



# Wildfires in Lebanon 2008-2021:

# Reporting on fires for a better risk management



MOE/UOB, 2021. Wildfires in Lebanon 2008-2021 (Mitri, G. Ed.). A joint report of the Ministry of Environment (MOE) and the University of Balamand (UOB), Beirut.

December, 2021

## Contents

| List of Figures      | 2  |
|----------------------|----|
| List of Tables       | 2  |
| MOE Foreword         | 3  |
| UOB Foreword         | 6  |
| Introductory notes   | 8  |
| Main causes of fires | 10 |
| Climate change       | 11 |
| Fire reporting       | 12 |
| Future prospects     | 28 |
|                      |    |

## List of Figures

| Figure 1. Annual number of fires (fire occurrences)   | 14         |
|---|------------|
| Figure 2. Annual burnt areas  | 14         |
| Figure 3. Annual length of the fire season in number of days (upper) and presentation of pea<br>months (below)                  | ак<br>15   |
| Figure 4. Comparison of fire occurrence (upper) and burned areas (lower) between 2008 an 2020.                                  | d<br>16    |
| Figure 5. Land cover/land use of fire affected areas (upper) and ownership of fire affected la<br>(lower) between 2008 and 2020 | ınds<br>17 |
| <b>Figure 6.</b> Distribution by Kadaa of fire occurrences (upper) and burnt area (lower) between                               | 10         |
| Figure 7. Land type affected by fires between 2008 and 2020   | 18         |
| Figure 8. Distribution of fuel type affected by fire between 2008 and 2020  | 20         |
| Figure 9. Distribution of main fire causes between 2008 and 2020  | 21         |
| Figure 10. Fire reporting individuals/agencies between 2008 and 2020  | 22         |
| Figure 11. Distribution of temporal fire occurrence between 2008 and 2020   | 23         |
| Figure 12. Times for intervention after reporting fires between 2008 and 2020   | 24         |
| Figure 13. Fire duration between 2008 and 2020  | 24         |
| Figure 14. Fire occurrence per Caza (2008-2020)   | 26         |
| Figure 15. Extent of burned areas per cadastral units (2008-2020)   | 27         |

## List of Tables

| Table 1. Average annual number of human and technical resources involved in fire-fighting |    |
|---|----|
| between 2008 and 2020   | 25 |

#### **MOE Foreword**

Lebanon's unique forest ecosystems play an important role in supporting high biodiversity and providing a variety of environmental goods and services.

Like many other Mediterranean countries, changes in the intensity, extent and frequency of wildfires have affected Lebanon's green cover in recent years. During the past three years, Lebanon has experienced some of its worst fire seasons in records with large and intense fires causing a devastating impact not only on the natural environment but also on the livelihoods of local communities.

This report is the fruit of a collaborative work since 2013 between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), related to the issuance of annual reports on wildfires in Lebanon based on data provided in the fire ID cards which are filled in by the Internal Security Forces (ISF). The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon. More specifically, the report sheds light on the state of fires in Lebanon from 2008 to 2021 with the aim to improve understanding about the problems we are dealing with and accordingly take necessary measures to improve fire risk management in the future.

I seize this opportunity to thank all efforts put in producing these annual fire reports especially those from the Ministry of Environment team members and the University of Balamand. Also, I extend my thanks to the Internal Security Forces (ISF) for contributing to filling the fire ID cards according to the unified form issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008.

To conclude, fire reporting for the period extending from 2008 to 2021 showed very alarming numbers with documented total burnt area of fires amounting to 21,674 ha and minimum total number of fires amounting to 2,249 fires. Reaching an average annual burnt area of 1,449 ha makes Lebanon's terrestrial ecosystems more exposed to damages and losses from fires. Accordingly, we commend the efforts deployed by all concerned ministries and institutions in

preventing and combating forest fires and we support the national response that can help in improving fire risk management in light of lessons learned throughout the past 10 years including the update of Lebanon's national strategy for forest fire management, the development of a specific wildfire law, the implementation of pilot actions for preventing wildfires and restoring burnt lands, and the strengthening of specific capacities in fire risk management, among others.

Nasser Yassin, Ph.D. Minister of Environment, Republic of Lebanon

## كلمة وزارة البيئة

تلعب النظم البيئية الفريدة للغابات في لبنان دورًا مهمًا في دعم التنوع البيولوجي وتوفير مجموعة متنوعة من السلع والخدمات البيئية.

مثل العديد من دول البحر الأبيض المتوسط الأخرى، أثرت التغيرات في شدة ومدى وتواتر حرائق الغابات على الغطاء الأخضر للبنان في السنوات الأخيرة. خلال السنوات الثلاث الماضية، شهد لبنان بعضًا من أسوأ مواسم الحرائق من ناحية حجم المساحات المحترقة وكثافة النيران التي تسببت في آثار مدمرة ليس فقط على البيئة الطبيعية ولكن أيضًا على سبل عيش المجتمعات المحلية.

هذا التقرير هو ثمرة عمل تعاوني منذ عام 2013 بين وزارة البيئة ومعهد الدراسات البيئية في جامعة البلمند فيما يتعلق بإصدار تقارير سنوية عن حرائق الغابات في لبنان بناءً على البيانات المقدمة في البطاقة الموحدة للحرائق والتي تملأها قوى الأمن الداخلي. يأتي التقرير تماشياً مع أبرز المتطلبات الفنية للاستر اتيجية الوطنية لإدارة حرائق الغابات في لبنان (المصادق عليها بقرار مجلس الوزراء رقم 52 تاريخ 2009/5/13) من خلال العمل على توحيد معلومات وبيانات الحرائق كوسيلة لتمكين الجهود المبذولة لفهم أفضل لمشكلة حرائق الغابات في لبنان. وبشكل أكثر تحديدًا، يسلط التقرير الضوء على حالة الحرائق في لبنان منذ عام 2008 لغاية عام 2021 بهدف تحسين فهم المشاكل التي نتعامل معها وبالتالي اتخاذ الإجراءات اللازمة لتحسين إدارة مخاطر الحرائق في المستقبل.

أغتنم هذه الفرصة لأشكر كل الجهود المبذولة في إنتاج هذه التقارير السنوية عن الحرائق، وخاصة تلك من أعضاء فريق وزارة البيئة وجامعة البلمند. كما أتقدم بالشكر لقوى الأمن الداخلي على مساهمتها في تعبئة البطاقة الموحدة للحرائق وفق النموذج الموحد الصادر بقرار من رئاسة مجلس الوزراء رقم 256 بتاريخ 2008/3/1.

في الختام، أود الإشارة إلى ما أبرزته بيانات الإبلاغ عن الحرائق للفترة الممتدة من عام 2008 لغاية عام 2021 من أرقامًا مقلقة للغاية حيث بلغ إجمالي مساحة الحرائق الموثقة 21674 هكتارًا و2249 حريقًا أساسيا. الوصول إلى متوسط مساحة محترقة سنويًا تقارب ال 1449 هكتارًا يجعل النظم البيئية للغابات في لبنان أكثر عرضة للأضرار والخسائر من الحرائق. وبناءً عليه، نشيد بالجهود التي تبذلها جميع الوزارات والمؤسسات المعنية في الوقاية من حرائق الغابات ومكافحتها، وندعم الاستجابة الوطنية التي يمكن أن تساعد في تحسين إدارة مخاطر الحرائق في ضوء الدروس المستخلصة على مدار السنوات العشر الماضية بما في ذلك تحديث الاستراتيجية الوطنية للحرائق، ووضع قانون محدد لحرائق الغابات، وتنفيذ إجراءات نموذجية لمنع حرائق الغابات واستعادة الأراضي المحترقة وتأهيلها، وتعزيز القدرات المحددة في إدارة مخاطر الحرائق من بين أمور أخرى.

> د. ناصر ياسين وزير البيئة الجمهورية اللبنانية

#### **UOB** Foreword

We at the University of Balamand (UOB) strive to contribute to nation building, ethical standards, inter-cultural dialogue, environmental responsibility, and human development. One of the tools to achieve our goals is by prioritizing and investing in the preservation of the Lebanese natural environment. Accordingly, UOB is keen on addressing, through its multidisciplinary Institute of the Environment, the pressing environmental concerns by undertaking scientific research and long-term monitoring of natural systems.

For the past several decades, Lebanon has been suffering from various socio-economic and environmental crises which affected our society and contributed to the degradation of our natural environment with negative repercussions on the nation as a whole. More specifically, Lebanon was ravaged by devastating wildfires in the years 2019, 2020 and 2021, many of which took place in the northern part of the country.

The University of Balamand and the Ministry of Environment have partnered since 2013 to jointly prepare the annual reports of wildfires in Lebanon. A mechanism of coordination was put in place between the concerned team at the Ministry of Environment and the concerned team at the Institute of the Environment at the University regarding the execution of the data analysis. This has resulted in producing thirteen fire reports till present.

We hope that this document compiling all reported data on forest fires from 2008 to 2021 will create a better understanding of the challenges facing wildfire management in the country and will foster a new commitment among all national and local stakeholders to generate sustainable solutions for fire risk management.

I take this opportunity to express our gratitude and appreciation to the team of the Ministry of Environment and our team at the Institute of the Environment who contributed to this common publication.

> Dr. Elias Warrak President

## كلمة جامعة البلمند

نحن في جامعة البلمند نسعى دوماً للمساهمة في بناء الوطن، والمعايير الأخلاقية، والحوار بين الثقافات، والمسؤولية البيئية، والتنمية البشرية. تتمثل إحدى أدوات تحقيق أهدافنا في تحديد الأولويات والاستثمار في الحفاظ على البيئة الطبيعية اللبنانية. لذلك وجدت جامعة البلمند أنه من الضروري معالجة الاهتمامات البيئية الملحة من خلال البحث العلمي ورصد الأنظمة الطبيعية من قبل معهد الدر اسات البيئية المتعدد الإختصاصات.

عانى لبنان خلال العقدين الماضيين من أزمات اجتماعية واقتصادية وبيئية مختلفة أثرت سلباً على مجتمعنا وساهمت في تدهور بيئتنا الطبيعية ونتجت عنها انعكاسات سلبية على الوطن ككل. وتحديدًا، الحرائق المدمّرة التي اندلعت في الأعوام 2019 و 2020 و 2021 ، وخاصةً في شمال لبنان.

في إطار تعاونها مع وزارة البيئة منذ 2013، أعدّت التقارير السنوية عن حرائق الغابات في لبنان. كما تم وضع آلية تنسيق بين الفريق المختص بوزارة البيئة والفريق المختص بمعهد الدراسات البيئية بالجامعة لتحليل البيانات. ممّا أدى إلى إنتاج ثلاثة عشر تقريرًا عن الحرائق لغاية الآن.

نأمل أن يعزز هذا التقرير الذي يجمع جميع البيانات المبلغ عنها بشأن حرائق الغابات من عام 2008 إلى عام 2021، تصوراً أفضلا للتحديات التي تواجه إدارة حرائق الغابات في البلاد، ونأمل أيضا أن يحفذ التزامًا جديدًا بين جميع أصحاب المصلحة لوضع حلول مستدامة في إدارة مخاطر الحرائق.

أغتنم هذه الفرصة للتعبير عن امتناننا وتقديرنا لفريق وزارة البيئة وفريقنا في معهد الدراسات البيئية الذين ساهموا جميعًا في إعداد هذا المنشور المشترك.

> د. الياس وراق الرئيس



## **Introductory notes**

The problem of wildfires in Lebanon is complex and should be addressed among the different sectors. It concerns all aspects related to forest management, prevention, suppression, and post-fire management. Yet, there is no doubt that wildfire risk has significantly worsened during the past thirteen years.

Changes in the wildfire regime are having a significant effect on Lebanon's forest ecosystems. More specifically, an increasing number of fires and extent of burnt areas are causing enormous economic and ecological damages as well as losses of human lives. The changes in fire occurrence closely reflect the recent socio-economic and environmental changes underway in the country. More specifically, changes in traditional land-use and lifestyles, de-population and repopulation of rural areas, decreases in grazing pressure and wood gathering and increases in the wildland-urban interface are leading to the recovery of vegetation and an increase in accumulated fuel. All these are parallel to the changes in the fire regime, from being few in number and affecting small areas, to becoming very numerous and affecting large areas every year.

In addition, we are more confident now that climatic factors are considered as a contributing factor. As large fires tend to be concentrated in days mostly when air humidity and fuel/soil moisture are low and wind speed is high, the recurrence of extreme weather conditions contributes to an increase fire risk and post-fire land degradation. More specifically, Lebanon's forests are experiencing multiple climate-related stressors: 1) extreme weather events like heat waves, 2) torrential rainfall, 3) drought periods and strong wind storms, and 4) recurrent intense wildfires, among others. National and international reports have already confirmed increases in fire frequency and severity that are affecting tree growth and survival as well as yield and quality of wood and non-wood forest products, wildlife habitat and the recreational, scenic, environmental and cultural value of forests. Also, fires started to cause an increasing number of human injuries, death, and loss of property.

This report compiles all fire reporting information for the years 2008 throughout 2021. The results show various un-precedent fire events especially in the past three years. These include, fires affecting cedar, juniper and fir forests in high country lands, big fires starting early in the fire season (e.g., in the month of July), extension of the fire season over the month of November and occurrence of disastrous fires in this month, increase in human injuries and damage to public health and losses in human lives for 3 consecutive years, among others.

It is hoped that the present report contributes to an improved fire risk management in the future and supports an urgent update of Lebanon's national strategy for forest fire management to meet more efficiently current challenges by learning from previously acquired national experience.

> George Mitri, Ph.D. Director of Land and Natural Resources Program Institute of the Environment, University of Balamand

## Main causes of fires

The most common indirect causes of fires are: 1) proximity of forested area to agricultural lands (the agricultural interface can be defined as an interface where farms, crops, and orchard, irrigated or non-irrigated intersect with forest lands), 2) average annual precipitation from 200 mm to 1100 mm - dry season length: 7 to 8 months, 3) change in agricultural habits (less wood and shrub collection, disappearance of old paths, undergrazing in some areas), 4) abandonment of forest and agricultural lands and marginalization of lands, 5) development of impenetrable dense fuel, 6) human development sprawl into forested lands, 7) re-population of rural/forest areas and 8) newly emerging activities in forest lands with the start of the pandemic and economic crises.

The most common direct causes of fire include: 1) land cleaning by fire, 2) burning waste in proximity of forested lands, 3) use of camp fires and fireworks during the fire season, and 4) arson fires. More specifically, direct causes of fires involve farmers who use fire to eliminate crop stubble and expand agricultural lands. In spite of the obvious risks, farmers set fire to agricultural residues even when large out-of-control fires are burning in the vicinity. Many smokers, hunters and campers throw lit cigarettes on the forest litter or along the roads and light cooking fires without taking the necessary precautions to extinguish them properly. Also, the burning of municipal waste and waste left by tourists/visitors were often carried out in conditions of high fire risk without taking the necessary precautions. Fixed installations such as high voltage power lines that are installed above forest areas can cause a fire under certain conditions (i.e. lack of maintenance of the vegetation cover below the power lines). Finally, many documented incidents showed arsonists taking suspicious actions which were responsible for a number of fire occurrences.

Yet a big percentage of fires remain with unknown causes (i.e., in reference to the annual fire reports which are presented as part of this document). This is mostly due to the lack of complete fire forensic investigations for most of fires we had in the country.

## **Climate change**

Almost all fires in Lebanon are human-caused events. Although many of the reasons for the recent increase in the number of fires and extent of burnt areas were likely related to various socio-economic changes, climatic factors play an important contributing factor.

The IPCC sixth assessment report on climate change 2021 highlighted the following facts to be experienced by the Mediterranean region (i.e., including Lebanon): high confidence of increase in mean temperature, high confidence of increase in extreme heat, high confidence of decrease in mean precipitation, medium confidence of increase in heavy precipitation, medium confidence of increase in heavy of increase in aridity, high confidence of increase in hydrological drought, and high confidence of increase in fire weather. As a result, extreme events are expected worsen the forest fire situation:

- Heat waves means large scale fires
- Drought periods means forest dieback
- Severe wind storms mean more damage to trees and forest dieback and uncontrollable fires
- Heavy rainfall means soil erosion, soil water scarcity and floods

More specifically, wildfire ignition and behavior depend on 1) predominating and prevailing weather conditions, and 2) vegetation moisture content, which is affected by precipitation, relative humidity, air temperature and wind speed. A number of studies suggested that severe weather events such as heat waves significantly contributed to an increase in the extent and frequency of fire. An increase in temperature enhances fuel dryness and reduces relative humidity, especially in regions with minimal or absent summer rainfall. Other studies suggested that in a changing climate, the fire season becomes longer and the severe fire months shift towards the end of the season.

Based on the above, Lebanon's forest ecosystems at different altitudinal ranges are increasingly exposed to intense and severe wildfires and over a longer period of time throughout the year.

## **Fire reporting**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE)/ Department of Ecosystems and the Institute of the Environment, University of Balamand (IOE-UOB), regarding annual reporting on wildfires in Lebanon. The analytical work of the reports was conducted based on data provided in the fire ID cards which are filled in by the Internal Security Forces (ISF). The annual fire reports (**Annex 1**) come in line with the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009).

Although the presented fire reports are comprehensive in terms of documented information, it is important to keep in mind that the reality on the ground (e.g., number of fires and extent of burnt areas) might significantly differ from what is reported. This is mostly due to the fact that not all fires are surveyed in the field and even when surveyed there is always a room for misinterpretation (e.g., underestimating or overestimating the fire affected area).

Accordingly, it is always important to support the field survey data with information coming from other sources (e.g., satellite imagery). In this context, the burnt areas in the past three years, namely 2019, 2020 and 2021 were mapped using relatively high resolution satellite data (**Annex 2**). The annual fire report of 2021 is still not published but the satellite-based map provides very valuable information about the extent of burnt lands thought the 2021 fire season.

Overall, the following statistics about major wildfires (i.e., those surveyed in the field and/or detected with the use of satellite data) were derived from all previous annual reports throughout the period 2008-2020 for use as baseline information in future works:

- Total burnt area of fires: **18,836 ha**
- Total number of fires: 2,171 fires
- Average annual burnt area: 1,449 ha
- Average number of annual fires: 167 fires
- Average start date: 19-April
- Average end date of the fire season: 6-November
- Earliest date of the fire season(s): 5-February
- Most extended end date of the fire season: 2-December
- Average peak month (number of fires): August
- Average peak month (burnt areas): September
- Average length of the fire season: 200 days

Burnt areas as derived from satellite images are presented for the last three years (i.e., 2019-2020-2021):

- 1. 2021 for a total of **2,838 ha** of burnt land (ref. satellite data) comprising the largest fires between 28 July and 3 August, 2021 in Akkar for a total area of 1,573 ha
- 2. 2020 for a total of **7,132 ha** of burnt land (ref. satellite data)
- 3. 2019 for a total of **2,679 ha** of burnt land (ref. satellite data)

However, an overview of <u>reported</u> fire events for the years 2008 throughout 2020 is presented below (the 2021 fire report has not been published until present). As previously mentioned, <u>a much larger number of fires might have affected a higher extent of</u> <u>burned areas across the country each year. These are not necessarily reflected in</u> <u>the following compiled figures.</u>

More specifically, the total annual number of annual fires (i.e., fire occurrences) is presented in **Figure 1** and the total annual burnt area is presented in **Figure 2**.



Figure 1. Annual number of fires (fire occurrences)



Figure 2. Annual burnt areas

Annual length of the fire season in number of days and presentation of peak months are presented in **Figure 3**.



**Figure 3.** Annual length of the fire season in number of days (upper) and presentation of peak months (below)

A comparison of monthly fire occurrence and burnt areas from 2008 to 2020 is also presented (**Figure 4**).



**Figure 4.** Comparison of fire occurrence (upper) and burned areas (lower) between 2008 and 2020

The main land cover/land use of fire affected areas (**Figure 5** upper) comprised forest/woodlot (55.1%), agricultural land (26.1%), and grassland (10.3%); a total of 27% of fire affected lands were privately owned, 25% were mixed lands (i.e., public/private), 19% were public lands, and 29% comprised not specified type of land ownerships (**Figure 5** lower).



**Figure 5.** Land cover/land use of fire affected areas (upper) and ownership of fire affected lands (lower) between 2008 and 2020

Wildfires unequally occurred across the 26 Caza (i.e., Kadaa). More specifically, the Caza of Sour was the most affected by number of fires (246 fires), followed by Marjeoune with



a total of 236 fires and Chouf (235 fires) (**Figure 6** upper). The Caza of Chouf alone was affected by 6,078.6 ha between 2008 and 2020 (**Figure 6**, lower).

**Figure 6.** Distribution by Kadaa of fire occurrences (upper) and burnt area (lower) between 2008 and 2020

Mountainous areas were affected by the largest extent of burned areas (61.1%), followed by valleys (22.6%). Mountains were also affected by the largest number of fires (56.8%), followed by valleys (19.6%) (**Figure 7**).



Figure 7. Land type affected by fires between 2008 and 2020

A total of 24.67% of affected fuel types (**Figure 8**) was mixed forest, followed by needle forest (16.3%).



Figure 8. Distribution of fuel type affected by fire between 2008 and 2020

A total of 57.6 % of the fires had unknown causes. Negligence was found as a main cause for 19.06% of all fires. Furthermore, 12.98% of the fire causes was due to Arson (**Figure 9**).



Figure 9. Distribution of main fire causes between 2008 and 2020

Local residents reported 46.65% of fire incidents, while 29.45% of fire incidents were reported by Internal Security patrols (**Figure 10**).



Figure 10. Fire reporting individuals/agencies between 2008 and 2020

Most of the fires started between noon and 4 pm (45.98%) and 20.17% of fires started between 8 am and noon. In addition, 18.03 % of fires started between 4 pm and 8 pm and 5.03% of fires started between 8 pm and midnight (**Figure 11**).



Figure 11. Distribution of temporal fire occurrence between 2008 and 2020

It was observed that 51.42% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 24.2% of interventions happened after 20 minutes and before 1 hour from the reporting time (**Figure 12**).

The largest number of fires lasted between 1 and 2 hours (45.21%). A total of 25.47% of fires lasted between 2 and 5 hours, and 10.3% of fires lasted between 5 and 12 hours. It was also observed that 5.19% of fires lasted between 12 and 24 hours. However, only 2.9% of fires lasted more than 24 hours (**Figure 13**).



Figure 12. Times for intervention after reporting fires between 2008 and 2020



Figure 13. Fire duration between 2008 and 2020

The following human and technical resources were involved in fire suppression on annual average between 2008 and 2020 (**Table 1**).

**Table 1.** Average annual number of human and technical resources involved in fire-fighting between 2008 and 2020

|                            | Avg. Nb.<br>of Small<br>Cars | Avg.<br>Nb. of<br>Water<br>Tanks | Avg. Nb. of<br>Other Cars | Avg. Nb.<br>of Human<br>Resources | Avg. Nb.<br>Lebanese<br>Army<br>Helicopters<br>used |
|----------------------------|------------------------------|----------------------------------|---------------------------|-----------------------------------|---|
| Civil Defense              | 105                          | 310                              | 19                        | 702                               |   |
| Army                       | 85                           | 11                               | 15                        | 545                               | 27  |
| Internal Security          | 102                          | 9                                | 16                        | 362                               |   |
| Ministry of<br>Agriculture | 3                            | 0                                | 1                         | 6                                 |   |
| NGO                        | 14                           | 9                                | 5                         | 71                                |   |
| Local Resident             | 0                            | 0                                | 0                         | 527                               |   |
| Total                      | 309                          | 339                              | 56                        | 2213                              | 27  |

Maps compiled from fire occurrence per Caza (**Figure 14**) and extent of burnt areas (**Figure 15**) per cadastral unit were produced to help in better visualization of historical fire distribution across the national territory.



Figure 14. Fire occurrence per Caza (2008-2020)



Figure 15. Extent of burned areas per cadastral units (2008-2020)

## **Future prospects**

As Lebanon endorsed in 2009 a National strategy for forest fire management (endorsed by the Council of Ministers' Decision No. 52/2009) in response to the increasing risk of wildfires, the current needs should be focused on reviewing and updating the strategy to facilitate its efficient implementation in light of current socio-economic and environmental changes and challenges.

In parallel, it will be essential to develop a wildfire law as an efficient tool for use in enforcing legal measures with the aim to reduce fire risk in the future. Some of the main points to be addressed in future initiatives at the national level by concerned ministries and institutions include:

- Consider and updated fire risk map and priority villages/towns of high risk
- Provide maps/data of burnt land in the last 10 years for protection, restoration and monitoring
- Provide a database on fire occurrence at the municipality level to identify and locate potential local problems associated with fire occurrence and address them properly
- List clearly roles and responsibilities under each ministry/authority
- Support local authorities to play their roles in local fire risk management
- Assess needed resources under each ministry to improve fire risk management
- Assess fire risk management needs for nature reserves and protected areas
- Assess local needs of municipalities for improved fire risk management
- Promote the use of existing fire danger tools for improved preparedness and digitize, synchronize and standardize the alert-response process for improved transparency and accountability
- Ensure timely communication of alerts, risks, and awareness
- Promote management of forests following national guidelines
- Promote shredding of wood residues and briquette production
- Update the forest law and associated articles related to fires
- Set the ground for international support in fire-fighting

- Build capacity in forest fire forensic investigation
- Develop adaptation means and measures to climate change
- Provide guidance about needs for further research (e.g., impact of climate change on fire risk, post-fire regeneration and recovery)
- Improve fire reporting (e.g., annual reports, fire id card, etc.) and aim to digitize and centralize data entry of the fire ID cards
- Promote the use of available technologies and innovation for improved fire risk management
- Prepare a basket of projects and assess budget of needed resources for fundraising

Annex 1: Fire reports 2008-2020





# State of Lebanon's wildfires in 2008

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2013 -

## **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008.

The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

### 2. FIRE DANGER IN THE 2008 FIRE SEASON

The calculated start date of the fire danger season for 2008 was 22 April, 2008 and the calculated end date was 14 November, 2008. The peak month was August (a total of 44 fires damaging 520 ha of vegetated land).

### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2008, a total of 230 fires were reported (Annexes 1 and 2), affecting a total area of 1070 ha (Figure 1)



Figure 1: Monthly distribution of fire occurrence and fire affected areas

The landuse of fire affected areas (Figure 2) comprised mixed land use (38%), forests/woodlands (33%), agricultural land (12%), and grassland (7%); 53% of fire affected lands were privately owned and 29% were public lands.



Figure 2. Landuse of fire affected areas (left) and ownership of fire affected areas (right)

Wildfires occurred in 22 out of 26 Cazas. More specifically, the Cazas of Sour, Chouf, and Sayda were affected by 34, 32, and 18 fires, respectively; while the Cazas of Jbeil, Zgharta, and Chouf were affected by 444 ha, 134 ha, and 88 ha of burned areas respectively (Figure 3).





Mountainous areas were affected by the largest number of fires and the largest extent of burned areas, followed by valleys and plains consecutively (Figure 4).



Figure 4. Land type affected by fires

Fire-affected type (Figure 5) consisted of 42% of needle forest (e.g. *Pinus sp.*), followed by mixed forest (11%), grassland (9%), mixed forest/agricultural land (9%), mixed grassland/agricultural land (8%).



Figure 5. Distribution of fuel type affected by fire

### 4. CAUSES OF FIRES

The main fire causes were unknown (57%). Negligence was reported as the main cause of fires for 26% of the reported fire events; 11% of causes involved human activities on natural lands. Arson fires represented only 4% of the total causes (Figure 6).



Figure 6. Distribution of main fire causes

#### 5. FIRE FIGHTING MEANS

#### Reporting

Local residents reported 40% of fire incidents, while 26% of fire incidents were reported by internal security patrols, 4% by farmers, and 18% by others. Forest guards reported only 0.4% of fires. Around 11% of fire incident reporting was not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies
# Fire starting time

Most of the fires started between noon and 4 pm (49%), and 21 % of fires started between 8 am and noon. In addition, 20% of fires started between 4 pm and 8 pm. (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 52% of first interventions in fire suppression occurred within the first 20 minutes after reporting time, while 18% of fire interventions happened after 20 minutes and before 1 hour from reporting time. Only 3% of interventions in fire suppression happened after one hour and a half from the reporting time. This was mainly due to lack of firefighting means (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 to 2 hours (59%); 22% of fires lasted between 3 and 5 hours and 10 % of fires lasted between 6 and 12 hours. Only 6 % of fires lasted between 12 and 24 hours, and 3% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                      | Nb. of<br>Small<br>Cars | Nb. of<br>Water<br>Tanks | Nb. of<br>Other<br>Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|----------------------|-------------------------|--------------------------|-------------------------|---------------------------|------------------------------|
| Civil<br>Defense     | 94                      | 343                      | 7                       | 865                       |                              |
| Army                 | 54                      | 5                        | 9                       | 556                       | 17 interventions             |
| Internal<br>Security | 138                     | 10                       | 20                      | 494                       |                              |
| NGO                  | 9                       | 0                        | 5                       | 53                        |                              |
| Local<br>Resident    | 0                       | 0                        | 0                       | 369                       |                              |
| Total                | 295                     | 358                      | 41                      | 2337                      |                              |

Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Figure 11. Fire occurrence in function of monthly mean temperature (left) and monthly mean precipitation in 2008 (right)



Figure 12. Burned areas in function of monthly mean temperature (left) and monthly mean precipitation in 2008 (right)









# **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

# <u>Biodiversity Program – Institute of the Environment -University of Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment, University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2009

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2014 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008.

The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2009 FIRE SEASON

The calculated start date of the fire danger season for 2009 was 19 May, 2009 and the calculated end date was 18 October, 2009. The peak month was July (a total of 78 fires damaging 435 ha of vegetated land).

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2009, a total of 265 fires were reported (Annexes 1 and 2), affecting a total area of 1300 ha (Figure 1).



Figure 1: Monthly distribution of fire occurrence and fire affected areas in 2009

The landuse of fire affected areas (Figure 2) comprised agricultural land (37%), forests/woodlands (31%), and grassland (27%); 50% of fire affected lands were privately owned and 23% were public lands.



Figure 2. Landuse of fire affected areas (left) and ownership of fire affected areas (right)

Wildfires occurred in 23 out of 26 Kadaa. More specifically, the Kadaa of Sour, Marjeoune, Chouf, El Koura and Bint Jbeil were affected by 38, 30, 27, 26 and 25 fires, respectively; while the Kadaa of Marjeoune, Bint Jbeil, and Hasbaya were affected by 464 ha, 152 ha, and 100 ha of burned areas respectively (Figure 3).







Mountainous areas were affected by the largest number of fires and the largest extent of burned areas, followed by valleys and plains consecutively (Figure 4).



Figure 4. Land type affected by fires

Thirty four per cent of affected fuel type (Figure 5) was mixed agriculture/grassland followed by grassland (18%), mixed forest/agricultural land (13%), mixed agriculture (8%) and mixed forest (7%).





# 4. CAUSES OF FIRES

The main fire causes were unknown (61%). Negligence was reported as the main cause of fires for 19% of the reported fire events; 13% of causes involved human activities on natural lands. Arson fires and agriculture practices represented only 2.7% each of the total causes (Figure 6).



Figure 6. Distribution of main fire causes

# **5. FIRE FIGHTING MEANS**

# Reporting

Local residents reported 43% of fire incidents, while 31% of fire incidents were reported by internal security patrols, 19% by others, and 5% by farmers. Forest guards reported only 1.5% of fires (Figure 7).



Figure 7. Fire reporting individuals/agencies

# Fire starting time

Most of the fires started between noon and 4 pm (49%), and 25 % of fires started between 8 am and noon. In addition, 21% of fires started between 4 pm and 8 pm (Figure 8).



Figure 8. Distribution of temporal fire occurrence

# Intervention time

It was observed that 51% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 18% of interventions happened after 20 minutes and before 1 hour from reporting time. Only 1.5% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 to 2 hours (64%); 26% of fires lasted between 3 and 5 hours and 6 % of fires lasted between 6 and 12 hours. Only 3 % of fires lasted between 12 and 24 hours and no fires were lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                      | Nb. of<br>Small<br>Cars | Nb. of<br>Water<br>Tanks | Nb. of<br>Other<br>Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|----------------------|-------------------------|--------------------------|-------------------------|---------------------------|------------------------------|
| Civil<br>Defense     | 91                      | 359                      | 37                      | 970                       |                              |
| Army                 | 98                      | 12                       | 17                      | 895                       | 17 interventions             |
| Internal<br>Security | 147                     | 15                       | 27                      | 561                       |                              |
| NGO                  | 4                       | 1                        | 14                      | 17                        |                              |
| Local<br>Resident    | 0                       | 0                        | 0                       | 669                       |                              |
| Total                | 340                     | 387                      | 95                      | 3112                      |                              |

Table 1. Human and technical resources



#### 6. FIRE SEASON OVERVIEW

Figure 11. Fire occurrence in function of monthly mean temperature (left) and monthly mean precipitation in 2009 (right)



Figure 12. Burned areas in function of monthly mean temperature (left) and monthly mean precipitation in 2009 (right)

#### 7. WILDFIRE PATTERN IN LEBANON

In 2009 the fire season was 54 days shorter than in 2008. July was the peak month for 2009 and August was the peak month for 2008 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison between 2008 and 2009 showed the following (Figure 14).

Figure 14. Comparison of fire occurrence (left) and burned areas (right) between 2008 and 2009



Annex 1: Fire occurrence per Kadaa (Caza) in 2009





BALAMAND

1988

2013

> 1.85 Ha

Km

# **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

# <u>Biodiversity Program – Institute of the Environment -University of Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2010

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2015 -

# **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2010 FIRE SEASON

The calculated start date of the fire danger season for 2010 was 5 May, 2010 and the calculated end date was 2 December, 2010. The peak month was June (a total of 74 fires damaging 965 ha of vegetated land). The fires during the months of January, February and March were not taken into consideration to calculate the fire season due to the exceptional peak in fire occurrence in February 2010.

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2010, a total of 320 fires were reported (Annexes 1 and 2), affecting a total area of 4661.26 ha (Figure 1).



#### Figure 1: Monthly distribution of fire occurrence and fire affected areas in 2010\*

\* When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).

The landuse of fire affected areas (Figure 2) comprised forests/woodlands (65.61%), mixed land (22.54%), , and agricultural land (5.88%); 49.33% of fire affected lands had mixed private and public ownerships, 10.87% were privately owned and 25.77% were public lands.



Figure 2. Landuse of fire affected areas (left) and ownership of fire affected areas (right)

Wildfires occurred in 22 out of 26 Kadaa. More specifically, the Kadaa of Chouf, , Sour, Marjeoune, Aakkar and Aley were affected by 40, 33, 29, 28 and 27 fires, respectively; while the Kadaa of Chouf, Becharre and Aakkar were affected by 2093.76 ha, 500.5 ha, and 456 ha of burned areas respectively (Figure 3).







Mountainous areas were affected by the largest number of fires and the largest extent of burned areas, followed by valleys and plains consecutively (Figure 4).



Figure 4. Land type affected by fires

Twenty one per cent of affected fuel type (Figure 5) was mixed agriculture/forest followed by mixed forest (18.6%), and broadleaves forest (5.7%).



Figure 5. Distribution of fuel type affected by fire

# 4. CAUSES OF FIRES

The main fire causes were unknown (68%). Negligence was reported as the main cause of fires for 18% of the reported fire events; 10% of causes involved human activities on natural lands. Arson fires and agriculture practices represented only 2% and 1% respectively of the total causes (Figure 6).



# Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

#### Reporting

Local residents reported 39.5% of fire incidents, while 37.2% of fire incidents were reported by internal security patrols, 23.1% by others, and 0.3% by farmers (Figure 7).





#### Fire starting time

Most of the fires started between noon and 4 pm (34%), and 24 % of fires started between 8 am and noon. In addition, 14% of fires started between 4 pm and 8 pm (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 51% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 23.5% of interventions happened after 20 minutes and before 1 hour from reporting time. Only 2.6% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

#### Fire duration

The largest number of fires lasted between 1 to 2 hours (40%); 22% of fires lasted between 2 and 5 hours and 13% of fires lasted between 5 and 12 hours. Only 7% of fires lasted between 12 and 24 hours (Figure 10).



Figure 10. Fire duration

# Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|          | Nb. of<br>Small Cars | Nb. of<br>Water<br>Tanks | Nb. of<br>Other<br>Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|----------|----------------------|--------------------------|-------------------------|---------------------------|------------------------------|
| Civil    |                      |                          |                         |                           |                              |
| Defense  | 260                  | 678                      | 46                      | 1381                      |                              |
| Army     | 304                  | 50                       | 56                      | 1450                      | 60 Interventions             |
| Internal |                      |                          |                         |                           |                              |
| Security | 271                  | 31                       | 70                      | 806                       |                              |
| NGO      | 6                    | 0                        | 7                       | 43                        |                              |
| Local    |                      |                          |                         |                           |                              |
| Resident | 0                    | 0                        | 0                       | 1230                      |                              |
| Total    | 841                  | 759                      | 179                     | 4910                      |                              |

Table 1. Human and technical resources



# 6. FIRE SEASON OVERVIEW

Figure 11. Fire occurrence in function of monthly mean temperature (left) and monthly precipitation in 2010 (right)



Figure 12. Burned areas in function of monthly mean temperature (left) and monthly precipitation in 2010 (right)

# 7. WILDFIRE PATTERN IN LEBANON

In 2010 the fire season was 54 days longer than in 2009 and equal to the duration in 2008 (206 Days). June was the peak month for 2010, July was the peak month for 2009 and August was the peak month for 2008 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality

A comparison between 2008, 2009 and 2010 showed the following statistics (Figure 14).



Figure 14. Comparison of fire occurrence (left) and burned areas (right) between 2008, 2009 and 2010







Annex 2: Extent of burned areas per cadastral units in 2010

# **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

# Biodiversity Program – Institute of the Environment -University of Balamand:

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2011

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2015 -

# **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2011 FIRE SEASON

The calculated start date of the fire danger season for 2011 was 4 March, 2011 and the calculated end date was 31 October, 2011. The peak month was August (a total of 27 fires damaging 71.9 ha of vegetated land).

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2011, a total of 80 fires were reported (Annexes 1 and 2), affecting a total area of 374.41 ha (Figure 1).



#### Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2011\*

\* When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).

The landuse of fire affected areas (Figure 2) comprised forests/woodlands (47.49%), agricultural land (28.31%), and grassland (18.35%); 40.17% of fire affected lands had mixed private and public ownerships, 24.31% were private lands, and 4.7% were public lands.





# Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 18 out of 26 Kadaa. More specifically, the Kadaa of Aakar, Marjeoune and Chouf were affected by 17, 12 and 11 fires, respectively; while the Kadaa of Aakar, Chouf and Aley was affected by 89.71 ha, 75.1 ha and 45.8 ha of burned areas respectively (Figure 3).

30.0

5011

2.0

0.0

17.5

0.3

12.0





2.9

0.0

0.3

1<sup>beil</sup>

20.0

1.80 5.90

25.0

6.1

Figure 3. Distribution by Kadaa of fire occurrence (upper), and burned areas (lower)

40

30

20

10

0

Alex

Mountainous areas were affected by the largest number of fires and the largest extent of burned areas, followed by valleys, and mixed lands of mountains and valleys consecutively (Figure 4).



Figure 4. Land type affected by fires

Thirty one per cent of affected fuel type (Figure 5) was broadleaved forests, followed by needle forests (18.3%) and agricultural field crops (16%).





# 4. CAUSES OF FIRES

The main fire causes were unknown (70.43%). Human activities in nature were reported as the main cause of fires for 13.14% of the reported fire events; 10.15% of causes were due to negligence. Landfill and arson fires represented 3.61% and 2.67% of the total causes, respectively (Figure 6).



Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

# Reporting

Local residents reported 48.75% of fire incidents, while 30% of fire incidents were reported by internal security patrols, 11.25% by others, and only 1.25% by farmers. Around 9% of fire incident reporting was not specified (Figure 7).


Figure 7. Fire reporting individuals/agencies

# Fire starting time

Most of the fires started between noon and 4 pm (46.25%), and 23.75 % of fires started between 4 pm and 8 pm. In addition, 8.75% of fires started between 8 am and noon. However, the starting time of 17.5% of fires was not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 38% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 24% of interventions happened after 20 minutes and before 1 hour from reporting time. Only 1% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 to 2 hours (39%); 30% of fires lasted between 2 and 5 hours, and 9% of fires lasted between 5 and 12 hours. Only 7% of fires lasted between 12 and 24 hours, and 1% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

# Resources employed in fire suppression

|                      | Nb. of<br>Small<br>Cars | Nb. of<br>Water<br>Tanks | Nb. of<br>Other<br>Cars | Nb. of<br>Human<br>Resources | Lebanese Army<br>helicopters |
|----------------------|-------------------------|--------------------------|-------------------------|------------------------------|------------------------------|
| Civil<br>Defense     | 52                      | 149                      | 2                       | 263                          |                              |
| Army                 | 53                      | 1                        | 1                       | 267                          | 13 interventions             |
| Internal<br>Security | 56                      | 1                        | 9                       | 190                          |                              |
| NGO                  | 30                      | 4                        | 5                       | 79                           |                              |
| Local<br>Resident    | 0                       | 0                        | 0                       | 386                          |                              |
| Total                | 191                     | 155                      | 17                      | 1185                         |                              |

The following human and technical resources were involved in fire suppression:

#### Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Figure 11. Fire occurrence in function of monthly mean temperature (left) and monthly precipitation in 2011 (right)



Figure 12. Burned areas in function of monthly mean temperature (left) and monthly precipitation in 2011 (right)

# 7. WILDFIRE PATTERN IN LEBANON

In 2011 the fire season (a total of 241 days) was 35 days longer than in 2010, and 89 days longer than in 2009. August was the peak month for 2011, while June was the peak month for 2010 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality

A comparison between 2008, 2009, 2010 and 2011 showed the following statistics (Figure 14).



Figure 14. Comparison of fire occurrence (left) and burned areas (right) between 2008, 2009, 2010 and 2011









# **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Biodiversity Program – Institute of the Environment -University of Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2012

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2015 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2012 FIRE SEASON

The calculated start date of the fire danger season for 2012 was 25 March, 2012 and the calculated end date was 7 November, 2012. The peak month was August (a total of 34 fires damaging 407.94 ha of vegetated land).

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2012, a total of 106 fires were reported (Annexes 1 and 2), affecting a total area of 837.96 ha (Figure 1).



#### Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2012\*

\* When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).

The landuse of fire affected areas (Figure 2) comprised forests/woodlots (74.1%), grasslands (16.1%), and agricultural lands (8.1%); 51.36% of fire affected lands had mixed private and public ownerships, 24.79% were public lands, and 10.29% were private lands.





Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 20 out of 26 Kadaa. More specifically, the Kadaa of Chouf, Aakar, and Batroun were affected by 16, 13 and 10 fires, respectively; while the Kadaa of El Koura, Rachaya and Sour were affected by 332.82 ha, 71 ha and 69.7 ha of burned areas respectively (Figure 3).





Figure 3. Distribution by Kadaa of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires (37.74%), followed by valleys (24.53%) and mixed lands of mountains and valleys (16.04%) consecutively; whereas valleys were affected by the largest extent of burned areas (43.57%), followed by mountainous lands (31.51%) and mixed lands of mountains and valleys (9.38%) consecutively (Figure 4).



Figure 4. Land type affected by fires

Forty two per cent of affected fuel type (Figure 5) was mixed forests, followed by broadleaved forests (19.7%), grasslands (6.44%) and a mixture of agricultural and grass lands (5.06%).



Figure 5. Distribution of fuel type affected by fire

# 4. CAUSES OF FIRES

The main fire causes were unknown (94.01%). Negligence was reported as the main cause of fires for 3.39% of the reported fire events; 2.47% of causes were due to human activities in nature. Whereas, agricultural practices, landfill and arson fires were insignificant, representing 0.12%, 0.014% and 0.001% of total causes, respectively; (Figure 6).



Figure 6. Distribution of main fire causes

# **5. FIRE FIGHTING MEANS**

# Reporting

Local residents reported 40.57% of fire incidents, while 21.7% of fire incidents were reported by internal security patrols and 19.81% by others. Around 18% of fire incident reporting was not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies

# Fire starting time

Most of the fires started between noon and 4 pm (47.17%), and 15.09 % of fires started between 4 pm and 8 pm. In addition, 12.26% of fires started between 8 am and noon. However, the starting time of 20.75% of fires was not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 46% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 21% of interventions happened after 20 minutes and before 1 hour from reporting time. Only 2% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 to 2 hours (31%); 21% of fires lasted between 2 and 5 hours, 7% of fires lasted between 12 and 24 hours, and 4% of fires lasted between 5 and 12 hours. Only 1% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

# Resources employed in fire suppression

|                            | Nb. of<br>Small<br>Cars | Nb. of<br>Water<br>Tanks | Nb. of<br>Other<br>Cars | Nb. of<br>Human<br>Resources | Lebanese Army<br>helicopters |
|----------------------------|-------------------------|--------------------------|-------------------------|------------------------------|------------------------------|
| Civil<br>Defense           | 53                      | 182                      | 6                       | 335                          |                              |
| Army                       | 42                      | 4                        | 8                       | 329                          | 19 interventions             |
| Internal<br>Security       | 51                      | 3                        | 7                       | 182                          |                              |
| Ministry of<br>Agriculture | 3                       | 0                        | 0                       | 0                            |                              |
| NGO                        | 1                       | 0                        | 1                       | 49                           |                              |
| Local<br>Resident          | 0                       | 0                        | 0                       | 257                          |                              |
| Total                      | 150                     | 189                      | 22                      | 1152                         |                              |

The following human and technical resources were involved in fire suppression:

#### Table 1. Human and technical resources



# 6. FIRE SEASON OVERVIEW

Figure 11. Fire occurrence in function of monthly mean temperature (left) and monthly precipitation in 2012 (right)



Figure 12. Burned areas in function of monthly mean temperature (left) and monthly precipitation in 2012 (right)

# 7. WILDFIRE PATTERN IN LEBANON

In 2012 the fire season (227 days) was 14 days shorter than in 2011, and 21 days longer than in 2010. August was the peak month for 2012; the same as in the year 2011 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality

A comparison between 2008, 2009, 2010, 2011 and 2012 showed the following statistics (Figure 14).



Figure 14. Comparison of fire occurrence (left) and burned areas (right) between 2008, 2009, 2010, 2011 and 2012









#### **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Biodiversity Program – Institute of the Environment -University of Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2013

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2015 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2013 FIRE SEASON

The calculated start date of the fire danger season for 2013 was 23 August, 2013 and the calculated end date was 1 December, 2013. The peak month was October (a total of 32 fires damaging 105.55 ha of vegetated land).

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2013, a total of 69 fires were reported (Annexes 1 and 2), affecting a total area of 203.52 ha (Figure 1).



# Figure 1: Monthly distribution of fire occurrence and fire affected areas in 2013\*

\* When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).

The landuse of fire affected areas (Figure 2) comprised forests/woodlands (61.02%), agricultural lands (26.4%), and grasslands (11.84%); 31.47% of fire affected lands were privately owned, 26.34% were public lands, 4.18% had mixed private and public ownerships.





# Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 18 out of 26 Kadaa. More specifically, the Kadaa of Aakar was affected by 11 fires, and El Koura and Sour were affected by 8 fires each; while the Kadaa of Chouf, Aakar and Baabda were affected by 61 ha, 38 ha, and 21.3 ha of burned areas respectively (Figure 3).



Figure 3. Distribution by Kadaa of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires and the largest extent of burned areas, followed by mixed lands of mountains and valleys, and valleys consecutively (Figure 4).



Figure 4. Land type affected by fires

Fifty four per cent of affected fuel type (Figure 5) was mixed forests followed by needle forests (6.74%), and agricultural seasonal crops (6.55%).



Figure 5. Distribution of fuel type affected by fire

# 4. CAUSES OF FIRES

The main fire causes were unknown (67.5%). Negligence was reported as the main cause of fires for 20% of the reported fire events; 10% of causes involved human activities on natural lands. Arson fires and agriculture practices represented only 2% and 0.74% respectively of the total causes (Figure 6).



Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

# Reporting

Local residents reported 42% of fire incidents, while 31.9% of fire incidents were reported by internal security patrols, 14.5% by others, and 4.35% by farmers (Figure 7).





# Fire starting time

Most of the fires started between noon and 4 pm (46.4%), and 23.2 % of fires started between 8 am and noon. In addition, 14.5% of fires started between 4 pm and 8 pm (Figure 8).



Figure 8. Distribution of temporal fire occurrence

# Intervention time

It was observed that 55.07% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 20.29% of interventions happened after 20 minutes and before 1 hour from the reporting time. Only 2.9% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).





#### Fire duration

The largest number of fires lasted between 1 to 2 hours (37.7%); 27.5% of fires lasted between 2 and 5 hours and 7.3% of fires lasted between 12 and 24 hours. Only 4.4% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

# Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                   | Nb. of Small Cars | Nb. of Water Tanks | Nb. of Other Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|-------------------|-------------------|--------------------|-------------------|---------------------------|------------------------------|
| Civil Defense     | 46                | 125                | 2                 | 287                       |                              |
| Army              | 34                | 2                  | 0                 | 136                       | 8 interventions              |
| Internal Security | 43                | 5                  | 0                 | 143                       |                              |
| NGO               | 0                 | 0                  | 0                 | 0                         |                              |
| Local Resident    | 0                 | 0                  | 0                 | 194                       |                              |
| Total             | 123               | 132                | 2                 | 760                       |                              |

| Table 1. Human and | technical resources |
|--------------------|---------------------|
|--------------------|---------------------|

#### 6. FIRE SEASON OVERVIEW



Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2013 (lower)



# Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2013 (lower)

# 7. WILDFIRE PATTERN IN LEBANON

In 2013 the fire season (a total of 100 days) was shortest among all those between 2008 and 2013. In particular, the fire season was 127 days shorter than in 2012. October was the peak month for 2013; while August was the peak month for 2011 and 2012(Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison between the years from 2008 to 2013 showed the following statistics (Figure 14).

Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) between the years from 2008 to 2013








#### **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

#### Biodiversity Program – Institute of the Environment -University of Balamand:

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2014

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Biodiversity Program at the Institute of the Environment, University of Balamand".

- Published in 2015 -

#### **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

#### 2. FIRE DANGER IN THE 2014 FIRE SEASON

The calculated start date of the fire danger season for 2014 was 13 February, 2014 and the calculated end date was 1 December, 2014. The peak month was September (a total of 39 fires damaging 64.9 ha of vegetated land).

#### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2014, a total of 156 fires were reported (Annexes 1 and 2), affecting a total area of 1851.93 ha (Figure 1).



#### Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2014\*

\* When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).

The landuse of fire affected areas (Figure 2) comprised forests/woodlands (96.14%), agricultural land (2.2%), and grassland (1.5%); 24.84% of fire affected lands had mixed private and public ownerships, 5.93% were private lands, and 4.72% were public lands.





## Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 21 out of 26 Kadaa. More specifically, the Kadaa of Chouf was affected by 21 fires, and El Koura and Jbeil were affected by 15 fires each; while the Kadaa of Chouf, Jbeil and Sayda were affected by 1074.3 ha, 404.6 ha and 96.3 ha of burned areas respectively (Figure 3).





Figure 3. Distribution by Kadaa of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires (51.92%), followed by valleys (19.87%) and plains (11.54%) consecutively; whereas valleys were affected by the largest extent of burned areas (78.37%), followed by mountainous lands (14.72%) and mixed lands of mountains and valleys (5.67%) consecutively (Figure 4).



Figure 4. Land type affected by fires

Sixty two per cent of affected fuel type (Figure 5) was needle forests, followed by mixed lands of forests and grass (22.6%) and mixed forests (8%).



Figure 5. Distribution of fuel type affected by fire

#### 4. CAUSES OF FIRES

The main fire cause was neglect (81.03%). Unknown causes of fires represented 16.03% of the reported fire events, and 1.63% of the total causes were due to human activities in nature; whereas, fires caused by landfill, arson and agricultural practices were insignificant (Figure 6).



Figure 6. Distribution of main fire causes

#### **5. FIRE FIGHTING MEANS**

#### Reporting

Local residents reported 46.79% of fire incidents, while 30.77% of fire incidents were reported by internal security patrols, 14.1% by others, and only 1.28% by farmers. Around 7% of fire incident reporting was not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies

#### Fire starting time

Most of the fires started between noon and 4 pm (41.67%), and 23.21 % of fires started between 4 pm and 8 pm. In addition, 19.05% of fires started between 8 am and noon. The starting time of 7.14% of fires was not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 46.15% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 21.79% of interventions happened after 20 minutes and before 1 hour from the reporting time. Only 1.92% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

#### Fire duration

The largest number of fires lasted between 1 to 2 hours (35.26%); 27.56% of fires lasted between 2 and 5 hours, and 9.62% of fires lasted between 5 and 12 hours. It was also observed that 4.49% of fires lasted more than 24 hours, and only 1.92% of fires lasted between 12 and 24 hours (Figure 10).



Figure 10. Fire duration

#### Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                   | Nb. of Small Cars | Nb. of Water Tanks | Nb. of Other Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|-------------------|-------------------|--------------------|-------------------|---------------------------|------------------------------|
| Civil Defense     | 129               | 271                | 4                 | 598                       |                              |
| Army              | 125               | 22                 | 7                 | 554                       | 37 interventions             |
| Internal Security | 92                | 15                 | 18                | 335                       |                              |
| NGO               | 4                 | 23                 | 5                 | 82                        |                              |
| Local Resident    | 0                 | 0                  | 0                 | 545                       |                              |
| Total             | 350               | 331                | 34                | 2114                      |                              |

Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2014 (lower)



Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2014 (lower)

#### 7. WILDFIRE PATTERN IN LEBANON

In 2014, the fire season (291 days) was 191 days longer than the fire season in 2013. The recorded fire season in 2014 was the longest among those from the years 2008 to 2014. September was the peak month for 2014, while October was the peak month for 2013 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison between the years from 2008 to 2014 showed the following statistics (Figure 14).

Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) between the years from 2008 to 2014









#### **Contact Information**:

Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Biodiversity Program – Institute of the Environment -University of Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2015

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program (Formerly Biodiversity Program) at the Institute of the Environment, University of Balamand".

### **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

#### 2. FIRE DANGER IN THE 2015 FIRE SEASON

The calculated start date of the fire danger season for 2015 was 9 May, 2015 and the calculated end date was 29 September, 2015. The peak month (in number of fires) was August (a total of 49 fires damaging at least of 311.1 ha of vegetated land).

#### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2015, a total of 107 fires were reported (Annexes 1 and 2), affecting a total area of 752.85 ha (Figure 1).



When the number of fires is different from zero and the corresponding burned area is equal to zero in the graph, it indicates that the data about the burned area is not available (N/A).



The landuse of fire affected areas (Figure 2) comprised forests/woodlands (74.3%), agricultural land (18.28%), and grassland (5.62%); A total of 22.09% of fire affected lands were privately owned, 17.01% were public lands, and 13.71% comprised mixed private and public ownerships.





Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 21 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Aakar, Chouf, El Koura and Marjeoune were all affected by 12 fires each, and Batroun, Jezzine and Sour were affected by 8 fires each. The Caza of Chouf, Marjeoune and Jezzine were affected by 212.2 ha, 112.7 ha and 62 ha of burned areas, respectively (Figure 3).





Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires (70.09%), followed by valleys (14.95%) and plains (13.08%) consecutively. Mountains were affected by the largest extent of burned areas (81.83%), followed by valleys (12.3%) and plain areas (4.52%) consecutively (Figure 4).



Figure 4. Land type affected by fires

Almost 50% of affected fuel types (Figure 5) was needle forests, followed by broadleaved forests (33%) and mixed forests (4.5%).



Figure 5. Distribution of fuel type affected by fires

#### 4. CAUSES OF FIRES

The main fire causes were unknown (66.8%). Negligence was reported as the main cause of fires for 13.72% of the reported fire events. Furthermore, 9.12% of causes were attributed to human activities in nature. Landfill and agricultural practices represented 6.24% and 3.98% respectively of the total fire causes; whereas arson fires were insignificant (Figure 6).



Figure 6. Distribution of main fire causes

#### **5. FIRE FIGHTING MEANS**

#### Reporting

Local residents reported 42.06% of fire incidents, while 32.71% of fire incidents were reported by Internal Security patrols, 14.02% by others, and 4.67% by farmers. Almost 7% of fire incident reporting individuals or agencies were not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies

#### Fire starting time

Most of the fires started between noon and 4 pm (46.73%), and 21.5 % of fires started between 4 pm and 8 pm. In addition, 11.21% of fires started between 8 am and noon. The fire starting times for around 11.21% of fires were not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 55.14% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 17.76% of interventions happened after 20 minutes and before 1 hour from the reporting time. Only 1.87% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

#### Fire duration

The largest number of fires lasted between 1 and 2 hours (48.6%). A total of22.43% of fires lasted between 2 and 5 hours, and 12.15% of fires lasted between 5 and 12 hours. It was also observed that 3.74% of fires lasted between 12 and 24 hours. Similarly, 3.74% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

#### Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                      | Nb. of Small<br>Cars | Nb. of Water<br>Tanks | Nb. of Other<br>Cars | Nb. of Human<br>Resources | Lebanese Army<br>helicopters |
|----------------------|----------------------|-----------------------|----------------------|---------------------------|------------------------------|
| Civil Defense        | 70                   | 229                   | 34                   | 495                       |                              |
| Army                 | 50                   | 8                     | 7                    | 362                       | 14 interventions             |
| Internal<br>Security | 57                   | 8                     | 2                    | 268                       |                              |
| NGO                  | 10                   | 2                     | 1                    | 83                        |                              |
| Local<br>Resident    | 0                    | 0                     | 0                    | 400                       |                              |
| Total                | 187                  | 247                   | 44                   | 1608                      |                              |

#### Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Weather observations are provided by the Automated Weather Station of the Institute of the Environment; University of Balamand (IOE-UOB) mounted at an elevation of 310 m above sea level in Kaftoun, El Koura, North Lebanon. These observations are presented for display purposes only and not for use in correlation analysis.

## Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2015 (lower)



Weather observations are provided by the Automated Weather Station of the Institute of the Environment; University of Balamand (IOE-UOB) mounted at an elevation of 310 m above sea level in Kaftoun, El Koura, North Lebanon.

These observations are presented for display purposes only and not for use in correlation analysis.

## Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2015 (lower)

#### 7. WILDFIRE PATTERN IN LEBANON

In 2015, the recorded fire season (143 days) was 148 days shorter than the fire season in 2014. It was the shortest, after the one of 2013, among those from the years 2008 to 2015. While September was the peak month (in number of fires) for 2014, August was the peak month for 2015, similarly to the years 2008, 2011 and 2012 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison between the years from 2008 to 2015 showed the following fire figures (Figure 14).



#### Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2015









#### **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

Land and Natural Resources Program – Institute of the Environment -University of Balamand:

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2016

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program (Formerly Biodiversity Program) at the Institute of the Environment, University of Balamand".
# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2016 FIRE SEASON

The calculated start date of the fire danger season for 2016 was 10 May, 2016 and the calculated end date was 28 November, 2016. The peak month (in number of fires) was June (a total of 56 fires damaging a minimum area of 299.93 ha of vegetated land).

# 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2016, a total of 260 fires were reported (Annexes 1 and 2), affecting a total area of 1870.54 ha (Figure 1).



# Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2016

The landuse of fire affected areas (Figure 2) comprised forests/woodlands (64%), agricultural land (15.30%), and grassland (12.56%); A total of 24.12% of fire affected lands were privately owned, 18.44% were public lands, and 31.20% comprised mixed private and public ownerships.





Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 21 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Sour was affected by 41 fires, followed by Aakar and Marjeeoune with a total of 24 fires each. The Caza of Sour, Aakar and Marjeoune were affected by 448.096 ha, 327.063 ha and 143.729 ha of burned areas, respectively (Figure 3).





Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires (66.15%), followed by valleys (21.15%) and plains (10.00%) consecutively. Mountains were also affected by the largest extent of burned areas (75.29%), followed by valleys (20.9%) and plain areas (2.94%) consecutively (Figure 4).



Figure 4. Land type affected by fires

A total of 36.54% of affected fuel types (Figure 5) was mixed agriculture and forests, followed by mixed forests (18.81%) and grassland (14.32%).



Figure 5. Distribution of fuel type affected by burned areas

# 4. CAUSES OF FIRES

The main fire causes were unknown (61%). Negligence was reported as the main cause of fires for 16.61% of the reported fire events. Furthermore, 11.99% of causes were attributed to Arson. Human Activities in nature, and landfills represented 4.31% and 3.78% respectively of the total fire causes (Figure 6).



Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

# Reporting

Local residents reported 49.62% of fire incidents, while 36.92% of fire incidents were reported by Internal Security patrols, 5% by others, and 3.46% by farmers. However, 5% of fire incident reporting individuals or agencies were not specified (Figure 7).





# Fire starting time

Most of the fires started between noon and 4 pm (45%), and 23.08 % of fires started between 8 am and noon. In addition, 21.2 % of fires started between 4 pm and 8 pm and 5% of fires started between 8 pm and midnight. The fire starting times for around 2.31% of fires were not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 64.23% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 20.38% of interventions happened after 20 minutes and before 1 hour from the reporting time. Only 0.77% of interventions in fire suppression happened after one hour and a half from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 and 2 hours (42.3%). A total of 30.77% of fires lasted between 2 and 5 hours, and 11.92% of fires lasted between 5 and 12 hours. It was also observed that 7.69% of fires lasted between 12 and 24 hours. However, 3.85% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

# *Resources employed in fire suppression*

The following human and technical resources were involved in fire suppression:

|                         | Nb. of Small<br>Cars | Nb. of Water<br>Tanks | Nb. of<br>Other Cars | Nb. of Human<br>Resources | Lebanese Army<br>Helicopters |
|-------------------------|----------------------|-----------------------|----------------------|---------------------------|------------------------------|
| Civil Defense           | 159                  | 486                   | 31                   | 1180                      |                              |
| Army                    | 87                   | 9                     | 27                   | 929                       | 89 interventions             |
| Internal Security       | 172                  | 7                     | 7                    | 578                       |                              |
| Ministry of Agriculture | 7                    | 0                     | 0                    | 8                         |                              |
| NGO                     | 28                   | 43                    | 0                    | 283                       |                              |
| Local Resident          | 0                    | 0                     | 0                    | 1042                      |                              |
| Total                   | 453                  | 545                   | 65                   | 4020                      |                              |

| Table 1. | Human | and t | echnical | resources |
|----------|-------|-------|----------|-----------|
|----------|-------|-------|----------|-----------|

#### 6. FIRE SEASON OVERVIEW

20

10

0

Jan





Jul Aug Sep Oct Nov Dec

Precipitation amount (mm)

47.8<mark>45.</mark>6

Feb Mar Apr May Jun

Number of fires

These observations are presented for display purposes only and not for use in correlation analysis.

#### Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2016 (lower)

100

50

0



Weather observations are provided by the Automated Weather Station of the Institute of the Environment; University of Balamand (IOE-UOB) mounted at an elevation of 310 m above sea level in Kaftoun, El Koura, North Lebanon. These observations are presented for display purposes only and not for use in correlation analysis.

# Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2016 (lower)

# 7. WILDFIRE PATTERN IN LEBANON

In 2016, the recorded fire season (202 days) was 59 days longer than 2015 and 89 days shorter than the fire season in 2014. While August was the peak month (in number of fires) for 2015, June was the peak for 2016, similarly to the year 2010 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison of monthly fire occurrence and burned areas from 2008 to 2016 showed the following figures (Figure 14).



# Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2016









#### **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Land and Natural Resources Program – Institute of the Environment - University of</u> <u>Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and ioe-firelab.balamand.edu.lb





# State of Lebanon's wildfires in 2017

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program at the Institute of the Environment, University of Balamand".

- Published in 2018 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2017 FIRE SEASON

The calculated start date of the fire danger season for 2017 was 27 February, 2017 and the calculated end date was 15 November, 2017. The peak month (in number of fires) was September (a total of 22 fires damaging a minimum area of 93.65 ha of vegetated land).

#### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2017, a total of 92 fires were reported (Annexes 1 and 2), affecting a total area of 263.71 ha (Figure 1).





The landuse of fire affected areas (Figure 2) comprised forests/woodlands (64.97%), agricultural land (13.05%), and grassland (12.84%); A total of 19.21% of fire affected lands were privately owned, 16.82% were public lands, and 58.72% comprised mixed private and public ownerships.





# Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 19 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Chouf and Sour were the most affected by number of fires, 14 each, followed by Akkar and El koura with a total of 20 fires. The Cazas of Akkar, Chouf, Aley and El Koura were affected by 86 ha, 63 ha, 36.3 ha and 24.6 ha of burned areas, respectively (Figure 3).





Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest number of fires (70.65%), followed by valleys (19.57%) and plains (8.70%) consecutively. Mountains were also affected by the largest extent of burned areas (70.33%), followed by valleys (26.9%) and plain areas (2.4%) consecutively (Figure 4).



Figure 4. Land type affected by fires

A total of 38.2% of affected fuel types (Figure 5) was mixed forests, followed by mixed agriculture/forest (21.84%) and grassland (13%).



Figure 5. Distribution of fuel type affected by fires

# 4. CAUSES OF FIRES

The main fire causes were unknown (79.65%). Negligence was reported as the main cause of fires for 13 % of the reported fire events. Furthermore, 6% of causes were attributed to human activities in nature (Figure 6).



Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

# Reporting

Local residents reported 51.09% of fire incidents, while 26.09% of fire incidents were reported by Internal Security patrols, 9.78% by others, and 2.17% by farmers. However, 10.87% of fire incident reporting individuals or agencies were not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies

# Fire starting time

Most of the fires started between noon and 4 pm (43.48%), and 28.26 % of fires started between 8 am and noon. In addition, 19.6 % of fires started between 4 pm and 8 pm and 4.35% of fires started between 8 pm and midnight. The fire starting times for around 1.09% of fires were not specified (Figure 8).



Figure 8. Distribution of temporal fire occurrence

#### Intervention time

It was observed that 53.20% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 39.10% of interventions happened after 20 minutes and before 1 hour from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 and 2 hours 48.3%. A total of 24.18% of fires lasted between 2 and 5 hours, and 10.99% of fires lasted between 5 and 12 hours. It was also observed that 4.44% of fires lasted between 12 and 24 hours. However, 7.69% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

# Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                            | Nb. of Small<br>Cars | Nb. of Water<br>Tanks | Nb. of Other<br>Cars | Nb. of Human<br>Resources | Lebanese Army<br>Helicopters<br>used |
|----------------------------|----------------------|-----------------------|----------------------|---------------------------|--------------------------------------|
| Civil Defense              | 50                   | 165                   | 0                    | 410                       |                                      |
| Army                       | 38                   | 6                     | 2                    | 381                       | 14                                   |
| Internal<br>Security       | 40                   | 6                     | 4                    | 209                       |                                      |
| Ministry of<br>Agriculture | 7                    | 0                     | 0                    | 6                         |                                      |
| NGO                        | 14                   | 14                    | 8                    | 42                        |                                      |
| Local Resident             | 0                    | 0                     | 0                    | 329                       |                                      |
| Total                      | 149                  | 191                   | 14                   | 1377                      | 14                                   |

#### Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Observations data are reported by the weather station 401000 (OLBA) – Latitude: 33.81 and Longitude: 35.48 at an altitude of 29 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis.

# Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2017 (lower)





Observations data are reported by the weather station 401000 (OLBA) – Latitude: 33.81 and Longitude: 35.48 at an altitude of 29 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis.

# Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2017 (lower)

# 7. WILDFIRE PATTERN IN LEBANON

In 2017, the recorded fire season (261days) was 59 days longer than the 2016 fire season. While June was the peak month (in number of fires) for 2016, September was the peak for the year 2017 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison of monthly fire occurrence and burned areas from 2008 to 2017 showed the following figures (Figure 14).

# Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2017









# **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

Land and Natural Resources Program – Institute of the Environment -University of Balamand:

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2018

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program at the Institute of the Environment, University of Balamand".

- Published in 2019 -

# **1. SCOPE**

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

# 2. FIRE DANGER IN THE 2018 FIRE SEASON

The calculated start date of the fire danger season for 2018 was 5 February, 2018 and the calculated end date was 23 September, 2018. The peak month (in number of fires) was September (a total of 21 fires damaging a minimum area of 104.6 ha of vegetated land).

#### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2018, a total of 41 fires were reported (Annexes 1 and 2), affecting a total area of 643.4 ha (Figure 1).



Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2018

The landuse of fire affected areas (Figure 2) agricultural land (80.31%), forest/woodlot (15.64%), and grassland (3.95%); A total of 6.49% of fire affected lands were privately owned, 8.78% were public lands, and 6.51% comprised mixed private and public ownerships.





Figure 2. Landuse of fire affected areas (upper) and ownership of fire affected areas (lower)

Wildfires occurred in 17 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Jezzine was the most affected by number of fires (6 fires), followed by Chouf with a total of 5 fires. The Cazas of Akkar, Sour, Chouf and Jezzine were affected by 500 ha, 50 ha, 31 ha and 31 ha of burned areas, respectively (Figure 3).





Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest extent of burned areas (93.57%), followed by valleys (2.4%) and plains (0.19%) consecutively. Mountains were also affected by the largest number of fires (58.54%), followed by valleys (29.27%) and plain areas (7.32%) consecutively (Figure 4).



Figure 4. Land type affected by fires

A total of 81.20% of affected fuel types (Figure 5) was mixed forests, followed by Brodleave forest (13.27%) and grassland (3.46%).




# 4. CAUSES OF FIRES

Arson was reported as the main cause of fires for 78.49 % of the reported fire events. Furthermore, 12% of causes were due to neglect, while 9% had unknown causes (Figure 6).



Figure 6. Distribution of main fire causes

# 5. FIRE FIGHTING MEANS

# Reporting

Local residents reported 51.22% of fire incidents, while 19.51% of fire incidents were reported by Internal Security patrols, 9.76% by farmers, and 7.31% by other. However, 12.20% of fire incident reporting individuals or agencies were not specified (Figure 7).



Figure 7. Fire reporting individuals/agencies

## Fire starting time

Most of the fires started between noon and 4 pm (56.1%), and 26.83 % of fires started between 8 am and noon. In addition, 9.75 % of fires started between 4 pm and 8 pm and 4.88% of fires started between 8 pm and midnight (Figure 8).



Figure 8. Temporal distribution of fire occurrence

#### Intervention time

It was observed that 46.3% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 24.4% of interventions happened after 20 minutes and before 1 hour from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

# Fire duration

The largest number of fires lasted between 1 and 2 hours (48.78%). A total of 24.39% of fires lasted between 2 and 5 hours, and 17.07% of fires lasted between 5 and 12 hours. It was also observed that 2.44% of fires lasted between 12 and 24 hours. However, 4.88% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

#### Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                            | Nb. of Small Cars | Nb. of<br>Water<br>Tanks | Nb. of Other Cars | Nb. of<br>Human<br>Resources | Lebanese Army<br>Helicopters<br>used |
|----------------------------|-------------------|--------------------------|-------------------|------------------------------|--------------------------------------|
| Civil Defense              | 19                | 71                       | 1                 | 110                          |                                      |
| Army                       | 13                | 1                        | 0                 | 85                           | 15                                   |
| Internal Security          | 14                | 2                        | 2                 | 105                          |                                      |
| Ministry of<br>Agriculture | 0                 | 0                        | 0                 | 0                            |                                      |
| NGO                        | 1                 | 0                        | 0                 | 5                            |                                      |
| Local Resident             | 0                 | 0                        | 0                 | 133                          |                                      |
| Total                      | 47                | 74                       | 3                 | 438                          | 15                                   |

#### Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html

# Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2018 (lower)



Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html

# Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2018 (lower)

# 7. WILDFIRE PATTERN IN LEBANON

In 2018, the recorded fire season (230 days) was 21 days shorter than the 2017 fire season. September was the peak for the year 2018 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality



A comparison of monthly fire occurrence and burned areas from 2008 to 2018 showed the following figures (Figure 14).

#### Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2018









#### **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

Land and Natural Resources Program – Institute of the Environment -University of Balamand:

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Website: www.balamand.edu.lb and home.balamand.edu.lb/wildfire





# State of Lebanon's wildfires in 2019

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program at the Institute of the Environment, University of Balamand".

- Published in 2020 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

## 2. FIRE DANGER IN THE 2019 FIRE SEASON

The calculated start date of the fire danger season for 2019 was 23 of May, and the calculated end date was 15 November 2019. The peak month (in number of fires) was July (a total of 47 fires damaging a minimum area of 670.5 ha of vegetated land).

#### 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2019, a total of 194 fires were reported (Annexes 1 and 2), affecting a total area of 3,155 ha (Figure 1).



Figure 1. Monthly distribution of fire occurrence and fire affected areas in 2019

The main land cover/land use of fire affected areas (Figure 2 upper) comprised agricultural land (66.61%), forest/woodlot (22.06%), and grassland (6.52%); a total of 34.58% of fire affected lands were privately owned, 29.82% were public lands, and 35.59% comprised not specified type of land ownerships (Figure 2 lower).





#### Figure 2. Land cover/Land use of fire affected areas (upper) and ownership of fireaffected areas (lower)

Wildfires occurred in 23 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Marjeoune was the most affected by number of fires (37 fires), followed by Sour with a total of 25 fires (Figure 3 upper). The Caza of Chouf alone was affected by 2024.4 ha (Figure 3, lower).



Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest extent of burned areas (77.82%), followed by valleys (17.08%) and plains (1.28%) consecutively. Mountains were also affected by the largest number of fires (58.76%), followed by valleys (23.2%) and plain areas (14.43%) consecutively (Figure 4).



Figure 4. Land type affected by fires

A total of 74.71% of affected fuel types (Figure 5) was mixed agriculture-forests, followed by mixed forests (15.31%) and broadleaved forest (4.66%).



Figure 5. Distribution of fuel type affected by fires

# 4. CAUSES OF FIRES

Arson was found as the main cause of fires for 63% of the reported fire events. Furthermore, 9% of causes were attributed to activities in nature, 5% of causes were due to landfill, while 19% of fires had unknown causes (Figure 6).



Figure 6. Distribution of main fire causes

#### 5. FIRE FIGHTING MEANS

#### Reporting

Local residents reported 50% of fire incidents, while 29.90% of fire incidents were reported by Internal Security patrols, 4.63% by farmers, and 8.25% by others (Figure 7).



#### Fire starting time

Most of the fires started between noon and 4 pm (46.39%), and 18.56% of fires started between 8 am and noon. In addition, 12.37 % of fires started between 4 pm and 8 pm and 11.34% of fires started between 8 pm and midnight. The remaining 11.34% of fires started between 4 am and 8 am (Figure 8).



Figure 8. Temporal distribution of fire occurrence

#### Intervention time

It was observed that 53% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 22% of interventions happened after 20 minutes and before 1 hour from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

#### Fire duration

The largest number of fires lasted between 1 and 2 hours (48%). A total of 26% of fires lasted between 2 and 5 hours, and 12% of fires lasted between 5 and 12 hours. It was also observed that 5% of fires lasted between 12 and 24 hours. However, only 2% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

#### Resources employed in fire suppression

The following human and technical resources were involved in fire suppression:

|                            | Nb. of Small Cars | Nb. of<br>Water<br>Tanks | Nb. of Other Cars | Nb. of<br>Human<br>Resources | Lebanese Army<br>Helicopters<br>(Nb. of times<br>used) |
|----------------------------|-------------------|--------------------------|-------------------|------------------------------|--|
| Civil Defense              | 122               | 357                      | 18                | 729                          | 18   |
| Army                       | 46                | 6                        | 13                | 471                          |  |
| Internal Security          | 108               | 4                        | 10                | 359                          |  |
| Ministry of<br>Agriculture | 3                 | 2                        | 0                 | 24                           |  |
| NGO                        | 27                | 22                       | 5                 | 145                          |  |
| Local Resident             | 0                 | 0                        | 0                 | 651                          |  |
| Total                      | 306               | 391                      | 46                | 2379                         |  |

#### Table 1. Human and technical resources

#### 6. FIRE SEASON OVERVIEW



Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html

# Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2019 (lower)



Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html

# Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2019 (lower)

# 7. WILDFIRE PATTERN IN LEBANON

In 2019, the recorded fire season (176 days) was 54 days shorter than the 2018 fire season. July was the peak month in number of fires for the year 2019 (Figure 13).



Figure 13. Comparison in fire inter-annual seasonality





# Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2019









#### **Contact Information**:

#### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Land and Natural Resources Program – Institute of the Environment - University of</u> <u>Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Websites: www.balamand.edu.lb home.balamand.edu.lb/wildfire firelab.balamand.edu.lb/FireLabWeb/FireDanger





# State of Lebanon's wildfires in 2020

"This report was produced within a collaborative framework between the Department of Ecosystems at the Ministry of Environment and the Land and Natural Resources Program at the Institute of the Environment, University of Balamand".

- Published in 2021 -

# **1.** SCOPE

In 2013, a collaborative work was initiated between the Ministry of Environment (MOE) and the Institute of the Environment, University of Balamand (IOE-UOB), regarding the execution of the data analysis related to wildfires in Lebanon. The main goal of this collaboration is to produce a yearly report on wildfire occurrence and the extent of burned areas in Lebanon.

The analysis is done based on the data provided in the fire ID cards filled in by the Internal Security Forces (ISF) and copied to the Ministry of Environment, knowing that the fire ID cards format was issued through the notification of the Presidency of Council of Ministers number 256 dated on 1/3/2008. The report comes in line with the highlights of the technical requirements of Lebanon's National Strategy for Forest Fire Management (endorsed by Council of Ministers Decision No. 52 dated 13/5/2009) by working towards the unification of fire information and data as a means to empower efforts in understanding better the problem of wildfires in Lebanon.

## 2. FIRE DANGER IN THE 2020 FIRE SEASON

The calculated start date of the fire danger season for 2020 was May 9, and the calculated end date was October 27, 2020. The peak month (in number of fires) was October (a total of 82 fires damaging a minimum area of 712.6 ha of vegetated land).

## 3. FIRE OCCURRENCE AND AFFECTED AREAS

In 2020, a total of 251 fires were reported (Annexes 1 and 2), affecting a total area of 1,851.088 ha (Figure 1). In reality, a much larger number of fires might have affected a higher extent of burned areas across the country. These are not necessarily reflected in this report mostly due to lack of complete field surveys.





The main land cover/land use of fire affected areas (Figure 2 upper) comprised forest/woodlot (66.40%), agricultural land (25.91%), and grassland (5.90%); a total of 59.51% of fire affected lands were privately owned, 13.30% were mixed lands (i.e., public/private), 16.92% were public lands, and 10.27% comprised not specified type of land ownerships (Figure 2 lower).





#### Figure 2. Land cover/Land use of fire affected areas (upper) and ownership of fireaffected areas (lower)

Wildfires occurred in 25 out of 26 Caza (i.e., Kadaa). More specifically, the Caza of Marjeoune was the most affected by number of fires (38 fires), followed by Sayda with a total of 24 fires (Figure 3 upper). The Caza of Jbeil alone was affected by 547.02 ha (Figure 3, lower).





Figure 3. Distribution by Caza of fire occurrence (upper), and burned areas (lower)

Mountainous areas were affected by the largest extent of burned areas (76.32%), followed by valleys (18.88%) and plains (1.66%) consecutively. Mountains were also affected by the largest number of fires (64.94%), followed by valleys (15.94%) and plain areas (13.55%) consecutively (Figure 4).



Figure 4. Land type affected by fires

A total of 38.42% of affected fuel types (Figure 5) was broadleaved forest, followed by mixed agriculture-forests (12.90%). A total of 16% of the affected fuel types was not specified.



Figure 5. Distribution of fuel type affected by fires

# 4. CAUSES OF FIRES

A total of 79.91 % of the fires had unknown causes. Neglect was found as a main cause for 11.29% of all fires. Furthermore, 2.55% of the fire causes was due to Arson and 1.99% was due to landfill (Figure 6).



Figure 6. Distribution of main fire causes

#### 5. FIRE FIGHTING MEANS

#### Reporting

Local residents reported 61.7% of fire incidents, while 28.9% of fire incidents were reported by Internal Security patrols and 3.6% by farmers (Figure 7).





# Fire starting time

Most of the fires started between noon and 4 pm (46.61%) and 20.32% of fires started between 8 am and noon. In addition, 18.33 % of fires started between 4 pm and 8 pm and 7% of fires started between 8 pm and midnight (Figure 8).



Figure 8. Temporal distribution of fire occurrence

#### Intervention time

It was observed that 51% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 30% of interventions happened after 20 minutes and before 1 hour from the reporting time (Figure 9).



Figure 9. Times for intervention after reporting fires

#### Fire duration

The largest number of fires lasted between 1 and 2 hours (46%). A total of 27% of fires lasted between 2 and 5 hours, and 12% of fires lasted between 5 and 12 hours. It was also observed that 8% of fires lasted between 12 and 24 hours. However, only 2% of fires lasted more than 24 hours (Figure 10).



Figure 10. Fire duration

#### Resources employed in fire suppression

The following human and technical resources were involved in fire suppression (Table 1):

|                            | Nb. of Small Cars | Nb. of<br>Water<br>Tanks | Nb. of Other Cars | Nb. of<br>Human<br>Resources | Nb. Lebanese<br>Army<br>Helicopters<br>used |
|----------------------------|-------------------|--------------------------|-------------------|------------------------------|---|
| Civil Defense              | 224               | > 610                    | 53                | > 1509                       |   |
| Army                       | > 157             | 16                       | 43                | > 664                        | 45  |
| Internal Security          | 140               | 8                        | 35                | > 474                        | -   |
| Ministry of<br>Agriculture | 15                | 3                        | 7                 | 42                           | -   |
| NGO                        | 48                | 3                        | 7                 | > 145                        | -   |
| Local Resident             | 0                 | 0                        | 0                 | > 651                        | -   |
| Total                      | > 584             | > 640                    | 145               | > 3485                       | 45  |

Table 1. Human and technical resources


### 6. FIRE SEASON OVERVIEW

Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html Precipitation data were downloaded from <a href="https://www.worldweatheronline.com/beirut-weather-averages/beyrouth/lb.aspx">https://www.worldweatheronline.com/beirut-weather-averages/beyrouth/lb.aspx</a>

## Figure 11. Fire occurrence in function of monthly mean temperature (upper) and monthly precipitation in 2020 (lower)





Observations data are reported by the weather station 401030 (OLBA) – Latitude: 34.45 and Longitude: 35.8 at an altitude of 5 m above sea level. These observations are presented for display purposes only and not for use in correlation analysis. en.tutiempo.net/climate/ws-401030.html Precipitation data were downloaded from <u>https://www.worldweatheronline.com/beirut-weather-averages/beyrouth/lb.aspx</u>

## Figure 12. Burned areas in function of monthly mean temperature (upper) and monthly precipitation in 2020 (lower)

### 7. WILDFIRE PATTERN IN LEBANON



In 2020, the recorded fire season (171 days) was 5 days shorter than the 2019 fire season. October was the peak month in number of fires for the year 2020 (Figure 13).

Figure 13. Comparison in fire inter-annual seasonality



A comparison of monthly fire occurrence and burned areas from 2008 to 2020 showed the following figures (Figure 14).

# Figure 14. Comparison of fire occurrence (upper) and burned areas (lower) in the period between 2008 and 2020









### **Contact Information**:

### Department of Ecosystems - Ministry of Environment:

Contact: Lara Samaha, Head of Department Ministry of Environment Beirut Central District, Lazarieh Center P.O.Box 11-2727 Beirut - Lebanon Tel: +961 (0)1 97 65 55 Fax: +961 (0)1 98 15 34 Website: www.moe.gov.lb

<u>Land and Natural Resources Program – Institute of the Environment - University of</u> <u>Balamand:</u>

Contact: George Mitri, Program Director Institute of the Environment University of Balamand P.O.Box: 100, Tripoli - Lebanon Tel: 00961-6-930250 ext. 3944 Fax: 00961-6-930 257 Websites: www.balamand.edu.lb home.balamand.edu.lb/wildfire firelab.balamand.edu.lb/FireLabWeb/FireDanger Annex 2: Satellite-based maps of burnt areas



The total number of identified fires was 117 and the total extent of delineated burned areas was 2,679 ha.



Document citation: Mitri, G. (2020). Mapping Lebanon's burnt areas of 2020: a brief note. Land and Natural Resources Program, Institute of the Environment, University of Balamand, Koura

Land and Natural Resources Program, Institute of the Environment, University of Balamand (UOB) - All rights reserved



# Mapping Lebanon's burnt areas of 2021: a brief note

Land and Natural Resources Program, Institute of the Environment, University of Balamand



Document citation: Mitri, G. (2021). Mapping Lebanon's burnt areas of 2021: a brief note. Land and Natural Resources Program, Institute of the Environment, University of Balamand.