

Forest Fires in Viterbo Province and in Lazio Region, in 1997-2012 Period: Origin, Frequency and Incidence

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Abstract

In average, nearly 90 forest fires occur every year in the territory belonging to each province in the Lazio region, and in 98% of cases, the human hand is directly responsible.

Consequently harsh penalties are described in the “Criminal Code”, which dictates imprisonment of up to 15 years if the arson causes serious and permanent damage to the environment. High are the costs that the State has to support each year for fire prevention and firefighting: around 500 million Euros.

By analyzing the records owned by the State Forestry, it emerges that just 1/3 of all wild fires actually originated in a forest area and a similar incidence rate is shown both for fires that have developed in the vicinity of roads and in agricultural areas.

Subsequently, analyses of rainfall and temperature trend have been performed, which highlighted that increasing average annual rainfall leads to a decrease in the number of forest fires recorded in the same period, implying a close relation between the two phenomena.

Keywords: Forest fire, Origin, Precipitation, Correlation

1 Introduction

Every year forest fires that occur nationwide in Italy cause incalculable damage, not only from the standpoint of forestry, but also from the economic point of view, social and human lives.

It has been shown that 98% of them are directly attributable to man, for imprudence, non-compliance of the regulations, or to the searching for illegal profits. The result is that forest fires, despite the predisposing factors such as abundant dry vegetation, poor rainfall, and high temperatures, are not a natural phenomenon, because without a trigger generated by man, the plant biomass, in order to get to the spontaneous combustion, should reach temperatures around 300 °C. Almost all forest fires are therefore attributable to arsonists or pyromaniac (in the second case the subjects are affected by a pathological obsession), with many different causes; it is therefore very difficult, in any investigation, to find out what was the reason.

Also to be noticed, is that the development of forest fires, not only a social impact [1] [2], with high costs for extinguishment operations, but also on biodiversity, and effects on vegetation [3] [4] [24, 28, 30, 31], and the microbial population [5], not excluding the fact that, these events disperse elements and chemical compounds in the environment that can persist over time [6] [7] [8] [9]. Another important aspect is the risk for the workers involved in fire extinguishment operations due to exposure to heat and fumes. [21] [22] [23] [24].

It is therefore important to develop systems to monitor [10] [11] and to prevent fires [12] [13], by analyzing also the chances and the dissemination of the events [14] [15] [16] [17] aiming for interventions in forested areas [18] as with political and social plans [19] [20] [26] [27] [28].

2 Materials and Methods

The purpose is to analyze the place of the elaborate early forest fire that occurred on the territory of the Lazio region and in particular the province of Viterbo, specifying for each province, from which place and in what number is the distinguishing fires originate in 8 territorial categories: forest, agricultural fields, fallow, pasture, railway, road, landfill and more by referring to the period 2003 to 2012.

It has been also observed annual area (Ha/year) covered by events, always referring to all provincial land areas and weighted with the regional average for the years of 2000-2012 reference.

The study was then compared with the trend of regional rainfall during the same period (1997-2012) analyzing both the amount of annual precipitation (mm) and the number of rainfall events that occurred during the reference years, whose values were taken from the regional database, and then putting in correlation values of the fires and the incidence of recorded rainfall, since it has a link between rainfall trend, thermometer and gunpowder events.

3 Results

Starting from the annual values, it has been defined the total number of fires for each province; considering the annual average number of fires from 1997 to 2012, it is shown that the province of Viterbo (43.625 events) remains well below the regional average (87.725 events), taking into account that the total number of fires in the territory of Tuscia was 698, while that of the Lazio Region, for the same period, was 7018 (value that also includes those of the Province of Viterbo); from these data, which express the trend in the number of fires, it can be observed that the Province of Latina (2790 cases) recorded the highest number of forest crimes from 1997 to 2012, followed by the Province of Frosinone (1699).

It is clear that the regional data are much more erratic over the years, registering a difference between the minimum and maximum of 123 fires (the maximum value was recorded in 2007, with 150.4 fire, and the minimum value in 2002, fires with 27.4), while the capital of Tuscia registered a difference between minimum and maximum of 82 events (the maximum is in the year 2012, with 98 fires and the minimum in the year 1999, with 16 fires (Table 1 – Figure 1).

Table 1: Number of fires per province, per year (years 1997/2012)

Province/Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Province total 1997/2012	Province average 1997/2012
VITERBO	36	55	16	49	54	17	81	39	33	28	76	41	32	18	25	98	698	43.63
FROSINONE	189	79	64	132	68	22	161	75	69	69	189	75	69	84	176	178	1699	106.19
LATINA	199	93	89	220	204	40	269	139	204	111	280	142	135	203	288	174	2790	174.38
RIETI	72	67	14	58	50	39	54	23	28	19	56	22	22	16	48	87	675	42.19
ROMA	61	52	41	92	89	19	103	48	57	30	11	64	66	33	72	18	1156	72.25
Regional total for year	557	346	224	551	465	137	668	324	391	257	752	344	324	354	609	715	7018	-
Regional average for year	111	69	45	110	93	27	134	65	78	51	150	69	65	71	122	143	-	87.73

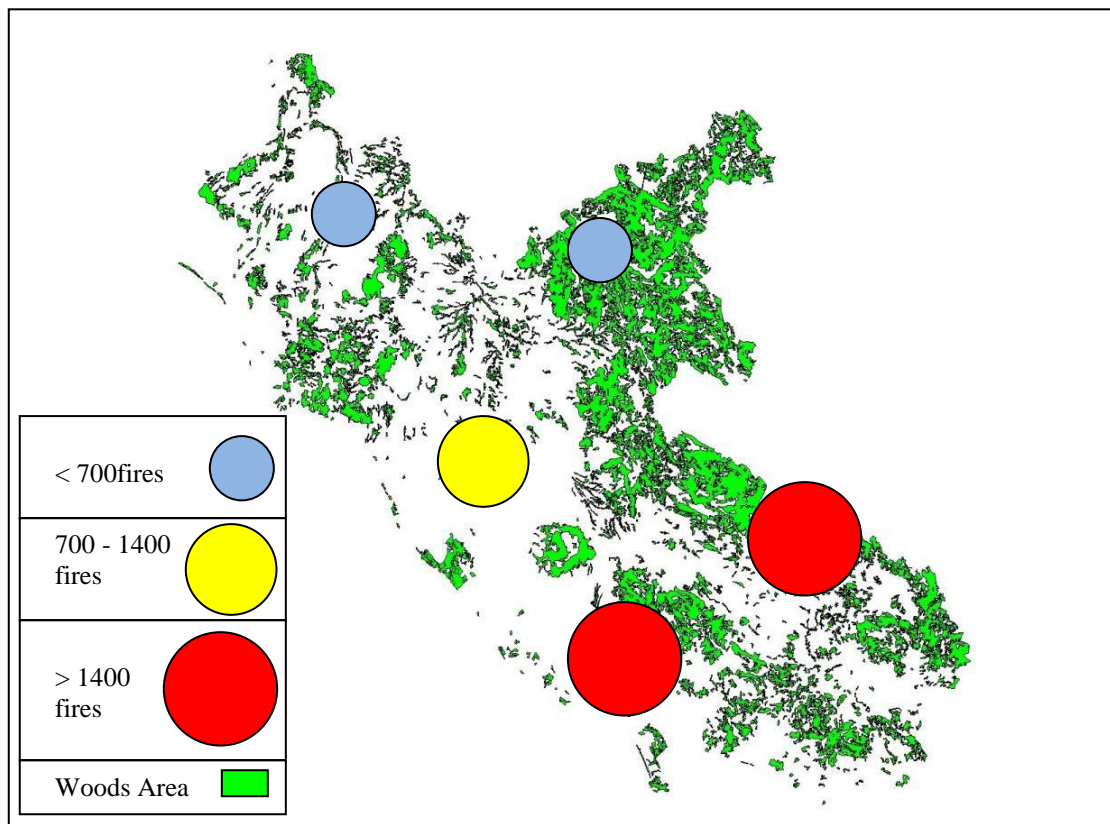


Fig. 1: Distribution woods in Lazio region and number of fires for each province per year (years 1997/2012)

The data of forest fires for the Lazio region, registered since 1997 to 2012, indicate where and in what number fires have originated from, grouping all locations where fires have originated from in three main categories: forest, agricultural land and roads.

Analyzing the data relative to Viterbo province (Table 2), it was found that most of the forest fires had no direct origin in the forest, that as starting location corresponds to only 38% of the total, but rather in the other two types with 62% of the events.

Table 2: Number of forest fire in Viterbo province, divided by starting location

YEAR	FOREST	AGRICULTURAL LAND	ROADS	TOTAL
2003	34	18	29	81
2004	16	12	11	39
2005	17	6	10	33
2006	10	8	10	28
2007	25	17	34	76
2008	15	11	15	41

Table 2: (Continued): Number of forest fire in Viterbo province, divided by starting location

2009	9	5	18	32
2010	2	11	5	18
2011	11	8	6	25
2012	36	29	33	98
Total	175 (38%)	125 (26%)	171 (36%)	471 (100%)

With regard to the area affected by fires in each province, for the years 2000 to 2012, the territory of Tuscia turns out to be the least susceptible to fires, with an annual average area covered by fire of 176.28 hectares (for a total of 2291.67 Ha), against 887.53 hectares of Frosinone (11537.96 Ha), 1930.12 hectares of Latina (25091.61 Ha), 204.07 hectares of Rieti (2652.986 Ha) and 362.80 hectares of Rome (4716.43 Ha). The values obtained for all the provinces were then compared with the regional average (712.18 ha / year) (Table 3).

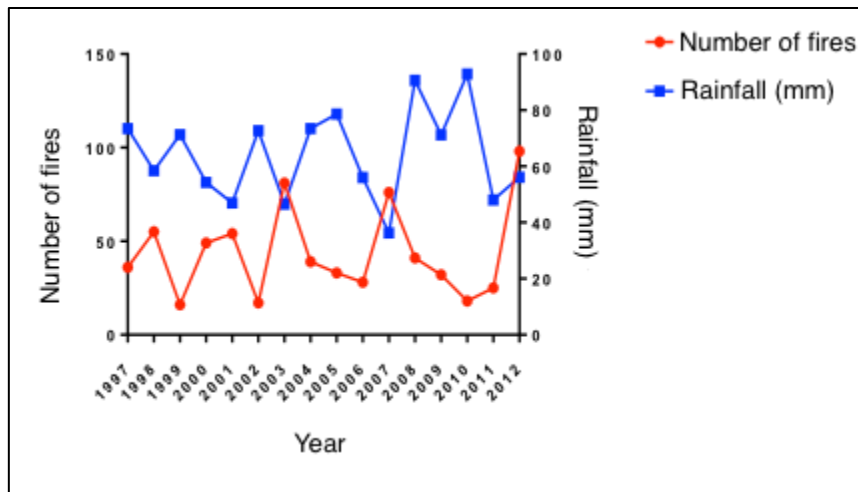
Table 3: Total area covered by forest fires per year (Ha)

YEAR	LAZIO AVERAGE	VITERBO	FROSINONE	LATINA	RIETI	ROMA
2000	1090.13	304.39	1132.10	2632.00	420.00	962.00
2001	712.51	412.58	502.50	2054.00	253.00	340.00
2002	126.56	85.66	69.30	134.00	264.00	79.00
2003	1083.14	155.68	1007.30	3644.40	157.05	451.29
2004	429.188	62.51	475.20	1449.49	47.30	111.44
2005	495.01	79.78	723.60	1418.68	120.92	132.08
2006	184.90	61.86	282.99	470.38	32.02	77.23
2007	1705.80	267.94	2336.98	4654.61	338.54	930.94
2008	340.32	108.32	483.40	925.51	39.64	144.73
2009	360.31	50.98	316.11	1198.77	82.14	153.57
2010	492.11	21.22	520.02	1782.75	68.82	67.76
2011	1119.32	56.00	1735.55	3454.43	208.95	139.70
2012	1119.12	622.77	1952.92	1272.60	620.60	1126.71
TOTAL	712.19	2291.67	11537.96	25091.61	2652.99	4716.43

Regarding the data on the incidence of rains recorded, particularly focusing on the of Viterbo Province in which in the year 2012 were observed a maximum of 98 fires, to which, however, does not correspond a minimum value of precipitation (recorded, instead, in 2007), compared with the incidence of forest fires (Graph 1), it is evident that, at the moment when the broken line relative to the performance of the rains recorded a negative slope, the one relating to the number of fires, instead, records a positive slope; this means that to the decreasing

amount of water rained during the year corresponds an increase in the number of fires which occurred during the same period.

It can be noticed also that in 2010, the year in which the highest level of precipitation was recorded (92.9 mm), the number of fires was 18 and in 2007, year which records the level of minimum rainfall, the number fire events rose to 76.



Graph 1: Comparison number of fires/precipitations

4 Conclusions

The analysis of the incidence of forest fires showed that the most common starting locations are: the forest itself, with an incidence rate of 38%, the agricultural lands with 26% and roads by 36%, and it may be concluded that most forest fires had not begun directly in the woods, attesting its percentage to around 1/3 of the total forest fires, value that slightly differs from those of the other two types (agricultural lands and roads).

Regarding their extension, for the years 2008 to 2012, the most frequent forest fires in the Viterbo Province are those that do not exceed one hectare, with a total of 84 events (35.96 hectares of the total area covered), while those that create more damage to forest areas are those that have an extension between 5 and 50 ha, which destroyed a total forested area equal to 1009.55 Ha (55 total events); the most common forest fires in the Lazio region instead are those with an area between 1 and 5 hectares, with a total of 839 events (2112.28 hectares of the total area covered), while those who have created more damage to forests, even in this case, are those of extension between 5 and 50 hectares, which have destroyed, in the reference years, a total area of 11687.73 hectares, for a total of 756 events.

Crossing the data on fires and precipitations (which are of stronger influence than the temperature on the incidence of forest fires), the decrease of the average annual millimeters of rain fell on the ground corresponded to an increase in the number of fires for the same year, confirming therefore, a close correlation between

the two phenomena. This correlation is also demonstrated by some institutional studies, which have shown that, depending on the intensity, the rains have different influences on fires. In particular, rainfall of significant intensity influence the water content of the wooden fuel still alive, while even low-intensity rainfalls have relevance on the dead tissues; more important, however, is the temporal distribution of rainfall: rainfall of low intensity, but well distributed over time, lower the fire danger, while keeping a high moisture content in both living and dead wooden fuels.

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