

Regional Consultation on Cross-boundary Cooperation in Fire Management

Skopje, 11 November 2016

Background Materials: National and Regional Analyses of Fire Management



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Background Materials: National and Regional Analyses of Fire Management

1. Forest Fires in South Eastern Europe – Regional Report and Country Studies by the Regional Fire Monitoring Center for SE Europe / Caucasus (published by the Regional Environmental Center for Central and Eastern Europe)

- Forest Fires in South Eastern Europe – Regional Report 2015
- Forest Fires Country Study Republic of Albania 2015
- Forest Fires Country Study Bosnia and Herzegovina 2015
- Forest Fires Country Study Kosovo 2015
- Forest Fires Country Study FYR Macedonia 2015
- Forest Fires Country Study Montenegro 2015
- Forest Fires Country Study Republic of Serbia 2015

2. International Forest Fire News No. 37: Special Issue on the 2007 Fire Season on the Balkan Peninsula and Neighboring Countries – UNECE / GFMC (December 2008)

- Forest Fires in Greece 2007
- Forest Fires in Bosnia and Herzegovina: Statistics 2003-2007
- Forest Fires in Bulgaria 2007
- Forest Fires in Croatia 2007
- Forest Fires in Croatia 2008
- Mine Fields and UXO Contamination in Croatia: Summary for 2008
- Republic of Albania – Fire Report 2007
- Republic of Serbia – Forest Fires in 2007
- Forest Fires in FYR Macedonia in 2007
- Ecological Damage Assessment of the Wildfires in the FYR Macedonia in 2007. Joint Mission by the UNEP-OCHA Joint Environment Unit, UNEP, UNDP and GFMC
- Wildfires in Turkey 2007
- Republic of Armenia – Forest Fires in 2007
- Review and Analysis of 40 Years of Fire Damages in Forests and Rangelands of the Islamic Republic of Iran (1968-2007)
- Advance Publication of Wildland Fire Statistics for Russia 1992-2007
- An Innovative Conceptual Model of a Forest Fire Management Information and Decision-Support System for Brandenburg State, Germany
- Analysis of the Wildland-Urban Interface Fire Problem of Greece

Forest Fires in South Eastern Europe

Regional Report



FOREST FIRES IN SOUTH EASTERN EUROPE
REGIONAL REPORT

2015

Produced by the Regional Fire Monitoring Center
(Key expert: Nikola Nikolov)

Editor: Aniko Nemeth
Regional Environmental Center for Central and Eastern Europe

Abbreviations

AIA	Administration for Inspection Affairs, Montenegro
BD	Brčko District, BiH
BiH	Bosnia and Herzegovina
CCFS	Climate Change Framework Strategy, Kosovo*
CFI	Cantonal Forest Inspectorate
CFO	Cantonal forest office, BiH
CFMC	Cantonal forest management company (BiH)
CFP	Communal forests and pasture
CMC	Crisis Management Centre, Former Yugoslav Republic of Macedonia
dbh	Diameter at breast height
DCEPR	Department of Civil Emergency Planning and Response, Albania
DES	Directorate for Emergency Situations, Montenegro
DFFRO	Directorate of Firefighting and Rescue Operations, Albania
DFHWPI	Directorate for Forestry, Hunting and Wood Processing Industry, Montenegro
DIF	Department for the Inspection of Forestry, Montenegro
DPR	Directorate for Protection and Rescue, Former Yugoslav Republic of Macedonia
DRR	Disaster risk reduction
DTFP	Directorate for Forest Protection and Treatment, Albania
EFFIS	European Forest Fire Information System
EMA	Emergency Management Agency, Kosovo*
ENVSEC	Environment and Security Initiative
ERCC	Emergency Response Coordination Centre
EU	European Union
FA	Forest Administration
FAS	Firefighting Association of Serbia
FAO	Food and Agriculture Organization
FBiH	Federation of Bosnia and Herzegovina
FFI	Federal Forest Inspectorate, FBiH
FHI	Forest and Hunting Inspectorate, Republika Srpska
FFO	Federal Forest Office, FBiH
FMP	Forest management plan
FPU	Fire Protection Union, Former Yugoslav Republic of Macedonia
GFMC	Global Fire Monitoring Center
GHG	Greenhouse gas
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
JRC	Joint Research Centre
KFA	Kosovo Forestry Agency
KEPA	Kosovo Environmental Protection Agency

LGU	Local-government unit
LULUCF	Land use, land-use change and forestry
MAEP	Ministry of Agriculture and Environmental Protection, Serbia
MAF	Ministry of Agriculture and Food, Albania
MAFRD	Ministry of Agriculture, Forestry and Rural Development, Kosovo*
MAFWE	Ministry of Agriculture, Forestry and Water Economy, Former Yugoslav Republic of Macedonia
MARD	Ministry of Agriculture and Rural Development, Montenegro
MAWMF	Ministry of Agriculture, Water Management and Forestry of FBiH
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MEFWA	Ministry of Environment, Forests and Water Administration, Albania
MEPP	Ministry of Environment and Physical Planning, Former Yugoslav Republic of Macedonia
MESP	Ministry of Environment and Spatial Planning, Kosovo*
MIA	Ministry of Internal Affairs, Kosovo*
MKFFIS	Macedonian Forest Fire Information System
MOFTER	Ministry of Foreign Trade and Economic Relations of BiH
MoU	Memorandum of understanding
NFI	National forest inventory
NGO	Non-governmental organisation
OSCE	Organization for Security and Co-operation in Europe
PE	Public enterprise
PFERS	Public Forest Enterprise of Republika Srpska, BiH
RFMC	Regional Fire Monitoring Center
RFPU	Regional fire protection unions
RFSD	Regional Forestry Services Directorate, Albania
RHMS	Republic Hydrometeorological Service, Serbia
RS	Republika Srpska
SIEFW	State Inspectorate of Environment, Forests and Waters, Albania
TCP	Technical cooperation programme
TFPU	Territorial fire protection unit
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded ordnance

** This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.*

Foreword

Forests represent a common heritage and have ecological, economic, social, aesthetic and cultural values that are impossible to quantify. Forest fires are one of the main threats to our forest resources and give rise to a wide range of devastating economic, social and ecological problems. Although the issue is receiving increased attention, and although forest fire prevention is being tackled in the framework of climate change adaptation measures both regionally and internationally, the necessary political drive is still lacking and policy and legal mechanisms still need to be put in place at national and regional level.

The political, social and economic changes that have taken place in the last two decades have generally had a negative impact in terms of forest fire prevention in the countries of the region. Many of the relevant institutions have been restructured or annulled, and new institutions have been established. Some competencies have been transferred to other institutions, giving rise to a number of regional obstacles. Common to most of the countries is the overall lack of coordination, and even the inconsistencies, between the various institutional and administrative frameworks.

Institutional capacities need further strengthening. There is an overall lack of well-established bilateral processes with neighbouring countries in the field of forest fire protection, and especially fire suppression (with respect to both sending and receiving assistance). Not enough joint actions are being implemented for the suppression of cross-border and internal forest fires.

Under the Environment and Security Initiative (ENVSEC), the Regional Environmental Center for Central and Eastern Europe (REC), with the support of Austrian Development Cooperation, is implementing a project aimed at identifying potential actions to combat this form of forest devastation in South Eastern Europe (SEE), as well as at enhancing dialogue and cooperation among SEE countries. One of the goals of the project is to identify concrete activities by which key actors can close the existing gaps in legislation, policy, implementation and enforcement in order to reduce or eliminate forest fires in SEE. The core project team comprised Aniko Nemeth, project manager; experts Bruno Mesquita and Danko Aleksic; and Gordana Kozhuharova, project director and ENVSEC regional desk officer for SEE.

The present report, covering SEE countries exclusively and financed by Austrian Development Cooperation, is the first step towards the ultimate objective of reinforcing bilateral processes with neighbouring countries in forest fire protection, especially fire suppression, and strengthening regional contacts among experts, academics, decision makers and other stakeholders with the aim of combating and preventing forest fires in SEE.

The REC has a solid track record in this field, with 25 years of experience in building capacities towards environmental management in SEE countries. The REC is committed to the security aspects implicit in addressing environmental challenges. It participates in and manages a number of important projects implemented under the ENVSEC Initiative, strengthening key decision makers in SEE to ensure peace and stability while safeguarding the environment.

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Acknowledgements

The present study was compiled in the context of the project “Addressing the risks of forest fires in South Eastern Europe”, financed by the Austrian Development Cooperation and implemented under the ENVSEC Initiative. It covers Albania, Bosnia and Herzegovina, Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and the Republic of Serbia.

The study was prepared mainly by the Regional Fire Monitoring Center (RFMC), together with Aniko Nemeth, Bruno Mesquita and Cecile Monnier, and with the contribution of Danko Aleksic. It is based on national reports prepared by the Regional Fire Monitoring Center’s key expert, Nikola Nikolov.

In 2010, the Regional Southeast Europe/Caucasus Wildland Fire Network, in cooperation with the Global Fire Monitoring Center (GFMC) and a team of forest fire specialists from the United Nations Economic Commission for Europe (UNECE)/United Nations Food and Agriculture Organization (FAO), with the financial support of the Council of Europe (European and Mediterranean Major Hazards Agreement, EUR-OPA), decided to establish the Regional Fire Monitoring Center (RFMC). The RFMC is hosted by the Faculty of Forestry in the Macedonian capital, Skope.

The aims of the RFMC are to:

- conduct and coordinate wildland fire research;
- implement research results in fire management policies and practice, supporting relevant ministries and specialised agencies in SEE/Caucasus;
- facilitate the exchange of information about wildland fires;
- provide information about the latest technological advances in fire management;
- provide capacity building (training) and advisory services to support the development of fire management policies and to enhance local and national fire management capabilities; and
- initiate, support and participate in bilateral and multilateral collaboration between countries in the region and beyond in the field of wildland fire prevention.

Disclaimer

The information contained in this report is based mainly on the findings of the national reports compiled by the Regional Fire Monitoring Center. Some gaps in information have been filled through additional research. It is important to bear in mind the general lack of hard statistical data in the forestry sector. This problem is particularly pronounced in some of the countries concerned. In addition, statistical data are often not updated, or are underestimated. The main objective of the report is not to provide completely accurate figures and data on all aspects of forest management and forest fire risk prevention and control, but rather to present general observations and trends with a view to drawing overall conclusions and recommendations for improvements. It remains the task of the national governments and relevant international organisations to develop more reliable and uniform data collection mechanisms and methodologies.

Given the above, the authors (REC) do not assume any responsibility for any mistakes and misinterpretations that may occur in the text. However, the REC welcomes any comments and suggestions that could be discussed at national, regional and international level and taken into account in future related policy and strategy papers.

Executive Summary

The status quo

In South Eastern Europe (SEE), the forestry sector has significant untapped potential and could contribute to the social and economic development of a large stratum of the population. It is therefore vital to identify those elements — such as forest fires — that are preventing the realisation of the full potential of forestry in the region.

In addition to forestry, forests play a significant role in other sectors, such as tourism, and are a valuable environmental resource in general.

Certain general patterns can be discerned in the SEE region covered by the present study (Albania, Bosnia and Herzegovina, Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and Serbia):

- the types of forests particularly prone to forest fires (in the Mediterranean and sub-Mediterranean parts of the region);
- the types of forests that are particularly vulnerable to forest fires, such as beech forests and large territories afforested with coniferous trees (especially *Pinus* spp.);
- national systems for forest fire protection involving large numbers of institutions and organisations;
 - the large number of laws regulating forest fire protection;
 - the lack of reliable and aggregated data on forest fires (forest fire statistics);
 - the lack of national early warning systems; and
 - the lack of proper tools, equipment and vehicles for forest fire suppression.

On the whole, forest fire prevention has been compromised by the political, social and economic changes that have taken place over the last two decades. Many of the institutions involved in forest fire protection (including ministries, directorates and agencies) have been restructured or annulled, new institutions have been established, and in some cases competencies have been transferred between institutions. As a result, one of the most pressing regional obstacles, and one that is common to most of the countries, is the overall lack of coordination, and even inconsistencies, between the various institutional and administrative frameworks.

Institutional capacities need further strengthening. There is an overall lack of well-established bilateral processes with neighbouring countries in the field of forest fire protection, especially fire suppression (in the case of either sending or receiving assistance). Not enough is being done in terms of the suppression of cross-border and internal forest fires.

In all countries of the region there is a clear lack of specialist equipment such as off-road vehicles, specialised fire trucks, aeroplanes and helicopters.

In addition, the impacts of climate change (lengthy dry periods, heat waves and decreased precipitation) are among the main factors behind the large number of forest fires and the large expanses of burned area.

The main causes of forest fires in the region are:

- agricultural burning;
- pastureland burning;
- negligence (along highways, railways etc.); and
- arson.

The rise in the incidence of arson as a reason for forest fires in the SEE region over the past decade is a cause for concern. The main motive for arson is economic, as arson attacks are generally connected to illegal logging.

Recommendations

The current international and regional legal, policy and institutional frameworks contain all the essential components for dealing with forest fires. However, they still need to be developed and improved in order to achieve greater efficiency in forest fire protection. In this context, efficiency does not refer only to efficient forest fire suppression, but also to efficient forest fire prevention.

The activities required to achieve efficiency can be implemented at both national and international level. The authors of the present report recommend that the countries concerned, in cooperation with international donors, first work on consolidating and strengthening their national institutions and capacities. Attention can then be given to regional and wider international networking. These two different processes should, in fact, be carried out in parallel.

The recommendations presented in this report can be implemented by:

- providing capacity-building trainings for relevant professional personnel (command personnel, forest firefighters etc.);
- promoting bilateral and regional cooperation;
- encouraging public participation and raising awareness;
- establishing national forest fire early warning systems;
- ensuring sufficient funds for forest fire protection;
- improving legal regulations;
- strengthening preparedness measures;
- strengthening prevention measures;
- developing fire management research programmes;
- replicating good fire management practices from other countries and regions; and
- using the capacities and resources of international organisations (ENVSEC, REC, UNEP, UNDP, OSCE, Council of Europe, GFMC, RFMC etc.).

I. Introduction

Global and regional context

Fire is a natural and beneficial part of many forest ecosystems, but the number and intensity of fires today is challenging fire managers and forest communities throughout the world. Each year wildfires destroy between 6 and 14 million hectares of fire-sensitive forests worldwide, a rate of loss and degradation comparable to that of destructive logging and agricultural conversion. At the same time, many fire-adapted forest ecosystems are fire starved.

The immediate impacts of fires are devastating to human communities and forest ecosystems. In the longer term, they adversely affect the supply of environmental services necessary for the well-being of local communities, threaten the survival of endangered species, damage the structural and compositional complexity of biologically important forests, and create suitable conditions for invasive species.

However, it is also important to understand that the role of fires varies according to the type of forest. In tropical, dry forests, boreal forests and some types of coniferous forests, for example, a certain amount of fire is essential in the maintenance of forest structure and function, and in the composition of the forest flora and fauna. In tropical, moist forests, however, fires are usually detrimental.

Forest fires may be started for many reasons. Some are practical and beneficial, some are accidental, and others are deliberately started in order to cause damage. All fires are potentially harmful to forest ecosystems or human communities, depending on both the condition of the forest at the time and how they are managed once they are burning.

According to the study "Forest Fires: Causes and contributing factors in Europe", prepared at the request of the European Parliament's Committee on the Environment, Public Health and Food Safety (2008), forest fires are the most important threat to forests and wooded areas in Southern Europe. Around 50,000 fires sweep through 700,000 to 1 million hectares of Mediterranean forest, other wooded land and other land each year, causing enormous economic and ecological damage as well as loss of human life.

The Balkan region, which includes parts of Southern and Eastern Europe, is no exception. In the area covered by the present report (comprising Albania, Bosnia and Herzegovina, Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and Serbia), over 220,000 hectares of forest were burned in the years 2007 and 2012 alone. The impacts of fires in this region vary — from economic losses related to fire suppression and burned timber mass to degradation, deforestation, soil erosion, pest infestations (especially bark beetles) and greenhouse gas emissions.

The aim and scope of the present report

The project “Addressing the risks of forest fires in South Eastern Europe” is financed by the Austrian Development Cooperation and implemented by the Regional Environmental Center (REC) under the Environment and Security (ENVSEC) Initiative. It covers Albania, Bosnia and Herzegovina, Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and Serbia. The present regional report provides an overview of the state of play in the forestry sector in SEE in terms of the general framework for forest protection; identifies gaps and practices; and analyses the occurrence and management of forest fires as well as measures implemented by the relevant national authorities for their prevention and mitigation.

The overall aim is to map the forest fire context in the individual countries and, from a regional perspective, to identify concrete regional priorities and actions to be taken by key stakeholders in order to close the gaps in laws, policy, implementation and enforcement.

Methodology and structure

This regional report is based predominantly on information obtained from experienced, nationally recognised forestry experts from the Regional Fire Monitoring Center (RFMC), based in Skopje. The RFMC was contracted in 2014 to undertake national fact-finding studies, using a questionnaire. The structure of these reports is presented in Annex I. The reports focused mainly on the forestry sector at national level; the organisation of forest management; forest fire prevention and control, including authorities and control mechanisms; the legal and policy regimes for regulating forestry activities; the main causes of forest fires; and the main prevention and mitigation activities. The individual country reports contained only very limited recommendations. Most of the recommendations presented in this regional report are made by the REC on the basis of the information received in the individual reports, but also in relation to the broader regional and international context.

The regional report is divided into the following sections:

1. The forestry sector, forests and fire history
2. The legal framework and institutional set-up in the field of forest fire management
3. The impact of forest fires on the environment, economy and human health

Regarding the methodological approach, the regional report is structured in such a way as to highlight the general trends in SEE countries and some of the common denominators, as well as the most noteworthy differences. It does not examine every single aspect of forest fires and the precise extent of activities, as this would require more reliable and comparable data and statistics. The report focuses on forest fires mainly from the perspective of causes, drivers, short- and long-term impacts and possible solutions.

The forestry sector, forests and fire history

1. Geography, topography and climate conditions (with relevance to forest fires)

Introduction

South Eastern Europe (SEE) is a sub-region comprising Albania, Bosnia and Herzegovina, Croatia, Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and Serbia. With the exception of Albania, the SEE countries were formerly constituent republics of the Federal Republic of Yugoslavia. The 1990s were a turbulent decade in the region, with the break-up of the Federal Republic of Yugoslavia and the creation of new countries. Ethnic and civil wars affected all the countries of the region, either directly or indirectly, exacting a high price.

From a geographical point of view, SEE countries are either landlocked (Serbia, Kosovo* and the former Yugoslav Republic of Macedonia) or have access to either the Adriatic or the Ionian Sea. Although the 20 km coastline of Bosnia and Herzegovina is surrounded by Croatian peninsulas, according to United Nations law the country has a right of passage to the open sea.

The topography of the region is characterised by vast mountainous areas that cover up to 70 percent, or even 80 percent, of the territory. The last Ice Age caused massive erosion in several parts of the mountain ranges. The rugged peaks of the Dinaric and Rodope mountains reach heights of well over 2,000 metres, making it difficult to access certain areas. The region is crossed by a number of rivers, including the Sava, Drina and Vardar, creating terrain ideal for agriculture. The Pannonian basin, from the northern part of Bosnia and Herzegovina and Serbia, as well as some of the areas with a Mediterranean climate lying southeast of the Dinaric Mountains and bordering the Adriatic Sea, are also suitable for agriculture.

A variety of unique fauna and flora can be found in the region, increasing its natural value. Large parts of the territory are covered by forests, ranging from 27 percent in Serbia to 39 percent in Kosovo* and up to 50 percent in Bosnia and Herzegovina.

Climate

Although the studied countries do not cover a large geographical area, their climatic conditions vary. From the west, there is a strong Adriatic and Mediterranean influence that fades as it meets the Dinaric Alps and other mountain ranges, as well as the large continental air mass coming down through the Pannonian and Wallachian plains. The coastal regions have a typically Mediterranean climate, with hot and dry summers and mild, wet winters. In the mountainous areas the air is cooler and the average annual rainfall is far higher, although in the valleys there is a mild continental climate with occasionally extremely high summer temperatures and relatively cold winters. The northern parts of Serbia and Bosnia and Herzegovina enjoy a typically continental climate with very hot summers and it is common for temperatures to fall below -15°C or even -20°C during the winter season. Despite its small size, Albania has a high number of climatic regions and includes the area with the highest precipitation in Europe due to the convergence of the prevailing airflow from the Mediterranean Sea and the continental air mass. Although the former Yugoslav Republic of Macedonia is small in area, it shows great diversity in terms of geological formations, climate, relief forms, soils and flora. As a result of the heterogeneity of natural conditions, the territory of the country can be

distributed in eight climate–soil–vegetation zones. About 56 percent of the territory belongs to two zones (continental sub-Mediterranean and warm continental).

Demography

The demographic shifts and lack of censuses in most of the countries covered by this report mean that the total population of the region can only be estimated. A figure slightly exceeding 20 million is likely, with a tendency to decrease due to significantly ageing populations and the high level of emigration resulting from the wars and ethnic/religious conflicts in the region. The Albanian populations in Kosovo* and Albania are very young (the average age in Albania is 28.9), but although the birth rate until the 1990s was relatively high (over four children per woman), it has now fallen to replacement level or even lower. None of the countries, with the exception of Albania, are ethnically homogenous. Minorities can constitute as much as 31 percent or even 33 percent of the total population (in Bosnia and Herzegovina and the former Yugoslav Republic of Macedonia respectively). The remarkably low fertility rate in Serbia, along with the emigration of approximately 500,000 people, has created one of the oldest populations in the world, although it is currently home to the largest European refugee population (7 percent of the total population). In Bosnia and Herzegovina, severe tensions between the three nationalities/religious groups (Bosniaks, Serbs and Croats; or Muslims, Serbian Orthodox and Roman Catholics) have created a longstanding conflict that has also resulted in strong migration towards Western Europe and led to the loss of over half a million of its 4.3 million population. Albania experienced strong internal migration starting in the 1990s, which led to a reduction in the population of the northern districts and a significant increase in the south, in particular in the cities of Tirana and Durrës.

General socioeconomic conditions

The 1990s was an extremely difficult decade in the history of the SEE region, when constant hostilities led to the emergence of a number of new nation states. The effects of the war and the legacy of the former centrally planned economy created obstacles to the adoption of effective reforms and hindered socioeconomic progress. Delayed and often unimplemented reform programmes made it impossible to establish fully functioning market economies, which led to inferior economic performance, declining living standards, rising unemployment and greater poverty.

Nevertheless, the region has growth potential. In the past decade it has outperformed other European economies as a result of efforts towards macroeconomic stability and reform. However, the recent global crisis has also struck the region, and a number of significant factors continue to hold back the economy. These include underdeveloped infrastructure networks, low levels of foreign direct investment and weak administrative structures and project promoters. The year 2009 saw a sharp drop in external trade and industrial production and a significant slowdown in economic growth. In addition, unemployment rates, which had been decreasing from very high levels, are predicted to rise sharply again and the level of public debt also remains very high across the region. [G1]

Studies indicate that, after the outstanding performance of most of the SEE countries, all the economies, with the exception of Albania, are declining due to the economic crises and the decrease in foreign direct investment (FDI) in the region. High dependency on FDI makes the region more susceptible to external shocks and high export–import trade deficits, which are most apparent in the case of Montenegro. Although Albania was the only country to have

recorded economic growth in 2009, its gross domestic product, calculated on the basis of purchasing power parity (GDP PPP), stands at 25 percent of the EU average and it is still a region that attracts little interest among investors due to power shortages, lack of water supplies and illegal activities.[G2] With its damaged economy, ethnic conflicts, international sanctions and poor external commerce, Kosovo* has the highest poverty level in the region (still considered a developing country according to the World Bank) with USD 2,100 GDP PPP per capita.[G8] The other four countries have a relatively higher GDP PPP per capita, with Bosnia and Herzegovina the lowest at 30 percent and Montenegro the highest, reaching 46 percent.[G3] Although the financial crisis has cut back the economic expansion of the so-called Balkan Tiger, Serbia, it is the fastest growing economy of the region, with significant FDI.[G4]

In SEE, as in more developed regions of the world, the service sector employs the largest proportion of the labour force and has the highest share of GDP, with the exception of Albania, where agriculture is still the most significant sector taking a 58 percent share of the labour market. Although the unemployment rate has been decreasing, it is still extremely high, ranging from 14 percent in Serbia to as high as 29 percent in the former Yugoslav Republic of Macedonia and even 50 percent in Kosovo*. In spite of its high unemployment rate, the former Yugoslav Republic of Macedonia was recently ranked by the World Bank as the “fourth best reformatory state” out of 178 countries, having undergone considerable reform and having created an open economy. Nevertheless, the poverty rate still stands at 22 percent, which shows that, despite significant progress, there are still a large number of issues to be addressed.[G5] All the countries covered are progressing with the necessary economic and institutional reforms as a step in the EU integration process.

Forests cover on average 40 percent of the SEE countries, while the EU average is 42 percent.[G6] Wood is used extensively in several countries of the region, but rather inefficiently. One of the main goals is to increase the efficient use of wood energy by the introduction of new technologies. To achieve this, commitment is needed at the political level, both nationally and locally, as well as closer cooperation between the various public and private bodies with an interest in forest management and energy. Forests are an important resource for survival, especially in terms of the provision of firewood. Per capita GDP and total nominal GDP are low in many areas, especially since the war, thus increasing the pressure on forestry resources.

The forestry sector contributes to poverty alleviation among rural populations. In some countries, including Albania, the distribution of the rural population and the distribution of forest resources do not correspond, resulting in a significant impact on forests. The rural plains, for example, which are home to 65.4 percent of the rural population, include only 40 percent of the country's forested area, 39 percent of its pastures and 73 percent of its agricultural land. The mountainous areas, which are home to 34.5 percent of the population, include 60 percent of the country's forests, 61 percent of its pastures and 27 percent of its agricultural land.[G7]

In Albania, forage and grazing for livestock are also important forestry products but are not included in official statistics, nor is their value reflected in GDP. Similarly, the environment services provided by the forests are not reflected in the (real) contribution of the forestry sector to the national economy. Such services include the protection of soil and water resources; the conservation of biodiversity; the protection of agricultural crops from climatic hazards; carbon sequestration and the slowing of climate change; the provision of shade, amenity and recreation; and the protection of coastal areas and fishing.

In summary, agriculture and forestry are significant in the region, although in some countries show a decreasing trend. In many SEE countries current migration patterns are characterised by young people moving from rural to urban areas. As a consequence, fewer young people are involved in forestry. In addition, people that have moved to more populated

areas may be living at a distance from forests they still own. As these forests are more vulnerable to theft, owners are often forced to sell them below their market value and to non-local proprietors, increasing the danger of abuse and overexploitation of the forestry resources.

The area and state of the forests

Total forest coverage

The countries covered in the present report do not take a consistent methodological approach to the classification of forest land, which should be taken into account when comparing statistics and aggregate data. In Kosovo*, most of the forest area is classified as forest land by means of the interpretation of aerial photographs and field surveys. Another way of classifying forest land is through photo interpretation without a field survey — which is particularly convenient for inaccessible areas.

Recent figures (mainly from 2008) show that the proportion of forest coverage ranges from 29 percent in Serbia to 54 percent in Montenegro. The average coverage is about 40 percent, compared to the EU average of 42 percent. A steady decline in forest land due to urbanisation and land-intensive activities such as agriculture, mining and heavy industry, is common to most countries. Increasing efforts are being made towards the afforestation of degraded land, often as an integral part of overall strategies towards sustainable forestry.

2. Overview of the forestry sector

The definition of what is considered forest and forest land inevitably has an influence on the forestry sector and its activities and competencies (including forest fire protection). In terms of forest fire protection activities, the definition is important not only for the forestry sector but also for the other institutions and organisations responsible for and involved in forest fire protection. The terms “forest” and “forest land” are defined in each country’s forest-related laws.

Albania – According to Article 2 of the Law on Forests and Forestry Services (No. 9385 of April 5, 2005), forest and forest land in the Republic of Albania are defined as follows:

“Forest is land with a dense array of forest trees in stable form or other forest vegetation with a low density, with an area greater than a tenth of a hectare with coverage of not less than 30 percent, that produces a timber mass and an impact on the surrounding environment, and that provides the functions of a forest.

Forest land (open forest) means land surface with forest vegetation and other non-forest vegetation, with coverage from 5 to 30 percent, bare surfaces, rocky places, eroded and non-productive land, nurseries, forest roads, lands not registered as having another use in the land-use cadastre, and similar agricultural lands ecologically functional in the national forest fund, which, all together, provide the functions of a forest.” [AL 2]

Bosnia and Herzegovina – According to Article 2 of the Law on Forests, forest and forest land in the Federation of Bosnia and Herzegovina are defined as follows:

“Forest, in terms of this law, means the land covered with forest trees or forest shrubs, whose area exceeds 500 m² and with a width of at least 10 metres. Forests are considered as ecosystems. Their status in the land cadastre does not have any implication in terms of this act.

Forest land, in addition to land overgrown with forest, includes uncultivated, unused or barren land outside the forest to the extent that provides, or supports, the function of the adjacent forest. Forest land also consists of areas with reduced forest cover, rocks, clearings and meadows inside forests.” [BiH 14]

Article 7 of the Law on Forests of Republika Srpska (Official Gazette of Republika Srpska Nos. 66/03, 75/08, 30/10) contains the following definition:

“Forests, within the meaning of this law, are surfaces covered by forest tree species over an area larger than 0.16 ha, with a minimum width of 20 metres and with land coverage by tree crowns of at least 20 percent, regardless of whether it comes from regeneration or adult trees, either from seeds or shoots from stumps or roots.”

According to Article 3 of the Law on Forests of Brčko District (Official Gazette of Brčko District, No 14/10), forest and forest land are defined as follows:

“(1) A forest, in the sense of this law, is:

- a) land overgrown with forest trees or forest shrubs forming a forest ecosystem comprising a biotope and biocenosis, with an area exceeding 500 m² and with a width of at least 10 metres;*
- b) forest nurseries and plantations of forest trees;*
- c) forest roads and other forest transport and fire protection infrastructure;*
- d) lakes, rivers, streams and other surface water and wetlands within the forest.*

(2) Forest land, in terms of this law, is:

- a) land that is not permanently appropriate for a different type of culture, except for growing forest, in accordance with the location, configuration, physical and chemical composition of the soil;*
- b) land that is designated for forest production in a spatial or urban plan;*
- c) land beside overgrown forest, including uncultivated, unused or barren land outside the forest to the extent that it provides or supports the functions of the neighbouring forest; or*
- d) land with reduced forest cover, meadows and clearings in forests.”*

Kosovo* – According to Article 2 of the Law on Forests (2003/3), forests and forest land are defined in the following way:

" 'Forest' is land registered as such in the cadastral records.

'Forest land' is land that is being managed for the production of wood or other forest products or whose best use, given its natural characteristics and economic conditions, involves the growing of trees."

Former Yugoslav Republic of Macedonia – Article 6 of the Law on Forests (Official Gazette of RM, No. 64, of May 22, 2009) defines forests as:

"Forest ecosystems that exist on forest land covered with forest tree and shrub species, bare land close to the forest, as well as other bare land and pastures inside the forest, forest nurseries, forest roads, seedling plantations, forest fire cleanings, wind protection belts with an area larger than 2 ares [0.02 ha], as well as forests in protected areas. Forests also consist of young stands and forest plantations with an area larger than 2 ares, as well as areas that are currently uncovered as a result of human activities or natural hazards, where natural regeneration has begun.

Separate groups of trees on areas smaller than 2 ares, border trees in agricultural land, plantations from fast-growing tree species as well as river bank vegetation, alleys and parks in inhabited places are not considered as forest." [MK 6]

Montenegro – According to Article 3 of the Law on Forests (Official Gazette of Montenegro, 74/10), forests and forest land in Montenegro are defined in the following way:

"Within the meaning of this law, forests shall be considered as land spanning more than 50 ares [0.5 ha], covered with forest trees having canopy cover above 10 percent of the land area and dominant trees higher than 5 metres (i.e. trees able to reach that height in their physiological maturity phase).

Within the meaning of this law, forest land shall be considered as land spanning more than 50 ares [0.5 ha], covered by forest trees:

- *higher than 5 metres (i.e. trees able to reach that height in their physiological maturity phase) and whose canopy cover is 5 to 10 percent of the land area;*
- *not able to reach a height of above 5 metres (i.e. covered by a combination of trees and low forest vegetation if coverage is higher than 10 percent of the land area).*

Forest and forest land shall also be deemed temporarily barren areas where the natural regeneration of forest trees has started, fire protection lanes, areas covered with non-

forest vegetation spanning less than 50 ares [0.5 ha] if it is within the forest or forest land complexes, forest tree protection belts spanning more than 50 ares and wider than 20 metres, and forest roads.” [MNE 5]

Serbia – According to Article 5 of the Law on Forests (Official Gazette of the Republic of Serbia, Nos. 30/10 and 93/12), forest and forest land in the Republic of Serbia are defined as follows:

“ ‘Forest’, in terms of this law, means an area larger than 5 ares [0.05 ha] covered with forest trees.

The term forest also includes forest nurseries in the forest complex and seed plantations, as well as protective belts of trees with an area larger than 5 ares.

The term forest does not include separate groups of forest trees on an area less than 5 ares, parks in urban areas, as well as trees located under power lines and in the corridor of constructed power lines, regardless of the area covered.

‘Forest land’ is land on which forest is grown, the land on which, due to its natural characteristics, it is more rational to grow forests, as well as land on which facilities for forest management, wildlife and the exercising of the amenities of the forest are located, and which cannot be used for other purposes, except in cases and under conditions stipulated herein.”

It is clear that, according to the current national laws in the region, the definitions of “forest” and “forest land” differ (even within the same country, in the case of Bosnia and Herzegovina). This has implications for the competencies of the relevant institutions in terms of territorial coverage and liabilities for forest fire protection. Although the terms are clearly defined in the laws, there are many problems in practice, especially in abandoned agricultural regions. Many abandoned agricultural fields are now covered with native vegetation (forest or shrubs), although according to the cadastre they are still agricultural lands. Thus, according to the definition in the law on forests, they are to be regarded as forest, but according to the cadastre they are agricultural land. This results in confusion within the competent institutions, and especially in institutions that belong outside the forestry sector.

1.1. Characteristics of forests

According to current legal regulations and official statistics, the condition of the forest fund in the countries of the region is described below.

1.1.1 Forest area

Albania – The forest area in Albania covers 1,498,957 ha, of which high forest occupies 294,957 ha, coppice forest 405,016 ha, shrubs 241,724 ha, and open forest 557,260 ha.

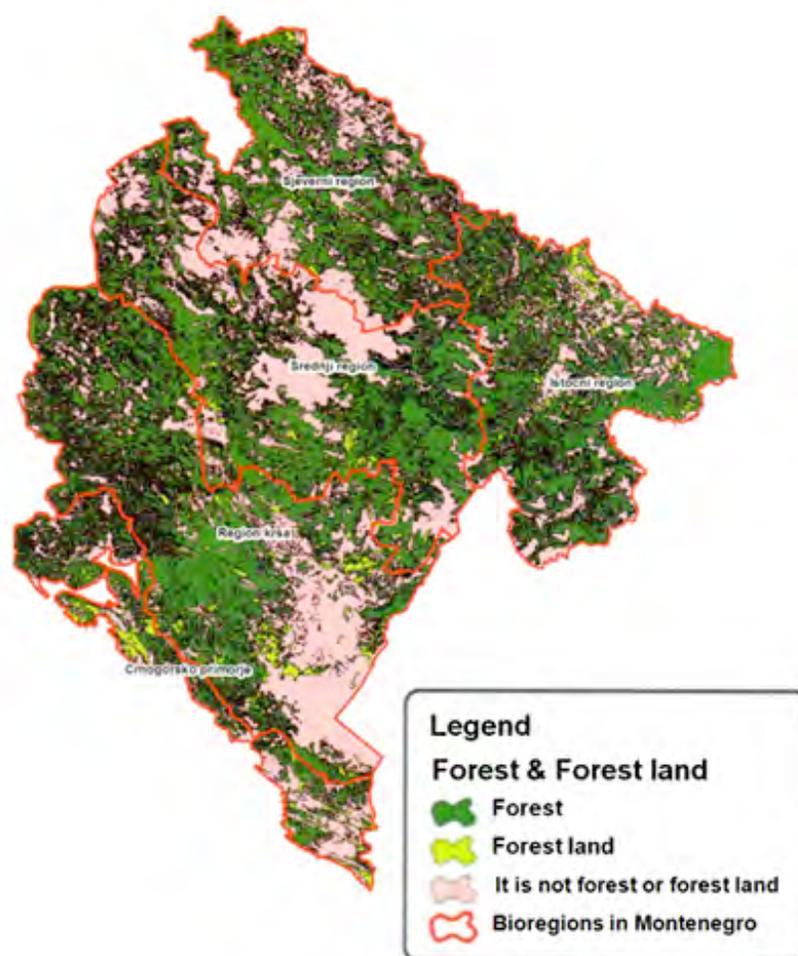
Bosnia and Herzegovina – According to the second national forest inventory, carried out between 2006 and 2009, forests and other forest land in Bosnia and Herzegovina cover 3,231,500 ha. This suggests that about 63 percent of the total territory of the country is covered with forest and other wooded land, which is one of the highest values in Europe.

Kosovo* – According to the national forest inventory, compiled in 2012, the total forest area in Kosovo* is 481,000 ha.

Former Yugoslav Republic of Macedonia – The total area of forest land in the country is 1,159,600 ha, of which forests cover 947,653 ha. [FYRM 3]

Montenegro – Forests and forest land cover 54 percent (743,609 ha) of the total area of Montenegro. The country has substantial forest coverage, among the highest in Europe, with 0.9 ha per capita. Forests cover 620,872 ha, while forest land covers 122,737 ha. [MNE 1]

Map 1. Forest and forest land in Montenegro



Source [MNE 2]

Serbia – Forests and other wooded land in the Republic of Serbia occupy 2,252,400 ha, which is about one-third of the territory of the republic. [SRB 2]

Map 2. Forests and forest land in Serbia



Note: This map does not show the territory of Northern Kosovo*, which is under the jurisdiction of the Ibar-Leposavic forest company operating in the framework of the Srbijasume public enterprise. Source: [SRB 3]

As shown in Table 1, the total area of forest and forest land in all six countries is 9,367,066 ha, and the average coverage with forest and forest land is 48 percent of their territory.

Table 1 Forest cover per country

Country	Forest and forest land cover (ha)	Forest and forest land cover out of the total country area (%)
Albania	1,498,957	52.0
Bosnia and Herzegovina	3,231,500	63.0
Kosovo*	481,000	44.7
FYR Macedonia	1,159,600	45.5
Montenegro	743,609	54.0
Serbia	2,252,400	29.0
	Total: 9,367,066	Average: 48.0

1.1.2 Ownership structure

Albania – According to Article 15 of the Law on Forests and the Forestry Service, national forests in Albania may be either publicly or privately owned.

“ 3. Public forests are divided into:

- a) forests and forest land owned by the state (state forests); and*
- b) forests and forest land used or owned by local governments (communal forests).*

4. The private forest fund (private forests) consists of:

- a) forests and forest land in private ownership;*
- b) trees and groups of trees that are located within the boundaries of land in private ownership, new forests that are planted in these lands, and parts of privately owned forests.” [AL 2]*

State forests are owned by the state. Communal forests are forests owned by the state but given over for communal use to a village or to several villages or communes. According to criteria developed by the Ministry of Agriculture and Food (MAF), parcels of communal forest of between 0.4 and 1 ha per family may be given for use to households of permanent residence in the village, subject to agreement between the local government and the forest authority. The specific rules and criteria for the definition and administration of these forests are subject to a special regulation of the MAF.

Private forests are any stands of trees and any forests created within the boundaries of land recognised as private property.[AL 5] Up until 1945, private forests in Albania covered 63,000 ha out of the 1,379,000 ha of the total forest area, according to the available data. The mass nationalisation of private property began in 1945, and a few years later the concept of private ownership vanished. The restitution of private forests to their former owners began after 1996. A total of 19,000 ha, or less than 30 percent of private forest areas, had been restored to their former owners by December 2007. The restitution process is very slow and the former owners face various problems in relation to the management of their forests. [AL 4]

According to data from the Ministerial Conference on the Protection of Forests in Europe (MCPFE), 15.8 percent of the forests in Albania are protected forest areas. The respective European average is about 12 percent. [AL 6]

Bosnia and Herzegovina – There is a sharp contrast in the proportions of high forest and coppice forest in public and private ownership. While the state owns 72 percent of high forests, coppice forests are predominantly in private ownership (434,000 ha or 62 percent of the total economic area of coppice forests).

Table 2. Ownership of economic high and coppice forests in Bosnia and Herzegovina

Economic forests	Area				Total in BiH
	State owned		Private owned		
	ha	percent	Ha	percent	ha
High forest	1 063 400	72	266 100	38	1 329 500
Coppice forest	408 700	28	434 500	62	843 200
All forests	1 472 100	100	700 600	100	2 172 700

Source [BiH 2]

Kosovo* – Around 180,800 ha (38 percent) of forests in Kosovo* are classified as privately owned, while 295,200 ha (62 percent) are classified as public forests.

Former Yugoslav Republic of Macedonia – Out of the total forest area, the share of state-owned forests is 90.14 percent, comprising 92.2 percent of the total standing volume. Privately owned forests cover 9.86 percent (94,146 ha) of the total forest area, comprising 7.8 percent of the total standing volume. [FYRM 3]

There are more than 200,000 parcels of forest (with an average size of 0.6 ha), in the hands of around 65,000 owners.

Montenegro – Around 500,041 ha (67.25 percent) of the total forest area are in state ownership, and around 243,568 ha (32.75 percent) are privately owned. [MNE 1]

Serbia – About 1,194,000 ha (53 percent) of the total forest area are in state ownership, while 1,058,387 ha (47 percent) are privately owned.

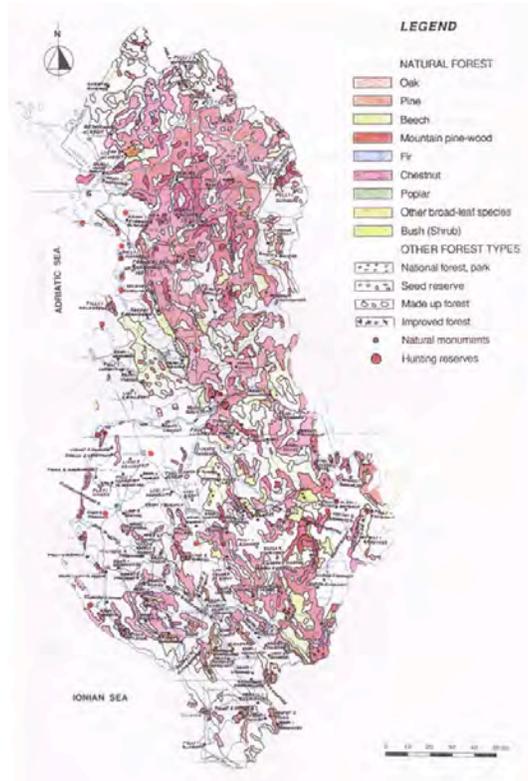
1.1.3 Forest types

Albania – The composition of Albania's abundant forest fund is shown in Table 3.

Table 3: Forest composition in Albania

No	Item	Area, Ha	Percentage
1	Forests ³	1,498,957	100.00%
2	High Forest	294,957	19.68%
2a	<i>From which: - Conifers</i>	84,461	
2b	<i>- Broadleaves</i>	210,496	
3	Coppice Forests	405,016	27.02%
4	Shrubs	241,724	16.13%
5	Open forest land ⁴	557,260	37.17%

Map 3. Forest types and forests by purpose in Albania



Source: [AL 3]

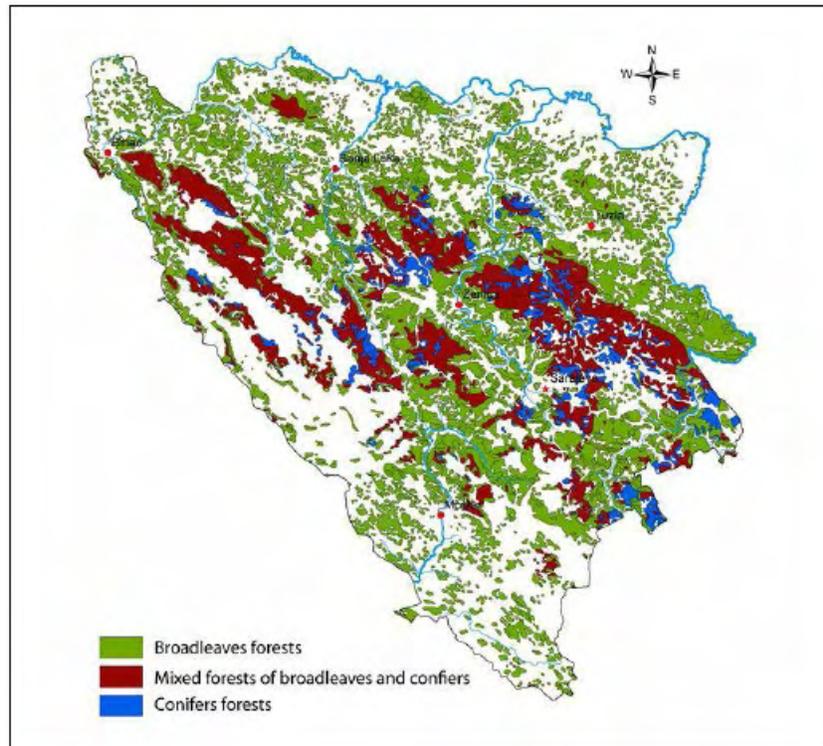
Bosnia and Herzegovina – About 1,652,400 ha of the total area of forest comprise high forest, while 1,252,200 ha are coppice forests. The rest of the area is characterised as “other wooded land” and comprises shrubs, barren forest land and other forest areas.

Table 4. Structure of forest area and forest land by vegetation form, purpose and availability in Bosnia and Herzegovina

Vegetation form	Available surface				Protective forest	Total
	Economic forests	Non-economic forests	Protected forests	Special purpose forests		
	ha	ha	ha	ha		
1. High forest	1 329 500	46 300	5 200	8 800	262 600	1 652 400
2. Coppice forest	843 200	158 700	1 600	2 400	246 300	1 252 200
1+2. All forests	2 172 700	205 000	6 800	11 200	508 900	2 904 600
3. Shrubbery	52 700	41 100	0	100	36 700	130 600
4. Barren land	55 700	88 400	800	3 400	38 900	187 200
3+4. Shrubbery and barren	108 400	129 500	800	3 500	75 600	317 800
5. Other forest areas	3 300	3 100		100	2 600	9 100
FAO forest (1+2+3+5)	2 228 700	241 600	6 800	11 400	548 200	3 035 700
6. All forest and forest land	2 284 400	337 600	7 600	14 800	587 100	3 231 500

Note: “Available surface” means surface not contaminated by landmines.
Source [BiH 2]

Map 4. Forest distribution in Bosnia and Herzegovina



Source [BiH 2]

Kosovo* – Forests in Kosovo* are dominated by broadleaved tree species, covering 93 percent of the forest area (449,400 ha; see Table 5). Coniferous forests cover almost 5 percent of the forest area (23,800 ha). [KOS 1]

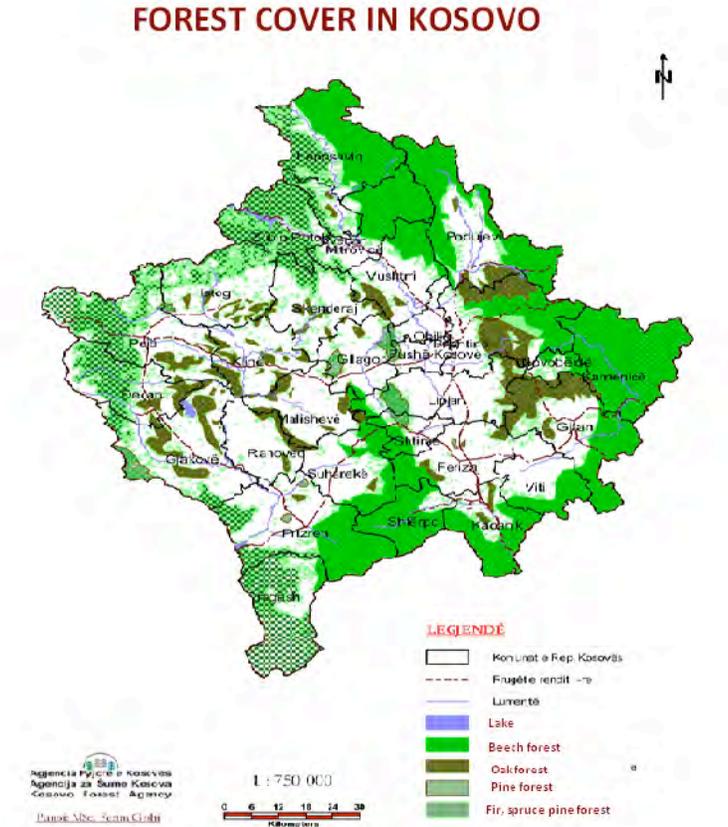
Coppice forests cover 84 percent of the total forest area. This is the result of extensive harvesting, in particular of short rotation coppice forestry for firewood production. Forests that regenerate naturally are mostly beech (*Fagus* spp.), mixed beech and conifers, and pure coniferous forests located at higher elevations. [KOS 1]

Table 5. Forest area in Kosovo* by forest composition and age class (ha)

Forest composition	Age class (years)						Total
	0-20	21-40	41-80	81-120	121-160	161-200	
Coniferous	4 600	3 600	11 400	3 400	800	0	23 800
Mixed	200	1 000	4 600	1 200	600	200	7 800
Broadleaved	139 600	157 200	127 800	21 800	2 800	200	449 400
Total	144 400	161 800	143 800	26 400	4 200	400	481 000

Source [KOS 1]

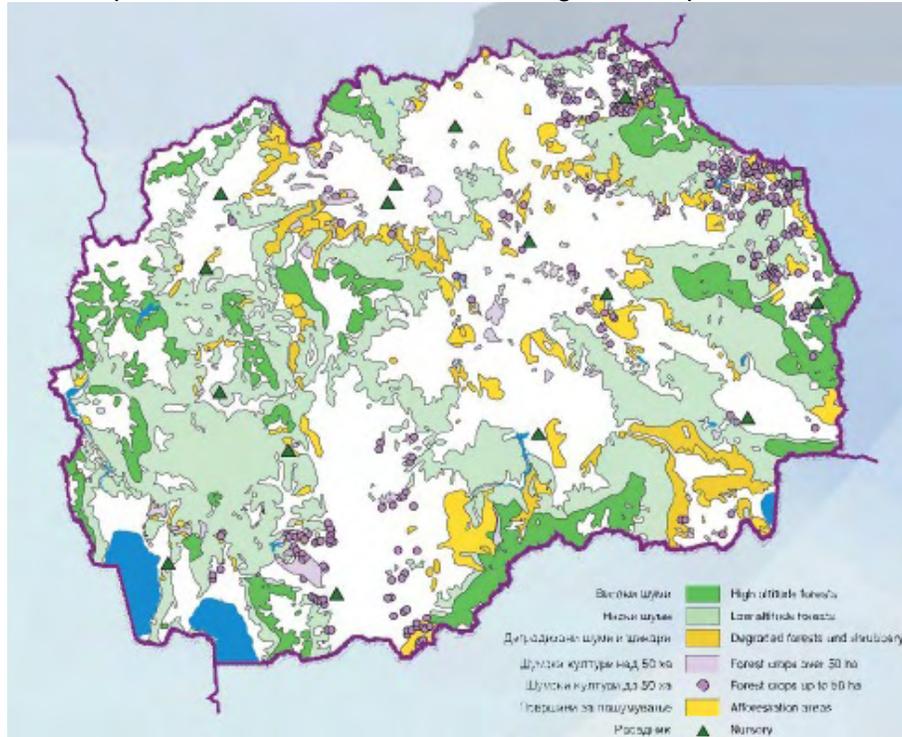
Map 5. Forest cover in Kosovo*



Source [KOS 1]

Former Yugoslav Republic of Macedonia – The most dominant species are beech (*Fagus moesiaca*) and various oak species (*Quercus* spp.), which make up 90 percent of the total area of native forest types.

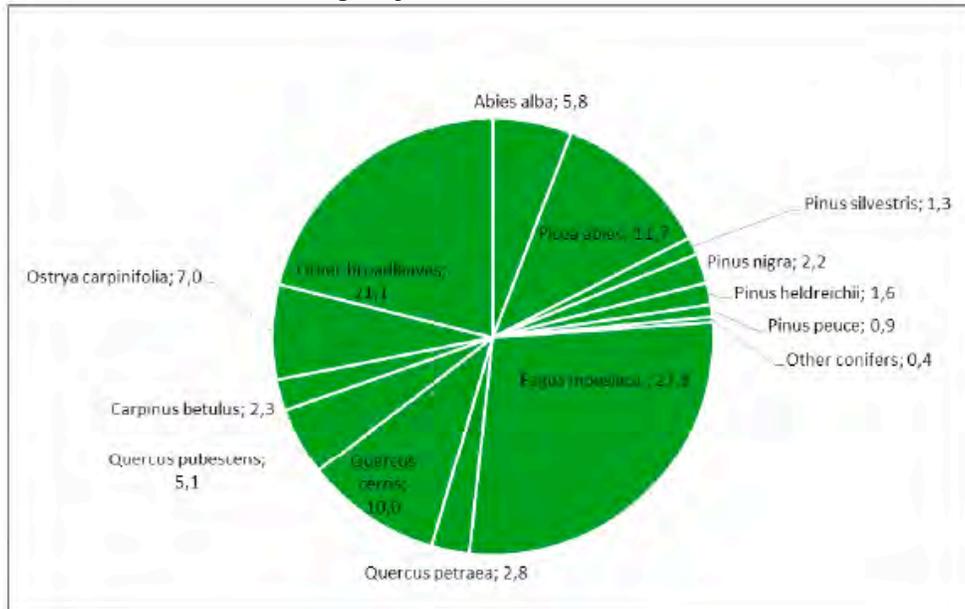
Map 6. Forest cover in the former Yugoslav Republic of Macedonia



Source [FYRM 3]

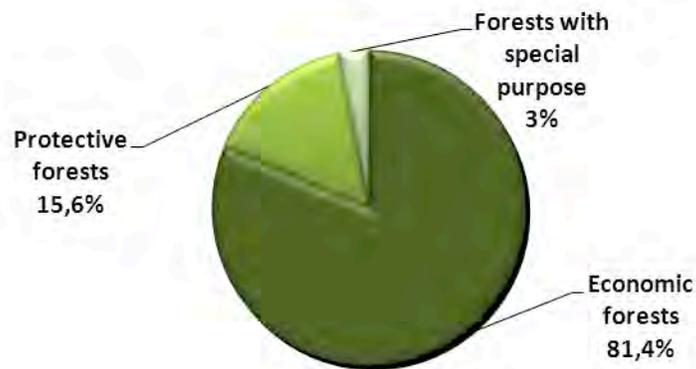
Montenegro – In terms of forest composition, the dominant trees in Montenegro's forests are beech, oak, spruce, fir and willow. There are 12 registered coniferous species and 59 registered broadleaved tree species in Montenegro. [MNE 3]

Figure 1 Distribution of trees in Montenegro by area (%)



Source [MNE 3]

Figure 2: Structure of forests in Montenegro by purpose



Source [MNE 2]

Serbia – Broadleaved trees account for 90.7 percent of the growing stock, conifers for 6 percent, and mixed forests of broadleaved trees and conifers for 3.3 percent. The average standing volume is 101.7 m³/ha, with 153 m³/ha in high forests (forests of seed origin) and 70 m³/ha in coppice forests. [SRB 1]

Forests in Serbia by composition
Map 7

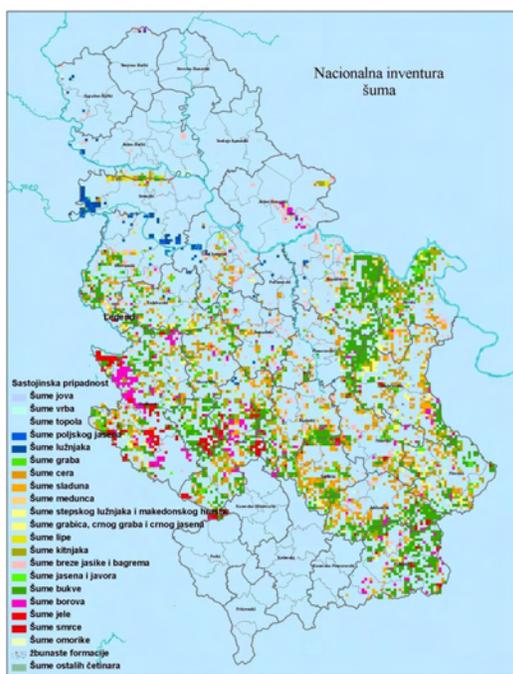


Table 6

Categories	Area (ha)	%
Oaks forests	720,800	32.0
Beech forests	660,400	29.3
Others	580,000	25.8
Conifers forests	243,200	10.8
Poplar forests	48,000	2.1
TOTAL	2,252,400	100.0

Source: [SRB 3]

Table 7. Forest area in Serbia by purpose

PURPOSE	AREA (ha)
Forests and forest stands with productive function	1,704,855
Forests and forest stands with productive-protection function	100,400
Forests with priority protection function	27,200
Protected natural areas ¹	412,745
Game parks and reserves	4,400
Forests designated for recreation and with cultural and educational functions	800
Educational base	1,600
Forests designated for country defense	400
TOTAL	2,252,400

Source: [SRB 2]

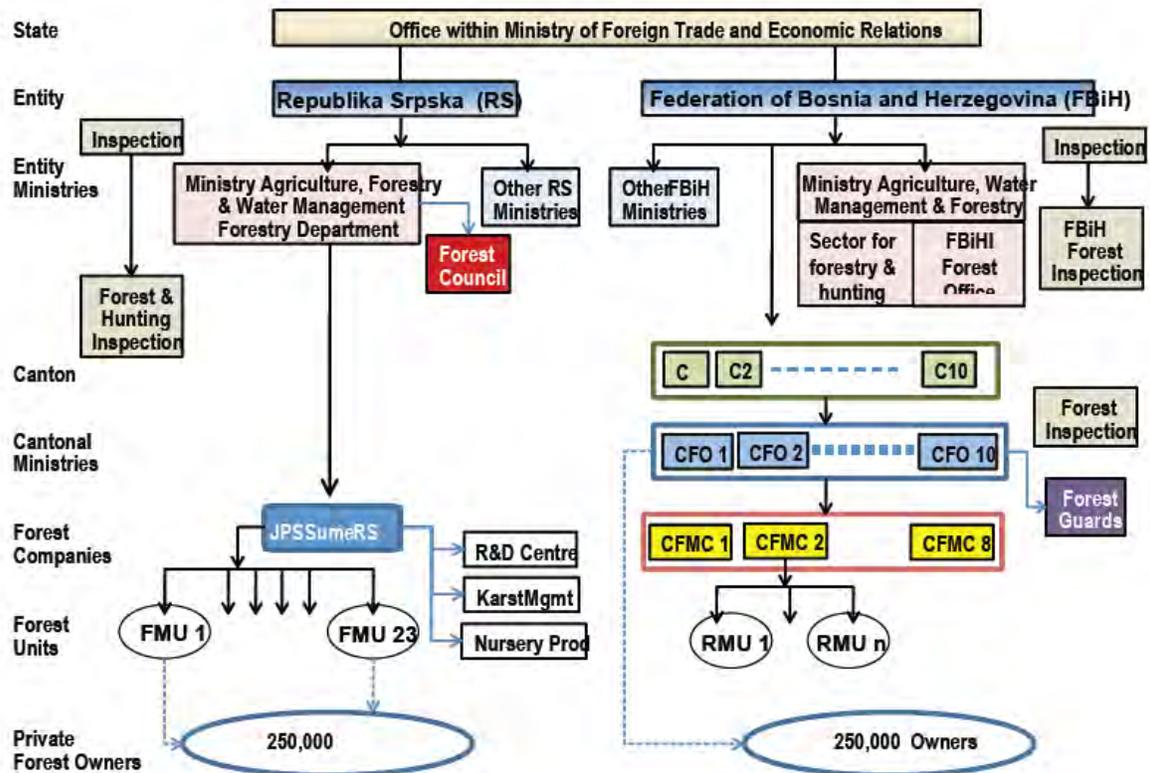
1.2. Major forestry stakeholders

Due to the region's historical, social, economic and political circumstances, the number and competencies of stakeholders in terms of forest management differ from country to country. The main stakeholders by country are presented in Table 8 (and in Figure 3 for Bosnia and Herzegovina).

The first conclusion is that there are a large number of forestry stakeholders in each country, including ministries, public enterprises, faculties, institutes and private owners.

The second conclusion is that there is no separate ministry for forestry in any country in the region. Instead, the forestry sector is part of other sectoral ministries, generally agriculture, environment or rural development, or the ministry of environment (Albania). This typically has negative implications for the forestry sector in terms of capacities (human and resources) and organisational structure. Taking into consideration the financial circumstances in the individual countries, this means that the forestry sector, in the framework of these institutions, must share the human and other resources of the ministry with other sectors, and very often they are not sufficient.

Figure 3. Organisation of the forestry sector in Bosnia and Herzegovina



Source [BiH 2]

Table 8. Major forestry stakeholders

Albania	Bosnia and Herzegovina	Kosovo*	Macedonia FYR	Montenegro	Serbia
<p>1. Ministry of Environment: - Directorate for the Protection and Treatment of Forests (Forestry Service)</p> <p>- State Inspectorate of Environment, Forests and Waters</p> <p>- Protected areas and national parks</p> <p>2. Communal forests: Forest users, forest user associations, local governments and communal forest federations</p> <p>3. Faculty of Forest Sciences</p> <p>4. Private forest owners</p>	<p>Because of the large number of stakeholders in Bosnia and Herzegovina, and their organisation at entity level, they are shown separately (Figure 3).</p>	<p>1. Ministry of Agriculture, Forestry and Rural Development (MAFRD) - Department of Forestry - Kosovo Forestry Agency (KFA)</p> <p>2. Municipalities</p> <p>3. Ministry of Environment and Spatial Planning (MESP) - Kosovo Environmental Protection Agency (KEPA)</p>	<p>1. Ministry of Agriculture, Forestry and Water Economy (MAFWE)</p> <p>2. Macedonian Forests public enterprise</p> <p>3. Saints Cyril and Methodius University in Skopje - Faculty of Forestry, Skopje</p> <p>4. Ministry of Environment and Physical Planning (MEPP) - National parks and protected areas</p> <p>5. Private forest owners</p>	<p>1. Ministry of Agriculture and Rural Development (MARD)</p> <p>2. Directorate for Forestry, Hunting and the Wood Processing Industry (DFHWPI)</p> <p>3. Administration for Inspection Affairs (AIA)</p> <p>4. Forest Administration</p> <p>5. Forestry Institute</p> <p>6. Private forest owners</p> <p>7. National Parks public enterprise</p>	<p>1. Ministry of Agriculture and Environmental Protection (MAEP)</p> <p>2. Srbijašume (Serbian Forests) public enterprise</p> <p>3. Vojvodinašume (Vojvodina Forests) public enterprise</p> <p>4. Borjak public enterprise</p> <p>5. National parks</p> <p>6. Faculty of Forestry, Belgrade, 7. Institute of Forestry, Belgrade</p> <p>8. Institute of Lowland Forestry and Environment, Novi Sad</p> <p>9. Private forest owners</p>

1.3. Fire history

Over the last two decades, forest fires have been one of the main causes of damage to forests and other natural resources in SEE countries. The extent of the damage caused does of course vary, depending on the year and the individual country.

Albania – Between 2004 and 2013, the annual average burned area was 2,731 ha of forests; 50 ha of (non-forest) protected areas; and 2,000 ha of other vegetation (e.g. wetlands). Damage included 15 houses burned; four high-voltage pylons damaged; and 23 people injured. Each year around 200 ha of olive trees and other agricultural crops are also burned.

Table 9. Forest fires in Albania (2005, 2006, 2008 and 2010)

Year	2005	2006	2008	2010
Nr. Of Cases	174	176	348	246
Forest surface (he)	3241	1081	-	1133
Burned surfaces (he)	300	108	1483	1133
Burned pastures (he)	1740	303	2716	1741
Value of damage in /000 Lekë(Albanian Money)	31682	81317	139131	63733

Source: General Directorate of Forests and Pastures

The most severe forest fires in recent years occurred in 2007 and 2012.

2007

- 1,190 fires in forests and pastures
- 2,700 ha of state forests burned
- 2,860 ha of communal forests burned
- 310 ha of private forests burned
- 6,263 ha of pastures burned
- Estimated damage of around EUR 20 million

2012

- 440 cases of fires in forests and 47 cases of fires in pastures
- 3,300 ha of forest area burned
- 1,300 ha of pasture burned

Studies have shown that 29 percent of these forest fires were caused by carelessness and negligence; 61 percent by unknown factors; 9 percent by arson; and only 1 percent by unusual events and lightning. However, it should be recognised that even those forest fires classified as “caused by unknown factors” can be considered to have been started as a result of human activity. They are classified under “unknown factors” as the precise cause is not known, but it can still be concluded that a large proportion of forest fires in Albania are started by human activities. [AL 9]

Bosnia and Herzegovina – Although forest fires are a significant ecological threat in Bosnia and Herzegovina, in the last decade it has been almost impossible to carry out a good-quality analysis, mainly because statistical data on fires and burned areas are not collected in the same way in the Federation of Bosnia and Herzegovina (FBiH), Republika Srpska (RS) and Brčko District (BD). Data from RS, for example, which are the most systematic, comprise precise figures for the number of fires and total burned area in larger locations. However, data are only available for 2010, 2011 and 2012, and the sites are not well defined. Data submitted on fires in FBiH cover the fire seasons from 2008 to 2012. However, there is no precise information on the distribution of fires on the territory of FBiH, thus the data cannot be used to analyse the occurrence of fires. The least accurate data are those from BD, thus in Table 6 the summary data for BiH are calculated without data from BD. [BiH 4]

According to Table 11, the total area of forest and forest land burned by forest fires in the period 2010 to 2012 is around 85,906.47 ha, and the number of fires is around 10,091. There are no official data about the economic losses caused by forest fires, although unofficially they are estimated at between EUR 2 and 10 million per year.

Table 10. Distribution of burned area (ha) in Bosnia and Herzegovina by land cover type in 2013

<i>Land cover</i>	<i>Area burned</i>	<i>% of total</i>
Forest /Other Wooded Land	2559.7	74.02%
Other Natural Land	608.27	17.59%
Agriculture	289.95	8.38%
Artificial Surfaces	0.07	0%
Total:	3457.99	100%

Source [BiH 5]

Table 11. Forest fires in Bosnia and Herzegovina (2010–2012)

ENTITY/YEAR	BURNED AREA (ha)	NUMBER OF FIRES	AVERAGE BURNED AREA PER FIRE (ha/fire)
2010			
FBiH	390.35	1,038	0.37
RS	1,523.06	79	19.28
BD	-	18	-
Average in 2010	1,913.41	1,117	1.71
2011			
FBiH	1,796.29	2,806	0.64
RS	14,970.25	298	50.24
BD	-	199	-
Average in 2011	16,766.54	3,104	5.40
2012			
FBiH	41,717.81	5,324	7.84
RS	25,508.71	546	46.72
BD	-	299	-
Average in 2012	67,226.52	5,870	11.45
Average for 2010– 2012	85,906.47	10,091	8.51

Source [BiH 4]

According to the Joint Research Centre (JRC) annual report for 2013, the 2013 fire season in Bosnia and Herzegovina was not severe, with the total burned area estimated at around 2,560 ha of forest and forest land.

There are no valid and official data for the main causes of forest fires in Bosnia and Herzegovina, although unofficially the main cause is human activity (in about 98 percent of all cases). [BiH 4]

According to some unofficial sources, the main reasons for forest fires in Bosnia and Herzegovina are agricultural burning (field clearing in spring and stubble burning in summer) and negligence when lighting fires in or near forests. There are some cases of arson, but these are not proved as there was no official investigation or court verdict. Lightning is a minor cause of forest fires (fewer than 2 percent of cases).

Kosovo* – According to the national forest inventory, one of the most negative and detrimental factors affecting forests and forestry is forest fires. Up until 2012, forest fires had affected around 12,200 ha of forest, or 2.5 percent of the total forest area (Table 12). It should be noted that areas where more than 25 percent of small trees were affected, or where more than 25 percent of the growing stock of measurable trees was affected, are taken into consideration and included in this table.

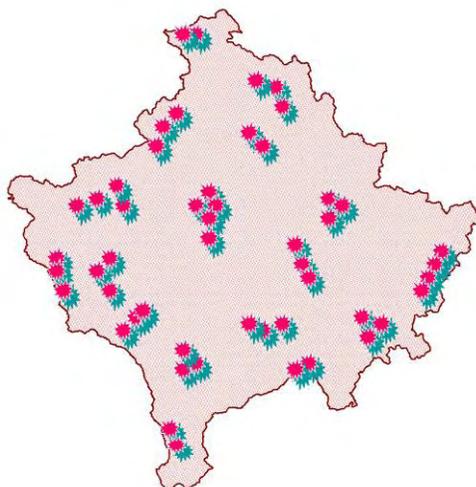
Table 12. Area of significant stand-level damage in Kosovo*, by forest composition and cause of damage (ha)

Forest composition	Cause of damage								Total
	Insects	Disease/fungi	Fire	Animal	Weather	Human impact	Suppression	Misc.	
Coniferous	200	200	2 200	0	400	800	0	800	4 600
Mixed	600	400	0	0	400	200	0	200	1 800
Broadleaved	3 000	10 200	10 000	1 800	2 400	7 800	5 200	11 400	51 800
Total	3 800	10 800	12 200	1 800	3 200	8 800	5 200	12 400	58 200

Source [KOS 1]

One of the most severe forest fire seasons (according to the JRC) during the last 10 years was in 2012, when 49 fires affecting over 40 ha were registered in Kosovo*, and around 8,376 ha of burned area was mapped using satellite technology. Of this area, 5,902 ha were forests and other wooded lands; 1,379 ha other natural lands; 1,085 ha agricultural land; and a small amount (10 ha) land with other types of cover. [KOS 2]

Map 8. Regions in Kosovo* with a high potential risk of fires



Source [KOS 4]

Former Yugoslav Republic of Macedonia – According to MAFWE data, in the period between 2004 and 2013 there were a total of 2,046 forest fires in the former Yugoslav Republic of Macedonia, the total burned area was 91,805.9 ha, and the total burned timber volume was 931,258.52 m³ (Table 13). Within the same period, the average number of forest fires was 205 per year, and the average size of burned area was 9,180 ha. The most severely affected year in this period was 2007, when 652 fires were recorded, resulting in 35,248.6 ha of burned area. The most severe individual forest fire occurred in 2012 in the pine afforestation near the city of Strumica, when four people were killed and 12 injured (civilians), seven of whom were children. [FYRM 19]

The total damage (burned timber volume plus suppression fees) caused by forest fires in this period has been estimated at around EUR 51 million. [FYRM 19]

Forest fires in the former Yugoslav Republic of Macedonia are typically caused by stubble burning, the burning of pastureland, and arson. Arson has emerged as a problem in the last 15 years. There are two main reasons for arson:

- pyromania, which is very rare; and
- economically motivated arson, connected to illegal logging. In some cases, fires have been started deliberately in order to cover up evidence of illegal logging activities. In other cases, fires have been lit in order to divert the attention of official institutions (forestry service, police etc.) towards fire suppression while illegal logging activities are taking place in other forest areas.

According to Articles 22 and 45 of the Law on Forests, the entity that manages the forest must organise the reforestation of deforested areas. Also, according to Article 58 the entity must introduce "forest order" (the term "forest order" is defined in Article 12, item 40, of the Law on Forests). This means that all trees damaged by fire must be removed from the burned area. In this case, the price of the timber is significantly lower than the official price.

Table 13 Forest fires in the former Yugoslav Republic of Macedonia

Year	Number of fires	Burned area (ha)	Burned timber mass (m ³)	Suppression fees (EUR)	Total fees (EUR)
2004	94	892.05	4,322.30	23,214.55	1,469,090
2005	182	1,368.00	1,063.00	42,018.11	411,181
2006	138	2,085.95	12,978.00	45,311.20	2,437,914
2007	652	35,248.60	617,678.67	386,852.46	21,494,700
2008	323	10,143.10	53,055.60	96,278.69	4,612,377
2009	38	197.00	756.50	313,627.00	5,812,889
2010	64	1,112.50	5,000.00	985,455.00	9,000,000
2011	390	20,856.80	65,042.80	400,153.00	1,719,105
2012	385	19,964.90	155,126.00	410,323.00	4,248,828
2013	170	6,379.12	16,235.00	115,000.00	434,333
Total	2,046	91,805.90	931,257.87	2,818,233.01	51,640,417
Average	205	9,180.00	93,125.80	281,823.30	5,164,041.7

Source: MAFWE, State Inspectorate for Forestry and Hunting

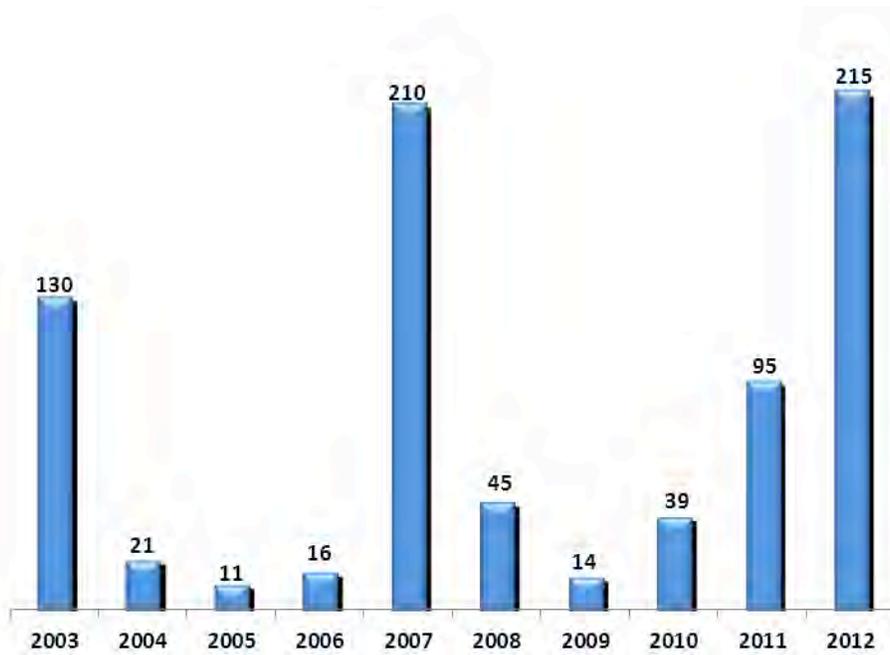
Montenegro – Forest fires are a global environmental and economic problem. Due to the country's geographical position in the Mediterranean region, and to the increasing negative impacts of climate change, Montenegrin forests are especially vulnerable. Forest fires are a constant threat to forests and forest lands in Montenegro. Along with their increased frequency, forest fires are becoming larger in scale and are threatening settlements and human lives as well as forests and agricultural land.

Over the past 10 years there have been around 800 large forest fires in Montenegro, and more than 18,000 ha of forests and over 800,000 m³ of wood mass have been damaged or destroyed. The greatest risk is to forests located in the coastal and central regions, where high air temperatures during the summer period and the typical vegetation create the necessary preconditions for forest fires to start. July and August are critical in terms of the occurrence of fires (very low level of precipitation, or often no precipitation), as are the months of February and March (in the case of dry and warmer winters). Fires usually break out between 10:00 and 18:00, coinciding with daily human activities.

The main causes of forest fires in Montenegro are very similar to those in other countries in the region: stubble burning in fields, the burning of pastures, and arson. One particularly disturbing fact is the occurrence of deliberate arson: fires are sometimes started due to the fact that, following a fire, non-wood forest products such as mushrooms, raspberries and blackberries grow more rapidly, and grazing land is also more productive.

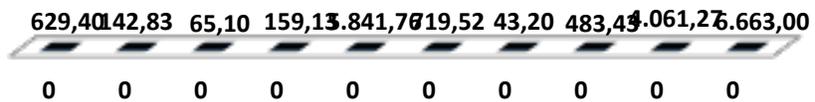
The annual average burnt area in the period between 2003 and 2012 was 1,880 ha, while the annual average number of fires was around 80. The total damage caused during this period has been estimated at over EUR 6 million.

Figure 4: Number of forest fires in Montenegro, 2003–2012



Source: Forest Administration

Figure 5: Burned area in Montenegro, 2003–2012 (ha)



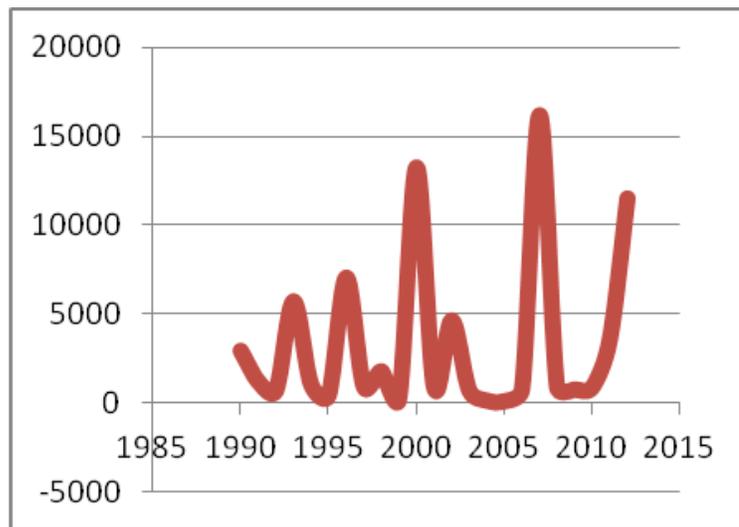
Source: Forest Administration

Serbia – In the period between 2004 and 2013, an annual average of 3,828 ha were burned in Serbia, of which 2,252.400 ha were forests. In terms of wildfires and forest fires, the most severe years were 2007 and 2012.

In 2007 there were 5,268 wildfires that destroyed 47,868 ha; 2,021 forest fires that destroyed 32,136 ha; and 3,247 low vegetation fires that destroyed 15,732 ha.

In 2012 there were 22,154 wildfires and 1,249 forest fires that destroyed 219,000 ha. Twenty-six members of the fire rescue units were injured. [SRB 4]

Figure 6. Burned area of forest and forest land (ha) and number of forest fires in Serbia (2004–2012)



Source: Forest Administration

Table 14. Number of fires in open spaces in Serbia

Number of fires in open spaces Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of forest fires	385	643	595	264	259	837	1,627	17,720	408	254	734	1,321
Number of fires in crops	189	221	175	213	62	62	147	552	286	98	721	416
Number of fires in meadows and grass fires	1,877	2,919	3,820	2,311	1,936	2,831	10,273	200	4,159	2,789	9,814	11,665
Number of fires in orchards	51	91	90	55	32	92	299	6,339	129	70	332	349
Number of fires at waste dumps	811	1,273	2,031	1,797	2,215	3,073	4,060	140	1,212	755	1,671	1,663
Number of other fires in open spaces	2,837	3,756	4,034	3,486	3,810	4,721	6,178	4,554	5,947	4,349	8,659	10,041
TOTAL	5,961	8,903	10,745	8,126	8,314	7,749	22,584	5,935	12,141	8,315	21,931	25,455

Source: Ministry of the Interior of the Republic of Serbia, Emergency Management Sector

Table 15. Burned area of forests and forest land in Serbia		
Year	Number of fires	Area (ha)
2004	22	98
2005	15	63
2006	43	715
2007	258	16,144
2008	45	824
2009	84	728
2010	72	855
2011	343	3.567
2012	328	11,462

Source: Forest Administration

In the last 10 years, 66 percent of all forest fires in Serbia were started by human activities, 3 percent were of natural origin, and 31 percent were of unknown origin. Even in those cases where the cause of the fire is recorded as unknown, unofficially the reason behind the fire is human activity. One of the most important causes of forest fires in Serbia is agricultural burning. [SRB 19]

Conclusions

According to the national data presented above, the most severe fire seasons in the region in the last 10 years were in 2007 (with a total burned area of 89,389 ha) and 2012 (with a total burned area of 134,338 ha). The reasons differ, but among the most significant are extreme weather conditions (high air temperature, severe winds and dryness), terrain configuration (very steep and inaccessible), type of vegetation, inappropriate measures on the part of the institutions responsible for forest fire protection (prevention and preparedness), and inadequate suppression measures.

In terms of cause, the majority of forest fires are the result of human activity, while lightning is responsible for around 2 percent of forest fires.

Most forest fires in the region (in almost all countries) are caused by agricultural burning (stubble burning in fields) and the burning of pastureland, largely because of negligence on the part of the people carrying out such activities. Fires along highways and railway lines can also be counted among fires caused by human negligence.

Arson is more frequent in some countries for economic reasons. The most typical motives for arson are illegal logging and the gathering of mushrooms, which grow more prolifically following a forest fire.

In a significant proportion of cases (in some countries over 60 percent) the cause is unknown.

According to the official available data concerning the number of forest fires in the region and the extent of the burned area during the most severe fire seasons, the highest number of forest fires in 2007 was recorded in Albania (1,190 fires) and the lowest number in Montenegro (210 fires). In terms of burned area in the same year, the biggest area was recorded in the former Yugoslav Republic of Macedonia (35,248 ha) and the smallest in Montenegro (5,841 ha). (There are no reliable data for Bosnia and Herzegovina and Kosovo* for 2007.)

The highest number of forest fires in 2012 was recorded in Bosnia and Herzegovina (5,870) and the lowest in Kosovo* (49). The biggest burned area was also recorded in Bosnia and Herzegovina (67,226 ha) and the smallest in Albania (3,300 ha).

II Legal framework and institutional set-up in the field of forest fire management

Forest fire protection depends on the legal framework and institutional set-up in the individual country.

As shown in Table 16, protection against forest fires is regulated by a different number of laws in each country, from four laws in Kosovo* to 16 in Bosnia and Herzegovina. These laws are complemented by other legal acts, such as rulebooks. Protection against forest fires is typically regulated by laws in the fields of forestry, environment and nature protection, agriculture, internal affairs and civil protection, and local self-governance.

The country's institutional set-up is another parameter in the complex field of forest fire protection. A large number of institutions and organisations are involved in the forest fire protection system. Some of them are government institutions (ministries, directorates, agencies etc.) and some are public organisations (volunteer firefighters, associations of private forest owners etc.). The most important institutions and organisations involved in forest fire protection are ministries of forestry, agriculture and the environment; ministries of internal affairs and emergency situations; ministries of defence; local self-governments; associations of volunteer firefighters; and private forest owners. In the framework of these institutions, or independent of them, there are also a large number of agencies, directorates and public enterprises. This kind of organisational set-up requires the precise distribution of competencies and the coordination of activities.

The legal regulations in the countries of the region are presented in Table 16.

Table 16. Main laws governing forest fire protection

Albania	Bosnia and Herzegovina	Kosovo*	FYR Macedonia	Montenegro	Serbia
<p>1. Law on Forests and the Forestry Service (No. 9385 of April 5, 2005)</p> <p>2. Law on the Pasture Fund (No. 9693 of March 19, 2007)</p> <p>3. Law on Civil Emergency Services (No. 8756 of March 26, 2001)</p> <p>4. Law on Protection from Fire and Rescue (No. 8677 of April 5, 2001)</p> <p>5. Law on Protected Areas (No. 8906 of June 6, 2002)</p> <p>6. Other regulations:</p> <p>- Regulation on Forest</p>	<p>1. Law on the Protection and Rescue of People and Material Goods from Natural and Other Disasters (Official Gazette of FBiH No. 39/03, 22/06 and 43/10)</p> <p>2. Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09)</p> <p>3. Law on Protection and Rescue in Emergency Situations (Official Gazette of RS No. 121/12)</p> <p>4. Law on Fire Protection in Republika Srpska (Official Gazette of RS No. 71/12)</p> <p>5. Law on Forests of Republika Srpska (Official Gazette of RS No. 66/03, 75/08, 30/10)</p> <p>6. Law on Forests of Brčko District BiH (Official Gazette of BD BiH No. 14/10)</p>	<p>1. Law on Forests (No. 2003/3)</p> <p>2. Law on Protection and Rescue from Natural Disasters and Other Disasters (No. 04/L-027)</p> <p>3. Law on Firefighting and Rescue (No. 04/L-049)</p> <p>4. Law on Nature Protection (No. 03/L-233)</p>	<p>1. Law on Forests (Official Gazette of FYRM, No. 64, of May 22, 2009)</p> <p>2. Law on Hunting (Official Gazette of FYRM, No. 26, of February 24, 2009)</p> <p>3. Law on Fire Protection (Official Gazette of FYRM, No. 67/4, of October 14, 2004)</p> <p>4. Law on Protection and Rescue (Official Gazette of FYRM, No. 36/04, of June 10, 2004)</p> <p>5. Law on Local Self-governance (Official Gazette of FYRM, No.</p>	<p>1. Law on Forests (Official Gazette of Montenegro, 74/10)</p> <p>2. Law on Game and Hunting (Official Gazette of Montenegro, 52/2008)</p> <p>3. Law on Protection and Rescue (Official Gazette of Montenegro, 13/2007)</p> <p>4. Law on Self-governance (Official Gazette of Montenegro, 42/2003)</p> <p>5. Law on National Parks (Official Gazette of Montenegro, 28/2014)</p> <p>6. Other regulations:</p>	<p>1. Law on Fire Protection (Official Gazette of SRB No. 111/09)</p> <p>2. Law on Emergency Situations (Official Gazette of SRB No. 111/09)</p> <p>3. Law on Forests (Official Gazette of SRB Nos. 30/10 and 93/12)</p> <p>4. Other documents and regulations:</p> <p>- Strategy for Fire Protection for 2012–2017 (Official Gazette of SRB No. 21/2012)</p> <p>- National Strategy for Protection and Rescue in Emergency Situations (Official</p>

<p>Protection against Fires, Pests and Diseases, and Related Financial Means (No. 25 of February 8, 1993)</p> <p>- Act of the Council of Ministers on Determining and Taking Measures against Fire and on the Rescue of Objects of Special Importance, Including Watersheds, National Parks etc. (No. 288 of June 27, 2002)</p> <p>- Guidelines on Determining and Taking Measures against Fire and on the Rescue of Objects of Economic and State Importance (implementing Act No. 288 of June 27, 2002) (No. 1 of July 30, 2002)</p>	<p>7. Law on Forests of Una-Sana Canton (Official Gazette of Una-Sana Canton No. 22/12)</p> <p>8. Law on Forests of Sarajevo Canton (Official Gazette of Sarajevo Canton No. 05/13)</p> <p>9. Law on Forests of Tuzla Canton (Official Gazette of Tuzla Canton No. 09/12 and 17/13)</p> <p>10. Law on Forests of Zenica-Doboj Canton (Official Gazette of Zenica-Doboj Canton No. 08/13)</p> <p>11. Law on Forests of Bosnian-Podrinje Canton (Official Gazette of Bosnian-Podrinje Canton No. 04/13 and 05/13)</p> <p>12. Law on the Competencies of the Authorities of Sarajevo Canton in the Field of Fire Protection and Firefighting (Official Gazette of Sarajevo Canton No. 23/11)</p> <p>13. Law on Fire Protection and Firefighting in the Area of Tuzla Canton (Official Gazette of Tuzla Canton</p>		<p>5, of January 29, 2002)</p> <p>6. Law on Environment (Official Gazette of FYRM, No. 53, of July 5, 2005)</p> <p>7. Law on Nature Protection (Official Gazette of FYRM, No. 67, of October 4, 2004)</p> <p>8. Law on Crisis Management (Official Gazette of FYRM, No. 29, of May 4, 2005)</p> <p>9. Law on Agricultural Land (Official Gazette of FYRM, No. 135, of November 8, 2007)</p>	<p>- National Strategies for Emergency Situations (2006)</p> <p>- National Strategy for Sustainable Development (2007)</p> <p>- National Forest and Forest Land Administration Policy (2008), which defines the direction of development and sustainable forest management</p> <p>- National Forestry Strategy and Plan for the Development of Forests and Forestry in the period 2014–2023 (adopted in April 2014), which sets out objectives and guidelines for the development of forests and forestry in accordance with the National Forestry Policy</p>	<p>Gazette of SRB No. 86/2011)</p> <p>- National Programme for Environmental Protection (Official Gazette of SRB No. 12/2010)</p> <p>- Forestry Development Strategy of the Republic of Serbia (Official Gazette of SRB No. 59/06)</p>
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	<p>No. 1/12)</p> <p>14. Law on Fire Protection and Firefighting in the Area of Central Bosnia Canton (Official Gazette of Central Bosnia Canton No. 15/12)</p> <p>15. Law on Fire Protection and Firefighting in the Area of Zenica-Doboj Canton (Official Gazette of Zenica-Doboj Canton No. 5/11)</p> <p>16. Law on Fire Protection and Firefighting in the Area of Una-Sana Canton (Official Gazette of Una-Sana Canton No. 04/13)</p>				
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Albania – According to the laws listed in Table 16, the main authorised institutions in the field of forest fire protection in Albania are outlined below.

1. **The Ministry of Environment, Forests and Water Administration (MEFWA)**, through the Directorate for Forest Protection and Treatment and the State Inspectorate of Environment, Forests and Waters (SIEFW).

The Directorate for Forest Protection and Treatment, as mentioned above, is responsible for forest management at state level, including forest fire protection. At regional level, this function is delegated to the Regional Forestry Services Directorate (RFSD). Besides other functions, the RFSD is obliged to ensure that all measures for prevention, preparedness and suppression are carried out, in accordance with the laws in force, by all forestry stakeholders: the public Forestry Service; the management of protected areas and national parks; forest and pasture users; and private forest owners.

The Forestry Service at regional level must prepare annual plans for forest fire protection that contain:

- an analysis of the causes of wildfires and factors that influence the spread of fire;
- fire statistics for the previous year;
- forest fire risk areas and periods;
- activities for the forecasting and prevention of forest fires;
- the name of the responsible entity and the location of the means, equipment and human resources for fighting forest fires;
- the responsible entity and the location of access roads to forests;
- technical fire prevention measures (fuel management and silvicultural and maintenance operations);
- training and information activities; and
- a financial plan.

Local branches of the national Forestry Service are dispersed throughout the country, with one in each district. When a wildfire occurs, Forestry Service personnel attend the scene but are active during the operational phase only, as observers or technical advisors. At present, the Forestry Service has no vehicles equipped to tackle forest fires.

The SIEFW inspects the above-mentioned institutions and organisations (among others) with respect to the prescribed measures for forest fire protection.

2. National parks, forest and pasture users and private forest owners

According to the legal regulations currently in force, national parks, forest and pasture users and private forest owners are under the same obligations as the Forestry Service.

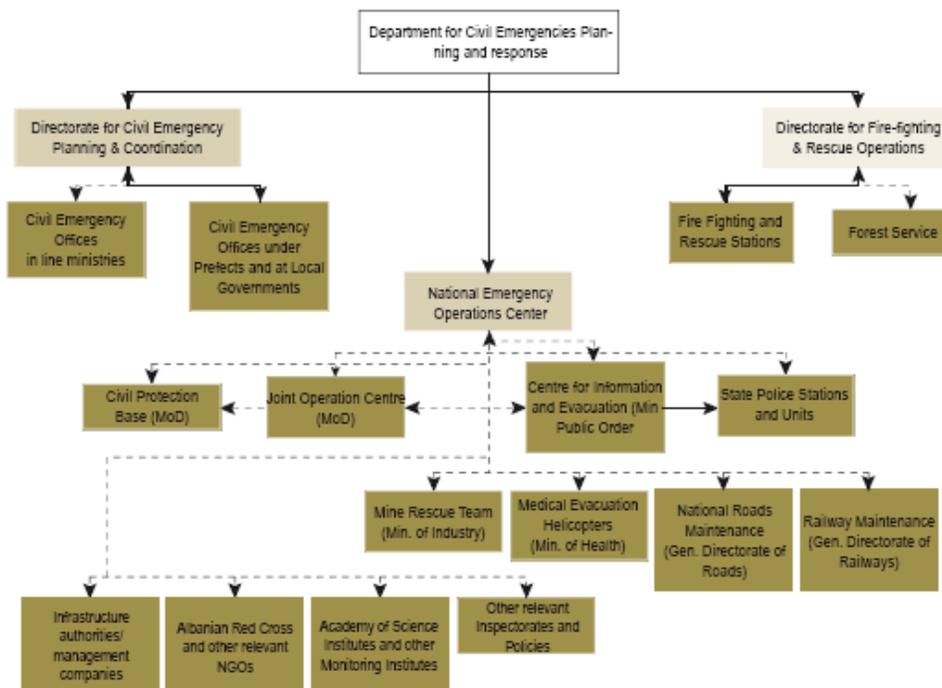
3. The Ministry of the Interior

The Ministry of the Interior has overall responsibility for managing civil protection. The ministry's Department for Civil Emergency Planning and Response (DCEPR) is responsible for ensuring effective coordination between all ministries, institutions and bodies in the field of disaster management. It has a close relationship with civil emergency officers in each of the 12 counties in Albania. It is divided into three units:

- The Directorate for Civil Emergency Planning and Coordination, which is the key institution for disaster management, especially coordination. This directorate has begun to move beyond mere preparedness and response towards recovery activities and the incorporation of disaster risk reduction elements into development plans, in particular for disaster-prone areas.
- The Directorate for Firefighting and Rescue Operations (DFFRO).
- The National Operations Centre for Civil Emergency, which has direct links with all operational forces.

At district level, professional firefighters are organised within fire stations under the jurisdiction of the DFFRO. The DFFRO cooperates with the national Forestry Service of the MEFWA. Firefighters are actively deployed by the DCEPR to tackle wildfires.

Figure 7. The structure of Albania's Department for Civil Emergencies, Planning and Response



Source: [AL 1]

Fires in forests, in agricultural and conservation areas and on other land, as well as the legal provisions for fire bans and the use of fires to reduce combustible vegetative matter and thus reduce the risk of wildfires, are regulated by the Law on Forests and Forestry Services and the Law on the Pasture Fund. The use of fire to enhance biodiversity is regulated by the Law on the Pasture Fund.

Cross-border collaboration is handled by the civil emergency service (DCEPR). Agreements have been made for collaboration during the forest fire season with Italy, Greece, the former Yugoslav Republic of Macedonia, Montenegro, Bulgaria, Kosovo* and Turkey.

Bosnia and Herzegovina – In accordance with the legislative acts and the political structure in Bosnia and Herzegovina, the main institutions responsible for forest fire protection are described below.

The forestry sector

As mentioned above, the forestry sector in Bosnia and Herzegovina is organised at entity level, thus forest fire protection in the framework of the forestry sector is also organised at entity level.

- The Federation of Bosnia and Herzegovina

At the level of FBiH, the Forestry Department within the Ministry of Agriculture, Water Management and Forestry of FBiH (MAWMF) has as its main bodies the Federal Forest Office (FFO) and the Federal Forest Inspectorate (FFI). Among other tasks, the FFO is responsible for silviculture and forest protection at entity level. In addition, there are 10 cantonal forest management companies (CFMCs), which are public enterprises with forest management units. Each CFMC, in accordance with existing legal regulations, is obliged to organise forest fire protection (among other activities). For this purpose, the CFMC must prepare a forest fire protection plan that covers, among other things, measures for forest fire prevention; the means and equipment to put out forest fires; forest roads; water supply sources; early fire detection; and the number and structure of firefighters. All these measures and activities must be in line with the Rulebook for the Content of Forest Fire Protection Plans (Official Gazette of FBiH No. 21/04).

Article 1 of the rulebook describes its main purpose as being to define “technical, preventive, silvicultural and other measures for forest fire protection that are required to be implemented by the CFMC, cantonal administrations for private forests and legal entities managing forests and forest land with a special management regime (hereinafter referred to as holders of rights to manage forests and forest land), in order to reduce the risk of the occurrence and spread of forest fires, ensure early fire detection and warning, and enhance the timeliness of the initial response for the localisation and suppression of fires.” [BiH 6]

At federal and cantonal level, the role of the FFI, besides the inspection of the CFMCs, is to ensure that all measures for forest fire protection are carried out in accordance with the current legal regulations.

Forest fire protection measures and activities are also regulated by the Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09), especially Articles 27 and 44.

- Republika Srpska

The Forest and Hunting Inspectorate (FHI), as a part of the MAFWM, ensures the implementation of all the legal liabilities and responsibilities of forest management entities (public and private) in terms of forest fire protection.

The Public Forest Enterprise of Republika Srpska, BiH (PFERS) was established by the Government of Republika Srpska, BiH, under Decision No. 03-599 of June 8, 1992 (Official Gazette of Republika Srpska BiH, No 9/92). The public enterprise comprises forest

management units; the Centre for Nursery Seed Production; the Research and Development and Project Centre; and the Centre for the Management of Rocky Terrain. There are 20 forest management units in the framework of the PFERS. [BiH 7]

In accordance with Article 34 of the Law on Forests of Republika Srpska (Official Gazette of Republika Srpska, BiH, No. 66/03, 75/08, 30/10), all forest management units are obliged to carry out activities for forest protection, including forest fire prevention. According to Articles 18 and 28 of the same law, forest management units must prepare a 10-year general management plan and an annual management plan that includes measures for forest fire protection (prevention, pre-suppression and suppression measures). This is also in line with Article 14 of the Law on Fire Protection of Republika Srpska (Official Gazette of Republika Srpska, BiH, No. 71/12) that regulates the content of fire protection plans.

National parks in Bosnia and Herzegovina

There are three national parks in Bosnia and Herzegovina: Sutjeska, Kozara and Una. They have almost the same obligations regarding forest fire protection as the forestry sector, and are regulated by the same laws: Sutjeska and Kozara National Parks in accordance with the current legal regulations in Republika Srpska; and Una National Park in accordance with the regulations in force in FBiH.

Local self-governance in Bosnia and Herzegovina

In accordance with Article 40 of the Law on Fire Protection of Republika Srpska (Official Gazette of Republika Srpska, BiH, No. 71/12), local self-governance units are obliged to organise fire protection services (in the form of territorial fire protection units) consisting of professional firefighters. Likewise, local self-governance units in FBiH are obliged to organise similar fire protection services in accordance with Article 16 of the Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09).

Ministry of Security of Bosnia and Herzegovina

The Ministry of Security of Bosnia and Herzegovina is responsible for the execution of international obligations, cooperation, coordination and the revision/approval of the protection and rescue programmes and plans of the entities. There are 10 sectors within the ministry, including the Sector for Civil Protection.

Under the existing legislation, both the state and the entities have jurisdiction over their own civil protection structures. Entities are both financially and jurisdictionally autonomous from

the state. Each level has its own specific mandate, with the state focusing on civil protection strategy while the entities focus on operational matters.

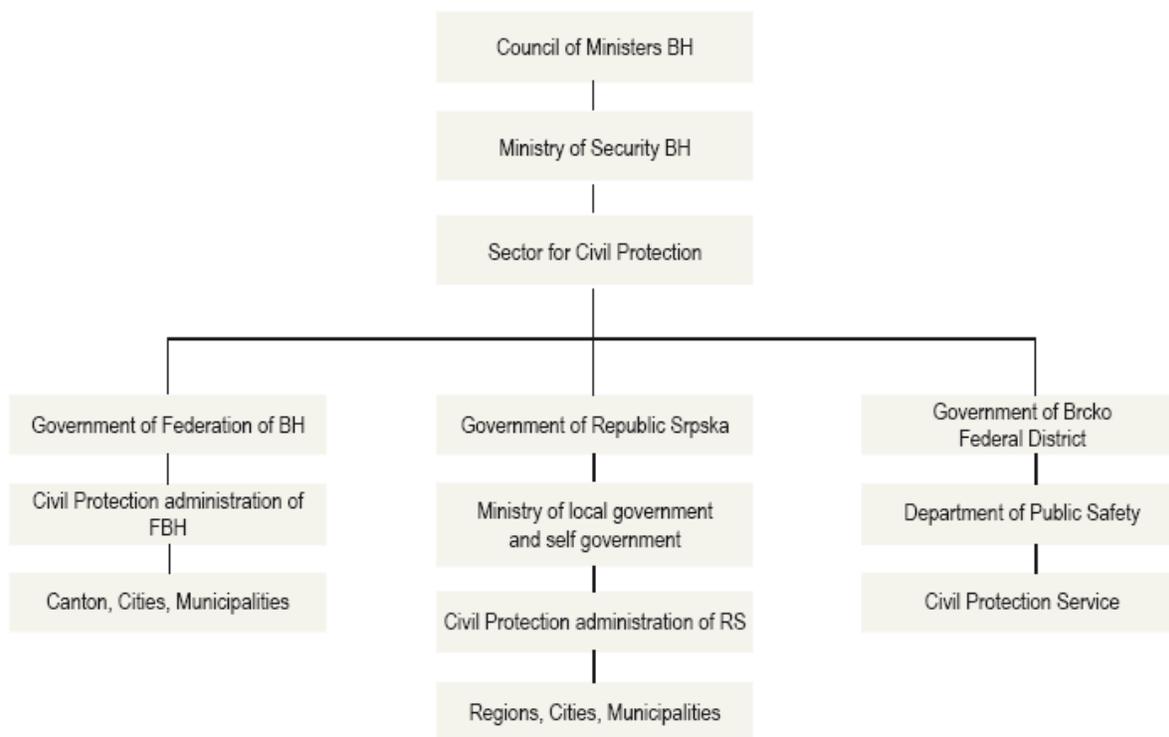
At the state level, the Sector for Civil Protection of the Ministry of Security is the highest-level body with competencies and responsibility for international cooperation, internal coordination, the strategic planning of protection and rescue measures, and training programmes.

Three departments have been established within the sector:

- The Department for the Strategic Planning of Protection and Rescue Measures
- The Department for Structures and Training
- The Department for International Cooperation

The Ministry of Security coordinates and manages the planning and exchange of data and information, and reports on risk reduction activities carried out in the entities and Brčko District. The entities and Brčko District, within the framework of their competencies in the area of protection and rescue, define, plan, train, organise, finance and execute protection and rescue measures with the aim of reducing risks and removing or mitigating the harmful consequences of disasters caused by natural or other hazards.

Figure 8. Organisation of the Sector for Civil Protection of Bosnia and Herzegovina



Source [BiH 8]

The structure of civil protection in FBiH reflects the administrative organisation of the entity, which is particularly complex and decentralised due to its three-tier administrative system of federation, cantons, and municipalities or cities. Each level has the constitutional authority to make regulations and to determine matters in all areas of society, including protection and rescue (Figure 9).

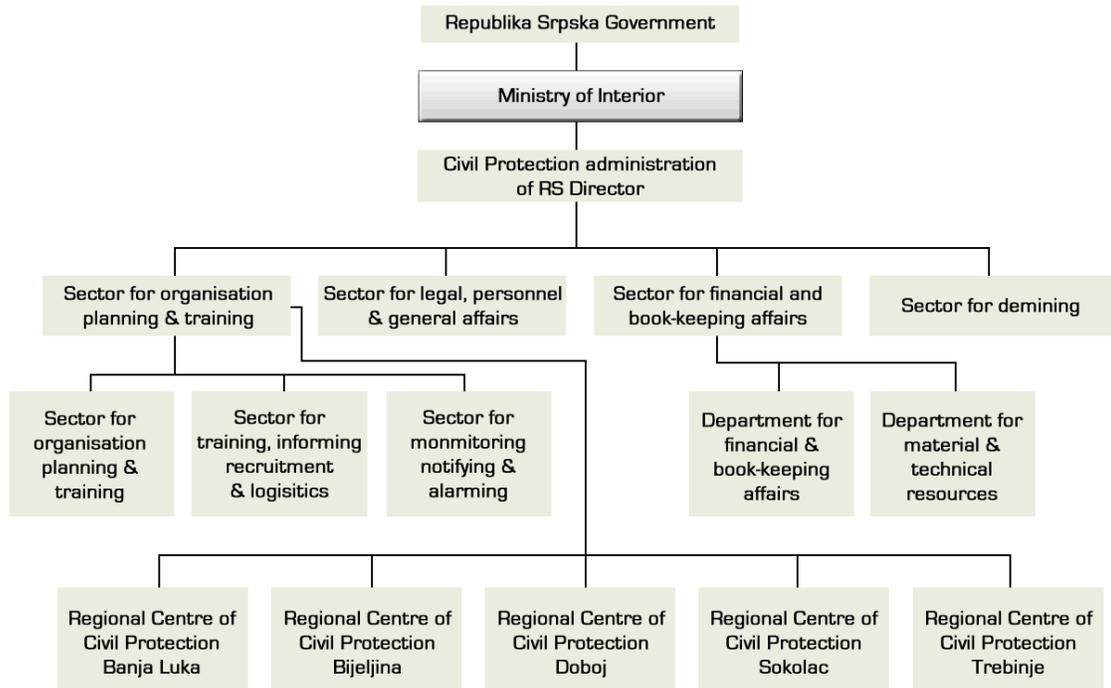
The Civil Protection Administration of Republika Srpska has competencies for planning; the issuing of obligations regarding the lending of material resources for civil protection needs; and damage assessment directives. The director of civil protection is responsible for the administration and organisation of the entire structure, as well as for training programmes for civil protection units (Figure 10).

Figure 9. Organisation of civil protection in the Federation of Bosnia and Herzegovina



Source [BiH 8]

Figure 10. Organisation of civil protection in Republika Srpska



Source [BiH 8]

No specific laws on civil protection have been adopted by Brčko District, and current legislation in this area refers to that of FBiH and Republika Srpska.

The Brčko District civil protection structure was established under the authority of the Sub-department of Public Safety and encompasses three main sections: the Civil Protection Section, responsible for the de-mining programme; the Fire Department; and the Information Section.

Municipality mayors command operations in the event of emergencies, while the role of the head of civil protection belongs to the director of the Department of Public Safety. [BiH 8]

Voluntary fire protection associations in Bosnia and Herzegovina

In accordance with Article 39 of the Law on Fire Protection of Republika Srpska (Official Gazette of Republika Srpska No. 71/12) and Article 46 of the Law on Fire Protection and Firefighting of FBiH (Official Gazette of FBiH No. 65/09), voluntary fire protection associations may be established. Voluntary firefighters may be engaged in fire suppression activities in urban and forest areas.

The following data help to present a clear picture of the capacities of the above institutions.

Out of the total of 79 municipalities in FBiH, 45 have professional firefighting units with a total of 802 firefighters. There are voluntary fire protection associations in 40 municipalities, with 627 volunteer firefighters. This means that there are 1,429 professional and voluntary firefighters in FBiH.

In Republika Srpska there are 641 professional firefighters and 608 volunteers (1,249 in total) distributed in five centres: Banja Luka, Bijeljina, Doboj, Sokolac and Trebinje.

In Brčko District there are 91 professional firefighters and no volunteers.

All firefighters (in FBiH, Republika Srpska and Brčko District) have vehicles and equipment for the suppression of urban fires. [BiH 4]

Kosovo* – According to the laws referred to in Table 16, the main institutions authorised for forest fire protection are those presented below.

- The Ministry of Agriculture, Forestry and Rural Development (MAFRD)

The MAFRD is the highest-level institution for the administration and management of forests in Kosovo*, working through the Department of Forestry and the Kosovo Forest Agency (KFA).

Through the KFA, the MAFRD implements legal regulations in terms of forest management in Kosovo*, while through the Forestry Inspectorate it ensures their implementation by all private and state entities in the forestry sector. The issue of forest fire protection is thus also regulated. Forest fire protection is part of all forest management plans (both annual and long term).

The issue of forest fire protection is treated in even greater detail at municipal level. The municipal branch of the KFA includes a forest protection office responsible for ensuring the implementation of regulations, and especially of Administrative Instruction MA-No22/2007 on Protection from Forest Fires. The obligations of all relevant natural and legal persons in this respect are described in Articles 2 and 3 of the instruction.

Article 2 contains the following provisions:

“(1) Natural and legal persons that manage forests and forest lands are obliged to register forests according to the risk of forest fires in harmonisation with the forest fire risk assessment provided in the appendices to the administrative instruction.

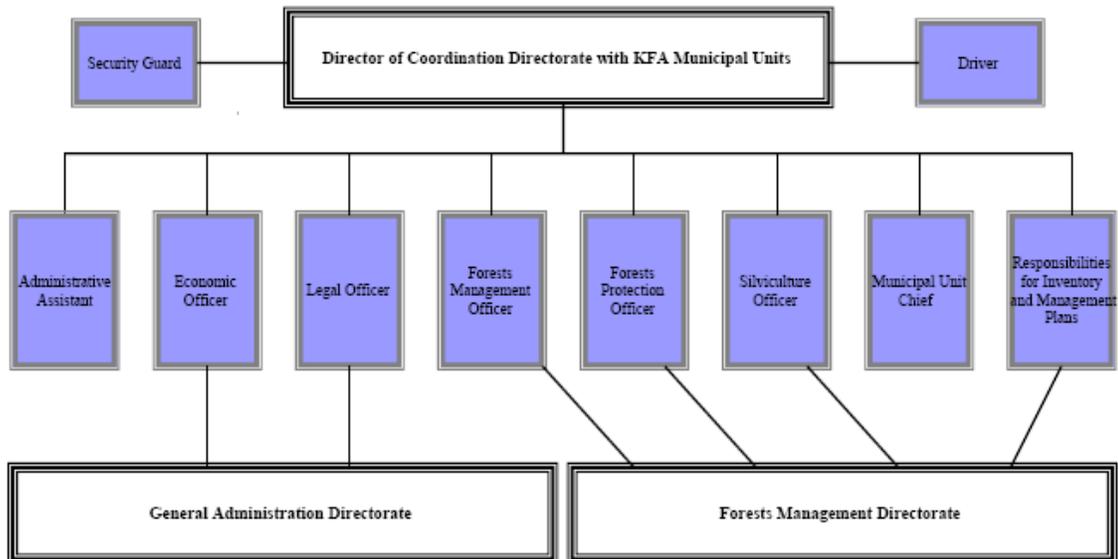
(2) Registration includes the surface area of controlled forests ranked according to forest fire risk level.”

Article 3 prescribes the following:

“(1) Natural and legal persons that manage forests and forest lands are obliged to:

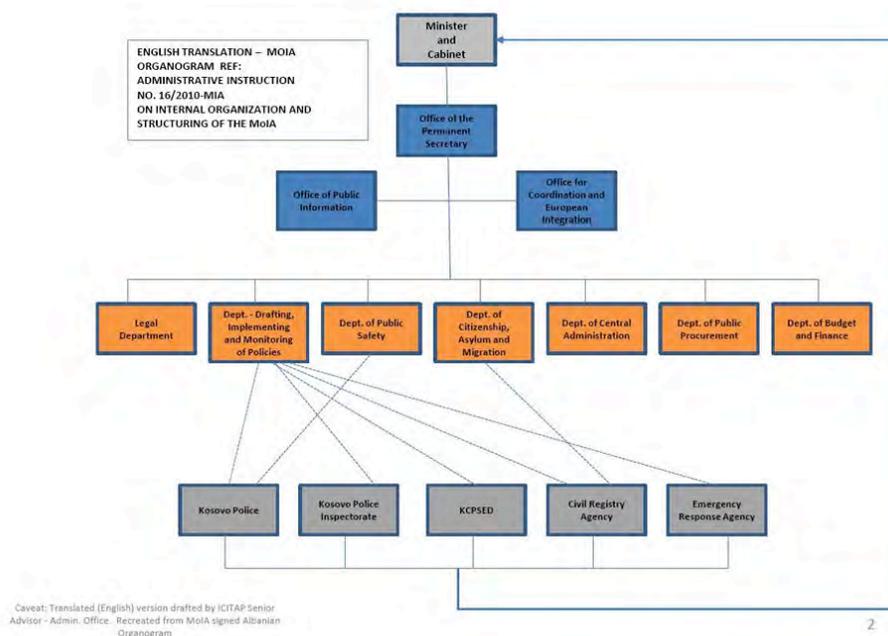
- 1. compile annual plans for the protection of forests and forest lands from fire;*
- 2. organise a detection and notification service;*
- 3. establish a service for the protection of forests from fire, or entrust this duty to a legal person specialising in this field;*
- 4. prepare and train forest staff for intervention and equip them with the necessary tools for opening up paths to fight fires and stop their spread;*
- 5. inform personnel of risk levels and enforce protection measures against fires; and*
- 6. raise public awareness, particularly among tourists and children, about the importance of forest protection, and undertake preventive measures according to forest fire risk.”*

Figure 11. Organisational structure of the Kosovo Forest Agency municipal units



Source [KOS 15]

Figure 12. Organisational structure of the Ministry of Internal Affairs, Kosovo*



Source [KOS 14]

- The Ministry of Internal Affairs (MIA)

The main goal of the MIA is to build, preserve and increase the security of all citizens in Kosovo*, in cooperation with them.

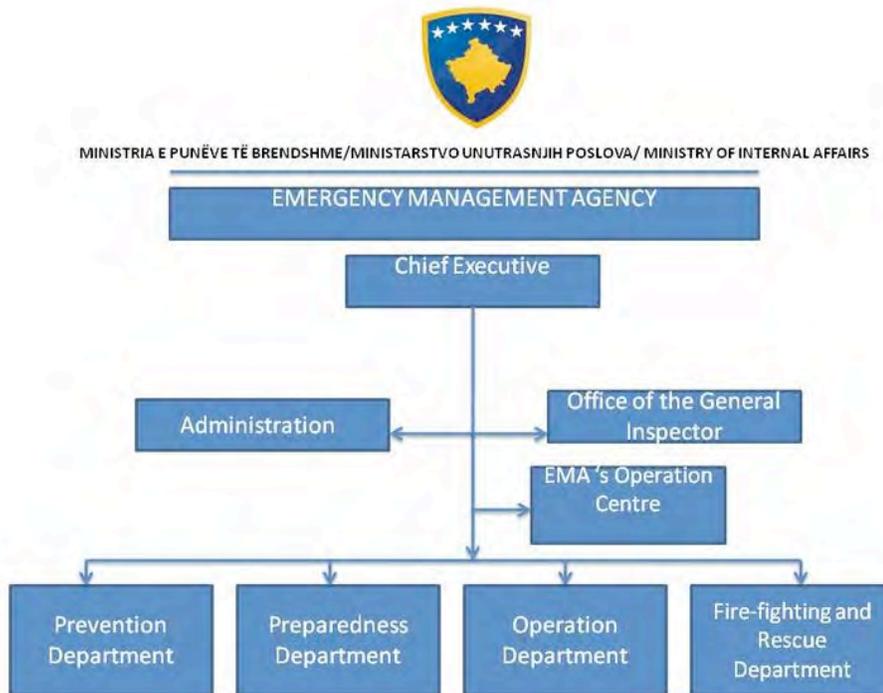
The Emergency Management Agency (EMA) operates within the MIA and is responsible for, among other things, forest fire protection. The main mission of the EMA, through the Department of Fire and Rescue, is to establish a solid foundation in the field of prevention, preparedness and response by providing leadership and ensuring the central coordination of firefighting services at all levels and within all structures.

Its functions are to:

- supervise, coordinate, direct and set standards for these tasks; provide a community fire protection, firefighting, rescue and emergency response; and act as an advocate for the Department of Fire and Rescue in terms of the challenges facing community, private and voluntary firefighters;
- develop and deliver educational programmes in the field of prevention and fire protection in partnership with other agencies, the emergency response community, the media and other stakeholders;
- support professional development, operational capacity and preparedness training for central, regional, local and private fire/rescue and emergency response structures;

- support regional and local entities in the collection, analysis and dissemination of data and special reports regarding the occurrence, control and consequences of any fire, health incidents and other emergency activities; and
- use and support the development of technologies for fire prevention, suppression and localisation; and support resource management studies and firefighting operations in the field.

Figure 13. Organisational structure of the Emergency Management Agency, Kosovo*



Source [KOS 15]

According to Article 4 of the Law on Firefighting and Rescue (No. 04/L-049), the responsibilities of the EMA include:

- structuring, classifying and defining the operational methods of professional firefighting and rescue units and professional staff;
- encouraging the establishment of volunteer firefighting and rescue associations in accordance with the risk assessment and fire protection plan; and
- establishing professional firefighting and rescue units in the territories of municipalities that lack a sufficient number of firefighting and rescue units.

- Municipalities

In accordance with Article 4 of the law, municipalities play a role in fire protection (including forest fire protection). Municipalities are responsible for:

- encouraging the establishment of one or more firefighting and rescue voluntary associations;
- structuring, organising, classifying and defining the operational methods of firefighting and rescue voluntary association units in accordance with the requirements of the agency, as defined in Paragraph 2, sub-paragraph 2.1;
- defining the tasks and number of voluntary firefighting staff; and the assets and equipment necessary for firefighting and rescue voluntary association units in accordance with the municipality risk assessment and central fire protection plan; and
- undertaking measures to establish firefighting voluntary units if they lack a sufficient number of firefighting and rescue units in their territory.

Former Yugoslav Republic of Macedonia – According to the laws listed in Table 16, the main institutions authorised for forest fire protection are described below.

1. Ministry of Agriculture, Forestry and Water Economy

The MAFWE was established by the Law on the Organisation and Operation of the Organs of State Administration (Official Gazette of FYRM, No. 58/2000, of July 21, 2000), and its competencies are described in Article 21 of the law. The MAFWE carries out activities related to:

- agriculture, forestry and water economy;
- the utilisation of agricultural land, forests and other natural resources; and
- inspection in the domain of its competencies.

There are two sectors within the MAFWE related to forestry: the Sector for Forestry and Hunting; and the Sector for Forest Police. The State Inspectorate for Forestry and Hunting also operates within the ministry. [FYRM 21]

The main purpose of the above organisational units is to secure the management of forests in accordance with Article 7 of the Law on Forests: "Forest management comprises silviculture, protection and forest utilisation, through the restoration, nursing, protection, afforestation, utilisation of forests and forest land, and other activities for the maintenance and improvement of the forest's functions."

The Sector for Forestry and Hunting is divided into four departments:

- The Department for Afforestation and Silviculture.
- The Department for Forest Protection — Among other activities, this department is obliged to monitor the situation in the field of forest fire protection and the protection of forests from other negative abiotic and biotic factors.
- The Department for Hunting — With respect to forest fires, the role of this department is to ensure the implementation of Article 23 of the Law on Hunting: “It is forbidden to burn stubble, weeds and other plant waste in hunting areas.”
- The Department for the Planning of Management Activities and Utilisation of Forests. [FYRM 21]

The task of the Forest Police is defined by Article 81 of the Law on Forests: "The guarding of state-owned and privately owned forests is organised by the Forest Police."

According to Article 82 of the same act, besides guarding the forests the Forest Police have a mandate to monitor and report on the situation in the forests regarding illegal logging and forest theft, forest fires, diseases, pests and other negative influences; to inform the authorities about the illegal appropriation of forests and forest land; and to initiate procedures within the legal institutions against those who break the law.

The monitoring of the implementation of the provisions of the Law on Forests is under the competency of the State Inspectorate for Forestry and Hunting. For the purposes of monitoring there are five regional units with 22 regional inspectors covering all the municipalities in the country. Competencies are defined in Chapter XI of the Law on Forests. One of the competencies is to ensure the implementation of all prescribed measures for forest fire protection by all entities that manage forests.

2. Macedonian Forests public enterprise

The public enterprise Makedonski sumi (Macedonian Forests) was founded on the basis of Decision of the Government of FYRM No. 3028/1 of December 15, 1997 (Official Gazette of FYRM No. 65/97), and began operation on July 1, 1998, as a legal successor to earlier enterprises for forest management. Its status as a subject that manages forests is determined by Article 87 of the Law on Forests: “*The public enterprise Macedonian Forests carries out the management of state-owned forests that have an economic and protective role. The public enterprise manages state-owned forests through its 30 subsidiaries. Among other tasks, the subsidiaries are responsible for protecting and taking care of the forests.*”[FYRM 22]

A total of 2,232 people are employed in the public enterprise (including its subsidiaries). In terms of highest academic qualification, two of the employees have a PhD and 15 an MSc, 410 are graduates (mainly forestry engineers), 74 have attended two years at college, 1,140 have completed high school (mainly forestry technicians), and 591 have completed primary school (forestry workers).

In accordance with Article 50 of the Law on Forests, the public enterprise (via all its subsidiaries) has "an obligation to carry out measures for forest protection from illegal logging, forest fires, natural disasters, diseases, insects, illegal pasturing and other damage".

In Article 1, items 27 and 28, of the same law the terms "fire in an open space" and "forest fire" are defined as follows:

"A fire in an open space refers to the uncontrolled burning of forest and forest land, regardless of the size of the burning area, the intensity of the fire or the cause of ignition, which includes the burning of agricultural land and pasture land, within 200 m of the edge of the forest.

A forest fire is the uncontrolled burning of forest and forest land, regardless of the size of the burning area, the intensity of the fire or the cause of ignition."

In the same article, item 29, the term "forest fire management" is defined as measures for protection against fires in open spaces, which comprise:

- "1) education and public awareness raising throughout the year;*
- 2) preparatory measures throughout the year aimed at institutions in charge for forest fire suppression; and*
- 3) direct measures used during a forest fire, aimed at localising and suppressing the fire."*

All these measures are part of the annual operating plan that each subsidiary is obliged to prepare for the current year and that the public enterprise must confirm. The plan is made obligatory by the Law on Protection and Rescue (Article 51).

Taking into consideration the complexity of the issue of forest fire protection, based on Article 50, paragraph 2, of the Law on Forests, the MAFWE has also adopted the Rulebook on Special Measures for Forest Fire Protection.

3. Directorate for Protection and Rescue (DPR)

The DPR was established in 2005 by the Law on Protection and Rescue. It is an independent government authority created by the merger of the civil protection sector from the Ministry of Defence and the Fire Protection Inspectorate from the Ministry of the Interior. It comprises four sectors with 11 departments, four independent units, and 35 local offices for protection and rescue (see Figures 14 and 15).

Its competencies and scope of activities are regulated by the Law on Protection and Rescue (Official Gazette of FYRM, No. 36/04, of June 10, 2004) as well as the Law on Fire Protection (Official Gazette of FYRM, No. 67/4, of October 14, 2004).

In relation to forest fires, the competencies of the DPR are coordination, inspection, prevention and suppression.

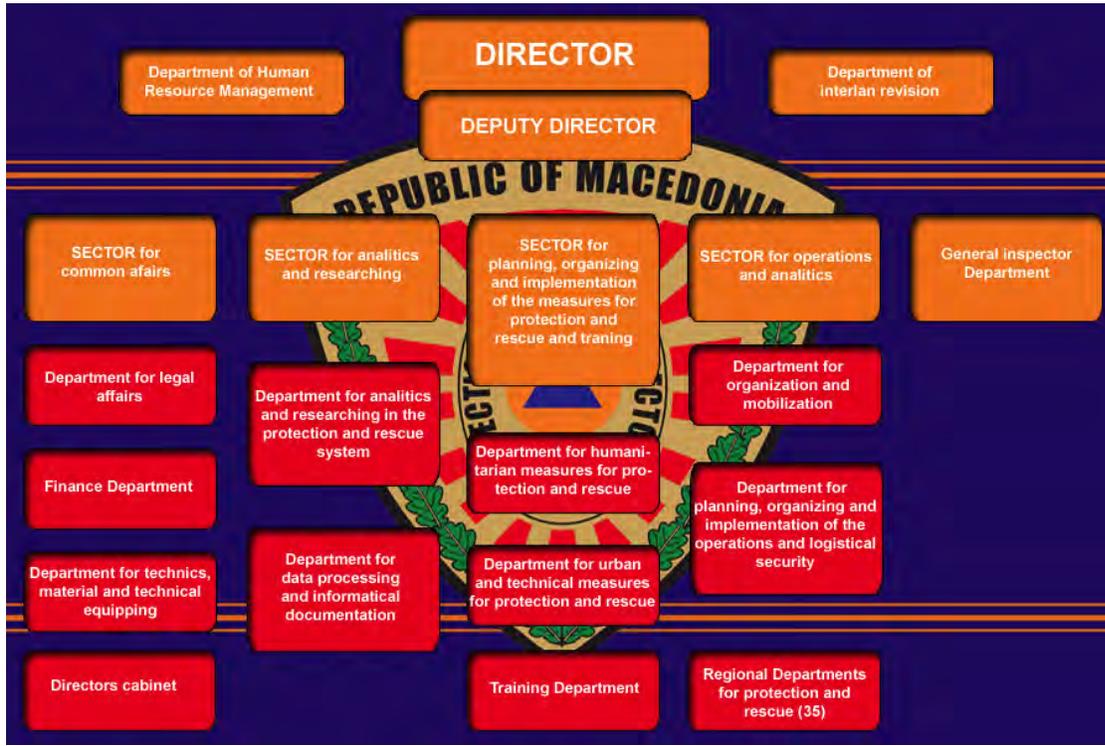
Coordination: In accordance with Article 51 of the Law on Protection and Rescue: “Organs of the state administration, organs of local self-governance units, trading societies, public enterprises, institutions and services are obliged to prescribe and project the organisation for the implementation of measures for protection and rescue and to implement measures of prevention.” The DPR has a mandate to coordinate these activities/plans (in regards of forest fires protection) from all institutions and organs in accordance with the current laws and regulations.

Inspection: The General Inspectorate Department has a mandate to carry out inspections of all authorised institutions for forest fire protection (the public enterprise Macedonian Forests, local self-government units, territorial fire protection units etc.) in order to ensure that they have prepared appropriate plans and taken all the necessary measures for prevention and preparedness in accordance with the laws and regulations in force.

Prevention: The DPR has a mandate to initiate procedures for the adoption of new laws or the improvement of existing laws, to undertake public awareness campaigns (independently or jointly with other institutions or organisations), and to organise educational measures (lectures).

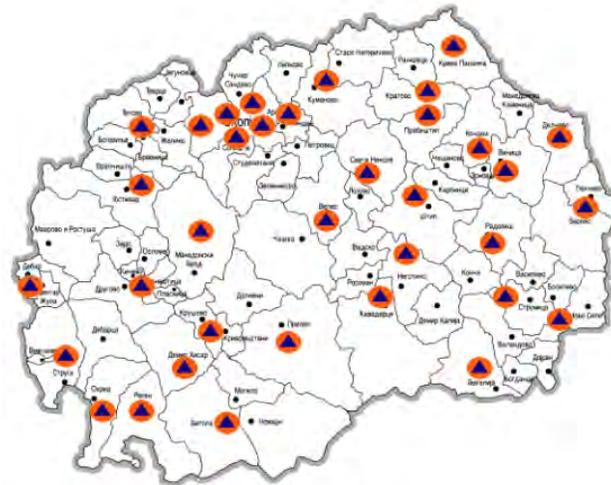
Suppression: In accordance with Article 18, item 6, of the Law on Protection and Rescue, the DPR has a mandate to participate in forest fire suppression activities. For this purpose, there are 35 teams for prompt response (around 700 people in total) to be engaged in the event of large forest fires. These teams are equipped mainly with hand tools. The Sector for Specialised Aircraft Services operates three aeroplanes (Air Tractor Europe, S.L) equipped for forest fire suppression. [FYRM 23]

Figure 14. Organisational structure of the Directorate for Protection and Rescue, Former Yugoslav Republic of Macedonia



Source: <http://www.dzs.gov.mk/>

Figure 15. Distribution of the regional departments of the Directorate for Protection and Rescue, Former Yugoslav Republic of Macedonia



Source: <http://www.dzs.gov.mk>

4. Local self-governance

In accordance with the Law on Fire Protection (Official Gazette of FYRM, No. 67/4, of October 14, 2004) and the Law on Local Self-governance (Official Gazette of FYRM, No. 5, of January 29, 2002), local self-governance units are obliged to organise a fire protection service (territorial fire protection units, or TFPUs) comprising professional firefighters. These units are trained and equipped mainly for the suppression of urban fires.

5. Crisis Management Centre (CMC)

The CMC was established in 2005 in accordance with the Law on Crisis Management (Official Gazette of FYRM, No. 29, of May 4, 2005). The main tasks of the CMC are to:

- ensure continuity in inter-sectoral and international cooperation, consultation and coordination in the field of crisis management;
- prepare and update the assessment of risks and dangers in crisis resolution; and
- propose measures and activities for the resolution of crisis situations and the performance of other duties prescribed by law.

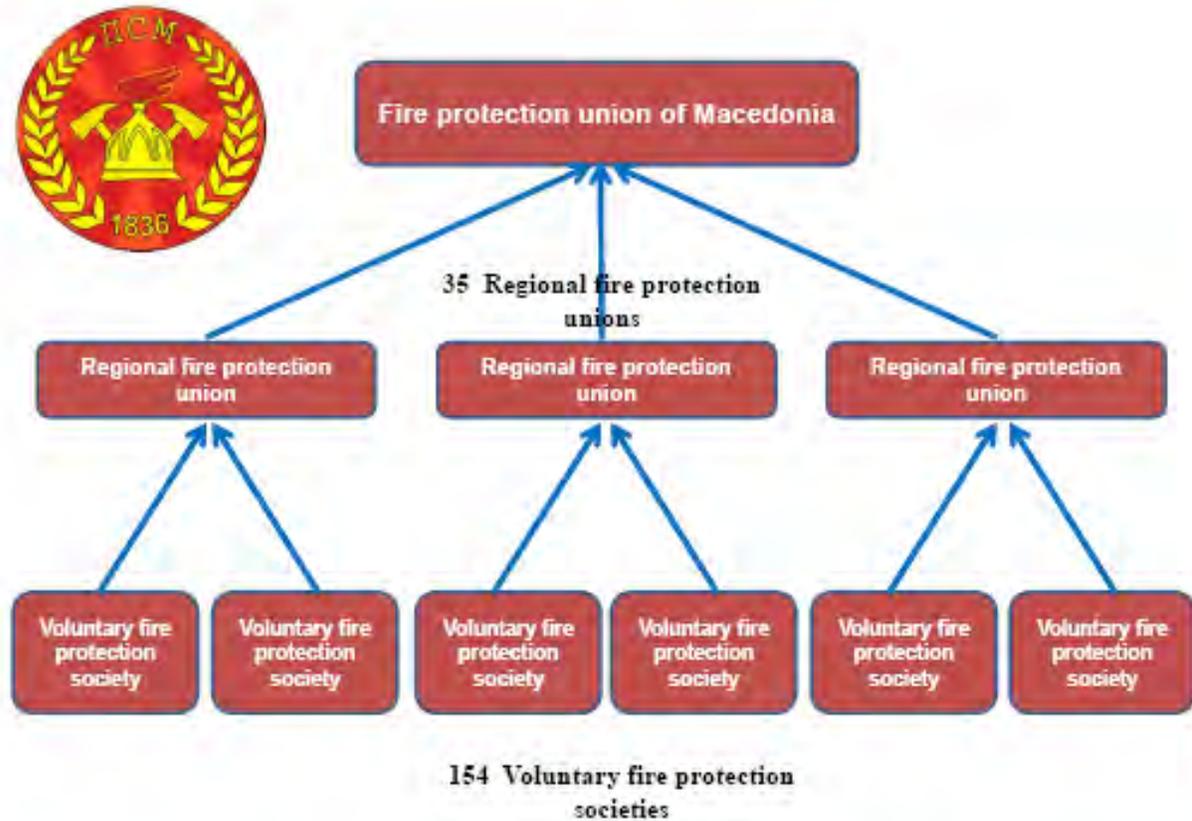
In line with the above, the CMC is in charge of forest fire management only during crisis situations at state level (such as during the 2007 fire season, when a state of emergency was declared in the former Yugoslav Republic of Macedonia). A web-based forest fire early warning system (the Macedonian Forest Fire Information System, or MKFFIS) has been available within the CMC for public use since 2014 (<http://mkffis.cuk.gov.mk/>). Some parts of the system are available exclusively to institutions responsible for forest fire protection in the country. [FYRM 25]

6. Fire Protection Union (FPU)

The Macedonian Fire Protection Union is an NGO that works according to the Law on Fire Protection (Official Gazette of FYRM, No. 67/4, of October 14, 2004) and the Law on Societies and Foundations (Official Gazette of FYRM, No. 52, of April 16, 2010). Its basic activity is defined in Code 8, sub-section 1, of the organisation's statutes as follows: "The union carries out measures and activities for preventing fire outbreaks, for firefighting and for rescuing people, property and valuables jeopardised by fires, climatic distress and other accidents." This means that the FPU carries out measures for fire prevention, pre-suppression and suppression, including forest fires. The engagement of firefighters (volunteers) in forest fire suppression activities is coordinated by the DPR (at state and local level). Today, there are around 154

voluntary fire protection societies within the FPU, organised into 35 regional fire protection unions (RFPU). [FYRM 16]

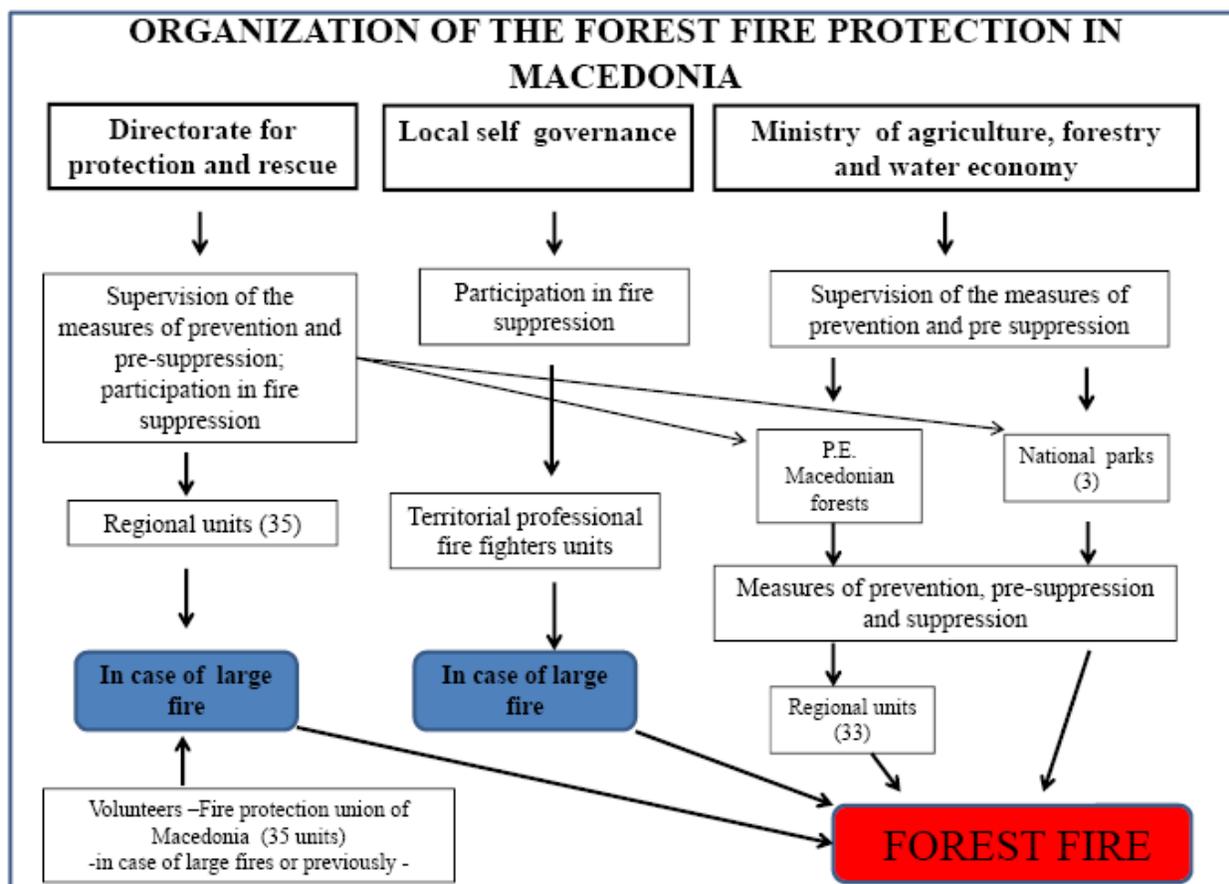
Figure 16. Organisational structure of the Macedonian FPU



Source: Nikola Nikolov. Involvement of volunteer firefighters in enhancing wildfire preparedness and response capacities in Macedonia, *Novosibirsk, 2013*

In accordance with the laws listed in Table 16, forest fire protection in the former Yugoslav Republic of Macedonia is organised as shown in Figure 17.

Figure 17. Organisation of forest fire protection in the former Yugoslav Republic of Macedonia

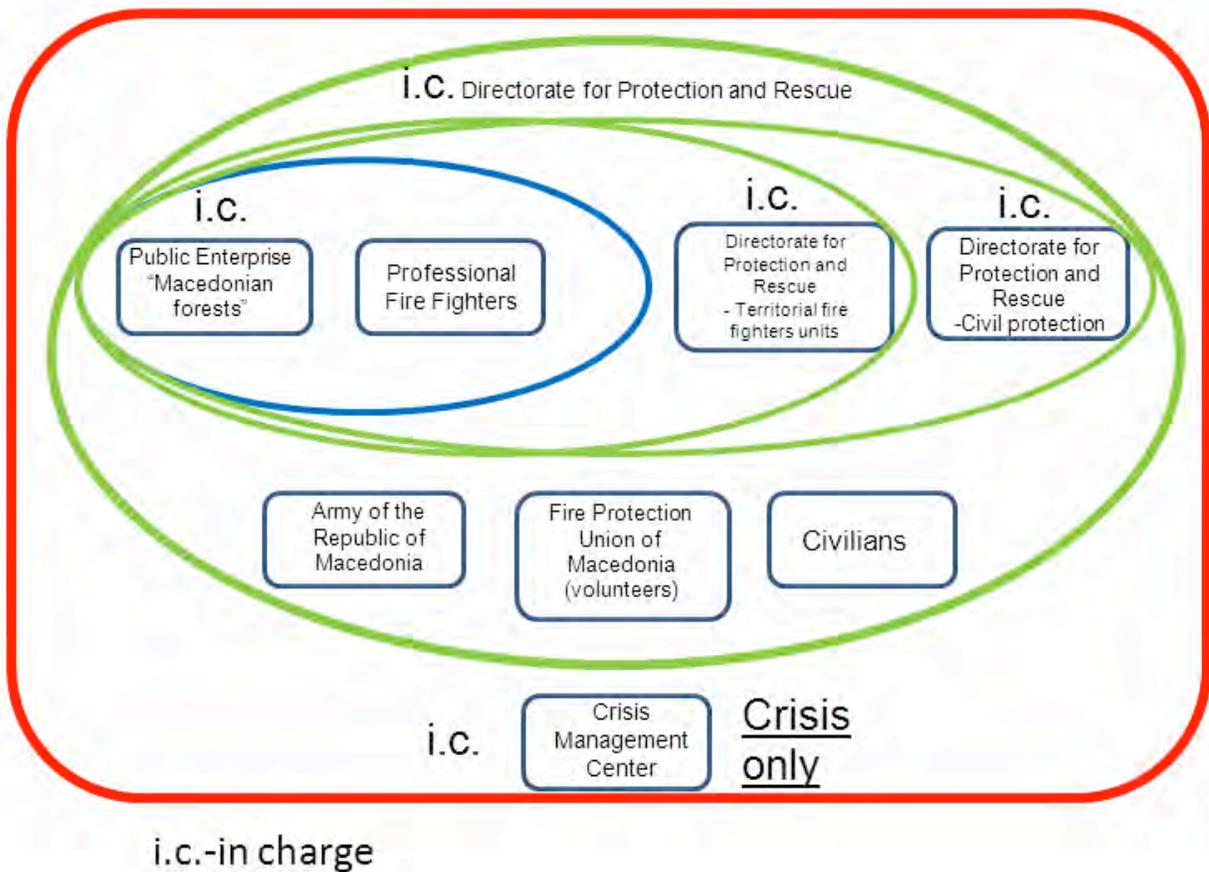


Source: Nikola Nikolov, *Organization of Forest Fire Protection in the Southeast European/Caucasus Region*, Seoul, 2013

Besides prevention and pre-suppression measures, one of the preconditions for effective fire suppression is a clearly defined chain of command and coordination. According to the Law on Forests, the company/entity that manages the forest is obliged to organise the initial fire suppression response. This is typically the public enterprise Macedonian Forests, through its regional subsidiaries. At this stage they are in charge of fire suppression actions. If a fire cannot be suppressed by the public enterprise, the local fire service can be called on for support, although the public enterprise is still in charge of fire suppression operations. If tackling the fire remains beyond their capabilities, the DPR will become involved and offer its resources. From that moment, the DPR is in charge of all operations, even if the FPU (volunteers) and the army

are involved. The CMC will only become responsible for coordinating firefighting if a “disaster situation” is officially proclaimed (i.e. if the fire becomes an emergency/crisis). This task includes the coordination of foreign assistance, for example targeting foreign aerial resources to the fire (Figure 18).

Figure 18. Command and coordination chain during forest fire suppression in the former Yugoslav Republic of Macedonia



Source: FAO/ TCP/MCD/3201

Montenegro – Based on the laws listed in Table 16, the main institutions competent in the field of forest fire protection are described below.

1. Ministry of Agriculture and Rural Development (MARD)

The MARD is responsible for the overall control of the forestry sector and plays a leading role in the process of forest resources management, the development of economic and other sectoral policies, and the implementation of these policies through the Directorate for Forestry, Hunting and Wood Processing Industry (DFHWPI).

The DFHWPI comprises three units:

1. Department for Forestry
2. Department for Hunting
3. Department for Monitoring in Forestry [FYRM 1]

The DFHWPI is responsible for approving the management plans prepared by private companies; monitoring and control in cooperation with the Forest Inspectorate; interfacing between donor projects, the ministry and forest stakeholders; overseeing the preparation of the national forest inventory; and performing environmental and social functions and services.

In relation to forest fire protection, the DFHWPI carries out the above activities and tasks mainly in accordance with Article 46 of the Law on Forests:

“It is prohibited to light fires in the open and to dispose of objects that may cause fire in forests and forest land, except in places intended for the respective purpose.

The competent administrative authority shall be obliged to ensure forest guarding services during periods of increased fire risks in forests and forest land.

In relation to forests and other forest land that are exposed to particular fire risk, special measures for prevention and preparations for fire extinguishing shall apply, in accordance with the law.

Forest owners and beneficiaries shall be obliged to act preventively, to suppress and participate in firefighting in their forests — that is, in forests they use.”

2. Administration for Inspection Affairs (AIA)

Within the AIA, the Department for the Inspection of Forestry, Hunting and Plant Protection carries out tasks related to inspecting the implementation of laws and regulations governing the field of forestry, hunting and the protection of forest products; taking administrative and other measures in order to remove detected irregularities and ensure the proper application of the regulations; submitting applications for initiating criminal proceedings

and filing criminal charges; giving initiatives for amendments to laws, regulations and by-laws; proposing measures for improvements in the area of supervision; preparing analyses, reports and information within the scope of the department; cooperating with other organs of the government, institutions and businesses; and undertaking other activities within its jurisdiction. [MNE 10]

With respect to forest fires, and in addition to the Law on Forests, all the tasks carried out by the department are in line with the Law on Protection and Rescue, in particular Article 47:

“Companies, other legal entities and entrepreneurs shall, under the conditions and in a way prescribed by law, participate in the protection and rescue of people and goods and supply tools, transport, technical and other necessary resources for protection and rescue.

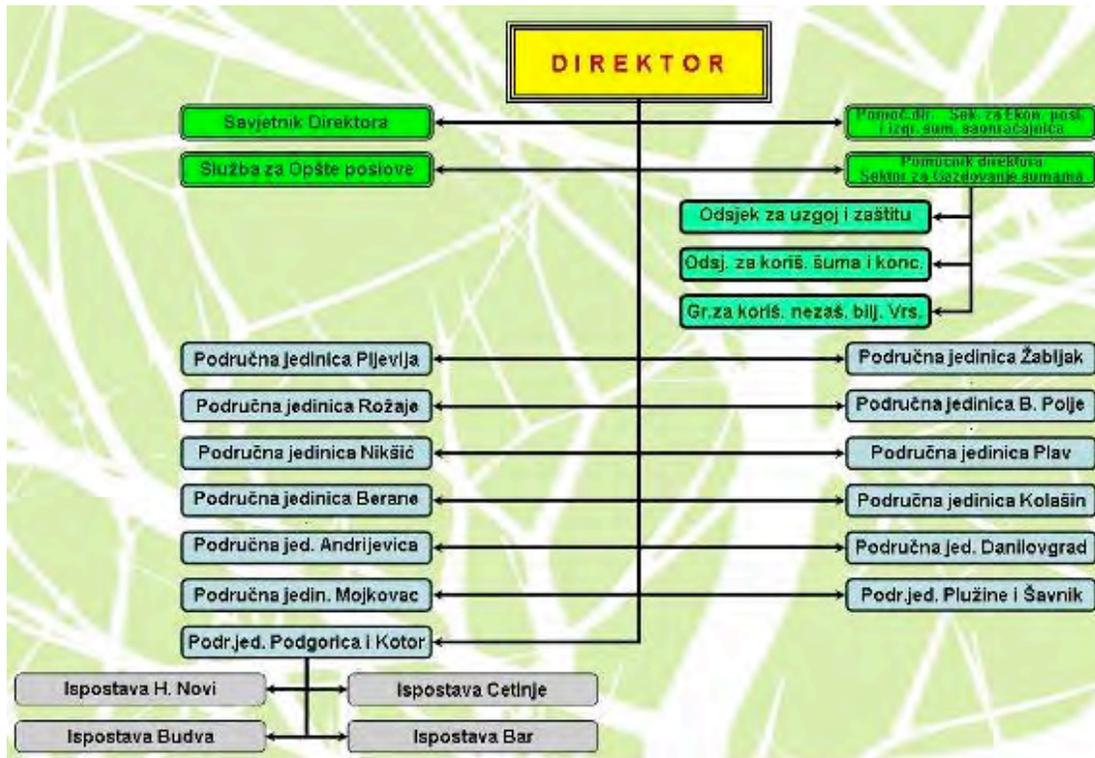
The persons referred to in paragraph 1 of this article are obliged to implement measures for protection and rescue in accordance with the law, protection and rescue plans and general acts.”

3. Forest Administration (FA)

The FA is the state administrative authority responsible for the management of both private and state-owned forests. The FA has a wide range of responsibilities, including forest protection; reforestation and improvement activities; the selection of seed stands; the conservation of natural and artificial forest values; protection against fires; reporting and forest management planning; the development of forest road programmes; the provision of services for forest utilisation; and advisory services.

The FA, which has its headquarters in Pljevlja, is divided into 15 regional units. The carrying out of work in the forests and the processing of forest products are left to the private sector and the market. The FA is the largest forest-related institution with approximately 400 staff, 85 of whom have a university degree (67 forest engineers) and 206 of whom are forest wardens in charge of forest management units, although in general without adequate education. [MNE 1]

Figure 19. Organisational structure of the Forest Administration



Source [MNE 12]

Within the FA, around 210 personnel, spread among regional units, are engaged in forest protection. In periods of increased risk of forest fires, additional personnel are engaged (on a contractual basis) and are given the primary task of observing and reporting fires, as well as directly participating in firefighting.

All 15 regional management units are obliged to carry out measures for forest fire protection (prevention, pre-suppression and suppression), together with the concessionaire or the private owner. This is in accordance with the Law on Protection and Rescue, the National Plan for Protection and Rescue from Fires, municipal plans for protection and rescue from fires, and entrepreneurial plans for protection and rescue from fires.

Some of these measures are set out in the framework of various management plans:

- General 10-year plans for the districts
- 10-year management plans for the units
- Annual detailed executive plan
- Afforestation plan
- Annual fire prevention and control plan

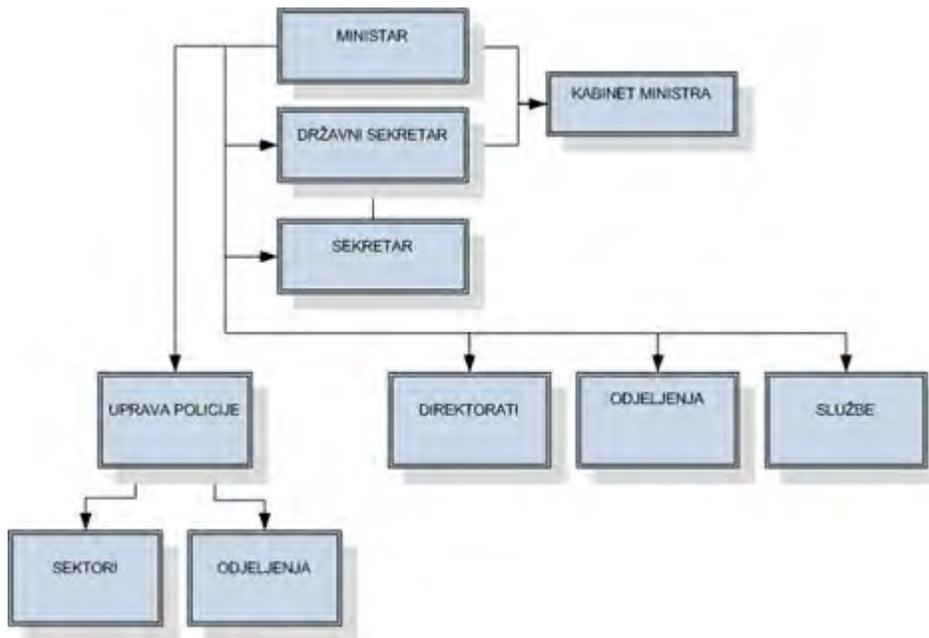
4. Ministry of Internal Affairs, Directorate for Emergency Situations

The organisation and activities of the Directorate for Emergency Situations are in accordance with the Law on Protection and Rescue (Official Gazette of Montenegro 13/2007), the National Strategy for Emergency Situations (2013) and the Law on Self-governance (Official Gazette of Montenegro 42/2003).

The directorate has a staff of 106 employees. There are units for emergency situations in all Montenegrin municipalities, with a total of 582 members. The firefighting service is organised at local level through municipal rescue and protection units. These units operate with a total of 194 fire trucks (mainly used for urban fires).

The directorate also includes the Unit for Aerial Firefighting. This unit operates four helicopters (Abell-412, Abell-212, Abell-206 and Gazelle); two Dromader aeroplanes; and two AT-802A Fire Boss firefighting aircraft.

Figure 20. Organisational structure of the Ministry of Internal Affairs



Source [MNE 11]

Inter-agency mechanisms include plans for protection and rescue from fires in Montenegro at national, local government/municipality and company level. All of these plans should be adjusted and harmonised with one another in accordance with the laws in force and the competencies of the institution/company.

Serbia – The main institutions competent in the field of forest fire protection in Serbia are described below.

1. Ministry of Agriculture and Environmental Protection (MAEP)

The MAEP (Forest Administration) has the role of coordinating and inspecting all entities that manage forests and forest land.

2. Srbijašume public enterprise

Srbijašume is a state enterprise for forest management founded by the National Assembly of the Republic of Serbia in July 1991.

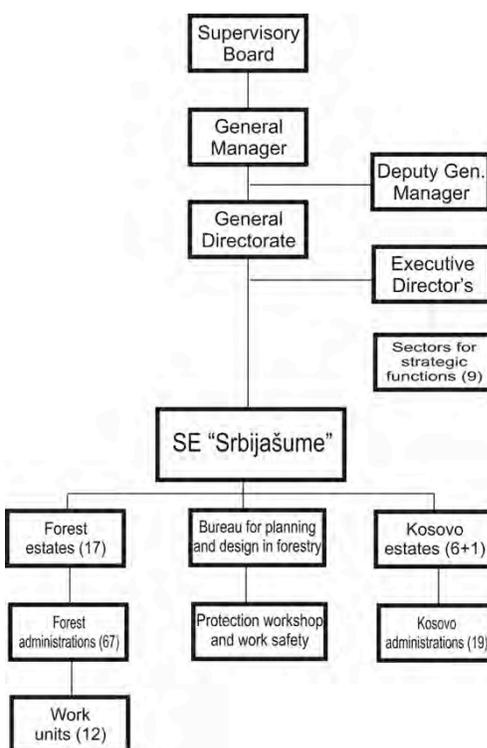
The public enterprise manages state forests and forest land on an area of 899,612.75 ha and performs professional activities in private forests on an area of 1,058,387.00 ha (data from December 2010). The public enterprise comprises nine sectors: for Forestry and Environmental Protection; for Forest Utilisation; for Commercial Affairs; for Finances and Accounting; for Development and International Cooperation; for Hunting, Fishing and Other Resources; for Legal Affairs; for Marketing and Public Relations; and for Real Estate.

In addition to its headquarters in Belgrade, there are 17 forest estates and 67 forest administrations throughout the territory of central Serbia, as well as the Ibar-Leposavić forest management unit on the territory of Kosovo*.

In accordance with the Forest Law, the public enterprise carries out measures and activities with the aim of preventing, suppressing and eliminating the consequences and harmful impacts of plant diseases, insects, rodents, wild game, human activities, fire, natural disasters and other biotic and abiotic factors.

Forest fire protection measures are carried out in all 17 forest estates and 67 forest administrations in accordance with their current management plans and plans for forest fire protection (as explained above). This means that they must organise appropriate measures for prevention, pre-suppression and suppression.

Figure 21. Organisational structure of the Srbijašume public enterprise, Serbia



Source: [SRB 8]

3. Vojvodinašume public enterprise

Forest fire protection is of great significance for this public enterprise, as fire represents a serious threat to forests and forest ecosystems on the territory that it manages, and especially to the forests of the Deliblato Sands and Subotica Sands.

In order to prevent outbreaks of fire and to be able to suppress forest fires, the public enterprise prepares a forest fire protection plan that foresees the following activities and measures:

- the assessment of fire danger categories for certain types of forests;
- the monitoring of climate conditions and fuel quantity in order to estimate the existing fire hazard;
- early warning and the detection of forest fires;
- the organisation of teams for first response;

- the construction of firebreaks and water tanks;
- the implementation of silvicultural measures for reducing the risk of fire outbreaks and the speed at which fires spread;
- the maintenance of picnic sites;
- the printing and distribution of information materials; and
- awareness raising among the local population.

4. Borjak public enterprise and national parks

The Borjak public enterprise, along with four national park public enterprises, have organised their forest fire protection according to the same principles and rules as the Srbijašume and Vojvodinašume public enterprises (carrying out the same set of prevention, pre-suppression and suppression measures for forest fire protection, in line with local conditions).

According to the current laws, entities that manage forests (public enterprises) must prepare plans for forest fire protection for all categories of forest ownership within their territory. Such plans are obligatory for forests that come within the first and second categories of fire risk according to the forest management plans and should include:

- a review of the current state of fire protection;
- an assessment of the fire risk;
- the organisation of fire protection;
- prescribed technical and organisational measures to eliminate weaknesses and strengthen capacities for fire protection; and
- a calculation of the necessary financial resources for this purpose.

In the form of an annex, the fire protection plan must also provide data on the number of firefighters, the equipment and technical training of the fire teams, the organisation of preventive measures, the teams' shifts, and the number of qualified personnel for the implementation of fire protection activities.

The plan must be approved by the Ministry of the Interior and the MAEP. Forest fire risks and the vulnerability of the forests are defined in the planning documents for forest management. In order to reduce these risks, decrease the vulnerability of forests and protect forests from fires, the management team must define appropriate management activities for the forest.

5. Ministry of the Interior

The operations of the Ministry of the Interior are based on a unique organisational structure throughout the territory of the Republic of Serbia, comprising territorial, linear and object-related principles of operation. In addition to the seat of the ministry in Belgrade, and in

line with the territorial division into districts, the tasks and duties that fall within the competency of the ministry are also performed by regional units — the regional police directorates of Belgrade, Kragujevac, Jagodina, Niš, Pirot, Prokuplje, Leskovac, Vranje, Zaječar, Bor, Smederevo, Požarevac, Valjevo, Šabac, Kraljevo, Kruševac, Čačak, Novi Pazar, Užice, Prijepolje, Novi Sad, Sombor, Subotica, Zrenjanin, Kikinda, Pančevo and Sremska Mitrovica, as well as a coordination directorate for Kosovo* and Metohija. There are four sectors within the ministry: for Analytics, Telecommunications and Information Technology; for Finance, Human Resources and Common Affairs; for Internal Affairs; and for Emergency Management.

Sector for Emergency Management

The Sector for Emergency Management seeks to build, maintain and improve the ability of the entire country to help prevent risks, respond to challenges, and mitigate the consequences of various disasters that may affect the region. It combines all existing resources in terms of protection, rescue and emergency response.

The operational division comprises the core members of the operational fire rescue units. At any time, 3,000 rescuers are ready to give their best to protect and rescue citizens in the Republic of Serbia. In addition to the basic fire rescue units, the sector has specialist rescue teams in the event of earthquakes, floods and other accidents, or in the event of technological accidents and accidents involving hazardous substances.

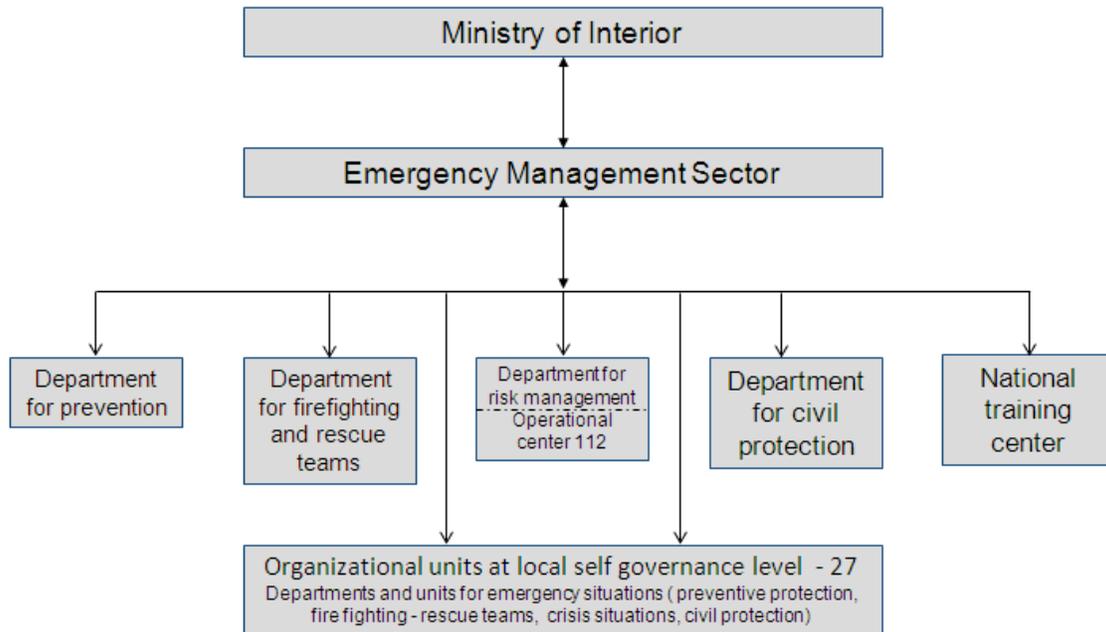
The headquarters of the sector comprises the Department for Prevention; the Department for Firefighting and Rescue Teams; the Department for Risk Management; the Department for Civil Protection; and the National Training Centre. At local level, the sector has 27 organisational units: four emergency situation boards in Belgrade, Kragujevac, Niš and Novi Sad; and 23 departments of emergency situations in Bor, Valjevo, Jagodina, Kikinda, Pančevo, Sremska Mitrovica, Užice, Šabac, Kraljevo, Novi Pazar, Pirot, Požarevac, Prokuplje, Čačak, Prijepolje, Smederevo, Subotica, Sombor, Zaječar and Zrenjanin.

The Department for Firefighting and Rescue Teams exercises timely legal supervision over the work of the fire and rescue units and industrial and voluntary fire brigades, as well as over their coordinated activities in the event of major emergencies. It has a direct influence over the work of the regional organisational units for firefighting and rescue operations. It comprises three units: the Unit for Technical Equipment for Firefighting and Rescue Teams; the Unit for the Control of Firefighting and Rescue Teams; and the Unit for the Coordination of Operational Activities.

The Unit for Technical Equipment for Firefighting and Rescue Teams actively participates in the organisation and supervision of the work of firefighting and rescue units; analyses the state of the technical equipment used by the fire and rescue units; undertakes the planning of material and technical resources and the procurement of the necessary resources to improve the technical equipment of the fire and rescue units; plans measures to ensure

adequate conditions for the accommodation of the fire and rescue units; monitors and studies the development of modern devices, equipment and protective systems; and cooperates with the manufacturers of such devices and equipment and with other organisations in the field of protection.

Figure 22. Organisational structure of the Serbian Ministry of the Interior



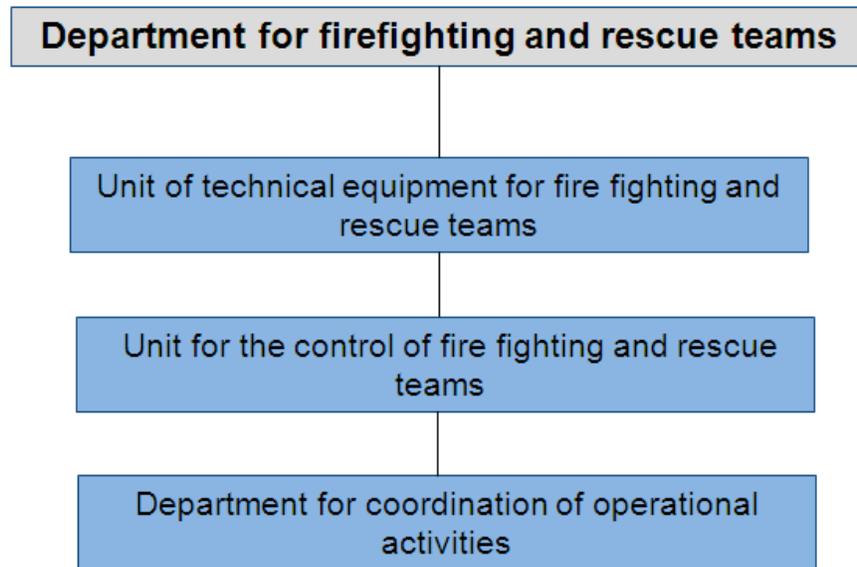
Source: [SRB 18]

The Unit for the Control of Firefighting and Rescue Teams is responsible for the fire and rescue units and for industrial and volunteer fire brigades. It controls their work and proposes appropriate measures for the improvement of fire brigades.

The Unit for the Coordination of Operational Activities is responsible for assessing the vulnerability of the territory in order to define the formation of new fire and rescue units, as well as the required number of staff. It is also responsible for coordinating the work of all the departments that are involved in emergency situations. It proposes and participates in the development and harmonisation of protection plans and operational plans with the state,

regional, city and local authorities. It maintains direct contact with other services operating in emergency situations.

Figure 23. Organisational structure of the Department for Firefighting and Rescue Teams, Serbia



Source: [SRB 15]

6. Firefighting Association of Serbia (FAS)

The FAS brings together volunteer fire associations and unions on the territory of the Republic of Serbia in the framework of programmes in the field of fire protection and prevention activities and professional training. Through the activities of its municipal, county, city and provincial unions, the FAS coordinates and jointly implements activities together with the professional firefighting units that are organised within the Ministry of the Interior and units that are located within the enterprise or institution, aimed at improving fire protection.

The establishment of volunteer fire societies and unions is regulated by the Law on Associations. The FAS conducts measures for prevention, preparedness and suppression.

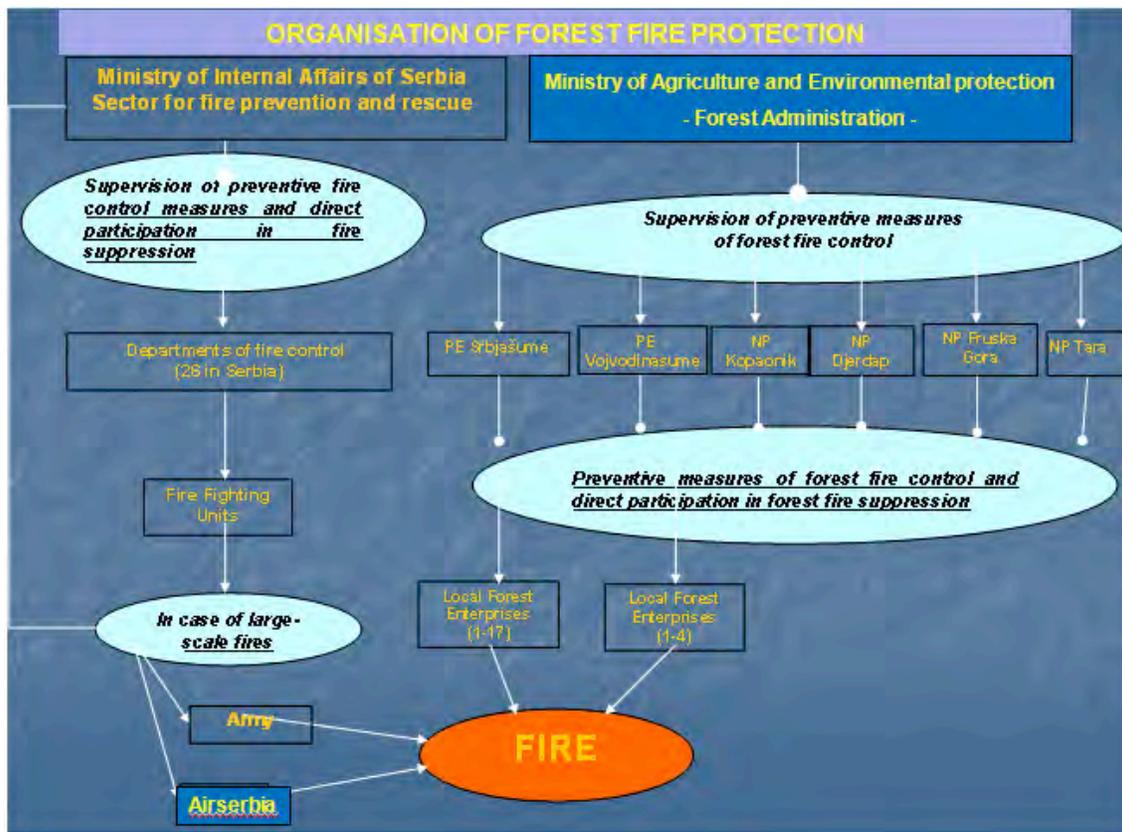
There are about 3,500 volunteer firefighters with firefighting equipment, most of them in eastern Serbia. Members of the volunteer brigades have rights, obligations and responsibilities under the Law on Fire Protection. The volunteer qualification standards are compatible with

those of professional firefighters and they are protected by the same legal safeguards. Local authorities provide some money for the work of volunteer firefighters.

The inter-agency mechanisms for fire protection and rescue in emergency situations are defined by the Law on Fire Protection, the Law on Emergency Situations and the Law on Forests as the responsibility of the Emergency Management Sector (Ministry of the Interior of Serbia).

The organisation of forest fire protection in Serbia is shown in Figure 24.

Figure 24. Organisation of forest fire protection in Serbia



Source: [SRB 17]

One of the biggest issues in terms of forest fire protection, not only in the region but also worldwide, is the set-up of the forest fire protection system. This refers primarily to the number and quality of the laws that regulate the issue of forest fire protection. It also refers to the number of institutions and organisations involved in forest fire protection. Having only one law and one responsible institution would make the system more streamlined, but this is not the

reality. In general, in all countries in the region the main law that covers forest fire protection, in terms of prevention, pre-suppression and suppression, is the law on forests. However, this law is aimed at the forestry service in the country. This means that all regulations on forest management are directed exclusively to the forestry service (and not to other institutions involved in forest fire protection), and only some parts and articles of the law concern forest fire protection.

The second most important law is the law on fire protection, or the management of crisis situations, or similar. This law regulates the issue of fire protection in general (urban fires, fires in specific locations etc.), and forest fires as part of fire protection. The law is aimed mainly at professional firefighters and emergency services.

Alongside these two laws and institutions/services, there are many others related to forest fire protection, including the law on protected areas, the law on pasture, the law on hunting, the law on agriculture, various public enterprises, national parks, hunting societies, volunteers etc.

Bearing in mind the number of laws and the number of institutions involved in forest fire protection (as well as their competencies and experience), Kosovo*, the former Yugoslav Republic of Macedonia, Montenegro and Serbia have the most "simplified" national system for forest fire protection. The forest fire protection systems in Bosnia and Herzegovina and Albania are far more complicated. However, taking into consideration experiences during 2007 and 2012 in the region, the national systems even in these countries are not as efficient as they should be.

III Impact of forest fires on environment, economy and human health

In the last 20 years, and in some specific years in particular, forest fires have been the most destructive factor (both qualitatively and quantitatively) affecting forests and other vegetation in Europe as a whole, and especially the countries of the SEE region. There are different data for the (social, economic and environmental) damage and losses caused by forest fires in SEE, mainly because of the different approaches used to calculate or estimate the real costs of the damage caused by forest fires.

The costs and losses associated with forest fires are often considered exclusively in terms of suppression costs, with relatively little attention given to the related losses of timber and forage values; forest habitats and populations (including endangered species and their critically protected habitats); air and water quality; recreational opportunities; local economies; and other resources and amenities important to all citizens. Health impacts are not usually considered in terms of monetary losses at all, and tallies of domestic animal or wildlife fatalities are rarely attempted or even mentioned. Rarely is there any attempt to quantify the long-term

consequences of a damaged renewable resource base in terms of providing for the needs of an ever-growing human population.

Using available official and unofficial data, some impacts of forest fires on the environment, economy and human health in the SEE region are outlined below.

Albania – The negative impacts of fires are extensive in conifer forests but less so in coppice forests and shrub land. The main negative impacts are erosion in the burned area following the fire, the destruction of the regeneration cover, and the disturbance of the land structure and water regime. Another negative impact is the reduction in forest productivity. Forest ecosystems in Albania are very sensitive to fire. In the coastal forest protection belt alone, surface fires in pine forests have a role in maintenance and are used as a control measure to minimise the amount of flammable material available for potential wildfires. In sites affected by fires, especially in the natural pine forests in the north of the country in Puke, Kukesi and Mirdita districts, the vegetation cover following a fire differs greatly from the vegetation before the fire.

In the southern part of the country, fire has traditionally been used as a means for cleaning and regenerating pastures. At these sites, the use of fire over many centuries has made big changes to ecosystems. One of the main impacts is the establishment of annual grasses and the disappearance of perennial plants. [AL 9]

The JRC estimates the amount of biomass burned and the quantity of gas emissions from forest fires in Albania up to August 31, 2007, as follows (10^3 tonnes):

- Biomass burned – 1,161.30
- Carbon dioxide (CO₂) emissions – 2,052.60
- Carbon monoxide (CO) emissions – 82.60
- Methane (CH₄) emissions – 4.30
- Volatile organic compounds (VOCs) emissions – 4.30
- Nitric oxide (NO_x) emissions – 5.80

There have been no fatalities caused by forest fires in the last 10 years, although 15 volunteer firefighters were injured and five houses destroyed in the region of Shkodra.

Bosnia and Herzegovina – There are no official data about the impacts of forest fires on the environment on the territory of BiH. Some data are available on the economic damage caused by forest fires and burned timber mass, but they are insufficient for a comprehensive analysis.

In general, the main environmental consequences of forest fires in BiH, as elsewhere, are:

- forest degradation;
- deforestation;
- soil erosion;
- outbreaks of pest infestations and diseases;
- loss of biodiversity; and
- emissions of GHGs and other gases.

In Brčko District, in the period between 2000 and 2012, total damage caused by forest fires was estimated at around BAM 2,300,000 [EUR 1,173,000] [BiH 4].

Table 17. Forest fires in Brčko District, 2000–2012

Year	Number of fires	Burned area (ha)	Estimated damage (KM)
2000	14	18.26	75,600
2001	7	13.42	21,400
2002	16	81.38	124,350
2003	45	196.24	378,600
2004	4	7.55	19,500
2005	7	16.35	32,400
2006	13	84.26	96,300
2007	42	187.58	218,420
2008	9	14.10	27,800
2009	15	21.60	32,000
2011	4	64.00	289,444
2012	2	55.9	908,390

Source [BiH 4]

According to some sources, the direct damage caused by forest fires in FBiH has been estimated at EUR 69,992 in 2004; EUR 734,995 in 2005; and EUR 883,120 in 2006. [BiH 9]

For the period between 2009 and 2013, the damage caused by forest fires in FBiH has been estimated at around BAM 56,250,000 [EUR 28,687,500]. [BiH 10]

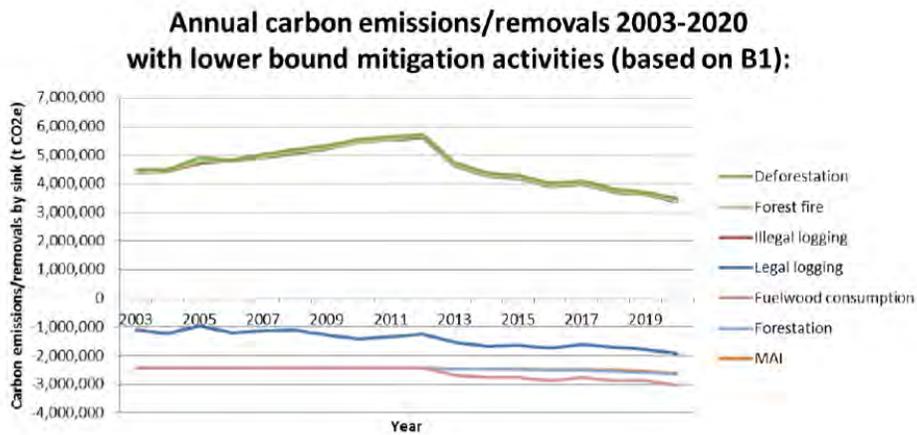
In the period between 2001 and 2007, around 291,951 m³ of wood mass were burned in forest fires in BiH, with damage estimated at around BAM 38,174,000 [EUR 19,468,740]. [BiH 11]

Kosovo* – Economic losses as a result of direct and indirect damage to infrastructure and structures in urban and rural areas are significant, although no detailed data are available. The total timber mass burned in the period between 2003 and 2014 is estimated at 459,000 m³. [KOS 8]

Human fatalities and injuries have been registered, although there are no available statistics.

The impacts on the environment of emissions from burning vegetation are addressed only in the context of the Climate Change Framework Strategy (CCFS) for Kosovo* (issued by the MESP in 2014). There are data for annual carbon emissions in the period 2003 to 2020 (real and estimated) in two climate scenarios. Among other sources of carbon emissions, these scenarios also consider forest fires (Figures 25 and 26).

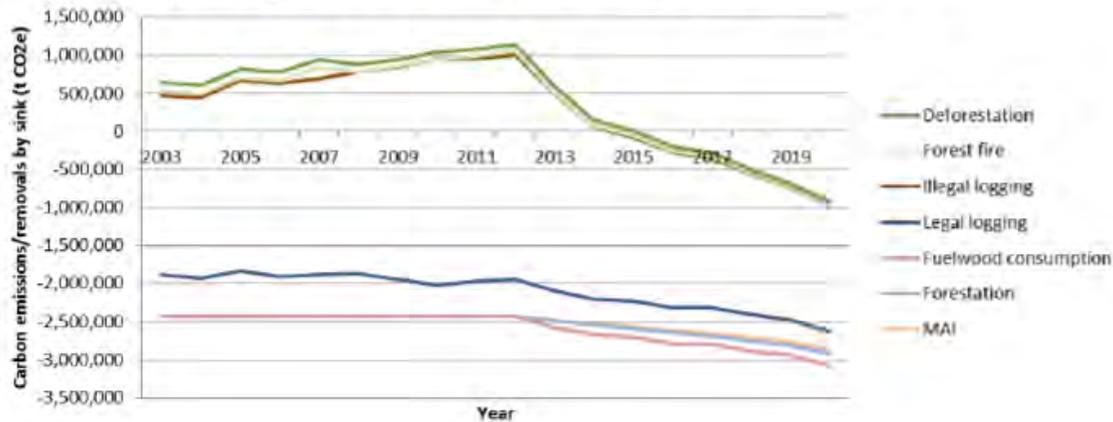
Figure 25. Estimated potential of a portfolio of mitigation activities across time (B1, lower bound)



Source [KOS 6]

Figure 26. Estimated potential of a portfolio of mitigation activities across time (B2, upper bound)

**Annual carbon emissions/removals 2003-2020
with upper bound mitigation activities (based on B2):**



Source [KOS 6]

Former Yugoslav Republic of Macedonia – There are different data on the (social, economic and environmental) damage and losses caused by forest fires in the former Yugoslav Republic of Macedonia, mainly due to the different approaches used to calculate or estimate the damage caused by fires.

For this reason, a forest fire damage and consequence assessment methodology was developed by the Regional Fire Monitoring Center (RFMC) within the framework of the project “Technical Assistance for the Development of an Integrated System for the Prevention and Early Warning of Forest Fires”, a joint project of the CMC and the Japan International Cooperation Agency (JICA). The methodology is undergoing checking, but following approval by all involved institutions it will be officially adopted. However, some aspects of forest fire damage (consequences for human and forest health, loss of biodiversity etc.) are still missing from the methodology.

The main environmental consequences of forest fires (not in priority order) are:

- forest degradation;
- deforestation;
- soil erosion;
- insect infestations and disease outbreaks;
- loss of biodiversity; and
- emissions of GHGs and other gases.

It is very difficult to prove that a particular instance of forest degradation has been caused exclusively by fire. Forest degradation is typically a long-term process caused by a variety of factors (in Macedonian forests by cutting, fires, insects etc.) and it mostly takes place in the country's oak forests (*Quercus* spp).

Deforestation, as a long-term process in the former Yugoslav Republic of Macedonia, is mainly caused by excessive cutting. Forest fires result in short-term deforestation (for a maximum of two years after the fire). After this short period, the native (generative or vegetative) regeneration of the forest begins, or the burned area is reforested (in accordance with the Law on Forests). Nevertheless, even this short period is sufficient for the appearance of the third consequence of forest fires — soil erosion.

The former Yugoslav Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Kyoto Protocol. In 2014, the country therefore prepared its Third National Communication on Climate Change. A national GHG inventory was prepared within the framework of this document. As part of the analysis of land use, land-use change and forestry (LULUCF) for the period from 2003 to 2009, forest fires were identified as the most important factor contributing to high GHG emissions in the period between 2000 and 2007. [FYRM 20]

The JRC estimates the amount of biomass burned and the quantities of emissions from forest fires up until August 31, 2007, at the following levels (10^3 tonnes):

- biomass burned – 288.3
- carbon dioxide (CO₂) – 474.7
- carbon monoxide (CO) – 22.2
- methane (CH₄)– 1.1
- volatile organic compounds (VOCs) – 1.1
- nitrogen oxides (NO_x) – 1.5

The Department of Forest and Wood Protection at the Faculty of Forestry in Skopje, serving as the National Centre for the Health Monitoring of Macedonian Forests, has detected a significant problem with bark beetles (*Ips* spp.) as a consequence of forest fires. After fires in pine forests, these bark beetles regularly attack the damaged and physiologically weak pine trees. After a while, infestation becomes very severe and the insects are able to attack even healthy trees. This species of insect is therefore the most important factor in the degradation of Macedonian forests (especially pine forests). It is very difficult to estimate the damage (whether economic or environmental) caused by such infestations, and their consequences, in relation to forest fires.

The total damage caused by fires (burned timber mass plus suppression fees) in the period between 2004 and 2013 has been estimated by the MAFWE at around EUR 5.1 million. Unfortunately, there is no assessment or calculation of the damage caused to the environment.

According to statistics from the DPR and the MAFWE on human fatalities and injuries, in 2012 four people died (two employees of the regional office of the public enterprise Macedonian Forests, one volunteer and one civilian), and 12 people were injured (seven children and five civilians) as a result of forest fires in the country.

In the last 10 years, only one comprehensive study on the consequences of forest fires in the former Yugoslav Republic of Macedonia has been undertaken (in 2007). Following the declaration of a state of emergency by the Macedonian Government on July 18, 2007, due to the severity of the forest fires, assistance was requested from the international community. As part of that assistance, the United Nations Development Programme (UNDP) and the Macedonian Government, represented by the CMC, agreed that the UN would carry out an assessment once the crisis had started to diminish. According to the agreement, the UN would examine the impact of the fires that had ravaged the country from three perspectives: environment, socioeconomics, and operations (disaster management). The task was completed in September 2007, and the final report, "Ecological Damage Assessment of Wildfires in the Former Yugoslav Republic of Macedonia in 2007", was published in October 2007.

Montenegro – The consequences of forest fires depend on the type of fire, the type of forest, the time and duration of the fire, the size of the burned area and the state of the forest ecosystems. In addition to damage in the form of timber loss, a fire may damage or completely destroy the ecological, social and economic functions of a forest. Such damage is associated with soil erosion, which eventually leads to desolate landscapes where the vegetation is not able to recover.

Even where forest fires do not cause significant direct damage to property, they have an indirect influence on the economy in general (reduced revenues in the timber industry as well as in the forestry, agriculture and tourism sectors). The tourism sector is very vulnerable, especially during the summer season. In case of severe fire seasons in Montenegro, forest fires may lead to significant economic losses, as many tourists leave or decide not to visit the country. Unfortunately, there are no official data regarding such trends.

According to the data for burned areas of forest and forest land from 2006 to 2010 [MNE3], most of the damaged forests are in the karst region (6.8 percent), and the percentage of fire-affected forest land is also highest in the karst region (14.7 percent) and eastern region (11.7 percent).

The total damage incurred during the 2003–2012 period has been estimated at over EUR 6 million. There were no recorded cases of injury or death.

Serbia – There are no data on hospital admissions and premature deaths related to heat and fire episodes in Serbia.

According to the Law on Air Protection, air quality is monitored in cases where there is a reasonable suspicion that poor air quality is harming human health or the environment. In crisis situations, the relevant entities (the Ministry of Environment, Mining and Spatial Planning, and other local units) must be informed immediately. Statistics are available regarding the impact of forest fires on the economy in 2007, 2012 and 2014:

- In 2007, the total burned area (forests, other woodland and other land) was 34,001 ha, and the total damage caused was EUR 31,530,831.
- In 2012, the total burned area (forests, other woodland and other land) was 12,125 ha, and the total damage caused was EUR 112,929,525.
- In 2014, significant areas were affected by floods, causing total damage of RSD 1,074,722,891.49 [EUR 8,956,024].

Conclusions

As mentioned at the beginning of this section, most of the data from the region are related to the size of the burned area, the volume of burned wood mass, the number of people injured, the number of fatalities, suppression expenses, and expenses for the clean-up of the burned areas. There are very few, or only partial, data regarding the negative consequences of fires in terms of forest degradation; deforestation; soil erosion; insect infestations and disease outbreaks; biodiversity loss; emissions of GHGs and other gases; and impacts on human health. This is largely due to the lack of a standard methodology for the assessment of such impacts, damage and expenses. A methodology that incorporates some of these parameters does exist in the former Yugoslav Republic of Macedonia in the framework of the MKFFIS early warning system that was developed under the CMC/JICA project “Technical Assistance for the Development of an Integrated System for the Prevention and Early Warning of Forest Fires”. However, the methodology is still undergoing checks and has not yet been officially adopted.

IV Special issues

Albania

Unexploded ordnance

Several areas of the country are still contaminated with unexploded ordnance (UXO) from the Second World War, although there are no official maps showing its distribution. This represents a potential danger in the case of fires in these areas. There are also landmines along the border area with Kosovo* that injure at least three to five people each year during firefighting.

Transboundary fires and international cooperation

In the past 10 years, transboundary fires in Albania have affected Greece, Kosovo*, the former Yugoslav Republic of Macedonia and Montenegro. Legal agreements on fire suppression have been signed with Italy, Kosovo* and Turkey, and international assistance for the suppression of forest fires has been given by Italy, Germany and Ukraine (during the 2007 and 2012 fire seasons).

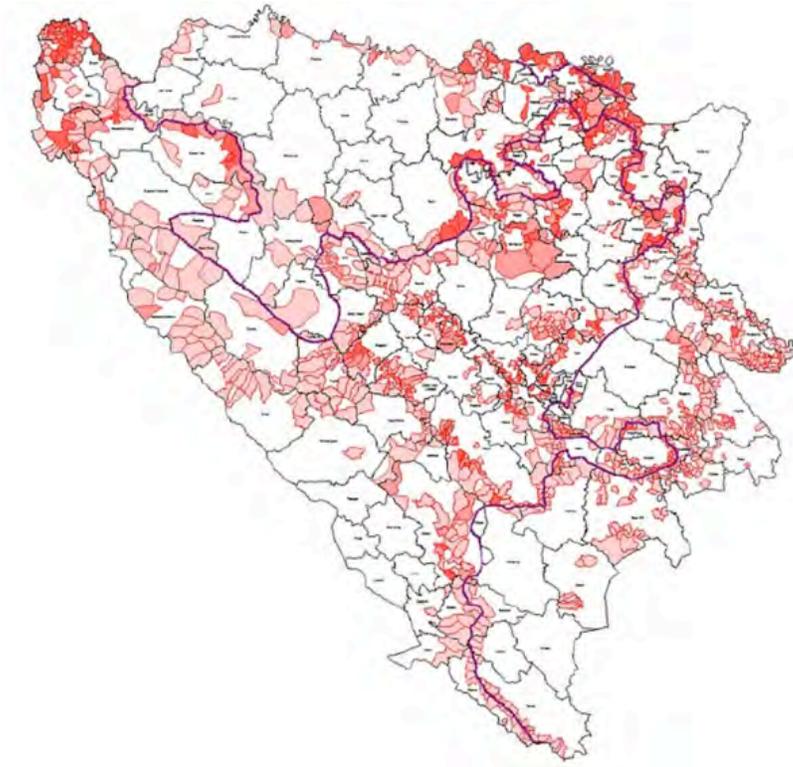
Bosnia and Herzegovina

Landmine contamination

One of the main problems in Bosnia and Herzegovina is the presence of landmines. The area currently contaminated by landmines is estimated at around 1,176.5 km², or 2.3 percent of the country's territory, of which 129,774.6 ha (10.5 percent) are forests or forest land. [BiH 12]

This represents a particular problem in terms of the implementation of the forest fire protection measures prescribed during forest management activities. In addition, it is almost impossible to organise forest fire suppression activities from either the ground or the air.

Map 9. Distribution of landmines in Bosnia and Herzegovina



Source [BiH 2]

Transboundary fires and international cooperation

Forest fires that have spread across the border from Croatia, Montenegro or Serbia have been recorded in the past. The areas most affected by forest fires in Bosnia and Herzegovina are mostly along the borders with Croatia and Montenegro, and cooperation agreements have been signed with both countries. In accordance with these agreements, Bosnia and Herzegovina received assistance from Croatia in 2011, 2012 and 2013, comprising 11 days and 11 aeroplanes (CL 415). Assistance was also provided by Turkey.

Personnel from Bosnia and Herzegovina regularly participate in international exercises and trainings. The most recent international training activity in terms of forest fire protection was the Regional Fire Management Training for South Caucasus and the Western Balkans, held in Antalya, Turkey, on October 15–17, 2014.

Kosovo*

Landmine contamination

As a consequence of events that took place on the territory of Kosovo* in 1998, landmines continue to present a risk. The UN managed a large mine clearance programme in Kosovo* between 1999 and 2001, which resulted in a declaration by the UN in 2001 that Kosovo* was free of mines. Since then, thousands of mines and cluster munitions have been cleared by the limited capacity of all the agencies remaining in Kosovo*. A comprehensive joint survey carried out in 2013 by the HALO Trust (the oldest and largest humanitarian landmine clearance organisation in the world) and the Kosovo Mine Action Centre (KMAC) identified 130 minefields and cluster munition strikes remaining in Kosovo*. Minefields still exist in rural areas where impoverished communities rely on agriculture and woodcutting for their income.[KOS 16] This could be a significant problem during forest fire suppression activities, as well as during forest management activities.

Transboundary fires and international cooperation

There are no data available about transboundary/cross-border fires, or about bilateral or regional agreements.

There is no official national programme or training centre for specialised training in forest fire protection, although various international projects have improved forest fire protection capacities. The first such project was for the establishment and training of a nucleus for forest fire protection in Pec/Peje. This joint project of the Italian State Forestry Service (Corpo Forestale dello Stato) and the MIA was implemented in 2004 and resulted in the training of 250 people in forest fire protection.

The second project was the participation of three people at a training organised in the framework of the Macedonian/FAO project “Strengthening National Forest Fire Preparedness in the Former Yugoslav Republic of Macedonia (TCP/MCD/3201)”, held on November 14 to 17, 2011, in Skopje.

The third project was the participation of three people at the Regional Fire Management Training for South Caucasus and the Western Balkans, held in Antalya, Turkey, on October 15 to 17, 2014.

Former Yugoslav Republic of Macedonia

Unexploded ordnance

Many forest sites and non-forest lands in the SEE region are contaminated by land mines and UXO remaining from recent conflicts. In the former Yugoslav Republic of Macedonia, there is a risk of UXO from the First World War being triggered and exploded by forest fires. The most contaminated area in the country is the 1917 front between Strumica and Bitola (i.e. between the Central Powers in the north and the Allied Powers in the south), where large numbers of grenades and mines pose a threat to firefighters and civilians. During the fires in July 2007, for example, more than 70 ammunition explosions were recorded in the immediate vicinity of Bitola, although fortunately there were no casualties. [FYRM 4]

Map 10. Distribution of UXO in the former Yugoslav Republic of Macedonia



Source: Nikola Nikolov, Wildfires management and UXO, land mines and radioactivity in the region of Southeast Europe/Caucasus, Kiev, 2009

Transboundary fires and international cooperation

The behaviour of forest fires is typically not predictable. Even where the course of the fire is predictable, it may not be possible to control or suppress large fires or fires on inaccessible terrain. For this reason, forest fires that break out in border regions may affect

neighbouring countries. This has happened along the Macedonian border, although such instances are rare. In September 2012, for example, a fire that originated on the Albanian side of the border spread to the Mavrovo National Park, and was tackled by Macedonian firefighters. More than 100 ha of grass and stubble near the forest were burned. In June 2012, a fire that started on the Greek side of the border spread to Kajmakchalan, a highly dangerous area contaminated with UXO from the First World War. Two firefighting planes tackled the blaze. In July 2012, near the Bulgarian border, 20 ha of grass, shrubs and low-quality oak forests were burned, and Bulgarian police assisted in suppressing the fire. No cases have been identified of fires spreading from Macedonian territory into neighbouring countries. In order to regulate such issues and to ensure efficiency in terms of forest fire protection (especially forest fire suppression), the former Yugoslav Republic of Macedonia has signed agreements, or is currently negotiating, with Bulgaria (negotiations), Croatia (agreement signed), Montenegro (negotiations), Serbia (memorandum of understanding), Slovenia (agreement signed), Bosnia and Herzegovina (cooperation agreement signed), Turkey (cooperation agreement signed), France and Hungary (bilateral collaboration). There are occasional exchanges of fire management personnel between the former Yugoslav Republic of Macedonia and neighbouring countries. [FYRM 33]

Besides bilateral and multilateral agreements, the country also has opportunities to offer and receive assistance via the EU Civil Protection Mechanism and its operational heart, the Emergency Response Coordination Centre (ERCC) (previously the Monitoring and Information Centre). The EU Civil Protection Mechanism was established in 2001 to foster cooperation among national civil protection authorities across Europe. The mechanism currently includes all 28 EU member states as well as Iceland, the former Yugoslav Republic of Macedonia, Montenegro, Norway and Serbia. It enables coordinated assistance from the participating states to victims of natural and human-made disasters in Europe and elsewhere.

Rural depopulation and land-use change

Rural depopulation and land-use change have a significant impact on forest fires, not only in the former Yugoslav Republic of Macedonia, but throughout the SEE region and Europe as a whole. In the former Yugoslav Republic of Macedonia, rural depopulation is more significant than land-use change. According to the national land cadastre, there is no significant land-use change in the country.

Rural depopulation has an influence on forest fires in three main ways:

- As a result of migration away from rural regions, large areas of agricultural land (arable land, pastures etc.) have been abandoned during the last 50 years. The lack of grazing and harvesting has resulted in the uncontrolled growth of vegetation, which has led to the build-up of huge amounts of “fuel”. This has increased the risk

of fire outbreaks during the forest fire season in these areas. This build-up of fuel also means that the fires are very severe and difficult to control.

- Some of the abandoned areas are now young forests, although according to the official cadastre they are still agricultural lands. This means that they fall outside forest management plans and are subject to almost no forest fire protection measures. There is a kind of "vacuum" in terms of competency over these areas in relation to forest fire protection.
- Since it is largely young people who are leaving the rural regions, the dramatically declining populations in these areas comprise mainly elderly people. This creates a problem in terms of the early detection of forest fires also affects the organisation of a prompt initial response by members of the local population.

There are no official data regarding the extent of abandoned agricultural lands, although unofficial estimates suggest around 60,000 ha. According to Law on Fire Protection, the territorial firefighting units, landowners, and the DPR are responsible for fire management on these lands.

Montenegro

Cross-border forest fires

Fires have been recorded as having spread into Montenegro from Bosnia and Herzegovina and from Albania.

Rural depopulation and land-use change

Population migration from villages to towns results in the build-up of "fuel" for forest fires on abandoned arable land, and to a shortage of people capable of participating in fire prevention and suppression.

Bilateral agreements

The Government of Montenegro has concluded bilateral agreements in the field of protection from natural and human-made disasters with the governments of Croatia, Greece, the former Yugoslav Republic of Macedonia, Slovenia, Serbia, Slovakia and Ukraine. Memorandums of understanding in the field of prevention and emergency situations have been signed with the Russian Federation, Italy and Armenia. There are also initiatives for agreements with Turkey, France, Bulgaria, Albania and Azerbaijan.

With respect to exchanges of fire management personnel with other countries, three requests for assistance from Albania were received during the fire season in 2012, and just one of them was realised. Assistance was provided by the Russian Federation in the 2007 and 2008

seasons, by Italy in 2009 (via the EU Mechanism), by Serbia in 2010, and by Croatia in 2012 (via the EU Mechanism).

Serbia

Radioactive contamination and unexploded ordnance

The use of bombs containing depleted uranium during the 1999 conflict is a specific problem that may have considerable environmental consequences. The Kingdom of Norway financed a project to identify contaminated areas in the municipalities of Bujanovac, Preševo and Kuršumlija. There are still areas contaminated with UXO, although no data are available. There are large areas of UXO in the area of Dobrosin, in the municipality of Vranje.

Land contaminated by radioactivity poses two main problems:

- It is dangerous for firefighters to remain in these areas during fire suppression because of the harmful radioactive radiation (although the level of radiation is not known).

- Gas emissions from forest fires in these areas will also be radioactive. If transported further by the wind, these contaminants may be deposited over long distances and in urban areas.

Terrain contaminated with UXO presents a danger to firefighters during forest fire suppression activities, but also for foresters and members of the local population.

A significant number of areas have been decontaminated since the bombing in 1999 but are still considered as potentially dangerous sites.

Transboundary fires and international agreements

A forest fire that had spread from Montenegro was recorded in the municipality of Prijepolje in July 2012; a forest fire that had started in Bosnia and Herzegovina was recorded in September 2012 in the Tara Mountain area; and a fire that had started in Bulgaria was also recorded in 2012 in Bosilegrad municipality.

Serbia exchanges fire management personnel with other countries. Assistance was provided in July 2012 to Montenegro; in August 2012 to Greece (Athos); and in August and September 2012 to Bosnia and Herzegovina. Assistance to Serbia has been provided by the Russian Federation.

The country has personnel specially trained and equipped to fight wildfires. The National Training Centre for Emergency Management is responsible for their training. Serbia has participated in joint fire management trainings through terrain simulation exercises in Croatia in

2012, in Slovenia in 2011, in Moldova in 2011, in Turkey in 2010, in Serbia in 2010 and in Croatia in 2007. Fire management materials are very similar in these neighbouring countries. Agreements on joint training, exercises and response have been signed with Slovakia, Azerbaijan, Bosnia and Herzegovina, Montenegro, the Russian Federation, Ukraine and Hungary. Agreements are currently in being negotiated with Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Greece and Romania. Women participate actively in the professional rescue services.

Rural depopulation

Serbia has a negative population growth rate and rural depopulation is very intensive. There is a clear increase in the average age of the rural population and a reduction in the workforce, thus there are fewer capable rural farmers and volunteers available.

The individual analyses above indicate the presence of various special issues in the region in terms of forest fires:

- unexploded ordnance and landmine contamination;
- transboundary fires and international cooperation; and
- rural depopulation.

Unexploded ordnance and landmine contamination

Unexploded ordnance in the region has two origins: UXO and landmines remaining from the conflicts in the 1990s (Bosnia and Herzegovina, Croatia and Kosovo*); and UXO remaining from the First World War (the former Yugoslav Republic of Macedonia). The situation is complicated by the fact that there are no adequate maps available showing the location of UXO and landmines in the region (with some exceptions), and there is no methodology for fire management in these terrains. In forests contaminated by UXO and landmines, this means the absence of any forest management methodology for fire risk reduction and fire suppression tactics.

Transboundary fires and international cooperation

Like other disasters, forest fires do not respect administrative borders. Permanent communication and coordination are therefore essential between the countries of the region in such situations. Firstly, there is a need for joint reporting from the affected area, followed by the organisation of joint fire suppression activities. This may involve firefighters crossing the national borders and pooling their capacities. In order to regulate this issue and ensure that activities are carried out appropriately and safely, certain documents and protocols are required. Almost all

countries in the region have signed bilateral agreements for collaboration on forest fire protection, including agreements with countries outside the region. These agreements cover not only the offering and receipt of assistance during forest fire suppression, but also the joint training of firefighters and other kinds of collaboration.

Rural depopulation

Rural depopulation, as a problem in terms of forest fire protection, has been explained above in the case of the former Yugoslav Republic of Macedonia. The process is ongoing in the region and must be taken very seriously.

V Recommendations for improvements in forest fire management

Based on the foregoing analysis, it is clear that forest fires have been one of the most detrimental factors in terms of forest, forestry and the environment in the SEE region in the past two decades. This is due, among other things, to extremely dry and hot periods (especially during the summer months), weak institutional capacities, poor legal regulations, and a low level of public awareness. The main weaknesses identified in terms of forest fire protection, and the required improvements, are outlined below.

Albania – A large number of institutions and organisations, both public and private, are involved in forest fire protection in Albania. In some cases, this is the main reason for the high number of fires and the large burned areas in some fire seasons. Problems arise when such a large number of authorised institutions and organisations are acting at different levels. In accordance with the legal regulations in force, all these institutions are obliged to carry out certain preventive, pre-suppression and suppression measures. In order to be efficient and effective, these measures must be coordinated and harmonised, and this is particularly important in the case of certain pre-suppression measures (early detection, the training of firefighters, the drafting of operational plans etc.) and during fire suppression. However, this is not what happens in reality, thus the existing regulations need to be reviewed and adjusted. Competencies must be made clear, with no overlapping, and procedures must be precisely established.

There are no qualification standards for personnel involved in firefighting. The Forestry Service provides training for staff involved in forest fire suppression. This training covers basic knowledge and firefighting techniques, but there is no professional training. Several study tours have been organised to Italy and Turkey, but these have been ad hoc and not part of an official training programme, nor are there any official training materials for forest fire protection.

The number of volunteer firefighters (seasonally) is between 2,500 and 3,000. These volunteers are integrated into firefighting operations and trained by the Forestry Service and the Fire and Rescue Training Centre. There are no legal insurance mechanisms and the volunteers are equipped only with hand tools. In addition, several programmes supported by forestry projects have been developed in the past 10 years to involve the local community in fire management. However, the involvement of the local community in forest fire protection (usually only in fire suppression) is only a partial and temporary solution. The organisation of fire protection associations and unions of volunteers (at national and local level), following the experiences of neighbouring countries (Serbia, the former Yugoslav Republic of Macedonia and Croatia), will engage the local community efficiently and permanently. Citizens of all ages can

be involved in forest fire protection, depending on whether the measures are aimed at prevention, pre-suppression or suppression, and this involvement would be permanent throughout the year.

Albania is a hilly/mountainous country with very steep terrain and a fragmented topography. These conditions favour the very rapid spread of forest fires. At the same time, access to such areas for fire suppression is very difficult. This is often one of the reasons for inefficient fire suppression and large burned areas. In order to improve the situation, the network of forest roads should be expanded (in accordance with the needs of the Forestry Service and the community).

There is a lack of professionally trained firefighters (in both the Forestry Service and the emergency services). There is also a lack of equipment, especially off-road vehicles. In this respect, it would be appropriate for the equipment to be provided first of all, and for trainings to be organised subsequently for firefighters on using the new equipment. This is particularly important in the case of specialised vehicles.

Bosnia and Herzegovina – As outlined above, the unique political structure of Bosnia and Herzegovina has an impact on the functioning of its public institutions and on all areas of public life, including forestry and forest fire protection. As a consequence, a large number of institutions (at state, federal, cantonal and municipal level) are involved in forest fire protection. In order to organise their activities and competencies, there are also a large number of legal acts (laws, by-laws, rulebooks etc.). This goes some way to explaining why the system of forest fire protection in Bosnia and Herzegovina is not as efficient as it should be. It can be concluded that the number of laws regulating this issue should be dramatically decreased, while the most important legal acts among entities and institutions should be harmonised. This is one of the most important preconditions for the better functioning of the forest fire protection system in Bosnia and Herzegovina.

The existence of a proper early warning system for forest fires may significantly improve preparedness for forest fire protection in Bosnia and Herzegovina. At present there is no early warning system in the country, with the exception of the possibility to use the European Forest Fire Information System (EFFIS). Taking into consideration the specific local context in Bosnia and Herzegovina, this system can be seen only as a temporary solution, and the need for a national early warning system remains.

The country also faces the problem of ensuring the existence of well-trained firefighters and appropriate vehicles for forest fire suppression. There is a need for training centres at entity level, offering the same (i.e. harmonised) training programmes. Special vehicles (fire trucks) for forest fire suppression must be procured using the same approach in both entities. All this will ensure that there are well-trained firefighters and appropriate vehicles, and, more importantly, will lead to an efficient, harmonised and functional forest fire protection system.

According to past experience and the 2014 study *Forest Fire Suppression in Bosnia and Herzegovina* [BiH 4], there is clearly a need to procure aerial means (aeroplanes and/or helicopters) for forest fire suppression.

The problem of the contamination of forests and forest land with landmines has already been emphasised. There are two urgent approaches related to “solving” this problem. The first is that all areas contaminated with landmines should be precisely mapped and the data made available to the public. This is vital not only for the local population and institutions competent for forest fire protection, but also in terms of the equipment (mainly aeroplanes) received as international assistance. The second is to identify the most appropriate way to manage these areas in order to reduce the risk of forest fires, and to select the most appropriate means of fire suppression. The final de-mining of these territories is, of course, essential.

Kosovo* – The existing laws and legal acts that regulate forest fire protection need to be harmonised. The issue of forest fires is currently regulated by a variety of laws implemented by different institutions, thus there are some overlapping competencies, uncertainties in procedures, and a lack of tools for coordinating activities between institutions.

There are no specialised, well-trained forest firefighters, and no educational institutes for training decision makers, planners, command staff or firefighters. In order to improve this situation, a special programme should be created for training existing firefighters and new personnel. This is equally important for the KFA and the EMA and is also related to the findings regarding the current legal regulations.

There is also a lack of special vehicles for forest fire suppression: there are no first-response vehicles in the forestry sector and no off-road fire trucks in the framework of the EMA.

There is no voluntary fire protection organisation in Kosovo*. One of the ways in which members of the local population can be actively involved in protection against fires (including forest fire protection) is through the establishment of voluntary organisations. Through the activities of such organisations, people of all ages can be engaged in forest fire protection (i.e. in prevention, pre-suppression and suppression). This is one of the best ways to raise public awareness, increase the preparedness of local communities for forest fire suppression, and address the problem of the lack of personnel in the relevant institutions.

One of the preconditions for defining the level of preparedness of the institutions responsible for forest fire protection during the fire season is the existence of an appropriate early warning system. Such a system in Kosovo* would allow the institutions responsible for forest fire protection to be more efficient and better organised.

Former Yugoslav Republic of Macedonia – Legal regulations with respect to forest fire protection in the former Yugoslav Republic of Macedonia are at a satisfactory level. However, there is still a need for a law or other legal document that harmonises the activities of the different institutions and organisations. One possibility would be to adopt a national plan for forest fire management. A document of this kind is being drafted in the framework of the FAO/TCP/MCD/3201 project "Strengthening National Forest Fire Preparedness". The role, purpose and tasks of the plan are outlined as follows:

“The National Fire Plan (NFP) is being created to ensure the safe, effective, and coordinated management of wildland fires. All entities covered by this plan agree to follow the procedures, protocols, and requirements included in the NFP as well as those adopted by the actions of the Steering Committee under the authorities included in this plan.

The NFP Steering Committee will be established with representatives from each of the departments and agencies covered by this plan. The individuals appointed to the Steering Committee will hold positions within the agencies, and have the authority to propose, negotiate, and approve all measures authorised in the NFP. The individual members will also take appropriate actions within their agencies to ensure that policies, procedures, and actions are understood and that the agencies initiate whatever process is required to comply with the requirements of the NFP.

The Steering Committee will appoint working groups to develop guidelines and protocols. The working groups will be staffed with qualified members of the appropriate agencies and organisations, including representatives from other groups not included on the Steering Committee if needed, to provide expertise and guidance. The working groups will develop plans, products (such as training materials) and guidelines. Final products will be submitted to the Steering Committee for adoption under the authority of the NFP.”

Another aspect that needs to be improved is the organisation of forest fire prevention campaigns (e.g. public awareness raising and educational campaigns). According to certain laws, the entities that manage forests and forest lands are obliged to undertake all measures for forest fire protection, including preventative measures. The related campaigns are organised separately by the managing entities, in an uncoordinated and non-harmonised manner, conveying different messages and with some overlapping. In this context, particular attention should be given to the following pre-suppression measures: the provision of specialised (properly trained) forest firefighters; the procurement of special vehicles and tools for forest fire suppression; the enhancement of the quality of planning documents; and the strengthening of research capacities.

The existence of specialised (properly trained) forest firefighters is one of the preconditions for effective and efficient forest fire suppression. Currently, the country has no specialised or well-trained forest firefighters, nor does it have an educational institute dedicated to the training of such personnel. In order to solve this problem, a special programme should be created for

training already active firefighters and new personnel. It would be aimed primarily towards the forestry sector (the Macedonian Forests public enterprise, national parks etc), the DPR and TFPUs. Relevant trainings have been organised within certain projects in recent years, for example the TCP/FAO project in 2012 and 2013 (trainings for trainers); and the OSCE/ENVSEC project “Enhancing National Capacity in Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus” (Antalya, Turkey) in 2010 and 2014. However, these were one-off activities.

The issue of training is closely connected with the need for proper equipment, tools and vehicles for forest firefighters. As well as being appropriately trained, firefighting personnel must be adequately equipped. At the moment there is a lack of equipment (mainly personal protective equipment), hand tools and special vehicles. The existing vehicles (off-road vehicles for initial response and special fire trucks) are very old and in poor condition. The number of hand tools is limited and the tools are not appropriate for the specific terrain and vegetation conditions.

Almost all measures for fire prevention and pre-suppression have to be prescribed and described in the framework of planning documents. In the forestry sector, these documents are the 10-year management plans and annual operating plans, while in the case of the DPR they comprise strategic and annual operating plans. The quality of the existing plans does not correspond to the current situation and needs.

Besides these prevention and pre-suppression measures, there are two other specific issues that should be addressed. One such issue is research in the field of forest fire protection. The only relevant national institute is the Faculty of Forestry in Skopje (Department of Forest and Wood Protection), and research is also carried out by the RFMC as a regional branch of the Global Fire Monitoring Center (GFMC). Many projects have been implemented to date, although there is no permanent research programme. Due to the increasing problem of forest fires in the former Yugoslav Republic of Macedonia and the technologically and scientifically advanced methods currently being used in forest fire protection, there is a clear need for a better national research programme.

The second issue concerns UXO. There is no precise map showing the distribution of UXO in forests and forest lands, which creates problems during forest fire suppression activities in these areas. A management approach, along with tactics/procedures for forest fires suppression in these areas, have not yet been defined, which remains a challenge.

Montenegro – There are various ways in which forest fire protection management in Montenegro should be improved.

A law on fire protection should be adopted, as there is no such law at present. Some issues related to forest fire management are regulated in existing laws (e.g. the Law on Forests and the Law on Protection and Rescue), but this is not sufficient. There are no regulations on

special equipment for forest fire suppression, personal protective equipment, volunteers etc. The new law on fire protection should regulate the formation, organisation and activities of firefighting units, fire protection associations and volunteers, as well as fire suppression and the conditions for producing, using and maintaining appliances, equipment and means for fire suppression.

The lack of such a law causes problems for various institutions (the Forest Administration, the DPR, local self-government units etc.) in regulating forest fires and harmonising joint activities.

The training of firefighting personnel is an issue of the utmost importance. In Montenegro there are 582 local rescuers (who also serve as forest firefighters), but only 117 of them have completed a specialised course on wildfires in the framework of projects and international training programmes. According to the Law on Protection and Rescue, all rescuers are obliged to complete basic training, but because of problems with the establishment of the National Training Centre, most rescuers have not completed such training. Some fire management training has been organised in neighbouring countries, thus Montenegro might make use of identical training materials and approaches.

There are no trained forest firefighters in the forestry sector (in either state-owned or private forests).

There are only three units of volunteer firefighters, with a total of 84 rescuers. These volunteers are mainly engaged in forest fire suppression activities during the summer fire season by the DPR. However, as has already been mentioned, their activities are not properly regulated and there is no national organisation of fire protection volunteers.

Improvements to the Law on Forests and the preparation of other legal acts can also be considered necessary. Although current legal acts contain some articles related to forest fires, the current Law on Forests must be improved, especially in relation to forest management. These improvements should be accompanied by the drafting of further legal acts, such as rulebooks.

There is also a need for a rulebook on the preparation of an annual forest fire operational plan, as well as a rulebook on special measures for forest fire protection (both intended for the forestry sector).

Serbia – In general, the legal regulations and institutional set-up with respect to forest fire protection in Serbia are at a satisfactory level, but some improvements still need to be made.

Early warning system

The Emergency Management Sector of the Ministry of the Interior of Serbia has compiled a natural disaster risk map for the country. Since 2008, the State Hydrometeorological Service of Serbia (RHMS) has forecast the risk of forest fires using the Canadian Fire Weather Index method. The RHMS also has a unique hydrometeorological early warning system, integrated into the National Protection and Rescue System as well as European and global hydrometeorological systems and programmes, which provides timely and accurate information, forecasts and warnings.

However, there is still a need for an early warning system for forest fires. This could be designed on the model of the European Forest Fire Information System (EFFIS) or the Macedonian Forest Fire Information System (MKFFIS). This kind of early warning system would serve as a basic tool for use by all institutions and organisations involved in forest fire protection in Serbia for planning their activities and resources.

Special vehicles and equipment

Although all institutions involved in forest fire protection have certain resources in the form of special vehicles and equipment, they are not sufficient. Most of the vehicles are obsolete, and the newly procured vehicles are almost all designed for urban fires. Other forest fire suppression equipment (hand tools, water supply systems, personal protective equipment etc.) is either obsolete or lacking.

Trained personnel

As mentioned above, Serbia has specially trained and equipped personnel for tackling wildfires, and the National Training Centre for Emergency Management is responsible for their training. However, bearing in mind that the forestry sector (public enterprises, national parks etc.) is responsible for forest fire protection, including fire suppression, there remains a shortage of trained personnel. The forestry sector is obliged to organise initial response and to participate in fire suppression, therefore more trained personnel are required for forest fire suppression.

Revision and improvement of forest fire protection plans

Although forest fire protection plans exist, some are not of appropriate quality, and their content is more formal than operational. Such plans need to be more accurate in terms of prescribed measures and duties in accordance with the competencies of the institutions. All plans must be harmonised in terms of content, quality and prescribed measures and activities.

Regional forest fire management issues

Although all fields/topics/issues related to forest fire management that require improvement or strengthening are explained above for each individual country, some are summarised below at regional level.

Institutional and sectoral responsibilities in forest fire management

The nature of wildfires dictates that their direct management — from prevention to preparedness to suppression — must be undertaken at a very local level. Land must be managed for prevention by the Forestry Service, individual foresters and farmers; and firefighters must be ready to respond quickly to nearby fires. However, this local organisation must be part of a broader, landscape-scale strategy to reduce the damaging potential of fires on the environment. This must be expressed in the land management and emergency response policies under which various agencies and sectors have obligations to manage aspects of wildfires.

A common theme running through the legislation and institutional set-up of the individual countries is that the relevant agencies and sectors undertake wildfire management activities to some extent in isolation from one another. Preventive action, in particular, is not connected to responsibility for suppression. The highest level of inter-sectoral coordination exists in relation to suppression activities, but it is still insufficient. The existing laws and institutional set-up need to be revised and improved in all the analysed countries.

Abandoned agricultural land and pastures

In contrast to trends elsewhere in the world, where primary forest is being cleared to make way for agricultural land and developments, the area of agricultural land in many parts of the SEE region is decreasing as fields are abandoned. This trend is associated with the ageing of rural communities and the migration of young people away from villages in the hope of better opportunities and lifestyles in urban areas or abroad. This is true of all the analysed countries with the exception of Kosovo*.

In terms of wildfires, this results in a greater threat to the remaining rural populations, settlements and resources. Due to the increasing quantity of fuel in abandoned fields, highly flammable areas are connected in the vicinity of rural settlements. To compound the problem, the ageing, declining and scattered populations in these areas have little capacity to prepare themselves for, or defend themselves against, the threat of uncontrolled fires.

Unexploded ordnance and landmines

The presence of UXO is an emerging concern in the management of wildfires on any land with vegetation cover. The combustion of UXO and the dispersal of contaminants pose a threat to the public and the environment over a wide area, and a particularly serious threat to firefighters working in contaminated areas.

Unexploded ordnance can be found on hundreds of thousands of hectares of forests and other land throughout the SEE region. Remnants from First World War battles along the 1917 frontlines in the southern area of the former Yugoslav Republic of Macedonia have repeatedly caused problems. During the 2007 fire season, for example, over 70 explosions of ammunition triggered by forest fires were recorded.

On some sites of earlier armed conflicts on the territory of the former Yugoslavia (e.g. in Bosnia and Herzegovina and Kosovo*), active landmines are limiting access and forest and fire management over large areas. In Bosnia and Herzegovina alone, more than 200,000 ha of forests are contaminated by landmines, and landmines are also a problem in Albania.

Improving the mapping of contaminated areas and gaining a better understanding of how to manage such lands in the interests of ecology, fire prevention and safety are essential activities in the above-mentioned countries.

Specialised training and personnel

Due to the nature of wildfires, those involved in prevention and suppression activities require additional skills and specialised equipment. This is particularly important in cases where wildfires are only one aspect of the firefighters' work, rather than their professional focus.

There are no firefighters dedicated primarily to tackling wildfires in any of the analysed countries. Firefighters in the forestry sector are recruited from among the sector's permanent employees (forest workers, forestry engineers etc.), and only for forest fire suppression activities. In most cases, emergency responders are given some level of specialised wildfire training to complement their primary roles in civil protection, urban firefighting or military service.

Training and expertise are shared among some of the countries in the region on an ad hoc basis.

Volunteer firefighters

The recruitment of volunteer firefighters is a popular way both of engaging local populations in wildfire management and of increasing overall wildfire response capacities in a cost-effective manner by training and equipping a widespread, part-time force of local people to assist in fire emergencies.

Although the approach taken varies greatly across the SEE region and beyond, some aspects are generally considered desirable, including: sufficient and compatible training to enable volunteers to effectively assist professional fire responders; sufficient and compatible equipment and communications; and reasonable financial and legal assistance and insurance to protect volunteers, their families and employers should volunteering result in time off work, injury or, at worst, fatality.

A comprehensive organisational structure of this kind exists only in the former Yugoslav Republic of Macedonia and Serbia, and only some aspects of it in Montenegro and Bosnia and Herzegovina. Where volunteer fire brigades exist, but without taking into consideration all the above-mentioned factors, the reasons for their shortcomings may be simply lack of funding, inadequate representation at higher levels of government, or even a preference to remain autonomous and self-reliant.

Special vehicles and equipment

As indicated above, there are a large number of institutions and organisations involved in forest fire protection, including forest fire suppression. All of them have certain resources for forest fire suppression (tools, equipment, vehicles etc.) at their disposal, but they are not sufficient.

Much of the equipment is outdated (the specialised vehicles, for example, are typically over 30 years old), non-operational or insufficient. The institutions and organisations involved in forest fire protection do not take the same approach or follow the same rules when it comes to the procurement of equipment and vehicles. All equipment and vehicles, regardless of ownership, must be part of the unique national forest fire protection system.

Newly procured vehicles are almost all designed for tackling urban fires. Other forest fire suppression equipment (hand tools, water supply systems, personal protective equipment etc.) is either obsolete or lacking. This is the case in all of the analysed countries. The equipment and vehicles currently in use need to be reviewed and a comprehensive national plan and strategy drawn up, including short-term, mid-term and long-term activities for the improvement of the situation. This must be done taking into consideration EU regulations and standards for the relevant equipment and vehicles. In this way, national resources would be shared efficiently at regional and wider level.

Participation of civil society

The goal of most agencies tasked with managing wildfires is to protect public assets as well as the lives, livelihoods and assets of the communities living in those areas that may be affected

by fires. Engagement with these populations can take a number of forms, including the formation of volunteer fire brigades, as mentioned above.

The most common form of engagement with civil society is raising public awareness of the possibility of wildfires during the fire season, along with providing advice to evacuate the area or take cover in the event of a wildfire. Emphasis is given to preventing forest fires from being started accidentally, for example by campfires or cigarette ends. Forest recreation areas may even be closed when the risk of fire is particularly high. Public information is usually disseminated via television and radio and roadside signage. Advice may also be published on websites in an attempt to reach a wider audience.

In the former Yugoslav Republic of Macedonia, in order to reduce the risk of accidental fires, members of the Fire Protection Union carry out "inspections" of the condition of farm machinery and the presence of fire extinguishers, ensuring adherence to fire prevention laws.

Year-round initiatives are also implemented, for example in the former Yugoslav Republic of Macedonia and Serbia, to raise awareness of the steps that individuals and organisations can take to reduce the national wildfire threat. The former Yugoslav Republic of Macedonia, for example, has a "Month for Protection against Fires" and a "National Day of Firefighters". An inter-sectoral approach is taken, integrating the agricultural sector in the fire management dialogue.

These are just a few examples of good practice in the region, but there is still a need to strengthen the participation of civil society in forest fire protection in all the analysed countries.

Use of advanced data and information systems (forest fire early warning systems)

In all countries in the region, a system operates during the fire season to provide at least the daily evaluation and reporting of the weather conditions in relation to fires, based on hydrometeorological input data. Almost all the systems in the region are based on the adapted Canadian Fire Weather Index (FWI) scale.

All the countries use internationally available datasets, such as the Moderate Resolution Imaging Spectroradiometer (MODIS), the European Forest Fire Information Service (EFFIS), the EU Meteorology Satellite (EUMETSAT) or the Canadian Global Early Warning System (EWS). Only the former Yugoslav Republic of Macedonia has its own national forest fire early warning system (MKFFIS).

There is an urgent need to develop a national forest fire early warning system in each of the other countries. In the future, using these national systems, a regional SEE system could also be developed.

Fire research and its application in forest and fire management

Research into wildfires and wildfire management can be divided into two broad directions. The first is related to the institutions carrying out the research. In the case of Spain, for example, research into wildfires is undertaken within the forest industry/forestry. This may contribute to reinforcing the misleading notion that vegetation fires are predominantly a “forest” issue. On the other hand, research in the former Yugoslav Republic of Macedonia, Serbia and Bosnia and Herzegovina is integrally linked to university departments that specialise in forestry, fire science, natural disasters and atmospheric science. No research is currently being undertaken into wildfires or their management in Albania, Kosovo* or Montenegro.

Another way of approaching wildfire research is to look at the main topics being investigated. In cases where the science of fires in the environment is at a relatively early stage, research is dominated by the exploration of fundamental fire behaviour and fire ecology topics, as researchers and managers alike attempt to understand the nature of fire in the landscapes of interest. This approach is taken in the former Yugoslav Republic of Macedonia and Bosnia and Herzegovina. Regardless of the approach used, wildfire research must be strengthened in all countries in the region.

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Forest Fire Country Studies

Republic of Albania



FOREST FIRES COUNTRY STUDY

REPUBLIC OF ALBANIA

2015

**Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations.....	3
I. The forestry sector, forests and fire history	4
1.1. Characteristics of forests	4
1.2. Major forestry stakeholders	8
1.3. Fire history	14
II. Legal framework and institutional set-up in the field of forest fire management	17
III. The impact of wildfires on the environment, economy and human health	21
IV. Special issues	22
V. Needs for improvement in forest fire management	23
Literature	25

Abbreviations

MAF	Ministry of Agriculture and Food
MCPFE	Ministerial Conference on the Protection of Forests in Europe
DGFP	Directorate General of Forests and Pastures
MoEFWA	Ministry of Environment, Forests and Water Administration
CCD	Coordination and Control Directorate
SCPC	Sector of Coordination and Police Control
ME	Ministry of Environment
SIEFW	State Inspectorate of Environment, Forests and Waters
RFSD	Regional Forestry Services Directorate
PA	Protected area
NP	National park
IUCN	International Union for Conservation of Nature
FPUA	Forests and Pastures Users' Association
LGU	Local government unit
CFP	Communal forests and pasture
DCEPR	Department of Civil Emergency Planning and Response
DRR	Disaster risk reduction
DFFRO	Directorate of Firefighting and Rescue Operations
UXO	Unexploded ordinance
DTFP	Directorate for Treatment and Forest Protection
NFCFP	National Federation of Communal Forests and Pastures

Kosovo This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.*

I. The forestry sector, forests and fire history

1. Overview of the forestry sector

Article 2 of the Law on Forests and Forestry Service (No. 9385 of April 5, 2005) contains the following definitions of forests and forest land in the Republic of Albania:

“Forest is land with a dense array of forest trees in stable form or other forest vegetation with low density, with an area greater than a tenth of a hectare with coverage of not less than 30 percent, that produces a timber mass, an impact on the surrounding environment and that provides the functions of the forest.

Forest land (open forest) means land surface with forest vegetation and another non-forest vegetation, with coverage from 5 to 30 percent, bare surfaces, rocky places, eroded and non-productive lands, nurseries, forest roads, land not registered as having another use in the land-use cadastre, and similar agricultural lands ecologically functional in the national forest fund, which all together provide the functions of forest.” [2]

1.1. Characteristics of forests

Albania is a mountainous country with greater topographic and climatic variety than any other European country: 52 percent of its surface is at an elevation of between 600 and 700 metres above sea level, with prevailing steep slopes (around 30 percent). Thus around 90 percent of its surface is subject to severe erosion. The northern, north-eastern, south-eastern and central areas are characterised by hilly/mountainous terrain, while the southern area along the Adriatic and Ionian coast is lowland.

All the forests (public and private) that make up the forest fund of Albania are grouped into 36 administrative units. There are 1,498,957 ha of forest area in Albania, subdivided according to the categories shown in Table 1.

Table 1. Subdivisions of the forest fund in Albania

Forest	1,498,957 ha	100%
High forest	294,957 ha	19.68%
Of which: - Coniferous	84,461 ha	
- Broadleaved	210,496 ha	
Coppice forest	405,016 ha	27.02%
Shrubs	241,724 ha	16.13%
Open forest	557,260 ha	37.17%

Source: [4]

The productivity of Albanian forests is 1.4 m³ of wood mass/year/ha, which is far lower than in other European countries. Changes in the landscape caused by opening up land for agriculture and heavy grazing; population growth; fires; increased demand for fuel wood and timber, etc. are important factors contributing to forest degradation in Albania.

The ownership of forests and forest land is addressed in Article 15 of the Law on Forests and Forestry Service:

“Ownership of national forests

1. National forests, by ownership, are divided into:

- a) publicly owned forests;*
- b) privately owned forests.*

2. The public forests are owned and managed by the Directorate General of Forestry Service and its subordinate bodies and local government bodies.

3. The public forests are divided into:

- a) forests and forest land owned by the state (state forests);*
- b) forests and forest land in use or owned by local governments (communal forests).*

4. The private forest fund (private forests) consists of:

- a) forests and forest land in private ownership;*
- b) trees and groups of trees that are located within the boundaries of the land in private ownership, new forests that are planted in these lands, and parts of privately owned forest.” [2]*

State forests are owned by the state.

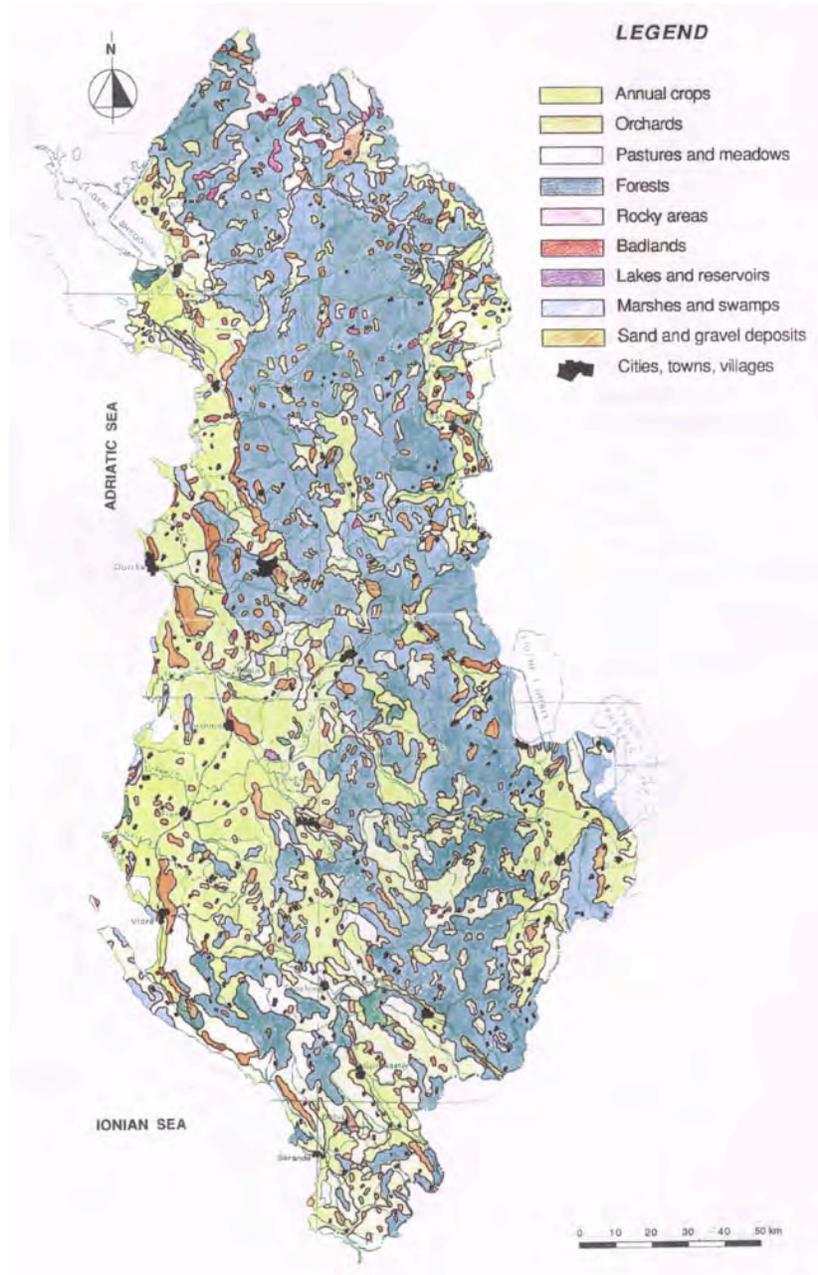
Communal forests are forests owned by the state but given over for communal use to a village or to several villages or communes. In accordance with criteria developed by the Ministry of Agriculture and Food (MAF), parcels of communal forest from 0.4 to 1 ha per family may be given for use to households of permanent residence in the village, subject to agreement between the local government and the forest authority. The specific rules and criteria for the definition and administration of these forests are the subject of a special regulation of the MAF.

Private forests are any bodies of trees and any forests created within the boundaries of land recognised as private property. [5] Up until 1945, private forests in Albania covered 63,000 ha out of the 1,379,000 ha of the total forest area, according to the available data. After 1945, the mass nationalisation of private property started and a few years later the concept of private ownership vanished. The restitution of private forests to their former owners began after 1996. A total of 19,000 ha, or less than 30 percent of private forest area, had been restored to their

former owners by December 2007. The restitution process is very slow and the former owners face various problems in relation to the management of their forests. [4]

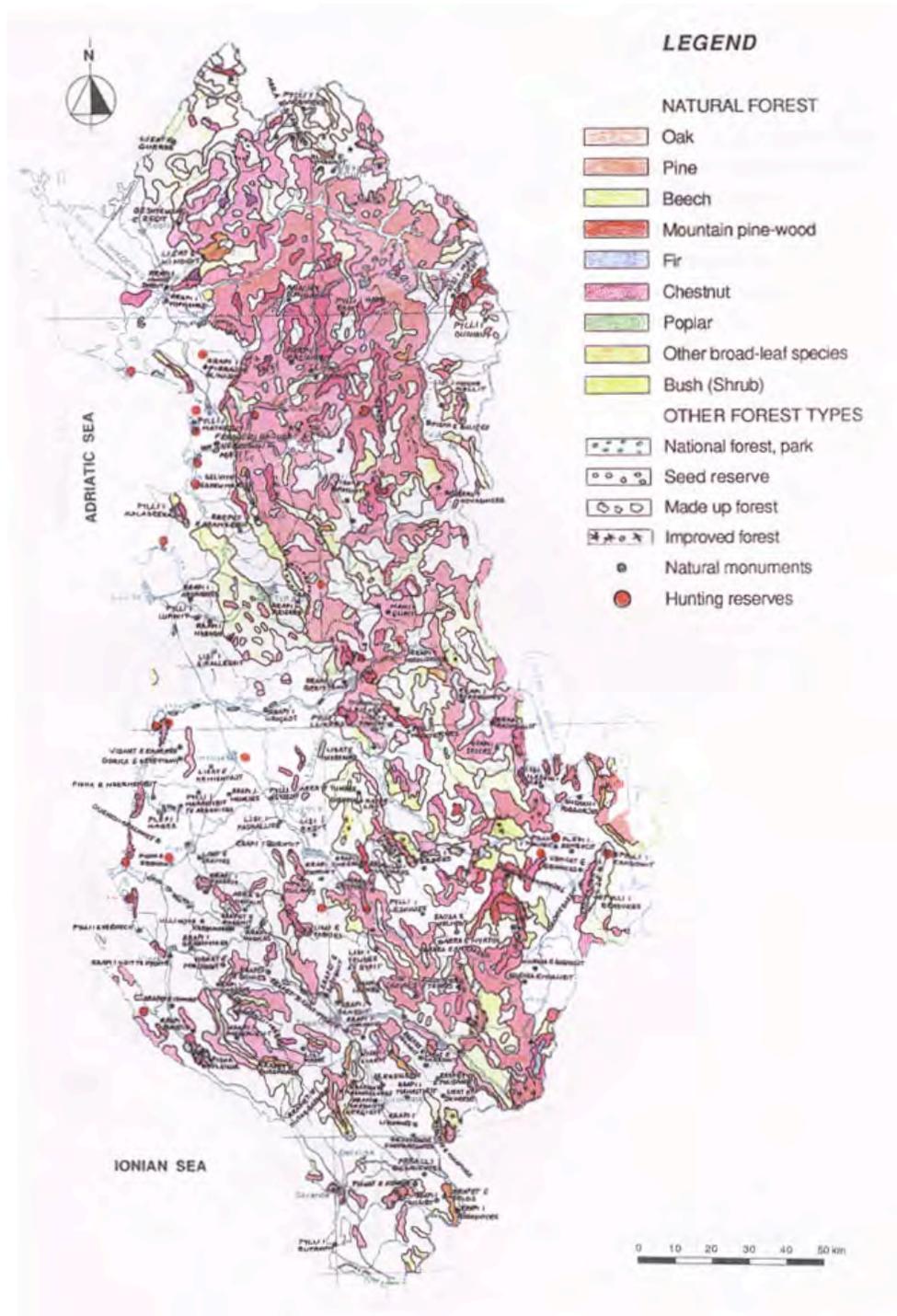
According to data from the Ministerial Conference on the Protection of Forests in Europe (MCPFE), 15.8 percent of the forests in Albania are protected forest areas. This equivalent European average is about 12 percent. [6]

Map 1. Land use in Albania



Source: [3]

Map 2. Forest types and forests by purpose



Source: [3]

1.2. Major forestry stakeholders

After the democratic transition in the 1990s, the process of restructuring the forest administration towards a market economy began. According to the 1992 Law on Forests and the 1993 Law on Forest Police, the district forest enterprises were transformed into forestry service directorates under the DGFP. By the end of 1997, the DGFP had five main directorates. At local level, forest control and forest management were delegated to 36 forestry service directorates, functioning at district level. Between 2002 and 2003, the DGFP began the process of institutional reform in the forest sector. In September 2005, the DGFP was abolished and the forestry sector was transferred to the Ministry of Environment, Forests and Water Administration (MoEFWA).

These reforms were aimed at dividing the regulatory and managerial functions by separating the Forest Police from forest management. With respect to illegal logging, the key body within the MoEFWA became the Sector of Coordination and Police Control (SCPC) under the Coordination and Control Directorate (CCD), which is responsible for planning and coordinating activities related to forest protection. The 36 district forestry services report indirectly to the SCPC through the General Secretary of the MoEFWA. Each of them has a specialised unit, the Sector for Forestry Police, responsible for control and monitoring. The institutional reform of the forestry sector has not been completed at the level of the district forestry service directorates, which carry out control and monitoring, the management of forest resources and the management of protected areas and hunting. This means that at field level the regulatory and managerial functions have not yet been separated. For this reason, at the beginning of 2010 the MoEFWA started to reorganise the Forestry Service on a regional basis, dividing the managerial functions and forest extension service and the regulatory and control functions into two separate bodies. [7]

In January 2014, the Council of Ministers decided to separate the Forest Police and control functions from the Forestry Service. Since then, forest management has been under the Directorate for Treatment and Forest Protection within the newly named Ministry of Environment (MoE), which delegates forest management to 12 regional forestry services. The Forest Police and control functions are under the State Inspectorate of Environment, Forests and Waters (SIEFW), which delegates control to 12 regional inspectorates at local level. Based on the reforms transferring communal forests to local-government units, the shift will be complete by 2016. According to the 2015 draft decentralisation strategy, the forests will be owned by the local-government units and the responsible ministry will be the Ministry for Local Government.

1.2.1. Ministry of Environment

The MoE works to guarantee a healthy environment for citizens; and to protect the environment from pollution, damage, the negative impacts of economic activities and other human impacts. The ministry must consider the environment as an added value for the generation of economic activities and protect it for future generations.

After the most recent government changes the forestry sector remained within the MoE, and institutional reform is ongoing. This reform has changed the structure of the administration of the forestry sector, with the Forest Police and control divided from management as separate institutions.

The main directorates within the MoE are the Directorate of Water Resources; the Directorate of Biodiversity and Protected Areas; the Directorate of Environment; the Directorate for Treatment and Forest Protection; and the Directorate of Priorities (which includes the sector of sustainable development of natural resources). All these directorates are under the General Directorate of Environmental Policies and Priorities.

The forestry sector comes under the jurisdiction of the Directorate for Treatment and Forest Protection. This directorate is responsible for forest management; the development of policies for the management of forests and pasture resources; the governance of forests and pastures; and forest extension services. Within this directorate are:

- the Sector for the Management and Treatment of Forests and Pasture; and
- the Sector for the Forest Cadastre and Communal Forests.

Since January 2014, the local forestry service is organised at regional level through the Regional Directorate of Forestry Services, which is responsible for the management of forests. Since January 2014, there is no longer a forestry service at district level.

Through this new re-organisation, and based on a decision of the Council of Ministers of January 2014, the State Inspectorate of Environment, Forests and Waters (SIEFW) was created as a separate institution.

1.2.2. The Forest Service

The management of state forests is delegated to the Public Forestry Service at local/regional level, which is under the direct responsibility of the MoE. The Forestry Service was established on the basis of forestry legislation and decisions of the Council of Ministers, both of which have undergone considerable changes since 1990. Prior to January 1, 2014, the Forestry Service was organised at district level, and both the Forest Police and forest management sectors were included in the district forestry service. As already mentioned, as of January 1, 2014, the Forestry Service and Forest Inspectorate are two separate units that operate at regional level. Illegal activities and forest crimes are monitored and controlled by the inspectorate. The Regional Forestry Services Directorate (RFSD) is responsible for the overall management of

state forests, silviculture, wood production, forest protection, the afforestation of barren land, the management of non-timber forest products, and support to other forest functions. The RFSD is responsible for the management and administration of protected areas and national parks. It is also responsible for providing services to forest users and communes, and for the management of communal forests and private forests. The Forestry Service has faced a variety of complex situations over the last two decades.

1.2.3. The State Inspectorate of Environment, Forests and Waters (SIEFW)

A Council of Ministers decision of January 29, 2014, created the SIEFW, which was at first a separate institution within the framework of the MoE. The SIEFW controls the enforcement of laws in the field of environment, forests and waters, and is responsible for all the functions of inspection in relevant fields in accordance with the responsibilities of the MoE.

There are four sections within the inspectorate: forestry, environment, water and finance. The inspectorate is organised and functions at national and regional level. At national level, the SIEFW plans and coordinates controls at national and regional level; ensures the harmonisation of inspection practices at national level; coordinates inspection activities; and provides technical, administrative and scientific support for inspection activities. The inspectorate controls and supervises the enforcement of the Law on Forests, the Law on Hunting and all other laws related to forestry, hunting and the environment. There is a regional office of the SIEFW in each of the 12 counties in Albania. These branches coordinate tasks with the customs offices and other relevant institutions for the prevention of damage to the environment, forests and waters.

1.2.4. Faculty of Forest Sciences

The Faculty of Forest Sciences was established in September 1959 in Tirana and is one of the faculties of the Agricultural University of Tirana. The faculty comprises two departments:

- The Department of Forestry works in the field of forest management, wildlife management, erosion control, environment and forest policy and economics.
- The Department of the Wood Industry deals with research related to physical properties of wood and wood macroscopy.

The main role of the faculty is education, scientific research and applied work in the field of forestry. The Faculty of Forest Science is the main educational institute in the field of forestry. Through its scientific work it contributes to the development of new forest management techniques, new policies for forest and nature management, practical guidance for plant breeding, and other work related to forestry and nature conservation.

1.2.5. Protected areas and national parks

A legal and regulatory framework on protected areas and national parks has been developed over the past decades that is in compliance with international obligations, standards and criteria established since 1991. This framework covers the designation of new protected areas and national parks, as well as their expansion, conservation and management.

Because Albania has committed itself to international obligations and standards by signing a number of international conventions and other regulatory instruments, there are several examples of integrated ecosystem management in Albania (at already protected areas or "pilot projects"), as well as participation in international biodiversity conservation and management activities. One of the government's priorities is the harmonisation of the legal forest framework with such conventions. This implies the improved management of natural resources, taking into consideration biodiversity and protected areas. Such integrated management is also aimed at raising public awareness and encouraging participatory approaches in the sustainable management of natural resources.

The Law on Protected Areas (No. 8906 of June 6, 2002) defines general criteria for the designation of PAs: "A protected area may be any terrestrial, water, sea or coastal territory, defined as an area for biodiversity preservation, of the territory's associated natural and cultural values, which are managed based on existing legal and managerial tools and methods."

According to the criteria for protected areas used by the International Union for Conservation of Nature (IUCN), national parks are classified as a separate category. According to Article 6 of the Law on Protected Areas, national parks are "wide territories of no less than 1,000 ha, having unique national and international values, a major part of which are natural ecosystems, little affected by human activity, where plants, animals and the natural physical environment are of a special educational and scientific importance".

Protected areas and national parks manage forests that are in state, communal and private ownership. Both protected areas and national parks come under the administration of the Forestry Service.

Economic activities are not permitted in forests located in protected areas and national parks. The production of wood products in protected areas is forbidden by law, and harvesting in national parks is also forbidden by law. According to Article 12/1 of the Law on Forests, "forests in protected areas and national parks are excluded from the classification categories as forests for harvesting".

Any illegal activities carried out inside national parks, including minor illegal cutting, are regarded as criminal offences according to the law. This creates difficulties for people living inside protected areas, who usually obtain firewood for household use through illegal cutting, having no alternative.

1.2.6. Communal forests: Forest users, forest users associations, local governments and communal forest federations

In Albania, communal forests are the most important sub-sector within forestry. In rural areas, there is a high level of dependency on natural resources from forests and pastures. Forestry is very important for land-use development in rural areas. Forests and pastures are used by farmers, typically in the form of agro-forestry systems. Within these agro-forestry systems, agricultural crops, trees and livestock are managed within the same land unit. Traditionally (i.e. before 1945), Albanian forest areas close to villages were either regarded as common “village forests” or divided among families and groups of families as “family forests” to fulfil their needs for wood, grazing and fodder. After 1990, with the transition from a centralised system to a free market economy, there was a focus on the transfer and usufruct of state forests and pastures to communes. The main custodians of forests and pastures in Albania are forest families, who undertake continual, sometimes seasonal, land management practices. Within the decentralisation process, associations of forest and pasture users have been established in most communes, while more recently, through the land transfer process, the role of local government units (communes and municipalities) has been strengthened. Regional federations and a national federation have been established and strengthened in order to represent the interests of communal forest and pasture users. Communal forest management remains the responsibility of local government units and the associations of forest and pasture users, supported by federations and the State Forest Extension Service. The control function lies with a separate forest inspectorate under the Environmental Inspectorate within the MoE.

At the same time as the institutional reform, a new forest law reflecting the major changes in the forestry sector over the last two decades is expected to be approved by the Parliament.

The recent transfer of management competences for communal forests and pasture lands to the communes and municipalities has fundamentally changed the management structure and focus for these areas. The new arrangements, as defined in Decision No. 22 of the Council of Ministers of 2008, establishes the management authority and gives responsibility over forests to local government units and local users (associations of forest and pasture users). This arrangement brings these forests and pastures under the management and accountability structures of the communes.

Although the situation in terms of ownership rights for individual forest and pasture users has not yet been greatly improved, the decentralisation of authority is expected to provide greater recognition of and respect for the rights of primary stakeholders — traditional forest families as local custodians of these resources.

Associations of forest and pasture users are local-level organisations that coordinate tasks among users and support the implementation of forest management activities.

The National Federation of Communal Forests and Pastures is a non-profit, non-governmental organisation that represents the interests of users of forests and pastures in Albania. Its mission is to address and represent the interests of its members, accelerate decentralisation, and legalise use/ownership rights in order to promote the sustainable management of forests and pastures.

To date, the Forestry Service is responsible for service provision, although this is not functioning. National and regional federations are filling part of the gap by providing services for associations of forest and pasture users.

1.2.7. Private forest owners

Private forests in Albania cover an area of 27,420 ha (2.6 percent of Albanian forests, which is a very small proportion compared to state and communal forests), with a standing volume of 3,402,000 m³ (4.4 percent of the total). The average standing volume in private forests is 124 m³/ha, which is higher than in communal and state forests. The main goals of the association of private forest owners are to address the needs and interests of private owners; help its members with the management of private forests; protect the forests and the environment; increase the tourism and recreation values of forests; and disseminate promotional materials.

Although private forest areas are very small, they have been intensively exploited in recent years. Owners are trying to make as much profit as possible, without thinking about the future of their forests. On the other hand, there are no subsidies available to encourage responsible management; there is no clear legislation on the management of private forests; and there is no manual on the technical aspects of private forest management. There are currently no investments in private forests, while illegal exploitation by the owners and illegal logging by others are among the biggest concerns in these forests. In some areas ownership is not clear: the completion of ownership documentation is complicated by bureaucracy and corruption, and there are many cases of conflict and disputed ownership. Forest management is typically ad hoc, leading to the degradation of private forests, low incomes, and frequent forest fires. [4]

1.3. Fire history

Between 2004 and 2013, the annual average burned area was 2,731 ha of forests; 50 ha of (non-forest) protected areas; and 2,000 ha of other vegetation (e.g. wetlands). Damage included 15 houses burned; four high-voltage pylons damaged; and 23 people injured. Each year around 200 ha of olive trees and other agricultural crops are also burned. This information is mostly provided by the state authorities and no independent studies have been carried out to confirm the figures. In 2007, for example, when fires were monitored by satellite, the situation was shown to be more negative than the figures reported by the responsible authorities. [19]

Table 2. Forest fires in Albania (2005, 2006, 2008 and 2010)

Year	2005	2006	2008	2010
Nr. Of Cases	174	176	348	246
Forest surface (he)	3241	1081	-	1133
Burned surfaces (he)	300	108	1483	1133
Burned pastures (he)	1740	303	2716	1741
Value of damage in /000 Lekë(Albanian Money)	31682	81317	139131	63733

Source: General Directorate of Forests and Pastures

The most severe forest fires in recent years occurred in 2007 and 2012.

2007:

- 1,190 fires in forests and pastures
- 2,700 ha of state forests burned
- 2,860 ha of communal forests burned
- 310 ha of private forests burned
- 6,263 ha of pastures burned
- Estimated damages of around EUR 20 million

2012:

- 440 cases of fires in forests and 47 cases of fires in pastures
- 3,300 ha of forest area burned
- 1,300 ha of pasture burned

Studies have shown that 29 percent of these forest fires were caused by negligence; 61 percent by unknown factors; 9 percent by arson; and only 1 percent by unusual events and lightning. However, it should be recognised that even those forest fires classified as “caused by unknown factors” can be considered to have been started as a result of human activity. They are

classified under “unknown factors” as the precise cause is not known, but it can still be concluded that a large proportion of forest fires in Albania are started by human activities. [9]

II. Legal framework and institutional set-up in the field of forest fire management

The following laws deal with forests, forest land, pastures and forest fire protection:

- Law on Forests and the Forestry Service (No. 9385 of April 5, 2005)
- Law on the Pasture Fund (No. 9693 of March 19, 2007)
- Law on Civil Emergency Services (No. 8756 of March 26, 2001)
- Law on Protection from Fire and Rescue (No. 8677 of April 5, 2001)
- Law on Protected Areas (No. 8906 of June 6, 2002)

According to this legal framework, all organisations that manage forests and pastures and the owners of private forests and pasture areas are obliged to take all the measures necessary to protect the areas under their jurisdiction. In addition to the Law on Forests and Forestry Service and the Law on Protection from Fire and Rescue, the following regulations/guidelines apply:

- Regulation on Forest Protection against Fires, Pests and Diseases, and Related Financial Means (No. 25 of February 8, 1993)
- Act of the Council of Ministers on Determining and Taking Measures against Fire and on the Rescue of Objects of Special Importance, Including Watersheds, National Parks etc., (No. 288 of June 27, 2002)
- Guidelines on Determining and Taking Measures against Fire and on the Rescue of Objects of Economic and State Importance (implementing Act No. 288 of June 27, 2002) (No.1 of July 30, 2002)

This legal basis establishes institutional obligations and responsibilities related to forest protection against fires, as well as the preventive measures to be taken in association with the relevant annual funds.

According to the laws listed above, the main institutions authorised in the field of forest fire protection in Albania are outline below:

1. The Ministry of Environment through the Directorate for Treatment and Forest Protection and the State Inspectorate of Environment, Forests and Waters (SIEFW).

The Directorate for Treatment and Forest Protection is, as mentioned above, responsible for forest management at state level, including forest fire protection.

At regional level, this function is delegated to the Regional Forestry Services Directorate. Besides other functions, the RFSD is obliged to ensure that all measures for prevention, preparation and suppression are conducted, in accordance with the laws in force, by all forestry stakeholders: the Public Forestry Service; protected areas and national parks; forest and pasture users; and private forest owners.

The Forestry Service at regional level must prepare annual plans for forest fire protection that contain:

- an analysis of the causes of wildfires and factors that influence the spread of fire;
- fire statistics for the previous year;
- forest fire risk areas and periods;
- activities for the forecasting and prevention of forest fires;
- the responsible entity and the location of the means, equipment and human resources for fighting forest fires;
- the responsible entity and the location of access roads to forests;
- technical fire prevention measures (fuel management and silvicultural and maintenance operations);
- training and information activities; and
- a financial plan.

Local headquarters of the national Forestry Service are dispersed throughout the country, with one in each district. When a wildfire occurs, Forestry Service personnel attend the scene but are active during the operational phase only, as observers or technical advisors. At present, the Forestry Service has no vehicles equipped to cope with forest fires.

The State Inspectorate of Environment, Forests and Waters (SIEFW) inspects the above-mentioned institutions and organisations (among others) with respect to the prescribed measures for forest fire protection.

2. National parks, forest and pasture users and private forest owners

According to the legal regulations currently in force, national parks, forest and pasture users and private forest owners are under the same obligations as the Forestry Service.

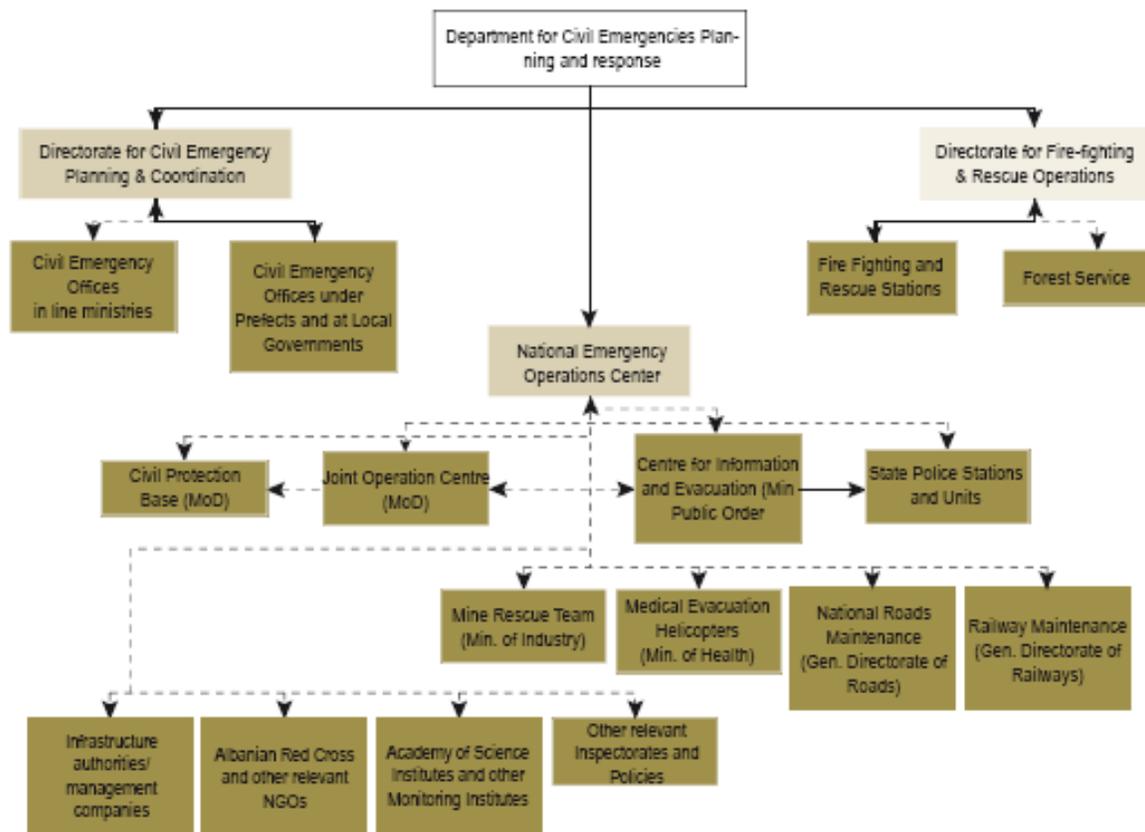
3. The Ministry of the Interior

The Ministry of the Interior has overall responsibility for managing civil protection. Among the ministry's departments is the Department of Civil Emergency Planning and Response (DCEPR). This department is responsible for ensuring effective coordination between all ministries, institutions and bodies in the field of disaster management. It has a close relationship with civil emergency officers in each of the 12 counties in Albania. It is divided into three units:

- The Directorate for Civil Emergency Planning and Coordination, which is the key institution for disaster management, especially coordination. This directorate has begun to move beyond mere preparedness and response towards recovery activities and the incorporation of disaster risk reduction elements into development plans, in particular for disaster-prone areas.
- The Directorate of for Firefighting and Rescue Operations (DFFRO)
- The National Operations Centre for Civil Emergency, which has direct links with all operational forces.

At district level, professional firefighters are organised within fire stations under the jurisdiction of DFFRO. The DFFRO cooperates with the national Forestry Service of the MoE. Firefighters are actively deployed by the DCEPR to tackle wildfires.

Figure 1. The structure of the Department for Civil Emergencies, Planning and Response



Source: [1]

Fires in forests, agricultural and conservation areas and other land, as well as the legal provisions for fire bans and the use of fires to reduce combustible vegetative matter and thus reduce the risk of wildfires, are regulated by the Law on Forests and Forestry Services and the Law on the Pasture Fund.

The use of fire to enhance biodiversity is regulated by the Law on the Pasture Fund.

Cross-border collaboration is handled by the civil emergency service (DCEPR) and agreements have been made for collaboration during the forest fire season with Italy, Greece, the former Yugoslav Republic of Macedonia, Montenegro, Bulgaria, Kosovo* and Turkey.

III. The impact of wildfires on the environment, economy and human health

The negative impacts of fires are extensive in conifer forests, but less so in coppice forests and shrub land. The main negative impacts are erosion in the burned area following the fire, the destruction of the regeneration cover, and the disturbance of the land structure and water regime. Another negative impact is the reduction in forest productivity. Bearing in mind the characteristics outlined above, forest ecosystems in Albania are very sensitive to fire. In the coastal forest protection belt only, surface fires in pine forests have a role in maintenance and are used as a control measure to minimise the amount of flammable material available for potential wildfires. In sites affected by fires, especially in the natural pine forests in the north of the country in Puke, Kukesi and Mirdita districts, the vegetation cover following a fire differs greatly from the vegetation before the fire.

In the southern part of the country, fire has traditionally been used as a means of cleaning and regenerating pasture. At these sites, the use of fire over many centuries has made big changes to ecosystems. One of the main impacts is the establishment of annual grasses and the disappearance of perennial plants. [9]

According to the JRC, the amount of biomass burned and the quantity of gas emissions from forest fires in Albania up to August 31, 2007, are estimated as follows (10^3 tonnes):

- Biomass burned – 1,161.30
- Carbon dioxide (CO₂) emissions – 2,052.60
- Carbon monoxide (CO) emissions – 82.60
- Methane (CH₄) emissions – 4.30
- Volatile organic compounds (VOCs) emissions – 4.30
- Nitric oxide (NO_x) emissions – 5.80

There have been no fatalities caused by forest fires in the last 10 years, although 15 volunteer firefighters have been injured and five houses destroyed in the region of Shkodra.

IV. Special issues

Unexploded ordnance (UXO)

There are several areas that are still contaminated with unexploded ordnance from World War II, although there are no official maps showing its distribution. It represents a potential danger in the case of fires in these areas.

There are also land mines along the border area with Kosovo*, and each year they cause injuries to at least three to five people during firefighting.

Transboundary fires and international cooperation

In the past 10 years, transboundary fires have occurred affecting Greece, the former Yugoslav Republic of Macedonia, Montenegro and Kosovo*.

Legal agreements on fire suppression have been signed with Italy, Turkey and Kosovo*, and international assistance for forest fire suppression has been given by Italy, Germany and Ukraine (during the fire seasons in 2007 and 2012).

V. Needs for improvement in forest fire management

A large number of institutions and organisations, both public and private, are involved in forest fire protection in Albania. In some cases, this is the main reason for the high number of fires and the large burned areas in some fire seasons. Problems arise when such a large number of authorised institutions and organisations act at different levels. In accordance with the legal regulations in force, all these institutions are obliged to carry out certain preventive, pre-suppression and suppression measures. In order to be efficient and effective, these measures must be coordinated and harmonised, and this is particularly important in the case of certain pre-suppression measures (early detection, the training of firefighters, the drafting of operational plans etc.) and during fire suppression. However, this is not what happens in reality, thus the existing regulations need to be reviewed and adjusted. Competencies must be made clear, with no overlapping, and procedures must be precisely established.

There are no qualification standards for personnel involved in firefighting. The Forestry Service provides training for staff involved in forest fire suppression. This training covers basic knowledge and firefighting techniques, but there is no professional training. Several study tours have been organised to Italy and Turkey, but these have been ad hoc and not part of an official training programme, nor are there any official training materials for forest fire protection. The Ministry of the Interior has, however, produced a National Civil Emergency Training Curriculum, comprising eight training manuals on disaster management, disaster response, disaster relief logistics and emergency preparedness.

The number of volunteer firefighters (seasonally) is between 2,500 and 3,000. These volunteers are integrated into firefighting operations and trained by the Forestry Service and the Fire and Rescue Training Centre. There are no legal insurance mechanisms and the volunteers are equipped only with hand tools. In addition, several programmes supported by forestry projects have been developed in the past 10 years to involve the local community in fire management. However, the involvement of the local community in forest fire protection (usually only in fire suppression) is only a partial and temporary solution. The organisation of fire protection associations and unions of volunteers (at national and local level), following the experiences of neighbouring countries (Serbia, the former Yugoslav Republic of Macedonia and Croatia), will engage the local community efficiently and permanently. Citizens of all ages can be involved in forest fire protection, depending on whether the measures are preventive, pre-suppression or suppression, and this involvement would be permanent throughout the year.

Albania is a hilly/mountainous country with very steep terrain and a fragmented topography. These conditions favour the very rapid spread of forest fires. At the same time, access to such

areas for fire suppression is very difficult. This is often one of the reasons for inefficient fire suppression and large burned areas. In order to improve the situation the network of forest roads should be expanded (in accordance with the needs of the Forestry Service and the community).

There is a lack of professionally trained firefighters (in both the Forestry Service and the emergency services). There is also a lack of equipment, especially off-road vehicles. In this respect, it would be appropriate for the equipment to be provided first of all, and for training to be organised subsequently for firefighters using the new equipment. This is particularly important in the case of the special vehicles.

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Forest Fire Country Studies

Bosnia and Herzegovina



FOREST FIRES COUNTRY STUDY

BOSNIA AND HERZEGOVINA

2015

**Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations.....	3
I. The forestry sector, forests and forest fires	6
1.1. Forest characteristics.....	7
1.2. Major forestry stakeholders	11
1.3. Fire history	14
II Legal framework and institutional set-up in the field of forest fire management	17
1.1. The Federation of Bosnia and Herzegovina	21
1.2. Republika Srpska.....	22
III. The impact of forest fires on the environment, economy and human health	24
IV. Special issues	26
V. Needs for improvement in forest fire management	28
Literature	29

Abbreviations

BiH	Bosnia and Herzegovina
PE	Public enterprise
NFI	National forest inventory
RS	Republika Srpska
FBiH	Federation of Bosnia and Herzegovina
BD	Brcko District
MOFTER	Ministry of Foreign Trade and Economic Relations of BiH
MAWMF	Ministry of Agriculture, Water Management and Forestry of FBiH
FFO	Federal Forest Office
FFI	Federal Forest Inspection
FMP	Forest management plan
CFO	Cantonal Forest Office
CFMC	Cantonal forest management companies
CFI	Cantonal Forest Inspection
FHI	Forest and Hunting Inspection
NGO	Non-governmental organisation
JRC	Joint Research Center
PFERS	Public Forest Enterprise of Republika Srpska
TFPU	Territorial Fire Protection Unit
EFFIS	European Forest Fire Information System

Bosnia and Herzegovina (BiH) has a unique political structure that influences the functioning of public institutions and all areas of life, including forestry and forest fire protection. A brief explanation of the political structure of BiH is therefore provided below, in order to contribute to an understanding of the country's forestry and forest protection.

According to the Dayton Agreement, BiH has a multi-level political structure. The most important level is the division of the country into two entities: Republika Srpska and the Federation of Bosnia and Herzegovina. The Federation of Bosnia and Herzegovina covers 51 percent of Bosnia and Herzegovina's total area, while Republika Srpska covers 49%. Brcko District, in the north of the country, was created in 2000 out of land from both entities. It belongs officially to both but is governed by neither, but instead functions under a decentralised system of local government. For election purposes, Brcko District voters can choose to participate in either the Federation or Republika Srpska. The seat of government of Bosnia and Herzegovina is in Sarajevo, and the Presidency building is in the centre of the city.

On the third level, FBiH is subdivided into 10 cantons. Each has its own cantonal government, which is under the law of FBiH as a whole.

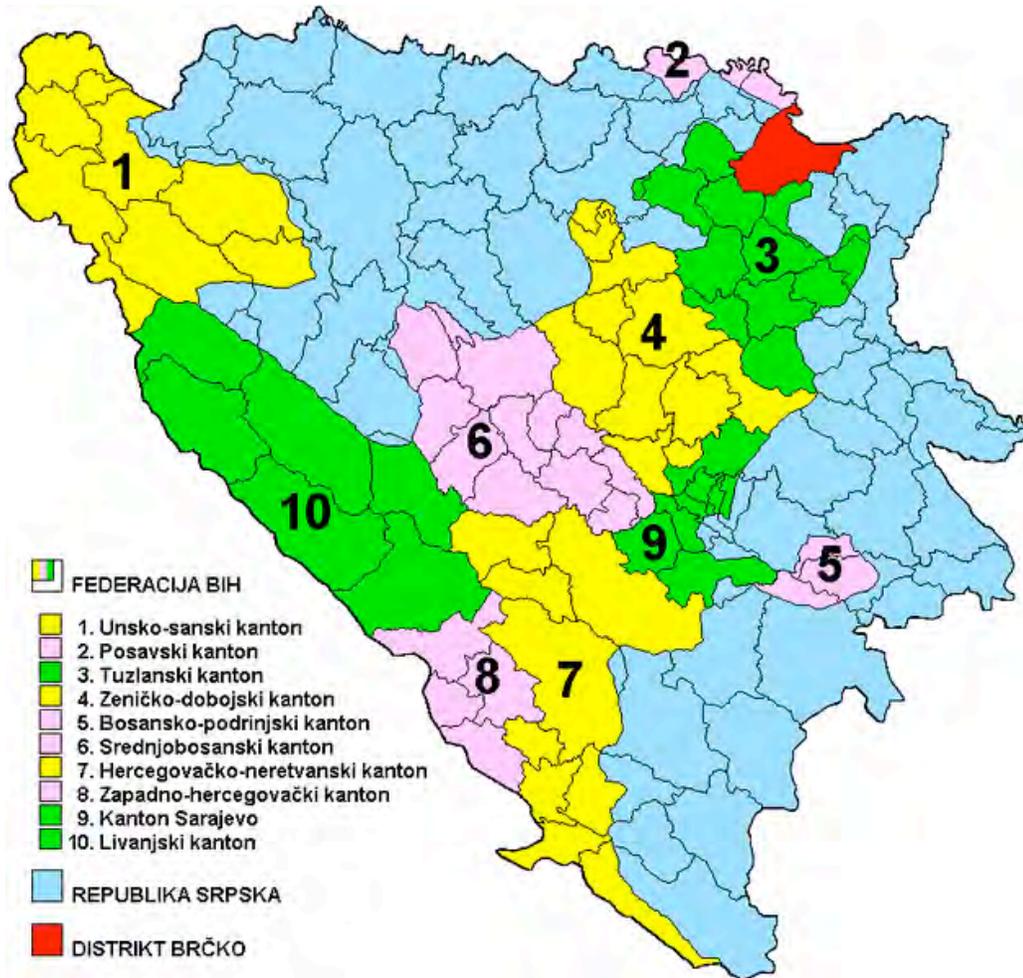
The fourth level of political division are the municipalities. There are 74 municipalities in FBiH and 63 in Republika Srpska. The municipalities also have their own local government, typically based in the most significant city in their territory. Many municipalities have a long tradition and history within their present boundaries. Others, however, were only created following the recent war after the traditional municipalities were split by the Inter-Entity Boundary Line. Each canton in FBiH consists of several municipalities, which are divided into local communities.

Besides entities, cantons and municipalities, Bosnia and Herzegovina also has eight "official" cities: Banja Luka, Mostar, Sarajevo, Zenica, Tuzla, Bihac, Siroki Brijeg and East Sarajevo. The territory and government of the cities of Bihac, Zenica, Siroki Brijeg, Tuzla, Banja Luka and Mostar correspond to the municipalities of the same name, while the cities of Sarajevo and East Sarajevo officially consist of several municipalities. Cities have their own city government whose power is between that of the municipalities and cantons (or entity, in the case of Republika Srpska).

The main implementing body of the civilian part of the Dayton Agreement is the High Representative, whose responsibilities are clarified by the Peace Implementation Council. The High Representative has many governmental and legislative powers, including the power to dismiss elected and non-elected officials. More recently, several central institutions have been established (such as the Defence Ministry, the Security Ministry, the state court and the indirect

taxation service) in the process of transferring part of the jurisdiction from the entities to the state. [1]

Map 1. Bosnia and Herzegovina



Source [3]

I. The forestry sector, forests and forest fires

1. Overview of the forestry sector

There is no Law on Forests at state level in BiH, although the terms "forest" and "forest land" are defined by separate laws and regulations in FBiH and RS. The Law on Forests in FBiH was quashed by the Constitutional Court in 2009, but the definitions of "forest" and "forest land" contained in this law are still in use in FBiH.

According to Article 2 of the law, forest is "land covered with forest trees or forest shrubs, whose area exceeds 500 m² and with a width of at least 10 m. Forests are considered as ecosystems. Their status in the land cadastre does not have any implication in terms of this act." Forest land, "in addition to land overgrown with forest, includes uncultivated, unused or barren land outside the forest to the extent that provides, or supports, the function of the adjacent forest. Forest land also consists of areas with reduced forest cover, rocks, clearings and meadows inside forests." [14]

According to Article 7 of the Law on Forests of RS (Official Gazette of RS No. 66/03, 75/08, 30/10), forests in RS are defined as "surfaces covered by forest species trees, with an area larger than 0.16 ha, a minimum width of 20 m, and with a degree of land coverage by tree crowns of at least 20 percent, regardless of whether it comes from regeneration or adult trees either from seeds or shoots from stumps or roots."

According to Article 3 of the Law on Forests of Brcko District (Official Gazette of Brcko District BiH No. 14/10), forests are defined as:

- "(1) a) land overgrown with forest trees (or forest shrubs as a forest ecosystem built of biotope and biocenosis, whose area exceeds 500 m² and with at least 10 m width;
- b) forest nurseries and plantations of forest trees;
 - c) forest roads and other forest transport and fire protection infrastructure;
 - d) lakes, rivers, streams and other surface water and wetlands within the forest."

Forest land is defined as:

- "(2) a) land that is not permanently appropriate for a different type of culture, except for growing forest, in accordance with the location, configuration, physical and chemical composition of the soil;
- b) land that is designated for forest production by the spatial or urban plan;
 - c) uncultivated, unused or barren land outside the forest to the extent that it provides or supports the functions of neighbouring forests; and
 - d) areas with reduced forest cover, meadows and clearings in forests."

1.1. Forest characteristics

According to the Second National Forest Inventory (NFI), carried out between 2006 and 2009, forests and other forest land in BiH cover 3,231,500 ha, of which 1,652,400 ha are high forests while 1,252,200 ha are coppice forests. The rest of the area is characterised as “other wooded land” and comprises shrubs, barren forest land and other forest areas. This suggests that about 63 percent of the total territory of BiH is covered with forest and other wooded land, which is one of the highest values in Europe.

Table 1. Structure of forest area and forest land by vegetation form, purpose and availability in BiH

Vegetation form	Available surface				Protective forest	Total
	Economic forests	Non-economic forests	Protected forests	Special purpose forests		
	ha	ha	ha	ha	ha	Ha
1. High forest	1 329 500	46 300	5 200	8 800	262 600	1 652 400
2. Coppice forest	843 200	158 700	1 600	2 400	246 300	1 252 200
1+2. All forests	2 172 700	205 000	6 800	11 200	508 900	2 904 600
3. Shrubbery	52 700	41 100	0	100	36 700	130 600
4. Barren land	55 700	88 400	800	3 400	38 900	187 200
3+4. Shrubbery and barren	108 400	129 500	800	3 500	75 600	317 800
5. Other forest areas	3 300	3 100		100	2 600	9 100
FAO forest (1+2+3+5)	2 228 700	241 600	6 800	11 400	548 200	3 035 700
6. All forest and forest land	2 284 400	337 600	7 600	14 800	587 100	3 231 500

Note: “Available surface” means surface not contaminated with landmines.

Source [2]

The distribution of high forests and coppice forests and their availability for economic production is shown in Table 2.

Table 2. High forests and coppice forests available for economic production in RS and FBiH

Silviculture form of forest	Available economic productive forests	
	in RS ha	in FBiH ha
1. High forest	647 300	673 300
2. Coppice forest	485 300	355 400
Total	1 132 600	1 028 700

Source [2]

In terms of ownership share of the two major forest forms, the ratios of high forests and coppice forests in public and private ownership are diametrically opposed. While the state owns 72 percent of high forests, coppice forests are predominantly in private ownership (434,000 ha or 62 percent of the total economic coppice forests).

Table 3. Ownership of economic high and coppice forests in BiH

Economic forests	Area				Total in BiH
	State owned		Private owned		
	ha	percent	Ha	percent	ha
High forest	1 063 400	72	266 100	38	1 329 500
Coppice forest	408 700	28	434 500	62	843 200
All forests	1 472 100	100	700 600	100	2 172 700

Source [2]

Timber and fuel wood are the primary products of the forestry sector in BiH. Growing stock is estimated at 435 million m³ (201 m³ per ha).

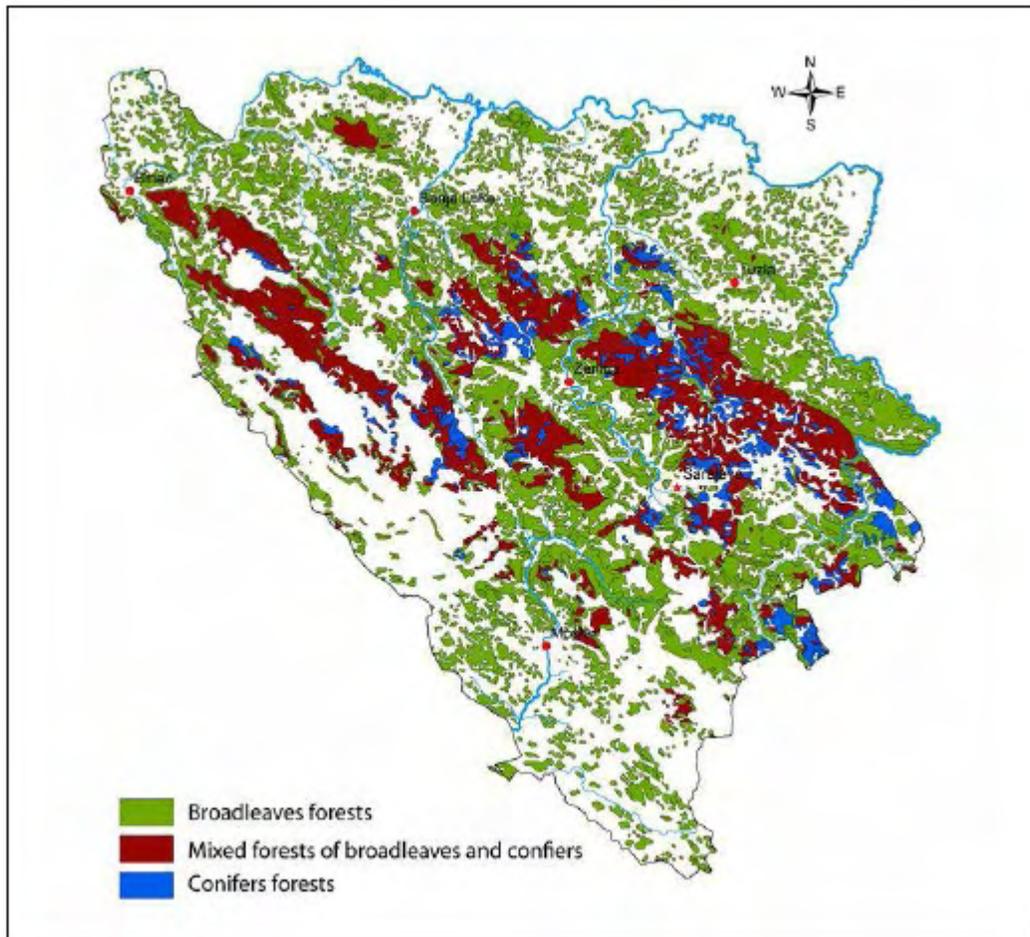
Table 4. Growing stock of accessible economic high and coppice forests by ownership in BiH

Economic forests	Growing stock - wood volume				
	Public owned		Private owned		Total in BiH
	in 1000 m ³	m ³ per ha	in 1000 m ³	m ³ per ha	m ³ per ha
High forest	299 630	282	53 968	202	266
Coppice forest	35 710	87	46 412	107	97
All forests	335 340	228	100 380	143	201

Source [2]

Forests in BiH comprise a huge diversity of forest types, ranging from coastal Mediterranean forests to mountain forests in central BiH. Map 2 shows the distribution of forests in BiH and the spatial patterns of coniferous forests in the highlands, mixed forests at medium altitudes and broadleaved forests on low-level terrains and floodplains.

Map 2. Forest distribution in BiH



Source [2]

According to the 2006 categorisation used by the European Environment Agency (EEA), the following categories of forests can be found in BiH: Category 4 – Acidophilous oak forests; Category 5 – Mesophytic deciduous forests; Category 6 – Beech forests; Category 7 – Mountainous beech forest; Category 8 – Thermophilous deciduous forests; Category 9 – Broadleaved evergreen forest; Category 10 – Coniferous forests of the Mediterranean, Anatolian and Macaronesian regions; Category 11 – Mire and swamp forests; and Category 12 – Floodplain forests.

1.2. Major forestry stakeholders

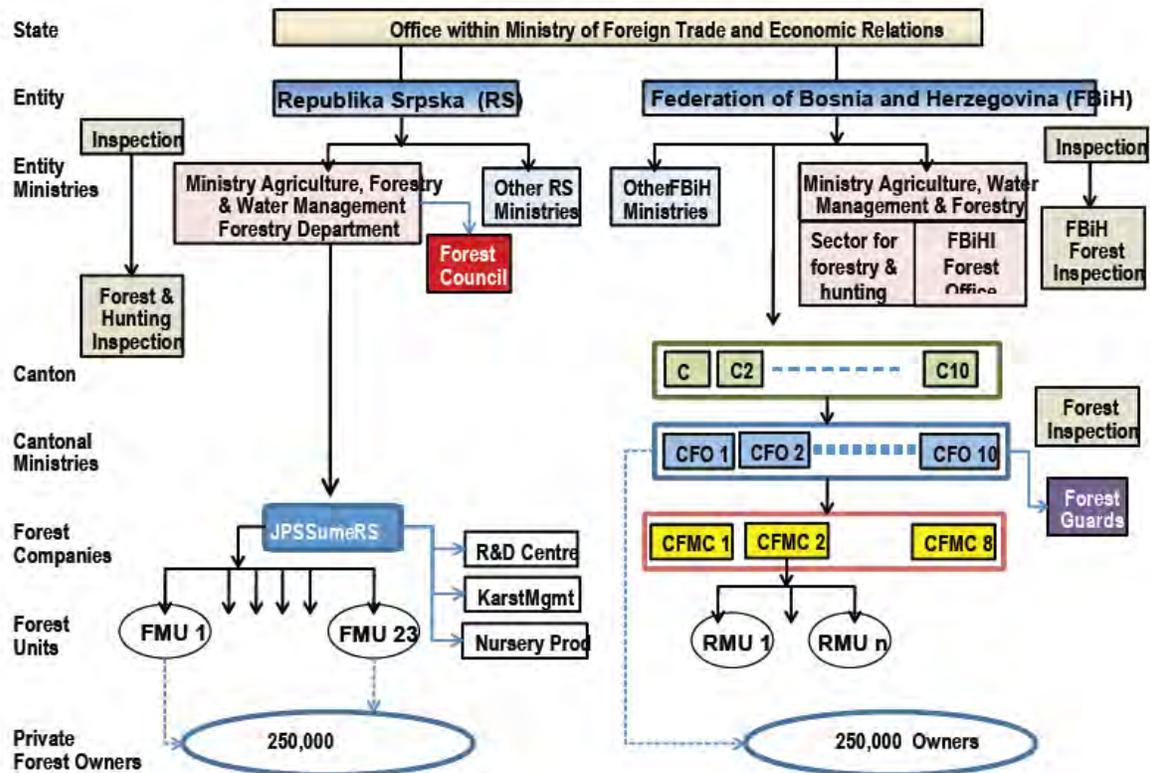
For a better understanding of the organisation and main stakeholders in the forestry sector in BiH, a brief explanation of the legal regulations is provided below.

The forestry sector in BiH is organised at entity level. Forest legislation comprises the following legal acts:

- The RS Law on Forests (2008) provides the overall framework and is supported by a series of 32 regulations adopted in 2009 and 2010 related to timber sales and the technical norms of forest management. The Law on Forests clarified the entity's ownership and administration responsibilities. Further elements of forest planning and the principles of sustainable forest management are included in the RS Spatial Plan for 2008–2015, which provides for the development of planning documentation, including the Strategy for Forestry Development for the period 2011–2021 (published in 2012), as well as for the revision of laws and regulations, including the Law on Forests.
- Based on the Decision of the Constitutional Court of FBiH of April 14, 2009 (Official Gazette of FBiH No. 36/09), the Law on Forests (Official Gazette of FBiH No. 20/02, 29/03 and 37/04) is no longer in force as of November 27, 2009. As a preliminary solution pending the adoption of a new law on forests, the Government of FBiH adopted the Regulation on Forests (Official Gazette of FBiH No. 83/09, 26/10, 33/10 and 38/10). According to the Decision of the Constitutional Court of FBiH No. U-28/10 of March 23, 2011 (Official Gazette of FBiH No. 34/11), the Regulation on Forests should have been in force by December 6, 2011. However, since the Regulation on Forests was not yet in force as of December 6, 2011, and as the Law on Forests has not yet been adopted, the forestry sector is unregulated at the level of FBiH.
- Brcko District adopted its own Forest Law in 2010. Based on the provisions of this law there are forest management plans for public forests (owned by BD) and for private forests (both for the period 2007–2016). Following the legal obligations, annual management plans are prepared and adopted by the Government of BD, which include necessary measures related to harvesting, silviculture, forest protection and forest guarding. Brcko District comprises mainly lowland and agriculture areas, thus forestry plays a subordinated role due to the small area covered by forests and the small scope of harvesting operations.

The organisational set-up and institutional arrangements in the forest sector are shown in Figure 1.

Figure 1. Organisation of the forestry sector in BiH



Source [2]

As already mentioned, direct competences in the forestry sector are held at entity level (FBiH and RS) and at the level of Brcko District. The institutions at these levels are responsible for the development of forest policy as well as for the development and implementation of forest legislation. Among its competencies, the Ministry of Foreign Trade and Economic Relations (MOFTER) is responsible for tasks and duties falling within the jurisdiction of the state of BiH, including the definition of policies and basic principles, the coordination of activities and the consolidation of entity plans with those of international institutions in the areas of agriculture, energy, environmental protection, the use of natural resources and tourism. The Sector for Agriculture, Food, Forestry and Rural Development operates within MOFTER, and in terms of forestry issues deals mainly with coordination activities.

1.2.1. Federation of Bosnia and Herzegovina

In FBiH, forest management competencies are devolved to the cantonal governments. Each canton is responsible for the forest resources within its administrative boundaries.

At FBiH level, there is a Forestry Department within the Ministry of Agriculture, Water Management and Forestry (MAWMF). The main bodies within the MAWMF are:

- the FBiH Forest Office (FFO), which is responsible for forest silviculture and protection, forest utilisation, subsidies and support payments for forestry, as well as the development and monitoring of processes in forestry, including an overall monitoring role in relation to activities within the forest sector; and
- the FBiH Forest Inspection (FFI), which performs overall inspection services safeguarding the implementation of all actions relating to the Law on Forests within FBiH. In the absence of an adopted law, the FFI also operates under the Law on Inspection.

At cantonal level, responsibility lies with the MAWMF of FBiH, with the exception of Sarajevo Canton, Zapadno-Hercegovački Canton and Bosansko-Podrinjski Canton, which fall under the responsibility of different ministries. In this respect, further important bodies are:

- the Cantonal Forest Office (CFO), which controls the activities of the cantonal forest management companies (CFMC) and provides advice and support to private forest owners. The CFO prepares forest management plans (FMP) for all private owners and plays a major role in guarding and protecting forest resources, including from illegal activities; and
- the Cantonal Forest Inspection (CFI), which forms part of the Cantonal Inspection Service. Their role is essentially the same as that of the FBiH Forest Inspection.

1.2.2. Republika Srpska

The Forestry Department within the MAWMF is responsible for forests and forestry in this entity. The main implementing bodies are:

- the Forestry Council, which is a forum for high-level discussion on forestry and forestry-related issues and developments, established under the Forest Law in 2008. Its nine members are representatives of the ministry, other state bodies, institutions and organisations that are related with the forest sector, local communities, NGOs, forest owners and others;
- the Forest and Hunting Inspection (FHI), which was transferred from the MAWMF in 2005 to the general Inspection Service, which has a total of 12 inspectorates. The FHI has six territorial divisions with a total of 17 inspectors. It carries out forest control

measures for both public and privately owned forests based on 10-year and annual forest management plans;

- the “Šume RS” public enterprise, which has a traditional organisational structure for a public forest company comprising a headquarters, 23 forest management units (FMUs), the Research Development and Design Centre that undertakes forest management planning, the Centre for Seedling Production and the Karst Management Centre; and
- FMUs, which report to the headquarters and are managed on a territorial basis that comprises a number of forest districts, which in turn comprise a number of management sub-units.

1.2.3. National parks

There are three national parks in BiH: Sutjeska (established in 1962); Kozara (1967) and Una (2008).

Table 5. Area of the national parks

Name	Entity	Area in ha
National parks		
Sutjeska	Republic of Srpska	17,250.00
Kozara	Republic of Srpska	3,494.00
Una	Federation of Bosnia and Herzegovina	19,800.00

Source [2]

Substantial proportions of the total area of the national parks are covered by forest:

- Kozara – 92 percent;
- Sutjeska – 66 percent; and
- Una – 64 percent.

1.3. Fire history

Although forest fires are a significant negative ecological factor in BiH, in the last decade it has been almost impossible to carry out a good-quality analysis, mainly because statistical data on fires and burned areas are not collected in the same way in FBiH, RS and BD. Data from RS, for example, which are the most systematic, comprise precise figures for the number of fires and burned areas in larger locations. However, data are only available for 2010, 2011 and 2012, and the sites are not well defined. Data submitted on fires in FBiH cover the fire seasons from 2008 to 2012. However, there is no precise information on the distribution of fires on the territory of FBiH, thus the data cannot be used to analyse the occurrence of fires. The least accurate data are those from BD, thus in Table 6 the summary data for BiH are calculated without data from BD. [4]

According to Table 6, the total area of forest and forest land burned by forest fires in the period 2010 to 2012 is around 85,906.47 ha, and the number of fires is around 10,091. There are no official data about the economic losses caused by forest fires, although unofficially they are estimated at between EUR 2 and 10 million per year.

Table 6. Forest fires in BiH (2010–2012)

ENTITY/YEAR	BURNED AREA (ha)	NUMBER OF FIRES	AVERAGE BURNED AREA PER FIRE (ha/fire)
2010			
FBiH	390.35	1,038	0.37
RS	1,523.06	79	19.28
BD	-	18	-
Average in 2010	1,913.41	1,117	1.71
2011			
FBiH	1,796.29	2,806	0.64
RS	14,970.25	298	50.24
BD	-	199	-
Average in 2011	16,766.54	3,104	5.40
2012			
FBiH	41,717.81	5,324	7.84
RS	25,508.71	546	46.72
BD	-	299	-
Average in 2012	67,226.52	5,870	11.45
Average for 2010–2012	85,906.47	10,091	8.51

Source [4]

Table 7. Distribution of burned area (ha) in BiH by land cover type in 2013

<i>Land cover</i>	<i>Area burned</i>	<i>% of total</i>
Forest /Other Wooded Land	2559.7	74.02%
Other Natural Land	608.27	17.59%
Agriculture	289.95	8.38%
Artificial Surfaces	0.07	0%
Total:	3457.99	100%

Source [5]

According to the Joint Research Centre (JRC) annual report for 2013, the 2013 fire season in BiH was not severe, with the total burned area estimated at around 2,560 ha of forest and forest land.

There are no valid and official data for the main causes of forest fires in BiH, although unofficially the main cause is the human factor (in about 98 percent of all forest fires). [4]

According to some unofficial sources, the main reasons for forest fires in BiH are agricultural burning (field clearing in spring and stubble burning in summer) and negligence when lighting fires in or near forests. There are some cases of arson, but these are not proved as there is no official investigation or court verdict. Lightning is a minor cause of forest fires (fewer than 2 percent of cases).

II Legal framework and institutional set-up in the field of forest fire management

Due to its unique political structure, BiH has a large number of legislative acts regulating forest fire issues:

- Law on the Protection and Rescue of People and Material Goods from Natural and Other Disasters (Official Gazette of FBiH No. 39/03, 22/06 and 43/10)
- Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09)
- Law on Protection and Rescue in Emergency Situations (Official Gazette of RS No. 121/12)
- Law on Fire Protection in Republika Srpska (Official Gazette of RS No. 71/12)
- Law on Forests of Republika Srpska (Official Gazette of RS No. 66/03, 75/08, 30/10)
- Law on Forests of Brcko District BiH (Official Gazette of BD BiH No. 14/10)
- Law on Forests of Una-Sana Canton (Official Gazette of Una-Sana Canton No. 22/12)
- Law on Forests of Sarajevo Canton (Official Gazette of Sarajevo Canton No. 05/13)
- Law on Forests of Tuzla Canton (Official Gazette of Tuzla Canton No. 09/12 and 17/13)
- Law on Forests of Zenica-Doboj Canton (Official Gazette of Zenica-Doboj Canton No. 08/13)
- Law on Forests of Bosnian-Podrinje Canton (Official Gazette of Bosnian-Podrinje Canton No. 04/13 and 05/13)
- Law on the Competences of the Authorities of Sarajevo Canton in the Field of Fire Protection and Firefighting (Official Gazette of Sarajevo Canton No. 23/11)
- Law on Fire Protection and Firefighting in the Area of Tuzla Canton (Official Gazette of Tuzla Canton No. 1/12)
- Law on Fire Protection and Firefighting in the Area of Central Bosnia Canton (Official Gazette of Central Bosnia Canton No. 15/12)
- Law on Fire Protection and Firefighting in the Area of Zenica-Doboj Canton (Official Gazette of Zenica-Doboj Canton No. 5/11)
- Law on Fire Protection and Firefighting in the Area of Una-Sana Canton (Official Gazette of Una-Sana Canton No. 04/13)

In accordance with the above legislative acts and the political structure in BiH, the main institutions responsible for forest fire protection are described below.

1. Ministry of Security of BiH

The Ministry of Security of BiH is responsible for the execution of international obligations, cooperation, coordination and the revision/approval of the entities' protection and rescue programmes and plans. There are 10 sectors within the ministry, one of which is the Sector for Civil Protection.

Under the existing legislation, both the state and the entities have jurisdiction over their own civil protection structures. Entities are both financially and jurisdictionally autonomous from the state. Each level has its own specific mandate, with the state focusing on civil protection strategy while the entities focus on operational matters.

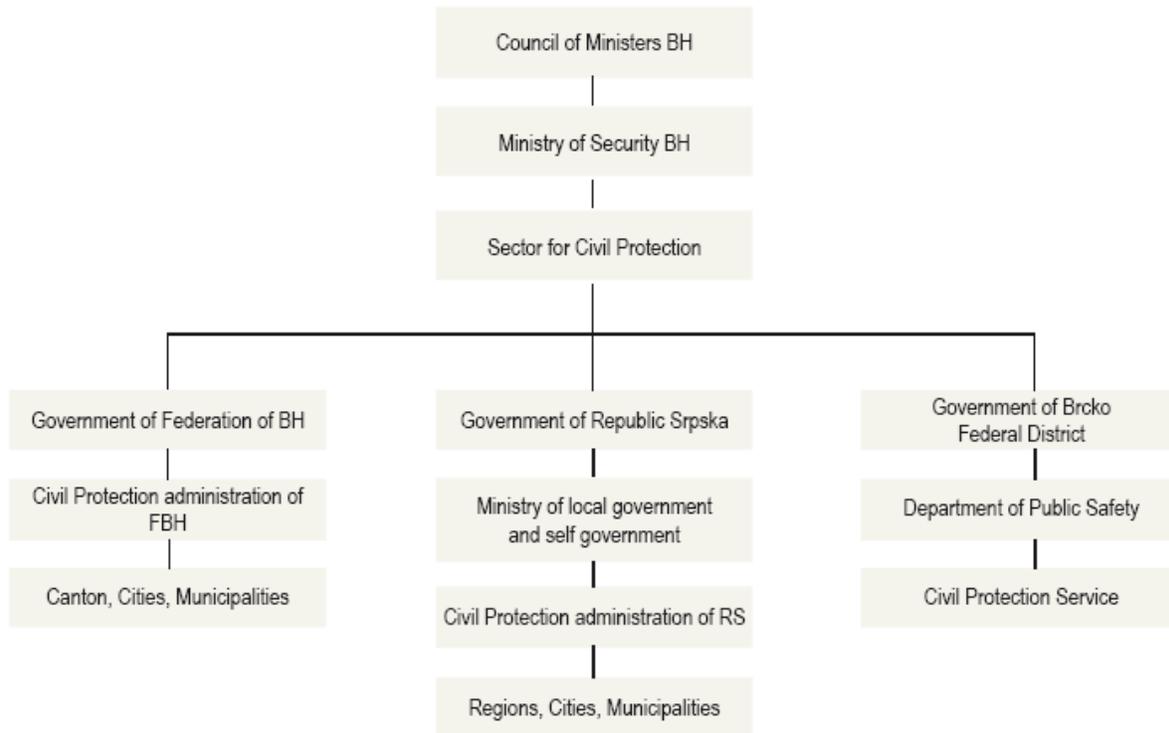
At the state level, the Sector for Civil Protection of the Ministry of Security is the highest-level body with competences and responsibility for international cooperation, internal coordination, the strategic planning of protection and rescue measures, and training programmes.

Three departments have been established within the sector:

- The Department for the Strategic Planning of Protection and Rescue Measures
- The Department for Structures and Training
- The Department for International Cooperation

The Ministry of Security coordinates and manages the planning and exchange of data and information, and reports on risk reduction activities carried out in the entities and Brcko District. The entities and Brcko District, within the framework of their competences in the area of protection and rescue, define, plan, train, organise, finance and execute protection and rescue measures with the aim of reducing risks and removing or mitigating the harmful consequences of disasters caused by natural or other hazards.

Figure 2. Organisation of the Sector for Civil Protection of BiH



Source [8]

The civil protection structure in FBiH reflects the administrative organisation of the entity, which is particularly complex and decentralised due to its three-tier administrative system of federation, cantons, and municipalities or cities. Each level has the constitutional authority to make regulations and to determine matters in all areas of society, including protection and rescue (Figure 3).

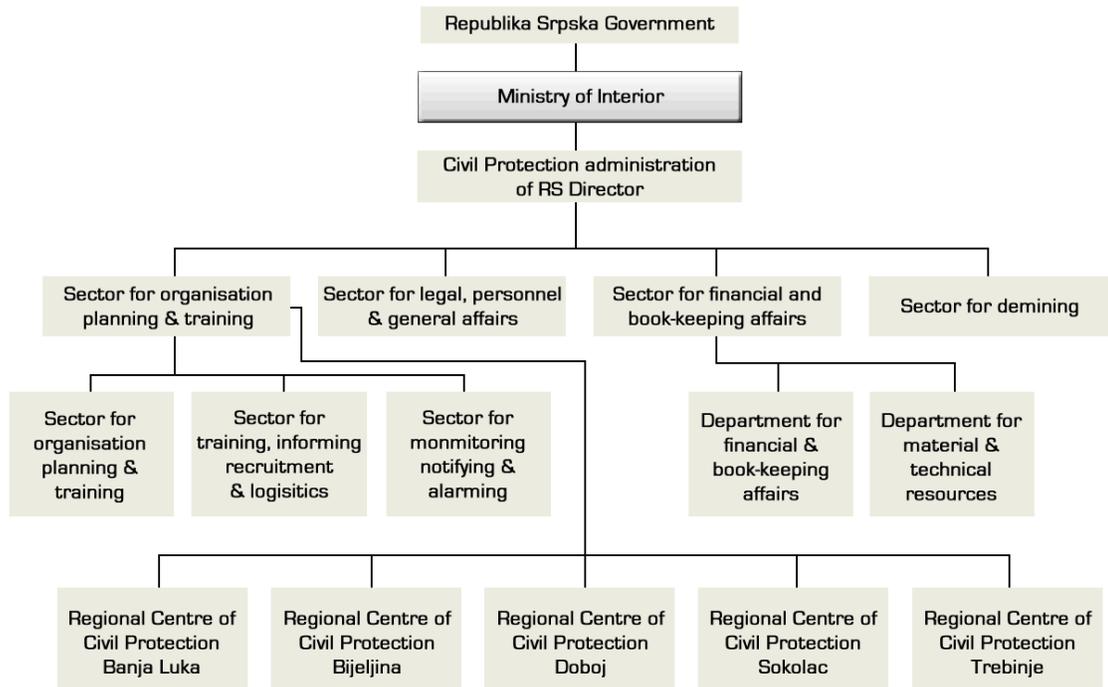
The Civil Protection Administration of RS has competences for planning; the issuing of obligations regarding the lending of material resources for civil protection needs; and damage assessment directives. The director of civil protection is responsible for the administration and organisation of the entire structure, as well as for training programmes for civil protection units (Figure 4).

Figure 3. Organisation of civil protection in FBiH



Source [8]

Figure 4. Organisation of civil protection in Republika Srpska



Source [8]

No specific laws on civil protection have been adopted by Brcko District, and current legislation in this area refers to that of FBiH and RS.

The Brcko District civil protection structure was established under the authority of the Sub-department of Public Safety and encompasses three main sections: the Civil Protection Section, responsible for the de-mining programme; the Fire Department; and the Information Section.

Municipality mayors command operations in the event of emergencies, while the role of head of civil protection belongs to the director of the Department of Public Safety. [8]

2. The forestry sector in BiH

As mentioned above, the forestry sector in BiH is organised at entity level, thus forest fire protection in the framework of the forestry sector is also organised at entity level.

1.1. The Federation of Bosnia and Herzegovina

At the FBiH level, the Forestry Department within the MAWMF has the FFO and FFI as its main bodies. Among other tasks, the FFO is responsible for silviculture and forest protection at entity level. At the cantonal level are 10 cantonal forest management companies (CFMCs), which are public enterprises with forest management units. Each CFMC, in accordance with the existing legal regulations, is obliged to organise forest fire protection (among other activities). For this purpose, the CFMC has to prepare a forest fire protection plan that covers, among other things, measures for forest fire prevention; the means and equipment to put out forest fires; forest roads; water supply sources; early fire detection; and the number and structure of firefighters. All these measures and activities must be in line with the Rulebook for the Content of Forest Fire Protection Plans (Official Gazette of FBiH No. 21/04).

Article 1 of the rulebook describes its main purpose as being to define “technical, preventive, silvicultural and other measures for forest fire protection that are required to be implemented by the CFMC, cantonal administrations for private forests and legal entities managing forests and forest land with a special management regime (hereinafter referred to as holders of rights to manage forests and forest land), in order to reduce the risk of the occurrence and spread of forest fires, ensure early fire detection and alert, and enhance the timely initial response for the localisation and suppression of fires”. [6]

The FFI, at federal and cantonal level, with the inspection of the CFMC, has a role to ensure that all measures for forest fire protection are carried out in accordance with the current legal regulations.

The forest fire protection measures and activities are also regulated by the Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09), especially Article 27 and 44.

1.2. Republika Srpska

The FHI, as a part of the MAFWM, ensures the implementation of all legal liabilities and responsibilities of forest management entities (public and private) in terms of forest fire protection.

The Public Forest Enterprise of Republika Srpska, BiH (PFERS) was established by the Government of Republika Srpska, BiH, under Decision No. 03-599 of June 8, 1992 (Official Gazette of the Serb People in BiH, No 9/92). The public enterprise comprises forest management units; the Centre for Nursery Seed Production; the Research and Development and Project Centre; and the Centre for the Management of Rocky Terrain. There are 20 forest management units in the framework of the PFERS. [7]

In accordance with Article 34 of the Law on Forests of RS (Official Gazette of RS No. 66/03, 75/08, 30/10), all forest management units are obliged to carry out activities for forest protection, including forest fire prevention. According to Articles 18 and 28 of the same law, forest management units must prepare a 10-year general management plan and an annual management plan that includes measures for forest fire protection (prevention, pre-suppression and suppression measures). This is also in line with Article 14 of the Law on Fire Protection of RS (Official Gazette of RS No. 71/12) that regulates the content of fire protection plans.

3. National parks in BiH

As mentioned earlier, there are three national parks in BiH: Sutjeska, Kozara and Una. They have almost the same obligations regarding forest fire protection as the forestry sector, and in accordance with the same laws: Sutjeska and Kozara National Parks in accordance with the current legal regulations in RS; and Una National Park in accordance with the regulations in force in FBiH.

4. Local self-governance in BiH

In accordance with Article 40 of the Law on Fire Protection of RS (Official Gazette of RS No. 71/12), local self-governance units are obliged to organise fire protection services (in the form of territorial fire protection units) consisting of professional firefighters. Likewise, local self-governance units in FBiH are obliged to organise similar fire protection services in accordance with Article 16 of the Law on Fire Protection and Firefighting in FBiH (Official Gazette of FBiH No. 65/09).

5. Voluntary fire protection associations of BiH

In accordance with Article 39 of the Law on Fire Protection of RS (Official Gazette of RS No. 71/12) and Article 46 of the Law on Fire Protection and Firefighting of FBiH (Official Gazette of

FBiH No. 65/09), voluntary fire protection associations may be established. Voluntary firefighters can be engaged in fire suppression activities in urban and forest areas.

The following data help to present a clear picture of the capacities of all the above institutions.

Out of the total of 79 municipalities in FBiH, 45 have professional firefighting units with a total of 802 firefighters. There are voluntary fire protection associations in 40 municipalities, with 627 volunteer firefighters. This means that there are 1,429 professional and voluntary firefighters in FBiH.

In RS there are 641 professional firefighters and 608 volunteers (1,249 in total) distributed in five centres: Banja Luka, Bijeljina, Dobož, Sokolac and Trebinje.

In Brčko District there are 91 professional firefighters and no volunteers.

All firefighters (in FBiH, RS and BD) have vehicles and equipment for the suppression of urban fires. [4]

III. The impact of forest fires on the environment, economy and human health

There are no official data about the impacts of forest fires on the environment on the territory of BiH. Some data are available on the economic damage caused by forest fires and burned timber mass, but they are insufficient for a comprehensive analysis. In general, the main environmental consequences of forest fires in BiH, as elsewhere, are:

- Forest degradation
- Deforestation
- Soil erosion
- Outbreaks of pest infestations and diseases
- Loss of biodiversity
- Emissions of GHGs and other gases

In Brcko District, between 2000 and 2012, the total damage from forest fires was estimated at around BAM 2,300,000 [EUR 1,173,000] [4].

Table 8. Forest fires in Brcko District, 2000–2012

Year	Number of fires	Burned area (ha)	Estimated damage (KM)
2000	14	18.26	75,600
2001	7	13.42	21,400
2002	16	81.38	124,350
2003	45	196.24	378,600
2004	4	7.55	19,500
2005	7	16.35	32,400
2006	13	84.26	96,300
2007	42	187.58	218,420
2008	9	14.10	27,800
2009	15	21.60	32,000
2011	4	64.00	289,444
2012	2	55.9	908,390

Source [4]

According to some sources, the direct damage caused by forest fires in FBiH was estimated at EUR 69,992 in 2004; EUR 734,995 in 2005; and EUR 883,120 in 2006. [9]

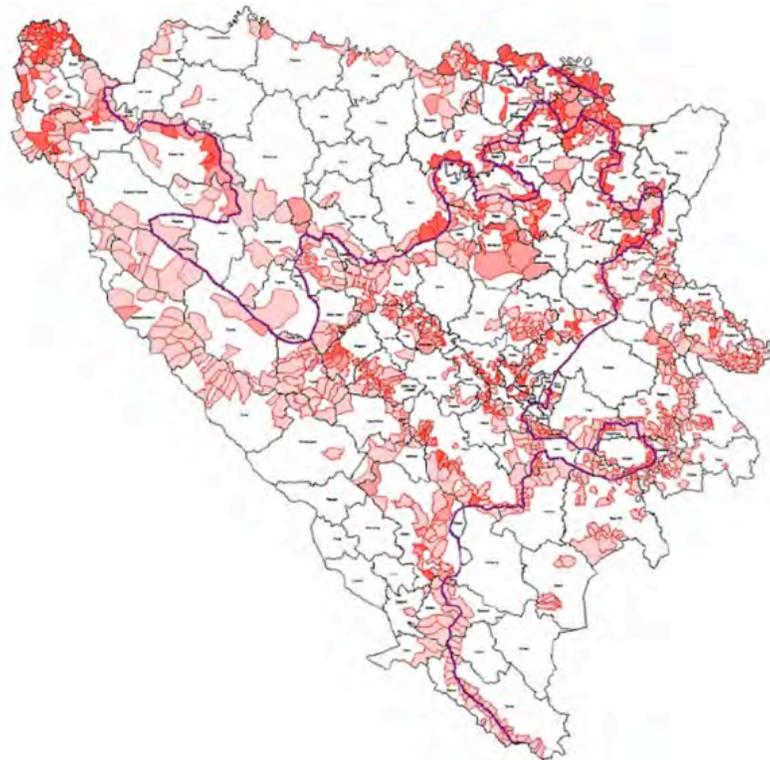
For the period between 2009 and 2013, the damage caused by forest fires in FBiH has been estimated at around BAM 56,250,000 [EUR 28,687,500]. [10]

In the period between 2001 and 2007, around 291,951 m³ of wood mass was burned by forest fires in BiH, with damage estimated at around BAM 38,174,000 [EUR 19,468,740]. [11]

IV. Special issues

One of the main problems in BiH is the existence of areas contaminated by landmines. The current area contaminated by landmines is estimated at around 1,176.5 km² or 2.3 percent of BiH territory, of which 129,774.6 ha or 10.5 percent are forests or forest land.[12] This represents a particular problem for the implementation of the forest fire protection measures prescribed during forest management activities. In addition, it is almost impossible to organise forest fire suppression activities, from either the ground or the air.

Map 4. Distribution of landmines in BiH



Source [2]

Transboundary fires and international cooperation

Forest fires that have spread across the border from Croatia, Montenegro and Serbia had been recorded in the past. The areas most affected by forest fires in BiH are mostly at the border with Croatia and Montenegro, and cooperation agreements have been signed with both countries. In accordance with these agreements, BiH received assistance from Croatia in 2011, 2012 and 2013, totalling 11 days and 11 aeroplanes (CL 415). Assistance was also given by Turkey.

Personnel from BiH regularly cooperate and participate in international exercises and trainings. The most recent international training activity in terms of forest fire protection was the Regional

Fire Management Training for South Caucasus and Western Balkans, held in Antalya, Turkey, on October 15–17, 2014.

V. Needs for improvement in forest fire management

As outlined at the beginning of this study, the unique political structure of BiH has an impact on the functioning of its public institutions and on all areas of public life, including forestry and forest fire protection. As a consequence, a large number of institutions (at state, federal, cantonal and municipal level) are involved in forest fire protection. In order to organise their activities and competences, there are also a large number of legal acts (laws, sub-laws, rulebooks etc.). All this helps to explain why the system of forest fire protection in BiH is not as efficient as it should be. It can be concluded that the number of laws regulating this issue should be dramatically decreased, while the harmonisation of the most important legal acts among entities and institutions should be ensured. This is one of the most important preconditions for the better functioning of the forest fire protection system in BiH.

The existence of a proper early warning system for forest fires may significantly improve preparedness for forest fire protection in BiH. At present there is no early warning system in BiH, with the exception of the possibility to use the European Forest Fire Information System (EFFIS). Taking into consideration the specific local context in BiH, this system can only be seen as a temporary solution and the need for a national early warning system remains.

The problem of ensuring the existence of well-trained firefighters and appropriate vehicles for forest fire suppression also exists in BiH. There is a need for training centres at entity level, but with the same (i.e. harmonised) training programmes. Special vehicles (fire trucks) for forest fire suppression must be procured using the same approach in both entities. All this will ensure that there are well-trained firefighters and proper vehicles, but, more importantly, it will lead to an efficient, harmonised and functional system of forest fire protection.

According to past experience and the 2014 study *Forest Fire Suppression in Bosnia and Herzegovina* [4], there is clearly a need to procure aerial means (aeroplanes and/or helicopters) for forest fire suppression.

The problem of the contamination of forests and forest land with landmines has already been emphasised. There are a couple of urgent issues related to the “solving” of this problem. The first is that all areas contaminated with landmines should be precisely mapped and the data made available to the public. This is necessary not only for the local population and institutions competent for forest fire protection, but also for the equipment (mainly aeroplanes) received as international assistance.

The second is to work towards identifying the most appropriate way to manage these areas in order to reduce the risk of forest fires, and the most appropriate means of fire suppression. The final demining of these territories is, of course, also a requirement.

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Forest Fire Country Studies

Kosovo*



FOREST FIRES COUNTRY STUDY

KOSOVO*

2015

**Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations.....	3
I. The forestry sector, forests and fire history	4
1.1. Forest characteristics.....	5
1.2. Major forestry stakeholders	8
1.3. Fire history	11
II. Legal framework and institutional set-up in the field of forest fire management	14
III. The impact of forest fires on the environment, economy and human health	21
IV. Special issues	23
V. Needs for improvement in forest fire management	24
Literature.....	25

Abbreviations

FAO	Food and Agriculture Organization
dbh	Diameter at breast height
MAFRD	Ministry of Agriculture, Forestry and Rural Development
DoF	Department of Forestry
KFA	Kosovo Forestry Agency
UNMIK	United Nations Interim Administration Mission in Kosovo
MESP	Ministry of Environment and Spatial Planning
KEPA	Kosovo Environmental Protection Agency
JRC	Joint Research Centre
MIA	Ministry of Internal Affairs
EMA	Emergency Management Agency
CCFS	Climate Change Framework Strategy

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

I. The forestry sector, forests and fire history

1. *Overview of the forestry sector*

According to Article 2 of the Law on Forests (2003/3), forests and forest land in Kosovo* are defined as follows: A forest is land registered as such in the cadastral records; while forest land is land that is being managed for the production of wood or other forest products or whose best use, given its natural characteristics and economic conditions, involves the growing of trees.

Although the terms “forest” and “forest land” are defined in the Law on Forest, the national forest inventory was carried out using the respective definitions provided by the United Nations Food and Agriculture Organization (FAO). All data for forest resources in Kosovo* are taken from this inventory and are in accordance with the FAO definitions:

A **forest** is land with tree crown cover of more than 10 percent and an area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ.

The forest may consist either of closed forest formations, where trees of various storeys and undergrowth cover a high proportion of the ground: or open forest formations with continuous vegetation cover in which the tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forests, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

Forests include: forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m.

Forests exclude: land predominantly used for agricultural practices.

Other wooded land is land either with a tree crown cover of 5 to 10 percent of trees able to reach a height of 5 m at maturity in situ; or a crown cover of more than 10 percent of trees not able to reach a height of 5 m at maturity in situ (e.g. dwarf or stunted trees) and shrub or bush cover.

It excludes: areas with the tree, shrub or bush cover specified above but of less than 0.5 ha and 20 m in width, which are classed under “other land”; and land predominantly used for agricultural practices. [1]

1.1. Forest characteristics

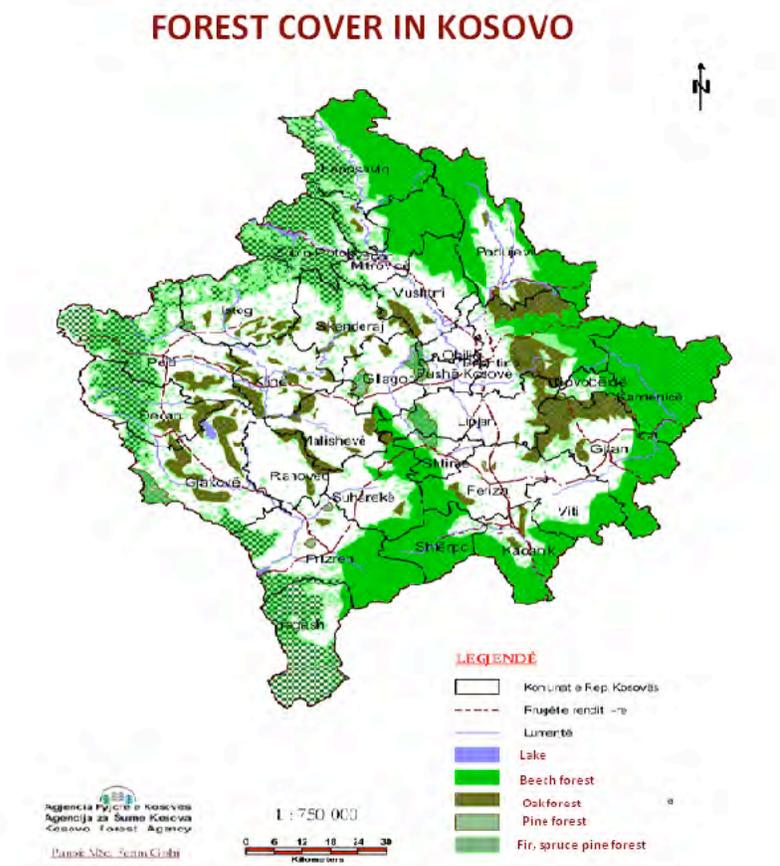
According to the 2012 national forest inventory, the total forest area in Kosovo* is 481,000 ha. Forests are dominated by broadleaved tree species, covering 93 percent of the forest area (449,400 ha; Table 1). Coniferous forests cover almost 5 percent of the forest area (23,800 ha). More than half of the total forest area comprises what are considered as even-aged forests.

Table 1. Forest area by forest composition and stand structure (ha)

Forest composition	Stand structure				Total
	Regeneration	Even-aged	Two-storied	Uneven-aged	
Coniferous	2 200	6 600	6 200	8 800	23 800
Mixed	0	400	3 200	4 200	7 800
Broadleaved	45 400	236 000	123 600	44 400	449 400
Total	47 600	243 000	133 000	57 400	481 000

Source [1]

Map 1. Forest cover in Kosovo*



Source [1]

As shown in Table 2, 180,800 ha (38 percent) of forests in Kosovo* are classified as privately owned, while 295,200 ha (62 percent) are classified as public forests. Coppice forests cover 84 percent of the total forest area. This is the result of extensive harvesting, in particular of short rotation coppice forestry for firewood production. Forests that regenerate naturally are mostly beech (*Fagus* spp.), mixed beech and conifers, and pure coniferous forests located at higher elevations.

Table 2. Forest area by stand origin and ownership (ha)

Stand origin	Ownership			Total
	Public	Private	Unknown	
Natural seeding	58 400	13 600	1 000	73 000
Planting and artificial seeding	2 000	800	0	2 800
Coppice	229 000	164 800	4 000	397 800
Coppice with standards	5 800	1 600	0	7 400
Total	295 200	180 800	5 000	481 000

Source [1]

Table 3. Forest area by forest composition and age class (ha)

Forest composition	Age class (years)						Total
	0-20	21-40	41-80	81-120	121-160	161-200	
Coniferous	4 600	3 600	11 400	3 400	800	0	23 800
Mixed	200	1 000	4 600	1 200	600	200	7 800
Broadleaved	139 600	157 200	127 800	21 800	2 800	200	449 400
Total	144 400	161 800	143 800	26 400	4 200	400	481 000

Source [1]

Table 4. Growing stock in forests by main tree species (dbh \geq 7 cm) (1,000 m³)

Tree species	2002	2012
<i>Quercus cerris</i>	5 170	4 282
<i>Quercus petraea</i>	4 276	3 669
Other <i>quercus</i> sp.	129	1 292
<i>Fagus</i> sp.	15 963	18 524
Other broadleaves	3 704	6 750
Undefined broadleaves	5 983	0
<i>Abies alba</i>	1 577	1 573
<i>Picea abies</i>	1 402	1 840
<i>Pinus</i> sp.	2 018	2 502
Other conifers	223	77
Total	40 445	40 508

Source [1]

1.2. Major forestry stakeholders

The Government of Kosovo* administers forests and forest land through the institutions described below.

Figure 1. Forest management structure



Source [7]

1.2.1. The Ministry of Agriculture, Forestry and Rural Development (MAFRD)

The MAFRD is the highest institution for the administration and management of forests in Kosovo*. The MAFRD administers forests through the Department of Forestry and the Kosovo Forestry Agency.

The Department of Forestry develops policies and sets the regulatory framework for forest management. It compiles the ministry's 10-year strategy for governing the forestry sector.

The Kosovo Forestry Agency (KFA) is the implementing body of the ministry. It acts as the administrator and manager of forest land (with the exception of the territory of the Ibar-Leposavić Forest Management Unit in northern Kosovo*, which is affiliated to the Srbijašume public enterprise based in Belgrade). The KFA, which was established in accordance with UNMIK Regulation No. 2000/27, carries out its functions through six regional offices in Pristina, Peja, Gjilan, Ferizaj, Prizren and Mitrovica. These KFA offices are responsible for drafting annual management plans, including the planning of permits each year; marking trees that are to be harvested on both private and public land; designing and implementing programmes for the protection of forests from diseases, pests and forest fires; and organising and monitoring the afforestation of degraded forest land. According to the Law on Forests (2003), the KFA is responsible for issues related to the regulation of forests and forest lands, and for the administration and management of public forest areas and forests in national parks in Kosovo*.

The Forestry Inspectorate: The inspectorate is a department under the KFA responsible for controlling forest activities in both public and private forests. In addition to conducting inspections in response to reports from different regions about forestry-related illegal activities, inspectors also conduct inspections in the forest and timber markets, often in cooperation with the police and the KFA. Although it is a relatively independent department under the KFA, some politicians have suggested that, due to its present inability to inspect other forest authorities and due to conflicts of interest, it should be an external and fully independent body.

1.2.2. Municipalities

Under the 2008 Law on Local Self-government (03/L-040), responsibility for protecting forests and issuing permits was transferred to municipalities. While municipalities collect revenues from the sale of confiscated wood, the revenue from permits is shared between the MAFRD and municipalities (70 percent to the central level and 30 percent to the municipalities).

Municipalities are obliged to send monthly reports about illegal logging, confiscated wood and other activities in the forests under their jurisdiction to their regional KFA office. Municipalities hire forest guards to patrol and secure forest land.

1.2.3. The Ministry of Environment and Spatial Planning (MESP)

The MESP is in charge of creating and implementing general management legislation in the field of environment, water, housing, spatial planning and construction. The MESP also has competences over national parks, covering around 25 percent of the total forest area in Kosovo*.

- The Kosovo Environmental Protection Agency (KEPA) is a government institution under the MESP, which focuses on maintaining the quality of air, water, soil and biodiversity; promoting the use of renewable energy resources; and ensuring the sustainable use of natural resources. There are two departments under the KEPA responsible for the management of national parks.

Figure 2. Organisational structure of the KEPA



Source: http://www.ammk-rks.net/repository/docs/Kepa_organisation_structure.jpg

The Directorate of National Parks is located in Prizren. According to its charter, the directorate is responsible for managing the entire territory of all national parks. However, as indicated in the Spatial Development Plan of the Sharr Mountain National Park, the directorate's management capacities only cover areas in Prizren and Suva Reka/Theranda municipalities. There is currently no entity equivalent to the directorate to oversee the other national park in Kosovo*: Bjeshket e Nemuna.

The Institute of Nature Protection issues cutting permits to private forest owners in the national parks based on a land ownership certificate and needs. The institute is also responsible for determining the boundaries of national parks and mapping them with the help of external experts. [7]

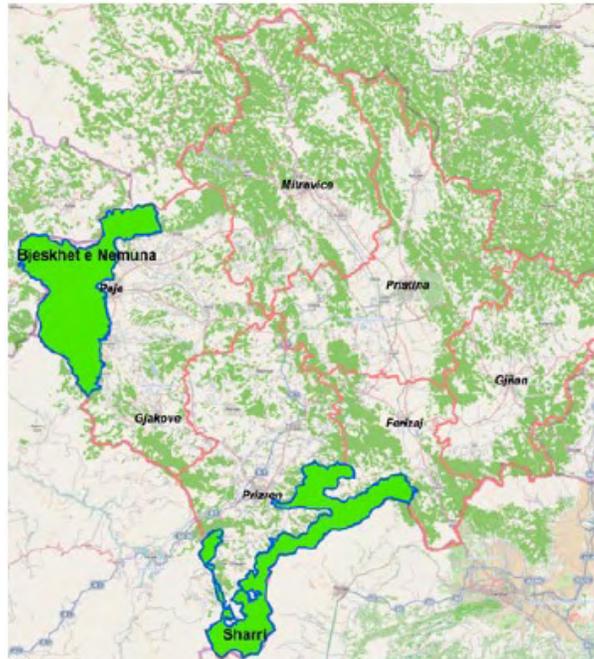
As already mentioned, there are two national parks in Kosovo*: the Sharr Mountain/Sharri National Park (Albanian: Malet e Sharrit; Serbian: Šar planina) in southern Kosovo*; and Bjeshket e Nemuna in western Kosovo*. Both national parks are located at high elevation in forested areas.

Table 5. Forest area and growing stock in national parks by forest composition (ha, m3)

National park	Resource	Forest composition			Total
		coniferous	mixed	broadleaved	
Sharri	Area (ha)	2 000	600	15 000	17 600
	Growing stock (m ³)	410 000	171 000	5 335 000	5 916 000
Bjeshket e Nemuna	Area (ha)	17 600	5 400	19 000	42 000
	Growing stock (m ³)	3 910 000	1 614 000	2 860 000	8 384 000
Total	Area (ha)	19 600	6000	34 000	59 600
	Growing stock (m ³)	4 320 000	1 785 000	8 195 000	14 300 000

Source [1]

Map 2. Location of national parks in Kosovo*



Source [1]

1.3. Fire history

According to the national forest inventory, one of the most negative and detrimental factors affecting forests and forestry is forest fires. Forest fires (up until 2012) have affected around 12,200 ha of forest, or 2.5 percent of the total forest area (Table 6). It should be noted that areas where more than 25 percent of small trees were affected, or where more than 25 percent of the growing stock of measurable trees was affected, are taken into consideration and included in this table.

Table 6. Area of significant stand-level damage, by forest composition and cause of damage (ha)

Forest composition	Cause of damage								Total
	Insects	Disease/fungi	Fire	Animal	Weather	Human impact	Suppression	Misc.	
Coniferous	200	200	2 200	0	400	800	0	800	4 600
Mixed	600	400	0	0	400	200	0	200	1 800
Broadleaved	3 000	10 200	10 000	1 800	2 400	7 800	5 200	11 400	51 800
Total	3 800	10 800	12 200	1 800	3 200	8 800	5 200	12 400	58 200

Source [1]

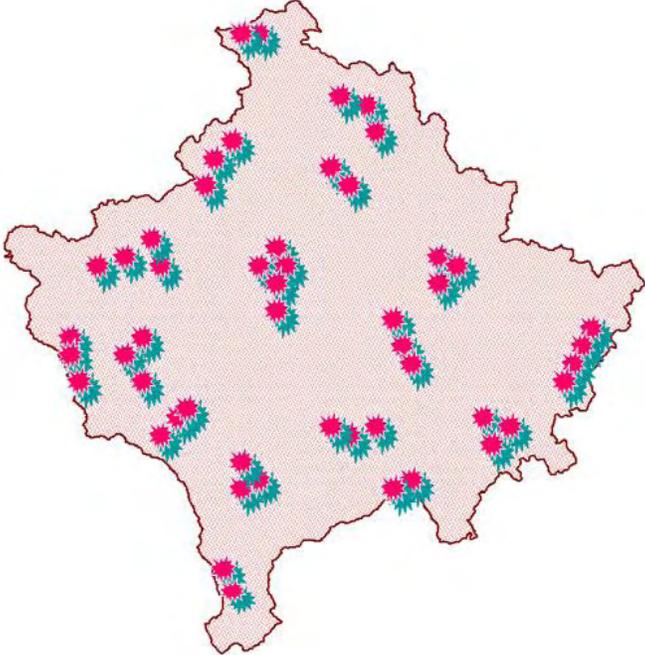
One of the most severe forest fire seasons (according to the JRC) during the last 10 years was in 2012, when 49 fires affecting over 40 ha were registered in Kosovo*, and around 8,376 ha of burned area was mapped using satellite technology. Of this area, 5,902 ha were burnt in forests and other wooded lands; 1,379 ha in other natural lands; 1,085 ha on agricultural land; and a small amount (10 ha) in other land cover. [2]

Photo 1. Area severely affected by forest fire in Radusha, Istog (234 ha burned in 2007)



Source [1]

Map 3. Regions with a high potential risk of fires



Source [4]

II. Legal framework and institutional set-up in the field of forest fire management

The most important legislative acts regulating the issue of forest fires in Kosovo* are:

Law on Forests (No.2003/3)

The main articles in this law concerning forest fires are Articles 26 and 27.

Article 26 (Protection of forests against fire) contains the following provisions:

26.1 No person may start an open fire in forests or on forest land without a permit.

26.2 For the purposes of this article, an open fire does not include a fire inside a building or inside a fireplace or device designed to contain the fire safely.

26.3 The Forest Agency may issue permits for starting open fires where such action is consistent with sustainable forest use.

26.4 The minister may issue rules governing the issuance of permits under this article.

Article 27 (Forest Agency protection and restoration authority) prescribes the following:

27.1

(a) Upon finding that the condition of private land threatens to damage forests of other ownership, the Forest Agency may order the owner to ameliorate the condition.

(b) Authority in this section includes the authority to order actions to reduce hazards or threats from fire, insects, disease and invasive organisms.

(c) If an owner fails to obey an order under this section within a reasonable time, the Forest Agency may enter the property, take action to ameliorate the condition, and invoice the owner for the costs of such action.

27.2

(a) Upon finding that the condition of private forests or forest land threatens to impair the sustainable use of forest resources, the Forest Agency may order the owner to take action to reduce the threat.

(b) Authority in this section includes the authority to order actions to protect forest soils and waters, and the authority to order reforestation.

(c) If an owner fails to obey an order under this section within a reasonable time, the Forest Agency may enter the property, ameliorate the condition, and recover the costs of such action from the owner. [9]

At this point it is important to mention that the MAFRD, on the basis of Article 1.3 (d) of UNMIK Regulation 2001/19 dated September 13, 2001, on the Executive Branch of the Provisional Institution of Self-government in Kosovo*, and Article 26, Paragraph 26.4 of the Kosovo Law on Forests 2003/3 dated March 20, 2003, has approved Administrative Instruction MA-No. 22/2007 on the Protection of Forests from Fire. This instruction determines technical, preventive and other measures for the protection of forests from fire that shall be taken by the owners or users of forests and forests lands in order to minimise the risk and rapid burning of fires in forests; detect and notify others of fires in forests; and to prevent and fight fires in forests. [10]

Law on Protection and Rescue from Natural Disasters and Other Disasters (No. 04/L-027)

This law regulates the protection of people, animals, property, cultural heritage and the environment against natural and other disasters, and their rescue in the event of such disasters. According to Article 3 (Definitions), fires (including forest fires) are considered within the category of “other disasters”: “Other disasters — heavy traffic accidents, air and railway traffic, fire, mine accidents, damage from dams and other ecological and industrial disasters caused by the work or behavior of human beings, extraordinary emergency situations such as high temperatures, the technical collapse of the energy system, power supply, telecommunication and information technology, terrorist acts and other types of large-scale violence.” [11]

Law on Firefighting and Rescue (No. 04/L-049)

The purpose of this law is to provide an effective response in the form of firefighting mechanisms aimed at rescuing people, property and the environment in emergency situations (Article 1).

The scope of this law includes the definition of the duties to be fulfilled by firefighting and rescue units established under this law (Article 2). [12]

Law on Nature Protection (No. 03/L-233)

This law regulates nature protection, the sustainable use of nature, and in particular the protection, conservation, renewal and sustainable use of natural resources, in a condition of natural balance. (Article 2)[13]

This protection includes protection against forest fires.

According to the laws referred to above, the main institutions authorised for forest fire protection are listed below.

- The Ministry of Agriculture, Forestry and Rural Development

As mentioned above, the MAFRD is the highest-level institution for the administration and management of forests in Kosovo*, working through the Department of Forestry and the Kosovo Forest Agency (KFA).

Through the KFA, the MAFRD implements legal regulations in terms of forest management in Kosovo*, while through the Forestry Inspectorate it ensures their implementation by all private and state entities in the forestry sector. The issue of forest fire protection is thus also regulated. Forest fire protection is part of all forest management plans (both annual and long term).

The issue of forest fire protection is treated in even greater detail at municipal level. The municipal branch of the KFA includes a forest protection office responsible for ensuring the implementation of regulations, and especially of Administrative Instruction MA-No22/2007 on Protection from Forest Fires. The obligations of all relevant natural and legal persons in this respect are described in Articles 2 and 3 of the instruction:

Article 2 contains the following provisions:

(1) Natural and legal persons that manage forests and forests lands are obliged to register forests according to the risk of forest fires in harmonisation with the forest fire risk assessment provided in the appendices to the administrative instruction.

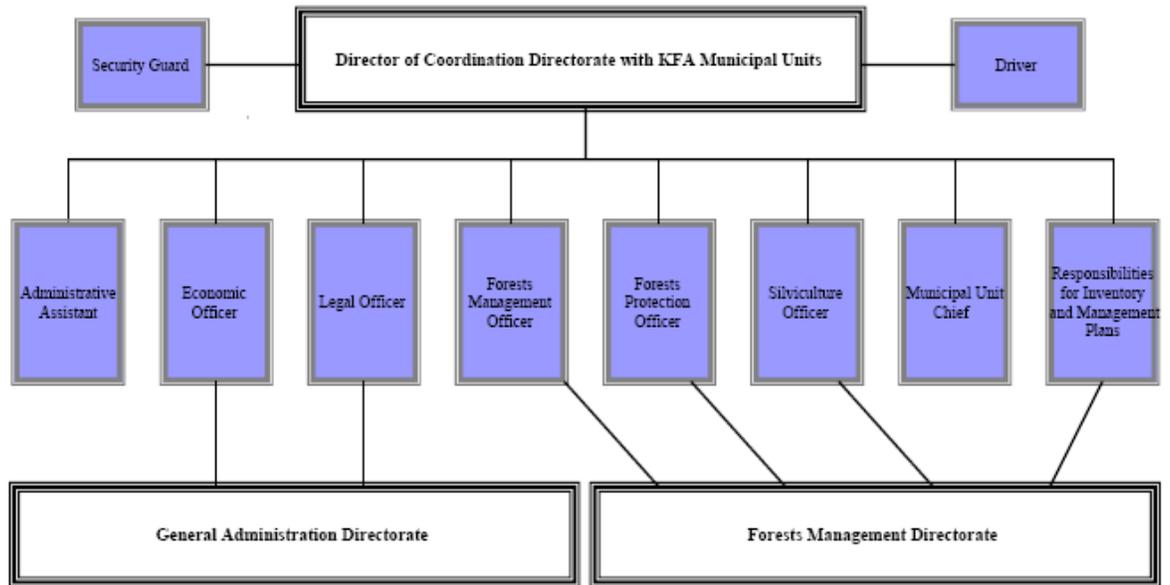
(2) Registration includes the surface area of controlled forests ranked according to the forest fire risk level.

Article 3 prescribes the following:

(1) Natural and legal persons that manage forests and forest lands are obliged to:

1. compile annual plans for the protection of forests and forest lands from fire;
2. organise a detection and notification service;
3. establish a service for the protection of forests from fire, or entrust this duty to a legal person specializing in this field;
4. prepare and train forest staff for intervention and equip them with the necessary tools for opening up paths to fight fires and stop their spread;
5. inform personnel of risk levels and enforce protection measures against fires; and
6. raise public awareness, particularly among tourists and children, about the importance of forest protection, and undertake preventive measures according to forest fire risk."

Figure 2. Organisational structure of the KFA municipal units



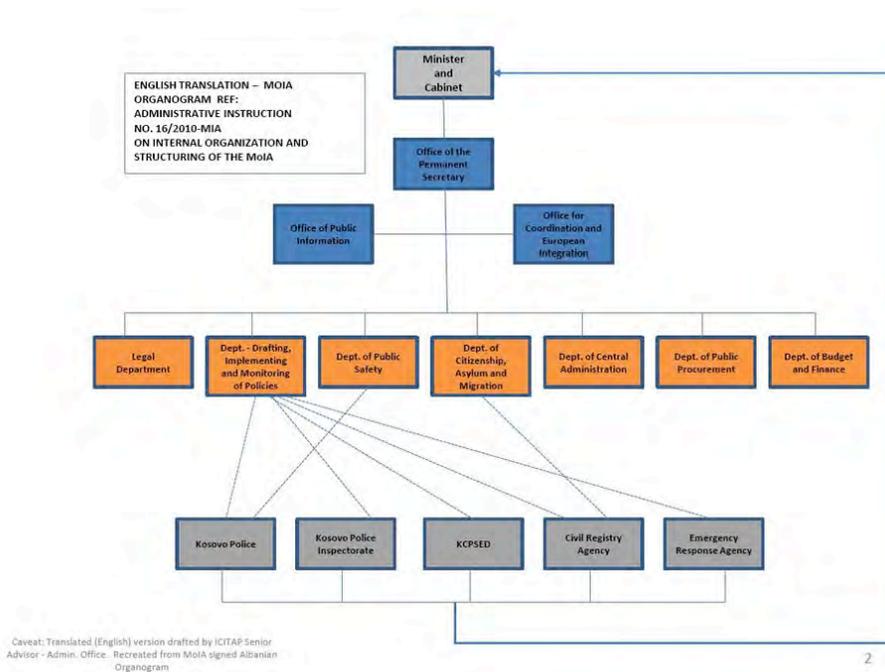
Source [15]

- The Ministry of Internal Affairs (MIA)

The main goal of the MIA is to build, preserve and increase the security of all citizens in Kosovo* and in cooperation with them.

The Emergency Management Agency (EMA) is established within the MIA. This agency is responsible, among other things, for forest fire protection.

Figure 3. Organisational structure of the MIA



Source [14]

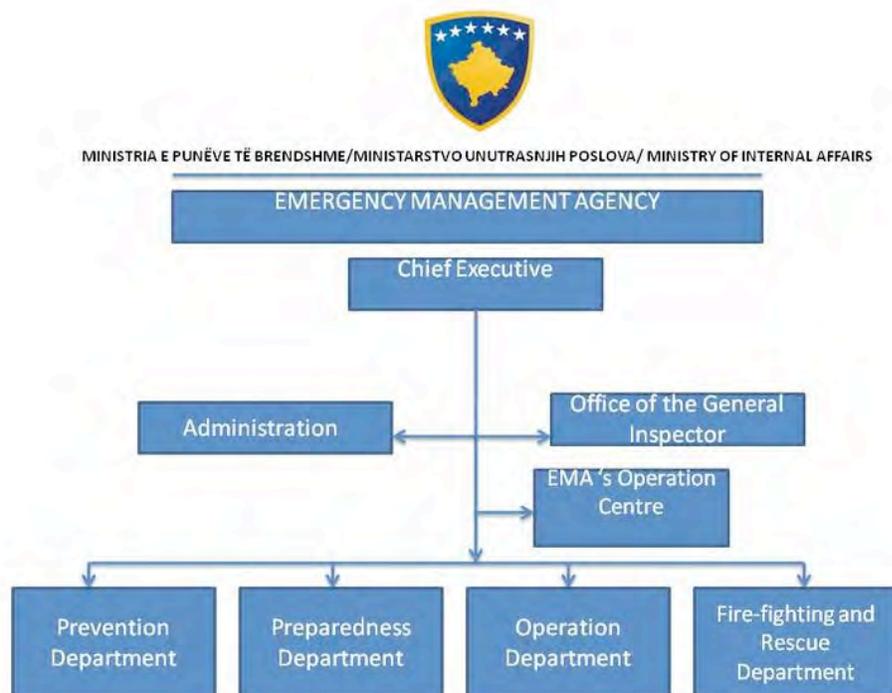
The main mission of the EMA, through the Department of Fire and Rescue, is to establish a solid foundation in the field of prevention, preparedness and response by providing leadership and ensuring the central coordination of firefighting services at all levels and within all structures.

Its functions are to:

1. supervise, coordinate, direct and set standards for these tasks; serve as a community fire protection, firefighting, rescue and emergency response; and act as an advocate for the Department of Fire and Rescue in terms of the challenges facing community, private and voluntary firefighters;
2. develop and deliver educational programmes in the field of prevention and fire protection in partnership with other agencies, the emergency response community, the media and other stakeholders;
3. support professional development, operational capacity and preparedness training for central, regional, local and private fire/rescue and emergency response structures;
4. support regional and local entities in the collection, analysis and dissemination of data and special reports regarding the occurrence, control and consequences of any fire, health incidents and other emergency activities; and

5. use and support the development of technologies for fire prevention, suppression and localisation; and support resource management studies and firefighting operations in the field.

Figure 4. Organisational structure of the EMA



Source [15]

According to Article 4 of the Law on Firefighting and Rescue (No. 04/L-049), the responsibilities of the EMA include:

- 2.1. Structuring, classifying and defining the operational methods of professional firefighting and rescue units and professional staff.
- 2.2. Encouraging the establishment of firefighting and rescue voluntary associations in accordance with the risk assessment and fire protection plan.
- 2.3. Establishing professional firefighting and rescue units in the territories of municipalities that lack a sufficient number of firefighting and rescue units.

- Municipalities

In accordance with Article 4 of the law, municipalities play a role in fire protection (including forest fire protection). Municipalities are responsible for:

3.1. Encouraging the establishment of one or more firefighting and rescue voluntary associations.

3.2. Structuring, organising, classifying and defining the operational methods of firefighting and rescue voluntary association units in accordance with the requirements of the agency, as defined in Paragraph 2, Sub-paragraph 2.1.

3.3. Defining the tasks and the number of voluntary firefighting staff; and the assets and equipment necessary for firefighting and rescue voluntary association units in accordance with the municipality risk assessment and central fire protection plan.

3.4. Undertaking measures to establish firefighting voluntary units if they lack a sufficient number of firefighting and rescue units in their territory.

Controlled fires may be used on agricultural lands and pastures, and there is no law that either bans or permits their use.

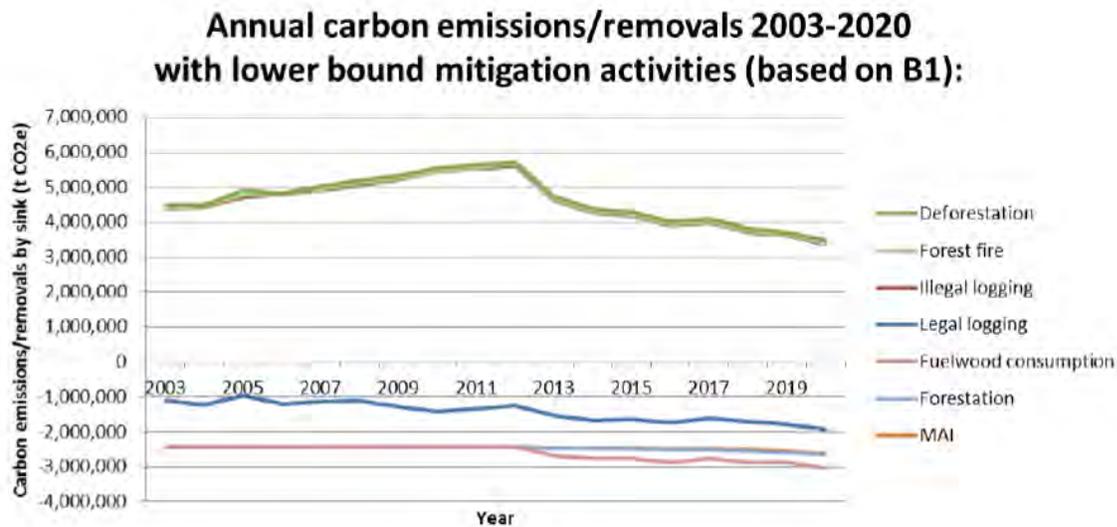
III. The impact of forest fires on the environment, economy and human health

Economic losses, as a result of direct and indirect damage to infrastructure and structures in urban and rural areas, are significant, although no detailed data are available. The total timber mass burned in the period between 2003 and 2014 is estimated at 459,000 m³. [8]

Human fatalities and injuries have been registered, although there are no available statistics.

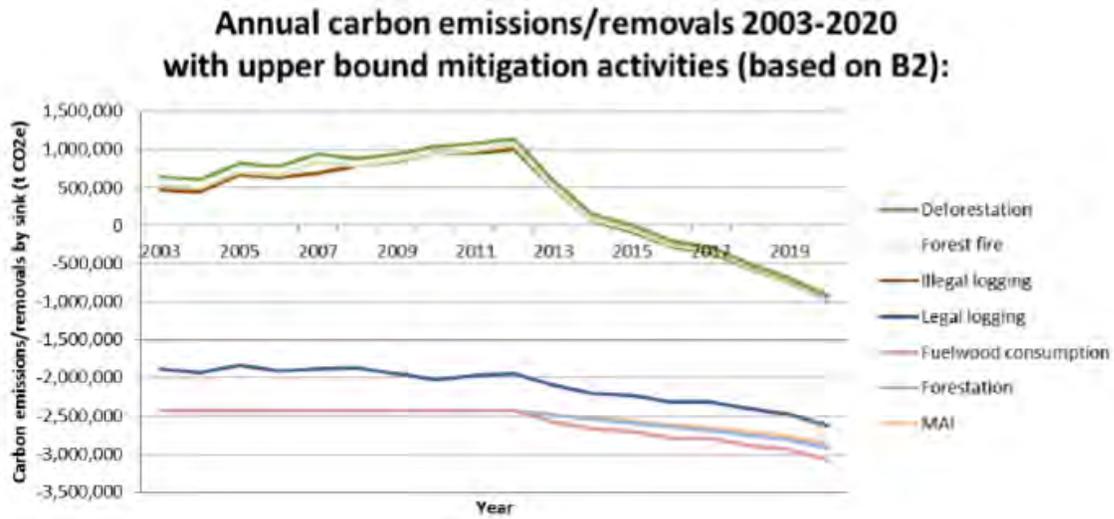
The impacts on the environment of emissions from burning vegetation are addressed only in the framework of the Climate Change Framework Strategy (CCFS) for Kosovo* (issued by the Ministry of Environment and Spatial Planning in 2014). There are data for annual carbon emissions in the period 2003 to 2020 (real and estimated) in two climate scenarios. Among other sources of carbon emissions, these scenarios also consider forest fires (Figures 5 and 6).

Figure 5. Estimated potential of a portfolio of mitigation activities across time (B1, lower bound)



Source [6]

Figure 6. Estimated potential of a portfolio of mitigation activities across time (B2, upper bound)



Source [6]

IV. Special issues

As a consequence of events that took place on the territory of Kosovo* in 1998, the risk of mines has been recorded.

The UN managed a large mine clearance programme in Kosovo* between 1999 and 2001, which resulted in a declaration by the UN in 2001 that Kosovo* was free of mines. Since then, thousands of mines and cluster munitions have been cleared by the limited capacity of all the agencies remaining in Kosovo*. A comprehensive joint survey carried out in 2013 by the HALO Trust (the oldest and largest humanitarian landmine clearance organisation in the world) and the Kosovo Mine Action Centre (KMAC) identified 130 minefields and cluster munition strikes remaining in Kosovo*. Minefields remain in rural areas in which impoverished communities rely on agriculture and woodcutting for their income. [16] This could be a significant problem during forest fire suppression activities, as well as during forest management activities.

There are no data available about transboundary/cross-border fires, or about bilateral or regional agreements.

There is no official national programme or training centre for special training in forest fire protection, although various international projects have improved forest fire protection capacities.

The first of these projects was the Establishment and Training of a Nucleus for Forest Fire Protection in Pec/Peje. This joint project of the Italian State Forestry Service (Corpo Forestale dello Stato) and the MIA was implemented in 2004 and resulted in the training of 250 people in forest fire protection.

The second was the participation of three people at a training organised in the framework of the Macedonian/FAO project Strengthening National Forest Fire Preparedness in the Former Yugoslav Republic of Macedonia (TCP/MCD/3201), held on November 14 to 17, 2011, in Skopje.

The third was the participation of three people at the Regional Fire Management Training for the South Caucasus and Western Balkans, held in Antalya, Turkey, on October 15 to 17, 2014.

V. Needs for improvement in forest fire management

The existing laws and legal acts that regulate forest fire protection need to be harmonised. The issue of forest fires is currently regulated by different laws implemented by different institutions, thus there are some overlapping competencies, uncertainties in procedures and a lack of tools for coordinating activities between institutions.

There are no specialised, well-trained forest firefighters, and no educational institutes for training decision makers, planners, command staff or firefighters. In order to improve this situation, a special programme should be created for training existing firefighters and new personnel. This is equally important for the KFA and the EMA and is also related to the previous findings regarding the current legal regulations.

There is also a lack of special vehicles for forest fire suppression. In particular, there are no first-response vehicles in the forestry sector and no off-road fire trucks in the framework of the EMA.

There is no voluntary fire protection organisation in Kosovo*. One of the ways in which members of the local population can be actively involved in fire protection (including forest fire protection) is through the establishment of voluntary organisations. Through the activities of such an organisation, people of all ages can be engaged in forest fire protection (i.e. in prevention, pre-suppression and suppression). This is one of the best ways to raise public awareness, increase the preparedness of local communities for forest fire suppression, and address the problem of the lack of personnel in the relevant institutions.

One of the preconditions for defining the level of preparedness of the institutions responsible for forest fire protection during the fire season is the existence of an appropriate early warning system. Such a system in Kosovo* would allow the institutions responsible for forest fire protection to be more efficient and better organised.

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Forest Fire Country Studies

Former Yugoslav Republic of Macedonia



FOREST FIRES COUNTRY STUDY
FORMER YUGOSLAV REPUBLIC OF MACEDONIA
2015

Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations.....	3
I. The forestry sector, forests and fire history	4
1.1. Forest characteristics.....	4
1.2. Major forestry stakeholders	7
1.3. Fire history	9
II. Legal framework and institutional set-up in the field of forest fire management	13
III. The impact of forest fires on the environment, economy and human health	25
IV. Special issues	28
V. Needs for improvement in forest fire management	31
Literature	34

Abbreviations

PE	Public enterprise
PEMF	The public enterprise Macedonian Forests
MAFWE	Ministry of Agriculture, Forestry and Water Economy
DPR	Directorate for Protection and Rescue
LSG	Local self-governance
TFPU	Territorial fire protection units
CMC	Crisis Management Centre
MKFFIS	Macedonian Forest Fires Information System
MFPU	Macedonian Fire Protection Union
RFPU	Regional fire protection unions
JICA	Japan International Cooperation Agency
GHG	Greenhouse gases
UNFCCC	United Nations Framework Convention on Climate Change
LULUCF	Land use, land-use change and forestry
JRC	Joint Research Centre
UN	United Nations
UXO	Unexploded ordnance
WW 1	World War One
EU	European Union
MIC	Monitoring and Information Centre
TCP	Technical Cooperation Programme
FAO	Food and Agriculture Organization
OSCE	Organization for Security and Co-operation in Europe
ENVSEC	Environment and Security Initiative
RFMC	Regional Fire Monitoring Centre
GFMC	Global Fire Monitoring Centre

I. The forestry sector, forests and fire history

1. Overview of the forestry sector

According to Article 6 of the Law on Forests (Official Gazette of FYRM No. 64 of May 22, 2009), forests in the former Yugoslav Republic of Macedonia are defined as follows:

- 1) *Forest ecosystems that exist on forest land covered with forest tree and shrub species, bare land close to the forest, as well as other bare land and pastures inside the forest, forest nurseries, forest roads, seedling plantations, forest fire cleanings, wind protection belts with an area larger than 2 a [0.02 ha], as well as forests in protected areas. Forests also consist of young stands and forest plantations with an area larger than 2 a [0.02 ha], as well as areas that are currently uncovered as a result of human activities or natural hazards, where natural regeneration has begun.*

Separate groups of trees on areas smaller than 2 a [0.02 ha], border trees in agricultural land, plantations of fast-growing tree species as well as river bank vegetation, alleys and parks in inhabited places are not considered as forest.[6]

According to Article 7 of the same law, “forest management” is defined as:

silviculture, protection and forest utilisation, through the restoration, nurture, protection, afforestation, utilisation of forests and forest land, and other activities for the maintenance and improvement of the forest's functions.[6]

Besides their basic goal, the definitions contained in these two articles of the Law on Forests (of forests, of what may not be considered as forest, and of forest management) may also be considered as a basis for defining the activities and competences of the forestry sector in terms of forest fire protection.

1.1. Forest characteristics

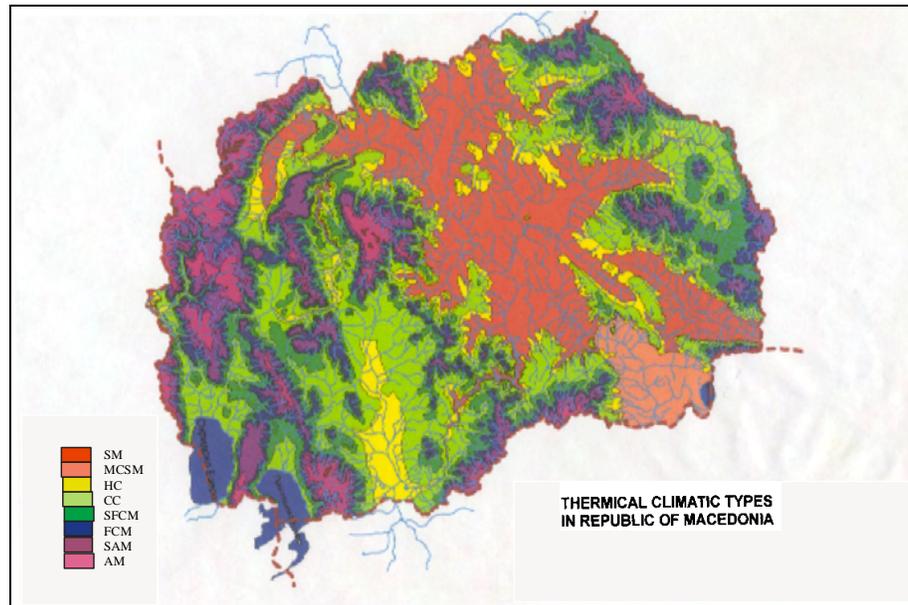
The total area of forest land in the former Yugoslav Republic of Macedonia is 1,159,600 ha, of which forests themselves cover 947,653 ha. The total standing volume in Macedonian forests is 74,343,000 m³, while the total annual increment is 1,830,000 m³ and the average annual increment per hectare is 2.02 m³. [3]

The distribution of different tree species and types of forest over the territory of the country depends of various factors, such as climate, soil and topography.

According to the climate and type of vegetation, the following thermo-climatic regions and sub-regions and forest/vegetation associations can be defined in the former Yugoslav Republic of Macedonia:

- Region with a sub-Mediterranean climate (50–500 m.a.s.l.) (Gevgelija-Valandovo region) (SM)
Quercus-Carpinetum orientalis (**Oberdemend Ht.**)
- Region with a moderate continental–sub-Mediterranean climate (up to 600 m.a.s.l.) (MCSM)
Quercus-Carpinetum orientalis macedonicum (**Rudski apud Ht.**)
- Region with a hot continental climate (600–900 m.a.s.l.) (HC)
Quercetum frainetto-cerris macedonicum (**Oberd Emend Ht.**)
- Region with a cold continental climate (900–1,100 m.a.s.l.) (CC)
Orno-Quercetum petraeae (**Em.**)
- Region with a sub-forest–continental–mountainous climate (1,100–1,300 m.a.s.l.) (SFCM)
Festuco heterophylla-Fagetum (**Em.**)
- Region with a forest–continental–mountainous climate (1,300–1,650 m.a.s.l.) (FCM)
Calamintha grandiflora-Fagetum (**Em.**)
- Region with a sub-alpine mountainous climate (1,650–2,250 m.a.s.l.) (SAM)
Fagetum subalpinum scardo pindicum (**Em.**)
Picetum subalpinum scardicum (**Em.**)
Myrtillo-Pinetum pencis subass. Subalpinum (**Em.**)
Pinetum mudhi macedonicum (**Em.**)
Junipero-Bruckentalium (**Em.**)
- Region with an alpine mountainous climate (above 2,250 m.a.s.l.) (AM)
grass associations [1]

Map 1. Thermo-climatic regions in the former Yugoslav Republic of Macedonia



Source: [34]

The most dominant species are beech (*Fagus moesiaca*) and various oak species (*Quercus spp.*), which make up 90 percent of the total area of native forest types. Forests mainly comprise deciduous tree species, while the share of conifers is around 11 percent of the total forest area. Around 550,000 ha of forests are categorised as coppice (low-quality forests), while around 390,000 ha are categorised as high forests (usually high-quality forests), of which around 140,000 ha are plantations (afforestation), mostly comprising coniferous tree species such as *Pinus nigra* (black pine) and *Cupressus arizonica* (Arizona cypress).

Out of the total area of forest, the share of state-owned forests is 90.14 percent, comprising 92.2 percent of the total standing volume. Privately owned forests cover 9.86 percent (94,146 ha) of the total forest area, comprising 7.8 percent of the total standing volume.[3] There are more than 200,000 parcels of forest (the average size of a parcel being 0.6 ha), which are the property of around 65,000 owners.

According to the official management plans, annual allowed removal is around 1,200,000 m³ (i.e. around two-thirds of the annual increment). The principal share of this amount is related to state-owned economic forests, while a very small part is correlated with protective and protected areas. The definite volume of annual removals is between 550,000 m³ and 750,000 m³ and

comprises mostly firewood (80–85 percent) used by households. Logs are used mostly by the domestic wood industry, while only a small share are exported.

State-owned forests for economic use are managed by the public enterprise (PE) Macedonian Forests (Makedonski sumi), while state-owned protected forests are managed by state-established national parks or other public enterprises. Private forests are managed by private owners, largely through alliances of private forest owners.

1.2. Major forestry stakeholders

The Government of the former Yugoslav Republic of Macedonia administers the forests and forest lands in state ownership through the following institutions:

1.2.1. Ministry of Agriculture, Forestry and Water Economy (MAFWE) www.mzsv.gov.mk

The State Inspectorate of Forestry and Hunting, as a body within the MAFWE, controls and supervises the enforcement of the Law on Forests, the Law on Hunting and all other laws and legally binding acts in the field of forestry and hunting. The Forestry Police, as a sector within the MAFWE, protects the forests in accordance with the Law on Forests. [21]

1.2.2. Public enterprise Macedonian Forests (PEMF) www.mkdsumi.com.mk

The public enterprise for managing state forests was founded on the basis of Government Decision No. 3028/1 of December 15, 1997 (Official Gazette of FYRM No. 65/97). It began operations on July 1, 1998, as the legal successor to the former enterprises for forest management. In accordance with Article 7 of the Law on Forests, its core activities are: silviculture, protection and utilisation of forests through the restoration, nurture, protection, afforestation and utilisation of forests and forest land, and other activities for the maintenance and improvement of forest functions. [22]

1.2.3. Saints Cyril and Methodius University of Skopje, Faculty of Forestry www.sf.ukim.edu.mk

The Faculty of Forestry in Skopje was established in 1947. Today, the faculty offers three undergraduate academic programmes, 10 postgraduate academic programmes, and doctoral studies with a tutoring system. The main mission of the faculty is education and the establishment of a highly educated and scientific staff in the field of forestry, landscape design, eco-engineering and eco-management. [26]

1.2.4. Ministry of Environment and Physical Planning www.moepp.gov.mk

In the framework of efforts towards integration into the modern trends of environmental protection in Europe and beyond, and as an important aspect of the reform process, the Macedonian Government established the Ministry of Environment (Law on the Amendment to and Supplementing the Law on Public Administration Bodies, Official Gazette of FYRM No. 63/98).

Article 122 of the above law defines the competences of the ministry, among which those closely related to forests and the forestry sector are:

- monitoring of the state of the environment;
- protection against noise and radiation;
- the conservation of biological diversity;
- the conservation of geological diversity, national parks and protected areas; and
- the supervision of inspection in fields within its scope.

Operating within the Ministry of Environment and Physical Planning is the State Inspectorate for the Protection of the Environment, which is competent for the control of all legal and physical entities in the field of environmental protection. [27]

1.2.5. National parks

There are three legally established national parks in the former Yugoslav Republic of Macedonia.

- Pelister National Park (<http://www.park-pelister.com/>) was established on November 30, 1948, mainly in order to protect the well-preserved forest of the endemic five-needle pine *Pinus peuce* (known as the Macedonian pine, or Molika). Today, the park covers an area of about 17,150 ha. [28]
- Mavrovo National Park (www.npmavrovo.org.mk), which covers an area of 11,750 ha, was declared in 1949. In 1952 it was enlarged to its present size of 73,100 ha. Around 27,000 ha of the total area are forests. It is thought to comprise more than 1,000 types of higher plant forms, around 100 of which are extremely rare in the Balkans. [29]
- Galichica National Park (www.galichica.org.mk) is situated between Lake Ohrid and Lake Prespa and covers an area of 22,750 ha. It was declared in 1958. Nineteen different forest communities have been discovered on its territory, indicating that the vegetation in the park is very rich, including several extremely rare types of flora. [30]

Map 2. National Parks in the former Yugoslav Republic of Macedonia



Source: [35]

1.2.6. Jasen PE www.jasen.com.mk

The Jasen forest reserve was declared in 1958. It covers an area of 24,000 ha and stretches across the mountain massifs of Suva Gora, Suva Planina and Karadzica. This reserve falls into the category of special nature reserve, protecting many species of flora and fauna and other natural rarities. [31]

1.2.7. Private forest owners www.naps.com.mk

The National Society of Private Forest Owners (Nacionalno Zdruzenie na Sopstvenici na Privatni Sumi) was founded in 1997, although its current name was only adopted in 2010 (Official Gazette of FYRM No. 52 of April 16, 2010). It is a non-governmental and non-political organisation, the main mission of which is the “protection of the individual and common interests of private forest owners without affecting the principles of sustainable forest management”. The society currently has a membership of around 1,500. [32]

1.3. Fire history

One of the most detrimental factors for forests and nature in the former Yugoslav Republic of Macedonia are forest fires. According to data from the MAFWE, in the period between 2004 and 2013 there were a total of 2,465 forest fires in the country, the total burned area was 91,805.9 ha, and the total volume of burned timber 931,258.52 m³ (see Table 1). Within the same period,

there were an average of 205 forest fires per year and the average size of the burned area was 9,180 ha annually. The most severely affected year in this period was 2007, when 652 fires were recorded, resulting in 35,248.6 ha of burned area. The most severe individual forest fire occurred in 2012 in the pine afforestation near the city of Strumica, when four people were killed and 12 injured (civilians), including seven children.[19]

The total damage (burned timber volume plus suppression costs) caused by forest fires in this period has been estimated at around EUR 51,000,000. [19]

Forest fires in the former Yugoslav Republic of Macedonia are usually caused by stubble burning, the burning of pastures and arson.

Arson has emerged as a phenomenon in the last 15 years. There are two main reasons:

- pyromania, which is very rare in the former Yugoslav Republic of Macedonia; and
- economically motivated arson, mainly due to illegal logging. There have been some cases of fires being started intentionally in order to “cover” illegal logging activities already carried out. There have also been cases of arson committed in order to occupy the attention of official institutions (e.g. the Forestry Police) with fire suppression while illegal logging activities were taking place in another forest area.

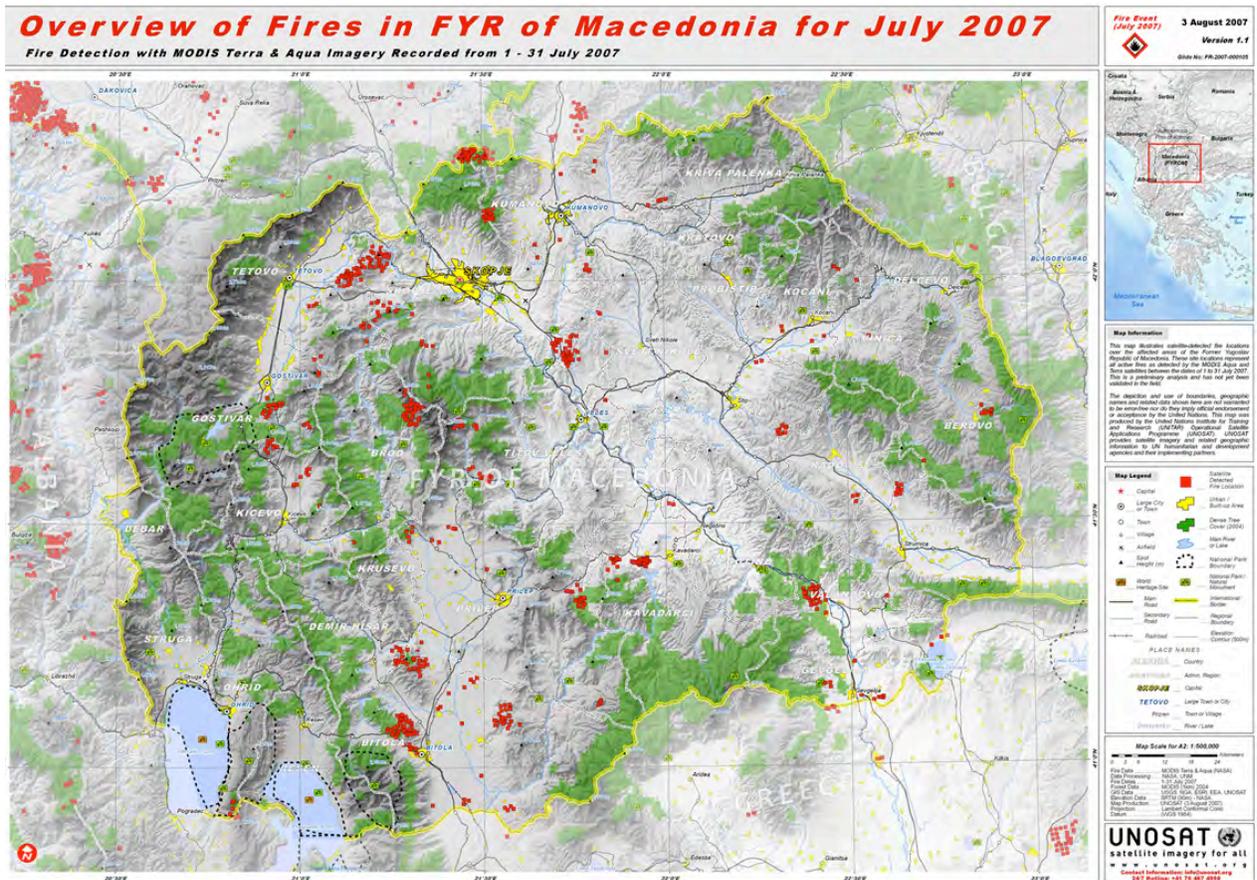
According to Articles 22 and 45 of the Law on Forests, the entity that manages the forest must arrange for the reforestation of the deforested area. Also, according to Article 58, it has to introduce "forest order" (the term "forest order" is defined in Article 12, item 40, of the Law on Forests). This implies that all trees damaged by fire must be removed from the burned area. In this case, the price of the timber is significantly lower than the official price.

Table 1. Forest fire statistics for the period 2004 to 2013

Year	Number of fires	Burned area (ha)	Burned timber mass (m ³)	Suppression costs (EUR)	Total costs (EUR)
2004	94	892.05	4,322.30	23,214.55	1,469,090.00
2005	182	1,368.00	1,063.00	42,018.11	411,181.00
2006	138	2,085.95	12,978.00	45,311.20	2,437,914.00
2007	652	35,248.60	617,678.67	386,852.46	21,494,700.00
2008	323	10,143.10	53,055.60	96,278.69	4,612,377.00
2009	38	197	756.50	313,627.00	5,812,889.00
2010	64	1,112.50	5,000.00	985,455.00	9,000,000.00
2011	390	20,856.80	65,042.80	400,153.00	1,719,105.00
2012	385	19,964.90	155,126.00	410,323.00	4,248,828.00
2013	170	6,379.12	16,235.00	115,000.00	434,333.00
Total	2,046	91,805.90	931,257.87	2,818,233.01	51,640,417.00
Average	205	9,180.00	93,125.80	281,823.30	5,164,041.70

Source: MAFWE State Inspectorate for Forestry and Hunting

Map 3. Overview of forest fires for July 2007 (MODIS Terra&Aqua Imagery)



Source: [4]

II. Legal framework and institutional set-up in the field of forest fire management

The most important legislative acts regulating the issue of forest fires in the former Yugoslav Republic of Macedonia are:

- Law on Forests (Official Gazette of FYRM No. 64, of May 22, 2009)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/ZAKON-ZA-SHUMITE-19-05-2009.pdf>
- Law on Hunting (Official Gazette of FYRM No. 26 of February 24, 2009)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakonot-za-lovstvoto-19-02-2009.pdf>
- Law on Fire Protection (Official Gazette of FYRM No. 67/4 of September 14, 2004)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakon-za-pozharnikarstvoto-16-09-2004.pdf>
- Law on Protection and Rescue (Official Gazette of FYRM No. 36/04 of June 10, 2004)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakon-za-zashtita-i-spasuvanje-20-07-2012.pdf>
- Law on Local Self-governance (Official Gazette of FYRM No. 5 of January 29, 2002)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakonot-za-lokalnata-samouprava-24-01-2002.pdf>
- Law on Environment (Official Gazette of FYRM No. 53 of July 5, 2005)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakonot-za-zhivotnata-sredina-22-06-2005.pdf>
- Law on Nature Protection (Official Gazette of FYRM No. 67 of September 4, 2004)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakon-za-zashtita-na-prirodata-15-09-2004.pdf>
- Law on Crisis Management (Official Gazette of FYRM No. 29 of May 4, 2005)
<http://www.macefdrr.gov.mk/files/dokumenti/pzrdo/Zakon%20za%20upravuvanje%20so%20krizi%202005.pdf>
- Law on Agricultural Land (Official Gazette of FYRM No. 135 of November 8, 2007)
<http://www.pravdiko.mk/wp-content/uploads/2013/11/Zakon-za-zemjodelsko-zemjishite-2012.pdf>

The way in which forest fires are regulated by the above laws will be shown in greater detail within the review of the institutional set-up. According to the laws listed above, the main institutions authorised in the field of forest fire protection are:

1. Ministry of Agriculture, Forestry and Water Economy (MAFWE)

The MAFWE was established by the Law on the Organisation and Operation of the Organs of the State Administration (Official Gazette of FYRM No. 58/2000 of July 21, 2000), and its competences are described in Article 21 of the same law. The MAFWE performs activities related to:

- agriculture, forestry and water economy;
- the utilisation of agricultural land, forests and other natural resources; and
- inspection in the domains of its competences.

There are two sectors within the MAFWE related to forestry: the Sector for Forestry and Hunting; and the Sector for Forest Police. The State Inspectorate for Forestry and Hunting also operates within the MAFWE. [21]

The main purpose of the above organisational units is to secure the management of forests in accordance with Article 7 of the Law on Forests: "silviculture, protection and forest utilisation through the restoration, nurture, protection, afforestation and utilisation of forests and forest land, and other activities for the maintenance and improvement of the forest's functions".

The Sector for Forestry and Hunting is subdivided into four departments:

- The Department for Afforestation and Silviculture
- The Department for Forest Protection — Among other activities this department is obliged to monitor the situation in the field of forest fire protection and the protection of forests from other negative abiotic and biotic factors.
- The Department for Hunting — Regarding forest fires, the role of this department is to ensure the implementation of Article 23 of the Law on Hunting: "It is forbidden to burn stubble in the fields, weeds and other plant waste in hunting areas."
- The Department for the Planning of Management Activities and the Utilisation of Forests [21]

The task of the Sector for Forest Police is defined by Article 81 of the Law on Forests: "The guarding of state and privately owned forests is organised by the Forest Police."

According to Article 82 of the same act, besides guarding the forests the Forest Police has a mandate to monitor and report on the situation in forests regarding illegal logging and forest crimes, forest fires, diseases, pests and other negative impacts; to inform the authorities about the illegal appropriation of forests and forest land; and to initiate procedures within the appropriate legal institutions against law breakers.

The State Inspectorate for Forestry and Hunting is responsible for monitoring the implementation of the provisions of the Law on Forests. For this purpose there are five regional units with 22 regional inspectors covering all municipalities in the country. Competencies are defined within Chapter XI of the Law on Forests. One of the competencies is to ensure the implementation of all prescribed measures for forest fire protection by all entities that manage forests.

2. Public enterprise Macedonian Forests (PEMF)

The PEMF was founded on the basis of Government Decision No. 3028/1 of December 15, 1997 (Official Gazette of FYRM No. 65/97). It began operating on July 1, 1998, as the legal successor to the former enterprises for forest management. Its status as a subject that manages forests is determined by Article 87 of the Law on Forests: "The management of state-owned forests with economic and protective assignments is carried out by the PEMF for the management of state-owned forests. This entity manages the state-owned forests through its 30 subsidiaries. Among other tasks, the subsidiaries are responsible for protecting and taking care of the forests. [22]

The PEMF (including its subsidiaries) has a total of 2,232 employees. According to their qualifications, they comprise two with a PhD; 15 with an Msc; 410 graduates (mainly forestry engineers); 74 with two years of college; 1,140 with a high-school certificate (mainly forestry technicians); and 591 with primary school education (forestry workers).

In accordance with Article 50 of the Law on Forests, the PEMF (via all its subsidiaries) is "obliged to conduct measures for the protection of forests from illegal logging, forest fires, natural disasters, diseases, insects, illegal pasturing and other damages".

In Article 1, items 27 and 28 of the same law, the terms "fire in open spaces" and "forest fires" are defined as follows:

"A fire in an open space is the uncontrolled burning of forest and forest land, regardless of the size of the burning area, the intensity of the fire or the reason for ignition, which includes the burning of agricultural land and pastures, closer than 200 m from the forest edge."

"A forest fire is the uncontrolled burning of forest and forest land, regardless of the size of the burning area, the intensity of the fire or the reason for ignition."

In the same article, under item 29, the term "forest fire management" is defined as measures for protection against fires in open spaces, which comprise:

- 1) Prevention measures in the form of education and public awareness raising throughout the year.
- 2) Preparatory measures, carried out throughout the year, prior to the outbreak of forest fires, with the aim of making ready the institutions responsible for forest fire suppression in the event of an outbreak.
- 3) Direct measures used during a forest fire aimed at localising and suppressing the fire."

All these measures are part of the annual operating plan that each subsidiary must prepare and that the PEMF must confirm. This plan is obligatory under the Law on Protection and Rescue (Article 51).

Taking into consideration the complexity of the issue of forest fire protection, based on Article 50, paragraph 2, of the Law on Forests, the MAFWE has adopted the Rulebook on Special Measures for Forest Fire Protection. The following articles contained in the rulebook can be regarded as the most relevant:

Article 1

This rulebook shall prescribe the special measures for forest fire protection.

Article 2

The measures for forest fire protection will be determined and carried out according to the degree of the forest fire danger rating.

Part of this rulebook is also Chapter V (Minimal technical means, tools and other equipment for forest fire suppression) of Article 19.

Article 19

Legal entities in charge of forest management with up to 100 employees should provide the following technical means and tools for forest fire suppression and other equipment necessary for suppression as follows:

	Number
1. Means of transport	
1.1. Off-road vehicles	2
1.2. Freight vehicles (trucks)	2
2.1. Mobile radio stations	10
2.2. Fixed radio stations	1
3. Equipment and tools	
3.1. Chain saws	4
3.2. Axes	10
3.3. Backpack pumps (25 l capacity).	25
3.4. Shovels	40

3.5. Mattocks	10
3.6. Rakes	15
3.7. Fire beaters	10
4. Other equipment	
4.1. Battery lamps	5 + 3 in reserve
4.2. Drinking water bottles/tanks	1 for 10 persons [18]

3. Directorate for Protection and Rescue (DPR)

The directorate was established in 2005 by the Law on Protection and Rescue.

The directorate is an independent government authority created by merging the civil protection activities under the Ministry of Defence with the Inspectorate of Fire Protection under the Ministry of Interior. It comprises four sectors with 11 departments, four independent departments and 35 local offices for protection and rescue. (Figures 1 and 2)

Its competencies and scope of activity are regulated by the Law on Protection and Rescue (Official Gazette of FYRM No. 36/04 of June 10, 2004) as well as the Law on Fire Protection (Official Gazette of FYRM No. 67/4 of September 14, 2004).

In relation to forest fires, the competencies of the DPR are coordination, inspection, prevention and suppression.

Coordination In accordance with Article 51 of the Law on Protection and Rescue, “The organs of state administration, the organs of local self-governance units, trading societies, public enterprises, institutions and services are obliged to prescribe and project the organisation for the implementation of measures for protection and rescue and to implement prevention measures.” The DPR has a mandate to coordinate these activities/plans (in relation to forest fire protection) from all institutions and organs in accordance with the current laws and regulations.

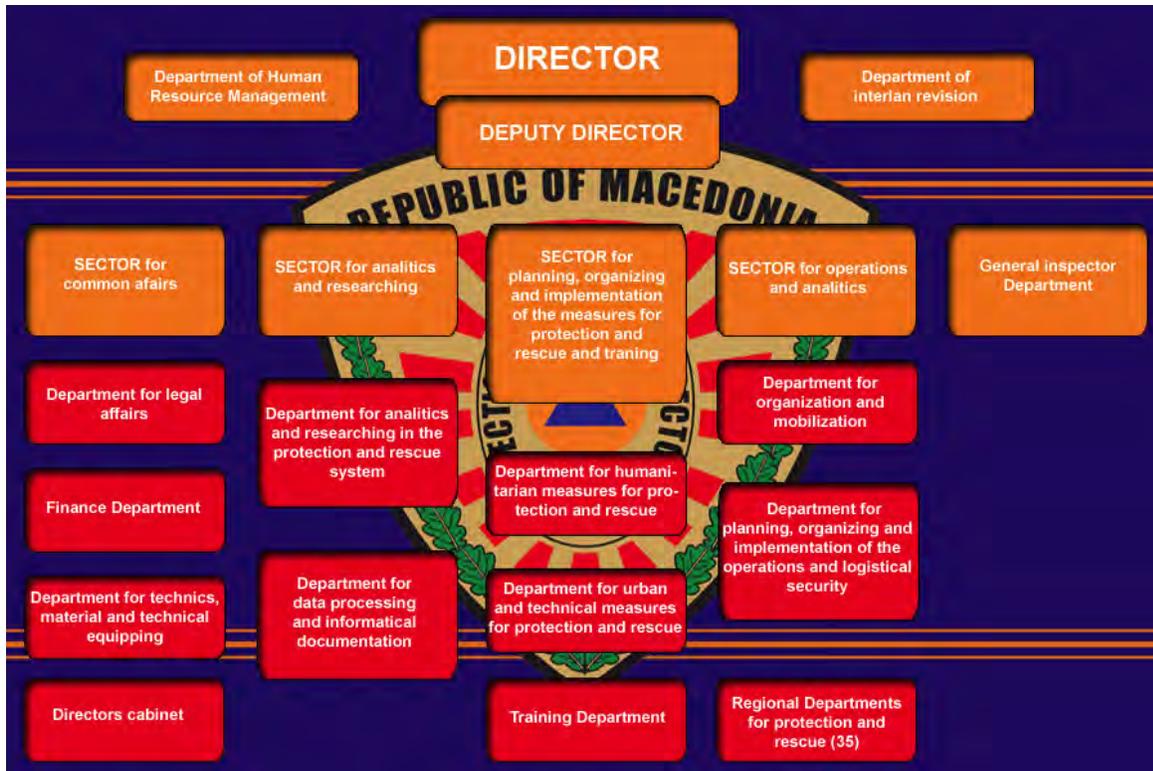
Inspection The General Inspectorate Department has a mandate to conduct inspections of all authorised institutions for forest fire protection (the PEMF, local self-governance units, and territorial fire protection units etc.) in order to check if they have prepared proper plans, taken all necessary measures for prevention and preparedness etc. in accordance with the current laws and regulations.

Prevention The DPR has a mandate to initiate procedures for the adoption of new laws or the improvement of existing laws; and to organise public awareness campaigns (independently or jointly with other institutions or organisations), educational measures (lectures) etc.

Suppression In accordance with Article 18, item 6, of the Law on Protection and Rescue, the DPR has a mandate to participate in the activities of forest fire suppression. For this purpose,

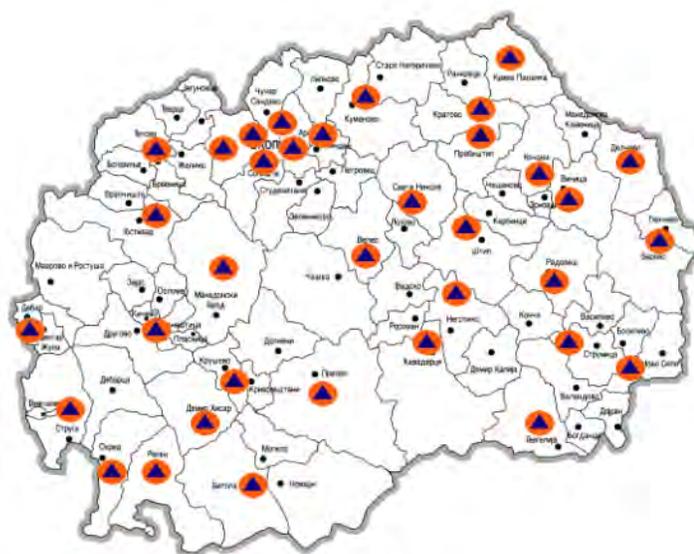
there are 35 teams for prompt response (around 700 people in total) to be engaged in the event of large forest fires. These teams are equipped mainly with hand tools. The Sector for Specialised Services with Aircraft operates three aeroplanes (Air Tractor Europe, S.L) specially equipped for forest fire suppression. [23]

Figure 1. Organisational structure of the DPR



Source: <http://www.dzs.gov.mk/>

Figure 2. Distribution of the regional departments of the DPR



Source: <http://www.dzs.gov.mk>

4. Local Self-governance units

In accordance with the Law on Fire Protection (Official Gazette of FYRM No. 67/4 of September 14, 2004) and the Law on Local Self-governance (Official Gazette of FYRM No. 5 of January 29, 2002), units of local self-governance are obliged to organise fire protection services (territorial fire protection units, or TFPUs) made up of professional firefighters. These units are mainly trained and equipped for the suppression of urban fires.

5. Crisis Management Centre

The Crisis Management Centre (CMC) was established in 2005 in accordance with the Law on Crisis Management (Official Gazette of FYRM No. 29 of May 4, 2005). The main tasks of the CMC are to:

- ensuring continuity in inter-sectoral and international cooperation, consultation and coordination in the field of crisis management;
- prepare and update the assessment of risks and dangers for resolving crises; and
- propose measures and activities for resolving crisis situations and performing other duties prescribed by law.

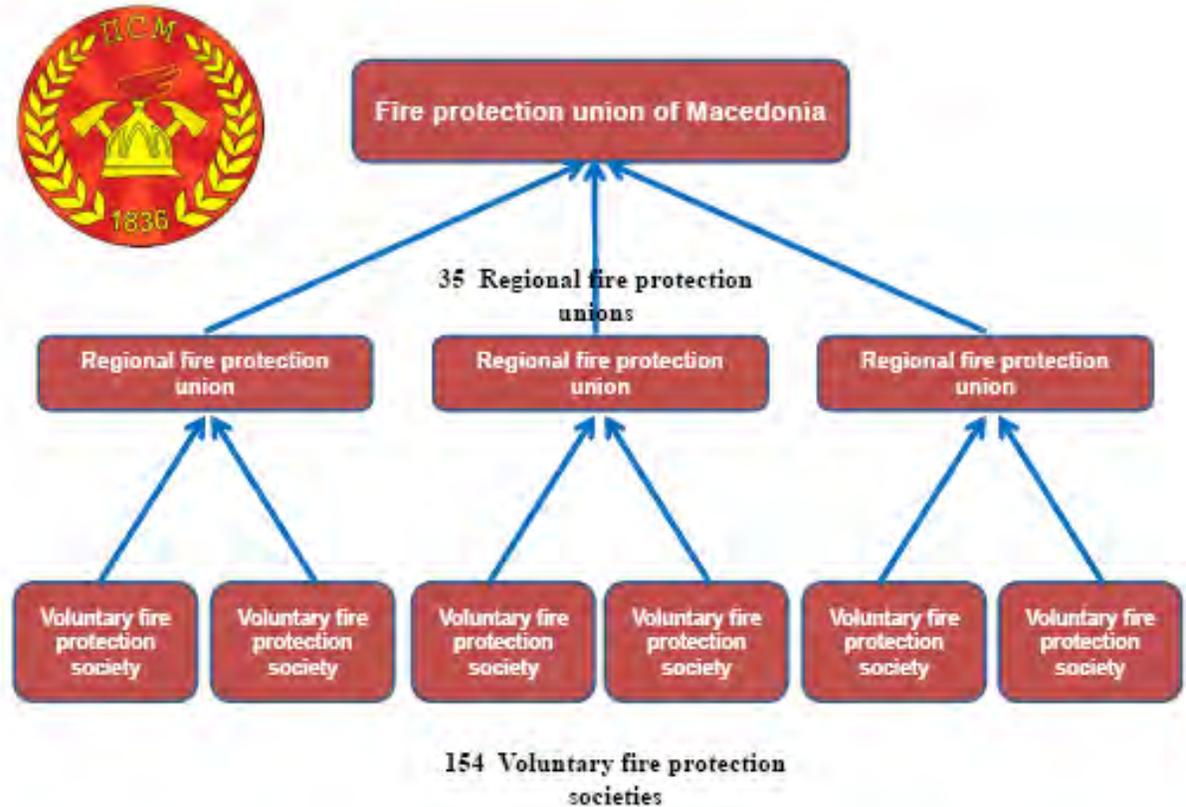
In line with this the CMC is in charge of forest fire management only during crisis situations at state level (such as the fire season in 2007, when a state of emergency was declared in the

former Yugoslav Republic of Macedonia). In 2014, within the CMC, a web-based early warning system for forest fires (the Macedonian Forest Fire Information System, or MKFFIS) was made available for public use at <http://mkffis.cuk.gov.mk/>. Certain parts of the system are available only to institutions responsible for forest fire protection in the former Yugoslav Republic of Macedonia. [25]

6. Macedonian Fire Protection Union

The Macedonian Fire Protection Union (MFPU) is an NGO that operates according to the Law on Fire Protection (Official Gazette of FYRM No. 67/4 of September 14, 2004) and the Law on Societies and Foundations (Official Gazette of FYRM No. 52 of April 16, 2010). Its basic activity, according to Article 8, Subsection 1, of the statutes of the MFPU is defined as follows: “The union implements measures and activities for preventing the occurrence of fires, for firefighting and for rescuing people, property and values jeopardised by fires, climatic distress and other accidents.” This means that the MFPU carries out measures for the prevention, pre-suppression and suppression of fires, including forest fires. The engagement of firefighters (volunteers) in forest fire suppression activities is coordinated and carried out by the Directorate for Protection and Rescue (at state and local level). Today, there are around 154 voluntary fire protection societies within the MFPU, organised in 35 regional fire protection unions (RFPUs). [16]

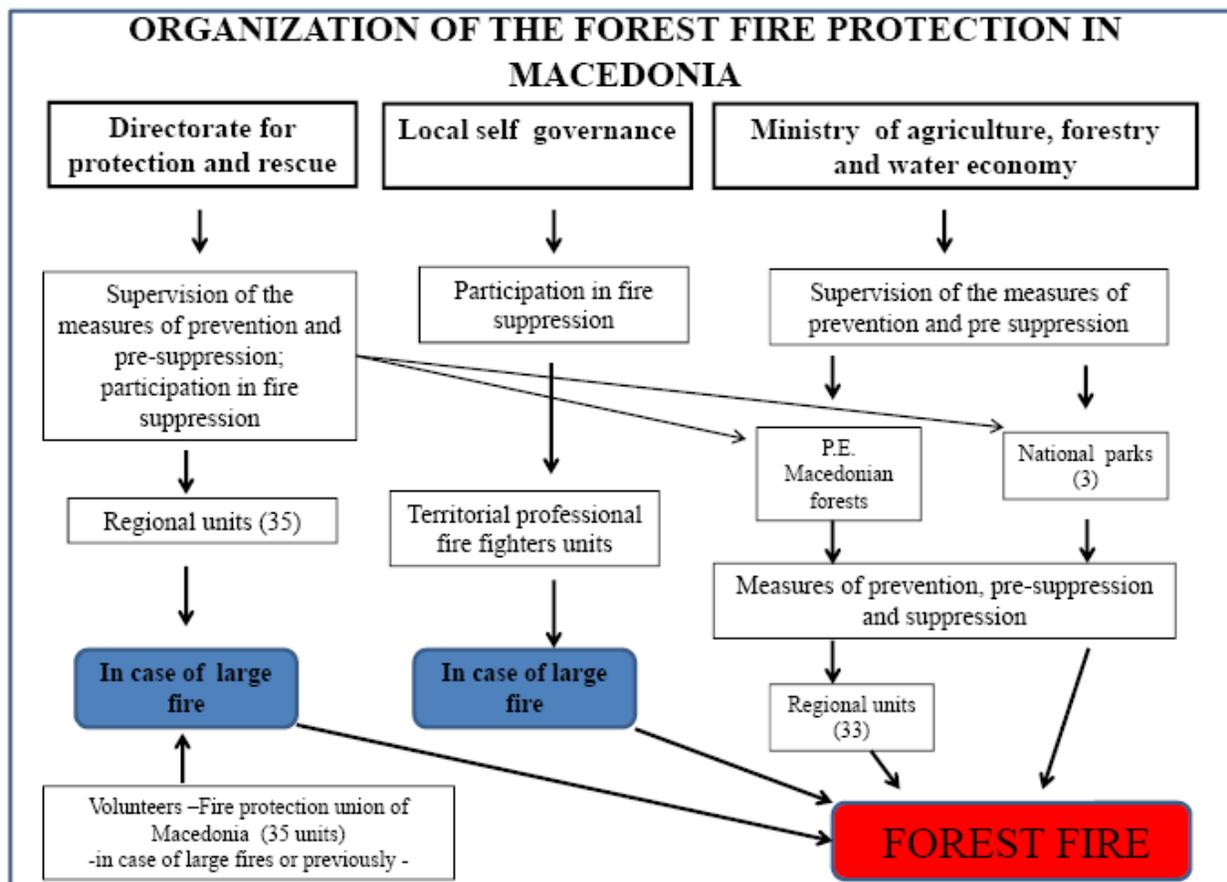
Figure 3. Organisational structure of the MFPU



Source: Nikola Nikolov, Involvement of volunteer firefighters in enhancing wildfire preparedness and response capacities in Macedonia, Novosibirsk, 2013

Taking into consideration the laws referred to above, the organisation of forest fire protection in the former Yugoslav Republic of Macedonia is illustrated in Figure 4.

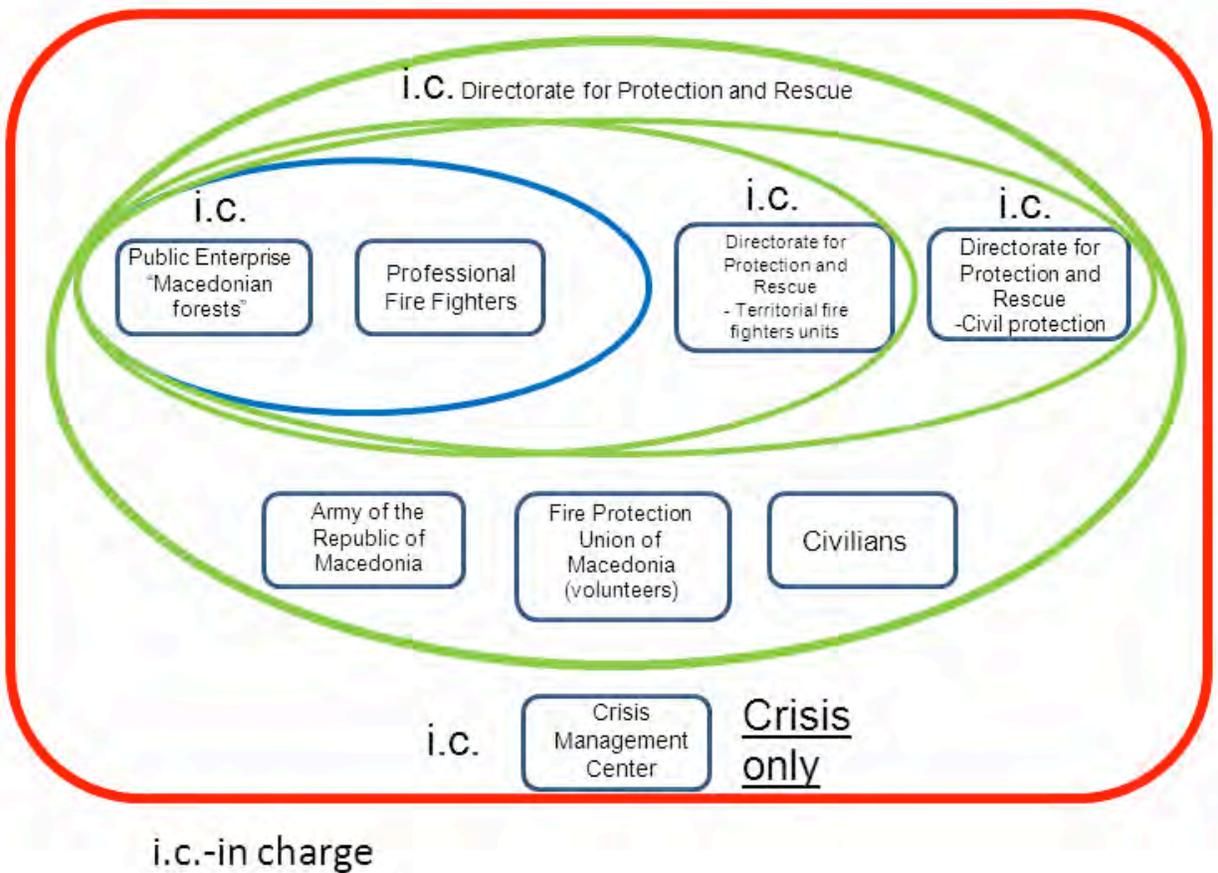
Figure 4. Organisation of forest fire protection in the former Yugoslav Republic of Macedonia



Source: Nikola Nikolov, Organization of Forest Fire Protection in the Southeast European/Caucasus Region, Seoul, 2013

Besides measures for prevention and pre-suppression, one of the preconditions for effective fire suppression is a clearly defined chain of command and coordination. According to the Law on Forests, the company/entity that manages forests has an obligation to organise the initial fire suppression response. This is usually the PEMF via its regional subsidiaries. At this point they are in charge of fire suppression actions. If a fire cannot be suppressed by the PEMF, they must call on the local fire service for support, although the PEMF is still in charge of the fire suppression operation. If the fire remains beyond their capacities, the DPR will contribute its resources. From this point the DPR is in charge of all operations, even if the MFPU (volunteers) and the army are involved. If a state of emergency is officially declared, the Crisis Management Centre will become responsible for coordinating the firefighting. This task includes the coordination of foreign assistance, for example targeting foreign aerial resources to the fire (Figure 5).

Figure 5. The command and coordination chain during forest fire suppression



Source: FAO/TCP/MCD/3201

There are regulations on the use of fire as a management tool in forestry, agriculture, protected areas and other land.

In accordance with Article 13, item 1, of the Law on Forests, setting fire to forests is strictly forbidden. Article 54 also forbids starting fires within the forest and on surrounding land at a distance of less than 200 m from the edge of the forest. In item 2 of the same article, as an exception from item 1, it is permitted to set fire under conditions and in places that are determined and indicated by the subject that manages the forest.

In accordance with Article 46 of the Law on Agricultural Land, it is forbidden to set fire to crops or stubble or to start fires near them.

According to Article 23 of the Law on Hunting, it is forbidden to burn stubble, weeds or other plant waste.

Forest fires do not always occur within the territory of a single country. Sometimes they pass the administrative borders between countries. In order to regulate all related issues and to increase the efficiency of forest fire protection (especially forest fire suppression), the former Yugoslav Republic of Macedonia has signed agreements (or agreements are being negotiated) with the following countries: Bulgaria (negotiations); Croatia (agreement signed); Montenegro (negotiations); Serbia (Memorandum of Understanding); Slovenia (agreement signed); Bosnia and Herzegovina (cooperation agreement signed); Turkey (agreement signed); France and Hungary (bilateral collaboration).

III. The impact of forest fires on the environment, economy and human health

There are different data on the damage and losses (social, economic and environmental) caused by forest fires in the former Yugoslav Republic of Macedonia, mainly because there are different approaches to calculating or estimating the damage caused by fires, and because there are several ways of defining the actual costs of forest fires.

The costs of forest fires and the losses they cause are often considered only in terms of suppression costs and losses of timber volume, while relatively little attention is given to the related losses of forest habitats and populations (including endangered species and their critically protected habitats), air and water quality, recreational opportunities, local economies, and other resources and amenities that are important to all citizens. Impacts on human health are not usually considered in terms of financial losses at all, while the tally of domestic animal or wildlife fatalities is rarely attempted or even mentioned.

In order to assist in the evaluation, the Forest Fire Damage and Consequence Assessment Methodology was developed within the framework of the CMC/Japan International Cooperation Agency (JICA) project “Technical Assistance for the Development of an Integrated System for Prevention and Early Warning of Forest Fires”. This methodology is still at the checking stage, but following its approval by all the involved institutions it will be officially adopted. However, some aspects of forest fire damage (consequences for human and forest health, biodiversity loss etc.) are still lacking from the methodology.

The main environmental consequences of forest fires are (not in order of priority):

- Forest degradation
- Deforestation
- Soil erosion
- Pest and disease outbreaks
- Biodiversity loss
- Emissions of greenhouse gases and other gases

It is very difficult to prove that a particular instance of forest degradation has been caused exclusively by forest fire. Forest degradation is typically a long-term process caused by various factors (in the case of the former Yugoslav Republic of Macedonia these include cutting, forest fires and pests) and in the former Yugoslav Republic of Macedonia it occurs mainly in oak (*Quercus spp.*) forests.

Deforestation, as a long-term process, is mainly caused by excessive cutting in Macedonian forests. Forest fires cause short-term deforestation (for a maximum of two years after the fire). After this short period the regeneration (generative or vegetative) of the forest begins, or the burned area is reforested (in accordance with the Law on Forests). However, even this short period is sufficient for the third consequence of forest fires — soil erosion.

The former Yugoslav Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and a party to the Kyoto Protocol. In 2014, the country therefore prepared its Third National Communication on Climate Change. A national greenhouse gases inventory was compiled in the framework of this document. Under the analysis carried out for land use, land-use change and forestry (LULUCF) for the period between 2000 and 2009, forest fires were identified as the most important factor contributing to high levels of greenhouse gas emissions between 2000 and 2007.[20]

According to the Joint Research Centre (JRC), the volume of biomass burned and emissions of gases from forest fires in the former Yugoslav Republic of Macedonia up to August 31, 2007, were estimated at the following levels (x 1,000 tonnes):

- - biomass burned – 288.3
- - emissions of carbon dioxide (CO₂) – 474.7
- - emissions of carbon monoxide (CO) – 22.2
- - emissions of methane (CH₄) – 1.1
- - emissions of volatile organic compounds (VOCs) – 1.1
- - emissions of nitrogen oxides (NO_x) – 1.5

The Department of Forest and Wood Protection of the Faculty of Forestry in Skopje serves as the National Centre for the Health Monitoring of Macedonian Forests and has detected a significant problem with bark beetles (*Ips* spp.) as a consequence of forest fires. Following fires in pine forests, bark beetles regularly attack the damaged and physiologically weak pine trees. After a while infestation becomes very severe and the insects are even able to attack healthy trees. As a result, this insect species is the most important factor contributing to the decline of Macedonian forests (especially pine forests). It is very difficult to estimate the damage (whether economic or environmental) caused by infestation in relation to forest fires.

According to the MAFWE, the total damage caused by fires (burned timber mass + suppression costs) in the period 2004 to 2013 is estimated at around EUR 5.1 million. Unfortunately, there has been no assessment or calculation of the damage caused to the environment.

In accordance with the statistics provided by the DPR and the MAFWE on human fatalities and injuries during forest fires in the country in 2012, a total of four people died (two employees of

the regional office of the PEMF, one volunteer and one civilian), and 12 people were injured (seven children and five adults).

Only one comprehensive study on the consequences of forest fires in the former Yugoslav Republic of Macedonia has been carried out in the last 10 years (in 2007). Following the declaration of a state of emergency by the Macedonian Government on July 18, 2007, due to the severity of the forest fires, the assistance of the international community was requested. As part of this assistance, the United Nations Development Programme (UNDP) and the Macedonian Government, represented by the CMC, agreed that the UN would carry out an assessment once the crisis had begun to diminish. According to the agreement, the UN would examine the impact of the fires that ravaged the country in three broad areas: environmental; socioeconomic; and operational (disaster management). The task was completed in September 2007 and the final report, "Ecological Damage Assessment of the Wildfires in the Former Yugoslav Republic of Macedonia in 2007" was published in October 2007.

IV. Special issues

The most important issues in addition to those outlined above are unexploded ordnance (UXO); transboundary fires and international cooperation; rural depopulation and land-use change

Unexploded ordnance

Many forest sites and non-forest lands in the Balkan region are contaminated by land mines and unexploded ordnance (UXO) from recent conflicts. In the former Yugoslav Republic of Macedonia, the threat of UXO explosions triggered by forest fires has its origins in the First World War. The most contaminated area in the country is the 1917 front line between Strumica and Bitola (between the Central Powers in the north and the Allied Powers in the south), where large numbers of grenades and mines pose a threat to firefighters and civilians. During the fires in July 2007, for example, more than 70 ammunition explosions were recorded in the immediate vicinity of Bitola, although fortunately there were no casualties. [4]

Map 4. Distribution of the UXO in the former Yugoslav Republic of Macedonia



Source: Nikola Nikolov, Wildfires management and UXO, Land mines and Radioactivity in the region of Southeast Europe/Caucasus, Kiev, 2009

Transboundary fires and international cooperation

The behaviour of forest fires is not always predictable. In the case of large fires or inaccessible terrain, even where the course of the fire can be predicted it is not possible to control or suppress the fire. This explains why forest fires that break out in border regions generally do not remain within the limits of a single country. Although this is a rare phenomenon in the case of

the former Yugoslav Republic of Macedonia and its neighbours, it does happen from time to time. In September 2012, for example, a fire on the Albanian side of the border spread to the Mavrovo National Park, but only Macedonian firefighters were on the spot. More than 100 ha of grass and stubble near the forest were burned. In June 2012 fire spread from the Greek side of the border to Kajmakchalan, in a highly dangerous area contaminated with UXO from the First World War and two firefighting planes were engaged. In July 2012, some 20 ha of grass, shrubs and low-quality oak forests were burned near the Bulgarian border, and Bulgarian police assisted in fire suppression. No incidents have been identified of fires spreading from Macedonian territory into neighbouring countries. In order to regulate all issues and ensure the efficiency of forest fire protection (especially forest fire suppression), the Macedonian Government has signed agreements, or is negotiating agreements, with Bulgaria (negotiations); Croatia (signed agreement); Montenegro (negotiations); Serbia (Memorandum of Understanding); Slovenia (signed agreement); Bosnia and Herzegovina (cooperation agreement signed); Turkey (agreement signed); France and Hungary (bilateral collaborations). There are occasional exchanges of fire management personnel between the former Yugoslav Republic of Macedonia and neighbouring countries. [33]

Besides its bilateral and multilateral agreements, the Macedonian Government has an opportunity to send and receive assistance via the EU Civil Protection Mechanism (Monitoring and Information Centre, MIC). The EU Civil Protection Mechanism was established in 2001 to foster cooperation among national civil protection authorities across Europe. The mechanism currently includes 31 countries: all 28 EU member states in addition to Iceland, Norway and the former Yugoslav Republic of Macedonia. The mechanism was set up to enable coordinated assistance from the participating states to victims of natural and human-made disasters in Europe and elsewhere.

Rural depopulation and land-use change

Rural depopulation and land-use change have a significant impact on forest fires not only in the former Yugoslav Republic of Macedonia but throughout South Eastern Europe. In the case of the former Yugoslav Republic of Macedonia, rural depopulation is more important than land-use change. According to the national land cadastre there is no significant land-use change in the country.

Rural depopulation has an impact on forest fires in three main ways:

- Through the rural depopulation process, over the past 50 years a large area of agricultural land (arable land, pastures etc.) has been abandoned. As a result, there is an uncontrolled growth of vegetation (in the absence of grazing, harvesting etc.), which leads to the build-up of huge amounts of ideal “fuel”. This leads to a high risk of fires starting during the forest fire season in these areas. The fuel build-up also makes the forest fires very severe and difficult to control.

- Some of the abandoned areas are currently young forests, although according to the official cadastres they are still agricultural land. This means that the areas are not included in any forest management plans and are left almost without any forest fire protection measures. There is a kind of "vacuum" in terms of responsibility over these areas with respect to forest fire protection.
- Because it is mostly members of the younger generation who are leaving the rural regions, the declining populations mainly comprise elderly people. This creates a problem in terms of the early detection of forest fires, but it also affects the organisation of prompt initial response by the local population.

There are no official data for the total area of abandoned agricultural land, although it has been unofficially estimated at around 60,000 ha.

According to the Law on Fire Protection, territorial firefighting units, landowners and the Directorate for Protection and Rescue are responsible for fire management on these territories.

V. Needs for improvement in forest fire management

In general, forest fire protection measures are divided into the following categories: prevention, pre-suppression and suppression. The same approach can be used when addressing the weaknesses in the system for forest fire protection in the former Yugoslav Republic of Macedonia.

Strengthening prevention

Legal regulations with respect to forest fire protection in the former Yugoslav Republic of Macedonia are at a satisfactory level. However, there is still a need for a law or legal document that harmonises the activities of the various institutions and organisations (currently regulated by other laws or legal documents). This could be achieved through the adoption of a national plan for forest fire management. Such a document is being prepared in the framework of the FAO/TCP/MCD/3201 project "Strengthening National Forest Fire Preparedness: The Former Yugoslav Republic of Macedonia". The role, purpose and tasks of the plan are briefly described in the following paragraphs:

"The Macedonian National Fire Plan (NFP) is created to provide the safe, effective and coordinated management of wildland fires. All entities covered by this plan agree to follow the procedures, protocols and requirements included in the NFP as well as those adopted by the actions of the Steering Committee under the authorities included in this plan."

The NFP Steering Committee will be established with representatives from each of the departments and agencies covered by this plan. The individuals appointed to the Steering Committee will hold positions within the agencies, and have the authority to propose, negotiate and approve all measures authorised in the NFP. The individual members will also take appropriate actions within their agencies to ensure that policies, procedures and actions are understood and that the agencies initiate whatever process is required to comply with the requirements of the NFP.

The Steering Committee will appoint working groups to develop guidelines and protocols. The working groups will be staffed with qualified members of the appropriate agencies and organisations, including representatives from other groups not included in the Steering Committee if needed, to provide expertise and guidance. The working groups will develop plans, products (such as training materials) and guidelines. Final products will be submitted to the Steering Committee for adoption under the authority of the NFP."

Another element of prevention that needs to be improved is the organisation of forest fire prevention campaign/s (public awareness raising and educational campaigns). In accordance with certain laws, the entities that manage forests and forest lands are obliged to convey information on all measures for forest fire protection, including measures for prevention.

Campaigns of this kind are organised separately, in an uncoordinated and non-harmonised manner, conveying different messages and with some duplication.

Strengthening pre-suppression

Special attention should be given to the following pre-suppression measures: providing specialised (properly trained) forest firefighters; procuring special vehicles and tools for forest fire suppression; enhancing the quality of planning documents; and strengthening research capacities.

The existence of specialised (properly trained) forest firefighters is one of the pre-conditions for effective and efficient forest fire suppression. Currently there are neither specialised nor well-trained forest firefighters in the country, nor is there an institution for educating and training such personnel. In order to address this problem, a special training programme should be created for already active firefighters and new personnel. This would be aimed primarily towards the forestry sector (the PEMF, national parks etc.), the DPR and TFPUs. Relevant trainings have been organised occasionally within certain projects in the last couple of years, including a TCP/FAO project in 2012 and 2013 (train-the-trainers sessions); and the OSCE/ENVSEC project “Enhancing National Capacity in Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus-Antalia” in 2010 and 2014.

The above issue is closely connected to the availability of appropriate equipment, tools and vehicles for forest firefighters. Well-trained personnel must also be adequately equipped. At present there is a lack of equipment (mainly of personal protective equipment), hand tools and special vehicles. Existing vehicles (off-road vehicles for initial response and special fire trucks) are very old and in poor condition. The number of hand tools is limited and the types of tools are not chosen in accordance with the specific terrain and vegetation.

Almost all fire prevention and pre-suppression measures must be prescribed and described in the framework of planning documents. In the forestry sector, these documents are 10-year management plans and annual operating plans, while under the DPR there are strategic and annual operating plans. The quality of the existing plans does not correspond to the current situation and needs.

In addition to prevention and pre-suppression measures, there are other specific issues that need to be addressed. One of these is research activity in the field of forest fire protection. The only relevant specialised national institutions in the country are the Department of Forest and Wood Protection of the Faculty of Forestry in Skopje, and the Regional Fire Monitoring Centre (RFMC) as a regional branch of the Global Fire Monitoring Centre (GFMC). Many projects have been implemented to date, but there is no programme for permanent research. Due to the increasing problem with forest fires in the former Yugoslav Republic of Macedonia, and bearing in mind the (technologically and scientifically advanced) methods currently being used in forest fire protection, the need for a better national research programme is evident.

The second specific issue is UXO. There is no precise map showing the distribution of UXO in contaminated forests and forest lands. This presents a problem during forest fire suppression activities in these areas. As yet, no methods have been defined for management, or for the tactics/procedures for forest fire suppression in these areas. Maps showing the distribution of UXO should therefore be produced. Defining the way to manage these areas and establishing procedures/tactics for forest fire suppression therefore represent a particular challenge.

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Forest Fire Country Studies

Montenegro



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REGIONAL ENVIRONMENTAL CENTER

FOREST FIRES COUNTRY STUDY

MONTENEGRO

2015

**Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations	3
I. The forestry sector, forests and fire history	4
1.1. Forest characteristics	4
1.2. Major forestry stakeholders	7
1.3. Fire history	9
II Legal framework and institutional set-up in the field of forest fire management	14
III. The impact of forest fires/wildfires on the environment, economy and human health	20
IV. Special issues	21
V. Needs for improvement in the forest fire/wildfire management.....	22
Literature	23

Abbreviations

MARD	Ministry of Agriculture and Rural Development
AIA	Administration for Inspection Affairs
FA	Forest Administration
DFHWPI	Directorate for Forestry, Hunting and Wood Processing Industry
DIF	Department for Inspection of Forestry
DES	Directorate for Emergency Situations
EU	European Union

I. The forestry sector, forests and fire history

1. *Overview of the forestry sector*

According to Article 3 of the Law on Forests (Official Gazette of Montenegro 74/10), forests and forest land in Montenegro are defined as follows:

“Within the meaning of this law, forests shall be considered land spanning more than 50 ares [0.5 hectares], covered with forest trees having canopy cover above 10 percent of the land area and dominant trees higher than 5 m — that is, trees able to reach that height when physiologically mature.

Within the meaning of this law, forest land shall be considered land spanning more than 50 ares [0.5 hectares], covered by forest trees:

- higher than 5 m — that is, trees able to reach that height when physiologically mature and whose canopy cover is 5 to 10 percent of the land area; and
- not able to reach the height of above 5 m — that is, land covered by a combination of trees and low forest vegetation if coverage is higher than 10 percent of the land area.

Forest and forest land shall also include temporarily barren areas where the natural regeneration of forest trees has started; fire protection belts; areas covered with non-forest vegetation spanning less than 50 ares [0.5 hectares] if it is within the forest or forest land complexes; forest tree protection belts spanning more than 50 ares [0.5 hectares] and wider than 20 m; and forest roads.” [5]

1.1. Forest characteristics

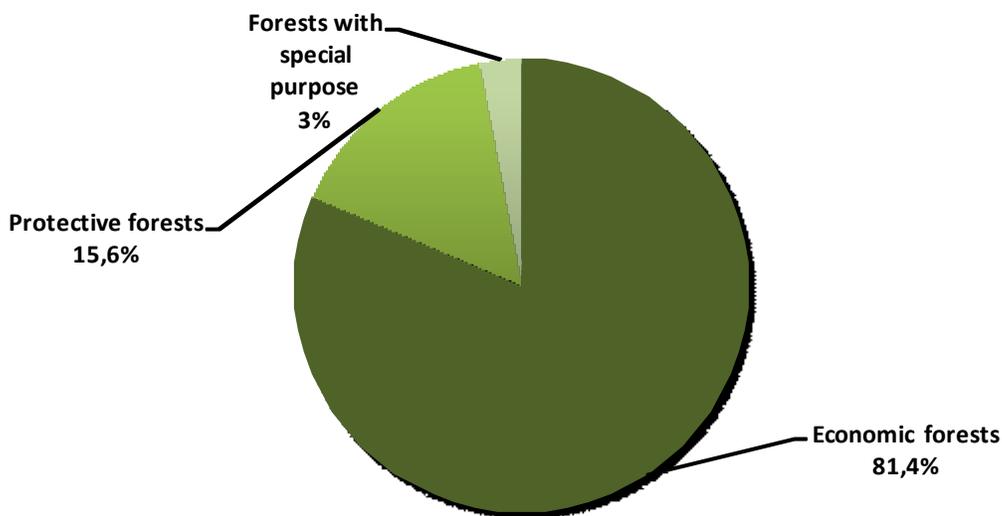
Forests and forest land cover 54 percent (743,609 ha) of the total area of Montenegro. The country has substantial forest coverage, among the highest in Europe, with 0.9 ha per capita. Forests cover 620,872 ha, while forest land covers 122,737 ha. Around 500,041 ha (67.25 percent) of the total forest area are in state ownership, while around 243,568 ha (32.75 percent) are privately owned. The total standing volume is estimated at 72,056,699 m³, comprising 29,527,555 m³ (40.98 percent) conifers and 42,529,144 m³ (59.02 percent) deciduous trees. [1]

The quality of hardwood in most of the high forests is relatively poor, due to a history of coppicing (especially in privately owned forests) as well as sub-standard forest management in state-owned forests over the past few decades, typically with the removal of better-quality trees while leaving trees of poorer quality. [1]

A trend towards reduced harvesting has been perceptible since 1989. Based on the assumption that the annual removal is two-thirds of annual growth, around 815,000 m³ of wood mass can be harvested annually. The Forest Administration releases a tender for concessions and auctions for slightly over 400,000 m³ of the wood volume. With the addition of fuel wood, as well as retail and sanitary harvesting, the annual removal is around 700,000 m³. Harvesting is therefore more or less equal to the projected volumes. [1]

In terms of forest purpose, 347,581 ha (81.4 percent) of the forests in Montenegro are economic forests, while 66,283 ha (15.6 percent) are protective forests and 12,975 ha (3 percent) are forests with special purposes. [2]

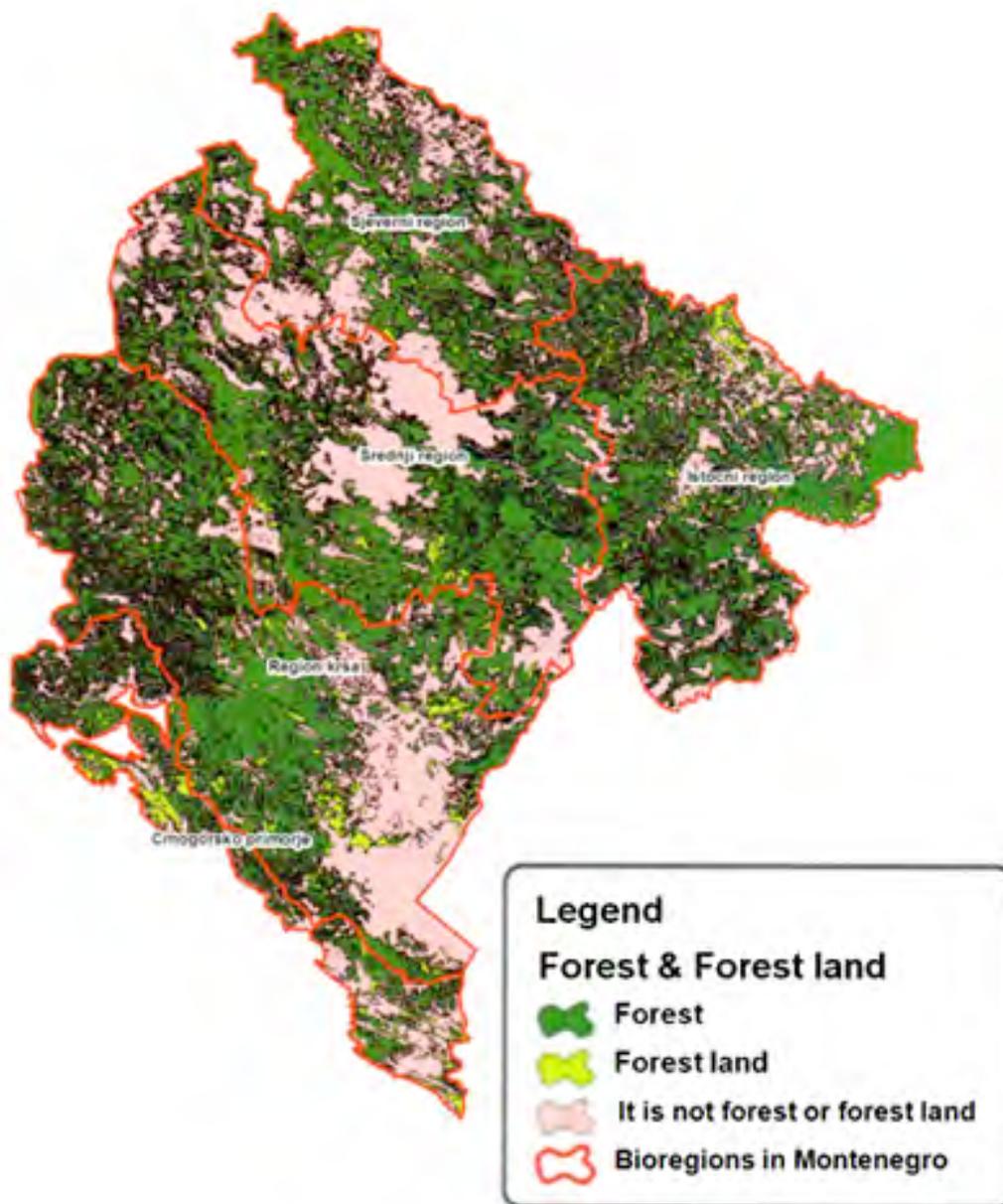
Figure 1. Structure of forests by purpose



Source [2]

Within the National Forest Inventory, the territory of Montenegro is divided into five areas: the Northern Region (which has the largest complex of black pine and mixed forests of scots pine and spruce); the Eastern Region (forests of beech and fir are widely spread through this region, along with Macedonian pine forests that can be found exclusively in this region); the Central Region (here the dominant forests are beech forests, mixed forests of fir and beech, forests of spruce and whitebark pine forests); the Karst Region (which has the thickest layers of carbonate rocks, mostly limestone, as well as severe erosion processes due to the large amount of rainfall); and the Montenegrin Coast (due to intense anthropogenic impacts over long years, the vegetation of this area has changed so that, rather than forest communities, other forms, such as underbrush, bushes and rocks, are now present).

Map 1. Forest and forest land in Montenegro



Source [2]

1.2. Major forestry stakeholders

The institutional set-up is divided between the public and private sector.

The public sector comprises:

- The Ministry of Agriculture and Rural Development (MARD)
- The Department for Inspection in Forestry, Hunting and Plant Protection, which is part of the Administration for Inspection Affairs (AIA)
- The Forest Administration (FA)
- The forestry and wood processing technology college in Berane

The private sector comprises:

- Private forest owners
- Former state-owned logging companies
- Private companies and concessionaires combining logging and wood processing [1]
- The Forestry Institute

The MARD is responsible for the overall control of the forestry sector and plays the leading role in the process of forest resources management, the development of economic and other sectoral policies; and the implementation of these policies.

The Directorate for Forestry, Hunting and Wood Processing Industry comprises three units:

1. The Department of Forestry
2. The Department of Hunting
3. The Department of Monitoring in Forestry [1]

The Directorate for Forestry, Hunting and Wood Processing Industry is responsible for approving the management plans prepared by private companies; monitoring and control in cooperation with the Forest Inspectorate; interfacing between donor projects, the ministry and forest stakeholders; overseeing the preparation of the National Forest Inventory; and performing environmental and social functions and services.

The Administration for Inspection Affairs (AIA) is an organ of the administration divided into seven sectors, including the Sector for the Protection and Safety of the Health of Humans, Animals, Plants and Forests. The sector comprises six departments, including the Department for Inspection in Forestry, Hunting and Plant Protection. This department carries out tasks

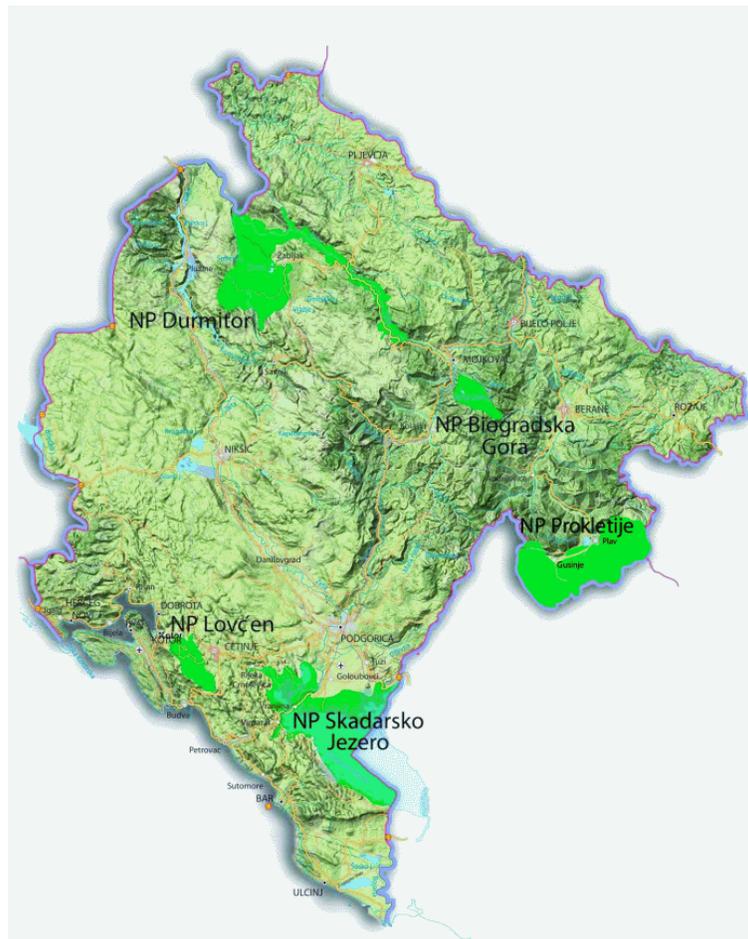
related to inspecting the implementation of laws and regulations governing the field of forestry, hunting and the protection of forest plants.

The Forest Administration (FA) is the state administration authority responsible for the management of both private and state-owned forests. It strives to improve forest management through adequate organisation and greater attention to forest protection. [1]

There are **five national parks** (<http://www.nparkovi.me/>) established by law in Montenegro:

1. Durmitor National Park, the largest national park in Montenegro, was established in 1952. It covers an area of 39,000 ha. It has been on the UNESCO World Heritage list since 1980. The park includes Mount Durmitor, the Tara River, Drage, Sušice, as well as the highest part of the Komarnica Canyon, from which numerous mountain peaks rise (48 of them are over 2,000 m above sea level).
2. Biogradska Gora National Park was established in 1952 on the territory of the municipalities of Kolašin, Pljevlja, Berane and Andrijevica. It has a total area of 5,650 ha, of which 1,600 ha are covered with forest.
3. Lovćen National Park was established in 1952 on the territory of the municipalities of Cetinje and Budva. It covers an area of 6,220 ha, of which 1,314 ha are forests.
4. Skadarsko Jezero/Skadar Lake National Park was established in 1983 on the territory of the municipalities of Podgorica, Cetinje and Bar. It covers an area of 40,000 ha.
5. Prokletije National Park was established in 2009 on the territory of the municipalities of Plav and Gusinje. It covers an area of 16,630 ha.

Map 2. National Parks of Montenegro



Source [15]

1.3. Fire history

Forest fires are a global environmental and economic problem. Due to its geographical position in the Mediterranean region and to the increasing negative impacts of climate change, Montenegrin forests are especially vulnerable. Forest fires are a constant threat to forests and forest lands in Montenegro. Along with their increased frequency, forest fires are becoming larger in scale and are threatening settlements and human lives as well as forests and agricultural land.

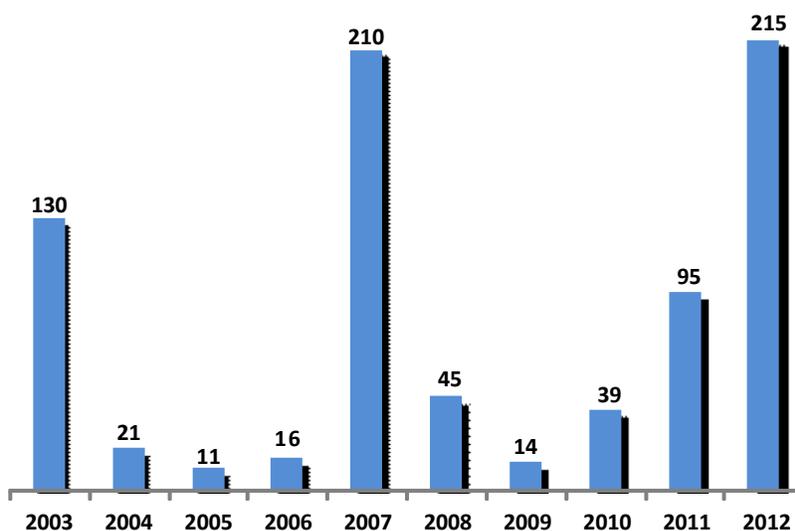
During the past 10 years there have been around 800 large forest fires in Montenegro, and more than 18,000 ha of forests and over 800,000 m³ of wood mass have been damaged or destroyed. The greatest risk is to forests located in the coastal and central regions, where high air temperatures during the summer period and the typical vegetation create the necessary preconditions for forest fires to start. July and August are critical in terms of the occurrence of

fires (very low level of precipitation, or often no precipitation), as are the months of February and March (in the case of dry and warmer winter). Fires usually break out between 10:00 and 18:00, coinciding with daily human activities.

The main causes of forest fires in Montenegro are very similar as in other countries in the region: stubble burning in fields, the burning of pastures and arson. One particularly disturbing fact is the occurrence of deliberate arson, due to the fact that, following a fire, non-wood forest products such as mushrooms, raspberries and blackberries grow more rapidly, and grazing land is also more productive.

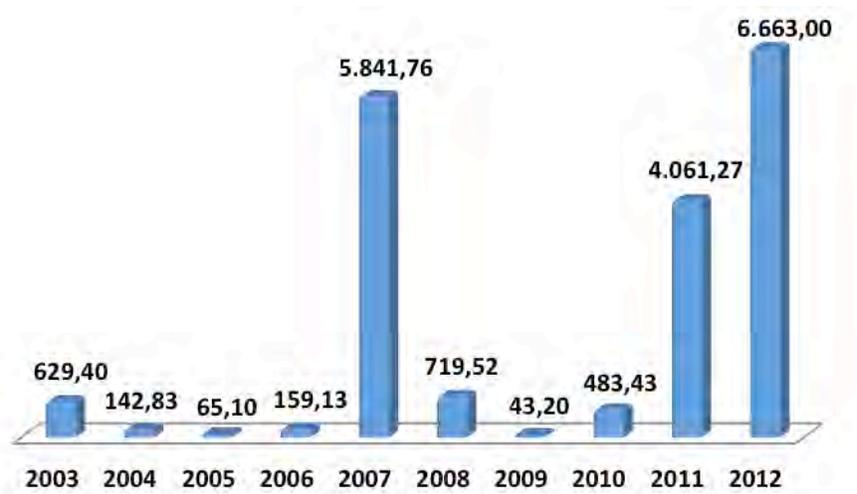
The annual average burnt area in the period between 2003 and 2012 was 1,880 ha, while the annual average number of fires was around 80. The total damage caused during this period has been estimated at over EUR 6 million.

Figure 2. Number of forest fires, 2003–2012



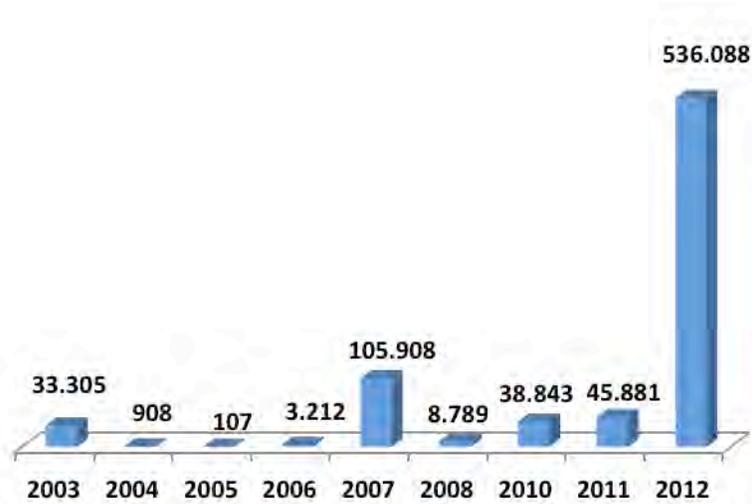
Source: Forest Administration

Figure 3. Burnt area, 2003–2012 (ha)



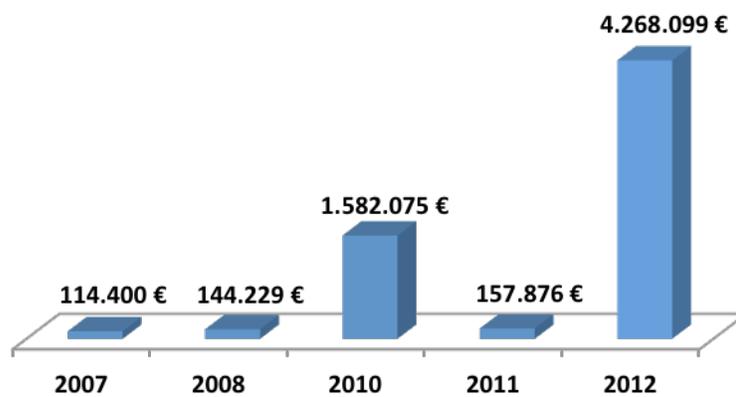
Source: Forest Administration

Figure 4. Total burnt wood mass, 2003–2012 (m³)



Source: Forest Administration

Figure 5. Total estimated damage, 2003–2012 (EUR)



Source: Forest Administration

Table 1. Burned areas of forest and forest land, 2006–2010

REGIONS	FOREST				FOREST LAND				FOREST AND FOREST LAND			
	Area	Damaged by forest fires	Share in the total	Share per region	Area	Damaged by forest fires	Share in the total	Share per region	Area	Damaged by forest fires	Share in the total	Share per region
	ha	ha	%	%	ha	ha	%	%	ha	ha	%	%
EASTERN REGION	152,194.0	6,603.0	2.6	4.3	11,249.2	1,317.5	13.6	11.7	163,444.0	7,920.4	19.7	4.8
NORTHERN REGION	127,279.3	4,160.3	13.6	3.3	33,907.3	1,024.5	10.6	3.0	161,186.5	5,185.1	12.9	3.2
CENTRAL REGION	181,979.8	4,703.7	15.4	2.6	27,598.9	806.6	8.3	2.9	209,578.7	5,510.3	13.7	2.6
KARST REGION	213,197.6	14,465.7	47.4	6.8	34,706.8	5,115.8	52.8	14.7	247,904.4	19,580.8	48.7	7.9
COASTAL REGION	53,481.4	599.7	2	1.1	18,536.2	1,403.3	14.8	7.6	72,017.6	2,030.0	5	2.8
TOTAL	728,132.1	30,532.4	100	4.2	125,998.4	9,667.7	100	7.7	854,131.2	40,226.6	100	4.7

Source: The First National Forest Inventory of Montenegro, Ministry of Agriculture and Rural Development, Podgorica, 2013

II Legal framework and institutional set-up in the field of forest fire management

The most important legislative acts regulating the issue of forest fires in Montenegro are:

- Law on Forests (Official Gazette of Montenegro 74/10)
- Law on Game and Hunting (Official Gazette of Montenegro 52/2008)
- Law on Protection and Rescue (Official Gazette of Montenegro 13/2007)
- Law on Self-governance (Official Gazette of Montenegro 42/2003)
- Law on National Parks (Official Gazette of Montenegro 28/2014)

There are also some strategic documents that regulate the issue of forest fires as part of other issues (forests, forestry, sustainable development etc.):

- National Strategies for Emergency Situations (2006)
- National Strategy for Sustainable Development (2007)
- National Forest and Forest Land Administration Policy (2008), which defines the direction of development and sustainable forest management
- National Forestry Strategy and Plan for the Development of Forests and Forestry in the period 2014–2023 (adopted in April 2014), which sets out objectives and guidelines for the development of forests and forestry in accordance with the National Forestry Policy

According to the laws listed above, the main institutions competent in the field of forest fire protection are described below:

1. The Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MARD) is responsible for the overall control of the forestry sector and plays the leading role in the process of forest resources management, the development of economic and other sectoral policies, and the implementation of these policies through the Directorate for Forestry, Hunting and Wood Processing Industry (DFHWPI).

The DFHWPI comprises three units:

1. Department for Forestry
2. Department for Hunting
3. Department for Monitoring in Forestry [1]

The Directorate for Forestry, Hunting and Wood Processing Industry is responsible for approving the management plans prepared by private companies; monitoring and control in cooperation with the Forest Inspectorate; interfacing between donor projects, the ministry and forest stakeholders; overseeing the preparation of the National Forest Inventory; and performing environmental and social functions and services.

In relation to forest fire protection, the DFHWPI performs the above activities and tasks mainly in accordance with Article 46 of the Law on Forests:

“It is prohibited to light fires in the open and to dispose of objects that may cause fire in forests and forest land, except in places intended for the respective purpose.

The competent administrative authority shall be obliged to ensure forest guarding services during periods of increased fire risks in forests and forest land.

In relation to forests and other forest land that are exposed to particular fire risk, special measures for prevention and preparations for fire extinguishing shall apply, in accordance with the law.

Forest owners and beneficiaries shall be obliged to act preventively, to suppress and participate in firefighting in their forests — that is, in forests they use.”

2. The Administration for Inspection Affairs

The Department for Inspection of Forestry, Hunting and Plant Protection (DIF) is part of the Administration for Inspection Affairs (AIA) and, as mentioned above, it carries out tasks related to inspecting the implementation of laws and regulations governing the field of forestry, hunting and the protection of forest products; taking administrative and other measures in order to remove detected irregularities and ensure the proper application of these regulations; submitting applications for initiating criminal proceedings and filing criminal charges; giving initiatives for amendments to laws, regulations and by-laws and proposing measures for improvements in the area of supervision; preparing analyses, reports and information within the scope of the department; cooperating with other organs of the government, institutions and businesses; and undertaking other activities within its jurisdiction. [10]

With respect to forest fires, and in addition to the Law on Forests, all the tasks carried out by the DIF are in line with the Law on Protection and Rescue, in particular Article 47:

“Companies, other legal entities and entrepreneurs shall, under the conditions and in a way prescribed by law, participate in the protection and rescue of people and goods and supply tools, transport, technical and other necessary resources for protection and rescue.

The persons referred to in paragraph 1 of this article are obliged to implement measures for protection and rescue in accordance with the law, protection and rescue plans and general acts.”

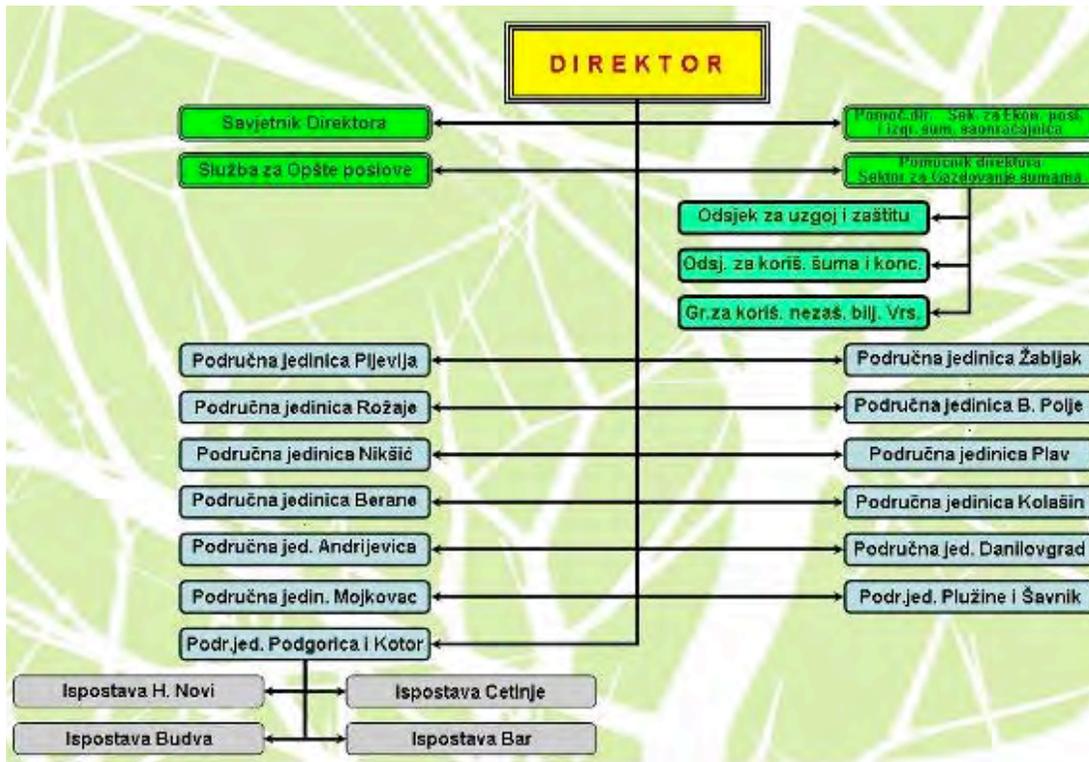
3. The Forest Administration

The Forest Administration (FA) is the state administration authority responsible for the management of both private and state-owned forests. The FA has a wide range of responsibilities, including forest protection; reforestation and improvement activities; the selection of seed stands; the conservation of natural and artificial forest values; protection against fires; reporting and forest management planning; the development of forest road programmes; the provision of services for forest utilisation; and advisory services.

The FA, which has its headquarters in Pljevlja, is divided into 15 regional units. The carrying out of work in the forests and the processing of forest products are left to the private sector and the market. The Forest Administration is the largest forest-related institution with approximately 400 staff, 85 of whom have a university degree (67 forest engineers) and 206 of whom are forest wardens in charge of forest management units, although in general without adequate education.

[1]

Figure 6. Organisational structure of the FA



Source [12]

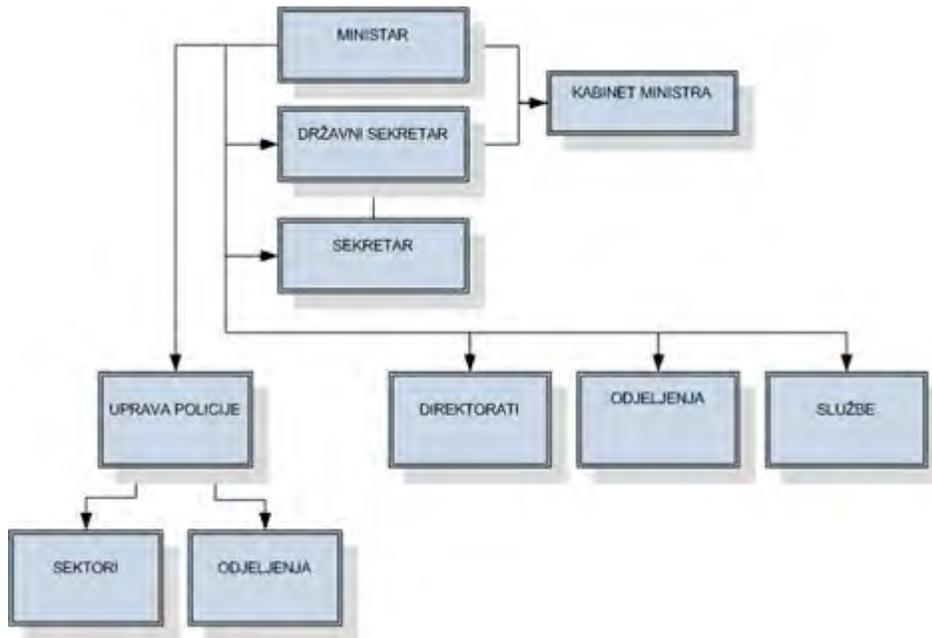
Within the FA, around 210 personnel are engaged in the field of forest protection and they are spread among the regional units. In periods of increased risk of forest fires, additional personnel are engaged (on a contractual basis) and are given the primary task of observing and reporting fires, as well as directly participating firefighting.

All 15 regional management units are obliged to carry out all measures for forest fire protection (preventive, pre-suppressive and suppressive), together with the concessionaire or the private owner. This is in accordance with the Law on Protection and Rescue, the National Plan for Protection and Rescue from Fires, municipal plans for protection and rescue from fires and entrepreneurial plans for protection and rescue from fires.

Some of these measures are set out in the framework of various management plans:

- General 10-year plans for the districts
- 10-year management plans for the units
- Annual detailed executive plan
- Afforestation plan
- Annual fire prevention and control plan

Figure 7. Organisational structure of the Ministry of Internal Affairs



Source [11]

Inter-agency mechanisms include plans for protection and rescue from fires in Montenegro at national, local government/municipality and company level. All of these plans should be adjusted and harmonised with one other in accordance with the laws in force and the competences of the institution/company.

The use of fire in forestry, agriculture, conservation areas and other lands is regulated by the Law on Protection and Rescue. Also, some legal provisions for fire bans exist in the Law on Protection and Rescue as well as the Law on Forests.

III. The impact of forest fires/wildfires on the environment, economy and human health

The consequences of forest fires depend on the type of fire, the type of forest, the time and duration of the fire, the size of the burnt area and the state of the forest ecosystems. In addition to damage in terms of loss of timber, forest fires may damage or completely destroy the ecological, social and economic functions of forests. Such damage is associated with soil erosion, which eventually leads to desolate landscapes where vegetation cannot be renewed.

Even where forest fires do not cause direct significant damage to property, they have an indirect influence on the functioning of the economy in general (reduced revenues in the timber industry and in the forestry, agriculture and tourism sectors). The tourism sector is very vulnerable, especially during the summer season. In case of severe fire seasons in Montenegro, forest fires may lead to significant economic losses (many tourists leave or decide not to visit the country). Unfortunately, there are no official data about such trends.

As shown in Table 1 above, most of the damaged forests are in the karst region (6.8 percent), and the percentage of fire-affected forest land is also highest in the karst region (14.7 percent) and eastern region (11.7 percent).

The total damage incurred during the 2003–2012 period has been estimated at over EUR 6 million. Fortunately, there were no recorded cases of injury or death.

IV. Special issues

Cross-border forest fires

Fires have been recorded crossing from Bosnia and Herzegovina to Montenegro, and from Albania to Montenegro.

Rural depopulation and land-use change

Rural depopulation and land-use change have an impact on forest fires in Montenegro. As a result of the process of migration from villages to towns there is a build-up of fine “fuel” on abandoned arable land and a lack of people capable of participating in fire prevention and suppression.

Bilateral agreements

The Government of Montenegro has concluded bilateral agreements in the field of protection from natural and human-made disasters with the governments of Croatia, Greece, the former Yugoslav Republic of Macedonia, Slovenia, Serbia, Slovakia and Ukraine. Memorandums of understanding in the field of prevention and emergency situations have been signed with the Russian Federation, Italy and Armenia. There are also initiatives for agreements with Turkey, France, Bulgaria, Albania and Azerbaijan.

With respect to exchanges of fire management personnel with other countries, three requests for assistance from Albania were received during the fire season in 2012, and just one of them was realised. Assistance was provided by the Russian Federation in the 2007 and 2008 seasons, by Italy in 2009 (EU Mechanism), by Serbia in 2010, and by Croatia in 2012 (EU Mechanism).

V. Needs for improvement in the forest fire/wildfire management

There are various moves that should be made in order to improve forest fire protection management in Montenegro.

A law on fire protection should be adopted, as there is no such law at present. Some issues related to forest fire management are regulated in existing laws (e.g. the Law on Forests and the Law on Protection and Rescue), but this is not sufficient. There are no regulations on special equipment for forest fire suppression, personal protective equipment, volunteers etc. The new law on fire protection should regulate the formation, organisation and activities of firefighting units, fire protection associations and volunteers, as well as fire suppression and the conditions for producing, using and maintaining appliances, equipment and means for fire suppression.

The lack of such a law causes problems for various institutions (the Forest Administration, the Directorate for Protection and Rescue, local self-government units etc.) in regulating forest fires and harmonising joint activities.

The training of firefighting personnel is an issue of the utmost importance. In Montenegro there are 582 local rescuers (who also serve as forest firefighters), but only 117 of them have completed a specialised course on wildfires in the framework of projects and international training programmes. According to the Law on Protection and Rescue, all rescuers are obliged to complete basic training, but because of problems with the establishment of the National Training Centre, most rescuers have not completed such training. Some fire management training has been organised in neighbouring countries, thus Montenegro might make use of identical training materials and approaches.

There are no trained forest firefighters in the forestry sector (whether state-owned or private forests).

There are only three units of volunteer firefighters, with a total of 84 rescuers. These volunteers are mainly engaged in forest fire suppression activities during the summer fire season by the Directorate for Protection and Rescue. However, as has already been mentioned, their activities are not properly regulated and there is no national organisation of fire protection volunteers.

Improvements to the Law on Forests and the preparation of other legal acts can also be considered necessary. Although they contain some articles related to forest fires, the current Law on Forests must be improved, especially in relation to forest management. These improvements should be accompanied by the drafting of further legal acts, such as rulebooks.

There is also a need for a rulebook on the preparation of an annual forest fire operational plan, as well as a rulebook for special measures for forest fire protection (both intended for the forestry sector).

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Forest Fire Country Studies

Republic of Serbia



FOREST FIRES COUNTRY STUDY

REPUBLIC OF SERBIA

2015

**Produced by the Regional Fire Monitoring Center
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Table of Contents

Abbreviations.....	3
I. The forestry sector, forests and fire history	4
1.1. Forest characteristics	4
1.2. Major forestry stakeholders	7
1.3. Fire history	10
II. Legal framework and institutional set-up in the field of forest fire/wildfire management.....	13
III. The impact of wildfires on the environment, economy and human health	21
IV. Special issues	22
V. Needs for improvement in forest fire management	24
Literature	25

Abbreviations

PE	Public enterprise
NP	National park
RS	Republic of Serbia
FAS	Firefighting Association of Serbia
MoU	Memorandum of Understanding
EU	European Union
RHMS	Republic Hydrometeorological Service
EFFIS	European Forest Fire Information System
MKFFIS	Macedonian Forest Fire Information System
BiH	Bosnia and Herzegovina

Kosovo This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.*

I. The forestry sector, forests and fire history

1. Overview of the forestry sector

According to Article 5 of the Law on Forests (Official Gazette of RS Nos. 30/10 and 93/12), forests and forest land in the Republic of Serbia are defined as follows:

“Forest, in terms of this act, means an area larger than 5 ares [0.05 ha] covered with forest trees.

The term forest also includes forest nurseries in the forest complex and seed plantations, as well as protective belts of trees with an area larger than 5 ares [0.05 ha].

The term forest does not include separate groups of forest trees on an area less than 5 ares [0.05 hectares], parks in urban areas, as well as trees located under power lines and in the corridor of constructed power lines, regardless of the area covered.

Forest land is land on which forest is grown, the land on which, due to its natural characteristics, it is more rational to grow forests, as well as the land on which facilities for forest management, wildlife and exercising the amenities of the forest are located, and which can not be used for other purposes, except in cases and under conditions stipulated herein.”

According to Article 8 of the same law, “forest management” is defined as follows:

“Forest management is a set of harmonised professional-scientific, technical- technological, economic, organisational and social activities undertaken in the forest in a particular period for the purposes of its protection, maintenance, enhancement and utilisation.”

1.1. Forest characteristics

The total forest area in Serbia is 2,252,400 ha, of which 1,194,000 ha (53 percent) are in state ownership, while 1,058,387 ha (47 percent) are privately owned.

Broadleaved trees account for 90.7 percent of the growing stock, conifers for 6 percent, while mixed forests of broadleaved trees and conifers account for 3.3 percent. The average standing volume is 101.7 m³/ha, with 153 m³/ha in high forests (forests of seed origin) and 70 m³/ha in coppice forests. [1]

Map 1. Forests and forest land in Serbia



Note: This map does not show the territory of Northern Kosovo, which is under the jurisdiction of the Ibar-Leposavic forest company operating in the framework of the Srbijasume public enterprise.

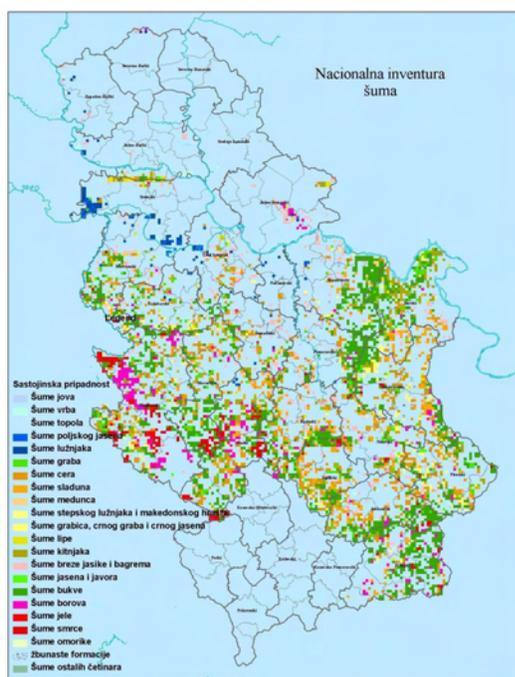
Source: [3]

Table 1. Forest area by purpose

PURPOSE	AREA (ha)
Forests and forest stands with productive function	1,704,855
Forests and forest stands with productive-protection function	100,400
Forests with priority protection function	27,200
Protected natural areas ¹	412,745
Game parks and reserves	4,400
Forests designated for recreation and with cultural and educational functions	800
Educational base	1,600
Forests designated for country defense	400
TOTAL	2,252,400

Source: [2]

Map 2. Forests by tree composition **Table 2.** Area and percentage of forest by tree species



Source: [3]

Categories	Area (ha)	%
Oaks forests	720,800	32.0
Beech forests	660,400	29.3
Others	580,000	25.8
Conifers forests	243,200	10.8
Poplar forests	48,000	2.1
TOTAL	2,252,400	100.0

1.2. Major forestry stakeholders

The Government of the Republic of Serbia administers the forests and forest lands in state ownership through the following institutions:

- Ministry of Agriculture and Environmental Protection
- Srbijašume public enterprise
- Vojvodinašume public enterprise
- Borjak public enterprise
- Fruška Gora National Park public enterprise
- Djerdap National Park public enterprise
- Kopaonik National Park public enterprise
- Tara National Park public enterprise

The enterprises listed above are also engaged in professional activities in private forests. Funds for their activities are provided from the budget of the Republic of Serbia.

Educational and research institutions:

- Faculty of Forestry, Belgrade,
- Institute of Forestry, Belgrade
- Institute of Lowland Forestry and Environment, Novi Sad

Private forests are managed by:

- Legal persons who own the forest
- Associations of forest owners
- Individual forest owners

1.2.1. Ministry of Agriculture and Environmental Protection (<http://www.mpzss.gov.rs/>)

The Law on Ministries (Official Gazette of the RS No. 44/2014) defines the authority of the Ministry of Agriculture and Environmental Protection. The competencies of the ministry in the forestry sector are defined primarily through the competencies of the Forest Administration.

The Forest Administration (according to Article 4 of the Law on Ministries) is an administrative body within the Ministry of Agriculture and Environmental Protection that implements public administration tasks and professional tasks related to forest policy; forest conservation; the promotion and utilisation of forests and wildlife; the protection of forests and wildlife; the control

of seeds and seedlings in forestry; inspections in the field of forestry and hunting; as well as other duties prescribed by law.

1.2.2. Srbijašume (Serbian Forests) public enterprise (www.srbijasume.rs)

Srbijašume is a state enterprise for forest management founded by the National Assembly of the Republic of Serbia in July 1991.

The public enterprise manages state forests and forest land on an area of 899,612.75 ha and performs professional activities in private forests on an area of 1,058,387.00 ha (data from December 2010). The public enterprise comprises nine sectors: the Sector for Forestry and Environmental Protection; the Sector for Forest Utilisation; the Sector for Commercial Affairs; the Sector for Finances and Accounting; the Sector for Development and International Cooperation; the Sector for Hunting, Fishing and Other Resources; the Sector for Legal Affairs; the Sector for Marketing and Public Relations; and the Sector for Real Estate.

In addition to its headquarters in Belgrade, there are 17 forest estates and 67 forest administrations throughout the territory of central Serbia, as well as the Ibar-Leposavić forest management unit on the territory of Kosovo*.

1.2.3. Vojvodinašume (Vojvodina forests) public enterprise (www.vojvodinasume.rs)

Vojvodinašume is a state enterprise for forest management founded by a decision of the Assembly of the Autonomous Province of Vojvodina in May 2002. It operates on the territory of the Autonomous Province of Vojvodina.

The public enterprise has three organisational levels:

- The company directorate
- Company subsidiaries: Sremska Mitrovica; Banat; Pančevo; Sombor; Novi Sad; and the company Vojvodinašume-Lovoturs in Petrovaradin
- Work units – forest administrations and other operational units

Table 3. Distribution of forests within Vojvodinašume

No.	Forest estate	Total area (ha)	Forests (ha)	Remaining land (ha)
1	Sremska Mitrovica	42,644.34	38,810.28	3,683.64
2	Pančevo	49,494.60	44,317.50	5,141.64
3	Novi Sad	14,143.93	12,468.49	1,661.51
4	Sombor	23,594.97	18,669.95	4,907.14
	Total	129,877.84	114,266.22	15,393.93

Source: [9]

1.2.4. Borjak public enterprise (www.borjak.rs)

This public enterprise was founded in 2004 by the municipality of Vrnjačka Banja. Its goal is to manage the protective forest covering an area of around 9,500 ha in the region of Vrnjačka Banja.

1.2.5. Kopaonik National Park public enterprise (www.npkopaonik.com)

Kopaonik National Park is located in central Serbia. Because of its natural resources, the area was declared a national park in 1981. The park covers an area of 11,810 ha. Considering the high number of endemic species of flora, the park is one of the most important centres of biodiversity in Serbia.

1.2.6. Djerdap National Park public enterprise (www.npdjerdap.org)

Djerdap National Park was established in 1974. The Djerdap Gorge and the natural riverbanks, covering over 637.99 km², form an area of outstanding cultural and historical values, important ecosystems with valuable and rare wildlife, indigenous flora and fauna and well-preserved natural forests of remarkable beauty.

1.2.7. Fruška gora National Park public enterprise (www.npfruskagora.co.rs)

Fruška Gora National Park was proclaimed in 1960 in order to provide for its permanent protection and to improve its natural resources and beauty. The area under active protection covers 25,525 ha.

1.2.8. Tara National Park public enterprise (www.npfruskagora.co.rs)

Tara National Park was established in 1981. It is located in western Serbia and covers an area of 19,175 ha. Together with some of the surrounding areas (Zaovine and Mokra Gora), the national park has been nominated by the national Man and the Biosphere Committee (MAB) as a potential biosphere reserve.

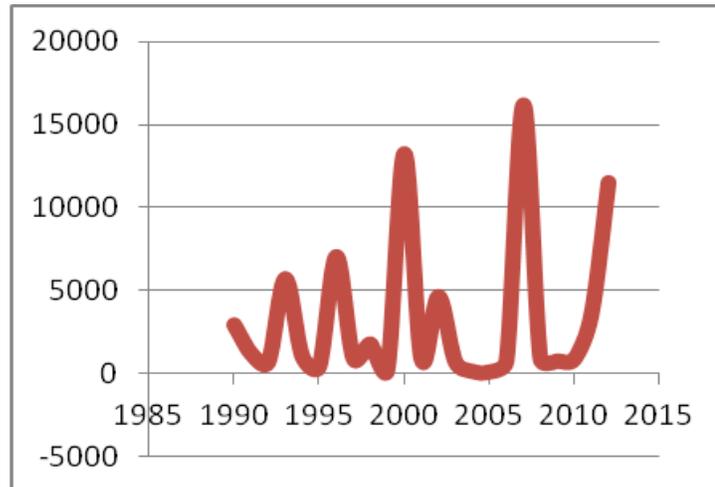
1.3. Fire history

In the period between 2004 and 2013, an annual average of 3,828 ha were burned in Serbia, of which 2,252.400 ha were forests. In terms of wildfires and forest fires, the most severe years were 2007 and 2012.

In 2007 there were 5,268 wildfires that destroyed 47,868 ha; 2,021 forest fires that destroyed 32,136 ha; and 3,247 low vegetation fires that destroyed 15,732 ha.

In 2012 there were 22,154 wildfires and 1,249 forest fires that destroyed 219,000 ha. Twenty-six members of the fire rescue units were injured. [4]

Figure 1. Burned area of forest and forest land (ha) and number of forest fires (2004–2012)



Source: Forest Administration

Table 4. Burned area of forests and forest land

Year	Number of fires	Area (ha)
2004	22	98
2005	15	63
2006	43	715
2007	258	16,144
2008	45	824
2009	84	728
2010	72	855
2011	343	3.567
2012	328	11,462

Source: Forest Administration

Table 5. Number of fires in open spaces

Number of fires in open space / Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of forest fires	385	643	595	264	259	837	1,627	17,720	408	254	734	1,321
Number of fires in crops	189	221	175	213	62	62	147	552	286	98	721	416
Number of fires in meadows and grass fires	1,877	2,919	3,820	2,311	1,936	2,831	10,273	200	4,159	2,789	9,814	11,665
Number of fires in orchards	51	91	90	55	32	92	299	6,339	129	70	332	349
Number of fires at waste dumps	811	1,273	2,031	1,797	2,215	3,073	4,060	140	1,212	755	1,671	1,663
Number of other fires in open spaces	2,837	3,756	4,034	3,486	3,810	4,721	6,178	4,554	5,947	4,349	8,659	10,041
TOTAL	5,961	8,903	10,745	8,126	8,314	7,749	22,584	5,935	12,141	8,315	21,931	25,455

Source: Ministry of the Interior of the Republic of Serbia, Emergency Management Sector

In the last 10 years, 66 percent of the total number of forest fires in Serbia have been started by human activities, 3 percent have had a natural origin, and 31 percent have been of unknown origin. Even in those cases where the cause of the fire is recorded as unknown, unofficially the reason behind the fire is human activity. One of the most important causes of forest fires in Serbia is agricultural burning. [19]

II. Legal framework and institutional set-up in the field of forest fire/wildfire management

The most important legislative acts regulating the issue of forest fires in Serbia are:

- Strategy for Fire Protection for 2012–2017 (Official Gazette of RS No. 21/2012)
- National Strategy for Protection and Rescue in Emergency Situations (Official Gazette of RS No. 86/2011)
- National Programme for Environmental Protection (Official Gazette of RS No. 12/2010)
- Forestry Development Strategy of the Republic of Serbia (Official Gazette of RS No. 59/06)

The main laws regulating the issue of forest fires and wildfires are:

- Law on Fire Protection (Official Gazette of RS No. 111/09)
- Law on Emergency Situations (Official Gazette of RS No. 111/09)
- Law on Forests (Official Gazette of RS Nos. 30/10 and 93/12)

According to the current laws, entities that manage forests (public enterprises) must prepare plans for forest fire protection for all categories of forest ownership within their territory. Such plans are obligatory for forests that come within the first and second categories of fire risk according to the forest management plans and should include:

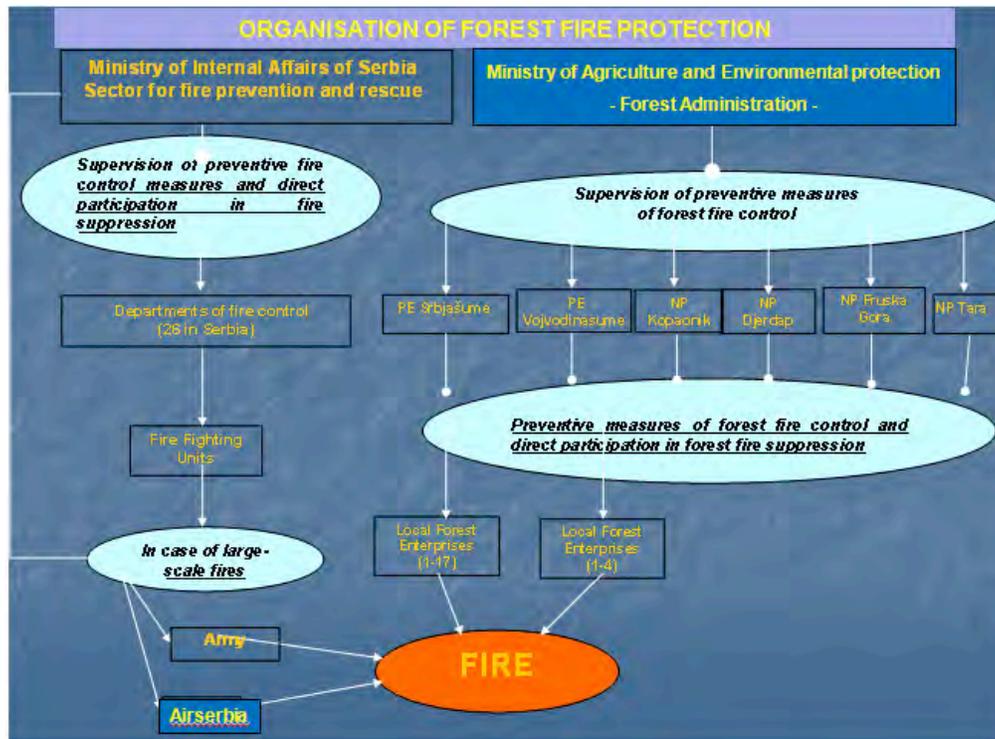
- a review of the current state of fire protection;
- an assessment of the fire risk;
- the organisation of fire protection;
- prescribed technical and organisational measures to eliminate weaknesses and strengthen capacities for fire protection; and
- a calculation of the necessary financial resources for this purpose.

In the form of an annex, the fire protection plan must also provide data on the number of fire fighters, the equipment and technical training of the fire teams, the organisation of preventive measures, the teams' shifts, and the number of qualified personnel for the implementation of fire protection activities.

The plan must be approved by the Ministry of the Interior and the Ministry of Agriculture and Environmental Protection. Forest fire risks and the vulnerability of the forests are defined in the planning documents for forest management. In order to reduce these risks, decrease the

vulnerability of the forests and protect forests from fires, the management team must define appropriate management activities for the forest.

Figure 2. Organisation of forest fire protection in Serbia



Source: [17]

1. Ministry of Agriculture and Environmental Protection (<http://www.mpzss.gov.rs/>)

In terms of forest fire protection, the Ministry of Agriculture and Environmental Protection (Forest Administration) has the role of coordinating and inspecting all entities that manage forests and forest land.

2. Srbijašume public enterprise

Srbijašume is a state enterprise for forest management founded by the National Assembly of the Republic of Serbia in July 1991.

The public enterprise manages state forests and forest land on an area of 899,612.75 ha and performs professional activities in private forests on an area of 1,058,387.00 ha (data from December 2010). The public enterprise comprises nine sectors: the Sector for Forestry and Environmental Protection; the Sector for Forest Utilisation; the Sector for Commercial Affairs; the Sector for Finances and Accounting; the Sector for Development and International

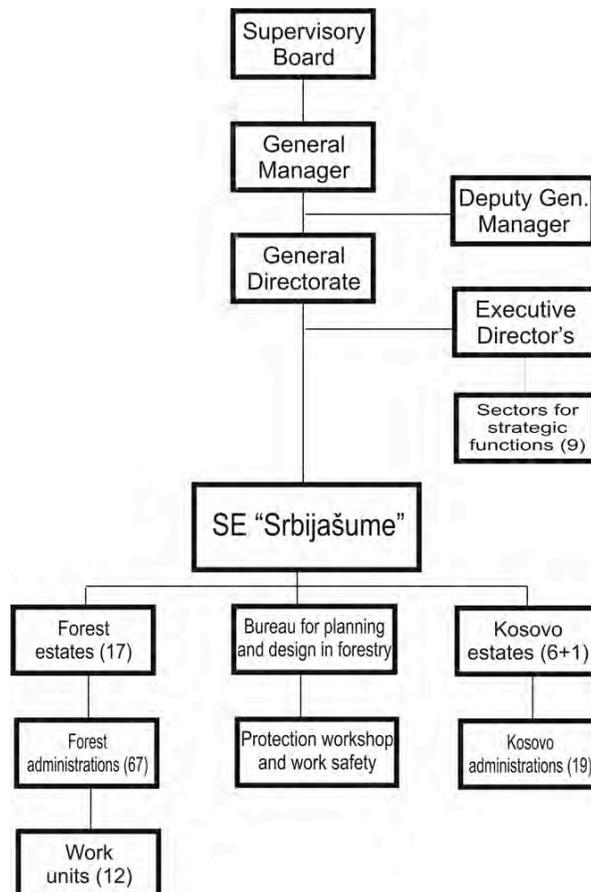
Cooperation; the Sector for Hunting, Fishing and Other Resources; the Sector for Legal Affairs; the Sector for Marketing and Public Relations; and the Sector for Real Estate.

In addition to its headquarters in Belgrade, there are 17 forest estates and 67 forest administrations throughout the territory of central Serbia, as well as the Ibar-Leposavić forest management unit on the territory of Kosovo*.

In accordance with the Forest Law, the public enterprise carries out measures and activities with the aim of preventing, suppressing and eliminating the consequences and harmful impacts of plant diseases, insects, rodents, wild game, human activities, fire, natural disasters and other biotic and abiotic factors.

Forest fire protection measures are carried out in all 17 forest estates and 67 forest administrations in accordance with their current management plans and plans for forest fire protection (as explained above). This means that they must organise appropriate measures for prevention, pre-suppression and suppression.

Figure 3. Organisational structure of Srbijašume public enterprise



Source: [8]

3. Vojvodinašume public enterprise

Forest fire protection is of great significance for this public enterprise, as fire represents a serious threat to forests and forest ecosystems on the territory that it manages, and especially to the forests of Deliblato Sands and Subotica Sands.

In order to prevent outbreaks of fire and to be able to suppress forest fires, the public enterprise prepares a forest fire protection plan that foresees the following activities and measures:

- the assessment of fire danger categories for certain types of forests;
- the monitoring of climate conditions and fuel quantity in order to estimate the existing fire hazard;
- early warning and the detection of forest fires;
- the organisation of teams for first response;
- the construction of firebreaks and water tanks;
- the implementation of silvicultural measures for reducing the risk of fire outbreaks and the speed at which fires spread;
- the maintenance of picnic sites;
- the printing and distribution of information materials; and
- awareness raising among the local population.

4. Borjak public enterprise and national parks

Borjak public enterprise, along with four national park public enterprises, have organised their forest fire protection according to the same principles and rules as Srbijašume and Vojvodinašume public enterprises (carrying out the same set of preventive, pre-suppressive and suppressive measures for forest fire protection, in line with local conditions).

5. Ministry of the Interior (www.mup.gov.rs)

The operations of the Ministry of the Interior are based on a unique organisational structure throughout the territory of the Republic of Serbia, comprising territorial, linear and object principles of operation. In addition to the seat of the ministry in Belgrade, and in line with the territorial division into districts, the tasks and duties the fall within the competence of the ministry are also performed by regional units — the regional police directorates of Belgrade, Kragujevac, Jagodina, Niš, Pirot, Prokuplje, Leskovac, Vranje, Zaječar, Bor, Smederevo, Požarevac, Valjevo, Šabac, Kraljevo, Kruševac, Čačak, Novi Pazar, Užice, Prijepolje, Novi Sad, Sombor, Subotica, Zrenjanin, Kikinda, Pančevo and Sremska Mitrovica, as well as a coordination directorate for Kosovo* and Metohija. There are four sectors within the ministry: the Sector for

Analytics, Telecommunications and Information Technology; the Sector for Finance, Human Resources and Common Affairs; the Internal Affairs Sector; and the Sector for Emergency Management.

Sector for Emergency Management

The Sector for Emergency Management seeks to build, maintain and improve the ability of the entire country to help prevent the risks, respond to the challenges, and mitigate the consequences of various disasters that may affect the region. It combines all existing resources in terms of protection, rescue and emergency response.

The operational division comprises the core members of the operational fire rescue units. At any time, 3,000 rescuers are ready to give their best to protect and rescue citizens in the Republic of Serbia. Accidents of various kinds — fires, floods, earthquakes, landslides and chemical accidents — can happen anywhere, at any time and without warning, thus priority is given to a high level of professionalism and the ability to respond in a timely manner. In addition to the basic fire rescue units, the sector has specialist rescue teams in the event of earthquakes, floods and other accidents, or in the event of technological accidents and accidents involving hazardous substances.

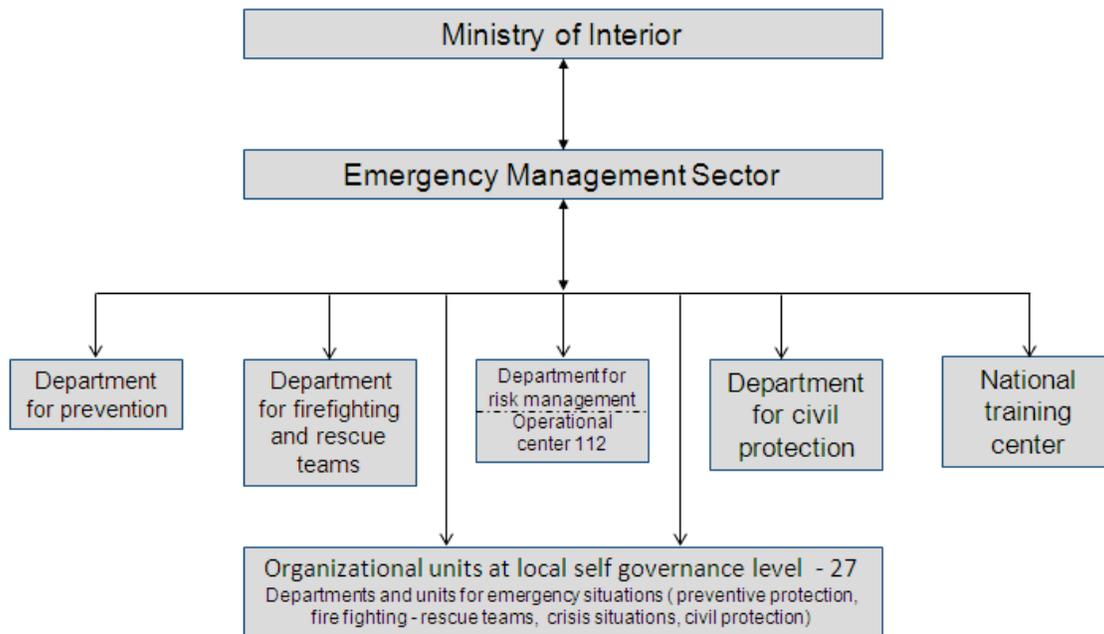
The headquarters of the sector comprises the Department for Prevention; the Department for Firefighting and Rescue Teams; the Department for Risk Management; the Department for Civil Protection; and the National Training Centre. At local level, the sector has 27 organisational units: four emergency situation boards in Belgrade, Kragujevac, Niš and Novi Sad; and 23 departments of emergency situations in Bor, Valjevo, Jagodina, Kikinda, Pančevo, Sremska Mitrovica, Užice, Šabac, Kraljevo, Novi Pazar, Pirot, Požarevac, Prokuplje, Čačak, Prijepolje, Smederevo, Subotica, Sombor, Zaječar and Zrenjanin.

The Department for Firefighting and Rescue Teams exercises timely legal supervision over the work of the fire and rescue units and industrial and voluntary fire brigades, as well as their coordinated action in the event of major emergencies. It has a direct influence over the work of the regional organisational units of fire at rescue operations in order to improve their work. It comprises three units: the Unit for Technical Equipment for Fire Fighting and Rescue Teams; the Unit for the Control of Firefighting and Rescue Teams; and the Unit for the Coordination of Operational Activities.

The Unit for Technical Equipment for Firefighting and Rescue Teams actively participates in the organisation and supervision of the work of firefighting and rescue units; analyses the state of the technical equipment used by the fire and rescue units; undertakes the planning of material and technical resources and the procurement of the necessary resources to improve the technical equipment of the fire and rescue units; plans measures to ensure adequate conditions for the accommodation of the fire and rescue units; monitors and studies the development of

modern devices, equipment and protective systems; and cooperates with the manufacturers of such devices and equipment and with other organisations in the field of protection.

Figure 4. Organisational structure of the Ministry of the Interior

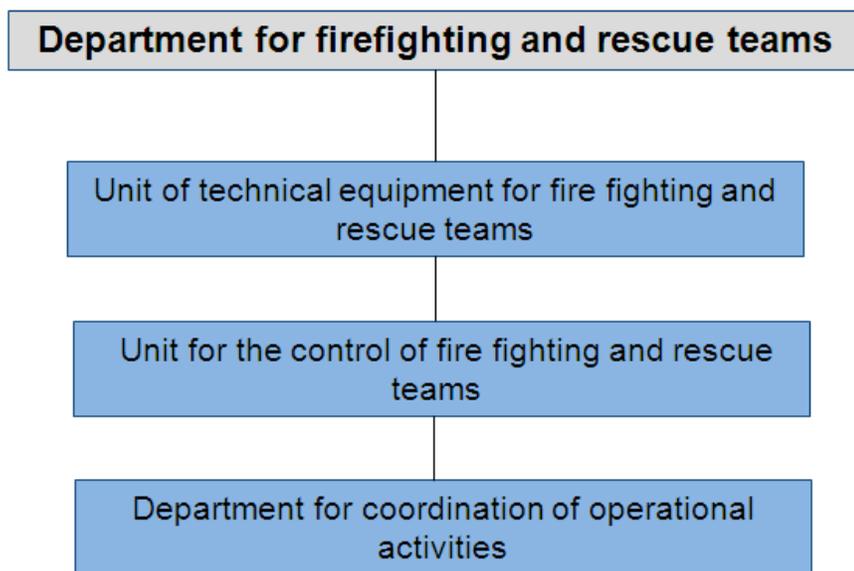


Source: [18]

The Unit for the Control of Firefighting and Rescue Teams is responsible for the fire and rescue units and for industrial and volunteer fire brigades. It controls their work and proposes appropriate measures for the improvement of fire brigades.

The Unit for the Coordination of Operational Activities is responsible for assessing the vulnerability of the territory in order to define the formation of new fire and rescue units, as well as the required number of staff. It is also responsible for coordinating the work of all the departments that are involved in emergency situations. It proposes and participates in the development and harmonisation of protection plans and operational plans with the state, regional, city and local authorities. It maintains direct contact with other services operating in emergency situations.

Figure 5. Organisational structure of the Department for Firefighting and Rescue Teams



Source: [15]

6. The Firefighting Association of Serbia (FAS) (www.vss.org.rs)

The Firefighting Association of Serbia brings together volunteer fire associations and unions on the territory of the Republic of Serbia in the framework of programmes in the field of fire protection and prevention activities and professional training. Through the activities of its municipal, county, city and provincial unions, the FAS coordinates and jointly implements activities together with professional firefighting units that are organised within the Ministry of the Interior and units that are located within the enterprise or institution, aimed at improving fire protection.

The establishment of volunteer fire societies and unions is regulated by the Law on Associations. The FAS conducts measures of prevention, preparedness and suppression.

There are about 3,500 volunteer firefighters with firefighting equipment, most of them in eastern Serbia. Members of the volunteer brigades have rights, obligations and responsibilities under the Law on Fire Protection. The volunteer qualification standards are compatible with those of professional firefighters and they are protected by the same legal safeguards. Local authorities provide some money for the work of volunteer firefighters.

The inter-agency mechanisms for fire protection and rescue in emergency situations are defined by the Law on Fire Protection, the Law on Emergency Situations and the Law on Forests as the responsibility of the Emergency Management Sector (Ministry of the Interior of Serbia).

Regulations governing the use of fire in forestry, agriculture, conservation areas and other lands can be found in the Law on Fire Protection, the Law on Forests, the Law on Agricultural Land and the Law on National Parks.

According to the Law on Fire Protection it is forbidden to burn stubble, crop residues or waste in the open air.

Cross-border activities include:

- Agreements on cooperation in the field of emergency and disaster management signed with Slovakia, Azerbaijan, Bosnia and Herzegovina, Montenegro, the Russian Federation and Ukraine, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Greece and Hungary, and in process with Romania.
- A memorandum of understanding on cooperation in the field of emergency situations with Italy.
- A letter of intent for cooperation in the field of emergency situations signed with France.
- A memorandum of understanding signed with the Danish Emergency Management Agency.

In forests, agricultural lands, protected areas and military areas or national border terrain, the responsibility for fire management lies with the Emergency Management Sector of the Ministry of the Interior, the Ministry of Agriculture and Environment, public enterprises and the public enterprises of national parks, subjects that manage hunting, private land owners and the users of state land. Changes are not planned because the current regulations are harmonised with EU regulations.

Prescribed fires are commonly used in agricultural lands, pastures, abandoned agricultural and pasture lands, and waste disposal sites, although they are banned by law. There are also benefits in relation to firefighting, when fire is used as counter fire. Some uses of prescribed fire are permitted by law under certain conditions in natural forests, intensively managed forests, forest plantations and agricultural lands.

III. The impact of wildfires on the environment, economy and human health

There are no data for related hospital admissions and premature deaths during heat and fire episodes in Serbia.

According to the Law on Air Protection, air quality is monitored in cases where there is a reasonable suspicion that poor air quality is harming human health or the environment. In crisis situations, the relevant entities (Ministry of Environment, Mining and Spatial Planning, and other local units) must be informed immediately. Statistics are available regarding the impact of forest fires on the economy in 2007, 2012 and 2014:

- In 2007, the total burned area (forests, other woodland and other land) was 34,001 ha and the total damage caused was EUR 31,530,831.
- In 2012, the total burned area (forests, other woodland and other land) was 12,125 ha and the total damage caused was EUR 112,929,525.
- In 2014, significant areas were affected by floods, causing total damage of RSD 1,074,722,891.49 [EUR 8,956,024].

IV. Special issues

The use of bombs containing depleted uranium during the 1999 conflict is a specific problem that may have considerable environmental consequences. The Kingdom of Norway financed a project to identify contaminated areas in the municipalities of Bujanovac, Preševo and Kuršumlja. There are still areas contaminated with unexploded ordnance, but no data are available. There are large areas of unexploded ordnance in the area of Dobrosin, in the municipality of Vranje.

Land contaminated by radioactivity poses two main problems:

- It is dangerous for firefighters to remain in these areas during fire suppression because of the harmful radioactive radiation (although the level of radiation is not known).
- The gas emissions caused by forest fires in these areas will also be radioactive and, if further transported by the wind, contaminants can be deposited over long distances and in urban areas.

Terrain contaminated with unexploded ordnance is dangerous for firefighters during forest fire suppression activities, but also for foresters and members of the local population.

A significant number of areas have been decontaminated since the bombing in 1999 but are still considered as potentially dangerous sites.

A forest fire that had spread from Montenegro was recorded in the municipality of Prijepolje in July 2012. A forest fire that had started in Bosnia and Herzegovina was recorded in September 2012 in Tara Mountain area, and a fire that had started in Bulgaria was also recorded in 2012 in Bosilegrad municipality. Serbia exchanges fire management personnel with other countries. Assistance was provided in July 2012 to Montenegro; in August 2012 to Greece (Athos); and in August and September 2012 to Bosnia and Herzegovina. Assistance to Serbia has been provided by the Russian Federation.

The country has specially trained and equipped wildfire fighters. The National Training Centre for Emergency Management is responsible for training. Serbia has participated in shared fire management training through terrain simulation exercises in Croatia in 2012, in Slovenia in 2011, in Moldova in 2011, in Turkey in 2010, in Serbia in 2010 and in Croatia in 2007. Fire management materials are very similar in these neighbouring countries. Agreements on joint training, exercises and response have been signed with Slovakia, Azerbaijan, Bosnia and Herzegovina, Montenegro, the Russian Federation, Ukraine and Hungary. Agreements are currently in process with Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Greece and Romania.

Women actively participate in the professional rescue services.

Serbia has a negative population growth rate and rural depopulation is very intensive. There is a clear increase in the average age of the rural population and a reduction in the workforce, thus the availability of capable rural farmers and volunteers is reduced.

V. Needs for improvement in forest fire management

In general, the legal regulations and institutional set-up with respect to forest fire protection in Serbia are at a satisfactory level, but some improvements still need to be made.

Early warning system

The Emergency Management Sector of the Ministry of the Interior of Serbia has compiled a risk map of natural disasters in the country. Since 2008, the State Hydrometeorological Service of Serbia (RHMS) has forecast the risk of forest fires in using the Canadian Fire Weather Index method. The RHMS also has a unique hydrometeorological early warning system, integrated into the National Protection and Rescue System, as well as European and global hydrometeorological systems and programmes, which provides timely and accurate information, forecasts and warnings.

However, there is still a need for an early warning system for forest fires. This could be designed on the model of the European Forest Fire Information System (EFFIS) or the Macedonian Forest Fire Information System (MKFFIS). This kind of early warning system would serve as a basic tool for use by all institutions and organisations involved in forest fire protection in Serbia for planning and creating their activities and resources.

Special vehicles and equipment

Although all institutions involved in forest fire protection have certain resources in the form of special vehicles and equipment, they are not sufficient. Most of the vehicles are obsolete, and the newly procured vehicles are almost all designed for urban fires. Other forest fire suppression equipment (hand tools, water supply systems, personal protective equipment etc.) is either obsolete or lacking.

Trained personnel

As mentioned earlier, Serbia has specially trained and equipped wildfire firefighters, and the National Training Centre for Emergency Management is responsible for their training. However, they are not sufficient, taking into consideration the fact that the forestry sector (public enterprises, national parks etc.) is responsible for forest fire protection, including fire suppression. The forestry sector is obliged to organise the initial response and to participate in fire suppression. The personnel need appropriate training for forest fire suppression.

Revision and improvement of forest fire protection plans

Although such plans exist, some are not of suitable quality. Their content is more formal than operational. The plans need to be more accurate in terms of prescribed measures and duties in accordance with the competences of the institutions. All plans must be harmonised in terms of content, quality and prescribed measures and activities.

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NOTE

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Call for contributions

Readers of the International Forest Fire News are warmly invited to send written contributions to the editor at the above address. These may be in the form of concise reports on activities in wildland fire management, research, public relations campaigns, recent national legislation related to wildfire, reports from national organizations involved in fire management, publications or personal opinions (letters to the editor). Photographs (black and white) and graphs, figures and drawings (originals, not photocopies, also black and white) are also welcome. Contributions are preferably received by e-mail.

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CONTENTS

Editorial	1
Special Issue on the 2007 Fire Season on the Balkan Peninsula	
Forest Fires in Greece 2007	2
Forest Fires in Bosnia and Herzegovina: Statistics 2003-2007	18
Forest Fires in Bulgaria 2007	20
Forest Fires in Croatia 2007.....	22
Forest Fires in Croatia 2008.....	25
Mine Fields and UXO Contamination in Croatia: Summary for 2008	28
Republic of Albania – Fire Report 2007	32
Republic of Serbia – Forest Fires in 2007.....	41
Forest Fires in Former Yugoslav Republic of Macedonia in 2007	48
Ecological Damage Assessment of the Wildfires in the Former Yugoslav Republic of Macedonia in 2007. Joint Mission by the UNEP-OCHA Joint Environment Unit, UNEP, UNDP and GFMC	53
Wildfires in Turkey 2007.....	73
Republic of Armenia – Forest Fires in 2007.....	78
Review and Analysis of 40 Years of Fire Damages in Forests and Rangelands of the Islamic Republic of Iran (1968-2007)	81
Advance Publication of Wildland Fire Statistics for Russia 1992-2007	85
RESEARCH & TECHNOLOGY	
An Innovative Conceptual Model of a Forest Fire Management Information and Decision-Support System for Brandenburg State, Germany	88
Analysis of the Wildland-Urban Interface Fire Problem of Greece	103

Due of the time lag between editing and print/distribution of IFFN, readers interested in meeting announcements are kindly requested to visit the Internet version of this issue for update and short-term announcement of meetings (continuously updated) and other global news on <http://www.fire.uni-freiburg.de>

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EDITORIAL

In Southeast Europe, notably on the Balkan Peninsula, the summer of 2007 was extremely dry and hot – the consequence of a jet stream pattern, which in 2007 was flowing further south as compared to average years, allowing low pressure systems to sweep over Western / Atlantic Europe and warmer air, pulled from Africa, flowing to Southeast Europe. This weather pattern resulted in extraordinary high meteorological fire danger on the Balkan Peninsula. And indeed – many countries of the region experienced extremely large and severe wildfires affecting whole landscapes – forests, open land vegetation types including protected areas, agricultural and pasture lands. Apart of environmental damages many cultural assets and residential areas were affected by wildfires and resulted in high economic losses and caused injuries and loss of lives of firefighters and rural inhabitants.

In some countries multiple large wildfires prompted governments to call for assistance from their immediate neighbors and at international level.

The Global Fire Monitoring Center (GFMC) requested the country focal points of the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network to evaluate the 2007 fire season. The results are presented in this volume of International Forest Fire News.

Two additional contributions from fire research projects are included in this volume – one covering conceptual model of a forest fire management information and decision-support system for Brandenburg State, Germany. The other contribution is addressing the wildland-urban interface fire problem of Greece.

Freiburg – Geneva, December 2008

Johann G. Goldammer

Forest Fires in Greece 2007

1. A First Assessment of the 2007 Wildfires

1.1 Extent of the fires

No official data for 2007 available at the time of writing this report. According to the European Forest Fire Information System, about 270,000 hectares of vegetation in Greece had been affected by wildfires by mid-September. This figure exceeds by far any previous record. The vast majority, 184,000 hectares, went in just four days, between 24 and 27 August 2007.

Most of the fires occurred in the south of Greece, in Peloponnese. Burned area mapping by the laboratory of forest management and remote sensing of the School of Forestry of the Aristotelian University of Thessaloniki, in cooperation with the World Wide Fund for Nature (WWF), completed by the end of September, produced an estimate of 177,265 ha, specifically for Peloponnese. Forest and other natural areas accounted for 55% (97,618 ha) of the total burned area while agricultural areas reached 16,432 ha. More than 30,000 ha burned are classified as Special Protection Areas of the NATURA 2000 network.

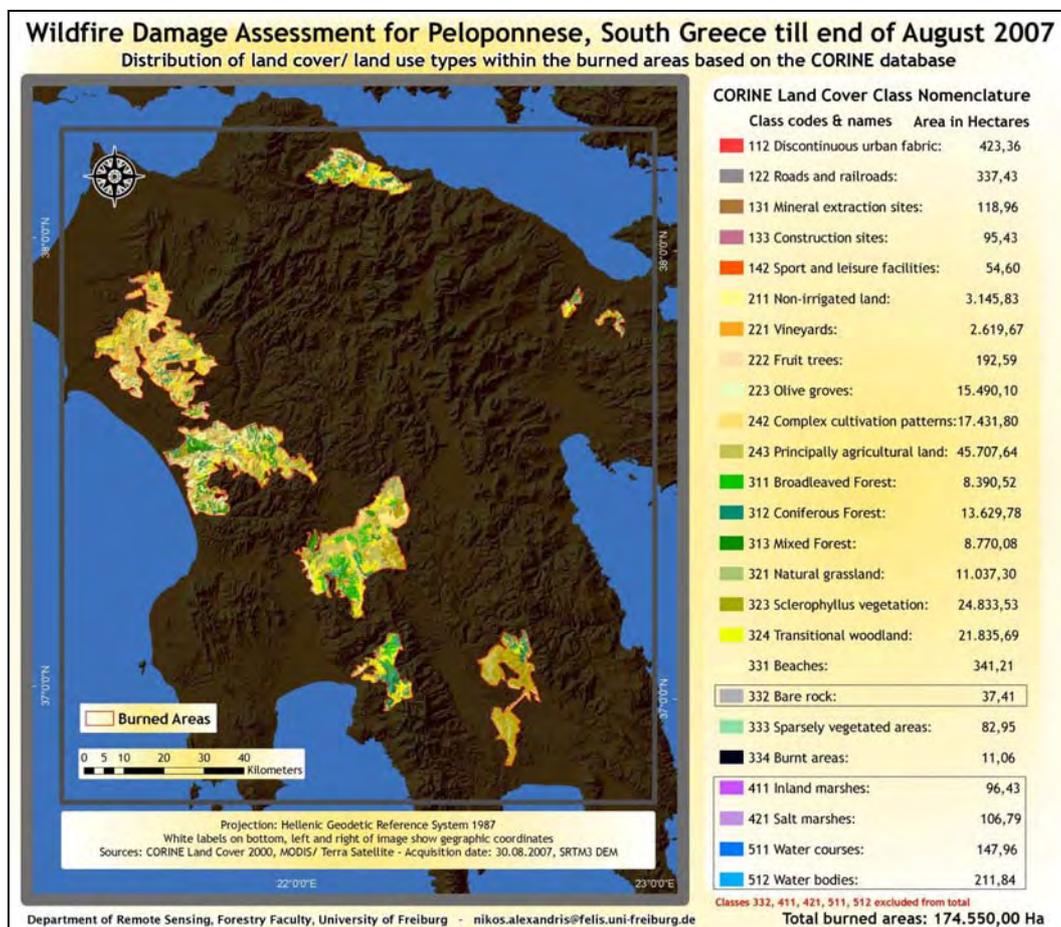


Figure 1. First quick assessment of the area burned by CORINE land cover classification at the end of August 2007. Source: Nikos Alexandris, Global Fire Monitoring Center (GFMC) and Department of Remote Sensing, Freiburg University.

1.2 Causes of the wildfires

There is lack of reliable data on fire causes in Greece, especially after 1997, when the responsibility of firefighting was transferred from the Forest Service to the Hellenic (Greek) Fire Corps. Earlier statistics

from the Forest Service, however, reveal that around the late 1980s to the early 1990s the vast majority of fires were due to human causes (Table 1).

Table 1. Wildfire cause statistics of the Forest Service 1988-1993

Fires Causes	1988 (%)	1993 (%)	1968–1993 (%)
Lightning	2.6	2.7	2.4
Accidental causes	3.1	2.5	3.5
1. Power lines	0.8	1.0	0.7
2. Engine sparks	1.4	1.0	2.1
3. Use of explosives	0.3	---	---
4. Army target shooting	0.6	0.5	0.7
Negligence	27.3	28.2	36.0
1. Stubble burning	11.8	9.0	16.0
2. Cigarettes	4.0	2.1	8.7
3. Garbage burning	4.2	2.5	3.9
4. Workers in the countryside	3.8	4.0	3.2
5. Recreationists and hunters	1.6	0.8	1.3
6. Other known causes	1.9	9.8	2.9
Deliberate causes	33.5	18.0	29.2
1. Rangeland improvement	15.6	6.6	---
2. Arson			
Deliberate (for profit, revenge, etc.)	17.2	10.8	---
By people with reduced mental capacity			
Children	0.3	0.2	---
Pyromaniacs	0.2	0.2	---
Other psychopaths	0.2	0.1	---
Mentally retarded	0.0	0.1	---
Unknown or suspected causes	33.5	48.6	28.9
Total	100	100	100

Table 2 is based on more recent data from the Greek Fire Corps and refers to only those cases that were investigated by the corresponding Fire Investigation Department and a report was sent to court. Obviously, this is not a complete un-biased sample.

Table 2. Fire cause statistics for the period 2000 to 2005 from the website of the Greek Fire Corps (www.fireservice.gr)

Cause	2000	2001	2002	2003	2004	2005	Total	Percent
Unknown	628	714	469	640	721	532	3,704	37.60%
Arson due to negligence	481	835	409	453	553	437	3,168	32.16%
Deliberate arson	297	389	209	359	398	300	1,952	19.81%
Accidental	4	2	2	15	9	1	33	0.33%
Natural	80	235	182	233	158	107	995	10.10%
Total	1,490	2,175	1,271	1,700	1,839	1,377	9,852	100.00%

In short, more than 95% of the fires are due to human causes. There is a general tendency of people to believe that most fires are deliberate, started by people who want to achieve gains on public land, taking advantage of the lack of a complete land cadastre, or want to build homes in forested areas where this is prohibited. Although the existence of such motives cannot be questioned in some cases,

there is a multitude of other reasons behind deliberate arson. Negligence is the most common cause. Education of people about fires is relatively poor. Furthermore, the general belief that “arsonists” are the overwhelming reason behind the fires, which is “cultivated” by the mass media, leading to indifference and negligent behavior of the people, does not help in reducing the number of fires that are due to negligence.

1.3 Description of selected extreme fires in 2007

In summer of 2007 Greece faced a very difficult fire season. Signs about the difficulty of the fire season were evident early on. Snowfall in winter was deficient, making it impossible for many ski areas to operate. Rainfall was also well below normal. A few rainy days in May did not solve the problem as they were followed by an early heat wave in the last days of June.

The difficult conditions were obviously the main contributing factor to the large fire disasters that the country faced. Some of the most notable ones are described below.

The fire on Parnis Mountain

The fire on Parnis Mountain, a few km NW of Athens that burned most of the Parnis National Park. The fire started in the area of Dervenohoria in the evening of 27 June 2007, at a distance of 15 km from the National Park. The cause were electric sparks from the overloaded power utility network that had been trying to cope with the high demand for electric power for the air conditioning units, as people were trying to find relief from the first – early – heat wave of the summer. Two large fires in central Greece, the first in the area of Agia on mount Ossa, that claimed two civilian lives, and the second on the extremely beautiful and highly visited Mount Pelion in Magnesia, as well as many other smaller fires, did not allow massive initial attack by aerial means. The fire potential was underestimated and firefighting efforts during the day of the 28 June 2007 were not of the urgency that would be expected for such a fire. In the evening, the fire passed the last open spaces at the base of Parnis and started a quick run in the draws of the mountain that were occupied by Aleppo pine (*Pinus halepensis*) forest at elevations below 800 m and fir forest (*Abies cephalonica*) above that. It created a huge convection column and rushed to the top of the mountain defying all efforts to control it.

The fire finally burned 5,600 ha including 2/3 of the precious Parnis National Park. More important, it created great concern for the people of Athens who felt that they lost an important natural reserve and recreation area which also helped to regulate the climate of the city and to filter the air they breathe.

The fire near the village of Doxaro, Rethymnon, Crete

On 11 July 2007, three seasonal firefighters lost their life while firefighting near the village of Doxaro, in the prefecture of Rethymnon, in Crete. A fourth firefighter sustained extensive burns and died in a hospital a few days later.

The fire was probably due to arson. Such events are common in Crete where shepherds regularly burn (illegally) the low thorny shrubs (mainly *Sarcopoterium spinosum*) called “phrygana” on the overgrazed rocky land, in an effort to stimulate growth of new palatable forbs and grasses for their goats. It started at 13:20 in an area such low shrubby vegetation bordering agricultural vegetation. According to the official announcement of the Greek Fire Corps, the total firefighting forces mobilized were 11 fire trucks with 30 firefighters, a Kamov-32 helicopter, two Canadair amphibian water bombers, and two hand crews of 8 firefighters each. It is unlikely that all these forces were on the fire at the time of the accident.



Figure 1. The draw through which the main fire entered into the core of the Parnis National Park late in the evening of 28 June 2007. The true fir (*Abies cephalonica*) forest burned completely. Average fire spread during this run was estimated at 4.5 km/h. Photo: G. Xanthopoulos.

The wind was not very strong and fire behavior in the phrygana vegetation did not appear threatening. The accident happened just before 17:00h. Based on the images projected on TV reports and on interviews of firefighters immediately after the accident, the firefighters tried to control the fire at the bottom and left side of a narrow steep canyon, using hoses from a fire truck that had stopped mid-slope on an unpaved road. They achieved this and retreated back on the road while there were small flames at some points on the opposite site of the canyon where the vegetation had not burned. Four firefighters of one of the two hand crews moved on that slope trying to extinguish these small flames with backpack pumps. At that moment the fire moved unexpectedly to unburned fuels under them at the bottom of the canyon. Helped by the nature of the fine fuels, the steep slope (more than 40%) and probably a wind gust, the fire became intense in seconds and started moving upslope towards the four firefighters. They started running but they made the choice to run along the steep slope moving further into the canyon where the fuels had not burned. The fire accelerated in the canyon behind them. They shouted for help on the radio. This is when their colleagues near the truck realized they were in grave danger but they could not react in the smoke-filled environment of the canyon.

The three firefighters fell after running for about 200 m. The fourth firefighter managed to climb a little further and protect himself in a little cave-like depression. According to the TV reports he suffered damage to his lungs in addition to receiving second degree burns over 40% of his body. Based on the accounts of the firefighters who witnessed the evolution of the accident, the time between the blow-up and the fatality was not longer than five minutes.

The four firefighters were 34 to 40 years old with 5-7 years of experience. According to their comrades they all were in good physical shape. Although it will be a long time before any official investigation reports, it appears that the two main reasons behind this accident are topography (box-canyon, Y-shaped near the point where the firefighters fell) and light flashy fuels. A third factor that may have played a critical role, since it was mentioned in some witness reports, is the firefighting activity of the Kamov-32 helicopter which produces a very strong downdraft. If it did make a drop in the canyon close to the area where the firefighters were operating, it could very well be the cause of the fire spotting to unburned fuels below the four firefighters and starting the blow-up.

The fire on Hymettus mountain

This fire was not important because of its large size but because it took place only three weeks after the fire on Parnis Mountain, on 16 July 2007, at the base of mount Hymettus, in an area that is practically in contact with the east side of Athens. It received extensive live coverage by the media and increased further the feeling of insecurity of the people.

The fire started at about 03:00pm in a well-guarded area next to the ring road of Athens, occupied by an Aleppo pine forest-park, under high wind conditions (45 km/h). In the 30 minutes that were needed for the aerial means to arrive it progressed quickly, unhampered by the suppression efforts of the ground forces, while the people watched, either from their balconies or from the live TV coverage. Then the aerial means arrived (6 Canadair water bombers, two Erickson and one MI-26 heavy lift helicopters) and taking advantage of the short distance to the sea (8 km) they controlled the fire in less than an hour. The final burned area reached 36 ha.

Fires in high elevation forests

Fires in high elevation forests, consisting of species like *Pinus nigra*, *Pinus sylvestris*, *Abies cephalonica*, *Abies alba*, etc. are quite uncommon in Greece. They usually occur for a short period at the end of the summer (August / early September) when these forests dry-out and before the first rains of autumn. The lack of snow and reduced rainfall of 2007 increased the probability for such fires much earlier. The fire on Parnis Mountain in late June was one such example.

Between July 19 and 5 August 2007, associated with the second heat wave of the summer, a series of fires erupted in high elevation forests, mainly in northern Greece, including many fires near the border with Albania most notable being the fire on Grammos mountain close to the city of Kastoria, a fire near the village of Kristallopigi of the prefecture of Florina, and a fire near the village of Amarantos, near the city of Konitsa in the prefecture of Ioannina; a fire on Belles mountain and another on Rodopi mountain both of them near the border with Bulgaria; and a fire on Pieria mountain in central Macedonia. In southern Greece, the fir forests on Parnassos and Elikonas mountains and near Fteri village in the prefecture of Achaia were also on fire.

Some of these fires continued burning for more than ten days. The amphibian water bombers are generally ineffective when fighting fires in these forests due to the long distance to the sea. Although heavy lift helicopters operated on these fires, their numbers were limited due to the high demand in many simultaneous fires. More important, water drops cannot fully extinguish fires in these forests that have thick canopies and deep humus and litter layers. Intervention by well-trained ground forces is absolutely necessary. Lack of well trained and sufficient in number hand crews in combination with poor tactics (for example, no use of fire to control fire) proved to be a major shortcoming. The nearly complete dependence of the Fire Corps ground forces on using water from fire trucks for putting out forest fires proved a major weakness in these areas that lack a dense road network.

On 5 August 2007 a cold front that passed over north Greece produced a lot of rain. In some places, especially in NW Greece, there was even heavy flooding. This helped to put out the fires in the mountains of north Greece. It also helped these areas to avoid what was to happen in the forests of southern Greece within the next month.

The fire of Aigialia

As the fires at the high elevation mountains were in progress, a series of fires also erupted in many parts of central and south Greece. Between 18 and 23 July 2007 attention was concentrated on the fires in the prefecture of Corinth, near the villages of Mapsos and Hiliomodi including the ancient site of Acrocorinthos – the ancient Acropolis of Corinth, a large fire near the city of Nafpaktos on the north coast of the golf of Corinth and a devastating fire on the tourist island of Kefallinia in the Ionian sea.

In the morning of 24 July 2007, a fire near the village of Kounina in Aigialia, an area along the north coast of Peloponnese in the prefecture of Achaia, caused huge devastation. The fire had been announced as “under control” the previous evening but re-started because the site was not attended properly. Being on a long steep slope and faced with delayed and inadequate initial attack, it accelerated quickly and very soon started threatening the villages in its path.

Within the next four days, the fire nearly reached the top of the north slope of the Panahaiko mountain burning more than 30,000 ha of forest and agricultural land, destroying more than 70 homes in many villages and killing three old civilians -a shepherd who tried to save his flock and two women who were unable to move and leave their home when it caught on fire- and large numbers of livestock. Furthermore, this fire demonstrated that the firefighting mechanism was unable to cope with the load imposed on it and was showing signs of collapse.

The fire of Penteli

On 16 August 2007 a fire started around 10:00am near a monastery on the slope of Penteli Mountain, the northeast boundary of the Athens basin. The initial ground attack failed. The northeast wind, blowing at about 25 km/h moved the fire front toward the Vrilisia and Nea Penteli suburbs of Athens. The fuel was mostly regenerating pine forest after a 1982 fire. The combination of heavy fuel and dry conditions with a medium wind resulted in the development of strong, nearly vertical, revolving convection column above the fire. The aerial means could not make water drops because of erratic winds and smoke, so the fire moved unchecked toward the two suburbs. Also, the rotation of the column resulted in a sideways spread of the fire flank in a west direction towards Kifissia and Ekali two of the richest suburbs of Athens.

At about 12:30pm the wind became stronger reaching approximately 35 km/h. The smoke column leaned forward, making it a wind-dominated fire (Rothermel, 1991), and the aerial means were able to start making drops. By that time, however, the fire had reached the settlements. By the end of the day the fire was partially controlled, after burning tens of houses and destroying an estimated 800 ha of precious forest. Again, all this was reported live on TV, making people wonder about the fire suppression mechanism's ability to protect them.



Figure 2. The fire of Penteli reaching the suburbs of Athens on 16 August 2007 at 12:47pm. Photo: Miltiadis Athanasiou.



Figure 3. Explosive fire behavior as the fire of Penteli, on 16 August 2007, is reaching one of the suburbs making police, firefighters and the public run for safety. Source: Footage offered to the Institute of Mediterranean Forest Ecosystems and Forest Products Technology by the Public TV Channel NET.



Figure 4. Explosive fire behavior as the fire of Penteli, on 16 August 2007, reaches one of the suburbs where it destroyed many houses. Source: Footage offered to the Institute of Mediterranean Forest Ecosystems and Forest Products Technology by the Public TV Channel NET.

The fires in Peloponnese and Evia

From 24 to 28 August 2007 a series of fires that started in the south part of Greece burned as if there was nothing and no one to control them. Within those days Greece faced its worst forest fire disaster ever both in regard to the size of burned area and to the loss of life and property. The damages were beyond imagination.

Fire danger had been extreme. Temperatures above 39°C for three days were followed by a day of strong winds with velocities of 50-70 km/hr winds and extremely low relative humidity. In addition to all these, the vegetation was severely water stressed. There had been no rain in southern Greece for the whole summer, and, for the first time on record, there had been three heat waves during the summer: the first in late June, the second in July and the third in August, just before the onset of the disaster. The level of water stress of the vegetation is reflected in predawn water potential measurements for August, made near Athens over a five-year period (Table 3) (Xanthopoulos et al., 2006). The summers of 2003, 2004 and 2005 had at least one rainfall event. In 2006, the last rainfall came in early in July. The water potential showed a pronounced drop by late August 2006, when two major fires occurred in Kassandra Peninsula (Northern Greece) and in the area of Mani in south Peloponnese. Although there had been some rain in late May 2007, June and July had been dry.

Table 3. Predawn water potential measurements of three Mediterranean species in Attica, in August of the years 2003-2007

Species	Water potential (bar)				
	5 August 2003	4 August 2004	7 August 2005	23 August 2006	9 August 2007
<i>Pinus halepensis</i>	-7.3	-6.5	-9.0	-23.7	-21.0
<i>Quercus coccifera</i>	-19.0	-20.0	-14.5	-28.5	-34.5
<i>Cistus creticus</i>	-20.5	-43.6	-26.0	-61.0	-45.0

When fires starting in this explosive situation were faced with ineffective initial attack from the ground, the stage was set for disaster. Two fires started on 23 August 2007, one on Mount Parnon east of Sparta and the other on Mount Taygetos west of Sparta in Peloponnese. They soon raged out of control. A new fire erupted the next day (24 August 2007) near the towns of Oitylo and Areopolis, roughly 30 km south of the fire of Taygetos. This fire caused the first six deaths and attracted the attention of the Fire Corps and the media – until news of massive fatalities at a new fire in Iliia (Western Peloponnese) came that afternoon.

As the news about the deaths started adding up, coordination started failing. New fires that started in other parts of Iliia, Arcadia, Messinia, Corinthia in Peloponnese, and on Evia Island north of Athens did not receive a proper initial attack. They escaped and started growing quickly. They were not attacked methodically. Fire trucks were sent to the villages in the way of the fires to protect them. Evacuations were ordered or spontaneously started from panic. The perimeters of all fires were practically abandoned. The fires grew and some united with each other. The large fleet of aials did not offer effective help partly because of the extreme conditions (on some occasions Canadair planes were not able to operate safely due to the wind and smoke) but also because ground forces below them could not finish extinguishing the fire.

For the next four days, aerial and ground forces were seen as ineffective, thanks to the large number and size of fires and the countless pleas for help, many of them relayed through the 24-hour live TV coverage. The planes and helicopters were sent in for a few drops only to then be called-off to another fire.

Not realizing that tactical firefighting was doomed to fail, the Fire Corps kept pushing people to evacuate villages indiscriminately. They should have coordinated capable villagers to prepare their homes and agricultural fields (such as clearing grasses in their olive groves) in advance, fight flanking fires with their agricultural equipment or protect themselves in the village. To its credit, the government declared a general state of emergency, mobilized the army and asked for international help.

The fires in Iliia started merging with each other by 26 August 2007. The situation turned critical as the first aerial reinforcements from other countries started arriving. One of the fires reached the ancient

site of Olympia, which was surrounded by mature pine forest. The site and its museum were barely saved by focused ground forces, strong aerial support and an on-ground automatic sprinkler system installed before the 2004 Olympic Games that only worked partially. All the forest around it, however, burned down.

Things started to improve by 27 August 2007 as relative humidity increased substantially, the wind calmed and the temperature dropped. Locals, realizing they would be homeless if they abandoned their villages, often refused to evacuate and stayed to defend their homes (which are generally built with stones or bricks and reinforced concrete) and cultivations. Officers of the Forest Service with forest workers started building firebreaks and performing small scale firing-out operations. A ground crew from Cyprus that came to help, successfully used backfiring techniques on Evia Island, to the surprise of the reporters who had never witnessed this technique being used by the Fire Corps. A French hand crew did the same on Parnon Mountain. Heavy equipment from the army created firebreaks on relatively flat ground.

By that time, a huge aerial fleet was operating in the skies over Peloponnese and Evia. Twenty-three airplanes and 18 helicopters from European Union and non-European Union countries supplemented the Greek aerial forces, forming arguably the largest aerial firefighting fleet operating anywhere. Significant international ground forces also started to arrive, creating a model of solidarity that hopefully will be repeated if another country finds itself in need.

Taking advantage of the calmer winds, the firefighting forces brought most of the fires under partial control in the next few days. However, the Greek TV channels were showing battles against fire re-starts along the large fire perimeters until the 5th of September. Much of their footage looked as a textbook example of the ineffectiveness of aerial firefighting when it is not followed by well-coordinated ground firefighting (Xanthopoulos, 2007a).



Figure 5. Explosive fire behavior in Ilia. The type of fuel, a mix of *Pinus halepensis* forest and olive groves is visible. Photo: Miltiadis Athanasiou.



Figure 6. A crown fire burning *Pinus halepensis* forest in Ilia on 25 August 2007. Photo: Miltiadis Athanasiou.



Figure 7. A photo showing two fires mixing with each other in Ilia on 25 August 2007. The smoke of another fire behind the camera is visible at the top of the photo. Photo: Miltiadis Athanasiou.



Figure 8. Large convection column in Ilia on 25 August 2007. Photo: Miltiadis Athanasiou.

1.4 Fire Damages in 2007

Eleven people had died before the huge fires at the end of August. The toll includes two Canadair CL-415 pilots who were killed on 23 July 2007 when they crashed while fighting a fire near the town of Styra on Evia Island. Then, the devastating fires of August claimed sixty six lives more. Most of the dead were caught in the open, either trying to flee or surrounded by the fire as they were trying to save their property. This death toll of seventy seven lives far exceeded anything that the country had experienced in the past (Xanthopoulos, 2007b).



Figure 9. Fire behavior in maquis in Arcadia on 31 August 2007. A spot fire that has started growing is visible to the left of the main fire. Photo: Miltiadis Athanasiou.

More than 110 villages were destroyed leaving thousands of people homeless, surrounded by blackened land. The government tried strongly to handle the situation on the public relations side. It announced increased support for the people whose properties were destroyed. It also talked about an organized arson plan, without, however, presenting any evidence.

More than 2/3 of the prefecture of Ilia burned. Large areas also burned in the prefectures of Arcadia, Laconia, Messinia, Corinthia, and on the island of Evia. Much of the burned area is agricultural, mainly olive groves. Estimates about the total financial damage of these fires vary tremendously as they are influenced by politics. An independent estimate by the international assessment firm Standard & Poors brought the damage in the range 3-5 billion €, corresponding to 1.4-2.4% of the gross national product of the country.



Figure 10. A well maintained olive grove in Arcadia that survived the fire. Photo taken on 1 September 2007 by Miltiadis Athanasiou.

As mentioned earlier, the total burned area exceeded 270,000 ha. The fire in Ilia exceeded 45,000 ha, breaking the all time record set in Aigialia only a month earlier.

The government won the elections on 16 September 2007. After that it continued providing support to the affected population. Aid also came from other countries such as Cyprus, from the private sector of economy (construction companies, banks, communication companies, etc.) and from private citizens and volunteer organizations. The government also initiated urgent burned area rehabilitation works trying to reduce damages due to flooding. Given the size of the burned areas it was not possible to protect all areas before the autumn rains. Significant damages occurred, especially in Ilia, but huge disasters and loss of lives have been avoided so far (December 2007).

The environmental damages are heavy. It is known that Mediterranean ecosystems are resilient to fire. However, the size of the burned areas is important. In this case the size is huge, being to a large extent the result of successful fire suppression in the previous "easy" fire years. Given this size soil erosion and flooding potential are much heavier than ever before. Wildlife has difficulty finding refuge and food. Seed sources for non-fire adapted species are often many kilometers away and will probably result in changes in vegetation composition. This is more of a problem in the high elevation forests where natural regeneration of *Abies* spp. is far from certain and even artificial regeneration through planting of seedlings cannot guarantee reestablishment of *Abies* stands.

It should be noted that the huge losses of 2007 followed a series of relatively “good” fire seasons, after the also disastrous fire season of 2000. The heavy investments on the fire suppression mechanism in the previous years appeared to have solved the problem. However, as explained below, this was far from true.

1.5 Fire prevention measures in 2007

The difficulty of the 2007 fire season was not hard to predict. It was evident by the end of February and the government tried to respond to it. Unfortunately, although the General Secretariat of Civil Protection produced a very successful daily next-day fire danger prediction map, the fire prevention mechanism of the country that includes among others the local authorities, the Forest Service, the Local Civil Protection officers, etc., proved inadequately prepared to take advantage of it. The efforts and funding spent were clearly not enough to make a difference.

Public preparedness proved to be extremely poor. Television and radio messages were relatively few and poor, and did not manage to alert and sensitize people. It suffices to note that in many cases in Peloponnese, the locals flocked the coffee shops in the villages discussing and watching the 24 hour coverage on TV as the fire burned their neighboring villages, instead of clearing vegetation around their homes before it was the turn of their village to be overrun by the fire.

Also, forest roads and firebreaks that would logically have to be prepared for such a fire season in a timely manner were not properly attended. Funding funneled from the General Secretariat for Civil Protection to the Regions of the country for such tasks, was inadequate and did not get in the proper hands (Forest Service) in time. The local authorities that mostly received such funds did not always act effectively or even properly.

1.6 Response to fires in 2007: Fire suppression

The Greek government, officially realizing the difficulty of the fire season of 2007 increased the number of contracted heavy-lift helicopters. However, this was not followed by efforts to strengthen the ground forces accordingly both in regard to training and preparedness and in terms of the number of seasonal employees. Furthermore, an unusually large number of Fire Corps officers retired in March as a result of the yearly evaluation of the top ranking officers.

During the fire season these shortcomings became evident. Neither the central coordination centre in Athens nor the local commands performed well especially in regard to achieving effective initial attack. Firefighters on the ground often found themselves without guidance or a specific plan to follow. Without these and proper material support their effectiveness was often very poor. Although the media tried to avoid blaming the firefighters, there was a lot of criticism towards the top officers of the Fire Corps for the obvious inadequacies and mistakes that contributed to the disaster.

2. National Cooperation in Responding to the 2007 Fires

2.1 Role / action of agencies at national and provincial level

The national cooperation in responding to the 2007 fires was relatively poor. The long-term problem of fuel build-up, which has been worsening in the last decades as the young people are abandoning the countryside and the Forest Service has been unable to manage forests appropriately – itself deteriorating in personnel, organization, funding, and morale after losing the responsibility for fire suppression to the Fire Corps in 1998 (Xanthopoulos, 2000) – has not been addressed by any means. Even locally, there was no effort of the Forest Service, the Local Authorities and the people to work together in the direction of preparing defensible space around the villages. In the publicity battles played on the mass media there was little room for fire science or the voice of true experts.

The Fire Corps personnel suffered a lot during the fire season. They did put a lot of effort and often stressed themselves to their limits but the result of their efforts was very poor. Their shortcomings in their own organization scheme, training, planning, manning etc., were further compounded by their poor level of cooperation with the other agencies, such as the General Secretariat for Civil Protection, the Forest Service, and even the Armed Forces (except for the Air Force which operates the Canadair water bombers). They also did not do a good job in organizing and supporting local volunteers and incorporating them in their plans.

The Army was mobilized by the government to support the Fire Corps only after the major part of the disaster in Peloponnese had already taken place. As a result its contribution was quite limited.

2.2 Role / action of local communities

The passiveness and even indifference exhibited by many people living in the affected areas were a real surprise to all those closely observing the evolution of the events. It is also difficult to explain. A possible explanation may be that the people were influenced by a sense of total disaster and inability to do anything that was reported by the TV stations. Little if any useful guidance was offered during the critical period of the last days of August. It was only after the first 2-3 days that local Forest Service officers with forest workers and some locals, realizing the breakdown of the suppression mechanism, started to act, clearing parcels of land and burning-out areas to stop the perimeter of fires that was otherwise unattended, and protect communities and properties.

3. International Cooperation

3.1 Receiving assistance

As mentioned earlier, the international help that was received by Greece was substantial. It consisted mostly of aerial resources but ground crews were also sent to help with firefighting operations. The European Union Civil Protection passed the Greek requests for help to the other EU countries. The Greek Prime Minister also communicated directly with the Russian president and secured additional Russian aerial resources to those contracted from the beginning of the season, including, for the first time, a Beriev-200 amphibian water bomber. The resources that arrived and operated in Greece in the last days of August and the first days of September are shown in Table 4.

Greece did not provide assistance to a neighbor country in 2007.

Table 4. A list of the countries that offered help with firefighting and the type of resources they contributed. Source: Official announcement of the Greek Fire Corps.

Country	Aerial Resources		Ground Resources	
	Airplanes	Helicopters	Personnel	Vehicles
France	4		72	
Spain	4			
Italy	1			
Croatia	1			
Turkey	1			
Portugal	1			
Russia	1			
Romania		1		
Serbia	7		55	7
Germany		5		
Switzerland		4		
Netherlands		3		
Austria	3	2		
Norway		1		
Sweden		1		
Slovenia		1		
Cyprus			139	14
Israel			60	
Hungary			19	5
Albania			4	1
Bulgaria			46	5
International Volunteers			7	
Total	23	18	402	32

4. Analysis and Recommendations

There is no question that the fire season of 2007 was a very difficult one in Greece. However, it cannot be considered unique, and it would be very simplistic to attribute the disaster to "extreme conditions due to climate change". For example, the period 1992-1994 was so rainfall-deficient that the water reserves of Athens dropped to such alarming levels that special measures had to be taken to reduce water consumption. Fires were difficult in those years and lives were lost (Xanthopoulos, 2007b) but the burned area remained at about 60,000 ha for each of the three years.

If adverse conditions are not the only one to blame for this disaster one should look for other contributing reasons. In the opinion of this author such reasons are the specific errors described earlier, but also some long term weaknesses of the current fire management scheme:

Firefighting organization (Greek Fire Corps) operational weaknesses:

- Heavy reliance on aerial means support during initial attack, which has led to relative complacency of the ground crews. Unfortunately this approach failed in 2007 due to the quick acceleration of the fire and the lack of timely and adequate aerial support due to the large number of fires.
- Inadequate dispatching and coordination by the central coordination centre in Athens.
- Lack of sophistication in coordinating large scale firefighting operations. Use of maps, fire behavior prediction tools, fuel maps etc., if any, is limited. Without good coordination by well trained and experienced officers, the often heroic efforts of the firefighters are wasted
- Nearly total reliance of ground forces on water for extinguishing the fire. Use of hand tools is limited and there is no provision for use of fire for fire control (backfire, or even burning-out). As a result, effectiveness in areas with few roads (such as in high elevation forests) was very low.
- The huge budget spent for forest firefighting every year is used mainly for contracting helicopters. Very little funds are diverted for other important purposes such as modern training, purchasing personal protection equipment, obtaining additional tools for alternative fire operations (e.g. portable pumps, drip torches, etc.).

Flawed overall fire management organization:

- The Forest Service, after losing forest firefighting responsibility to the Fire Corps in 1998, has practically been excluded from fire management operations. Although, according to the law it is still responsible for fire prevention, its deteriorating status and lack of funding preclude any serious work on this.
- Forest management has nearly been abandoned for the same reasons. The result is increasing biomass in the forest. The abandonment of villages by younger population contributes further to the problem of fuel build-up.
- Forest road condition has been constantly deteriorating due to lack of funding for maintenance.

The problems have been obvious for sometime and have been explained in writing many times (Xanthopoulos, 2000, 2004, 2007c). However, as firefighting is more straightforward and impressive, it has not been possible to this date to convince decision makers about the need for a balanced approach that will involve all players in a system that will maximize their contribution towards an integrated and effective fire management scheme. It can only be hoped that the disaster of 2007 will bring second thoughts, realization of the flaws, and changes in the right direction. Otherwise, if emphasis is given only on increasing the firefighting capacity quantitatively, acquiring or contracting more aerial means and hiring more firefighters, it will not be long before Greece will experience another round of disaster.

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Forest Fires in Bosnia and Herzegovina: Statistics 2003-2007

Forest fire statistics for in Bosnia and Herzegovina for the period from 2003 to 2007 are provided in Tables 1 and 2.

Table 1. Forest fires in the Republic of Serbska

Year	Number of fires	Burned are (ha)	Burned Timber		Damage (CM)
			Number of Seedlings (in Afforestations)	m ³	
2003	476	21,403		243,336	7,288,186
2004	90	630		146	282,253
2005	105	494		712	196,350
2006	84	1,988,050		73	151,540
2007	567	17,952		27,859	2,880,718
Total	1,322	42,467		272,125	10,799,047

Note: CM – Convertible Marks (1CM = 0.5 Euro)

Table 2. Forest fires in the Federation Bosnia and Herzegovina

Year	Number of fires	Burned are (ha)	Burned Timber		Damage (CM)
			Number of Seedlings (in Afforestations)	m ³	
2003	894	36,383	67,442	14,402	45,623,119
2004	145	688	29,300	5,746	1,349,385
2005	195	793	155,970	2,529	1,433,240
2006	220	1,969	105,519	233	1,722,084
2007	932	13,742	326,440	40,017	9,574,263
Total	2,386	53,575	684,671	62,927	59,702,091

Note: CM – Convertible Marks (1CM = 0.5 Euro)

One of the biggest current and future forest fire problems in Bosnia and Herzegovina are unexploded ordnance (UXO), remnants from the civil war. The total forested territory contaminated by UXO in the country is ca. 220,000 ha. In the Federation Bosnia and Herzegovina alone the area of UXO-contaminated forests is estimated about 127,129 ha, equivalent to 9.9% of the total forest land. Furthermore there are spots in the country that are contaminated by radioactivity resulting from the use of uranium-depleted ammunition by NATO.



Figures 1 and 2. Sites contaminated by UXO and not yet cleared in Bosnia and Herzegovina are marked with warning signs.

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Forest Fires in Bulgaria 2007

The forest lands in Bulgaria comprise of 4,089,762 hectares (ha) and occupy 37% of the territory of the country. 3,691,868 ha (89 %) of those are classified as wooded lands.

During the last seven years more than 100,000 ha of forests were affected by wildfires. 2007 was the second worst year in the history of the Bulgarian forests with 1,479 forest fires and 43,000 ha burned after the devastating fire season of 2000 (1,710 forest fires and 57,406 ha burned).

The peak of situation was in the period 19 to 30 July 2007. In that time the weekly averages of FWI for Bulgaria was the highest in Europe. Disaster situation was declared in 11 municipalities on the territory of five regions (Stara Zagora – 4, Lovech – 3, Haskovo – 2, Smolian 1, Pazardjik –1).

In year 2007 were clearly delineated typical for our country two peaks for the number of the fires. The first of them was in March and the second during July and August.

The main reasons for the forest fires during 2007 are as follows:

- Carelessness – 78%
- Deliberate or Arson – 5%
- Natural – 1%
- Unknown – 16%

The immediate loses for Bulgarian forests in 2007 are calculated on the amount of 5 million Euro (not including the budget for the restoration of the burned areas.

During the fire disaster 51 houses were burned, 21 families were evacuated, three persons died, 14 were affected, 6 of them were firefighters.

In the end of July 2007 Bulgaria requested assistance through:

- The EU Civil Protection Mechanisms / Monitoring and Information Center (MIC) – as a Member State
- NATO Euro-Atlantic Disaster Response Coordination Centre (EADRCC) – as a Member State
- Russia – on the basis of a bilateral agreement

We received 3 proposals from:

EU – Offer from a private company
 NATO – Assistance from the Republic of Turkey
 Russia – Aircraft with crew

In the first days of August a firefighting aircraft Il-76 was sent from Russia to Bulgaria and operated in Stara Zagora and Haskovo regions.

During the summer of 2007 Greece requested assistance through the EU Civil Protection Mechanism and by neighbor countries. In September 2007 Bulgaria deployed five fire trucks with 49 fire fighters to Greece.

Table 1. Forest fire statistics for Bulgaria for the period 1998-2007

Year	Total number of fires	Total burnt area (ha)	Burnt forest lands (ha)	Caused by human activities (number)	Natural causes (number)	Unknown causes (number)
1998	578	6,967	6,060	147	6	425
1999	320	8,291	4,198	84	9	227
2000	1,710	57,406	37,431	385	18	1,307
2001	825	20,152	18,463	187	19	619
2002	402	6,513	5,910	150	7	245
2003	452	5,000	4,284	281	9	162
2004	294	1,137	881	172	5	117
2005	241	1,456	1,456	125	7	109
2006	393	3,540	3,540	190	9	194
2007	1479	42,999	42,999	1163	18	298
Mean	669	15,346	12,522	288	11	370



Figures 1-3. Wildfire prevention and preparedness measures in Bulgaria include green fuel breaks in reforestation areas (left) and fire hazard (fuel) surveys in the different forest types. Photos: GFMC:

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Editorial Note

Readers are encouraged to download the report about the "Eastern European, Near East and Central Asian States Exercise on Wildland Fire Information and Resources Exchange 2005" (EASTEX FIRE 2005), which was hosted by Bulgaria, 20-22 April 2005 (IFFN No. 33, 6-9; online: http://www.fire.uni-freiburg.de/iffn/iffn_33/03-IFFN-33-EASTEX-FIRE-2005-Report.pdf)

Forest Fires in Croatia 2007

The 2007 Fire Season in Comparison to the last Decade

During the past decade Croatia experienced a number of extreme fire years, notably in 1998, 2000 and 2003 with record burned areas of more than 100,000 ha of all types of wildlands (high forest, other forested lands, agricultural lands, other wildlands) affected by fire. The preliminary data of 2007 reveal that the total burned area was less (Table 1). However, the fire season in Croatia in 2007 was extraordinarily severe. The Fire Weather Index (FWI) was high or very high on 92% of the days in the period between 20 June and 20 September 2007. Between 20 July and 5 August a minimum of 45 fires occurred per day simultaneously, with a maximum of 85 fires on 29 July.

In neighboring Bosnia and Herzegovina the situation was also severe and resulted in 33 wildfires passing the borderline near the towns of Vrgorac, Metković and in the Dubrovnik-Cavtat Region.

On 30 August 2007 an extremely intense wildfire overrun a crew of firefighters on Kornati Islands resulting in 12 fatalities and one severely injured. At the time of writing this report the detailed circumstances that lead to this tragic disaster are not yet known.

Table 1 shows the causes of the fires during the last decade. The data of 2007 will be completed in the 2008 report (see following contribution in this issue of IFFN).

The economic fire damages are shown in Table 2. The data of 2007 are preliminary. More details will be given in the 2008 report (see following contribution in this issue of IFFN).

Fire Prevention and Preparedness Measures

After a warm winter season with abundant vegetation growth and high fire hazard in all vegetation types it was anticipated that the fire season 2007 would become severe. After late winter / spring fires an extremely hot summer made public awareness raising necessary, especially during the summer.

At the same time the numbers of operational forces were increased from 5,000 firemen to 6,200 firemen, including reinforcements by special police forces; the Army was prepared to intervene. The Government of the Republic of Croatia increased the average annual fire fighting budget of € 2 Million by additional € 1 Million.

Fire Response in 2007

With more than 3,600 operational firemen activated (including the reinforcements of 2400 Army and Police forces distributed in 45 locations in the Mediterranean areas of Croatia and 250-350 firemen on stand-by in the continental units, the following aerial firefighting assets were activated:

- 4 CL-415
- 1 AT 805F
- 4 to 6 helicopters (Mi-8)

Special emphasis was given to inter-agency cooperation between local fire service units, local and regional Government and the National Protection and Rescue Directorate, Ministry of Interior, Ministry of Defense and the Croatian Forest Service. Local communities were involved in providing logistical support for dislocated fire units, surveillance and patrolling.

International cooperation

Receiving assistance

- No assistance was requested and received in by Croatia 2007

Providing assistance

- Bosnia and Herzegovina 12 September 2007 2 CL 415 and 34 firemen/8 vehicles
- FYR Macedonia 24-26 July 2007 1 CL 415
- Greece 29 August - 3 September 2007 1 CL 415

Analysis and recommendations

- The warm winter did not stop vegetation growth, resulting in high fuel loads and in a large number of fires during last winter/spring season.
- The numbers of fires in summer 2007 were similar to the average number of fires during the summers from 1998 to 2006, but the burned area was 26% higher

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Croatia

Table 1. Causes of wildfires in Croatia 1997-2007: Number of wildfires, area burned and damages.

Year	No. of Fires	Deliberate or Arson	Accidental or Negligence	Other and Unknown
1997	3.775	115	2697	963
1998	5.408	83	3892	1433
1999	3.832	142	2816	874
2000	7.797	123	6654	1020
2001	4.024	63	2859	1102
2002	4.692	56	3364	1272
2003	6.924	93	4723	2108
2004	2.855	41	1886	928
2005	3.368	35	2328	1005
2006	3.574	217	2596	761
2007	5.206	n/a	n/a	n/a

Table 2. Landscape fires in Croatia 1997-2007: Number of wildfires, area burned and damages.

Year	Total			Agriculture			Forest Lands			Forests			Other Wildlands		
	No. of Fires	Area (ha)	Damage (€)	No. of Fires	Area (ha)	Damage (€)	No. of Fires	Area (ha)	Damage (€)	No. of Fires	Area (ha)	Damage (€)	No. of Fires	Area (ha)	Damage (€)
1997	3.775	42.10	n/a	1,305	11.376	3,763,288	1,084	13,526	74,219,041	683	6,819	72,503,562	1,386	3,675	N/a
1998	5.408	123.63	n/a	2,561	52.695	13,736,301	1,181	29,131	35,644,110	711	17,691	26,471,781	1,666	12,676	19,470,274
1999	3.832	20.03	19,518,356	1,363	7.276	3,443,014	846	4,225	5,522,329	386	1,659	3,467,671	1,623	4,304	5,030,685
2000	7.797	176.13	n/a	3,119	42.357	27,986,986	1,620	46,255	n/a	730	27,407	91,391,096	3,058	41,271	n/a
2001	4.024	38.04	74,382,055	1,360	7.046	3,084,247	856	10,790	18,046,301	358	1,818	2,767,671	1,808	9,415	35,205,205
2002	4.692	85.44	34,249,589	2,383	61.846	11,009,041	843	10,499	8,050,959	329	5,997	6,627,534	1,466	2,600	7,138,630
2003	6.924	104.95	n/a	2,345	36.961	7,193,973	2,160	29,212	n/a	560	13,305	n/a	2,419	9,567	74,689,863
2004	2.855	12.22	14,027,671	772	3.016	1,727,808	760	3,237	4,789,863	198	1,466	3,106,438	1,323	2,735	2,720,137
2005	3.368	27.07	12,883,836	1,082	13.321	3,011,507	936	5,653	3,791,781	185	1,044	2,540,548	1,350	2,449	2,288,767
2006	3.574	24.71	15,163,836	1,114	10.862	2,382,466	887	5,930	3,476,438	250	1,694	1,365,068	1,573	1,993	5,828,493
2007	5.206	67.68	n/a							565	19,110				

Forest Fires in Croatia 2008

Following the 2007 of forest fires in Croatia the 2008 reports provides the consolidated (final) statistical data for 2007 and 2008.

1. Extent: Number, Area and Types of Forests and Other Vegetation affected by Fire

Table 1. Fire in forests and other wooded lands

Year	Ownership	Number of fire	Area (ha)		Causes										
			High forest	Other forest land	Human disregard	Electric lines	Traffic	Forest activities	Agricultural activities	Mines	Lightning	Arson	Self combustion	Other	Unknown
2007	State	293	1,858	11,979	13	5	5	2	42	-	7	23	2	8	186
	Private	38	1,990	3,385	4	1	-	-	-	-	-	-	-	-	33
	Total	331	3,848	15,364	17	6	5	2	42	-	7	23	2	8	219
2008	State	228	1,352	5,336	15	6	8	3	23	2	6	6	-	4	155
	Private	56	276	300	10	1	-	1	7	-	-	-	-	-	37
	Total	284	1,628	5,636	25	7	8	4	30	2	6	6	-	4	192

Source: Ministry of Regional Development, Forestry and Water Management

Table 2. Fire in agricultural lands

Year	Area (ha)	Number of Fires	Damage (€)
2007	37,603	2,213	8,265,321
2008	29,189	1,691	7,209,352

Source: Ministry of Interior

Table 3. Fires in other open areas

Year	Area (ha)	Number of fire	Damage (€)
2007	5552	1483	2,369,769
2008	3002	1214	3,881,509

Source: Ministry of Interior

Description of Selected Extreme Fires in 2008

Between June and October 2008 there were 2,673 fires with highest number of 815 fires in August. During August 7,325 firemen and 2,143 vehicles were involved in fire suppression. The total duration of interventions was 3,159 hours.

Forest fires by size in the period June to October 2008:

< 5 ha	81.30%
5-10 ha	4.34%
10-100 ha	5.25%
>100 ha	0.47%

The occurrence of the largest forest fires (10-100 ha) was in September.

Forest fires 2008 by active suppression time:

< 4 hours	88.72%
4-12 hours	5.98%
> 12 hours	4.39%

The fire danger index in the country between June and October 2008 is provided in Figures 1 and 2.

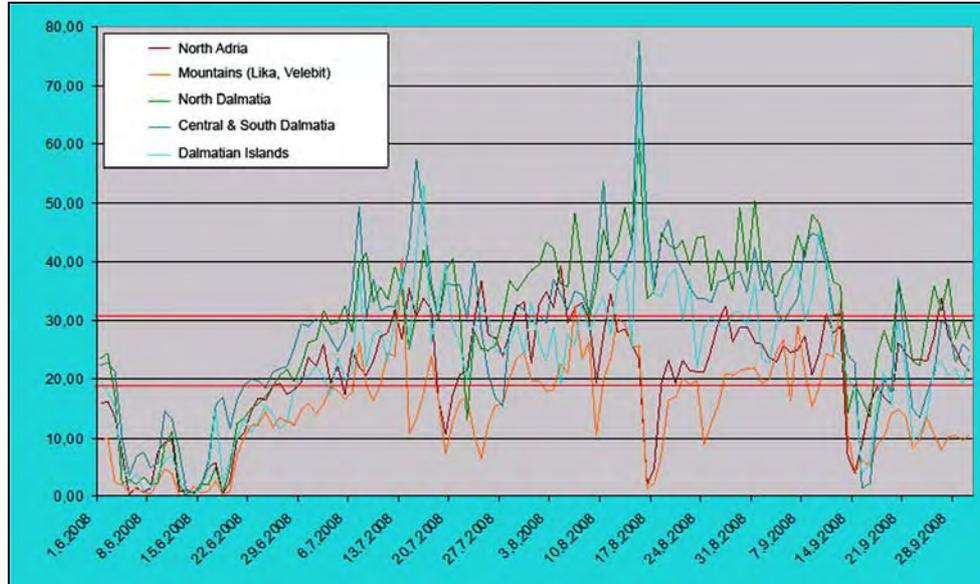


Figure 1. Fire danger index in coastal regions of Croatia during the period June to October 2008

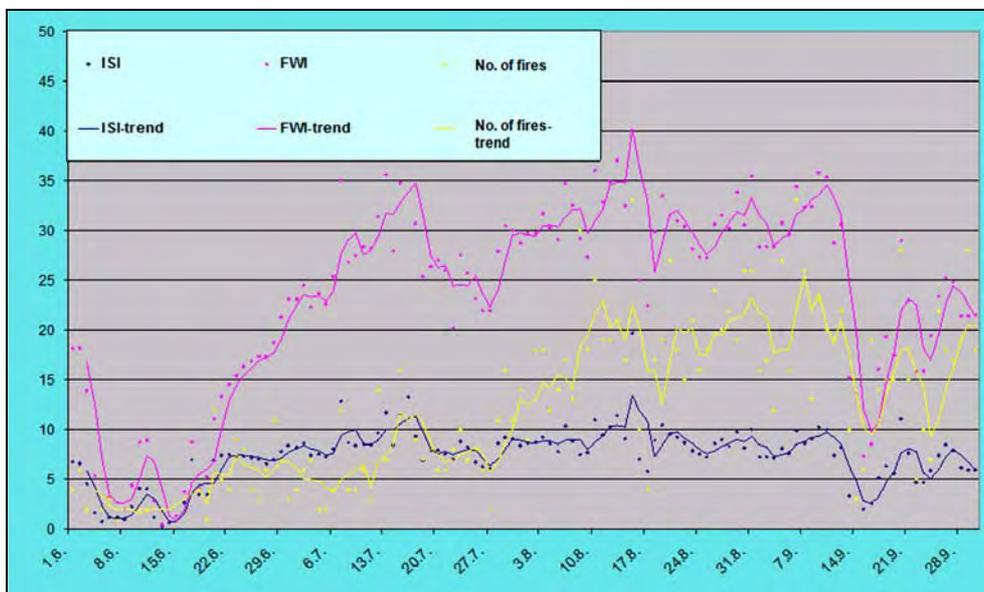


Figure 2. Forest fires number and fire danger index during the period June to October 2008

2. Fire Damages in 2008

Forest and forest lands	-	37.0 m €
Agricultural lands	-	7.2 m €
Other open space	-	3.9 m €

3. Fire Preparedness and Response in 2008

- The Government of the Republic of Croatia released / reserved 2.5 m € for suppression
- 6,000 firemen in total (3,600 operative firemen, 2,400 voluntary firemen, army, police forces distributed on 45 locations)
- 250-350 firemen in pre-alert in continental part of the country
- 4 CL-415
- 1 AT 805F
- 5 AT 705FF
- 4-6 helicopters (Mi-8)

4. National Cooperation in Responding to the 2008 Fires

Role / action of agencies at national and provincial level

- Cooperation of local fire service units, interventional fire units, local Government (local / regional / county level)
- Cooperation of National Protection and Rescue Directorate, Ministry of Interior, Ministry of Defense, Croatian Forest

Role / action of local communities

- Logistical support for dislocated fire units
- Surveillance and patrolling of wildlands

5. International Cooperation

Receiving assistance

There was no request for receiving assistance 2008.

Providing assistance

Assistance was provided to Bosnia and Herzegovina on 9 September 2008 by 2 CL-415, 15 firemen and 7 vehicles.

6. Analysis and Recommendations

In 2008 the number of forest fires was 17.8% higher as compared to 2007 but the size of areas burned were 64.17% less. Preventive measures and public awareness rising should be more focused in future.

Sources

Data were provided by the Ministry of Regional Development, Forestry and Water Management, the National Protection and Rescue Directorate and the Ministry of Interior

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Mine Fields and UXO Contamination in Croatia: Summary for 2008

On 31 December 2008, the overall mine suspected area of the Republic of Croatia totaled 954.5 km² (including 4.7 km² of areas contaminated with cluster ammunition of KB-1 and MK-1 type that is not classified as mine suspected area according to the valid regulations and standards), extended through 111 towns and municipalities and was marked with 14,986 mine warning signs (Fig. 1)



Figure 1. Mine suspected areas in Croatia

Mine search and demining operations in 2008 resulted in releasing the area of 33,109,979 m² out of which 20,883,364 m² through mine search and 12,226,615 m² through demining (Fig. 2).

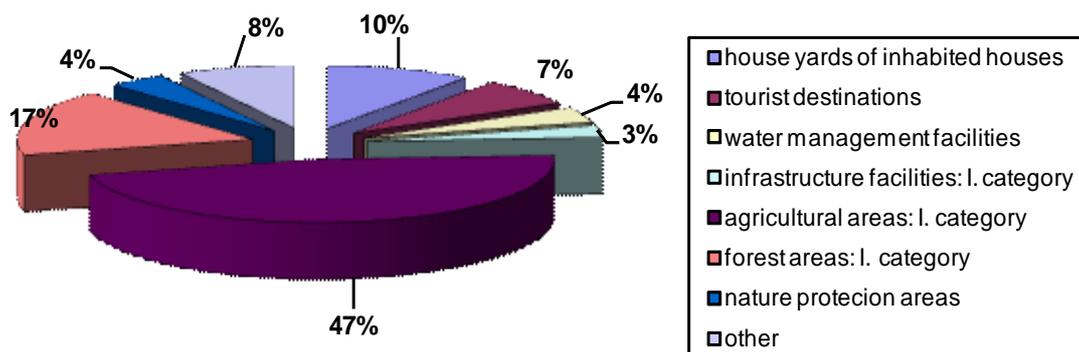


Figure 2. Structure of searched and cleared mined areas

Parallel to the operations of mine search and demining of mine suspected areas performed by accredited legal entities and non-governmental organization "Norwegian People's Aid", survey teams of the Croatian Mine Action Centre performed in 2008 the revision of general survey of the entire mine suspected area in the Republic of Croatia. On 1 October 2008, the revision of the entire mine suspected area was finished. By applying criteria determined by Standard Operating Procedures (SOP 01.01.) mine suspected area was reduced for 9.4 km². These activities resulted in reduction of mine suspected area of the Republic of Croatia in 2008 in the size of 42.5 km². Average weekly realization amounted to 662,200 m². There were 1,805 pieces of antipersonnel mines, 2,617 pieces of antitank mines and 3,402 pieces of unexploded ordinances found and destroyed.

Quality assurance over completed mine search and demining operations in 2008 was conducted by 12 Quality Control Officers and 23 Quality Assurance Monitors performing the control sample search. There was the total of 338 quality controls over completed mine search and demining operations performed on 3,778 control samples totaling 587,939 m² equal to 1.68% of the total searched and demined area. Also, there was the total of 918 quality assurances during the execution of mine search and demining operations performed.

Financial resources for mine search and demining operations, in total 43.5 m € have been contributed from State Budget, donations and IBRD loan. Average price of all mine search and demining operations contracted in 2008 was 1.06 €/m² + VAT, what represents a decrease of 8.1% in relation to 2007. The reason for the price decrease is projecting bigger projects on agricultural areas where demining machines can be used intensively.

In 2008, there were 6 mine incidents registered involving 7 persons (Fig. 3). During 2008, there were incidents registered involving 3 deminers of commercial companies. Two persons were killed out of which one deminer while 4 persons suffered major bodily injuries.

Relevant state administration authorities were involved in solving the problems of mine victims relating to medical rehabilitation. Other forms of assistance were conducted mostly by nongovernmental sector and financing was ensured by different donations of the international or domestic subjects. In 2008, there were different one-time projects of financial support and education (scholarships, legal and psycho-social and medical support, orthopedic aids) realized with the purpose of mine victim assistance. There were also summer and winter workshops organized for children and young people mine victims.

Mine victims are entitled to health care and acquisition of orthopedic aids to the amount covered by the Croatian Health Insurance Institute. However, there are certain problems detected in the programs of psycho-social rehabilitation of victims and their employment.

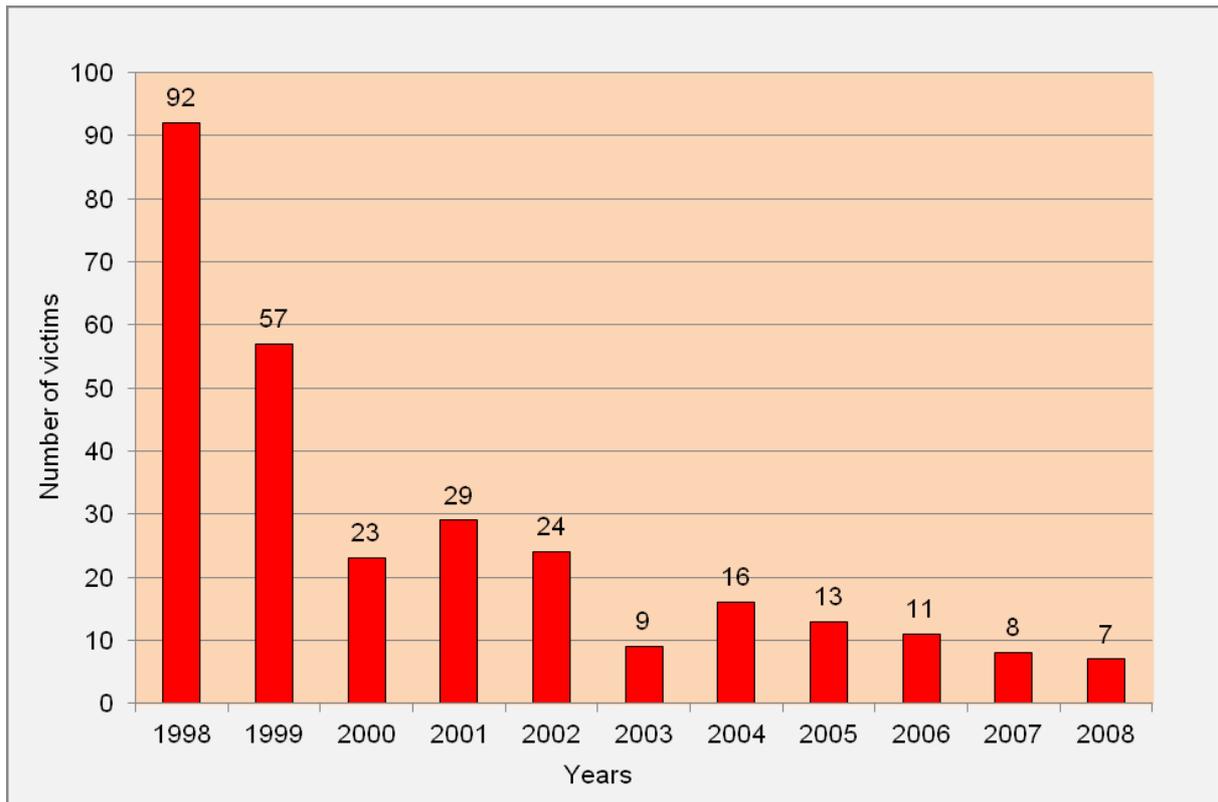


Figure 3. Number of mine victims in Croatia (1998-2008)

In 2008, the emphasis was put on presentation of Croatian experience in mine action within the international mine action community and diplomatic posts in the Republic of Croatia. Establishment of the cluster that integrates experience and capacities of the Croatian Mine Action Centre, CROMAC-CTDT, commercial demining companies and equipment manufacturers resulted in realization of an initiative of the Croatian Mine Action Centre, Ministry of Foreign Affairs and European Integration and Trade and Investment Promotion Agency. Uniting all demining subjects in the Republic of Croatia opened the door to exporting the Croatian know-how and technologies to foreign markets i.e. countries facing the mine problem. First results became evident through expressing interest by Turkey, Yemen, Georgia and Egypt in strengthening of co-operation.

The position of mine warning signs is one of the basic elements of mine information system presented on mine-contamination maps (<https://misportal.hcr.hr>) submitted to state administration bodies, local and regional self-administration, police administrations and other natural and legal entities upon request.

Pursuant to the official data, there are still a lot of forest areas which are contaminated with land mines and unexploded ordinances.

Because of that a great forest areas are not covered with management activities and their degradation process is still going on. Also, in context of forest fires, in contaminated areas of high fire danger, because of the lack of preventive measures in these areas, forest fires are very frequent. The biggest problem on these areas is forest fires suppression. It is made only with the air forces. As suppression on contaminated areas is not very effective without use of ground forces, in "fire years" Croatia has very, very big burnt areas. Fires are also damaging mines (a few of them are activated by fire) what is very dangerous for demining operators.

Table 1. State-owned forest areas contaminated with mine fields and UXO

Regional Forest Office	Mine Field Area (MFA) (ha)	Timber volume on MFA (m ³)	10 year felling on MFA (m ³)	Forest roads (km)	Total forest/forest land area (ha)	Mine field areas (%)
Koprivnica	0	0	0	0.00	135,718	0.00%
Buzet						
Vinkovci	6,178.67	873,907	162,711	0.00	72,344	8.54%
Osijek	11,908.38	1,437,674	516,980	0.00	77,159	15.43%
Našice	3,556.52	940,545	101,410	0,00	82,997	4.29%
Požega	461.65	71,793	2,412	0.00	51,450	0.90%
Bjelovar	2,792.01	641,384	32,444	0.00	131,664	2.12%
Zagreb	94.41	24,714	2,560	0.30	81,154	0.12%
Sisak	10,265.94	1,917,816	245,534	0.00	87,935	11.67%
Karlovac	2,379.41	428,779	13,289	0.00	82,883	2.87%
Ogulin	5,721.82	1,588,386	245,427	29.10	60,580	9.45%
Delnice	55.22	22,290	3,440	0.00	96,293	0.06%
Senj	65.52	18,627	--	0.00	109,659	0.06%
Gospić	36,351.62	6,664,546	965,666	11.10	315,141	11.54%
Split	50,982.27	312,203	--	0.00	559,974	9.10%
Nova Gradiška	10,341.00	3,339,486	410,280	48.20	74,036	13.97%
Total	141,154.44	18,282,150	2,702,153	88.70	2,018,987	6.99%

To help solving problems with contaminated forest areas and protect naturally regenerated forest areas, Croatian Forests Ltd., as the enterprise which is managing 2.7 million ha of state-owned forest, are contributing annually with 5-7 m €

Sources

- (1) Croatian Mine Action Center (www.hcr.hr)
- (2) Ministry of Regional Development, Forestry and Water Management

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Republic of Albania – Fire Report 2007

1. Introduction

Albania, with a small territory of 28,750 km², is one of the European countries with rich vegetation, which originated during the Tertiary era. Today's vegetation of Albania is composed of endemic relic vegetation and of species that have invaded from neighboring regions through migration, having phylogenetic similarities with floristic elements of neighboring countries. Albania is a mountainous country with higher topographic and climatic variety than the other European countries: 52% of its surface is on elevation between 600 and 700 m above sea level with prevailing steep slopes (ca.30%). Thus, ca.90 % of its surface is subject to severe erosion. The northern, north-eastern, south-eastern and central areas are characterized by hilly-mountainous terrain; whereas the north-southern/coastal area along the Adriatic and Ionian coast is lowland.

Climate extremes range from extreme cold winters in the northern, north-eastern and south-eastern areas to very hot and dry summer along the coast. Rainfall regimes vary from north to south and from coast to inland. There are fewer rainy days in the south than in the north, but months without rainfall can occur at any time of the year, as it is typical for the Mediterranean climate. Local precipitation differences lead to diverse vegetation patterns. Forests occupy 1.025 million ha, with a standing volume of about 82 million m³ and an average annual growth of 1.4 m³ per ha (this is very low compared with many country of Central Europe). The management regime of the forest areas is as follows:

- 460,950 ha are high forest (46% of the total forest area) consisting of 171,850 ha coniferous and 289,370 ha broadleaved species
- 332,250 ha coppice forests (29% – mainly oaks)
- 257,850 ha shrub lands (25%)

Taking into account the functions of the forest areas, 193,000 ha perform a protective function while the rest (836,650 ha) are productive forests.

The reforms in the forest sector have been very rapid and with big changes regarding the ownership of the forests and pasture lands. During the transition period, 60 % of the forests area and more than 70 % of the pasture areas have been transferred to the property of local governments and local communities. This rapid change has caused a lot of problems that have to do with the lack of capacity and resources of the local governments in fire management. Furthermore, the lack of experience in forest fire suppression is noted during the fire season.

Fire Impacts

The negative fire impacts are very large in the conifer forests and less in coppice and shrubs. The main negative impacts are the erosion after the fire occurrence in the area burned, the destruction of the regeneration cover, the influence in land structure and water regime circle. Farther more there are impacts on diminution of the forest productivity. With all the characteristics mentioned above the forest ecosystems in Albania are very sensitive from the fire. Only in the coastal forest protection belt, surface fires in pine stands have the role of maintenance and as a measure of controlling the fire propagation. In the sites affected by fire especially in the natural pine forests in the North of the country in the districts of Puke, Kukesi, Mirdita we can see that the vegetation cover after the fire is very different from the pre-fire vegetation.

In the southern part of the country, traditionally for centuries, the fire is used as a tool of cleaning and regeneration of pastures. In these sites the long use of fire has resulted in significant changes of the ecosystems. One of the main impacts is the favoring of the establishment of annual grasses and the disappearance of biennial and perennial plants.



Figure 1. A fire near Tuç, Puka District, severely burned natural pine forest (*Pinus nigra*) The fires started on 19 July 2007 and was suppressed 5 days later on 24 July 2007 after burning area 27 ha (Photo: G. Hoxhaj).



Figures 2 and 3. During the extremely dry summer of 2007 wildfires affected all types of forests, e.g. the pine (*Pinus nigra*) forest Qafa e Barit, Puka District, or the beech (*Fagus sylvatica*) forest in Malesi e Madhe District (Photos: G. Hoxhaj).

It was noted that the regeneration of the shrubs is very fast after the fires, depending of the severity and the intensity of the fires in these sites. One of the main problems arising from severe fires in these sites is the erosion and the water regime in the first years.

Considerable damages were observed in the fauna, and change of behavior of animals and birds. Altogether it is underlined that the fire impacts in the Albanian forest are predominantly negative in all ecosystems and land-use systems.

2. Assessment of Fire Situation in the Country

Extent: Number, area and types of forests and other vegetation affected by fire

The year 2007 has been the most severe year regarding the number of fires and area affected by forest fires in Albania. A national emergency situation was declared and the government created an inter-ministerial committee "Central Unit for Civil Emergencies" (CUCE), led by the vice-prime minister. The committee brought together all the state agencies that are responsible for the disaster management including forest fires. A national coordination centre was established at the operational centre of General Staff of the Armed Forces. This centre coordinated all the human and logistic resources all over the country.

During this very difficult period firefighting resources from the Ministry of Defense, Ministry of Interior, Ministry of Environment, Forest and Water Administration (Forest Service), Prefectures, and Local Government were coordinated. To be ready for a rapid intervention, more than 200 soldiers from the Army were dispatched to four regions, nearby the most important forest areas, two in the north two in the south. This has helped a lot during the days of severe fires.

The firefighting operations were mainly lead by forest service specialists. Effective use of the resources was noted in many cases. However, there were also cases of lack of coordination and control of the situation. Local governments and local communities in general have been very passive.

The Ministry of Interior, responsible for the management of civil emergencies, requested assistance through the Monitoring and Information Center (MIC) of the European Commission and other international organizations (e.g., NATO) for aerial support and other means.

Some brief evaluation of the resources received from other countries:

- Ukraine supported Albania with a fixed-wing firefighter aircraft type Antonov 32 (AN-32). Evaluation: very expensive and inefficient due to performance characteristics.
- Aerial support from Italy with 2 Canadair water bombers provided professional and very successful operations. This aerial support from Italy was received under a bilateral government agreement on civil emergencies cooperation.
- The German government, following a request of the Albanian Government, provided two light helicopters. Their helibucket capacity was 500 l of water. The helicopters operated in the northern part of the country in firefighting operation near the Drini River and in the area surrounding Tirana. To facilitate their flights the crew was accompanied by an Albanian pilot from the Albanian Air Force. According to our evaluation the operations were not very effective due to the need to refuel in the centralized fuel depot in Tirana as well as the low carrying capacity of water.

Table 1. Wildfire statistics for Albania 1997-2007

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land	Total Area Burned on forest, Other Wooded Land, & Other Land (ha)	Area of Forest Burned (ha)	Thereof area of "Forest 1" (ha)	Thereof area of "Forest 2" (ha)	Thereof area of Open Steppe / Grassland and Pastures (ha)	Thereof area of "Peat Swamp / Wetlands" (ha)	Human Causes (% of No.)	Natural Causes (% of No.)	Unknown Causes (% of No.)
1997	735	1847								
1998	601	680								
1999	628	689								
2000	915	3675								
2001	327	1434	941		941	493	100			55
2002	140	690	650		650	40	99	1		63
2003	771	6359	4419		4419	1948	95	5		57
2004	143	1473	491		491	982	100	0		40
2005	174	3241	300		300	1740	100			61
2006	176	1081	108		108	303	98	2		60
2007	1190	12120	5857		5857	6263	97	3		71
Average	580	3329	1824		1824	1681	98.5			53.7

Causes of wildfires, reasons or underlying causes of human-ignited fires

The year 2007 was the most problematic and severe year so far concerning the occurrence of an extremely large number and area affected by forest and pasture fires in Albania. The total surface affected by fires according to the forest police data is around 40,000 ha. The causes of fires in 2007, recorded by the forest police, were:

- Intentionally set fires: 218
- Fires caused by negligence: 128
- Unknown causes: 843

In 180 cases, the forest service has sent a request for penal responsibility to the prosecution office. Around 40 persons have been accused for intentional damage of property by fire. Until now no one is detained in prison.

Description of selected extreme fires in 2007

During the 2007 fire season every day in all over the country we have had around 40-50 cases of wildfires. Some of the fires were put out after 3 or 5 days. The most affected areas were in the regions of Puke, Mirdita, Dibra and Kukes. In the Dibra district the most affected area was the National Park of Lura. The fires in this region lasted at least 15 days. There have been severe fires due to the composition of the forest, topography, high temperatures, long draught, and lack of human resources to intervene by fire extinction. In this region the most important problem was the consequence of the rural exodus – the lack of human resources because the area is abandoned by people. The causes of fires in these regions were also exclusively by humans, some intentionally set fires, some caused by negligence. Due to the characteristics of the area it was very difficult to find the violators.

Fire damages in 2007

The most important factor that has created the fire emergency situation during 2007 was the long drought period, accompanied by a large number of ignitions. The other reason that had had a strong impact on the situation was the above-mentioned abandonment of the rural areas from the population. This trend of rural depopulation is resulting in:

- Lack of human resources to be involved on fire suppression operations
- Accumulation of vegetation (succession; fuel accumulation) in the forests and pastures as a result of abandoning the traditional, intensive use of territory.

Another problem was the use of fire as traditional tool for land management like burning of agricultural wastes after harvesting the crops and the burning of winter pastures. Although it is recognized that fire is an essential tool for agriculture and pastoralism it is observed nowadays that the lack of skill and awareness of fire danger during droughts, as well as insufficient people to collaborate in safe burning are resulting in escaped, uncontrolled fires.

In some areas where the level of poverty is high we noted that fires had been set by purpose in order to be employed in fire suppression operations. In some areas fires have been set as a result of conflict of ownership or over the use of the territory. In the region of Puka some fires have been set as a reaction to the decision of the Forest Administration to sell the timber to private companies. The bigger damages have been caused by wildfires in 30 years-old pine afforestations.

During 2007 the political situation has been calm. The local government and the local community have played a very important role during this situation. There have been causes of good and bad examples – but unfortunately more bad examples, e.g. because of negligent performance of the head of the commune and the indifferent attitude of the local people to help in fire operation. It has also been noted that the operations of voluntary units in communes and villages failed due to the low motivation, insufficient organization and unclear responsibility of the structures. The fire observation and information system of the Forest Service has been weakened as a consequence of low availability of observers and lack of communication equipment.

There is an overall lack of infrastructures, logistics and capacities for fire management. There are few trained people only, and they are insufficiently equipped. The coordination between the state agencies, which had failed at the beginning of the season, was improved very much during the functioning of the Central Unit for Civil Emergencies.

Fire prevention measures in 2007

To prevent the forest wildfire the Ministry of Environment, Forest and Water Administration (MEFWA) and its dependent structures from top down have performed the below listed actions:

- Since the beginning of the year 2007 the MEFWA has developed the yearly National Plan for Forest and Pasture Fire Management (NPFPFM). A coordination unit has been established at MEFWA.
- On 2 June 2007 a national workshop was organized in Shkodra city with representatives of all stakeholders of state agencies and non-government organizations to discuss the improvement of the coordination of the actions to prevent and suppress forest fires.
- Based on its legal mandate MEFWA issued an edict, which places obligation on all state agencies at regional level and all local government units to take prevention measures for prevention and suppression of forest fires.
- Following the rules set by the NPFPFM all Forest Service Directorates (FSD) in districts developed own fire management plans at local level.
- Voluntary units for forest fire suppression operations in every village have been organized by the Forest Service.
- In the National Forest Parks and Protected Areas a supplementary observation system was established during weekends.
- A TV advertisement spot was broadcasted to inform the public about the damages caused by forest fires. The spot was transmitted in several national and local TV channels. Some leaflets and information mails were distributed to local communities.
- The MEFWA invited local population to be very cautious using fire during the day and to actively participate in fire suppression operations.
- The mobile telephone companies were encouraged to distribute attention messages to their entire clients concerning the fire danger.

Response to fires in 2007: Fire suppression

During the fire season all the personnel of the forest police – on average about 1000 staff every day – and all logistic capacities have been involved in prevention and suppression of forest fires. Around 60 transportation trucks and six light trucks have been involved in fire operations. In some districts caterpillars and water tenders were hired to suppress fires.

3. National Cooperation in Responding to the 2007 Fires

Role / action of agencies at national and provincial level

The roles of government agencies that are involved in the forest fire management are:

National level:

- The Ministry of Environment, Forest and Water Administration (MEFWA): Prevention, suppression and post-fire rehabilitation. MEFWA played the lead role on the management of the forest fire situation in 2007. Following the initiative and request of MEFWA the Central Unit for Civil Emergencies was set up. The ministry has managed the human and material resources of the Forest Service to meet the needs and limitations of the fire situations.
- Ministry of Interior: Prevention and suppression. The Directorate of Civil Emergency and the General Directorate of Fire Protection and Rescue have been very important actors in the coordination of resources on the large fires.

- Ministry of Defense: Suppression. The ministry served as a facility centre for the Central Unit for Civil Emergencies and as a resource for human forces ready to intervene on forest service request.
- Ministry of Agriculture: Prevention.

Regional level:

- Prefectures of the regions: Coordination of all state agencies resources on regional level.
- Forest Service Directorate (FSD): Prevention, suppression and rehabilitation. The FSD has managed the human and material resources of the Forest Service according to the needs and limitations of the situation.
- Fire Fighting Units (FFU): Suppression. The FFU has helped the forest service to suppress forest fires in the cases where the access to the fire theatre by fire trucks was possible.
- Army units: Suppression. The Army forces have helped with human support on the most dangerous and critical situations.
- Local Government (LG): Prevention, suppression and rehabilitation. LG helped the Forest Service to organize the local community to support fire suppression.

Role / action of local communities

The Local Communities (LC) have a very important role on the fire management. Based on the fact the all forest fires have been caused by humans, the involvement of LC was considered as a key issue for the success of fire suppression operations. Several LC provided valuable support in the fire suppression operations, especially in the southern part of the country where their involvement prevented the spread of the fires. In most of the cases, however, the LC have been very passive and they have asked for financial support to be involved on fire suppression operations. The experience in the 2007 fire season revealed that there are fundamental limitations regarding the LC involvement in fire management. There is a lack of responsibility for LC for fire prevention, lack of experience, and logistic support. There is no coordination with other structures / agencies. An aggravating factor was that even private forest / land owners had been very passive during the fire season, even on their own property.

4. International Cooperation – Receiving and Providing Assistance

During the 2007 fire season Albania cooperated with several countries through direct agreements or through international organizations. The Directorate of Civil Emergencies (DCE) in the Ministry of Interior is responsible for this cooperation and coordination.

During the critical fire situations DCE has asked for help from Greece, Italy and the Monitoring and Information Center (MIC) of the European Commission and the North Atlantic Treaty Organization (NATO).

The first aerial support was provided by Ukraine, with an AN-32. This operation was rather expensive and inefficient. The payment for the operations was covered by the Albanian Government and the embassy of the United States of America to Albania.

Aerial support was provided by Italy with two Canadair airplanes. These airplanes have been very successful in fire suppression operations. The aerial support from Italy was a result of a bilateral government agreement on civil emergencies cooperation. The request for assistance was made from the Directorate of Civil Emergencies to the Italian counterpart. The response of the Italians was based on their domestic emergencies and available resources for out-of-area missions. The Albanian part secured the full accommodation of the cabin crews of the planes and refueling of the aircraft during the operations and for the return to Italy.



Figure 4. In August 2007 two CL-415 from Italy supported the firefighters in Puka District. The aerial photo shows a waterbomber operating over a pine forest near Kryezi village, Puke district (Photo: G. Hoxhaj)

Following a request of the Albanian Government Germany provided two light helicopters. Their helibucket capacity was 500 l of water. The helicopters operated in the northern part of the country in firefighting operation near the Drini River and in the area surrounding Tirana. To facilitate their flights the crew was accompanied by an Albanian pilot from the Albanian Air Force. According to our evaluation the operations were not very effective due to the need to refuel in the centralised fuel depot in Tirana as well as the low carrying capacity of water.

Support from Poland and the Czech Republic by hand tools for fire fighters was very welcome!

Along the border region with Greece there was good cooperation in exchanging information, and in a few cases aerial support.

The assistance provides to our neighbors consisted information exchange for the fire situation in the border area and on the availability of our water resources to the aerial operators inside Albania.

5. Analysis and Recommendations

In 2007 all forest fires have been caused by humans. Negligent performance of the Local Communities and lack of responsibility by Local Government structures was noted. After more than 55% of the forests have been transferred to the property of the Local Communities there is still much to be done to raise their attention to and responsibility for fire prevention and suppression:

- During the year 2007 forest fires have caused the highest damages ever recorded in the country, with severe negative impacts on the social, economic and natural environment;
- Fire prevention measures have not been effective;
- Due to the low level and performance of observation and information systems the response to fires has been weak and has resulted in aggravated situations;
- Lack of logistic support and efficient coordination of fire suppression operations in the field, lack of stringent command and control;
- National cooperation in responding to the 2007 fires (inter-agency, involvement of civil society) became effective at the moment of establishment and functioning of the Central Unit for Civil Emergencies.

Problems identified

- Lack of support and interest from the local communities to prevent and suppress forest fires;
- Lack of human resources in rural areas;
- Low efficiency of human and material resources. There are resources, including helicopters, that cannot be dispatched and used due to lack of coordination, experience and some low-cost investments;
- Lack of logistic support and difficulties of effective use of these resources for the state agencies and local community;
- Lack of knowledge on effective and efficient use of aerial support and coordination of aerial and land interventions;
- Steep and fragmented topography and difficulties to access the forest areas;
- Vacuum of ownership and responsibilities between central and local government;
- Lack of responsibility for fire prevention and suppression in private forests;
- Traditional use of fire as a tool for forest and pasture management resulting in escaped wildfires;
- Missing adequate legal framework regarding the land management after fire;
- Lack of community involvement in forest fire management;
- Lack of effective fire management plans based on the real condition of every region, district or community;
- Need for the establishment of initial attack units, to be located in the most fire-endangered forest areas;
- Lack of an effective fire detection and observation systems;
- Need to improve the effective use of tools and equipments that are used by the Forest Service;
- Improvement of strong collaboration between local government, NGOs, forest owners and international agencies is required;
- Need to rise of public awareness regarding the forest fires;
- Need to improve the legal framework;
- Need to regulate the legal use of fire as a land management tool, based on the traditional use of fire, advanced ecological and environmental considerations and a clear regulatory concept;
- Need to enhance international exchange of experience, information and strong collaboration in the region;
- Need to systematically investigate fire causes in order to develop adequate strategies in fire prevention;
- Implementation of the action plan of the national strategy for forest fire management. Develop visions and a strategy to meet the challenges of fire management in Albania in the future, a country in which demographic and climate changes will increasingly affect natural ecosystems and land-use systems resulting in increased vulnerability to wildfires.

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Republic of Serbia – Forest Fires in 2007

1. Statistical Data

On the Balkan Peninsula the fire season of 2007 was extremely severe – and Republic of Serbia was one of the countries most affected. Tables 1 and 2 provide comparative statistical data for the period 2005 to 2007 and details for the 2007 fire season.

Table 1. Wildfire occurrence and causes in Republic of Serbia 2005 to 2007

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Lands (ha)	Total Area Burned on Forest, Other Wooded Land, & Other Land (ha)	Area of Forest Burned (ha)	Area of Other Wooded Land Burned (ha)	Human Causes (% of No.)	Natural Causes (% of No.)	Unknown Causes (% of No.)
2005	15	63	53	10	100	0	0
2006	29	569	537	31	94	0	6
2007	482	34,001	16,582	17,414	80	2	18

Table 2. Detailed fire statistics for Republic of Serbia 2007

No. of Fires on Forest & Other Wooded Land	Total Area Burned on Forest, Other Wooded Land						Type of forest fires		
	State forest			Private forest			Total Area Burned on Forest, Other Wooded Land, & Other Land (ha)	Crown (ha)	Surface (ha)
	Area of Forest Burned (ha)	Area of Other Wooded Land Burned (ha)	Total Area burned (ha)	Area of Forest Burned (ha)	Area of Other Wooded Land Burned (ha)	Total Area burned (ha)			
487	7,878	4,682	12,560	8,709	12,732	21,441	34,001	2,837	31,164

Causes and other factors influencing wildfires

In 2007 the forest fires in Serbia were 80% caused by humans. Like in previous years agricultural burnings were the main reason. Climate change is also influencing the forest fire situation. Very low level of rainfall in the period autumn-winter 2006-2007 and in spring-summer 2007 as well as unusual high temperatures – the highest recorded since the last 100 years – created favorable conditions for wildfire ignition and severe fire behavior. Figure 1 reflects that extremely dry and hot summers that occurred between 1990 and 2007 resulted in high areas burned.

During the year we had two critical periods when wildfires burned all over the country. The first extreme fire situation happened in April, caused in most cases by agricultural burning, after autumn and spring without rainfall. The second extreme fire situation occurred in July. At that time the drought period continued while high temperatures reaching at maximum in urban regions (44-45°C) and more than 30°C in the mountains. A detailed breakdown of fire occurrence in 2007 is provided in Table 3.

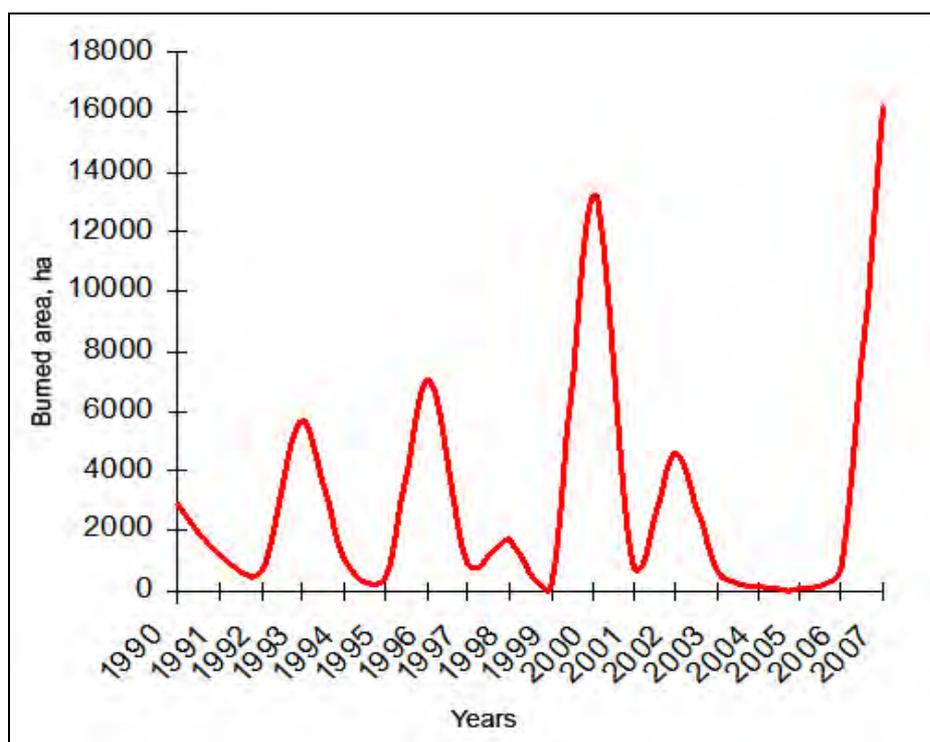


Figure 1. Forest areas burned in Serbia 1990-2007. Source: Directorate of Forests, Republic of Serbia

Table 3. Number of fire and size of burned areas by month in 2007

Month	No. of Fires in Forests and Other Wooded Land	Total Area Burned on Forest and Other Wooded Land (ha)
January – April	231	3946
May	2	69
June	23	357
July	208	28,773
August	7	856
Total	487	34,001

Preliminary data of damages caused by wildfires

Compared with damages in earlier years maximum damages of forests were experienced in 2007 (direct damages, indirect, costs of recovery and total costs) (Tab. 4). National Parks and protected areas were extremely affected by fires (Tab. 5).

Table 4. Damages (€) caused by wildfires affecting forests in Republic of Serbia

Total Area Burned of Forests and Other Wooded Lands (ha)	Area of Forest Burned (ha)	Direct Damages (€)	Indirect Damages (€)	Costs of Extinction-Blackout (€)	Recovery & Rehabilitation (€)	Total Costs (€)
34,001	16,582	4,336,039	20,902,118	422,863	5,869,811	31,530,831

Table 5. Most significant fires affecting protected areas and National Parks of Serbia in 2007

National Park	Number of Fires	Total Area Burned on Forests and Other Wooded Lands (ha)
PE NP Đerdap	82	707
PE NP Tara	5	95
SRN Deliblato Sands	1	592
Nature Park Stara Planina	5	1,390
Total	90	2,784

2. Action Taken in 2007

Fire prevention measures

Usual measures were carried out in the beginning of the year, according to the Fire Protection Law and Forestry Law:

- Public enterprises prepare plans of protection against forest fires and convey them to the commanders of units of fire department in the Ministry of Internal Affairs, as well as to commanders of fire brigades and representatives of the Community.
- Republic forest inspectors in January-March control the plans, objects and equipment for forest fire protection.

Also, the Directorate of Forests and the Sector for Fire Prevention and Rescue improved cooperation in the beginning of the year. Seminars with were organized with all subjects involved in forest fire protection in which the current state, equipment and communication improvement were analyzed.

New measures were established in preparedness and expectation of heat and drought escalating in summer:

- A Fire Suppression Headquarters was established by the Government and also at local level
- Public enterprises established active attendance during 24 hours.
- In July 2007 the Forest Sector organized daily press conferences in order to inform and appeal public.



Figure 2. Public awareness signs and billboards are visible throughout the country (Photo: GFMC)

Response to fires

Pursuant to Law of Fire Protection and Law of Forestry the Republic Serbia has organized forest fire suppression according to the scheme provided in Figure 2.

When the lookout observers (foresters) detect a forest fire, they immediately inform the fire warden unit, headed by the forest officer. The crew goes to the site of the forest fire and undertakes the initial fire suppression. The action of forest fire fighting is directed by the chief forest officer, who is in permanent contact with the officer on duty within the local forestry enterprise. If it is estimated that the unit cannot extinguish the fire on their own, they inform the Fire Department of the Ministry of Internal Affairs of Serbia. Then, pursuant to the Fire Protection Law, the action of forest fire suppression is undertaken by the Commander of the fire crew unit.



Figures 3 to 5. Fire observation towers are equipped with camera systems, as demonstrated to visitors of UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network and the Global Fire Monitoring Center (GFMC) during a field assessment in August 2007 (Photos: GFMC)



Figures 6 to 8. Hand tools are efficient and effective means for suppressing surface fires and cutting fire lines (Photos: GFMC and Directorate of Forests)

If the fire develops to a large-scale fire, the responsible officers at the Headquarters of the Public Enterprise are informed, i.e. the Executive Director of the Sector for Forestry and Wildlife Management. The authorized sector of the Headquarters can demand the engagement of the Army and also of other institutions to assist in fire suppression. In the case when several institutions participate in the suppression of forest fires, it is obligatory to form the Fire Suppression Headquarters, consisting of the leadership of all institutions involved.

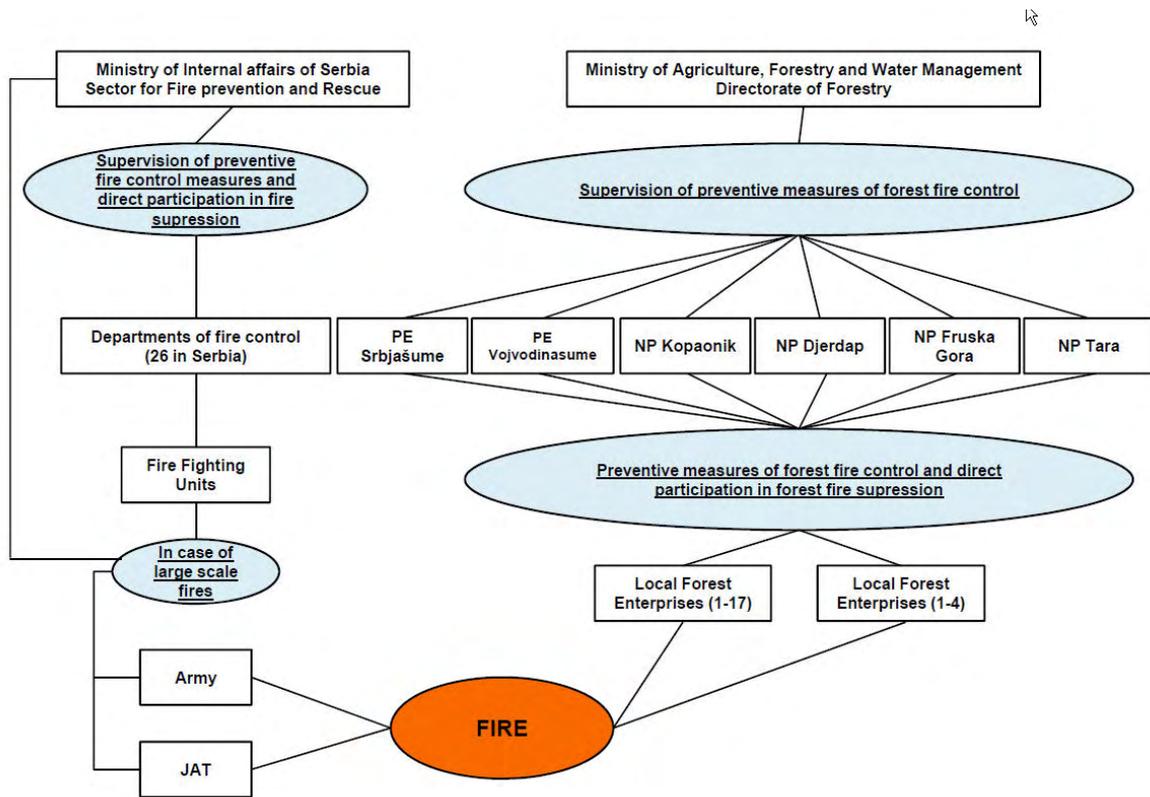


Figure 9. Organization of forest fire suppression in Republic of Serbia

Organizational structure and units/persons responsible for organization of protection from forest fire and extinction in PE "Srbijašume" or PE "Vojvodinašume" are:

- General direction – Sector for Silviculture and Forest Protection
- Forest estate – The officer responsible for silviculture and forest protection
- Local forestry enterprises or Forest Managing Unit (FMU) – Chief of the FMU
- Forest section – The responsible forest engineer
- Operation units – The responsible forester

Moreover, regular police, Army, hunters, organized in Hunting Association of Serbia, participated in fire suppression this year, as well as local population and others.

3. National Cooperation in Response to the 2007 Fires

Cooperation between Sector of forestry (MAFWM – Directorate of Forests, Public Enterprises and National Parks), the Ministry of Internal Affairs (Sector for Fire Prevention and Rescue) and the Ministry of Defense was very efficient.

Civil society didn't have important role in fire suppression this year. The highest number of volunteers traditionally exists in AP Vojvodina, but this year the number of forest fires there was small. Also, in another part of the Republic civil society representatives serving as volunteers are engaged more on an individual basis and thus their overall role is less significant.

The role and involvement of local communities in earlier years was more active than in 2007.

4. International Cooperation in Response to the 2007 Fires

The Ministry of Internal Affairs had a good cooperation with Republic of Bulgaria in managing several fires that were crossing the borders between the two countries.

Receiving assistance

Republic of Serbia received assistance from Russia by a deployed Iljushin-76, which we used in fire suppression in July, at locations where the ground forces could not stop the fires for long time and the fire size had grown to large areas. The airplane was used in the following places: Stara planina, Svrlijske planine, Kuršumlija Deliblatska peščara (Fig. 3).



Figure 10. Aerial suppression by the Russian IL-76 of extended fires in the mountains of Serbia
(Photo: GFMC archive)

Providing assistance

Ministry of Internal Affairs of Serbia, Sector for Fire Prevention and Rescue sent in Greece help which include 55 firemen and 6 special motor vehicles for fire suppression.



Figures 11 and 12. View of open lands and forests affected by wildfires in Republic of Serbia in 2007
(Photos: Directorate of Forests and GFMC)

5. Analysis and Recommendations

The following problems have been identified:

1. Inadequacy in the application and outdated legal principles regarding to the protection of forest fires
2. Lack of human resources for prevention and suppression measures
3. Inadequate material and technical equipment of all subjects to enforce measures for fire protection
4. Lack of educational measures for firefighters and personnel of headquarters
5. Lack of means for communication
6. Weak information of the public
7. Most of forests are not enough accessible by roads and insufficient extent of firebreaks

Recommendation are given for enhancing effectiveness for international cooperation

1. Organization of training courses for firefighters and personnel of headquarters
2. Definition of procedures for receiving and providing assistance from neighbor countries and other countries
3. Establishment of unique terms definition and elements for data base

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1. Ministry of Agriculture, Forestry and Water Management, Directorate of Forests
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3. National Parks Tara, Fruška Gora, DJerdap

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Forest Fires in Former Yugoslav Republic of Macedonia in 2007

1. Statistical Data of the Fire Season 2007

At the end of the 2007 the extreme fire season was evaluated. The following provides a summary of the national assessment.

Table 1. Extent: Number, area and types of forests and other vegetation affected by fire. Source: P. E. "Macedonian forests"-Skopje (1999-2007).

Year	Number of Fires	Burned Area (ha)	Burned Timber Volume (m ³)	Suppression Costs (€)	Total Costs (€)
1999	69	2,414.80	1,950.00	32,512.00	372,921.00
2000	476	46,235.73	711,782.00	976,142.00	15,642,775.00
2001	161	6,263.30	88,260.00	66,810.81	9,851,849.00
2002	65	1,186.30	24,661.28	15,193.10	298,902.00
2003	144	1,068.88	10,987.00	44,607.87	251,527.00
2004	94	892.05	4,322.30	23,214.55	1,469,090.00
2005	182	1,368.00	1,063.00	42,018.11	411,181.10
2006	138	2,085.95	12,978.00	45,311.20	2,437,914.46
Total	1,329	61,515.01	856,003.58	1,245,809.56	30,736,159.56
<i>Average</i>	<i>166</i>	<i>7,689.38</i>	<i>107,000.44</i>	<i>155,726.2</i>	<i>3,842,019.95</i>
2007	652	35,248.60	617,678.67	386,852.46	21,494,700.40

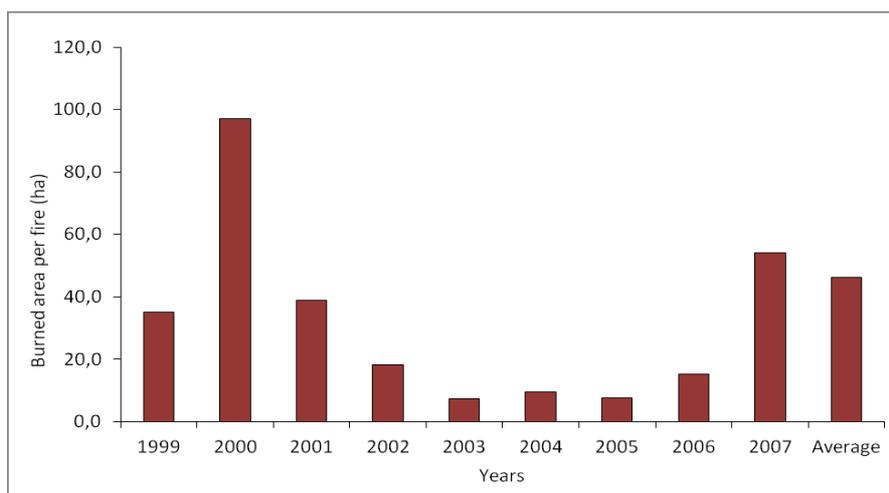


Figure 1. Average burned area per fire (1999-2007)

2. Causes of Wildfires

The most important causes of fires in the year 2007 were: burning of stable fields, burning of pasture lands and negligence-along to roads and railways. Special category is arson: due to illegal logging and politically motivated.

3. Selected Extreme Fires in 2007

Bitola fire: 23 to 26 July 2007

In the period of four days more than 5,000 ha of 45-50 years old pine afforestations were burned. *Comment:* Very bad organization of the fire suppression action even few airplanes and helicopters and about thousand fire-fighters had been engaged in the action.

Berovo fire: 24 to 28 July 2007

In the period of five days about 1,500 ha of high quality natural pine forests were burned. *Comment:* The burned area has very high potential of soil erosion. Reason of the fire (unofficially): Arson (illegal logging)



Figures 2 and 3. Extreme fire weather and behavior led significant environmental damages
Photos: GFMC

4. Fire Prevention Measures

On the beginning of the fire season TV spots and information on the local radio stations were broadcasted and information in newspapers regarding increased fire danger published. Apart of these measures, it was declared that during the fire season any access to the forest for all citizens except foresters was prohibited.

5. Crisis Management Structure at Local and National Level

The structure of the disaster management (responsible for fire suppression) at local and national level during forest fires in 2007 is shown in Figure 2. The main weakness of the organization was the lack of coordination and cooperation between Crisis Management Centre (CMC) and Directorate for Protection and Rescue (DPR). The result of that was disorganization during actions of suppression and very low efficiency although were engaged big number of fire-fighters, airplanes and helicopters.

It should to be emphasized the lack of hand tools and all kind of equipment needed for fire suppression, especially the lack of special off road vehicles for initial attack.

Table 2. Engaged trucks and machines in the period 18 July to 5 August 2007 (Source: CMC)

Date	Fire Trucks	Off-road Vehicles	Bulldozers	Tankers
18 July	18	15	0	0
19 July	21	19	2	0
20 July	34	27	0	0
21 July	21	31	2	3
22 July	44	40	3	0
23 July	32	85	7	0
24 July	55	65	9	4
25 July	49	76	14	5
26 July	37	61	13	2
27 July	29	48	16	1
28 July	18	21	6	0
29 July	9	14	2	0
30 July	12	40	3	1
31 July	6	39	13	1
01 August	1	0	2	0
02 August	4	0	0	0
03 August	1	0	2	1
04 August	6	0	0	0
05 August	0	0	0	0

Table 3. Engaged human resources in the period 18 July to 5 August 2007 (Source: CMC)

Date	DPR	Army	Fire Brigades	Public Enterprises	P.E. Macedonian Forests	Local Citizens	Total
18 July	50	30	46	0	62	73	261
19 July	0	0	69	0	154	37	260
20 July	0	32	144	5	142	197	520
21 July	21	236	80	24	131	131	623
22 July	55	376	171	31	154	336	1.123
23 July	25	400	174	176	400	511	1.686
24 July	886	380	238	92	582	930	3.108
25 July	749	296	178	129	428	660	2.440
26 July	672	147	148	81	390	621	2.059
27 July	455	88	93	65	446	579	1.726
28 July	132	237	103	21	151	264	908
29 July	183	301	32	9	101	245	871
30 July	117	298	47	84	138	86	770
31 July	237	208	35	51	127	132	790
01 August	155	217	11	47	65	18	513
02 August	70	120	27	65	5	10	297
03 August	43	180	144	77	0	17	461
04 August	50	180	24	59	28	53	394
05 August	0	0	0	18	0	0	18

Table 4. Engaged airplanes (Source: CMC)

Type of Aircraft	Days
Fire Suppression Tasks	
2 Helicopters Mi – 17	9
3 Airplanes AN – 2	11
Fire Monitoring	
Helicopter – Bel	7
Airplane – Zlin 242 L	6

6. National Cooperation in Responding to the 2007 Fires

Generally, local citizens were included in the actions of fires suppression (cf. Tab. 3). However, their involvement was very bad organized and without proper equipment and tools.

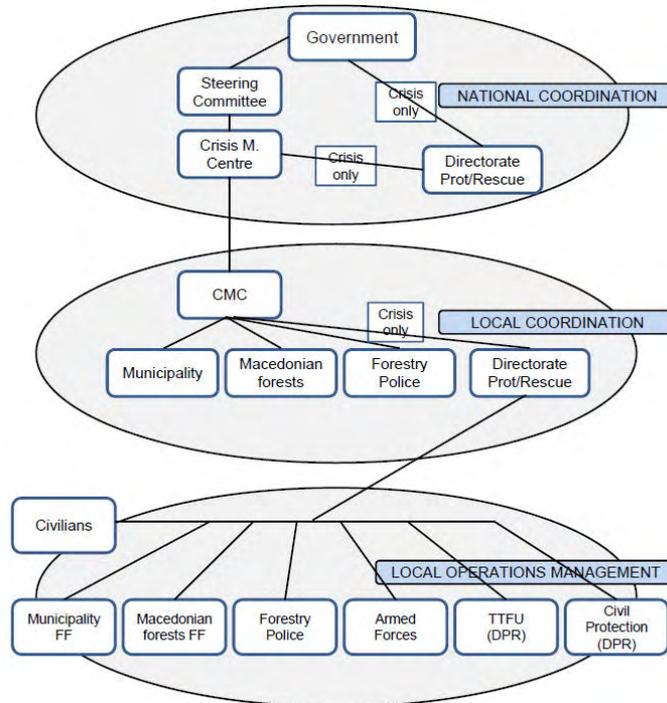


Figure 2. Disaster management structure in Macedonia (2007)

7. International Cooperation

Receiving assistance

Table 5. Assistance received in 2007 (Source: CMC)

Type of Aircraft	Assistance Provided by	Days
Canadair CL-415	Croatia	3
Canadair 32	Turkey	6
Helicopter – Bell 412	Slovenia	6
Helicopter – UH 1D	Germany	6

Providing assistance

Although the situation in the Republic of Macedonia was extremely bad, tree fire trucks with crews were provided to help Greece. Unfortunately, due to political reasons, after 12 hours waiting on the Greek border the offered assistance was denied.

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Joint UNEP / OCHA Environment Unit



Ecological Damage Assessment of the Wildfires in the Former Yugoslav Republic of Macedonia in 2007

Joint Mission by the UNEP-OCHA Joint Environment Unit, UNEP, UNDP and GFMC

Executive Summary

Between July and August 2007 the Former Yugoslav Republic of Macedonia (FYR Macedonia) experienced extended wildfires, which severely affected forests and other vegetation on an area exceeding 50,000 hectares (ha). By end of July 2007 the damages in fire-affected forests as well as the costs for suppression already amounted 21 million Euros. At the time of compiling this assessment there were no damage figures available for the month of August 2007. Although nearly 200 people were forced to evacuate from Bitola direct impact on residential areas has been thankfully minimal. Damage to infrastructure has been relatively slight. However, there were quite a few occasions where damage to these areas (communities and public infrastructure) was only averted at the very last moment.

In response to the request of the Government of FYR Macedonia, UNDP, in a cooperative effort with the Joint UNEP / OCHA Environment Unit, UNEP and the Global Fire Monitoring Center (GFMC), a mission was deployed to FYR Macedonia to assess the damages of the wildfires in FYR Macedonia in 2007 and to recommend action for future fire disaster risk reduction. The GFMC was deployed through the Joint UNEP/OCHA Environment Unit. The mission was implemented between 27 August and 7 September; the field assessment team was deployed between 29 and 31 August 2007. The field assessment was conducted in the most fire-affected regions. These regions were also representative for the fire occurrence and fire effects throughout the whole country. Agencies and individuals involved in wildfire prevention and suppression were consulted in all regions visited.

All wildfires were consequences of human activities, e.g., agricultural burnings, careless use of fire, and in some cases suspected arson. Extremely dry, hot and often windy weather conditions prevailing during the whole fire season created extreme fire situations and often made firefighting impossible. This situation is aggravated by the consequences of the rural exodus. The widespread abandonment of land cultivation is resulting in increasing loads of unused combustible materials in forests and former agricultural and pasture fallow lands. With a reduced presence of the young generation of rural population and average over-aging of the rural communities, the human resources available for fire prevention and fire suppression activities are dramatically dwindling.

 	<p>Report prepared by the Global Fire Monitoring Center (GFMC) by Johann G. Goldammer (GFMC) and Nikola Nikolov, Faculty of Forestry (Skopje, FYR Macedonia) / UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network Edited for IFFN – 30 September 2007</p>	
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The prime responsibility in fire prevention and initial fire suppression in the state-owned forests is with the Public Enterprise "Macedonian Forests". This basic responsibility is very appropriate. However, there are expectations by non-state landowners that P.E. Macedonian Forests would also be responsible for fire prevention and control on non-state forest and other lands. Legally this expectation cannot be met due to a lacking mandate, although the P.E. Macedonian Forests is usually and informally responding to all wildfires regardless of land ownership. However, human and technical resources for fire management of P.E. Macedonian Forests are inadequate to professionally and successfully suppress forest fires.

Besides a lack of trained personnel, most of the firefighting equipment is outdated, obsolete and overall insufficient. This severe underfunding and under equipping extends beyond fire management itself into areas of communications, basic office equipment, even office space.

Secondly and very much related to the scale of damage witnessed the general crisis-management system is requiring a severe overhaul. There is a great need for unity and a systematic approach to crisis management. The fires of 2007 have highlighted a picture of competing mandates, duplication of efforts, coordination and leadership clashes both at local and central level. Key preparatory activities are performed in isolation to others, the evident expertise the country has in various areas related to the crisis management system is either under-utilized or left outside the system altogether.

It is therefore recommended that a number of measures to be taken to overcome the institutional weaknesses and to improve capacities in fire management. The proposed measures include:

- Launch of a fire management capacity building programme for FYR Macedonia and initiation of a capacity building training programme at regional level; assistance to be sought e.g. through the Environment and Security Initiative (ENVSEC), the Joint UNEP / OCHA Environment Unit, UNDP, Council of Europe (CoE) through its Euro-Mediterranean Major Hazards Agreement (EUR-OPA) and GFMC
- Strengthening the fire management capabilities of P.E. "Macedonian Forests"
- Establishment of adequately trained and equipped voluntary rural fire brigades
- Call for a National Round Table on Fire Management to be supported by UNDP, GFMC and the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network
- Replacement of obsolete and procurement of sufficient firefighting equipment for the local fire services and P.E. "Macedonian Forests" (provision of model units for wildland fire response, fully equipped with vehicles, tools and personal protective equipment); assistance to be sought through UNDP and national agencies
- Upgrading fire research and training at the Forestry Faculty in Skopje and conduct regional fire management summer schools
- As the FYR Macedonia is aiming at joining the EU, request of a "Twinning" (or Twinning Light) project between FYR Macedonia and an EU member state, to adapt Macedonian legislation and practical procedures in forest and fire management.
- Development of a regional strategy on cooperation in wildland fire management and establishment of a Balkans Regional Fire Monitoring Center; assistance to be sought through UNDP, GFMC and the UNISDR Regional SE Europe / Caucasus Wildland Fire Network, flanked by ENVESC and CoE / EUR-OPA
- Convene a "Regional Balkan Wildland Fire Crisis Conference" (or "Summit"), in which highest-level possible government commitment should be sought, under the joint auspices, among other, of UN specialized agencies and programmes (UNDP, UNEP, the Joint UNEP / OCHA Environment Unit, FAO), the European Commission, Council of Europe / EUR-OPA, ENVESC, OSCE and NATO, and facilitated by the UNISDR Global Wildland Fire Network and its regional network, the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network, with the main objective to:
 - Address the underlying causes of increasing threats of wildfires to the environment and society, notably the consequences of land-use change and climate variability
 - Outline the need for the development of national policies and strategies addressing land-use, forestry and forest protection, nature conservation and fire management
 - Elaborate agreement for strengthening fire management capabilities in the region through standardized and joint regional training and introduction of improved technologies for wildfire suppression
 - Development of border-crossing mechanisms and agreements on mutual assistance in fire emergency situations

1. Introduction

In July-August 2007 the FYR Macedonia was severely affected by extended forest fires and fires occurring in other vegetation. The extreme size and impacts of fires were determined by the extremely dry weather conditions on the one side, and the lack of human and technological resources for fire management on the other side.

In response to the request of the Government of FYR Macedonia UNDP, in a cooperative effort with the Joint UNEP / OCHA Environment Unit, UNEP and the Global Fire Monitoring Center (GFMC) deployed a mission to FYR Macedonia to assess the damages of the wildfires in FYR Macedonia in 2007 and to recommend action. This report focuses on one of the three parts of that mission: the ecological damage. Other aspects (socio-economic and crisis management) of the mission are examined separately. As this report on ecological damage is designed to also be prepared as stand-alone version there may be a little duplication in the areas of damage.

The mission was implemented between 27 August and 7 September; the field assessment team was deployed between 29 and 31 August 2007. The field assessment was conducted in the most fire-affected regions. These regions were also representative for the fire occurrence and fire effects throughout the whole country. Agencies and individuals involved in wildfire prevention and suppression were consulted in all regions visited.

This report provides a summary of the on-site assessment and investigations in the FYR Macedonia and recommendations for action for future prevention, response and mitigation of wildfires.

2. Mission Narrative

After a preparatory meeting on 27 August 2007 the field mission started on 28 August 2007 and ended with a debriefing at the Center for Crisis Management (CMC) on 1 September 2007. The complete mission report including a detail mission narrative is available in the original report.¹

3. Results of the On-Site Investigations and the Field Assessment

3.1 The 2007 fire season: Climatic conditions

In summer 2007 the jet stream was flowing further south as compared to average years, allowing low pressure systems to sweep over Western / Atlantic Europe. Warmer air was pulled from Africa, which was affecting South-eastern Europe for weeks. Appendix 1 provides an example of a pressure chart, which is illustrating the reasons for the flow of hot air masses from Africa to the Balkans.

The extreme heat and dryness is reflected by the weekly averages of fire danger level, which were determined by the Joint Research Center (JRC) using the Fire Weather Index (FWI). An example for the month of July for Europe, including the Balkans, is provided in Appendix 1.

An exact comparison of climatological information for FYR Macedonia (long-term average weather data vs. weather data of 2007) is not yet possible due to the lack of evaluated weather data of the current year. However, the high temperatures recorded in summer of 2007 exceeded by far the long-term average temperatures for the summer months. Appendix 1 provides the long-term climatic conditions for a post-mission evaluation.

3.2 Preliminary summary of area burned by vegetation types

Detailed data on area burned and number of fires in August 2007 are not yet available. The fires recorded until the end of July 2007, however, indicate that the area burned by wildfires in 2007 most likely will be higher than in the most recent extreme fire year 2000.

Unfortunately the statistical data collected by various agencies or units – both long-term as well as in 2007 – are inconsistent and probably not comparable. Different sources of fire statistical data come up

¹ <http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/FYROM-2007.pdf>

with different numbers – see datasets provided by the Ministry for Internal Affairs (MIA) for the period 1989-2005 (Tables 2 and 3) vs. the data compiled by P.E. “Macedonian Forests” for 1999-2006.

The mission had the impression that the data compiled by the Public Enterprise “Macedonian Forests” are the most reliable. With a burned area of more than 32,000 ha recorded by end of July 2007, the total area devastated by fire in 2007 most likely will exceed the area burned in the extreme fire year 2000, during which ca. 46,000 ha of forests and other lands had been burned. It is assumed that the total area burned may exceed 50,000 ha.²

3.3 Fire causes

In many cases the causes of the fires are unknown. However, local briefings revealed that agricultural burnings, especially straw residual burning caused many fires, as it usually happens in late summer. Other fires may have been caused accidentally. Arsonists have set some fires. However, there is limited proof, except for two fires in Berovo and Katlanovo, which were set intentionally and which are currently investigated.

The long-term average data show that about 65% of wildfires in Macedonia were caused due to negligence, 7.5% were ignited intentionally and lightning caused only 2%. For 25.5% of fires, the causes were unknown due to difficulties in determine the cause. It is strongly assumed, however, that the majority, if not all, of the fires with unknown origin were started by people.

The farmers, who were using fire, most likely have not been aware of the extreme weather conditions, especially the influence of wind, which caused the spread of land-use fires and created high-intensity wildfires that were difficult to control.

3.4 Fire impacts on vegetation, environment and secondary disasters

An overview of the specific fire impacts is given in the following:

Forests

The degree of ecological and economic damages varied by forest types. High-value forests, such as natural or planted pine forests (*Pinus nigra*, to a lesser extent *P. sylvestris*), have been severely damaged (destroyed) by fire in many places. The “severity” of fires (i.e. the deep fire impact on the forest floor and soil cover; the consumption of all burnable material on the forest floor as well as damage of destruction of tree crowns) was often a result of extreme drought, strong winds and topography (on steep terrain high-intensity, up-slope moving fires are developing very fiercely). Most of the fire-affected pine forests will not regenerate sufficiently by natural regeneration, and need to be re-forested. The value of the partially burned timber (the tree stems are charred by fire) is reduced. The costs of salvage logging and preparation of the land for restoration / sanitation amount to ca. 1000 €/ ha. It means that the costs for rehabilitation of 1000-ha burns (such fire sizes have been reported in many forest districts) will amount to 1 million Euro. This magnitude of costs must be kept in mind when judging the investments necessary for appropriate fire prevention and control measures.

As pine reforestations are very sensitive to fire, it should be considered to use different species for reforestation, e.g. oak species (*Quercus* spp.). Oaks are also affected by fire but have a good potential of regenerating naturally (from sprouting). Thus, fire affected oak stands may not require high investments for rehabilitation.

High-altitude forests with different tree species, e.g. spruce and fir species have not been visited during the assessment mission. However, there are reports of fires burning in national parks in which such forests may have affected by fire. In general, these mountain forests are very sensitive to fires, and fires represent of threat to biodiversity and mountain ecosystem stability.

² According to a quick satellite survey by the JRC a total of 36,492 ha of lands were affected by fire by end of August 2007, of which 30,645 ha were forest lands (84%):
http://effis.jrc.it/documents/2007/EFFIS_Newsletter_2_2007.pdf

The forest fire damage assessment by the Public Enterprise "Macedonian Forests" estimates a damage of forest products and the costs for fire suppression in the magnitude of 21 Million Euro (as of end of July 2007).

For private forest owners the situation can be rather difficult. The majority of the ca. 60,000 private forest owners have very small forests; the average size is 0.5 ha. One farmer interviewed by the mission team lost the whole forest on his property of 3.5 ha. For such a case a fire can be economically very disastrous.

Other lands

Degraded forests affected by fire in some cases have a history of earlier fires and land-use. The economic value of degraded forests and brushland is less than the high-value forests.

Only a limited amount of agricultural lands or other cultivated lands have been affected by wildfires. The team noticed some viticulture and fruit tree plantations damaged by wildfires. The authorities in general did not report major damages in agricultural crops.

Infrastructures

In some places damages of infrastructures were reported and observed, e.g. some burned power and telephone masts. In general there was limited damage, although it was observed that many electric power lines were near or even over burned vegetation. The potential of damages, however, was very high, but was successfully prevented by fire suppression efforts. The TV tower at Katlanovo (near Skopje) was threatened by fire in July 2007, but successfully protected.

Near Gevgelija a short section of railway sleepers burned, but could be repaired at short notice. At the fires near Katlanovo the highway and tunnel had to be closed for several hours in order to avoid traffic safety problems due to fire and smoke.

Most endangered was the coal-fired electric power plant Oslomej near Kicevo. The fires burned nearby this power plant and created some spotting fires, which were falling on the main per plant facility. The fire personnel prevented the ignition of the facility. Burning of this power plant could have caused enormous direct and indirect damages (e.g. loss of electricity with subsequent economic losses in the region or even countrywide).

Social / humanitarian (public health, safety and security)

In a number of regions the loss of some buildings was reported, e.g. some weekend houses. In the outskirts of Bitola a small informal settlement of the local Roma population was partially burned down, several barracks were destroyed or damaged. The authorities evacuated 178 persons from the fire scene. There were no casualties. While some of the evacuees were allowed to return after the fire, a total of 32 persons are currently still hosted in a holiday resort and are waiting for decisions and actions by the city of Bitola to provide new housing ground and to assist building of barracks. Details on the fire impact on the Roma community in Bitola are provided in the tandem report.

Other regions reported about losses of private houses and equipment, e.g. in Berevo the loss of one house, one weekend house and one tractor was reported. In Strumica the authorities reported the loss of several barns and cattle stable.

The Red Cross units were actively participating in the fire and rescue operation in several places where peri-urban or village sites were endangered by fire, e.g. in Bitola and Kicevo. The Red Cross gave advice to people to protect themselves from heat stress. Although severe smoke pollution was reported in the call for international assistance (Appendix 3), the regional representatives of the Red Cross and other authorities did not consider smoke pollution and health risk as a major problem during the fire crisis.

The fire and forestry units reported about several critical situations in which firefighters were threatened by the wildfires, e.g. during fires burning near Prilep where firefighters were trapped by fire. However, no casualties were reported. For comparison: in Croatia six firefighters were killed and seven severely injured in a fire in the last week of August 2007. (Note: By 6 September the number of fatalities in Croatia has increased to 11 firefighters.)

In conclusion it can be stated that unlike the situation in Greece, where more than 64 people had been killed by fires and more than 3000 houses burned during the fire episode of August 2007, the humanitarian consequences of wildfires in FYR Macedonia were less severe.

However, the potential for higher losses was there, including the long-term effects of smoke pollution (damage through inhalation of smoke particles, with the risk of short-term effects on elderly and young people and those suffering cardio-vascular diseases, asthma, etc., or long-term effects such as cancer).

Other damages: Secondary damages and disasters

It is very likely that considerable damage will be caused by secondary events. Bark beetles most likely will infest pine forests, which were partially damaged by fires. The expected mass infestation will result in additional damages affecting surrounding unburned forest stands.

In most areas fires burned on steep terrain (slopes). The high severity of fires has burned the protecting humus layer and removed the grass-herb vegetation. In some places the fires penetrated the ground through burning of old tree stumps and roots. The effects of these hot-burning fires make these slopes very prone to soil erosion, with the consequence of loss of soil and nutrients. This will be a major impediment for regeneration and reforestation.

Once heavy rainfalls in autumn-winter will hit these burned sites, it is expected that massive surface runoff will lead to floods, landslides, mudslides and rock falls. The downstream effects of heavily burned sites may become more disastrous than the direct fire damage in terms of timber losses and reforestation costs.

Specific issues: UXO threat to human security

Many forest sites and non-forest lands in the Balkan region are contaminated by land mines and unexploded ordnance (UXO) from recent conflicts. In FYR Macedonia the threat of UXOs to be triggered and exploded by forest fire is stemming from World War I. Most contaminated is the former line of contact of 1917 between Strumica and Bitola (LoC between the Austro-Hungarian, German, Bulgarian and Turkish forces in the North and the Antanta Union in the South), where large numbers of grenades and mines are threatening firefighters and civilians. During the fires in July 2007 more than 70 explosions of ammunition were recorded in the immediate vicinity of Bitola, but no casualties occurred.

3.5 Fire management

The following summary is concentrating on the technical fire management capabilities. An analysis of the general Crisis Management System in light of the forest fires can be seen in the separate report (including some aspects of multi-stakeholder involvement at a local/national level).

Wildfire prevention and preparedness

The prevention of forest fires is the task of the forest owner (Law on Forests, 1997). The Public Enterprise "Macedonian Forests" plays an important role in this regard. However, the enterprise is allocating very limited resources for technical fire prevention measures, e.g. for creating firebreaks, pruning of trees alongside roads, planting of greenbelts, or construction and operation of fire watch towers.

The economic situation of private forests is rather difficult. The average small size of the forest properties, usually intermixed with forests of other owners, makes fire prevention measures extremely difficult, not to say impossible, unless agreement can be reached by a group of forest owners of a forest complex.

During the field mission it was noted that only very few billboards and other public education / information materials have been posted. Some leaflets addressing forest fire risk were presented by the authorities in Kicevo, including materials in Albanian language.

Wildfire response: Fire suppression

Forest owners have the primary responsibility for fire response. Since private forest owners have limited to none capabilities in fire suppression, the Public Enterprise "Macedonian Forests" is serving *de facto* as the only acting entity to initially respond to fires (initial attack) regardless of forest ownership. P.E. Macedonian Forests is actually acting like a public body ("Forest Service") although it does not have a mandate or budget to do so. P.E. Macedonian Forests is acting because there are no resources in private or community forests to respond to fire.

If a fire cannot be suppressed P.E. „Macedonian Forests“ calls the local Fire Service for support and the Directorate for Protection and Rescue is involved. In a declared "disaster situation" (emergency / crisis dimension of a fire) the Crisis Management Center is responsible for coordinating fire fighting. This task includes the coordination of foreign assistance, e.g. targeting foreign aerial resources to the fire to be suppressed.

The mission received several reports from the regions (e.g., Struga) that private landowners expected that P.E. Macedonian Forests should fight fires also on private lands. These landowners did not participate in fire fighting.

In almost all regions it was reported that there are insufficient to none volunteers for firefighting. Some exceptions, however, indicate the potential for volunteer involvement: In Kicevo-Krusino it was reported that a fire, which broke out on 26 July 2007 in the afternoon, the local population was immediately through the local media. Immediately about 400 to 500 people assisted the foresters, fire services and the armed forces in combating the fires and saving very valuable forest resources. In Tetovo a representative of a volunteer group of Brevenica reported the availability of volunteers, which at moment have no budget and no equipment at all.

Equipment, professional competence and firefighters personnel safety

In all regional meetings visited (Annex: itinerary map of field assessment mission) the representatives of the agencies involved (P.E. Macedonian Forests, Fire Services, DPR, CMC) reported in detail about the available technical / equipment resources to combat fires. The reports reveal that the equipment for fire suppression in forests and other lands outside villages and towns are absolutely insufficient. Compared to international standards the available resources almost nil.

In many regions the total amount of equipment included a small number of fire swatters (fire beaters) and backpack pumps. In some regions one single vehicle for transport of personnel was available. In some regions vehicles were borrowed or made available by private persons.

The units dispatched to fight forest fires do not have any specific training for capacitating the personnel to carry out fire suppression professionally and – most importantly – safely.

In all regions it was reported that units, which did not have any tools for fire suppression, had to attack fires burning with extreme intensities.

Rehabilitation of fire-affected lands

It was noted during the mission that P.E. Macedonian Forests was already working on preparations for post-fire sanitation cutting (salvage logging and removal of fire-damaged trees to reduce bark beetle infestations in burned pine stands) and reforestation.

The rehabilitation of forests damaged by high-severity fires (fires burning deep into organic terrain and depleting the soil from protecting humus and vegetation cover) must receive highest priority in order to reduce the degradation or loss of soils due to erosion and increased surface water runoff. Reforestation must receive priority in watersheds where heavy rainfalls may cause floods and destabilization of mountain slopes.

International cooperation in fire suppression

During the fire crisis in 2007 the government requested international assistance. Appendix 5 provides an overview of the assistance given by countries and donor organizations. Aerial fire fighting resources were received from some countries. The efficiency of foreign aerial firefighting missions

varied. In the case of the fire near Kicevo the deployment and aerial attack of a Croatian Canadair CL-215 was particularly successful.

During the fire crisis in the whole Balkan region numerous fires crossed national borders. This was also the case in FYR Macedonia. Authorities in Struga reported about border-crossing fires from Albania. They reported that there were no official communication channels with Albania, and that all action at the border had to be done in an unofficial way. There is also no communication with the authorities in Kosovo.

During the peak of the fire crisis in Greece, the government of FYR Macedonia offered assistance to Greece by sending a mixed firefighter team with the most experienced personnel. The Greek authorities, however, did not allow the fire crew to cross the border.

4. Conclusions

4.1 General: Implications of changing socio-economic conditions and regional climate on fire regimes and institutional capabilities in fire management

The fire assessment mission team has been confronted the dramatic social, economic and political changes in the rural space of the FYR Macedonia. Most visible during the mission were:

Consequences of the rural exodus

- Reduction in agricultural and pastoral activities
- Reduction in the overall use of biomass
- Together with increasing size of fallow lands with bush and forest encroachment, the reduced utilization of biomass constituting an increasing availability and continuity of fuels available to wildfires
- Villages becoming over-aged and even completely vacated due to the exodus of the young generation to the cities
- Decrease of availability of young, active rural population ready to prevent and suppress fires

Consequences of political and structural changes in the society

- Institutional weakening of the authority and efficiency of the forestry authorities
- Degraded financial capabilities of the fire and rescue services and other stakeholders concerned directly or indirectly with fire prevention and control
- Impoverished private forest and land owners with virtually non-existing capability on fire prevention and control

Consequences of climate extremes such as in 2007

- Unprecedented heat wave
- Extreme desiccation of forests and other vegetation
- Extended dry season without rainfall
- Occurrence of strong dry and hot winds favouring the intensity, spread and uncontrollability of wildfires
- Neighbouring countries are similarly affected, with consequences on reduced availability of foreign fire disaster assistance

Consequences of fires on the country and the environment

- As a consequence of these developments the territory of the country is becoming increasingly vulnerable to fire
- The effects of fire on the natural environment in the country constitute a major threat to the sustainability of forests, forestry and the role of forests in the stability of the country's environment and society.

By evaluating the multiple and cumulative effects of human-driven and natural developments on the vulnerability of FYR Macedonia to fire, and the whole Balkan region respectively, it is concluded that highest political priority should be given to strengthen the protection of forest and other vegetation

resources against the increasingly detrimental impacts of fire on ecosystem stability and society in the country and its neighbors.

Decisive action is urgently needed.

4.2 Current fire situation and fire management capabilities in FYR Macedonia

As a consequence of the weakened financial capabilities of all stakeholders concerned, the fire management capabilities in the country are extremely poor. In all regions visited and forestry and fire service units inspected the Fire Assessment Mission Team witnessed the almost non-existing capabilities in fire management.

Almost all local branches and fire service units had extremely small amounts of hand tools, often overaged and not functioning, limited to none means of transport, especially lack of off-road vehicles for transport of firefighters, no suitable fire trucks and limited amount of water tenders. There is no adequate personal protection equipment for the safety of firefighters available.

Special training required for professional forest (wildland) fire fighters does not exist in the country. Firemen are exclusively trained in structural fire fighting, or management of hazardous materials, but there was no indication of availability of training materials or procedures in forest fire fundamentals and suppression.

Several regional authorities underscored the lack of personnel, which is required by the Law on Local Self-government: "Fire Protection Provided by the Territorial Fire-fighting Units" i.a.w. the Law on Fire Protection (Official Gazette of the Republic of Macedonia No. 67/04), especially considering Article 6, which is stipulating the minimum number of firemen in the fire protection units i.a.w. the number of inhabitants of municipalities.

The responsible units of P.E. "Macedonia Forests" and the fire services reported that they were tackling large forest fires of sizes of up to several hundred or more than thousand hectares with virtually not tools at all. In some cases firemen had to use / borrow private vehicles to drive to the fire front.

4.3 Needs for improvement of fire management capabilities

The weak status of the forestry authorities and other forest owners, notably the private forest owners, as well as the catastrophically inadequate equipment, operational means and training of the fire service and rescue units require a swift and massive response towards the improvement of professional capacity and equipment of the authorities concerned with fire protection. The investments that will be required will be rather moderate.

5. Recommendations

5.1 Fire management training in FYR Macedonia

Given the lack of professional training of forestry and fire service personnel in the country is recommended to conduct a fire management capacity building programme for FYR Macedonia.

Given the fact that the countries in the Balkan region are suffering similar problems of shortcomings in fire management, and the fact that many fires are crossing the borders between all Balkan countries, it is strongly suggested to initiate a capacity building training programme at regional level. The programme should first focus of "training for trainers" from the Balkan countries.

This is in line with the recommendations of the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network and, among other, the recommendations of the 2007 UNDP-UNEP Fire Mission to Kosovo.³

³ UNDP / Joint UNEP/OCHA Environment Unit / GFMC, Fire Situation Assessment Kosovo, Final Report, 15 August 2007 (on file at Joint UNEP/OCHA Environment Unit and GFMC)

Given the interest and already existing engagement of the Environment and Security Initiative (ENVSEC) in addressing the increasing fire problem in the region – in particular with involvement of GFMC, UNEP and OSCE and considering the potential interests of NATO – it is recommended to implement this programme under the financing and implementation scheme of ENVSEC.

The Joint UNEP / OCHA Environment Unit and the Council of Europe (CoE) through its Euro-Mediterranean Major Hazards Agreement (EUR-OPA) have indicated a strong interest to partner in such a programme.

At academic level it is strongly suggested that the Forestry Faculty in Skopje should receive additional resources to enhance fire research and training of forestry students. Training courses for forestry students could also be conducted in conjunction with universities from neighbouring countries, e.g. in joint summer schools. This kind of academic training could be possibly financed by ENVSEC.

5.2 Fire management organization

The fire season of 2007 revealed that the land managers (forest managers, managers of other lands), who have primary responsibility for fire prevention and initial attack, need to be strengthened in performing their duties.

It is strongly recommended that the P.E. “Macedonian Forests” shall be strengthened through provision of professional training and equipment in order to improve forest fire prevention, preparedness and initial suppression capabilities.

Considering the increasing degradation and destruction of the forests of the country as a consequence of climate extremes, socio-economic changes and fire, as well as secondary damages or disasters following the fire, it should be considered to elevate the status of P.E. “Macedonian Forests” to a National Forest Service mandated to have primary responsibility and supervisory functions for forestry and forest protection, notably fire protection, in the whole country.

This would follow the principle of “land managers being responsible for fire management”. The negative experiences in other countries, notably in Greece, where urban-focussed fire services have prime responsibility for rural fire management, should be taken into consideration when taking decision to strengthen the land manager’s capabilities.

However, the improvement of efficient support of the professional and voluntary fire services to P.E. “Macedonian Forests” is very crucial.

Given the need on the one side, and the availability / willingness of civil society on the other side, to involve civil and voluntary engagement on forest fire management it is urgently recommended to implement Article 22 (1) (11) of the Law on Local Self-government: “Fire Protection Provided by the Territorial Fire-fighting Units” i.a.w. the Law on Fire Protection (“Official Gazette of the Republic of Macedonia” No. 67/04), especially considering Article 7, which is stipulating:

(1) For the purpose of extinguishing fires in woods and open spaces, under circumstances of increased danger of occurrence of such fires, the municipalities – at a request of the Protection and Rescue Directorate – shall engage seasonal firemen, who operate as part of the units of Article 5 herein. Priority in engaging seasonal firemen is given to firemen working in voluntary firefighting units and associations in which they have been active for at least two years.

It is recommended that UNDP to sponsor the national dialogue necessary for the development of a national fire management strategy. A National Round Table on Fire Management could be facilitated through the GFMC and the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network. This network can contribute with relevant expertise.

5.3 Fire suppression hardware

As reported by local / regional authorities and confirmed by the Mission, the firefighting equipment in FYR Macedonia is obsolete. In most regions the firefighting equipment is outdated, often broken.

Besides a need for fire management training there is a need to strengthen the technical capabilities of the Fire Services by upgrading the fire suppression hardware

It is suggested that UNDP take the lead to support the country in resources mobilization and procurement of services and equipment for improving fire management capabilities. This project would constitute the hardware delivery and should be closely coordinated with the “soft” component of capacity building of human resources, tentatively to be covered by the ENVSEC / CoE EUR-OPA mechanism (cf. 5.1). The hardware to be purchased would constitute a number of model units for wildfire response, fully equipped with vehicles, tools and personal protective equipment (PPE).

The purchase of hardware component through a UNDP initiative should support the Government of FYR Macedonia in making decisions for further investments in forest fire management.

5.4 Rehabilitation and securing the stability of fire-damaged forests and other lands

The rehabilitation measures to be taken in order to secure regeneration or reforestation of fire-damaged lands and to prevent secondary pests (e.g., bark beetle infestation) or secondary disasters and other detrimental post-fire effects (loss of topsoil and soil nutrients by erosion; landslides, mudslides, flash floods and extended floods as a consequence of increased surface runoff) need to be planned carefully. This task is primarily conducted by P.E. “Macedonian Forests”. The decision about the future stocking of the fire-damaged lands must be taken carefully. Pine reforestations will continue to be vulnerable to wildfire, particularly on areas with limited access, e.g. on steep terrain and lacking forest roads. It is strongly recommended to analyze the historic and potential natural vegetation of fire-affected sites in order to avoid reforestation with the wrong species (e.g. pine reforestations in places that should better be reforested with oak species), and to consider future climate conditions and the overall wildfire risk.

Securing of the stability of fire-damaged stand must include carefully sanitation cuttings, particularly for the prevention of mass outbreaks of bark beetles in fire damaged opine forests. Attention should be paid, however, to avoid cutting of partially fire-affected trees (scorched trees) which could survive if properly protected from bark beetle infestation. Monitoring of bark beetle populations with pheromone traps is recommended.

Sensitive watersheds must be reforested with highest priority in order to prevent the loss of soil and excessive surface run-off of water during heavy rainfall events. P.E. “Macedonian Forests” must be provided the necessary funding to implement the rehabilitation of the damaged areas during the winter 2007-2008.

5.5 Proposal for a EU Twinning project for fire management

As the FYR Macedonia is aiming at joining the EU, it should be considered to initiate a “Twinning” (or Twinning Light) project between FYR Macedonia and a EU member state, to adapt Macedonian legislation and practical procedures in forest and fire management. The GFMC and the Forestry Faculty of Skopje / UNISDR Regional SE Europe / Caucasus Wildland Fire Network are available to facilitate the development of a Twinning request.

5.6 Proposal for a coordinated regional (Balkan) fire management strategy

The concurrent problems and needs of all neighbouring Balkan countries to improve fire management capabilities are implying a regional approach to be taken in which the limited capabilities of the Balkan countries to encounter the fire problems would be strengthened by coordinated, collective and mutually enabling action. In 2006-2007 the UNISDR Regional SE Europe / Caucasus Wildland Fire Network developed a draft regional strategy on cooperation in wildland fire management, which is offering an initial concept of regional cooperation (Appendix 5). There is a need to further develop the strategy at inter-governmental level.

UNDP, through the GFMC and the UNISDR Regional SE Europe / Caucasus Wildland Fire Network, flanked by ENVESC and CoE / EUR-OPA, could support the endeavors to strengthen the regional dialogue and networking.

Concrete proposals for immediate action, e.g. the establishment of a Regional Fire Monitoring Center for the Balkan region or the inclusion of the Balkan languages into the international Wildland Fire Management Glossary could be implemented relatively swiftly and at moderate costs.

5.7 Proposal for a Balkan Regional Fire Crisis Conference or Summit

At the time of delivery of this report the fire season in the FYR Macedonia and neighbouring countries is almost over. From Bulgaria in the North down to Greece in the South of the Balkans all countries have suffered an unprecedented severe fire season in 2007. The severity of the fire season was an expression of the accumulated societal, economic and environmental changes in the region – and this should be evaluated. Decisive action must be taken to address the underlying causes for the extreme fires and to reduce the increasing vulnerability of forests and society to fire.

The Balkan countries have recognized the inter-connectedness and interdependence of the natural space and its protection efforts. The autumn rains have begun. The region should not go to hibernation. Instead, it is suggested to call urgently for a “Regional Balkan Wildland Fire Crisis Conference” (or “Summit”), in which highest-level possible government commitment should be sought. The summit should

- Address the underlying causes of increasing threats of wildfires to the environment and society, notably the consequences of land-use change and climate variability
- Outline the need for the development of national policies and strategies addressing land-use, forestry and forest protection, nature conservation and fire management
- Elaborate agreement for strengthening fire management capabilities in the region through standardized and joint regional training and introduction of improved technologies for wildfire suppression
- Development of border-crossing mechanisms and agreements on mutual assistance in fire emergency situations

The Global Fire Monitoring Center (GFMC) through the UNISDR Global Wildland Fire Network and its regional network – the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network – are available to facilitate this process.

This crisis summit should be co-sponsored by those who have been involved in mastering the fire crisis in the region in 2007 and / or are available to assist the region to build capabilities in fire management. It is suggested that the main actors to be invited to provide joint auspices would include, among other, UN specialized agencies and programmes (UNDP, UNEP, the Joint UNEP / OCHA Environment Unit, FAO), the European Commission, Council of Europe / EUR-OPA, ENVESC, OSCE and NATO.

6. Appendices

1. Weather pattern 2007 and data long-term average climatological data
2. Forest fire statistical data (long-term and 2007 fire season)
3. Satellite reconnaissance of fires and international assistance
4. Photographs of the mission

Appendix 1

Weather Pattern 2007 and Long-term Average Climatological data

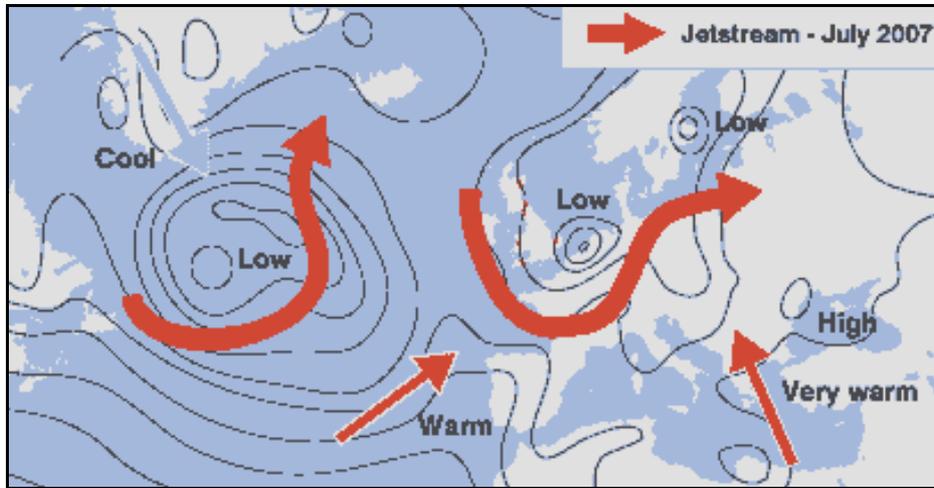


Figure 1. In summer 2007 the jet stream was flowing further south as compared to average years, allowing low pressure systems to sweep over Western / Atlantic Europe. Warmer air was pulled from Africa, which was sweeping over Southeastern Europe. Example of pressure chart: 24 July 2007. Source: UK Met Office

Table 1. Climatological information for FYR Macedonia: Average weather data provided by WMO

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	-3.6	4.0	36	10
Feb	-1.3	8.4	36	9
Mar	1.9	13.6	40	10
Apr	5.4	18.6	40	10
May	10.0	23.9	60	11
Jun	13.0	27.4	46	10
Jul	14.8	29.8	34	7
Aug	14.6	30.0	27	6
Sep	11.4	26.1	36	6
Oct	6.3	19.5	42	7
Nov	1.4	11.2	56	9
Dec	-2.2	5.3	51	11

Source: WMO <http://worldweather.wmo.int/090/c00199f.htm#wxforecast>

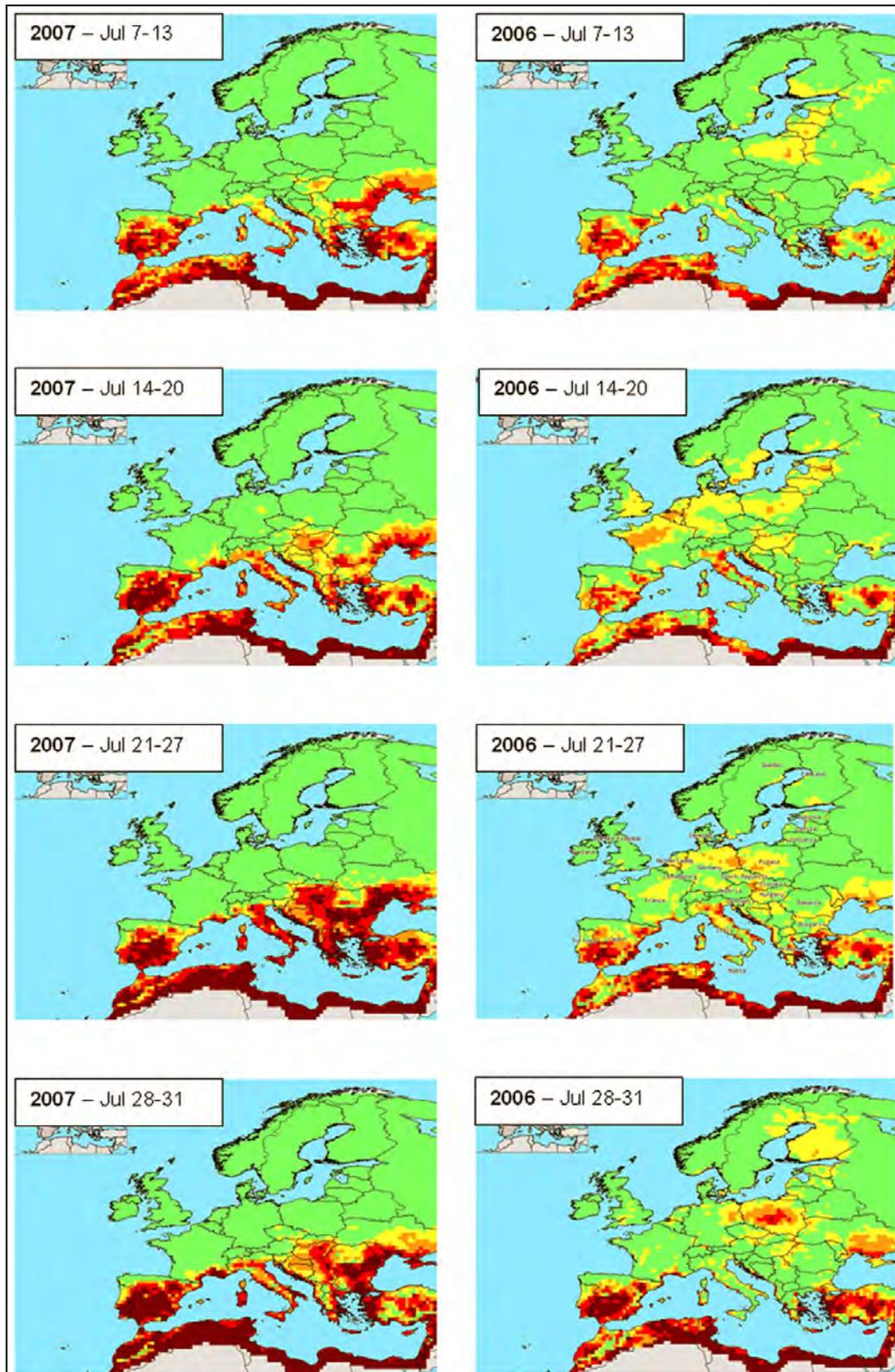


Figure 2. The extreme heat and dryness in the Balkan region is reflected by the weekly averages of fire danger level, which were determined by the Joint Research Center (JRC) using the Fire Weather Index (FWI). An example for the month of July for Europe including the Balkans (left column) as compared to 2006 (right column) has been extracted from the European Forest Fire Information System (EFFIS) Newsletter No. 7 (6 September 2007).

Appendix 2

Forest Fire Statistical Data: Long-term and 2007 Fire Season

Table 2. Overview of forest fires in the FYR Macedonia for the period 1 January to 31 July 2007. Source: Private Enterprise "Macedonian Forests". Note: 1 Euro = 60 denars. The total damages / costs of 1,255,626,112 denars correspond to 21 million Euro.

	Administrative Unit	Number of Fires	Burned Area (ha)	Burned Timber (m ³)	Suppression Costs (denars)	Total Damages / Costs (denars)
1	Malesevo - Berovo	17	1548.8	163931.0	567,556.00	75,265,125.45
2	Ravna Reka - Pehcevo	23	424.0	800.0	436,001.00	1,815,285.00
3	Osogovo - K.Palanka	15	179.7	1436.2	254,054.00	13,104,280.00
4	Kratovo - Kratovo	4	105.0	3300.0	245,719.00	1,621,159.00
5	Osogovo - Kocani	17	403.1		544,287.00	544,287.00
6	Serta-Stip	6	443.6	8446.0	342,000.00	80,534,800.00
7	Plackovica - Radovis	19	486.8	4236.0	441,100.00	1,920,900.00
8	Plackovica - Vinica	43	733.0	2000.0	750,370.00	4,802,675.00
9	Belasica - Strumica	33	2346.8	816.0	431,304.00	520,584.00
10	Salandjak - Valandovo	6	28.5	184.0	55,500.00	398,650.00
11	Kozuv - Gevgelija	14	1855.2	31254.0	565,560.00	16,583,041.77
12	Demir Kapija - D.Kapija	8	124.5	615.0	200,000.00	687,610.00
13	Bor - Kavadarci	12	245.5	197.0	334,869.00	8,077,429.00
14	Crn Bor - Prilep	18	664.0		502,070.00	502,107.00
15	Babuna - Veles	47	2396.9	40196.0	2,688,137.00	66,572,582.00
16	Sumarstvo - Sv. Nikole	7	93.0		475,800.00	475,800.00
17	Kajmakcalan - Bitola	10	6022.0	132020.0	727,600.00	298,013,230.00
18	Bigla - Demir Hisar	24	1165.6	42444.3	1,158,305.50	14,852,867.63
19	Lipa - Krusevo	2	462.0	21489.0	47,650.00	8,997,462.00
20	Prespa drvo - Resen	6	110.0		225,860.00	375,860.00
21	Galicica - Ohrid	15	452.3	1826.0	279,952.00	3,115,129.00
22	Jablanica - Struga	16	632.0	350.0	478,860.00	478,860.00
23	Stogovo - Debar	5	28.0	195.0	18,000.00	388,500.00
24	Lopusnik - Kicevo	55	1696.8	14640.0	1,506,054.00	80,474,289.50
25	Sandanski - M.Brod	32	1374.5	34022.5	1,422,720.00	49,608,975.00
26	Sar - Gostivar	17	1395.2	26317.2	334,689.00	15,818,196.00
27	Lesnica - Tetovo	41	1739.4	9417.0	176,285.00	125,956,647.60
28	Karadjica - Skopje	52	3297.9	46397.5	2,736,250.00	361,380,750.00
29	Kumanovo - Kumanovo	12	1831.0	5395.0	1,017,740.00	22,461,160.00
30	Golak - Delcevo	13	379.9	80.0	277,870.00	277,870.00
	Total	589	32,665	592,005	19,243,360	1,255,626,112

Table 3. Number of forest fires in FYR Macedonia for the period from 1989 to 2005 (Source: Ministry for Internal Affairs - MIA)

Land Use	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	Average
Deciduous	33	65	9	57	111	68	9	15	26	26	256	395	58	26	25	22	13	1 214	71.4
Coniferous	11	43	6	32	50	23	3	18	36	20	34	133	26	5	22	22	18	502	29.5
Mixed	31	73	11	98	141	65	9	40	78	73	82	454	60	21	41	26	20	1323	77.8
Shrub forests	9	37	4	26	43	14	0	5	10	11	-	-	7	4	0	1	1	172	10.1
Other	11	23	8	22	45	25	3	12	24	21	80	205	14	3	8	2	6	512	30.1
Total-forests	95	241	38	235	390	195	24	90	174	151	452	1187	165	59	96	73	58	3723	218.9

Table 4. Burned area in FYR Macedonia for the period from 1989 to 2005 (Source: MIA)

Land Use	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	Average
Deciduous	172.2	1 987.6	49.5	904.4	6 034.3	1 486.3	47.5	54.3	271.0	160.9	1062.2	16 182.9	2 468.7	472.3	491.7	890.00	766.5	33 502.3	1 970.7
Coniferous	40.5	1260.6	5.7	208.2	1 368.2	2 523.1	1.3	100.6	1 299.7	156.7	332.1	1 660.5	1 007.7	5.2	115.6	92.87	227.1	10 405.67	612.1
Mixed	118.8	876.4	35.9	7 632.9	4 446.8	1 471.8	5.4	429.8	652.7	1 282.1	343.2	17 345.4	2 888.6	111.1	3 025.8	589.18	2985.7	44 241.58	2 602.44
Shrub forests	1 258.8	1 214.0	345.0	359.6	462.9	174.3	0.0	85.0	1 138.3	21.5	0.0	0.0	77.5	44.5	0.0	1.50	1.0	5 183.9	304.9
Other	43.1	421.8	7.7	285.1	2 111.6	146.2	51.2	316.4	2 12.1	268.0	254.5	2 739.7	224.3	26.0	303.2	10.50	36.3	7 457.7	438.7
Total-forests	1 633	5 760	444	9 390	14 424	5 802	105	986	3 574	1 889	1 992	37 929	6 667	659	3 936	1 585	4 017	100 791	5 929

Appendix 3

Satellite Reconnaissance of Fires and International Assistance

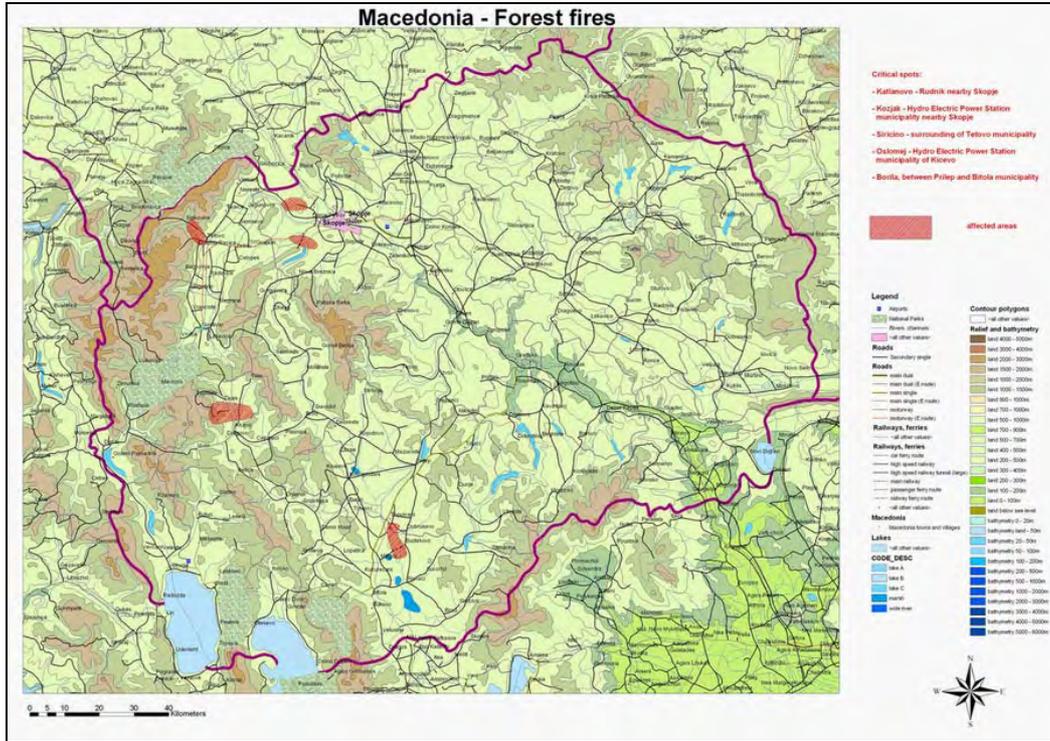


Figure 3. Fire location map provided by Relief Web (27 July 2007)

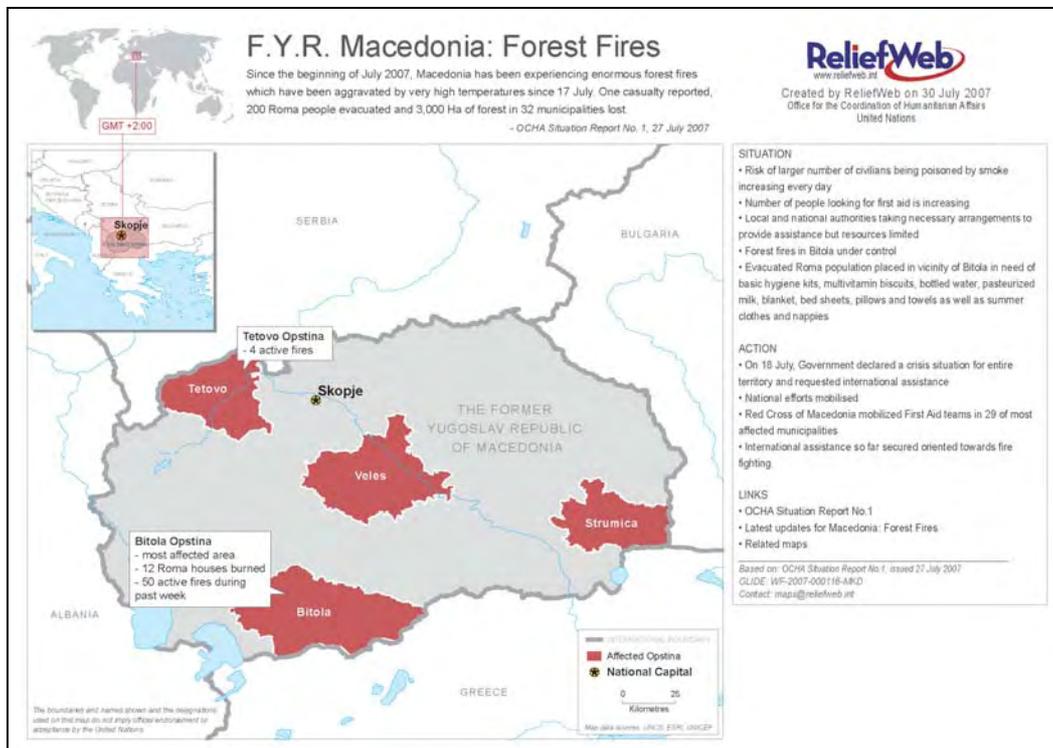


Figure 4. Fire location map provided by Relief Web (30 July 2007)

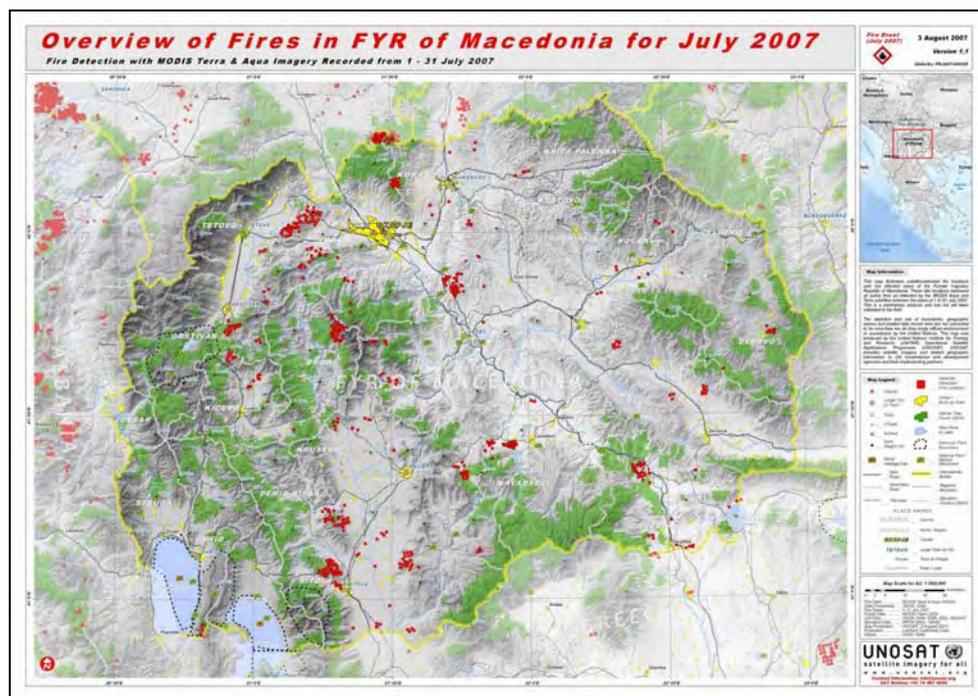


Figure 5. Fire location map provided by UNOSAT for the period 1-31 July 2007

Table 5. Received assistance for the fire crisis situation in 2007

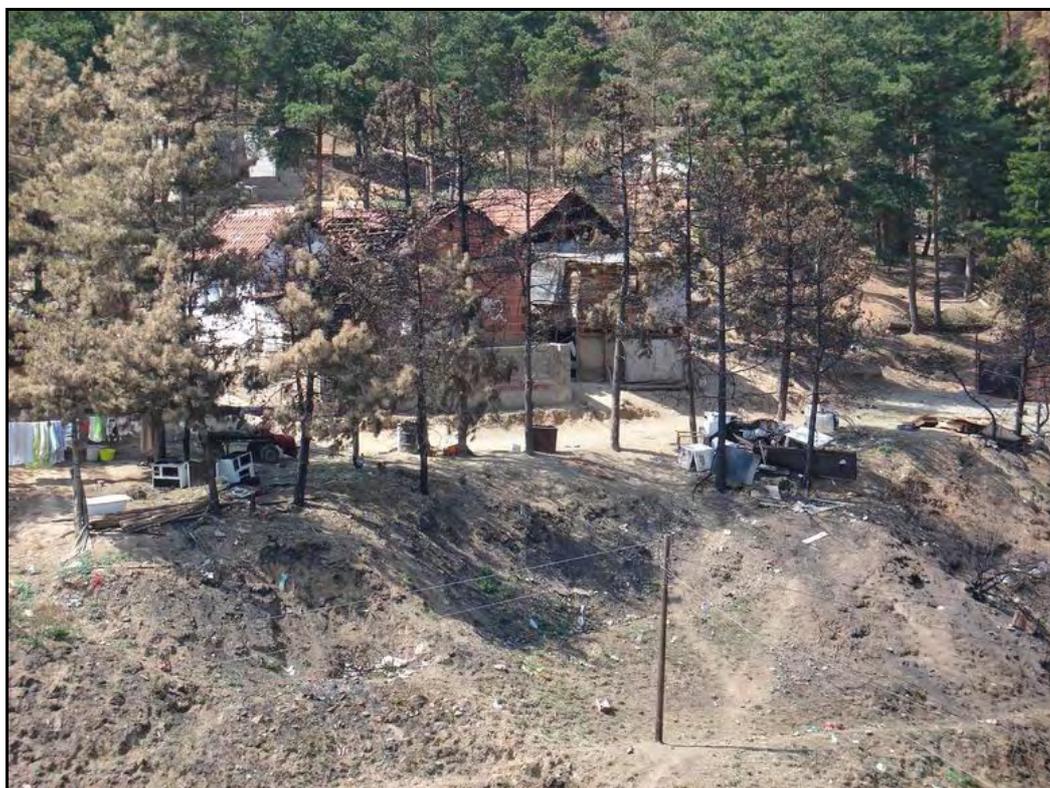
Received Assistance for the Wildfire Crisis Management						
	State or Institution	Assistance in FF equipment	Assistance in expertise	Financial assistance	Value (\$US)	Value (€)
(1)	Norway	FF equip.				494,963
(2)	Sweden	FF equip.	2 experts		110,375	
(3)	France	1 FF vehicle	6 experts			
(4)	Austria	FF equip.	2 experts			7,100
(5)	Germany	FF equip.				50,000
(6)	Poland	FF equip.				110,000
(7)	Czech Rep.	FF equip.				
(8)	U K	FF equip.	4 experts			
(9)	Estonia	/				31,956
(10)	Denmark	FF equip.				
(11)	Israel	FF equip.				
(12)	Lithuania	FF equip.				
(13)	UNDP	/		100,000	100,000	
(14)	UN OCHA	Relief items		30,000	30,000	
(15)	UNICEF	Relief items		100,000	100,000	
(16)	USAID	/		50,000	50,000	
				Total	390,375 \$US	694,000 €

Appendix 4 - Photographs

Selected photographs illustrate main fire phenomena encountered during the field mission.



Burned pine forest on a site with high erosion risk



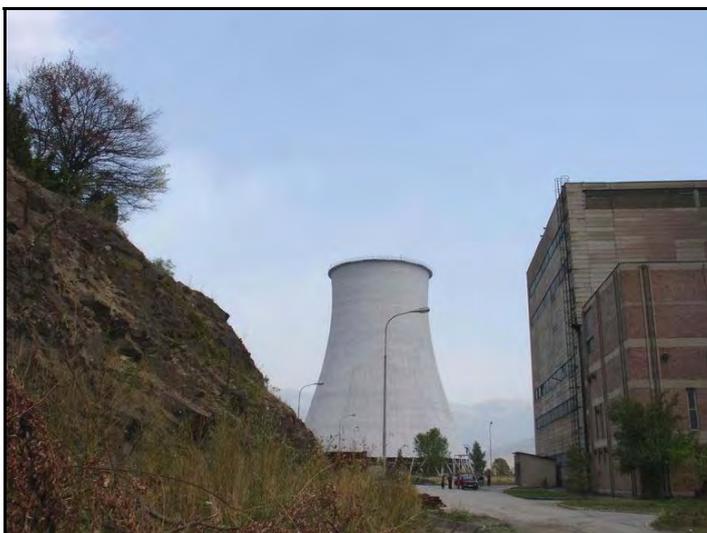
Fire-affected informal settlement of Roma at the outskirts of Bitola



Infrastructure, e.g. telephone lines and electric power transmission lines at risk



Unexploded Ordnance (UXO) collected in the surroundings of Bitola and stored in the Army Base Bitola: During the fires in July 2007 more than 70 explosions of WW-I grenades and other UXO were recorded nearby Bitola.



The electric power plant Oslovej near Kicevo was at threat to be affected by wildfires burning at the very edge of the facility (left in the photograph) by burning embers (spot fires) falling out on the structures of the power plant.

Wildfires in Turkey 2007

1. Number, Area and Types of Forests and Other Vegetation Affected by Fire

Turkey is a country with a land mass of 77.079 million hectares (ha), of which 21.2 million hectares is forested, representing about 27.2 per cent of country's total land area (Orman Genel Müdürlüğü - OGM, 2007). About 12 million ha of forested lands is subjected to and under the threat of forest fires. Fire has always had a pervasive influence on forests of Turkey and their management, consuming thousands of hectares of forest land annually resulting in high suppression costs and causing great damages in lost timber, real estate and recreational values, and even loss of life.

Forest fire activity in the country is highly correlated with weather conditions, land use practices and vegetation associations (Canakcioglu and Ozkazanc, 1997). The most fires occur where Mediterranean climate with high temperatures and low to nonexistent precipitation during fire season is predominant in the southern and western Anatolia. In the period 1937-2007, a total of 82,556 fires burned a total of 1,582,590 ha of forest land. This represents 1,163 fires on 22,290 ha annually with an average area burned per fire of 19.17 ha (OGM, 2007).

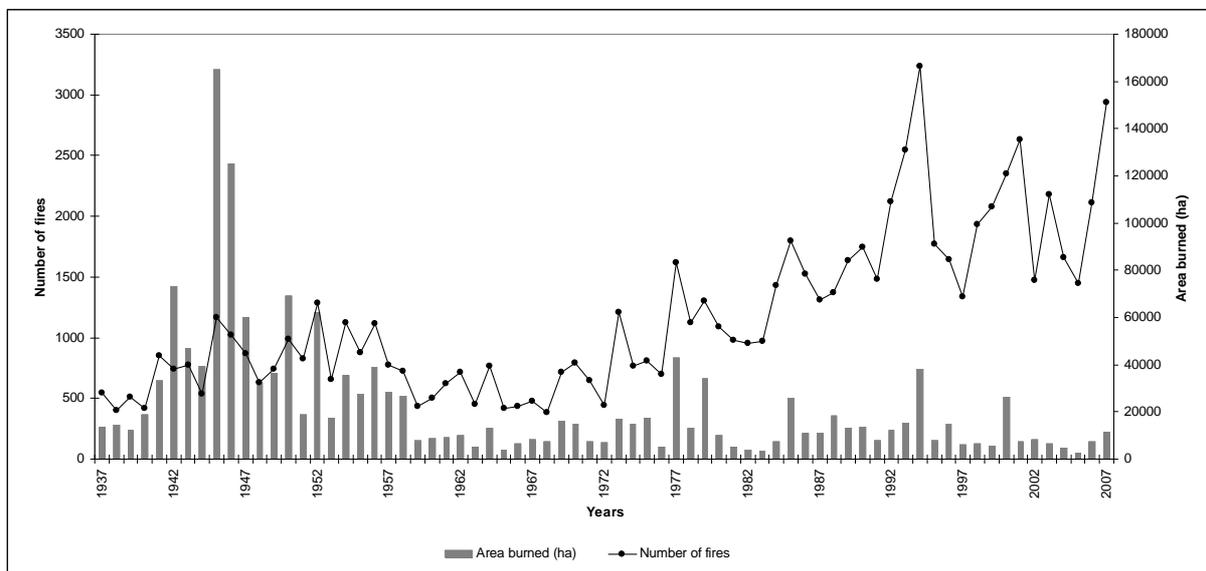


Figure 1. Forest fires in Turkey between 1937 and 2007 (Source: OGM 2007)

Average annual fire loss according to the last 10 year's data is about the 0.00061 % (Sixty one in One hundred thousand). This is a very low value compared to other countries in the Mediterranean Basin. Biggest damage was in Çanakkale (0.00183), and followed by Muğla (0.00171) İzmir (0.00139), Adapazarı (0.00130), Adana (0.00129) and Antalya (0.00118). In the period 1998-2007, a total of 20,702 fires burned a total of 87,913 ha of forest land. This represents 2070 fires on 8791 ha annually with an average area burned per fire of 4.25 ha (OGM, 2007).

As can be seen from the figures, there has been a gradual increase in the number of fire starts and a decrease in area burned. This may seem contradictory, but it is not. Thanks to the technological advances and the lack of recognition of the ecological roles of fires in forest ecosystems, fires have been successfully kept out of these systems over the last several years.

2. Causes of Wildfires

Majority of forest fires in Turkey are caused by people. Human-caused fires account for 94 to 97% of all fires, while natural agents are responsible for the remaining 3 to 6%. People-caused fires can be examined under three broad categories – voluntary, involuntary, and unknown fires. Of the human-caused fires, according to the recent statistics, 14 per cent is classified as arson, 58 per cent as negligence and carelessness, 5 per cent accident, and 23 per cent as unknown (Bilgili et al., 2004).

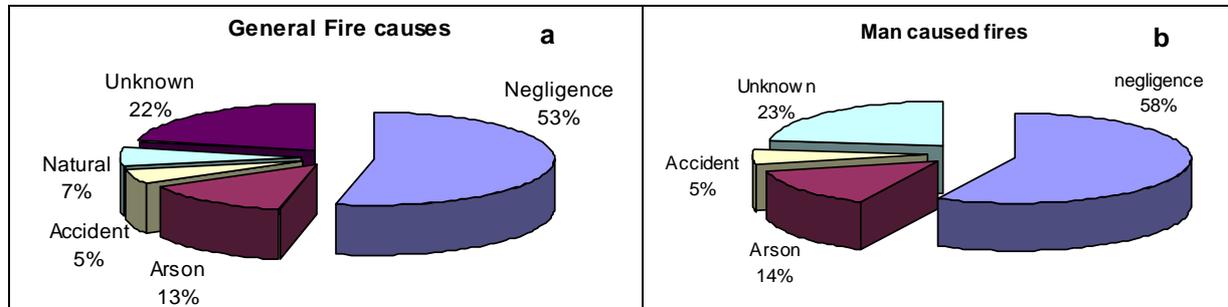


Figure 2. Fire incidences by causes: (a) general, (b) human caused fires

According to the last ten year's statistics, fire causes are: negligence and carelessness, 48 per cent; arson, 14 per cent; lightning, 4 per cent; and unknown, 34 per cent (OGM, 2007).

According to the last year's (2007) statistics, fire causes are: negligence and carelessness, 55 per cent; arson, 16 per cent; lightning, 11 per cent; and unknown, 18 per cent (OGM, 2007) (Fig. 3).

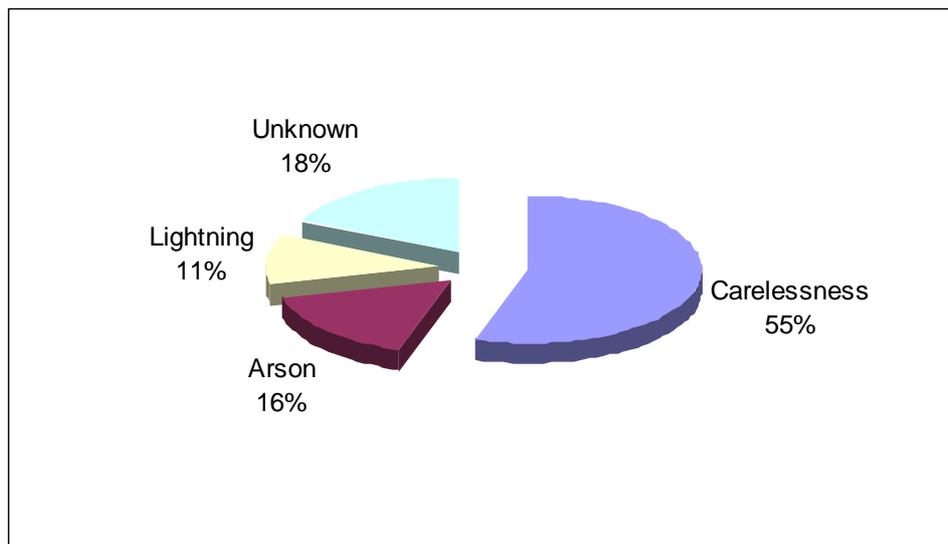


Figure 3. Fire incidences by causes in 2007

Arson fires are set for several reasons. About 7.8 million people live in 20,974 villages in or near forests (Anonymous, 2007). Socio-economic life standards of most of these people are well below the national average. People with low income and low life standards see the forests as an earning ground for their sustenance. Therefore, people set fire in the forest to create jobs that will earn them some provision or manipulate vegetation to improve and produce useful plants for their animals to graze. Personal conflicts between people and forestry officials or between shepherds or different villagers have also been reported to have been a cause for fires.

When examined in detail, it is very obvious that fire causes are closely related with land management activities, standards of living, population dynamics and associated public policies. Thus, to better understand the underlying causes of fires, the subject should be examined in relation to these factors.

3. Extreme Fires

Table 1 shows the fires burned in 2007 exceeding 100 ha. Almost all fires started in the high fire season when relative humidity was relatively low and temperature high. Coupled with the rugged topography, high winds in almost all large fires augmented the rapid acceleration of fire spread.

Table 1. Fires burned in 2007 exceeding 100 ha

No.	Regional Directorate	State Forest Enterprise	Forest Conservation Unit	Date	Time	Forest Type	Area burned (ha)
1	Balikesir	Balikesir	Balya	25/8/2007	16.15	HF	100
2	K.Maras	Antakya	Yayladagi	28/7/2007	13.30	DF-DC	105
3	Kutahya	Emet	Hisarcik	25/7/2007	14.10	HF	110
4	Istanbul	Vize	Cerkezkoy	25/8/2007	12.00	HF-DF	112
5	Bursa	Bilecik	Osmaneli	28/6/2007	15.25	HF	127
6	Denizli	Usak	Usak	18/7/2007	10.55	HF-DF-DC	130
7	Antalya	Kas	Saklikent	6/9/2007	14.15	HF-DF	140
8	Adapazari	Golcuk	Karamursel	9/7/2007	13.00	DF	144
9	Izmir	Manisa	Manisa	15/8/2007	10.20	HF-DF	156
10	Bursa	Bursa	Kestel	24/8/2007	14.00	HF-DF	168
11	Antalya	Kumluca	Akdag	21/6/2007	11.00	HF-DF	185
12	Adana	Osmaniye	Hasanbeyli	16/7/2007	16.30	HF	187
13	Balikesir	Balikesir	Akdogan	25/8/2007	15.15	HF	196
14	Mugla	Milas	Milas	15/7/2007	11.55	HF-DF-P	223
15	Amasya	Vezirkopru	Karacam	12/8/2007	14.00	HF	272
16	Adana	Saricam	Saricam	23/8/2007	17.00	P	283
17	Izmir	Izmir	Bornova	15/8/2007	11.20	HF-DF	290
18	Mugla	Milas	Bodrum	7/7/2007	11.05	DF-HF	308
19	K.Maras	Antakya	Yayladagi	16/7/2007	15.30	HF-DC	317
20	Antalya	Manavgat	Selale	8/7/2007	9.40	HF-P	321
21	Antalya	Kas	Kasaba	23/7/2007	14.50	HF-DF	324
22	Kutahya	Simav	Sogut	25/7/2007	14.45	HF	380
23	Mugla	Kemer	Kemer	19/5/2007	19.00	HF-P	390
24	Antalya	Tasagil	Burmahan	24/8/2007	11.00	HF-DF	513
25	Mersin	Gulnar	Pempecik	16/7/2007	15.45	HF	911

HF: High Forest; DF: Degraded Forest; DC: Degraded Coppices; P: Plantation

3. Fire Damages

80% of the forest fires occurred between June and October. Most of the fire damages in 2007 occurred in Mugla, Izmir, Kütahya, Antalya and Adana Regional Forest Directorates.

The budget allocated in the year 2007 for suppressing forest fires was 155 million Euros (225 million USD). Available resources included 838 fire trucks, 29 helicopters, 20 airplanes, 780 fire look-out towers, 144 water tankers, 142 bulldozers, 38 loaders, 126 graders, 115 trailers, 52 caravans, 717 motorbikes, 8,472 radio, 650 fire crews (of 5-7 men). As needed new resources are being added and new technologies adopted. These forces are allocated to each district based on fire danger levels and area in question. In addition, 1,756 km of tower road, 18,559 km fuel breaks, and 8,899 km fire breaks are in place. There are also 600 water ponds and pools.

4. Fire Prevention Measures

The year 2007 has seen more activities concerning fire prevention, pre-suppression and suppression. Many educational, social programs have been launched to increase the level of public awareness

concerning the forest fires. Many ponds have been constructed and water tankers bought in 2007. These have come in handy in fighting many potentially disastrous fires. Fire crews have been strengthened with new recruits.

5. Response to Fires

All fires have been attended to and dealt with according to the fire control plan prepared for each district. These plans envisage all the steps from observation to control and to mop-up of fires.



Figure 4. A village damaged by wildfire (Photo: OGM)



Figure 5. OGM firefighters in action (Photo: OGM)

6. National Cooperation in Responding to the Fires

Role of agencies at national and provincial level

Fire management in Turkey is a state responsibility. Duties are carried out by the state forest enterprises functioning under regional directorates. Fire control policies have been developed around a strong emphasis on total fire control as a response to destructive fires. Regardless of the high costs involved, it is the forest service department's responsibility and policy that all the required activities are planned and implemented immediately.

Risk is associated with ignition, and risk abatement involves raising the level of awareness of general public and various responsibility groups to the dangers of ignition and subsequent forest fires through education and enforcement. It is of the opinion of the forestry service that a strongly favorable public opinion is a vital necessity in any effort to reduce the number of people-caused fires.

Role of local communities

Local people are responsible by law to immediately to respond to a fire situation when and if requested. The response of the local people and communities to a fire has risen considerably in recent years. This has mostly been a result of the changing attitudes towards forest resources and of the success of the public awareness campaigns.

Non-governmental organizations help raise the level of awareness of general public and various responsibility groups to the dangers of ignition and subsequent forest fires through education and conducting/supporting relevant activities. These activities involve seminars, TV/radio programs, practical field work, and suggestions brought to the attention of policy makers.

Academia has a very important role in all aspects of fire management. However, their effectiveness has been fairly limited. Only in recent years, however, have the scientific studies been increasingly conducted and the results obtained put into practice. The most important step in this regard has been step taken for the establishment of a National Fire Danger Rating System.

7. International Cooperation

The Balkan region has seen one of the worst fire seasons in recent history. Many countries have suffered extreme losses. This has necessitated the international cooperation in fighting forest fires. In this regard, Turkey has sent help to neighboring countries (Tab. 2).

Table 2. Countries that received help from Turkey in fighting fires in 2007

Country	Resources
Syria	2 aircrafts, 4 helicopters
Greece	1 aircraft
Macedonia FYROM	1 aircraft, 2 helicopters

8. Analysis and Recommendations

Recent fire events have made it extremely clear that fire is a phenomenon beyond the national boundaries and requires immediate international attention to mitigate its negative effects and understand its ecological role in forest ecosystems. This calls for a genuine cooperation of all parties somehow affected from fires.

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Republic of Armenia – Forest Fires in 2007

Introduction

In this short report a brief assessment of fire situation in the country is given reflecting the situation by the end of 2007.

Table 1. Fire statistics of the Republic of Armenia 1998-2007

Year	Total Number of Wildfires	Number of Forest Fires*	Forest Area Affected (ha)	No. of other Vegetation Fires	Area of Other Vegetation Affected (ha)
1998	1403	32	322.65		
1999	1162	13	68.07		
2000	1203	35	25.04		18.9
2001	1290	13	126.87		139.8
2002	1003	4	5.4		0.2
2003	974	4	0.4	133	3.52
2004	1271	2	1.5	459	12.0
2005	1124	10	20.125	280	25.35
2006	1241	10	299.5	951	34.36
2007	832	1	12.5	655	

* Note: Mainly in juniper, oak and pine forests

Wildfires in 2006-2007

One of the extreme fires happened in the summer of 2006 in Meghri region, when almost 190 ha of forest and around 80 ha of vegetation were burned. The cause is unknown. The fire conditions were determined by the extremely and unusually hot, dry and windy weather conditions during summer 2007. After the emergency call, the regional authorities mobilized the fire fighting forces to suppress the fire, which took 10 days. One person was injured. Mainly oak trees suffered from the fire.

In 2007 the only fire in the territory of the Republic of Armenia occurred in the area of Yerevan forestry territory during the summer. The territory was afforested between 2004 and 2007. The main area that was burned, however, was grass and shrub vegetation, and no harm was caused to forest cultures. The fire was responded swiftly by personnel of the forest and fire services. The economic damages were negligible.

Causes of wildfires

The main reasons of forest and wildfires in the territory of the Republic of Armenia are human-ignited fires, mainly fires escaping from stubble burning or burning of post-harvest residuals on croplands, or sometimes accidental ignitions.

Fire Damages

The fire damages in Armenia have been estimated for the decade 1998-2007 (Tab. 2).

Table 2. Estimation of fire damages in the Republic of Armenia 1998-2007

Year	Fire damages			
	Forest fires		Other fires	
	Arm Dram	US Dollars	Arm Dram (millions)	US Dollars
1998	1,507,246	2,843		
1999	698,736	1,318	119.4	221,930
2000	1,396,199	2,649	411.6	781,020
2001	55,652,250	101,555	108.9	198,700
2002	314,500	600	221	384,350
2003	no damage	no damage	146.7	248,645
2004	975,178	1,735	318.9	567,440
2005	15,707,375	33,491	235.2	501,500
2006	500,241,800	1,106,729	382	845,130
2007	no damage	no damage	331	945,700



Figures 1 and 2. Typical wildfires on agricultural and pasture lands in Armenia caused by crop residual and intentional pasture burning. Photos: GFMC.

Fire prevention measures in 2007

According to the “Civil Defense Action Plan 2007” of the Ministry of Agriculture of the Republic of Armenia the regional branches of the state enterprise “Armenian Forest” (*Hayantar*), a non-profit organization, in Vayots Dzor and Lori regions of Armenia organized training in 2007 on “The suppression of fires and the organization of liquidation of their consequences”. The training was organized for the regional authorities and emergency agency employees.

Action of agencies at national, provincial and local levels

Every year *Hayantar* is preparing and distributing to its regional branches a plan of action for fire prevention and preparedness. The plan includes particularly the construction of emergency routes (roads) and maintenance / repair of the old roads, as well as the creation and maintenance of firebreaks.

The regional offices of *Hayantar* and local authorities are undertaking every year a number of activities, which include:

- Awareness raising and preparedness of the local population to the activities concerning the prevention and suppression of forest fires
- Provision of equipment and transportation, including replenishment of fuel stocks for transportation
- Preparation of rules on service, food and provision of drinking water for the supply of firefighters
- Provision of 24-hour duty in the buildings of *Hayantar* local offices and forestry units
- Organization of fire patrols in forests
- Preparation of the fire-fighting equipment and transport means for standby for quick response to a fire alert
- Forbidding the entrance of the population to the forests during the high fire-danger periods of the year

International cooperation

In 2007 there was neither assistance received from neighbor countries and other countries nor assistance provided to neighbor countries and other countries

Analysis and recommendations

At the local and provincial levels there is a need to establish separate groups in Syunik, Tavoush and Lori regions of the Republic of Armenia – the regions with the main concentration of forests – which will be fully equipped with fire-fighting equipment, transportation etc.

At the local and provincial, as well as national level there is a strong need of modern technical equipment, including fire-protection equipment, communication means and personal protective equipment (clothing), as well as transportation. Administration buildings and foresters houses are insufficiently equipped with technical and communication means.

There is a need for meetings and workshops on technical issues on national, regional and international levels. There is a need for reforestation of lands affected by the fires, joint fire research, and regional cooperation in fire, water and related environmental management.

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Review and Analysis of 40 Years of Fire Damages in Forests and Rangelands of the Islamic Republic of Iran (1968-2007)

Introduction

Out of the territory of the Islamic Republic of Iran of 136 million hectares (ha) the share of forests is 14,202,559 ha. Rangelands are covering an area of 90 million ha. 62% of the forest lands (8,855,870 ha) are located in the Zagros mountain range, and 13 percent (1,847,886 ha) in the North of the country, and the remainder (3,549,086 ha) distributed all over the country. The forest cover corresponds to 0.2 ha per capita (for comparison: globally the forest cover per capita is 0.8 ha). Iran is on 4th place of forest cover of the countries between northern Africa and Middle East.

Table 1. Forest surface in the North and the South of Iran by forest type (in ha)

Forest Type	Forest Area in other Parts of the Country (ha)	Forest Area in the North of the Country (ha)	Total	Percent (%)
Dense Forests	755,777	940,826	1,696,603	12
Semi- Dense Forest	286,846	593,927	3,400,773	23.9
Sparse Forest	7,842,183	313,133	8,155,316	57.4
Wetlands Forest	30,400	-	30,400	0.2
Planting Forest	919,468	-	919,468	6.5
Total	12,354,673	1,847,886	14,202,559	100

The area of forests in Iran has been reduced by half during the last 30 years. There are many reasons to destroy forests but one of the most important ones is fire. Fires are also affecting rangelands. The use of fire and inability to control are the main reasons for fire damages.

Materials and methods

Wildland fire statistics were collected (fire cases and burnt area) in all regions of Iran (29 provinces). Statistical data from provinces were compared and thus sensitivity to fire of provinces evaluated.

Discussion

Table 2 shows that, for example, the average of daily burned surface in the year 1968 was 3.94 ha. This daily rate has reached 122 ha in 1977. Thus, during 30 years, this amount has increased 31 times. In 2007 it decreased to 76.7 ha due to improved monitoring, protection and control by the forests and rangelands organization.

The comparison statistical data shows an increase of the average of burnt surface of forests and rangelands since the decade 1968-1976 by 7.5 times in the recent three decades (Table 2).

Table 2. Number of fire cases, burnt surface in ha, burnt surface average during 40 years per day

Time Period	Number of Fires	Total Area of Forests and Rangelands burned (ha)	Average Surface Burned in each Fire (ha)	Area Burned in each Fire (ha)	Damages (million \$US)
1968-1976	701	21,643	30.9	5.9	5.0
1977-1986	1,210	68,302	56.4	18.7	15.9
1987-1996	3,635	148,943	41	40.8	34.6
1997-2006	10,426	162,191	15.6	44.4	37.6
Totals and Averages	15,972	401,079	36	27.45	93.1

Causes of wildfires

The causes of wildfires in natural vegetation in Iran are classified as follows:

a) Human factors:

Intentional burning:

- To provide more space for agriculture and animal breeding
- Local and racial conflicts
- Conflicts between people and government and guards of natural resources

Accidental and negligent fires:

- Inattention of tourists
- Inattention of farmers, shepherds, hunters, charcoal makers, mine workers, nomads and villagers
- Throwing incendiary materials by passengers
- Inattention to using residues and pieces of trees products for creating fire
- Using fire to control harmful insects, birds and reptiles
- Use of fire by honey collectors during exploitation of natural and artificial beehives
- Explosion of dynamite by road construction and, drilling mining companies
- Children and narrow-minded people
- Fireworks in the forests and rangelands
- Military activities (use of tracer bullets and exploding land mines)
- Garbage burning
- Smokers
- Car accidents
- Explosions caused by gas pipelines crossing forests and rangelands

b) Non-human causes:

- Lightning

According to the data provided by the Organization for Forests and Rangeland Protection 2,483 fire cases that occurred between 1968 and 1992 reveal the distribution of causes (Table 3).

Table 3. Causes of wildfires in forests and rangelands of Iran

Fire Causes	Number of Fires	Percent
Intentional fire	292	11.7
Negligence	1,185	47.7
Unknown cause	995	40.1
Lightning	11	0.5
Total	2,483	100

Fire seasons

The fire seasons differ in regions throughout the country. The fire season in the northern forests and rangelands of Iran begins with the foliage loss in autumn and the influence of warm Mediterranean winds which rise temperature and decrease moisture. This situation lasts until the beginning of snow fall in winter (from 1 October to 20 December).

In other parts of country this season starts with decreasing humidity and rising temperatures from 15 April to 20 November.

Different provinces of country are divided to three groups according to sensitivity to fires:

1. Very critical provinces: These provinces are at the first place for number of fire cases and burnt surface – Kordestan, Lorestan, Fars, Kermanshah and Ilam.
2. Critical provinces: Golestan, Kohgiluyeh and Boyer-Ahmad, Chaharmahal and Bakhtiary, and Boushehr.
3. Low-risk provinces: Mazandaran, Hamedan, Hormozgan and all other provinces except the above-listed.

Analysis of damages of forests and rangelands in the past 40 years

The calculation of damages in terms of money is difficult or almost impossible concerning the intangible benefits, e.g. emotional benefits of forests like pleasure of recreation in the natural environment, damage to natural flora and fauna, soil and water resources.

However, it is possible to calculate damages of some products such as wood, provender, cosmetic and medicinal plants. All financial damages have calculated \$US 93.1 million during the last 40 years (without considering spiritual, non-tangible benefits).

According to Table 4 the annual area destroyed by fire amounts to about 10,027 ha of forests and rangelands. But the velocity of increase of these damages has been 31 times as much from 1968 until 1997. The total burned level was 1,442 ha in 1968, while this amount has been 44,596 ha in 1997.

Table 4. Calculation of burned surfaces and financial damages in \$US

Time Period	Number of Fires	Burned Area (ha)	Damages (\$US)
1347-1386 (1969-2008) (accumulated)	15,972	401,079	93.1 million
Average annual damages	399	10,027	2.3 million

Problems and barriers to improve the protection of natural resources

The main problems for insufficient protection of nature include:

- Disagreement between responsible land management authorities: Although in Iran forests and rangelands must be controlled by the Organization for Forests and Rangeland Protection there are four zones for organizing environmental protection considering native cultures of Iran. In some regions forests and rangelands have been divided among native people, and this process is continued. There is no coordination between native tribe groups and the Organization for Forests and Rangeland Protection.
- Lack of resources: Due to the lack of security guards the Organization for Forests and Rangeland Protection offenses against forest regulations cannot be encountered. In some cases officers and workers of the Organization for Forests and Rangeland Protection cannot do anything because of poverty of people. For example in provinces which tribes are living, most of people are earning for their livelihood by harvesting and selling forests and rangeland products. Preventing this will result in increase of unemployment in those regions.

- Transition and changes of jurisdiction and management responsibility from the Ministry of Natural Resources to the Ministry of Agriculture, and the separation of the Ministry of Agriculture from the Ministry of Jihad, and again merging them, were harmfully affecting the state of nature protection in Iran.

Suggestions for possible solutions

The following recommendations are given for improving natural resources and avoiding detrimental wildfires:

- Training of staff of the Organization for Forests and Rangeland Protection must be improved. Financial resources must be provided for the Organization for Forests and Rangeland Protection. Specialists must be trained at various levels, including training by institutions for higher education. For example throughout Iran there is no specialist who has a higher education in the field of forest fire science and / or management.
- The establishment of a National Fire Management Center in Iran is necessary. This Center should be connected to the Global Fire Monitoring Center (GFMC), which at present does not have classified information about fires occurring in forests and rangelands of Iran.
- In various regions of Iran trees which are resistant to fire must be recognized and be used as green fire protection belts.
- Improvement of training, research and administrative capabilities by appropriate funding to pay more attention to forest and rangeland fire in Iran.
- Adding the subject of wildland fire science and management to the subjects offered by Iranian universities.
- Prioritize definition and protection of high-risk wildfire zones in Iran, and for post-fire recovery of forest and rangelands affected by fire.

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Advance Publication of Wildland Fire Statistics for Russia 1992-2007

This advance publication is serving the increasing demands for statistical data on forest fires and fires burning other vegetated lands in the Russian Federation. Please see the sources and explanation of different datasets in the footnotes of the table.

Table 1. Comparative fire statistics for total vegetated area and forest area burned in the Russian Federation in the period 1996 to 2005, based on agency reports and remote sensing.

Year	Agency Reports based on Ground and Aerial Observations ¹			Satellite-Derived Data (NOAA AVHRR) Based on Fire Counts and Derived Area Burned ²			
	Number of Fires Reported	Total Area Burned (ha)	Forest Area Burned (ha)	Total Number of Fires (events investigated)	Total Area Burned (ha)	Number of Forest Fires	Forest Area Burned (ha)
1992	17 617	885 541	497 819				
1993	14 478	1 098 889	719 352				
1994	14 783	644 737	488 430				
1995	17 615	412 029	322 710				
1996	22 623	2 209 654	1 789 583	7 006	4 723 430	3 544	3 164 410
1997	23 090	861 148	643 969	3 402	3 546 870	1 580	2 376 490
1998	15 931	3 000 569	2 365 017	6 046	8 977 640	2 808	6 015 260
1999	18 138	711 799	533 150	7 835	4 566 080	3 639	3 059 220
2000	13 447	1 117 799	898 911	7 982	6 147 300	3 440	4 118 490
2001	14 561	1 220 305	792 357	6 335	5 212 800	3 050	3 490 560
2002	19 066	1 856 730	1 204 757	10 178	10 626 170	4 462	7 130 340
2003	21 699	2 634 722	2 071 057	15 707	17 937 800	8 852	14 510 230
2004	16 729	532 184	424 404	7 862	4 445 530	3 411	3 080 300
2005	10 923	963 000	706 900	19 526	9 288 550	7 114	5 180 400
2006	14 930	1 842 114	1 179 766	21 744	13 105 264	10 468	8 490 840
2007	9 776	1 082 517		23 024	9 975 250	10 069	6 468 880

Note: Starting in 2007 *Avialesookhrana* is providing only total area burned data

¹ Agency data provided by the Aerial Forest Protection Service *Avialesookhrana* of Russia for the fire-protected forest land under the jurisdiction of the Federal Forest Agency (Federal Forest Fund). In the average these statistical data represent ca. 90% of fires recorded statistically. The remainder of ca. 10% is data collected within the responsibility and jurisdiction of other agencies, e.g. the National Park Service.

² Satellite data provided by the Sukachev Institute of Forest, Remote Sensing Laboratory, Russian Academy of Sciences, Siberian Branch, Krasnoyarsk, Russian Federation, courtesy A. Sukhinin. The Krasnoyarsk satellite receiving station is covering the Russian Federation between the Ural Mountains in the West and Sakhalin Island in the East and recording fires and area burned independent of landownership. Compared to the data published in 2006 (Goldammer, 2006), this table includes updated and corrected data of burned areas based on a revision of the NOAA AVHRR database, using Landsat-7-ETM images. It was found that non-corrected NOAA data provide area burned exceeding 27% in comparison with Landsat data. The recalculation of data derived from active fire data involved the application of sub-pixel multi spectral methods for estimating the area of small fires and for correcting the areas of large fires. The daily geolocation of each fire line (fire edge) of fires, which continued several days, was corrected. In conclusion it is stated that due to low spatial resolution of AVHRR and the non-precise geolocation of AVHRR-derived fire sites a systematic mistake led to an overestimate of the burnt area as published earlier (Goldammer, et al. 2005). Values of burnt areas have been corrected for the Siberian Federal District, Yakutia and Far East. The number of fires was also corrected by combining separate single active fire signals with the nearest cluster of recorded

The following maps show examples of regular updates of fire information in the Russian Federation by the Global Fire Monitoring Center (GFMC). The examples are taken from the daily SITREP of 7 May 2007: http://www.fire.uni-freiburg.de/GFMCnew/2007/05/0507/20070507_ru.htm.

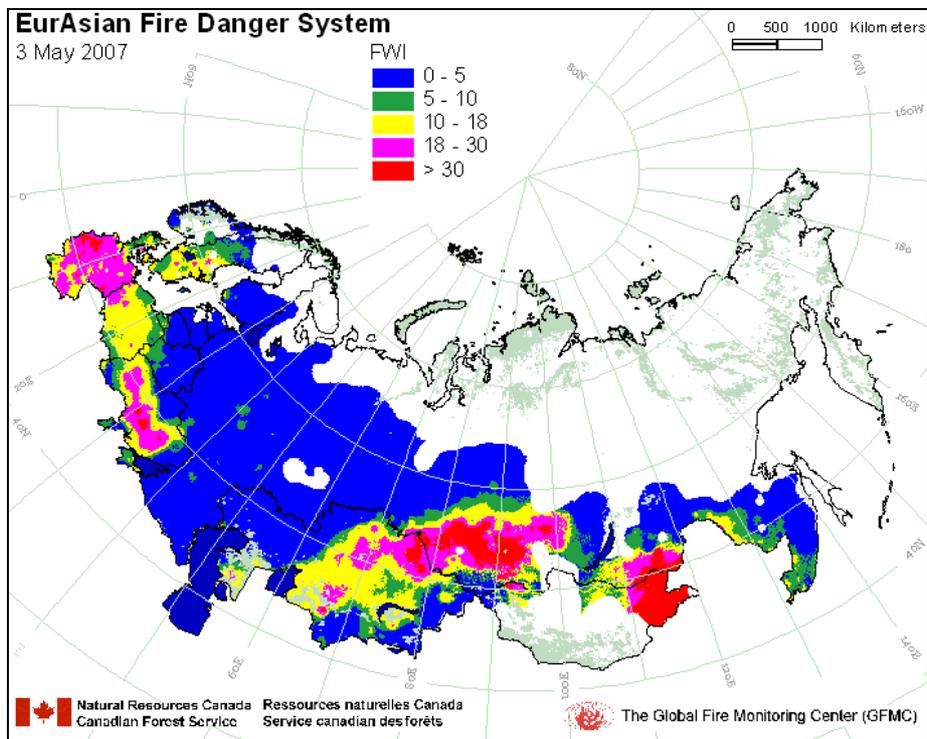


Figure 1. The Eurasian Fire Weather Information System is based on the Canadian Forest Fire Danger Rating System (CFFDRS) produced by the Canadian Forest Service and accessible through the Global Fire Monitoring Center (GFMC). This map shows a typical daily forecast of the Fire Weather Index (FWI) for 3 May 2007. Source: GFMC (<http://www.fire.uni-freiburg.de/fwf/eurasia1.htm>)

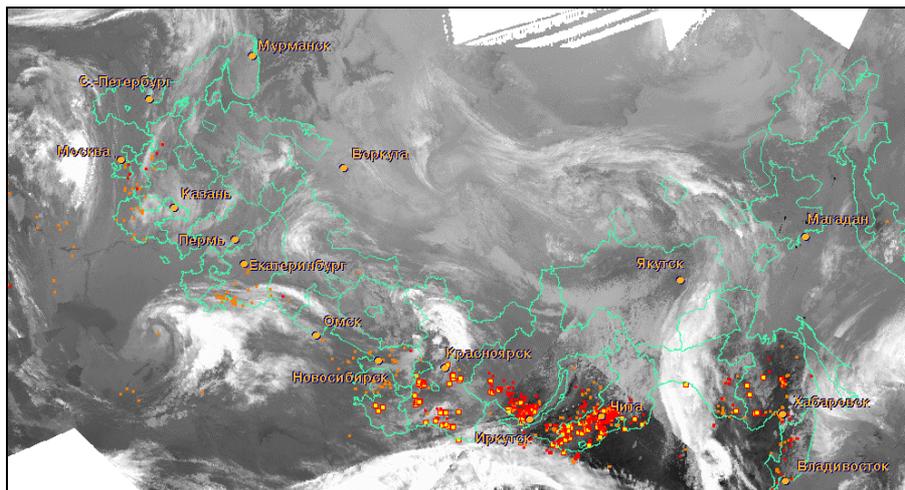


Figure 2. This satellite (NOAA 12&14 AVHRR) composite of 7 May 2007 (04:00 GMT) is an example of daily satellite images published by *Avialesookhrana*. The red squares indicate locations of active fires depicted by the MODIS sensors.

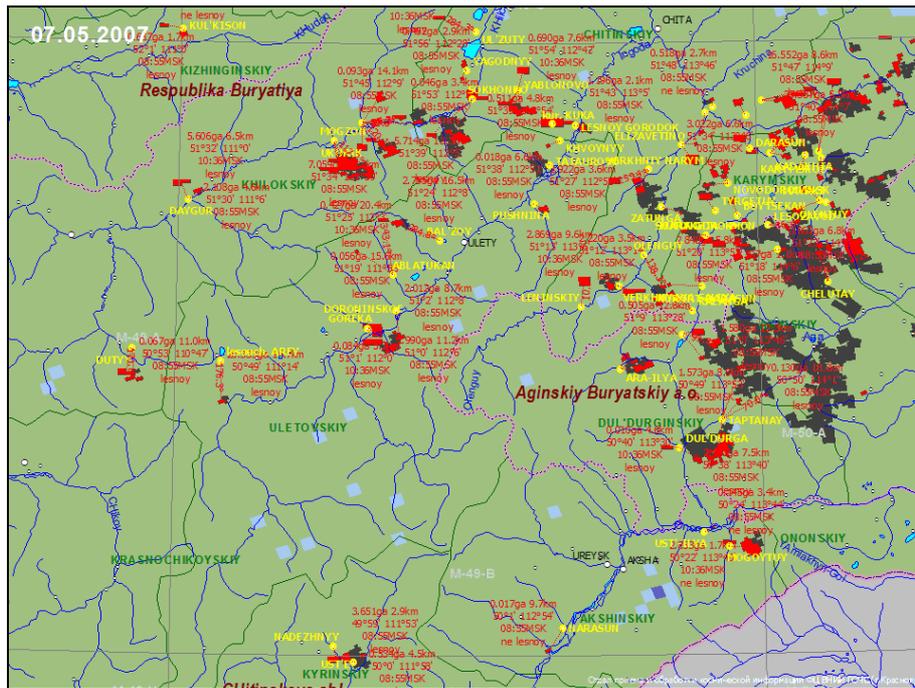


Figure 3. Example of a detailed fire maps produced by the Fire Laboratory of the Sukachev Institute of Forest, Krasnoyarsk, in collaboration with the Emergency Situation Monitoring and Forecasting Agency, Krasnoyarsk. The maps are produced on the base of satellite data (classification by the NOAA AVHRR). They show the fire locations (by latitude and longitude) and the area affected by fire (red signature = active fires of the day; black = area burned during previous days, size in ha). The red arrow at each fire location points to the nearest populated place. The active fires are derived from the MODIS sensors.

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RESEARCH & TECHNOLOGY

An Innovative Conceptual Model of a Forest Fire Management Information and Decision-Support System for Brandenburg State, Germany

Abstract

Research and development conducted within the Forest Fire Cluster of the German Research Network on Natural Disasters is built on a number of separately evolved concepts that were integrated in a cooperative research project. The Forest Fire Cluster has the responsibility of three major components. The first component consists of an innovative conceptual model for a fire information system and decision-support for early warning, monitoring, information management and simulation of wildfires in pine forests of Brandenburg State, Germany. The second component provides the link between the locally applicable system and a global fire information system provided by the Global Fire Monitoring Center (GFMC). The third component includes modelling of historic occurrence and future trends of fire occurrence due to regional climate change and is implemented by an associated project of the Potsdam Institute for Climate Impact Research (PIK), and it is published separately.

The first component is composed by a number of different modules. Firstly, it includes the adaptation of established fire behavior simulations models (BEHAVE, FARSITE) implemented by the Fire Ecology Research Group. For the first time a fire behavior model has been applied for the specific conditions of pine forests in the eastern, continental part of Germany, including the interspersed heathlands that constitute an important carrier of a wildfire at landscape level. The characteristics of these forests are quite typical for temperate-hemiboreal pine forests of Eurasia. Secondly, it includes a fire detection component (Automated Fire Detection System - AWFS) implemented by the German Aerospace Center (DLR). The development of the AWFS meets the requirements for fast, cost-effective and reliable fire detection system. And thirdly, it includes a fire danger rating and forecast system implemented by the (German Meteorological Service - DWD). The national fire-danger rating system has consolidated during the project lifetime. During the research project the work of the Global Fire Monitoring Center (GFMC) constituted the link from national to international levels.

The value added by the research project is a mutual support of individual research projects and their final merging into a comprehensive decision-support tool for fire management. Insight gained by the research project concerning the operational use of satellite remote sensing information in the management of active wildland fires will be useful for the development of urgently needed operational spaceborne fire systems.

Keywords: Forest fire, wildland fire, decision support, fuel classification, fire behavior, fire weather, fire detection, fire modelling, dispatch, remote sensing.

1. Introduction

The current high probability of forest fire occurrence in Brandenburg, Germany resulting in part from low precipitation, sandy soil sites with low water-holding capacity, and the fire hazard of the prevailing fire-prone pine forest stands, might further increase due to climatic change (Thonicke and Cramer, 2006). The cluster "Forest Fire" within the German Natural Disaster Research Network (DFNK) analyses current fire hazards and provides tools required for advanced operational decision support for wildfire response. This cluster research has the responsibility of three major components. The first component consists of an innovative conceptual model for a fire information system and decision-support for early warning, monitoring, information management and simulation of wildfires in pine forests of Brandenburg State, Germany. This component includes the adaptation of established fire behavior simulations models (BEHAVE, FARSITE) implemented by the Fire Ecology Research Group, a fire detection component (Automated Fire Detection System – AWFS) implemented by the German Aerospace Center (DLR) and a fire danger rating and forecast system implemented by the (German Meteorological Service - DWD). The second component provides the link between the locally applicable system and a global fire information system provided by the Global Fire Monitoring Center (GFMC). The third component includes modelling of historic occurrence and future trends of fire occurrence due to regional climate change and is implemented by an associated project of the

Potsdam Institute for Climate Impact Research (PIK); the report of the third component is published separately.

Accordingly, the structure of this work follows this general cluster scheme and it is presented in sections each one corresponding to a specific issue raised in each component. To help the readers follow we briefly present this general scheme which it is distinguished into the research components for building a fire information system and the implementation of the fire information system. The former consists of three modules that is fire behavior simulation models, automated fire detection system, and fire danger rating and forecast system. The concepts, methods and results of each one of these modules are presented in details in the following corresponding sections. The implementation of the fire information system operates as an umbrella and intends to put together all modules by providing a common basis for their requirements and needs.

What it is aimed by the implementation of the forest fire management information and decision-support system is a multi-function based system to cover not only the fire behavior modelling-simulation part but to cover also various research and applied issues in wildland fire management. This fire information system could be also utilized as a warning solution by estimating fire risk potential given that a network of weather stations can be online connected with it. The ability to simulate a real process under hypothetical scenarios can help to acquire a prior knowledge about the effects and outcomes resulting from such processes and contribute for a better fire management and planning. An optimized dispersal of fire fighting forces especially under conditions of limited resources can be achieved by utilizing a prior knowledge of fire behavior acquired by the simulation. The fire simulation provides a lot of insight of what has to be expected from a particular fire situation, not only in terms of the physical parameter of a fire (rate of spread, intensity). The simulation on a landscape scale allows the prediction of fire direction and its behavior in the field setting. Dispatching of firefighting resources will be made much easier and effective.

2 Forest and Heathland Characteristics in Brandenburg, Experimental Site of 2001

The Forest Fire Experiment 2001 was conducted at various forest stands that have characteristics typical for extended pine forest stands in Brandenburg State, Germany. For the development of a fire behavior model specific data are essential. As data like fuel load, rate of spread, flame length, temperatures and fire weather were not existing, live burning experiments were conducted to collect these input-data.

The experimental sites of 2001 are owned by Vattenfall Mining Europe (former Lausitzer Braunkohle AG) open-cast coal mining enterprise near the city of Cottbus (51°47'03"N, 14°24'20"E). The location and characteristics of the experimental plots, each between 0.3 ha and 1 ha surrounded by a clearcut buffer zone, provided suitable conditions in terms of safety for an experimental forest fire. Three of the plots were up to 100 years old low-productivity Scotch pine (*Pinus sylvestris* L.) stands with minor dimensions, typical for the region. The fourth plot was a 15-years old *P. sylvestris* stand. The fuel bed at all four plots consisted mainly of grass (*Calamagrostis* spp., *Deschampsia* spp.), forest litter and dead downed woody material. The fuel load (available fuel for the experimental fire) varied from 5 to 15 t ha⁻¹.

For the validation of a heathland fire model experimental fires were conducted in continental heathlands (*Calluna vulgaris* (L.) Hull.) in the Federal Forest Service District Lausitz in summer 2002. For these experimental fires the Federal Forest Service provided three plots (0.5 ha each) with homogeneous *C. vulgaris* cover.

The purpose of a heathland model was to include the heathland-forest interface in the decision support system in case of catastrophic wildfires. Open sites covered by heather vegetation located between forest complexes are suitable to rapidly carry a wildfire from a burning forest to the adjoining forest stand. The fuel loads on the heathland plots ranged between 9 and 15 t ha⁻¹.

Both experimental areas are located in the south-eastern part of Brandenburg State, a region with a very low level of precipitation and sandy soils with little water storage capacity. The climatic conditions for both experimental sites are as follows:

Climatic zone:	medium-dry lowland climate
Average temperature (Cottbus):	8.8 °C
Average annual temperature scale:	19.3°C
Average annual precipitation (Döbern):	627 mm
Precipitation during the vegetation period:	316 mm

The combination of the site characteristics with the inherent characteristics of the *P. sylvestris* stands and the *C. vulgaris* ecosystems result in a high wildfire hazard. Figure 1 provides a scene of the forest fire experiment conducted for the research project in 2001 that shows the spatial arrangement of surface and live crown fuels that lead to high-intensity crowing fire.

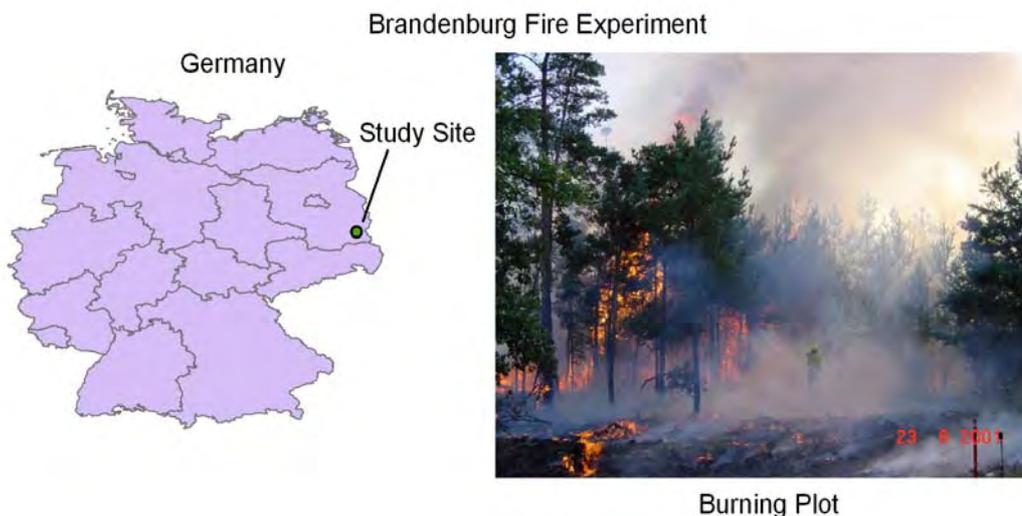


Figure 1. View of one of four burning plots of the Brandenburg Fire Experiment, 23 August 2001. The experimental site was structured inhomogeneously, thus allowing to observe a range of different fuel and fire behavior conditions.

3 The Research Components for Building a Fire Information System

3.1 Automated Fire Detection System AWFS

The Automated Fire Detection System AWFS (Kührt et al., 2000) provides the fire detection and location component of the Forest Fire Management Decision-Support System (Fig. 3). The AWFS was designed to meet the following technical requirements specified by German forest authorities:

- Automatically recognize smoke formation of 10 m expansion within a radius of 10 km and within 10 minutes after becoming visible
- High reliability in respect of fire recognition
- Acceptable rate of false alarms
- Localize the source of the fire
- Easy maintenance
- Automatic transmission of smoke data to a control center
- Full record-keeping of all events
- Data transmission to control center must enable the operator to independently evaluate the potential hazard
- The costs should be lower compared with the conventional method (fire detection towers operated by personnel)

Technical systems for forest fire detection use CCD cameras, infrared sensors, and spectrometers for detecting the smoke gases, laser backscattering, or other methods. AWFS tested in Germany is a system based on a high-resolution Frame Transfer CCD camera with special red-free filter which was

originally developed for space missions (Michaelis et al., 1999). AWFS detects fire by the trail of smoke within some minutes after its visibility. One system controls an area of about 300 square kilometers. The camera scans the forests from the top of the observation tower. The pictures are resolved with 14 bits and transmitted via optical fibers to the computer unit which is located in the tower. Here they are analyzed by specially developed software. At any detected smoke formation, compressed pictures and further details (time, position) are reported to the control center, where they are processed in a PC and displayed on a monitor. With a number of computer-assisted supports the operator is able to make reliable decisions.

3.1.1 Tests and results

AWFS was installed and tested on three observation towers in the State of Brandenburg, Germany, during the four forest fire seasons (1999-2002) and with special test activities. One of these activities was the Brandenburg fire experiment on 23 August 2001.

Each of the more than 120 fires which arose in the observed region of about 1000 km² during the test period was recognized within some minutes. The false alarm rate due to special weather conditions and harvest activities (dust clouds) commonly remained below 2 %, which is well acceptable for the operator who evaluates the alarms of several systems and calls the fire brigade.

The absolute bearing exactness of every camera is better than 1°. Therefore, several systems can locate the source of fire with approximately 100 m at a distance of 10 km. An impressive example for the precision of locating fires was a smoke signal of a structural fire in a small town in Brandenburg State, several kilometres away from the observing towers. With the intersection of bearings from two towers and the use of the digital map it was possible to determine the name of a short street in the town where the fire had started. The fire department was alerted immediately.

In the forest fire experiment in 2001 AWFS detected all four experimental fires within one revolution of the camera, i.e. within seven minutes. In one case the alert was already given about one minute after the smoke came up.

3.2 Fire Behavior Simulation Models

Since no adequate models exist to describe fire behavior under central European conditions, models developed and successfully applied in other regions had to be used and adapted. The standard software BEHAVE developed at the U.S. Forest Service Intermountain Sciences Laboratory (Rothermel, 1972) provided an appropriate tool, especially since they are representative for homogenous ecosystems and fuel arrangements. Predicted fire behavior parameters from the BEHAVE model were compared with those observed in Brandenburg's pine forests and heathland fires.

In a subsequent step, a fire dispatching and modelling system was created with FARSITE (Finney, 1998) at the forest district level. The FARSITE model contains the same algorithms and formulas as BEHAVE, but can be used to simulate fire on a range of landscape features with different fuel models using a GIS-approach. Thus, the data have to be prepared in raster format. The input data sets contain information about elevation, slope, aspect, fuel type, crown closure, stand height and crown bulk density (Finney, 1998). The fire itself is modelled as a moving elliptical wave, the shape of this ellipse is determined by wind and topography (Huygens's principle, cf. Richards, 1990, 1995).

The work presented in this section describes the construction and testing of new and appropriate fuel models through fuel inventory and comparisons of predicted versus observed fire behavior parameters. Fuel models are one of the basic inputs to fire behavior simulation modelling and they are described by a number of parameters associated to fire propagation dynamics.

3.1.2 Field inventories

Fuel sampling within 35 pine stands in the region was conducted with the transect method by (Brown, 1974). A classification of fuels is possible into one of the four time-lag classes (1, 10, 100 or 1000 hours). The time-lag is defined as the time period required for a fuel particle to reach approximately 63% of the difference between the initial moisture content and the equilibrium moisture content in a different milieu (see Byram, 1963). This characteristic of the fuel particle is strongly correlated to its diameter, so in fire management one estimates the time-lag period by measuring the particles'

diameter. Dead and downed woody fuels have been grouped into classes that reflect the rate at which they can respond to changes in atmospheric conditions (i.e., 1-hour = <0.6cm, 10-h = 0.6-2.5 cm, 100-h = 2.5-7.6 cm and 1000-h = 7.6-20.3cm diameter).

Additionally, grass and duff sampling was done on 0.5 m² plots within the stands. The entire above-ground material was sampled to determine the oven-dry weight (load per ha).

The pine stands were classified using cluster analysis into six groups. Factors determining grouping were stand age and the time since last thinning. In young pine stands (<20yrs.), the litter layer consisted mainly of 1- and 10-h fuels, while grasses were not established yet. Older stands (21-40 yrs.) are structured similarly, but with higher amounts of available fuels. In later stand stages (41-60 yrs.) grasses and shrubs invade due to increased light availability on the forest floor. Old stands are characterized by thick duff layers, a continuous grass layer and less dead and down material. Very high amounts of dead and down material was observed in stands where thinning was conducted before their fifth year. Usually, thinning take place from stand age 35, so that younger stands are not affected. For detailed information on fuel classification in pine stands and other parameters included in the modelling process see Hille and Goldammer (2002).

Heathlands are rather homogenous fuels of a single species. The shrub *Calluna vulgaris* is classified as 'live woody fuel', dead parts of the plants and litter beneath them are considered as 1-h fuels.

Two of the created fuel models were actually validated in the field. Fuel model 23 was tested during a forest fire experiment in summer 2001 (Goldammer et al., 2001). The heathland model 26 was validated in summer 2002. Descriptions of all fuel models developed are summarized in Table 1.

3.2.1 Experiment results – Fuel model validation

Figure 2 shows the simulation results with the measured fuel and weather data during the fire as input into the BEHAVE-model and the observed fire characteristics. For the conditions measured during the fire, the BEHAVE-model calculates a fast increase of fire spread for higher wind speeds, the pine model #23 being more influenced by wind speed than the heathland model.

We observed a high variance of observed spread rates, which was caused by fuel inhomogeneity and short-time changes in wind speed. Therefore, the observed values are visualized by ranges (ellipsoids in Fig. 2). For the pine model #23, the simulated fire spread for a range of wind speeds (line in Fig. 2) goes right through the cloud of observed fire spread (ellipsoids). In heathlands, the predicted rate of spread is below the observed average spread by ~20%.

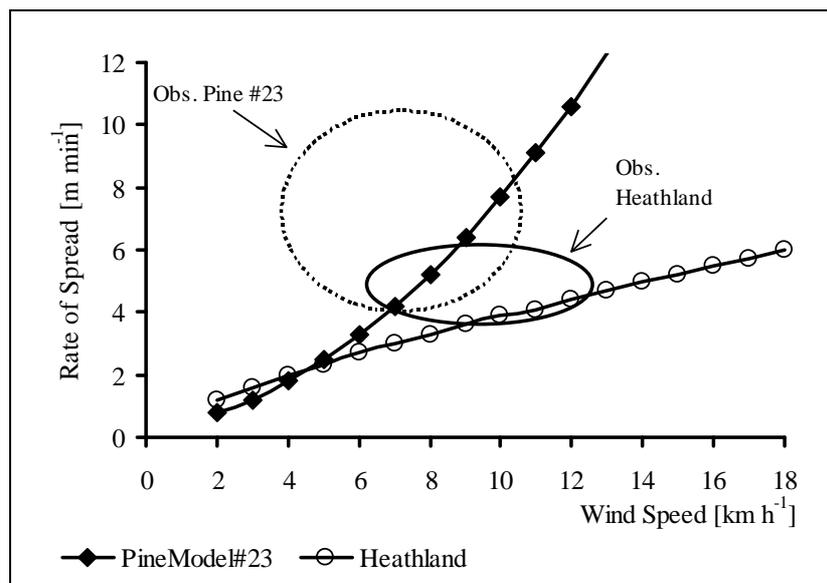


Figure 2. Simulated fire spread (lines) for the two tested fuel models and the observed data from the fire experiments (ellipses). Due to a high variation in wind-speed during the experimental burns, it was impossible, to measure the exact wind-speed and the time when rate-of-spread measurements were taken. Therefore the range of wind speed during the experiment and the measured spread rates are presented here.

Given the high variability of fuel and wind, the fire behavior is well met with the two models. Especially for the pine model #23, the calculated spread rates and flame lengths (data not shown) are in range of the observed values. We therefore assume that also the other created fuel models for pine stands (Tab. 1) will give reasonable results in predicting fire behavior, although they are not validated yet.

Table 1. Fuel models for pine stands of different age and continental heathlands. Fuel loads of the different fuel classes were used as the main input parameter in FARSITE. Fuel model 25 corresponds to all stands independently from their age.

Model #	Stand Type	Grass	1-h	10-h	100-h	Live woody	Fuel bed depth m
		t ha ⁻¹					
21	<20 yrs.	0	7.81	7.61	0	0	0.15
22	21-60 yrs.	0	8.06	11.7	4.09	0	0.2
23	61-100 yrs.	0.78	8.13	13.43	2.56	0	0.2
24	>101 yrs.	0.54	11.61	17.84	1.02	0	0.15
25	Thinning <5 yrs.	0.42	10.27	20.57	6.47	0	0.3
26	Heathland	0	3.20	0	0	9.60	

3.2.2 Simulation results – Model application

Using the results and the gained experience of the BEHAVE modelling, a FARSITE simulation was created. On a 1000 ha former military bombing range, covered with pine forests and extensive heathland areas (Federal forest in the Lausitz region, Eastern Germany), fuel and stand information was collected to allow a classification by fuel models specified in Table 1 (see also Burgan and Rothermel, 1984).

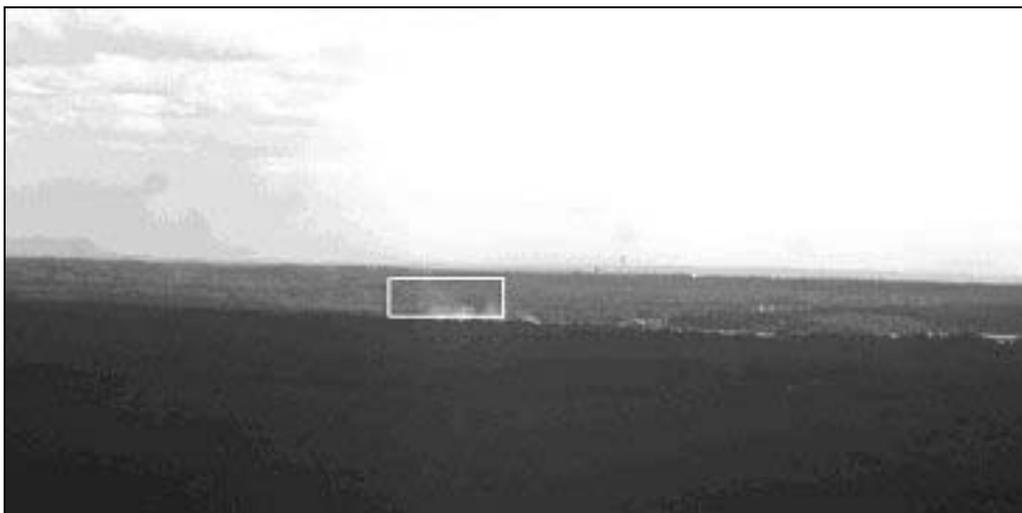


Figure 3. Screenshot of the workable FARSITE 2-D landscape view. Colours represent different fuel models. Forest roads and fire barriers are displayed as grey thin and thick lines, respectively. Two ignitions are modelled for 6 hours under dry weather conditions with strong winds from the west. The two fires are not stopped by forest roads, only the wide fire barriers of bare mineral soil (30 m wide) are able to stop fire's spread.

For the fire simulation, a digital landscape was created, using available information such as maps, digital elevation models, stand boundaries, roads etc. A raster grid of 6 x 6 m was chosen to be able to represent even small compartment and fire breaks (which are 30m wide in reality) within the study area. Figure 4 shows the workable raster view of parts of the simulation area.

The FARSITE model is very useful in extreme fire weather situations, where several fire suppression resources have to be positioned at places where they can reach high effectiveness. One scenario is presented in Figure 4: Under dry conditions in late summer (Temp. 30° C, RH below 50 % and strong winds from the West [17 km h^{-1}]) two ignitions were observed by the Automated Fire Detection System (cf. para. 3.2). The coordinates are imported into FARSITE and the simulation runs for six hours.

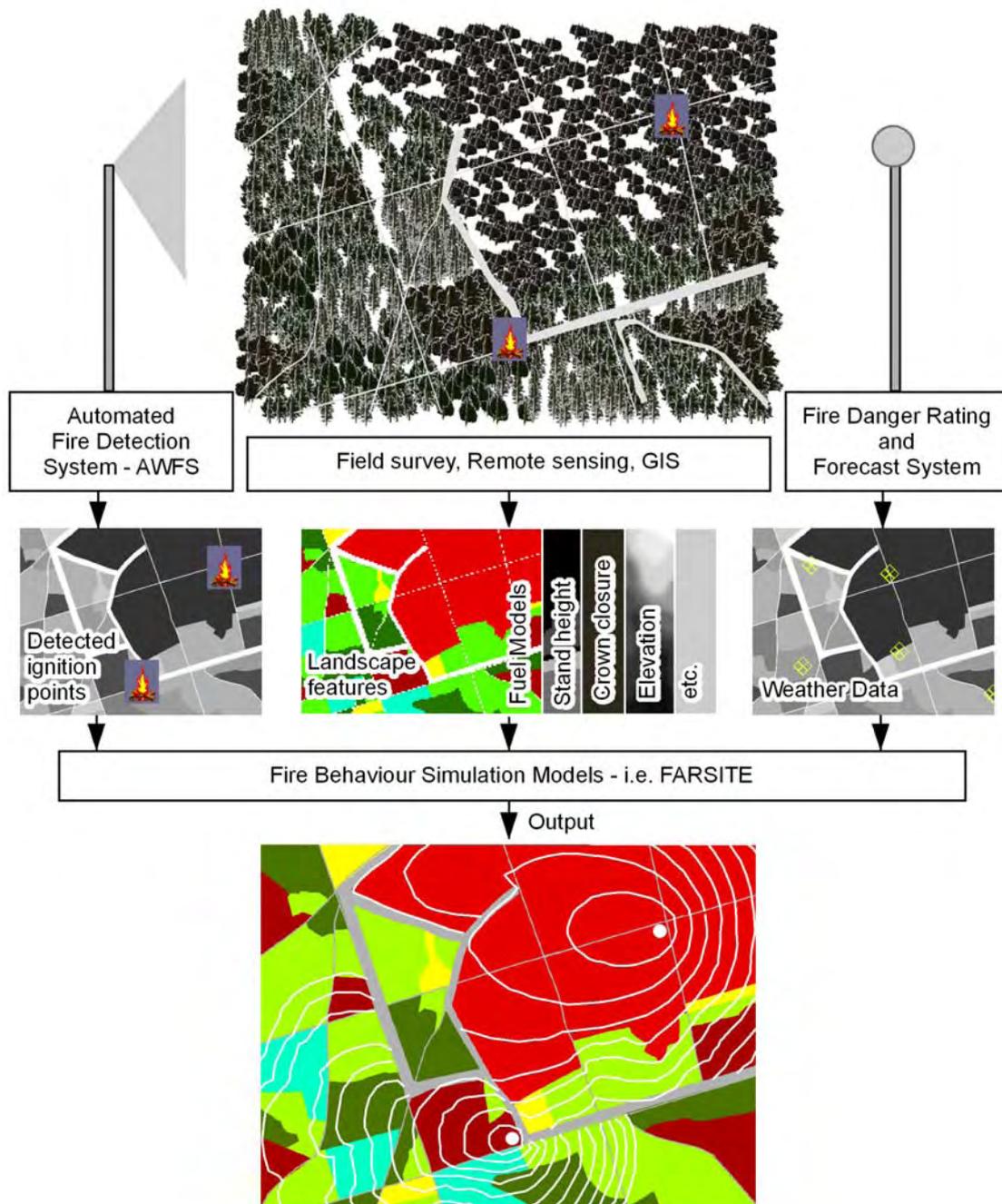


Figure 4. Visual impression of forest fire smoke detection by the AWSF at start of the 2001 Brandenburg fire experiment.

FARSITE calculates the expected spread of the fire in 30-minute intervals, presented as thin white lines in Figure 4. The model outputs reveal that the forest roads are not able to stop or slow down the

fire. The fast fire spread in the heathland (Mod. 26) makes suppression very difficult and dangerous. Therefore fire suppression resources have to be positioned at the wide fire barriers (30 m wide fuel breaks) in the sampling area (grey areas).

The second ignition in the southern part of the test area occurred in a pine forest. Here, the spread is slower, but without suppression activities, the fire would not stop at the forest roads, too. Under a situation, where suppression forces are limited, one would decide to locate all engines around the forest fire and trust on the effectiveness of the fire barriers, which will stop the heathland fire according to the simulation.

3.3 Fire Danger Rating and Forecast System

It is commonly known that some of the facets of weather support the ignition and propagation of forest fires: on the one hand, lightning strikes may directly ignite fires, and on the other hand, precipitation and evaporation affects the water content of dead and living vegetation and therefore indirectly controls the success of anthropogenic ignitions. Additionally, air motion influences the oxygen supply of the source of the fire and the spreading of the fire. Finally, fair weather means that the number of people frequenting the forests increases and permits a broad spectrum of activities of foresters and farmers (on neighbouring farmland), so that the number of potential ignition sources (fire risk) increases. In order to prevent fire losses, the objective of the national weather services is to forecast the weather-dependent forest-fire risk and to issue fire-weather warnings to fire-fighting agencies, forest authorities, emergency services and the public when the weather becomes critical.

3.3.1 Implementation of the national to local fire-weather danger forecast

Within the framework of the German Weather Service (Deutscher Wetterdienst – DWD) operational forest-fire danger forecast are currently using domestic and foreign fire-weather ratings, such as the German M-68 index and the Canadian Fire-Weather Index (FWI) (Wittich, 1998). The indices, together with additional meteorological information, are sent to forest authorities and disaster control centres of the Ministries of Interior of the Federal States of Germany so that they can issue the necessary instructions.

During the fire season the DWD daily issues the M-68 index via the internet under <http://www.dwd.de/WALDBRAND> (Wittich, 2002). Figure 5 shows the danger-rating chart for Germany on 5 June 2002, containing five risk levels (level 1 = low danger, ..., level 5 = extreme danger). Clicking on one of the ~ 200 station circles, one can get a time series over several days, which is composed of the current-day index, the index of two previous days and that of three forecast days, thus illustrating the temporal course of the forest-fire potential.

For the implementation of a local decision-support system based on automatic fire detection and modelling of fire behavior precise on-site real-time fire weather data are required to obtain a realistic model output. In an optimized system weather data would gathered automatically through a dense network of weather stations, transmitted to the data processing center and integrated into the decision-support system. Alternatively, fire weather data could be obtained at or near the fire site by a mobile weather station or by ground personnel using a mobile fire-weather kit. Taking into account the local variability of fire-weather data the latter alternative will meet the demands of on-site weather information.

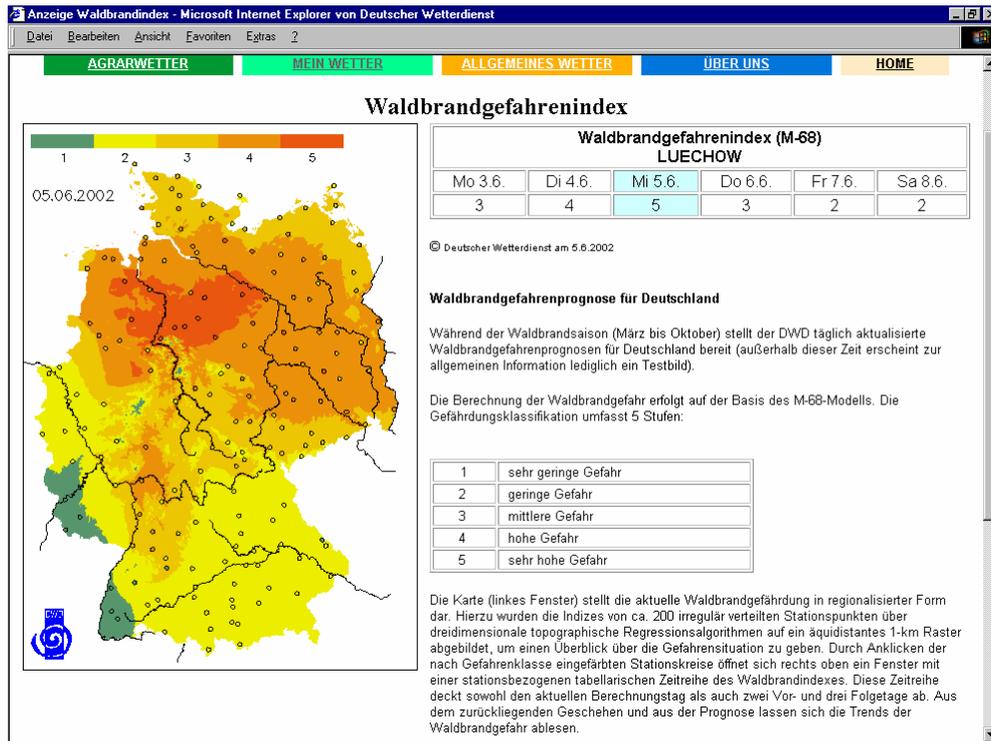


Figure 5. Example of the German Weather Service (DWD) fire-weather / fire-danger forecast via the internet for 5 June 2002. During the fire season a map provides a daily overview for Germany's territory. The system allows the retrieval of the fire danger index (M-68) for individual stations to obtain the fire-danger forecast for the current day (right hand example: Luechow, 5 June 2002), for the past two days and the next two days.

An overview of fire danger at regional level, e.g. for assessing fire danger in Europe and the neighbouring countries, is provided by the Eurasian Experimental Fire Weather Information System generated on the basis of the Canadian Forest Fire Danger Rating System (CFFDRS) by the Northern Forestry Centre, Canada, for the Global Fire Monitoring Center (GFMC). The system allows downloading a number of Fire Weather Index Components (Fine Fuel Moisture Code – FFMC, Duff Moisture Code – DMC, Drought Code – DC, Initial Spread Index – ISI, Buildup Index – BUI, and the Fire Weather Index – FWI) and Meteorological Data (Fig. 6). This regional system is still operating on a provisional basis due to the lack of automated inputs from hourly weather observations, especially in Russia. The Canadian Forest Service is working on a Global Experimental Fire Weather Information System to be displayed at the GFMC in late 2003.

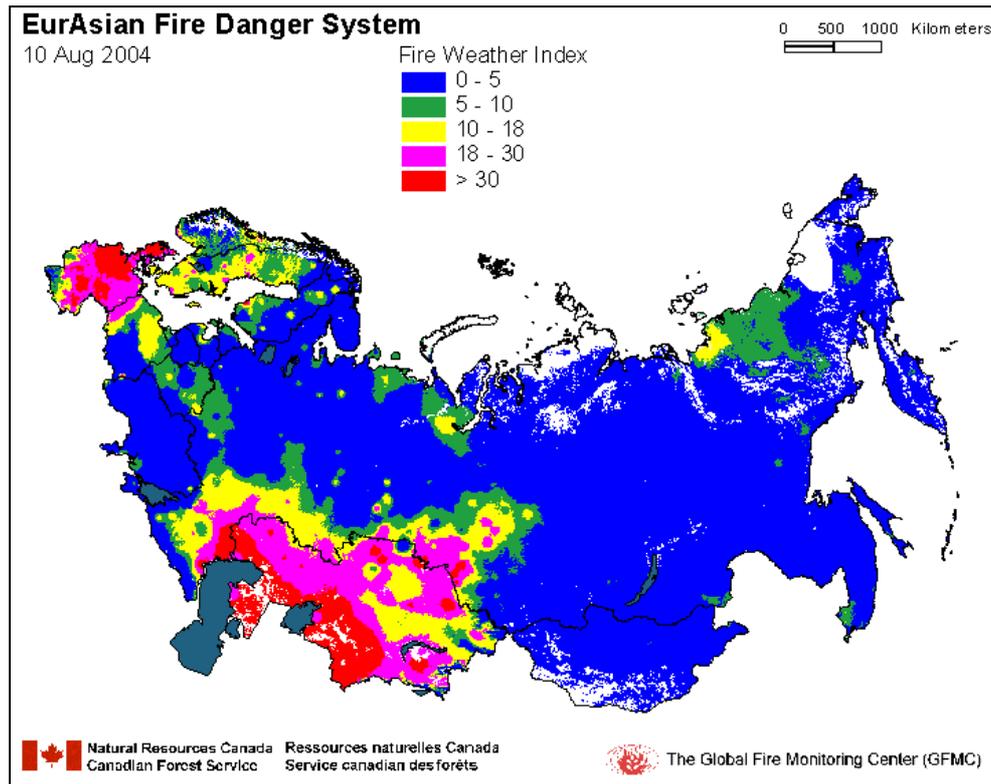


Figure 6. Example of a daily fire weather index map of the Eurasian Experimental Fire Weather Information System generated on the basis of the Canadian Forest Fire Danger Rating System (CFFDRS) by the Northern Forestry Centre, Canadian Forest Service, for the Global Fire Monitoring Center (GFMC).

Source: <http://www.fire.uni-freiburg.de/fwf/eurasia.htm>

4. Implementation of the Fire Information System

Theoretically, data and information about what it is considered as fire structural parameters (i.e. fuel, weather, and topography), contain the descriptive (i.e. attributes) as well as the spatial (i.e. coordinates) component. The spatial component sets up the basic requirements to consider it as a geographical information system (GIS); for instance, descriptive information of fuel is spatially distributed within the geographical extent of the study area.

Conceptually, the integration of all the necessary information under a common processing scheme presupposes firstly the necessary compatibility among different data layers. To maintain spatial information of any descriptive parameter in a digital form, a number of different alternatives are available including, among others, the format of the data (i.e. raster vs. vector type), the type of spatial objects (i.e. point, line or polygon), the type of measurements (i.e. nominal, ordinal, interval, or ratio), and the spatial resolution or scale (DeMers, 1997).

4.1 Integration of fuel data, fire behavior model, weather and fire detection data in a GIS

Primary observations and data referring to the structural parameters of wildland fires may exist in multiple types and multiple scales. Their integration under a common scheme might be prohibited because of several incompatibilities. For instance, elevation gradients, as well as weather data are better represented by continuously data using the raster data type. However, their primary data source may considerable differ. For instance, fire weather observations are provided at specific points in space that correspond usually to meteorological weather stations. To convert point observations into continuous surfaces by filling the gaps in the between unsampled sites, interpolation procedures have to be applied, like inverse distance weighting, nearest neighbors, splines, or geostatistics (Burrough and McDonnell, 1998). On the other hand, road network and firebreaks, which are depicted as linear or polygon objects depending on the scale level, are introduced into the fire information system as vector or raster type. To allow however their co-processing with other spatial information, as for instance for

fire behavior modelling, vector objects should be converted to raster objects by considering during the conversion process the maintenance of the original information.

In addition to the fire structural parameters information, the fire behavior model and the fire detection and monitoring system are another two critical components of a fire information system. Fire behavior, formally is defined as “the manner in which a fire behaves as a function of the variables of fuel, weather and topography”. The fire behavior modelling phase enables us to simulate a real fire event and allows us to test hypothetical scenarios about its propagation, and suppression strategy. A fire can be inserted and simulated into fire behavior modelling system either manually by the system operator or automatically if this system is connected online to an appropriate fire detection system. Apart from the input of the ignition source, real data referring to fire propagation can also be introduced into the system so that the modelling phase of the system be continuously supplied with the updated information for validation and self-correction.

GIS, by providing tools, resources and a proper organizational context to gather, manage and process spatial referenced information (Burrough, 1986), can support the integration of fuel data, fire behavior model, weather data, and the fire detection system. The main functional process that has to be resolved is the data management including collection, homogenization, maintenance and future update of the information. Information may come from completely different sources, and be different in scale, content, accuracy, etc. To enable the integration of such different spatial layers of information under a common functional schema, certain procedures have to be implemented and supported.

4.2 New space-borne fire information - decision support systems (a successful demonstrator mission and proposed next steps)

In principle, a fire information – decision support system should support the requirements of the input, maintenance, update and processing of the appropriate information. Concerning the data management subsystem, the ability to work independently under a semi-automatic or fully automatic mode, when possible, is very important. Furthermore, its ability to receive online information about input (i.e. fire weather data) as well as output data (i.e. fire behavior) is another important aspect. Remote sensing and GIS, being complementary tools for gathering and processing data and information, could be the heart of the data management subsystem. Remote sensing can contribute to generation of the information to support the requirements of updated and spatially distributed information. Various remote sensing applications can be found in literature for estimating fuel parameters and fire risk before the fire (Chuvienco and Congalton, 1989; Leblon et al., 2002), for detection and monitoring during a fire (Bourgeau-Chavez et al., 1997; Kasischke et al., 1993), and for burned land mapping and post fire effects assessment after the fire (Jakubuskas et al., 1990; Koutsias and Karteris, 1998).

The research project provided an opportunity to test the advanced spaceborne Bi-Spectral Infrared Detection (BIRD) sensing system for the detection and characterization of high-temperature events (HTE). BIRD is the first space borne sensor that offers the capability to provide daytime detection of small fires with areas exceeding $\sim 15 \text{ m}^2$ and to estimate their radiative energy release. For fires with areas exceeding $\sim 0.15 \text{ ha}$, an estimation of the effective fire temperature and area is also feasible. This capability of BIRD is especially important for the detection of small fires. A quantitative comparison showed that BIRD's Hot Spot Recognition System is an order of magnitude more sensitive than other available space borne sensors used for active fire remote sensing (Oertel et al., 2004a).

In addition, the high sensitivity of the BIRD IR sensor system allows the characterization of low intensity surface fires in forests (under canopy) which are difficult to be detected by other satellite systems (Oertel et al, 2004b; Zhukov et al., 2005). During the project's scientific forest fire experiment the Advanced BIRD Airborne Simulator (ABAS) was used to test the capabilities of this new spaceborne fire detection and characterization system (Oertel et al., 2002) before BIRD was launched to the orbit in October 2001. The results of the tests of ABAS (Fig. 7) and the semi-operational utilization of BIRD in summer 2003 (Fig. 8) confirmed the capabilities of the new sensor system, the BIRD Hot Spot Recognition System. An integration of prospective BIRD type operational sensors with the prototype decision-support system would provide an opportunity to generate information of additional value for a fire management decision support system.

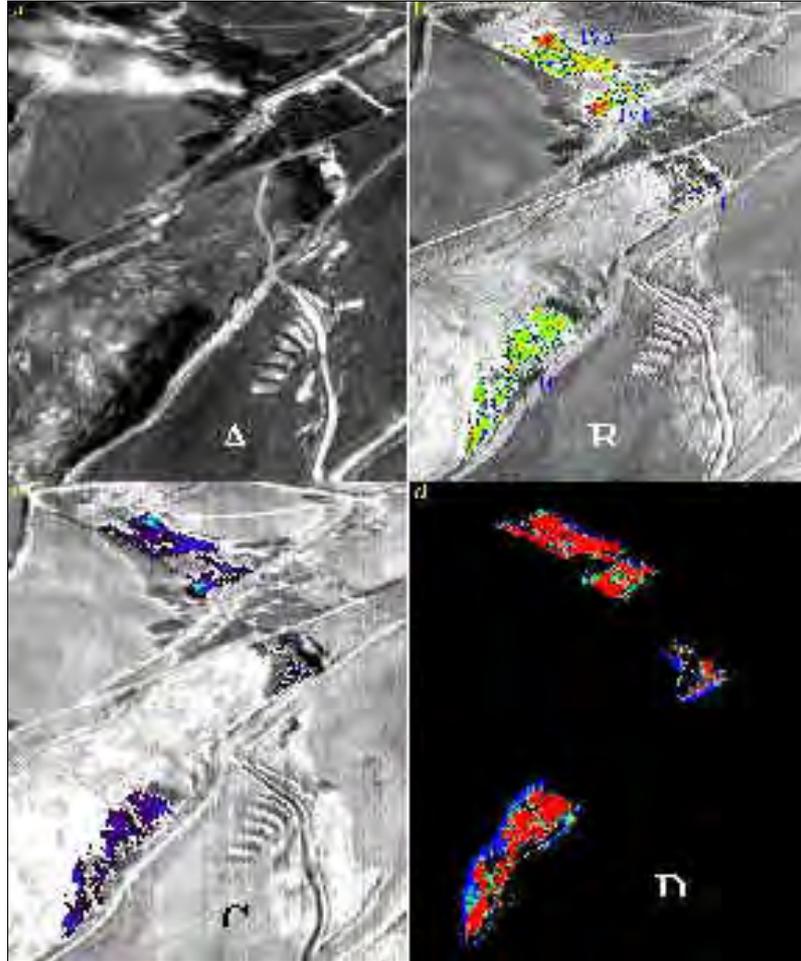


Figure 7. Fragments of an ABAS scene showing the experimental fires in the burning and smoldering Plots I, II und IV of the Brandenburg forest fire experiment on 23 August 2001.

Based on the recent and unique experience with the BIRD demonstrator mission in 2001 – 2004, an operational and commercially based Fire Recognition Satellite System (**FIRES**) is proposed to be developed. FIRES shall consist of four BIRD-like identical satellites, which detect, classify, and geo-reference fire data on board and broadcast the information in real time down to wildland fire managers and agencies. On earth, information on fire location and intensity to be provided by the prospective FIRES constellation satellites shall be received and visualized on-line with mobile, hand-held receivers similar to GPS-receivers (**Fire-GPS**). This tabulated, very compact fire information shall be received instantaneously within the reach of one of the FIRES-satellites radio transmitter to deliver in real time precise information on the spread and intensity of a fire front, thus allowing verifying and updating the outputs of the fire spread model (Oertel and Ruecker, 2005).

*Further, the BIRD mission in general and its Hot Spot Recognition System in particular are precursors of the prospective Fire detection and monitoring IR Sensor, the **InfraRed Element** foreseen as a multiple flown payload passenger of the planned ESA satellites "Sentinel 2" and "Sentinel 3" which are part of the Space Component – (ESA/PB-EO(2005)93) – of the European initiative on Global Monitoring for Environment and Security (GMES).*

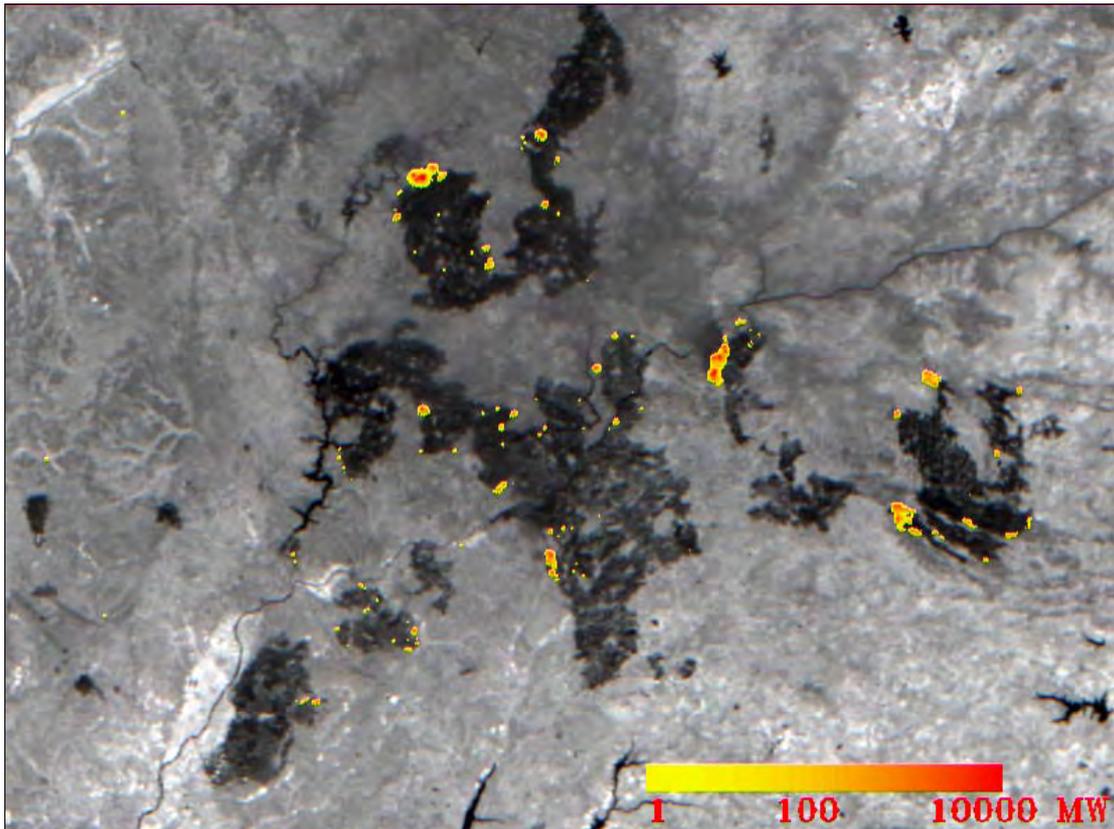


Figure 8. Example of a BIRD fire product image fragment showing forest fires in the center of Portugal on 4 August 2003. The fire radiant power is color-coded in Megawatt per pixel and is overlaid on the black and white background showing the dark fire scars.

5. Conclusions and Outlook

Research and development conducted within the Forest Fire Cluster of the German Research Network on Natural Disasters is built on a number of separately evolved concepts that were integrated in a cooperative research project. For the first time a fire behavior model has been applied for the specific conditions of pine forests in the eastern, continental part of Germany, including the interspersed heathlands that constitute an important carrier of a wildfire at landscape level. The characteristics of these forests are quite typical for temperate-hemiboreal pine forests of Eurasia. Thus, the results of this work can be easily adapted to neighbouring countries where similar pine forests cover large areas, e.g., Poland, Belarus, and the Russian Federation. The development of the AWFS meets the requirements for fast, cost-effective and reliable fire detection system. The national fire-danger rating system has consolidated during the project lifetime. During the research project the work of the Global Fire Monitoring Center (GFMC) constituted the link from national to international levels. Besides the function of a support body for the development of national to international policies and fire management strategies the *modus operandi* of the GFMC provided an opportunity to implement the regional Eurasian Experimental Fire Weather Information System in cooperation with the Canadian Forest Service and to test the BIRD satellite mission in various vegetation types around the world. The concept of the German Natural Disaster Research Network (DFNK) provided an exemplary opportunity to conduct multi- and interdisciplinary fire research and has contributed to establish a new and unprecedented collaborative culture of wildland fire science in Germany. The value added by the research project is a mutual support of individual research projects and their final merging into a comprehensive decision-support tool for fire management. Insight gained by the research project concerning the operational use of satellite remote sensing information in the management of active wildland fires will be useful for the development of urgently needed operational spaceborne fire systems (Ahern et al., 2001).

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Analysis of the Wildland-Urban Interface Fire Problem of Greece

Abstract

During the last 30 years Greece gradually acquired a serious wildland-urban interface fire problem, mostly intensified around metropolitan areas and touristic locations. Extensive urbanization of a large part of the rural population for economic reasons, unplanned touristic development and ever increasing demand for summer housing from the middle-class urban households have created acute human pressure for land use change through fire and, subsequent, encroachment on public wildlands. At the same time, human settlements engulfed by wildland vegetation and forest land fragmentation in a mosaic of agricultural, forest and rural areas have created increased fire hazard and fire suppression planning difficulties. The following measures are proposed for alleviating the problem: (a) Establishment of legislature pertaining to the regional and urban planning of wildland-urban intermix areas; (b) Strict regulations regarding the location of the waste disposal sites and other public and private enterprises of human activities in forest lands; (c) Legislature for fire safety regulations for houses and residents in the wildland-urban interface; (d) Special forest management practices pertaining to the 'peri-urban forests' (wildlands that surround urban settlements). All silvicultural treatments and management practices will set as priority the protection of the urban structures that they surround; and, (e) Development of particular fire-safety planning and installations designed for cultural monuments and antiquities that are surrounded by forest vegetation constituting the natural setting of the monument and part of its scenic beauty.

Keywords: Peri-urban forest, wildland/urban interface, fire, Mediterranean, Greece.

1. Introduction

Greece has a severe wildland fire problem which has significantly augmented during the last 30 years. Almost 80% of the total number of fires occurs at the Mediterranean zone which extends from the coastal line to an elevation of approximately 800 m, including all the islands. This area combines the typical Mediterranean climate (pronounced hot and dry period during the summer, mild winters with most of the total rainfall) with flammable vegetation types comprised of drought resistant and fire-adapted evergreen / broadleaved sclerophyllous shrublands (maquis) and low-elevation coniferous forests of Aleppo pine (*Pinus halepensis* Mill.) in the mainland, and Calabrian pine (*Pinus brutia* Ten.) in the islands. Also, due to the fact that in the Mediterranean zone of Greece takes place most of the country's economic activities (90% of touristic development, 70% of industry, 40% of agricultural activities, most urban development), over 70% of the total population is concentrated in these areas. This has resulted in an ever increasing human pressure on the natural environment for land use change, which is reflected by the high frequency of arsons and 'unknown'-cause fires in the wildlands. The intermix of human settlements with natural ecosystems created a severe wildland-urban interface fire problem that has become a major issue of political debate and confrontation, due to the public awareness and mass media attention especially during the summer months when most fires occur. We will analyze the wildland-urban interface fire problem of Greece in terms of its current status, causes and possible mitigation measures.

2. Causes of the Wildland-Urban Interface Fire Problem of Greece

Greece has undergone significant social changes over the last 30 years (since the 1970s) which created and aggravated its wildland-urban interface fire problem:

1. Large parts of the population from mountainous areas migrated to the major urban centers (internal migration). The 'urbanization' of Greece resulted in half the population residing in only two cities (Athens, Thessaloniki).
2. There was significant but unplanned touristic development all over Greece and, particularly, the Greek islands, resulting in a continuous construction of holiday resorts and hotel accommodations in the wildlands without any fire safety infrastructure.
3. There has been a 'fashion'- trend in most middle class urban families for acquiring a 'vacation house' near the sea for summer vacations.

4. Human activities in the forests have increased due to the enhanced accessibility that resulted from an extended forest road network in combination with the ever increasing number of private cars.
5. Numerous municipal waste disposal sites have been arbitrarily established on public forest lands.
6. There has been extensive intermix of agricultural areas, forest lands and rural settlements over large areas in the Greek Mediterranean countryside, creating a 'mosaic' of different land uses and fire hazards.

All these reasons resulted in tremendous pressure for land use change of wildlands for urban, touristic and agricultural development in the Mediterranean areas. Given the fact that Greece still lacks a national cadastre (register) and land use classification mapping, the public forest lands were the first to be attacked by arsonists aiming at the destruction of the natural vegetation through fire and, subsequently, the encroachment and conversion of the burned areas to urban settlements or agricultural areas. In most cases, law enforcement procedures for the eviction of intruders from the burned wildlands are time-consuming and ineffective. On the contrary, in many cases followed a 'legalization' of the encroachment on the burned public wildlands by the Greek government for 'social reasons', thus creating an additional motive for arson. Consequently, in Greece the most densely inhabited or touristically developed areas are fire-stricken (Attica peninsula with Athens metropolitan area, Thessaloniki with the Chalkidiki peninsula, Kavala, Aegean and Ionian islands, Crete, Magnesia and Evia) with severe fire rural/urban interface problem which coincides with high fire frequency and areas burned, mostly attributed to arson or unknown causes.

The wildland/urban fire interface problem of Greece first became apparent when a large, wind-driven fire on 4 August 1981, in the northern suburbs of Athens, resulted in the destruction of many luxurious residences. In 1985, numerous arsons destroyed the peri-urban forests that surrounded Kavala, in Northern Greece. In 1995, a large fire (6500 ha) in the Penteli mountain at the outskirts of Athens metropolitan area, burned approximately 100 structures causing panic to the population. Another fire at the same mountain in 1998 was equally destructive and received huge media attention and public awareness, thus creating a severe political issue. Multiple arsons burned most of the aesthetic forest that surrounded Thessaloniki in July 1997. Numerous fires devastated large areas of public pine forests at the Chalkidiki peninsula in 1981, 1985 and 1990, resulting in the development of numerous summer cottages and villas in the burned areas without urban planning. Additionally, significant economic losses result every year from fires that burn at the rural/urban interface and expand from forest areas to adjacent agricultural lands (mostly olive groves, grapevines, and wheat fields).

Finally, in most cases, the natural fire regime has been altered in the wildland-urban interface due to increased fire frequency, thus adversely affecting biodiversity and ecosystem processes in these areas. Also, expanding urbanization has resulted in wildlife habitat fragmentation.

3. Particularities of Fire Suppression in the Wildland-Urban Interface

Fire suppression in the intermix context of urban and wildland is complicated and particular. In some instances, wildlands constitute enclaves within urban environments, and suppression proceeds within the general context of urban firefighting. In other cases, houses form small 'islands' within a 'sea' of public wildlands, and wildfires must be controlled as ancillary functions to general wildland fire control. In other words, the mixture of wild, urban, agricultural, public and private lands prevents either urban or wildland fire strategies (Pyne et al., 1996).

Perhaps the really unresolved issue is not so much the suppression of an isolated structural fire but the protection of structures within the context of a true fire intermix (Weise and Martin, 1994). Ethical instincts and legal structures impose the preferential protection of houses (not to mention their residents) even if this means that the overall fire continues to propagate freely. Perimeter control is problematic; counterfiring is almost impossible; prescription control unthinkable. No clearly articulated strategy exists (NWCG, 1989). Instead, firefighting resources, especially engines, are massed and dispatched to protect structures. Control of structural fires differs from control of wildland fires in several respects (Radke, 1983). There is, first, the question of people, victims who may need medical attention, residents who need evacuation, onlookers who may require restraint. There is also a matter of fire behavior. Compared to wildland fires, fuel loads in structures are heavier, fuel moisture lower, residence time longer, and fire build – up more rapid (Fischer and Arno, 1988). A review of past wildland-urban interface fires showed that most structures were lost or damaged when they were not

separated from the surrounding flammable vegetation, built in steep (over 50%) slopes, and the firefighting forces had poor access to the structures, limited water supply, and they arrived late (Moore, 1981).

When a fire occurs, it is often unclear to what extent suppression should emphasize the saving of property or the containment of the spreading fire. It is likely that fire management will focus on just such issues in the coming decade (Gale and Cortner, 1987).

4. Proposed Measures for Alleviation of the Wildland-Urban Interface Fire Problem

The wildland-urban interface fire problem of Greece can be alleviated with a combination of institutional and technological measures:

1. Establishment of legislature pertaining to the regional and urban planning of wildland-urban intermix areas. These regulations should provide for restricted areas where construction is not allowed due to high fire risk, for maximum housing density per unit of wildland area, for adequate road network density for easy accessibility of all structures, for evacuation routes and sites in case of emergency. Also, strict regulations should apply regarding the location of the waste disposal sites and other public and private enterprises of human activities (open mines, amusement parks, picnic areas, nature trails, etc.).
2. Establishment of fire safety regulations for houses and residents in the wildland-urban interface. The residents will be obliged to apply all fire safety regulations at their own expense for their house (clearing vegetation, provide extra sources of water, use appropriate building materials) with severe penalty for the violators.
3. Jurisdiction by legislature should be granted to the firefighting forces regarding the selection of the appropriate fire strategy for optimal results (i.e., choice of fire protection priorities, forced evacuation of people from residences, destruction of fences and gardens, use of private water sources, curfew of vehicle circulation).
4. Assignment of a special category in forest management practices pertaining to the 'forests at the urban interface'. These forests should not be managed on a traditional 'sustained yield' basis or as purely 'protective forests', but rather as 'peri-urban forests' (wildlands that surround urban settlements) and, therefore, all silvicultural and management practices will focus on the protection of the urban structures that they engulf. In other words, the primary management objective of the 'peri-urban forests' is the protection of the human lives and structures that reside in them, and secondary, the aesthetics of the landscape. These objectives should be clearly described and imposed by specific and regulatory guidelines issued by the Forest Service.
5. Provisions for extra water supply and intensive urban silvicultural practices (pruning, thinning, fuel removal and isolation, breaking of horizontal continuity, etc) should be applied in all peri-urban forests. Special underground installations for ample water supply should be established in the wildland areas prior to urban development.
6. Special fire-safety planning and installations should be designed and established for cultural monuments and antiquities that are surrounded by natural vegetation of high aesthetic value, constituting the natural setting of the monument and part of its scenic beauty (Ancient Olympia, Mount Athos, etc.). In such cases, all fire suppression measures should aim at adequately protecting the monument without disturbing the natural beauty of the site (Dimitrakopoulos, 2000).

5. Conclusions

During the last 30 years Greece acquired a serious fire problem at the wildland-urban interface, mostly intensified around metropolitan areas and touristic locations. Internal migration, touristic development and need for summer housing have created increased human pressure for land use change through fire and, subsequent, encroachment on public wildlands. Legislative and regulatory measures regarding the function and management of 'peri-urban forests' need to be imposed by the State and Municipal authorities for fire hazard reduction and the protection of human settlements.

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