

ISSN 1821-1046

UDK 630

INSTITUTE OF FORESTRY  
BELGRADE

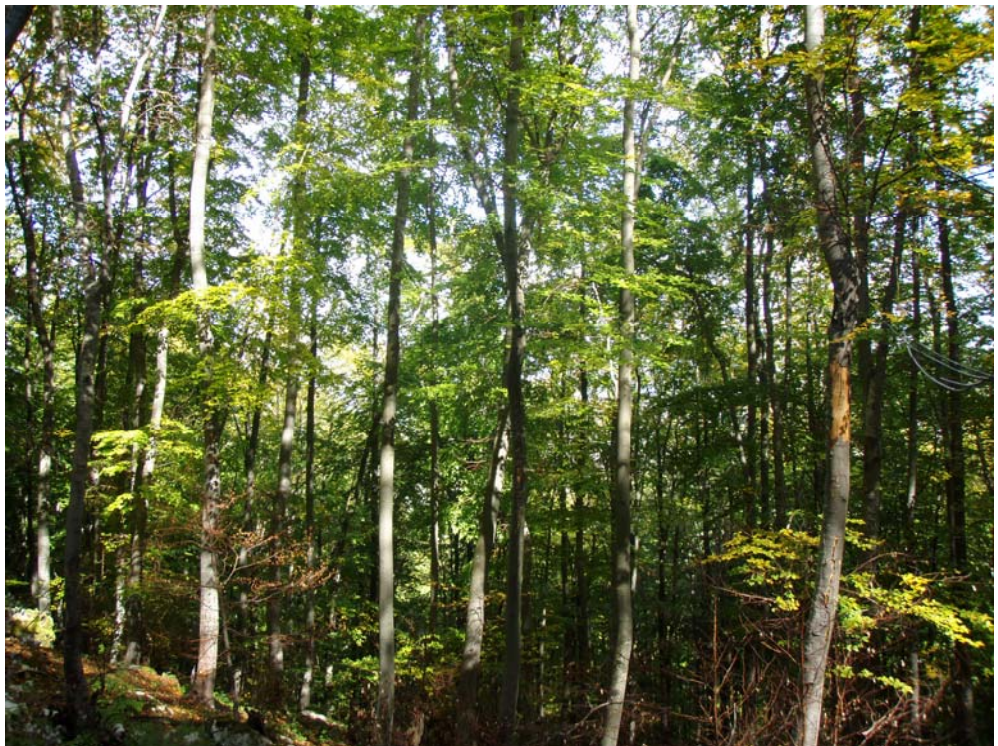


INSTITUT ZA ŠUMARSTVO  
BEOGRAD

**SUSTAINABLE FORESTRY    ODRŽIVO ŠUMARSTVO**

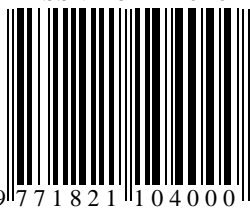
COLLECTION  
TOM 59-60

ZBORNİK RADOVA  
TOM 59-60



**BELGRADE    BEOGRAD**  
**2009.**

ISSN 1821-1046



9 771821 104000

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2009.**



**INSTITUTE OF FORESTRY BELGRADE**      **INSTITUT ZA ŠUMARSTVO BEOGRAD**

**PROCEEDINGS**      **ZBORNİK RADOVA**

**Publisher**

Institute of Forestry  
Belgrade, Serbia

**Izdavač**

Institut za šumarstvo  
Beograd, Srbija

**For Publisher**

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**Za izdavača**

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**Printed in**

150 copies

**Tiraž**

150 primeraka

**Printed by**

Klik print

Beograd

**Štampa**

Klik print

Beograd

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Belgrade, 2009

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Beograd, 2009

**Cover Page:** Author of the Photos Mara Tabaković-Tošić, Ph.D.

**Naslovna strana:** Autor fotografije dr Mara Tabaković-Tošić

CIP – Каталогизација у публикацији  
Народна библиотека Србије, Београд

630

**SUSTAINABLE Forestry** : collection = Održivo šumarstvo = zbornik radova / glavni i odgovorni urednik Mara Tabaković-Tošić. –2009, T. 59/60– . – Beograd (Kneza Višeslava 3) : Institut za šumarstvo, 2009- (Beograd: Klik print). – 24 cm

Godišnje. – Je nastavak: Zbornik radova – Institut za šumarstvo = ISSN 0354-1894

ISSN 1821-1046 = Sustainable Forestry

COBISS.SR-ID 157148172

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UDK 630\*43 (497.11) = 111  
Original scientific paper

## WILDFIRES IN SERBIA – CHANCE OR FREQUENT PHENOMENON

Mara TABAKOVIĆ-TOŠIĆ<sup>1</sup>, Miroslava MARKOVIĆ<sup>1</sup>,  
Snežana RAJKOVIĆ<sup>1</sup>, Milorad VESELINOVIĆ<sup>1</sup>

**Abstract:** *The forest ecosystem is one of the most complex ecosystems on the planet. The various influences cause the destabilization of it, and fire -uncontrolled wildfire is one of the main factors. The wildfires which in the blink of an eye turn the beautiful forests in the fire-ravaged places, bare lifeless areas, and cause damages worth millions to the forest-based economy and disturbances in business, pose a serious, global, social and economic problem which is always relevant. Realizing the gravity of the situation, Directorate of Forests within the Ministry of Agriculture, Forestry and Water Management initiated and entrusted the Institute of Forestry in Belgrade with the task of making the project “Wildfires in Period 2003-2007“ in 2007, and some results of it is presented in this paper. In the period 2003-2007 in the forest ecosystems of Serbia 579 wildfires in the area of 9872,80 ha were reported. They were caused mostly by humans, occurred mainly in the parts of the year which are critical for their occurrence, and initiated in the part of the day when it is hardest to extinguish them. The results presented in this paper give the opportunity to the lower organizational units and forest owners to take the appropriate measures of readiness and organization of the wildfire protection on time in the forthcoming years.*

**Key words:** wildfires, period 2003-2007, Serbia, analysis

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<sup>1</sup> Mara Tabaković-Tošić, Ph.D., Miroslava Marković, M.Sc., Snežana Rajković, Ph.D., Milorad Veselinović, Ph.D., Institute of Forestry, Belgrade  
Translation: Marija Stojanović

## ŠUMSKI POŽARI U SRBIJI – SLUČAJNOST ILI REDOVNA POJAVA

**Izvod:** Šumski ekosistem je jedan od najsloženijih na planeti. Razni uticaji izazivaju njegovu destabilizaciju, a vatra-nekontrolisani šumski požar je jedan od glavnih faktora. Požari koji za tren oka divne šume pretvaraju u zgarišta, gole bezživotne površine, a šumskoj privredi donesu milionske štete i poremećaje u poslovanju, predstavljaju ozbiljan i uvek aktuelan globalni društveni i privredni problem. Sagledavajući ozbiljnost situacije, Uprava za šume Ministarstva poljoprivrede, šumarstva i vodoprivrede je 2007. godine inicirala, i Institutu za šumarstvo u Beogradu poverila, izradu projekta "Šumski požari u periodu 2003-2007. godine", a deo rezultata je prezentovan u ovom radu.

U periodu 2003-2007. godina, u šumskim ekosistemima Srbije zabeleženo je ukupno 579 požara na površini od 9872,80 ha. Većinom ih je izazvao čovek, dešavali su se uglavnom u kritičnim periodima godine za njihovu pojavu, a inicirani su u delu dana kada je gašenje najteže. Rezultati, navedeni u ovom radu pružaju mogućnosti da se u narednim godinama, na nivou nižih organizacionih jedinica korisnika šuma, sprovedu pravovremeno odgovarajuće mere pripravnosti i organizacije protivpožarne zaštite.

**Ključne reči:** šumski požari, period 2003-2007. godina, Srbija, analiza

### 1. INTRODUCTION

Wildfires, which in the blink of an eye turn the beautiful forests in the fire-ravaged places, bare lifeless areas, and cause damages worth millions to the forest-based economy and disturbances in business, pose a serious social and economic problem which is always relevant. Alongside material damages owing to the lost wood volume, fire extinguishing expenses, fire sites rehabilitation, and new reforestation, since they destroy the all living things, and disturb the natural beauty of the landscape, which means that they also cause the ecological harm, which is three to ten times greater than the value of the burnt tree.

Wildfires as the unbridled elements of the specific type not only act ultimately destructively on the forests and forest land, but also cause great and irreparable damages to other industrial branches which are directly or indirectly connected to the forest and its complex useful functions (For instance, agriculture, water management, health and recreation tourism, wood industry, traffic, etc).

We must always expect the wildfire occurrence, but at the same time must aspire to reduce the number of them and the loss which they cause.

Wildfires used to be considered the unbridled elements, which irregularly, occur by no definite reason, although it was always known that they cause the catastrophic consequences. However, the history of forestry teaches us that the forests on each continent regularly sustained the consequences of this disaster, and they must have been one of the major causes for the decrease of forest cover to modern insufficient levels. Man over years and decades establish new stands, and then the fire break out which destroy everything “like lightning”.

In the multi-decade development of the forestry in our country, the problem of the wildfires has not always been treated with the maximum attention, although the frequency of them made it necessary. Many wildfires which have ravaged through our forests so far and left very hard consequences, point to the fact that they most dangerous and destructive harmful factors, since in the relatively short time can cause vast direct and indirect damages.

Attention and activity, which were expressed in the critical years to a maximum level, as a rule became less intensive in the period when the wildfires occur less frequently. Therefore, it was often the case that we were caught unprepared by the new occurrences of the wildfires and we were not able to tackle it successfully. The fact that the number of the wildfires occurred in the forests of our country was sometimes higher than the permitted level is one more proof of it.

The results of the statistical analysis of the occurrence of the wildfires in Serbia point to the fact that they must be treated as the frequent phenomenon in the forest managements. When we claim this, we always use as the starting point the possibility that every year to come can be critical, i.e. the occurrences of the wildfires can be always expected under the certain weather and other conditions which are favourable to them. The scope of wildfires and levels of damages to a great extent depend upon the organizational and technical readiness of the anti-fire service.

Many areas which are damaged or destroyed by the wildfires are not always completely rehabilitated and as a result often totally or partially lose the forest vegetation. Therefore, this question poses a special problem, since each postponement of the rehabilitation of the fire-damaged areas carries new risks: chaining of damages, occurrence of the secondary harmful factors, barren terrains, investment of the significantly more money, and as a whole putting in jeopardy the possibility of the re-establishment of the original condition.

The etiology of wildfires is diverse. Some causes and agents are peculiar to some regions of our country. The more abundant and diverse wildfires in some place, the more the forests are endangered, wildfires frequent and with the harder consequences.

The increasing number of the wildfires and devastated areas of the forest and forest cultures is above all the consequence of the global warming of

the Earth – unfavourable weather conditions in the last few years, as well as the fast industrialization and urbanization. During the fire season, particularly on weekends, state holidays and vacations, children and adults flock to forests, and thanks to the extensive road networks reach the remotest points, where they can neglectfully cause burning of the surrounding dry grass, litter, dry branches, lying trees, etc.

The ground fire originated in this way can spread over the greater area, unless it is contained on time, as well as to reach the tree crowns, particularly in the case of conifer stands. In addition, the inadequate behaviour of the individual agricultural producers is also a great problem, since they clean the fields prior to spring sowing by burning, which can be the very frequent core of the fire spreading to the forest ecosystems in the vicinity.

The increasing number of the wildfires in the recent years has been the direct result of certain activities in the forestry economy, which has yet to be explained and stressed. It is mainly the result of the rapid increase of the areas covered by conifer cultures (Tabaković-Tošić, 2006). They are most usually established as monocultures in the aim of more economical wood production. Introduction of conifers in the deciduous forests and other types of reforestation, aimed at the protection and improvement of the environment, also increase the danger of wildfires. In this way the new relations of the conifer trees have been established lately, and their spatial arrangement has been altered. Simultaneously, in these areas the appropriate necessary “anti-fire forest arrangement” has not taken place (cuts, belts, etc.) (Rakonjac et al, 2003, Tabaković-Tošić and Lazarev, 2003).

Forest ecosystem is one of the most unstable ecosystems on the planet. The various influences cause the destabilization of it, and fire- uncontrolled wildfire is one of the main factors. Wildfires are global problem, and it can be safely concluded from the great number of the international organizations and projects which deal with them, such as: The Global Fire Monitoring Center (GFMC), International Strategy for Disaster Reduction (US ISDR), UN Office for the Coordination of Humanitarian Affairs (UN-OCHA), UN Environment Programme (UNEP), Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO), UN Economic Commission for Europe (ECE) Timber Committee, Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD), Consortium on Natural and Technological Catastrophes, World Institute for Disaster Risk Management (DRM), International Global Atmospheric Chemistry (IGAC), International Union of Forestry Research Organization (IUFRO), Russian Federal Aerial Fire Protection Service, Albert-Ludwigs-Universität Freiburg Germany, Max Planck Society for the Advancement of Sciences, Max Planck Institute for Chemistry, UN – ISDR / GFMC Global Wildland Fire Network – Regional Southeast Europe Wildland Fire Network (FAO - Forestry Department, 2001).

The legal regulation in most of the countries precisely defines the struggle against the wildfires and the role which the institutions have in this struggle. Fire-sites rehabilitation is also prescribed by the law, as the need and obligation with the widely-defined objectives. The consequences of the wildfires are demonstrated over many years, and are sometimes irreparable. Realizing the gravity of the situation, Directorate of Forests within the Ministry of Agriculture, Forestry and Water Management initiated and entrusted the Institute of Forestry in Belgrade with the task of making the project “Wildfires in Period 2003-2007” in 2007, and some results of it is presented in this paper.

## **2. METHOD**

The project task was implemented in several phases and requested the engagement of a great number of scientists and professionals of the different specialties, as well as the use of all readily-available methods for collection, procession, analysis and synthesis of the relevant data, which is in accord with very complex, multidiscipline topic which is dealt with. In the first phase all the wildfires were noted, regardless of the size of the area which they covered in the Republic of Serbia. For the fire-damaged areas all the significant data such as: climate, orographic, phytocenosis, etc. were collected, stand and ecological origins were determined, as well as health condition – occurrences of the herbal diseases and economically harmful insect species. The collection of maps in the electronic form was done for each wildfire and each group of wildfires, i.e. the solid database as the base for the further work by planned segments was formed. The referents for the cultivation and forest protections PE Srbijašume, PE Vojvodinašume, PE NP Fruška Gora, PE NP Tara and PE NP Đerdap were of a great help during the data collection. Therefore, we would like to express our gratitude to them.

## **3. RESULTS AND DISCUSSION**

The frequent occurrence of the wildfires and extreme increase of the fire-damaged areas which were reported worldwide in the last decade are mainly the results of the global change of the climate conditions, such as melting and decrease of the average precipitation, particularly in the periods which are critical to the wildfire initiation. The consequences of such processes in the Republic of Serbia are analyzed by the occurrences of wildfires – number, type and frequency in some seasons and parts of the days, as well as by the size of the fire-damaged area, occurrence of biotic harmful agents, and healing for the period 2003-2007.

### 3.1 The number of wildfires, size and type of the fire-damaged area

**Table 1.** *The total number of the wildfires in the period 2003-2007 in the Republic of Serbia*

FOREST USERS	FOREST DISTRICT	Year					Total	
		2003.	2004.	2005.	2006.	2007.	For Forest District	For Forest Estate
<b>PUBLIC ENTERPRISE VOJVODINAŠUME</b>								
FOREST ESTATE BANAT PANČEVO	Zrenjanin	2	-	-	-	6	8	15
	Banatski Karlovac			1	-	1	2	
	Vršac	1	-	-	1	2	4	
	Bela Crkva	-	-	-	-	1	1	
	<b>Total Forest Estate Banat Pančevo:</b>	<b>3</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>10</b>	<b>15</b>	
FOREST ESTATE NOVI SAD	Novi Sad	2	2	-	1	-	5	14
	Titel	-	-	-	-	2	2	
	Bačka Palanka	3	2	-	-	-	5	
	Futog	-	1	-	-	1	2	
<b>Total Forest Estate Novi Sad:</b>	<b>5</b>	<b>5</b>	<b>-</b>	<b>1</b>	<b>3</b>	<b>14</b>		
FOREST ESTATE SREMSKA MITROVICA	Klenak	1	-	-	-	-	1	8
	Kupinovo	-	-	1	-	4	5	
	Višnjicevo	-	-	-	-	2	2	
<b>Total Forest Estate Sremska Mitrovica:</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>6</b>	<b>8</b>		
FOREST ESTATE SOMBOR	Apatin	3	1	-	-	-	4	22
	Subotica	-	3	-	4	11	18	
<b>Total Forest Estate Sombor:</b>	<b>3</b>	<b>4</b>	<b>-</b>	<b>4</b>	<b>11</b>	<b>22</b>		
<b>PUBLIC ENTERPRISE VODE VOJVODINE</b>								
	Sombor	-	-	-	-	1	1	1
<b>Total Public Enterprise Vode Vojvodine:</b>		<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>1</b>	
<b>PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>								
	Working Unit Sremska Kamenica	6	1	1	-	3	11	20
	Working Unit Beočin	2	-	2	-	1	5	
	Working Unit Vrdnik	-	-	2	-	1	3	
	Working Unit Erdevik	-	-	-	-	1	1	
<b>Total Public Enterprise National Park Fruška Gora:</b>		<b>8</b>	<b>1</b>	<b>5</b>	<b>-</b>	<b>6</b>	<b>20</b>	
<b>PUBLIC ENTERPRISE SRBIJAŠUME</b>								
FOREST ESTATE BEOGRAD	Avala	2	-	-	-	3	5	15
	Lipovica	-	2	-	-	-	2	
	Rit	3	-	1	-	4	8	
<b>Total Forest Estate Beograd:</b>		<b>5</b>	<b>2</b>	<b>1</b>	<b>-</b>	<b>7</b>	<b>15</b>	
FOREST ESTATE BORANJA LOZNICA	Šabac	-	1	-	-	1	2	4
	Mali Zvornik	-	-	-	-	1	1	
	Valjevo	-	-	-	-	1	1	
<b>Total Forest Estate Boranja Loznica:</b>		<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>4</b>	
FOREST ESTATE SEVERNI KUČAJ KUČEVO	Kučevo	2	1	1	1	7	12	26
	Majdanpek	1	-	-	-	3	4	
	Žagubica	1	-	-	1	3	5	

FOREST USERS	FOREST DISTRICT	Year					Total	
		2003.	2004.	2005.	2006.	2007.	For Forest District	For Forest Estate
	Požarevac	-	-	-	-	5	5	
<b>Total Forest Estate Severni Kučaj Kučevo:</b>		<b>4</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>18</b>	<b>26</b>	
FOREST ESTATE JUŽNI KUČAJ DESPOTOVAC	Jagodina	1	-	1	1	7	10	48
	Čuprija	8	1	-	2	6	17	
	Despotovac	6	3	2	4	4	19	
	Paraćin	-	1	-	-	1	2	
<b>Total Forest Estate Južni Kučaj Despotovac:</b>		<b>15</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>18</b>	<b>48</b>	
FOREST ESTATE RASINA KRUŠEVAC	Aleksandrovac	1	-	-	-	10	11	60
	Brus	7	5	1	1	17	31	
	Ražanj	2	-	1	-	4	7	
	Trstenik	-	2	-	-	5	7	
	Kruševac	-	-	-	-	4	4	
<b>Total Forest Estate Rasina Kruševac:</b>		<b>10</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>40</b>	<b>60</b>	
FOREST ESTATE GOLIJIA IVANJICA	Čačak	1	-	-	-	-	1	25
	Ivanjica - Kušići	3	-	1	-	2	6	
	Devići	-	-	1	-	1	2	
	Sjenica	6	1	-	1	8	16	
<b>Total Forest Estate Golija Ivanjica:</b>		<b>10</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>11</b>	<b>25</b>	
FOREST ESTATE ŠUMARSTVO RAŠKA	Novi Pazar	1	-	-	-	4	5	19
	Tutin	-	-	1	1	9	11	
	Raška	-	-	-	2	1	3	
<b>Total Forest Estate Šumarstvo Raška:</b>		<b>1</b>	<b>-</b>	<b>1</b>	<b>3</b>	<b>14</b>	<b>19</b>	
FOREST ESTATE PRIJEPOLJE	Prijepolje	-	-	-	1	-	1	19
	Nova Varoš	1	-	-	-	-	1	
	Priboj	5	-	-	1	11	17	
<b>Total Forest Estate Prijepolje:</b>		<b>6</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>11</b>	<b>19</b>	
FOREST ESTATE UŽICE	Kosjerić	1	1	-	-	1	3	21
	Zlatibor	1	1	-	-	2	4	
	Užice	6	-	-	1	7	14	
<b>Total Forest Estate Užice:</b>		<b>8</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>10</b>	<b>21</b>	
FOREST ESTATE STOLOVI KRALJEVO	Ušće	1	-	-	-	2	3	9
	Kraljevo	3	-	-	-	3	6	
<b>Total Forest Estate Stolovi Kraljevo:</b>		<b>4</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>5</b>	<b>9</b>	
FOREST ESTATE LEPOSAVIĆ	Zubin Potok	1	-	-	-	1	2	8
	Leposavić	-	-	-	-	6	6	
<b>Total Forest Estate Leposavić:</b>		<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7</b>	<b>8</b>	
FOREST ESTATE KRAGUJEVAC	Kragujevac	1	-	-	2	10	13	16
	Gornji Milanovac	-	-	-	-	3	3	
<b>Total Forest Estate Kragujevac:</b>		<b>1</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>13</b>	<b>16</b>	
FOREST ESTATE TOPLICA KURŠUMLIJA	Prokuplje	-	-	-	2	26	28	60
	Blace	-	-	-	-	2	2	
	Kuršumlja	-	-	-	-	30	30	

FOREST USERS	FOREST DISTRICT	Year					Total	
		2003.	2004.	2005.	2006.	2007.	For Forest District	For Forest Estate
<b>Total Forest Estate Toplica Kuršumljija:</b>		-	-	-	2	58	60	
FOREST ESTATE NIŠ	Aleksinac	6	-	-	1	31	38	64
	Niš – Bela Palanka	5	1	1	2	6	15	
	Sokobanja	4	1	-	-	6	11	
<b>Total Forest Estate Niš:</b>		15	2	1	3	43	64	
FOREST ESTATE ŠUMA LESKOVAC	Lebane	6	-	3	-	16	25	45
	Medveđa	2	-	1	1	5	9	
	Predejane	1	-	-	-	-	1	
	Vučje	1	-	-	1	5	7	
	Crna Trava	-	1	-	-	-	1	
<b>Total Forest Estate Leskovac:</b>		10	1	5	2	27	45	
FOREST ESTATE VRANJE	Vranje	-	-	-	2	7	9	24
	Bosilegrad	-	-	-	-	3	3	
	Bujanovac	-	-	-	-	4	4	
	Surdulica	-	-	-	-	7	7	
<b>Total Forest Estate Vranje:</b>		-	-	-	2	22	24	
FOREST ESTATE PIROT	Pirot	-	-	2	1	7	10	10
<b>Total Forest Estate Pirot:</b>		-	-	2	1	7	10	
<b>PUBLIC ENTERPRISE NATIONAL PARK KOPAONIK</b>								
<b>Total Public Enterprise National Park Kopaonik:</b>		-	-	-	-	-	-	0
<b>PUBLIC ENTERPRISE NATIONAL PARK TARA</b>								
Working Unit Mitrovac		-	-	-	-	1	1	5
Working Unit Crni vrh		-	-	-	-	1	1	
Privat Forests - Rastište		1	-	-	-	2	3	
<b>Total Public Enterprise National Park Tara:</b>		1	-	-	-	4	5	
<b>PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP</b>								
Working Unit Dobra		2	-	-	-	5	7	21
Working Unit Tekija		-	-	-	4	2	6	
Working Unit Donji Milanovac		-	-	-	-	8	8	
<b>Total Public Enterprise National Park Đerdap:</b>		2	-	-	4	15	21	
<b>FACULTY OF FORESTRY – EXPERIMENTAL AREA</b>								
<b>Total Faculty of Forestry :</b>		-	-	-	-	-	-	0
<b>S R B I J A</b>		113	32	25	39	370	579	579

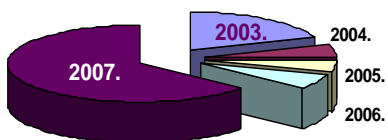
In the Republic of Serbia in the analyzed five-year-period 579 wildfires were reported. The most of them (370) occurred in 2007, then in 2003 (113),

whereas the situations in 2004 (32), 2005 (25) and 2006 (39) were very similar (Table 1).

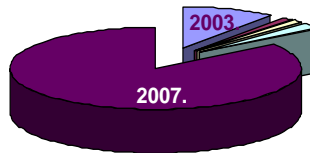
**Table 2. Fire-damaged areas of the forest stands in the period 2003-2007**

FOREST USERS	Fire-damaged area of the forest stands (ha)					Total (ha)
	2003.	2004.	2005.	2006.	2007.	
<b>PUBLIC ENTERPRISE VOJVODINAŠUME</b>						
FOREST ESTATE BANAT PANČEVO	46,40	-	9,00	18,00	618,62	692,02
FOREST ESTATE NOVI SAD	5,94	53,69	-	10,00	2,02	71,65
FOREST ESTATE SREMSKA MITROVICA	1,50	-	2,98	-	33,95	38,43
FOREST ESTATE SOMBOR	9,60	5,13	-	12,03	5,52	32,28
<b>TOTAL PUBLIC ENTERPRISE VOJVODINAŠUME</b>	<b>63,44</b>	<b>58,82</b>	<b>11,98</b>	<b>40,03</b>	<b>660,11</b>	<b>834,38</b>
<b>PUBLIC ENTERPRISE VODE VOJVODINE</b>						
<b>TOTAL PUBLIC ENTERPRISE VODE VOJVODINE</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2,00</b>	<b>2,00</b>
<b>PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>						
<b>TOTAL PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>	<b>33,12</b>	<b>1,00</b>	<b>6,75</b>	<b>-</b>	<b>9,65</b>	<b>50,52</b>
<b>PUBLIC ENTERPRISE SRBIJAŠUME</b>						
FOREST ESTATE BEOGRAD		3,00	2,50	-	4,75	13,98
FOREST ESTATE BORANJA LOZNICA	-	5,40	-	-	3,65	9,05
FOREST ESTATE SEVERNI KUČAJ KUČEVO	63,85	10,00	60,00	43,00	674,44	851,29
FOREST ESTATE JUŽNI KUČAJ DESPOTOVAC	321,53	10,48	3,69	11,25	710,06	1057,01
FOREST ESTATE RASINA KRUŠEVAC	36,17	11,75	2,00	2,00	232,55	284,47
FOREST ESTATE GOLIJIA IVANJICA	81,48	20,00	4,35	0,60	63,29	169,72
FOREST ESTATE ŠUMARSTVO RAŠKA	1,70	-	4,00	8,50	225,39	239,59
FOREST ESTATE PRIJEPOLJE	19,35	-	-	1,50	90,93	111,78
FOREST ESTATE UŽICE	35,35	2,15	-	1,00	69,90	108,40
FOREST ESTATE STOLOVI KRALJEVO	2,20	-	-	-	66,25	68,45
FOREST ESTATE LEPOSAVIĆ	95,03	-	-	-	722,76	817,79
FOREST ESTATE KRAGUJEVAC	5,00	-	-	8,50	87,49	100,99
FOREST ESTATE TOPLICA KURŠUMLIJA	-	-	-	1,05	1921,60	1922,65
FOREST ESTATE NIŠ	139,84	15,20	7,50	1,70	519,82	684,06
FOREST ESTATE	102,50	8,00	16,25	6,50	434,49	567,74

FOREST USERS	Fire-damaged area of the forest stands (ha)					Total (ha)
	2003.	2004.	2005.	2006.	2007.	
ŠUMA LESKOVAC						
FOREST ESTATE VRANJE	-	-	-	5,00	272,74	277,74
FOREST ESTATE PIROT	-	-	3,54	16,50	676,90	696,94
<b>TOTAL PUBLIC ENTERPRISE SRBIJAŠUME</b>	<b>907,73</b>	<b>85,98</b>	<b>103,83</b>	<b>107,10</b>	<b>6777,01</b>	<b>7981,65</b>
<b>PUBLIC ENTERPRISE NATIONAL PARK KOPAONIK</b>						
TOTAL PUBLIC ENTERPRISE NATIONAL PARK KOPAONIK	-	-	-	-	-	-
<b>PUBLIC ENTERPRISE NATIONAL PARK TARA</b>						
TOTAL PUBLIC ENTERPRISE NATIONAL PARK TARA	0,25	-	-	-	55,15	55,40
<b>PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP</b>						
TOTAL PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP	0,50	-	-	68,74	879,61	948,85
<b>FACULTY OF FORESTRY – EXPERIMENTAL AREA</b>						
TOTAL FACULTY OF FORESTRY	-	-	-	-	-	-
<b>S E R B I A</b>	<b>1005,04</b>	<b>145,80</b>	<b>122,56</b>	<b>215,87</b>	<b>8383,53</b>	<b>9872,80</b>



**Graph 1.** *The number of the wildfires in the period 2003-2007*



**Graph 2.** *The size of the fire-damaged forest areas in the period 2003-2007*

The analysis of the data presented in Tables 1 and 2, as well as in Graphs 1 and 2, lead to the conclusion that by average per a wildfire in 2003 the significantly smaller area was damaged than in 2007 (8.89 ha : 22.66 ha). Averagely, per a wildfire in 2004, 4.56 ha of forest stands were damaged, in 2005, 4.90 ha, and in 2006, 5.53 ha. Generally speaking, in the observed five-year-period there was a positive correlation between the number of wildfires and average fire-damaged area.

Due to the type of the forest ecosystems, there are certain conditions which influence the occurrence, extension and duration of the wildfires, such as the presence of the dry soil cover and type of the density, i.e. inflammability of it.

According to the quantity and content of the initial burning material (type of tree), climate, soil and exposition, the areas covered by forests are

classified into four groups according to the endangerment level:

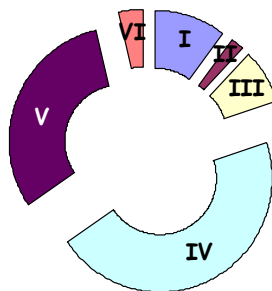
- areas of extreme endangerment
- areas of very high endangerment
- areas of high endangerment
- areas of the low endangerment

In regard to only type of the tree, forest ecosystems in Republic of Serbia were classified by the appropriate levels of endangerment by the wildfires in the following way:

- first level: stands and cultures of pines and larch trees
- second level: stands and cultures of spruce, fir and other conifers
- third level: mixed stands and cultures of deciduous and conifer trees
- fourth level: stands and cultures of oak and hornbeam
- five level: stands of beech and other deciduous trees
- sixth level: shrubberies and glades

For the each level of endangerment, according to the Law on Forests, on the common and specific bases, as well as by the programs of management, the measures aimed the protection from the wildfires, the most important of which are preventive ones, are prescribed.

**Graph 3.** *Fire-damaged forest areas from some levels of the endangerment by wildfires*



The forest cover in Serbia is 27 %, or 2.3 million ha. Around 56% of this area, 60% of the volume, and 62.5% of the volume increment are state-owned, i.e. 44% of the area, 40% of the volume, and 37. 5% of the volume increment are state-owned.

The percentage of the type of trees in the total volume is: beech 47%, oak 25%, poplar 1%, other deciduous trees 16%, spruce 5%, fir 3%, pine 2%, and the other conifers 1%. In this paper all the wildfires which occurred in the forest stands which are state-owned, and the smaller number of the stands which private-owned, are analyzed. It was not possible to obtain the accurate data on the forests in the private-owned forests in some regions of Serbia, but the general indicators point to the fact that the situation was similar as in the state-owned forests.

In the observed five-year-period, 41.14 % of the fire-damaged area of the forest stands is of the IV level of the endangerment by the wildfires, 29.87% is of the V level, 9.94% is of the I level, 7.50% is of the III level, and 1.81 % of the II level (Graph 3). When it is compared with the percentage of some species in the aforesaid total wood volume, the ratio is following: oak stands 29.87%:25%, beech and other deciduous trees stands 9.94%:64%, conifer trees 19.25%:11% (Table 3, Graph 3).

**Table 3.** Fire-damaged areas of the forest stands in the period 2003-2007 within the appropriate levels of endangerment by wildfires

FOREST USERS	N	Type of the wildfire										
	P (ha)	I	II	III	IV	V	VI	I/II-V	IV-I	I/V	I-II	IV-V
<b>PUBLIC ENTERPRISE VOJVODINAŠUME</b>												
FOREST ESTATE BANAT PANČEVO	N	-	-	1	-	12	2	-	-	-	-	-
	P (ha)	-	-	449,46	-	233,06	9,50	-	-	-	-	-
FOREST ESTATE NOVI SAD	N	-	-	-	-	14	-	-	-	-	-	-
	P (ha)	-	-	-	-	71,65	-	-	-	-	-	-
FOREST ESTATE SR. MITROVICA	N	-	-	-	6	2	-	-	-	-	-	-
	P (ha)	-	-	-	34,93	3,50	-	-	-	-	-	-
FOREST ESTATE SOMBOR	N	10	-	3	1	7	-	-	-	-	-	-
	P (ha)	3,64	-	11,55	5,00	12,09	-	-	-	-	-	-
<b>TOTAL PE VOJVODINAŠUME</b>	<b>N</b>	<b>10</b>	<b>-</b>	<b>4</b>	<b>7</b>	<b>35</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
	<b>P (ha)</b>	<b>3,64</b>	<b>-</b>	<b>461,01</b>	<b>39,93</b>	<b>320,30</b>	<b>9,50</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>PUBLIC ENTERPRISE VODE VOJVODINE</b>												
<b>TOTAL PE VODE VOJVODINE</b>	<b>N</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
	<b>P (ha)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2,00</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>												
<b>TOTAL PE NP FRUŠKA GORA</b>	<b>N</b>	<b>2,5</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>15,5</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
	<b>P (ha)</b>	<b>5,90</b>	<b>-</b>	<b>-</b>	<b>4,70</b>	<b>39,17</b>	<b>0,75</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>PUBLIC ENTERPRISE SRBIJAŠUME</b>												
FOREST ESTATE BEOGRAD	N	6	-	-	1	8	-	-	-	-	-	-
	P (ha)	2,98	-	-	1,50	9,50	-	-	-	-	-	-
FOREST ESTATE BORANJA LOZNICA	N	3	-	-	-	1	-	-	-	-	-	-
	P (ha)	3,65	-	-	-	5,40	-	-	-	-	-	-
FOREST ESTATE SEVERNI KUČAJ	N	6,83	-	-	0,5	14,33	2,33	2	-	-	-	-
	P (ha)	41,70	-	-	11,00	538,17	172,77	87,65	-	-	-	-
FOREST ESTATE JUŽNI KUČAJ	N	8	1	-	14	24	-	-	1	-	-	-
	P (ha)	148,91	1,00	-	482,33	392,77	-	-	32,00	-	-	-

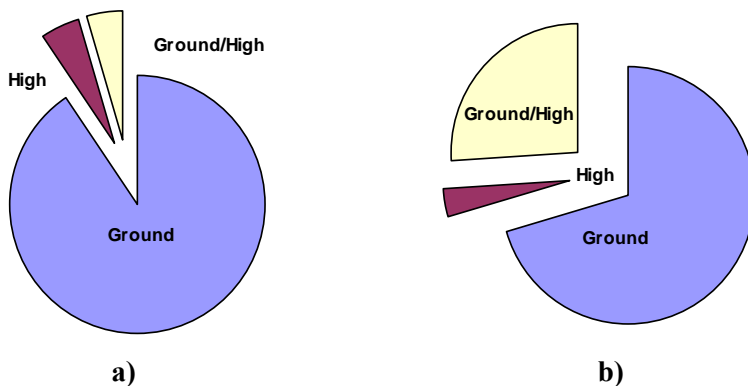
FOREST USERS	N	Type of the wildfire										
	P (ha)	I	II	III	IV	V	VI	I/II-V	IV-I	I/V	I-II	IV-V
FOREST ESTATE RASINA KRUŠEVAC	N	7,33	2,33	-	32,5	15,83	1	-	-	1	-	-
	P (ha)	35,31	32,20	-	152,22	39,74	15,00	-	-	10,00	-	-
FOREST ESTATE GOLJIJA IVANJICA	N	8	2	1	6	3	1	-	-	-	3	1
	P (ha)	56,62	2,40	10,00	39,80	6,60	15,00	-	-	-	31,20	8,10
FOREST ESTATE ŠUMARSTVO RAŠKA	N	3,5	11,5	-	2,5	1,5	-	-	-	-	-	-
	P (ha)	143,21	49,10	-	38,08	9,20	-	-	-	-	-	-
FOREST ESTATE PRIJEPOLJE	N	8	2	-	4	3	1	1	-	-	-	-
	P (ha)	13,90	1,45	-	56,52	24,91	5,0	10,00	-	-	-	-
FOREST ESTATE UŽICE	N	15	-	1	4	-	-	-	-	-	-	1
	P (ha)	49,15	-	2,00	57,20	-	-	-	-	-	-	0,05
FOREST ESTATE STOLOVI KRALJEVO	N	4	-	-	2	-	-	-	3	-	-	-
	P (ha)	12,00	-	-	1,20	-	-	-	55,25	-	-	-
FOREST ESTATE LEPOSAVIĆ	N	2	-	1	3	-	-	2	-	-	-	-
	P (ha)	2,60	-	95,03	712,16	-	-	8,00	-	-	-	-
FOREST ESTATE KRAGUJEVAC	N	N	5,83	-	-	8,33	1,83	-	-	-	-	-
	P (ha)	P (ha)	35,10	-	-	35,53	30,36	-	-	-	-	-
FOREST ESTATE TOPLICA	N	8	-	-	50	-	2	-	-	-	-	-
	P (ha)	14,85	-	-	1887,8	-	20,00	-	-	-	-	-
FOREST ESTATE NIŠ	N	24,5	5	-	13,5	12	9	-	-	-	-	-
	P (ha)	59,22	25,20	-	97,45	447,17	55,02	-	-	-	-	-
FOREST ESTATE ŠUMA LESKOVAC	N	19,5	2	-	15,5	6	1	-	-	-	-	1
	P (ha)	36,48	5,51	-	435,60	12,15	8,00	-	-	-	-	70,00
FOREST ESTATE VRANJE	N	9	2	1	7,5	4,5	-	-	-	-	-	-
	P (ha)	71,34	10,50	118,00	55,00	22,90	-	-	-	-	-	-
FOREST ESTATE PIROT	N	5,33	0,75	-	0,58	3,33	-	-	-	-	-	-
	P (ha)	280,20	15,60	-	6,17	394,97	-	-	-	-	-	-
<b>TOTAL PE SRBIJAŠUME</b>	N	<b>136</b>	<b>34,41</b>	<b>4</b>	<b>156,58</b>	<b>104,82</b>	<b>19,16</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>3</b>
	P (ha)	<b>972,12</b>	<b>177,52</b>	<b>225,03</b>	<b>4034,03</b>	<b>1939,01</b>	<b>321,15</b>	<b>105,65</b>	<b>87,25</b>	<b>10,00</b>	<b>31,20</b>	<b>78,15</b>
<b>PUBLIC ENTERPRISE NATIONAL PARK TARA</b>												
<b>TOTAL PE</b>	N	-	<b>1</b>	<b>2</b>	-	-	<b>2</b>	-	-	-	-	-

FOREST USERS	N	Type of the wildfire										
	P (ha)	I	II	III	IV	V	VI	I/II-V	IV-I	I/V	I-II	IV-V
NP TARA	P (ha)	-	1,00	54,25	-	-	0,15	-	-	-	-	-
<b>PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP</b>												
TOTAL PE NP ĐERDAP	N	-	-	-	4,33	15,33	1,33	-	-	-	-	-
	P (ha)	-	-	-	279,63	648,22	21,00	-	-	-	-	-
S E R B I A	N	149	36	10	170	172	26	5	4	1	3	3
	P (ha)	981,66	178,52	740,29	4358,29	2948,70	353,09	105,65	87,25	10,00	31,20	78,15

**Table 4.** Areas of the forest stands endangered by the ground and high wildfires in the period 2003-2007

FOREST USERS	Type of the wildfire						Total	
	Ground		High		Ground/High			
	N (%)	ha (%)	N (%)	ha (%)	N (%)	ha (%)	N	ha
FOREST ESTATE BANAT PANČEVO	14 (93,3)	242,56 (35,1)			1 (6,7)	449,46 (64,9)	15	692,02
FOREST ESTATE NOVI SAD	14 (100)	71,65 (100)					14	71,65
FOREST ESTATE SR. MITROVICA	8 (100)	38,43 (100)					8	38,43
FOREST ESTATE SOMBOR	22 (100)	32,28 (100)					22	32,28
PUBLIC ENTERPRISE VODE VOJVODINE	1 (100)	2,00 (100)					1	2,00
PE NP FRUŠKAGORA	20 (100)	50,52 (100)					20	50,52
FOREST ESTATE BEOGRAD	15 (100)	13,98 (100)					15	13,98
FOREST ESTATE BORANJA	3 (75,0)	6,97 (77,0)	1 (25,0)	2,08 (23,0)			4	9,05
FOREST ESTATE SEVERNI KUČAJ	22 (84,6)	500,49 (58,8)			4 (15,4)	350,80 (41,2)	26	851,29
FOREST ESTATE JUŽNI KUČAJ	46 (95,8)	1007,02 (95,3)	2 (4,2)	49,99 (4,7)			48	1057,01
FOREST ESTATE RASINA	59 (98,3)	280,97 (98,8)	1 (1,7)	3,50 (1,2)			60	284,47
FOREST ESTATE GOLJA	22 (88,0)	118,52 (69,8)	3 (12,0)	51,20 (30,2)			25	169,72
FOREST ESTATE ŠUMARSTVO	8 (42,1)	32,0 (13,4)	9 (47,4)	85,06 (35,5)	2 (10,5)	122,53 (51,1)	19	239,59
FOREST ESTATE PRIJEPOLJE	18 (94,7)	110,38 (98,7)	1 (5,26)	1,40 (1,3)			19	111,78
FOREST ESTATE UŽICE	21 (100)	108,40 (100)					21	108,40
FOREST ESTATE STOLOVI	5 (55,6)	2,5 (3,6)	1 (11,1)	1,00 (1,5)	3 (33,3)	64,95 (94,9)	9	68,45
FOREST ESTATE LEPOSAVIĆ	3 (37,5)	458,00 (56,0)	1 (12,5)	95,03 (11,6)	4 (50,0)	264,76 (32,4)	8	817,79
FOREST ESTATE KRAGUJEVAC	15 (93,7)	100,74 (99,7)	1 (6,3)	0,25 (0,3)			16	100,99
FOREST ESTATE TOPLICA	52 (86,6)	1216,90 (63,3)	1 (1,7)	0,20 (0,01)	7 (11,7)	705,55 (36,7)	60	1922,65
FOREST ESTATE NIŠ	62 (96,9)	659,06 (96,3)	2 (3,1)	25,00 (3,7)			64	684,06
FOREST ESTATE ŠUMA LESKOVAC	41 (91,1)	553,94 (97,6)	4 (8,9)	13,80 (2,4)			45	567,74
FOREST ESTATE VRANJE	23 (95,8)	273,94 (98,6)	1 (4,2)	3,80 (1,4)			24	277,74
FOREST ESTATE PIROT	6 (60,0)	124,42 (17,8)	1 (10,0)	15,20 (2,2)	3 (30,0)	557,32 (80,0)	10	696,94

FOREST USERS	Type of the wildfire						Total	
	Ground		High		Ground/High			
	N (%)	ha (%)	N (%)	ha (%)	N (%)	ha (%)	N	ha
PE NP TARA	3 (60,0)	0,40 (0,7)	1 (20,0)	1,00 (1,8)	1 (20,0)	54,00 (97,5)	5	55,40
PE NP ĐERDAP	21 (100)	948,85 (100)					21	948,85
<b>TOTAL</b>	<b>524</b>	<b>6954,92</b>	<b>30</b>	<b>348,51</b>	<b>25</b>	<b>2569,37</b>	<b>576</b>	<b>9872,80</b>



**Graph 4.** *The number of wildfires (a) and fire-damaged area (b) within the different types of the wildfires in the period 2003-2007*

### 3.2 Annual dynamics of the occurrence of the wildfires

The occurrence of the wildfires in the forest mainly depends upon the weather conditions and humidity of the burning material. Since these factors continue to alter over the year, there is different number of wildfires which can occur in some months.

They can occur in each month, but according to the analysis of the results of the fifty-year monitoring three critical periods can be singled out. The first of them is the early spring (from March to mid-April), second one is summer (from mid-July to late August), and third one is in the autumn (from the early September to mid-October).

The condition favourable to the occurrence of the spring wildfires is the certain quantity of the dry litter such as branches and twigs, which are easily inflammable and very prone to combustion, in the forest stands. In this period the precipitation is lower, the strong winds are frequenter, the snow melts, the burning material is scarce with the humidity. In addition, it is the beginning of the season of the agricultural activities, the plots are cleaned out of the weeds and other waste materials. The agriculturists tend to burn them collected in a

heap. However, due to air circulations the flame originated in this way is most occasionally spread to the forest stands in the vicinity.

In the following period the conditions are less favourable to the occurrence of the wildfires due to vegetation thriving and plant material development, which is resistant against burning and combustion (green grass, new succulent young leaves on the trees and bushes), and spring rains are more frequent.

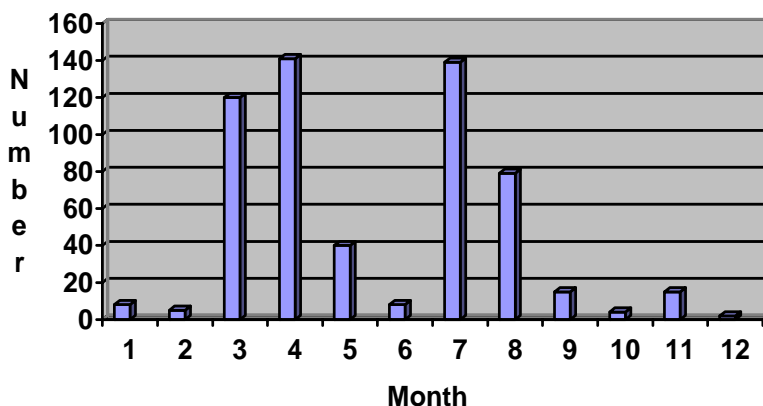
July and August are characterized by the high air and soil temperatures, low relative humidity, and thereby the lack of precipitation, ripening and drying of the grass vegetation, but also by the abrupt occurrence of the greater number of people (wildfire initiators) who visit forests (tourists, hikers). The similar situation is reported to the mid-October. As the year approaches the end, the conditions for the occurrence of the wildfires become less favourable.

**Table 5. Annual dynamics of the occurrence of the wildfires in the period 2003-2007**

FOREST USERS	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
<b>PUBLIC ENTERPRISE VOJVODINAŠUME</b>												
FOREST ESTATE BANAT	1	1	4	3	1	-	5	-	-	-	-	-
FOREST ESTATE NOVI SAD	-	-	6	-	1	-	1	4	1	-	1	-
FOREST ESTATE SR. MITROVICA	-	1	1	1	-	2	1	2	-	-	-	-
FOREST ESTATE SOMBOR	-	-	2	9	5	1	2	1	2	-	-	-
<b>PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>												
PE NP FRUŠKA GORA	2	1	5	8	-	-	1	1	1	-	1	-
<b>PUBLIC ENTERPRISE SRBIJAŠUME</b>												
FOREST ESTATE BEOGRAD	-	-	3	4	-	-	6	1	1	-	-	-
FOREST ESTATE BORANJA	-	-	1	-	-	-	3	-	-	-	-	-
FOREST ESTATE SEVERNI KUČAJ	-	-	7	8	1	-	6	2	-	1	1	-
FOREST ESTATE JUŽNI KUČAJ	1	-	7	8	3	-	11	15	1	2	-	-
FOREST ESTATE RASINA	-	-	18	12	1	-	16	9	1	1	2	-

FOREST USERS	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
FOREST ESTATE GOLLIJA	-	-	4	6	7	-	5	1	-	-	1	1
FOREST ESTATE RAŠKA	-	-	1	5	1	-	4	6	1	-	1	-
FOREST ESTATE PRIJEPOLJE	-	-	5	7	3	-	1	1	-	-	-	-
FOREST ESTATE UŽICE	-	-	3	3	1	1	8	2	3	-	-	-
FOREST ESTATE STOLOVI	-	-	3	-	1	-	3	1	-	-	1	-
FOREST ESTATE LEPOSAVIĆ	-	-	2	-	-	-	5	1	-	-	-	-
FOREST ESTATE KRAGUJEVAC	-	-	3	1	-	1	10	-	-	-	1	-
FOREST ESTATE TOPLICA	-	-	9	21	-	-	19	11	-	-	-	-
FOREST ESTATE NIŠ	1	1	8	20	13	2	5	11	2	-	1	-
FOREST ESTATE ŠUMA	2	-	7	11	1	1	14	6	1	-	2	-
FOREST ESTATE VRANJE	-	1	15	5	1	-	1	-	1	-	-	-
FOREST ESTATE PIROT	1	-		3	-	-	6	-	-	-	-	-
<b>PUBLIC ENTERPRISE NATIONAL PARK TARA</b>												
PE NP TARA	-	-	-	-	-	-	1	4	-	-	-	-
<b>PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP</b>												
PE NP ĐERDAP	-	-	6	6	-	-	5	-	-	-	3	1
<b>S E R B I A</b>	<b>8</b>	<b>5</b>	<b>120</b>	<b>141</b>	<b>40</b>	<b>8</b>	<b>139</b>	<b>79</b>	<b>15</b>	<b>4</b>	<b>15</b>	<b>2</b>

2 wildfires in Forest Estate Prijepolje and 1 in Public Enterprise Vode Vojvodina without date.



**Graph 5.** Annual dynamics of the occurrence of the wildfires in the period 2003-2007

The practical significance of the knowledge on the annual dynamics of the occurrence of the wildfires is reflected in the possibility of applying timely and appropriate measures of readiness and organisation of the fire protection in the forest management units and directorates.

### 3.3 Annual dynamics of the occurrence of wildfires for the five-year period

The factors which influence the combustion, in 24 hours, are subject to certain oscillations. Therefore, the intensity of the wildfire sustain great changes and has four phases.

*Phase A - time: 10-18 hours* (This is the warmest part of the day. All factors which are relevant to the development of wildfires are expressed to a maximum – low humidity and high air temperature, the strongest sunlight, wind, dry burning material, sparks and twinkles are formed and fly around... In this phase, the wildfires are most resistant to containing in its all main points.)

*Phase B - time: 18-04 hours* (When the evening comes, the wind is more still, air cools, relative humidity increases, burning material absorbs humidity from the air. These changes become more intensive at night, until 4 a.m, when the conditions for the fire extinguish are most favourable).

*Phase C - time: 04-06 hours* (Upon the gradual decrease of the intensity of burning at night, the fire intensifies again. The greatest result of the activities aimed at containment of wildfires in the forest can be achieved in period 18-06 hours.)

*Phase D - time: 06-10 hours* (In this period small pockets begin to emit smoke, smoldering fire turns into flame and advances at a fast pace. Separate, isolated parts of the wildfire connect and form single fire front. The wind is

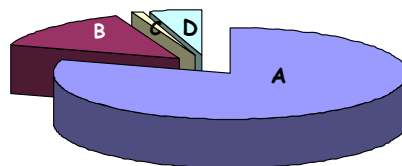
greater, humidity decreases, the air temperature becomes higher. The extinguishing conditions get worse. Since 8 to 10 a.m. the wildfire again enters its most dangerous A phase.)

**Table 6.** *Annual dynamics of the occurrence of the wildfires in the period 2003-2007*

Forest Estate	phase A 10-18 hours	phase B 18-04 hours	phase C 04- 06 hours	phase D 06-10 hours	Unknown time
<b>PUBLIC ENTERPRISE VOJVODINAŠUME</b>					
BANAT PANČEVO	6	1	-	-	8
NOVI SAD	10	1	-	-	3
SREMSKA MITROVICA	2	2	-	-	4
SOMBOR	16	2	-	1	3
<b>PUBLIC ENTERPRISE NATIONAL PARK FRUŠKA GORA</b>					
FRUŠKA GORA	1	-	-	1	18
<b>PUBLIC ENTERPRISE SRBIJAŠUME</b>					
BEOGRAD	1	-	-	-	14
BORANJA LOZNICA	3	-	-	-	1
SEVERNI KUČAJ	4	2	-	2	18
JUŽNI KUČAJ	3	1	-	-	44
RASINA KRUŠEVAC	40	5	-	2	13
GOLIJA IVANJICA	18	2	-	-	5
RAŠKA	8	-	-	-	11
PRIJEPOLJE	-	-	-	-	-
UŽICE	-	-	-	-	-
STOLOVI KRALJEVO	7	-	-	-	2
LEPOSAVIĆ	4	-	-	-	3
KRAGUJEVAC	10	3	-	-	3

Forest Estate	phase A 10-18 hours	phase B 18-04 hours	phase C 04- 06 hours	phase D 06-10 hours	Unknown time
TOPLICA KURŠUMLIJA	25	7	1	3	24
NIŠ	37	6	1	2	18
ŠUMA LESKOVAC	-	-	-	-	45
VRANJE	16	2	1	2	3
PIROT	-	-	-	-	10
<b>PUBLIC ENTERPRISE NATIONAL PARK TARA</b>					
TARA	-	-	-	-	5
<b>PUBLIC ENTERPRISE NATIONAL PARK ĐERDAP</b>					
ĐERDAP	3	4	-	-	14
<b>S E R B I A</b>	<b>214</b>	<b>38</b>	<b>3</b>	<b>13</b>	<b>269</b>

**Graph 6.** Annual dynamics of the occurrence of the wildfires in the perios 2003-2007



The greatest number of the wildfires in the observed five-year-period is initiated in the phase A, i.e. when the conditions for the fast and successful containment are most favourable. The initial time is not known for 269 wildfires, but it can be concluded indirectly that most of them occurred in this part of day, since it was reported that they were mostly caused by man, during the agricultural works.

### 3.4 Initiators of the wildfires in the observed period

The analysis of the initiators of the wildfires is necessary in order to determine the level of the danger of the re-occurrence of them, but also enables the correct estimation of the target groups which should be educated in this area.

### **a) Human activity**

**Agriculturalists:** The private-owned soil is to be found in almost all management units in the area covered by forests in Serbia. By doing preparatory agricultural activities (clearance, grass removal and burning) and other ones, the population in the vicinity of the forests pose the permanent and great danger because they might cause wildfires.

**Collectors of the forest fruits:** In the fire season many people and children go to the forest in order to collect different forest fruits (fungi, strawberries, black berries, dog-roses, medicinal plants). During their stay, due to carelessness and neglectfulness they can cause wildfire by a non-extinguished cigarette or making an open fire.

**Medical and hiking tourism:** The most of the weekend vacation areas are situated in the very vicinity of the forest stands. Very often, by neglectfulness, by burning of waste material which cannot be safely removed, the wildfire which easily spreads to the surrounding area is caused. There are numerous examples of this, and one of the most recent is the neglectfulness of the weekenders in the area of Zavoј Management Unit (Forest Estate Pirot) in 2007. On that occasion uncontrolled burning of litter caused the burning of dozens hectares of pine cultures. The hotel guests practically spend every day out of their rooms, in the forests, where they walk and sunbathe all day. The critical periods are weekends and state holidays, when a great number of motorized hikers come to one-day or two-day excursions. This group of the potential initiators of wildfires is very dangerous, since they penetrate deep in the forest, where they make fire for the preparation of food, which they place next to the trees. They also frequently leave non-extinguished embers behind, which in the combination with the weak air circulation can blaze up fire and spread it to the areas in the vicinity.

**Hunters and fishermen:** The hunters and fishermen which live nearby, cross and move through the forest can also cause wildfire, either by making an open fire in order to prepare food, or by throwing away the non-extinguished cigarettes.

**Electrification and railway traffic:** The high voltage and low voltage spark of electrical network, as well as train sparking produced when they pass through forest areas, can sometimes cause wildfires.

### **b) Natural disasters**

**Storm and thunder:** Electrical discharge in the atmosphere are particularly dangerous in the hilly-mountainous areas and places where the individual trees are very high and abundant and as a result dominate the area and are often the target of the flesh of lightning.

**Table 7. Initiators of the wildfires in the period 2003-2007**

Forest users	Initiators of the wildfires											
	Man		Thunder		Electrical line and train		Transferred		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Banat Pančevo									15	100	15	100
Novi Sad	10	71,4							4	28,6	14	100
Sremska Mitrovica	2	25,0							6	75,0	8	100
Sombor	1	4,6							21	95,4	22	100
PE Vode Vojvodine	1	100									1	100
PENP Fruška Gora									20	100	20	100
Beograd	12	80,0							3	20,0	15	100
Boranja Loznica	2	50,0							2	50,0	4	100
Severni Kučaj	20	76,9							6	23,1	26	100
Južni Kučaj	34	70,8							14	29,2	48	100
Rasina Kruševac	50	83,3							10	16,7	60	100
Golija Ivanjica	19	76,0							6	24,0	25	100
Šumarstvo Raška	8	42,1			1	5,3	2	10,5	8	42,1	19	100
Prijepolje	10	52,6	1	5,3	2	10,5			6	31,6	19	100
Užice	16	76,2	3	14,3					2	9,5	21	100
Stolovi Kraljevo	9	100									9	100
Leposavić	4	50,0			3	37,5			1	12,5	8	100
Kragujevac	4	25,0			2	12,5			10	62,5	16	100
Toplica Kuršumljija	55	91,7							5	8,3	60	100
Niš	63	98,4							1	1,6	64	100
Šuma Leskovac	40	88,9							5	11,1	45	100
Vranje	20	83,3							4	16,7	24	100
Pirot	9	90,0							1	10,0	10	100
PE NP Tara	3	60,0	2	40,0							5	100
PE NP Đerdap									21	100	21	100
<b>Total</b>	<b>391</b>	<b>67,9</b>	<b>6</b>	<b>1,0</b>	<b>8</b>	<b>1,4</b>	<b>2</b>	<b>0,3</b>	<b>169</b>	<b>29,4</b>	<b>576</b>	<b>100</b>

By the analysis of the data presented in Table 7, we come to the dismal conclusion that man, in regard with the wildfires, is the most important destructor of the forest stands in Serbia. Undoubtedly, humans caused 399 (69.3%) wildfires, and probably the majority of the ones the causes of which are unknown (169 or 29.4%). Agricultural works aimed at the preparation for sowing, which are in Serbia still performed in a rather primitive way, by burning the remains of the previous crops, are dominant in the human activities. In only six cases nature exhibited its capricious manners. Two wildfires in the observed period started in Kosovo and spread to the areas in the vicinity.

### 3.5 Wildfires and biotic causes of the damages

Wildfires in the conifer cultures and stands are by its character and harmful effects more significant than these in the deciduous ones. The wood in the fire-damaged areas burns quickly, which leads to the disappearance of the original stand. Upon cleaning and rehabilitation, it is necessary to conduct reforestation, in order to provide conditions for the re-establishment of the natural harmony. Under the current conditions, the fire-damaged areas are mainly healed, i.e. reforested by the Austrian and Scotch pines. There are two main types of the pine cultures: cultures established in the typical upper forest zone of conifers and these established on the untypical habitats, mainly the habitats of oak and other deciduous trees, in the valleys. Artificially established stands in the lower forest zone are developed by the ecological conditions which greatly differ from these in the upper zone. The health condition of the seedlings and cultures in the fire-damaged areas to a great extent depends on the presence of the biotic harmful factors, mainly on phytofag organisms.

The increase in the number of species and plentitude of some groups of phytofags is mainly the consequence of the formation of the greater number of ecological niches in the fire-damaged areas. It mainly refers to the feeding and availability of the appropriate type of food. In the fire-damaged areas the great quantities of the dry and partially burnt wood, which serves as the perfect base for the development of the significant insect species, mainly from order *Coleoptera*, i.e. families *Cerambycidae*, *Buprestidae* and *Scolytidae*, remain. The succession of the species of phytofag insects occur in the partially burnt parts of the trees, which depends on the remaining plant cover and measures which are taken and aimed at rehabilitation.

In the places where the wildfire destroys forest vegetation, grass plots with the important participation of the indigenous deciduous tree types, spontaneously conquering their natural habitats, re-establish. The altered content of phytocenosis causes the important changes in zoocenosis as well, which is reflected in the succession of the species which are typical for the open habitats and the feeding of which is related to the plant species, of which the newly-formed phytocenosis is made. Entomofauna in these communities differs greatly from the one in the areas where cleaning has not been conducted and in which a lot of dry and partially-burnt dry trees and twigs remain, and by its content and plentitude, is very similar to the entomofauna from the surrounding area which is not fire-damaged. In such ecosystems the presence of the species from families *Chrysomelidae* and *Curculionidae*, since the feeding of them is mainly based on leaf consumption, is reported.

In the areas in which cleaning was performed, in the forms of the sanitary felling and re-establishment of the forest order, in the places where the branches and felled wood material were collected, xylofag insects develop.

The partially-burnt trees are favourable to the large-scale multiplication of the species which are both typical and non-typical for the areas with such conditions.

The wildfires and extreme temperature which is emitted by fire influence the soil, by transforming and reducing the organic and non-organic matter, particularly influencing the reduction of the microbial activity of soil microorganisms.

During the wildfire a great quantity of organic compounds is emitted: hydrocarbons, polycyclic aromatic hydrocarbons (PAH), phenol derivatives and solid substances (soot, tar). A part of them remain in the soil where they become part of the matter flow chain by the bioaccumulation of the absorbed toxins in the soil, water and living organisms, as well as by increasing of the pollution concentration in food chain, and reduction of the physiological activities of plants.

After rehabilitation and reforestation, young plants are particularly sensitive and the vitality of them is very endangered, since the environmental conditions, particularly soil conditions differ greatly from the conditions in the facilities in which the seedlings were produced had at their disposal all the conditions which are necessary for the normal, undisturbed development. Owing to a decrease in vitality, they become liable to the influence of the numerous harmful biotic factors, which are present in this and the surrounding area. By the application of the selected measures of care and protection, their vitality should be raised to the appropriate level and it should be enabled to them to grow and develop until they reach the appropriate vitality, which is important to the survival of the newly-established cultures.

#### **4. CONCLUSION**

The data on the dynamics of the wildfires in Serbia and some regions of it published in the domestic scientific press or presented at various consultations and seminars, leads to the clear conclusion that this occurrence cannot be considered occasional anymore.

The frequent occurrence of the wildfires and extreme increase of the fire-damaged areas, which were reported worldwide in the last decade, are mainly the results of the global change of the climate conditions, such as melting and decrease of the average precipitation, particularly in the periods which are critical to the wildfire initiation.

In the Republic of Serbia in the period 2003-2007, 579 wildfires were reported. The most of them (370) occurred in 2007, then in 2003 (113), whereas the situation in 2004 (32), 2005 (25) and 2006 (39) are very similar. Averagely, per a wildfire in 2004, 4.56 ha of forest stands were damaged, in 2005, 4.90 ha,

and in 2006, 5.53 ha. Generally speaking, in the observed five-year-period there was a positive correlation between the number of wildfires and average fire-damaged area.

In the observed five-year-period, 41.14 % of the fire-damaged area of the forest stands is of the IV level of the endangerment by the wildfires, 29.87% is of the V level, 9.94% is of the I level, 7.50% is of the III level, and 1.81 % of the II level (Graph 3). When it is compared with the percentage of some species in the aforesaid total wood volume, the ratio is following: oak stands 29.87% :25%, beech and other deciduous trees stands 9.94%: 64%, conifer trees 19.25% : 11%.

The annual dynamics of the occurrence of the wildfires in Republic of Serbia in period 2003-2007 is identical with the 50-year average and is a perfect proof of the justifiability of emphasizing the aforesaid critical periods. The majority of the wildfires were initiated in phase A, i.e. at the time when the conditions for the fast and successful containing of them are least favourable. The initial time is not known for 269 wildfires, but it can be concluded indirectly that most of them occurred in this part of day, since it was reported that they were mostly caused by man, during the agricultural works.

By the analysis of the data presented in this paper, we come to the dismal conclusion that man, in regard with the wildfires, is the most important destructor of the forest stands in Serbia. Undoubtedly, humans caused 399 (69.3%) wildfires, and probably the majority of the ones the causes of which are unknown (169 or 29.4%). Agricultural works aimed at the preparation for sowing, which are in Serbia still performed in a rather primitive way, by burning the remains of the previous crops, are dominant in the human activities. In only six cases nature exhibited its capricious manners. Two wildfires in the observed period started in Kosovo and spread to the areas in the vicinity.

Wildfires in the conifer cultures and stands are by its character and harmful effects more significant than these in the deciduous ones. The wood in the fire-damaged areas burn quickly, which leads to the disappearance of the original stand.

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## **WILDFIRES IN SERBIA – CHANCE OR FREQUENT PHENOMENON**

*Mara TABAKOVIĆ-TOŠIĆ, Miroslava MARKOVIĆ,  
Snežana RAJKOVIĆ, Milorad VESELINOVIĆ*

### **Summary**

Wildfires used to be considered unbridled elements, which irregularly, occur by no definite reason, although it was always known that they cause the catastrophic consequences. However, the history of forestry teaches us that the forests on each continent regularly sustained the consequences of this disaster, and they must have been of the major causes for the decrease of forest cover to modern insufficient levels.

In the multi-decade development of the forestry in our country, the problem of the wildfires has not always been treated with the maximum attention, although the frequency of them and scope of the damages which they caused made it necessary.

The greatest attention and maximum activities in the struggle with wildfires were most usually exhibited in the critical years, when they frequently occurred. Nevertheless, our attention became less intensive in the period when the wildfires occur less frequently, and as a result were often caught unprepared by the new occurrences of the wildfires and unable to tackle it successfully. The fact that the number of the wildfires occurred in the forests of our country was sometimes higher than the permitted level and show tendency of the permanent growth, is one more proof of it. The data on the dynamics of the wildfires in Serbia and some regions of it published in the domestic scientific press or presented at various consultations and seminars, leads to the clear conclusion that this occurrence cannot be considered occasional anymore.

The frequent occurrence of the wildfires and extreme increase of the fire-damaged areas, which were reported worldwide in the last decade, are mainly the results of the global change of the climate conditions, such as melting and decrease of the average precipitation, particularly in the periods which are critical to the wildfire initiation.

In the Republic of Serbia in the period 2003-2007, 579 wildfires were reported. The most of them (370) occurred in 2007, then in 2003 (113), whereas the situation in 2004 (32), 2005 (25) and 2006 (39) are very similar. Averagely, per a wildfire in 2004, 4.56 ha of forest stands were damaged, in 2005, 4.90 ha, and in 2006, 5.53 ha. Generally speaking, in the observed five-year-period there was a positive correlation between the number of wildfires and average fire-damaged area.

In the observed five-year-period, 41.14 % of the fire-damaged area of the forest stands is of the IV level of the endangerment by the wildfires, 29.87% is of the V level, 9.94% is of the I level, 7.50% is of the III level, and 1.81 % of the II level (Graph 3). When it is compared with the percentage of some species in the aforesaid total wood volume, the ratio is following: oak stands 29.87%:25%, beech and other deciduous trees stands 9.94%: 64%, conifer trees 19.25%:11%.

The annual dynamics of the occurrence of the wildfires in Republic of Serbia in period 2003-2007 is identical with the 50-year average and is a perfect proof of the justifiability of emphasizing the aforesaid critical periods. The majority of the wildfires were initiated in phase A, i.e. at the time when the conditions for the fast and successful containing of them are least favourable. The initial time is not known for 269 wildfires, but it can be concluded indirectly that most of them occurred in this part of day, since it was reported that they were mostly caused by man, during the agricultural works.

By the analysis of the data presented in this paper, we come to the dismal conclusion that man, in regard with the wildfires, is the most important destructor of the forest stands in Serbia. Undoubtedly, humans caused 399 (69.3%) wildfires, and probably the majority of the ones the causes of which are unknown (169 or 29.4%). Agricultural works aimed at the preparation for sowing, which are in Serbia still performed in a rather primitive way, by burning the remains of the previous crops, are dominant in the human activities. In only six cases nature exhibited its capricious manners. Two wildfires in the observed period started in Kosovo and spread to the areas in the vicinity.

Wildfires in the conifer cultures and stands are by its character and harmful effects more significant than these in the deciduous ones. The wood in the fire-damaged areas burn quickly, which leads to the disappearance of the original stand.

# ŠUMSKI POŽARI U SRBIJI – SLUČAJNOST ILI REDOVNA POJAVA

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## Rezime

Šumski požari su ranije uglavnom smatrani stihijama, koje se javljaju samo od slučaja do slučaja, neredovno, mada se uvek znalo da tada nose katastrofalne posledice. Međutim, iz istorije šumarstva poznato je da su šume svih kontinenata redovno trpele od ove nepogode, te je ona sigurno izvršila jedan od najvećih uticaja na drastično umanjeње procenta šumovitosti na današnje nedovoljne razmere.

U višedecenijskom razvoju šumarstva naše zemlje, problem šumskih požara nije uvek postavljen i rešavan sa maksimalnom pažnjom, mada su njihova učestalost i razmeri šteta to nužno zahtevali.

Najveća pažnja i puna aktivnost u borbi protiv šumskih požara ukazivana je najčešće u kritičnim godinama, kada su njihove pojave bile izuzetno brojne. Međutim, pozornost je obično popuštala u periodima kada su oni bili ređi, pa se često i dešavalo da nas nove pojave šumskih požara, zateknu nespemne da im se na vreme i uspešno suprotstavimo. To potvrđuje i činjenica da se požari u šumama naše zemlje još uvek javljaju u nedozvoljeno visokom broju, i čak imaju tendenciju permanentnog porasta.

Prema podacima o dinamici pojava šumskih požara u Srbiji i pojedinim njenim regionima, publikovanim u domaćoj stručnoj štampi ili prezentiranim na raznim savetovanjima i seminarima, jasno se može zaključiti da se ova pojava više ne može smatrati povremenom.

Protekle decenije učestalost šumskih požara i enormno povećanje opožarenih površina, prvenstveno su rezultat globalne promene klimatskih uslova u smislu otopljavanja i umanjeња prosečnih vrednosti padavina, posebno u kritičnim periodima za inicijaciju požara.

U području Republike Srbije u periodu 2003-2007. godina, evidentirano je 579 šumskih požara na površini od 9872,80 ha. Najviše (370) ih se desilo 2007. godine, zatim 2003. (113), dok su 2004. (32), 2005. (25) i 2006. (39), približno jednake. Prosečno u jednom požaru u 2003. godini opožarena je znatno manja površina nego u 2007. (8,89 ha : 22,66 ha). Po jednom požaru, 2004. oštećeno je 4,56 ha šumskih sastojina, 2005. - 4,90 ha i 2006. godinie 5,53 ha. Uopšteno gledano, u posmatranom petogodišnjem periodu broj požara je bio u pozitivnoj korelaciji sa prosečnom opožarenom površinom.

U posmatranom petogodišnjem periodu, 44,14% opožarene površine šumskih sastojina su iz kategorije IV stepena ugroženosti od požara, 29,87% iz V stepena, 9,94% iz I, 7,50% iz III i 1,81% iz II. Kada se ovo uporedi sa procentualnim učešćem pojedinih vrsta u gore navedenoj ukupnoj drvnjoj zapremini, odnos je sledeći: sastojine hrasta 29,87% : 25%, sastojine bukve i ostalih lišćara 9,94% : 64%, sastojine četinara 19,25% : 11%.

Godišnja dinamika pojave šumskih požara u području Republike Srbije u periodu 2003-2007. godina, u potpunosti je identična sa pedesetogodišnjim prosekom i

savršeno potvrđuje opravdanost izdvajanja pomenutih kritičnih perioda. Najveći broj inicirano je u fazi A, odnosno u vreme kada su uslovi za njihovo brzo i uspešno suzbijanje najnepovoljniji. Za 269 šumskih požara se ne zna tačno inicijalno vreme, ali posredno, može se zaključiti da se i većina njih desilo u ovom periodu dana, budući da je evidentirano da ih je, uglavnom, izazvao čovek obavljajući razne poljoprivredne radove.

Analizom podataka navedenih u ovom radu, dolazi se do poražavajućeg zaključka da je čovek, kada su u pitanju šumski požari, najznačajniji destruktor šumskih sastojina u Srbiji. Apsolutno sigurno, on je prouzrokovao 399 (69,3%) požar, a verovatno i najveći broj onih za koje se ne zna uzrok (169 ili 29,4%). Radovi u poljoprivredi, koji se u Srbiji još uvek obavljaju na, kada je u pitanju priprema za setvu, dosta primitivan način paljenjem ostataka prethodnih useva, imaju dominantni položaj u okviru ljudskih aktivnosti. U samo šest slučajeva priroda je ispoljila svoju čudljivost. Dva požara u posmatranom periodu su prenešeni sa Kosova.

Požari u četinarskim kulturama i sastojinama su po svom karakteru i štetnosti značajniji od onih u lišćarskim. Drvo na opožarenim površinama brzo i lako izgara, pa su u njima uglavnom svi imali karakter visokog, a što je imalo za posledicu nestajanje prvobitne sastojine.

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