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## **SCHEME OF ORGANISATION AND PROCEDURES IN THE ACTIONS OF ENTITIES ON FOREST FIRE PROTECTION – PREVENTION AND SUPPRESSION OF FOREST FIRES**

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**Abstract:** *Organisations and procedures play an important role in the preventive fire protection of forest as well as in the calculation of effective forest fire suppression. In order for the fight against forest fires to be successful, all entities involved in risk management in forest fire protection must know their place and role, both in the segment of preparedness, preventive action, action on forest fires and in the field rehabilitation. Knowledge of the legality of forest fires, mode of action, equipment and extinguishing agents, rapid fire detection, preparation of planning documents is very important for the actions of entities in the protection of forest from fires to be effective.*

**Key words:** fire protection entities, prevention, organisation scheme

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# ŠEMA ORGANIZACIJE I PROCEDURA U POSTUPANJU SUBJEKATA NA ZAŠTITI ŠUMA OD POŽARA – PREVENCIJA I SUZBIJANJE ŠUMSKIH POŽARA

**Izvod:** *U preventivnoj zaštiti šuma od požara kao i u načunu efikasnog suzbijanja šumskih požara organizacija i procedure u postupanju imaju važnu ulogu. Da bi borba sa šumskim požarima bila uspešna svi subjekti koji učestvuju u upravljanju rizicima u zaštiti šuma od požara moraju znati svoje mesto i svoju ulogu, kako u segmentu pripravnosti, preventivnog delovanja, delovanja na nastali šumski požar i u delu sanacije terena. Poznavanje zakonitosti šumskih požara, način dejstva, korišćenje opreme i sredstava za gašenje, brzo otkrivanje požara, izrada planskih dokumenata je vrlo važno da bi postupanje subjekata u zaštiti šuma od požara bilo efikasno.*

**Ključne reči:** subjekti zaštite od požara, prevencija, šema organizacije.

## 1. INTRODUCTION

Wildfire prevention includes a whole complex of measures and activities that need to be implemented to prevent wildfire occurrence, and in case a fire does occur, it entails an organised approach to fire extinguishing and rehabilitation.

Wildfire prevention is one of the most important elements in the risk management system regarding the protection of forests against wildfire. Preventive measures taken to protect forests against wildfire are aimed at reducing the risk of wildfire occurrence, the number of fires, and the incurring damage.

The level of wildfire prevention applied in the Republic of Serbia is varying both in state-owned enterprises that manage state forests and in privately owned forest areas, where almost no preventive measures are applied to protect forests against fire.

Measures taken to prevent wildfire occurrence must be included in the wildfire protection plans for all forest areas regardless of the type of ownership. Wildfire protection plans must enlist specific measures that should enable:

- effective prevention of wildfire occurrence;
- in case it occurs, quick detection and extinguishing in the initial stage with a small number of people and simple extinguishing equipment and agents, which is also important in terms of economy.

## 2. METHODOLOGY AND AREA OF RESEARCH

Analysis of data with open fires in the Braničevo district, which includes the territories of the municipalities of Požarevac, Kučevo, Petrovac, Veliko Gradište, Golubac, Žagubica, Žabari and Malo Crniče. The analysis of the documentation of the Sector for Emergency Situations on the holding of classes in the field of fire protection was carried out, as well as the number of radio and television reports, professional and popular material in magazines. An analysis of the regulations on the risk of forest fires in the researched area was carried out.

Based on the analysis of the aforementioned documentation, the number of wildfires was analyzed depending on the cause (for the period from 1998 to 2008), as well as the number of reports submitted for the period of 2007 and 2015.

### 3. RESEARCH RESULTS WITH DISCUSSION

The largest number of fires in Serbia and other neighboring countries, i.e., over 95% of wildfires, are caused by human activity. Based on the database of the Sector for Emergency Situations - Department in Požarevac, the number of forest fires according to causes for the Braničevski district for the period 2000-2010 is presentation in Table 1. (Ratknić, T. et al., 2017; Ratknić, T. et al., 2019).

**Table 1.** *The number of wildfires by cause for the Braničevo administrative district from 2000 to 2010.*

Total number of wildfires	Number of wildfires caused by human activity	Number of wildfires caused by natural phenomena	The number of fires whose cause has not been determined
2220	2087	44	89
100%	94,01%	1,98%	4,01%

Therefore it is of utmost importance in wildfire prevention to plan measures against potential causes of wildfires. Little has been done in this regard in the Republic of Serbia, and the preventive effects in this area are negligible.

First of all, wildfire education is mainly overlooked at schools, and school children are not taught about the importance of forest conservation, the protection of forests against wildfires, and extinguishing when they occur.

Every country must educate schoolchildren and create habits in wildfire prevention and environmental protection in general. Schools should find methods and topics to integrate wildfire education into their curricula. Electronic and written media should be used to popularise participation in wildfire prevention. Field experts and radio and television stations should be engaged to produce professional and popular materials to raise awareness about the importance of wildfire protection. Based on the database of the Sector for Emergency Situations - Department in Požarevac, education of children and students in schools in the field of fire protection in Braničevo District in 2009 is presentation in Table 2.

**Table 2.** *Education of schoolchildren and students in the field of fire protection in the Braničevo district in 2009*

Municipality	Total number of schools	Number of schools where classes in the field of wildfire protection were held	Number of schools where training was organised and fire protection equipment was demonstrated
Požarevac	15	10	8
Kučevo	5	1	1
Petrovac	6	0	0
Veliko Gradište	2	2	2
Golubac	2	1	1
Žagubica	4	2	2
Žabari	2	2	2
Malo Crniće	3	0	0

Another form of prevention includes biological and technical protection measures, their planning and implementation, elaboration and classification of elements that can be applied in the system of biological and technical protection measures, and the factors that can hinder their application. According to Bertović (1987), as dominant biological-technical measures protection in a preventive sense, parts of biological-technical measures should be processed as:

1. mixed planting of broadleaves and conifers, application possibilities and hindering factors;
2. group mixture of broadleaves and conifers, application possibilities;
3. construction of biological fire barriers relying on natural and artificial obstacles;
4. construction of fire protection lines and breaks that suit the terrain characteristics;
5. application of different protection models, depending on the type of vegetation, terrain composition and slope, wind direction and velocity, etc.
6. proposal of the type of vegetation that would be most suitable in terms of efficient biological and technical protection and acceptable regarding the economic and technical aspects of its use.

The primary aim of biological and technical protection measures is to reduce the number of fires. However, it is even more important that, in case of fire, these measures enable rapid localisation to a small area, involvement of a small number of people and the use of simple extinguishing equipment and agents.

Furthermore, prevention should also consider the selection of the most favorable models of fire lines and breaks depending on the type of vegetation, soil composition, aspect, orography and climate.

### **3.1 The role of meteorology in wildfire forest protection**

Meteorology has a very important role in the protection of forests against fire, both in the pre-fire stage and during the fire. The method of forecasting the wildfire hazard and, based on that, preparing man forces and resources, depending on the observed elements and specific factors, must be included in the implementation of the system for the monitoring of the risk and occurrence of wildfire (Ratknić T., et al., 2019; Ratknić, T. et al., 2019).

The wildfire danger forecast provides the following three levels of information:

- the first level of information refers to intermediate indices that analyse the data related to the factors that affect the occurrence of fire and provide the necessary prevention measures and means of suppression;
- the second level of information refers to the final index that determines the risk of fire and its spread depending on the state of the fuel material;
- the third level of information proposes the final solution to the current danger.

Organisations that participate in the implementation of wildfire hazard and warning systems must be fully aware of their role and method of action. The

following institutions are engaged in the assessment of the wildfire risk and degree of threat:

- Republic Hydrometeorological Service of Serbia,
- Sector for Emergency Management,
- Public and other companies dealing with forest management and wildfire forest protection,
- State authorities of all levels,
- Local self-government bodies,
- Media companies and electronic and written media,
- Other interested institutions and bodies,
- Inspection authorities

The wildfire risk assessment system should (Đorđević, 2012):

- make sure that the means allocated for the prevention and suppression of wildfire are distributed according to the degree of threat regarding both the time and space;
- set the dates for the activities to promote prevention and inform the public about the potential fire agents;
- to raise preparedness to a higher level.
- Adequate implementation of this system can reduce the number of potential wildfires and help recover the land after the fire.

This system should also include inspection authorities (Prevention department of the Sector for emergency management, municipal police, municipal inspection, agriculture and forestry inspections, etc.) that plan their activities to identify and sanction potential fire-starters based on the fire risk levels provided by the fire risk assessment system Based on the database of the Sector for Emergency Situations - Department in Požarevac, comparative data were given before and after the implementation of Article 50 of the Fire Protection Act, which refers to the control of open burning in the Braničevo District for the years 2007 and 2015 (Table 3. )

**Table 3.** Comparative data before and after the enactment of Article 50 of the Law on Fire Protection that refers to the management of open burning in the Braničevo District in 2007 and 2015

<b>Number of wildfires in 2007</b>	<b>The number of reports submitted for open burning</b>	<b>Fires reduced (%)</b>
112	0	0%
<b>Number of wildfires in 2015</b>	<b>The number of reports submitted for open burning</b>	<b>Fires reduced (%)</b>
65	27	Око 45 %

### 3.2 Fire detection system in wildfire protection

Preventive measures to protect forests against fires cannot prevent their occurrence but can minimise the number of wildfires that, with good organisation,

early detection and timely extinguishing, can be suppressed quickly and successfully.

The Republic of Serbia has a poor system of early detection of wildfire occurrence. It takes a long time for a detected fire to be reported, which delays the start of its extinguishing to the time when the fire is already in a raging stage, and a large number of people and heavy equipment are needed to extinguish it. Consequently, it takes a long time to extinguish the fire, and the outcomes of the interventions are often uncertain. Based on the database of the Sector for Emergency Situations - Department in Požarevac, the time from the beginning to the discovery of the fire in the Braničevo District for the period 1998-2008 is presented in Table 4.

**Table 4.** *Time from fire occurrence to the detection in the Braničevo District for 1998-2008*

Total number of fires	Time needed to detect a forest fire 1-15 minutes	Time needed to detect a forest fire 15-30 minutes	Time needed to detect a forest fire 30-60 minutes	Time needed to detect a forest fire 60-90 minutes	Time needed to detect a forest fire 90-120 minutes	Time needed to detect a forest fire over 120 minutes	Time of fire occurrence not determined
2220	215	282	414	408	332	202	367
% 100	9,7	12,7	18,7	18,4	14,9	9,1	16,5

In the Republic of Serbia, the segment of wildfire forest protection that relates to the early detection of wildfires is not clearly defined. It can be performed through (Đorđević, 2012) :

- observation from the ground,
- observation from the air,
- combined method of observation,
- special cameras that collect meteorological data and detect a fire
- other ways (satellite monitoring, etc.)

Each method of wildfire monitoring has its characteristics and costs that determine its efficiency and effectiveness.

Every subject involved in wildfire forest protection should study different wildfire detection systems, their applicability and cost-effectiveness in relation to the characteristics of a given area since different systems produce different results in different areas. They cannot be economical if they are not selected based on the required features. The camera surveillance systems seem to be the most effective method. However, this is not the case in our country. The actual effectiveness of the camera monitoring in our areas ranges from 35 to 40% of the territory, depending on the terrain, weather conditions, and technical requirements. The rest of the territory should be covered by other types of observation, including the most expensive one –air observation, This type of observation should mostly be implemented through regular activities of sports clubs, such as training or scheduled flights.

### **3.3 Entities dealing with wildfire protection and their role**

The entities that are obliged to participate in wildfire forest protection, both in prevention and suppression, must be defined for each area.

A scheme of preparedness must be developed for each entity. It defines all measures that each entity participating in firefighting must undertake in different seasons and the time they should be implemented.

All entities engaged in the protection of forests against fires should make a classification of fire event levels based on the size of the fire as well as the entities that participate and take measures during each wildfire event.

A scenario for the outbreak of large wildfires that can be categorised as an emergency must be developed carefully. In case of such large fires, emergency headquarters are activated. Before this, it must be defined who establishes the headquarters, who are the members, how are decisions made, how it functions, when to declare an emergency, types of decision-making, ways of engaging people, equipment and means for fire extinguishing, etc.

In case of large fires, expert operational teams are formed to monitor, control and find solutions to overcome the emergency.

### **3.4 Defining the wildfire extinguishing model**

Determining the methods of extinguishing wildfires is one of the most important segments of wildfire suppression. The proper selection of the method of fire extinguishing determines its effectiveness and success, the number of people involved, the means and equipment needed, and the time required to extinguish a fire.

Several methods of extinguishing wildfires are applied in practice, but the following are the most often applied ones (Vasić, 1983):

- direct extinguishing,
- indirect extinguishing,
- combined extinguishing,
- air extinguishing.

Each area has its characteristics defined by the type of fuel material, terrain configuration, type of soil, type of climatic conditions, availability of fire extinguishing means, passable roads, availability of biological and technical protection measures, etc., and the fire extinguishing scenario largely depends on this.

It is also important to determine the equipment that can be used and its effectiveness in different extinguishing methods.

The direct extinguishing method includes:

- extinguishing the front of the fire,
- extinguishing by encircling the fire,
- extinguishing by surrounding the fire from the background,
- extinguishing combined with existing natural and artificial obstacles

The indirect extinguishing of wildfires can be done by the following methods:

- removal of combustible material in front of the fire,
- plowing of combustible material,
- burning of combustible material,
- extinguishing with water and chemical substances,
- stopping the fire by digging canals and other obstacles.

### **3.5 Analysis of the existing infrastructure in wildfire protection**

To determine the state of wildfire protection, it is important to study the existing forest infrastructure in the Republic of Serbia, assess its suitability for wildfire prevention and propose a plan to improve the infrastructure. The plan must include the timeframe for the proposed activities.

This segment implies building new roads for firefighting vehicles and equipment, firefighting lines and breaks and the most suitable access to water sources, water supply management, protection of major buildings, picnic areas, national parks, and supply of water used to extinguish fires from the air, etc.

### **3.6 Model of the equipment and infrastructure needed for wildfire protection**

Firefighting equipment has an important role in the effective prevention and suppression of wildfires. It is wrong to think that all types of wildfires can be extinguished with the same type of equipment, without taking into account the combustible material, type of fire, climatic conditions, soil and bedrock, infrastructure, forest management, the use of obstacles in firefighting, etc. The success of wildfire extinguishing depends on the selection of firefighting equipment and fire extinguishers, which results in faster fire damage restoration, lighter equipment used, fewer people needed to extinguish the fire, less time, and lower cost of intervention that increases, which all improve the economic aspect of risk management in wildfire protection.

Besides the firefighting equipment, the accompanying fire extinguishers have to be defined because they contribute to the effectiveness of the firefighting process.

In order to select the firefighting equipment and fire extinguishers, it is necessary to know:

- what and how burns,
- who extinguishes what and how.

Classification of firefighting equipment according to the mode of operation:

- firefighting equipment with the cooling effect;
- firefighting equipment with the smothering effect;
- equipment for removing combustible material in front of the fire.

According to the location and mode of operation, firefighting equipment can be classified as:

- land firefighting equipment and
- areal firefighting equipment.

For areas at risk of wildfires, it is necessary to classify the equipment and study its effectiveness depending on the field conditions, the type of fire, the type of fuel, the soil, climatic conditions, and the supply of extinguishing agents.

Regarding the effectiveness of equipment used in aerial firefighting, it is necessary to study the time needed to discharge water and propose ways to improve the existing infrastructure and thus increase the efficiency of aerial firefighting. It is also important to map the areas that are favorable or unfavorable for aerial fire extinguishing.

We must also consider the possibility of using agents that can improve the effects of extinguishing combustible forest material, such as the application of various types of suppressants and retardants that typically penetrate into forest fuel material.

Regarding the applicable and efficient firefighting equipment, it is further necessary to map the firefighting equipment for each area, depending on:

- types of vegetation
- topography and orography
- types of fire
- arrangement of forest areas
- types and quality of roads
- soil characteristics
- openness of the forest area
- climatic factors
- supply of water and other extinguishing agents
- arrangement of water sources
- manpower available in the most unfavorable conditions
- the possibility of bringing together and mobilising people
- the possibility of extinguishing wildfires from the air
- characteristics of the equipment at the disposal
- efficacy
- delivery and distribution of equipment

### **3.7 Model for the preparation of wildfire protection plans – a proposal to amend the existing rulebook for the preparation of fire protection plans**

Every country with a large number of wildfires, a large area of forest affected by fires and extensive material damage, endangered lives, buildings and environment seeks to find solutions to fight these issues as efficiently as possible. Planning documents such as wildfire protection plans are the starting point for proper and effective wildfire protection, both in prevention and suppression.

The current rulebook for the development of fire protection plans does not provide a specific method for their development, which impedes the preparation of these planning documents, both for forest users and inspecting authorities that carry out inspections and approve the wildfire protection plan.

The wildfire protection plan is an important document that must enhance the efficiency of wildfire protection, and determine important elements that affect the risk management system in wildfire protection. The preparation of wildfire protection plans has not provided so far a complete picture of the state of protection, and adequate measures that should be taken to make this protection better and more efficient, and the organisation of the fire suppression faster and more efficient in order to minimise the damage and costs incurred by fire suppressing and extinguishing. The creation of wildfire protection plans is a complex process, affecting and encompassing many fields (forestry, meteorology, fire protection, firefighting, biology, etc.) and in many ways different from the development of fire protection plans intended for buildings. The Rulebook on the method of development and content of the Fire Protection Plan of autonomous provinces, local self-government units and entities classified in the first and second categories of fire risk has been adopted but it does not provide the method of developing this planning document, which is a serious shortcoming, considering that the Regulation on the categorisation of buildings, activities and soil in terms of fire risk includes the areas with different types of plant cover, i.e. forest area.

### **3.8 Wildfire protection plans a**

Fire protection plans are acts enacted by autonomous provinces, local self-government units and legal entities classified into the first and second categories of fire risk.

The Law on Fire Protection (Official Gazette of the RS No. 111/09 20/15) specifies who should adopt fire protection plans and how. For the first time in the Law on Fire Protection, the area and the type of plant cover are taken into account when categorising. This change in the Law on Fire Protection is of great importance since it deals with the land and plant cover of special interest and under a special protection regime, such as national parks. A by-law that regulates the method of preparing and the content of fire protection plans and the conditions that legal entities must fulfill for the preparation of fire protection plans was also adopted.

### **3.9 Proposed method of preparation and content of wildfire protection plans**

The Law on Fire Protection (Official Gazette of the RS No. 111/09 and 20/15) and the Decree on the Classification of Facilities, Activities and Land into Fire Risk Categories (Official Gazette of the RS No. 76 /10) include land categorisation in terms of area and plant cover. This land categorisation requires the development of high-quality forest protection plans, not included in the Rulebook for the development of plans.

Wildfire protection plans should have the same structure as other plans. This structure should include:

1. description of the current state of fire protection,
2. fire risk assessment,
3. organisation of fire protection,
4. proposal of technical and organisational measures to eliminate deficiencies and improve the state of fire protection,
5. estimation of financial needs,
6. necessary calculation and graphs.

Regarding the content, such a soil and forest protection plan would be fairly different from other fire protection plans and would have its specific characteristics.

### **3.10 Description of the current state**

The description of the current state should contain the following elements:

1. Land area, type of vegetation, division into compartments and sections;
2. The type of vegetation by compartment and section (coniferous forests, deciduous forests, mixed forests, degraded forests, thickets and brushwood, etc.);
3. Age of forest trees by species, amount of forest litter, and silvicultural forms and classes);
4. Accessibility of forest areas in terms of the road network;
5. Condition and quality of roads leading to areas of high-quality forest and roads within areas of high-quality forest and what vehicles they are open to (fire engines, people and equipment transporters, fire-fighting machines, etc.);
6. Potential dangers and agents of fire in the given area (charcoal pits, illegal dumps, facilities with open fire, picnic areas, etc.);
7. The state of water sources and method of water supply in case of fire;
8. The state and availability of firefighting equipment (belonging to legal entities, fire departments, nearest fire rescue department, etc.).
9. Assessment of the suitability of the available firefighting equipment in the area, bearing in mind that different wildfires require different equipment.
10. The state of firefighting services and manpower (available to legal entities, firefighting units, units of volunteers, the nearest firefighting and rescue departments, specialised civil protection units, aircraft vehicles that can be used for surveillance, observation and extinguishing, etc.)
11. State of the observation system (method of observation, condition and number of observation posts, other observation systems)
12. Ways of detecting and reporting fires (from the ground, from the air, surveillance cameras, etc.)
13. Possibility of extinguishing fire from the air (possibility, method of water supply, etc.)
14. Biotechnical protection measures (current state – mixed forests, biological fire breaks, after-fire breaks, expansion of existing lanes, cleaning and care)

15. Types of fire barriers, roads, lanes and their state (type, number, width, state throughout the year, etc.)
16. State of the water supply system (the map of natural sources and the possibility to use artificial sources throughout the year by setting up pools that can be refilled, etc.)
17. The application of the system for wildfire danger forecast in its territory.
18. The possibility and method of communication between all entities engaged in fire protection (radio, telephone, and other types of communication and speed of establishing the connection).
19. Quick establishment of collecting points for people and equipment, use of chemical agents (retardants and suppressants);
20. Method of coordination with headquarters for emergency management (republic, district, city, municipality, etc.);
21. Method of firefighting logistical support;
22. Firefighting operational maps for certain areas of the legal entity.
23. The risk of endangering buildings, people and other goods located in the forest or near the threatened area and how to protect them quickly;
24. Ways of fighting and measures to be taken against potential causes of fire with an assessment of their effectiveness.
25. Fire events and their causes registered in the last 10 years.

### **3.11 Assessment of wildfire risk**

Wildfire risk assessment is carried out using a special method and system of assessment that is precisely defined and the same for all entities.

The main goal of the wildfire risk assessment is:

1. to present an accurate picture of the forest wildfire risk to the institutions dealing with the protection of forests against fire.
2. to determine and classify the risks of wildfires in the observed area.
3. to determine how possible it is to protect forests against wildfires in a certain area and to apply additional protection measures.
4. to show the specialised services dealing with fire protection and participating in fire extinguishing the specific characteristics and fire dangers in the observed area.
5. to find models of supplementary protection measures and more efficient firefighting when a fire occurs in an area.

### **3.12 Parameters for assessing the risk of wildfires**

Numerous factors affect the risk of wildfire, but for the sake of its easier application in practice, the risk assessment method takes into account only those considered to be the most important and with the strongest impact on the risk of wildfire (Ratknić, T. 2018). The most important parameters in the wildfire risk assessment are:

- a) vegetation and fuel material
- b) natural disasters that lead to fires
- c) anthropogenic factor (human risk)

- d) climate
- e) drought
- f) bedrock (parent material and soil type)
- d) orography
- h) forest management
- i) fire history in the observed area

### **3.13 Degree of wildfire risk**

The degree of wildfire risk is assessed based on the presented parameters of wildfire risk. Points are assigned for each parameter and summed up for the observed area. The method of calculation is presented in the methodology of wildfire risk assessment (Ratknić, 2018).

Numerical indicators of the wildfire risk are used to create a risk map that presents the threatened areas in different colours, namely:

- First degree – red
- Second degree – orange
- Third degree – yellow
- Fourth degree – green

Previous assessments of the risk of wildfire took into consideration only the predominant vegetation, which was not sufficient to make a comprehensive assessment of the risk. Therefore, the new method of assessing the risk of wildfire aims to achieve a more comprehensive and higher-quality assessment.

### **3.14 Organisation of wildfire protection**

The organisation of wildfire protection should include:

1. the manner in which fire protection is organised within the entity that manages or uses forests and forest land (number of people, fire departments, communication, etc.);
2. the manner in which communication will be achieved with other entities dealing with wildfire protection (Ministry, public estates, institutes, state bodies, headquarters, etc.);
3. means and methods of communication;
4. data on the protection service, the fire department, and the number of people trained for fire protection;
5. procedures taken by all entities in forest protection and firefighting actions and procedures that regulate the implementation of preventive and repressive measures with the exact method of coordination;
6. fire extinguishing equipment, its characteristics and the possibility of its effective application in the intended area;
7. training methods and programmes in the field of wildfire protection, basic and special training.

### **3.15 Proposal of technical and organisational measures to eliminate deficiencies in wildfire protection**

The proposal for technical and organisational measures to eliminate deficiencies in wildfire protection should contain:

1. measures to be taken to reduce the risk of wildfires and measures to improve risk management in wildfire protection (prevention, preparedness, fire emergency response and post-fire rehabilitation),
2. biotechnical measures of wildfire protection to raise the level of protection,
3. measures to fight against potential causes of fire,
4. measures to improve the wildfire forecasting system,
5. measures to upgrade the wildfire detection system, and improve the existing or introduce new modern wildfire observation and reporting systems,
6. measures to be taken to prepare for the start of fire season,
7. measures and preparedness during the wildfire season,
8. measures to build and maintain fire roads in order to conduct fire prevention and suppression,
9. measures to improve the state of the water supply needed in firefighting and arrangement of water intakes and to construct new sources of water supply used in firefighting,
10. measures for the maintenance and security of picnic and other forest areas where a large number of people gather with the aim of reducing the risk of fire,
11. measures to plan and procure firefighting equipment and means according to the characteristics of the terrain,
12. measures to organise and manage firefighting actions in order to achieve better communication between all the entities involved and the correct use of extinguishing means and equipment,
13. measures to elaborate wildfire extinguishing methods and strategies based on the characteristics of the forest areas and procedures for the application of certain extinguishing methods,
14. measures related to fire ignition and plant waste burning in open and near forest edges,
15. measures to change and upgrade the communication system,
16. development of a system for modeling wildfires in order to predict these events,
17. ability to provide quick and effective first aid to the injured while firefighting,
18. measures for the terrain rehabilitation after a fire and recovery of the burned areas,
19. application and construction of information systems to improve risk management in wildfire protection (GIS, meteorological information system, environmental protection system, Ministry of Internal Affairs information system, notification and surveillance system, etc.).

### **3.16 Calculation of the necessary financial resources**

Calculation of the necessary financial resources should include:

1. a realistic assessment of the financial elements of the proposed technical and organisational fire protection measures,
2. the dynamics of execution of technical and organisational measures with a plan of financial resources for a period of five years.

### **3.17 Graphics**

Graphics that display:

1. operational maps showing areas with the highest risk of wildfires,
2. maps and tables with an overview of areas according to the degree of fire hazard created using the given methodology of the system for determining the risk of wildfire with all the foreseen elements,
3. maps of roads, fire-fighting lines and canals, firefighting water supply points and facilities that must be protected as a matter of priority in the event of a fire,
4. area-specific equipment with the map of the areas where the equipment can be used effectively (manual equipment, water fire extinguishers, mechanised equipment, air fire extinguishers),
5. places with observation posts and other systems for quick fire detection and reporting,
6. climatic diagrams for specific areas,
7. a map of water supply points (managed and unmanaged), places to keep special water tanks used in case of fire, and places to refill tanks in firefighting aircraft,
8. collecting points for people, equipment and chemical extinguishers and the places most favorable for operational headquarters and emergency headquarters (close to the area, protected and safe, accessible, with logistical assistance, etc.).
9. a map of the areas particularly endangered by fire with the highest number of fires in the past 10 years.

All data in wildfire protection plans must be clear, precise, and correct. All unnecessary elements, both in terms of the text and the graphs, must be avoided.

## **4. CONCLUSIONS**

The organisation and performance of all entities dealing with wildfire protection are of utmost importance for the proper functioning of the whole system of risk management in wildfire protection. Cooperation and mutual interaction of all entities and precisely prescribed activities both in wildfire prevention and when a fire occurs must improve all segments of fire protection. Besides the improvement of all the engaged systems (the fire hazard system, the education system at all levels, the early fire detection system, the fire prevention system, the

fire extinguishing system), and the preparation of appropriate planning documents, the appropriate system of communication between all the entities in wildfire protection, the number of fires can be reduced and the efficiency in wildfire protection increased

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# **SCHEME OF ORGANISATION AND PROCEDURES IN THE ACTIONS OF ENTITIES ON FOREST FIRE PROTECTION – PREVENTION AND SUPPRESSION OF FOREST FIRES**

*Goran ĐORĐEVIĆ, Mihailo RATKNIĆ, Ljubinko RAKONJAC, Tatjana DIMITRIJEVIĆ*

## **Summary**

Wildfire prevention includes a whole complex of measures and activities that need to be implemented to prevent wildfire occurrence, and in case a fire does occur, it entails an organised approach to fire extinguishing and rehabilitation. Wildfire prevention is one of the most important elements in the risk management system regarding the protection of forests against wildfire. Preventive measures taken to protect forests against wildfire are aimed at reducing the risk of wildfire occurrence, the number of fires, and the incurring damage.

The level of wildfire prevention applied in the Republic of Serbia is varying both in state-owned enterprises that manage state forests and in privately owned forest areas, where almost no preventive measures are applied to protect forests against fire.

Measures taken to prevent wildfire occurrence must be included in the wildfire protection plans for all forest areas regardless of the type of ownership. Wildfire protection plans must enlist specific measures that should enable: effective prevention of wildfire occurrence and in case it occurs, quick detection and extinguishing in the initial stage with a small number of people and simple extinguishing equipment and agents, which is also important in terms of economy.

The organisation and performance of all entities dealing with wildfire protection are of utmost importance for the proper functioning of the whole system of risk management in wildfire protection. Cooperation and mutual interaction of all entities and precisely prescribed activities both in wildfire prevention and when a fire occurs must improve all segments of fire protection. Besides the improvement of all the engaged systems (the fire hazard system, the education system at all levels, the early fire detection system, the fire prevention system, the fire extinguishing system), and the preparation of appropriate planning documents, the appropriate system of communication between all the entities in wildfire protection, the number of fires can be reduced and the efficiency in wildfire protection increased.

## **ŠEMA ORGANIZACIJE I PROCEDURA U POSTUPANJU SUBJEKATA NA ZAŠTITI ŠUMA OD POŽARA – PREVENCIJA I SUZBIJANJE ŠUMSKIH POŽARA**

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## **Rezime**

Preventivna zaštita od požara obuhvata čitav kompleks mera i aktivnosti koji trebaju da se realizuju da do požara u šumi ne dođe, a ukoliko do požara i dođe da se organizovanim načinom pristupi na sanaciji i gašenju požara. Sama preventivna zaštita šuma od požara, jedan je od najvažnijih elemenata u sistemu upravljanja rizikom u zaštiti šuma od požara. Preventivne mere u zaštiti šuma od požara imaju za cilj da se smanji rizik od nastanka požara u šumi, umanju broj nastalih požara i umanje štete koje nastaju dejstvom šumskih požara.

Nivo primenjenih preventivnih mera za zaštitu šuma od požara u Republici Srbiji je neujednačen, kao u državnim preduzećima koja gazduju državnim šumama tako i na površinama koje su u privatnom vlasništvu, gde se gotovo ne primenjuju preventivne mere na zaštitu šuma od požara.

Mere za sprečavanje nastanka šumskih požara moraju pre svega biti sadržani pre svega u planovima zaštite šuma od požara za sva područja pod šumom bilo kojoj svojnini pripadaju. U planovima zaštite šuma od požara moraju da se daju konkretne mere koje trebaju da omoguće efikasno sprečavanje nastanka šumskih požara da i kada požar nastane, bude brzo otkriven i ugašen u početnom stadijumu sa upotrebom malog broja ljudi i malo opreme i sredstava za gašenje, što je važno i sa ekonomskog aspekta.

Organizacija i način postupanja svih subjekata koji se bave zaštitom šuma od požara je vrlo važna u sistemu upravljanja rizikom u zaštiti šuma od požara. Saranja i međusobna interakcija svih subjekata i tačno propisani načini delovanja kako u preduzimanju preventivnih mera zaštite, ali i delovanja kada požar nastane mora da omogući uspešnost u svim delovima zaštite. Pored usavršavanja svih uticajnih sistema: sistema opasnosti od nastanka požara, sistem edukacije na svim nivoima, sistem ranog otkrivanja požara, preventivni sistem zaštite, sistem gašenja požara pa do izrade odgovarajućih planskih dokumenata uz odgovarajući sistem povezanosti subjekata na zaštitu šuma od požara, može da smanji broj požara i poveća efikasnost u zaštiti šuma od požara.