International Forest Fire News (IFFN) No. 28 (January – June 2003) p. 92-102

The Former Yugoslav Republic of Macedonia

Review of Forest and Range Fires

Summary

The paper presents general information on forest and range fires that have affected The Former Yugoslav Republic of Macedonia over the last decade, then on the state-of-the-art as to the occurrence of forest fires and fires on agricultural and other lands with special attention to the problems affecting the ecosystem and economy of the country.

Introduction

The territory of Macedonia covers an area of 25,713 km^2. Approximately 90% of the territory is covered by some kind of vegetation with different management rationales. For agriculture 1,291,251 ha are used (pastures covering 631,704 ha included) whereas 1,034,974 ha are forests and other wooded lands. Climate, soil, topographic and other conditions enabled development of a very large biodiversity in vegetation types and species ranging from Mediterranean to arctic provenience. Also, some vegetation species end and some begin their spreading.

Background

Over last several decades forest fires and fires on agricultural and other lands have been occurring occasionally. The year 1969 was an exception. However, over the past 20 years the frequency of fires gradually increased, particularly during the last 12 years, reaching its maximum in the year of 2000.

Seldom occurrence of forest and range fires in the past created an unjustified impression that such fires do not pose a serious risk to ecosystems and the economy of the country. The factors like vegetation, climate conditions, topography etc. have been neglected, resulting in the fact that country has not established a long-term strategy for coping with the potential adverse effects, neither developed National Fire Danger Rating and Fire Behaviour Systems. Such professional misunderstanding and minimization of the fire related problems prevented establishment of a modern national forest fire protection, prevention and suppression system.

Vegetation

Rich biodiversity is divided in several vegetation regions: *Oak, Beech, Subalpine* and *Alpine* (Table 1). Depending on the regional climate, orographic and other factors the regions are divided in several subregions (areas). *The Oak Region* is divided in Submediterranean, Continental-submediterranean, Warm-continental and Cold-continental climate areas in which 57 associations are determined. *The Beech Region* is divided in Submontane-continental and Mountain-continental areas with 53 determined associations, out of which some are also characteristic for subalpine climate region. The Subalpine and Alpine region is mostly covered with high-mountain pastures on different substratum and type of soils with 35 grass associations.

The dendroflora is composed of 319 species of trees and bushes, with more than 80 subspecies and varieties systematized in 119 genus, 54 families, 31 unions, 11 orders and 6 classes. Out of the total number of tree species, 16% are endemic or sub-endemic to the Balkan.

STATISTICS ON FOREST AND RANGE FIRES

For some period of time forest and range fires have not been recognized as a problem, and thus in many aspects have not been treated seriously. However, when they became a problem the shortage of relevant qualitative and

quantitative data on the phenomena became quite evident. Even the principal institutions, like Ministries sectorally responsible for management of forest and agricultural lands and their protection against natural and man-made hazards lack such data. The problem was treated quite statistically, and for a long time only a statistics on some quantificators was regularly kept (number of fires, burnt area, quantity of damaged wood pulp, some loss estimates, etc.).

Longer-period statistics on some data on occurred fires (forest, fires on agricultural lands, dumps and other uncultivated lands) is kept in the following three state institutions: The Ministry for Agriculture, Forestry and Water Management (MAFWM), the Ministry of Internal Affairs (MIA) and Republic Statistical Bureau (RSB). The MAFWM keeps a record of fires on forestlands, only. The Statistical Bureau keeps a record on all fires, but only for parameters relevant for their use, quantifying and acquiring them in accordance to methodology fit solely for statistical uses.

The most complete record on urban and forest fires (forest lands, dumps and other open urban/rural spaces) is kept only in the Ministry of Internal Affairs – Directorate for Fire Protection, Explosions and Dangerous Materials. It is the principle authority for fire protection in Macedonia because the fire pre-suppression, suppression and liquidation are under its principal responsibility.

Number of Fires and Burnt Area (1989 – 2000)

Number of Fires

The largest number of fires (Table 2 and Figure 1) occurred in the year of 2000 (3,795), than in 1999 (1,413), 1993 (1,014) while the smallest number is reported for the year of 1991 (160).

The largest number of fires occurred mostly in the Municipalities on the north, central, and south part of the country. Furthermore, the Western part of the country is more affected than the Eastern (Figure 2). The distribution patterns of forest fires by Municipalities (Figure 3) are almost the same as the distribution of all occurred forest and range fires (Figure 1).

Burnt Area

The largest burnt area (Table 3 and Figure 1) is recorded in the year of 2000 (52,624.5 ha), than in 1993 (18,526.4 ha) and in 1992 (11,482.5 ha). The smallest burnt area is recorded in the year of 1995 (323.3 ha). However, the size of burnt area (Table 3) does not always correspond to the number of occurred fires (Table 2). In particular, the limited number of fires affecting the largest areas most frequently has been occurring along the valley of Vardar River that is exposed to strong influences of Mediterranean climate. These, large burnt area, fires affect also the central part of the country along the river valleys intersecting with the valley of Vardar River.

The largest burnt areas are recorded in the Northern, Central and Southern parts (South-east and South-west included) of the country (Figure 3). The eastern part of Macedonia is more affected than the western. While the fire susceptibility of eastern Macedonia is radically higher, the overall burnt areas in western Macedonia are smaller due to its more humid climate conditions, higher elevation of terrains and the type of predominant vegetation (Figure 3).

The distribution patterns of forest fires by Municipalities are almost the same as the distribution of all occurred forest and range fires.

Number of Fires and Burnt Area by Land Use

Number of Fires

Over the given period, the total number of occurred fires is 10,267 with annual average of 855.6 fires. Intentional burning of stubble fields after the harvest results in an increasing trend of the number of fires on agricultural lands, so the average number of these fires is approaching the forest fire averages.

About 25 % of fires occurred on agricultural lands (Table 4) while about one third are forest fires. However, out of the total number of fires (10,267), almost 43% of fires are allocated to other lands and dumps due to the fact that in the moment of the fire occurrence the character of land-use of the area affected has been unknown.

Burnt Area

The total burnt area is 119,031.8 ha (Table 5) with annual average of 9919.6 ha. Almost 70% of the total burnt area is associated with the forests and forest lands because of improper and insufficient firefighting capacity for hardly accessible mountain and forest terrains, as well as the intensity of occurred fires. Only 15% of the total burnt area is agricultural land, with increasing trend.

Dynamics of Forests Fire Occurrence

The monthly dynamics of the occurrence of the forest fires (Figure 4.1) indicates that they occur through the whole year, however with two pronounced peaks in spring and in summer-autumn period. The daily dynamics of forest fires occurrence (Figure 4.2) shows that they occur throughout the entire day. They are frequent in the period between 10 to 18 hours, but the most frequent between 13 to 14 hours.

Causes

Almost 65% of the fires occurred due to negligence, 7.5% were ignited intentionally, and lightning caused only 2%. For 25.5% of fires the cause is unknown due to the difficulties in discovering the cause. Consequently, about 72.5% are of anthropogenic origin.

LEGISLATION

The prevention and suppression of forest and range fires until 1989 was based on elaborated forest management plans and the experience, as well as provisions of the existing [until recently] forest law (Official Gazette of SRM No. 20/74, 15/86, 51/88, 20/90 and Official Gazette of RM No. 37/91, 44/91, 83/92). However, the increased number of fires in former Yugoslavia from 1985, in particular along the Dalmatian Adriatic Sea coast (presently in Croatia, Mediterranean climate zone), forced establishment of a new legislation for prevention of forest and range fires, which was enforced in 1989 as Regulations for Special Measures of Protection of Forests and Agriculture Land.

The Regulations comprised two parts, on forests and on agriculture lands. While a method for evaluating the potential danger to agricultural lands (such as grasslands, cultivated grains, etc.) has not been developed, and therefore not presented and legalized, the part on forests included a methodology for estimating the degree of potential danger to forest stands and proposed prevention measures related to the degree of estimated danger level.

The enforced fire risk assessment methodology allocated the highest fire risk to degraded forests in lower *Quercus* sp. region (Table 1) and pseudomaquis formations, what was somehow in contradiction with experience. A number of forest fires frequently occurred in higher *Quercus* sp. region and regions of *Fagus* sp., *Abies* sp., *Pinus* sp., etc., that were estimated as stands of low to moderate risk. Moreover, the method itself was static, relied on average annual parameter estimates, underestimating the influence of dynamic changes related to fire occurrence and behaviour.

Necessary Improvements

The world experience indicates that reliable fire risk estimates as well as the estimates on fire behaviour should be based on quantities interrelating the phenomena in time and space. Planning of prevention strategy and tactics, technical and human resources for suppression is more based on estimates (models) on fire behaviour (fuel model, fuel moisture, slope of terrain, wind direction and velocity, fire propagation velocity, fire line intensity, heat released per unit area, reaction intensity, fire perimeter, burnt area, flame length, etc.).

To achieve more efficient results in forest and range fires prevention and suppression, for Republic of Macedonia is of utmost importance to establish and introduce a system that, through qualitative and quantitative indicators and their rational interpretation will enable:

- prediction of forest and range fires in time and space (fire hazard assessment);
- in case of occurrence, monitoring and control of spreading, assessment of behaviour (rate of forward spread, intensity, flame length, size, released energy, etc.); and,
- prescribed burning as agro-technical measure, which is presently prohibited because of increased probability for ignition of uncontrolled fires.

In order to resolve some of the listed ongoing problems, under the Protocol for bilateral Scientific and Technical cooperation between USA and Republic of Macedonia, a joint cooperative research project on "Determination of Fuel Models for Predicting Fire Behaviour and Assessing Fire Danger in the Republic of Macedonia" was launched in 1997.

As an intermediate result of this project, a daily fire danger ratting system was created including a procedure for determination of fuel models for estimating a fire behaviour and some behavioural characteristics of fires in different environmental conditions. The achievements are already summarized in terms of adequate legislation "Regulations for Special Measures of Protection of Forests Against Forest Fires" and enforced (Official Gazette of RM No. 69/2001).

In order to overcome the problem of collecting and processing data on forest fires and fires on agricultural and other lands, there is an ongoing process for approval and legalization of a unique and uniform Fire Damage Inspection and Loss Assessment Form, compatible with EEC regulations, for recording, acquisition and processing of forest, agricultural and other lands fire and burnt area data.

Concluding Remarks

- Over the last decade (1989-2000) 10,166 forest and range fires occurred with a total burnt area of 118,235 ha.
- About 31% of the total number of fires occurred in forests and forestlands with a burnt area ranging about 71% of the total burnt area.
- The largest burnt area per fire is associated to forest fires.
- The cause of ignition is dominantly negligence and arson. For substantial number of fires the cause is unknown.
- The number of fires occurred in the year of 2000 and corresponding burnt area, as well, show a maximum that is ever recorded.
- Firefighting capacity of the country is partly sufficient to cope with the fires in flat and agricultural lands, but insufficient for hardly accessible mountain and forest terrains.
- The Country does not have a unique and uniform methodology for fire damage inventory, data acquisition and loss estimation. The content of forms used by different agencies (Statistical Bureau, Ministry of Forestry and Agriculture and Ministry of Interior) for data collection and loss estimation differs, providing sometimes misleading and unreliable estimates.
- There is a strong need for enforcing a unique national procedure and system for collection and processing of data on forest and range fires.
- The intermediate results from above mentioned projects, particularly the fuel models developed, should be incorporated in adequate up-to-date fire prediction and behaviour systems.

References

Todorcevski, T. 1994. Fire prediction techniques. Security, No.1, Skopje.

Andreevska, D., and T. Todorcevski. 1995. Data on forest and range fires occurred in the territory of Republic of Macedonia. Proceedings of XIX Conference of Plant Protection, Ohrid.

The Ministry of Interior of Republic of Macedonia. Annual Statistical Reviews 1988-2000.

Ministry of Agriculture, Forestry and Water Management of Republic of Macedonia. Annual Summary Reviews 1988-1997.

Todorcevski, T., and N. Nikolov. 1998. Brief review on collecting statistical data for range fires and proposal for improvement. Proceedings of the XXIII Conference for Forest and Range Fires Protection, Ohrid.

Todorcevski, T., and Z. Milutinovic. 1999. Forest and range fires in Republic of Macedonia. Presentation Paper, Missoula, MT, USA.

Milutinovic, Z., and T. Todorcevski. Determination of fuel models for predicting fire behavior and assessing fire danger in the Republic of Macedonia. US – Republic of Macedonia joint research project, 1997-2000.

Milutinovic, Z., and T. Todorcevski. 2001. Manual for defining the way and procedure for determination of fire behavior fuel models. Report IZIIS 2001-40-1, Skopje, November 2001.

Regulations for Special Measures of Protection of Forests Against Forest Fires. Official Gazette of RM No. 69/2001.

IFFN/GFMC contribution submitted by:

Trajko R. Todorcevski
Higher Inspector, Directorate for Protection Against Fires, Explosions and Hazardous Materials
Ministry of the Interior
Dimce Mircev St.
1000 Skopje
The Former Yugoslav Republic of Macedonia

Fax: +389-2-142624
Tel: +389-2-142718
e-mail: taco@freemail.org.mk

and

Zoran V. Milutinovic
Professor and Head, Section on Risk and Disaster Management
Institute of Earthquake Engineering and Engineering Seismology
University "St. Cyril and Methodius"
PO. Box 101
73, Salvador Aliende St.
1000 Skopje,
The Former Yugoslav Republic of Macedonia

Fax: +389-2-112163
Tel: +389-2-176155
e-mail: zoran@pluto.iziis.ukim.edu.mk

Table 1. Climate, vegetation, rock substratum and soil characteristics by vegetation regions.

Region	Climate area	Vegetation	Substratum	Type of soil
Oak region	**Submediterranean** a= 50-500 m b= 14.2°C c= 4,440°C d= 233 days e= 650 mm f= 27 g= 46	*Coccifero-Carpinetum orientalis*	Solid and decayed acidic rocks Solid and decayed basics rocks Decayed limestone rocks Pure limestone rocks	Silicate eutric regosoil-cinammon forest soil Silicate eutric regosoil-eutric ranker Silicate-limestone regosoil, rendzina Black soil on limestone, terra rossa
	Continental-submediterranean a= 600 m b= 12.7°C c= 3,940°C d= 214 days e= 510 mm f= 23 g= 40	*Querco-Carpinetum orientalis macedonicum*	Solid and decayed acid rocks Solid and decayed basic and neutral rocks Decayed limestone Pure limestone	Silicate eutric regosoil- ranker, cinnamonic forest soil Lessoidn basic rocks-eutric ranker cinnamonic forest soil Silicate or limestone regosoil, rendzina, cinnamonic forest soil, chernozem Black soil on limestone, terra rossa
	Warm-continental a= 600-900 m b= 10.9°C c= 3,310°C d= 196 days e= 700 mm f= 34 g= 65	*Quercetum frainetto-cerris*	Solid and decayed acid rocks	Silicate regosoil, ranker, cinnamonic forest soil
	Cold-continental a= 900-1,100 m b= 9.0°C c= 2,560°C d= 166 days e= 800 mm f= 42 g= 90	*Orno- Quercetum petreae*	Solid and decayed acidic rocks Solid and decayed basic rocks	Litosol on acidic rocks, ranker, eutric cambisol Litosol on basic rocks, eutric ranker
Beech region	**Submontane-continental** **a= 1,100-1,300 m** b= 8.0°C c= 2,560°C d= 153 days e= 900 mm f= 50 g= 110	*Fagetum submontanum* or *Festuco heterophylae-fagetum*	Compact and decayed acid rocks Compact and decayed limestone Pure limestone	Litosol on acid rocks, districtive ranker Litosol on basic rocks, eutric ranker Black soil on limestone, typical distric brown forest soil, brown soil on limestone
	Montane-continental a= 1,300-1,650 m b= 6.4°C c= 1,990°C d= 141 days e= 1,070 mm f= 63 g= 155	*Fagetum montanum* or *Calamintho grandiflorae-Fagetum*	Solid and decayed acid rocks Solid and decayed basic rocks Pure limestone	Litosol on acid rocks, districtiv ranker, typical districtive cambisol Litosol on basic rocks, eutric ranker, typical eutric cambisol Black soil on limestone, humus brown forest soil, podzolized brown forest soil
Subalpine	**Subalpine** **a= 1,650-2,250 m** b= 4.8°C c= 1,330°C d= 105 days e= 1,000 mm f= 67 g= 209	*Fagetum subalpinum* and subalpine coniferous forests like *Fagetum subalpinum scardo pindicum, Myrtillo-Pinetum peucis, Pinetum mughi macedonicum*	Solid and decayed acid rocks Pure limestone	Districtive cambisol with humus, districtive ranker Black soil on limestone, podzolized forest soils and brown podzolic soils
Alpine	**Alpine** a> 2,250 m b= 0.4°C e= 790 mm f= 82	Unions: *Edraintheto - Seslerion* *Seslerion comosae*	Solid and decayed acid rocks Pure limestone	Litical districtive ranker with organic layer Black soil on limestone with organic layer, organic-mineral black soil on limestone

a- elevation; b- average annual temperature; c- sum of temperature ≥10 °C; d- period with temperature ≥10 °C
e- annual amount of rainfall; f- drought index (De Martonne); g- rain factor (Lang)

Table 2. Number of fires by municipalities (1989-2000). Source: Ministry of Internal Affairs (MIA).

Municipality	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Berovo	4	10	1	12	10	3	2	3	10	6	3	32	**96**
Bitola	9	9	6	12	20	29	4	6	20	2	18	240	**375**
Brod	5	20	2	21	43	24	2	10	19	8	15	65	**234**
Valandovo	3	6	5	9	6	11	4	2	16	8	24	30	**124**
Vinica	1	6	4	2	2	0	0	0	2	2	16	28	**63**
Gevgelija	5	6	5	16	21	7	6	6	10	8	29	140	**259**
Gostivar	13	14	5	18	18	16	2	7	18	24	54	177	**366**
Debar	1	0	0	1	6	8	2	1	2	1	10	40	**72**
Delcevo	3	4	1	6	7	4	0	0	0	5	9	8	**47**
Demir Hisar	2	3	0	3	7	9	0	1	7	2	9	36	**79**
Kavadarci	3	7	1	0	8	13	0	1	0	1	7	34	**75**
Kicevo	7	5	1	2	4	3	1	2	1	3	14	129	**172**
Kocani	5	26	1	10	23	14	0	2	0	3	27	0	**111**
Kratovo	4	12	3	8	6	14	1	2	4	4	8	33	**99**
Kriva Palanka	6	7	2	11	26	5	0	1	6	12	23	128	**227**
Krusevo	3	3	2	0	5	15	3	1	5	6	15	118	**176**
Kumanovo	21	80	16	71	134	48	12	35	107	64	89	209	**886**
Negotino	2	9	1	8	4	2	0	4	3	1	50	114	**198**
Ohrid	11	16	5	14	14	3	0	3	5	3	33	86	**193**
Prilep	8	19	10	32	69	27	3	4	10	6	106	263	**557**
Probistip	7	7	3	14	15	11	1	2	6	3	22	34	**125**
Radovis	5	5	1	2	25	13	3	2	9	4	17	69	**155**
Resen	7	15	12	18	13	20	2	7	13	10	18	118	**253**
Sveti Nikole	5	18	4	15	20	16	2	6	1	5	68	65	**225**
Skopje	50	230	47	87	382	247	122	380	494	147	214	764	**3164**
Struga	2	5	3	3	7	6	2	1	2	0	55	163	**249**
Strumica	3	15	2	23	37	24	2	2	9	8	9	49	**183**
Tetovo	4	9	2	4	13	7	1	3	7	4	28	175	**257**
Veles	3	32	10	20	50	16	5	13	17	6	288	238	**698**
Stip	3	19	5	7	19	20	5	6	18	1	135	210	**448**
TOTAL	**205**	**617**	**160**	**449**	**1014**	**635**	**187**	**513**	**821**	**357**	**1413**	**3795**	**10166**

Table 3. Burnt Area (ha) by municipalities (1989-2000). Source: MIA

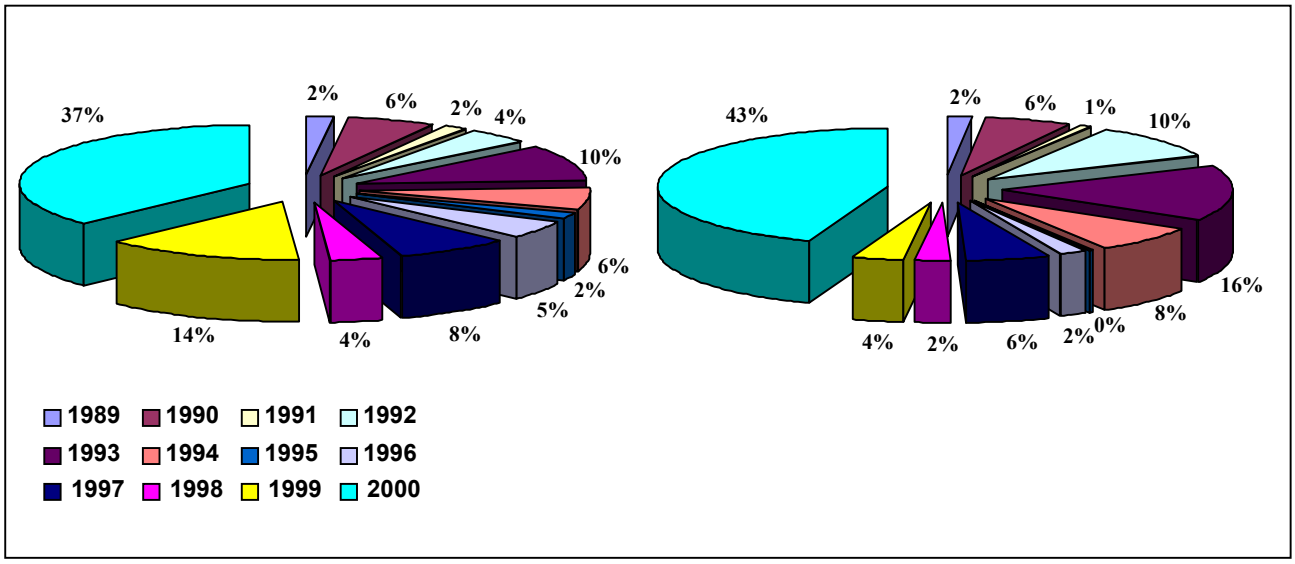
Municipality	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Berovo	3.0	101.9	0.0	53.0	129.9	1.6	21.0	23.0	43.4	123.6	0.2	605.1	**1105.6**
Bitola	12.6	1124.6	0.1	106.1	242.0	300.6	2.4	39.2	2057.1	651.0	125.0	11470.0	**16130.5**
Brod	67.0	282.9	5.0	450.5	232.6	2601.0	5.2	13.3	150.0	41.0	87.6	1854.7	**5790.7**
Valandovo	3.5	35.0	26.0	106.0	2075.2	35.1	70.2	0.0	24.0	55.6	125.0	3952.0	**6507.6**
Vinica	0.2	49.5	17.3	8.0	10.1	0.0	0.0	0.0	10.0	16.0	4.0	12.0	**127.1**
Gevgelija	1299.7	87.7	121.1	2417.1	660.9	51.0	5.5	40.0	56.5	153.1	236.2	866.0	**5994.8**
Gostivar	38.3	16.1	3.0	30.0	84.0	85.0	1.1	5.0	41.2	48.6	7.0	159.4	**518.8**
Debar	3.6	0.0	0.0	3.0	52.5	38.5	1.0	20.0	4.0	0.0	7.0	20.0	**149.6**
Delcevo	0.3	40.5	0.0	100.0	39.4	10.6	0.0	0.0	0.0	34.0	0.5	118.0	**343.4**
Demir Hisar	0.6	13.0	0.0	28.0	15.0	58.5	0.0	0.5	14.4	6.0	3.5	239.8	**379.3**
Kavadarci	7.3	111.0	16.0	0.0	333.0	414.1	0.0	2.0	0.0	0.3	11.5	123.1	**1018.2**
Kicevo	30.6	32.0	0.0	20.5	16.0	15.0	1.0	150.0	20.0	9.3	0.7	163.7	**458.8**
Kocani	18.0	98.2	250.0	55.9	1059.2	798.3	0.0	32.0	0.0	21.0	24.0	0.0	**2356.7**
Kratovo	2.0	141.7	0.0	16.7	14.8	39.3	15.0	2.5	28.5	20.0	127.5	276.7	**684.8**
Kriva Palanka	24.1	87.2	0.2	233.3	62.5	11.5	0.0	2.0	3.8	66.8	37.2	406.6	**935.1**
Krusevo	34.0	11.3	10.0	0.0	10.0	26.7	8.6	0.2	16.0	10.5	30.7	171.3	**329.2**
Kumanovo	112.6	1400.4	56.3	976.8	733.6	781.4	66.4	480.5	987.3	622.5	676.5	3632.7	**10527.0**
Negotino	16.0	160.5	2.5	3034.0	1571.0	4.0	0.0	20.0	270.0	50.0	94.0	1221.5	**6443.5**
Ohrid	18.7	34.5	2.9	172.2	888.0	8.0	0.0	5.1	29.0	38.0	37.0	0.0	**1233.4**
Prilep	29.0	197.6	22.5	366.6	1085.7	785.1	5.0	115.3	430.1	70.0	521.3	3265.7	**6893.9**
Probistip	7.3	439.2	36.0	39.2	259.0	271.1	0.4	0.8	43.8	4.5	56.0	428.2	**1585.5**
Radovis	34.2	53.1	0.0	15.0	763.4	79.7	1.8	15.0	65.1	10.3	52.0	837.0	**1926.5**
Resen	15.5	343.0	10.1	19.2	463.9	42.0	1.0	11.6	14.2	23.0	13.1	148.0	**1104.8**
Sveti Nikole	3.9	16.5	10.1	51.5	1018.2	71.9	0.7	21.2	0.9	159.5	286.5	667.0	**2307.8**
Skopje	7.5	674.4	12.4	2741.5	282.7	1041.4	57.7	1009.4	1404.0	501.6	431.0	10543.7	**18707.3**
Struga	0.0	0.6	0.1	1.2	50.1	6.7	1.0	30.0	0.1	0.0	47.5	118.0	**255.3**
Strumica	3.3	119.4	1.5	147.0	300.3	44.1	0.2	1.5	30.1	36.1	0.0	0.0	**683.4**
Tetovo	12.2	20.6	2.0	5.2	44.8	8.4	0.1	2.8	78.6	13.0	3.0	151.4	**342.1**
Veles	4.3	1447.3	297.3	254.0	5792.2	821.8	49.1	144.1	1092.1	7.2	1011.1	10056.2	**20976.7**
Stip	1.6	104.8	95.1	31.0	236.6	545.3	9.0	4.7	118.8	20.0	135.0	1116.7	**2418.7**
TOTAL	**1810.9**	**7244.3**	**997.7**	**11482.5**	**18526.4**	**8997.7**	**323.3**	**2191.7**	**7032.8**	**2812.4**	**4191.6**	**52624.5**	**118235.9**

Table 4. Number of Fires by vegetation cover and land use (1989-2000). Source: MIA.

Land Use	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**	***Average***
Deciduous	33	65	9	57	111	68	9	15	26	26	256	395	**1070**	***89.2***
Coniferous	11	43	6	32	50	23	3	18	36	20	34	133	**409**	***34.1***
Mixed	31	73	11	98	141	65	9	40	78	73	82	454	**1155**	***96.3***
Scrub forests	9	37	4	26	43	14	0	5	10	11			**159**	***13.3***
Other	11	23	8	22	45	25	3	12	24	21	80	205	**479**	***39.9***
Total-Forests	**95**	**241**	**38**	**235**	**390**	**195**	**24**	**90**	**174**	**151**	**452**	**1187**	**3272**	***272.7***
(%)	***45.67***	***39.06***	***23.17***	***52.34***	***38.42***	***30.76***	***12.83***	***17.54***	***21.17***	***42.30***	***30.60***	***31.04***	***31.87***	
Stubble fields	9	55	11	26	93	73	25	71	115	41	322	769	**1610**	***134.2***
Grain fields	1	20	5	6	33	66	28	23	69	31	17	59	**358**	***29.8***
Orchards	4	28	7	27	30	16	3	13	20	16	17	75	**256**	***21.3***
Vineyards	1	18	4	6	22	17	2	13	21	17	0	0	**121**	***10.1***
Meadows	6	19	7	46	84	43	2	13	38	6	0	0	**264**	***22.0***
Total-Agr. Land	**21**	**140**	**34**	**111**	**262**	**215**	**60**	**133**	**263**	**111**	**356**	**903**	**2609**	***217.4***
(%)	***10.10***	***22.69***	***20.73***	***24.72***	***25.81***	***33.91***	***32.09***	***25.93***	***32.00***	***31.09***	***24.10***	***23.61***	***25.41***	
Dumps	6	16	15	7	41	31	26	22	32	15	116	261	**588**	***49.0***
Other Lands	86	220	77	96	322	193	77	268	353	80	553	1473	**3798**	***316.5***
Total	**92**	**236**	**92**	**103**	**363**	**224**	**103**	**290**	**385**	**95**	**669**	**1734**	**4386**	***365.5***
(%)	***44.23***	***38.25***	***56.10***	***22.94***	***35.76***	***35.33***	***55.08***	***56.53***	***46.84***	***26.61***	***45.29***	***45.35***	***42.72***	
rand Total	**208**	**617**	**164**	**449**	**1015**	**634**	**187**	**513**	**822**	**357**	**1477**	**3824**	**10267**	***855.6***

Table 5. Burnt area (ha) by vegetation cover land use. Source: MIA.

Land Use	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total	*Average*
Deciduous	172.2	1987.6	49.5	904.4	6034.3	1486.3	47.5	54.3	271.0	160.9	1062.2	16182.9	**28413.1**	***1019.2***
Coniferous	40.5	1260.6	5.7	208.2	1368.2	2523.1	1.3	100.6	1299.7	156.7	332.1	1660.5	**8957.2**	***746.4***
Mixed	118.8	876.4	35.9	7632.9	4446.8	1471.8	5.4	429.8	652.7	1282.1	343.2	17345.4	**34641.2**	***2886.8***
Scrub forests	1258.8	1214.0	345.0	359.6	462.9	174.3	0.0	85.0	1138.3	21.5			**5059.4**	***421.6***
Other	43.1	421.8	7.7	285.1	2111.6	146.2	51.2	316.4	212.1	268.0	254.5	2739.7	**6857.4**	***571.5***
Total-Forests	**1633.3**	**5760.4**	**443.8**	**9390.2**	**14423.8**	**5801.7**	**105.4**	**986.2**	**3573.9**	**1889.1**	**1992**	**37928.5**	**83928.3**	***6994.0***
(%)	***90.19***	***79.52***	***44.49***	***81.78***	***77.86***	***64.48***	***32.57***	***45.00***	***50.82***	***67.18***	***47.31***	***71.02***	***70.51***	
Stubble fields	112.2	480.6	228.4	137.5	572.8	540.4	93.6	718.1	949.6	371.5	854	4858.4	**9917.1**	***826.4***
Grain fields	2.0	126.2	56.3	35.6	810.7	557.6	78.0	48.9	308.4	121.6	60.8	293.1	**2499.2**	***208.3***
Orchards	2.9	63.0	4.2	35.0	69.3	63.2	4.2	13.4	75.7	49.5	52.8	130.7	**563.9**	***47.0***
Vineyards	6.0	12.4	17.2	203.6	287.8	360.9	1.1	156.4	74.0	81.4	0	0	**1200.8**	***100.1***
Meadows	19.5	160.7	31.7	806.9	1061.8	595.9	1.3	147.6	869.6	119.0	0	0	**3814**	***317.8***
Total-Agr. Land	**142.6**	**842.9**	**337.8**	**1218.7**	**2802.5**	**2117.9**	**178.2**	**1084.4**	**2277.1**	**742.9**	**967.6**	**5282.2**	**17995.0**	***1499.8***
(%)	***7.87***	***11.64***	***33.86***	***10.61***	***15.13***	***23.54***	***55.07***	***49.48***	***32.38***	***26.42***	***22.98***	***9.89***	***15.12***	
Dumps	1.0	1.0	1.0	17.0	2.0	4.0	26.0	3.0	9.0	0.0	.3.5	11.5	**75.5**	***6.6***
Other Lands	34.0	640.0	215.0	857.0	1298.0	1074.0	14.0	118.0	1172.0	180.0	1251	10180	**17033**	***11419.4***
Total	***35.0***	***641.0***	***216.0***	***874.0***	***1300.0***	***1078.0***	***40.0***	***121.0***	***1181.0***	***180.0***	***1251.0***	***10191.5***	**17108.5**	***1425.7***
(%)	***1.93***	***8.85***	***21.65***	***7.61***	***7.02***	***11.98***	***12.36***	***5.52***	***16.79***	***6.40***	***29.71***	***19.08***	***14.37***	
Grand Total	**1811.0**	**7244.3**	**997.6**	**11482.9**	**18526.3**	**8997.5**	**323.6**	**2191.5**	**7032.0**	**2812.0**	**4214**	**53402.2**	**119031.8**	***9919.6***


37%
2%
6%
2%
4%
10%
6%
2%
5%
8%
4%
14%
43%
2%
6%
1%
10%
16%
8%
0%
2%
6%
2%
4%
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

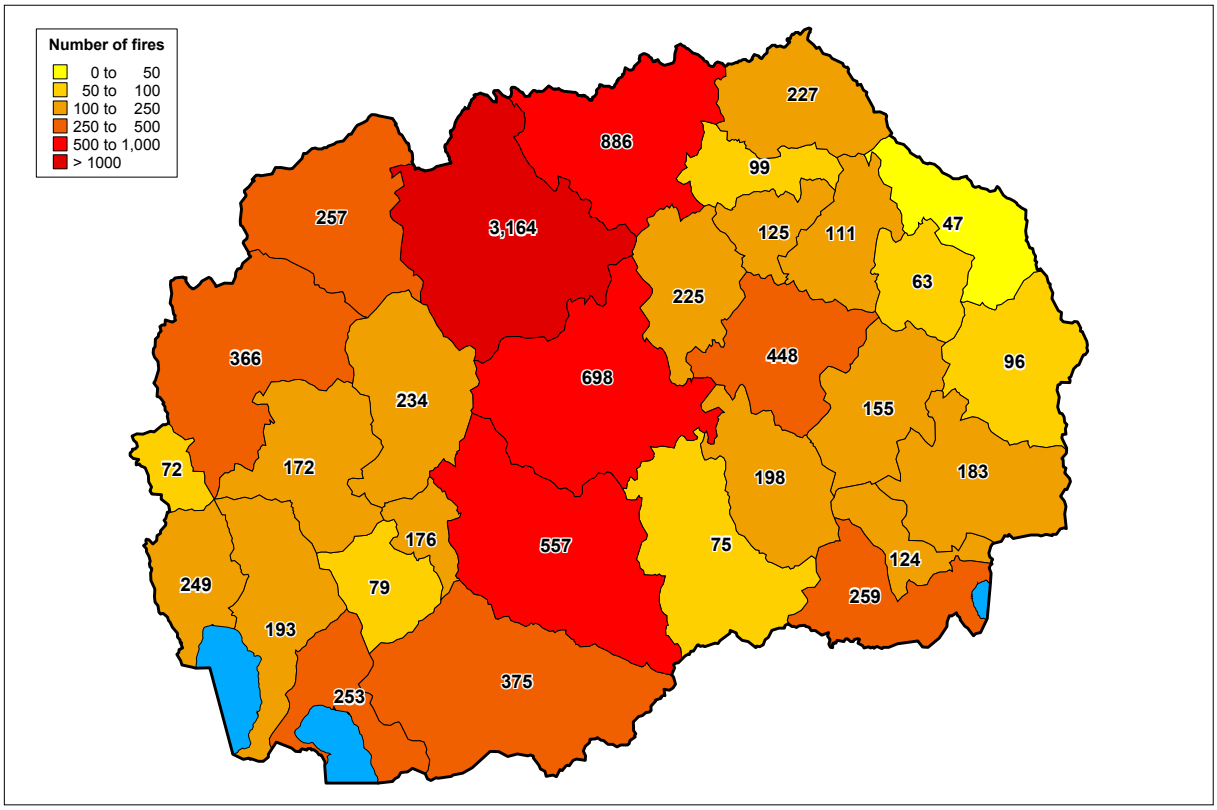


Figure 2. Number of fires by municipalities 1989-2000. Source: MIA.

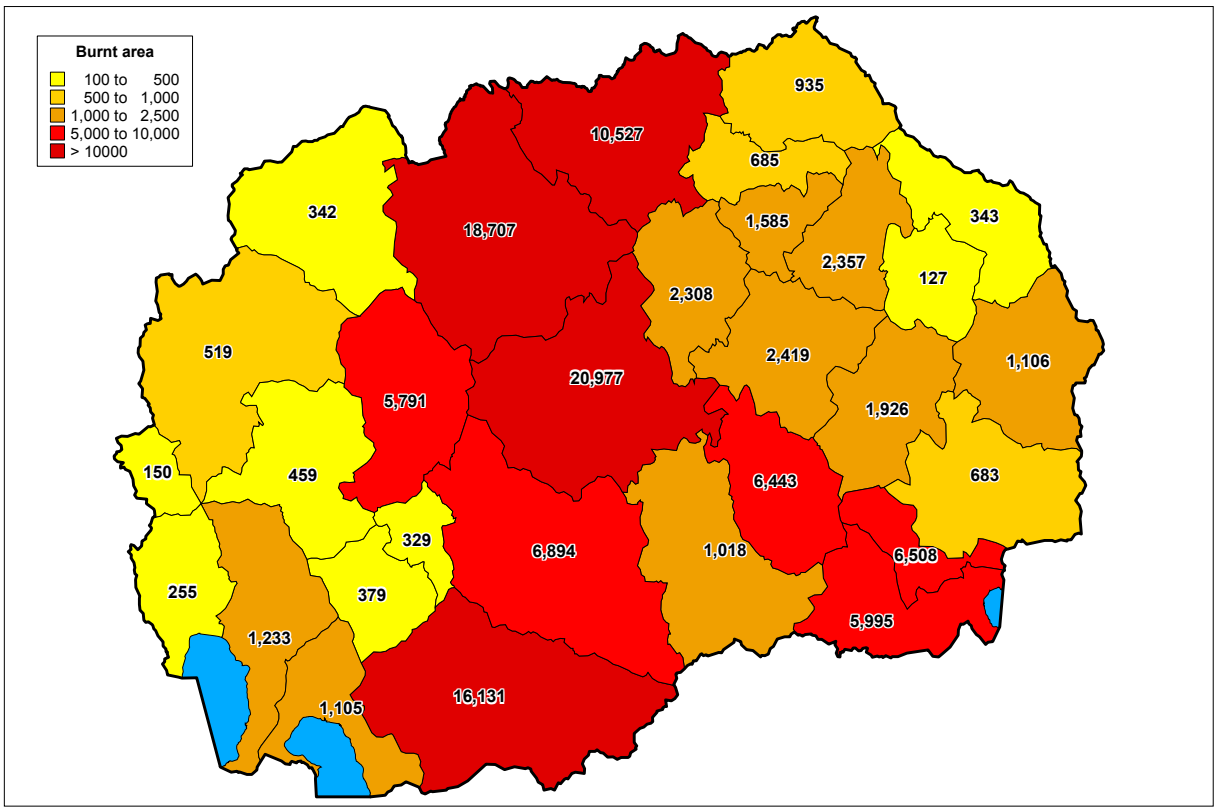
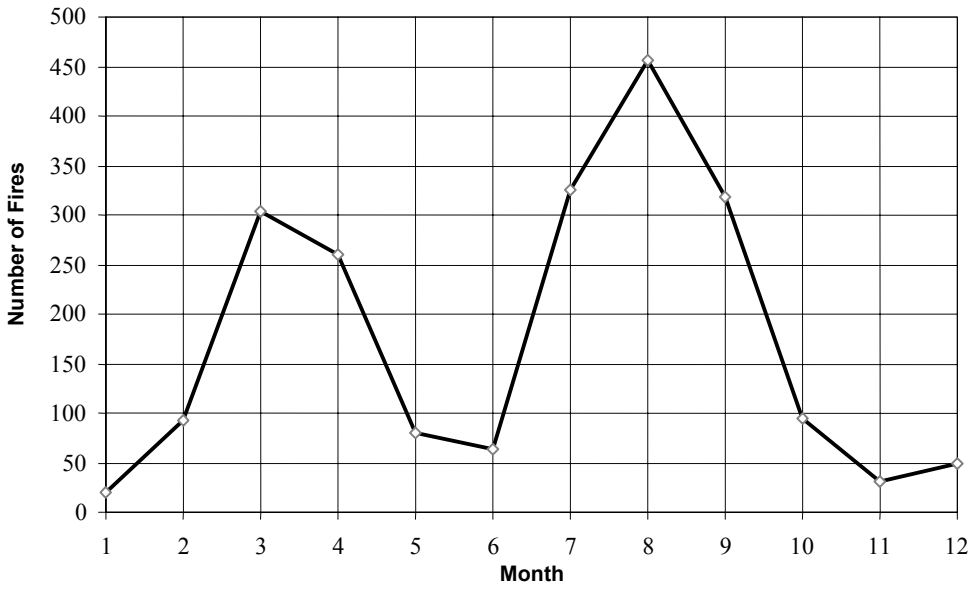
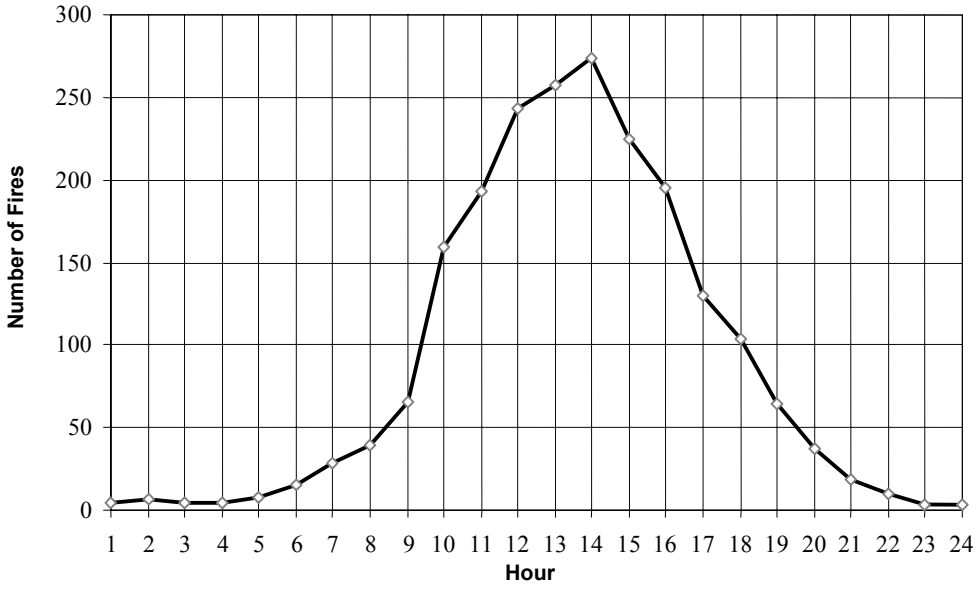


Figure 3. Burnt area (ha) by municipalities 1989-2000. Source: MIA.


Number of Fires
500
450
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Month


Number of Fires
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour