

Research Article

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Forest Fires in Region of Souk Ahras (North Eastern Algeria) Assessment and Analysis

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ABSTRACT

Forest fires are one of the main natural hazards of the world's forests. The Mediterranean forest, in general, and that of the Souk Ahras region, in particular, has undergone significant deforestation in recent decades as a result of fires which may upset the ecological balance, the conservation of forest ecosystems and associated species.

The originality of this work lies in the study of the evolution of forest fires in the Souk-Ahras region over an eleven year period (2008 - 2018).

In fact, during this period, 889 fires burned 5025.8 ha of plant formations and undoubtedly caused immense losses of wood, goods and sometimes human lives.

Although the anger of this disaster can be frightening, the forest fire will always remain a problem that every individual faces and must find a solution to.

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Introduction

Forest fires are one of the major natural hazards to forests worldwide. In some countries and some regions, such as the Mediterranean for example, it is even the greatest natural risk in forests, forests that can be affected in the long term or even irreversibly. Despite the considerable efforts deployed in prevention and extinction actions, large forest fires remain recurring events that often have interactions with infrastructures and dwellings, thus affecting large sections of the population [1].

Of all the factors of aggression of the forest in the Mediterranean and more particularly in Algeria, forest fires are the most devastating factor of degradation by its losses due to its intensity and its brutality which affect large forest areas and preforests in short periods. Its consequences can be observed on the environmental or ecological, social and economic level [2].

Forest fires and natural areas constitute the most dangerous disaster to human life in several Mediterranean countries, including Algeria. The consequences on the natural environment are much more serious, since they result in immediate forest loss. In Algeria, the area covered annually by fire is 26,015 ha [3].

The region of Souk Ahras rich in forest heritage is a prosperous study environment for conducting serious research on forest fires and their impact on the environment. The analysis of the statistics of the toll of forest fires in the Souk Ahras region shows that the latter does not escape the phenomenon of forest fires. Its vision consists of organizing data based on the number of fire outbreaks, the area burned, the area burned per fire, the risk of fire and the annual loss of wooded capital.

The Purpose of this Publication is Twofold:

- Inventory (report) of forest fires in this region during the period 2008 – 2018.
- Analysis of the phenomenon.

Material and Methods

Presentation of the Study Area

The Souk-Ahras region is located in northeastern Algeria. It is installed at the gates of Algeria in a natural passage between Tunisia and the rest of the country.

It is limited (Figure 1):

- To the North-East by the wilaya of el Taref.
- To the northwest by the wilaya of Guelma.
- To the south by the wilaya of Tébessa.
- To the South-West by the wilaya of Oum-El-Bouaghi.
- To the east by Tunisia.



Figure 1: Location of the study area [4]

The region of Souk-Ahras is distinguished by two essential characteristics: the mountainous North being part of the Atlas Tellien and the South being part of the high plains.

The region is characterized by water scarcity; this can be explained by climatic conditions in which precipitation is clearly insufficient on the one hand and the lack of means and infrastructures for rational recovery and storage on the other hand [5]. We note the presence of three wadis: Oued Mellegue, Oued Medjerda and Oued Echaref.

The climate is characterized by a hot and dry summer from 25 to 35°C in July and August, and a cold and wet winter from 1 to 15°C in January. Precipitation varies between 350 and 650 mm/year.

The forest area is estimated at 97,280 hectares, representing a rate of 23% of the total area of the region.

The main species are pine d'Aleppo (33569 ha), l'eucalyptus (29779 ha), cork oak (12535 ha), zeen oak (4837 ha) and others (16560 ha).

Data Collection

Data from the survey of forest fires during the period 2008 - 2018 collected from the forest conservation of the Wilaya of Souk Ahras, relate to the description and analysis of each fire.

The analysis of forest fires was based on the development of a summary sheet, indicating the following information:

- Nature of burned plant formations
- Date and time of the fire
- Burned area
- Number of fires
- Area burned per fire source
- Annual fire risk, the number of fires
- Annual loss of wooded capital, area burned

Results and Discussion

Assessment of Forest Fires in the Souk-Ahras Region (Period 2008-2018)

Distribution of forest fires according to plant formations

During the period 2008-2018, we recorded a total burned area of

5025.8 ha for 889 fires. The forest is the plant formation that was the most affected by the fires with 2856.15 ha or a rate of 56.82% of the total burned area during this period.

This is explained by the density and sensitivity of the plant cover of the forests of northern Algeria of the Mediterranean type, characterized by great fragility and particular sensitivity to fires due to flammable and highly pyrophilic material (resinous, very dense undergrowth, etc.) [6].

In addition, the maquis is moderately affected. We record in fact 1839.75 ha, i.e. a percentage of 36.6% of the total burnt area, then in last place come brushwood with 329.9 ha, i.e. 6.56% of the total burnt area (Table 1 and Figure 2).

Table 1: Plant Formations Burned in the Souk Ahras Region (Period 2008 -2018)

Plant formations	Forests	maquis	brushwood	Total
Burned areas (ha)	2856.15	1839.75	329.9	5025.8
Burned areas (%)	56.82%	36.6%	6.56%	100.00%

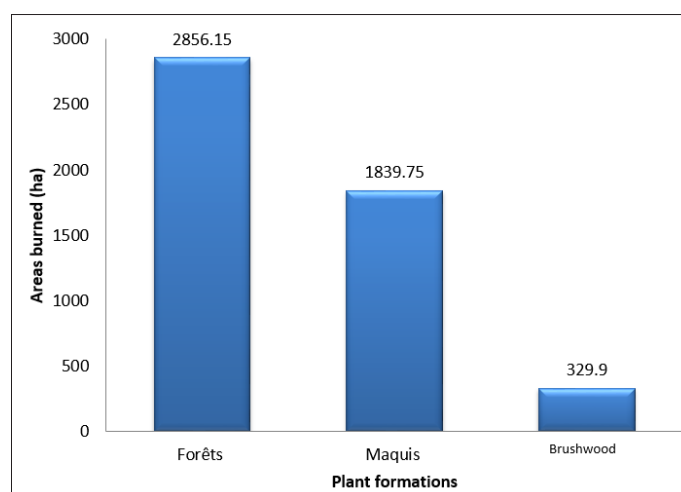


Figure 2: Burned Plant Formations in the Souk-Ahras Region (Period 2008 - 2018)

Breakdown of Forest Fires by Species

Of the 5025.80 ha of forest plant formations affected by fire during the period 2008-2018, it should be noted in particular that the Aleppo pine remains the species most affected by fire with an area of 2356.35 ha i.e. a percentage of 46.88% of the total burned, then comes the maquis with 1839.75 ha i.e. a rate of 36.60%, cork oak in third position with an area of 422.1 ha i.e. a rate of 8.39%.

Brushwood represents 6.56%, i.e. an area of 329.9 ha (Table 2 and Figure 3). If not for the rest of the species, they are little affected because the dominant species in the forests of the study region are the Aleppo pine and the cork oak.

Table 2: Plant Species Burned in the Souk-Ahras Region (Period 2008-2018)

Species	Aleppo pine	Oak cork	Zeen Oak	Cedar	Eucalyptus	Alpha	maquis	brushwood	Other Species	Total
Burned areas (Ha)	2356.35	422.1	26.25	0	30	0	1839.75	329.9	21.45	5025.80
Burned areas (%)	46.88%	8.39%	0.52%	0%	0.59%	0%	36.60%	6.56%	0.42%	100.00%

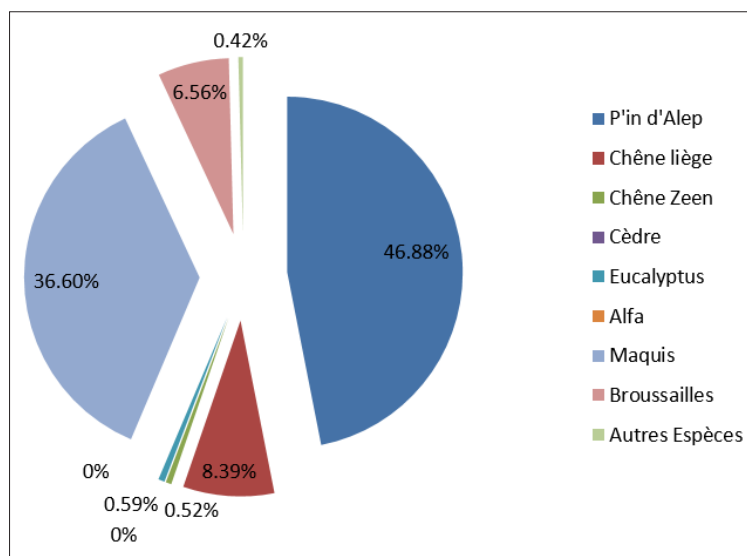


Figure 3: Burned Plant Species in the Souk-Ahras Region(Period 2008-2018)

Annual Distribution of Forest Fires

The report for the period 2008 - 2018 shows a total area covered by the fire of 5025.80 ha for 889 households.

By individually examining the situation of fires by year, we see that the greatest number of outbreaks of fires were recorded during the three years 2010, 2012 and 2014 with respectively 134, 148 and 121 outbreaks of fires (Table 3). The latter led to a fatal loss of the surface area of the vegetation cover. Indeed for the three years, we recorded 2658.30 ha or 52.89% of the total burnt. But the year 2012 remains the most dramatic, when the area covered by the fires was 1346.75 ha or a rate of 26.79% of the total burned area (Figure 4).

In addition, it should be noted that the number of hearths decreased significantly in 2018 compared to previous years with a downward trend in the area covered by the fire. This positive result could be credited to the protection actions undertaken and the presence of greater means of intervention.

Table 3: Annual Frequency of Forest Fires in the Souk-Ahras Region (Period 2008-2018)

Year	Number of households	Area burned (ha)	Burned areas (%)
2008	106	627.1	12.47%
2009	43	79.3	1.57%
2010	134	443.85	8.83%
2011	62	250.5	4.98%
2012	148	1346.75	26.79%
2013	31	171	3.4%
2014	121	867.7	17.26%
2015	54	169.4	3.37%
2016	90	604.2	12.02%
2017	98	344.5	6.85%
2018	2	121.5	2.41%
TOTAL	889	5025.80	100.00%

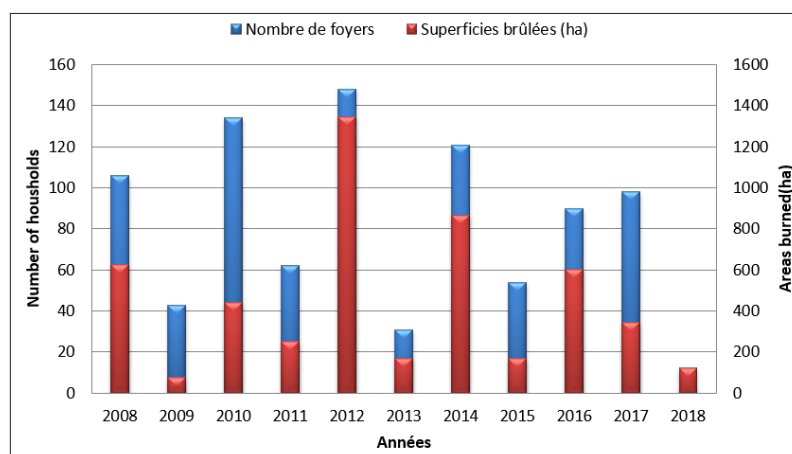


Figure 4: Annual Frequency of Forest Fires in the Souk-Ahras Region (Period 2008-2018)

Monthly Distribution of Forest Fires

Depending on weather conditions, the frequency and size of fires are different from month to month and from year to year.

However, during the period 2008-2018, it was found that the month of August was the most critical 504 fires broke out during this period (2008-2018) and covered 69.30% of the total burnt area, i.e. 3483.3 ha.

Then comes the month of July when 222 outbreaks were recorded with an area of 921.5 ha, representing a percentage of 18.33% of the total burned area. As well as during the month of September during which there were 130 fires and 11.13% of the area burned (Table 4).

The months of October and June come far behind with respectively 18 and 15 of the total outbreaks. For the other months of the year, no outbreaks were recorded (Figure 5).

This can be explained essentially by the conjunction of seasonal meteorological factors which are favorable to fires (violent and hot winds, excessive drought, etc.) during the hottest period of the year and also to certain human behavior in relation to the parallel increase in tourist pressure during this holiday period.

Table 4: Monthly Frequency of Forest Fires in the Souk-Ahras Region (Period 2008 – 2018)

Month	Number of households	Burned areas (ha)	Burned areas (%)
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	15	32.75	0.65%
July	222	921.5	18.33%
August	504	3483.3	69.30%
September	130	559.75	11.13%
October	18	28.5	0.56%
November	0	0	0
December	0	0	0
TOTAL	889	5025.80	100.00%

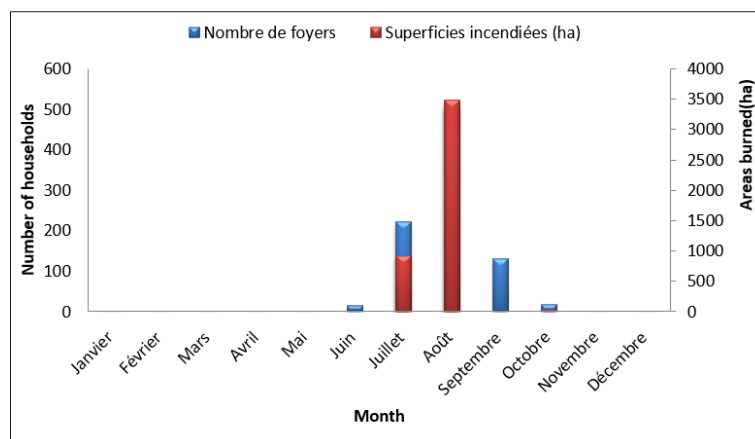


Figure 5: Monthly Frequency of Forest Fires in the Souk-Ahras Region (Period 2008-2018)

Distribution of Forest Fires According to Time Slots

When we count forest fires according to the declaration schedule, we see a very high number of fires that took place between six o'clock (06h) and 20 o'clock (20h). This number is 815 which represents 91.67% of the total number of fires declared during the period of 2008-2018. During the night, a minimum of only 74 outbreaks of fires are recorded, a rate of 8.32%.

Table 5: Hourly Frequency of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008-2018)

Time slots	0h to 06h	06h to 10h	10 a.m. to 12 p.m.	12 p.m. to 4 p.m.	4 p.m. to 6 p.m.	6 p.m. to 8 p.m.	8 p.m. to 12 a.m.	Total
Number of households	20	120	178	430	45	42	54	889
Percentage (%)	2.24%	13.49%	20.02%	48.36%	5.06%	4.72%	17.33%	100.00%

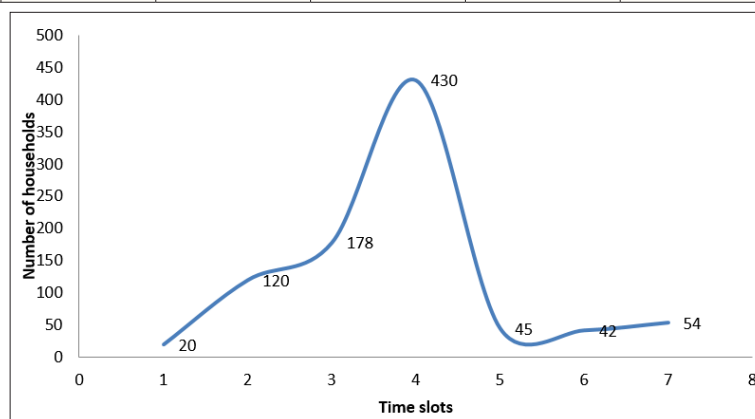


Figure 6: Hourly Frequency of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008-2018)

Breakdown of Fire Outbreaks by Area Class

Table 6 showing a classification of fire outbreaks by order of burned areas during the 2008-2018 study period; the number of fires that did not reach 10 hectares amounted to 700 outbreaks or 78.74%. For the other classes, there is a low number of 89 households between 10 ha and 50 ha, i.e. 10.01% of the total (Figure 7). Then the number gradually decreases with increasing area. This provides some information on the effectiveness of the intervention.

In addition, it must be recognized for a perfect significance of the observed phenomenon, that these burnt areas were most often the result of numerous fires of low and medium importance, rather than one or more fires of great importance.

However, weather conditions, the nature of the species, the structure of the vegetation and the relief determine the vulnerability of our forests. Being also convinced that the size of a fire also depends essentially on the speed of its extinction and this will explain why a high proportion of declared fires do not exceed 10 hectares.

Table 6: Ranking of Forest Fire Outbreaks by Order of Importance of Areas Burned in the Souk-Ahras Region (Period 2008-2018)

Area slices (ha)	0 to 10	10 to 50	50 to 100	100 to 600	more than 600	Total
Number of households	700	89	36	34	30	889
Percentage (%)	78.74%	10.01%	4.04%	3.82%	3.37%	100.00%

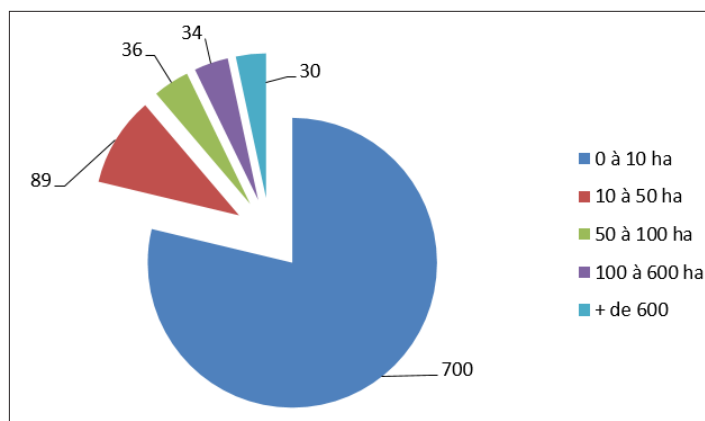


Figure 7: Ranking of Forest Fire Outbreaks by Order of Importance of Areas Burned in the Souk-Ahras Region (Period 2008-2018)

Distribution of Forest Fires According to Weekdays

If we examine Table (7) and Figure (8) showing the frequency of forest fires during the weekdays, we see almost total uniformity in the number of fires from Saturday to Friday. At the very least, the greatest numbers of fires correspond to weekend days (weekends). For the rest of the days, there is a slight increase on Wednesday.

Table 7: Frequency of Forest Fires During Weekdays in the Souk-Ahras Region (Period 2008-2018)

Weekdays	SATURDAY	Sunday	Monday	Tuesday	Wednesday	THURSDAY	Friday	Total
Number of households	158	101	97	123	136	131	143	889
Percentage (%)	17.8%	11.4%	10.9%	13.8%	15.4%	14.7%	16.2%	100.00%

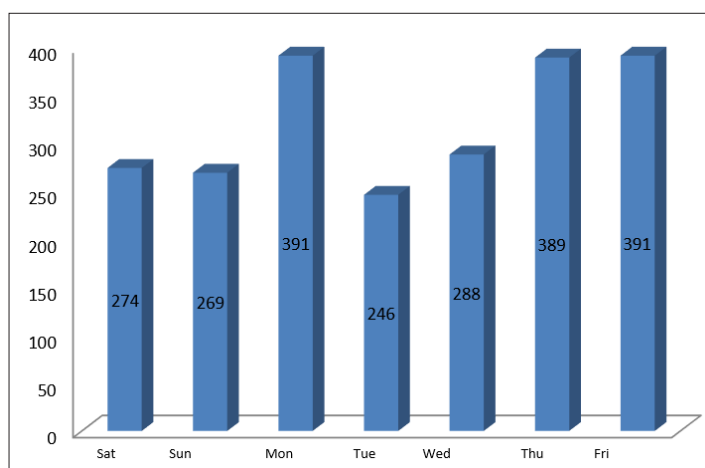


Figure 8: Frequency of Forest Fires During Weekdays in the Souk-Ahras Region (Period 2008-2018)

Relationship Between Fires and Climatic Factors

Relationship Between Forest Fires and Precipitation

A close relationship between rainfall and the number of fires. Thus, we find that ‘an increase in precipitation ‘always accompanies’ decrease in the number of outbreaks of’ forest fires and vice versa (Table 8 and Figure 9).

Table 8: Relationship Between Rainfall and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Year	Number of households	Precipitation from June to October (mm)	Precipitation from June to October (%)
2008	106	78.6	8.50%
2009	43	167.8	18.15%
2010	134	66.7	7.21%
2011	62	100.5	10.87%
2012	148	34.7	3.75%
2013	31	89.9	9.72%
2014	121	61.7	6.67%
2015	54	101.6	10.99%
2016	90	67.8	7.33%
2017	98	75	8.11%
2018	2	80	8.65%
Total	889	924.3	100%

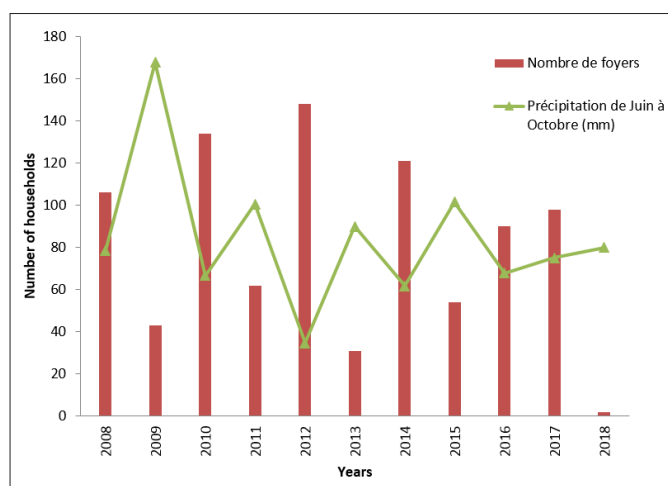


Figure 9: Relationship Between Rainfall and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

I 'year 2012 is the most critical from the point of view of forest fires where we recorded a minimum of rainfall compared to other years (3.75%) of total rainfall.

On the contrary, the 'year 2009, exposed to heavy rainfall (107.8 mm or 18.5%) is characterized as a minimum number of outbreaks of' forest fires (43 outbreaks only).

This explains the impact and role of precipitation on the phenomenon of forest fires. The more abundant the precipitation, the higher the rate of' fuel moisture increases and thus less is the frequency of fires. On the contrary, if precipitation is less abundant, the fuels are less humid, which therefore favors the' outbreak of fires.

Relationship Between Forest Fires and Maximum Temperatures
I' an increase in temperature is favorable to forest fires, and a decrease in temperature also leads to a decrease in the number of fire outbreaks (Table 9 and Figure 10).

Temperature has a very important role in the sense that it indicates the condition of the passage of heat from one substance to another; it is a factor that affects the availability of energy. Furthermore, it promotes the evaporation and drying out of fuels and therefore makes them more vulnerable to the risk of fire [7].

Table 9: Relationship Between Maximum Temperatures and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Year	Number of households	Maximum temperature from June to October (°C)
2008	106	39.3
2009	43	31.7
2010	134	38.8
2011	62	34
2012	148	39.6
2013	31	29.7
2014	121	32
2015	54	35
2016	90	37.7
2017	98	38
2018	2	31.6

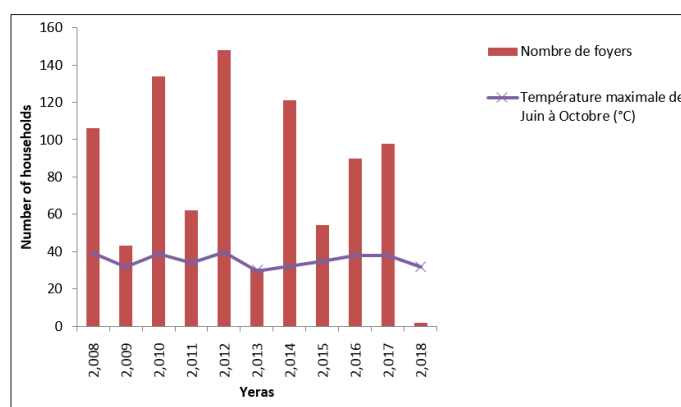


Figure 10: Relationship Between Maximum Temperatures and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Relationship of Forest Fires to Relative Air Humidity

The influence of humidity can s'explain at the level of the fuels whose' humidity is dependent on' humidity of the' air is the water content of the fuel [8].

So a decrease in the ' humidity of the 'air leads to an increase in the number of outbreaks of forest fires (Table 10 and Figure 11).

Table 10: Relationship Between the Average Relative Humidity (%) and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Year	Number of households	Average relative humidity from June to October (%)
2008	106	54
2009	43	61
2010	134	35
2011	62	68
2012	148	59
2013	31	68
2014	121	57
2015	54	48
2016	90	50
2017	98	55
2018	2	71

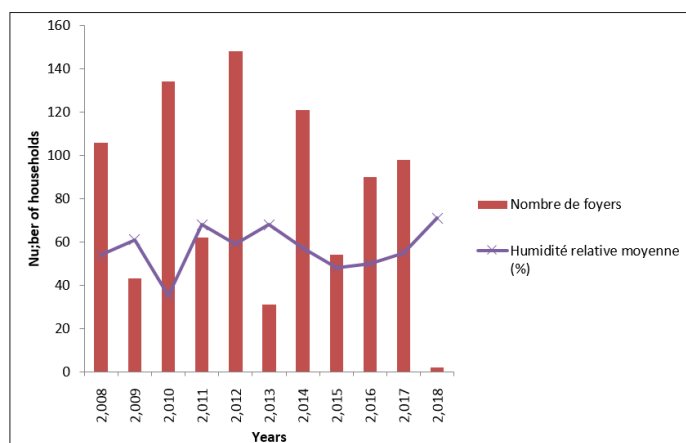


Figure 11: Relationship Between the Average Relative Humidity (%) and the Number of Forest Fire Outbreaks in the Souk Ahras Region (Period 2008 - 2018)

Relationship Between Forest Fires and Wind Speed

In addition to the role of carrier over great distances of sparks or burning materials, the wind which dries the fuel and which is an inexhaustible reservoir of oxygen to the fire helps in a more than significant way to the propagation of the fire; he directs it according to his direction and he heats the combustibles against the fire [9].

The wind is considered as a factor aggravating the severity of fires and this by acting on the process of combustibility. The more the wind blows, the drier the fuels and therefore the combustion is faster. Not only the wind speed but also its direction must be taken into account [10].

Table 11: Relationship Between Average Wind Speed (M/S) and the Number of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Year	Number of households	Average wind speed from June to October (m/s)
2008	106	3.5
2009	43	3.0
2010	134	3.2
2011	62	3.1
2012	148	2.8
2013	31	2.7
2014	121	3.6
2015	54	2.0
2016	90	2.3
2017	98	2.8
2018	2	2.1

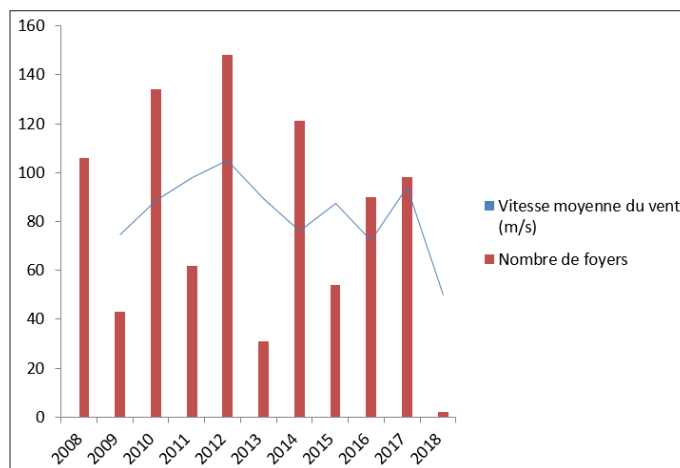


Figure 12: Relationship Between Average Wind Speed (M/S) and the Number Of Forest Fire Outbreaks in the Souk-Ahras Region (Period 2008 - 2018)

Policy for the Fight Against Forest Fires in the Region of Souk Ahras

The conservation of Souk Ahras forests has set up an operational system on the following points of view:

In Terms of Awareness

Prevention aims, among other things, to appropriately modify human behavior by informing and raising awareness among the population [3]. One of the major objectives of the information is to explain why the forest must be protected and how to protect it (example of radio broadcasts, conferences, days, open days on the forest administration, television activities and participation, press, etc.).

On the Regulatory Level

Elaboration and approval of decrees of wilaya having appeal to the prevention and the Fight against forest fires and their application since the beginning of the campaign in 01/06 until October 31 of the year (Order bearing campaign of preventive Fight against forest fires, Order establishing the campaign for preventive and active Fight against forest fires, Order establishing municipal intervention groups, etc.).

In Terms of Prevention

Prevention is used in a broad sense; it designates the measures taken before the fire in order to reduce the risk and the previous measures to reduce the risk of fire (surveillance and alert, lookout post, mobile forest brigades, tracks forests, firebreak trenches, water points, etc.).

Conclusion

Forest fires are and will remain one of the major destructive problems for Mediterranean forests in general.

Today, less than 5% of fires are considered to be of natural origin due mainly to lightning, for the rest, man is directly or indirectly involved in the destruction of the forest.

From the data provided by the conservation of the forests of Souk Ahras in the form of daily, monthly, annual and hourly reports, we have created a database in order to analyze the phenomenon of forest fires at the level of this locality for a period of 11 years spanning from 2008 to 2018, 889 declared outbreaks caused the disappearance of an area of 5025.8 ha. This result makes it possible to establish for these years an average of 456.89 ha per year. The largest number of fires in 2012 of 148 households with a rate of 26.7% of the total number registered. On the other hand in 2018 the burned surface is considered acceptable compared to the annual average recorded of the wilaya, this is due to several factors, including the factor. The month of August is the month with the highest number of homes, an average of 504 homes, and the largest area 3204.3 ha. With regard to schedules, most fire starts were counted during the day and more specifically between 6 a.m. and 8 p.m.

The analysis of the parameters gives an idea of the means of response, the speed of the intervention and the possibility offered by the terrain to the penetrability of the response machinery.

To reduce the effect of fires, knowledge of fuels is a solution indicated in the management of forest ecosystems. Two fundamental elements seem to come into play here. On the one hand the climatology factor on the other by human activity.

Given these results, the danger of forest fires remains high, which requires management plans based on the fire risk prevention plan which itself is based on maps of sensitivity to forest fires.

References

1. Plana E, Font M, Serra M, Chauvin S, Gladine J (2016) Forest fires, guide for journalists and the media. EFIRECOM project. CTFC Edition 36.
2. Moro C (2006) Flammability and dryness of tree heather and strawberry tree, spatial risk of heather. National Institute of Agronomic Research 53.
3. Asnoui S (2016) Report and analysis of forest fires in the Wilaya of Relizane during the period 111.
4. C F S A (2018) Conservation of Souk Ahras forests. Internal document.
5. Zouaidia H (2006) Assessment of forest fires in eastern Algeria 153.
6. Khelifi H (2002) The forest and pre-forest formations of the mountains of Algeria; diversity and sensitivity. National Agronomic Institute Dept Bot 15.
7. Hsupply A (1980) I'Blidean Atlas, climate and plant levels. OPU Algiers 532.
8. Iayec S (1989) Biological parameters to improve the risk index» forest fires Mediterranean forestry station. Avignon 23.

9. Demontgolfier J (1989) "Protection of forests against fires", Technical Guide for French Mediterranean Foresters. Eighteen cards. Aix-en-Provence: CEMAGREF.
10. Dupuy L (2000) The possible contributions of fire physics to the design and maintains fuel breaks t XXI 4: 497-510.

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