Belgrade, in a digital form, according to the field status and the blueprint of the basic layout of the test subplots drawn by the team of the Faculty of Forestry in Belgrade in 2010.

Parameter type	Frequency of monitoring
Ozone injuries	Annually
Meteorology	Continuously
Phenology	Several times a year
Forest litterfall	Continuously

Assessment of the crown condition in Level II intensive monitoring encompasses assessment of defoliation, injury detection, tree condition, crown shade (damage), crown visibility, fructiferousness of the visible crown parts and presence of the secondary sprouts. Out of the total number of spruce trees marked, 30 trees were selected within subplot 2 for the purpose of crown condition monitoring.

Phenological observations included 15 selected spruce trees (*Picea abies* L.). Phenophases were observed continuously, in succession, and the following parameters were detected and monitored: budding, change in color of conifer needles, significant indications of needle or crown damage, other injuries (broken branches and trees and uprooted trees), secondary budding and blooming. The aforesaid parameters were monitored in the trees located within the test plot, starting from the first field visit.

For litterfall sampling 15 collector pads for collection of dead organic remnants of forest trees (litterfall). The average collection surface area was 500 cm^2 per pad and the total collection surface area amounted to 0.75 m^2.

For wet deposition collection within the test plot, 15 collectors of precipitation falling through the tree crowns (“throughfall”), 5 collectors of deposition sliding down the tree trunks (“steamflow”) and 5 snow collectors (“bulk”) were placed in appropriate positions.

Soil solution is sampled by means of gravitational lysimeters placed into the front vertical wall of the existing pedological profiles at defined depths below the organic layer horizon.

For meteorological monitoring performed in order to obtain information on microclimatic conditions, data provided by Kopaonik automatic weather station of the Hydrometeorological Service of Serbia, which is situated near the Level II test plot on Mt. Kopaonik, were used. The location of the weather station ensured representative meteorological data according to the ICP Forests Manual. The following mandatory parameters were monitored: precipitation (PR), air temperature (AT), relative air humidity (RH), wind speed (WS), wind direction (WD) and solar radiation (SR).

At the end o 2011, the measuring instruments were checked and prepared for the climatic conditions typical of long and severe winters at such altitudes.

In April 2012, the equipment was washed and sterilized and minimum required repairs were performed. Phenological observations were conducted continuously. Wet deposition collection and soil solution sampling were carried out on a monthly basis. Upon each field visit, litterfall collectors were emptied.

3. RESULTS AND DISCUSSION

During 2012 parameters with continuous and an annual-basis frequency of monitoring were monitored.

3.1 Assessment of the Crown Condition – 2012 Intensive Monitoring

Crown condition assessment of the trees at the Level II test plot Kopaonik was performed as at August 23, 2012. As in prior years, the assessment included 30 spruce trees selected for annual crown condition monitoring in subplot 2.

Table 2. *XX2012. (PLT) Data on the subplot dedicated for crown condition assessment, Level II, Kopaonik*

No.	State code	Subplot no.	Assessment date	Latitude	Longitude	Altitude code	Team identification	Other findings
1	67	2	230812	+43^{0}17'30"	+20^{0}48'50"	35	REIGO	

Crown condition assessment focused on determining the degree of defoliation, tree drying and removal, tree status, crown shade, crown visibility, foliage transparency and other findings.

Injuries were also detected in selected trees. For each tree where injury/damage was identified, location, symptom, cause and intensity of injury/damage are stated.

Table 3. *XX2012. (TRC) Crown condition parameters, Level II Kopaonik*

No.	Sub-plot no.	Assessment date	Tree no.	Species	Drying - removal	Tree status	Crown shade	Crown visibility	Defoliation	Foliage transparency	Other findings
1	2	230812	75	118	01	1	2	2	10	25	*U.b.**
2	2	230812	76	118	01	1	1	2	10	20	*U.b.**
3	2	230812	78	118	01	1	2	2	10	25	*U.b.**
4	2	230812	79	118	01	1	1	2	15	25	*U.b.**
5	2	230812	80	118	01	1	1	2	20	25	*U.b.**
6	2	230812	85	118	01	1	2	2	15	25	*U.b.**
7	2	230812	86	118	01	1	3	3	15	30	*U.b.**
8	2	230812	87	118	01	3	3	3	30	70	*U.b.**
9	2	230812	88	118	38	5	6	2	100	99	*U.b.**
10	2	230812	91	118	41						Felled
11	2	230812	92	118	01	2	3	3	30	60	*U.b.**
12	2	230812	93	118	01	1	3	3	30	60	*U.b.**
13	2	230812	94	118	01	3	3	3	50	80	*U.b.**
14	2	230812	95	118	01	2	3	3	20	30	*U.b.**
15	2	230812	96	118	01	1	4	4	20	30	*U.b.**
16	2	230812	97	118	01	1	3	3	20	50	*U.b.**
17	2	230812	98	118	01	1	3	3	20	80	*U.b.**
18	2	230812	113	118	01	1	2	2	25	60	*U.b.**
19	2	230812	114	118	01	1	4	3	25	80	*U.b.**
20	2	230812	115	118	01	1	3	3	30	50	*U.b.**
21	2	230812	117	118	01	1	4	3	25	50	*U.b.**
22	2	230812	118	118	01	1	3	2	20	65	*U.b.**
23	2	230812	119	118	01	3	3	3	95	90	*U.b.**
24	2	230812	120	118	01	1	1	2	30	40	*U.b.**
25	2	230812	121	118	01	1	3	3	15	20	*U.b.**
26	2	230812	124	118	01	1	2	2	25	60	*U.b.**

No.	Sub-plot no.	Assessment date	Tree no.	Species	Drying - removal	Tree status	Crown shade	Crown visibility	Defoliation	Foliage transparency	Other findings
27	2	230812	125	118	38	5	3	3	100	99	*U.b.**
28	2	230812	126	118	01	1	2	2	15	40	*U.b.**
29	2	230812	77	118	01	1	3	2	15	30	*U.b.**
30	2	230812	123	118	01	1	1	1	15	20	*U.b.**

**Usnea barbata*

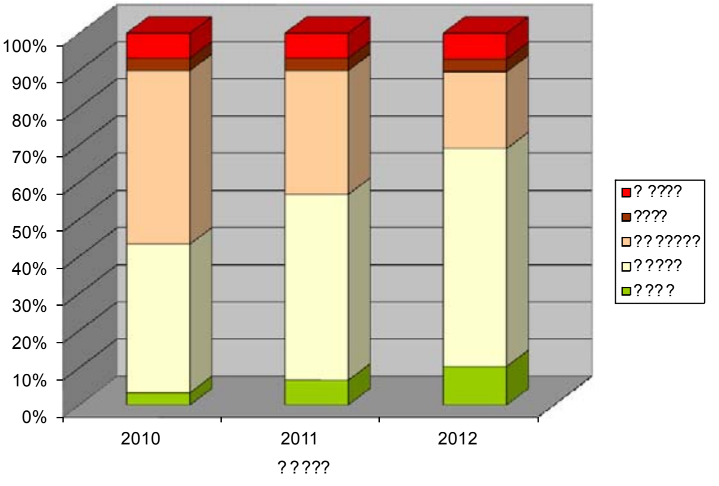
Tables 3 and 4 present crown condition parameters and injury/damage parameters at the Level II test plot Kopaonik.

Table 4. *XX2012. (TRD) Injury/Damage parameters, Level II Kopaonik*

No.	Sub-plot no.	Assessment date	Tree no.	Injured tree part	Symptom	Symptom designation	Crown part	Time of injury/damage inception	Cause	Cause description	Injury/ Damage intensity	Other findings
1	2	230812	75	00								*U.b.**
2	2	230812	76	00								*U.b.**
3	2	230812	78	11	02	38	3	3	301	CHRYABI	1	*U.b.**
4	2	230812	79	11	02	38	3	2	301	CHRYABI	2	*U.b.**
5	2	230812	80	11	02	38	3	3	301	CHRYABI	2	*U.b.**
6	2	230812	85	11	02	38	3	2	301	CHRYABI	2	*U.b.**
7	2	230812	86	13	02	38		3	999		1	*U.b.**
8	2	230812	87	31	10	65		3	220	IPSTYPO	3	*U.b.**
9	2	230812	88	04	10	65		3	220	IPSTYPO	7	*U.b.**
10	2	230812	91	04	22			1	400		7	
11	2	230812	92	33	17	58		2	500		2	*U.b.**
12	2	230812	93	33	17	58		3	500		1	*U.b.**
13	2	230812	94	33	17	58		3	500		3	*U.b.**
14	2	230812	95	11	02	38	3	2	301	CHRYABI	1	*U.b.**
15	2	230812	96	00								*U.b.**
16	2	230812	97	00								*U.b.**
17	2	230812	98	32	17	60		3	999		1	*U.b.**
18	2	230812	113	00								*U.b.**
19	2	230812	114	11	02	38	3	3	301	CHRYABI	1	*U.b.**
20	2	230812	115	00								*U.b.**
21	2	230812	117	00								*U.b.**
22	2	230812	118	00								*U.b.**
23	2	230812	119	34	11	57		3	304	TRAMSPP	6	*U.b.**
24	2	230812	120	11	02	38	3	3	301	CHRYABI	1	*U.b.**
25	2	230812	121	11	02	38	3	3	301	CHRYABI	1	*U.b.**
26	2	230812	124	24	13		2	2	999		2	*U.b.**
27	2	230812	125	04	10	65		3	220	IPSTYPO	7	*U.b.**
28	2	230812	126	00								*U.b.**
29	2	230812	77	00								*U.b.**
30	2	230812	123	00								*U.b.**

**Usnea barbata*

As compared to the previous two years, the number of trees not subject to defoliation has increased, as well as the percentage of trees with weak defoliation, whereas the percentage of trees with moderate defoliation has declined. The percentage of trees with strong defoliation has remained almost the same as in the previous years.



Graph 1. *Comparative presentation of defoliation in the period from 10/10-10/12 – Level II, Kopaonik*

3.2 Phenological Observations in 2012

At Level II test plot 15 spruce trees (*Picea abies* L.) were selected for phenological observations (Table 5).

The vegetation of the dominant species commenced rather late. Observed from different expositions of the evaluated trees, budding started in the third week of June 2012, whereafter slightly opened male and female reproductive organs were identified, which in conifer trees are called "blossoms." Pollination lasted until mid-July, which is easily perceived in mature spruce trees in the form of pollen clouds carried by the wind.

Table 5. *XX 2012. (PLP) Registration of trees selected for intensive phonological monitoring*

No.	Sub-plot no.	Species code	Placement date	Tree no.	Visible crown part	Surveillance direction	Surveillance position	Other findings
1	2	118	210612	75	3	4	1	*U.b.**
2	2	118	210612	76	3	4	1	*U.b.**
3	2	118	210612	78	3	4	1	*U.b.**
4	2	118	210612	79	3	4	1	*U.b.**
5	2	118	210612	80	3	4	1	*U.b.**
6	2	118	210612	85	3	4	1	*U.b.**
7	2	118	210612	86	3	4	1	*U.b.**
8	2	118	210612	87	3	5	1	*U.b.**
9	2	118	210612	88	2	6	1	*U.b.**
10	2	118	210612	98	3	4	1	*U.b.**
11	2	118	210612	114	2	6	1	*U.b.**
12	2	118	210612	118	2	4	1	*U.b.**
13	2	118	210612	120	1	7	1	*U.b.**
14	2	118	210612	121	1	5	1	*U.b.**
15	2	118	210612	124	2	8	1	*U.b.**

**Usnea barbata*

Table 6. *XX 2012. (PHE) Phenological phenomena monitoring (spring aspect)*

No.	Sub-plot no.	Species code	Event	Observation date	Event registered	Other findings
1	2	118	3	210612	1	*Usnea barbata*
2	2	118	3	210612	1	*Usnea barbata*
3	2	118	3	210612	7	*Usnea barbata*
4	2	118	2	210612	7	*Usnea barbata*
5	2	118	2	210612	7	*Usnea barbata*
6	2	118	2	210612	7	*Usnea barbata*
7	2	118	2	210612	7	*Usnea barbata*
8	2	118	5	210612	7	*Usnea barbata*
9	2	118	5	210612	7	*Usnea barbata*
10	2	118	5	210612	7	*Usnea barbata*
11	2	118	2	210612	7	*Usnea barbata*
12	2	118	3	210612	7	*Usnea barbata*
13	2	118	2	210612	7	*Usnea barbata*
14	2	118	4	210612	1	*Usnea barbata*
15	2	118	4	210612	1	*Usnea barbata*

Table 7. *XX 2012. (PHE) Phenological phenomena monitoring (autmn aspect)*

No.	Sub-plot no.	Species code	Event	Observation date	Event registered	Other findings
1	2	118	3	101012	1	*Usnea barbata*
2	2	118	3	101012	1	*Usnea barbata*
3	2	118	3	101012	7	*Usnea barbata*
4	2	118	2	101012	7	*Usnea barbata*
5	2	118	2	101012	7	*Usnea barbata*
6	2	118	2	101012	7	*Usnea barbata*
7	2	118	2	101012	7	*Usnea barbata*
8	2	118	5	101012	7	*Usnea barbata*
9	2	118	5	101012	7	*Usnea barbata*
10	2	118	5	101012	7	*Usnea barbata*
11	2	118	2	101012	7	*Usnea barbata*
12	2	118	3	101012	7	*Usnea barbata*
13	2	118	2	101012	7	*Usnea barbata*
14	2	118	4	101012	1	*Usnea barbata*
15	2	118	4	101012	1	*Usnea barbata*

Table 8. *XX 2012 (PHI) Phenological phenomena recording*

No.	Sub-plot no.	Tree no.	Event	Observation date	Event registered	Surveillance method applied	Other findings
1	2	75	3	210612	6	3	*Usnea barbata*
2	2	76	3	210612	6	3	*Usnea barbata*
3	2	78	3	210612	6	3	*Usnea barbata*
4	2	79	2	210612	6	3	*Usnea barbata*
5	2	80	2	210612	7	3	*Usnea barbata*
6	2	85	2	210612	6	3	*Usnea barbata*
7	2	86	2	210612	6	3	*Usnea barbata*
8	2	87	5	210612	7	3	*Usnea barbata*
9	2	88	5	210612	7	3	*Usnea barbata*
10	2	98	5	210612	6	3	*Usnea barbata*
11	2	114	2	210612	7	3	*Usnea barbata*
12	2	118	3	210612	6	3	*Usnea barbata*
13	2	120	2	210612	6	3	*Usnea barbata*
14	2	121	4	210612	6	3	*Usnea barbata*
15	2	124	4	210612	6	3	*Usnea barbata*

3.3 Litterfall Sampling and Analysis in 2012

In 2012, 1545.33 kg/ha of litterfall ended up on the land surface of the forest ecosystem represented by the test plot. The litterfall was in the form of absolutely dry dead organic remnants produced by forest trees (assimilation organs of spruce and rowan trees, twigs, bark, blossoms, fruits etc.). The examined forest ecosystem deposited via litterfall to the land surface 77.48 kg of ashes and 1467.85 kg of combustible organic matter.

The most present of all nutrition macroelements in the litterfall collected was carbon, which comprised 47.23% of the litterfall. The total carbon inflow to the land via litterfall in the examined ecosystem amounted to 729.91 kg/ha.

Second most present nutrition element in the litterfall was nitrogen. A gram of litterfall contains 11.13 mg of the total nitrogen. This means that 17.19 kg of the total amount of nitrogen reaches the land vial litterfall.

Table 9. *XX2012 (LFP) Basic data on litterfall sampling*

No.	State code	Sub-plot no.	Latitude	Longitude	Altitude	No. of collectors	Total collection area	Sample collection period		Other findings
								from	to	
1	67	02	+43^0 17' 30"	+20^0 48' 50"	1712/35	15	0.75	21.05.12	19.10.12	

Table 10. *XX2012 (LFM) Results of litterfall analysis*

No.	Sub-plot no.	Collection period		Collector no.	Species code	Sample code	Dry mass per m2 [kg/m^2]	Mass of dry 1000 Conifer needles (g)	**C** (g/100g)	**N** (mg/g)	**P** (mg/g)	**Ca** (mg/g)	**Mg** (mg/g)	**K** (mg/g)	Other findings
		from	to												
1	2	21.05.12	19.10.12	-9	118	11	0.1545	3.782	47.233	11.127	0.582	8.857	2.526	3.009	

3.4. Deposition Collection and Analysis

At Level II test plots special attention is paid to wet deposition, whereby the most relevant is examination of the chemistry of the deposit in the immediate contact with plant organs where pollutants from the air remain (ICP Forests, 2010c).

In 2012 there were eight periods of collecting samples from collectors. 5 joint samples were collected from the “throughfall“ collectors, 6 joint samples from “steamflow“ collectors and 4 joint samples from “bulk” collectors. The results of the chemistry analyses of the samples are provided in Tables XX2012.PLD and XX2012.DEM.

Figure 2. *"Throughfall" collector*

Figure 3. *"Steamflow" collector*

Table 11. XX2012(PLD) *General data on the test plot for atmospheric deposition*

No.	State	Test subplot no.	Collector code	Latitude	Longitude	Altitude (code)	Active collection period		No. of collection periods	Collector model	Collector height (m)	Collector area (m^2)	Number of collectors	Other findings
							from	to						
01	67	02	1	+43^{0}17'30"	+20^{0}48'50"	35	290212	230812	05	1	1.00	0.002	15	
02	67	02	2	+43^{0}17'30"	+20^{0}48'50"	35	231211	190412	04	1	1.00	0.002	5	
03	67	02	4	+43^{0}17'30"	+20^{0}48'50"	35	290212	230812	06	1	1.10	0.002	5	

Table 12. *XX2012(DEM) Laboratory analysis data for atmospheric deposition*

No.	Test subplot	Collection periods		Period no.	Sample code	Sampling	pH	Conductivity (µS/cm)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	N-NH4 (mg/l)	Cl (mg/l)	N-NO3 (mg/l)	S-SO_4 (mg/l)	Alcality	Other findings
		from	to															
01	02	231211	180112	01	02	1	4.92	16.8	0.176	5.143	0.320	0.246	1.2	4.004	4.422	14.547	4.64	
02	02	180112	290212	02	02	1	5.51	32.3	0.340	2.455	0.585	9.980	1.906	1.502	2.260	21.715	3.48	
03	02	290212	150312	03	02	1	5.39	21.5	0.548	3.452	0.694	4.896	1.44	3.254	4.261	12.228	3.48	
04	02	290212	150312	03	01	1	6.31	34.2	1.459	2.365	0.743	0.764	1.454	5.756	2.421	16.866	4.64	
05	02	290212	150312	03	04	1	3.98	198.5	2.478	4.784	1.785	1.387	11.112	8.009	2.311	28.462	3.48	
06	02	150312	190412	04	01	1	5.02	55.6	1.065	3.086	0.655	0.962	1.948	5.756	3.489	18.131	4.06	
07	02	150312	190412	04	02	1	4.81	27.8	0.298	4.763	0.629	0.954	0.367	5.006	4.142	21.715	2.90	
08	02	150312	190412	04	04	1	3.71	351	2.126	4.235	2.478	1.784	9.531	33.036	5.151	43.009	1.74	
09	02	190412	210512	05	01	1	5.78	21.7	1.147	1.220	0.383	0.670	0.191	4.004	7.761	30.781	4.64	
10	02	190412	210512	05	04	1	4.17	123.6	2.315	3.438	1.233	16.19	3.692	8.009	11.134	29.938	1.74	
11	02	210512	210612	06	01	1	6.3	31.1	3.876	8.953	0.974	1.268	0.777	4.505	6.040	25.089	4.06	
12	02	210512	210612	06	04	1	4.8	48.3	4.037	6.935	2.365	3.872	1.793	5.256	4.684	22.137	4.64	
13	02	210612	190712	07	04	1	5.9	100.4	4.764	7.092	1.342	2.242	2.873	7.008	3.413	32.257	5.81	
14	02	190712	230812	08	01	1	5.31	41.1	2.897	3.289	1.975	2.188	0.777	7.008	2.727	50.388	4.06	
15	02	190712	230812	08	04	1	4.54	109.4	4.984	2.785	2.102	3.025	7.427	9.010	4.922	42.587	6.97	

3.5. Soil Solution Sampling and Analysis

Tables 13. XX2012 (PSS) and 12. XX2014 (SSM) present the basic data on the soil solution measurements and chemical analyses of the collected samples of the soil solution.

Table 13. *XX2012(PSS) basic data on the soil solution measurement*

No.	State code	Test subplot no.	Latitude	Longitude	Altitude	Collector	Collector type	Earth layer	Collection depth	Commencement date	Completion date	No. of monitoring	Other findings
01	67	2	+43^{0}17'30"	+20^{0}48'50"	1712/35	1	2	H	-0.30	271011	230812	03	

Table 14. *XX2012 (SSM) Data on the soil solution*

No.	Test subplot no.	Collection period		Period no.	Collector	pH	Conductivity (µS/cm)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	$N\text{-}NO_3$ (mg/l)	$S\text{-}SO_4$ (mg/l)	Alcality (µeq/l)	Na (mg/l)	$N\text{-}NH_4$ (mg/l)	Cl (mg/l)	Other findings
		from	to														
01	02	271011	210512	01	00	4.8	341	5.984	10.654	3.243	30.032	30.781	2.32	5.438	10.392	14.015	
02	02	210512	190712	02	00	6.92	122.5	6.953	12.558	2.428	24.404	24.245	2.90	11.190	2.231	5.006	
03	02	190712	230812	03	00	6.21	88.0	9.876	9.475	3.254	15.618	28.673	4.06	5.945	2.019	10.011	

3.6. Meteorological Monitoring

According to the data obtained from the weather station Kopaonik of the Hydrometeorological Service of Serbia, mean monthly air temperatures exhibit regular annual patterns, with values on the rise from January to July and on decline toward the year-end. The coldest month in the period under review was February, with the mean monthly air temperature of -6.9^{0}C, while the warmest month was July, when the mean monthly air temperature was 17.0^{0}C.

Mean monthly precipitation quantities ranged from 0.2 mm in August to 138.9 mm in January.

Mean monthly relative air humidity was the lowest in August and the highest in January.

Mean monthly wind speed in the analyzed period ranged from 2.6 to 4.3 ms^{-1}.

Table 15. *Meteorological data for 2012 from weather station Kopaonik*

Month	PR	AT	AT min	AT max	RH	RH min	RH max	WS	SR
	mm	°C	°C	°C	%	%	%	m/s	W.h/sq.m
I	138.9	-6.5	-9.5	-3.5	95	90	99	3.6	468
II	86.9	-6.9	-10.0	-3.4	93	85	98	4.3	604
III	47.6	-0.4	-4.4	4.5	76	54	91	3.0	1452
IV	111.3	3.6	-0.4	8.0	85	67	96	4.2	1592
V	113.5	7.5	3.4	11.9	88	71	99	2.9	1436
VI	47.8	14.6	8.9	19.7	72	49	93	3.0	2600
VII	16.5	17.0	11.2	22.6	69	48	91	2.8	2397
VIII	0.2	16.3	10.5	22.2	55	37	78	2.6	2305
IX	22.5	13.2	8.2	18.4	66	48	85	3.2	1750

Data obtained through research at Level II test plot Kopaonik were entered into the ICP on-line database in Hamburg.

4. CONCLUSION

As in the previous two years, parameters with continuous and an annual-basis frequency of monitoring were reviewed.

Crown assessment of the trees within Level II test plot Kopaonik was performed as at August 23, 2012.

As compared to the previous two years, the number of trees not subject to defoliation has increased, as well as the percentage of trees with weak defoliation, whereas the percentage of trees with moderate defoliation has declined. The percentage of trees with strong defoliation has remained almost the same as in the previous years.

The vegetation of the dominant species commenced rather late. Observed from different expositions of the evaluated trees, budding started in the third week of June 2012. Pollination lasted until mid-July.

In 2012, 1545.33 kg/ha of litterfall ended up on the land surface of the forest ecosystem represented by the test plot. The litterfall was in the form of absolutely dry dead organic remnants produced by forest trees. The examined forest ecosystem deposited via litterfall to the land surface 77.48 kg of ashes and 1467.85 kg of combustible organic matter. The most present of all nutrition macroelements in the litterfall collected was carbon, which comprised 47.23% of the litterfall. Second most present nutrition element in the litterfall was nitrogen. A gram of litterfall contains 11.13 mg of the total nitrogen. This means that 17.19 kg of the total amount of nitrogen reaches the land vial litterfall.

In 2012 there were eight periods of collecting wet deposition samples from collectors and three periods of soil solution sampling.

The coldest month in the period under review was February with the mean monthly air temperature of -6.9^0C, while the warmest month was July, when the mean monthly air temperature was 17.0^0C. Mean monthly precipitation quantities ranged from 0.2 mm in August to 138.9 mm in January.

REFERENCES

Nevenić, R., Rakonjac, LJ., Orlović, S. (2011): Praćenje uticaj zagađenja vazduha i njegovih efekata u šumskim ekosistemima na teritoriji Republike Srbije – monitoring stanja šuma Nivo I i Nivo II. Monografija. Institut za šumarstvo. Beograd. ISBN 978-86-80439-28-0. UDK 630*1:502.175(497.11). pp. 1-294.

Monitoring and Impact Assessment of Air Pollution and its Effects in Forest Ecosystems on the Territory of the Republic of Serbia. Monograph; NFC Serbia – National Focal Center

***** (2010): MANUAL on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. United Nations Economic Commissions for Europe. Convention on Long-range Tran boundary Air Pollution. International Co-operative Programme on Assessment and Monitoring of Air Pollution

Effects on Forests (ICP Forests). Programme Coordinating Centre of ICP Forests. Johann Heinrich von Thunen-Institute. Institute for World Forestry, Hamburg, Germany. ISBN 978-3926301-01-1. www.icp-forests.org/Manual.htm

***** (2010a): Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests – Parts I, II, IX, V, VII, VIII, IX, XVII; ISBN 978-3-926301-01-1, Edited in 2010

***** (2010b): Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests – Part X – Sampling and Analysis of Soil, ICP Forests, 2010, updated: 05/2010

***** (2010c): Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests – Part XIV – Sampling and Analysis of Deposition," ICP Forests, 2010, updated: 05/2010

***** (2010d): Europe`s Forests 1985-2010. 25 Years of Monitoring Forest Condition by ICP Forests. Hohann Heinrich von Thuunen – Institute, Institute for World Forestry. PCC of ICP Forests, Hamburg, Germany.

***** 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

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