ISSN 1831-9424

European Commission

JRC TECHNICAL REPORT

Forest Fires in Europe, Middle East and North Africa 2021

Joint Research Centre

EUR 31269 EN

Contact information
Address: Joint Research Centre, Via Enrico Fermi 2749, TP 261, 21027 Ispra (VA), Italy
Email: JRC-EFFIS@ec.europa.eu
Tel.: +39 0332 78 6138

EU Science Hub
https://joint-research-centre.ec.europa.eu

JRC130846

EUR 31269 EN

Print	ISBN-978-92-76-58616-6	ISSN 1018-5593	doi:10.2760/058256	Catalogue no: KJ-NA-31-269-EN-C
PDF	ISBN 978-92-76-58585-5	ISSN 1831-9424	doi:10.2760/34094	Catalogue no: KJ-NA-31-269-EN-N

Luxembourg: Publications Office of the European Union, 2022

How to cite this report: San-Miguel-Ayanz, J., Durrant, T., Boca, R., Maianti, P., Libertá, G., Artés-Vivancos, T., Oom, D., Branco, A., de Rigo, D., Ferrari, D., Pfeiffer, H., Grecchi, R., Onida, M., Löffler, P. 2022. *Forest Fires in Europe, Middle East and North Africa 2021*, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/34094, JRC130846.

Recommended citation for country reports: e.g. Kok, E., Stoof, C., 2021. Country report for The Netherlands, in San-Miguel-Ayanz *et al.* (Eds), *Forest Fires in Europe, Middle East and North Africa 2021*, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/34094, JRC130846.

Abstract

This report contains the annual summary of the fire season of 2021 with official figures provided by 34 contributing countries for the number of fires, burnt areas and fire prevention efforts, and the analysis of fire danger and areas mapped in the European Forest Fire Information System (EFFIS).

Cover image: Wildland-urban interface fire affecting the Adriatic Coast of Italy in August 2021. Image taken by National Fire Corps helicopter. (*photo C.N.VV.F.*)

Contents

Authors – European report

JOINT RESEARCH CENTRE

Directorate E: Space, Security & Migration
Disaster Risk Management

EFFIS TEAM

Jesús San-Miguel-Ayanz[1]
Tracy Durrant[2]
Roberto Boca[3]
Giorgio Libertà[1]
Alfredo Branco[3]
Daniele de Rigo[3]
Davide Ferrari[2]
Pieralberto Maianti[3]
Tomàs Artés Vivancos[1]
Duarte Oom[1]
Hans Pfeiffer[2]
Rosanna Grecchi[3]

DIRECTORATE-GENERAL ENVIRONMENT

Directorate D1: Natural Capital
Land Use & Management

Marco Onida[4]

DIRECTORATE-GENERAL FOR CLIMATE ACTION

Directorate A: International, Mainstreaming and Policy Coordination

Peter Löffler[5]

1 European Commission, Joint Research Centre (JRC),
Directorate for Space, Security and Migration, Disaster Risk Management Unit,
Ispra (VA), Italy

2 External consultant for the European Commission
(Engineering Ingegneria Informatica S.p.A.) Piazzale dell'Agricoltura (RM), Italy

3 External consultant for the European Commission
(ARCADIA SIT s.r.l) Vigevano (PV), Italy

4 European Commission, Directorate General Environment,
Directorate D: Natural Capital, Land–Use and Management
Brussels, Belgium

5 European Commission, Directorate General for Climate Action,
Directorate A: International, Mainstreaming and Policy Coordination Adaptation
Brussels, Belgium

Authors – Country reports

Algeria	Abdelhafid BENCHIKHA	Direction Générale de la Protection Civile
	Mohamed ABBAS	Direction Générale des Forêts
Austria	Raphael KOLLER	The Austrian Fire Brigade Association
	Harald VACIK	University of Natural Resources and Life Sciences, Vienna
	Mortimer MÜLLER	
	Kilian HEIL	Austrian Federal Ministry of Agriculture, Forestry, Regions and Water Management
Bulgaria	Vladimir KONSTANTINOV	Executive Forest Agency
Croatia	Miljenko DESKIVIC	Directorate for Forestry, Hunting & Wood Industry, Ministry of Agriculture
	Ante KALIGER	National Protection and Rescue Directorate
	Siniša PETKOVIČEK	
Cyprus	Kostas PAPAGEORGIOU	Ministry of Agriculture, Rural Development and Environment
	Petros PETROU	Department of Forests
	Ioannis TOUMASIS	
Czech Rep.	Jan PECL	Fire and Rescue Service of the Czech Republic General Directorate
Estonia	Mati VALGEPEA	Estonian Environment Agency
Finland	Rami RUUSKA	Ministry of Interior, Department for Rescue Services
France	Lionel RICHOILLEY	Ministère de L'Agriculture et de la Souveraineté Alimentaire
	Fabrice CHASSAGNE	Ministère de l'Intérieur et des Outre Mer/ Direction Générale de la Sécurité civile et de la gestion des crises
	Remí SAVAZZI	Office National des Forêts
Germany	Astrid GONSCHOREK	Federal Agency for Agriculture and Food
Greece	Maria PANTELI	Ministry of Environment and Energy; Directorate General for the Forests
Hungary	Peter DEBRECENI	National Food Chain Safety Office, System Management and Supervision Directorate
	Dániel NAGY	
Ireland	Ciaran NUGENT	Forest service, Department of Agriculture, Food and the Marine (DAFM)
Israel	Avraham Ben ZAQUEN	Fire and Rescue Commission, Ministry of Public Security
Italy	Marco di FONZO,	CUFAA – Comando Carabinieri per la Tutela Forestale – Nucleo Informativo Antincendio Boschivo
	Renato SCIUNNACH	
	Gianfilippo MICILLO	National Fire Corps – Forest Fire Fighting Service
	Giovanni FRESU	
	Marcello MARZOLI	
	Enrico POMPEI	Mipaaf – Ministry of agricultural food and forestry policies - General Directorate of Mountain Economy and Forestry
	Silvia FERLAZZO	
	Davide ASCOLI	
	Raoul ROMANO	
Latvia	Andis PURS	State Forest Service; Environmental and Forest Protection Department
	Zigmunds JAUNĶIĶIS	
Lebanon	George MITRI	University of Balamand
Lithuania	Svetlana REPŠIENĖ	Ministry of Environment, State Forest Enterprise
	Zbignev GLAZKO	

Morocco	Fouad ASSALI Hajar BENAISSA Hicham MHARZI ALAOUI	National Centre for Forest Climate Risk Management National Water and Forest Agency - Rabat
Netherlands	Edwin KOK Cathelijne STOOF	Netherlands Institute for Public Safety, Netherlands Fire Service Department of Environmental Sciences, Wageningen University
North Macedonia	Maja TIMOVSKA	Protection and rescue Directorate Planning, prevention and development sector
Norway	Dag BOTNEN	The Norwegian Directorate for Civil Protection (DSB)
Poland	Józef PIWNICKI Ryszard SZCZYGIEŁ	Forest Research Institute Forest Fire Protection Department
Portugal	João MOREIRA Miguel CRUZ	Institute for Nature Conservation and Forests National Authority for Emergency and Civil Protection
Romania	Călin POPA	Ministry of Environment, Waters and Forests
Serbia	Slobodan MILANOVIĆ	Centre for Forest Fire Research - University of Belgrade Faculty of Forestry Forest Directorate - Ministry of Agriculture, Forestry and Water Management
Slovakia	Valéria LONGAUEROVÁ	National Forest Centre; Forest Research Institute
Slovenia	Jošt JAKŠA	Ministry of Agriculture, Forestry and Food
Spain	Celia GARCÍA FECED	Ministry for the Ecological Transition and the Demographic Challenge Wildland Fire Management Service
Sweden	Leif SANDAHL Stefan ANDERSSON	Swedish Civil Contingencies Agency (MSB) Civil Protection Department, Natural Hazards and Decision Systems Section
Switzerland	Stefan BEYELER Michael SAUTTER Marco CONEDERA Boris PEZZATTI	Federal Office for the Environment Swiss Federal Research Institute WSL
Turkey	Hasan Murat ERSOZ Mustafa SONGÜR Alper YILMAZ	General Directorate of Forestry In TURKEY
UK	Rob GAZZARD	Forestry Commission Forest Research UK
Ukraine	Serhii SYDORENKO	Ukrainian Research Institute of Forestry and Forest Melioration named after G. M. Vysotsky
	Mykola GONTARUK	The State Forest Resources Agency of Ukraine
	Olena PAVLENKO	State Enterprise Forestry Innovation and Analytical Centre

Preface "Forest Fires in Europe, Middle East and North Africa 2021"

2021 was again a drastic year that raised our concern about wildfires and their impacts in the European Union and its neighbour countries. Over 5 500 km^2 of land were burned in 2021 – more than twice the size of Luxembourg – with over 1 000 km^2 within protected areas of Europe's Natura 2000 network., the EU's reservoirs of biodiversity. The damage caused in many of these invaluable ecosystems will take many years to restore. The Union Civil Protection Mechanism (UCPM) was triggered nine times in 2021 to support affected countries in extinguishing fires and complement national capacities. Wildfires not only affected EU countries but impacted hard on some of our neighbouring countries in the Mediterranean region, causing large numbers of human casualties and damage.

However, in this report we are not only taking stock on the damage caused by wildfires in 2021, but we also look at the impact of wildfires in 2022. Currently, 2022 is the year with the highest number of fires since 2006. This is in addition to what is expected to be recorded as the most severe drought in Europe in 500 years. The area burnt expands to over 8 600 km^2 in the EU – the largest area burnt by wildfires since 2006. The UCPM was triggered 11 times in the same period to support with aerial and ground firefighting forces to bring the wildfires under control. Although the area burnt by wildfires was remarkably extensive this year, the number of victims caused by these fires has been contained, thanks to the prevention measures implemented by the EU and its Member States and the enhanced preparedness and firefighting operations of the fire management services.

The EU continues to work on mitigating the impact of wildfires: the new EU Strategy on Adaption to Climate Change, published in March 2021, sets out the framework for preparing for the unavoidable impact of climate change. The 2021 new EU Forest Strategy[1] provides the basis for enhanced fire prevention and climate resilience of our forests, building on the guidelines for prevention of wildfires[2]. These guidelines include managing vegetation to avoid the accumulation of fuels on the ground.

Furthermore, in 2021 the EU reinforced the UCPM capacity to increase the aerial firefighting means at its disposal and to assist countries during this fire season. This reinforced capacity is coordinated by the Emergency Response Coordination Centre (ERCC) of the European Civil Protection and Humanitarian Aid Operations (ECHO). The support of the Joint Research Centre, through the provision of timely information on ongoing forest fires, aids informed decision- making on dispatching the aerial means funded by the EU.

The drastic effect of wildfires in Europe, presented in this report for 2021, reflects many of the impacts presented in the 2020 report. It is expected that these will be again included in the 2022 report – when the impact of this season's wildfires will be fully evaluated. Wildfires raging from west to east and across northern, central and southern European countries offer clear evidence of the effects of climate change. The result is not only the expansion of the affected areas, but the longer duration of the fire season. The latter now extends beyond the traditional summer months. Furthermore, the high frequency and intensity of wildfires in the summer puts our fire-fighting services under unprecedented conditions of fire danger, with aerial firefighting often losing its effectiveness, and ground firefighting difficult or impossible. The trend of these unprecedented fires occurs not only in Europe, Middle East and North Africa, but across the globe, as in California, Australia, South America, etc. It is thus essential, along with enhancing preparedness and response capacities, to prepare our population through education and awareness-raising campaigns to live with wildfires, as they become more frequent and intense because of climate change.

The trend of wildfires in Europe, possibly aggravated by increased fire danger conditions under existing climate change scenarios, calls for a comprehensive and coordinated approach to prevent and mitigate wildfires. As mentioned in previous reports in this series, it is necessary to reiterate that around 96% of wildfires in the EU are caused by human actions. This means that prevention measures must be stepped up and include a strong focus on raising the awareness of key stakeholders - including rural actors in direct contact with natural areas, as well as the enlarged population segment living in the so-called wildland urban interface. Enhanced information on wildfire risk areas in Europe[3] and new risk management practices, such as those recommended under the new EU Forest Strategy, can result in measures leading to a reduction in the number of fire outbreaks and the mitigation of their impact when they occur. Moreover, the development of early warning and information systems for wildfires can pave the way to evidence-based policy- making

[1] https://ec.europa.eu/environment/strategy/forest-strategy_en
[2] https://op.europa.eu/en/publication-detail/-/publication/4e6cc1f1-8b8a-11eb-b85c-01aa75ed71a1
[3] https://publications.jrc.ec.europa.eu/repository/handle/JRC130136

to protect our forests, restore those already damaged by wildfires and minimize the number of human casualties, especially every summer.

Increasing fire-suppression capacities is necessary. However, it will not be sufficient without, at the same time, increasing efforts to prevent fire from igniting in the first place. There is a need for an integrated wildfire risk management approach and a close collaboration between EU institutions and wildfire management services and civil protection authorities. Exchange of good practices and experiences, and information-sharing on wildfires is essential for a coordinated approach to wildfire risk management. These exchanges are facilitated by mechanisms such as the Expert Group on Forest Fires, the Expert Groups under the UCPM, and the European Forest Fire Information System. These mechanisms, coordinated by the Directorate General for Environment, the Directorate General for Civil Protection and Humanitarian Aid Operations, and the Joint Research Centre respectively, could be put to further use: Only through better information and stronger cooperation across the EU will it be possible to tackle the growing threat of wildfires and their potentially devastating effects because of climate change.

This new report of the "Forest Fires in Europe, Middle East and North Africa" series provides, once again, valuable insights, presenting national fire management activities and the actions taken at both national and European levels during the fire campaigns in 2021. Thus, it is an important source of information supporting evidence-based policymaking and the design of current and future initiatives for mitigating the effects of wildfires at the European Union and international level.

Mariya Gabriel

European Commissioner for Innovation, Research, Culture, Education and Youth

Virginijus Sinkevičius

European Commissioner for Environment, Oceans and Fisheries

Janez Lenarčič

European Commissioner for Crisis Management

Executive summary

This issue of the EFFIS annual report on forest fires for the year 2021 is the 22nd in the series. This report is consolidated as highly appreciated documentation of the previous year's forest fires in Europe, Middle East and North Africa. The section on national reporting gives an overview of the efforts undertaken at national and regional levels in the majority of countries in the EFFIS network. This is followed by information from EFFIS on the evolution of fire danger in the European and Mediterranean regions and the damage caused by fires in the 43 countries on the network.

The preparation and publication of the report aims at improving cooperation with the members of the Expert Group on Forest Fires (EGFF) especially with regard to fire prevention and climate change adaptation measures in relation of fires. Our common aim is to maintain and protect our landscapes and natural heritage, to avoid loss of human lives and to minimise the damage caused to property by uncontrolled forest fires.

The aim of the European Forest Fire Information System (EFFIS) is to provide harmonised information on forest fires and assessment of their effects in the pan-European region. For this purpose, collaboration with EU Member States and neighbouring countries has been on-going since 1998. EFFIS started as a pilot project of collaboration between the European Countries and the European Commission in the area of fire information and fire prevention.

On the Commission side, EFFIS was initiated by the Joint Research Centre in collaboration with the DG Environment. Due to the high support from the Expert Group on Forest Fires, which constitutes the network of experts from the countries contributing to EFFIS, the system was developed to an operational level supporting national and European policies and providing the information basis for the discussion of issues related to forest fires in the European Parliament[4]. Currently, EFFIS provides operational support to DG ECHO in the area of civil protection, DG DEFIS in the implementation of the Copernicus Regulation [3] as well as to DG REGIO regarding the implementation of the EU Solidarity Fund Regulation [4] for critical fires. In 2015, EFFIS was included as a component of the EU Copernicus Program Emergency Management Services, which provides a legal and financial basis for its operation under this framework since then.

EFFIS provides an ideal platform for countries to exchange good practices on fire prevention, firefighting, restoration practices and other activities related to fire management, and for the European Commission to update the forest fire services in the countries on relevant initiatives at the European level.

Since its first operation in the year 2000, the number of countries contributing to the information on forest fires in EFFIS and receiving data from it has increased steadily. The EFFIS system was used by government organizations and citizens, with over 414 000 users from 197 countries in 2021.

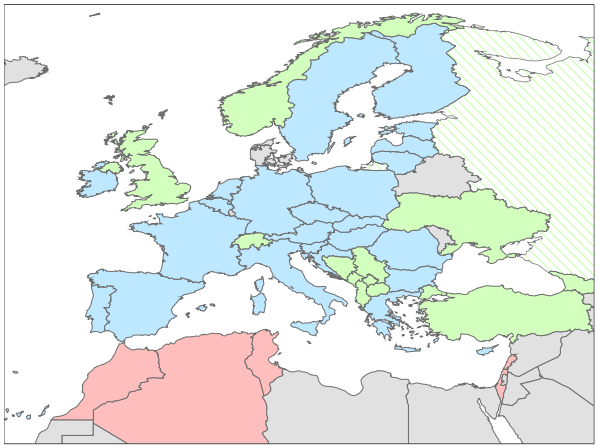


Figure 1. EFFIS network (blue: EU; green: non-EU; pink: MENA).

Currently, the EFFIS network constitutes 43 countries, including 25 EU Member States (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and the Netherlands), 13 European non-EU countries (Albania, Bosnia & Herzegovina, Republic of North Macedonia, Georgia, Kosovo, Montenegro, Norway, Serbia, Switzerland, Turkey, Ukraine and the United Kingdom), and 5 MENA countries (Algeria, Israel, Lebanon, Morocco and Tunisia). (Russia is temporarily excluded from the network).

[4]http://www.europarl.europa.eu/plenary/en/parliamentary-questions.ht

1 Forest Fires in 2021: Country reports from National Fire Services

1.1 Introduction to the 2021 fire season

Table 1. Overview of the number of fires and burnt areas as reported by the contributing countries in 2021[5].

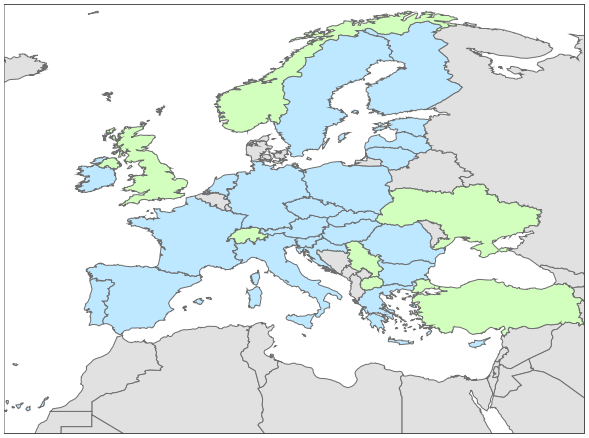
Country	Number of fires			Burnt area (ha)			Notes
	2021	2011-20 average	2021 as % of average	**2021**	2011-20 average	2021 as % of average	
Algeria	1631	2976	55	100101	38355	261	
Austria	164	222	74	117	57	205	
Bulgaria	349	499	70	3143	5140	61	
Croatia	116	201	58	6660	13529	49	
Cyprus	111	100	111	6612	1509	438	
Czech Rep.	1517	1410	108	411	375	110	
Estonia	32	74	43	33	111	30	
Finland	1231	1245	99	785	543	144	
France	4739	4323	110	15114	13373	113	
Germany	548	923	59	148	743	20	
Greece	1250	947	132	108418	24253	447	
Hungary	1154	1331	87	2413	4956	49	
Italy	5989	5418	111	151964	64819	234	
Latvia	448	607	74	504	634	80	
Lebanon	131	154	85	1508	1435	105	Average 2015-2020
Lithuania	46	157	29	11	102	11	
Morocco	435	463	94	3064	2954	104	
Netherlands	212	636	33	18	442	4	Average 2017-2020
North Macedonia	113	204	55	6796	4407	154	
Norway	653	264	247	653	1027	64	
Poland	3295	7383	45	894	3656	24	
Portugal	8186	17713	46	28360	130706	22	
Romania	278	353	79	2101	2325	90	
Serbia	75	127	59	1630	3983	41	
Slovakia	101	244	41	159	456	35	
Slovenia	73	92	79	124	270	46	
Spain	8780	11341	77	87880	96593	91	
Sweden	4087	4740	86	861	4728	18	
Switzerland	85	98	87	35	108	33	
Turkey	2793	2631	106	139503	9095	1534	
Ukraine[6]	659	1649	40	289	10708	3	

[5] Some countries do not report precise figures for fire numbers/burnt area and are not included in this table.

[6] Data on forest fires reflect statistics obtained from forest users and owners, which are coordinated by the State Forest Resources Agency of Ukraine (73% of all forests in Ukraine).

1.2 European countries

The following chapters contain the reports from the contributing European countries. The reports are arranged in alphabetical order and comprise reports from 23 Member States and 7 other non-EU members of the EFFIS network.



1.2.1 Austria

Fire danger in the 2021 fire season

The year 2021 did not bring any intense fire seasons and the lowest number of forest fires since 2016. Nevertheless, it was an exceptional forest fire year due to the major fire in October in Hirschwang/Rax.

While several forest fire disasters challenged the action forces around the globe, the situation in Austria was far from extreme. As of today, 164 forest fires were recorded, which is the lowest number since 2016 (141 forest fires) and only slightly more than half the number of fires compared to the record year 2015 (280).

The total area affected by forest fires would have been below average without the major fire in October. Thus, however, 117 hectares of forest land were damaged by uncontrolled fires in 2021. The last time a larger forest area was affected was in the heat and drought year of 2003 - about 122 hectares at that time.

The weather over the course of the year was characterised by a mildly humid beginning, followed by a rather dry but cool April and a cold May. June brought an exceptionally intense heat wave and regional drought, and the beginning of July was widely hot. Nevertheless, there was no particular increase of forest fire events, which is probably due to the cool and partly wet previous months.

Most forest fires in 2021 occurred in July (34), followed by June (32). Only one forest fire was recorded in January and December respectively. Lower Austria again recorded the highest number of forest fires (48), followed by Styria (37) and Carinthia (29). Only one forest fire was documented in Vienna.

The rest of the summer had unsettled weather conditions.

Two weeks of drought in October combined with a south-facing slope, pine forest and wind favoured the largest forest fire in decades:

Above Hirschwang/Rax in southern Lower Austria, the black pine forest caught fire over a large area. Although the fire intensity was comparatively low, the fire spread rapidly due to the impassable terrain and the favourable conditions and could only be brought under control after days. Based on on-site inspections and drone flights, 88 hectares were affected after an initial 50 hectares; corrected for slope the burnt area was 109 hectares.

This forest fire covered a larger area than the extreme fires in 2014 near Absam, Tyrol (80 ha) and in 2015 near Lurnfeld, Carinthia (60 ha), although the fire intensity was lower. The fire in Hirschwang/Rax is probably the largest forest fire in more than sixty years.

Fire occurrence and affected surfaces

With regard to the regional distribution, the long-term trend is reflected. Most forest fires occurred in Lower Austria, followed by Styria, Carinthia and Tyrol. The lowest number of forest fires was registered in Vorarlberg (3), Burgenland (3) and Vienna (1). Regional hotspots were the valleys in the western Alpine and the eastern peri-alpine belt.

The forest fire distribution in the monthly comparison shows the temporally wet conditions during the year. In March and April only 51 fires were recorded, and after a decrease in May (16 fires) the summer months June and July with some heat waves led to 66 documented forest fires. Thereafter, a wet and cold August only brought two uncontrolled fires in the forest. At the end of the season in October only four fires were detected, but with the large forest fire in Hischwang/Rax 88 hectares of forest were burned.

The mean burnt area for a forest fire in Austria was around 0.7 hectares in 2021, which is above the last years but below the 1990s and early 2000s. However, in previous years the number of documented small fires is underrepresented, which is why there is a larger average fire size.

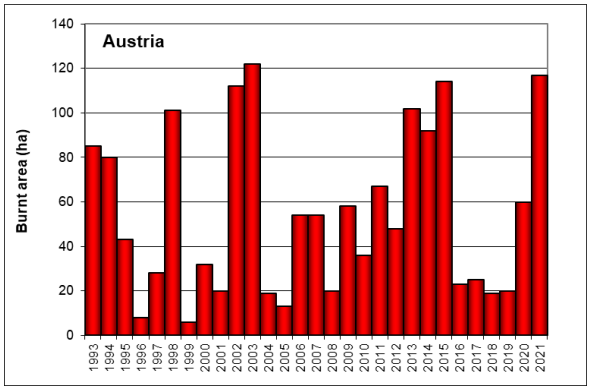
The yearly trends in terms of numbers of fires, burnt areas and average fire size since 1993 are displayed in Figure 2 below.

Injuries and loss of human life

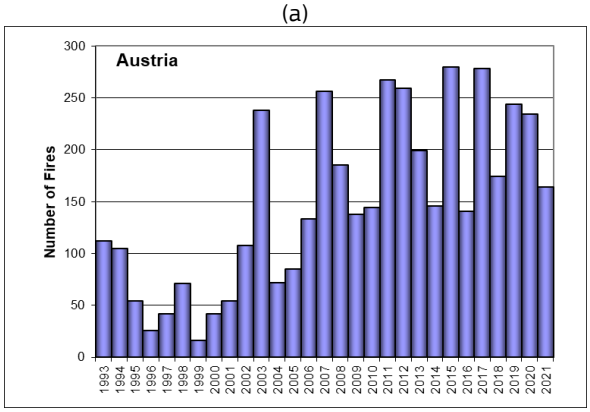
There were only minor injuries and no deaths in the ranks of the fire brigades. In 2021, sixteen people were injured in wildfires, most of them firefighters. There were no fatalities recorded.

Fire causes

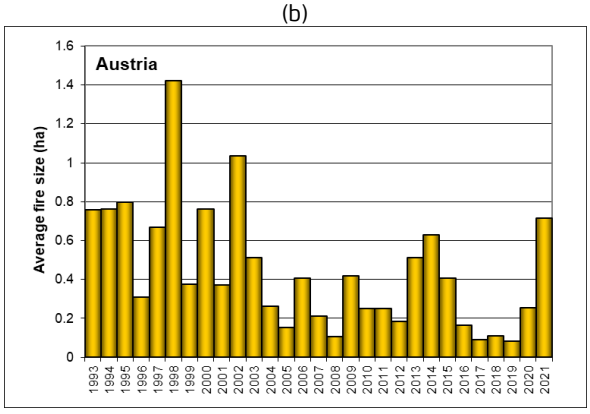
Most forest fires in the year 2021 were anthropogenic caused. For 137 fire events (84%) human influence was the most likely fire trigger. Negligence (e.g. discarded cigarettes, hot ashes, fires out of control) was the cause of over 50% of all fires. For 15% of the forest fires, arson was the assumed ignition cause. Some fires were also caused by power lines, sparks from trains or the exact human cause remained unknown. The 27 forest fires (16%) not caused by human, were ignited by lightning strikes, which is near the long-term mean (17%).



(a)



(b)



(c)

Figure 2. Burnt areas (a), number of fires (b) and average fire size (c) in Austria from 1993 to 2021.

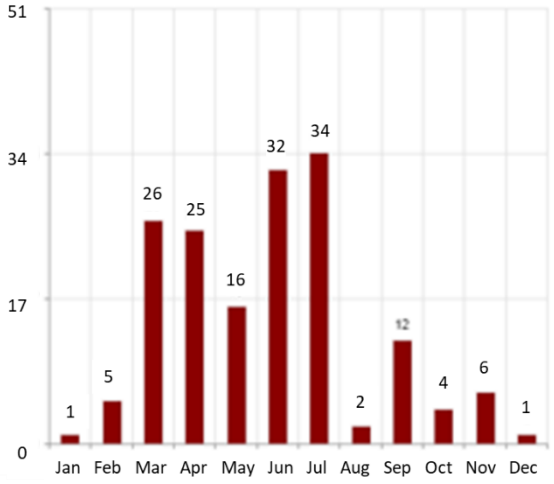


Figure 3. Number of fires by month in Austria in 2021.

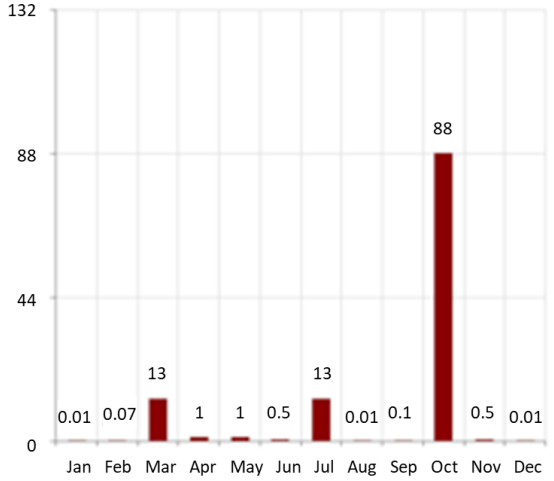


Figure 4. Burnt area in ha by month in Austria in 2021.

Fire fighting means

The Austrian fire brigades started to update their specific equipment (tools and clothing) for fighting forest- and wildfires. In the centre of excellence for "Forest fire fighting" in Tyrol (fire academy Tyrol) joint trainings in the field of "ground forest fire fighting" and "command and control for aerial forest fire fighting" were held for members of all nine provincial fire brigade associations. In all 9 federal states there are special trained units for fighting forest fires, especially as ground air support units. The teams have specific training. The equipment includes extinguishing containers for helicopter use and auxiliary material for alpine use. Some provinces are equipped with specialized forest fire fighting trucks and pick-up cars. There are currently efforts to procure containers with forest firefighting equipment that can be transferred either by truck or by aerial vehicles.

Fire prevention activities and information campaigns

With the Forest Fund Act 2020, the Austrian Federal Government has endorsed a 350 million euro investment and relief package for agriculture and forestry to support domestic forests, thus creating for the first time an economic basis for systematically addressing the issue of forest fires in Austria. The funding can now be used until 2025 to set up short- and long-term preventive measures and implement an integrated forest fire management in Austria. https://www.parlament.gv.at/PAKT/VHG/XXVII/BNR/BNR_00092/index.shtml.

In 2021, the Institute of Silviculture at the University of Natural Resources and Life Sciences Vienna started a comprehensive assessment of the forest fire hazard at municipal level for Austria. The fire danger maps will help the national, regional and local authorities to adapt their fire management plans.

Efforts to elaborate a national action plan to prepare against the rising threat of forest fires were started by the Federal Ministry for Agriculture, Regions and Tourism. The final action plan will be the result of a collaboration between 17 institutions and will address the necessary measures for the next 10 years to better perceive, prevent and fight forest fires in Austria.

Operations of mutual assistance

In Austria, the local fire brigades fight forest fires. The local fire brigades are supported by the regional structures of the fire brigade associations (e.g. disaster relief units and specialised units). Aerial means (helicopters, planes) were provided by the ministry of the Interior (MoI), the Ministry of Defence (MoD) and private companies. There is a close cooperation between these partners, also in the area of joint trainings and exercises.

Climate change

Climatic conditions and how they impacted the fire season

The Austrian forest fire regime can have very different characteristics depending on the seasonal weather. In addition to a development such as in 2021, there were also years in which the spring fire season failed and instead an unusually intensive summer fire season (as in 2013) or late autumn/winter fire season (as in 2015) was recorded. Due to climate change and the increase in the duration and intensity of dry periods and heat waves, more intensive forest fire seasons are expected in the future.

National adaptation strategies / plans

With the Forest Fund Act 2020 and other project activities (e.g. AFFRI 2, CONFIRM), several measures are planned to adapt Austrian forests to climate change, e.g. by the preparation of recommendations for forest owners and forest companies for an adaptive forest management to reduce the forest fire hazard or through awareness raising measures for the general public. Furthermore, a national action plan is elaborated to better understand, prevent and supress forest fires in Austria.

Research activities aimed at improving fire management

Current forecasts of forest fire danger in Austria have too coarse resolutions, are solely based on weather information and do not consider actual surface moisture and vegetation conditions. The project CONFIRM (Copernicus Data for Novel High-resolution Wildfire Danger Services in Mountain Regions) aims to integrate high-resolution Copernicus Sentinel-1 and 2 observations on vegetation conditions with LiDAR data, fire weather forecasts, socioeconomic information, topographic data and the Austrian forest fire database to develop a novel, high-resolution and satellite-supported integrated forest fire danger system (IFDS) for Austria. The project partners exploit novel satellite retrievals and state-of-the art machine-learning methods to develop daily reanalyses and forecasts of forest fire ignition and spread potential according to the requirements of meteorological agencies, fire fighters, foresters and infrastructure providers.

(Sources: Institute of Silviculture, University of Natural Resources and Life Sciences, Vienna; Austrian Federal Ministry of Agriculture, Regions and Tourism; The Austrian Federal Fire Brigade Association, Austria).

1.2.2 Bulgaria

Fire occurrence and affected areas

According to the Executive Forest Agency database in 2021, the number of forest fires in Bulgaria was 349 and the burnt area is estimated to be 3 143.4 ha, with 413.7 ha of them burned by crown fires. The average size per forest fire in 2021 decreased to 9 ha. The biggest forest fire affected 466.6 ha of forest territories. The largest number and area burnt by forest fires were reported in Regional Forest Directorate /RFD/ Kardzhali (40 fires and 818 ha), RFD Kustendil (44 fires and 785.5 ha) and RFD Plovdiv (37 fires and 629.6 ha). More than 71% of all burned forest areas in the country are concentrated in these three RFDs.

Distribution of the burnt areas in 2021 according to ownership is:

- State forest - 65%,
- Municipal forest – 24%
- Private forest – 11%.

The main causes for the forest fires during 2021 are as follows:

- Carelessness – 228 in number (65%);
- Arson - 10 in number (3%);
- Natural - 28 in number (8%);
- Unknown - 83 in number (24%).

The total number of fires, burnt area and average fire size from 1991 to 2021 is presented in Figure 5 and forest fire statistics including causes are in Table 2.

The direct losses by forest fires in 2021 are estimated at only 80 000 Euro, although the average losses for the last 10 years total about 2 000 000 Euro.

Fire prevention activities

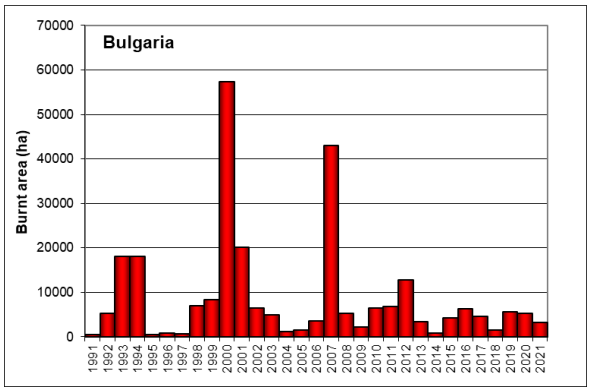
Activities for forest fire prevention are the priority of the Ministry of Agriculture, Foods and Forests and the Executive Forest Agency (EFA). Annually before the active fire season, all regional authorities develop an annual plan for forest fire protection of the forest areas and an action plan for forest fire fighting. Those documents are to be submitted annually to the committee of representatives from EFA and to the Directorate General for Fire Safety and Protection of the Population.

Injuries and loss of human lives

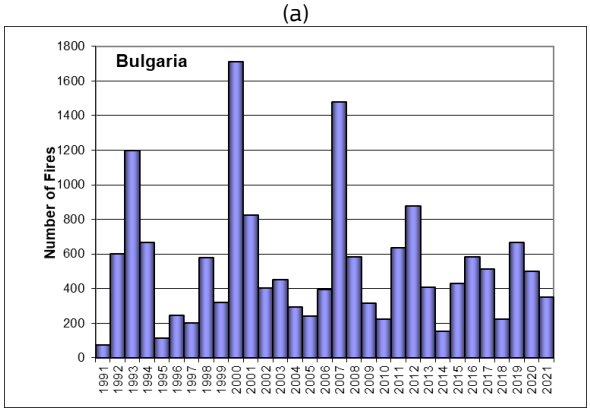
Unfortunately, the year of 2021 was marked by a tragic incident when at the beginning of August in the battle with the fire two foresters of the Southwest State Forest Enterprise - Blagoevgrad lost their lives, and another employee received severe burns. This is the first reported case in the country of loss of human life by forest officials while fighting a fire.

Table 2. Forest fire statistics for Bulgaria 2012-2021.

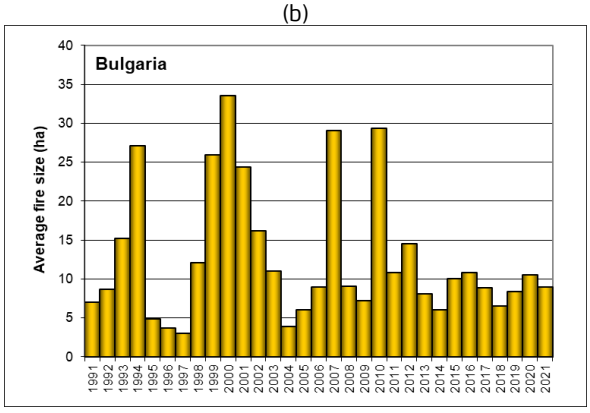
Year	Burnt area (ha)		Fire causes (number)			Total number of fires
	Total	Forest lands	Human activities	Natural	Unknown	
2012	12730	12730	669	42	165	876
2013	3314	3314	334	12	62	408
2014	916	916	128	3	20	151
2015	4313	4313	335	12	82	429
2016	6340	6340	472	22	90	584
2017	4569	4569	433	14	66	513
2018	1453	1453	201	7	14	222
2019	5619	5619	550	8	110	668
2020	5258	5258	350	13	136	499
2021	3143	3143	238	28	83	349
Mean	**4766**	**4766**	**371**	**16**	**83**	**470**



(a)



(b)



(c)

Figure 5. Burnt areas (a), number of fires (b) and average fire size (c) in Bulgaria from 1991 to 2021.

(Source: Executive Forest Agency, Bulgaria).

1.2.3 Croatia

Fire danger in 2021

The calculation of the average monthly danger class for the occurrence and spread of vegetation fires for the summer (June, July and August) 2021, which is also the hottest and driest part of the year, shows (Figure 6) that in Dalmatia the average class was large and very large, and in the northern Adriatic moderate and large.

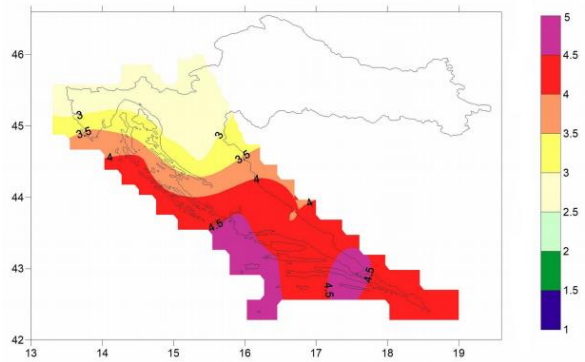


Figure 6. The average monthly danger class for the occurrence and spread of vegetation fires for summer (June, July and August) 2021.

The deviation of the average hazard class in the summer season (Figure 7) compared to the multi-year average (2003-2020) was positive in most areas, and the most positive anomalies were recorded in the interior of Dalmatia and on certain islands (Mali Lošinj, Vis, Lastovo, Hvar). There was a negative deviation in the northern Adriatic (Rab and Senj) due to heavy rainfall in the form of showers.

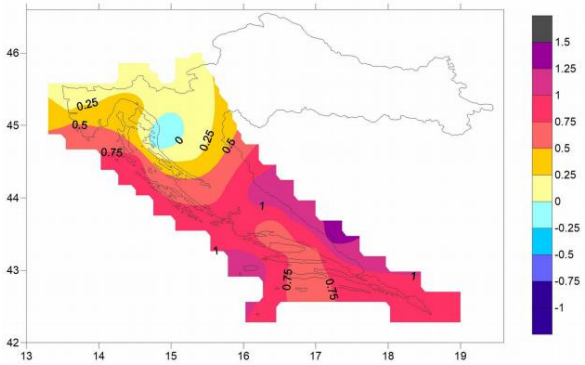


Figure 7. Deviation of the average monthly danger class for the occurrence and spread of vegetation fires for summer (June, July and August) 2021 compared to the multi-year average (period 2003-2020) for the Adriatic and coastal areas.

In conclusion, it can be said that this year's fire season deviated from the average and that the risk of fire in the greater part of the Adriatic and on the coast was elevated, which was additionally influenced by situations with moderate and strong winds.

Therefore, warnings were issued for meteorological conditions that may additionally increase the probability of fire occurrence. There were most warnings of the lowest level (yellow), and 17 of the medium level (orange). Fortunately, the highest level warning: red, was not issued this year.

Fire occurrence and affected surfaces

In the period from 1 of January to 31 of December 2021, a total of 116 fires burned 6 660 ha of forest and other land owned by the Republic of Croatia and private forest owners (state and private forests and agricultural land that were burned as part of forest fires).

In the area of state forests managed by Croatian Forests L.T.D., in 2021 there were 111 fires and 4 327 ha were burned. This is a year with a below-average number of fires and below-average burnt area.

Most fires (86 or 77%), and most of the total affected surface (3 976 ha or 92%) occurred in the region of Dalmatia (karst area).

Table 3. Burnt area according to land type.

Year	Area burned in forest fires (ha)			
	Forest	Non-forest	Other / Agricultural	Total
2010	753	267	101	1121
2011	6937	3106	5512	15555
2012	15515	6201	3106	24804
2013	942	628	429	1999
2014	120	45	23	188
2015	6569	1462	1385	9416
2016	4288	2698	114	7100
2017	31931	12560	4052	48543
2018	750	478	278	1506
2019	1304	498	377	2180
2020	13306	8148	2540	23994
2021	**4222**	**1865**	**573**	**6660**

It is important to point out that in 2021 the highest number of fires occurred in July and August: a total of 63 or 54% of all fires by number, and 4 254 ha of burned area or 71% in terms of area (Figure 8).

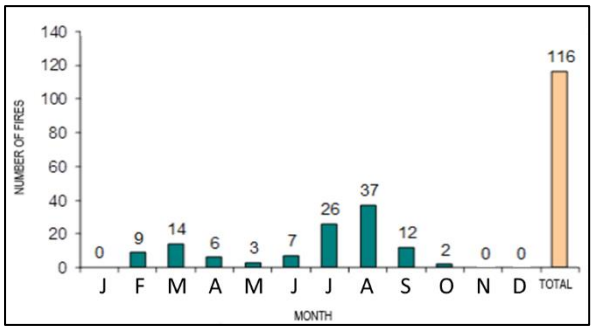
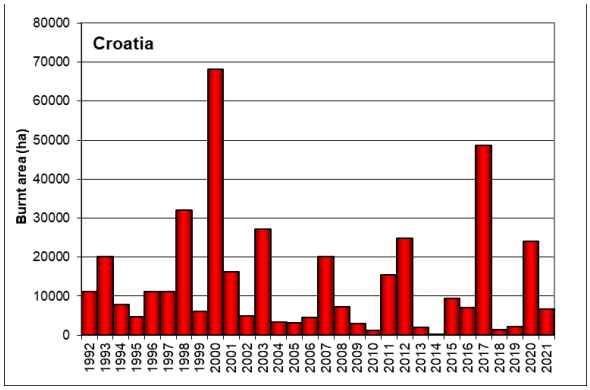
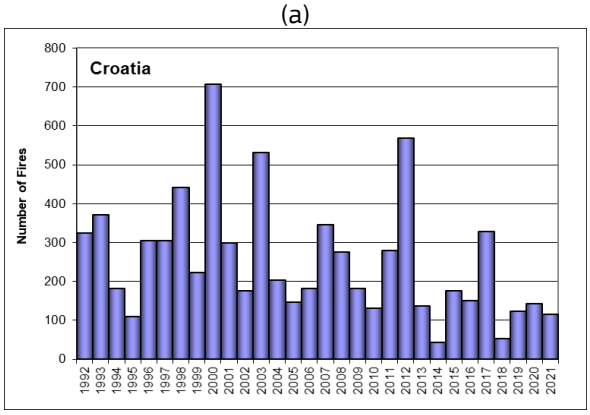


Figure 8. Monthly numbers of fires in 2021.

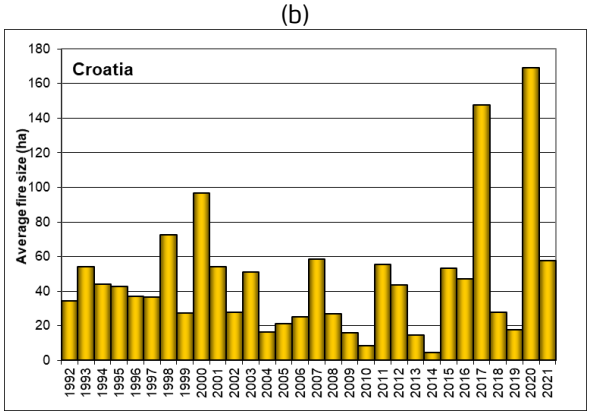
The trend of number of fires, burnt area and average fire size can be seen in Figure 9.



(a)



(b)



(c)

Figure 9. Burnt areas (a), number of fires (b) and average fire size (c) in Croatia from 1992 to 2021.

The biggest fire of the 2021 fire season broke out near Seget Gornji and spread to the area of Trogir, Plano (part in the City of Trogir, part in the City of Kaštela) and Labin Dalmatinski (Prgomet municipality).

The fire started on August 2, and was reported at 10:15 at Seget Gornji, Trogir, Plano, Kaštela, Labin (WGS 43°32'40''; 16°12'21''). It was localized on August 5 at 10:20 a.m. and extinguished on August 6 at 12:00 p.m.

Figure 10, Figure 11. Images from surveillance camera of Croatian Forest L.T.D.

It is important to note that fire on agricultural land in this Report, as well as in the Register of Forest Fires in general, refers to those agricultural lands that were burned as part of a forest fire and were then recorded. In addition, numerous fires occurred in the Republic of Croatia, which occurred and covered exclusively agricultural land, but such fires were not recorded by the forestry profession and they are not presented in this report.

(Source: Directorate for Forestry, Hunting & Wood Industry, Ministry of Agriculture, Croatia; National Protection and Rescue Directorate, Croatia).

1.2.4 Cyprus

Review of the 2021 season

The 2021 fire season in Cyprus was severe from a variety of standpoints and will go down in history as one of the most destructive. The country experienced an aggressive fire activity, an above-average burnt area and fire incidents with significant impacts on people, communities and the environment. The relative stable trend of the annual burned area that was displayed since 2017, was interrupted abruptly, mainly due to the catastrophic fire of the 3rd of July, at Arakapas community, Limassol District.

Fire danger in the 2021 fire season

In January 2021, the weather in Cyprus was wet and relatively warm. The mean air temperature was about 2.5°C above normal and the area average precipitation was 115% of normal.

In February the weather was dry and relatively warm. The mean air temperature was 2°C above normal and the average precipitation was 26% of normal.

In March the weather was relatively dry. The mean air temperature was 0.5°C above normal and the area average precipitation was 66% of normal.

In April the weather was relatively dry and warm. The mean air temperature was about 1.5°C above normal and the area average precipitation was 54% of normal. Extremely high temperatures were recorded during certain periods of the month, when maximum temperatures were about 9 to 13°C above normal.

In May the weather was extremely dry and hot. The mean air temperature was about 3.0°C above normal and the area average precipitation was 0% of normal. During the period 1-5 of May, extremely high temperatures were recorded all around Cyprus, when maximum temperatures were about 7°C to 14°C above normal.

In June the weather was dry and relatively cool. The mean air temperature was 0.5°C above normal and the area average precipitation was 33% of normal. Heat wave conditions prevailed during the period 28-30 of June, with maximum daily temperatures exceeding 40°C.

In July the weather was hot and dry. The mean air temperature was 1.5°C above normal and the area average precipitation was 50% of normal. Heat wave conditions prevailed during most days of the month, when maximum temperatures were up to 7.0°C above normal, exceeding 40°C. The highest monthly temperature was 43.1°C, recorded on July 2.

In August the weather was extremely hot and relatively wet. The mean air temperature was about 2.5°C above normal and the area average precipitation was 110% of normal. During the periods 1-7 and 19-27 of August, extremely high temperatures were recorded almost in all areas of Cyprus, when maximum temperatures were about 2°C to 8°C above normal. The highest monthly temperature was 44.3°C, recorded on August 4.

In September, the weather was relatively wet and hot. The mean air temperature was 1.0°C above normal and the area average precipitation was 158% of normal.

In October, the weather was warm and dry. The mean air temperature was 0.5°C above normal and the area average precipitation was 20% of normal.

In November the weather was dry and warm. The mean air temperature was about 2.5°C above normal and the area average precipitation was 56% of normal.

In December the weather was relatively warm and extremely wet. The mean air temperature was about 1.0°C above normal and the area average precipitation was 188% of normal.

Fire occurrence and affected surfaces

During 2021, Cyprus experienced 111 forest fires that burned 6 612 hectares, mostly forest and other wooded land. Of these, 11 fires were over 50 ha in size.

Table 4. Number of forest fires and burnt areas in Cyprus from 2017 to 2021.

Year	*Number of fires*	*Burned area (ha)*		
		Total	*Forest and other wooded land*	*Agriculture and other artificial land*
2017	92	428	270	158
2018	131	1136	997	139
2019	99	733	494	239
2020	108	1305	1002	303
2021	111	6612	4791	1821

Major fires in 2021

Arakapas fire

This followed an unprecedented heat wave that lasted for 6 consecutive days, when Cyprus suffered one of the worst and most catastrophic fires in decades. The fire broke out early in the afternoon of July 3, near Arakapas community, Limassol District. Fanned by strong winds, the fire swept through 9 nearby communities, which were forced to evacuate. Four people died trying to escape the blaze. The devastating fire burned 4 450 ha covered with forest vegetation and agricultural crops. The aerial means that were involved in the fire-fighting operation included 9 national assets, composed of 4 aircraft and 5 helicopters, 2 aircraft from Greece, 2 aircraft from Israel and 2 helicopters from the British Sovereign Bases in Cyprus.

Giolou fire

At noon of 19 September 2021, a fire broke out near Giolou community, Paphos District. The blaze burned 600 ha, mostly of shrubland and agricultural crops.

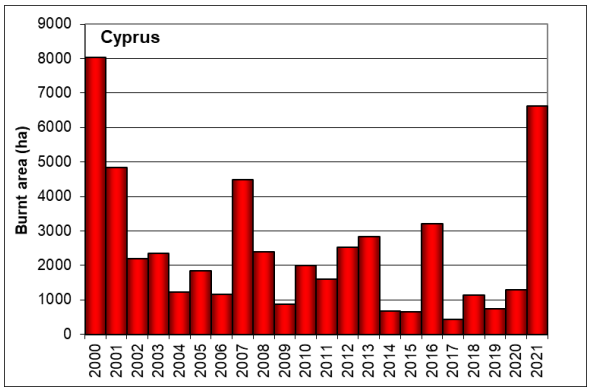
Agia Marina Xyliatou fire

The fire started on June 16, 2022 and destroyed 286 ha of pine forest, other wooded land and agricultural crops.

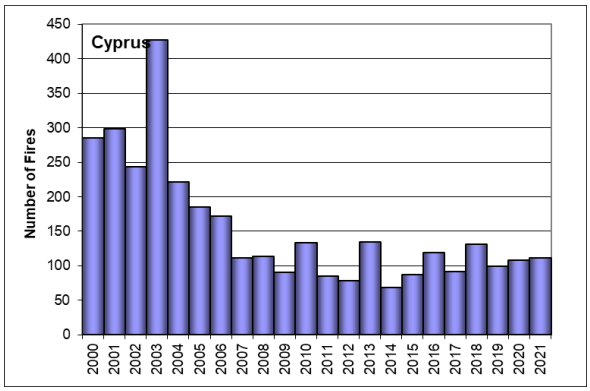
Fire causes

Out of the 111 forest fires that occurred in Cyprus during 2021, 18 forest fires (16%) were of unknown origin. Regarding forest fires with known cause, most fires were deliberately set (52 fires - 56%), followed by negligence (39 fires - 42%) and natural (2 fires - 2%).

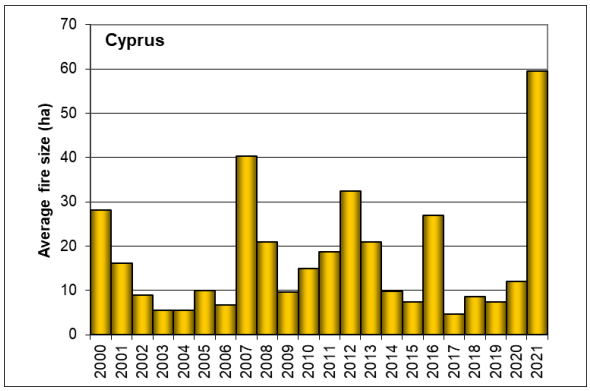
The trends regarding both the number of fires and burnt areas over the last 21 years (2000-2021) are shown in Figure 12.



(a)



(b)



(c)

Figure 12. Burnt areas (a), number of fires (b) and average fire size (c) in Cyprus from 2000 to 2021.

Fire fighting means

The aerial firefighting means that were available during the 2021 fire season, consisted of 6 primary aerial assets of which 4 were light type firefighting airplanes and 2 were medium type firefighting helicopters. In addition, 2 light type helicopters and 1 coordination helicopter were available for use as secondary aerial assets, if needed.

Fire prevention activities and information campaigns

The fire prevention program consisted of various activities, including fire break construction and maintenance, fuel management and law enforcement. Despite the COVID-19 related constraints, the level of preparedness and the emergency response capability of firefighting forces remained unchanged. For fire detection purposes, 46 lookout stations operated throughout the fire season and air and ground patrol missions were executed. Moreover, numerous enlightenment activities aiming to raise public awareness, were implemented.

Injuries and loss of human lives

During the 2021 fire season, 4 civilians lost their lives.

Operations of mutual assistance

On the 3rd of July, Cyprus requested assistance through the EU Civil Protection Mechanism (UCPM) asking for support to tackle the massive forest fire event at Arakapas community. Greece, Italy and France offered assistance via the UCPM. Moreover, Cyprus requested assistance from Israel, based on a bilateral agreement. Support to combat the fire included the rescEU module from Greece composed of 2 Canadair aircraft, 2 Air-tractor aircraft from Israel and 2 helicopters from the British Sovereign Bases in Cyprus. In addition, the European Commission's Copernicus Emergency Management Service was activated to provide damage assessment maps of the affected area.

On August 4, following a request for assistance from Greece to tackle massive fires that were raging in the country for days, Cyprus responded with 2 light type airplanes and a ground team of 40 people with 2 fire engines.

Climate Change

For a second year in succession, Cyprus experienced an intense drought period combined with above-average temperatures. Extreme heat wave conditions persisted for consecutive days during certain periods, unleashing record-breaking high temperatures across specific areas of Cyprus. Extremely high temperatures prevailed during most days of the 2021 fire season, reaching and exceeding 40°C and in certain cases climbing to highs of 43°C - 44°C.

(Source: Ministry of Agriculture, Rural Development and Environment, Department of Forests, Cyprus).

1.2.5 Czech Republic

Fire occurrence and affected surfaces

Forest fires fighting and prevention is covered by the Fire and Rescue Service of the Czech Republic.

In 2021 a total number of 1 517 forest fires were recorded and about 411 ha of forest areas were burned. The total number of fires was around average compared to the 10 years average (2011-2020) of 1 410. The burned area was also almost the 10 years average of 375 ha. The 2021 fire season was not as severe as 2020, but considering total numbers, it was one of the worst fire seasons in the last 20 years. As usual, the fires were very often concentrated according to the usual fire risk level over the country (Figure 13).

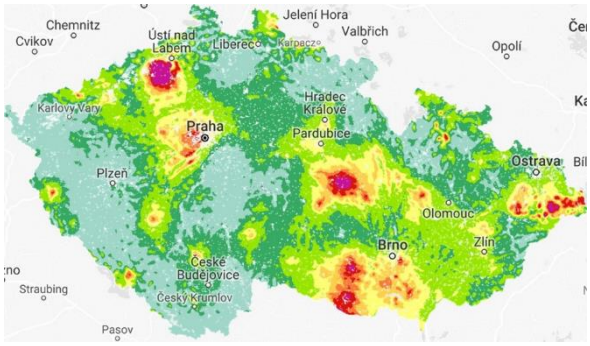


Figure 13. Forests with high risk level, usual situation (Source: Czech Academy of Sciences, project CzechAdapt).

Table 5. Number of fires, burnt area, economic losses and casualties in Czech Republic since 2005.

Year	No. of fires	Burnt area (ha)	Damage caused m.EUR	Saved values m.EUR*	People killed	People injured
2005	626	227	0.8	4.9	0	12
2006	693	405	0.3	4.0	0	16
2007	805	316	0.7	13.3	0	20
2008	470	86	0.1	4.5	3	10
2009	514	178	0.3	6.2	0	20
2010	732	205	0.2	5.0	1	12
2011	1337	337	0.3	6.5	1	27
2012	1549	634	1.8	26.2	2	30
2013	666	92	0.2	3.0	0	7
2014	865	536	0.3	3.3	2	10
2015	1748	344	0.7	24.7	1	33
2016	892	141	0.2	7.8	0	6
2017	966	170	0.3	3.4	2	9
2018	2033	492	0.6	10.5	0	35
2019	1963	520	0.7	12	0	31
2020	2081	484	0.7	10	2	21
2021	1517	411	0.3	7.1	0	15

**refers to the amount that would have been lost without intervention.*

Fire causes

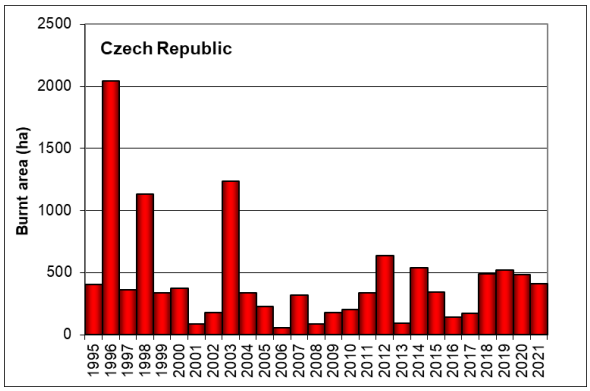
The main causes for the forest fires are usually:

- Negligence 50%
- Human caused, unknown motivation 30%

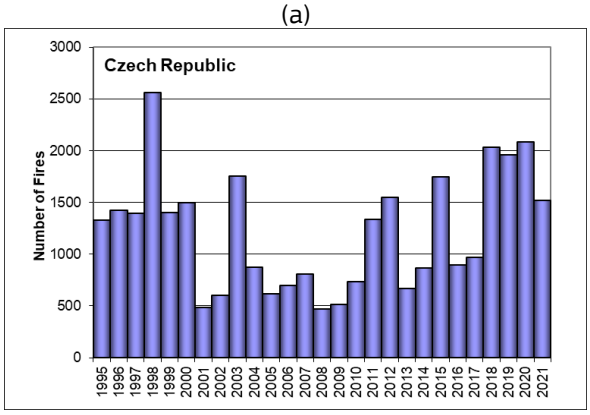
Injuries and loss of human lives

There were no people killed but 15 people were injured due to forest fires in 2021. In total, there were 197 people injured and 9 people killed in the last 10 years due to forest fires.

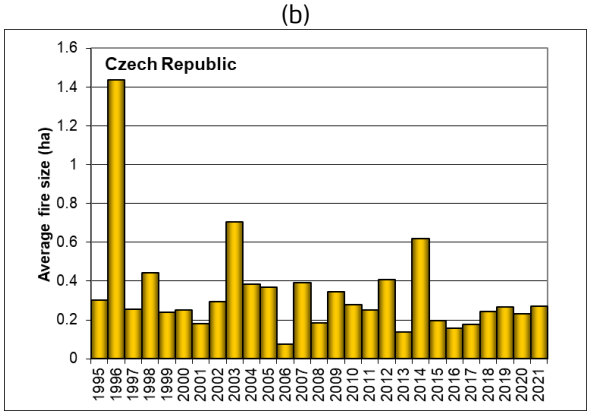
The trends regarding the number of fires and burnt areas from 1995 to 2021 are shown in Figure 14.



(a)



(b)



(c)

Figure 14. Burnt areas (a), number of fires (b) and average fire size (c) in Czech Republic 1995-2021.

Firefighting means

It is very common, for bigger fires, to use large scale helicopter support, for tactical exploration and for aerial firefighting as well, using water buckets with up to 2 500 litres of water. If needed, it is possible to ask for army helicopters or some private planes in case of emergency. Because of a rapid growth of the number of forest fires and visible climate changes, some decisions were made, such as buying special fire tracks or a consideration of new aerial firefighting means. The newest fire truck suitable for forest fire fighting is the Tatra CV-40 with a total water capacity of 21 000 litres of water, or special heavy armoured firetrucks with high fire and explosives resistance such as CZS 40 Titan or CZS 15 Triton (Figure 15).

Figure 15. (from the left) CV 40_21000-S3, CZS 40_12000 (Titan), CZS 15_2000 (Triton).

Figure 16. (Top) Army helicopters; (bottom) Police firefighting helicopter.

(Source: Fire and Rescue Service, General Directorate, Czech Republic).

1.2.6 Estonia

Fire occurrence and affected surfaces

In 2021, 32 forest fires and wildfires were recorded, burning 32.54 ha in total.

Table 6. Forest fires in Estonia 2005-2021

Year	Number	Area (ha)			
		Forest	Non-forest	Total	Average
2005	65	74.6	10.3	84.9	1.3
2006	248	1243.0	779.0	2637.7	10.6
2007	64	58.2	234.2	292.4	4.6
2008	71	299.7	979.5	1279.3	18.0
2009	47	42.9	16.5	59.4	1.3
2010	30	20.7	4.1	24.8	0.8
2011	24	15.5	3.8	19.3	0.8
2012	5	2.5	-	2.5	0.5
2013	15	33.4	45.1	78.5	5.2
2014	91	67.0	9.8	76.8	0.8
2015	67	82.7	0.4	83.1	1.2
2016	84	117.7	5.2	122.9	1.5
2017	61	24.6	8.4	33.0	0.5
2018	230	418.5	11.0	429.5	1.9
2019	143	56.5	12.7	69.2	0.5
2020	24	119.8	70.7	190.5	7.9
2021	32	32.5	0.02	32.5	1.0

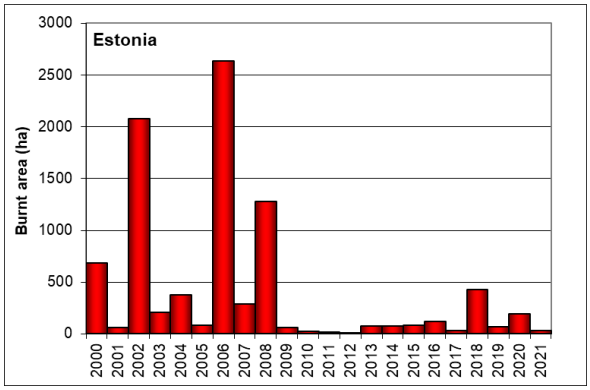
The first forest fire in 2021 was recorded in April, the last one in September. The largest forest fire of 2021 occurred in May in the west of the country with an area of 8.16 ha. The summer of 2021 was exceptionally hot from the last part of June throughout July.

For the first time in history the access restrictions to forests and other vegetated areas and sites with peat ground were imposed in 6 counties (out of 15) from the middle of July. Restrictions included the ban for making barbecue, bonfires, smoking and entering the relevant areas on motor vehicles. Due to the restrictions, active communication and on-site inspections the forest fires were small in size – the burnt area was equal to or bigger than 1 ha in only 5 cases. The burnt area, number of fires and average fire size for the years 2000-2021 are shown in Figure 17.

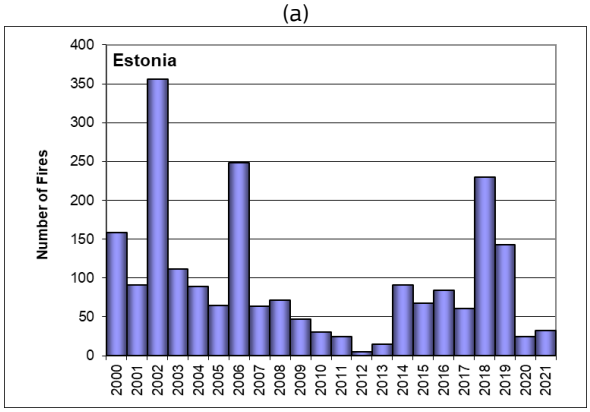
Comment about the data collection routine in Estonia.

The Estonian Environment Agency is involved in two ways:

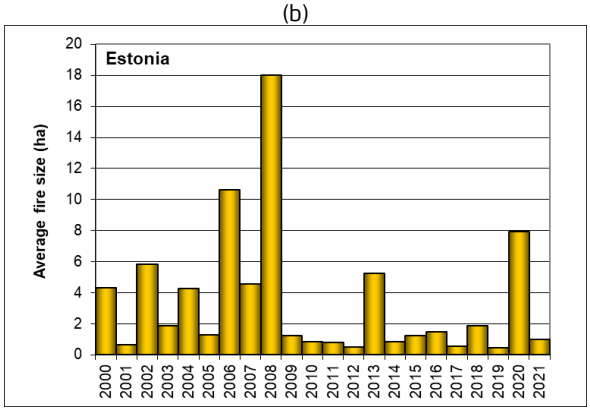
- On-site measurements of the forest fire areas were made (results are used in GHG reporting for LULUCF sector). This is done in the following spring (so this spring the forest fire areas of 2021 were measured). All areas bigger than 0.1 ha are measured. The Initial list of forest fires comes from the open data source of the Estonian Rescue Board. Until 2019 it was possible to use the emergency call centre logs (making it possible to assess better what was burning and what was the cause). It provided the opportunity to include small-size forest fires as the result of the desktop analysis exercise. This is no more the case for 2020 and 2021.
- Compilation of national statistics on forest fires and publishing those in Forestry Statistics Yearbook (see e.g. chapter 6 of the "Statistical Yearbook Forest 2020" https://keskkonnaportaal.ee/sites/default./files/Teemad/Mets/Mets2020.pdf



(a)



(b)



(c)

Figure 17. Burnt areas (a), number of fires (b) and average fire size (c) in Estonia from 2000 to 2021

Fire causes

In 2021, 18 of the 32 fires were of unknown origin, one was caused by lightning and the rest were of human origin.

(Source: The Estonian Environment Agency, Estonia).

1.2.7 Finland

Fire danger in the 2021 fire season

Based on information from the Finnish Meteorological institute, the overview from summer 2021 was quite a normal and average year in Finland. June and especially July was warm and dry in the whole of Finland. August was quite a normal Finnish late summer month. Fire warnings (days per month) for 2021 are presented below in Figure 18.

Fire occurrence and affected surfaces

The number of forest fires in 2021 in Finland was at a normal average level. There were 2 357 wildfires in Finland last year of which 1 231 of them were reported as forest fires. The total burned area was around 972 ha of which ca. 785 ha occurred in forest area. The average burned forest area per fire was 0.64 ha. The 10 years statistics from 2012 to 2021 are presented in Figure 20.

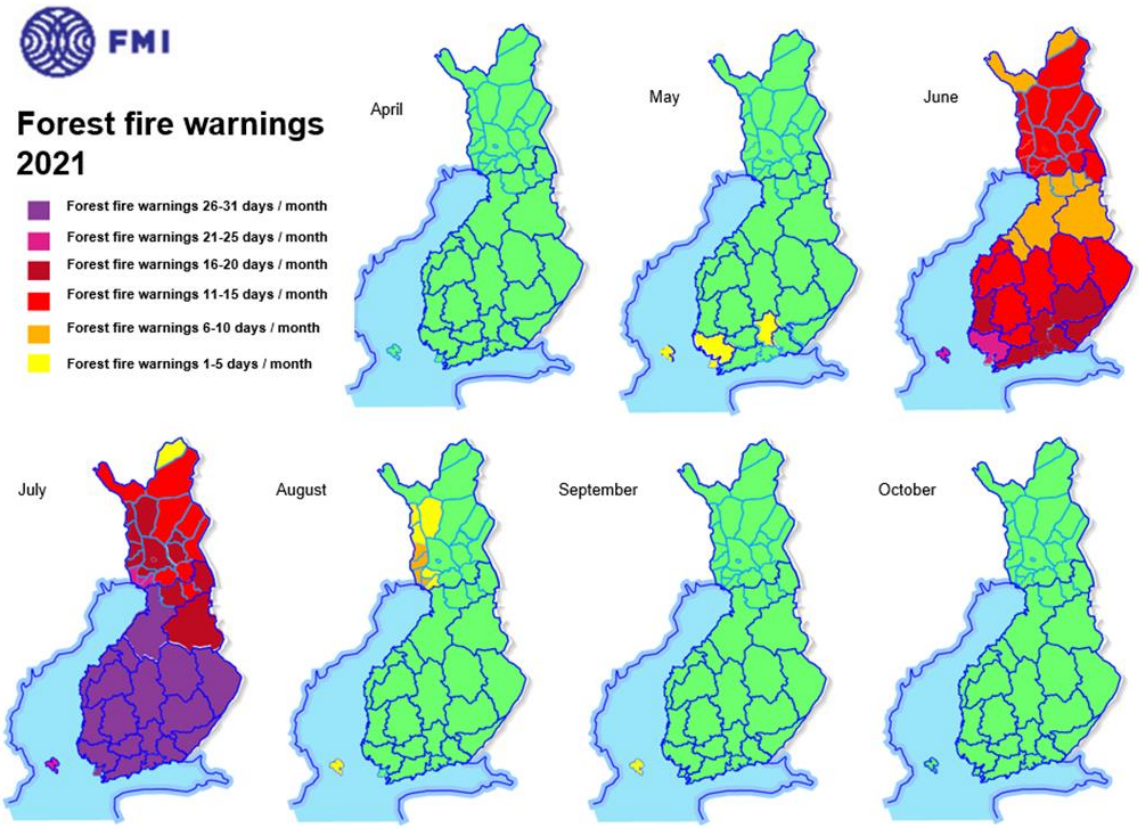


Figure 18. Fire danger days in Finland 2021.

Fire causes

The most common cause of wildfires in Finland was human actions. These caused more than 70%, mainly from accidents. The second biggest reason was natural (less than 10% of fires). The reason for the fire could not be found in over 10% of the cases.

Loss of human lives

One person died and one was injured in two forest fires in Finland in 2021. Some people suffered from burns in fires. Some of the wildfires caused damage to buildings, and a few wildfires were caused by fires from buildings or vehicles.

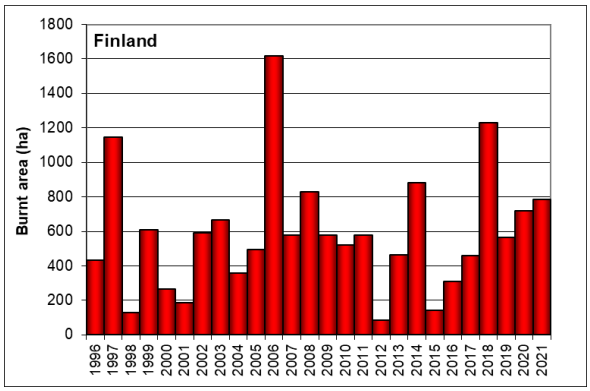
Operations of mutual assistance

There was information sharing between neighbouring countries and the EU.

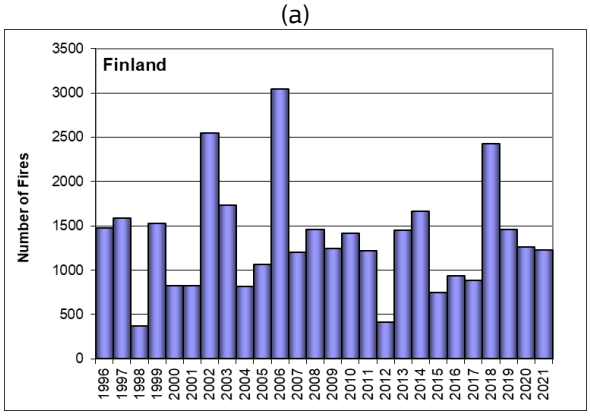
Fire prevention activities and information campaigns

- Legislation, fire index versus authorities' actions, and a ban on open fires
- Information campaigns
- More co-operation with other authorities and institutes such as the Finnish meteorological institute.

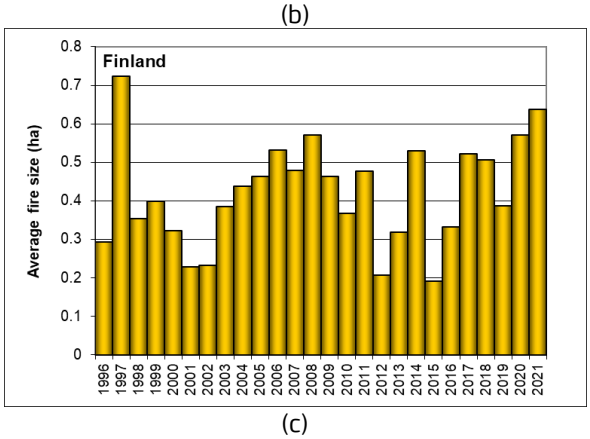
The yearly trends in terms of number of fires and burnt area from 1996-2019 in Finland are shown in Figure 19 and Figure 20.



(a)



(b)



(c)

Figure 19. Burnt areas (a), number of fires (b) and average fire size (c) in Finland from 1996 to 2021.

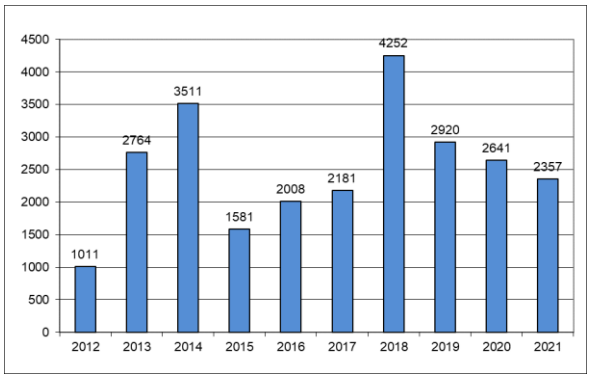


Figure 20. Total number of wildfires including forest fires from 2012-2021.

Fire fighting means

- Finnish military forces NH 90 helicopters are available to extinguish forest fires.
- More co-operation between other authorities such as the border guard.
- Continuation of forest fire aerial officer education for fire officers.
- There is a goal to improve HNS (Host Nation Support) systems for forest fires.
- Continue to improve Finnish Forest fire capacities for international assistance.
- Helicopters (Border guard, army, private), helicopter situation is better than last year.
- Fire & rescue services (strong volunteer fire brigade force, 15 000 volunteers also in rural areas), co-operation between rescue services (for example Arctic Rescue Team)
- New innovative equipment (harvesting machines with water tank and hoses etc.)

Climate Change

<u>Climatic conditions and how they impacted the fire season</u>

In the future, the forest-fire risk is expected to increase in Finland and elsewhere in Northern Europe due to global warming. However, so far, annual burned areas in Finland have not increased noticeably.

<u>National adaptation strategies / plans and in particular regarding plans to adapt the forest sector to climate change in order to limit forest fire risks</u>

Finland's National Forest Strategy, adopted by the Government in February 2015, specifies the main objectives for forest-based business and activities until 2025. The strategy was updated in 2019.

Research activities aimed at improving fire management

The research named "*Forest fires in area of Fennoscandia when the climate and the structure of the forests change*" started in 2019 and was finished in May 2021.

Other development goals in future:

- Northern European co-operation (Aerial forest fire fighting with RescEU forces etc.);
- ensure early warning systems;
- co-operation with rescue services;
- new innovative solutions and equipment.

(Source: Ministry of the Interior, Finland).

1.2.8 France

Fire danger in the 2021 fire season

After a winter that saw rainfall accumulations generally close to average, a period of rainfall deficit led to strong operational activity in late March / early April with several notable fires, particularly in the South-West. This episode was followed by cold and rainy weather which limited the risk, quite continuously in the south-eastern quarter of France, but more temporarily elsewhere, which led to a new peak in activity at the end of April, without any notable fire but with some significant surface fires between 5 and 20 ha in sectors of the northern part of the country that is less accustomed to fires.

Then the months of May and June were calmer as usual, but a very marked drought settled on the coast of the Occitania region, already in deficit at the start of the year. This is reflected in the month of June by operational activity a little more sustained than usual, with several fires exceeding ten hectares.

In July the risk remained limited to this sector, with an episode of strong winds in mid-July bringing several notable fires there. In the hinterland of the southern zone and elsewhere in France, the drought was very slight due to recurring rainfall, and there were very few forest fires, but an episode of hot temperatures and low humidity in the northern half of France led to around thirty notable fires in standing cereal and stubble fields which affected nearly 300 ha, fortunately with very marginal spreads to brush or neighbouring forest environments.

At the end of July/beginning of August in the South zone, a few rainy episodes followed by westerly winds temporarily and locally reduced the risk, with operational activity which sometimes was quite sustained, but without any major excess. In mid-August, the heat wave that hit the eastern Mediterranean countries moved west and reached the south of France. Combined with several episodes of strong winds, it generated very significant risk and a peak of activity from August 16 to 20 with several large fires, including the largest of the year in Gonfaron in the Var. At the end of the month, the risk spread to the hinterland and to the south-west, hitherto relatively spared, with a few larger fires, and even to the rest of France with a few more stubble fires.

The month of September was then relatively warm but with several heterogeneous rainy periods, which ended up reducing the risk, leading to calmer operational activity, a situation that continued into the autumn.

Fire occurrence and affected surfaces

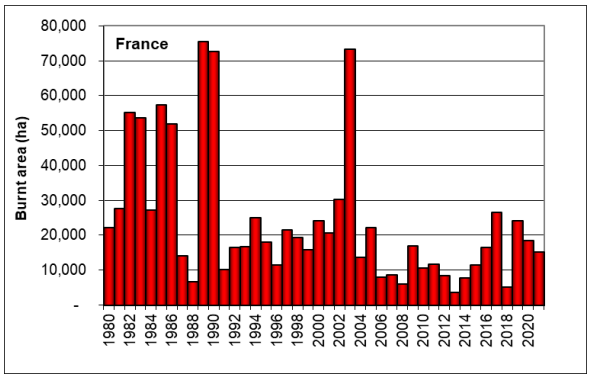
The data includes all the areas covered by fire recorded in the National database (BDIFF = Database on Forest Fires in France): forest fires in the strict sense + other vegetation fires. However, the census of other vegetation fires is still heterogeneous: exhaustive in the South-West, increasing in power in the rest of France, and no census in the historical Prometheus database which covers 2/3 of the South-East. (This is called AFERPU = Other Fires in the Rural and Peri-urban Space; their listing is optional and is done without their surface).

Data outside the Mediterranean are therefore artificially inflated by these vegetation fires. This point should improve in 2023 with the merger of the Prometheus sub-base with the BDIFF, which will make it possible to have comparable data everywhere, but with the inconvenience of a temporal break in the method of accounting for burned areas, which should be taken into account during interannual comparisons.

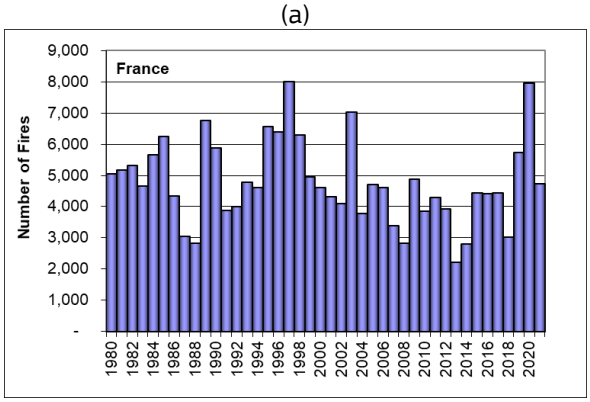
In 2021, 15 114 ha were affected by total of 4 739 fires in France.

This balance is lower than last year but remains slightly higher than the average of the last 15 years (12 260 ha for 4 186 fires from 2006 to 2020).

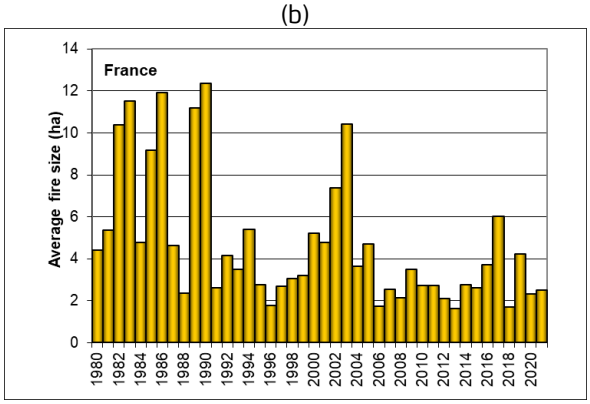
The yearly trends in terms of numbers of fires and burnt areas in France since 1980 are displayed in Figure 21.



(a)



(b)



(c)

Figure 21. Burnt areas (a), number of fires (b) and average fire size (c) in France from 1980 to 2021.

2021 ranks 6th in the statistics of the last 15 years, as can be seen in Figure 23 below:

The 2021 distribution by zone and by type of fire can be found in Table 7 and Table 8 below:

Table 7. Burnt area in hectares.

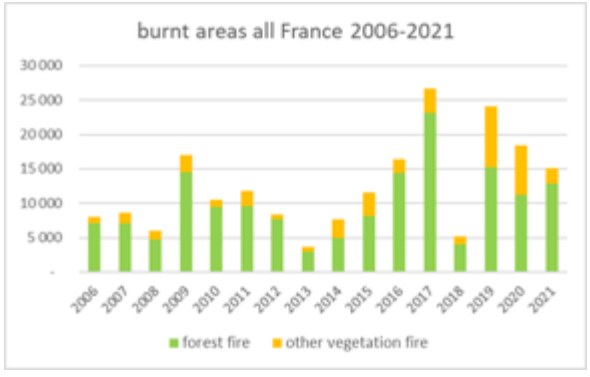
2021	Forest fire	Other vegetation fire	**Total**
South-East	10795	472	**11267**
South-West	1608	851	**2459**
Rest of mainland France	419	698	**1117**
Overseas territories*	71	200	**271**
Total France	**12892**	**2221**	**15114**

Table 8. Number of fires.

2021	Forest fire	Other vegetation fire	**Total**
South-East	1641	305	**1946**
South-West	261	872	**1133**
Rest of mainland France	393	1158	**1551**
Overseas territories*	16	93	**109**
Total France	**2311**	**2428**	**4739**

** Oversea territories = Réunion, Mayotte, Guyane*

Figure 22. French zones.



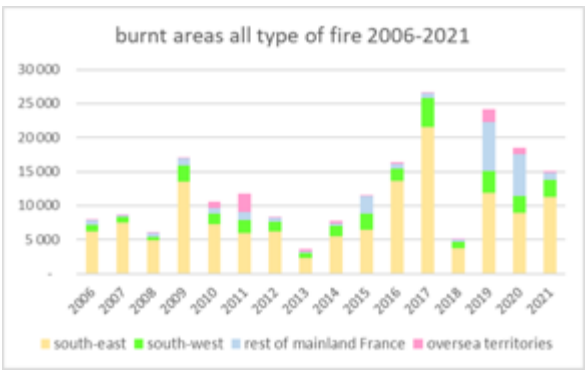


Figure 23. Burnt areas categorised by land type (left) and region (right).

Seasonal distribution

There is a peak in March-April, setting a new record in number compared to the previous 10 years. Regarding burnt area, the peak caused by the single fire in Gonfaron masks a generally below-average summer (Figure 24, Figure 25).

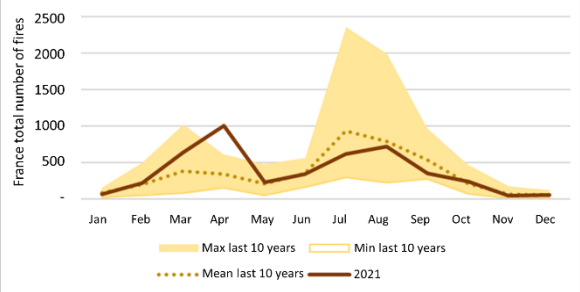


Figure 24. Monthly distribution of number of fires

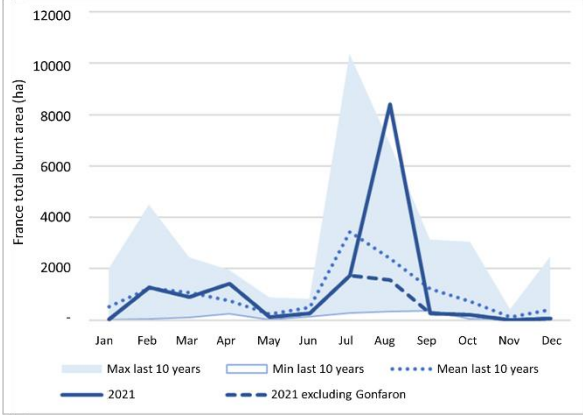


Figure 25. Monthly distribution of total burnt area (ha).

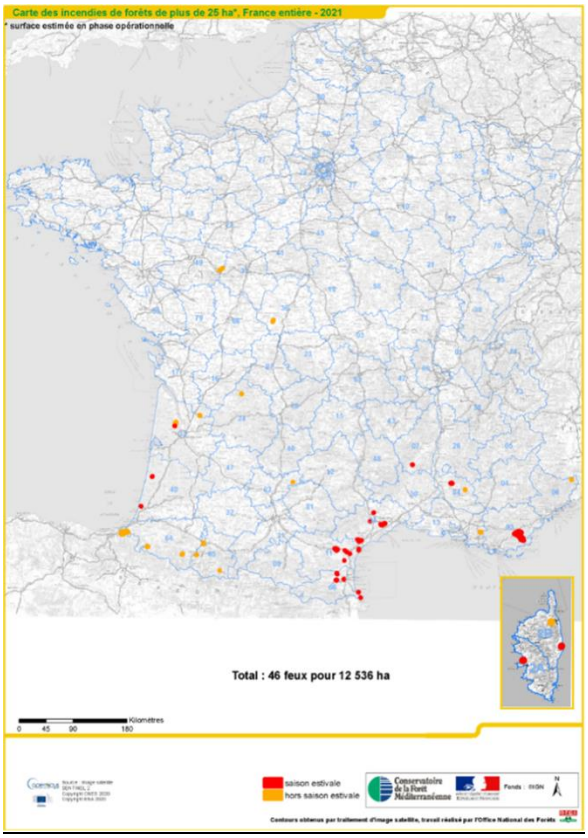


Figure 26. Spatial distribution of the largest fires (greater than 25 ha).

South-West of France :

In 2021, 1 133 fires affected New Aquitaine burning a total of 2 459 ha. This year is marked by the importance of the winter fires occurring in the Pyrenean zone, since 1 500 ha concern the Pyrénées-Atlantiques region alone; i.e. 62% of the regional burnt area in 2021. On the single day 20/02 more than 1 000 ha of vegetation was consumed around the Rhune massif (Urrugne, Ascain) and in Licq-Athérey.

Over the past 16 years, 2021 ranks tenth among the years with the most fire starts, with around 250 less recorded than the average. In terms of significant figures, it should be noted that two monthly records were broken: that of the maximum for the month of April (322 fires) and that of the minimum in July (only 63 fires). The figures subsequently remained at below-average levels until the end of the summer.

In terms of surface area, the year was the fourth highest since 2006 with an exceptional share of mountain events (monthly record in February greatly exceeded with 1 081 ha). By way of comparison, the total of the burnt areas (663 ha) in the most sensitive area of the Landes de Gascogne massif (departments 24-33-40-47), which usually represent the largest areas, are well below the averages, with 400 ha less burned.

South-East of France:

As at the national level, there is a peak in March-April setting a new record in numbers compared to the previous 10 years. The summer is then generally below average but in reality very heterogeneous, with significant activity on the coast, particularly that of the Occitane where it is above average, and very reduced activity in the hinterland and in Corsica. Finally, the last 4 months of the year were particularly calm.

Major fire

The most important fire of the year was the Gonfaron fire (Var department) on August 16. It started at the end of the afternoon on the edge of a motorway service area (originally from a cigarette butt) and then developed very rapidly (in particular with many jumps, favoured by extremely dry vegetation) first in the Plaine des Maures and then crossing the Massif des Maures. It then remained active and continued to expand for 3 days before being brought under control.

The eventual damage was:

- Two dead and 6 slightly injured, including 4 firefighters,
- 7500 people evacuated,
- 1 campsite destroyed,
- more than 400 buildings impacted, including 130 completely destroyed, making it the most destructive fire known in France.
- many natural areas of high ecological value affected, including the Plaine des Maures Nature Reserve, home to a large population of Hermann's tortoise (protected species) which was two-thirds burned.

The 6 832 ha burned rank this fire in eighth position among the 16 fires of more than 5 000 ha recorded in the southern zone since 1973, and was the largest since 1990.

Figure 27. Satellite image of the 17th August showing the fire still active in the north.

Figure 28. Aerial view of buildings affected.

Fire Causes

Of the 4 739 fires recorded in 2021, the majority (2 813) are of an unknown cause. Among the other fires, 52 are attributed to a natural cause (lightning), 1 294 are of an accidental nature, and 580 fires are of voluntary origin. The share of fires of unknown cause is slightly above average, and the number of lightning fires is unusually low (Figure 29).

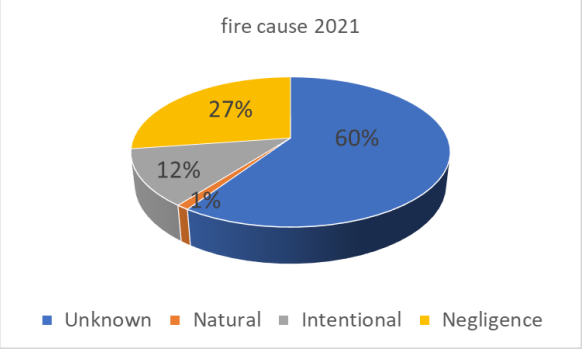


Figure 29. Main causes of wildfire in France in 2021.

Fire fighting means

To support firefighters funded by local authorities (37 000 in the Mediterranean departments, 7 700 in the Landes massif), the Ministry of the Interior deployed reinforcements that included:

- 660 military Civil Protection Training and Response Units (UIISC);
- 17 water bombers (12 Canadair, 5 Dash);
- 2 heavy water bomber helicopters (Super-Puma);
- 3 reconnaissance and coordination planes as well as about thirty rescue and command helicopters.

Under a protocol signed with the Ministry of Defence, with funding from the Ministry of Interior, 45 men, 15 vehicles and three helicopters were assigned to the work of protecting forests.

Finally, 24 reserve firefighters from departmental fire and rescue strictly respecting the required qualifications coming from different areas of defence were positioned. At the request of the *Centre Opérationnel de Gestion Interministérielle des Crises* (COGIC) of the Directorate General of Civil Security and crisis management, they were thus able to supplement local arrangements on demand.

The effectiveness of the intervention mechanism depends on its ability to act without delay by applying a strategy of rapid attack for incipient fires based on the forecast mobilization of resources to combat during periods of high risk. Ongoing cooperation with *Météo France* and the *Office National des Forêts* (ONF) makes it possible to have specifics on the level of foreseeable danger to anticipate the danger and to be more reactive in operational response in the event of a fire.

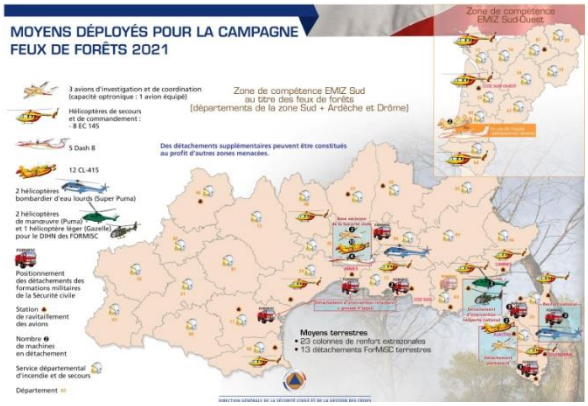


Figure 30. Means deployed for the 2021 fire campaign.

Thus, in periods of high risk, both national and local resources are mobilized proactively according to the danger level to act promptly while the fire is still manageable. The UIISC elements are deployed in the most sensitive forests alongside local fire brigades; water bombers provide armed air surveillance missions (*guet aérien armé*: GAAR), and the military provide patrols alongside local actors (foresters, firefighters, members of community committees for forest fires).

The summer reinforcement mechanism mobilized by the Ministry of the Interior until mid-September was in high demand.

During the year, the civil water bombing aircrafts were engaged on around 200 fires. The majority of these engagements were made between the middle of July and the end of September. During the summer of 2021, civil security aircraft carried out nearly 3 700 drops during 1 700 flight hours, including 510 hours in GAAR. 1 600 tonnes of retarding additive were consumed.

The heavy helicopters recently integrated into the operational system were engaged in around twenty fires and carried out more than 400 drops during 80 hours of flight. The interest of this type of carrier in the fight against forest fires has been confirmed since 2019 and will be renewed in 2022.

In general, the level of commitment of the national means is slightly lower than those of 2019 and 2020. They were engaged on nearly 200 fires during the summer and the DGSCGC coordinated 20 000 men/day within the reinforcement columns in addition to the operational device of ForMiSC (*Formations Militaires de la Sécurité Civile*).

Finally, the reinforcement columns of firefighters were mobilized during the summer to reinforce the preventive measures of the fire and rescue services of the Mediterranean departments when the danger of forest fire was particularly high

As in 2020, the DGSCGC coordinated the commitment of the equivalent of around sixty columns of firefighters, generating an activity equivalent to 20 000 man/days. The peak of activity was reached in mid-August during unfavourable weather conditions in Provence, which notably generated the largest fire of the season (Gonfaron, 6 800 ha).

Finally, national land and air resources were engaged on several occasions within the framework of the European mechanism in Italy, Greece and Algeria.

Fire prevention activities and information campaigns

Communication campaigns

A national inter-ministerial campaign was launched by the 3 ministries (agriculture, environment and interior) in charge of prevention and control. It was based on simple messages with pictograms, taken up on several media supports are social networks and posters. Examples of visuals are shown below:

Figure 31. Examples of fire prevention visuals

- In the south-east zone, this was supplemented by information campaigns which were carried out at departmental level (NUTS3) and the whole zone (NUTS1), to publicize the preventive regulations (limitation or prohibition of the use of fire, traffic circulation in the massifs, clearing obligations, etc). and to disseminate safety recommendations. The Delegation for the Protection of the Mediterranean Forest (DPFM) has a website (www.dpfm.fr) which provides information on the regulations and relays information relating to the prevention of forest fires.
- in the south-west zone, local information campaigns also exist, and the DFCI (*Défense des forêts contre l'incendie*) Aquitaine has a website (www.dfci-aquitaine.fr) and social networks which also develop these themes.

Field equipment

- In the south-east zone, this represents an investment of approximately €11.6 million in works, which received financial support from the European Union (approximately €1.7 million from EAFRD: the European Agricultural Fund for Rural Development); for the maintenance of existing equipment (tracks, water points, etc.);
- In the south-west zone, it represents an investment of approximately €5.2 million in works, which benefited from the financial support of the European Union (approximately €2.2 million from EAFRD), the Ministry of Agriculture (approximately €1.5 million), the Regional Council (€0.4 million) and funding for forest owners and local authorities organized within the DFCI Aquitaine (approximately €1.1 million), for the creation of 82 km of tracks, 2 km of culverts, 24 fixed water points, 23 portable tanks and 9 automatic fire detection towers. All maintenance of existing equipment (42 000 km of tracks and 5 000 water points) is carried out by the DFCI.
- In the south-east and south-west areas, prescribed burning sites for the maintenance of particular areas in preparation for the season were carried out by departmental or regional units made up of firefighters and foresters.

The danger forecast is carried out by Météo-France.

- Production of automatic hazard maps for the whole of France based on different indices for dead or dormant vegetation (spring/winter fires and field fires in summer) and living vegetation (summer fires)
- In the south-east and south-west zone, provision of dedicated forecasters for the production of expert hazard maps and operational support.
- In the south-eastern zone, these forecasts are supplemented by monitoring the water content of the vegetation, implemented by foresters.

During summer:

- a thousand foresters took part in surveillance and alerts (lookouts, surveillance, deterrence and first intervention patrols) for a total of approximately 36 000 days financed by the State and local authorities;
- Interdisciplinary cells (forestry, firefighter, gendarme or police) operated in most Mediterranean departments and are being set up in the south-west, to research the causes of fires, with the aim of directing the prevention and improve the penal response.

Impacts on human lives

The year 2021 was marked by the death of 2 civilians during the Gonfaron fire in the Var on August 16. These 2 people died in an isolated house in the middle of the massif which was poorly protected (poor quality of construction and insufficient clearing).

Operations of mutual assistance

The year 2021 was marked by significant support from France to other European countries facing large-scale forest fires. France thus sent the following within the framework of the EU Civil Protection Mechanism (Table 9):

Table 9. Operations of mutual assistance in 2021.

Jul 24	2 Canadairs in Italy – Sardinia
Aug 4	2 Canadairs in Italy in the Rome region
Aug 5	241 personnel and around sixty vehicles in Greece
Aug 6	3 Canadairs and a coordination aircraft in Greece
Aug 10	7 forest fire experts in North Macedonia
Aug 12	3 Canadairs and a coordination aircraft in Italy - Calabria
Aug 12	2 Canadairs and a coordination aircraft in Algeria

Climate Change

In the centre and the north of the country, the cumulative dry and relatively hot years since 2017 have weakened certain forest stands, limiting their growth and causing drying out.

These effects have been accentuated by pathogen attacks (particularly bark beetles), which make the affected stands much more sensitive to potential crown fires (whereas these were infrequent in these regions until now).

To deal with this extension of the fire danger to areas that had hitherto been little affected, the relevant ministries have extended communication campaigns and measures to raise public awareness of this emerging risk throughout the metropolitan area.

A national network of forestry advisers is being set up by the National Forestry Office.

Research activities aimed at improving fire management

A study was conducted in 2010 by the National Forestry Office, the National Forest Inventary and Météo-France on the evolution of the areas concerned by the risk of fire throughout the metropolitan territory. This study is being updated to aim to resolve a number of points for improvement identified at the time.

The first step, carried out in 2021, consisted of producing a homogeneous vegetation sensitivity map over the whole of France, based on data from the forest inventory, bioclimatic zones, exposure and soil water reserves. This map, the illustration of which is shown in Figure 32, is intended to be combined with simulations of meteorological parameters according to 3 scenarios and 3 horizons which should be produced in the autumn of 2022.

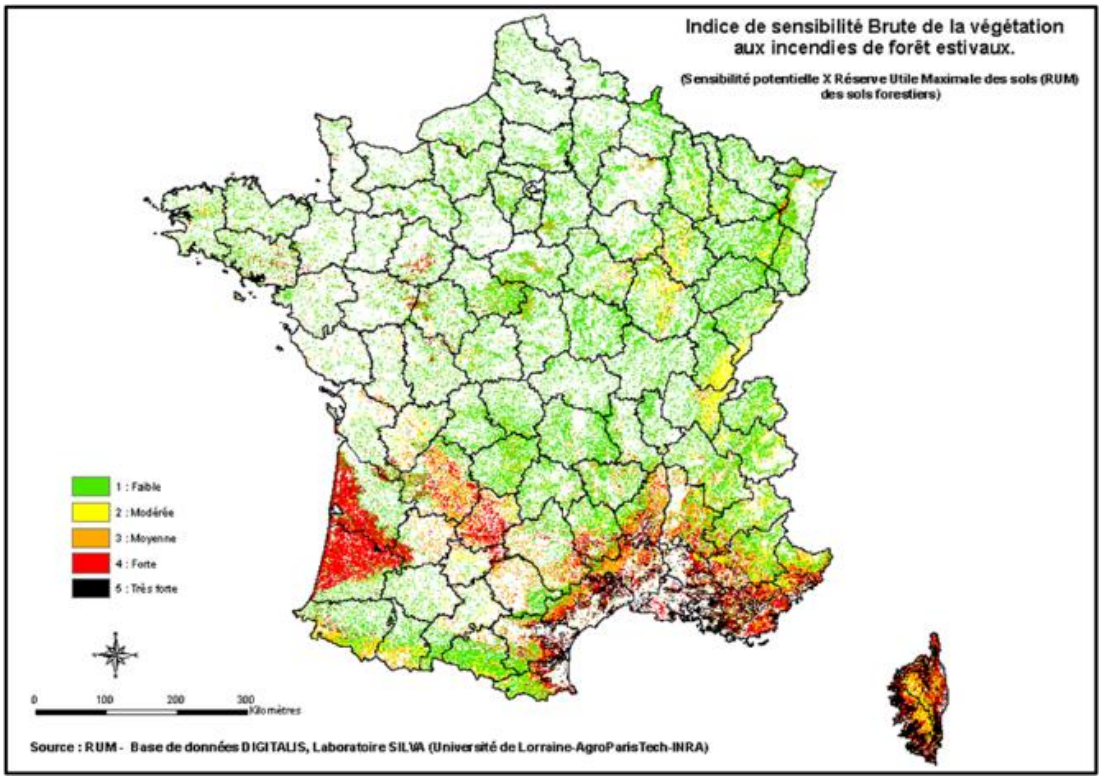


Figure 32. Vegetation sensitivity map

(Source: Ministère de l'Intérieur – DGSCGC / SPGC / BAGER; Ministère de l'Agriculture et de l'Alimentation: DGPE / SDFE / SDFCB / BGED, France).

1.2.9 Germany

Fire occurrence and affected surfaces

According to the data supplied by the authorities, in 2021 a total of 548 forest fires were reported in Germany, corresponding to a burnt area of 148 ha (52 ha in deciduous forests and 95 ha in coniferous forests). The number of fires and the total burnt area were both lower than was recorded in 2020.

In 2021 the most affected province (Land) in terms of total burnt area was Bayern, with Brandenburg coming a close second. Between them these two Länder accounted for over half of the total burnt area recorded in the country (Table 10, Figure 33). However, a greater number of fires was recorded in Brandenburg. Four Länder (Bremen, Hamburg, Saarland and Schleswig-Holstein) did not record any fires.

Table 10. Burnt area in total and by forest type, and total number of fires, Federal Republic of Germany, 2021.

	Burnt area (ha)			*Number of fires*
	Coniferous forest	*Broadleaved forest*	*Total*	
Baden-Württemberg	2.38	5.06	7.44	29
Bayern	9.41	32.71	42.12	22
Berlin	0.02	0	0.02	1
Brandenburg	38.78	3.11	41.89	168
Bremen	0	0	0	0
Hamburg	0	0	0	0
Hessen	0.39	2.16	2.55	29
Mecklenburg-Vorpommern	14.94	0.08	15.02	28
Niedersachsen	2.73	1.69	4.42	98
Nordrhein-Westfalen	1.61	4.13	5.74	79
Rheinland-Pfalz	0.38	0.04	0.42	8
Saarland	0	0	0	0
Sachsen	1.66	1.52	3.18	34
Sachsen-Anhalt	22.66	0.57	23.23	40
Schleswig-Holstein	0	0	0	0
Thüringen	0.5	1.28	1.78	12
Germany	**95.46**	**52.35**	**147.81**	**548**

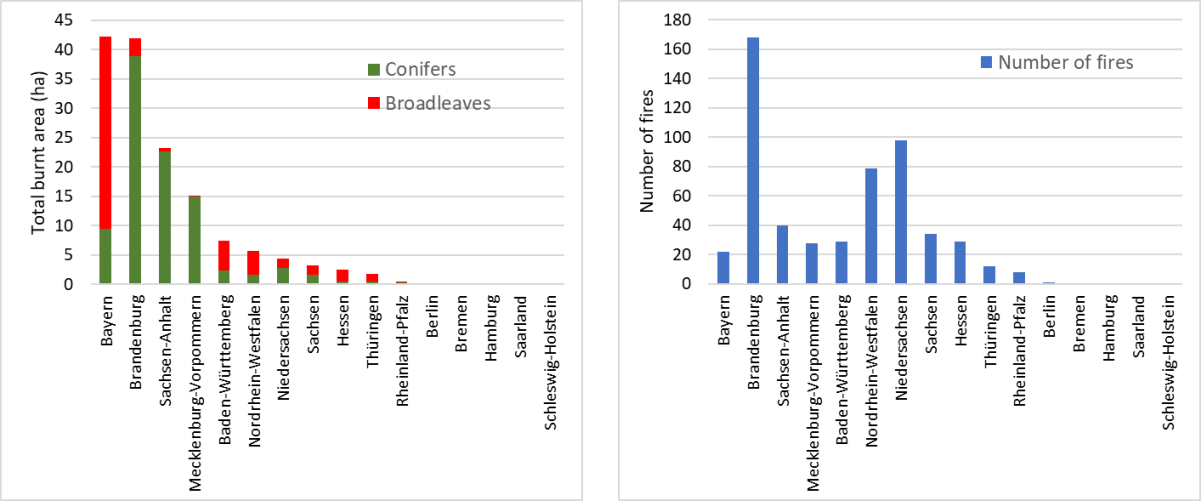


Figure 33. Burnt area (left) and number of fires (right) in Germany in 2021 by Land, ordered by total burnt area.

In 2021 there were two peaks of the season: one in Spring (April) and another one in June. (Figure 34).

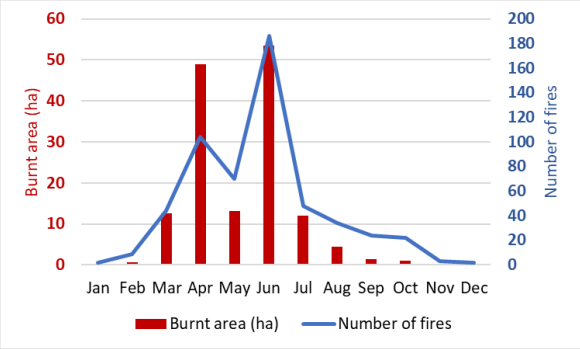


Figure 34. Number of fires and burnt area by month in Germany in 2021.

The economic damage caused by forest fires in 2021 is estimated to be around 0.67 million Euro (Table 11). This is significantly below the figure for 2020 and also below the long-term average from 1991 to 2021, which is 1.76 million Euro. The cost per hectare burnt was estimated at 4 533 Euro/hectare.

Table 11. Losses from forest fires in Germany in 2021.

	Year	2019	2020	**2021**
Total volume of non-recoverable wood (1000m³ overbark)	Sawlog size	135.5	149.1	**8.1**
	Other	90.2	61.7	**12.9**
	Total	225.7	210.7	**12.9**
Total value (1000 Euro)	Wood & other tangible losses[1)]	1663	1596	**659**
	Other[2)]	558	598	**659**
	Total	2221	2194	**670**

1) Estimate of the stand expectation value less the stumpage value plus consequential costs caused by fire (additional planting cost etc.) as well as other material damage.
2) Other damage according to material value method (Koch) or other comparable cost estimates.

In 2021, approximately 6.03 million Euro were spent on prevention and control measures (Table 12).

Table 12. Expenditure on forest fire prevention and control.

Expenditure (1000 Euro)	2019	2020	**2021**
Forest service	4804	4883	**5499**
Other (public and private)	277	195	**527**
Total	5080	5078	**6026**

The trend of the burnt areas, number of fires and average fire size in Germany for the years 1991-2021 are shown in Figure 35.

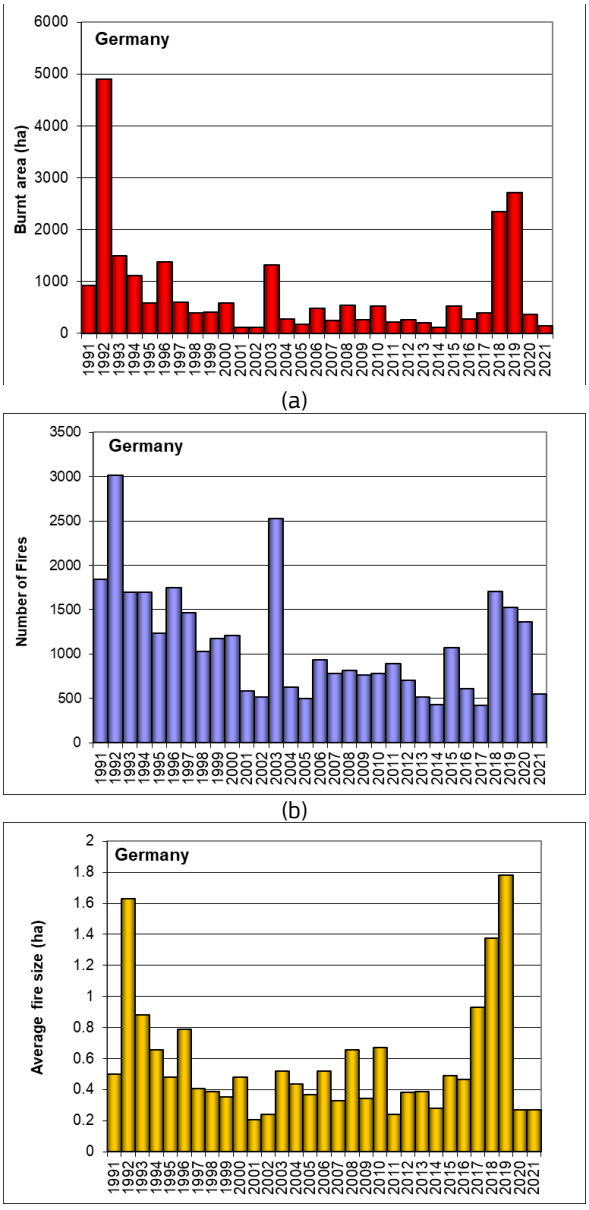


Figure 35. Burnt areas (a), number of fires (b) and average fire size (c) in Germany from 1991 to 2021.

Burnt areas and numbers of fires categorised by land and ownership type are detailed below in Table 13 and Table 14.

Table 13. Type of land.

	2019	2020	**2021**
Coniferous	1985.42	269.82	**95.46**
Non-coniferous	725.68	97.84	**52.35**
Total burnt area (ha)	2711.1	367.66	**147.81**
Number of fires	1523	1360	**548**

Table 14. Type of ownership

	2019	2020	**2021**
Public	1339.42	169.25	**88.86**
Private	1371.68	198.41	**58.95**
Total burnt area (ha)	2711.1	367.66	**147.81**
Number of fires	1523	1360	**548**

Fire causes and impacts

The main causes of forest fires during 2021 are shown in Figure 36 and Table 15.

Within the category of accident/negligence fires (Table 16), the majority (74) were caused by the general public (campers, visitors, children etc.):.

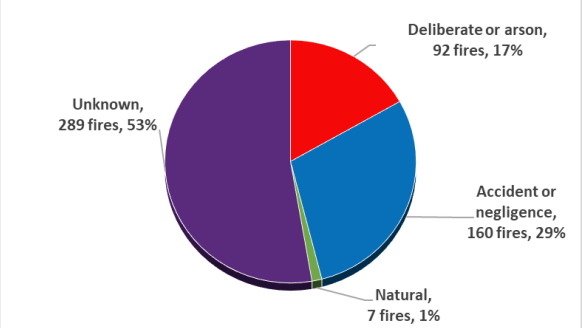


Figure 36. Causes of forest fires in 2021.

Table 15. Main causes of fires in 2019-2021.

	Number of fires			Burnt area (Hectares)		
	2019	2020	**2021**	2019	2020	**2021**
Arson	244	253	**92**	134.04	40.81	**20.05**
Negligence (total)	514	374	**160**	1119.38	113.53	**76.46**
Natural causes (lightning)	93	32	**7**	18.67	11.89	**0.48**
Unknown causes	672	701	**289**	1439.01	201.43	**50.82**
Total fires	1523	1360	**548**	63.15	10.26	**147.81**

Table 16. Detailed breakdown of negligence causes in 2019-2021

	Number of fires			Burnt area (Hectares)		
	2019	2020	**2021**	2019	2020	**2021**
Agricultural operations	42	21	**16**	56.81	5.80	**9.83**
Logging and forest operations (including prescribed burning)	73	54	**25**	6.34	4.46	**3.22**
Other industrial activities	1	0	**1**	0.00	0.00	**0.08**
Communications (railways, electricity lines, etc)	16	10	**7**	28.81	20.28	**0.17**
General public (campers, other visitors, children)	183	177	**74**	41.97	48.34	**19.70**
Other (military, etc.)	199	112	**37**	985.45	34.65	**43.46**

(Source: Federal Agency for Agriculture and Food, Germany).

1.2.10 Greece

Fire danger in the 2021 fire season

The forest fire season for 2021 in Greece started out with extremely high temperatures above the normal level, in most parts of the country. The precipitation level, especially in May, recorded zero not only in the Attica region but also in the southern mainland.

In addition, the summer of 2021, from the middle of June until the end of August, was characterized by abnormal high temperatures approaching a maximum of 46 degrees Celsius, in the northern and central continental parts of the country. This period was considered the most notable heat wave in terms of duration for the last 35 years. Due to the long period of drought the risk of fire danger increased and recorded large and notable fires between the 3rd and 11th of August.

Long term high pressure weather had led to a dry July and August which was the main reason for 2021 being a year of high fire danger over most parts of the country at the same time. Dry air had also caused the vegetation to dry out, which also easily ignited and gave a rapid spread of fire.

Fire occurrence and affected surfaces

The most notable forest fires for 2021 are listed below:

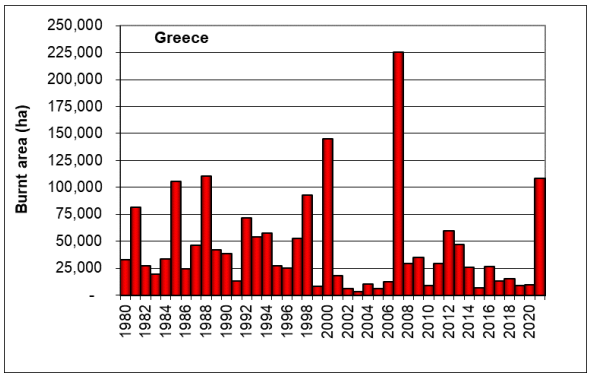
- 19–20 May in Schinos area- Gerania mountain
- 3 August Eastern Mani
- 3-6 August in Attica area
- 3–11 August in Evia island
- 4-5 August in Ancient Olympia
- 8 August in Gortynia area - Arkadia
- 1 August in Rhodes island

According to information received from the local Forest Services, a total number of 1 250 forest fires were recorded across Greece, with an affected burnt area of 108 418 hectares on wooded and non-wooded forest land. More specifically, 101 190 hectares were burned on wooded forest land and 7 228 hectares were reported on non-wooded forest land. The majority of fires (899) resulted in less than 1.00 hectare of burnt area.

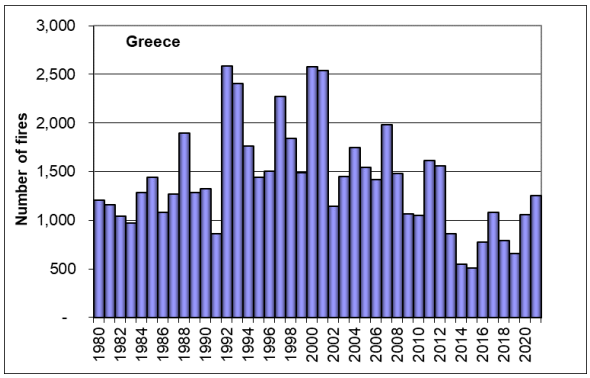
From the current provisional results, there is a significant increase in the total number of fire incidents not only from 100 to 500 hectares of burned area with twenty-five (25) fire incidents for 2021 compared with the previous fire season with four (4) fire incidents, but also in the larger fires.

In 2021 nineteen (19) fire incidents were recorded with a total burned area greater than 500 hectares for, in comparison with 2020 when three (3) such fire events were noted (Figure 37, Table 17).

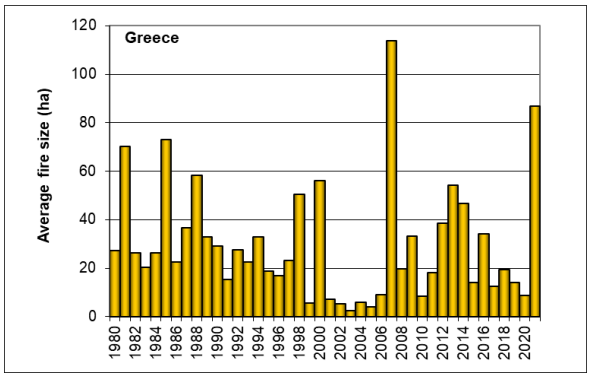
The yearly trends in terms of numbers of fires, burnt areas and average fire size in Greece from 1980 are shown in Figure 37.



(a)



(b)



(c)

Figure 37. Burnt areas (a), number of fires (b) and average fire size (c) in Greece from 1980 to 2021.

Table 17 shows the number of fires and burnt area in Greece in 2021. These numbers are still provisional and are likely to rise when the compilation of fire data will be completed.

Table 17. Number of fires and burned area in 2021 by regional forest administration

FOREST ADMINISTRATION AUTHORITIES	*Number of fires*						*Burned area (ha)*		
	Total	*<1 ha*	*1-5 ha*	*5-100 ha*	*100-500 ha*	*>500 ha*	*Total*	*Wooded*	*Non wooded*
Macedonia-Thrace	201	132	38	28	3	0	1840.6	996.83	843.77
Epirus & Western Macedonia	251	185	45	18	1	2	12175.66	12094.3	78.36
Thessaly and Central Greece	270	187	38	33	9	3	43724.3	42548.7	1175.61
Peloponnese, Western Greece & Ionian	298	218	49	12	9	10	37064.2	33821.3	3242.9
Attica	48	28	6	9	1	4	12749.7	10943.8	1805.91
Crete	166	141	14	11	0	0	289.49	208.63	80.86
Aegean	16	8	5	1	2	0	577.8	576.47	1.40
TOTAL	**1250***	**899**	**195**	**112**	**25**	**19**	**108418***	**101190**	**7228.81**

***** *provisional*

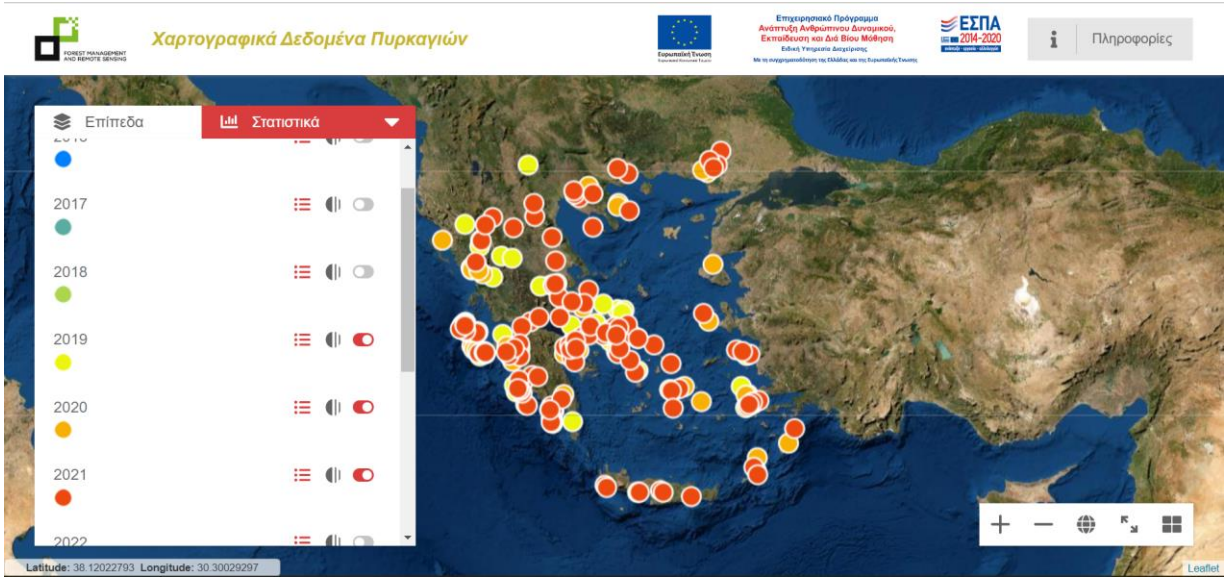


Figure 38. Map with the most notable fire locations in Greece in 2019, 2020 and 2021. (Source: Aristotle University of Thessaloniki- Laboratory of Forest Management and Remote Sensing, http://epadap.web.auth.gr).

Fire fighting means and information campaigns

In 2021 the Fire Brigade personnel consisted of 18 453 people, 11 399 of whom were permanent personnel of the Fire Brigade dealing also with structural fires, 2 497 were personnel employed with a five years contract and 2 310 were seasonal personnel, hired for forest fire suppression activities. A further 105 civil service staff and 2 132 volunteer fire fighters were also involved.

The Fire Brigade of Greece has a total of 3 574 vehicles of various types. These vehicles are distinguished as follows:

Table 18. Firefighting means

Firefighting vehicles	1965
Support vehicles	1223
Special vehicles	233
Motor cycles	164
Total	3574

The aerial means used during the 2021 campaign are shown in Table 19.

Table 19. Aerial means participating in the 2021 campaign.

National fleet		
Type	Number	Availability 2021 (max)
Aircraft CL-415	7	6
Aircraft CL-215	13	9
Aircraft PEZETEL	18	18
Helicopter SUPER PUMA AS 332 L1	2	2
Helicopter BK 117 CL	3	3
Helicopter CHINOOK	3	3
Aircraft C-130	1	1
Total	**48**	**43**
Leased air means		
Type	Availability 2021	
Medium Press Helicopters	12	
Heavy Duty Helicopters	10	
Personnel Helicopters	6	
Personnel Transport Aircraft	2	
Amphibious Medium Type of Aircraft	1	
Lightweight Type of Aircraft	6	
Total	**37**	

Injuries and loss of human lives

During the fire-fighting period of 2021, thirty three (33) Fire fighters were injured and one (1) citizen was killed.

Operations of mutual assistance

The contribution and the assistance of other countries was remarkable by sending firefighters, fire-fighting vehicles and aircrafts not only from the members of the European Union (Austria, French, Germany, Spain, Croatia, Poland, Slovak, Sweden, Czech Republic), but also from other countries (Egypt, Switzerland, United Kingdom, Russia, Turkey, Qatar, Israel).

Climate Change

Climatic conditions and how they impacted the fire season

There were a few weather and climate events in 2021 including floods, heavy snowfall, heat waves and wildfires.

During the period from 22nd of June until the end of August the heat wave conditions prevailed on the central continental parts of the country. The exceedingly high temperatures above 39 degrees Celsius recorded in several stations daily combined with the intense drought period, and the Greek mainland experienced mega fires.

The climate is changing and it is increasingly clear that Greece must increase its preparedness to deal with wildfire campaigns enhancing the prevention and protection.

(Source: Ministry of Environment and Energy; Directorate General For The Forests And The Forest Environment, Greece).

1.2.11 Hungary

Fire danger in the 2021 fire season

FWI derived data and values were reported throughout the whole fire season by the Forest Authority (FA). FA has been using the JRC's data service to monitor the daily fire danger situation.

83% of the usual amount of precipitation fell in 2021, and its distribution was extreme both in space and time. Examining the precipitation amount, it can be said that less precipitation than usual fell in a significant part of the country. There were only small regions where the amount of precipitation was the same as the long-term average. The largest negative anomaly occurred in the Great Plain. March and June were very dry. This summer was the 5th warmest in the last 120 years.

During the second half of February and the entire month of March, there was little or no precipitation on most days. Due to the dry period, the number of forest fires began to rise sharply on the penultimate day of February. The fire-risk period lasted until mid-April. Of the 45 days between February 27 and April 12, there were 27 days with 10 or more forest fires. The spring drought period ended in mid-April. The number of fires was also lower than the average of the last decade. The second dry period developed in June, when more forest fires occurred compared to the average of the last ten years. After the dry June, July turned out to be wetter, so the number of forest fires was low. During the second part of September the number of fire incidents increased, which was not a known phenomenon until now. The end of the fire season is indicated by the decrease in the number of fire incidents and the end of risky days. This period has been pushed to the last days of October.

The daily values of the FWI from June to the end of September were above the average of the last 40 years in Hungary. In 2021, there were 73 days when a total fire ban was ordered in at least one county. In the spring fire season, there were no conditions that would have justified the declaration of high danger period and total fire ban.

Fire occurrence and affected surfaces

Forest fires data are collected in close cooperation with the disaster management authority. Data are collected on the spot by fire fighters, who have been uploading the database day by day. Forest fires data are produced and analysed with a GIS method and checked on the spot by the forest authority. The gathered fire data are processed and evaluated by size, date, cause and duration of fires. Data from 2011-2021 are shown in Table 20.

Table 20. Number of fires and burnt areas.

Year	*Total number of wildfires*	*Forest fires*		*Other land types*
		Number	*Burned area (ha)*	*Number*
2011	8 436	2 021	8 056	6 415
2012	15 794	2 657	14 115	13 137
2013	4 424	761	1 955	3 663
2014	5 535	1 042	4 454	4 493
2015	5 057	1 069	4 730	3 988
2016	2 531	452	974	2 079
2017	6 782	1 454	4 934	5 328
2018	2 981	530	906	2 451
2019	7 296	2 088	6 541	5 208
2020	4 339	1 239	2 895	3 100
2021	4 350	1 154	2 413	3 196

A total of 1 154 forest fires were registered in 2021. This value is not extreme; it is considered average in this decade. The average burned area per fire was 2.1 ha. Fire totally or partially consumes forests and causes serious harms. Based on the yearly data set we found there were more fires than the average of the previous 10 years last summer.

Figure 39 represents the tendencies experienced in the last decade (2011-2021) that there are two most dangerous forest fire periods during every year. Traditional use of grassland includes burning methods in early spring, which can accidentally spread to nearby forest. These fires usually burn in March and April. Spring forest fires usually burn with low or medium intensity in broadleaf forests, juvenile growth, shrubs and grasslands. Summer fires were registered in the Great Plain, where crown fires can also occur in pine forests.

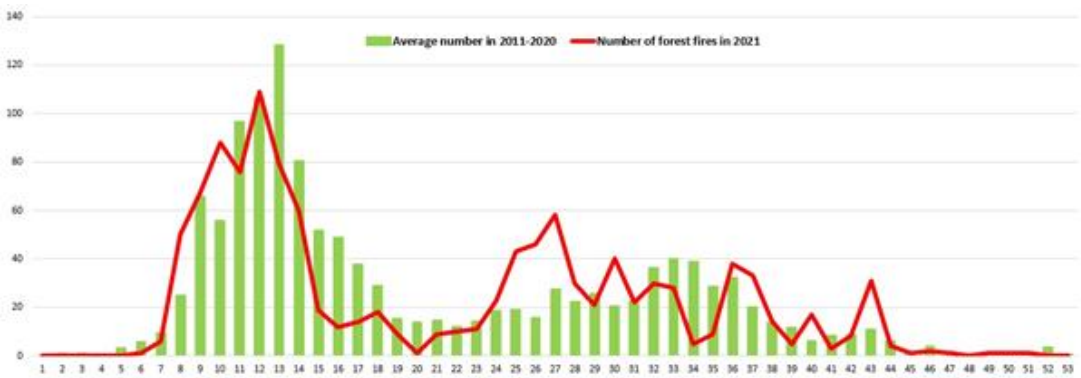


Figure 39. Average number of forest fires per week in Hungary 2021.

A total of 618 forest fires occurred in spring, which is 53% of all forest fires in 2021. Most of the spring fires (49%) burn in northern areas (Borsod-Abaúj-Zemplén County, Heves County, Nógrád County and Pest County) which indicates these areas as high forest fire danger zones. In these areas not only traditional grassland management methods, but other social-economic factors add to forest fire danger. A total of 463 forest fires occurred in the summer period but there were no large fires last summer.

With GIS analysis, we can say that the majority of forest fires do not ignite inside the forest, but in the agricultural area adjacent to it. We have found that 58% of the fires occurred in a 500 metre zone around residential areas. 88% of all forest fires are no further than 2 km from residential areas in 2021.

98% of forest fires were surface fires this fire season, when surface litter and other dead vegetal parts and smaller shrubs burnt down. The average rate of fires smaller than 1 hectare is almost 77%. There was no large fire in 2021. There were only 2 fire events where more than 50 hectares were burnt. Statistical analysis shows that the number of forest fires under 0.5 ha has been increasing in the last decade. In particular, the increase in the number of spot fires under 1000 m^2 is significant (Table 21).

Table 21. Classification of fires by size class in Hungary in 2021.

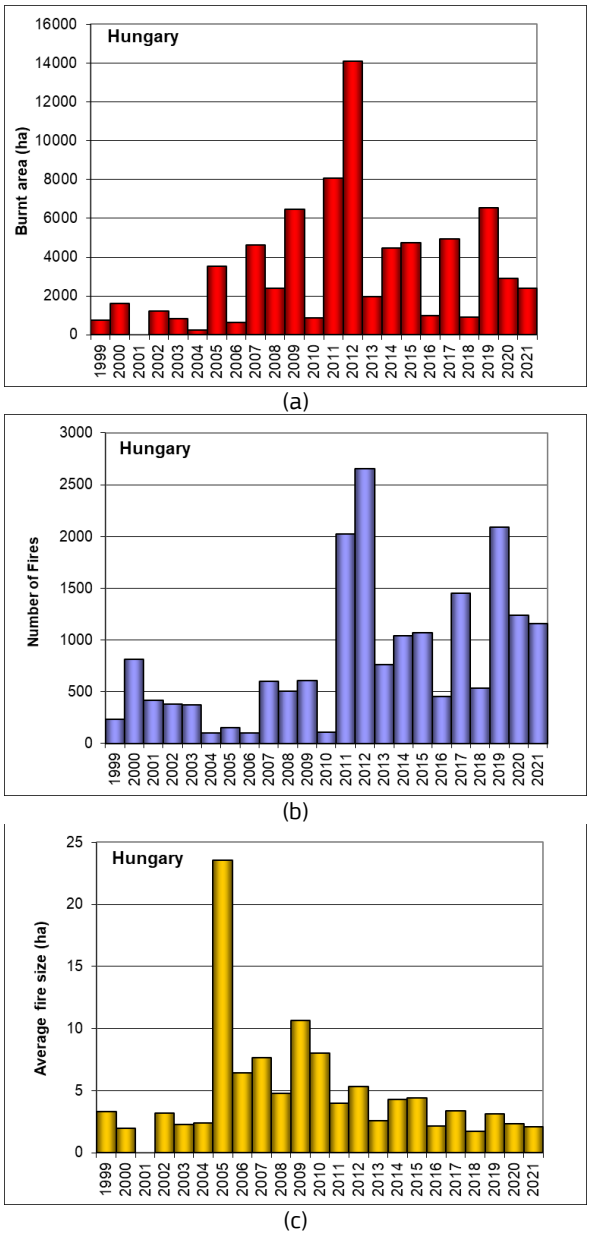
Classification of burnt area	Number of forest fires	Burnt area (ha)
less than 1 ha	893	252
1 – 50 ha	258	1611
50 – 100 ha	1	100
100 – 500 ha	2	450
more than 500 ha	0	0
Total:	**1154**	**2413**

Analyzing the statistics we can see that a total of 367 hectares of forest land were burned or affected by forest fire during 2021. In addition, more than 1 549 hectares of grass vegetation and 497 hectares of other wooded land were destroyed in forest fires (Table 22).

Table 22. Fires by forest type

Forest type	Total burnt area (ha)
Forested land	367
Other wooded land	497
Other land	1549
Total	**2413**

The yearly trends in terms of number of fires and burnt area from 1999 are shown in Figure 40.



(a)

(b)

(c)

Figure 40. Burnt areas (a), number of fires (b) and average fire size (c) in Hungary from 1999 to 2021.

Fire Causes

99 % of forest fires are human induced (negligence or arson). Most fires are induced by negligence (adults and infants) and only a small proportion of fires are caused by arsonists. Typical forest fire causes are the incorrectly extinguished fires of hikers, illicit agricultural fires, discarded cigarette butts and sometimes slash burning.

Fire fighting means

85% of fires were usually extinguished in less than an hour after arrival at the fire. The fire service arrived at the fire in 30 minutes on average.

Injuries and loss of human lives

There were no injuries or deaths in forest fires.

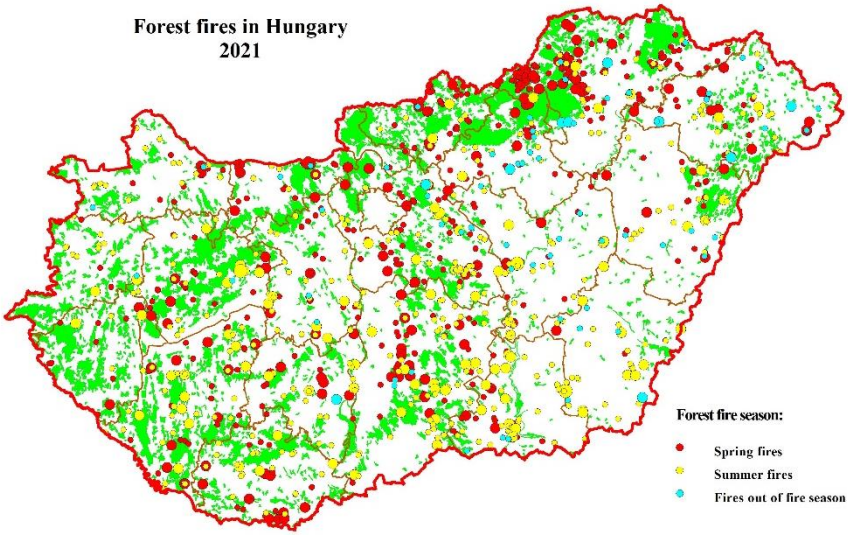


Figure 41. Locations of forest fires in Hungary in 2021.

Operations of mutual assistance

Fire service equipment was not heavily damaged. Neither Fire Service nor Forest Authority served mutual assistance last year.

Fire prevention activities and fire information campaigns

Forest fire prevention is carried out in cooperation with the forestry authority and the National Directorate General for Disaster Management, based on community and domestic legislation.

The forestry authority also participates in the work of the Forest Fire Working Group of the National Fire Prevention Committee. The National Food Chain Safety Office has delegated experts to the Disaster Risk Assessment System project, which is implemented by the National Directorate General for Disaster Management. We participated in the field training organized by fire fighters. The new fire cause scheme developed by JRC has been incorporated into the national forest fire information system.

Two of us participated in the online workshop of the EUMETSAT project last spring. We have been using the data services of the National Meteorological Service, including the public data of the Meteorological Database. We also presented the possibilities of using the fire weather index at the First National Interdisciplinary Climate Change Scientific Conference organized by the Hungarian Climate Change Scientific Board in the spring of 2021.

Climate conditions and how they impacted the fire season

According to the analysis of the National Meteorological Service, both spring and summer average temperatures rose by more than 1.5 degrees compared to the base period (1980-2010).

The increase in the number of hot summer days also indicates a warming trend. The amount of annual precipitation is slightly decreasing in Hungary. The decline is similar to the trend in Southern Europe. Comparing the four seasons, compared to the last 100 years, the amount of precipitation decreased the most in spring. The amount of summer precipitation has not decreased dramatically, but there are significant differences in its distribution. The number of rainy days has decreased. Precipitation is falling more and more often in the form of short-lasting intense showers and thunderstorms. As a result of the changes presented above, it can be shown that the fire season starts in mid-February and lasts until the end of October in dry years. The number of fire-risk days increased in droughty springs.

National adaptation strategy

The forestry authority has proposed a review of forest fire prevention plans at the national and county levels. The criteria and content of reviews has been compiled by the forest authority following the suggestions and best practices published in the issue of the European Commission Expert Group on Forest Fires in 2021.

Research activities aimed at improving fire management

The Forest authority has a short project on a voluntary basis to explore hotspots with GIS methods using the data of the Forest Fire Information System. We want to incorporate the results of the research into the forest fire protection plans at country and county level.

(Source: National Food Chain Safety Office; Forestry Directorate).

1.2.12 Ireland

The Department of Agriculture, Food and Marine (DAFM) is the agency responsible for forest Protection in Ireland.

Fire occurrence and affected surfaces

Based on available Copernicus data, during 2021 it is estimated that approximately 3 200 ha of land was affected by fire, including approx. 100 ha of forest lands. Most of the area affected is land managed primarily for Conservation, including approx. 2 000 ha of National Park land. The forest land affected comprised 49 ha of commercial forest and approx. 50 ha of native forest managed for conservation.

Table 23. Estimated total losses in 2021.

Forest	Non-Forest
100 ha	3 100 ha

Fire danger during the 2021 season

The 2021 fire season in Ireland took place in a continued Covid-19 operating environment.

Fire risk conditions for 2021 were generally typical for Ireland; however, changes in human behavioural patterns influencing ignitions were observed during and following periods of public movement restrictions. Increased numbers of ignitions associated with illegal waste dumping, public recreation and other non-agricultural activities were noted from April onwards, particularly in the southern region.

The DAFM Forest Fire Danger Rating System was activated with a Condition Yellow notice in early March 2021. A further six Condition Orange Notices were issued between April and July, in line with prevailing weather and fire risk conditions. No Condition Red notices were issued during 2021.

The most significant phase of fire activity occurred between April 22nd and April 26th, coinciding with high temperatures and easterly wind conditions that permitted a sustained period of large-scale fire activity.

Fire prevention activities

Annual forest fire preparedness and coordination events involving large groups were postponed due to the pandemic situation. The potential for wildfires to divert essential services away from the public health emergency was evident to authorities early on and reflected in strong fire prevention media messaging across several Government Departments. There was significant media and awareness activity by relevant Government Departments, including Ministerial statements following initial fires in March 2021 and following later incidents.

A new Fire Weather reporting system was launched by Met Eireann (Irish Weather Service) during 2021 following extensive testing. This development was also accompanied by the launch of a new soil moisture measurement network, that will improve monitoring of soil moisture deficits across Ireland and this information can also inform improved fire danger analysis, especially for peat soils.

Promotion of land management activities aimed at vegetation management and fuels reduction in upland areas, continued through the network of European Innovation Partnership EIP-AGRI Projects throughout 2021. A number of these projects are focussed on upland areas with ongoing fire management issues.

Figure 42. EIP-funded pond intended for aerial fire-fighting near Athea, Co. Limerick. (*Image: DAFM*)

Fire Activity

Fire activity in Ireland is primarily monitored through three Regional Emergency Control Centres covering Southern, Western and Eastern Regions.

Some illegal agricultural burning activity was observed during March and into early April, notably in Co. Wicklow and Laois. Some Fire activity on military training land was also noted. 2020 and 2021 have generally seen reduced levels of agricultural burning activity, and a greater focus of fire activity on non-agricultural land types.

Notable incidents:

A significant phase of fire activity occurred between Friday April 22nd and Tuesday April 26th. Late on 22nd April a fire was reported in Killarney national park in SW Ireland, and within 24 hours this fire had spread rapidly to cover over 2 000 ha of predominantly steep mountain terrain. Firefighting response was greatly hampered by the terrain, heavy accumulated fuel loads and the remote location of the fire site, largely without road access.

Boats were required to transport crews and portable pumps and equipment to the main fire location. Kerry Fire and Rescue Service led the suppression effort assisted by the Irish Defence Forces with a single AW139 aircraft.

Several other agencies and voluntary groups were also involved in supporting the operation.

This large-scale incident occurred simultaneous to a similar large wildfire in the Mourne Mountains in the east of Northern Ireland and helicopter resources were also assigned to this incident by the National Directorate for Fire and Emergency Management.

A significant urban interface fire occurred at Howth in Dublin City in July 2021 following a period of sustained dry weather, and required several weeks of effort to extinguish due to persistent smouldering peat and re-ignition issues in the area affected. This fire threatened homes at several points and was eventually fully extinguished. A similar urban fire also occurred at Cobh, Co. Cork during this time.

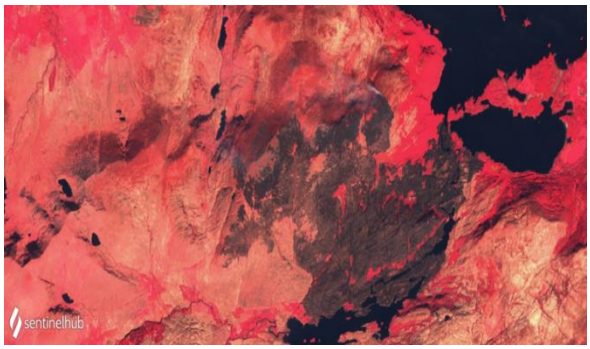


Figure 43. Killarney National Park Fire April 23, 2021. (*Image ESA/Copernicus/Sentinelhub*).

Figure 44. Killarney National Park Fire, April 23, 2021. *(Image: Civil Defence*)

Fire Suppression

Fire suppression activities are usually conducted and led by Local Authority Fire and Rescue Services. On state owned forest lands, National Parks and Nature Reserves, these services can be augmented by additional firefighting personnel, air support and ground equipment from Coillte Teoranta (State Forestry Board), National Parks and Wildlife Service, Bord Na Mona (Irish Peat Board) and the Irish Defence Forces where required.

Ground operations during 2021 were augmented by 3 Helicopters (2 X EC120, 1 X AS365) sourced from private sector contractors with additional medium lift helicopter support (AW 139, EC135) from the Irish Defence Forces.

International Assistance

Irish Defence Forces AW139 and EC135 helicopters and Irish Coastguard S92 helicopter resources were despatched to assist Northern Ireland Fire and Rescue Service on April 24th, in response to a direct request from Northern Irish authorities.

Loss of human lives

There were no human injuries, deaths or structure losses reported following forest fires during 2021.

(*Source: Forest Service, Department of Agriculture, Food and the Marine, Ireland*).

1.2.13 Italy

Fire Danger

In 2021, the mean fire danger in Italy during the fire season (July to September) was markedly above the average (period 1988-2020), corresponding to the 96% of the highest FWI in 2007 (Figure 45, left). Note that FWI does not display a strong trend over the period of analysis (red dotted line -Figure 45, left).

A significant proportion of the inter-annual change in total burnt area in Italy is explained by changes in fire weather (Figure 45, right). A change in FWI from one year to the next is correlated with the corresponding change in burnt area, with 2021 showing above average changes for both FWI and burnt area.

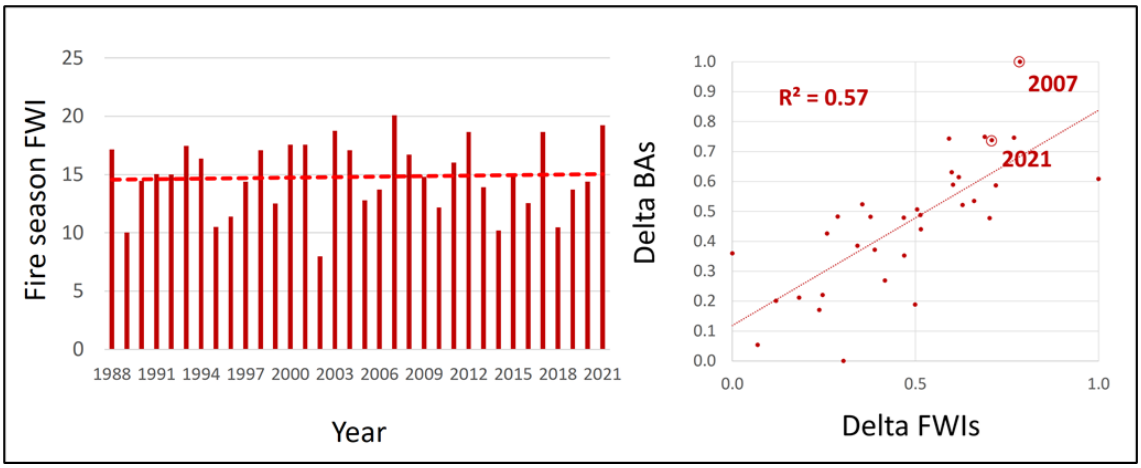


Figure 45. Mean daily fire weather in Italy during the fire season (July-September) from year 1988 to 2021. The red dotted line indicates the linear trend over the period of analysis (left). Total burnt area in Italy for years 1988-2021 as a function of mean daily fire weather during the fire season (right). Calculations used the delta approach to correct for autocorrelation: a change in burnt area (Delta BAs) from one year to the next is correlated with the corresponding delta in FWI. Changes are standardized from 0 to 1. Year 2007 (highest FWI and largest burnt area) and 2021 are evidenced by a double circle. Fire weather was indexed using the FWI according to the Global fire danger re-analysis (Vitolo et al. 2019).

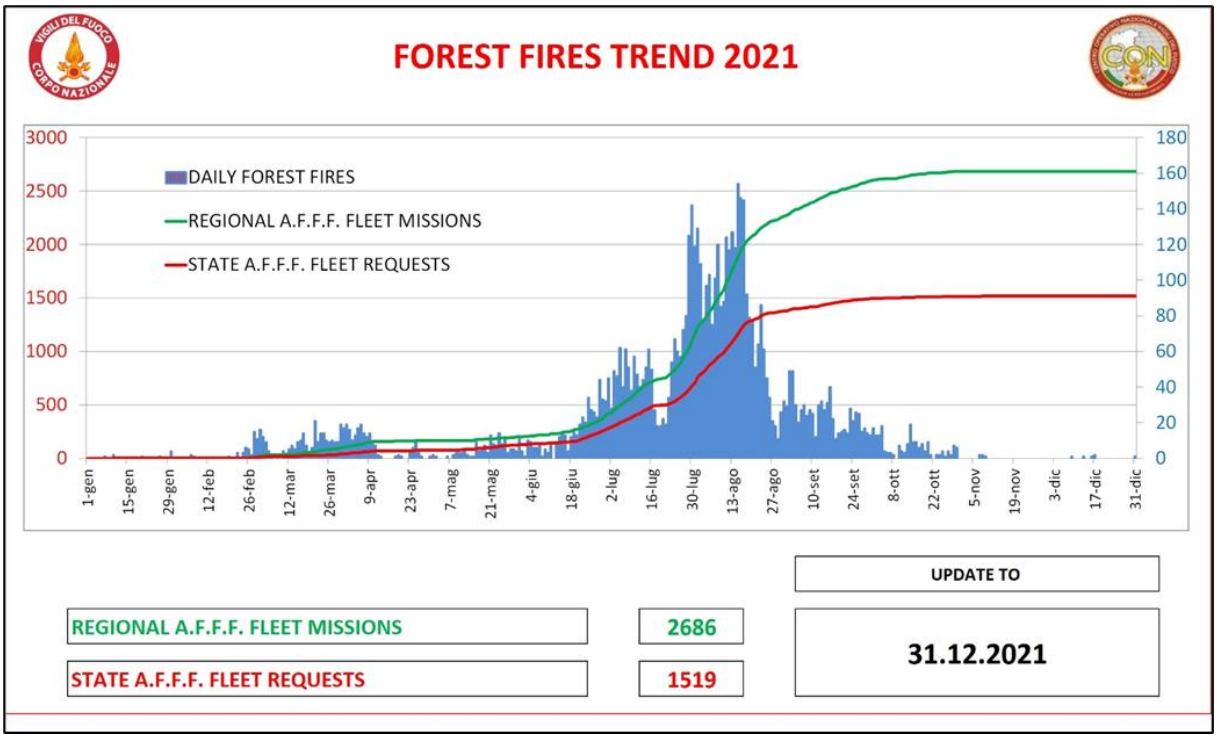


Figure 46. Daily number of forest fires in 2021; number of missions of forest fire fighting aircraft.

Fire occurrence and affected surfaces

At National level, the number of forest fires and burn scar area in 2021 were higher than the previous year: +23.1% in terms of number of fires, +273% in terms of burnt area. The average area per fire more than doubled from 11.4 ha to 25.4 ha.

Analysing in detail the data split per region, it is evident that this increase is mainly due to the forest fire trend in three regions, Sicilia, Calabria and Sardegna, where the climate conditions (high temperature, dry hot winds, a prolonged drought) favoured the spread of fire and increased the difficulties for the operations of fire-fighters.

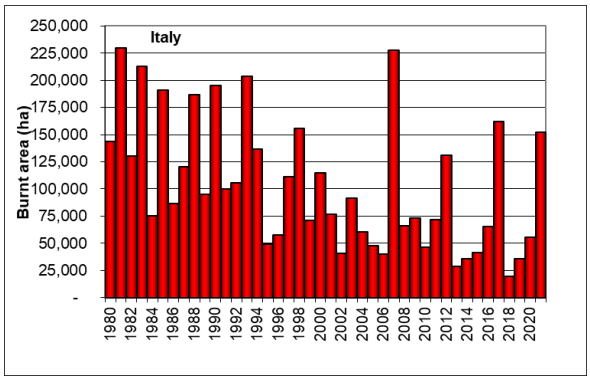
In Sardegna in particular, 1 108 fires were recorded: more than 18% of the total at National level; Sicilia region registered the larger total burn scar area: circa 60 000 ha: 40% of the total at National level. A large part of the burnt surface was made of agricultural areas and uncultivated land in Sicilia and Sardegna (respectively 58% and 76% of the total regional burnt area).

On the opposite, in Calabria fires affected mainly forests (87% of the total at the regional level). It is worthwhile to highlight that in these three regions the larger fires of the year were registered: the Montiferru fire in Sardegna with an affected surface of 13 000 ha, the Madonie fire in Sicilia (about 10 000 ha) and the Aspromonte fire in Calabria (7 000 ha).

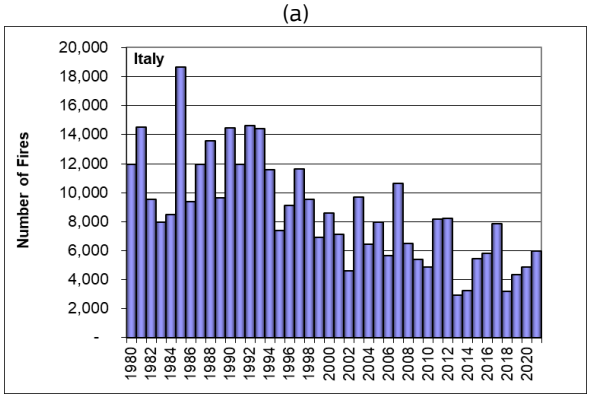
Table 24. Number of fires and burnt area in Italy by region in 2021.

	Num. fires	% share of fires	Forest	Non-forest	Total	Av. fire size
ABRUZZO	90	1.5	1129.5	1932.1	3061.6	34.0
BASILICATA	238	4.0	1555.6	2293.7	3849.3	16.2
BOLZANO	20	0.3	3.5	7.8	11.3	0.6
CALABRIA	739	12.3	24796.4	3685.3	28481.7	38.5
CAMPANIA	559	9.3	5372.6	1628.0	7000.6	12.5
EMILIAR.	162	2.7	104.4	100.8	205.2	1.3
FRIULI	40	0.7	59.5	43.5	103.0	2.6
LAZIO	341	5.7	6429.9	1110.9	7540.8	22.1
LIGURIA	171	2.9	659.5	51.9	711.4	4.2
LOMBARDIA	168	2.8	222.2	25.5	247.7	1.5
MARCHE	84	1.4	111.2	255.4	366.6	4.4
MOLISE	101	1.7	499.1	2061.4	2560.5	25.4
PIEMONTE	139	2.3	752.0	221.0	973.0	7.0
PUGLIA	476	7.9	3552.5	6227.5	9780.0	20.5
SARDEGNA	1108	18.5	6202.5	19603.2	25805.7	23.3
SICILIA	978	16.3	24947.0	34925.0	59872.0	61.2
TOSCANA	405	6.8	361.6	533.1	894.7	2.2
TRENTO	21	0.4	1.8	0.1	1.9	0.1
UMBRIA	95	1.6	248.4	214.9	463.3	4.9
VALLE D'AOSTA	4	0.1	4.3	0.7	5.0	1.3
VENETO	50	0.8	13.6	15.5	29.1	0.6
TOTAL	5989	100	77027.1	74937.3	151964.4	25.4

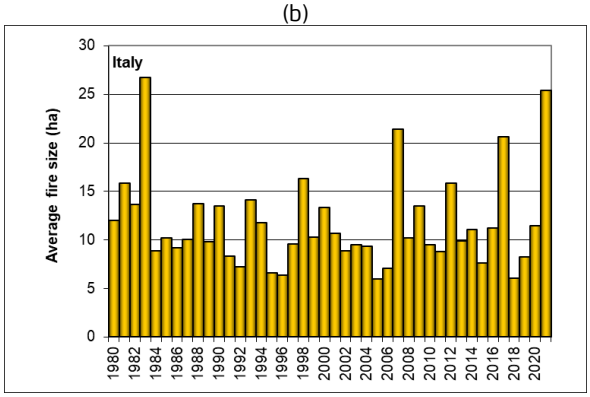
The yearly trends in terms of numbers of fires and burnt areas in Italy since 1980 are shown in Figure 47.



(a)



(b)



(c)

Figure 47. Burnt areas (a), number of fires (b) and average fire size (c) in Italy from 1980 to 2021.

Fire causes

About 2% of forest fires are due to natural causes (lighting). The analysis highlights that for the man-made and intentional fires, the most frequent motivations are the renewal of pastures, while further reasons are linked to hunting activity, social unrest and pyromania. Unintentional causes are mainly due to activities related to burning plant debris generated by agriculture activities: in this case the perpetrators are mainly elderly people, who are not able to keep the fire under control and sometimes become victims of those fires.

Fire-fighting means

In Italy, according to the National Law, the local Authorities (Regioni) have the task to extinguish forest fires with ground crews, composed of volunteers and forest workers, as well as Regional Forest Corps in the autonomous regions. Ground crews are supported by light and medium helicopters rented by the Regioni. Each regional system is managed by a Common Operational Room. Regions can sign specific agreements with the National Fire Corps (C.N.VV.F.) to carry out the activity of forest firefighting. The State coordinates, through the Unified Air Operational Centre (COAU), the National Forest firefighting air fleet: 19 Canadair CL415 and 6 heavy helicopters Erickson S64, all of them owned and managed by the National Fire Corps. During the summer campaign, some military helicopters and other medium helicopters from CNVVF are also available.

Regional air fleets include some 70 helicopters operated by private companies. Puglia Region was the only one to rent planes (2 AT 802 F Fire Boss). In the course of 2021, regional aircrafts were engaged on 2686 missions; National assets received 1519 requests (almost 50% submitted by Sicilia and Calabria).

Ground crews (hand crews and engine crews) make a large use of a pick-up with small water tank (400-600 litres) able to move on the narrow roads of the Italian network covering hills and mountains. The National Fire Corps usually employs pick-ups and provides heavy fire engines also used to fill other smaller means.

Hand crews and engine crews work in close collaboration with the small and medium helicopters. Often, in the mountain areas, ground crews create mobile water points for helicopters using removable tanks filled by heavy fire engines. When the road network does not allow them to reach the fire with trucks, ground crews, especially in the northern part of the country, use long fire hose lines to control the flames on the flanks and for mop up operations.

In these operations, cooperation and coordination between regional crews and fire brigade is crucial (Figure 48, Figure 49)

Figure 48. helicopter of the regional fleet scoops water in a removable tank filled by the National Fire Corps.

Figure 49. Hose lines realized by Lombardia Region FFF Volunteers.

When the road networks do not allow for the use of hoses, the crews use hand-tools like, rakes, beaters, shovels, hoes, etc. In the blowers. Blowers are frequently used especially in the pastures.

Figure 50. Lombardia region Forest fire fighting volunteers and Firemen employed in direct attack.

Figure 51. Lombardia region Forest fire fighting volunteers and Firemen employed in direct attack.

When possible, according to safety conditions, and in particular the knowledge of the places, ground crews also work during the night with hand-tools and hoses, taking advantage of the lower temperature and higher air humidity.

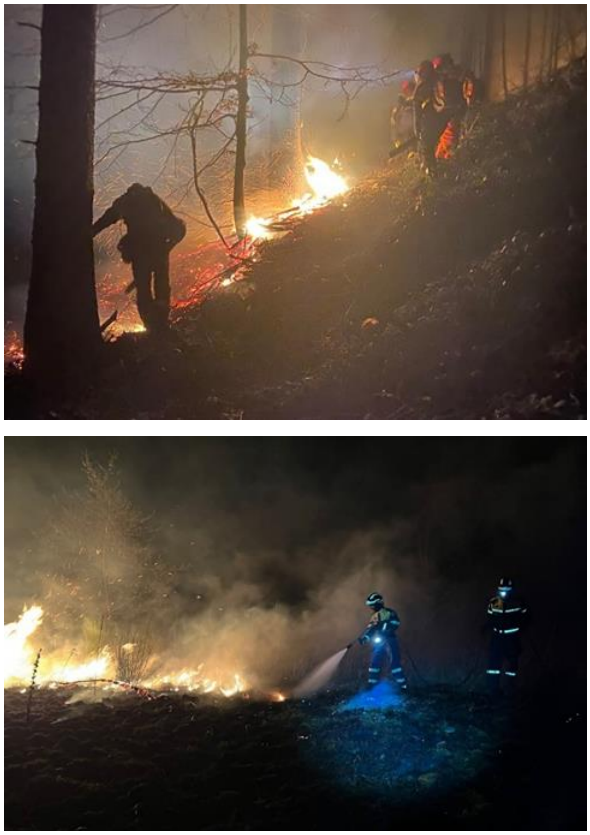


Figure 52. direct attack with hand-tools and water during the night.

After the 2017 fire campaign, one of the worse in the history of the country, the Italian Government decided to increase the ground and air resources of the National Fire Corps through a 10-year plan of investments aimed to improve the response of the State to wildfires. After the purchase of 2 additional heavy helicopters Erickson S64, the National Fire Corps is upgrading its fleet of medium helicopters (AW 139) to be ready for the most dangerous events and improve the distribution of the State firefighting air-means on the territory. The National Fire Corps is carrying out specific tests for the use of long-term retardant good for both Canadair CL415 and Erickson S64 in indirect attack against wildfires with extreme fire behaviour.

Figure 53. Erickson S64 during training with long term retardant.

Figure 54. Canadair CL 415, AT 802 F fire Boss during training with long term retardant

Fire prevention activities and information campaigns

Fire prevention in Italy involves several actors at both regional and national levels. Regional forest agencies are in charge of setting the Regional Fire Management plan (RFM-plan) where fire prevention activities are programmed (Art. 3, Law 353/2000), usually for the following 5 years. Planned activities include:

- the maintenance of the road and fuel-break network to support firefighting;
- the realization of pyro-silviculture interventions in blocks (i.e., variable retention harvest, prescribed burning) to increase forest ecosystem services resistance and resilience;
- information campaigns targeted at citizens with both short-term (e.g., fire danger rating) and long-term goals (e.g., increasing risk awareness). These plans complement the RFM-plan in high fire risk territories defining the spatiotemporal distribution and resources for fuel management activities for a period of 10 years, including extraordinary interventions with the aim to improve the forest vegetation structures and its resistance and resilience to fire disturbance.

The main funding scheme to finance prevention interventions in Italy, as defined by both RFM-plans and Specific Fire Prevention Plans remain the measures and interventions of the Rural Development Program (RDP) of the European Commission (https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development_en).

The EU Reg. 1305/2013 has re-proposed direct support to interventions for the prevention of damage caused to forests by fire (Sub-measure 8.3) and restoration of forests damaged by fire (8.4) for the programming period 2013-2022 (extended by the Commission until 2022).

In the face of an average annual increase in the number of fires and forest area affected by fire, compared to the previous period (2007-2014), there has been an average reduction at national level of about 15% of the resources committed by the regional rural development programs for measures 8.3 and 8.4, allocating a total of 508 million (of which 378 for measure 8.3, and 130 for measure 8.4).

Sub-measure 8.3 has been activated by 16 Regions and the Autonomous Province of Bolzano, with a total expenditure as of December 31, 2020, of 175 million euros compared to the 378 initially programmed. The Regions that have recorded the highest expenditure are Campania and Tuscany that have spent more than 40 million euros, while only Liguria and Umbria have presented a percentage of expenditure realized, compared to the programmed, higher than 85%.

The new programming period provides for a single National Plan that introduces with the SRD 12 intervention a direct support to the regions to cover all or part of the costs incurred to carry out "Investments for the prevention and restoration of forest damage".

The intervention therefore includes investments aimed at carrying out both prevention and protection of the heritage, and interventions for the restoration and/or ecological and functional recovery of forest ecosystems, affected by natural disasters, adverse weather conditions or catastrophic events, including fires, hydrogeological instability, storms, floods, attacks of harmful organisms and plant diseases.

A financial commitment co-financed by the European EAFRD fund of € 197 675 235.46 is planned and the intervention will be activated by all regional administrations, except for the Abruzzo and Campania Regions which provide their own resources to carry out similar interventions.

Overall, therefore, there is a financial commitment reduced by 60% compared to the previous programming phase.

International assistance operations in 2021

During 2021 only 1 forest fire fighting mission was carried out at the request of the EU Civil Protection Mechanism. 2 Canadair CL 415 aircraft of the National Fire Corps were engaged for 5 days in Austria (mission from 29/10/2021 to 02/11/2021) for a forest fire on Mittagstein Mount at the southwest of Vienna: 10 operational missions, 32 drops were executed by the Italian AFFF in Austria. Again, the anomalous period of the mission is probably linked to climate changes.

Conversely, Italy also requested assistance to the European Mechanism to support its response to forest fires in the worst period of the 2021 fire season

Figure 55 and Figure 56. Italian crew and Canadair during a RescEU mission.

Injuries and loss of human lives

According to National Fire Corps data (through the official reporting system 'Stat-Ri-web'), in 2021, 20 persons were injured due to forest fires; 5 of them were first responders (1 professional fireman, 2 Forest Fire Fighting Volunteers, 1 member of the regional Forest Corps, 1 forest worker) who suffered minor trauma and smoke inhalation. Moreover, 1 casualty was due to forest fires: a breeder who was trying to save his cattle.

The toll of vegetation fires (not forest fires according to the national law) was heavier: 7 casualties and 32 injured people; 7 injured were first responders (professional firemen). 3 of the injured are due to road accidents triggered by the reduced visibility caused by the smoke of fires.

Climate change

The year 2021 was less warm than previous years, however, characterized by monthly temperature anomalies of opposite sign throughout the year. Precipitation was also 7% lower than the average.
Numerous heat waves were recorded in Italy in 2021, the most intense of which was recorded in the second week of August when, in some places of Sicily, temperatures exceeded 48 degrees Celsius.

Coming to the details of temperatures, 2021 was characterized by an anomaly of +0.23 degrees compared to the 1961-1990 period. However, this annual value had a rather marked spatial and temporal distribution. In fact, a colder spring (-0.93°C) with April in evidence was followed by much warmer than average months (summer +1.02°C) with June and August having monthly anomalies greater than 1.5°C.

The spatial distribution of temperature anomalies was also uneven; northern regions had temperatures averaging with those recorded over the reference period, while central regions and particularly southern Italy and the two largest islands (Sicilia and Sardegna) experienced an average rise in temperatures of almost 0.5°C.

Rainfall decreased by 7% compared to the reference period, but this figure is conditioned by a much wetter-than-average January (+91%), which was followed by a series of consecutive drier-than-average months.

The number of consecutive days without rain (CDD), is a significant figure to relate to fire trends. In 2021 it recorded the highest values in southern Sicilia, western and central Sardegna, and the Tyrrhenian coast where more than 100 consecutive days without rain were recorded with peaks in some locations of 139 CDD.

The presence of numerous heat waves in central southern Italy combined with the CDD index in these areas created the conditions for the formation of GIFs (large forest fires). During 2021, 17 fires with an area greater than 1 000 ha were recorded by EFFIS, 16 of which were concentrated in Sicilia, Sardegna and Calabria.

In 2021, forest fires and vegetation fires represented a very heavy problem in Italy. The winter campaign, which usually affects the alpine regions, did not show a particular virulence, also because of the lock-down due to COVID-19 and the related limited presence and mobility of people in open places. The summer campaign, on the other hand, had an early start, at least in some regions such as Sicilia and Sardegna, and a remarkable progression, due to drought, high temperatures and dry winds that mainly affected the central-southern regions; two main peaks were registered: one in the second half of July, the other around Mid-August. The phenomenon was still active till mid-October: further evidence that the "fire season" is systematically lengthening.

The situation became particularly critical in the second half of July in Sardegna with the Montiferru fire on 24/07/2021. Here, in a single fire, over 13 000 hectares of territory were damaged with different phases of the fire also affecting rural-urban interface areas; after the culminating phase in Sardegna, the most important fire was registered in Sicilia with the Madonie fire (about 10 000 hectares, mainly of agricultural surfaces); a few days after in Calabria there was the Aspromonte fire with about 7 000 burned hectares consisting, this time, mainly of wooded areas.

Fortunately, there was no overlap between the events in Sardegna and those in Sicilia and Calabria; this situation allowed the national Forest Firefighting System to be able to sustain the impact.

Figure 57. Images of fires in Sardegna, Sicilia and Calabria.

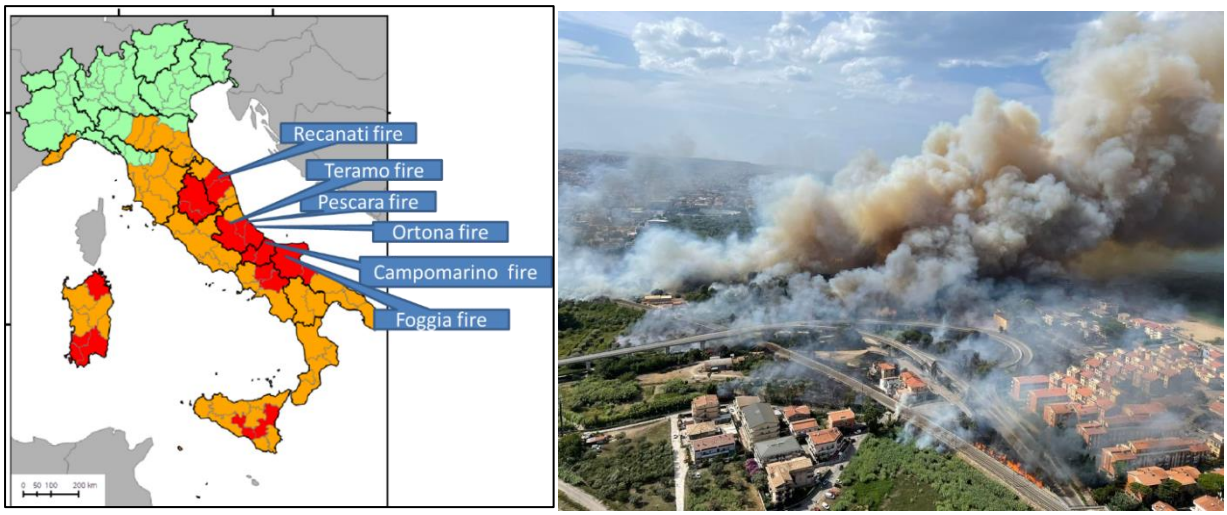


Figure 58. 01/08/2021 - according to the danger forecast, a series of very dangerous urban-wildland interface fires affected the Adriatic coast.

The Government declared the state of mobilization of the National Civil Protection System, provided for by the P.C. Code, on July 31st for Sicilia and August 8th for Calabria. As part of the national mobilization, the northern regions, not affected by the fires, sent many teams of FFF volunteers both to Sicilia and Calabria, while the Fire Brigade sent Incident Commanders and operational teams. But the commitment of the National Fire Corps was particularly heavy throughout the summer: according to the situation in act and the fire risk forecast, hundreds of fire brigade teams were pre-alerted to move in support of the most affected regions.

According to the fire risk forecast of Civil Protection Department, for 65 days during the summer the FFF Ground Modules of Fire Brigade were pre-alerted to support the regions for interventions in the National territory: a total of 900 modules and 8000 firemen; on 01/08/2021, according to the forecast, in a few hours 6 wildfires requested this kind of support.

August 1st, in fact, was the worst day of the campaign, when in addition to the critical situation in Sicilia, a strong wind caused a series of very dangerous fires throughout the Adriatic coast. Puglia, Molise, Abruzzo and Marche, were affected by many interface fires; during the forest fire fighting operations it was necessary to close the Adriatic motorway and the railway line in several places. In many situations it was necessary to evacuate camping sites, villages and urban suburbs. In addition to the FFF State fleet managed by the COAU, the intervention of all the helicopters of the Fire Brigade fleet was also necessary, including those of the emergency technical rescue service.

It is quite evident that wildfire campaigns are no more well defined in terms of time and space, and often complicated by contemporary hydrogeological events. The borderlines between forests and agricultural lands are no longer well defined. In the marginal areas, fields are no longer cultivated, and transition shrub stands are growing, creating suitable areas for the fast spreading of fires. For these reasons, the protective effect of cultivated areas is decreasing and, in the worst years, like 2007 or 2017, agricultural areas are no longer fire lines to stop wildland fires; on the contrary, they become areas which allow a faster spread of fires to the forests. Noteworthily, fires involving agricultural areas, including those with transition shrub stands, are growing and their number exceeds forest fires. National Fire Corps data (Stat-Ri-web) report in 2021 more than 94 000 “vegetation fires” (Figure 59), better defined as “rural fires”, (not classified as forest fires according to the National law). This evolution also increasingly challenges the response system.

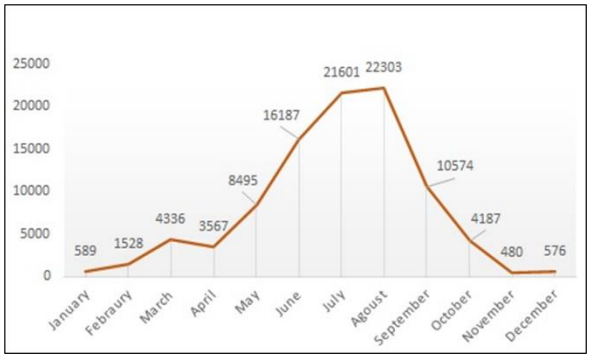


Figure 59. Numbers of vegetation fires (“rural fires”) in Italy during 2021. These fires are not classified as forest fires according to the national law (*data from National Fire Corps*).

National or sectoral (forest) adaptation strategies and plans: adaptation measures promoted to limit forest fire risks

After the 2021 summer campaign, the Government issued a regulation to improve coordination and forecasting capacities, as well as prevention and response to forest fires.

In particular, the Law 155/2021 aims at:

1. improving the forecasting and alerting capabilities of the National Civil Protection Department for the whole Italian territory;
2. enhancing the response capacity of the State fleet with additional aircrafts and helicopters and more infrastructures to service the fleet;
3. upgrading air and ground response assets (air and ground vehicles, equipment, safety clothes, etc.);
4. enhancing training activities;
5. improving the update rate of the burn scar register.

Within the same Law the following is also provided:

- a "National coordination plan for technological updating, and to increase the operational capacity in forecasting, prevention and active fight" prepared by the National Civil Protection Department with the help of an inter-institutional technical committee;
- a three-year funding plan (2021-2023);
- heavier administrative sanctions;
- amendments to the Penal Code;
- formalisation of the concept of "urban-rural interface";
- identification of the mitigation actions suitable to reduce the rural fires risk.

The same Law assigns part of the resources of the National Strategy for the development of internal areas of the country (100 million euro for the period 2021-2023) to fund local Authorities for projects aimed at forest fires prevention in fire risk prone areas, also including actions and measures to deter the abandonment of forest care activities, so as to enhance and protect the forest heritage.

Research activities aimed at improving fire management

Several studies and research programs aiming at improving fire management in Italy were carried out and published in 2021. Ascoli *et al.* (2021) tested the hypothesis that in Italy large wildfires and repeated fires (series 2007-2017) selectively burn areas characterised by a more intense land abandonment (series 1980-2006). They found that large fires (>500 ha) affected areas with higher rates of forest expansion, and recurrent fires tended to occur in areas with higher transitions from abandoned pastures and grasslands towards shrublands. Interestingly, buffer areas of 200 m along large fire perimeters experienced lower levels of land abandonment and higher increases in orchards and vineyards, suggesting that continuous management of agroforestry territories limits large fires by increasing the accessibility and effectiveness of firefighting.

D'Este *et al.* (2021a) developed a set of models combining multi-source remote sensing data (SAR, Sentinel 1, 2 and LIDAR), field data and machine learning techniques to quantitatively estimate fine dead fuel load (1-h time lag) and understand its determining factors in Mediterranean vegetation types. The results showed that Random Forest had more predictive power compared to the other models, while LIDAR variables were more important in fuel estimation than optical and radar variables.

Several studies addressed wildfire exposure, risk and adaptation (e.g., Bacciu *et al.* 2021, Salis *et al.* 2021) with particular focus on the wildland urban interface (WUI). A WUI raster map was created for the Italian peninsula with a resolution of 30 m per pixel (D'Este *et al.* 2021b). The map creation process consisted of three fundamental steps: (1) selection of buildings within the wildland-urban interface areas and subsequent classification of these into isolated, scattered, and clustered buildings; (2) creation of the tree canopy cover layer (low, medium, high); (3) generation of WUI map by the intersection of 3x3 previous products to obtain 9 categories of WUIs.

Spano *et al.* (2021) explored differences between citizens with and without previous wildfire experience in terms of 1) knowledge, 2) perceptions, 3) information, 4) self-protection, and 5) community involvement. Additionally, they investigated differences in the same variables focusing more deeply on individuals with previous wildfire experience, classifying them according to fire-related employment and WUI proximity. Results partially confirmed the hypothesis that direct experience leads individuals to have a greater preparedness on the topic of wildfires.

Several studies addressed fire effects on air quality, soil, vegetation and fauna (Ancillotto *et al.* 2021, Castagna *et al.* 2021, Maringer *et al.* 2021, Memoli *et al.* 2021). Argentiero *et al.* (2021) adopted a combination of methods to easily assess post-fire erosion and prevent potential risk in subsequent rain events. The model they presented is structured into three modules that were implemented in a GIS environment. The first module estimates fire severity with the Monitoring Trends in Burn Severity method; the second estimates runoff with rainfall depth–duration curves and the Soil Conservation Service Curve Number method; and the third estimates pre and post fire soil erosion.

Tedim *et al*. (2021) proposed a Translational Wildfire Science as a new field of knowledge that captures the comprehensive dynamics of wildfire events, providing relevant information accessible to practitioners and citizens, and facilitating the transfer of scientific knowledge into practice. In the framework of the European Innovation Action STRATEGY (http://strategy-project.eu/) the National Fire Corps proposed and supported the standardisation activities carried out within the CWA (CEN Workshop Agreement) on "Management of forest fire incidents – SITAC-based symbology" – https://www.cencenelec.eu/news-and-events/news/2022/workshop/2022-01-11-management-of-forest-fire-incidents-sitac-based-symbology/, which leverage on the SITAC (Standardization of Firefighting Tactical Situation Management) symbology, to propose the widespread, cross-border, cross-jurisdictional adoption of a common standardised symbology to support tactical management of forest fire response.

References

Ancillotto, L., Bosso, L., Conti, P., & Russo, D. (2021). Resilient responses by bats to a severe wildfire: conservation implications. Animal Conservation, 24(3), 470-481.

Argentiero, I., Ricci, G. F., Elia, M., D'Este, M., Giannico, V., Ronco, F. V., ... & Sanesi, G. (2021). Combining Methods to Estimate Post-Fire Soil Erosion Using Remote Sensing Data. Forests, 12(8), 1105.

Ascoli, D., Moris, J. V., Marco, M., & Lorenzo, S. (2021). Land use change towards forests and wooded land correlates with large and frequent wildfires in Italy. Annals of Silvicultural Research 46(2): 177-188.

Bacciu, V., Hatzaki, M., Karali, A., Cauchy, A., Giannakopoulos, C., Spano, D., & Briche, E. (2021). Investigating the climate-related risk of forest fires for Mediterranean Islands' blue economy. Sustainability, 13(18), 10004.

Castagna, J., Senatore, A., Bencardino, M., D'Amore, F., Sprovieri, F., Pirrone, N., & Mendicino, G. (2021). Multiscale assessment of the impact on air quality of an intense wildfire season in southern Italy. Science of The Total Environment, 761, 143271.

Comando Carabinieri per la Tutela Forestale - Nucleo Informativo Antincendio Boschivo . Analisi sul fenomeno incendi boschivi 2021. Roma, 2022.

D'Este, M., Elia, M., Giannico, V., Spano, G., Lafortezza, R., & Sanesi, G. 2021a. Machine Learning Techniques for Fine Dead Fuel Load Estimation Using Multi-Source Remote Sensing Data. Remote Sensing, 13(9), 1658.

D'Este, M., Giannico, V., Lafortezza, R., Sanesi, G., & Elia, M. (2021b). The wildland-urban interface map of Italy: A nationwide dataset for wildfire risk management. Data in brief, 38, 107427.

Fioravanti G., Fraschetti P., Lena F., Perconti W., Piervitali E. (ISPRA), Pavan V. (ARPAE). Gli indicatori del Clima in Italia nel 2021. ISPRA Stato dell'Ambiente 98/2022.

Maringer, J., Hacket-Pain, A., Ascoli, D., Garbarino, M., & Conedera, M. (2021). A new approach for modeling delayed fire-induced tree mortality. Ecosphere, 12(5), e03458.

Memoli, V., Santorufo, L., Panico, S. C., Barile, R., Di Natale, G., Trifuoggi, M., ... & Maisto, G. (2021). Stability of mediterranean burnt soils under different plant covers. Catena, 206, 105581.

Salis, M., Arca, B., Del Giudice, L., Palaiologou, P., Alcasena-Urdiroz, F., Ager, A., ... & Duce, P. (2021). Application of simulation modeling for wildfire exposure and transmission assessment in Sardinia, Italy. International Journal of Disaster Risk Reduction, 58, 102189.

Spano, G., Elia, M., Cappelluti, O., Colangelo, G., Giannico, V., D'Este, M., ... & Sanesi, G. (2021). Is Experience the Best Teacher? Knowledge, Perceptions, and Awareness of Wildfire Risk. International journal of environmental research and public health, 18(16), 8385.

Tedim, F., McCaffrey, S., Leone, V., Vazquez-Varela, C., Depietri, Y., Buergelt, P., & Lovreglio, R. (2021). Supporting a shift in wildfire management from fighting fires to thriving with fires: The need for translational wildfire science. Forest Policy and Economics, 131, 102565.

Vitolo, C., Di Giuseppe, F., Krzeminski, B., & San-Miguel-Ayanz, J. (2019). A 1980–2018 global fire danger re-analysis dataset for the Canadian Fire Weather Indices. Scientific data, 6(1), 1-10.

Photo credits:
National Fire Corps (C.N.VV.F.)
Lombardia region Forest Fire Fighting Volunteers

Sources: Comando Carabinieri per la Tutela Forestale - Nucleo Informativo Antincendio Boschivo; Italian National Fire Corps – Forest fire Fighting Service; Ministry of Agricoltural, Food and Forestry Policies- Directorate General for Mountain Economy and Forestry, Italy).

1.2.14 Latvia

Fire danger in the 2021 fire season

In 2021. the forest fire-fighting period was set from 26 April and lasted until 6th of September.

Fire occurrence and affected surfaces

Overall, in 2021 there was a relatively low fire risk. In the reporting year, 581 forest land fires were detected and extinguished, of which 503.82 ha of forest land was affected, including 110.75 ha of young stands. The biggest forest fire occurred on July 26, 2021 in the Riga regional forest district, Sigulda region, swamp Pemmes, as a result of which 174.15 ha of forest land was burned.

The average forest fire area in 2021 was 1.08 ha.

Table 25. Number of fires and burnt areas by month in 2021.

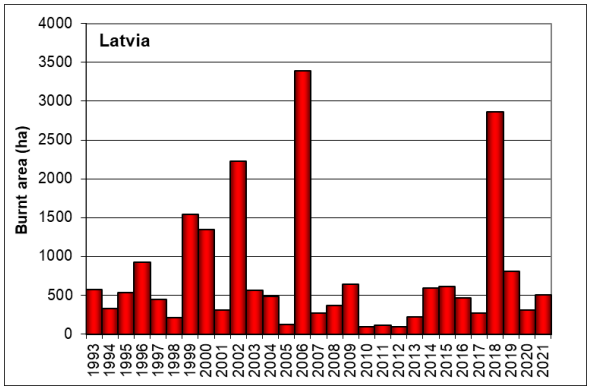
Month	Number of forest fires	Burnt area (ha)
January	3	0.0017
February	0	0
March	15	2.0926
April	127	199.6597
May	39	17.4178
June	72	23.8715
July	148	257.6898
August	15	0.8465
September	10	0.0137
October	13	2.2155
November	6	0.0068
December	0	0
Total	448	503.8156

Fire prevention measures in 2021 cost 111 830 Euro (Table 26).

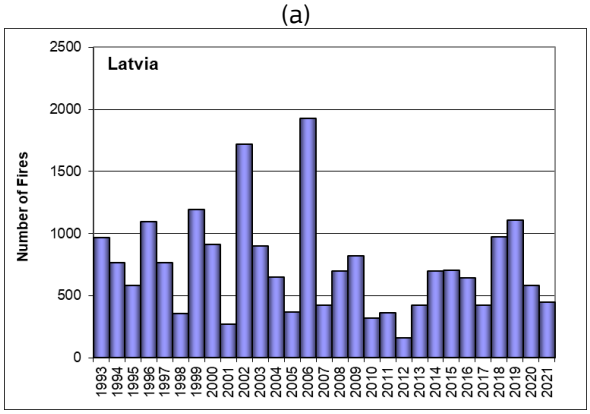
Table 26: Expenditure on fire prevention measures in Latvia in 2021.

Title	Costs, EUR
Latvian State forest	
Creating new fire breaks, 1 km	150
Existing fire break cultivation, 2978km	66002
Water point, warning sign renovation	45678
Total	111830
Riga City Forest	
Creating new fire breaks, 0 km	
Existing fire break cultivation, 548km	

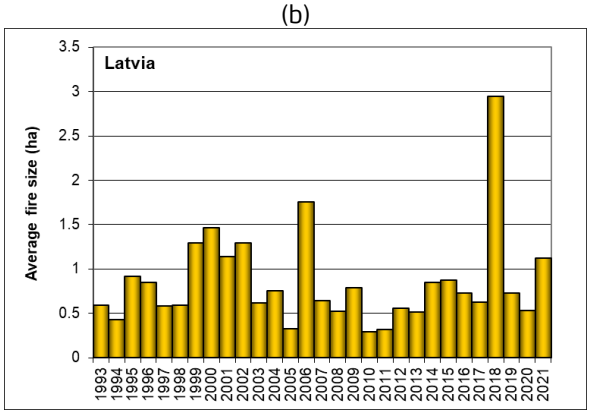
The yearly trends in terms of number of fires and burnt area during the last 28 years in Latvia are shown in Figure 60.



(a)



(b)



(c)

Figure 60. Burnt areas (a), number of fires (b) and average fire size (c) in Latvia from 1993 to 2021.

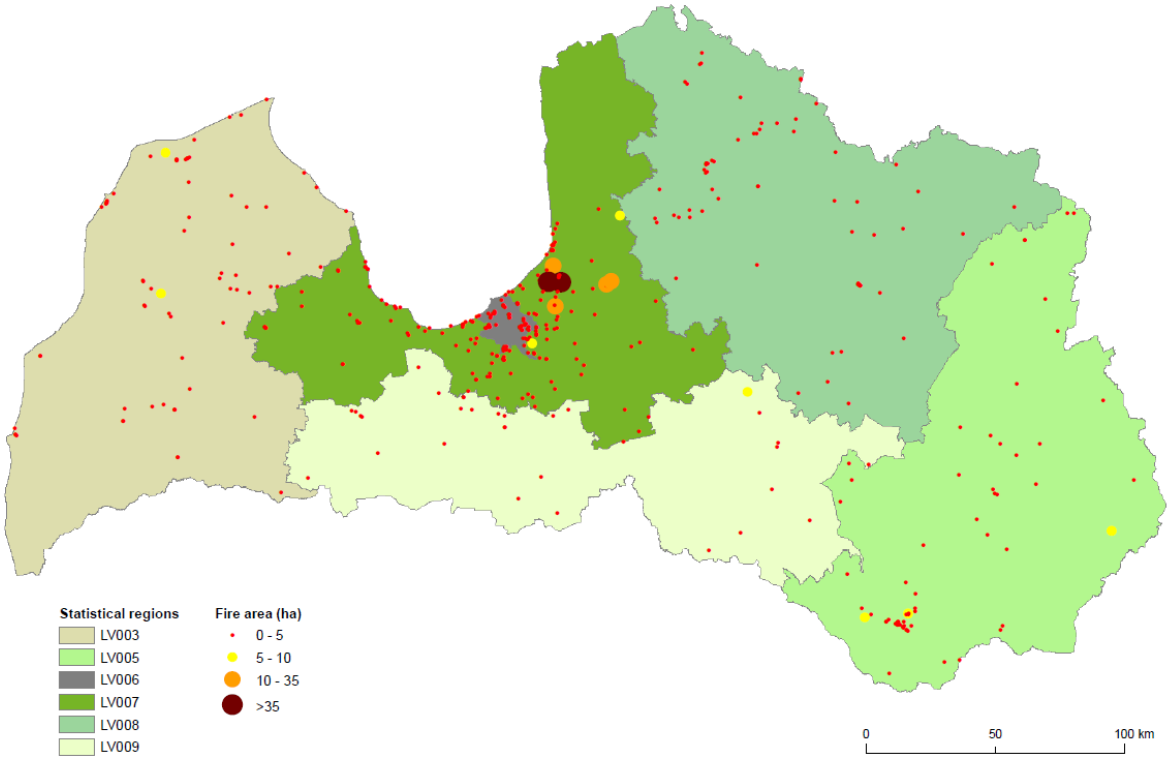


Figure 61. Map of forest fire locations in Latvia in 2021.

Preventive measures

The Service uses a network of fire observation towers (179 fire observation towers) to ensure fire protection. The State Forest Service has installed a Remote Fire Detection and Monitoring System (RFDMS) on 12 fire observation towers in the Riga Regional Forest, which has initiated activities. The system identified 179 sites, including forest fires (Figure 62).

In the summer of 2021, the Service provided jobs for seasonal employees in 308 positions (tower duty officers, drivers of specialized fire trucks, forest firefighters, forest fire station managers, operational duty officers).

New equipment

In 2021, the Service purchased 1 new Mercedes Benz UNIMOG 4023 forest fire truck. In total, the Service has 17 Mercedes Benz UNIMOG 4000 and 14 Mercedes Benz UNIMOG 4023 forest fire trucks to ensure the rapid detection, control and elimination of forest fires. The service also has at its disposal 85 Toyota Hilux SUVs equipped with extinguishing equipment. In 2021 5 new Polaris Ranger 1000 quad bikes were purchased.

Figure 62. Remote Fire Detection and Monitoring System.

(Source: State Forest Service, Environmental and Forest Protection Division, Latvia).

1.2.15 Lithuania

Fire danger in the 2021 fire season

The number of wildfires and the total burnt area was lower than in 2020, and was also lower than in the last decade. The first fire in 2021 was recorded in April, the last one in November. Fire danger during the fire season 2021 was characterized by high temperatures levels and high wind levels.

A heat wave in Lithuania occurred in May and July. The number of fires was influenced substantially by the weather conditions in spring and summer. The most notable forest fires for the 2021 season are listed below.

Table 27. Largest fires in Lithuania in 2021.

Date	Burnt area, ha
2021-06-10	4.04
2021-06-19	2.08

Fire occurrence and affected surfaces

In 2019, according to the data of the State Forest Enterprise, 46 forest fires occurred and damaged 11.01 ha of forest, of which State forest accounted for 10.01 ha and forest fires in private forests covered 1 ha. In 2021 only 2 forest fires were bigger than 1 ha, with a total burnt area over 6.12 ha. The highest number of forest fires occurred in July (45.65% of fires and 17.06 of burnt area).

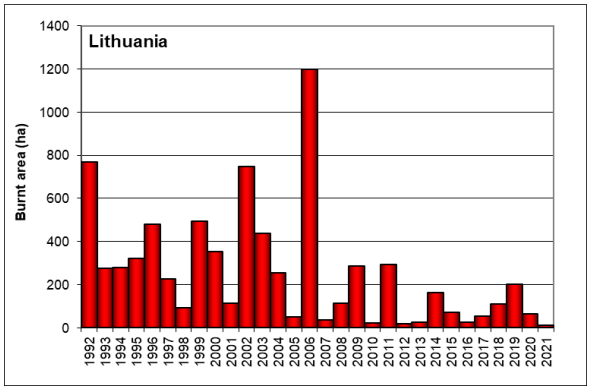
Fire Causes

In many cases, the ignition source for fires is associated with traditional agricultural burning practices, although the fire causes for the majority of fire incidents remained unknown. Fire departments of the regional units and forest officials have reportedly visited fire locations 168 times, according to reports of forest fires

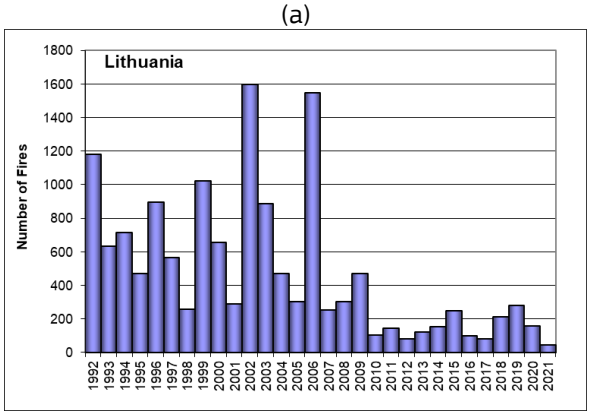
Economic costs

The total damage was estimated to be 9 344 euro.

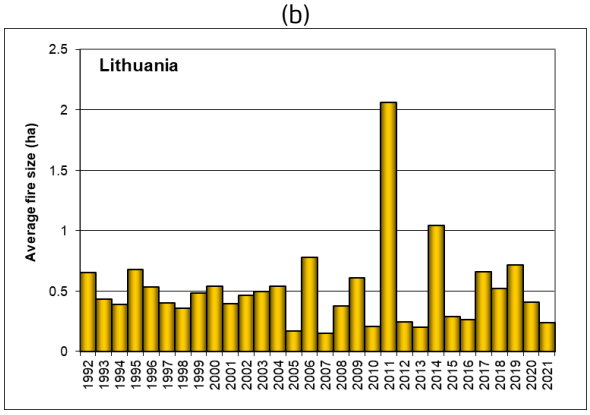
The yearly trends in terms of number of fires and burnt area during the last 30 years in Lithuania are shown in Figure 63.



(a)



(b)



(c)

Figure 63. Burnt areas (a), number of fires (b) and average fire size (c) in Lithuania from 1992 to 2021.

Fire prevention activities

The State Forests Enterprise organizes the establishment of a uniform system of state fire prevention protection measures. Contracts between Lithuanian Hydro meteorological Service and State Forests Enterprise are signed annually concerning calculations of complex forest fire figures and pronouncements of classes of fire rates in each territory of the state forest enterprise.

A Forest Fire Danger Map is updated daily (at 12 a.m.) from April to September and can be found on http://www.meteo.lt/lt/web/guest/misku-gaisringumo-klases-prognozes.

Every year state forest enterprises, together with Fire and Rescue Services and Armed Forces, organize educational training in the forest in order to check how organizations are able to organize forest fire extinction, manage difficult situations, control the actions, collaborate with each other and keep the connection.

In order to sustain the system of general state fire protection measures, state forest enterprises budgeted 4.20 million Euro from their own funds in 2021, and 12 167 km of firebreaks were mineralized.

Automatic early warning systems for forest fire prevention "Fire Watch" are used in the 25 regional divisions of State Forest Enterprise having forests with high fire risk (total 24 central stands and 84 detectors). Forest fire detection systems help to detect forest fire focus coordinates with better precision, so that the fire brigades can arrive at the fire faster and extinguish it more effectively.

In 2021 the State Forest Enterprise has acquired 7 Iveco Eurocargo heavy-duty forest fire trucks (2 m³ water capacity), 9 Autel EVO II drones, mobile forest fire extinguishers, protective sets of firefighter's clothing for members of the main and reserve fire brigades (1.1 thousand units).

Operations of mutual assistance and loss of human lives

No operations of mutual assistance were taken and no casualties were reported in Lithuania during the fire season of 2021.

Climate Change

The winter of 2020/2021 was colder than normal. Summer was much warmer than usual (1.9º anomaly) and this season was the hottest since 1961.

After the last three drier years, the average precipitation during the 2021 was close to the norm - 701 mm.

The driest month of the year was February - the precipitation was only 12 mm (28% of the standard climate norm). Less than 70% of precipitation fell in June, July and December. May was the wettest month during the year, and August ranked second wettest since 1961 (almost two monthly rainfall rates dropped).

21 natural and 1 catastrophic meteorological extremes and 13 hydrological extremes were recorded. Most of these events were observed in the summer and occurred locally. The sudden change of weather combined with heavy snowfall and wet snow cover on 25-27 January caused a lot of damage to the forests. The intense heat of 7-18 July caused drought in some parts in the north-west of the country.

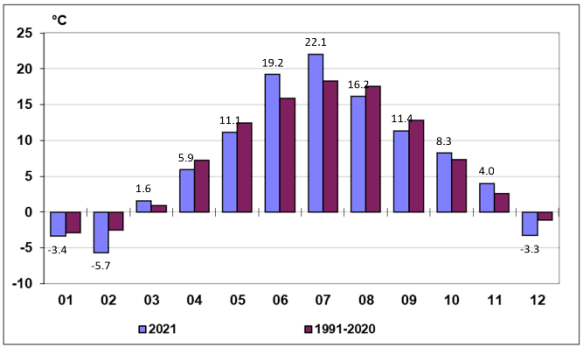


Figure 64. Average air temperature in the months of 2021 and the standard climate norm.

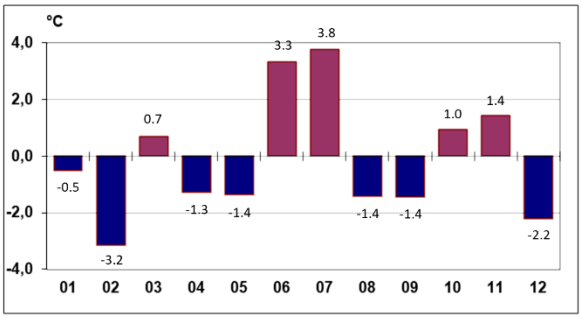


Figure 65. Deviation of the average air temperature from the standard climate norm for the months of 2021.

(Source: State Forest Enterprise, Forest Policy Group, Ministry of Environment, Republic of Lithuania).

1.2.16 The Netherlands

Fire danger in the 2021 fire season

The fire danger in 2021 was in general low. Unlike the previous three years, there were no (long) periods of drought. This wildfire season in The Netherlands was characterized as very mild, with no large wildfires and a total amount of fires that is far under the average of the period 2017-2020.

Fire occurrence and affected surfaces

In 2021, 212 wildfires were reported.

As outlined in the 2017 EFFIS report (San Ayanz *et al* 2018[1]), all wildfires are included in our count, regardless of their size or of the fuel type (forest, heathland, cropland, etc.) they burn in. This means that also fires of 10-100 m^2 are counted. As these (very) small fires cannot be readily identified using satellite analysis, the surface area of fires is estimated estimated from photo and video material, or in the field, although this is not systematically done for all fires. The estimated total affected surface in 2021 was 18 hectares, representing 81 out of 212 fires (38%). The remaining 131 fires that are not included in this surface area estimate are all very small (less than 0.1 hectare). With only 18 hectare, the total estimated surface area burned in 2021 is much lower than the average of 2017-2020.

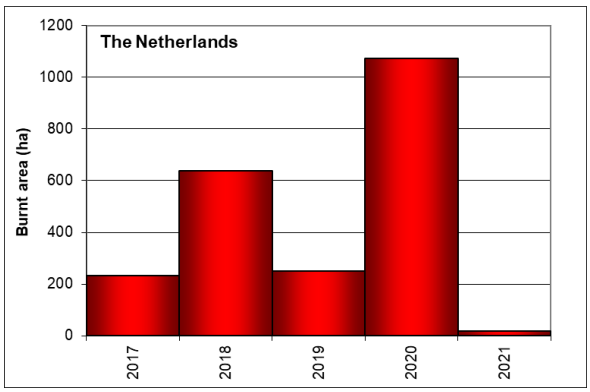
The vegetation type in which the fire occurred is registered for most larger fires (fires that exceed ~100 m^2) based on field observation, ground-based imagery and news reports. In 2021, 7 hectare (39 %) of the affected area was forest, 9 hectare (50%) was other non-wooded land (mostly heathland and peatland) and 2 hectare (11%) was agricultural land.

As written before, no large wildfires occurred in 2021 in The Netherlands. The largest fire, with an estimated surface of 4.4 hectares, occurred in the municipality of Breda. Also, the number of 'regular' fires at the military training sites was very low in 2021, with just 49 wildfires combined on both training sites.

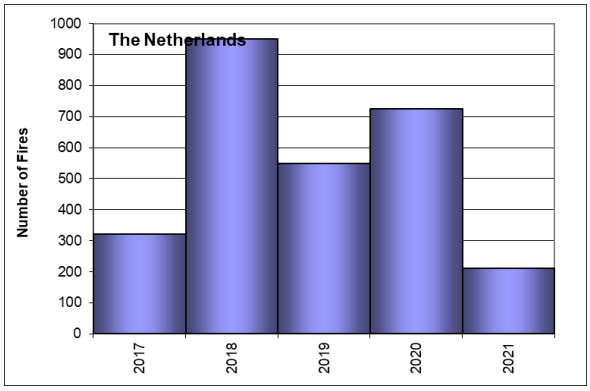
Figure 60 shows the total burnt area, number of fires and average fire size in The Netherlands for the last 5 years. Most of the fires occurred in the Spring (as is common in the Netherlands) (Figure 67).

Injuries and losses of human life

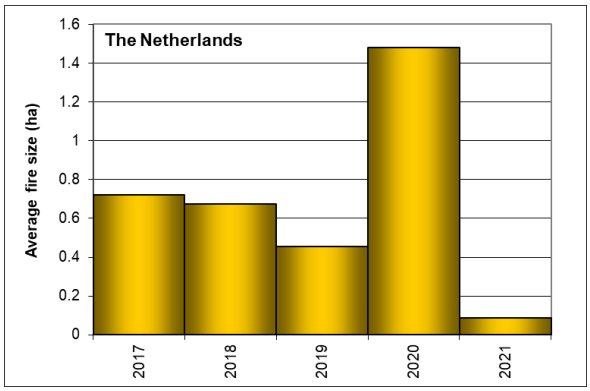
One fatal injury was reported. An elderly woman died during the escalation of a controlled burning of reed slash. The accident happened on 31 March 2021 near the village of Sint Jansklooster.



(a)



(b)



(c)

Figure 66. Burnt areas (a), number of fires (b) and average fire size (c) in The Netherlands from 2017 to 2021.

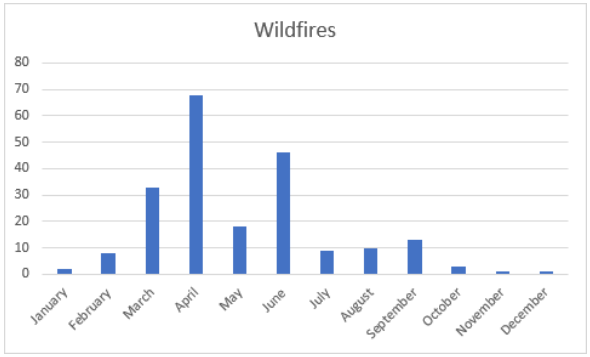


Figure 67. Monthly distribution of numbers of wildfires in 2021.

[1] https://effis.jrc.ec.europa.eu/reports-and-publications/annual-fire-reports

Figure 68. Burnt area during the Brecht-fire in Belgium, where mutual aid was provided by the Netherlands.

Fire causes

Fire cause investigation is not systematically done for wildfires in the Netherlands. The information available on fire cause is therefore based on four official fire cause investigations performed by the Wildfire Cause and Origin Investigation Team, of which three were in the Netherlands and one in Belgium (Brecht). These investigations resulted in one case where cause could not be identified, one cause due to a phosphorous grenade on military terrain, and one due to controlled reed burning. The Belgian case was identified as caused by shooting practice.

For all other 209 fires in the Netherlands, the cause was not investigated by the Wildfire Cause and Origin Investigation Team. In some cases the local fire investigators from the police or fire department did an assessment. For 125 fires (59% of total), the cause was not assessed or listed at all, while 87 fires (41% of total) were informally assessed. In 79 of these latter cases the cause was informally assessed and identified; in 8 cases the cause was informally assessed but uncertain. Most of the fires with an identified cause ignited due to the use of weapons (on military exercise sites, 50 of all fires) or by humans, mostly deliberate (17 of all fires).

Anecdotal evidence suggests that the number of fires ignited by natural causes (lightning) or due to working activities near vegetation (EFFIS classification 304 – 'Works') in the Netherlands is very small, with the far majority of fires caused by human behaviour (deliberate or accidental).

In 2021, the Netherlands Fire Service has started a database with a questionnaire for wildfires. Fire investigators and fire officers can put relevant information about fire causes and fire behaviour in this database, which is intended to serve as a way to obtain more information about the fires.

Fire fighting means

In 2020, approximately 416 engines were sent to extinguish the wildfires, with an average of 2 engines per fire. In addition, the suppression activities were supported by a total of 158 water trucks (with a capacity of at least 10 m^3).

At least 3 times, an Unmanned Aerial Vehicle from the Fire Department was used to make thermal images of the spread of the wildfires. The Wildfire Tactical Advisors were deployed once for a major wildfire just over the border in Belgium. The Fire Bucket Operations team was deployed twice: for the wildfire in Belgium and for a purely urban fire in a metal scrapyard. The Handcrew was not deployed for fire suppression in 2021.

Fire prevention activities and information campaigns

In 2020, the preparations for a new Wildfire Cause and Origin Investigation Course (FI 210) started. Due to the Covid pandemic, it was impossible to start this course in 2021. The new date of the course is foreseen in the spring of 2023. Meanwhile, over 80 candidates from various (Northwestern) European countries have indicated their interest in participating in this Wildfire Investigation Course. The aim is to start an international course, where participants can also exchange information about wildfire investigations in their own countries.

After the large fires in 2020, the team of Wildfire Tactical Advisors was expanded in 2021. At the start of the 2021 wildfire season, 9 Wildfire Tactical Advisors were trained and available for assistance in the whole country. Next to that, a trial has been started where these Wildfire Tactical Advisors are informed at an early stage during a wildfire, so they can prepare themselves in case the fire will grow larger. The Wildfire Tactical Advisors are trained in the use of the wildfire spread model and they do have more knowledge about firefighting capacities and wildfire tactics. The group has had a (digital) meeting with the team leader of the Wildfire Tactical Advisors in the UK to exchange information.

Operations of mutual assistance

The Netherlands Fire Service assisted during a major wildfire on a military site in Belgium with the Fire Bucket Operations (aerial means, in cooperation with the Ministry of Defence), wildfire tactical advisors and the wildfire cause and origin team.

Figure 69. Joint consultation during the Brecht-fire in Belgium.

Figure 70. Firefighters from the Netherlands Fire Service are joining a prescribed burn training in Catalonia.

Climate Change

According to the Dutch Royal Meteorological Institute (KNMI) 2021 was, after three very warm years, a normal year regarding the temperatures[1].

In 2021, there was an average of 1800 hours of sunshine (Table 28). The amount of precipitation in 2021 was average, but there was a big difference between the northern part of The Netherlands (939 mm in Leeuwarden) and the south(west)ern part (662 mm in Woensdrecht).

Table 28. Summary of weather conditions in 2021 (KNMI, 2021) for De Bilt (number of days), and national average (sunshine, rainfall). Source: https://www.knmi.nl/nederland-nu/klimatologie/maand-en-seizoensoverzichten/2021/jaar

Weather conditions	**Year 2021**	**Normal**
Ice days (max. temp. < 0°C)	**7**	8
Frost days (min. temp. < 0°C)	**50**	53
Warm days (max. temp. > 20°C)	**97**	93
Summer days (max. temp. > 25°C)	**20**	28
Tropical days (max. temp. > 30°C)	**1**	5
Hours of sunshine	**1800**	1774
Precipitation (mm)	**806**	795

National adaptation strategies

In The Netherlands, a project has been initiated to make sure that the country is prepared for the climate change in 2050.

This program is called the Deltaplan: where at first the Deltaplan has been focussing mainly on the risk of flooding, the plan now also takes into account other effects of the climate change, such as increasing drought (Kennisportaal Klimaatadaptatie, 2020). While there is interest in landscape fires, it is not on the agenda here.

Practical and applied research

In 2021, the renewal of the National Safety Strategy started. Wildfires is one of the themes in the category of natural disasters. Experts from a variety of organisations gave their opinion on a new wildfire-scenario that takes the climate change into account.

From the autumn of 2021, colleagues from the Netherlands Fire Service joined courses and exchanges in European countries with a lot more operational knowledge. This knowledge can be shared through the participants in their own fire brigades and teams in The Netherlands. One of the main objectives for 2022 is to organise more exchanges -with more colleagues who can join- so we can bring the experience and knowledge of other countries to The Netherlands.

Ongoing EU projects focused on improving fire management in the Netherlands are

- the PyroLife Innovative Training Network (Wageningen University, Stoof), PyroLife in which current Netherlands-focused PhD projects and associated Master studies consider 1) past, present and future fire danger; 2) ecosystem services and disservices, 3) fire behavior; 4) spatial design of fire resilient landscapes; 5) fire policy; 6) traditional fire knowledge and uses, and 7) lessons that can be learned from Dutch adaptive water management. The impact of the 2020 Deurnese Peel fire on soils peatland soil pH were published by Marcotte et al. (2022), in the International Journal of Wildland Fire.
- FIRE-RES, a GreenDeal project on integrated fire management with a Germany-Netherlands Living Lab (Wageningen University, Stoof & De Vries), focusing on governance, risk awareness, learning, amongst other things using serious games and multi-stakeholder assessments.
- SEMEDFIRE (Wageningen University, Stoof & De Vries), a newly funded project focusing on knowledge exchange for integrated fire management between Mediterranean and temperate European countries
- FireLinks COST Action (VU University, Veraverbeke as the Dutch representative), organized an international meeting in Arnhem, The Netherlands, early Summer 2021 to discuss fire modeling and interactions between various fire-related EU projects.

<u>Other academic research and student projects</u>

De Hoop *et al.* at the VU University Amsterdam published a multi-stakeholder analysis of fire risk reduction in a densely populated area in the Netherlands, focusing on a case-study in the Veluwe area. The article is available open access (https://iopscience.iop.org/article/10.1088/1748-9326/ac8b97/meta)

Also at the VU University, PhD student Shudong Zhang found that drought can enhance fire regimes in black pine (*Pinus nigra*) stands both directly and indirectly: directly by dry conditions promoting wildfire and indirectly by black pine succumbing to honey fungus (*Armillaria*) when weakened by drought episodes; and thereby its deadwood becoming more flammable than deadwood derived from healthy black pine stands. The publication is forthcoming.

(Source: Netherlands Institute for Public Safety, Netherlands Fire Service; Department of Environmental Sciences, Wageningen University, Netherlands).

[1]https://www.knmi.nl/over-het-knmi/nieuws/gemiddeld-normaal-2021-met-recordaantal-codes-oranje-en-rood

1.2.17 Norway

Fire danger in the 2021 fire season

Norway replaced the WBKZ-system with FWI (Fire Weather Index) in 2021, adapted to Norwegian conditions.

Weather parameters are air temperature, humidity, precipitation, wind and snow. For example, the forest fire risk index may increase either with the absence of precipitation or with increasing winds. Similarly, the risk of forest fires decreases with less wind and precipitation.

The fire season is normally from March to September. Still, there will be variations, since the country is 1 750 km from south to north and there may be flooding in one part of Norway while there is a high forest fire index another place.

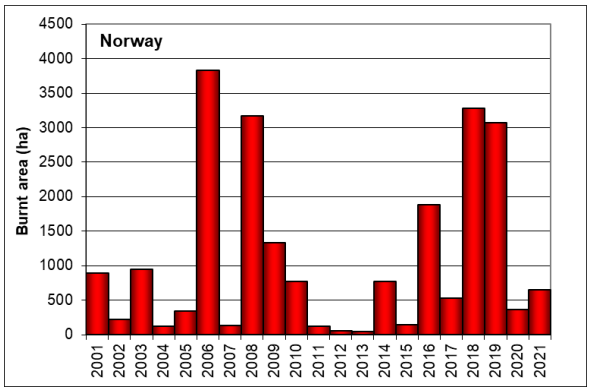
The fire season starts in the south-west in March-April and due the season it moves south and east. In the western part it is mainly brush fires. In the southern part it is fires in pines on poor soil that dries up quickly which are most common. The largest areas with forest are in the eastern part of Norway.

Overall, there has been a low average forest fire risk for the 2021 season. The period after snow melts and until new vegetation is green, it was a high risk for wildland fires. It was a period in the start of June where there was high fire risk in all parts of the country at the same time. There was also a period in September where the southern part of Norway had a high fire risk.

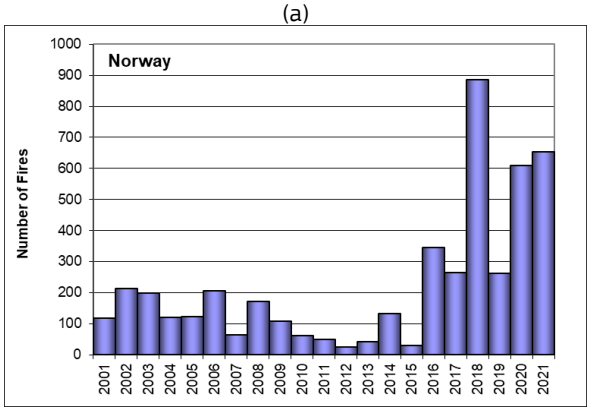
Fire occurrence and affected surfaces

In 2021 there were 653 forest fires recorded in Norway; 228 ha of productive forest and 425 ha of other wooded land.

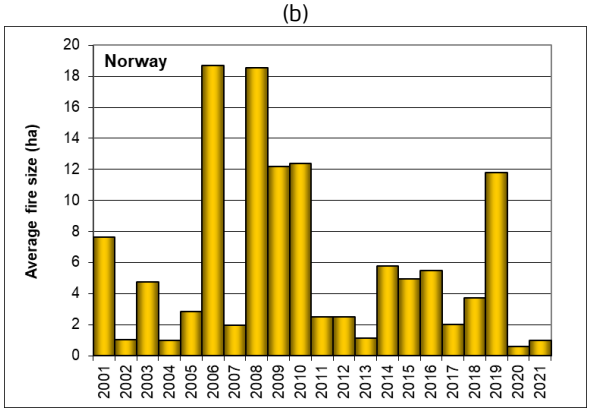
The trends regarding both the number of fires and burnt areas from 2001-2021 are shown in Figure 12.



(a)

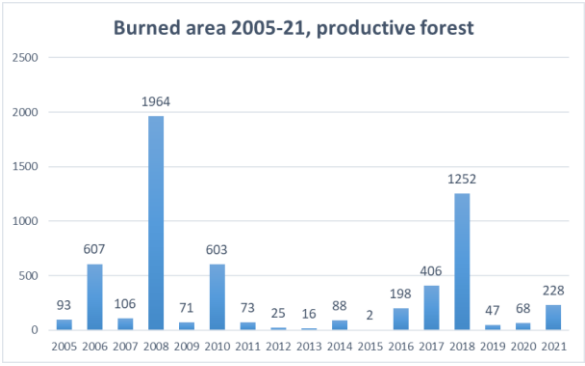


(b)



(c)

Figure 71. Burnt areas (a), number of fires (b) and average fire size (c) in Norway from 2001 to 2021.



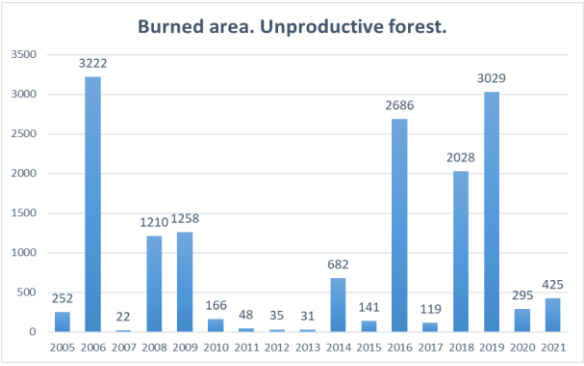


Figure 72. Burnt area of productive/unproductive forest in Norway 2005-2021.

Figure 73. At Øygarden close to Bergen (west of Norway) some buildings were ignited as consequences of wildland fires in the beginning of June. Photo: *Bergen Fire Service*.

Fire fighting means

The Directorate for Civil Protection has an agreement with a private helicopter company.

Normally, a helicopter is centrally located in the eastern part of Norway. Through the agreement it is possible to increase the number of helicopters and their location if the fire risk is high. The company has 8 locations in Norway and has agreements with other partners.

Helicopters are available for Fire Services in the period from 15 April to 15 September (24/7). For 2021, the helicopter(s) were used in 29 fires with approx. 215 hours in the air. Use of helicopter(s) for exercises was 20 hours.

The Directorate for Civil Protection has established an expert team that supports the local fire chief officer when large forest fires occur and when the helicopter is requested.

Norwegian fire services consist of 4 000 full-time and 8 000 part-time firefighters where the fire department is an all-risk service. For those municipalities that have significant forest fire risk, it is established groups only for fighting forest fires. These groups are managed by the fire services.

Fire causes

Mainly, forest fires are man-made. This can be children playing with fire, burning debris or grass, forestry etc.

The second largest cause of forest fires is lightning/thunderstorms. Fires can occur immediately, or there may be fires next day after the vegetation has dried.

Fire prevention activities and information campaigns

The municipalities are responsible for the Fire Services in Norway and the Fire Service is responsible for prevention and action regarding forest fires. Some activities are assigned to Governmental Authorities through the Directorate for Civil Protection.

Responsibilities: Directorate for Civil Protection:

- Establishment of frameworks for the population and Fire Services through laws and regulations. In Norway is it by law prohibited to use fires in the forest or wildland in the period from 15 April to 15 September.
- Following up and maintaining agreements with air resources and coordinate placement and numbers of helicopters.
- Following up and maintaining agreement with forest fire management support.
- Developing and maintaining the system for statistics reporting fires (BRIS).
- Facilitate Norwegian Forest Fire committee (Members represented: Directorate for Civil Protection, Fire Services, The Norwegian Meteorological Institute, Insurance, Aerial resources, and Fire Associations).
- Participate in a Nordic working group for wildland fires. The group is considering a rescEU-team. Mandate is given by the Ministry for each country for development of Nordic cooperation regarding overview of resources, sharing of resources and increased interoperability between the Nordic countries.

Responsibilities: Norwegian Meteorological Institute:

- Providing information on the forest fire index through the internet and providing information through television (Forecast) when the forest fire index is high.
- Participate in a Nordic working group developing a new common forest fire index.

Responsibilities: Fire Service, municipalities:

- Prevention: risk analysis, monitoring (air / plane), exercises / skills, information / campaigns and prescribed burning.
- Preparedness: handling the fires with focus on the fire potential (initial attack).

Figure 74. Haugaland fire and rescue

Figure 75. *Photo: Onar Walland*

Climate change

Climatic conditions and how they impacted the fire season

Climate change in Norway leads to higher air temperature and it is expected that there will be more precipitation, but also droughts due to increased temperature.

The consequences of this are increased growth in grass, shrubs and trees. This leads to overgrowing of cultural landscapes, a longer fire season and larger fires as a result of more fuel.

National adaptation strategies / plans and in particular regarding plans to adapt the forest sector to climate change in order to limit forest fire risks.

The Directorate for Civil Protection is still working with analysis to adapt the national preparedness to large forest fires. It will at a later stage be made a preventive analysis.

Research activities aimed at improving fire management

Project: Wildland-Urban Interface (WUI) Fire Risk
Period: January 2016 – December 2024
Owner: Western Norway University of Applied Sciences
Contact: Torgrim Log, prof.
Description: The goal of the project is to prevent devastating WUI fires in the *Calluna vulgaris* (heather) dominated Norwegian landscape. The project shall develop risk warnings and support civic groups working to reduce the WUI fire risk in coastal Norway.

Operations of mutual assistance

None.

Injuries and loss of human lives

None.

Figure 76. *Photo: Arjen Kraaijeveld*

Figure 77. *Photo: Arjen Kraaijeveld*

(Source: Directorate for Civil Protection (DSB), Norway).

1.2.18 Poland

Fire danger in the 2021 season

The meteorological conditions determined the forest fire danger risk trend in the year 2021 and favoured the occurrence of forest fires, especially at the beginning of the fire season. The diagrams (Figure 78 - Figure 82) show the variations of air temperatures, precipitation, pine (Pinus sylvestris L.) litter moisture, relative air humidity, and the national degree of forest fire danger risk (NDFFDR) in the 2021 fire season (April-September). They also present the number of fire outbreaks.

The mean monthly air temperature was 15.6°C at 9 a.m. and 20.1°C at 1 p.m. – they were lower in comparison to the mean temperature of the previous decade (2011-2020), which reached 15.8°C and 21.5°C respectively. In 2020 it was 15.8°C and 21.0°C respectively.

In April, the coldest month of the 2021 season, the mean temperature was 6.4°C at 9 a.m. and 10.8°C at 1 p.m. These temperatures were lower, in comparison to 2020 by 3.1°C at 9 a.m. and by 4.8°C at 1 p.m. In May the mean air temperature increased to 13.3°C at 9 a.m. and to 16.9°C at 1 p.m.

June and July were similar in terms of temperatures for both measurement dates, which reached 21.7°C and 21.9°C at 9 a.m. and 26.2°C and 26.4°C at 1 p.m. respectively. The warmest month of the 2021 season was July.

In September the air temperature dropped to 13.3°C at 9 a.m. and to 19.0°C at 1 p.m. The maximum mean air temperature occurred on June 19th at 1 p.m. and reached 33.7°C.

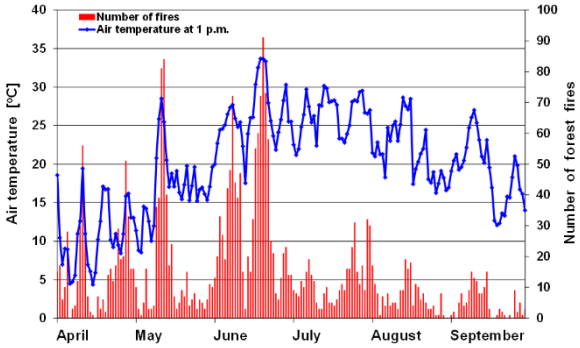


Figure 78. Air temperatures and numbers of forest fires in fire season 2021.

The mean daily precipitation in the 2021 season was 2.4 mm (0.2 mm more than in the 2020 season). For comparison, the mean daily rainfall in 2011-2020 reached 2.1 mm. The highest mean daily rainfall occurred in August, amounting to 4.1 mm/day. The maximum value of precipitation (20.1 mm/day) in the 2021 season was recorded on May 3rd.

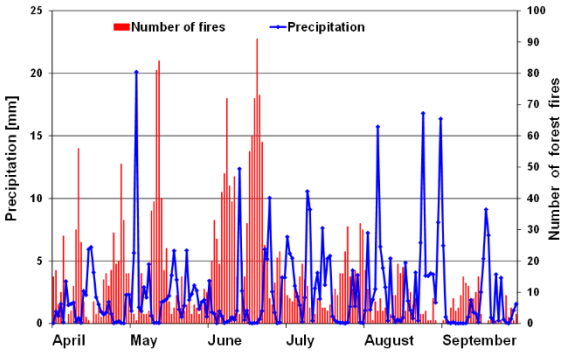


Figure 79. Precipitation and numbers of forest fires in fire season 2021.

Mean pine (*Pinus sylvestris* L.) litter moisture values (the reference fuel type for Poland's conditions), were 32.9% at 9 a.m. and 27.6% at 1 p.m., which was almost equal to and below the flammability threshold of 30% for dead ground cover. In the 2019 and 2020 seasons they reached respectively 27.1% and 22.1%, as well as 29.3% and 23.9%. For comparison the average from years 2011-2020 amounted to 30.6% and 25.1%. In June 2021 were recorded the lowest values (23.1% and 18.2%, respectively). In April, May, August and September) the litter moisture was above the mean values for the season 2021. The highest mean litter moisture occurred in August (37.5% at 9 a.m. and 32.2% at 1 p.m.), and in September (36.1% at 9 a.m. and 31.4% at 1 p.m.)

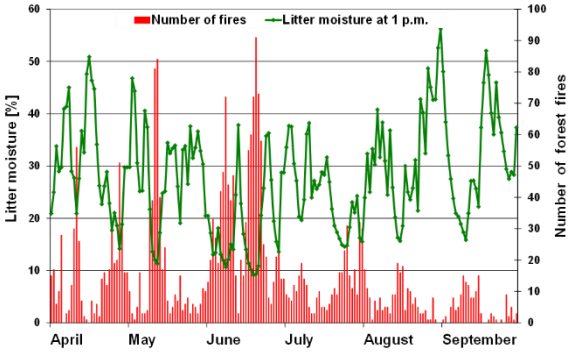


Figure 80. Litter moisture and numbers of forest fires in fire season 2021.

The average relative air humidity in the 2021 fire season reached 80.8% at 9 a.m. and 60.1% at 1 p.m. It was higher comparable to the values of the mean relative air humidity in the years 2011-2020 at 9 a.m. and at 1 p.m. (75.2% and 54.8% respectively). For comparison, in 2020 it was 76.8% and 54.1% respectively. The lowest values (below the average for the 2021 season) at 9 a.m. were recorded in June (66.8%), May (76.1%) and April (79.5%). The higher values, in the morning term of observation, occurred in July (80.9%), August (88.1%) and September (93.5%). In the afternoon, air humidity was significantly below the average for the 2021 fire season in June (48.4%), April (58.2%) and May (59.6%). The highest afternoon values of relative air humidity occurred in September (67.4%) and August (66.8%).

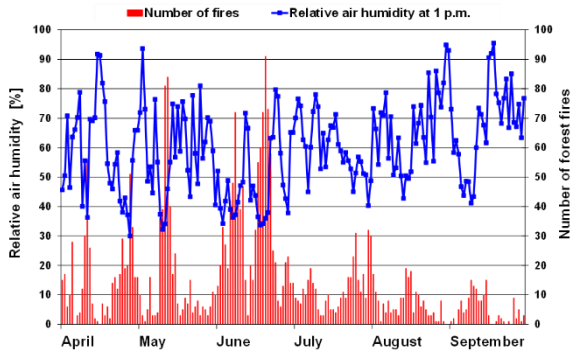


Figure 81. Relative air humidity and numbers of forest fires in fire season 2021.

The average national degree of forest fire danger (NDFFDR) in the four-degree scale (0, 1, 2, and 3) reached 0.9 at 9 a.m. and 1.0 at 1 p.m. It was a little lower in comparison to the 2020 season, when it was 1.2 and 1.3 respectively. This means that the fire danger in the whole analysed period was low.

The greatest forest fire danger appeared in June, when NDFFDR reached 1.5 at 9 a.m., and 1.8 at 1 p.m. In May NDFFDR reached 1.0 and 0.9 respectively.

The percentage of occurrence in the third level of forest fire danger in the afternoon was 24.9% in June, 8.7% in April and 7.9% in May. The lowest forest fire danger was in September, when NDFFDR reached 0.5 at 9 a.m. and 0.6 at 1 p.m., and the percentage of occurrence in the third level of forest fire danger was 0.0 in the morning, and only 0.7%.in the afternoon.

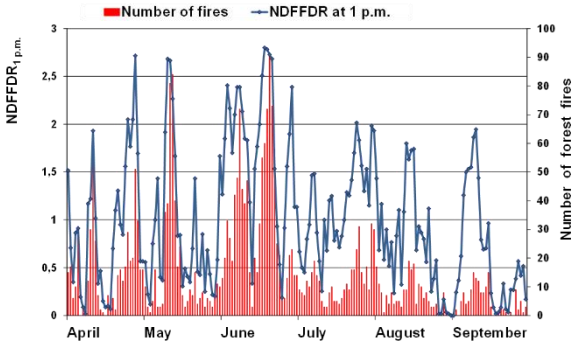


Figure 82. The National Degree of Forest Fire Danger Risk and numbers of forest fires in fire season 2021.

Fire occurrence and affected surfaces

In 2021 in Poland, a total of 3 295 fires broke out (2 243 in forest and 1 052 in other non-wooded natural land), over 3 332 less than in 2020 (6 627 fires), with a surface area of 893.74 ha (575.42 forest and 318.32 ha other non-wooded natural land), over 7 522.90 ha less than in the last year (8 416.64 ha) - Table 29 and Figure 85.

The greatest proportion of fires occurred in June (31.23%; i.e. 1 029) – Figure 83. This was followed by May (14.39%) and April (14.02%). The lowest number of fires in the fire season (April-September) occurred in September (4.43%) and August (6.34%). 82.06% of fires occurred in the fire season.

The largest number of fires in 2021, similar to last year, occurred in Mazowieckie Province (689 - 20.91%). The lowest number of forest fires occurred in Opolskie Province (51) and Warmińsko-mazurskie Province (67). These data are illustrated in Figure 86-Figure 88.

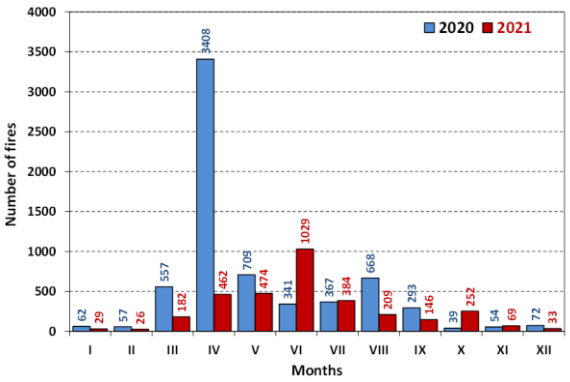


Figure 83. Distribution of number of forest fires by months in 2020 and 2021 in Poland.

The largest burnt forest areas and other non-wooded natural land were recorded in:

- Pomorskie Province (190.23 ha),
- Mazowieckie Province (175.32 ha),
- Warmińsko-Mazurskie Province (98.10 ha).

The smallest area was in Opolskie Province (7.39 ha) and Podlaskie Province (9.73 ha).

Small fires; i.e. with a surface area of less than or equal to 1 ha, represented 96.60% of all the fires in 2021 (Figure 84), with the burnt area amounting to 36.69%.

Fires with a surface area of between 1 ha and 10 ha represented 32.40% of the burnt area, with their number representing only 3.19%.

In addition, there were 6 large fires (>10 and ≤100 ha) represented 14.13% of the burnt area, and 1 very large (>100 ha) represented 16.78% of the burnt area.

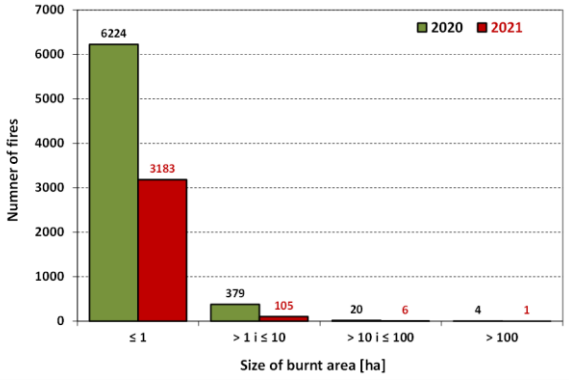


Figure 84. Distribution of the number of forest fires by size of burnt area in the years 2020 and 2021 in Poland.

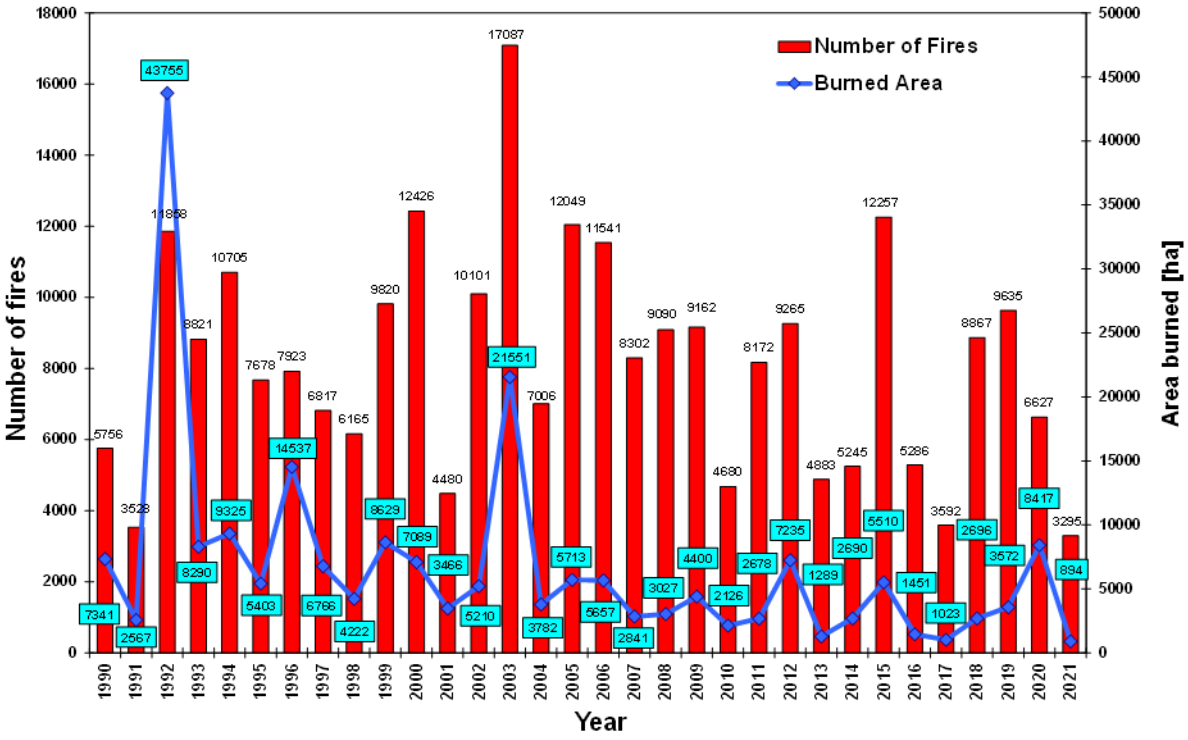


Figure 85. Total number of fires on high forest and area burned in Poland in the period 1990-2021.

Table 29. Forest fires in Poland in the period 2007-2021.

Year	Number of fires			Burnt area (ha)		
	Forest	Non wooded	Total	Forest	Non wooded	Total
2007	5 086	3 216	8 302	1 642.64	1 198.24	2 840.88
2008	5 568	3 522	9 090	1 810.74	1 216.39	3 027.13
2009	5 633	3 529	9 162	2 524.58	1 875.90	4 400.48
2010	2 975	1 705	4 680	1 358.26	767.98	2 126.24
2011	5 126	3 046	8 172	1 526.11	1 151.66	2 677.77
2012	5 752	3 513	9 265	4 781.65	2 453.62	7 235.27
2013	3 168	1 715	4 883	810.42	478.12	1 288.54
2014	3 603	1 642	5 245	1 956.90	733.55	2 690.45
2015	8 292	3 965	12 257	3 765.87	1 744.03	5 509.90
2016	3 545	1 741	5 286	862.37	588.68	1 451.05
2017	2 334	1 258	3 592	692.73	329.80	1 022.53
2018	5 947	2 920	8 867	2 047.26	648.87	2 696.13
2019	6 532	3 103	9 635	2 340.74	1 231.73	3 572.47
2020	4 458	2 169	6 627	1 842.34	6 574.30	8 416.64
2021	2 243	1 052	3 295	575.42	318.32	893.74

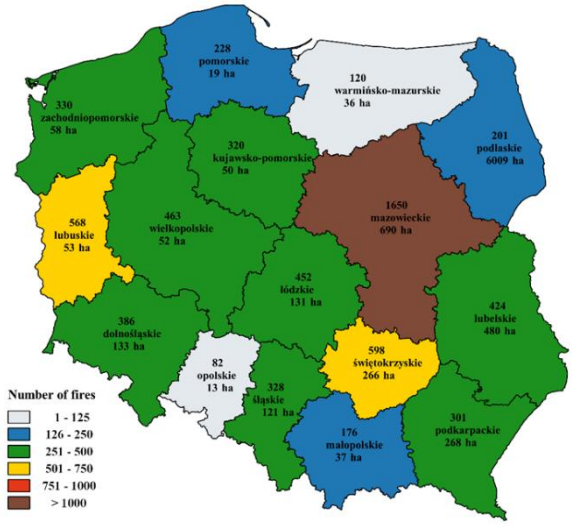


Figure 86. Number of forest fires and burned areas by provinces (NUTS2) in 2020.

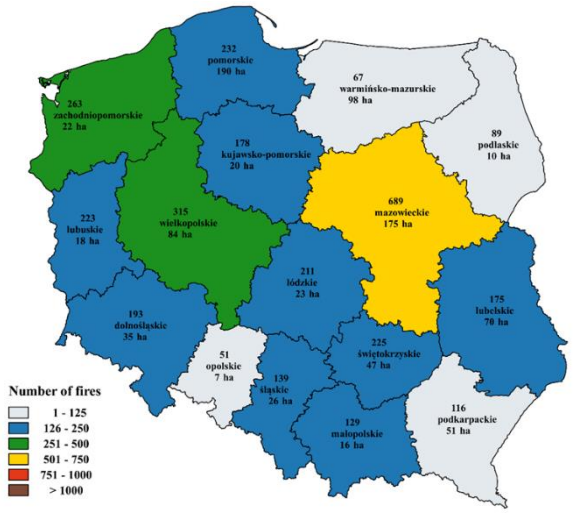


Figure 87. Number of forest fires and burned areas by provinces (NUTS2) in 2021.

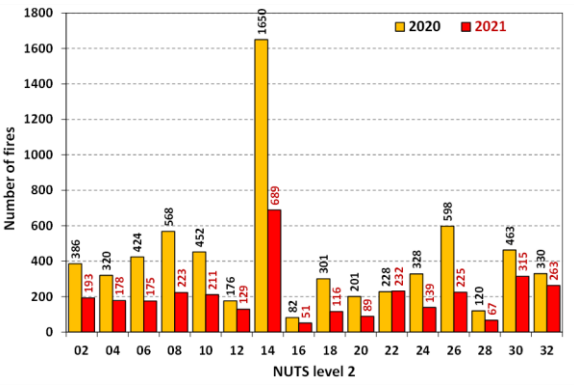
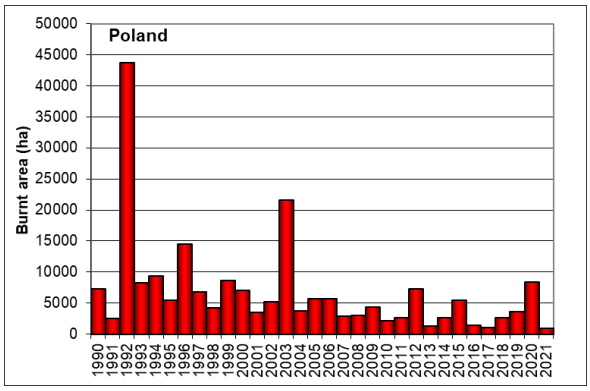
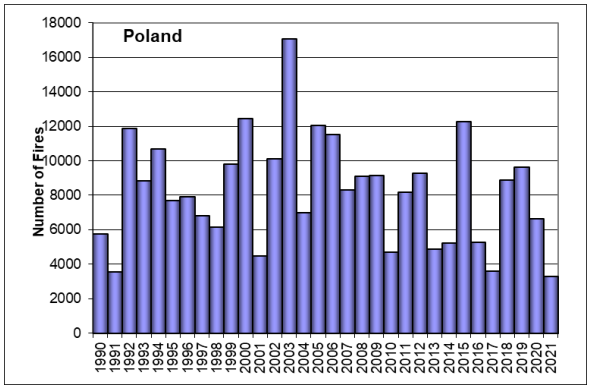


Figure 88. Distribution of the number of forest fires by province (NUTS2) in 2020 and 2021 in Poland.

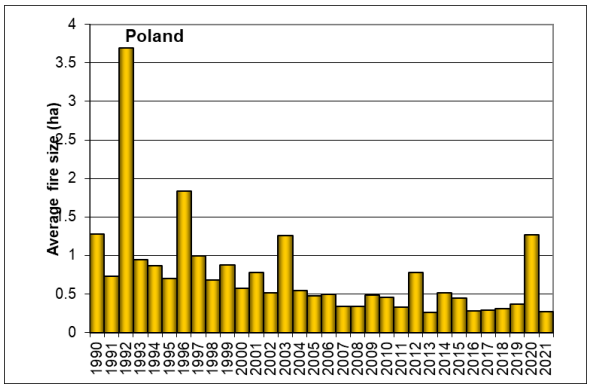
The burnt area, number of fires and average fire size for the years 1990-2021 are shown in Figure 89.



(a)



(b)



(c)

Figure 89. Burnt areas (a), number of fires (b) and average fire size (c) in Poland from 1990 to 2021.

Fire causes

Human activity was the main cause of forest fires; specifically arson represented almost half of the fires (41.67%), followed by negligence (26.19%) and accident (6.10%), whereas unknown causes accounted for 25.28% (Figure 90).

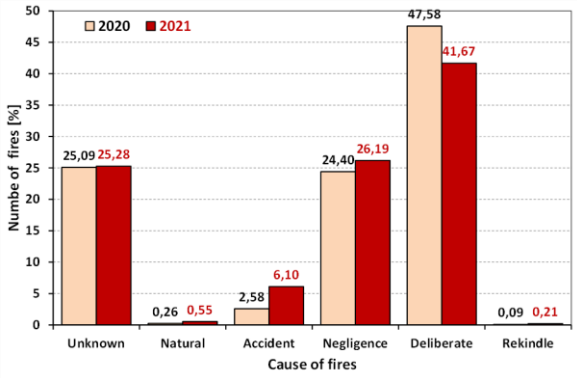


Figure 90. Distribution of the number of forest fires by causes in 2020 and 2021 in Poland.

Fire fighting means and information campaigns

The "State Forests" National Forest Holding (State Forests NFH) had equipment at its disposal consisting of:

- 31 fire suppression airplanes and 6 helicopters,
- 333 patrol and fire suppression vehicles,
- 4 medium and 3 heavy vehicles,
- 257 portable pumps, including 171 floating ones.

These means were used to extinguish 6% of all the fires in the areas managed by the State Forests NFH, whereas the other fires were suppressed by units of the State Fire Service and voluntary fire brigades.

In 2021, as part of information and promotion activities, the following measures in the State Forests NFH were taken:

- about 4 400 lectures in schools, youth camps and at country-meetings,
- 430 interviews were provided on the radio and the television,
- 47 500 posters, information leaflets and calendars related to forest fires were disseminated,
- 2 578 information boards were erected.

Fire prevention activities

In forest areas managed by the State Forests NFH, works were carried out to prevent the conditions for fire outbreaks and to reduce their spread, by repairing 3 735 km of fuel breaks and building 39 km of new fuel breaks; in addition, forests were cleaned over a surface area of 14 920 ha, by reducing the quantity of inflammable biomass.

The observation system of the State Forests NFH consisted of:

- 705 fire protection lookout points, including 320 (45.39 %) equipped with a system of TV cameras;
- 6 patrol airplanes, 31 fire suppression airplanes and 6 helicopters;
- 333 ground light patrol vehicles, including 329 with suppression modules.

The effectiveness rate of fire detection by fire protection lookout points was 29%, airplanes detected 2% of fires and civilians notified of 63%. The other 6% of fires were detected by fire protection patrols.

The communication and alarm network in the State Forests NFH consisted of: 5 922 radio-telephones, including 984 base sets, 2 079 mobile sets and 2 859 hand held sets, as well as 79 converters to the frequency band used by the State Fire Service.

Water supply for fire suppression purposes was provided by 11.4 thousand water supply points, including 4.1 thousand natural points and 2.6 thousand artificial ones. Moreover, water was supplied by more than 4.7 thousand hydrants located in the vicinity of forests.

In 2021, the fire protection costs incurred by the State Forests NFH amounted to 101.150 million PLN, including 27.662 million PLN for fire aviation.

Information on Poland's National Forest Fire Information System can be found on: https://bazapozarow.ibles.pl.

Poland's Forest Fire Danger Map, which is updated daily from March to October (at 9 a.m. and at 1 p.m.), is shown on http://bazapozarow.ibles.pl/zagrozenie/

(Source: Forest Research Institute, Forest Fire Protection Department, Poland).

1.2.19 Portugal

Fire danger in the 2021 fire season

The annual fire hazard maps are produced every year by the Portuguese nature conservation and forest services (Institute for Nature Conservation and Forests) in the beginning of each year. The 2021 fire hazard map (Figure 91) showed the Portuguese mainland regions that were predicted as most exposed to wildfires.

This map contains not only the wildfire hazard scaled from 1 to 5 for each 25 metre pixel, but also the delimitation of rural areas that, cumulatively: i) have 500 hectares or more, ii) have a high or very high wildfire hazard (top two classes) and iii) did not burn in the last 10 years. These are the most critical areas regarding fire danger and are mainly located at the Centre-North Interior and southern regions.

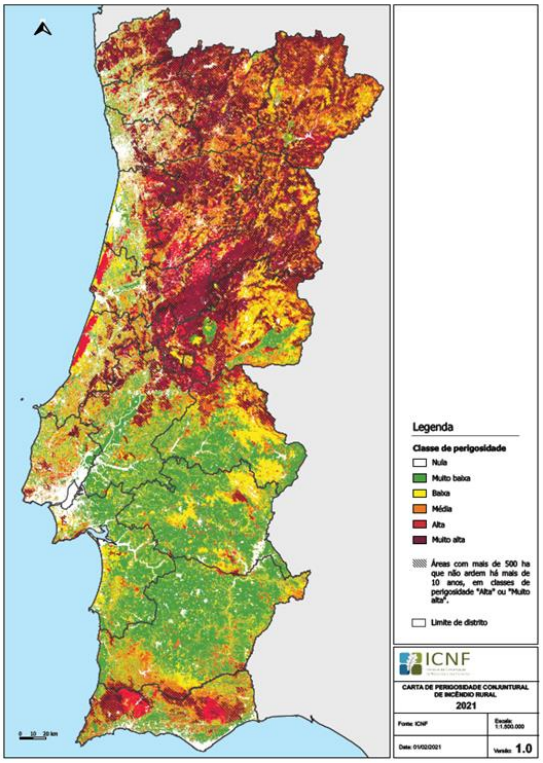


Figure 91. 2021 fire hazard map.

A local and daily wildfire danger evaluation is published for each of the 278 municipalities of Portuguese mainland territory (Figure 92) by the Portuguese meteorological services *(Instituto Português do Mar e da Atmosfera*). This evaluation combines the annual wildfire hazard map (Figure 91) with the meteorological forecast for each day (FWI index).

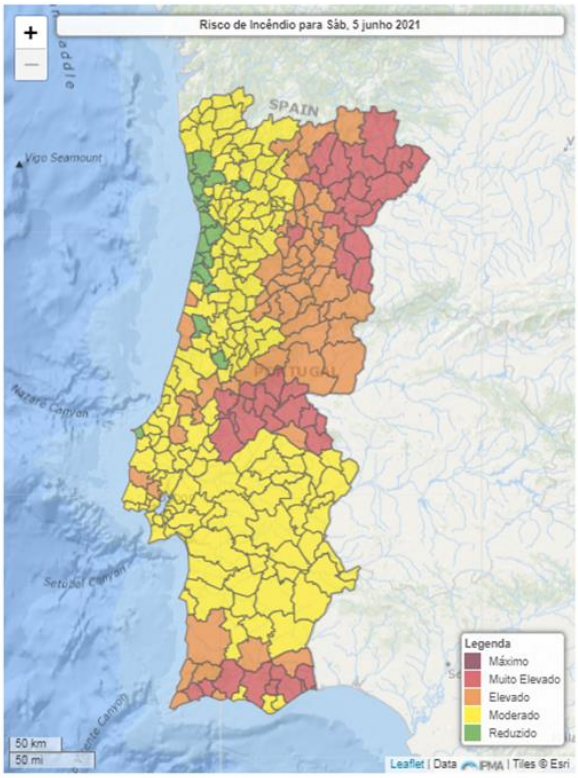


Figure 92. Example of evaluation of the daily wildfire danger (5th of June).

The 2021 Daily Severity Rating index (DSR) for the Portuguese mainland Territory can be assessed in Figure 93. The figure shows that 2021 was a year with a meteorological severity below average when compared with the previous decade (2011-2020).

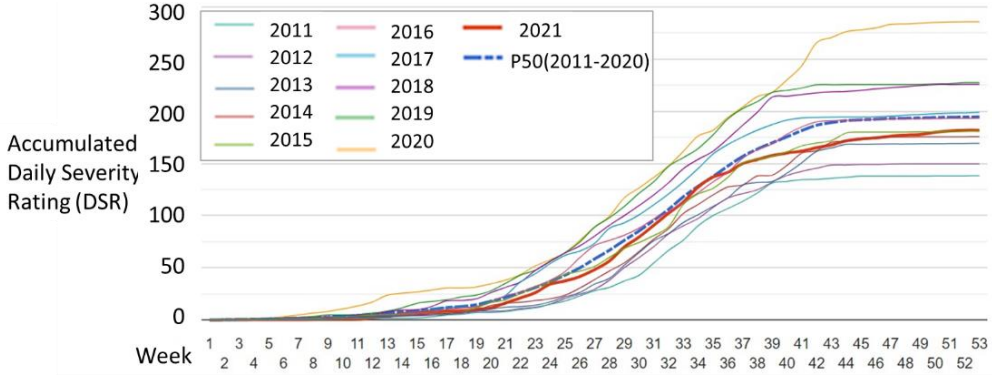


Figure 93 . Daily average accumulated DSR index for the Portuguese mainland Territory.

Fire occurrence and affected surfaces

In Portuguese mainland territory (NUTS 1 PT1) the burnt area in 2021 was 28 360 ha (Table 30). The burnt area represents 22% of the average of the previous decade, which was 130 706 ha. The biggest fire in 2021 occurred at the southern region of Algarve and resulted in 6.6 thousand hectares burned (Figure 94).

Regarding the number of wildfires, there was in 2021 a total of 8 186 fires which represents a decrease of 54% when compared to the average of fires in the last decade and a decrease of 15% compared with 2020 (Table 30).

Table 30. Number of wildfires and burnt area in Portugal mainland territory from 2011 to 2021.

Year	Number of wildfires	Burnt area (ha)
2011	29 782	77 104
2012	25 352	117 985
2013	23 129	160 387
2014	9 388	22 820
2015	19 643	67 200
2016	16 104	167 808
2017	21 006	539 921
2018	12 273	44 578
2019	10 832	42 085
2020	9 619	67 170
Annual average 2011-2020	17 713	130 706
2021	**8 186**	**28 360**

In Madeira's archipelago (PT3), 44 wildfires were recorded in 2021. The total burnt area in this region was 72 ha (46 ha in forest and other wooded lands and 26 ha in shrublands).

In the Azores archipelago (PT2) a total of 162 wildfires were recorded in 2021. The total burnt area in the Azores was not collected, but it is rather small when comparing to Madeira or Mainland territories.

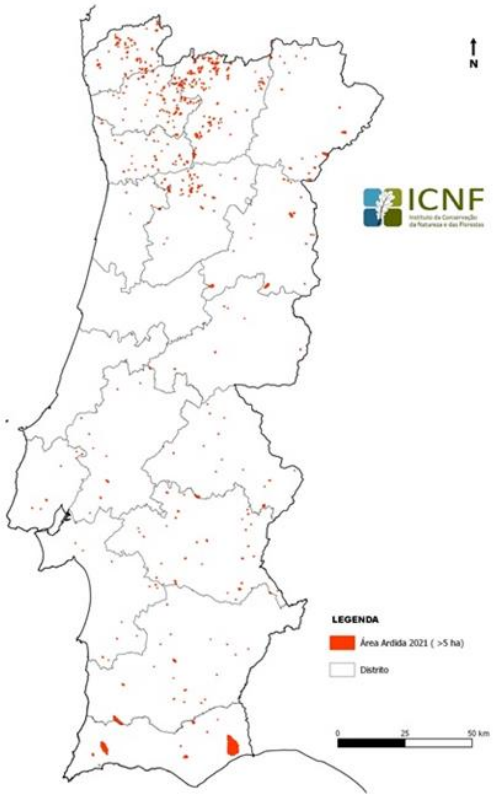


Figure 94. Burnt areas in 2021 in Portuguese Mainland territory.

The most affected region in 2021 was the North Region with a total burnt area around 12 thousand hectares. This region's burnt area represents 42% of the total burnt area (Table 32).

Around 36% of the total number of fires in 2021 occurred in July and August (Table 31). Wildfires in these two summer months represent around 51% of the 2021 total burnt area.

Table 31. Wildfires in Portugal Mainland (monthly distribution)

Month	Number of fires	Burnt area (ha)			
		Forest and other wooded land	Shrublands	Agricultural land	Total
January	213	153	1913	7	2073
February	39	7	65	1	72
March	1281	1481	5111	38	6630
April	459	186	436	11	633
May	595	90	187	131	408
June	960	523	384	577	1484
July	1343	1610	1979	803	4393
August	1569	3848	5080	1234	10162
September	649	166	602	94	862
October	622	31	494	102	627
November	352	48	780	23	850
December	104	16	141	8	165
TOTAL	**8186**	**8158**	**17172**	**3030**	**28360**

Table 32. Number of fires and burnt areas in Portugal in 2021 (NUTS2).

PT1 - NUTS 2 Region	Number of fires	Burnt area (ha)			
		Forest and other wooded land	Shrublands	Agricultural land	Total
North	4146	2113	9695	150	11957
Centre	1832	901	1953	269	3123
Lisbon	809	22	166	74	262
Alentejo	1100	1915	466	1360	3741
Algarve	299	3207	4893	1177	9277
TOTAL	**8186**	**8158**	**17172**	**3030**	**28360**

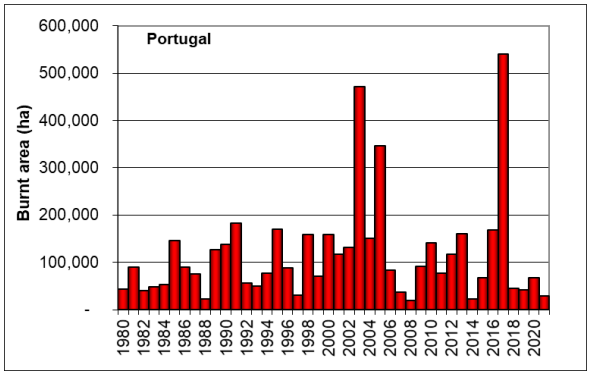
Within an analysis approach that seeks to remove the effect of meteorology in the assessment of the annual burnt area extension, each rural fire in 2021 was assigned a "weighted burnt area" value, obtained from the average of the burnt area of all fires (for the decade 2011-2020) of the respective DSR class in the respective district. As a result, a total value of "weighted burnt area" (for the year 2021) of 39 363 hectares was estimated. This value reflects the total burned area that would be obtained if all fires from 2021 followed the historical average "behaviour" given the meteorological severity of the day/place in which they occurred.

The actual burnt area value (28 360 ha) corresponds to 72% of the "weighted burnt area", which means that the burnt area in the year 2021 is considerably less than the "expected" burnt area, taking into account the verified meteorological severity.

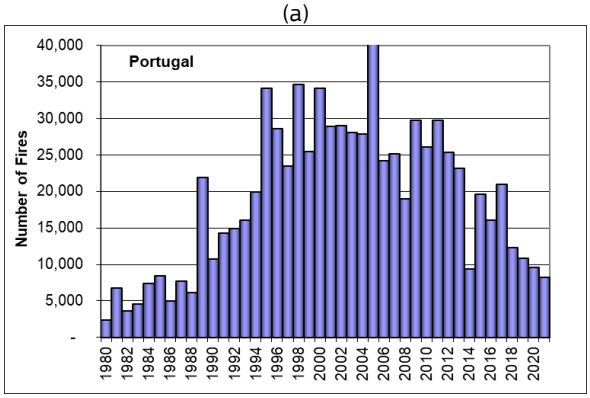
Among those fires with determined cause, intentional acts corresponded to 26% and accidents or negligence were present in the ignition of 68% of the total number of fires (Figure 97). The use of fire for renewal of pastures in mountain grazing still has a strong impact on the burnt areas total.

In 2021 the ICNF-managed application for fire permits allowed a more controlled use of fire, not only regarding fire risk, but also enabling a better preparedness of local authorities and fire management agencies, with a maximum of 13 606 permits processed in just one day (on March 8th) in a total of 1 120 092 in the year.

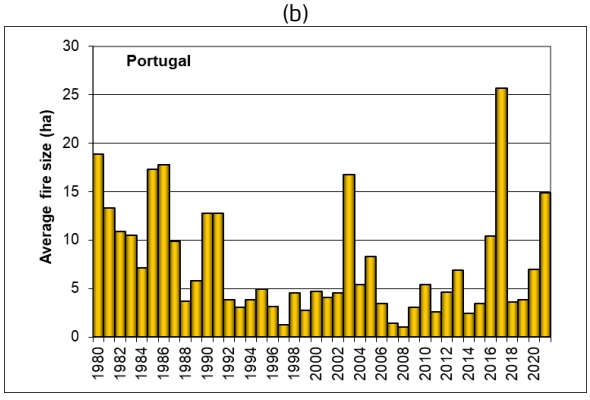
The yearly trends in the number of fires and burnt areas in Portugal is shown in Figure 95.



(a)



(b)



(c)

Figure 95. Burnt areas (a), number of fires (b) and average fire size (c) in Portugal 1980-2021.

Fire causes

Of the 8 186 occurrences registered in 2021, the National Guard proceeded with the investigation of causes for 7 940 forest fires (97%), of which 584 were of unknown origin (Figure 96).

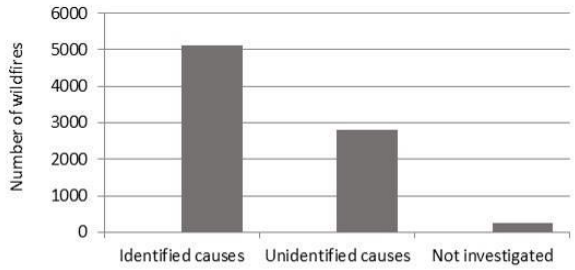


Figure 96. Wildfires 2021 causes investigation

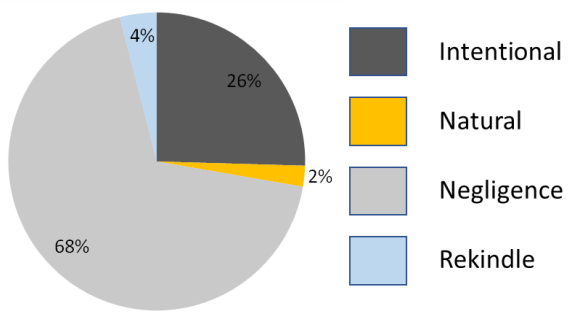


Figure 97. Main causes of rural fires 2021.

Fire fighting means

During the most critical phase of 2021 [July-September period], the Special Firefighting Devices (DECIF) expressed in the National Operational Directive (DON) No. 02/2021 integrated a total of 12 058 operational, 2 656 vehicles and 60 aerial firefighting resources. Although the aerial resources are not responsible for the suppression of forest fires, as these fires are fought on the ground through the use of land resources, their use in wildfire firefighting is essential for the area of rising fires and for reducing the intensity of the fronts of fire, making possible a faster and safer intervention of terrestrial resources.

The level of commitment of air resources was much less than in 2020, with a total of 3 895 missions and more than three thousand flight hours spent.

Fire prevention activities and information campaigns

Planning

In 2021, after a process of collaborative work and public consultation, the Government approved the National Action Program (PNA), which implements, in mainland Portugal, the strategic options defined in the National Integrated Rural Fire Management Plan (approved and published in June 2020); namely the programmes, projects and initiatives that materialize the four strategic guidelines: increase the value of rural areas; cherish the rural areas; modify behaviours; manage risk efficiently.

The National Plan's vision is "Protect Portugal from severe rural fires" and, despite the likely increase of the fire risk, the targets for the 2020-2030 planning horizon are:

- The loss of lives in fires, although possible, is rare;
- The ratio of fires extending across more than 500 ha is below 0.3% of the total number of fires;
- The cumulative burned area over a period of a decade is less than 660 000 ha (to be revised by 2023 to a figure that takes into account the loss of goods and services).

The PNA includes 97 projects with an overall budget of 7 000 million euros. Some of these projects break down into key projects at a regional and sub-regional level.

Also in 2021, the Integrated Rural Fire Management System (SGIFR) was approved. The SGIFR provides, at the national level, the macro-policies and strategic guidelines that contribute to reduce the danger and change the behaviour of the owners, users and direct and indirect beneficiaries of the rural territory, and establishes its operating rules.

With a logic of polycentric governance, at the end of 2021 the National Commission for the Integrated Rural Fire Management and other 4 regional and 2 sub-regional commissions were created, with the primary purpose of designing action programs for their jurisdictions.

There is a clear commitment to the definition of a model based on the prevention and minimization of risks, either through awareness-raising actions, or through the establishment of territorial defence networks, in which fuel management assumes a leading role with repercussions on the sanctioning regime.

Forest fuels management

Forest fuels management is one of the key-actions in the forest fire prevention domain. In 2021, a total area of 88 058 ha was managed. Almost 4 thousand hectares were managed with prescribed burning.

Figure 98. The Loriga Fire, which affected 348 ha of communal lands in the Serra da Estrela Natural Park in March 2021, had its right flank efficiently stopped by a recently implemented shaded fuelbreak. In 2021 7 336 ha of shaded fuelbreaks were created, mainly in mountain in the Norte and Centro regions of mainland Portugal.

Water reservoirs

During 2021, 716 water reservoirs (including water tanks) had maintenance and improvement works and 32 new water reservoirs were created.

Forest roads

In 2021, 4 055 kilometres of forest roads were created or under heavy maintenance.

"Portugal Chama" campaign

In 2021, the "*Portugal Chama*" ("Portugal is Calling") awareness campaign proceeded. Its main message is individual responsibility in order to promote, among citizens, more adequate behaviour and practices towards the reduction of the high number of ignitions and the increase of the territory resilience to fires.

It was a comprehensive nationwide campaign (mainly on TV, radio, printed press and social media); however, it focuses on the most relevant causes of rural fires, both in terms of the number of occurrences and in terms of the burnt area (heap burnings, renewal of pastures in mountain grazing areas, use of machinery and recreational activities and leisure in rural areas).

The acquisition of advertising space for spots and publication of advertisements took place between May 15th and ended on October 15th, 2021, during which the messages were communicated in 461 TV spots, 3 138 national radio spots, 14 636 regional radio spots and 251 printed press advertisements.

"Safe village – safe people "program

In 2021, the "Safe Village" and "Safe People" programs continued, jointly promoted with the municipalities and civil parishes, with the objective of establishing measures to protect people, goods and buildings in the urban-forest interface, as well as promoting awareness actions regarding risk behaviours and self-protection measures to be adopted. Within the scope of these programs since 2018, in 2021 there are already a total of 2 064 villages involved (1 537 with identified places of refuge/shelter), 1 920 local security officers designated and 835 evacuation plans prepared. In the context of raising awareness of populations and in the frame of process of modernizing the warning system, in particular when predicting the occurrence of high-severity weather episodes, a notification system was applied in collaboration with mobile operators by sending SMS messages. In the context of rural fires risk, on 15 of August, 2.5 million SMS were sent to the population of the districts at extreme risk.

Automatic daily emails service

The Portuguese nature conservation and forest services (Institute for Nature Conservation and Forests) provides an automatic daily email distribution service that provides useful information to all agents involved in wildfire prevention and suppression operations. Among the information that is daily spread within this service, two email types stand out:

- "*Locais críticos*" – This email provides the daily forest hazard information for the user's region, showing the places (list and map) where the fire hazard is expected to be worst. The fire hazard is estimated with an algorithm that combines meteorological forecast with structural fire hazard, local ignition and burnt area historical statistics, among other variables.
- "*Perigo de reacendimento*" – This email provides a list and map of the recently extinguished fires that are, simultaneously, more likely to rekindle and are expected to do more damage.

Assistance phone-line

During 2021, the official assistance phone line continued. Around 106 thousand calls were received from citizens, mainly to obtain information and help with the web application that analyses fire hazard and gives individual authorization to the use of fire in vegetation debris burning and pasture renewal. The official phone line also provides information on legislation of fuel management around houses and other structures in order to reduce the fire risk.

Burning permit

The burning permit application processed almost 1.2 million permits in 2021 and has around 544 thousand registered users. The permits are granted if the local weather forecast analysis shows that the burning can be executed in a safe way. This programme is considered to be a very important tool in reducing the number of fires (and burnt area) as burnings are one of the most significant causes of wildfire in Portugal.

Figure 99. Prescribed burning in the Natura 2000 site Fernão Ferro/Lagoa de Albufeira, in January 2021, as part of a wetland restoration project.

Injuries and loss of human life

Regarding the impact of fires on the loss of human lives, there is a downward trend after 2017, and in 2021 there were 6 fatalities, of which 2 were operational (2 firefighters in a road accident on the way to fire on 22/07/2021, in the district of Bragança, municipality of Vinhais) and 4 civilians resulting from the burning of agriculture vegetation or uncontrolled shrubland burning that caused uncontrolled fires, which is related to the majority of civilian casualties in the last 4 years.

Operations of mutual assistance

In 2021, under the bilateral agreement and in a cross border initial attack procedure, Spanish resources intervened in 8 fires near the border line, engaging 9 aerial means, 13 vehicles and 92 firefighters.

(Sources: Ministry of Environment and Climate Action, Institute for Nature Conservation and Forests (ICNF), SGIF/System for Forest Fire Information Management; Ministry of Internal Administration, National Authority for Emergency and Civil Protection (ANEPC); Ministry of the Presidency, Agency for Integrated Rural Fire Management (AGIF); Regional Government of the Azores, The Azores Regional Civil Protection and Fire Service; Regional Government of Madeira, Institute for Forests and Nature Conservation, Portugal).

1.2.20 Republic of North Macedonia

Fire danger in the 2021 fire season

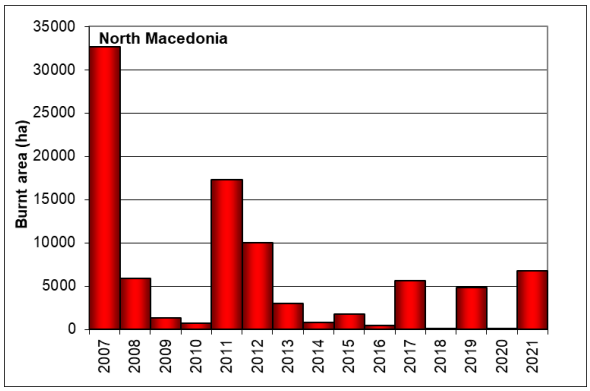
The forest fire season for 2021 in North Macedonia began with relatively high temperatures until the middle of the July, and especially in August. Moreover, June was characterized with unstable weather conditions that prevailed during certain periods of the month, with rain, local thunderstorms and hail. On the other hand, in the middle of July the weather was extremely hot with a daily maximum temperature of 40 degrees Celsius in the southern mainland of the country, and with high wind levels (22/07-25/07). The majority of fires occurred in the late spring and during the summer months. The summer of 2021 was hot and very dry over many regions, particularly in the east and south east region. The fire risk will remain extreme to very extreme in most of North Macedonia.

Fire occurrence and affected surfaces

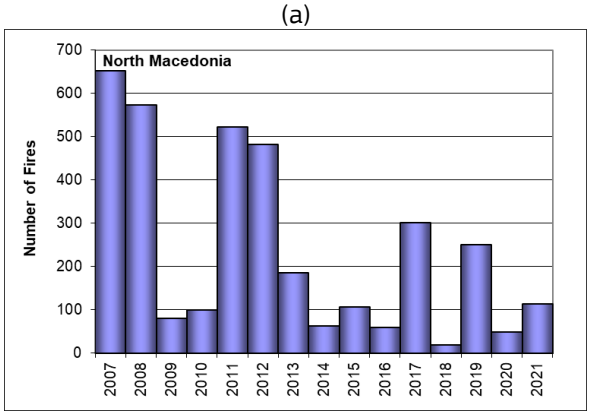
During the year 2021 there were 1 141 fires of which 113 were forest fires, affecting in total an area of 6 796.4 ha. The agricultural affected area was 1 905.1 ha and the total affected area was 8701.5 ha. 10% of the total numbers of fires were forest fires. The analysis of the preconditions, reasons and factors and factor leads to the conclusion that North Macedonia is region with a high risk of fires on its territory.

The damage is not only economical but on a much bigger scale-inestimable damage for plant conditions.

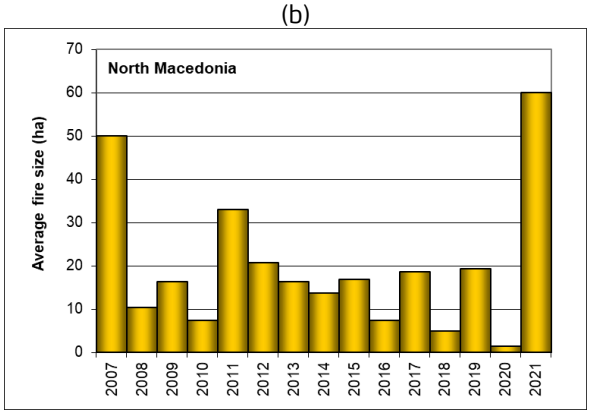
The burnt area, number of fires and average fire size for the years 2007-2021, and the number of fires and burnt area according to types of fires for 2021 are shown in Figure 100 and Figure 101.



(a)

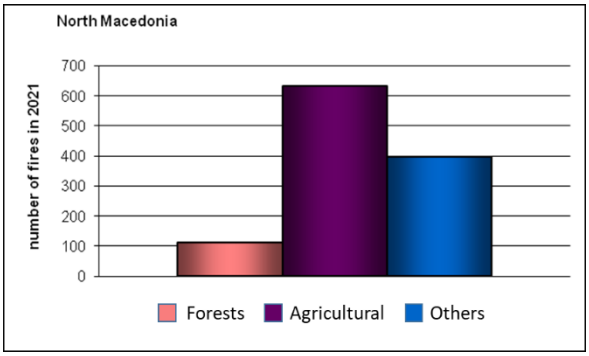


(b)

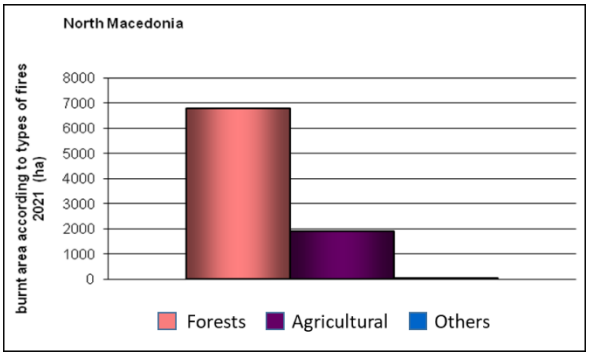


(c)

Figure 100. Burnt areas (a), number of fires (b) and average fire size (c) in the North Macedonia from 2007 to 2021.



(a)



(b)

Figure 101. Number of fires (a) and burnt area (b) according to the type of fires in 2021.

Fire prevention activities and information campaigns

The protection and rescue directorate through the Department for Prevention, Planning and Development, started preparations for the upcoming fire season in November 2020. An analysis of last year's forest fires with lessons learned was produced. Immediately after, the preparations began with updating the planning documents, checking the condition of equipment for extinguishing fires, and the condition of the protection and rescue forces. The problems were noted, and approaches were taken to resolve them. Taking into account last year's forest fires, a program was drawn up with proposed measures to overcome the situation. The Annual Operational Plan for forest fire management was created by the PC "National forests" and its subsidiaries. The prevention activities start conducting meetings before the season of forest fires, and this year the Protection and Rescue Directorate-PRD conducted a campaign with the staff of the PRD, including the 35 Regional departments, from 15/05 to 15/06/2021 for reduction of risks from forest fires.

The National Forest Authority kept its efforts in the forest fire planning at the local, municipal levels. The municipal planning objective is pursued by the technical support to the municipalities forest offices, based in the Municipal Plans for Forest Fire Prevention and the Municipal Operational Plans, which are part of the previous plans and are updated on a yearly basis. The municipalities provide technical support; by the end of the year there were established 34 Plans for Forest Fire Prevention and 28 Municipal Operational Plans approved. 96% of the municipalities are covered by Forest Fire Prevention Municipal Plans.

As part of the campaign, manuals for reducing the risk of fires were distributed in major cities in the country, at toll booths, at border crossings, in rural areas, in National Parks, and in picnic places where posters with steps of forest fire protection were placed.

Fire prevention and firefighting activities were undertaken along with public information campaigns. For the purpose of awareness raising, media events such as press conferences, short reports and announcements on the TV and radio were organized.

Collaboration with the operational meteorological services has been consolidated in order to improve the performances by integrating additional data sources.

We have developed a public awareness campaign for forest fires prevention under the slogan "Let's be prepared". Several actions were taken, following four main strategic axes: National and regional awareness campaigns in the media, warning for hazardous behaviours, promoted by the National Authority for Civil Protection, National Forest Authority and municipalities.

In the public information domain, the National Authority of Civil Protection – Protection and Rescue Directorate – PRD made significant efforts on the availability of on-line information. To reach that goal, it published seven reports at a critical period, and the PRD services displayed on-line information of the most relevant forest fire incidents. Also, the Meteorological Services provided online information concerning FWI and its forecast. The PRD also provided its partners with an online service for FWI mapping.

School campaigns - During 2021 there were more than 25 presentations in schools and colleges in North Macedonia, giving information to raise awareness on environmental issues, social and economic factors caused by fire, its causes and how it can be avoided. Between 10 and 15 June, there was the final trip for the winners of the competition of this school campaign.

Rural Campaigns - In these campaigns direct actions are intended for the rural population trying to sensitize the population about the most common types of negligence. They transmit a message about the importance of human action to prevent fires.

The Ministry of Interior through its organizational units realized a preventive activity regarding fire in an open space. During meetings, leaflets with practical advice for greater protection were distributed to the citizens, and through short educational talks, they were informed about the risks of lighting a fire in an open space and its consequences. in cooperation with the public enterprise National Forests in accordance with the operational plan "Safe summer 2022" they implemented the preventive campaign - "Summer without fires". The main goal of the campaign was the protection and preservation of green forest areas, agricultural land, meadows and pastures from fires, primarily by raising the awareness of citizens about the risks of fires and their damage.

Climate Change

Rural fire management actions play a central role in national policies to combat and adapt to climate change. The climate is changing and it is evident in whole territory of the country. National adaptation strategies / plans, particularly regarding plans to adapt the forest sector to climate change in order to reduce the probability of catastrophic forest fire seasons (which greatly increase the emission of CO^2) take as specific the main objectives for forest-based business and activities.

Operations of mutual assistance

A number of wildfires were burning in the east and north-east of the country. People were evacuated from Kočani City (north-east North Macedonia) as the fire approached urban areas. North Macedonia requested ground forest firefighting teams through the EU Civil Protection Mechanism on 3 August.

Following the requests, the European Civil Protection Mechanism was activated on 3 August 2021. The request for assistance was closed on August 23, 2021.

Austria: 1 ground firefighting module, a total of 435 members (3 rotations), 57 vehicles (16 specialized vehicles for fires, medical team, ambulance, 24 trucks, 9 trailers). They operated in Pehchevo and Budinarci until August 13, 2021.

Slovenia: 1 ground firefighting module operating in Berovo and Vinica until 14 August (2 rotations), 16 vehicles. In kind assistance: 400 fire backpacks, 10 chainsaw and multifunctional fire extinguishing tools, 100 fire brooms.

Bulgaria: 1 ground firefighting module (25 firefighters and 6 specialized fire trucks) deployed from 4 August until 11 August.

Romania: 1 air firefighting module with C-27 Spartan aircraft- Carpatian and C130 (for logistic support) operating in Pehcevo and Prilep area until 13 August.

France: Drones and 1 advisory team (6 members) and 1 advisory team (9 members), which operated in Raovic from August 11, 2021.

Denmark: In-kind assistance: 60 protective helmets, 200 fire hoses, 3 fire pumps, 3 pump hoses, 3 tents.

2 ERCC Liaison Officers

Copernicus Emergency Management Service EMSR529 activated on August 5, 2021 (fast mapping).

The European Commission coordinates and co-finances the deployment of EU assets in response to the fires. Rapid response teams (RRT) from the Department of Operations and Logistics comprise eight Fire Teams with a total of 56 members. The same RRTs were deployed in the regions from Berovo, Valandovo, Bitola, Kumanovo, Gostivar, Ohrid, Vinica and Kisela Voda - Skopje. All RRTs are equipped with personal and common firefighting equipment. A total of 63 firefighters were mobilized in 2021. They were engaged in all reported fires in the Republic of Northern Macedonia (Kočani, Berovo, Veles, Valandovo, Skopje, Tetovo, Gostivar, Kicevo, Ohrid and other places throughout the country).

Assistance on bilateral basis

Serbia: 4 helicopters of the Ministry of Interior, type Gazelle, Bell 412 and Eurocopter 146.

Montenegro: 1 helicopter of the Ministry of Defense of Montenegro, type Bell 412.

Loss of lives

No casualties were reported during the forest fires season of 2021.

Figure 102. Firefighting module operating in Berovo region.

Figure 103. Welcome from Director PRD to support from Slovenia.

Figure 104. Forest Fire near Kočani town.

Figure 105. Ground firefighting module operating in Pehchevo and Budinarci.

Figure 106. Austrian ground firefighting module operating in Berovo.

Figure 107. Slovenian and Austrian ground firefighting module operating in Berovo and Vinica.

Figure 108. Slovenian and Austrian ground firefighting module operating in Berovo and Vinica.

Figure 109. Austrian ground firefighting module operating in Berovo region.

Figure 110. Ground firefighting module operating.

(Source: Protection and rescue Directorate, Sector for prevention, planning and development, Department for analytics and research, Republic of North Macedonia).

1.2.21 Romania

Meteorological characteristics during 2021

In 2021, the average temperature registered at the national level was 9.8ºC, 0.2ºC higher than the climatological normal (1991-2020). Positive deviations were recorded in seven months of the year, the average monthly temperature at the national level being higher than normal (1991-2020) with values between 0.1ºC (June) and 2.2ºC (January). In the rest of the months, the deviation was negative and had values between -0.2 in September and -2.5 in April.

The year 2021 is ranked as the ninth of the warmest years in Romania, from 1961-2021.

The maximum temperature in 2021 reached the value of 41.1ºC and was registered in Calafat, on 01/08/2021.

The total amount of precipitation in 2021 was at the national average (695.3 mm), 4% higher than the annual climate norm (1991-2020). The deviations were positive in six months of the year, between 1% (April) and 91% (December) and negative in four months, between -10% (July) and -51% (September). The highest annual amount of precipitation in 2021 was recorded at the weather station Stâna de Vale, and the smallest, 355.0 mm, at Sulina.

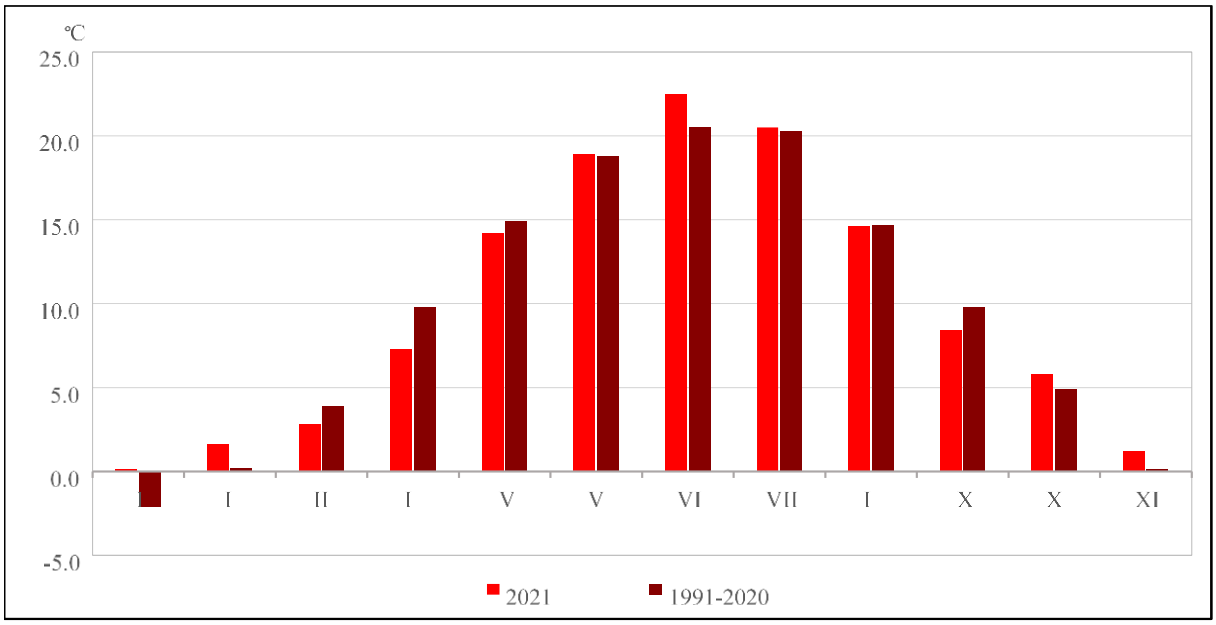


Figure 111. The national mean monthly temperature in Romania in 2021, compared with the standard climatological normal (1991-2020).

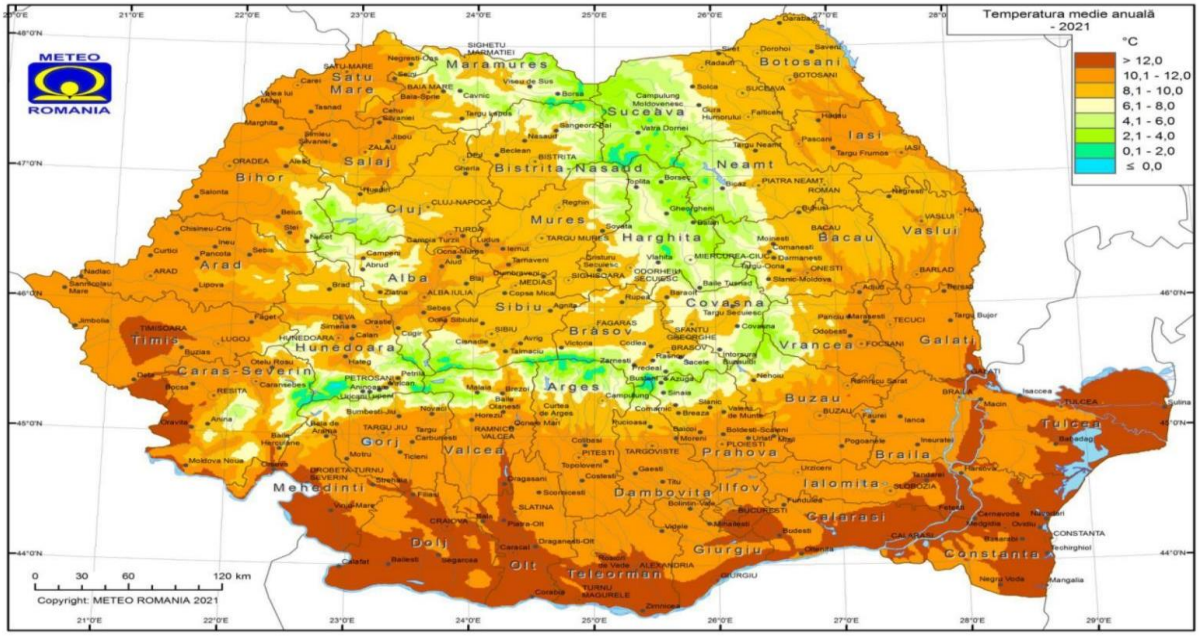


Figure 112. Annual mean air temperature in 2021 in Romania.

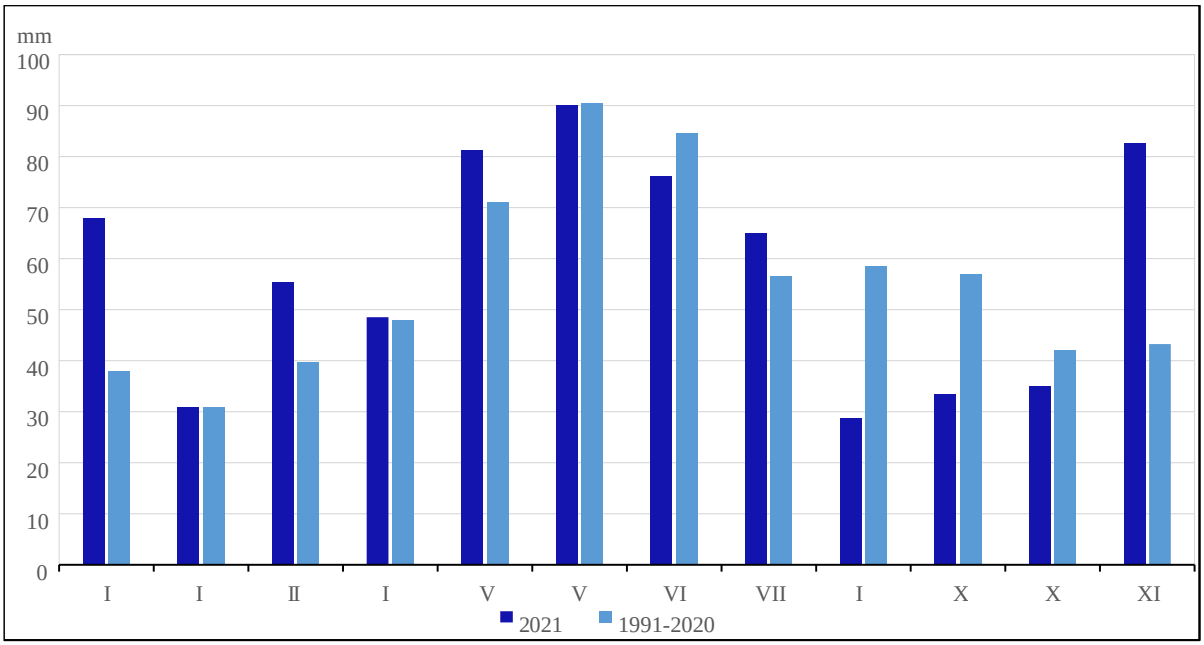


Figure 113. National mean monthly precipitation amount in Romania in 2021, compared with the standard climatological normal (1991-2020)

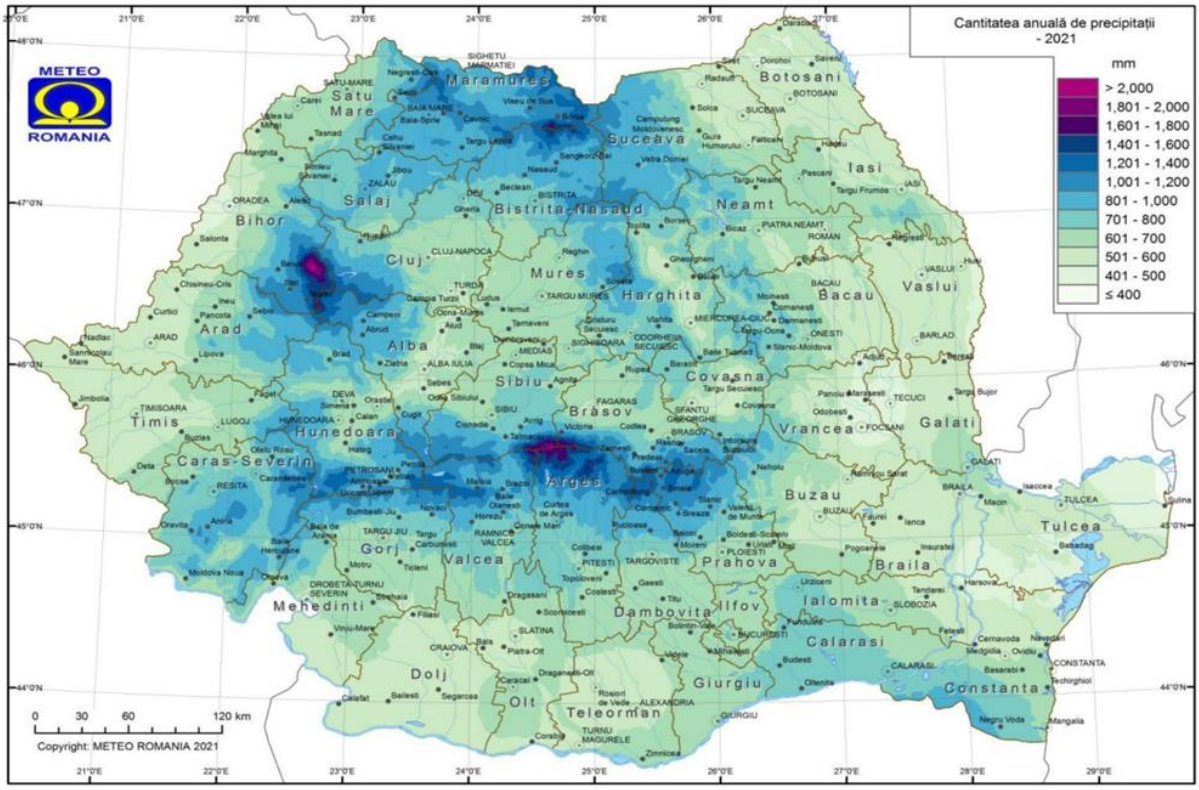


Figure 114. Annual mean precipitation quantity in 2021 in Romania

Fire occurrence and affected surfaces

The year 2021 was a quiet one as regards forest fires since during the critical period in which the vegetation fires generally occurred (during the months of April-May) it was raining almost continuously and therefore the main cause of forest fires was eliminated.

Thus, at the national level, only 278 forest vegetation fires were recorded, affecting 2 101.14 ha, of which:

- 277 fires occurred on 2 101.02 ha in the national forest;
- 1 fire occurred on 0.12 ha in forest vegetation, located on land outside the forest.

As a result of the fires, at national level an estimated damage of 26.45 thousand Euro occurred, burning 63.29 thousand seedlings of plantations and natural regenerations plus 63.77 cubic meters of standing or under operation timber.

A summary of the number of fires and total burnt area by cause, land ownership and fire type is presented in Table 33-Table 35.

Table 33. Causes of forest fires.

Cause of fire	EFFIS code	Number of fires	Burnt area (ha)
Unknown	100	59	342.12
Lightning	201	1	4.00
Electrical power	301	3	10.94
Works	304	1	0.50
Other accident	307	1	0.30
Vegetation management	411	111	1158.15
Agricultural burnings	412	78	511.97
Recreation	414	6	13.36
Other negligent use of fire	415	8	37.05
Cigarettes	422	7	17.09
Vandalism	513	2	5.24
Rekindle	600	1	0.30

Table 34. Nature of the affected property.

Property type	Number of fires	Burnt area (ha)
State public property	181	801.43
Communities public property	13	166.47
Private property	65	812.21
Public property/communal property (common)	7	28.35
Private property/communal property(common)	12	292.68

Table 35. Type of fire.

Fire type	Number of fires	Burnt area (ha)
Litter fires	276	2055.15
Mixed fires (litter, canopy)	2	45.99

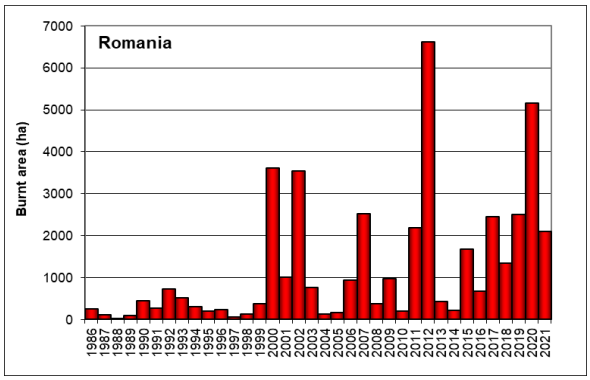
In 2021, 8 forest fires were recorded which burned for longer than 24 hours. The biggest area affected by a single fire was 173.28 ha.

In 2021, the densest period with recorded forest fires was between February 27 and April 13, when 90 fires were recorded on an area of 581 ha, with a maximum of 13 fires on February 27 and 13 April.

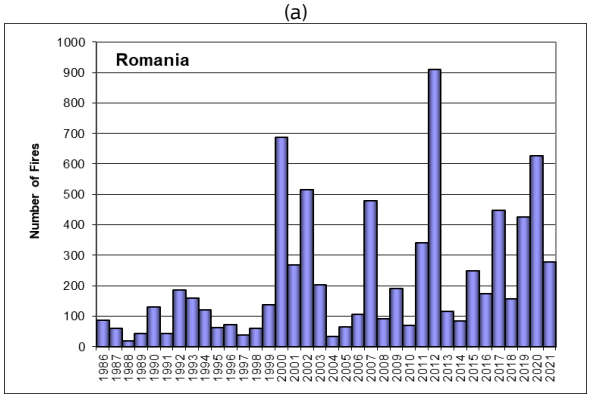
In contrast, no fires were recorded between May 11 and June 30. Also, a period in which no fires were recorded was December (except for the first day of the month).

The main cause was the fire propagation from burned pastures on drier, warmer and windy weather.

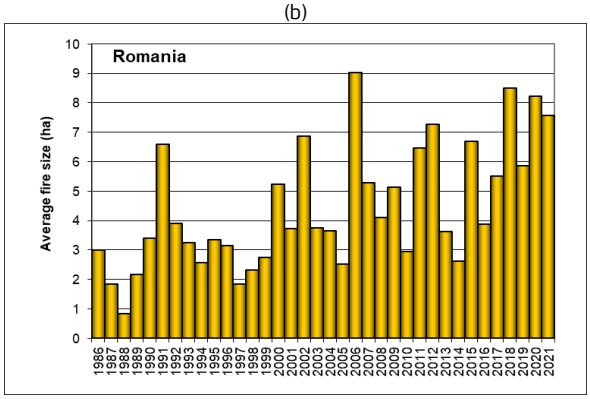
The burnt area, number of fires and average fire size for the years 1986-2021 are shown in Figure 115.



(a)



(b)



(c)

Figure 115. Burnt area (a), number of fires (b) and average fire size (c) in Romania from 1986 to 2021.

Fire fighting means and fire prevention activities

The firefighting actions involved a total of 5 120 people, of which:
- Forest rangers – 1 197 people;
- Military and civilian fire-fighters – 2 030 people;
- Policemen and gendarmes - 281 people;
- Volunteers (Citizens) – 1 651 people.

In 2021 we continued to work to update the forest fire technical instructions, but the planned term of completion was postponed to 2022.

Regarding forest fire legislation, we have proposed tightening fines for people who cause vegetation fires.

(Source: Romanian Ministry of Environment, Waters and Forests (forest fires data); Romanian National Meteorological Institute (meteorological data), Romania).

1.2.22 Serbia

Introduction

According to the national forest inventory, the total forest area in the Republic of Serbia (without data for the administrative province of Kosovo and Metohija) covers 2 252 400 ha. State-owned forest represents 53% of the forested area whilst 47% is in private ownership.

The most dominant forest types are broadleaved forest with beech and oaks as a main species, while coniferous forest types cover less than 20% of the total forested area. The elevation in Serbia ranges from 28 to 2 169 m.

Annual air temperature varies from 11°C for altitudes of up to 300 m to 6°C for altitudes over 1 000 m. Lower regions receive from 540-820 mm of precipitation while higher regions with altitudes above 1 000 m receive from 700-1 000 mm of precipitation on average.

Fire occurrence and affected surfaces

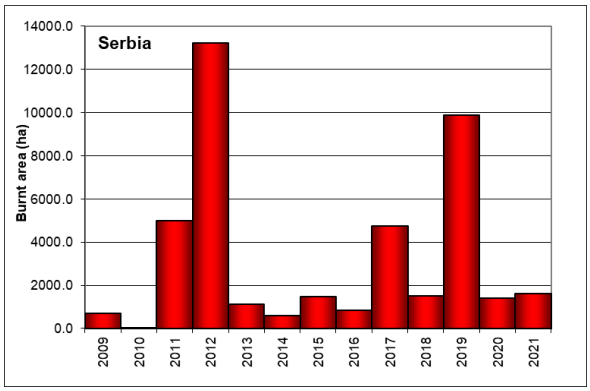
The 2021 fire season was calmer than an average fire season in Serbia. Only 75 forest fires were recorded with more than 1 630 ha of total burnt area and with 21.8 ha of forest fire on average (Figure 116).

The biggest forest fire, with 107.3 ha of burnt area, was recorded in the management unit "Crni vrh-Ljeskovac", forest district Prijepolje-Priboj, which is situated in the southwestern part of Serbia.

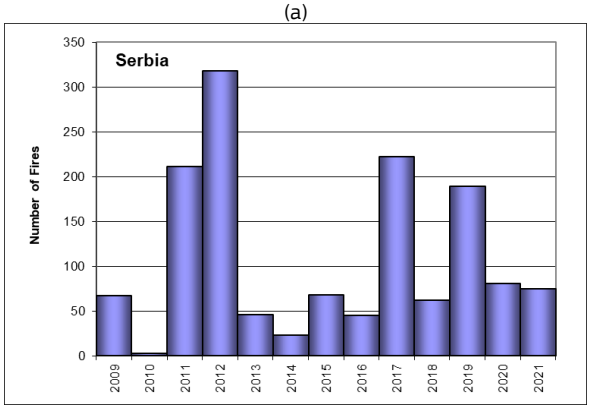
Usually, Serbia has two peaks of forest fire activity. The first one is in March or April and the second one in July and August, depending on the season. Contrary to the previous fire season in 2020, when only one peak in forest fire activity was recoded in April, during the 2021 season the highest fire activity was recorded in July and August (Figure 117b).

Table 36. Number of fires and burnt area in Serbia.

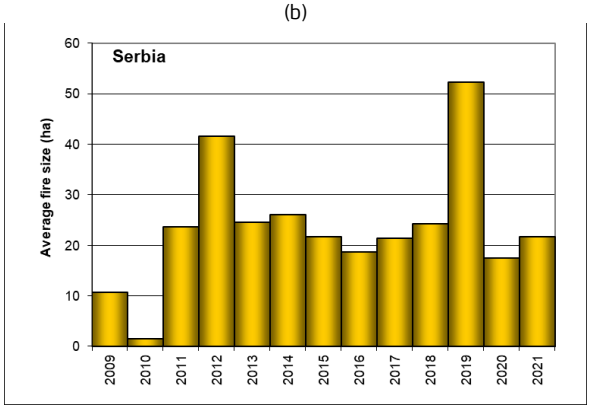
Year	Number of fires	Burnt area (ha)	Average burnt area
2009	67	712.00	10.63
2010	3	4.40	1.47
2011	211	5002.78	23.71
2012	318	13226.44	41.59
2013	46	1131.83	24.61
2014	23	599.19	26.05
2015	68	1474.24	21.68
2016	45	843.29	18.74
2017	222	4756.80	21.43
2018	62	1501.92	24.22
2019	189	9871.73	52.23
2020	81	1417.43	17.50
2021	75	1633.53	21.78



(a)



(b)



(c)

Figure 116. Burnt area (a), number of fires (b) and average fire size (c) in Serbia from 2009 to 2021.

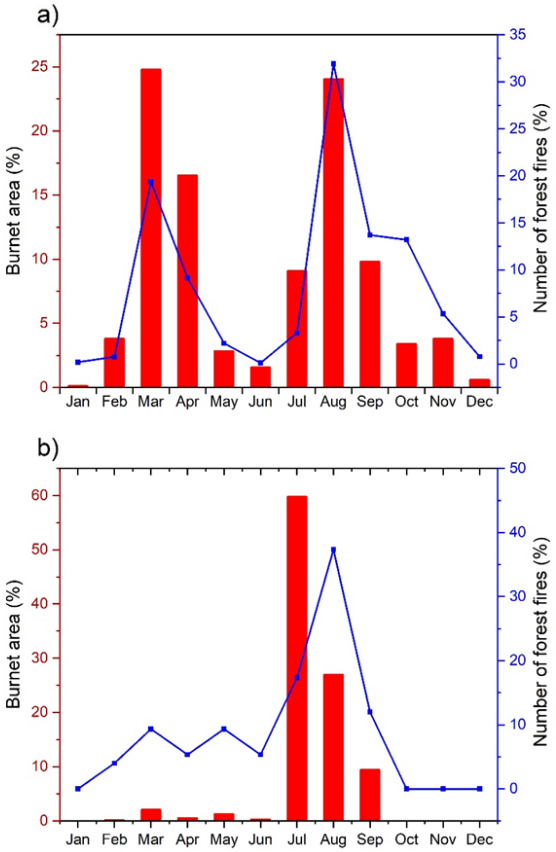


Figure 117. Monthly distribution of forest fires: a) for the years 2011-2021, b) season 2021.

Fire prevention activities and information campaigns

Information about the FWI is provided by the Republic Hydrometerologica Service of Serbia on a daily basis for each administrative unit in Serbia at the NUTS2 level. Fire danger activities are prohibited during the fire season in all forests. The State Forest Enterprise starts a campaign in the public media about the forest fire danger each year before the fire season. The Forest Directorate, as a part of the Ministry of Agriculture, Forestry and Water Management Invested in the maintenance and establishment of new fuel breaks at a cost of 40 000 and 10 000 euros respectively, before the 2021 fire season.

Injuries and losses of human lives

During the season 2021 there were no losses of human lives in forest fires.

Fire causes

The main cause of the forest fire was negligence during the previous decade [59.2%], while in the 2021 fire season, unknown reason was reported as the major cause [50.7%] followed by natural causes [16%] (Figure 118).

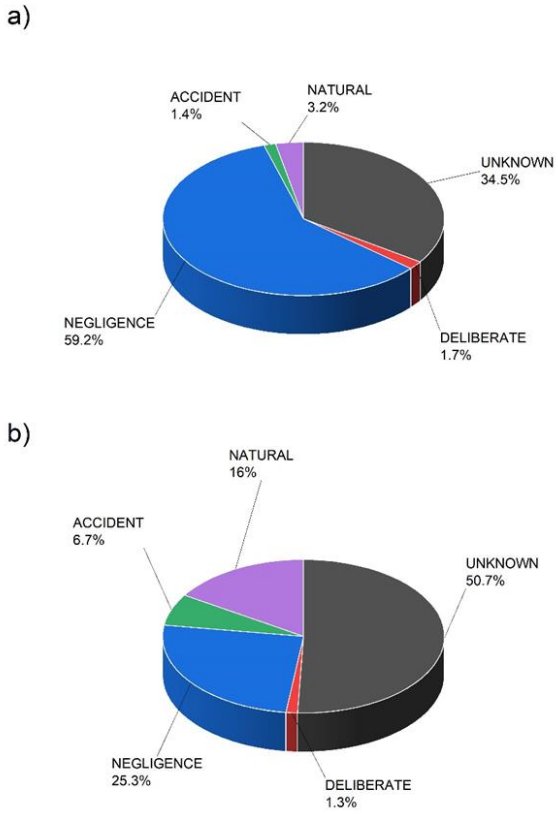


Figure 118. Causes of forest fire: [a] for the years 2011-2020; [b] season 2021.

Firefighting means.

All firefighting measures are under the responsibility of the Sector for Emergency Situations which is a part of the Ministry of Internal Affairs in Serbia. The operational core of the Sector consists of members of operational fire and rescue units. At any moment, 3 280 of them are ready to react. The seat of the Sector for Emergency Situations consists of several departments including the Directorate for Fire and Rescue Units and Civil Protection. At the local level, the Sector has 27 organizational units, four Emergency Situations Administrations in Belgrade, Kragujevac, Nis and Novi Sad, and 23 Departments for Emergency Situations all around Serbia. Along with the ground troops and firefighting vehicles, at least four helicopters are available for fire suppression if it is needed from the other parts of the Ministry of Internal Affairs in Serbia.

Operations of mutual assistance.

Serbia assisted Bosnia and Herzegovina with three helicopters in the battle to extinguish the forest fire in the protected area with one of the most important stands of Serbian spruce (*Picea omorika*) in July 2021. Also, on August 4, 2021, four helicopters were sent to North Macedonia as assistance in suppression of several large forest fires. A few days later, the greatest support was sent to Greece. In total, 37 firefighters with 12 fire vehicles as ground troops and 3 helicopters with aerial teams were sent to Greece on August 8, 2021. Most of them were engaged in the firefighting battle for the island of Thassos.

Climatic conditions and how they impacted the fire season.

During the 2021 fire season, the highest daily air temperature (40.7°C) was recorded on June 30 in Smederevska Palanka. The highest number of tropical days was recorded in Leskovac and was 71 days. In other parts of Serbia, 49 to 69 tropical days were recorded, which is 13 to 32 tropical days more than the average number for the reference period 1981-2010. In the northern, eastern, and western parts of Serbia, the year 2021 had average amounts of precipitation. In the south and in central parts of Serbia, the year 2021 was rainy and very rainy, and in the areas of Požega, Leskovac and Dimitrovgrad it was extremely rainy. It was only dry in the area of Zlatibor, where larger forest fires were registered during July and August. Four heat waves were recorded in Serbia during the summer 2021. The first heat wave was recorded in the north from June 17 to 25, in other regions from June 21 to 26, and in the eastern part of Serbia from June 23 to 1. July. The second wave was recorded in most of Serbia in the period from July 6 to 16, in the eastern part until July 18. The third heat wave was recorded in the period from July 25 to August 2, while in the eastern part this wave was lasting until August 4. The fourth heat wave was recorded only in the areas of Zlatibor and Zaječar, in the period from August 7 to 12. (https://www.hidmet.gov.rs/data/klimatologija/ciril/2021.pdf).

National adaptation strategies / plans

The Serbian Law on climate change was adopted on 18 March 2021, and its implementation will establish a system for reducing greenhouse gas emissions and ensuring adaptation to changed climate conditions. The law fulfils the obligations under the UN Framework Convention and the Paris Agreement and harmonizes domestic legislation with European Union regulation.

Research activities aimed at improving fire management

In the period 2019-2020, with the support of the Forest Directorate [Ministry of Agriculture, Forestry and Water Management], forest fire occurrence probability was modelled and mapping is done by a Random Forest method based on the following predictors: drought code [DC] from the Canadian fire Weather System, anthropogenic features [distances to roads, settlements, agricultural and arable land and population density] vegetation types [derived from CORINE 2012] and topographic features derived from a digital elevation model [elevation, slope and inclination]. During 2021, new models were created for the central part of Serbia based on the Random Forest method. In contrast to previous models, bioclimatic variables [Precipitation of Driest Quarter and Mean Temperature of Driest Quarter] were used instead of DC as weather index predictors. Also, CORINE 2018 was used instead of CORINE 2012 to extract vegetation predictors. A new map with the forest fire occurrence probability will be presented in the next report after the model for the northern part of Serbia will be created.

Sources: Forest Directorate - Ministry of Agriculture, Forestry and Water Management, Centre for Forest Fire Research - University of Belgrade Faculty of Forestry.

1.2.23 Slovakia

Fire danger in the 2021 fire season

The 2021 fire season was not critical from the point of view of fire hazard. The number of wildfires and the average size was similar to previous years.

The number of fires was influenced substantially by the weather, the number of days with rain and the human factor (negligence particularly) in spring and summer.

Fire occurrence and affected surfaces

A total number of 101 forest fires was reported in Slovakia in 2021, corresponding to a total burnt area of 158.94 ha. The average burned forest area per fire was 1.6 ha.

The biggest fire occurred on 25/03/2021 around the village Mužla, district Nové Zámky, and damaged 40 hectares of mixed forest. The cause of the fire was negligence of adults.

The number of fires and burnt area by month in 2021 are presented in Figure 119 and the total number of fires, burnt area and average fire size from 1991 to 2021 are shown in Figure 120.

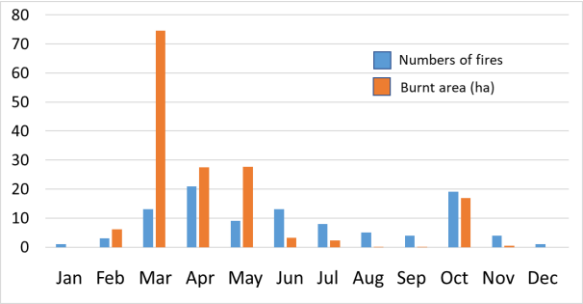
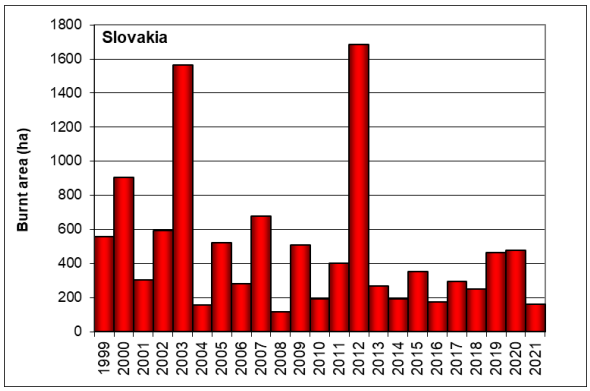
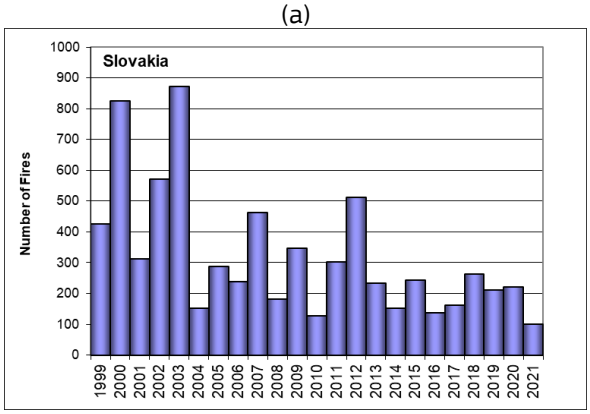


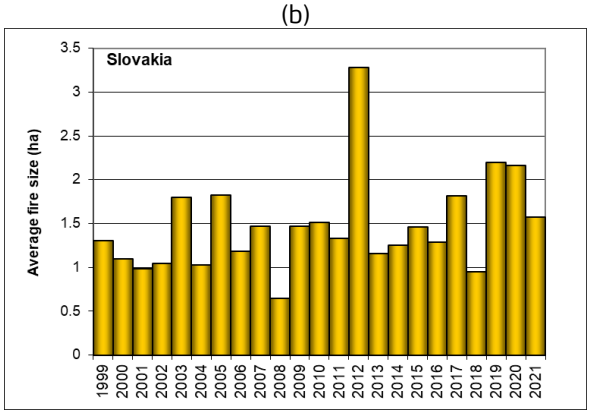
Figure 119. Number of fires and burnt area by month in Slovakia 2021.



(a)



(b)



(c)

Figure 120. Burnt areas (a), number of fires (b) and average fire size (c) in Slovakia from 1999 to 2021.

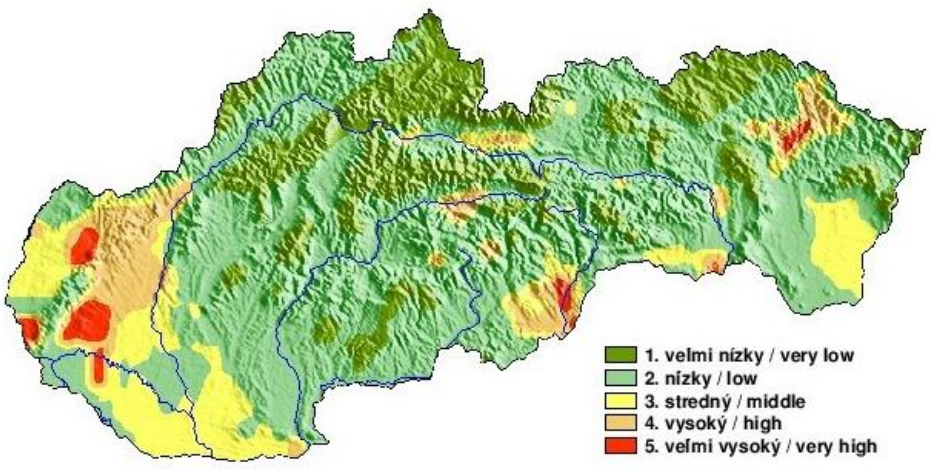


Figure 121. Information on the forest fire index - Slovak Hydrometeorological institute.

Fire causes

Forest fire causes in 2021 are shown in Figure 122, and causes for the years 2011–2021 are presented in Table 37.

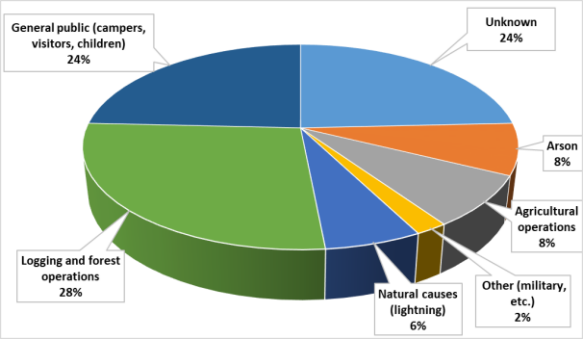


Figure 122. Causes of forest fires in 2021.

Fire prevention activities

- Provide information on the forest fire index through the internet page of the Slovak Hydrometeorological institute;
- Provide information through television when the forest fire index is high;
- Information campaigns;
- Prohibit fire dangerous activities in periods with high Fire index;
- Use of a stationary camera system for the early detection of forest fires.

Injuries and loss of human lives

During the 2021 fire season, no persons were reported injured or killed in Slovakia.

Figure 123. Fire fighting in Mužla, 25/3/2021.

Table 37. Forest fire causes for the years 2011-2021 (number of fires).

	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Basic information	Total fires	**303**	**517**	**233**	**153**	**242**	**136**	**162**	**262**	**210**	**221**	**101**
Known causes (Human)	Arson	8	42	33	26	23	12	11	19	7	18	8
	Negligence (see also B below)	244	409	177	112	167	98	108	179	156	113	63
Known causes (Natural)	Lightning	1	8	4	2	12	0	10	9	4	0	6
Unknown	Unknown	50	58	19	13	40	26	33	55	43	36	24
B: Supplementary information: Total negligence	Agricultural operations	59	135	26	24	26	21	20	19	25	39	8
	Logging/forest operations	21	56	15	18	21	14	21	37	27	5	27
	Other industrial activities	0	1	7	1	5	0	0	1	28	1	1
	Communications (railways, electricity lines, etc.)	1	7	3	1	2	1	2	2	3	7	2
	General public (campers, other visitors, children)	222	208	125	67	110	62	65	119	72	113	24
	Other (military, etc.)	0	2	1	1	3	0	0	1	1	2	2

Figure 124, Figure 125. Fire fighting in Mužla, 25/3/2021.

(Processed: National Forest Centre - Forest Research Institute Zvolen, Slovakia; Source: Institute for Fires and Expertise of the Ministry of Interior of the Slovak Republic).

1.2.24 Slovenia

In 2021, according to the data of the Forest Service, 73 forest fires were reported, with a total burnt area of 124 ha, of which 24.6 ha were in forest (Table 38). 8 of the 73 fires were over 1 ha, and the average fire size was 1.7 ha.

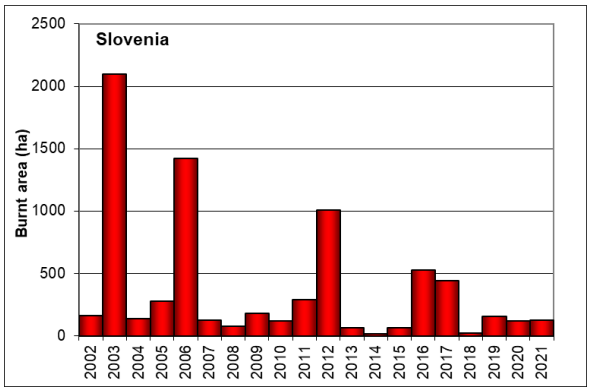
Table 38. Number of fires and burnt area in Slovenia 2021.

Number of fires	< 1 ha	65
	>= 1 ha	8
	Total	73
Burnt area	Woodland	24.60
	Bushes	0.00
	Non woodland	99.40
	Total	124.00

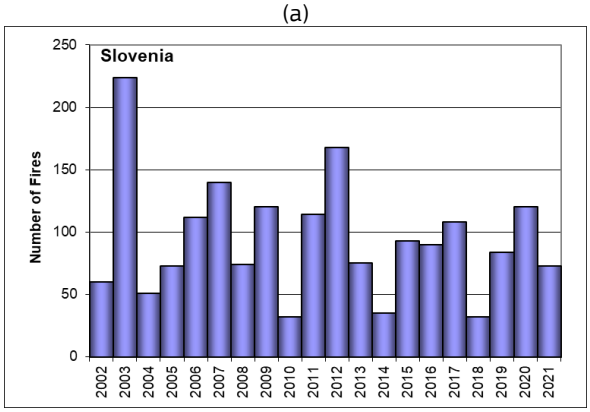
Figure 126 shows the trends in terms of number of fires and burnt area during the last 17 years in Slovenia. As was the case in previous years, the most affected region in terms of burnt area was Sežana, which accounted for 88% of the total, and 33% of the number of fires (Table 39).

Fire causes

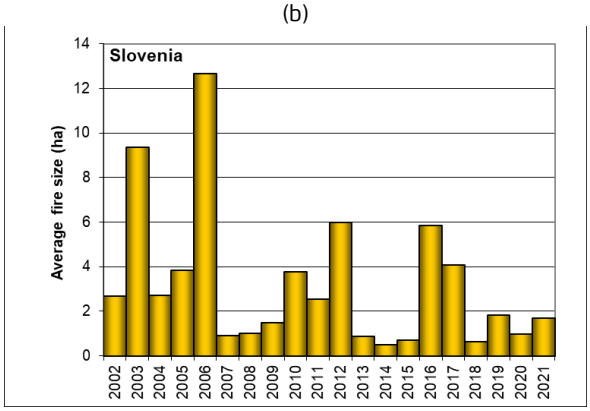
In 2021, 25 fires were of unknown origin. Of the remaining 48 fires, 23 were deliberately started and the remaining 25 were reported as accidental or negligent, mostly because of agricultural burnings.



(a)



(b)



(c)

Figure 126. Burnt areas (a), number of fires (b) and average fire size (c) in Slovenia from 2002 to 2021.

Table 39. Number of fires and burnt area by forest management unit in Slovenia in 2021.

	Number of fires			Burnt area (ha)			
Region	**<1 ha**	**≥1 ha**	**Total**	**Forest**	**Scrub**	**Non wooded**	**Total**
Tolmin	0	1	1	1.28	0.00	0.83	2.11
Bled	0	0	0	0.00	0.00	0.00	0.00
Kranj	4	0	4	0.82	0.00	0.00	0.82
Ljubljana	20	0	20	1.87	0.00	0.20	2.07
Postojna	0	1	1	1.12	0.00	0.63	1.75
Kočevje	1	0	1	0.01	0.00	0.00	0.01
Novo mesto	11	0	11	2.45	0.00	0.99	3.44
Brežice	0	0	0	0.00	0.00	0.00	0.00
Celje	4	0	4	0.98	0.00	0.07	1.05
Nazarje	0	0	0	0.00	0.00	0.00	0.00
Slovenj Gradec	2	0	2	0.47	0.00	0.08	0.55
Maribor	4	1	5	2.23	0.00	0.25	2.48
Murska Sobota	0	0	0	0.00	0.00	0.00	0.00
Sežana	19	5	24	13.37	0.00	96.35	109.72
Total	**65**	**8**	**73**	**24.60**	**0.00**	**99.40**	**124.00**

(Source: Ministry of Agriculture and the Environment, Slovenia).

1.2.25 Spain

Fire danger in 2021

According to the State Meteorological Agency (AEMET), the year 2021 in Spain was very warm, with average temperatures above the average values of the historical series in the seasonal periods with the highest incidence of fires.

It should be noted that the summer was extremely hot in central and eastern Andalusia, and in western Murcia, and hot or very hot in most of the national territory.

To this general situation we must add the two heat waves registered in the peninsular territory and the Balearic Islands, and three in the Canary Islands. In the middle of August there was a remarkable heat wave. They greatly increased the presence of combustible fuel in the forest, due to their duration.

Regarding rainfall, 2021 was humid or very humid in significant areas of the Cantabrian coast and both sub-plateaus, which could have led to relatively higher growth of herbaceous vegetation during the season. On the contrary, 2021 was very dry in areas of Andalusia, Castilla y León, Catalonia, Galicia, Aragón, Extremadura or Canary Islands.

This meteorological situation may have a direct correlation with the development of the large fires that occurred in the interior of the peninsula last summer.

Number of fires and affected surfaces

The provisional statistics for the period between January 1 and December 31, 2021, are compiled with the information sent by the autonomous communities on a weekly basis during the summer campaign and monthly for the rest of the year.

Number of forest fires

According to these data, the total number of fires decreased by 22.58% compared to the average of the last decade, with a decrease of 22.49% in the number of small fires (area <1 ha) and 22.77% in larger fires (area ≥ 1 ha) respectively. This is the fourth lowest figure for the period 2011-2021.

Table 40. Number of fires in 2021 compared with the 10 year average.

	Average 2011-2020	*2021*
Number of fires <1ha	7568	5866
Number of fires ≥1ha	3773	2914
Total	**11341**	**8780**

Burnt areas

Regarding the burnt areas, there was a decrease compared to the 10-year average of 17.34% in the wooded lands and 9.02% in forest areas (sum of wooded and non-wooded lands). The year 2021 depicts the sixth position in terms of affected forest area.

Table 41. Burnt area in 2021 compared with the 10 year average.

Burnt area (ha)	*Average 2011-2020*	*2021*
Other wooded land	29642.01	24503,35
Forest	96592.57	87879.74

Large fires

According to the provisional statistics compiled by the relevant departments in the autonomous communities, during 2021 there were 18 large forest fires (Grandes Incendios Forestales, GIF), a category which includes fires in excess of 500 hectares (Table 42). Twelve of them took place during the summer. In total, the GIFs registered accounted for 52.52% of the total burnt area, and only 0.21% of the total number of fires that occurred in the year.

Regarding the incidence of GIF by geographic regions, the interior communities experienced both the highest number of fires and was also the region with the widest burnt area. The forest area affected in the Canary Islands was produced almost entirely (94.65%) by the GIF that occurred in Arico (S.C. Tenerife).

Of the 18 major fires, 11 had consequences on the population or their assets, and 8 required the activation of the Military Emergency Unit (*Unidad Militar de Emergencias*, UME) for their extinction. In 15 of these large fires the means of the Ministry for Ecological Transition and Demographic Challenge (*Ministerio para la Transición Ecológica y el Reto Demográfico*, MITECO) intervened.

The two large fires with the widest burnt area were also the ones with major consequences for the population and their assets:

- Sotalvo (Ávila). Started on August 14 and it was the biggest forest fire of the year, devastating an estimated area of 21 138 ha (see Figure 127). More than 900 people had to be evacuated, many of whom required shelter. A forest firefighter was injured. There were electricity cuts and roadblocks, two of them on the State Network. For its suppression, the activation of the UME was necessary together with regional means and MITECO.
- Jubrique (Málaga). The second largest fire of the year started on September 8, and affected 7 664 ha. It was the more complex fire of the year, with a very virulent behaviour, due to topography and meteorology, registering the highest consequences in Civil Protection matters. A forest firefighter sadly died during suppression activities and two were injured. 2 670 people were evacuated, half of them requiring shelter. Many rescues were made and two municipalities were confined. There were electricity cuts and roadblocks, one of them on the State Network. The forest fire also required the activation of the UME together with regional means and MITECO. Moreover, a Forest Fires Assessment and Advisory Team (FAST) coordinated by MITECO participated in suppression operations by sending experts from Catalonia and Comunidad Valenciana.

Table 42. Large fires in 2021.

Province	*Municipality of origin*	*Start date*	*Burnt area (ha)*
Almería	Berja	21/01	623.81
Almería	Olula de Castro	01/02	718.27
Navarra/Guipúzcoa/ Francia	Bera-Lesaka-Irún	20/02	1125.96
Cantabria	Udías	20/02	731.09
Cantabria	Soba	29/03	793.72
S.C. Tenerife	Arico	20/05	3052.00
Ciudad Real	Chillón/Almadén	12/07	868.94
Albacete	Liétor	24/07	1932.74
Albacete	Tobarra	24/07	556.51
Cuenca	Víllora	25/07	501.96
Huelva	Villarasa	25/07	622.04
Barcelona/ Tarragona	Bellprat/Santa Coloma de Queralt	26/07	1288.85
Ávila	El Tiemblo	06/08	622.27
Ávila	Sotalvo	14/08	21138.66
Salamanca	San Felices de los Gallegos	17/08	1735.23
Badajoz	Alburquerque	18/08	697.35
Lugo	Ribas de Sil	05/09	1477.60
Málaga	Jubrique	08/09	7664.69

Figure 127. Action of a helicopter in the Sotalvo fire (Ávila), 14/08/2021.

Geographical distribution of forest fires

Given the heterogeneity of the national territory in terms of meteorology, topography, vegetation and existing socioeconomic factors, forest fires are traditionally analysed by region according to four zones that are considered homogeneous. The defined zones are the following:

NORTHWEST: includes the autonomous communities of Galicia, Asturias, Cantabria and the provinces of León and Zamora.

MEDITERRANEAN: includes the autonomous coastal communities with the Mediterranean Sea, including its interior provinces.

CANARY ISLANDS: includes the entire Canary archipelago.

INTERIOR COMMUNITIES: Includes the provinces of the rest of the non-coastal autonomous communities, except León and Zamora, as well as the Basque Country.

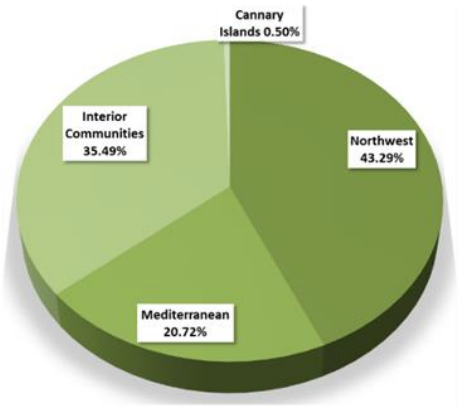
The Northwest region suffered the greatest number of fires, with 43.29% of the annual total. It is followed by the Interior Communities with 35.49%, the Mediterranean region (20.72%) and finally the Canary Islands with less than 1% of the total number of fires.

Regarding total forest area affected, the Interior Communities depict 46.85% of the total, followed by the Northwest (31.06%), the Mediterranean region (18.41%), and the Canary Islands (3.67%).

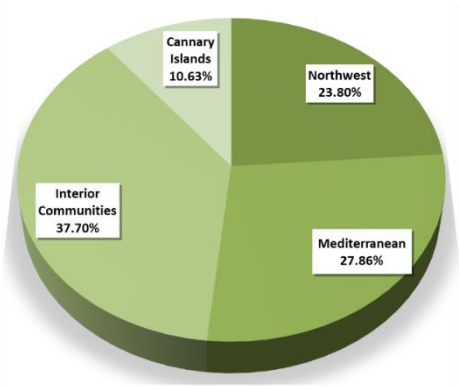
Considering the wooded, the highest burnt areas occurred in the Interior Communities, reaching almost 40%, leaving the remaining 60% distributed among the rest of the regions.

The distribution of the total number of fires by geographical area is shown in Figure 128.

a)



b)



c)

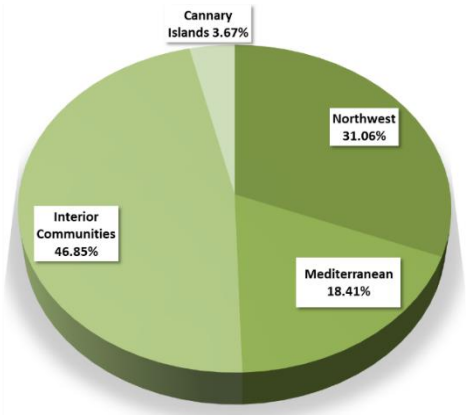
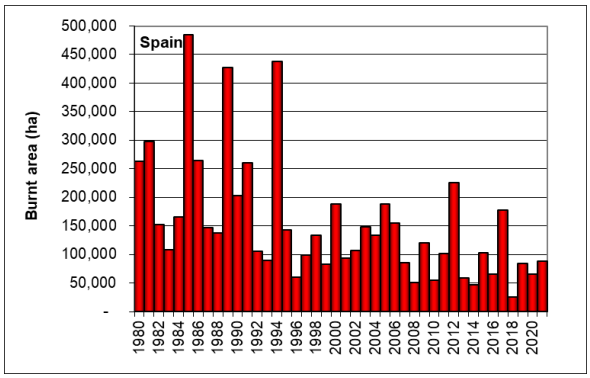
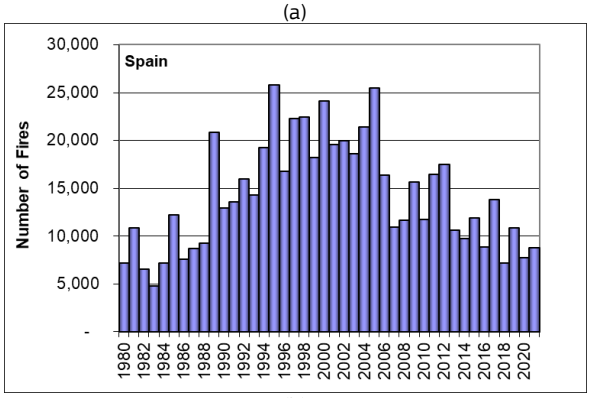


Figure 128. Number of forest fires (a), burnt area of wooded land (b), and burnt area of forest (c) in 2021 by geographic region.

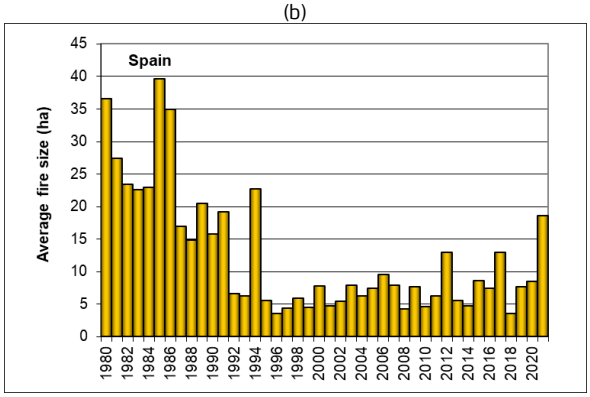
The yearly trends in terms of numbers of fires and burnt areas during the last 41 years in Spain are shown in Figure 129.



(a)



(b)



(c)

Figure 129. Burnt areas (a), number of fires (b) and average fire size (c) in Spain for the last 41 years.

Civil Protection in forest fires

Loss of human life and injuries

In 2021 we regret to report the death of 1 forest firefighter on September 9 during suppression operations in Jubrique (Málaga) fire.

In 13 forest fires, at least 61 people had to be assisted by health services, 25 of them belonging to the suppression teams.

Damage to infrastructure

Due to the continuity of the houses with the forest, the risk of so-called Urban Forest Interface Fires causes houses and other infrastructures to be damaged. Thus, in 2021, 18 forest fires caused damage to infrastructures.

Evacuations and disruption to transport

Preventive evacuations were carried out in 57 fires, affecting some 6 400 people, highlighting:

- 600 evacuees in the fire of Azuébar (Castellón) on August 14;
- 900 evacuees in the fire of Sotalvo (Ávila) on August 14;
- 2 600 evacuees in the fire of Jubrique (Málaga) on September 8.

In 61 fires, roads were cut, mostly regional and local, but on 20 occasions the State Road Network was affected. In 8 forest fires, the railroad network was interrupted.

Operations of mutual assistance

In 2021, as in previous years, the Protocol between Spain and Portugal on technical cooperation and mutual assistance in Civil Protection matters and the Additional Protocol on mutual aid in border areas was applied and thus support was given to Portugal as follows:

Support with State means

Miranda do Douro (Bragança), August 6:
MITECO supported this cross-border fire by sending 2 medium-capacity amphibious aircrafts.

Support with regional means in cross-border fires

- Castilla y León intervened 12 times in cross-border fires, of which 8 were on the border with Salamanca and 4 with Zamora.
- Extremadura intervened in 2 fires on the border with Badajoz.
- Galicia intervened in 1 fire on the border with Orense.

These mutual aid protocols also imply aid from Portugal in the Spanish territory, which materialised in the following interventions:

Support with Portuguese means in cross-border fires in Spanish territory

- Andalusia, on 2 occasions.
- Castilla y León, on 1 occasion.
- Extremadura, on 1 occasion.

RESCEU programme

For the third consecutive year, Spain collaborated with the Union's Civil Protection Mechanism to support other countries that request it, within the rescEU program, with two high-capacity amphibious aircraft, available from June 15 to October 31.

During this period, two requests for help to mobilise these resources were received:

- Turkey: 2 aircrafts (2-7 August) and 1 aircraft (8-12 August). Overall, 123:15 flight hours (87:35 in suppression operations) and 271 drops.
- Greece: 1 aircraft (7-11 August). Overall, 44:30 flight hours (32:05 in suppression operations) and 69 drops.

Prevention and suppression means

Integral Prevention Teams (Equipos de Prevención Integral de Incendios Forestales, EPRIF)

In 2021, 21 EPRIFs were operational: 10 associated to integral services of BRIF bases, and therefore working all year long in prevention or suppression, depending on the season; 4 annuals centred in prevention all year; and 7 operational during off-summer months.

EPRIFs work mainly on training activities and meetings with various groups, including ranchers, farmers, hunters, neighbourhood associations, representatives of town halls or teachers, in order to reconcile interests and raise awareness of forest fire prevention.

It is worth mentioning the treatment of 741 hectares with 119 prescribed and controlled burns. This helps to reduce the risk of forest fires by reducing forest fuel and creating discontinuities in the vegetation, while also achieving other objectives such as improving pastures, favouring the habitat of various species or improving accessibility in the forest areas. A total of 672 plots were prepared for burning, although the weather conditions did not allow all the work to be completed.

Preventive Work Brigades (Brigadas de Labores Preventivas, BLP)

The Preventive Work Brigades acted, in collaboration with the autonomous administrations, from the beginning of the year until the beginning of the summer campaign. Once the summer campaign was over, preventive work was resumed, which ended at the end of December.

During these two work periods, they carried out fire prevention work on more than 2 000 hectares of forest land, which mainly consisted of construction and maintenance of strips and areas of greater resistance to forest fires, through clearing, thinning, pruning and prescribed burning.

In total, more than 400 workers distributed in the 10 Preventive Work Brigades carried out preventive forestry work close to the surroundings of the BRIF bases. As already noted, the BLPs also work from time to time in support of EPRIFs in the execution of prescribed burns.

Reinforcement Brigades against Forest Fires (Brigadas de Refuerzo en Incendios Forestales: BRIF)

The Ministry deploys 5 BRIF-i during the winter-spring campaign in the Northwest of the Peninsula, and 10 BRIFs during the summer campaign distributed throughout the national territory.

In the summer campaign the BRIF are composed of three teams each comprising 2 supervisors and 14 specialists under the command of 1 technician. For transport and support for fire extinction they have two transport and extinction helicopters with 1 200 litre of capacity. In the Puerto del Pico (Ávila) aerial base, a BRIF-B type brigade is available, which is smaller in size and similar to the brigades of the BRIF-i winter campaign, consisting of 3 teams of 7 specialists, 1 foreman and 1 technical staff equipped with a single helicopter.

These highly specialized helicopter transport personnel units can operate anywhere in the country where needed. BRIF personnel receive continuous education and training that allows them to act in the most demanding situations and the most complicated fires. The mastery of all techniques of extinction, including backburning, is essential in its performance.

In the 2021 campaign, the BRIF worked for 2 151 hours in 283 fire interventions and suppressed a total front length of 264 801 metres. The BRIF with the highest activity during this campaign was that of Tineo (Asturias), with 51 interventions combining the summer and winter campaigns.

During the winter campaign the most interventions were made by the BRIF of Ruente (Cantabria) with a total of 45. This BRIF is only operational during the winter-spring months.

Aerial means

MITECO has an aerial means deployment managed from the Forest Fire Defence Area, which covers the national forest area throughout the year. During the two periods of greatest occurrence of forest fires, winter and summer campaigns, the number of available means is strengthened. Complete information on these means is available on: https://www.miteco.gob.es/es/biodiversidad/temas/incendios-forestales/extincion/medios_aereos.aspx

During 2021, MITECO's air forces carried out a total of 1 291 interventions in forest fire suppression, in support of the means of the respective autonomous communities. In total, they flew for 3 752 hours, making 17 109 drops. Table 43 and Figure 130 detail the distribution of actions in support of the autonomous communities and in other countries.

Table 43. Number of interventions of MITECO's air forces in support of the autonomous communities and other countries in 2021.

Autonomous community	Number of fires	Interventions	Hours of flight	Drops
Andalucía	82	185	0769:07	3672
Aragón	17	33	0064:34	346
Asturias, Principado de	44	84	0183:09	1073
Balears, Illes	12	12	0013:29	36
Canarias	23	91	0130:07	526
Cantabria	38	46	0086:00	634
Castilla León	48	278	0920:04	4698
Castilla-La Mancha	17	66	0181:08	714
Cataluña	23	90	0297:38	823
Ceuta	0	0	0000:00	0
Comunidad Valenciana	8	19	0076:07	206
Extremadura	40	105	0262:10	1640
Galicia	56	174	0363:52	1600
Madrid, Comunidad de	3	9	0019:20	70
Murcia, Región de	3	3	0005:45	56
Navarra, Comunidad Foral de	16	28	0089:38	215
País Vasco	0	0	0000:00	0
Rioja, La	10	51	0158:52	454
TOTAL NACIONAL	**440**	**1274**	**03621:00**	**16763**
Other countries: Greece, Portugal and Turkey	8	17	0131:16	346
TOTAL	**448**	**1291**	**3752:16**	**17109**

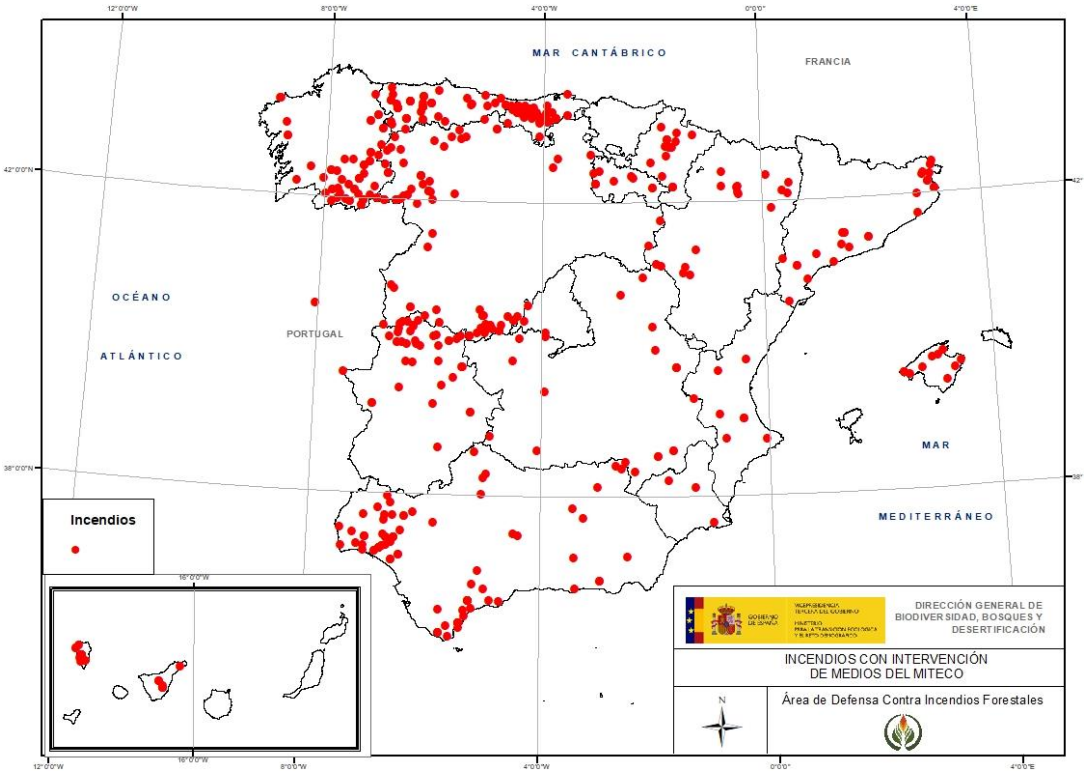


Figure 130. Location of forest fires with the intervention of MITECO means of suppression during 2021.

Other prevention activities

Training and awareness actions against forest fires

During 2021, the traveling exhibition entitled "*50 years of knowledge and prevention of forest fires*", created in 2019 to commemorate 50 years of the National Forest Fire Statistics (*Estadística General de Incendios Forestales*, EGIF), was shown in various centres and public spaces from the Community of Madrid.

Artificial intelligence techniques for preventing and suppressing forest fires

During 2021, the ARBARIA project continued. This is a computer system for the analysis and prediction of forest fires making use of artificial intelligence techniques associated with Machine Learning and Deep Learning. It has been developed together with the Ministry of Agriculture, Fisheries and Food.

ARBARIA uses historical data on forest fires that have occurred in Spain in recent decades and publicly accessible open data related to meteorology and socioeconomic factors. Using two different algorithmic models, ARBARIA makes it possible to explain and predict the weekly occurrence of fires at the provincial level, as well as to identify patterns of forest fire causality associated with the socioeconomic characteristics of each municipality. The predictive and explanatory capacity of both models provides very valuable information for extinction or prevention actions.

Coordination and planning actions

Joint Commission, Ministry of Defence - Ministry for Ecological Transition and Demographic Challenge

During 2021, two meetings of the Joint Commission were held in charge of coordinating the operational, maintenance and availability needs of the Canadair aircraft owned by the Ministry. Meetings were held on February 1 and December 15, respectively, to agree on the deployment and renewal of the aircraft fleet, as well as to analyse aspects of the 2021 campaign.

Committee for the Fight against Forest Fires (CLIF)

This is a technical committee for coordination between the competent administrations in the defence against forest fires, chaired by the Deputy Director General for Forest Policy. It meets twice a year, before and after the summer season.

Centre for the Coordination of National Information on Forest Fires (CCINIF)

In accordance with Royal Decree-Law 11/2005, the main functions of the CCINIF are to centrally channel and make available to all the competent public administrations, in real time, all the information available to the different public administrations in relation to the evolution of the risk of forest fires, the material, technical and personal means available at all times and forest fires, once they occur.

Information on incidents involving the Ministry's State means is updated two times a day on the webpage. Likewise, the interventions of the means in the forest fires that occurred the previous day are published daily, and the link to the fire risk map published by the State Meteorological Agency for the next seven days is shown.

This information can be consulted updated daily at the following link:
https://www.miteco.gob.es/es/biodiversidad/temas/incendios-forestales/estadisticas-actuaciones.aspx

Figure 131. Tabuyo del Monte BRIF-i withdrawing from the extinction in the fire of Allande (Asturias), 18/04/2021.

(Source: Ministry for the Ecological Transition and the Demographic Challenge, Wildland Fire Management Service, Spain).

1.2.26 Sweden

Fire danger in the 2021 fire season

For the 2021 fire season, an improved version of the fire risk forecast model (based on the Canadian Forest Fire Weather Index [FWI] System) was introduced. Prior to 2021, only one time step per day (12 UTC) was available to represent an entire 24-hour period. With the new version, it was possible to show the evolution of the fire risk parameters over the course of the day, using hourly output data from the fire risk forecast.

The grass fire season started in February (the first risk was announced on 22 February, depicted in Figure 132). As soon as the snow cover has melted away, the grass that grew during the previous year can act as fuel for potential grass fires.

As the temperature increases towards the spring, the area with grass fire risk extends towards the north. Getting closer to the summer, new grass starts to grow, again starting in the south part of Sweden, which ends the grass fire season in that area. As with the snow cover, the extent of the green grass grows towards the north, until all of the previous years' grass has been replaced, marking the end of the grass fire season in Sweden. The last day with grass fire risk in 2021 occurred on 20 June, represented in Figure 132. The period with forest fire danger stretched from May to September, yielding an overlap with the grass fire season during May and June.

Since the year 2000, the number of days that grass fire risk was announced has increased from 21 to 103 days, as depicted in Figure 133. This evolution may however stem from several reasons. Most importantly, during the more recent years, more attention has been put on local and short-lived risks, in contrast to the beginning of the 21-year period.

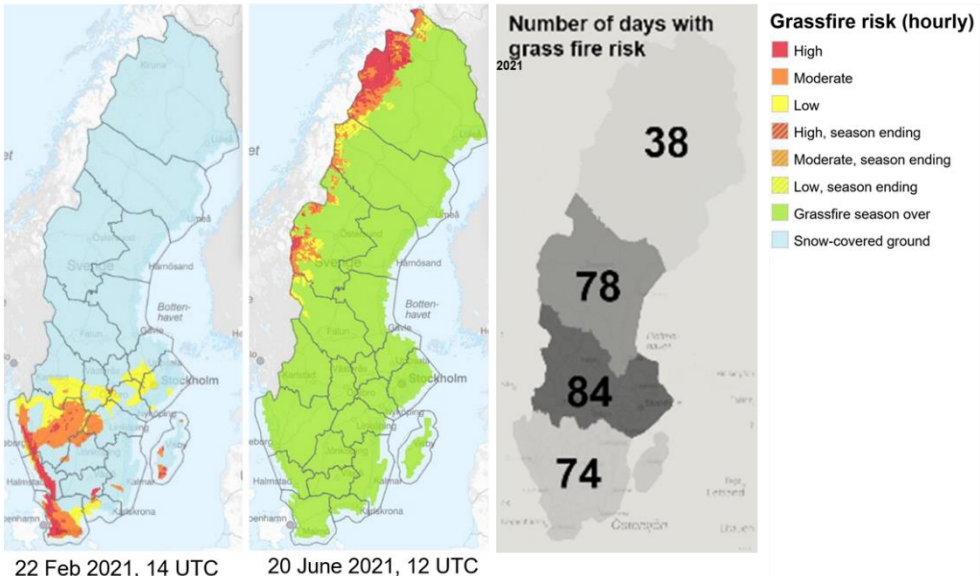


Figure 132. Maps representing the first and the last day of the grass fire season, respectively, as well as the number of days that a grass fire risk was announced during the season in the four different regions.

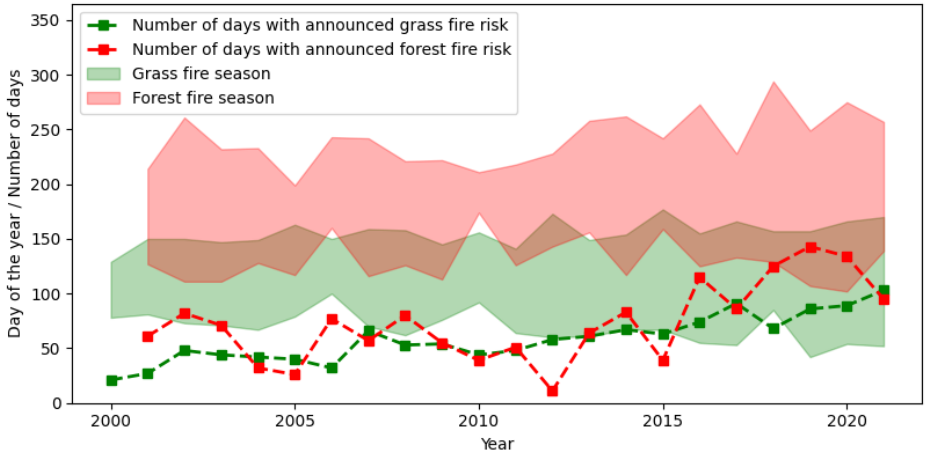


Figure 133. Fire season extent in Sweden 2000-2021, and the number of days during the season that a risk was announced for grass and forest fire, respectively.

Characteristics of the Swedish fire season

The following sequences of maps highlights some characteristics of the fire hazard in Sweden.

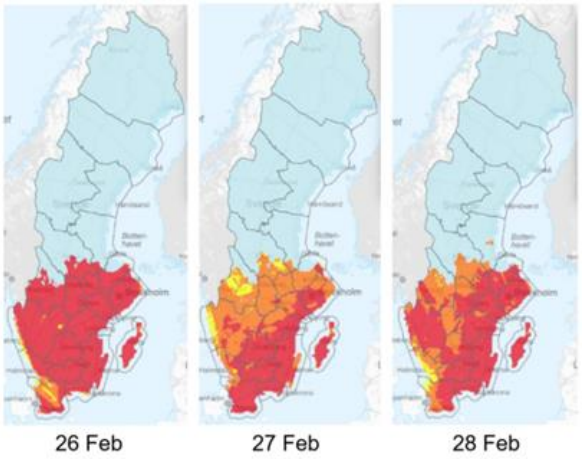


Figure 134. The snow melted away in the south and only four days after the first grass fire danger alert of 2021, the risk was high in most areas in southern Sweden.

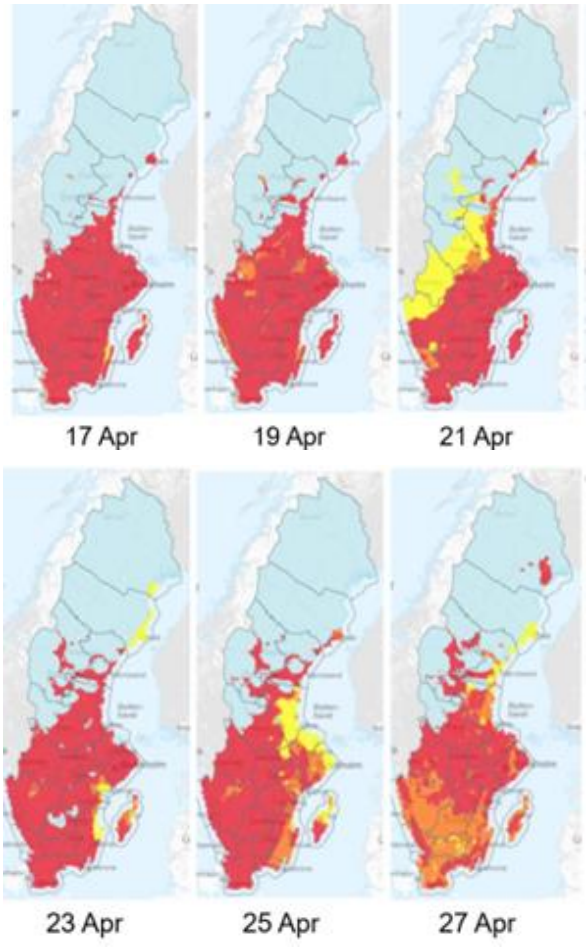
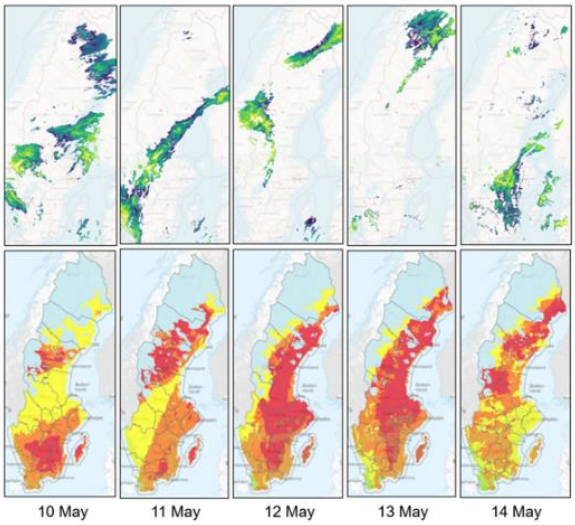


Figure 135. In April, the snow cover started to melt also in the central parts of Sweden.



Radar data from the Swedish Meteorological and Hydrological Institute.
Background map ©openstreetmap.org contributors: the data is available under the Open Database License opendatacommons.org

Figure 136. Recent radar observations combined with the prevailing grass fire risk illustrates how the risk adapts to precipitation on a hourly basis. In areas affected by rainfall, the fire danger is reduced.

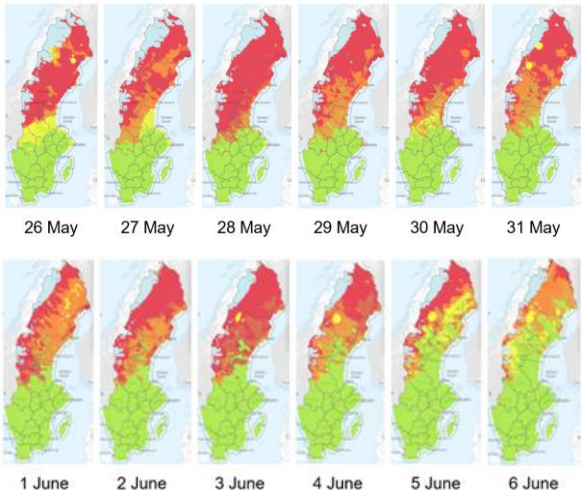
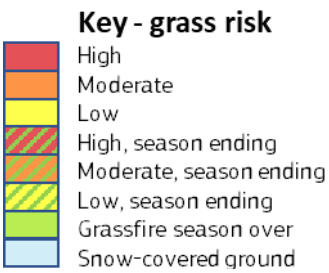


Figure 137. The grass fire risk change over a 12-day period.



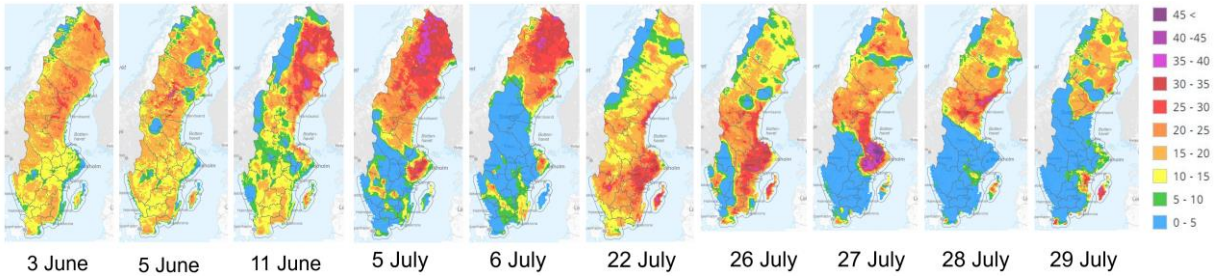
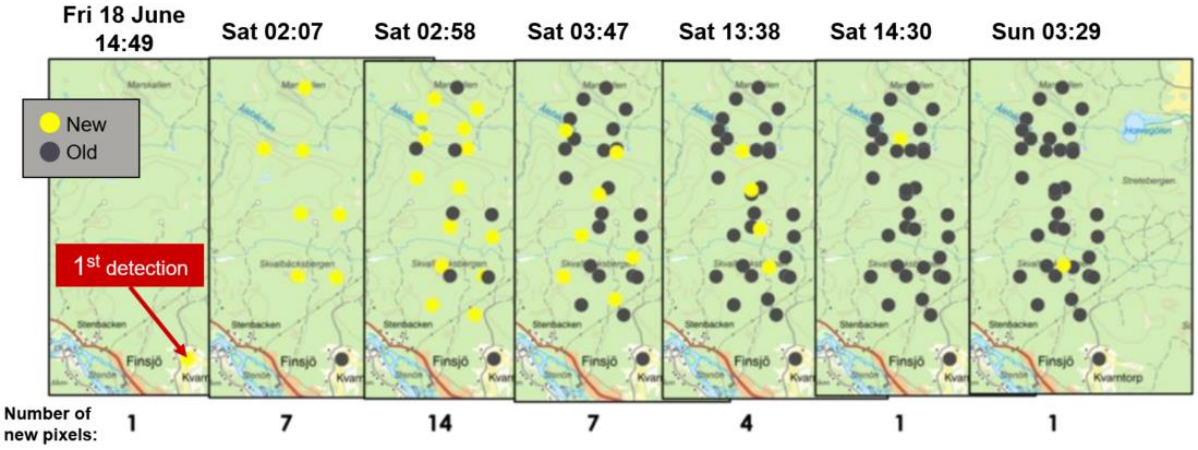


Figure 138. Snapshots of the FWI situation on different days in June and July. The maps show how the risk can vary over a large geographical area during the summer.

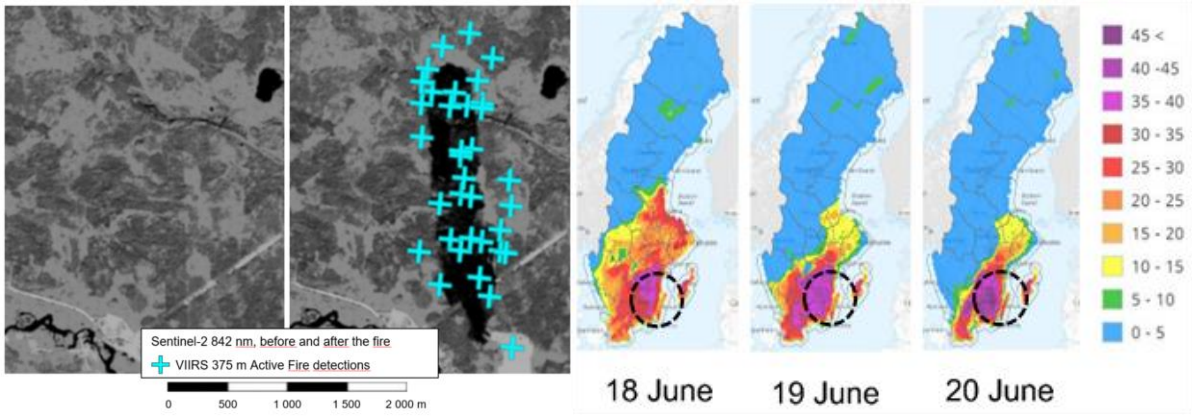
Fires in 2021

During 2021, a test of active fire satellite detection was carried out, where the VIIRS 375 m Active Fire algorithm from NOAA/NASA was applied on data from the Joint Polar Satellite System (JPSS) satellites Suomi-NPP and NOAA-20, and where detections in urban and industrial areas or near other known heat sources were discarded.

The forest fire of greatest spatial extent in 2021 started near Finsjö on 18 June. As shown in Figure 139, the Finsjö fire was detected by the satellites. The locations of the pixels on the ground can be compared to the burned area that shows in Figure 139b. Apart from the on-ground resources, the fire was fought with helicopters and water scooping aircrafts.



(a)



(b) (c)

Satellite data exported from Sentinal Hub EO Browser, used under the CC BY 4.0 License
Background map ©openstreetmap.org contributors: the data is available under the Open Database License opendatacommons.org

Figure 139. (a) The temporal and spatial distribution of the detected pixels that were associated with the forest fire in Finsjö, in June 2021. The detections were obtained from the VIIRS 375 m Active Fire algorithm. Detections were obtained from both satellites in the JPSS program (NOAA-20 and Suomi-NPP). (b) The burned area is represented by the darker area that appears in the right panel, on which the VIIRS satellite detections are marked out too. (c) The FWI values during the fire. The dashed circle marks out the location of the fire.

During the season, a total of 76 vegetation fires, depicted in Figure 140, were identified among the satellite detections. Out of those, 60 fires occurred during June-August. The polar orbit (affecting the temporal coverage) of the satellites, as well as cloudy conditions are two factors that causes the number of detected fires to be low compared to the actual number of vegetation fires, which was 4 087 in 2021.

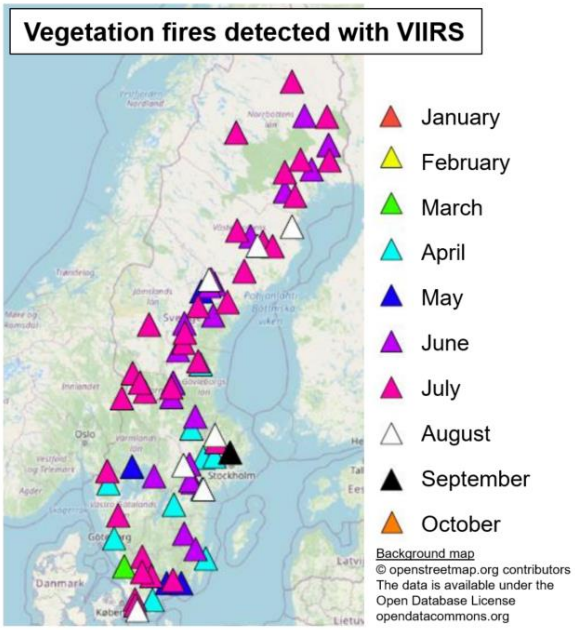


Figure 140. The 76 VIIRS satellite detections that were associated with vegetation fires during 2021.

Fire occurrence and affected surfaces

During 2021 the number of fires recorded was 4 087. The burned area consisted of 861 hectares (ha) of productive forest, 479 ha of other wooded land, 116 ha of other open land and 97 ha of agriculture field or pasture.

There were 12 fires with spatial extent of at least 10 ha and the two largest fires among these (130 ha and 100 ha, respectively) started in June. The total burned area for the 12 largest fires was 338 ha (23% of the total burned area of the 4 087 fires).

The burnt area, number of fires and average fire size for the years 1998-2019 are shown in Figure 141.

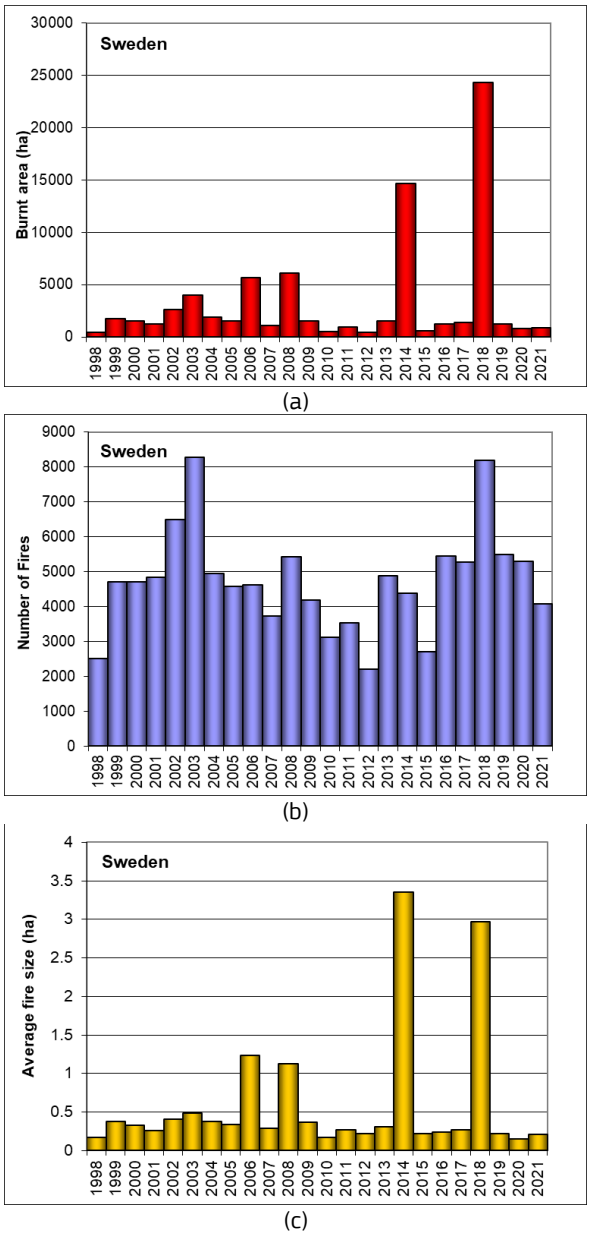


Figure 141. Burnt areas (a), number of fires (b) and average fire size (c) in Sweden from 1998 to 2021.

The monthly pattern of fire numbers and burnt areas in 2021 are shown in Figure 143.

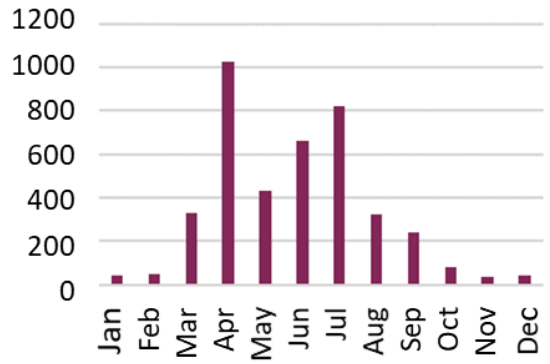


Figure 142. Total number of fires by month in 2021.

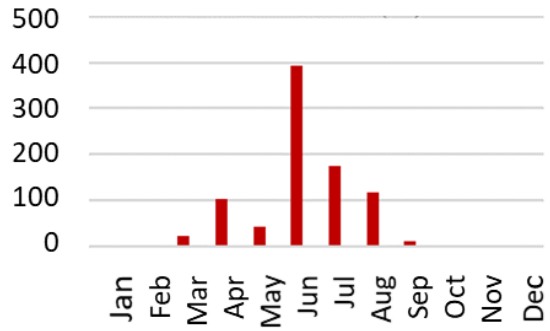


Figure 143. Total burnt area (ha) by month in 2021.

Fire Causes

In 2021, 42% of the fires had unknown causes and 19% were deliberate. 13% were caused by use of fire and 6% had a known cause not specified, while 5% were caused by recreation and 4% by thunder strikes.

Injuries and loss of human life

During 2021, one civil person died in connection with wildfires. Furthermore, there were 17 civilians injured and transported to healthcare.

International support and training

In May 2021, Sweden and Finland conducted a "table-top" exercise in operations with airborne firefighting resources. Due to Covid restrictions, no field exercise was carried out.

Sweden provided support to Greece (firefighting operations on the island of Evia and outside Athens) with two water-scooping planes (Fireboss), as part of rescEU. The Swedish support operation in Greece lasted for about a week.

Climate change

In a warmer and drier climate, the fire hazard in Sweden is expected to generally increase during the season, but also to have an earlier start in the year. Also, some uncommon types of fire can be expected to become more frequent. An example of such a fire was a fire in a cropped field in southern Sweden. Pictures from the fire are shown in Figure 144.

Remarks, from a climate perspective, on temperature and precipitation patterns during 2021 are presented in Table 44, where the observations from 2021 are compared to the climatological mean temperature and precipitation amounts during the period 1991-2020.

Table 44. Remarks on temperature and precipitation anomalies during the 2021 fire season. Data from the Swedish Meteorological and Hydrological Institute.

Month	Anomalously high temperatures	Anomalously low precipitation amounts
Feb	Yes. All time high in southern Sweden.	In southern Sweden (10-50%*)
Mar	Yes. All time high along the southern east coast.	Along the northern east coast (25-50%*)
Apr	No	Along the southern east coast and the west coast (25-50%*) and (locally) in the north (50%*)
May	No	In the eastern central to northern part of Sweden (50%*)
June	Yes. 18-19 June**: highest June temperature since 1947.	In the south and in the central north (25-50%*)
July	Yes. Extensive areas with a +2°C anomaly*.	In the north and along the central east coast (50%*)
Aug	No	Along the south part of the border to Norway (50%*)
Sept	No	Along the south to central part of the east coast (50%)

* compared to the climatological (1991-2020) monthly mean for the current month

** around the same time and area of the largest forest fire of 2021 (130 hectares in Finsjö). Data from a case study of this fire are depicted in Figure 139.

Figure 144. A cropped field burned in Svedala on 27 July, 2021.
Photo credit: Svedala Municipality Fire Department.

(Source: Swedish Civil Contingencies Agency (MSB); Risk & Vulnerability Reduction Department, Natural Hazards & Critical Infrastructure Section, Sweden).

1.2.27 Switzerland

Weather conditions and state of the forests 2021

Switzerland had one of the wettest winters in 60 years and in some regions the wettest summer since the beginning of the measurements in 1864.

In addition to the high amount of precipitation (partly in the form of high amounts of snow), record-breaking sunny and warm days were observed on the northern side of the Alps in the end of February and at the end of the winter. On the other hand, the amount of sunny and warm days was markedly low on the southern side of the Alps.

The spring was wet and cold. May was locally the wettest month for a hundred years. From a national point of view, it was the coldest spring for thirty years. The rain at the end of May was the starting point of a three-month long precipitation period, which expanded into the summer.

Summer 2021 was locally the wettest summer since the beginning of measurements. The last time such a wet summer was observed was in 1987. Due to this high amount of precipitation, in particularly in June and July, regional floods occurred.

In fall, the weather changed the other way round. Locally it was the driest fall since the beginning of measurements and regarding to the actual weather norm (1981-2010) 2.5 degrees warmer than the average. In addition to the temperature, fall was very dry and sunny. In particular, the weather on the northern side of the Alps was very sunny. Snowfall was reported on both sides of the Alps down to the lowlands together with the beginning of the winter 2021/ 2022 in November. It was then followed by mild temperatures and rain at the end of the year 2021.

Fire occurrence and affected surfaces

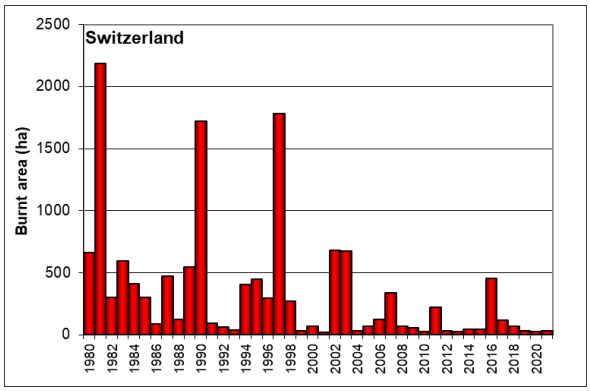
As the weather was wet, the wildfire season was calm. According to the SwissFire database, Switzerland recorded 85 wildfires in 2021 (as reported by August 2022) which burned 35.14 hectares in total (known area). The majority of the wildfires (59) and area burnt (29.52 ha) occurred in the winter half year. 26 wildfires and an area of 5.62 ha burnt in the summer half year.

Fire Causes

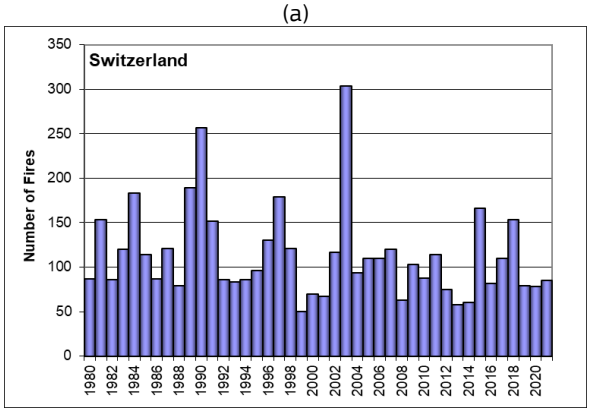
The main cause of fire in Switzerland was negligence. Three lighting caused wildfires were reported.

Loss of human life

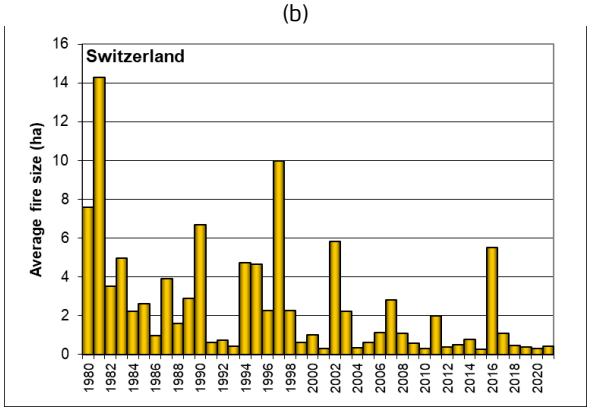
No loss of life or major damage to buildings were reported in 2021.



(a)



(b)



(c)

Figure 145. Burnt areas (a), number of fires (b) and average fire size (c) in Switzerland from 1980-2021.

Fire prevention activities

Due to the weather situation with high amounts of precipitation, the wildfire danger situation was relaxed. Only for a few days and only in parts of Switzerland wildfire danger level three was exceeded. Mainly in the Swiss Central plateau, wildfire danger partly increased. No fire bans were set in order to prevent wildfires. The Federal Office for the Environment (FOEN) proceeded its work on the national wildfire danger information and warning systems (called IGNIS). Therefore, the FOEN will base its future wildfire danger warning on the Canadian FWI System.

(Sources: Federal Office for the Environment, WSL Federal Research Institute, MeteoSwiss).

1.2.28 Turkey

Fire occurrence and affected surfaces

In Turkey, the coast-line, which starts from Hatay and extends through the Mediterranean and Aegean up to Istanbul, has the highest fire risk. In another words, approximately 57% (12.5 million ha) of Turkey's forest area is located in fire sensitive areas.

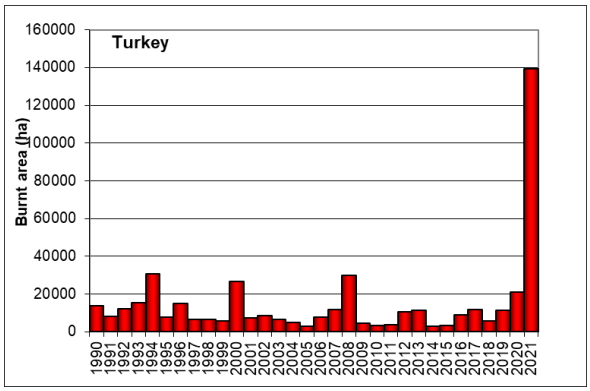
According to data derived from the General Directorate of Forestry, Department of Forest Fire Combating, in 2021 the total burnt area was 139 503 hectares. The number of fires was 2 793 in the same year

Forest fires mostly occurred during the period of March-December, particularly in June, July, August and September. When we look at the number of forest fires, July is the highest month with 503 fires and 104 665 ha (Table 46). Table 45 gives the forest fire statistics for Turkey 1990-2021.

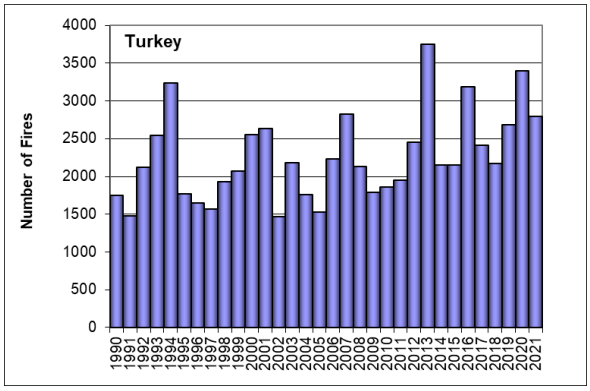
Table 45. Forest fires in Turkey 1990-2021.

Year	Fire Number	Burnt Area (ha)
1990	1750	13742
1991	1481	8081
1992	2117	12232
1993	2545	15693
1994	3239	30828
1995	1770	7676
1996	1645	14922
1997	1569	6517
1998	1932	6764
1999	2075	5804
2000	2555	26653
2001	2631	7394
2002	1471	8514
2003	2177	6644
2004	1762	4876
2005	1530	2821
2006	2227	7762
2007	2829	11664
2008	2135	29749
2009	1793	4679
2010	1861	3517
2011	1954	3612
2012	2450	10455
2013	3755	11456
2014	2149	3117
2015	2150	3219
2016	3188	9156
2017	2411	11992
2018	2167	5644
2019	2688	11332
2020	3399	20971
2021	**2793**	**139503**

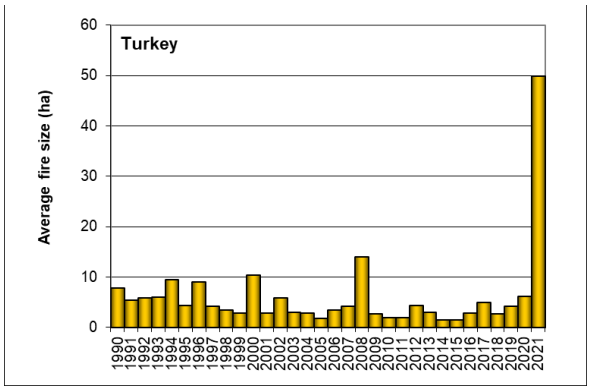
The yearly trends of numbers of fires and burnt areas in Turkey since 1990 are shown in Figure 146.



(a)



(b)



(c)

Figure 146. Burnt areas (a), number of fires (b) and average fire size (c) in Turkey from 1990 to 2021.

Table 46. Monthly distribution of forest fires in 2021.

Month	Number Of Fires	Burnt Area (Ha)
Jan	149	272
Feb	138	123
Mar	102	50
Apr	154	130
May	310	445
Jun	374	563
Jul	503	104665
Aug	419	32183
Sep	328	486
Oct	182	383
Nov	99	147
Dec	35	56
TOTAL	**2 793**	**139503**

The biggest fires in history were encountered at the same time. Areas larger than 1 000 hectares were affected by 21 fires.

Figure 147. Large fire in Turkey in 2021.

Figure 148. Agriculture fire.

In addition to forest fire, General Directorate of Forest has been intervening in agriculture fires for the recent years, which is about 2 556 non-forest incidents in 2021 (Figure 148).

Fire Causes

In Turkey, 78% of forest fires take place in forested areas up to 400 metre altitude.

These areas are:

- High populated areas.
- Areas of high migration.
- Areas where there are valuable lands.
- Places with cadastral problems.
- Tourism areas.

Most of the fires in Turkey were caused by human activities (91% in total) The causes of forest fires in 2021 are shown in Figure 149.

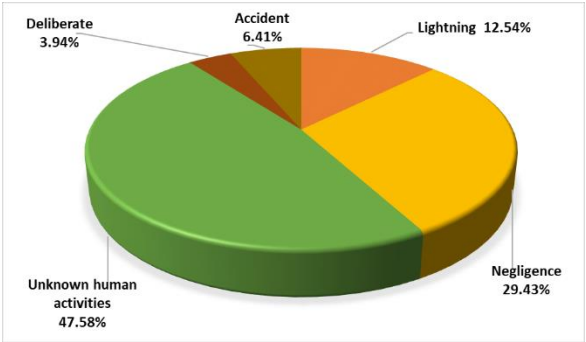


Figure 149. Fire causes in Turkey in 2021.

Fire Management

Fire management in Turkey is carried out under the responsibility of the General Directorate of Forestry (GDF). Duties are carried out by state forest enterprises functioning under regional directorates.

Regardless of the high costs involved, all required activities are planned and implemented immediately. Fire management deals mainly with activities concerning early detection, prevention and control.

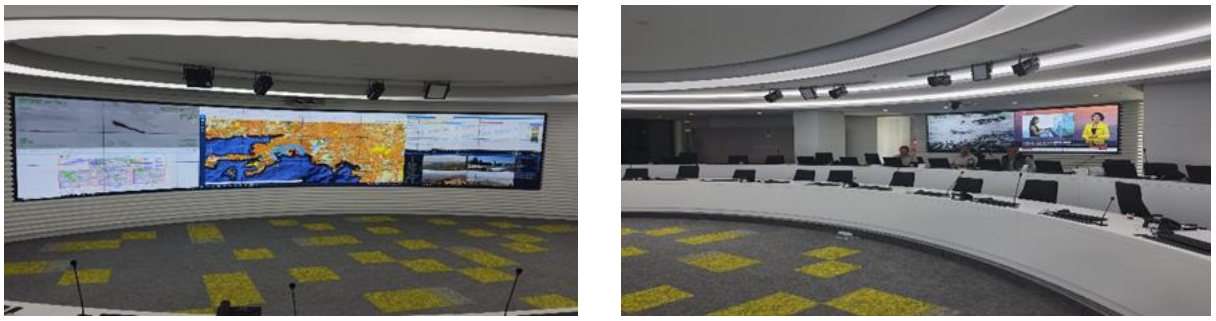


Figure 150. Fire Management Centre in Ankara.

Early Fire Warning Systems

So far, a total of 776 fire towers have been built to detect fire and report to firefighting teams. With 324 cameras at 162 points, the fires detected in our forests in the fire sensitive zone are reported to the fire management centres and the teams are sent.

The system enables rapid detection of forest fire to visible range optical cameras (Fire management centres can also monitor the progress through these cameras)

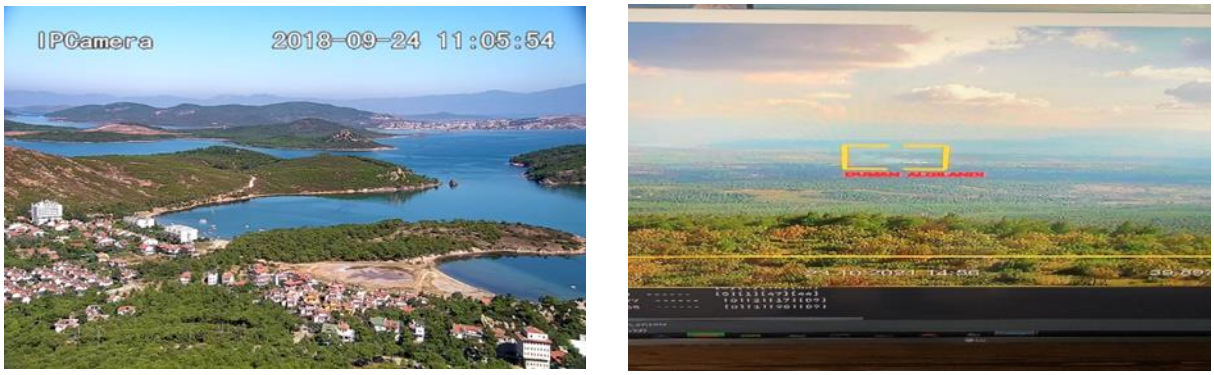


Figure 151. The camera images from fire towers.

Unmanned aircraft were used for the first time in 2021. Fire detection can be done easily with thermal cameras. Thermal cameras have been found to be very useful for managers in the ongoing fires at the decision stage.

With these tools, it guided the managers in the detection and management of forest fires.

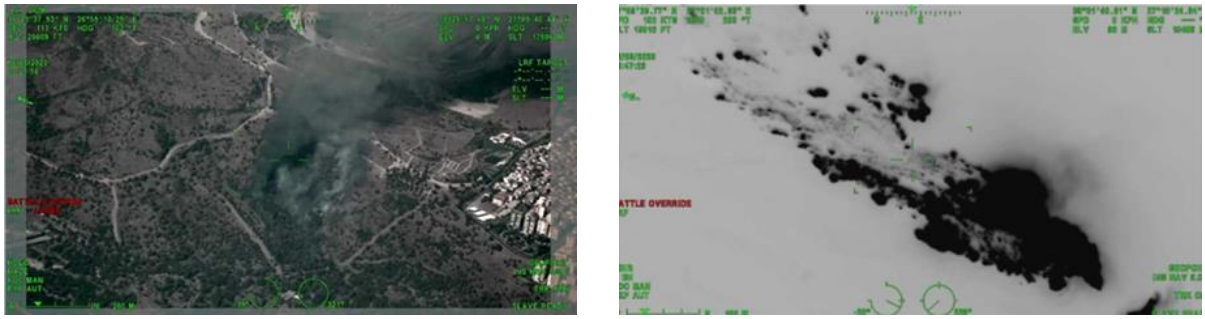


Figure 152. The camera images from unmanned aircraft.

Construction of Pools and Ponds

During 2021, for the purpose of shortening the periods of forest fire attack in forested areas where water sources are scarce, 4 350 fire pools and ponds were used.

With these water sources, the water intake times of the helicopters were shortened.

Figure 153. Fire pools and ponds.

Fire Fighting Means

In 2021, 21 000 personnel were involved in fire detection, communication and extinguishing activities. Ground and air equipment used for firefighting in 2021 are presented in Table 3.

Table 47. Firefighting forces in Turkey in 2021.

Land Means		**Aerial Means**	
Bulldozer	185	Leased Helicopter	55
Grader	263	Aircraft	20
Fire Truck	1065	Administrative helicopter	6
Water Tank	285		
First intervention vehicle	2270		
Motorcycle	524		

Preventive measures

Fire sensitive Regional Forest Directorates

- Planting fire resistant species when rehabilitating burning areas.
- Converting existing forest to fire resistant forest. (YARDOP Project: Rehabilitation of Burned Areas and the Establishment of Forest with Fire Resistant Species Project)
- Creating differential elements (roads etc.) in order to stop probable fires starting in settlements and agriculture lands from going towards forest.
- Planting fire-resistant species along roadsides in order to hinder forest fire from turning into crown fire.

Figure 154. Preventive measures.

National Forest Fire Risk Estimations in Turkey

MEUS (Meteorological Early Warning System)

We have been using the MEUS (meteorological early warning system) with wind, wind direction, temperature and humidity to create our 3-day daily fire risk maps. (Figure 155). Measures are increased by evaluating hourly changes and relative risks.

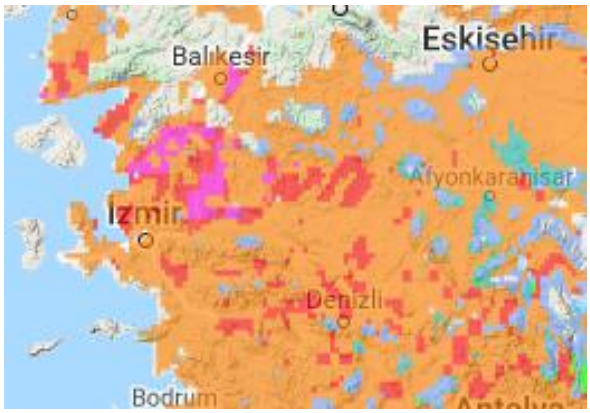


Figure 155. Example of daily fire risk map (location in İzmir)

Education, Public awareness and information campaigns.

Several education/training and awareness raising campaigns have been carried out.

Training of Technical staff.

A Fire Expert Training Program has been put into effect for personnel who will take charge in forest fires. Subjects such as fire-fighting methods, application of fire-use, first aid etc., have been given to technical staff in this training program.

In 2012 the International Forest Fire Fighting School was opened in Antalya. The facilities provided training to forest fighting teams at national and international level with a forest fire simulator.

Training of Technicians

Information has been given to technicians about the use and maintenance of tools used to combat forest fires, such as GPS, meteorological equipment, electronic hand tools and communication devices.

Training of Workers

Training has been given to Forest Fire Workers about fire-fighting methods, first-aid and other technical subjects.

Public awareness and information campaigns can be aggregated into 2 groups:

Awareness-raising activities for target groups.

- Activities for children and young people:

During 2021, brochures, books and magazines on forests were distributed to schools and other places to raise awareness about environmental, social and economic issues, fire causes and how they can be avoided.

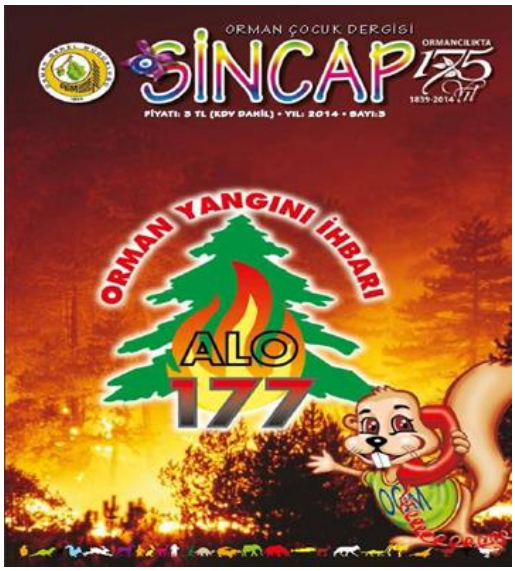


Figure 156. Example of children's magazine.

- Activities for forest villagers, hunters and shepherds:

In our country, there are 16 000 villages located beside or inside forest areas and 6.2 million people living in these areas. Forest villagers are causing forest fires by going about their agricultural activities, so messages have been transmitted to them about the importance of human action in preventing fires.

Awareness-raising activities at national level:

- Activities for specific days and weeks. (e.g. World Forestry Day).
- Coordination meetings with local authorities.
- Cooperation with radio and television channels.
- Cooperation with media and voluntary organizations.
- Training of personnel working in travel agencies and tourist facilities in fire risk areas about forest fires and the preventative measures needed to be taken.
- Training of soldiers and local fire departments.

Table 48. Number of fires and burnt area in 2021 by forestry regions and fire size class.

Region	<1.0 Ha		1.1 - 5.0 Ha		5.1 - 20.0 Ha		20.1 - 50.0 Ha		50.1 - 200.0 Ha		200.1 - 500.0 Ha		500.1 - 800 Ha		800.1 – 1500.0 Ha		> 1500 ha		TOTAL	
	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area	Nr Fire	Brt Area
ADANA	147	28	22	51	12	133	4	122	1	107	0	0	0	0	1	964	3	6293	190	7699
AMASYA	62	18	16	42	3	21	0	0	0	0	0	0	0	0	0	0	0	0	81	81
ANKARA	39	4	6	15	1	7	0	0	0	0	0	0	0	0	0	0	0	0	46	26
ANTALYA	231	55	27	68	5	51	4	134	1	86	2	656	1	515	0	0	7	58792	278	60358
ARTVİN	17	6	5	11	1	7	0	0	0	0	0	0	0	0	0	0	0	0	23	24
BALIKESİR	75	12	9	15	2	16	1	21	0	0	0	0	0	0	0	0	0	0	87	64
BOLU	24	4	8	17	1	7	0	0	0	0	0	0	0	0	0	0	0	0	33	28
BURSA	56	8	3	7	2	20	0	0	0	0	0	0	0	0	0	0	0	0	61	35
ÇANAKKALE	73	10	6	13	3	24	2	61	0	0	0	0	0	0	0	0	0	0	84	107
DENİZLİ	41	15	16	38	6	68	1	45	1	141	2	766	0	0	0	0	0	0	67	1074
ELAZIĞ	95	38	30	73	10	99	2	91	2	156	1	365	0	0	2	1836	0	0	142	2657
ERZURUM	24	13	12	31	1	19	0	0	0	0	0	0	0	0	0	0	0	0	37	62
ESKİŞEHİR	16	2	0	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	17	12
GİRESUN	65	28	21	49	9	70	0	0	0	0	0	0	0	0	0	0	0	0	95	147
ISPARTA	39	9	2	4	5	52	1	40	0	0	1	204	1	541	1	1192	0	0	50	2043
İSTANBUL	74	11	4	10	3	23	0	0	0	0	0	0	0	0	0	0	0	0	81	43
İZMİR	214	34	32	84	10	118	4	168	1	73	1	347	0	0	0	0	0	0	262	825
K.MARAŞ	154	38	28	60	11	115	2	55	5	631	0	0	0	0	0	0	0	0	200	900
KASTAMONU	66	12	9	24	3	26	0	0	0	0	0	0	0	0	0	0	0	0	78	62
KAYSERİ	18	5	2	6	1	6	0	0	0	0	0	0	0	0	0	0	0	0	21	18
KONYA	18	4	5	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	17
KÜTAHYA	36	6	5	12	1	6	0	0	0	0	0	0	0	0	0	0	0	0	42	24
MERSİN	70	12	10	25	4	42	0	0	2	170	0	0	1	544	0	0	2	8869	89	9661
MUĞLA	297	46	28	68	16	161	3	94	8	875	4	1160	0	0	2	2222	6	38474	364	43101
SAKARYA	40	10	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	16
Ş.URFA	105	40	35	86	21	182	1	30	1	52	0	0	0	0	0	0	0	0	163	390
TRABZON	38	17	20	54	9	99	1	25	0	0	0	0	0	0	0	0	0	0	68	195
ZONGULDAK	25	3	6	11	0	0	1	49	0	0	0	0	0	0	0	0	0	0	32	62
National Park	26	4	2	4	2	14	1	38	3	294	1	370	0	0	0	0	1	9052	36	9775
TOTAL	2185	490	372	898	143	1395	28	973	25	2584	12	3868	3	1600	6	6214	19	121480	2793	139503

(Source: Regional Forestry Directorate of Antalya, Turkey).

1.2.29 Ukraine

General Information

The total area of forest plots in Ukraine is 10.4 million hectares. Forests of Ukraine according to their purpose and distribution within the country perform mainly ecological (water protection, protective, sanitary and hygienic etc) functions. The forest ratio according to the whole country area is 15.9%. Forest distribution is unequal in Ukraine. Forests are concentrated mainly in the Polissya and Ukrainian Carpathians. The forest ratio is different in different natural zones, and it does not reach the optimum level (20%) when forests have an optimal positive impact on the climate, soil, water resources, mitigate consequences of erosion and can improve forest productivity.

The largest share in age structure has middle aged stands – 45%. The share of mature and over mature stands is only 17%. The average age of forests is around 60 years. A gradual aging of forests is taking place, leading to deterioration of sanitary conditions. Ukrainian forests comprise over 30 tree species. The prevailing species are: pine (*Pinus silvestris*), oak (*Quercus robur*), beech (*Fagus silvatica*), spruce (*Picea abies*), birch (Betula pendula), alder (Alnus glutinosa), ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*) and fir (*Abies alba*). The most fire dangerous coniferous forests occupy 43% of the total area, in particular, pine stands (35%), which grow in the North of Ukraine (Polissia zone) and in the South (Steppe zone) along the biggest rivers and also in the Crimea peninsula.

In Ukraine there is a historically formed situation with subordination of state forests to numerous permanent forest users (for forest management, forests are given for permanent use to enterprises, institutions and organizations of several dozen ministries and agencies). The major part of the Ukrainian forest is under subordination of State Forest Resources Agency enterprises (73%).

Fire danger in the 2021 season

For the third year in a row, the 2021 fire season began not on April 1, but a month earlier, on March 2.

The winter of 2021 was marked by a significant amount of precipitation. Unlike the previous winter period of 2019-2020, when scientists recorded the absence of "meteorological" winter with stable snow cover and prolonged frosts, this year the winter was typical – severe, with short-term thaws at temperatures up to +2-+3°C and severe frosts down to -16°C during the day and down to -32°C at night. During the winter, a stable snow cover of up to 40 cm (over 130 cm in the Carpathians) was formed, which lasted until mid-February 2021.

In the second half of February 2021, there was a rapid increase in air temperature, without significant precipitation, with a simultaneous increase in daylight hours and active solar radiation.

The first half of March 2021 was cold. Noticeable warming came in the middle of the month. Average temperatures in March ranged from 1.9°C in the north of the country to 4.7°C in the south regions. Significant precipitation was only in the West and North of Ukraine and reached 92.7 mm during the month.

Sufficient volumes of snow and water have accumulated in the river basins to form the 2021 water table at the level of average multi-year values.

The last five-year period was characterized as dry – severe droughts were observed each year during 2016-2020 (2020 was the driest year). During that 5-years period, groundwater dropped 50-60 cm below the normal level; therefore, during the relatively wet 2021 year, the groundwater level was restored to its average level.

The strong winds in the spring have become a usual event in the south of Ukraine, especially in February and March. These wind regimes contributed to the rapid drying of dead surface fuel. As a result of these factors, the natural conditions for the occurrence of forest fires in the South and East of Ukraine were already formed at the beginning of March 2021.

Due to the solid snow cover, which lasted continuously for a long time (1.5 months) and lasted almost until the end of winter (until mid-February), in the spring of 2021 the fire danger in the territory of Ukraine, which usually increased sharply in the spring (the presence of significant loads of dead dry grass in areas bordering the forest, which dries extremely quickly to a combustible state) was absent. With the appearance of a stable cover of green grass and young leaves on trees (in April-May), the risk of fire spreading from open landscapes to forest lands has dropped sharply. This led to a small number and area of forest fires in the spring of 2021, compared to 2020 (only 1 large fire was registered, which occurred on April 2).

In contrast to 2020, when during the fire season there were periods of continuous drought that lasted for more than 1 month in the Central, Southern, and Eastern parts of Ukraine, in 2021 there were no such periods of severe droughts.

From April to September 2021, precipitation was recorded regularly: in the North and West of Ukraine with a frequency of 1 time in 7-10 days; in the Central, South and East parts of Ukraine with a frequency of 1-2 times per month. Such weather conditions contributed to a reduction in the number and area of forest fires in the spring and summer of 2021.

For five years in a row, starting from 2017, the driest period of the year, especially for the East and South of Ukraine, was the autumn months.

In September 2021, a complete absence of precipitation was recorded in the South of Ukraine. In mid-October, precipitation occurred only in three regions: Cherkasy, Mykolaiv, and Sumy. This led to an increase of fire danger in autumn.

The driest month of 2021 was October, which saw the largest number and area of forest fires in 2021: 167 fires with a total burnt area of 71.92 hectares.

There was almost no precipitation in November 2021, but the decrease in average daily air temperature contributed to the reduction of fire danger in the forests of Ukraine.

The average annual temperature in 2021 was lower compared to 2019 and 2020. But the intensity of temperature increasing during the fire season was observed: this indicator exceeded the climatic norms by 0.4-2.0°C throughout the territory of Ukraine.

The minimum air temperatures in 2021 fell in January and February In the South part of Ukraine, minimum temperatures ranged from -12 to -14°C; in the eastern regions -16 to -18°C; in the West they reached -14 to -22°C, and in the central regions -15 to -24°C. In the northern regions, the lowest temperature was recorded at the level of -22 to -26°C.

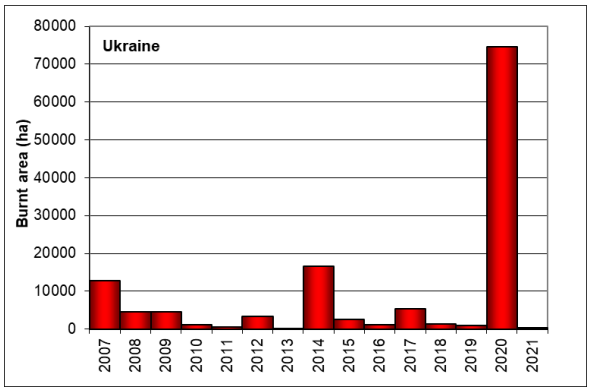
A steady increase in air temperature was observed during the fire season, and only April and October were marked by cold weather. The maximum average monthly temperatures in Ukraine for 2021 were recorded in July and August at the level of 34.4-40.9°C.

Abnormally high temperatures exceeded the values of 2019 and 2020 in most of the country, with the exception of Ivano-Frankivsk, Ternopil, Chernivtsi, Kherson and Vinnytsia regions. Maximum temperatures rose in the North to 37-38°C in August, in the East to 39-41°C in July, in the West of the country to 36-39°C during July and August, in the southern regions were within 38-41°C in July and August, in the central regions 37-38°C in August and July.

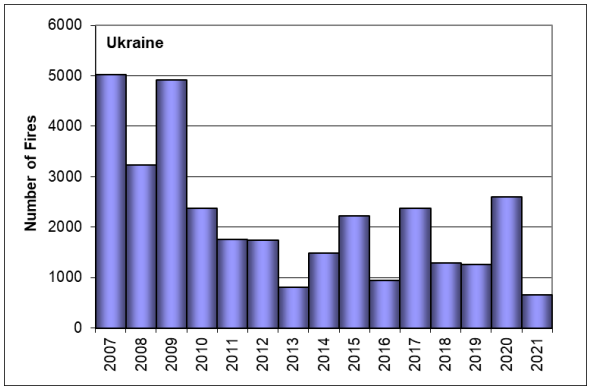
Since 2018, a new fire danger assessment methodology has been implemented in Ukraine. It has 5 classes of fire danger: I – no fire danger; II – low fire danger; III – medium fire danger; IV – high fire danger; V – extreme fire danger. The distribution of days by fire danger classes during the fire season 2021 is given in Figure 158. (*data provided by: State Enterprise Forestry Innovation and Analytical Center, Pavlenko O.*)

Fire occurrence and affected surfaces

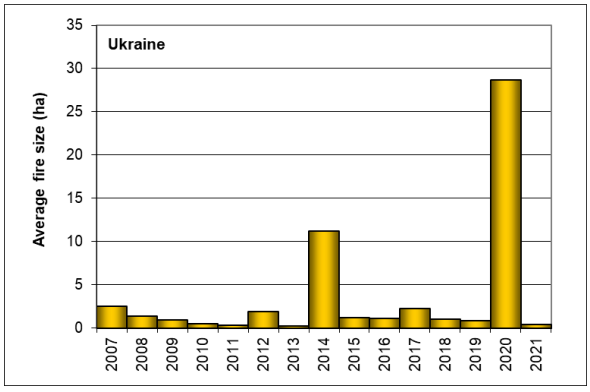
In 2021, 659 fires with a total burnt area of 289 hectares were supressed in the forests belonging to the State Forest Resources Agency of Ukraine, which is 4 times less than the number and 258 times less than the total burnt area of fires in 2020. The average area of one fire decreased 66 times and amounted to 0.44 hectares (Figure 158).



(a)



(b)



(c)

Figure 157. Burnt areas (a), number of fires (b) and average fire size (c) in Ukraine from 2007 to 2021.

During the fire season of 2021, three peaks of fire danger were observed: in May, July and October.

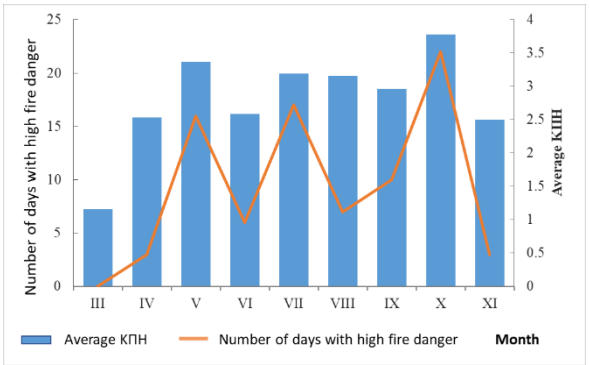


Figure 158. Number of days with a high class of fire danger and average fire danger class during the fire season 2021.

Taking into account the abnormally dry autumn, fire danger was increased at the end of the fire season, and the fire peak in 2021 shifted to September-October (43.8% of all forest fires) (Figure 159).

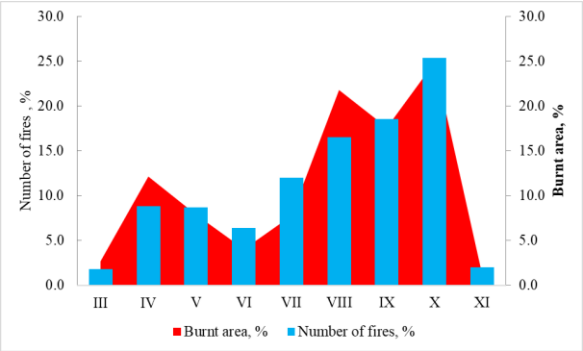


Figure 159. Number of fires and burnt area distribution by month in the 2021 fire season.

The biggest number of forest fires were registered in Kherson (114 cases), Kharkiv (91), Luhansk (68), Kyiv (67) and Dnipropetrovsk (64) regions.

The largest total burnt areas were registered in Dnipropetrovsk (50 hectares), Zhytomyr (42), Kherson (39), Luhansk (36) and Kharkiv (33) regions (Figure 160). In two cases (Volyn and Luhansk regions) fires that started as surface fires escaped and transformed to crown fires.

Only one large forest fire was registered in Dnipropetrovsk region with a total area of 6 hectares, which occurred as a result of military trainings.

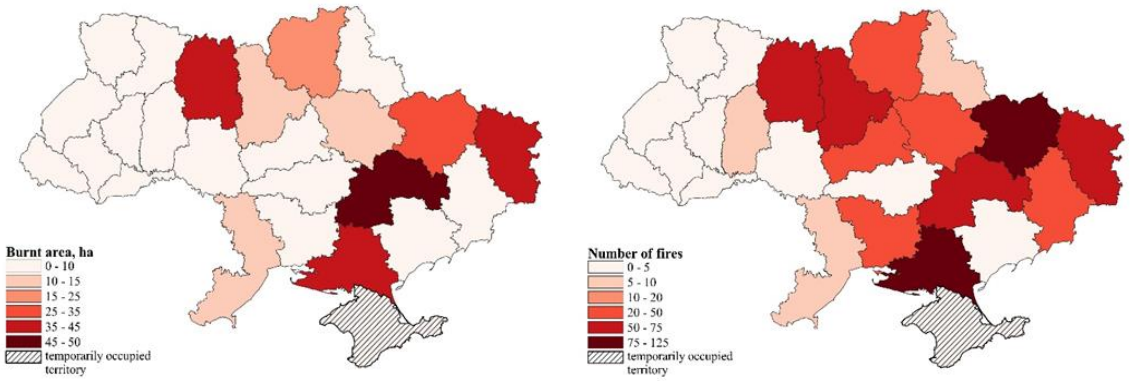


Figure 160. Distribution of burnt areas (A) and fire incident numbers (B) by regions (oblasts) in 2021.

Economic losses

The economic losses caused by forest fires are shown in Figure 161.
In 2017 they were estimated to be 43 800 000 Ukrainian hryvnia (UAH),
in 2018 it was 27 200 000 UAH,
in 2019 – 6 700 000 UAH,
in 2020 – 19 100 000 000 UAH,
and in 2021 – 2 100 000 UAH.

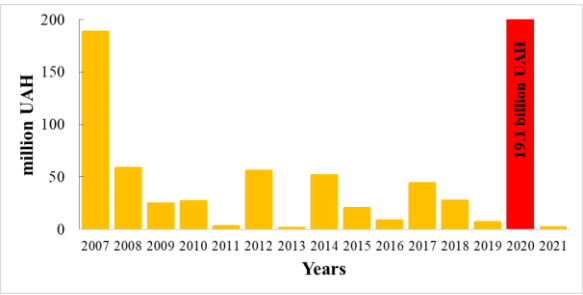


Figure 161. Economic losses caused by forest fires (data provided by the State Forest Resources Agency of Ukraine and State Service of Statistics).

Fire causes

The majority of forest fires (more than 85%) were caused mainly by the negligence of local people. The main cause of forest fires is the violation of the fire safety requirements in forests during the period of high fire danger.

Fire fighting means and fire prevention activities

Protection of forests belonging to the scope of management of the State Forest Resources Agency of Ukraine is carried out by the State Forest Guard officers, the total number of which is 17 thousand persons, almost 14 thousand of which are directly involved in daily forest protection at the level of forestry.

Direct protection of forests from fires is carried out by about 17 thousand workers of state forest protection. Technical equipment of forest fire departments includes 647 fire trucks, 433 firefighting modules on a four-wheel drive chassis and adapted equipment, over 1 000 motor pumps, 8 800 individual sprayers, 2 200 radio stations, etc.

Elimination of forest fires in the initial stage is the responsibility of the appropriate departments of forestry enterprises. If there is a threat of a large forest fire, units from the State Emergency Service of Ukraine, regional state administrations and other services are involved within their competence in order to extinguish the fire.

Forest fires in 2021 were mostly liquidated at the initial stage by the forces of the State Forest Guard (71%), with the involvement of significant forces and means of the State Emergency Service of Ukraine (29%), which in turn increased the costs of their elimination.

4.1 thousand articles and appearances on radio and TV were published in the mass media and distributed through social networks.

In 2021, 48.0 km of firebreaks and 53.1 thousand km of fuelbreaks were created, 275.9 thousand km of fuel breaks and firebreaks were restored.

Research Activities

In 2021, several research projects aimed at improving fire management were completed:

1) "To study features of pyrogenic damage in forests growing in different natural zones in Ukraine and develop the activities to reduce its negative consequences" *S.Sydorenko, V. Voron, I.Koval, Ye. Melnyk, I. Tymoshchuk. Ukrainian Research Institute of Forestry and Forest Melioration named after G. M. Vysotsky (URIFFM)– Laboratory of Forest Ecology. Steppe Branch of URIFFM.*

This project was started in 2020, and the planned project duration is 5 years. The project was started at the request of the State Forest Resources Agency of Ukraine (State Registration No 0120U101893).

During 2021 a task to develop the National scale zoning of forest fire risks was completed. Fire Zoning is necessary to identify the most vulnerable areas to justify providing additional funding to these areas (for the state enterprises that are responsible for forest management) to ensure the implementation of fire prevention treatments.

2) "Fire Management Plan for the Chernobyl Exclusion Zone" *Sydorenko S, Borsuk O, Zibtsev S, Varukha A, Pavlichenko P, Kirilyuk E., Riva Duncan, Jeff Stevenson, Shust O., Baitala M., Halash S., Testov P., Galushchenko O., Demidenko J., Kyryliuk E., Kizyun R., Korchak O., Kramarenko E., Slobodenyuk S., Stukalenko K., Udovenko K. Ukraine, US FS.*

"Forest fire safety in Ukraine".

Under the Grant Agreement № 18-IG-11132762-423 from 17.09.2018.

Subproject: Plan of fire safety and fire safety enforcement measures on the territory of exclusion zone and zone of unconditional (mandatory) displacement (fire management plan). The development of an official Fire management plan has been launched as a first step towards the implementation of this practice in Ukraine. With further integration into the current regulatory framework.

(Source: State Forest Resources Agency of Ukraine; Ukrainian Research Institute of Forestry and Forest Melioration, Ukraine)

1.2.30 United Kingdom

Introduction

Parts of the UK experienced a fourth consecutive year of a prolonged dry period as well as several dry and very warm periods, especially in Spring. These conditions provide the ideal environment for the development and spread of large and disruptive wildfires. However, wildfire incidents and area burnt was the lowest in four years but above the 10 year average.

Fire danger in the 2021 season

The Met Office reported that 2021 was slightly warmer than average for the UK overall, most notably in Northern Ireland. Rainfall was broadly close to average, though the western half of Scotland had a rather dry year. It was a sunnier than average year in many northern and western areas, although the Midlands, south-east England and East Anglia were duller than average.

Notable extreme events during the year included wintry weather with snowfalls during January and February, a hot spell in July leading to the issue of heat health warnings, heavy and persistent rain in northern England and southern Scotland in late October, and significant disruption caused by Storm Arwen in late November for which a rare Red weather warning was issued. Five named storms affected the UK during 2021, resulting in significant tree damage in the north east of England and south east of Scotland.

Overall spring was colder than average, with notable warm spells only at the end of March and the end of May, and there were regular frosts in many areas. Most of March and April were relatively settled, and April was also notably sunny, but May was very unsettled and cold except for the final few days.

The summer was warmer than average, with mean temperatures more than 1.5 °C above normal over parts of western Scotland but barely above average in southern and south-eastern counties of England. The south-east of England, as well as being coolest relative to average, was particularly wet, with almost double the average rainfall in a few places, though Wales, northern England, and the majority of Scotland were much drier than average, with less than half the usual rainfall in some places. Sunshine was above average for northern England, most of Scotland, and parts of Northern Ireland.

The first half of June was generally settled and warm in most areas, and there was a notable very warm spell during July, but other periods have been unsettled, often with thunderstorms and localised downpours in certain areas. The second half of August was mostly dry.

Using analysis of EFFIS, Wildfires in 2021 resulted in a decrease in the number and area burnt over the last four years, with incidents focused in Spring and the largest amount burnt in Scotland (see Figure 162 and Figure 163). Small to moderate incidents also occurred across the rest of the United Kingdom.

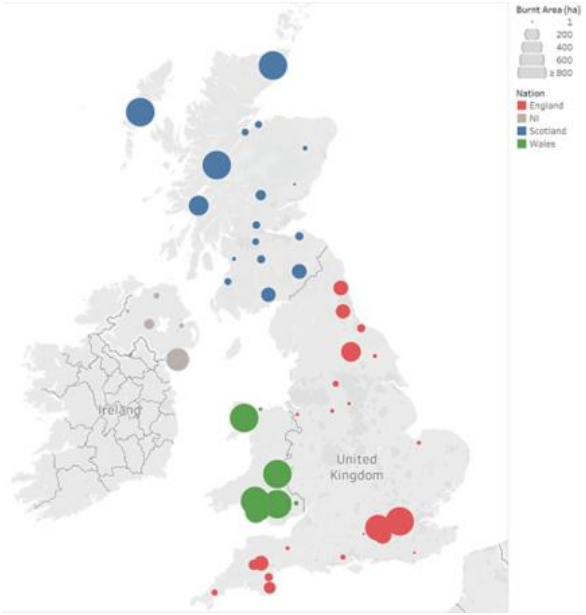


Figure 162. Location of wildfire in the United Kingdom (*Analysis by Dr Thomas Smith of London School of Economics using EFFIS data*).

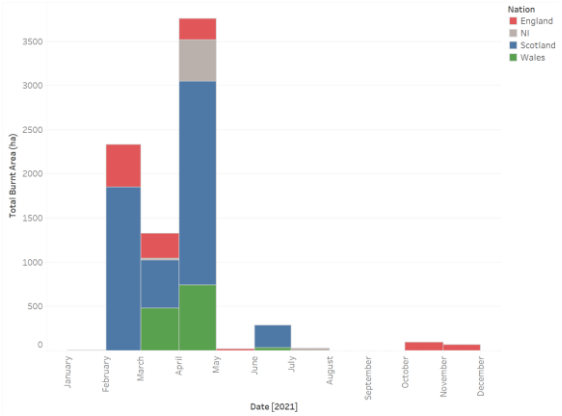


Figure 163. Area burnt by nation in the United Kingdom by month in 2021 (*Analysis by Dr Thomas Smith of LSE using EFFIS data*).

Using the definition of the National Fire Chief Council (NFCC) and National Operations Guidance (NOG) (the criteria are one or more of the following):

- ≥ 1 hectare (10,000 m^2)
- ≥ 4 Appliances or vehicles
- ≥ 6 hours duration
- Flame Length of ≥1.5 m
- Serious Risk to Life, Environment, Infrastructure, Property.

There were 237 wildfires recorded on the UK National Resilience Reporting Tool (NRT). This represents a 59% increase on 2020.

United Kingdom

UK wildfire conference

The UK Wildfire conference was due to be held in 2021 but was postponed due to uncertainty around Covid. EWWF supported some of the planning for the postponement to 2022 and the creation of an interim wildfire webinar in November 2021 hosted by the Northern Ireland Environment Agency (NIEA).

England and Wales

The first wildfire to meet the NOG criteria was recorded on 11th February in Devon, with the last being recorded on 2nd December in Dorset (a span of 295 days). The 2021 NOG criteria wildfires began earlier than in 2020 by 37 days and ended later in the year by 76 days. The 2021 'season' was 111 days longer than in 2020.

The 237 wildfires occurred within 25 FRS areas. 22 in England (Cornwall, Cumbria, Derbyshire, Dorset & Wiltshire, Devon & Somerset, Durham and Darlington, Essex, Greater Manchester, Hampshire & IoW, Hereford and Worcester, Lancashire, Merseyside, Northumberland, North Yorkshire, West Yorkshire, Surrey, West Sussex, Staffordshire, Royal Berkshire, Nottinghamshire, South Yorkshire and Suffolk) and all 3 FRS in Wales (South Wales, North Wales and Mid and West Wales).

The National Fire Chiefs Council (NFCC) continued to grow and embed its specialist wildfire tactical advisors (WTA) group during 2021 and has increased the number of FRS who provide support to the Tactical Advisor capability to 20 providing 47 wildfire tactical advisors. UK National Resilience has taken on a greater role in coordinating the management and deployment of the WTAs.

NFCC has further developed a coordinated and consistent fire and rescue service social media and communications framework to support individual services in their delivery of wildfire prevention and safety messaging.

Natural England reported Sites of Special Scientific Interest (Natura 2000) in 2021 with 28 separate incidents reported by staff. These occurred on 25 sites with an area being burnt of approximately 600 hectares. Five National Nature Reserves were affected with a total burn area of 42 hectares.

England and Wales Wildfire Forum

The England and Wales Wildfire Forum (EWWF) is a multi-agency stakeholder group of public, private and third-sector parties which works to address wildfire issues. Throughout 2021, the forum continued to share updates amongst members about relevant policy, guidance, research, opportunities and news about wildfires.

During 2021, EWWF and the Scottish Wildfire Forum provided an evidence submission to The House of Lords Select Committee on Risk Assessment and Risk Planning which was considering risk assessment and risk planning in the context of disruptive national hazards.

Wildfire Framework for England

The Home Office has produced a Wildfire Framework with support from the EWWF and government departments, principally Defra, the Cabinet Office and the Department for Levelling Up, Housing and Communities (DLUHC). This is a significant, and very welcome, document as it "identifies responsibilities, clarifies relationships and facilitates coordination at government level and between key wildfire stakeholders, in England." Therefore, it is of fundamental importance to guiding how the EWWF and other partners liaise with government in a coordinated approach to wildfire mitigation.
https://fireengland.uk/sites/default/files/2021-12/211220%20Wildfire%20Framework%20for%20England.pdf

Scotland

Scottish Fire and Rescue Service (SFRS) are currently reviewing the definition of wildfires following recent research on the topic to ensure that there is a consistent and useful definition for the whole of Scotland.

SFRS attended 144 large outdoor fires (over 1000m^3) from January to December 2021, with most incidents occurring in February (30) and April (50). 53% of large outdoor fires in 2021 occurred in Spring and 22% in Winter.

The Scottish Wildfire Forum issued 7 Wildfire Danger Assessments in 2021 for "Very High" or "Extreme" fire danger conditions. 5 warnings were issued in the period 20th March – 28th May i.e. the highest fire danger was in the late winter – spring period.

45 large fires >30ha registered on MODIS in 2021, all 45 occurred in the 1st Jan – 14th June period i.e. late winter – spring period. The largest fire (261ha) was in the Na h-Eileanan Sar (Western Isles) region on 12 Feb 2021. This was when eastern and central Scotland had a blizzard (snow and gales) known as the "Beast from the East". At the same time a number of wildfires occurred on the Isle of Skye in the west, where there was no snow, high wind and low relative humidity. A larger number of fires were recorded in the VIIRS system but it is likely that some of these fires were traditional burning for land management purposes.

A key part of the fire prevention work was the communication of the fire danger messages. The Scottish Wildfire Forum continued to enhance the communications strategy for the distribution of wildfire danger messages to emergency planners, utility companies, rural industries and the general public. The Scottish Fire and Rescue Service and other agencies of the Scottish Government increasingly co-ordinated their efforts with support from the forum.

There was also significant work carried out through a number of agencies, co-ordinated by Visit Scotland, on messaging related to the continued high level of use of the countryside by the public. New fire prevention messages and materials were developed in relation to campfires, barbecues and other ignition sources. This work on social media directing fire prevention messages to younger demographics by the Cairngorms National Park Authority and others continued and was complimented by work on the ground by Ranger Services and special patrols by SFRS and Police Scotland. Feedback indicated a significant number of hits for these messages.

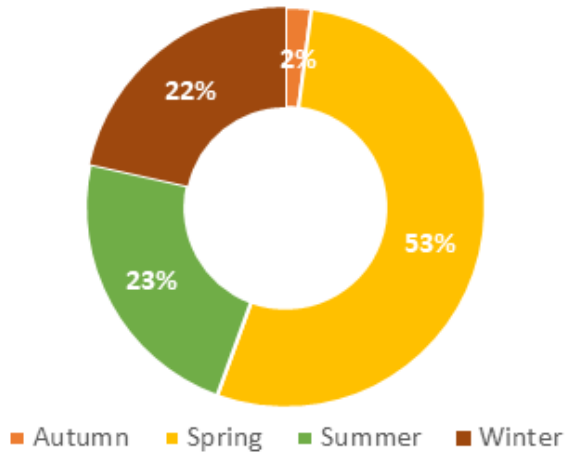


Figure 164. Seasonal distribution of large outdoor fires in 2021.

The location of large outdoor fires in Scotland is provided below.

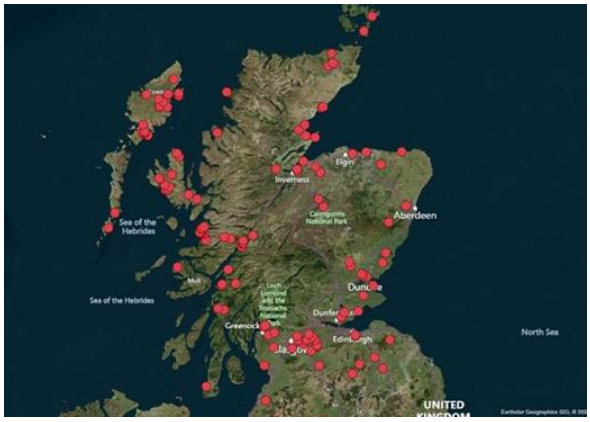


Figure 165. Location of large outdoor fires in Scotland in 2021.

Northern Ireland

Northern Ireland is developing a Strategic Way Forward to address the wildfire issue. A cross government Strategic Wildfire Group has been established and a Wildfire Stakeholder Forum has also been set up which includes a wide variety of government agencies, land managers and environmental organisations. Through co-design these groups have drafted shared goals, themes and recommendations for action and will now begin to develop an implementation plan.

The Forest Service Emergency Fire Plan was activated from 11th March 2021 to 23rd June 2021. During this period, NI Fire and Rescue Service, supported by Forest Service staff, attended 17 fire incidents with a resulting burnt area of approximately 43.4 hectares of forested land and 29.6 hectares of open ground on Forest Service managed property.

Fire prevention activities and information campaigns

NFCC, and individual Fire and Rescue Services, supported the distribution of Met Office wildfire risk notifications and the dissemination of wildfire prevention social media throughout 2021.

The Department for Environment, Food and Rural Affairs (DEFRA), including Forestry Commission, National Parks and Natural England as well as Devolved Administrations supported Fire and Rescue Services using social media and other approaches to inform and warn the public of period a high wildfire risk during the Coronavirus period.

Operations of mutual assistance

No requests were made to the United Kingdom for mutual assistance for wildfire incidents during 2021.

Climate change

2021 saw the publishing of the 3rd Climate Change Risk Assessment (CCRA) for the United Kingdom, including a commissioning of papers on UK wildfire and climate change (see Research Activities section). https://www.ukclimaterisk.org/

Wildfire is seen as a cross-sector risk linking to infrastructure, heath, built and natural environment, business, industry and international themes. Additionally, interdependencies have been mapped out for wildfire linked to existing climate drivers, hazardous events and impacts.

Research activities aimed at improving fire management

UK Wildfires and their Climate Change

This report assesses the magnitude of present and future UK wildfire risk in the context of climate change, together with a review of the response to that risk in terms of adaptive risk management. The report offers a more comprehensive assessment of wildfire risk for the third CCRA, bringing together new evidence that has emerged over the past five years.

https://www.ukclimaterisk.org/independent-assessment-ccra3/research-supporting-analysis/#uk-wildfires-and-their-climate-challenges

The effects of climate change on indicators of fire danger in the UK

An analysis using a version of the Met Office wildfire model and the latest UKCP18 climate projections (Arnell *et al.*, 2021) showed how climate change substantially increases fire danger across the whole of the UK. The greatest absolute fire danger is in the south and east, although danger is projected to increase everywhere. Results are available at ukcri.org. The projected amount of change varies to a certain extent across different indicators of fire danger, supporting the need for the development of a fire danger rating system tailored to UK conditions.

Arnell, N.W., Freeman, A., & Gazzard, R. (2021b). The effect of climate change on indicators of fire danger in the UK. Environmental Research Letters 16, 044027 10.1088/1748-9326/abd9f2

https://iopscience.iop.org/article/10.1088/1748-9326/abd9f2

In January 2021 the UK Wildfire Research Group met virtually for a second time to bring together researchers and practitioners to develop proposals to the research recommendations defined in Natural England's "The causes and prevention of wildfire on heathlands and peatlands in England (NEER014)".

This followed up the series of focused breakout room discussions, participants explored the topics to identify potential collaborations and funding sources in order to progress the topic within the research community.

"Toward a UK fire danger rating system: Understanding fuels, fire behaviour and impacts"

At the start of 2021, the NERC-funded UK Fire Danger Rating System project (UKFDRS) was still working through the disruption due to the Covid-19 pandemic. Through 2021 we were able to restart our field monitoring and laboratory work, and in spring 2021 several full-time postdoctoral research associates and technician roles joined the project.

In September 2021, the project team met in person for the first time at Wareham Forest to explore recent fire activity and to further develop research activities across the different work packages.

In April 2021, the NERC-funded UKFDRS project and the Scottish FDRS project held a joint webinar to share updates on both projects. A recording of the presentations can be found here: https://www.youtube.com/watch?v=co7d9tDcoGY

The project secured a 12 month no-cost extension from the funder NERC (Natural Environment Research Council) to account for the Covid-19 disruption during 2020. The revised end date for the project is now 31st December 2024.

For more information, please visit the project website (www.ukfdrs.com) or find on Twitter (@ukfdrs).

Scottish Fire Danger Rating System

The results of the Scottish Fire Danger Rating Research Project were published in October 2021 https://www.hutton.ac.uk/sites/default/files/files/publications/SFDRS-Research-Report-Final-15-2-2022.pdf.

This identified a clear pattern of predominantly spring fires in shrub, pasture and bog fuel types, which was different from the European norm.

Research into the Scottish Fire and Rescue Service (SFRS) wildfire: incident reporting system by the James Hutton Institute and data analysts in SFRS continued.

2021 saw the continuation of the Leverhulme Centre for Wildfires, Environment and Society.

A collaboration between four UK universities (Imperial College London, King's College London, University of Reading and Royal Holloway, University of London), it is a ten-year, £10 million activity addressing the many challenges of wildfire, integrating approaches from the social and natural sciences. Its aims are to develop theory and advance prediction capability for wildfire; quantify its impacts on societies and economies; and initiate a process leading to better ways for people, ecosystems and wildfire to coexist. For more information please visit the project website: wildfire@imperial.ac.uk and follow on Twitter: @centrewildfires

UK partners in Pyrolife – This is a large ITN network funded by EU H2020 programme to train a new generation of fire scientists embracing diversity of knowledge, approaches, views and cultures. UK partners in Pyrolife are Nick Kettridge at University of Birmingham and Guillermo Rein at Imperial College London

(Source: Forestry Commission, UK).

1.3 Comparison of Southern EU countries with longer time series (1980-2021)

The long time series of forest fire data available for these 5 large southern countries (Portugal, Spain, France, Italy, and Greece) justifies a separate analysis as has been the case in previous reports.

Figure 166a shows the total burnt area per year in the five large Southern Member States since 1980. The statistics vary considerably from one year to the next, which clearly indicates how much the burnt area depends on seasonal meteorological conditions.

The total burnt area in 2021 was 391 736 ha (Figure 166a), nearly double the previous year's total, and the highest since 2017. Of the five countries, Italy recorded the highest burnt area, but Greece had a worse season compared with previous years, with their fourth highest burnt area since 1980.

Figure 166b shows the yearly number of fires in the five southern Member States since 1980.

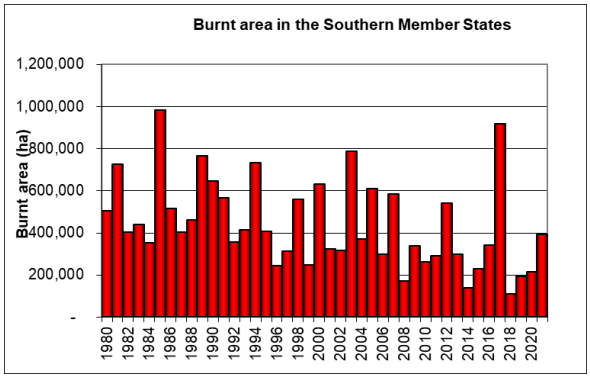
After the increases recorded during the 1990s, which was also partly due to the improvement in recording procedures, since around the mid-2000s the number of fires has shown a general downwards trend. In 2021 the total number of fires was 28 944, less than the previous years and among the lowest of the last decades. (see Table 49 and Annex 1 for details).

Figure 166c shows the yearly average fire size in the five countries since 1980. There is generally a difference in average fire size before and after 1990.

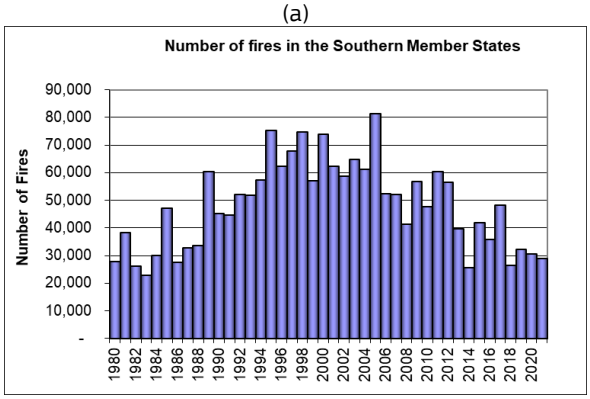
This is a similar trend to that observed in the number of fires and is also partly due to the same reasons (the additional fires that are recorded thanks to the improvements in the statistical systems are the smallest ones). It is also largely due to the improvements of the fire protection services of the countries.

However, recent years have seen some large average fire sizes that compare with the figures of the 1980s.

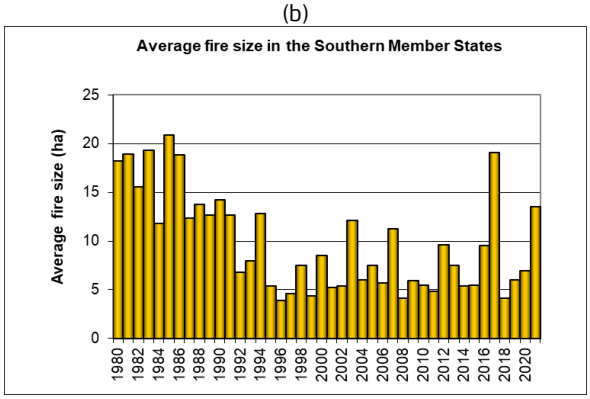
In 2021 the average fire size was 13.5 ha, the second highest since 1990 and beaten only by the exceptional year of 2017 in recent decades. The average fire size for Greece increased nearly 10-fold compared with 2020. Spain and Italy both recorded average fire sizes around double those of 2020, and those of France were around 10% higher. Only Portugal registered a drop in average fire size with respect to 2020.



(a)



(b)



(c)

Figure 166. Burnt area (a), number of fires (b), and average fire size (c) in the five Southern Member States since 1980.

Figure 167 compares the yearly averages of burnt areas, number of fires and average fire size for the periods 1980-89; 1990-1999, 2000-9 and 2010-2019 with the figures for 2021. It shows each of the 5 countries separately and also their total.

Table 49 gives a summary of the burnt areas and number of fires for the last 42 years, the average for the 1980s, the 1990s, the 2000s, the 2010s and the average for the last 2 years, together with the figures for 2021 alone.

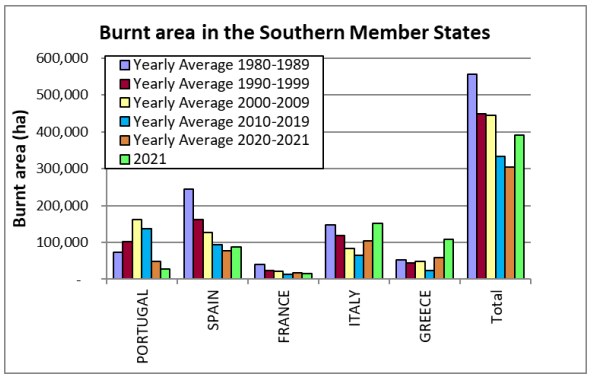
The total burnt area for 2021 was higher than the average for the last two decades. (Figure 167a).

The total number of fires, however, was lower than any of the previous four decades. This implies that the season was marked by fewer, but larger fires, which is borne out by the average fire size. (Figure 167b,c).

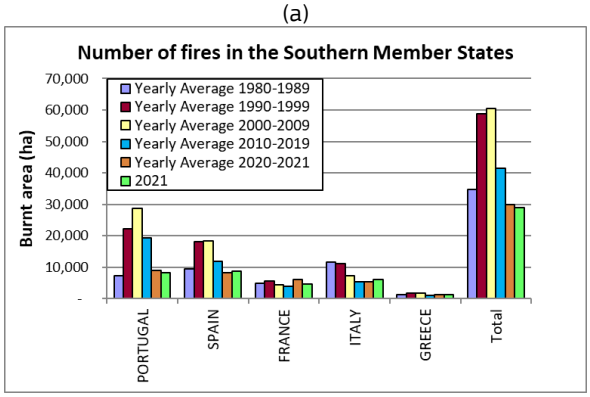
Figure 168 shows the contribution of each of the five Member States in terms of burnt areas and number of fires to the overall figures for all five countries in 2019.

Since the area of each country is different, and the area at risk within each country is also different, the comparisons among countries cannot be absolute. It should also be borne in mind that different ways of recording fires, e.g. through satellite mapping rather than ground measurements, may lead to an under-representation of the smallest fires and result in an inflated figure for average fire size.

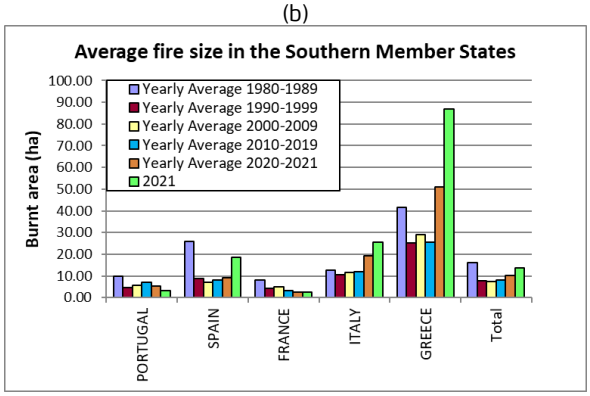
In 2021, Italy accounted for the highest proportion of burnt area (39% of the total), although more fires were recorded in Spain (30% of the total number of fires) and Greece had the largest average fire size.



(a)

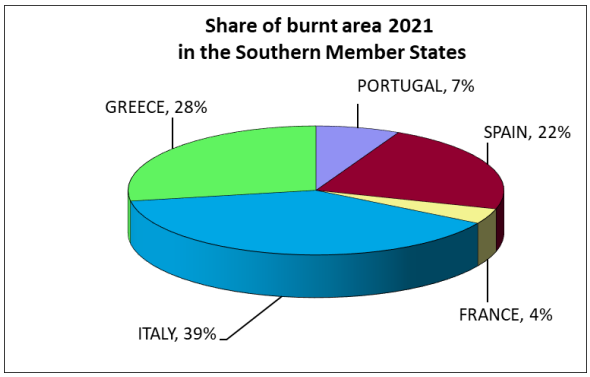


(b)

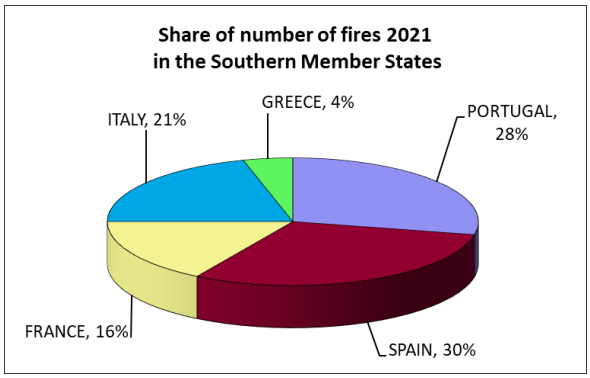


(c)

Figure 167. Burnt areas (a), number of fires (b), and average fire size (c) in the five Southern Member States in the year 2021 as compared with average values for previous decades.



(a)



(b)

Figure 168. Share of the total burnt area (a) and the total number of fires (b) in each of the Southern Member States for 2021.

Table 49. Number of fires and burnt area in the five Southern Member States in the last 42 years.

Number of fires	PORTUGAL	SPAIN	FRANCE	ITALY	GREECE	TOTAL
2021	**8 186**	**8 780**	**4 739**	**5 989**	**1 250**	**28 944**
% of total in 2021	28%	30%	16%	21%	4%	100%
Average 1980-1989	7 381	9 515	4 910	11 575	1 264	34 645
Average 1990-1999	22 250	18 152	5 538	11 164	1 748	58 851
Average 2000-2009	28 774	18 369	4 418	7 259	1 695	60 514
Average 2010-2019	19 362	11 860	3 865	5 420	946	41 452
Average 2020-2021	8 903	8 263	6 056	5 427	1 155	29 803
Average 1980-2021	18 940	14 178	4 748	8 691	1 401	47 958
TOTAL (1980-2021)	795 477	595 479	199 416	365 027	58 826	2 014 225

Burnt areas (ha)	PORTUGAL	SPAIN	FRANCE	ITALY	GREECE	TOTAL
2021	**28 360**	**87 880**	**15 114**	**151 964**	**108 418**	**494 082**
% of total in 2021	7%	22%	4%	39%	28%	100%
Average 1980-1989	73 484	244 788	39 157	147 150	52 417	556 995
Average 1990-1999	102 203	161 319	22 735	118 573	44 108	448 938
Average 2000-2009	160 985	127 229	22 362	83 878	49 238	443 693
Average 2010-2019	138 084	94 514	12 475	63 907	24 220	333 307
Average 2020-2021	47 765	76 902	16 096	103 810	58 859	304 118
Average 1980-2021	115 312	153 150	23 797	103 398	43 275	438 990
TOTAL (1980-2021)	4 843 096	6 432 302	999 479	4 342 697	1 817 544	18 437 565

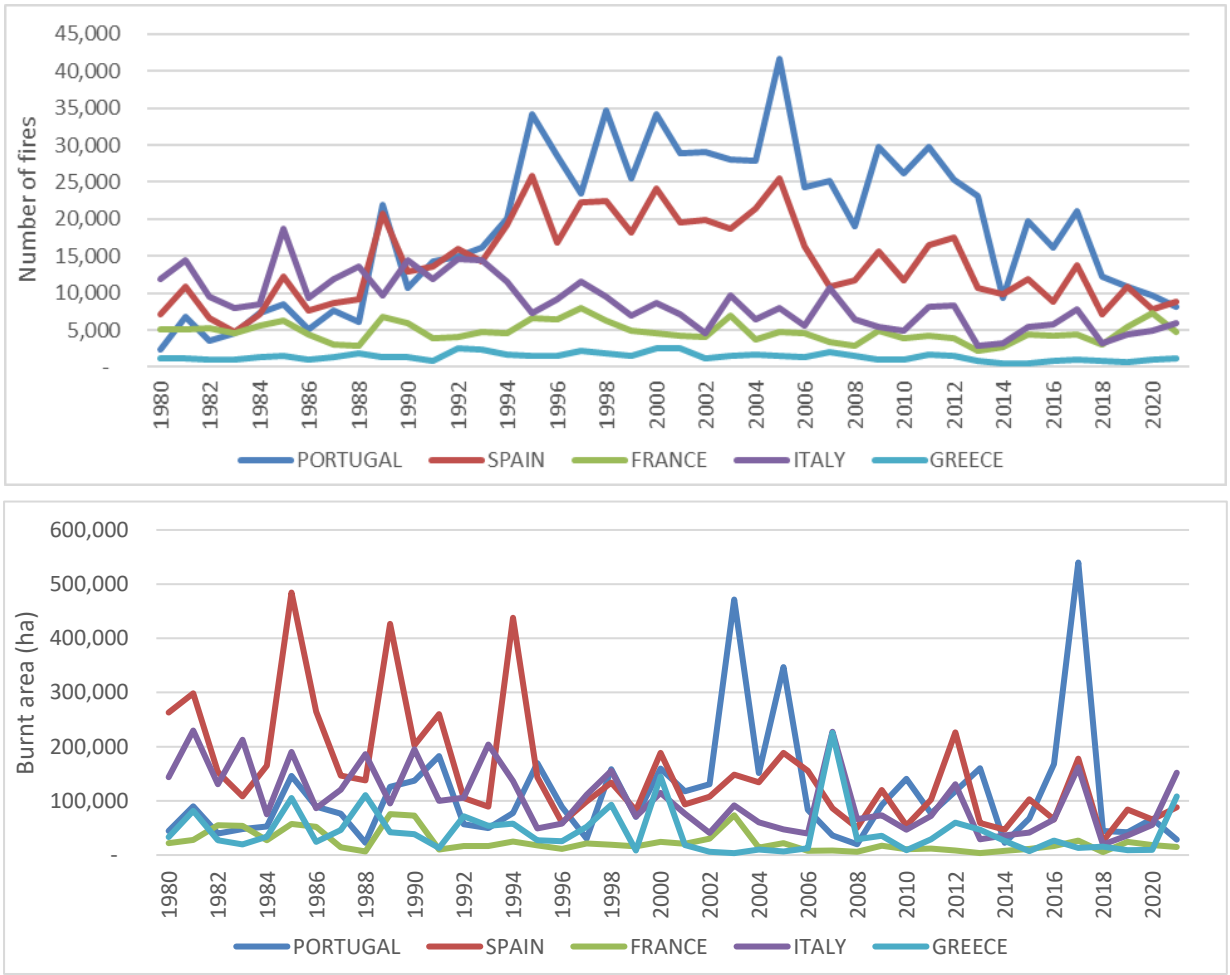
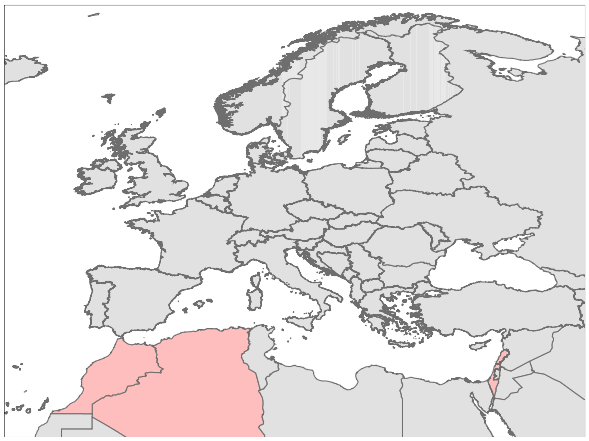


Figure 169. Comparative number of fires (top) and burnt area (bottom) in the 5 large EU-Med countries 1980-2021.

1.4 Middle East and North Africa Countries



1.4.1 Algeria

Introduction

The forest heritage in Algeria represents approximately 4.1 million hectares, which makes an afforestation rate of 11% of the northern surface of the country. These forest massifs are composed of very combustible species including 68% Aleppo pine, 21% cork oak and very narrow areas covered by other species, such as eucalyptus, cedar and zeen oak. Most of these massifs are sheltered in rugged relief, along two large mountain ranges crossing the north of the country from east to west.

This national capital is constantly threatened by the risk of fire which, each summer, devours thousands of hectares of forest and maquis, especially since the forests in Algeria lack facilities and accessibility, which further complicates the task of intervention in the event of a fire outbreak.

Moreover, the risk of fire does not spare the harvest fields, which include the various crops on the ground, as well as the palm groves in the south of the country. These economic riches, in turn, endure the lack of preventive measures against the outbreak and spread of fire, which also remains their main destructive enemy.

In this context, awareness-raising and education campaigns for the benefit of local residents, farmers and citizens, on compliance with basic preventive provisions against fire, should be emphasized according to the different categories of population, so as to better identify the problem of wildfires during the fire season.

Fire danger in the 2021 fire season

The 2021 summer season was characterized by very high temperatures in the northern region of the country, following successive heat waves from the south.

These periods of intense heat, known as "Sirroco", which lead to a rapid drying of the vegetation, were quite frequent during the 2021 summer season, in particular during the months of July and August, during which the risk of forest fires attained very high levels, thus causing a rapid spread of fire starts. The average area burned (forests-maquis-scrubland) per fire outbreak during the 2021 season is the highest average recorded over the past ten (10) years, without considering the areas of Alfa and mountain fruit trees burned, the extent of which was very large during the 2021 season.

Below is a summary diagram (Figure 170) illustrating the average areas burned per fire over the past 10 years.

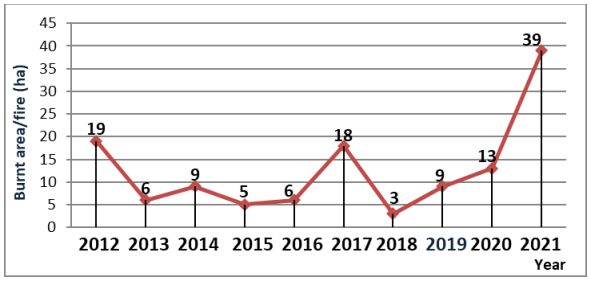


Figure 170. Average burnt area per fire for the last 10 years (Forest/maquis/scrub, ha/fire).

Fire occurrence and affected surfaces

The 2021 season was exceptional in terms of the extent of the forest fires recorded in certain forest areas of the wilayas, which experienced an unusual intensity in terms of the number of fires declared and the areas burned. Also, some fires caused considerable human and material damage. The overall area covered by the fire is estimated at 100 101 hectares, caused by a total number of 1 631 fires. This area is the largest recorded in more than a decade.

The distribution of the overall area burned, by type of vegetation (Figure 171), namely forest, maquis, scrub, Alfa and mountain fruit trees, shows that during the 2021 season, the area of mountain fruit trees burned, in particular fig and olive trees, experienced a huge increase.

In fact, it represents more than 36% of the total area burned, which was the main cause of the exceptionally high balance recorded.

The burnt area of the forests, during the 2021 campaign was also considerable, and represents approximately 26% of the total balance recorded, followed respectively by the areas of the maquis representing approximately 21%, the scrubland 16.4% and the Alfa with a low rate of about 0.35% of the total burned area.

The monthly distribution of the total area of forests, maquis and brush covered by fire (Figure 172) shows that August was the period with the most damage in terms of the total area burned: 72% of the annual total. This is mainly due to the large number of heatwaves recorded during this month. The month of July also saw significant damage (16.5% of the total). However, the months of October, September and June saw respectively smaller burned areas ranging between 0.5% and 6% of the total area.

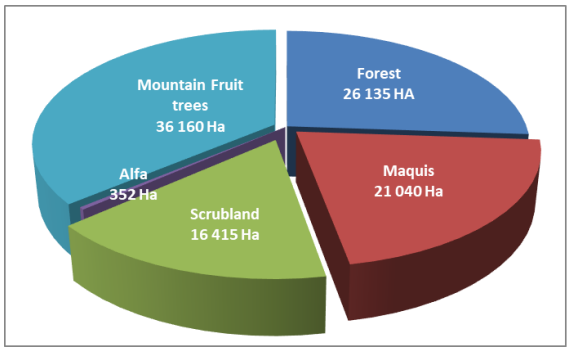


Figure 171. Burnt area in 2021 classified by vegetation type.

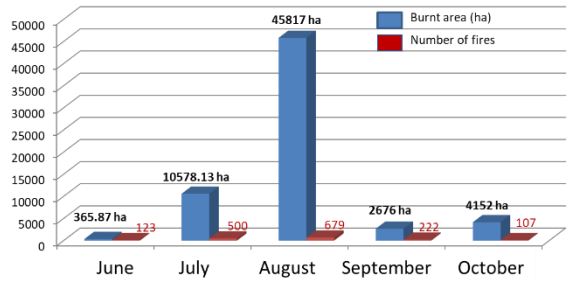


Figure 172. Burnt areas and number of fires during the five months of the fire season in 2021.

The distribution of the total area burned in terms of forests, maquis and scrubland, by the three regions of the country, shows that the East region of the country was the most affected by fires, followed by the Centre region and then the West region which experienced insignificant damage during the fire season (Figure 173).

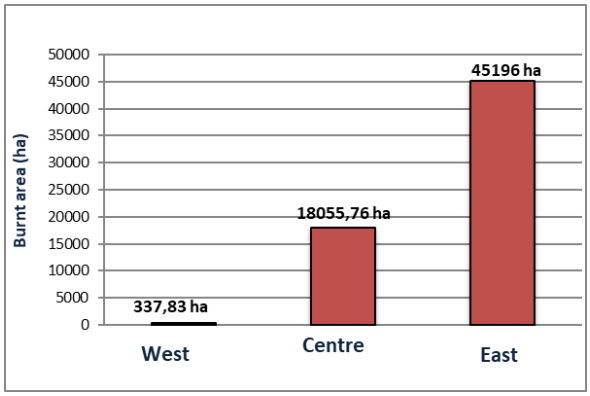


Figure 173. Total burnt area in 2021 by region.

Forest fire prevention in 2021

The 2021 forest firefighting campaign saw massive preparation, in particular with the easing of restrictions linked to COVID19. Many actions were carried out in terms of preventive work, citizen awareness and the establishment of organizational systems to deal with forest fires. Below is a list of the main actions carried out:

Table 50. Preventive activities in 2021.

Preventive Actions
Opening and maintenance of firebreak trenches
Maintenance of road and railway verges
Maintenance under high voltage lines
Opening and maintenance of forest tracks
Construction and maintenance of water points
Silvicultural work
Awareness actions
Organisation of conferences and debates
Organization of exhibitions and open days with distribution of leaflets
Hosting TV and radio shows
Sermons and religious talks
Organization of local meetings
Organizational Actions
Update of the “Forest Fires” intervention plans
Establishment of operational committees responsible for coordinating intervention operations
Installation of local residents' committees
Implementation of numerous simulation exercises involving the sectors concerned
Training sessions on forest fire simulator for civil protection officers

Monitor, alert, intervention and response

In accordance with the Algerian regulations relating to forest fires, the system put in place for surveillance, alert and first intervention was provided by the forest services. However, the massive interventions on the declared fires were ensured by the means of the civil protection units, reinforced if necessary by mobile forest fire columns, set up for this purpose. These mobile columns constituted a considerable strike force in support of the units' intervention means, thus enabling the civil protection departments of the departments to deal with multiple fires, without constantly having to request reinforcements from neighbouring departments.

In addition, an aerial combat device, consisting of six helicopters, was mobilized to support the intervention teams operating on the ground, particularly during operations carried out in inaccessible places and in areas where the fire threatened homes.

In addition to these provisions, the intervention means of the civil protection were regularly located in sensitive zones, in particular close to large crop fields during the harvest-threshing season and in the forest massifs frequented by citizens for leisure.

Below is a representative diagram of the overall system, deployed to support the campaign to fight forest fires in 2021 (Figure 174).

Loss of human life

It should be noted that in addition to the huge areas burnt by the fire, some forest fires also caused considerable human and material damage, in particular, during the period from August 09 to 16, 2021, which was the most dramatic in the history of forest fires in Algeria. A significant number of fire starts was recorded in the Centre and East regions of the country. However, the most tragic toll was recorded in the wilaya of Tizi Ouzou where 376 fire outbreaks were recorded, including 106 gigantic fires that caused colossal human and material damage.

The Civil Protection services evacuated 31 people who died of their burns, in addition to dozens of injured and asphyxiated. Other people who died or were inconvenienced by the smoke were also reported by the other local services of this wilaya.

Mutual assistance operations between states

During the 2021 forest fire campaign, aerial resources were deployed on several occasions to support ground intervention resources. In addition to Civil Protection helicopters, Algeria requested air resources consisting of two Canadair aircraft from France as well as two Tresch aircraft from Spain.

A total of 1 042 drops were carried out by the above-mentioned aerial means, in particular on forest fires threatening homes or inaccessible to ground intervention means.

Figure 174. Resources used in the 2021 season in Algeria.

(Source: Direction Générale de la Protection Civile; Direction Générale des Forêts, Algeria).

1.4.2 Israel

Fire danger in the 2021 fire season

The year 2021 was warmer than average (1995 to 2009), as were most of the years in the last two decades. It included some unusual weather events like the prolonged rain stoppage at the beginning, the prolonged and unusual heat wave in August and the "Carmel" system with the strong winds and the heavy rainfall amounts in December.

In 2021 there was an increase of about 100% in days that were classified as dangerous for the outbreak of forest fires compared to 2020 (Figure 175).

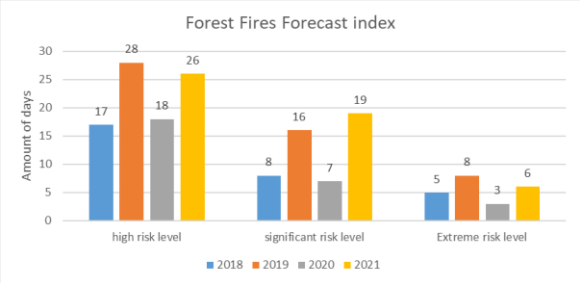


Figure 175. Forest fire forecast index

Injuries and loss of human life

On August 15-16, a huge forest fire occurred in the Jerusalem Mountains, approximately 12 thousand dunams of forest and nature reserve were burned. Several houses and businesses were damaged. There were no casualties or injuries. For the first time in Israel, a Hercules aircraft was used to extinguish forest fires in the Judean Mountains.

Fire occurrence and affected surfaces

About 808 forest fires were recorded in 2021, which is an increase of 3% compared to the previous year (Figure 176). The same rate of growth recorded in the total burned area (Figure 177).

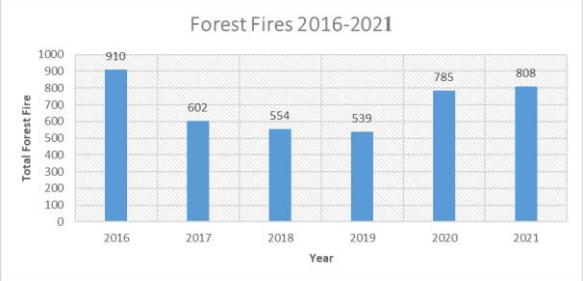


Figure 176. Number of fires in Israel 2016-2021.

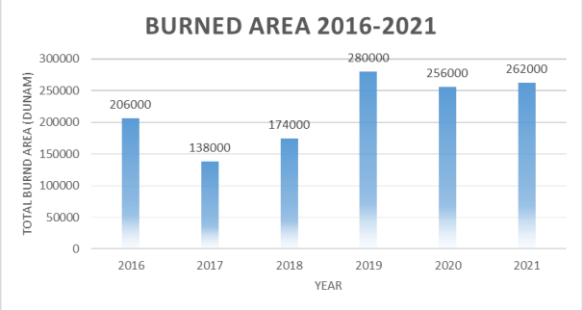


Figure 177. Burnt area in Israel 2016-2021.

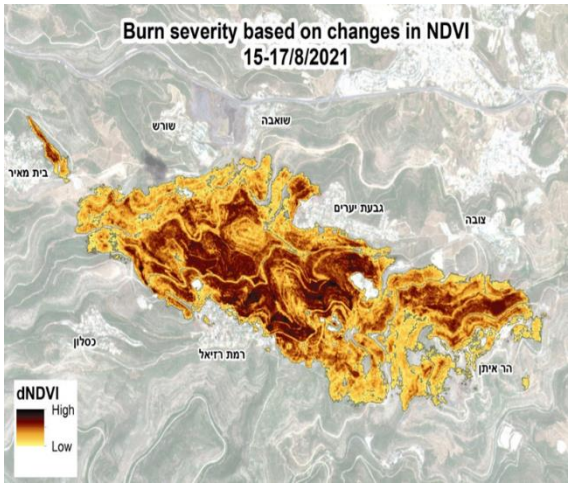


Figure 178. Fire in the Jerusalem Mountains.

Operations of mutual assistance

During 2021, Israel participated in two international aid missions.

On July 4, two Air Tractor planes and a Hercules C-130 plane took part in the firefighting efforts in Cyprus.

On August 10, an Israeli delegation to the forest fires in Greece included two Air Tractor planes, a Hercules C-130 plane, fifteen fire fighters and commanders.

Figure 179(a,b,c,d) International aid missions in Cyprus and Greece

(Source: Fire and Rescue Commission, Ministry of Public Security,Israel).

1.4.3 Lebanon

Lebanon's annual forest fire reports are completed within the framework of a collaborative work between the Ministry of Environment (MOE) and the Land and Natural Resources Program, Institute of the Environment, University of Balamand (LNR-IOE-UOB). The presented information is mostly based on the 2021 fire report (MOE/UOB, 2022) from which reported fires were based on field inspections only. Many other fires may have not been initially visited in the field, therefore remaining un-reported. In addition, Mitri (2021) conducted a post-fire impact assessment of the 2021 fires in Lebanon using satellite images and field surveys. The main results of this assessment are presented accordingly.

Fire danger in 2020

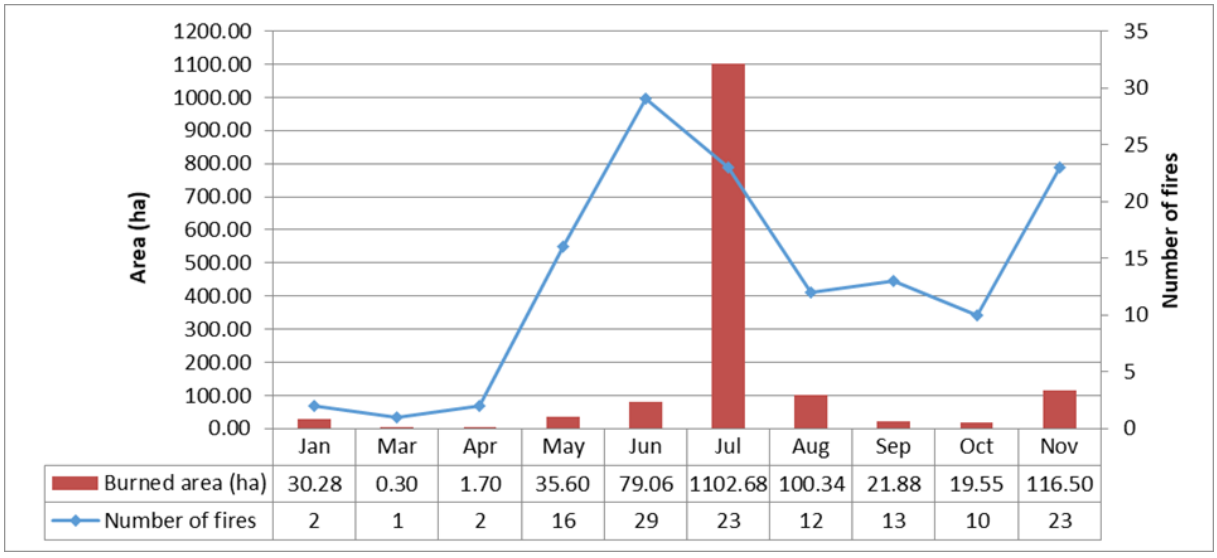
In July 2021, Lebanon experienced some of its largest and most devastating wildfires. The most damaging fires broke out in the forests of Quobayat, Andqet and Akroum in the Akkar region (North of Lebanon), mostly burning dense pine trees.

Fire season Overview

The calculated start date of the fire season for 2021 was April 4 and the calculated end date was November 14, 2021. The peak month (i.e., in number of fires) was June and the peak month in extent of burnt areas was July. A total of 131 fires were reported, affecting a total area of 1 508 ha (Figure 180).

In reality, a much larger number of fires affected a significantly higher extent of burnt areas across the country. Those fires were not necessarily reflected in MOE/UOB (2022) mostly due to lack of complete field surveys.

The following graphs (Figure 181, Figure 182) show the occurrence of fires in relationship to mean monthly temperature and monthly precipitation



	Jan	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Burned area (ha)	30.28	0.30	1.70	35.60	79.06	1102.68	100.34	21.88	19.55	116.50
Number of fires	2	1	2	16	29	23	12	13	10	23

Figure 180. Monthly distribution of fire occurrence and fire affected areas in 2021 (source: MOE/UOB, 2022).

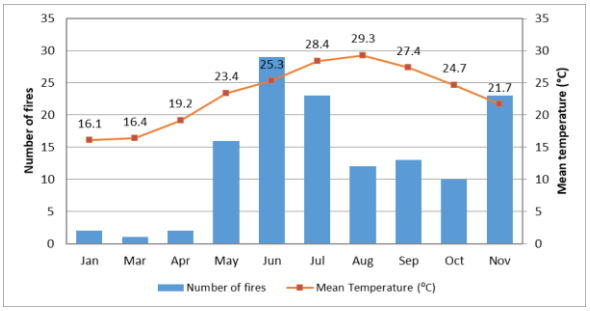


Figure 181. Number of fires in relation to mean temperature.

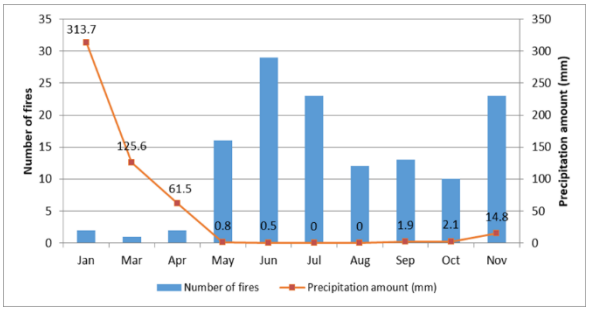


Figure 182. Number of fires in relation to precipitation.

Observation 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 https://www.worldweatheronline.com/beirut-weather-averages/beyrouth/lb.aspx

Land use type

The main land cover/land use of fire affected areas (Figure 183) included forest/woodlot (92.22%), agricultural land (6.96%), and grassland (0.42%), among others.

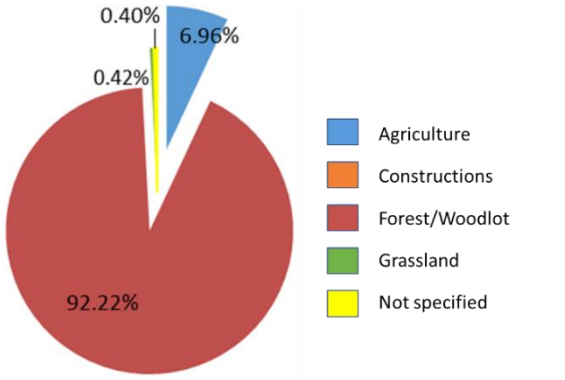


Figure 183. Land-use of fire affected areas (source: MOE/UOB, 2022).

Affected fuel type

A total of 73.55% of affected fuel types (Figure 184) was mixed forest, followed by broadleaved forests (13.82%).

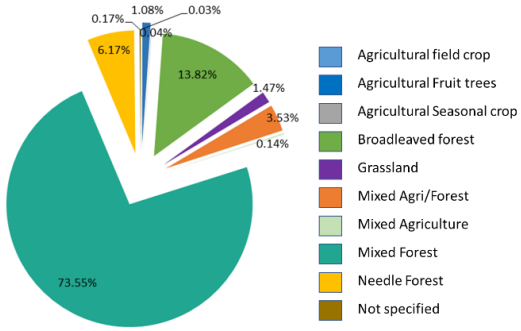


Figure 184. Distribution of fuel type affected by fires (source: MOE/UOB, 2022).

Causes of fire

A total of 83.03 % of the reported fires had unknown causes. Neglect accounted for 4.2% of all fires causes, while 1.68% of the fire causes were due to Arson (Figure 185).

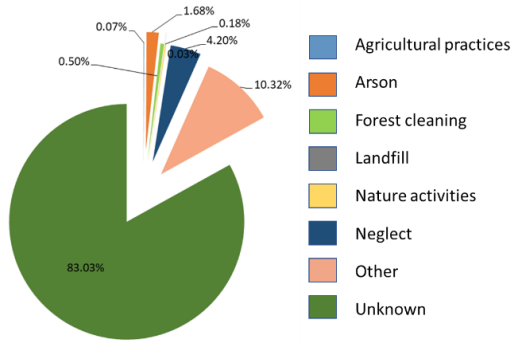


Figure 185. Distribution of main fire causes (source: MOE/UOB, 2022).

Intervention time

It was observed that 52% of first interventions in fire suppressions occurred within the first 20 minutes after the reporting time, while 38% of interventions happened after 20 minutes and before 1 hour from the reporting time (Figure 186).

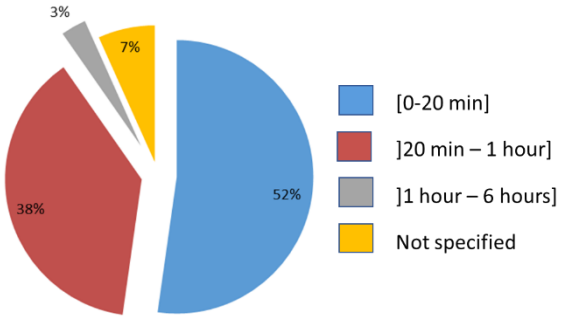


Figure 186. Times for intervention after reporting fires (source: MOE/UOB, 2022)

Fire duration

The largest number of fires lasted between 1 and 2 hours (38%). A total of 8% of fires lasted between 5 and 12 hours, and 7% of fires lasted between 12 and 24 hours. It was also observed that 6% of fires lasted more than 24 hours. (Figure 187).

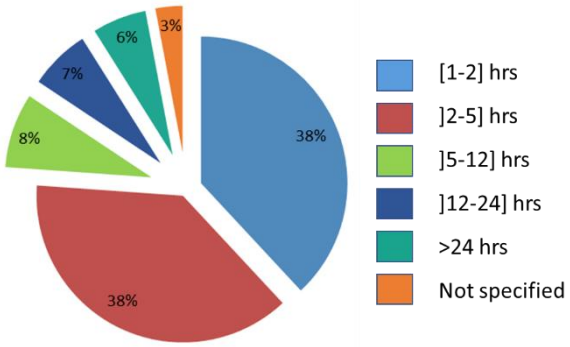


Figure 187. Fire duration (source: MOE/UOB, 2021).

Injuries and losses of human lives

One civilian reportedly died in the fires of Akkar while volunteering to fight fires. An official number of non-fatal injuries in civilians and firefighters was not available.

Resources employed in fire suppression

The following human and technical resources were involved in fire suppression of reported fires (Table 51).

Table 51. Human and technical resources involved in fire control throughout 2021 (source: MOE/UOB, 2022).

	Number				Lebanese Army helicopters used
	Small Cars	Water Tanks	Other Cars	Human Resources	
Civil Defense	76	> 331	15	> 1263	
Army	35	4	3	> 331	10 (>20 flights)
Internal Security	51	3	3	219	-
Ministry of Agriculture	6	0	0	18	-
NGO	16	0	3	> 50	-
Local Resident	0	0	0	> 689	-
Total	**188**	**> 341**	**24**	**> 2527**	**10**

Research activities aimed at improving fire management

Mitri (2021) assessed the impact of 2021 fires at the landscape level using Sentinel 2-A images. As a result, a total area of 2 838 ha of burnt lands was mapped. This included an area of 2 100 ha of burnt forests (including shrubland with dispersed trees) of which 419 ha was of burnt cedar, juniper and fir trees. An area of 53 ha of burnt lands was located in high mountainous lands (i.e., >1 500 m above sea level). Also, an area of 215 ha burned in agricultural land. The fires burned around 1 631 ha within Key Biodiversity Areas (KBAs). (Figure 188).

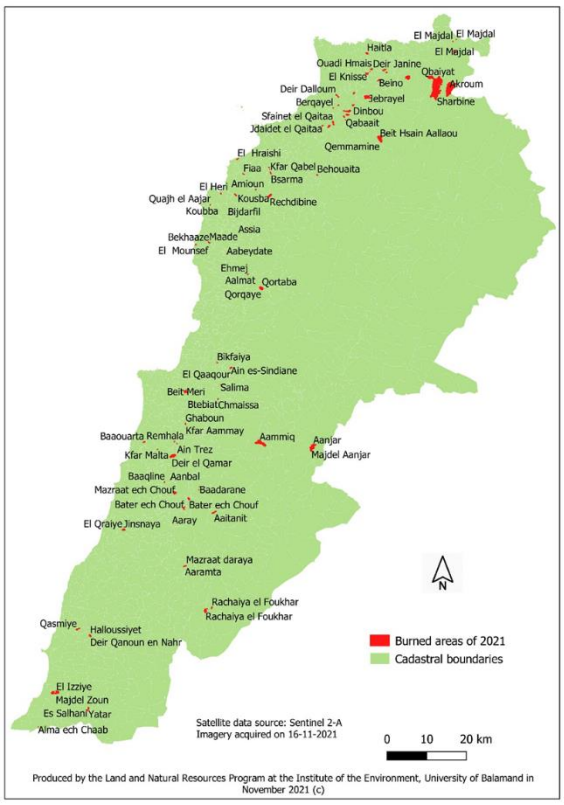


Figure 188. Map of burned areas in 2021 (Source: Mitri 2021).

MOE/UOB (2021) published the compiled report of wildfires in Lebanon 2008-2020. 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

References:

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

MOE/UOB, 2022. State of Lebanon's wildfires in 2021. Beirut, Lebanon.

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.

(Source: Land and Natural Resources Program, Institute of the Environment, University of Balamand, Lebanon).

1.4.4 Morocco

Background

In over 9 million hectares of forest domain representing more than 20% of the national area, forest formations in Morocco cover an area of 5 814 000 ha (broadleaves, conifers…) and 3 318 260 ha of *stipa tenacissima* (Figure 189), and are distributed among the different bioclimatic zones, from semi-arid to humid.

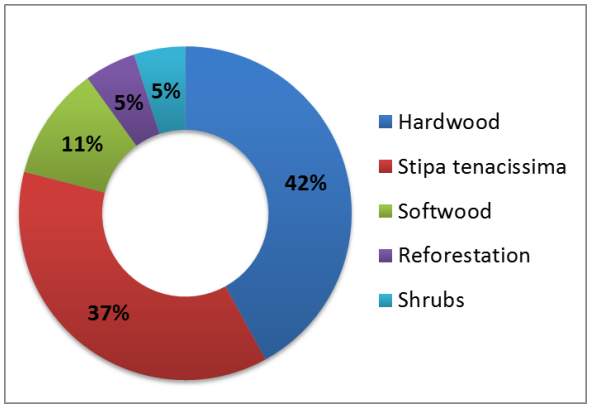


Figure 189. Composition of forest land in Morocco.

As in Mediterranean countries, forested areas in Morocco are subject to a recurrent risk of fires that is favoured by the extreme flammability of forest species during the summer. The consequences of this risk are prejudicial in terms of social, economic and environmental components. Indeed, the forest land is an open space where access (except rare situations) is free. Riparian forest populations live in a subsistence economy (using forests for their needs of construction wood and firewood, various non-timber forest products, and pasture). Consequently, forests are under a very strong human pressure.

Through the analysis of annual reports of forest fires during the years 1960 to 2021, an average of 301 fires per year is calculated for an annual average area affected of 3 022 ha (DEF, 2021).

Although limited compared to the average area burned in other countries with similar conditions, especially the Mediterranean, this area is important in view of the major roles played by forests and the difficulties of their reconstruction and regeneration with regard to the national socio economic and environmental context.

To face the recurring and imponderable phenomenon of fire, a National Plan of Prevention and Fight against forest fires (in French: *Plan Directeur de Prévention et de Lutte Contre les Incendies "PDCI"*) was adopted with the participation of all institutional partners concerned by this issue: Ministry of the Interior (MI), Water and Forest Department (DEF), Ministry of Equipment and Transport (MET), Royal Gendarmerie (GR), Civil Protection (PC), Agency for Economic and Social Development for Northern Provinces and Prefectures (ADPN) and the Administration of Land Conservation, Cadastre and Mapping (ACFCC). The plan focuses on the actions of equipment and forest management for fire prevention, risk prediction, monitoring and warning and also on the coordinated operations to fight against forest fires.

Despite the efforts made at different levels by all institutions involved in forest fire management in Morocco, the system calls for continuous improvements, not only in terms of prevention and prediction, but also in terms of operational and organizational interventions.

Fire occurrence and affected surfaces

From 1960 to 2021

Through the analysis of the available data on forest fires in Morocco during the period 1960 to 2020, a total of 18 662 outbreaks of fire and a total area damaged (but not lost) of 187 339 ha are reported, giving an average of 301 fires per year for an annual average area of 3 022 ha affected, with maxima of 11 000 ha in 1983 and 8 660 ha in 2004 (Figure 190, Figure 191). The absolute minimum was recorded in 2002 with 593 ha.

It should also be noted that, globally and since 1960, the trend of fire numbers and area affected by forest fires has never stopped increasing; but the shapes of the increases are not similar. Indeed, the increase in fire number has been continuous from an average of 442 between 2001-2010, to 463 forest fires in the last decade (2011-2020).

The period from 1960 to 1974, represents the portion where fire number and area burned are at the lowest levels (154 fires and 2 073 ha) compared to the averages for the period covering 1975 to 2014 (331 fires and 3 442 ha).

We note that the area affected per fire, which reached a value of 6 ha during the period 2012-2021, has decreased by 50% compared to the national average recorded since 1960, which was about 11 ha per fire (Figure 192).

2021 fire season

During 2021, a total of 435 fires was recorded, affecting an area of 3 064 ha, an average of 7 ha per fire.

The number of fires recorded in 2021 has decreased by around 6% compared to the average of the last 10 years and the burnt area has increased slightly by around 4% compared to the average of the last decade. (Figure 193).

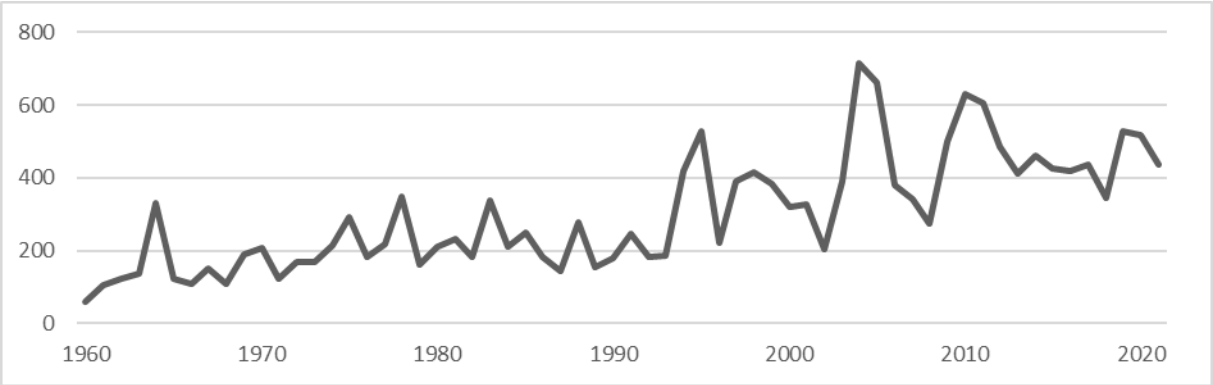


Figure 190. Evolution of forest fire numbers from 1960 to 2021 (DEF, 2021).

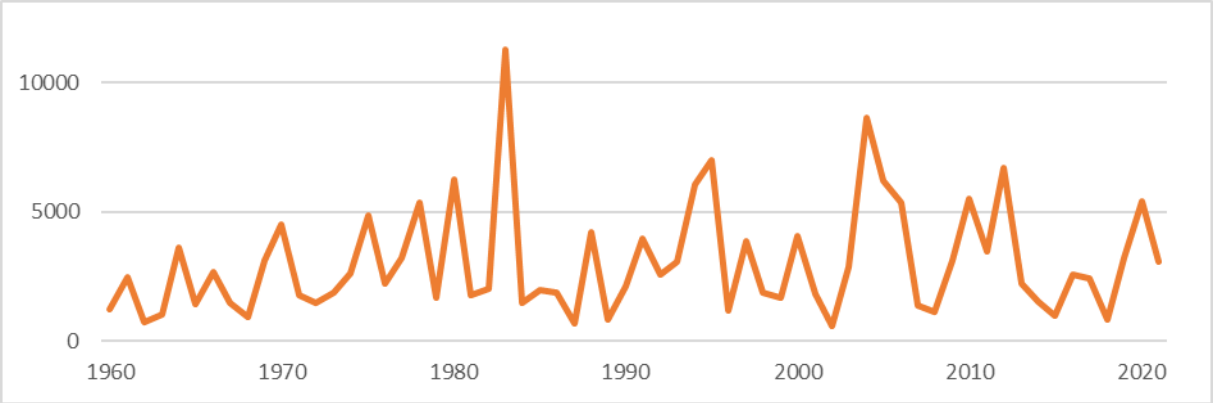


Figure 191. Evolution of forest fire area from 1960 to 2021 (DEF, 2021).

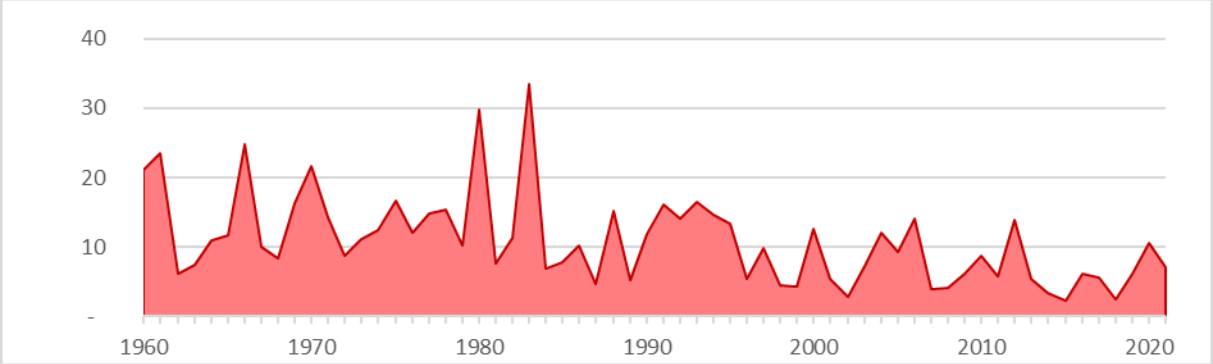


Figure 192. Evolution of area affected per fire from 1960-2021.

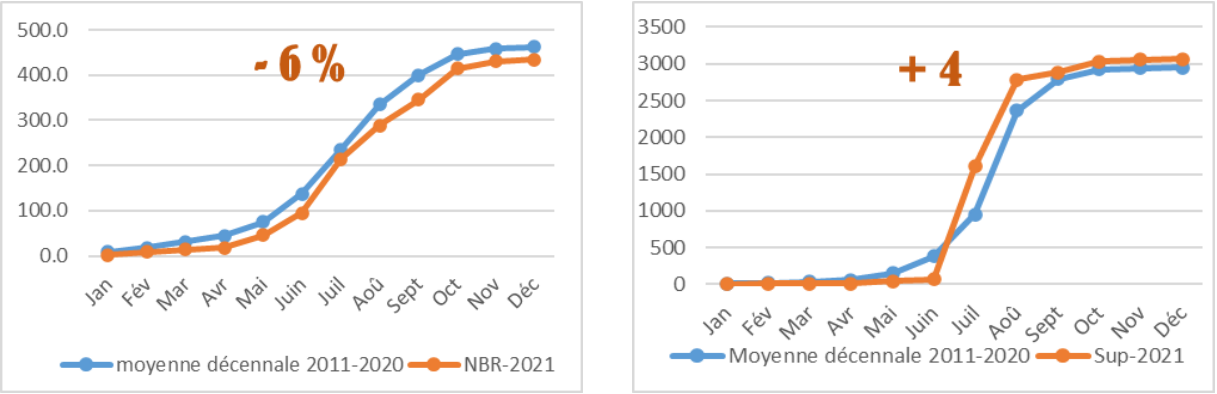


Figure 193. Evolution of number of fires (left) and burnt area (right) in 2021 compared to the last decade.

Distribution of fires

The distribution of fires recorded in 2021 (Table 52), based on the type of vegetation affected, is as follows:

- For wooded land, an area of 1 983 ha (65% of the total area burned) was affected by fires;
- The shrub and herbaceous covers were affected by fires that covered an area of 1 081 ha, equivalent to 35% of the total area burned.
- For wooded stands, holm oak trees are in first place with an area of 431 ha affected, equivalent to 14% of the total area burned in this category, followed by the Allepo pine trees with an area of 373 ha affected (12%).

Table 52. Distribution of fires, based on the type of vegetation affected in 2021.

Species			Burnt Area (Ha)	% Area
Wooded		Tannin Acacia	0	0
		Argan	0.32	0.01
		Carob	1.12	0.04
		cork oak	310.64	10.14
		holm oak	430.94	14.06
		Zeen oak	250.6	8.18
		Eucalyptus with umbels	2	0.07
		nippled eucalyptus	40.41	1.32
		beaked eucalyptus	44.07	1.44
		blue mimosa	0.02	0
	Broadleaves Total		**1080.12**	35.25
		Cedar	20.81	0.68
		Atlas Cypress	0.1	0
		Red juniper	66.03	2.15
		Thuniferous juniper	0.06	0
		Oxyhedron	35.57	1.16
		Pines aleppo	372.63	12.16
		Pines maritime	297.62	9.71
		Thuja	103.65	3.38
		Oriental thuja	6	0.2
	Coniferous Total		**902.48**	29.45
Wooded Total			**1982.59**	64.7
Non wooded		Alfa	63.22	2.06
		Bovine gorse	1	0.03
		Lentisk	0.05	0
		Secondary species	700.74	22.87
		Herbaceous cover	316.68	10.33
Non wooded Total			**1081.68**	35.3
Grand Total			**3064.28**	100

The data relating to the distribution of fires according to size classes of affected areas are represented in Table 53. Indeed, 90% of reported fires were under control with the speed and efficiency required, since the area affected did not exceed 5 ha for each fire. It is also noted that only 1 fire (0.23% of the total number of fires) affected an area of over 500 hectares, representing 36% of the total area burned.

Table 53. Distribution of fires according to classes of affected areas.

Size Class (ha)	Number		Area (ha)	
	Count	%	Area	%
0-5 ha	390	89.66	226.37	7.39
5-10 ha	16	3.68	107.30	3.50
10-20 h	17	3.91	226.71	7.40
20-50 ha	5	1.15	158.90	5.19
50-100 ha	3	0.69	230.00	7.51
100-500 ha	3	0.69	1015.00	33.12
>500 ha	1	0.23	1100.00	35.90
Total	**435**	**100**	**3064.28**	**100**

The data showing the distribution of fires by forest region are reported, below, in Figure 194 and Figure 195.

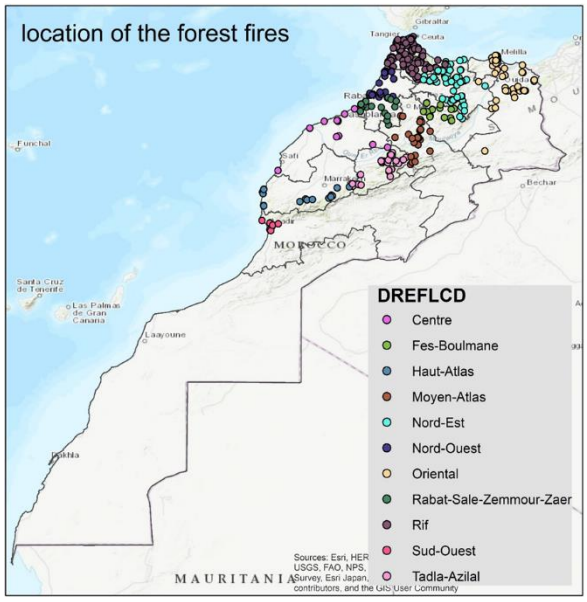


Figure 194. Location of the forest fires recorded in 2021 in Morocco

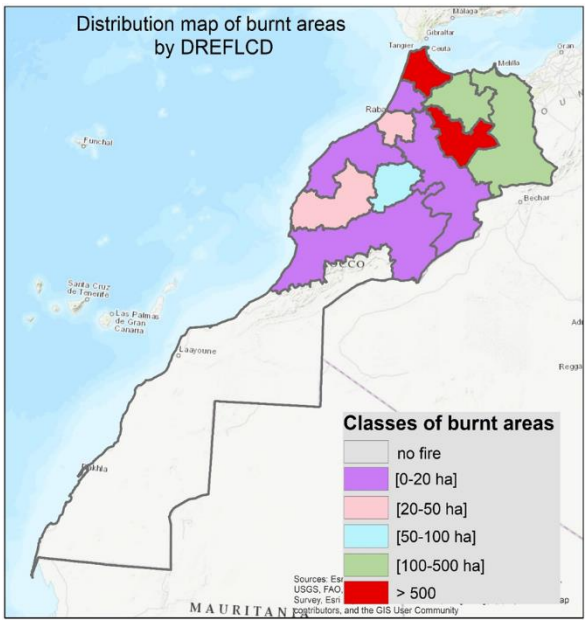


Figure 195. Geographic distribution of fires according to the affected area size classes.

The Rif region (Tanger, Tetouan, Chefchaouen...) ranks first in terms of area affected with 1 577 ha (51% of the total area recorded nationally) and it also ranks first in terms of the number of fires with 117 fires (27% of the total number)

The occurrence of fires is concentrated in the provinces of Rif and Pre-Rif (including Tangier and Tetouan); this situation is favoured by the terrain, the high sensitivity of forest stand types (pine, cork oak matorral...) and the intense human pressure on land resulting from the use of fire as a practice of cleaning land for their cultivation.

Loss of human lives

No lives were lost in the 2021 season.

Firefighting means

The means mobilized by the different departments in 2021 in Morocco for the operations against forest fires, are as follows (Table 54):

Table 54. Means mobilized in Morocco in 2021.

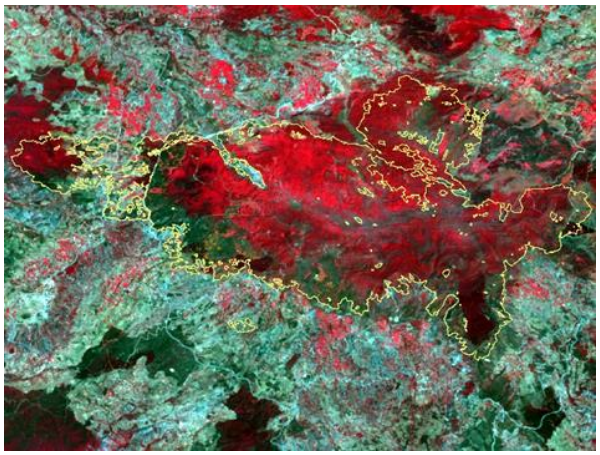
Activities	Department	Quantity
Monitoring and alerts	Water and Forest Department	**1381** watchers (4-5 months)
	Ministry of the Interior	**1139** watchers (2.5 months)
Ground intervention	Water and Forest Department	**332** forest fighters with **95** vehicles for the first intervention
	Civil Protection	[Total Estimated at 370 persons with CCF, CCR, CCI and other engines]
	Auxiliary Forces	[Estimated at 430 persons]
	Royal Armed Forces	[Estimated at 520 persons]
Aerial control	Royal Gendarmerie	**12** Turbo Trush aircraft
	Royal Air Forces	**5** Canadairs CL415

The big fires marking the 2021 campaign

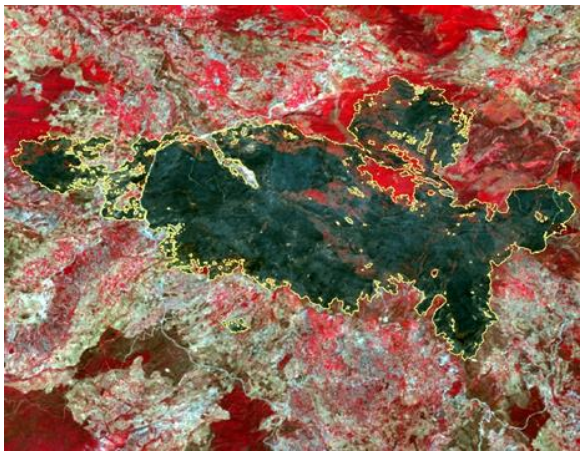
The breaking heatwave that swept across the country in July and August sparked, for the first time in Moroccan history, an outbreak of 20 coinciding fires burning about 1 200 hectares of forest (specifically between July 9 and 11). As the unprecedented heatwave spread across Morocco, with temperatures ranging, concurrent strong winds helped facilitate the outbreak and spread of forest fires in many of Morocco's provinces.

Chefchaouen suffered the most damage in Morocco caused by the largest forest fire of the year, which broke out in the rural community of Derdara burning an estimated 1 100 ha, followed by the province of Sefrou, where two concurrent fires broke out in the rural communities of Ighzrane and Laanoussar burning an estimated 350 and 470 hectares respectively. The Laanoussar continued to spread to the neighboring Ifrane province.

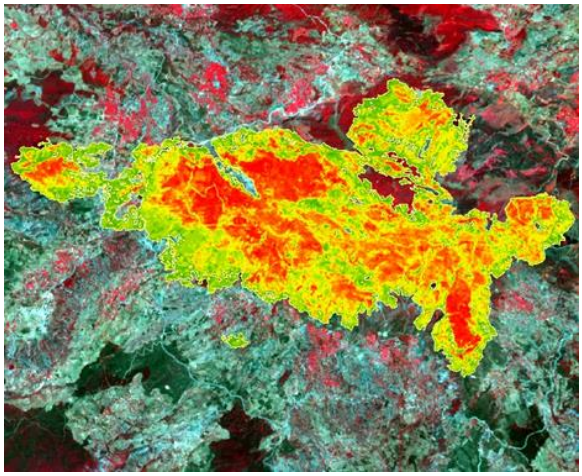
Chefchaouen Fire in the Jbel Sougna forest (Tanagoub and Derdara Communes)



(a) Image sentinel-2A Pre-fire (09/08/2021)



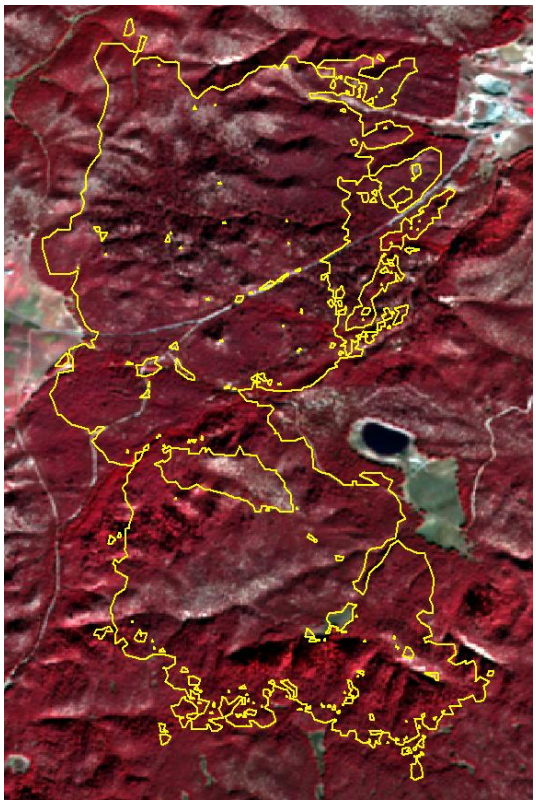
(b) Image sentinel-2A Post-fire (31/08/2021)



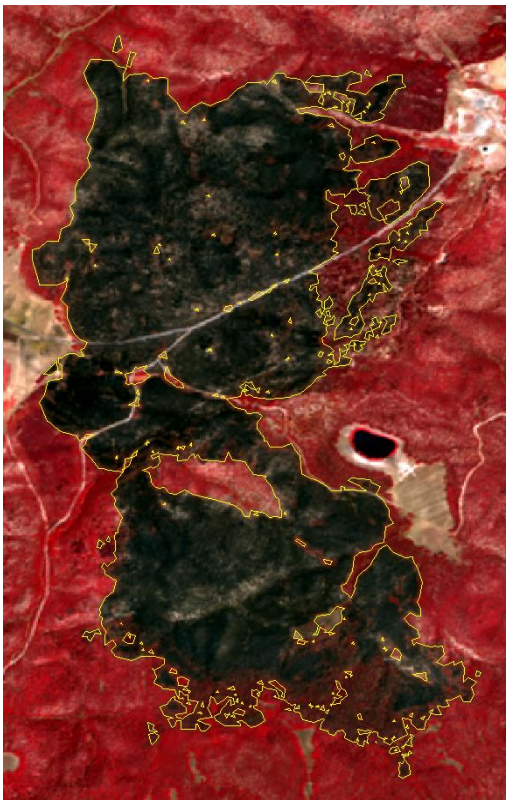
(c) Fire severity index (NBR)

Outbreak of fire	14/08/2021 at 13:30
Mastery of fire	20/08/2021 at 19:00
Burnt area	1100 ha
Forest	Jbel Sougna
Province	Chefchaouen
Affected species	cork oak, zeen oak, maritime pine, secondary species and herbaceous layer
Causes and origins of the fire	Unknown
Intervention	Population, FA, civil Protection, PN, FAR, GR, AL, EF
Means used	VPI, Canadaires and Truchs

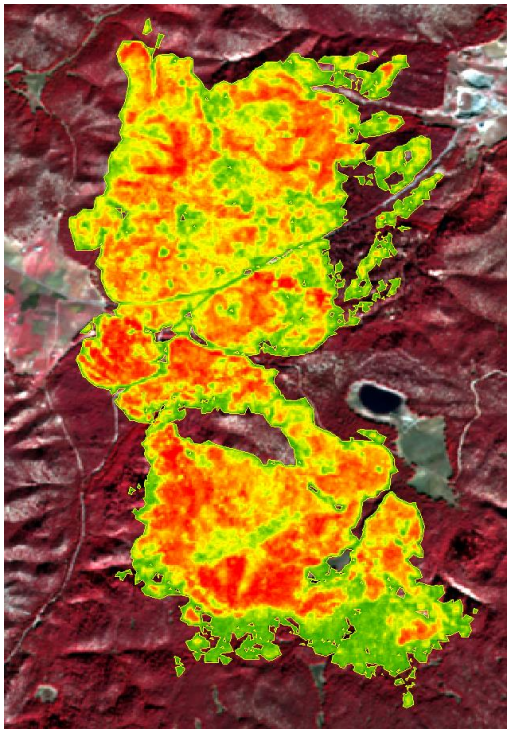
Sefrou Fire (Dayat Aoua and Laanoussar Communes)



(a) Image sentinel-2A Pre-fire (09/08/2021)



(b) Image sentinel-2A Post-fire (31/08/2021)



(c) Fire severity index (NBR)

Outbreak of fire	09/07/2021 at 15:00
Mastery of fire	11/07/2021 at 16:30
Burnt area	470 ha
Forest	Sefrou
Province	Sefrou ,Ifrane
Affected species	Holm oak, Oxycedar juniper, Aleppo pine, Maritime pine
Causes and origins of the fire	Unknown
Intervention	Population, FA, civil Protection, GR, AL, EF
Means used	VPI, Canadaires

(Source: Service de la Protection des Forêts, Département des Eaux et Forêts, Morocco).

2 Wildfires in 2021: Country reports from EFFIS

The EFFIS Danger Forecast was developed to support the Commission's Directorate-General for the Environment and the forest fire-fighting services in the EU Member States. From 2002, at the request of the Member States, operation of the EFFIS Danger Forecast was extended to six months starting on 1 May and ending on 31 October, and in 2006 to nine months, from 1 February to 31 October. From 2008 the EFFIS Danger Forecast system has run continuously throughout the year without interruption.

The geographic extent has been enlarged over the years from the initial extent that covered only the Mediterranean region. Now the system covers the whole of Europe and MENA (Middle East & North Africa) countries.

The meteorological data used to run the model has also changed during the years. At the beginning the system started using forecasted data provided by MeteoFrance with a spatial resolution of around 50 km. Then over time other providers were included, such as DWD (Deutscher Wetterdienst) and ECMWF (European Centre for Medium-Range Weather Forecast) and the resolution has improved. Now the system runs with three different data sets from three providers: ECMWF (the primary), Meteo France and DWD; with a spatial resolution in a range from around 10 km to 25 km.

In this chapter the fire danger trends assessed by EFFIS in the different countries during the 2021 fire season are presented, comparing them with long term trends.

Through the Danger Forecast module of EFFIS the situation has been continuously monitored and the risk level analysed and mapped.

The following figures show fire danger throughout 2021 as determined by the average FWI values assessed in the individual countries.

In the following charts we present fire weather index data for the current year, showing how it compares against the long-term minimum and maximum, the 10-90 percentiles, and the long term average (measured from 1980-2021). This makes it possible to see whether and when extreme conditions occur in the current year.

The countries analysed are those participating in the EFFIS network for which data are available, and are presented in alphabetic order within the two groups (European countries and MENA countries) in the graphs that follow.

How to read the charts

The red area encloses the most extreme values seen in the 42 year period from 1980-2021.

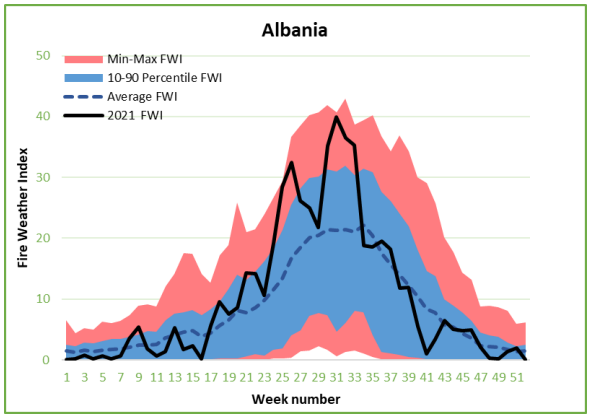
The blue area encloses the 10-90th percentiles: i.e. 80% of observations fall within this band.

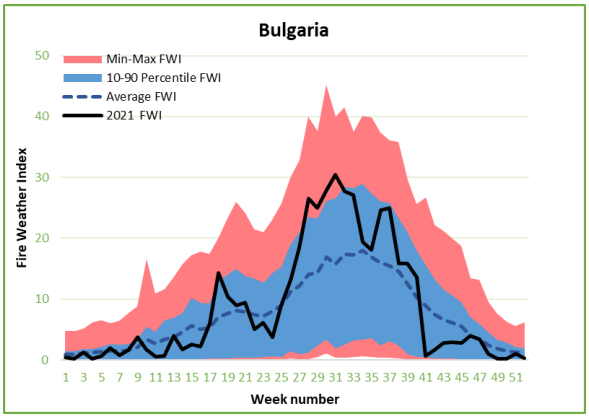
The dotted line signifies the 42-year average.

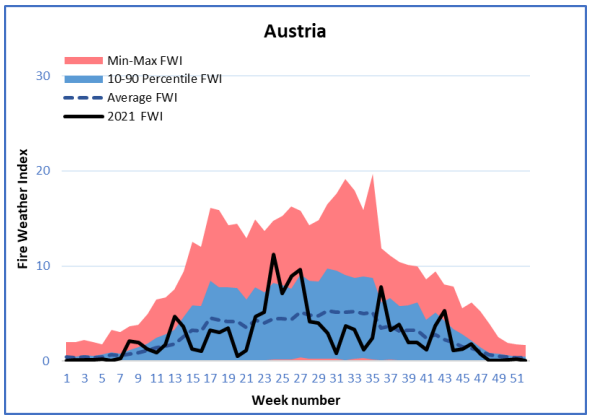
The solid black line shows the current year (2021).

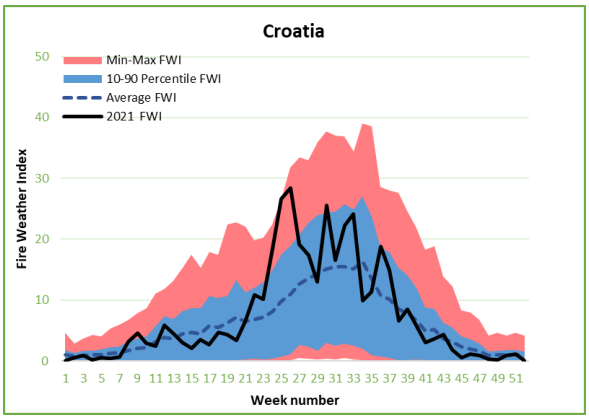
NOTE: Four colour-coded scales have been used to present the FWI: **0-30** for the most northern countries where fire danger rarely reaches high levels; **0-50** for central countries, **0-60** for the Mediterranean and Turkey, and **0-130** for the MENA countries.

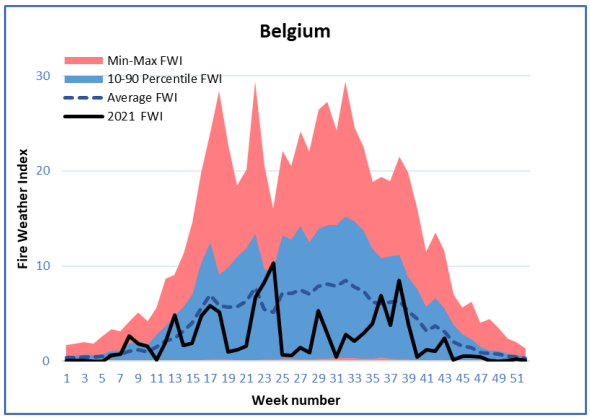
European countries

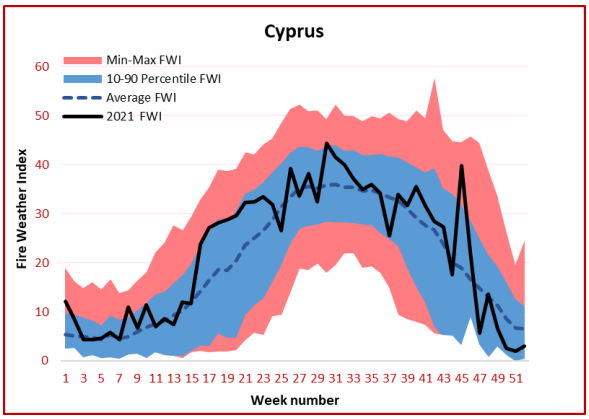


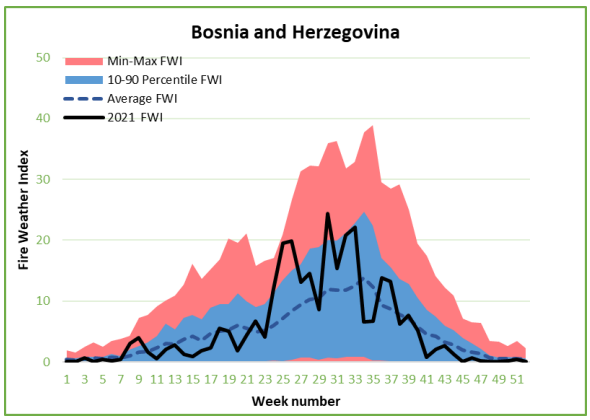


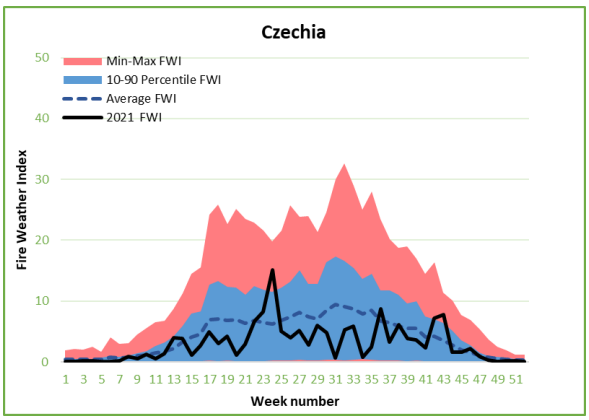


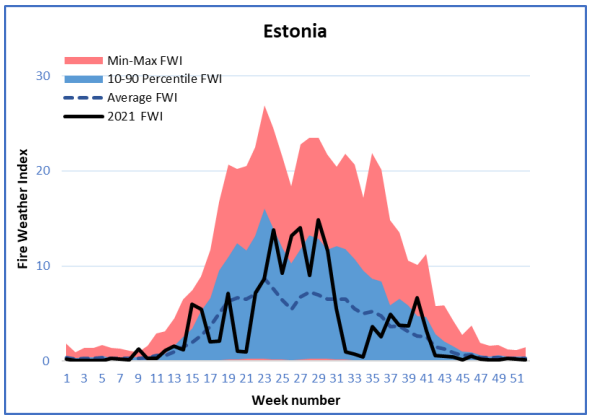


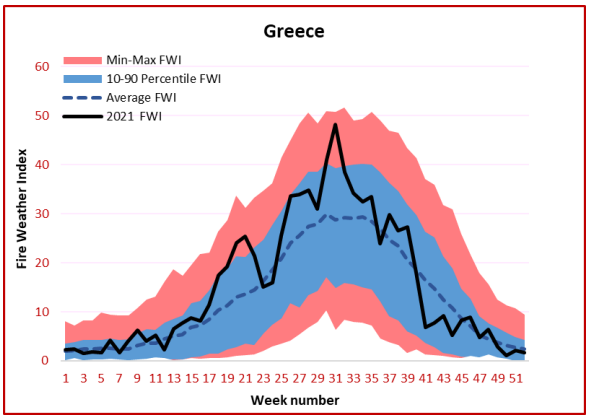


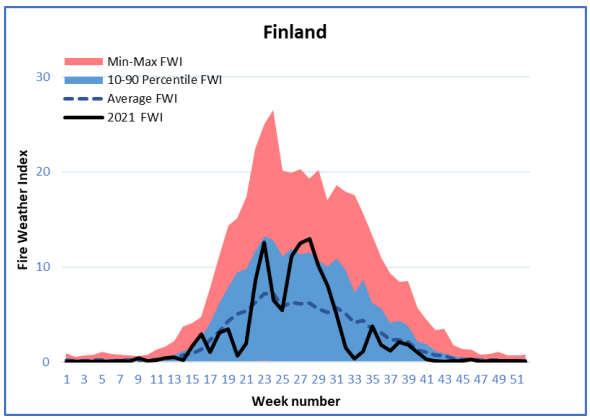


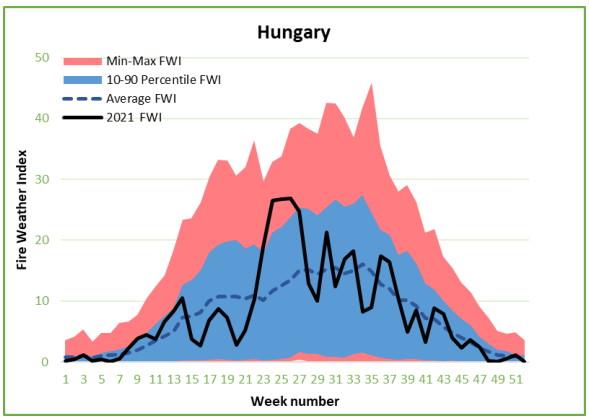


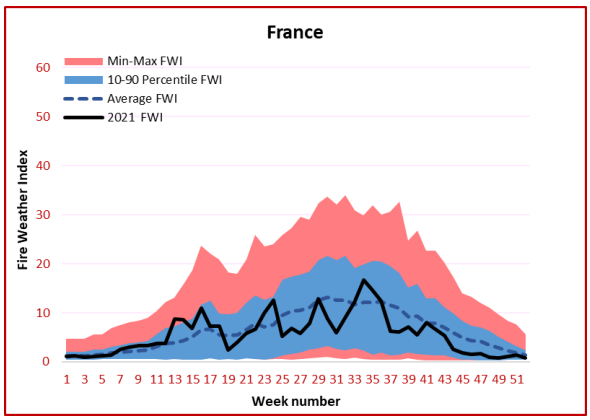


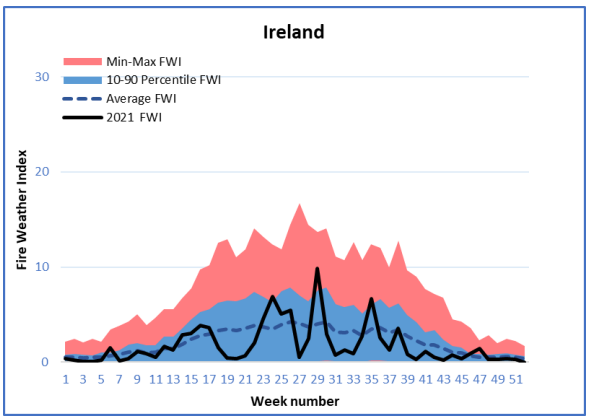

Estonia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

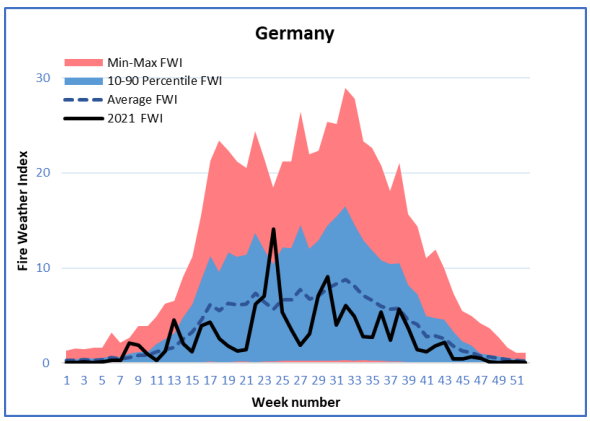

Greece
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

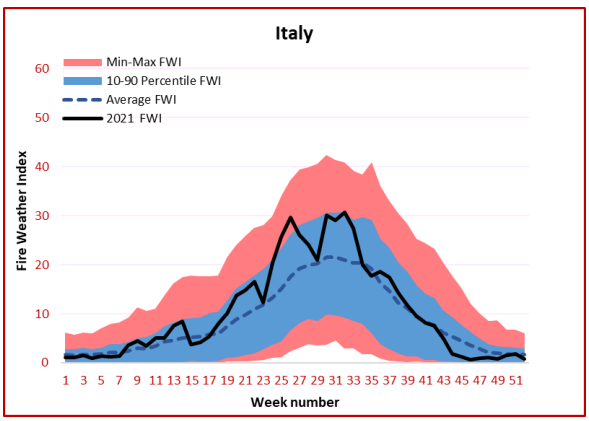

Finland
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

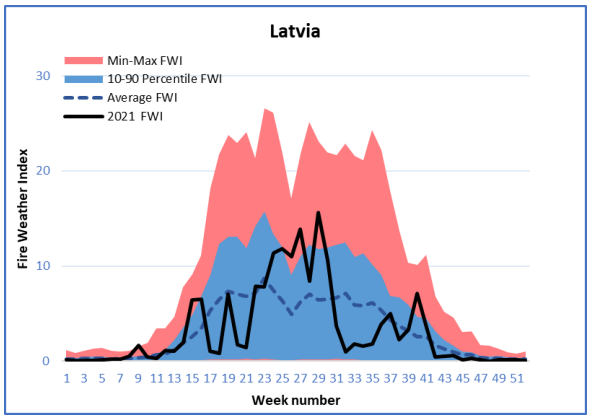

Hungary
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

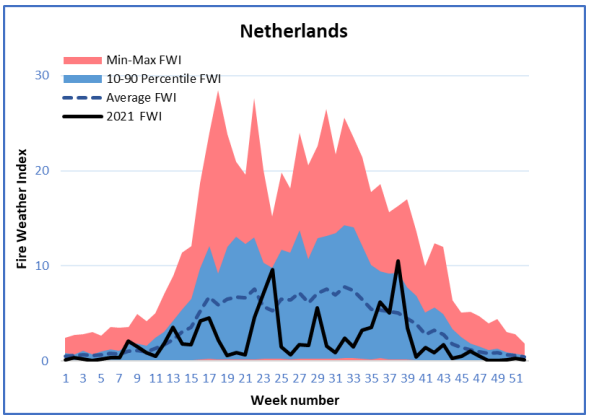

France
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

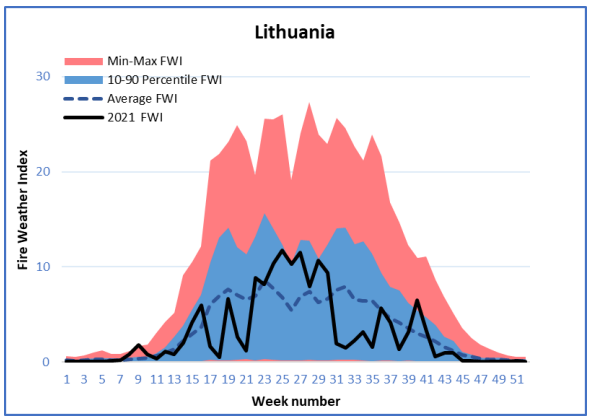

Ireland
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

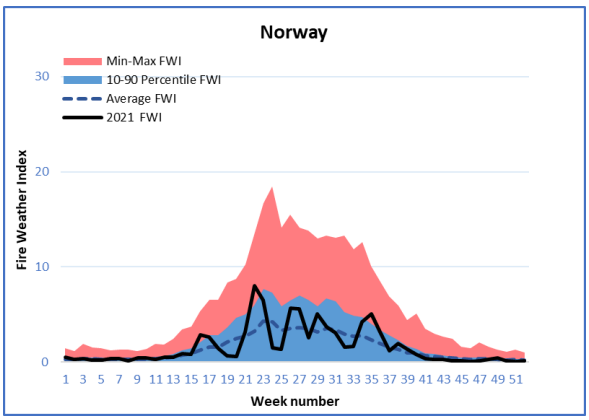

Germany
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

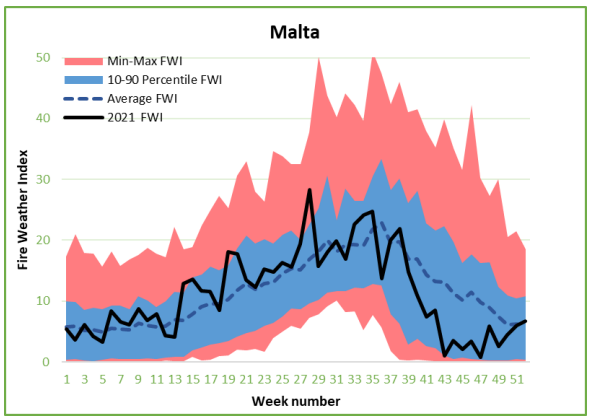

Italy
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

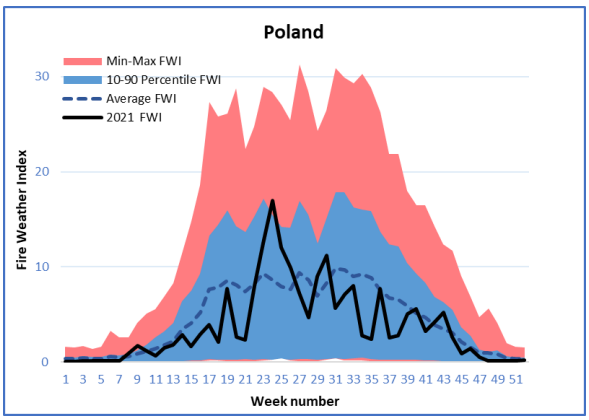

Latvia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

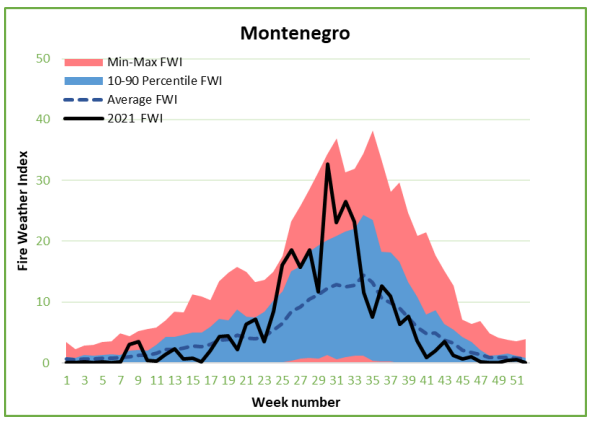

Netherlands
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

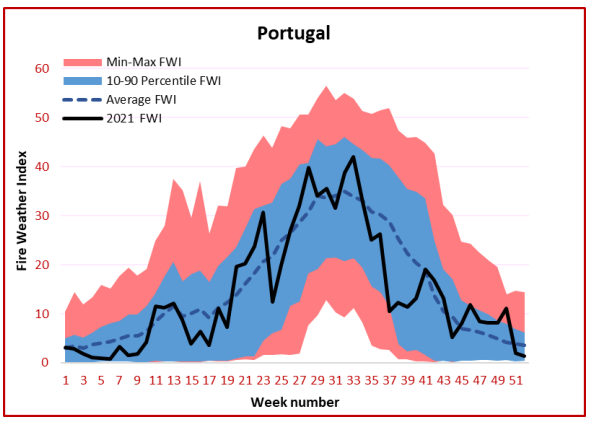

Lithuania
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

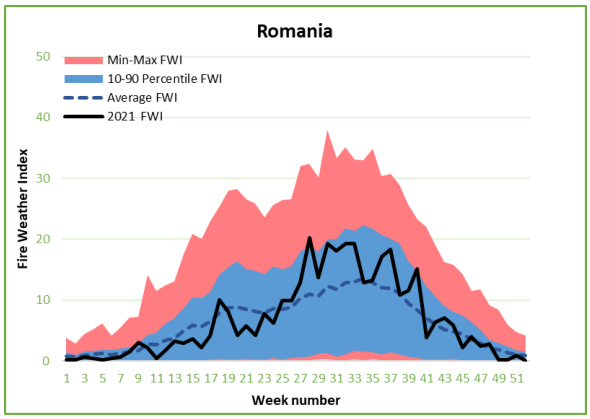

Norway
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

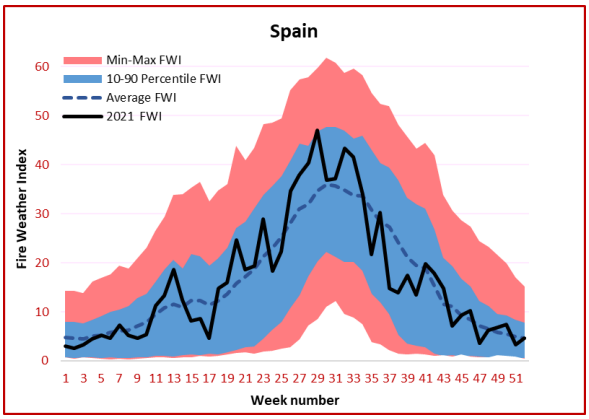

Malta
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

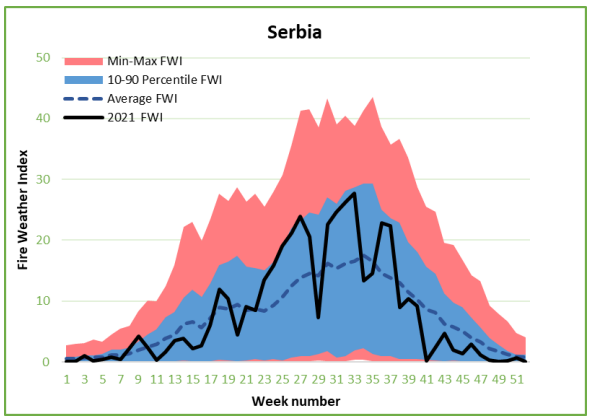

Poland
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

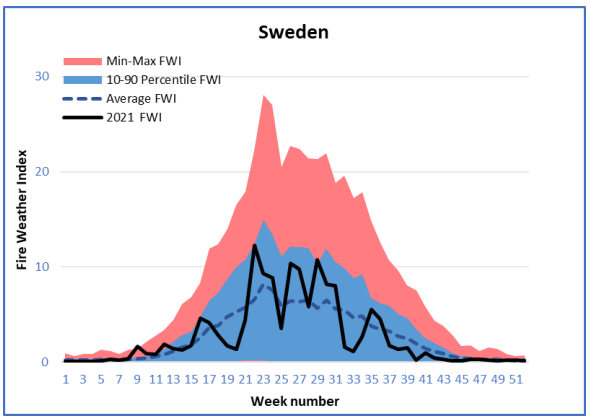

Montenegro
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

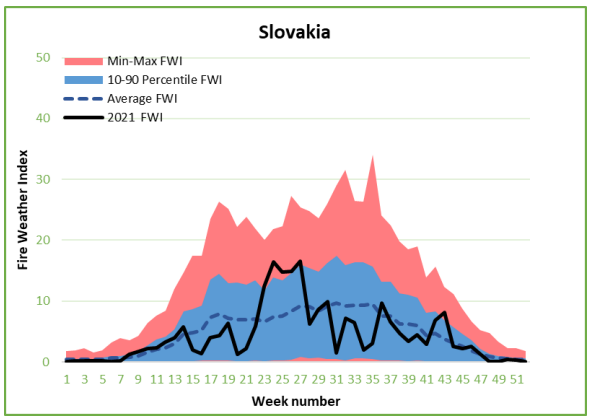

Portugal
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

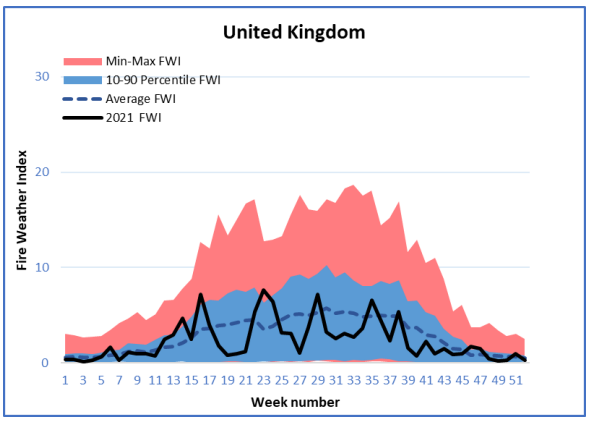

Romania
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

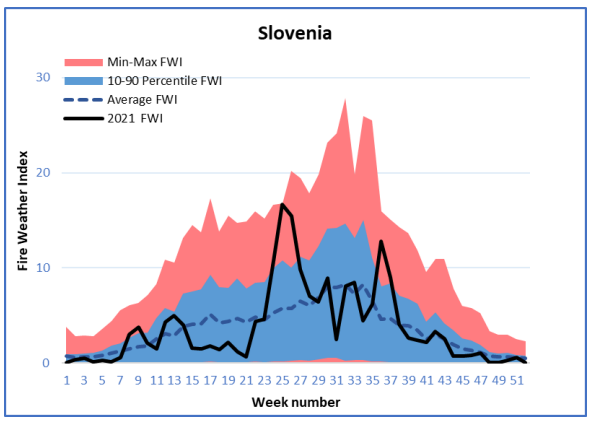

Spain
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

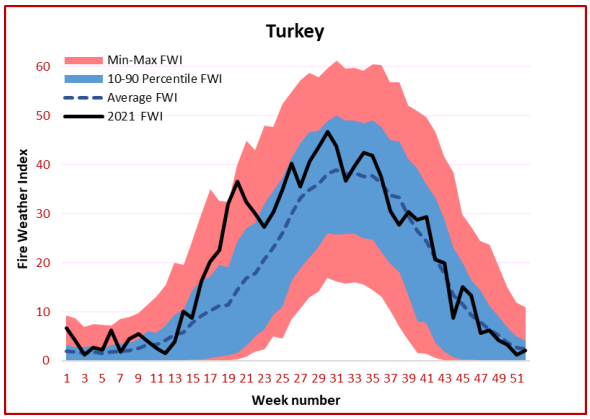

Serbia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

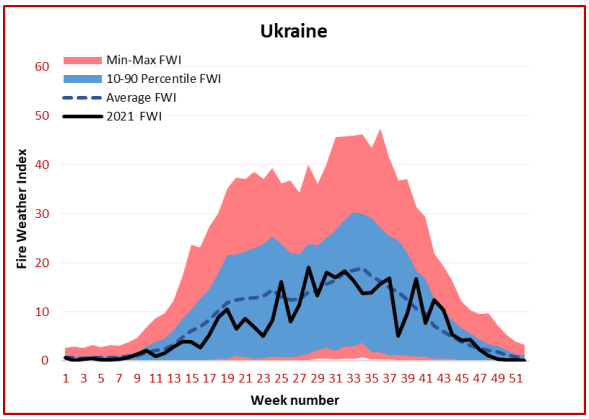

Sweden
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number


Slovakia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

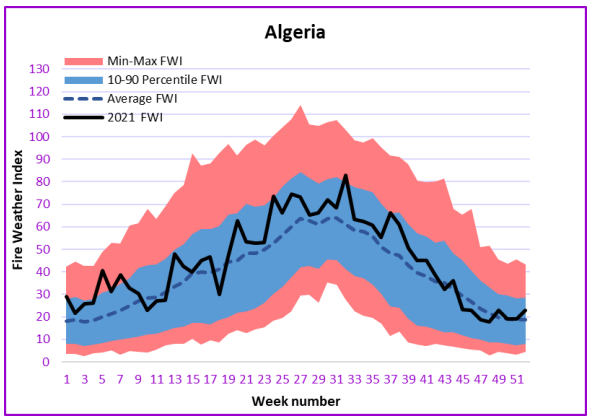

United Kingdom
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

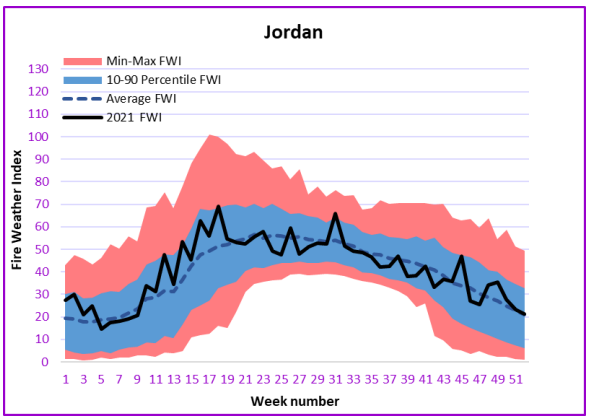

Slovenia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

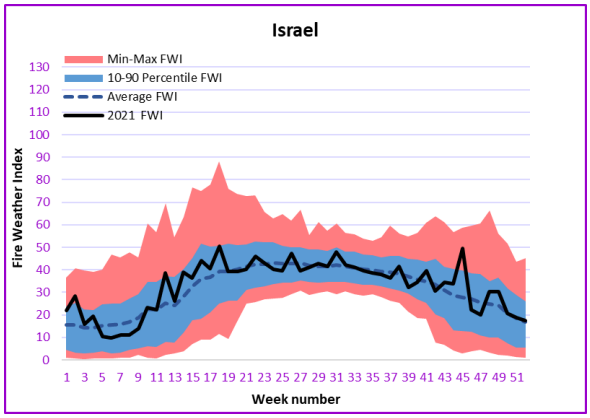


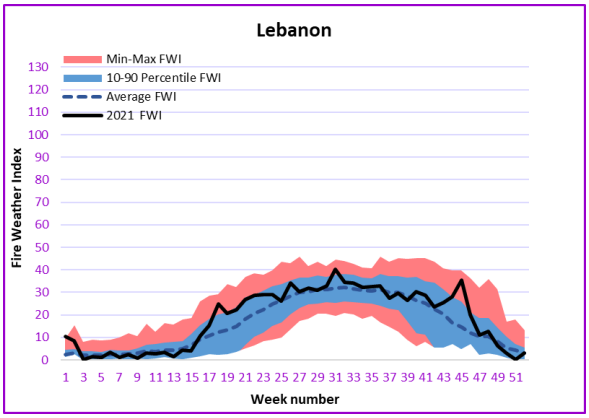


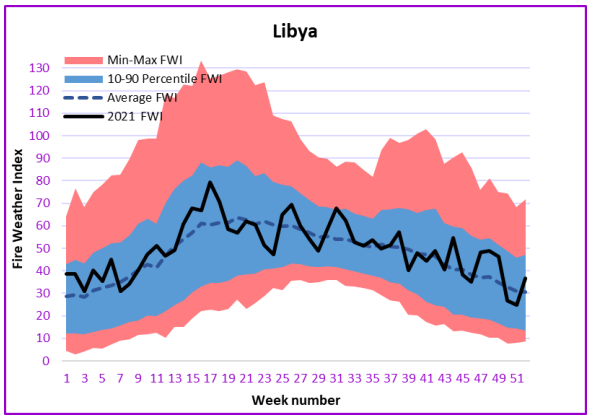
MENA countries

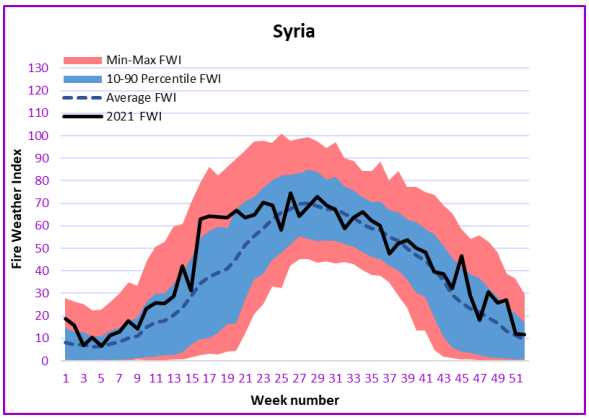


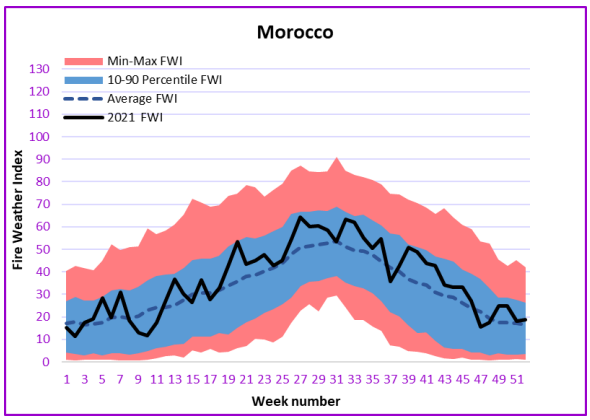


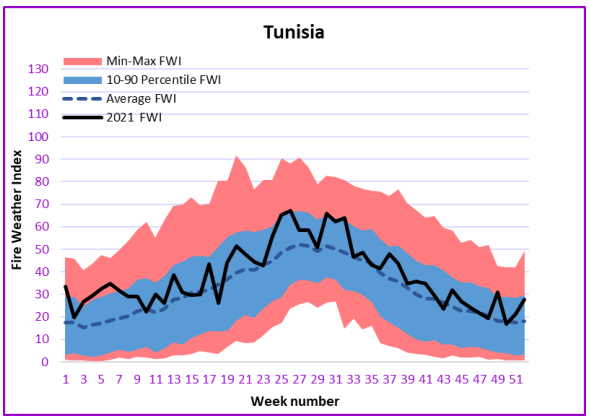


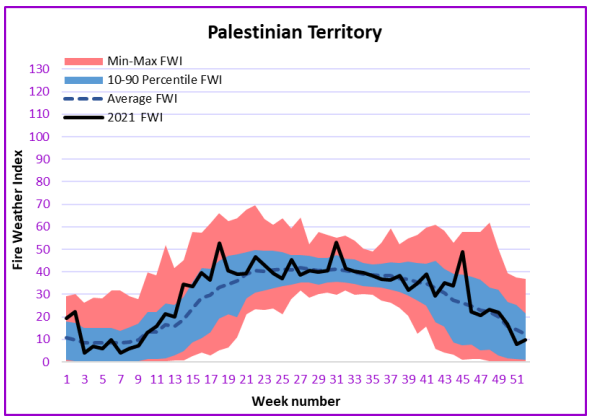



Libya
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number


Syria
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number


Morocco
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number


Tunisia
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number


Palestinian Territory
Min-Max FWI
10-90 Percentile FWI
Average FWI
2021 FWI
Fire Weather Index
Week number

2.1 EFFIS Rapid Damage Assessment: 2021 results

The Rapid Damage Assessment module of EFFIS was set up to provide reliable and harmonized estimates of the areas affected by wildfires during the fire season. The methodology and the spatial resolution of the satellite sensor data used for this purpose, from the MODIS sensor, at 250 metre spatial resolution, allowed fires of about 30 ha or larger to be mapped. This methodology was enhanced in 2018 through the use of Sentinel 2 imagery, at 20 metre spatial resolution, which allowed the mapping of fires of about 5 ha or larger. In order to obtain the statistics of the burnt area by land cover type, the data from the European CORINE Land Cover database were used. Therefore, the mapped burnt areas were overlaid with the CLC data, making it possible to derive damage assessment results comparable for all the EU countries.

EFFIS Rapid Damage Assessment is based on the analysis of MODIS satellite imagery. The MODIS instrument is on board both the TERRA (morning pass) and AQUA (afternoon pass) satellites. MODIS data has 2 bands with spatial resolution of 250 metres (red and near-infrared bands) and 5 bands with spatial resolution of 500 metres (blue, green, and three short-wave infrared bands). Mapping of burnt areas is based mainly on the 250 metre bands, although the MODIS bands at 500 metres resolution are also used, as they provide complementary information that is used for improved burnt area discrimination. This type of satellite imagery allows detailed mapping of fires of around 30 ha or larger. Although only a fraction of the total number of fires is mapped (fires smaller than 30 ha are not mapped), the analysis of historical fire data has determined that the area burned by wildfires of this size represents in most cases the large majority of the total area burned. On average, the area burned by fires of at least 30 ha accounts for about 85% of the total area burnt every year in the Southern EU. As mentioned above, since 2018, through the use of Sentinel 2 imagery nearly about 95% of the total burnt area is mapped in EFFIS. The results for each of the countries affected by forest fires are given in the following paragraphs in alphabetical order, followed by a section on the MENA countries.

The total area burned in 2021, as shown by the analysis of satellite imagery, is shown in Table 55.

These figures may also include agricultural and urban areas that were burned during the wildfires, which may not strictly be considered forest fires in the countries concerned. Figure 196 below shows the scars caused by forest fires during the 2021 season.

In 2021, fires were mapped in 43 countries and a total burnt area of 1 113 464 ha was mapped, a similar total to that mapped in 2020.

Table 55. Areas mapped in 2021 estimated from satellite imagery.

Country	*Area (Ha)*	*Number of Fires*
Albania	31275	329
Algeria	134273	295
Austria	82	2
Belgium	659	2
Bosnia and Herzegovina	63284	294
Bulgaria	4261	80
Croatia	10074	113
Cyprus	6339	24
Denmark	369	19
Finland	2793	42
France	34986	587
Germany	285	27
Greece	131254	222
Hungary	573	8
Iraq	25	1
Ireland	3609	50
Israel	4021	32
Italy	159537	1422
Jordan	2	1
Kosovo under UNSCR 1244	7580	92
Latvia	312	6
Lebanon	2360	50
Libya	377	11
Lithuania	65	5
Montenegro	43469	198
Morocco	6083	81
North Macedonia	21511	136
Norway	991	22
Palestinian Territory	143	2
Poland	51	12
Portugal	31582	749
Romania	20957	121
Serbia	7708	139
Slovakia	115	1
Slovenia	81	2
Spain	91295	901
Sweden	1287	48
Switzerland	12	2
Syria	18798	118
Tunisia	29009	98
Turkey	206013	612
Ukraine	27866	128
United Kingdom	8098	234
Total	**1113464**	**7318**

Summary	**Total Area (Ha)**
EU27	500566
Other European countries	417807
Middle East and North Africa	195091
Natura2000 and other protected sites	102598

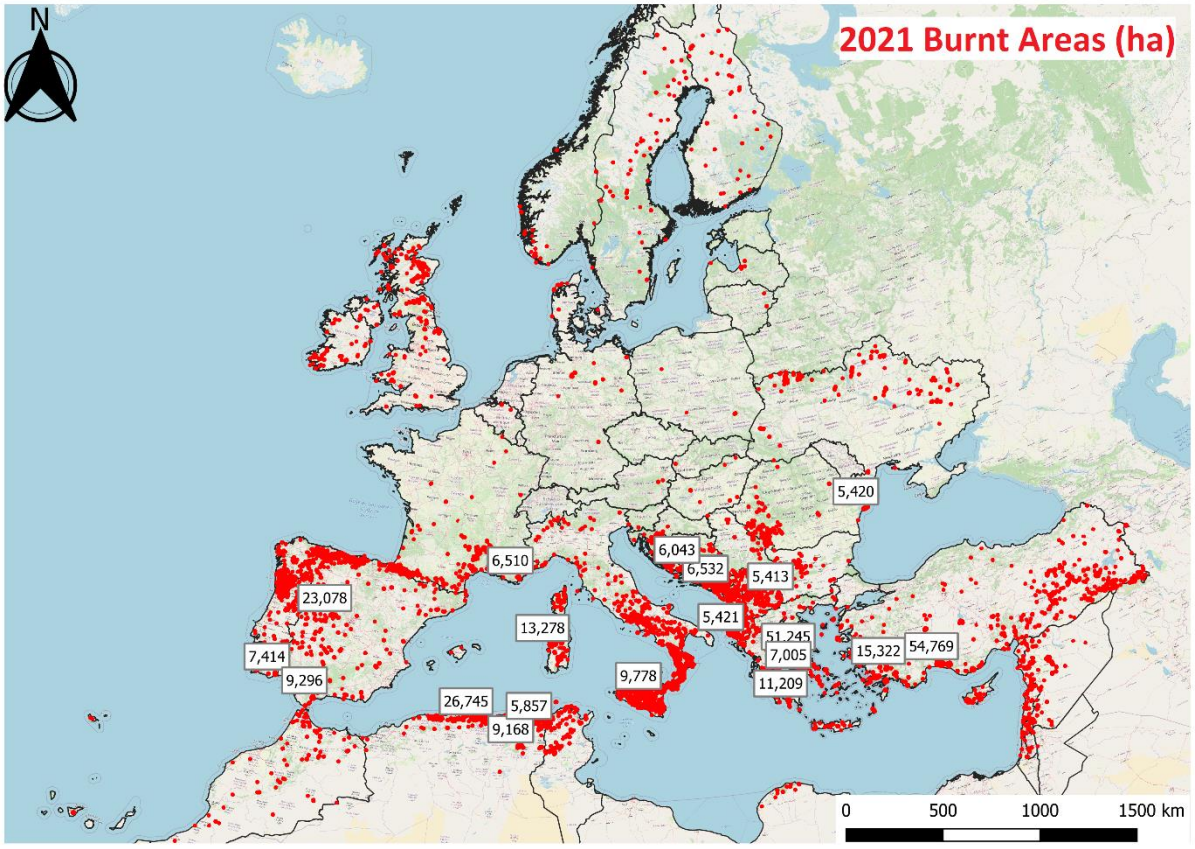


Figure 196. Burnt areas mapped during the 2021 fire season. Largest fires are indicated in ha.

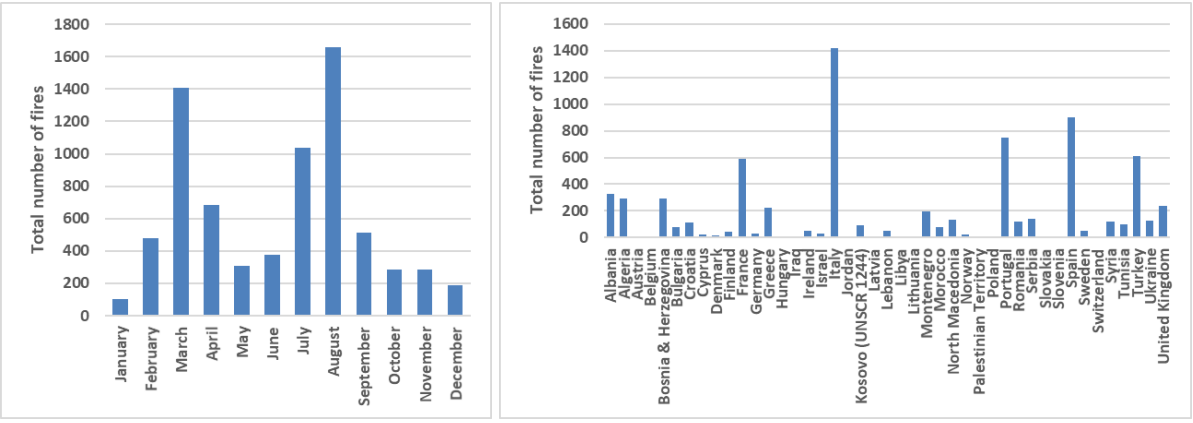


Figure 197. Total number of fires mapped by month and country in 2021.

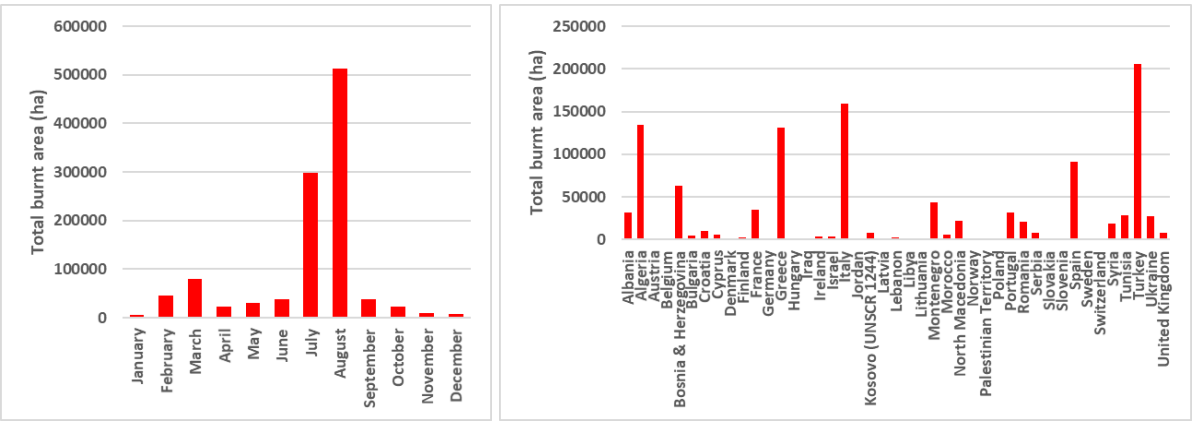


Figure 198. Total burnt area of fires mapped by month and country in 2021.

2.1.1 Damage to Natura2000 and other protected sites

Of particular interest is the analysis of the damage caused by fires to the areas protected within the Natura2000 network, as they include habitats of especial interest which are home for endangered plant and animal species.

The category of Natura2000 areas only exists in the countries of the European Union. Information on other protected areas outside the EU is presented for those countries for which the information is available. The area burnt within the Natura2000 and other protected sites is presented below.

Country	*Area (Ha)*	*% of Natura2000 Area*	*Number of Fires*
Austria	72.0	0.005846	1
Belgium	643.1	0.167338	2
Bulgaria	1937.1	0.051546	20
Cyprus	196.3	0.120738	3
Denmark	230.0	0.059806	4
France	9277.2	0.135198	164
Germany	118.8	0.002167	3
Greece	10453.5	0.292012	35
Finland	1605.1	0.03295	5
Hungary	563.9	0.028311	5
Ireland	2209.4	0.242724	9
Italy	25222.6	0.437154	206
Latvia	218.9	0.029986	2
Poland	40.0	0.000658	1
Portugal	7902.0	0.41354	91
Romania	15289.3	0.359062	36
Slovenia	76.0	0.01065	1
Spain	21668.0	0.157953	142
Sweden	447.2	0.007855	2
EU27 total	**98170.4**		**732**
Albania	6.9	0.70516444	1
Algeria	2737.7	1.64471275	15
Morocco	544.0	0.07587772	3
United Kingdom	1139.1	0.06466358	15
Non-EU total	**4427.7**		**34**
TOTAL	**102598.1**		**766**

Fires were mapped in 18 of the 27 EU member states and four non-EU countries that have information on protected areas.

The total burnt area in protected areas in 2021 was 102 598 ha, less than in the last two years and slightly below the average of the previous 10 years.

The most affected country in 2021 was Italy, followed closely by Spain. These two countries accounted for 45% of the total burnt in protected areas.

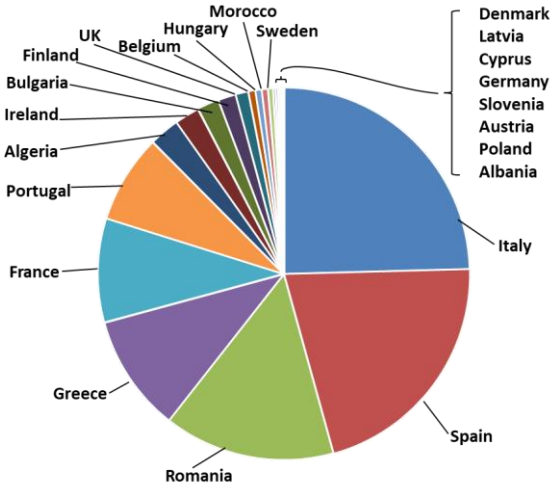


Figure 199. relative proportions of burnt area mapped in protected areas in 2021, ordered by size.

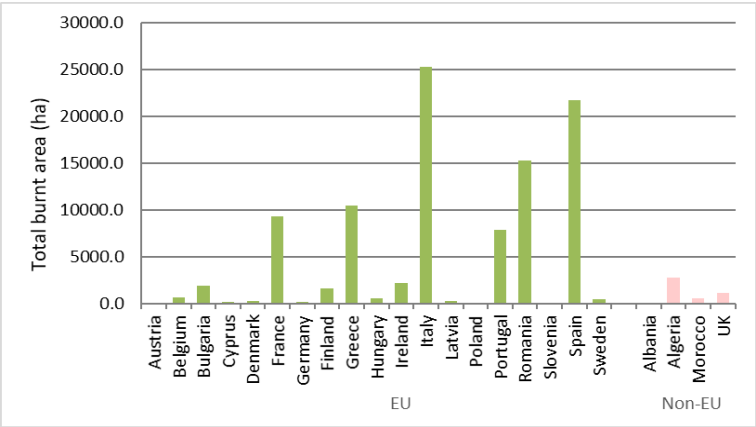


Figure 200. Burnt area in Natura2000 sites and other protected areas in 2021.

2.1.2 Affected land cover types

In 2021, the vegetation types were classified into more detailed categories than used in previous years, as follows:

Category	Description
Broadleaved forest	Vegetation formation composed principally of trees, including shrub and bush understoreys, where broad-leaved species predominate.
Coniferous forest	Vegetation formation composed principally of trees, including shrub and bush understoreys, where coniferous species predominate.
Mixed forest	Vegetation formation composed principally of trees, including shrub and bush understoreys, where neither broad-leaved nor coniferous species predominate.
Other Natural	Other natural land not included in the other categories
Sclerophyllous	Bushy sclerophyllous vegetation, includes maquis and garrigue.
Transitional	Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/recolonization.
Agriculture	Cultivated crops
Artificial	Includes urban and industrial areas, mine, dump and construction areas.
Other	Other land types not included in the above categories

A detailed description of all the land cover types used can be found in:

Bossard, M., Feranec, J., Otahel, J., Steenmans, C., 2000. **CORINE land cover technical guide – Addendum 2000**. Report No. 40. *European Environment Agency*.

https://www.eea.europa.eu/ds_resolveuid/032TFUPGVR

In 2021, around a quarter of the total burnt area was in the Agriculture land type. Forest (comprising Broadleaved Forest, Coniferous forest and Mixed Forest) together accounted for 28%, and other natural land types (Sclerophyllous, Transitional and Other Natural Land) accounted for most of the remainder (nearly one half) of the total.

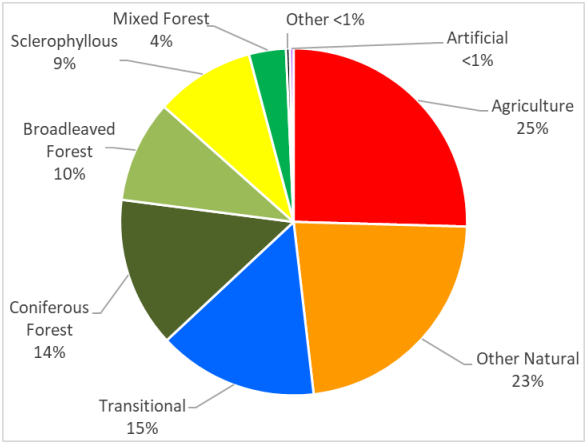


Figure 201. Proportions of land cover types affected in 2021 (all countries, ordered by total burnt area).

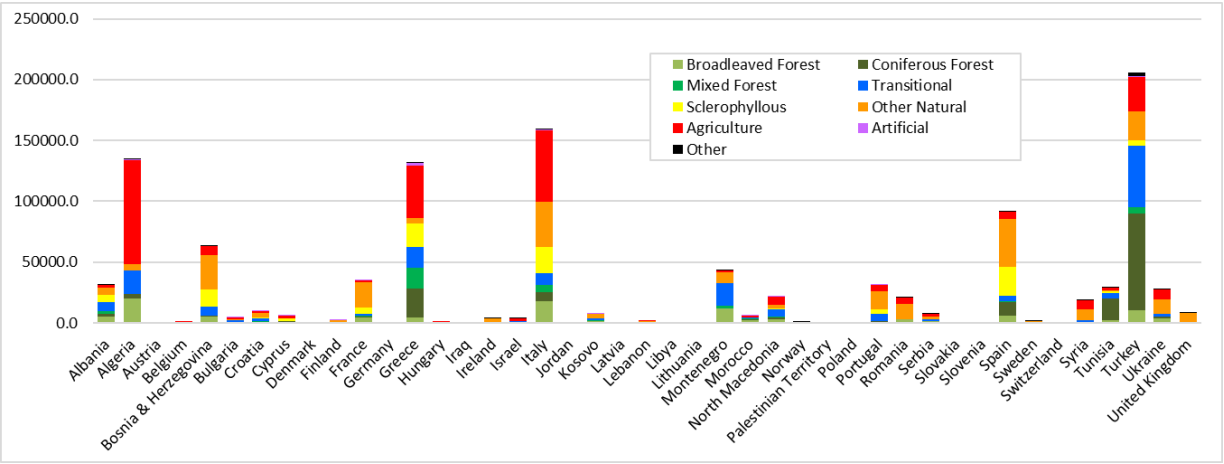


Figure 202. Burnt area in each country in 2021 by CORINE land class.

2.1.3 European countries (EU27)

In 2021, wildfires were mapped in 22 of the EU27 countries in 2021: (Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden), burning 500 566 ha in total. This is above the amount recorded in 2020. August was the month when a significant proportion of the damage occurred, particularly in Greece.

Of this total, 102 598 ha occurred on Natura2000 sites. This amounts to 20% of the total, a smaller proportion than in 2020.

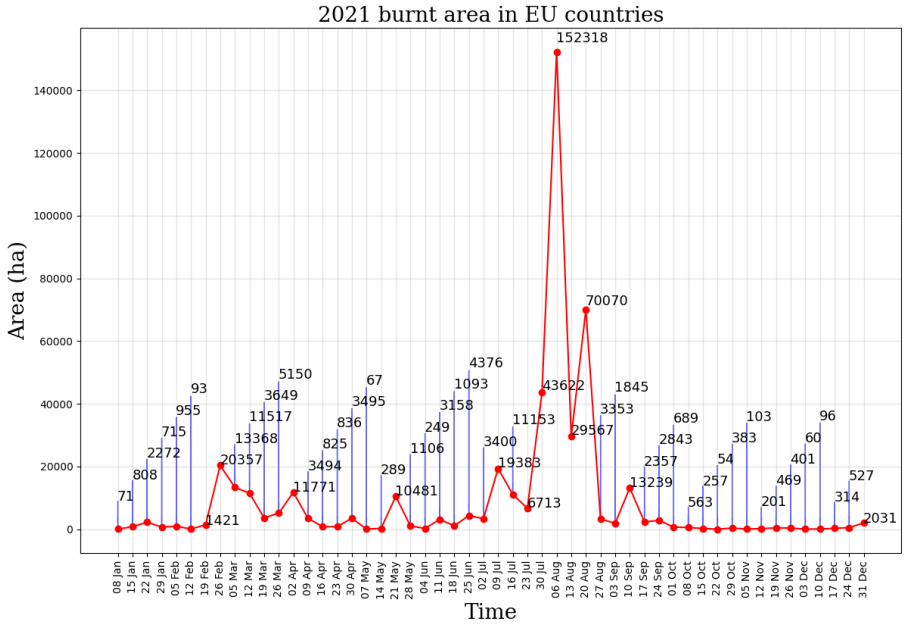


Figure 203. Burnt area weekly evolution in 2021 (European Union countries).

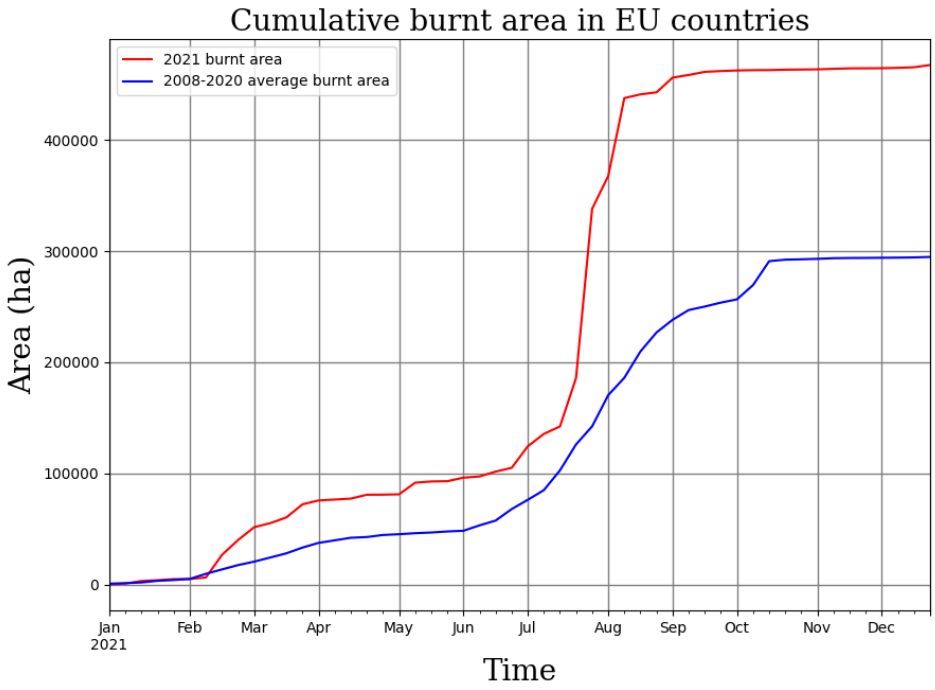


Figure 204. Cumulative burnt area in 2021 (European Union countries).

2.2 Mapped burnt area by country

The following section details the burnt areas mapped in each country in 2021. European countries (EU and non-EU) are listed alphabetically, followed by the MENA countries.

Burnt areas are split into different land cover types using the CLC 2018 database unless otherwise specified.

In 2021, for the first time, fires smaller than 30 ha were also included in the mapped totals. However, almost all damage comes from fires of over 30 ha (Table 56), and general observations about the season with respect to previous years can still be made.

Table 56. Analysis of the portion of mapped burnt areas over 30 ha in 2021.

Region	% of mapped burnt area from fires >30ha
EU	94%
Other European countries	97%
MENA countries	98%

2.2.1 Albania

The mapped burnt area in Albania was significantly higher than recent years (apart from 2017). 329 fires were mapped between February and November, burning a total of 31 275 ha. The peak of the season was in July and August, when 90% of the damage occurred. 8 fires over 500 ha were mapped, the biggest of which occurred in Korcë province at the end of July and covered over 5 000 ha. Around one third of all the burnt area was mapped in forest lands (Table 57). Burnt area scars from the fires in 2021 can be seen in Figure 205.

Table 57. Distribution of burnt area (ha) in Albania by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	5610	17.9
Coniferous forest	2018	6.5
Mixed forest	2372	7.6
Transitional	6883	22.0
Sclerophyllous vegetation	6275	20.1
Other Natural Land	6118	19.6
Agriculture	1972	6.3
Artificial Surfaces	9	0.0
Other Land Cover	18	0.1
TOTAL	31275	100

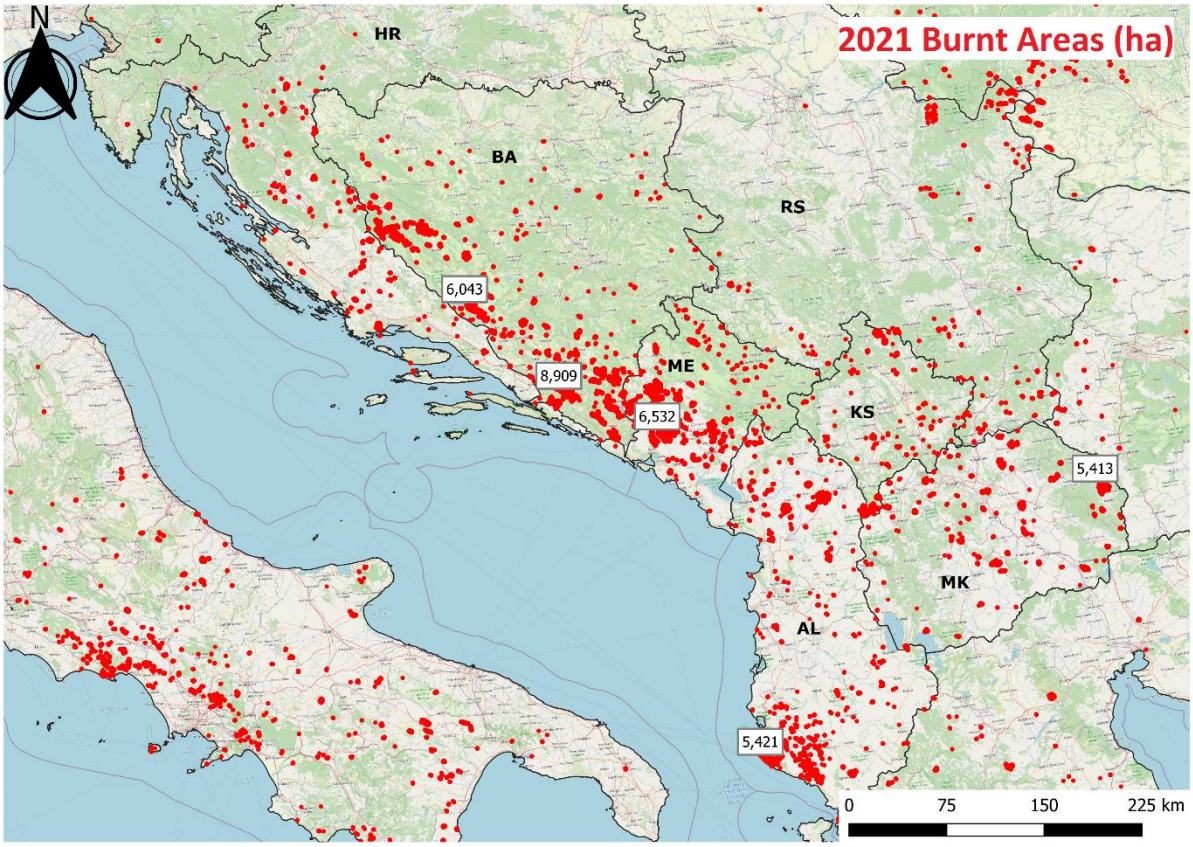


Figure 205. Burnt area scars in the Balkans in 2021. Largest fires are indicated in ha.
AL=Albania; BA=Bosnia & Herzegovina; HR=Croatia; KS=Kosovo under UNSCR 1244; ME=Montenegro; MK=North Macedonia; RS=Serbia.

2.2.2 Austria

Two fires were mapped in Austria, in July and October. The larger of the two (72 ha) occurred in a Natura2000 site. Coniferous forest was the most affected land type.

Table 58. Distribution of burnt area (ha) in Austria by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	44	53.5
Mixed forest	22	27.2
Transitional	4	4.4
Other Natural Land	12	14.8
TOTAL	82	100

2.2.3 Belgium

Two fires were mapped in Belgium early in the season, in March and April, totalling 659 ha. The largest fire burnt over 500 ha in Brecht. Almost all of the total (98%, 643 ha) was on Natura2000 land, amounting to 0.167% of the protected area of the country.

Table 59. Distribution of burnt area (ha) in Belgium by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	3	0.5
Mixed forest	37	5.6
Transitional	21	3.2
Other Natural Land	593	90.0
Agriculture	5	0.8
TOTAL	659	100

2.2.4 Bosnia and Herzegovina

The fire season in Bosnia was somewhat lighter than the previous year. 294 fires were mapped between January and October, burning a total of 63 284 ha. There were two peaks of fire activity in the season: one in February/March and the second in July/August. 45% of the total burnt area was mapped in Other Natural Land. There were a number of large fires: 23 were over 500 ha, and the largest covered almost 9 000 ha in Ljubinje in August. Figure 205 above shows the locations of the large fires in 2021.

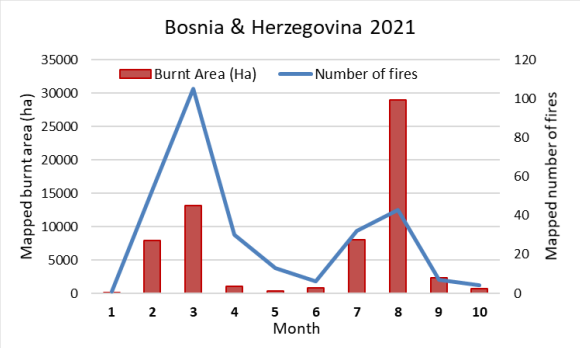


Figure 206. Monthly mapped burnt area and number of fires in Bosnia & Herzegovina in 2021.

Table 60. Distribution of burnt area (ha) in Bosnia & Herzegovina by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	5352	8.5
Coniferous forest	407	0.6
Mixed forest	357	0.6
Transitional	7178	11.3
Sclerophyllous vegetation	14471	22.9
Other Natural Land	28354	44.8
Agriculture	7142	11.3
Artificial Surfaces	21	0.0
Other Land Cover	1	0.0
TOTAL	63284	100

2.2.5 Bulgaria

The 2021 fire season in Bulgaria was light, with a total mapped burnt area less than half of that in 2020, even taking into account that fires smaller than 30 ha were included in 2021. A total of 80 fires were mapped, burning 4 261 ha in two main waves: one in February/March and the other in the summer when two-thirds of the damage occurred. None of the fires exceeded 500 ha.

Of the annual total, nearly half (1 937 ha) occurred on Natura2000 sites, which amounts to 0.167% of the total Natura2000 land in Bulgaria.

Table 61. Distribution of burnt area (ha) in Bulgaria by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	397	9.3
Coniferous forest	358	8.4
Mixed forest	370	8.7
Transitional	976	22.9
Other Natural Land	665	15.6
Agriculture	1491	35.0
Artificial Surfaces	5	0.1
TOTAL	4261	100

2.2.6 Croatia

In Croatia the fire season was significantly lighter than the previous year, with 10 074 ha mapped from 113 fires, compared with 2020, when 27 477 ha was mapped from fires over 30 ha. The season started early, and almost half of the annual burnt area was mapped in February/March. A second peak was observed in August, including a fire of over 1 400 ha in Split-Dalmatia province. Four other fires of over 500 ha were also mapped, these 5 fires accounting for 40% of the annual total between them. None of the fires were mapped in protected areas.

Burnt area scars from these fires can be seen in Figure 205 above.

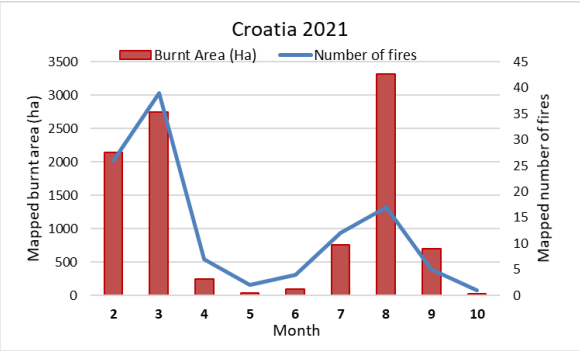


Figure 207. Monthly mapped burnt area and number of fires in Croatia in 2021.

Table 62. Distribution of burnt area (ha) in Croatia by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	1070	10.6
Coniferous forest	77	0.8
Mixed forest	53	0.5
Transitional	2579	25.6
Sclerophyllous vegetation	509	5.1
Other Natural Land	3604	35.8
Agriculture	2129	21.1
Artificial Surfaces	53	0.5
TOTAL	10074	100

2.2.7 Cyprus

It was an extreme season in Cyprus, even allowing for the fact that fires of less than 30 ha were included. 24 fires burned a total of 6 339 ha, the highest figure for over 10 years, although most of the damage was caused by a single fire of 4 627 ha in Larnaca District in July (Figure 208). A second fire of 530 ha was mapped in September in Paphos district.

Natura2000 land was relatively unaffected; accounting for only 196 ha or 3% of the total, and 0.12% of the protected land in the country.

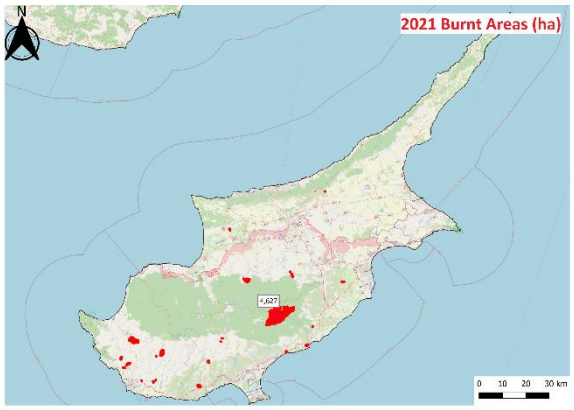


Figure 208. Burnt area scars in Cyprus in 2021, showing the large fire in Larnaca district.

Table 63. Distribution of burnt area (ha) in Cyprus by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	3	0.0
Coniferous forest	1637	25.8
Transitional	18	0.3
Sclerophyllous vegetation	1847	29.1
Other Natural Land	98	1.5
Agriculture	2698	42.6
Artificial Surfaces	38	0.6
TOTAL	6339	100

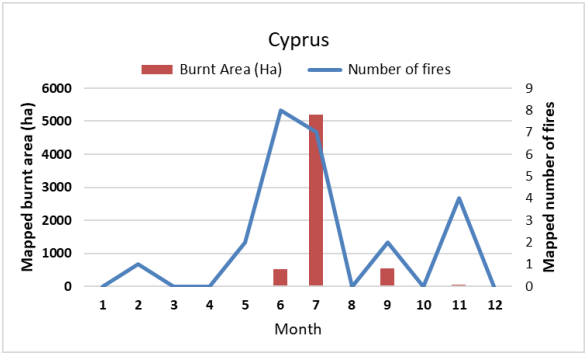


Figure 209. . Monthly mapped burnt area and number of fires in Cyprus in 2021.

2.2.8 Denmark

In 2021, 19 fires were mapped in Denmark, mostly early in the season in February/March. A total of 369 ha was mapped, almost all in Other Natural Land.

Table 64. Distribution of burnt area (ha) in Denmark by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Transitional	5	1.3
Other Natural Land	364	98.7
TOTAL	369	100

2.2.9 Finland

The summer in Finland saw two unusually large fires mapped, with one over 1 000 ha and the second over 600 ha, both in Lappi province on the same day in August (Figure 210). In total there were 42 fires mapped in 2021 between May and August, resulting in a burnt area of 2 793 ha. Of this, 1 605 ha occurred on Natura2000 land, corresponding to 57% of the total and 0.033% of the Natura2000 land in the country.

Table 65. Distribution of burnt area (ha) in Finland by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	706	25.3
Mixed forest	102	3.6
Transitional	36	1.3
Other Natural Land	1761	63.1
Agriculture	1	0.0
Artificial Surfaces	187	6.7
TOTAL	2793	100

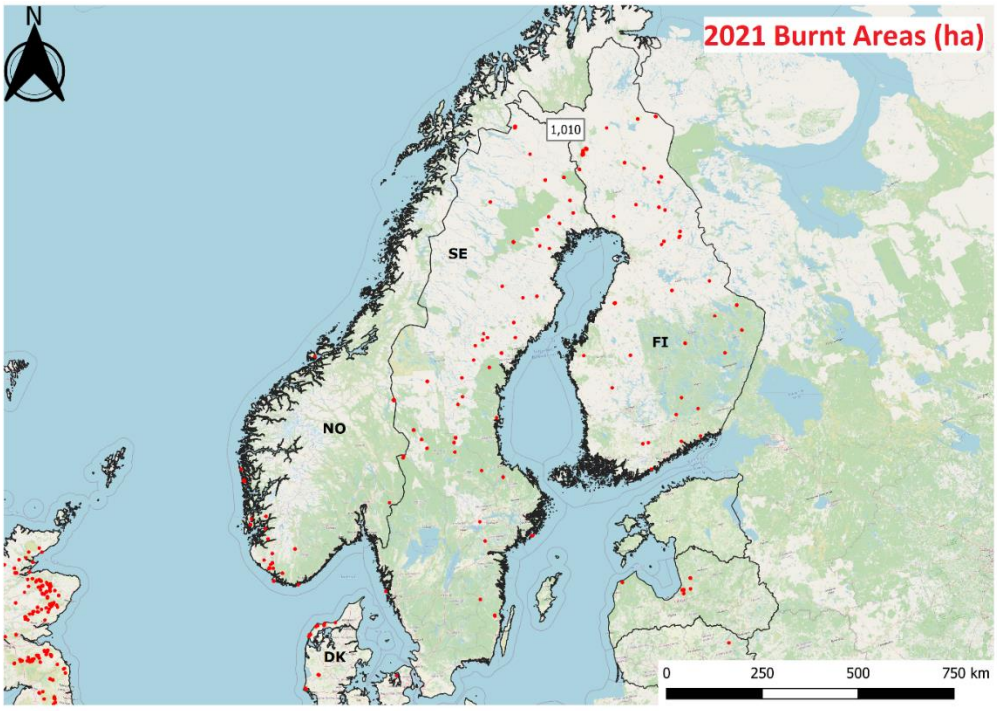


Figure 210. Burnt area scars in Scandinavia in 2021. Largest fire is indicated in ha.
NO=Norway; SE=Sweden; FI=Finland; DK=Denmark.

2.2.10 France

The season started early in France, with several very large fires in the Pyrénées-Atlantiques in February. One was over 1 350 ha and three others exceeded 500 ha. This peak corresponds in large part to prescribed burning implemented in a legal and controlled manner for the purpose of maintaining pastures. These burned areas are therefore not counted by France as "forest fires", which largely explains the difference of almost 20 000 ha between the total figure detected and announced in this paragraph and the statistics provided by France for this report. A second peak occurred in August, when the largest fire of the year for France occurred in Var, covering 6 500 ha. The total burnt area in France was 34 986 ha from 587 fires, over twice that mapped in 2020, but still below the extreme year of 2019. Of this total, 9 277 ha occurred on Natura2000 sites which corresponds to 27% of the total area burnt and 0.135% of the total Natura2000 areas in the country.

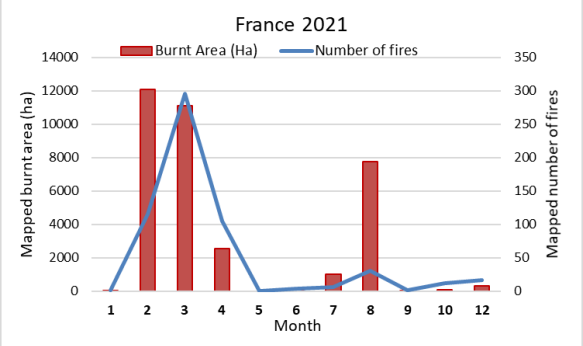
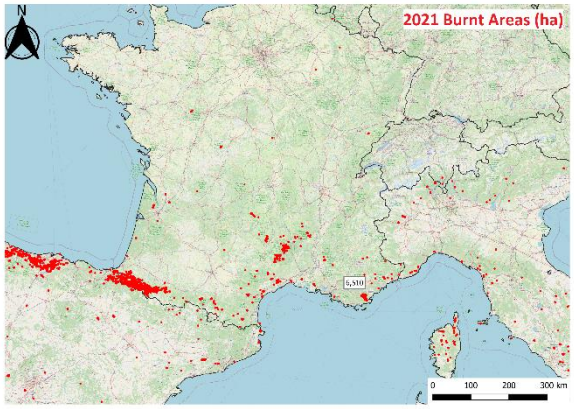


Figure 211. Monthly mapped burnt area and number of fires in France in 2021.



Burnt area scars in southern France and Corsica in 2021. Largest fire is indicated in ha.

Table 66. Distribution of burnt area (ha) in France by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	4319	12.3
Coniferous forest	653	1.9
Mixed forest	1294	3.7
Transitional	887	2.5
Sclerophyllous vegetation	5617	16.1
Other Natural Land	20389	58.3
Agriculture	1772	5.1
Artificial Surfaces	54	0.2
TOTAL	34986	100

2.2.11 Germany

The 2021 fire season on Germany was mild. 27 fires were mapped, resulting in a total burnt area of 285 ha, less than in 2020, even though fires below 30 ha were included in 2021. Fires were mapped between February and September but over 80% of the damage occurred early in the season, between February and April.

Of the annual total, 119 ha occurred in Natura2000 sites, amounting to 42% of the total and 0.002% of the Natura2000 area in the country.

Table 67. Distribution of burnt area (ha) in Germany by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	1	0.4
Coniferous forest	5	1.8
Mixed forest	12	4.3
Transitional	5	1.8
Other Natural Land	259	90.9
Agriculture	3	1.0
TOTAL	285	100

2.2.12 Greece

It was an extreme year for fires in Greece, and resulted in the highest mapped burnt area since the historically bad year of 2007. A total of 131 254 ha was mapped from 222 fires. This total included the second largest fire across the whole of the area covered by EFFIS when a fire of over 51 000 ha burned a large portion of the island of Evia (Figure 212).

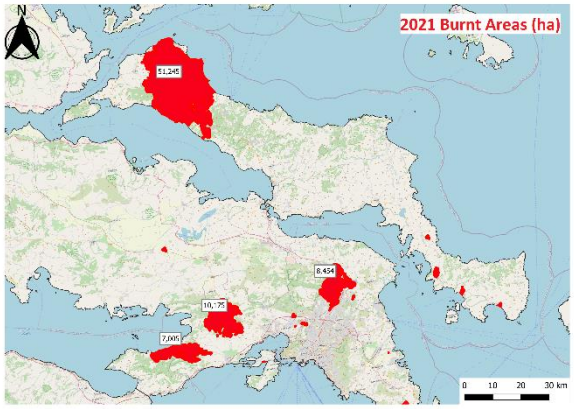


Figure 212. Burnt area scar in Evia, the second largest fire in 2021, and the largest in the EU27.

Although the largest, this was not the only extreme fire in Greece in 2021. Three others over 10 000 ha were also mapped, in addition to 8 over 1 000 ha and a further 5 over 500 ha. Most of these fires occurred in August and together almost 90% of the annual total was mapped in this month (Figure 213).

Figure 213. Monthly mapped burnt area and number of fires in Greece in 2021.

Of the total, 10 453 ha occurred on Natura2000 sites, amounting to 8% of the total and 0.29% of the total Natura2000 area of Greece. Table 68 presents the distribution of the mapped burnt area by land cover type. Figure 214 shows the burnt area scars in Greece.

Table 68. Distribution of burnt area (ha) in Greece by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	4803	3.7
Coniferous forest	23611	18.0
Mixed forest	16994	12.9
Transitional	17349	13.2
Sclerophyllous vegetation	18873	14.4
Other Natural Land	4882	3.7
Agriculture	43048	32.8
Artificial Surfaces	1664	1.3
Other Land Cover	31	0.0
TOTAL	131254	100

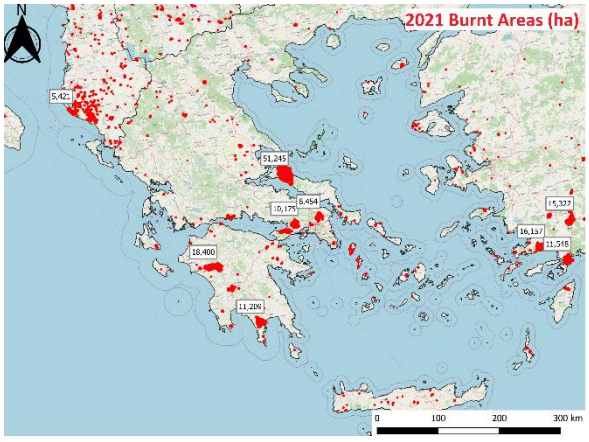


Figure 214. Burnt area scars in Greece in 2021. Largest fires are indicated in ha.

2.2.13 Hungary

Eight fires burned a total of 573 ha in Hungary in 2021. Practically all of the damage occurred in July and September and most of it (564 ha) was on Other Natural Land in Natura2000 sites, amounting to 98% of the total and 0.028% of the Natura2000 area in the country.

Table 69. Distribution of burnt area (ha) in Hungary by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2	0.4
Coniferous forest	3	0.5
Mixed forest	2	0.3
Transitional	3	0.5
Other Natural Land	558	97.4
Agriculture	5	0.9
TOTAL	573	100

2.2.14 Ireland

The total burnt area of 3 609 ha from 50 fires mapped in Ireland was slightly higher than in the last three years, although this is mostly because of a very large fire of 1 799 ha that occurred in April in Muckross municipality in the South-West province. In total, 85% of the damage occurred early in the season in April. 61% of the burnt area (2 209 ha) was recorded in Natura2000 sites, which corresponds to 0.243% of the total Natura2000 land in the country. The most affected land type in 2021 was Other Natural Land, as shown in Table 70. Mapped burnt area scars in Ireland in 2021 can be seen in Figure 232 below.

Table 70. Distribution of burnt area (ha) in Ireland by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	24	0.7
Coniferous forest	5	0.1
Mixed forest	1	0.0
Transitional	80	2.2
Other Natural Land	3384	93.8
Agriculture	95	2.6
Other Land Cover	19	0.5
TOTAL	3609	100

2.2.15 Italy

In 2021, Italy was the country second most affected by fires in terms of burnt area (after Turkey), and recorded the highest number of fires. The total burnt area of 159 537 ha mapped from 1 422 fires was the highest recorded in over a decade. 90% of the damage occurred in July and August (Figure 216).

There were 49 fires over 500 ha, the highest number of large fires mapped in 2021 across Europe, the Middle East and North Africa.

15 of the 49 fires exceeded 1 000 ha and the largest (in Sardinia) was over 13 000 ha. Sicily was particularly affected, with 32 of these 49 large fires occurring there (Figure 215).

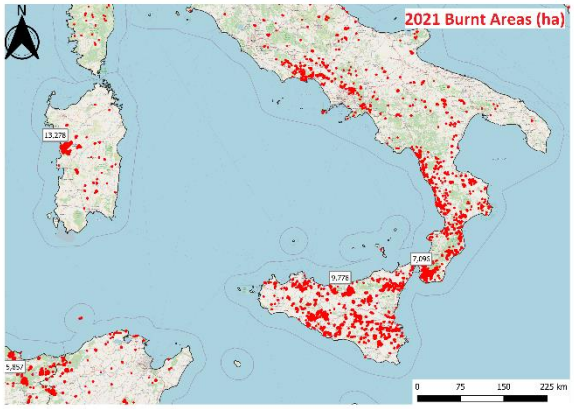


Figure 215. Burnt area scars in southern Italy and Sardinia. Largest fires are indicated in ha.

Of the year's total, 25 223 ha occurred on Natura2000 sites, corresponding to 16% of the total and 0.437% of the Natura2000 land in Italy. Table 71 presents the distribution of the mapped burnt area by land cover type.

Table 71. Distribution of burnt area (ha) in Italy by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	17672	11.1
Coniferous forest	7435	4.7
Mixed forest	6169	3.9
Transitional	9813	6.2
Sclerophyllous vegetation	21530	13.5
Other Natural Land	37239	23.3
Agriculture	58630	36.8
Artificial Surfaces	432	0.3
Other Land Cover	617	0.4
TOTAL	159537	100

Figure 216. Monthly mapped burnt area and number of fires in Italy in 2021.

2.2.16 Kosovo under UNSCR 1244

The total burnt area mapped in Kosovo was comparable with the 2020 season, taking into account the inclusion of smaller fires in 2021. 92 fires were mapped, giving a total burnt area of 7 580 ha. In common with other countries in this region, the worst month was August, when almost half the annual damage occurred, but there was also a late end to the season with three of Kosovo's largest fires recorded in October and November. Mapped burnt area scars can be seen in Figure 205 above.

Figure 217. Monthly mapped burnt area and number of fires in Kosovo in 2021.

Table 72. Distribution of burnt area (ha) in Kosovo by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	1792	23.6
Coniferous forest	115	1.5
Mixed forest	40	0.5
Transitional	1614	21.3
Other Natural Land	3600	47.5
Agriculture	413	5.5
Artificial Surfaces	6	0.1
TOTAL	7580	100

2.2.17 Latvia

Six fires were mapped in Latvia, covering a total of 312 ha between April and July. 219 ha of this total occurred in Natura2000 sites, corresponding to 70% of the total burnt area and 0.03% of the total protected area in the country.

Table 73. Distribution of burnt area (ha) in Latvia by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	21	6.7
Mixed forest	14	4.5
Transitional	59	18.9
Other Natural Land	218	69.8
TOTAL	312	100

2.2.18 Lithuania

Five fires were mapped in Lithuania in May and June, resulting in a total burnt area of 65 ha. No Natura2000 land was affected.

Table 74. Distribution of burnt area (ha) in Lithuania by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	2	3.5
Transitional	1	1.2
Other Natural Land	62	95.4
TOTAL	65	100

2.2.19 Montenegro

The fire season in Montenegro was comparable to that of 2020 and significantly worse than the long term average. A total of 43 469 ha from 198 fires was mapped between February and November. However, in common with many other countries, August was the month when most of the damage occurred, in this case 75% of the annual total (Figure 218). The largest fire covered over 6 500 ha, and 11 exceeded 1 000 ha, with a further 7 greater than 500 ha. Figure 205 above shows the mapped burnt area scars.

Table 75. Distribution of burnt area (ha) in Montenegro by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	11656	26.8
Coniferous forest	363	0.8
Mixed forest	2263	5.2
Transitional	18390	42.3
Other Natural Land	9179	21.1
Agriculture	1595	3.7
Artificial Surfaces	19	0.0
Other Land Cover	5	0.0
TOTAL	43469	100

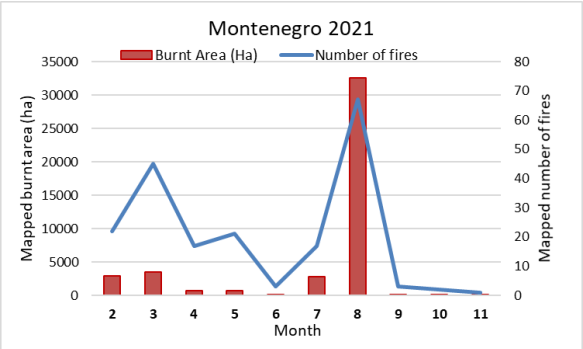


Figure 218. Monthly mapped burnt area and number of fires in Montenegro in 2021.

2.2.20 North Macedonia

136 fires were mapped in North Macedonia giving a total burnt area of 21 511 ha, ten times that mapped in 2020 but still well below the extreme year in 2019. Similar to other countries, August was by far the worst month, when two-thirds of the damage was recorded. The largest fire of the year covered more than 5 000 ha in Pehčevo municipality in the east of the country, and there were 7 other fires that exceeded 500 ha, all occurring in July and August. The burnt area scars are shown in Figure 205 above.

Table 76. Distribution of burnt area (ha) in North Macedonia by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2938	13.7
Coniferous forest	1850	8.6
Mixed forest	180	0.8
Transitional	6424	29.9
Sclerophyllous vegetation	432	2.0
Other Natural Land	3345	15.5
Agriculture	6333	29.4
Artificial Surfaces	9	0.0
TOTAL	21511	100

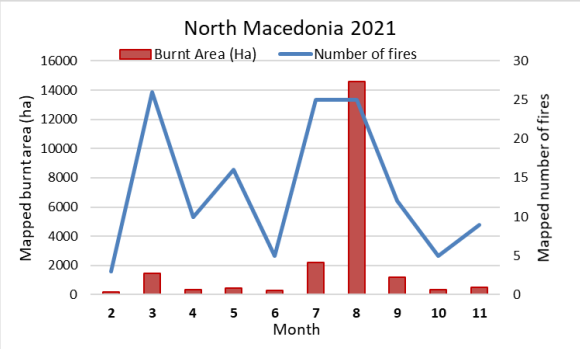


Figure 219. Monthly mapped burnt area and number of fires in North Macedonia in 2021.

2.2.21 Norway

There were fires mapped in Norway from March to August, resulting in a total of 991 ha from 22 fires. Most of the damage occurred early in the season, in April and June. Other Natural Land was the land cover type most affected, as shown in Table 77.

Table 77. Distribution of burnt area (ha) in Norway by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	43	4.4
Coniferous forest	23	2.3
Mixed forest	55	5.6
Other Natural Land	859	86.7
Agriculture	9	0.9
Other Land Cover	2	0.2
TOTAL	991	100

2.2.22 Poland

It was a light year in Poland. Twelve fires were mapped, all in June and in Other Natural Land, giving a total burnt area of 51 ha. 78% (40 ha) of this total was on Natura2000 land, amounting to 0.001% of the Natura2000 area of the country.

Table 78. Distribution of burnt area (ha) in Poland by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Other Natural Land	51	100.0
TOTAL	51	100

2.2.23 Portugal

The 2021 fire season in Portugal was relatively light, and resulted in only half the total burnt area mapped compared with 2020. There were two peaks in the season: one early in March when a large number of relatively small fires occurred, and a second one in August which saw the largest fires of the year. The biggest one was in the Algarve in August, and burned over 7 000 ha. There was a second fire over 2 000 ha, also in the Algarve and a third over 500 ha in the Alentejo Litoral province. (This is a significant fall in large fires compared with 2020, when there were 21 fires over 500 ha, with the largest covering over 15 000 ha). The mapped burnt areas in Portugal in 2021 can be seen in Figure 220.

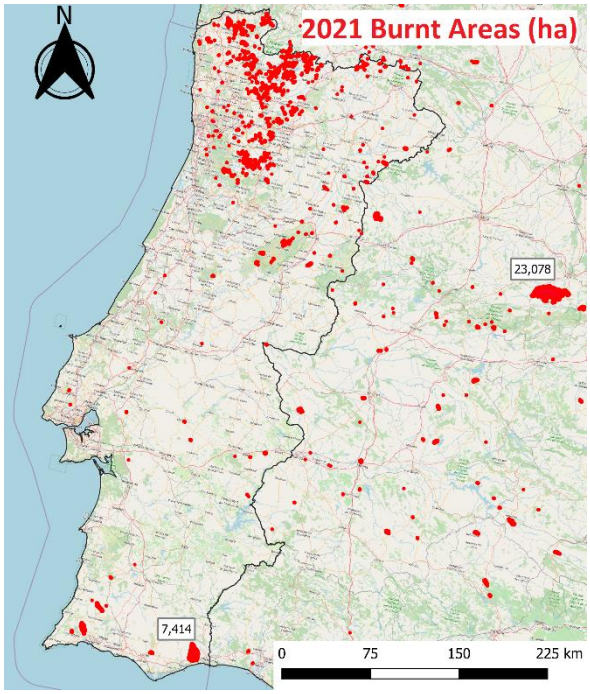


Figure 220. Burnt area scars in Portugal in 2021. Largest fires are indicated in ha.

Of the mapped total, 7 902 ha occurred on Natura2000 sites, corresponding to 25% of the total area burnt, and 0.414 % of the total Natura2000 areas in Portugal. The distribution of the mapped burnt area by land cover type is shown in Table 79.

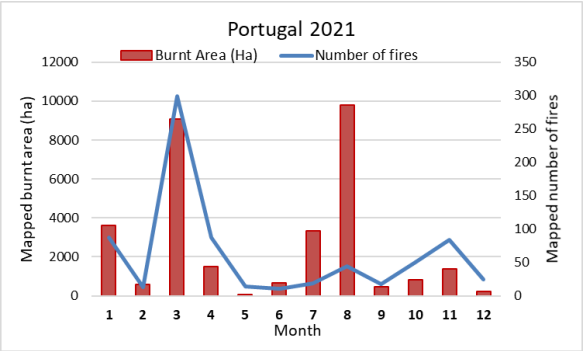


Figure 221. Monthly mapped burnt area and number of fires in Portugal in 2021.

Table 79. Distribution of burnt area (ha) in Portugal by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	1118	3.5
Coniferous forest	406	1.3
Mixed forest	239	0.8
Transitional	5458	17.3
Sclerophyllous vegetation	4167	13.2
Other Natural Land	14749	46.7
Agriculture	5315	16.8
Artificial Surfaces	130	0.4
TOTAL	31582	100

2.2.24 Romania

The 2021 fire season in Romania was significantly better than the previous two years. The total of 20 957 ha mapped from 121 fires was just over one quarter of the totals recorded in those years. Most of the damage occurred early in the season, with 60% of the annual burnt area occurring in March. There were 6 fires over 1 000 ha and one over 500 ha, five in the Tulcea region early in the year (including the largest, of 5 420 ha), and the other two in Mehedinți province in August.

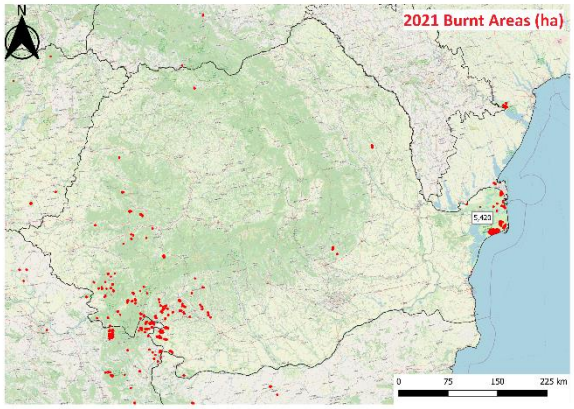


Figure 222. Burnt area scars in Romania in 2021. Largest fires are shown in ha.

In total, 15 289 ha (73%) of the mapped burnt area was on Natura2000 sites, representing 0.359% of the total Natura2000 area of Romania, a significant drop from the previous two years. Table 80 presents the distribution of the mapped burnt area by land cover type. As in previous years, most of the mapped burnt area occurred on Other Natural Land.

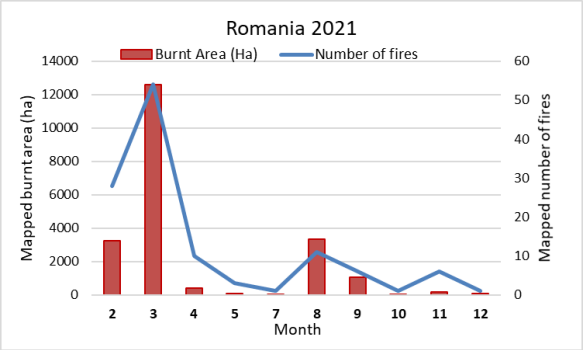


Figure 223 Monthly mapped burnt area and number of fires in Romania in 2021.

Table 80. Distribution of burnt area (ha) in Romania by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2747	13.1
Mixed forest	6	0.0
Transitional	343	1.6
Other Natural Land	12319	58.8
Agriculture	5277	25.2
Artificial Surfaces	259	1.2
Other Land Cover	6	0.0
TOTAL	20957	100

2.2.25 Serbia

The 2021 fire season in Serbia was somewhat better than that of 2020, with a total annual burnt area of 7 708 ha from 139 mapped fires. There were two peaks to the season (Figure 224), but the largest fire of the year (1 311 ha, in Kladovo municipality in East Serbia) occurred in August. Burnt area scars from these fires can be seen in Figure 205 above.

Table 81. Distribution of burnt area (ha) in Serbia by land cover type in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	1245	16.2
Coniferous forest	479	6.2
Mixed forest	162	2.1
Transitional	1445	18.7
Other Natural Land	1691	21.9
Agriculture	2681	34.8
Artificial Surfaces	4	0.1
Other Land Cover	2	0.0
TOTAL	7708	100

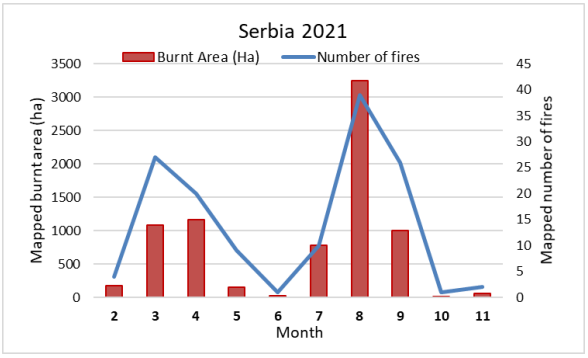


Figure 224, Monthly mapped burnt area and number of fires in Serbia in 2021.

2.2.26 Slovakia

A fire of 115 ha was mapped in July, covering Other Natural Land. No Natura2000 land was impacted.

Table 82. Distribution of burnt area (ha) in Slovakia by land cover type in 2021.

Land cover	*Area burnt*	*% of total*
Other Natural Land	115	100.0
TOTAL	115	100

2.2.27 Slovenia

Two fires were mapped in Slovenia, resulting in a total burnt area of 81 ha. The larger of the two, 76 ha in February, was on a Natura2000 site and amounted to 0.011% of the Natura2000 area of the country.

Table 83. Distribution of burnt area (ha) in Slovenia by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Transitional	5	6.2
Other Natural Land	76	93.8
TOTAL	81	100

2.2.28 Spain

The 2021 fire season in Spain was the worst since 2017, although the total burnt area of 91 295 ha from 901 fires was still only two-thirds of that measured in the extreme year of 2017. Like Portugal, the season was notable for a large number of relatively small fires in Spring. However, the main damage of the year occurred in August, mostly because of one fire in Ávila province that covered more than 23 000 ha, the second largest fire to be mapped in the EU (after the one in Evia, Greece). There were 8 other fires over 1 000 ha mapped, and a further 14 over 500 ha (Figure 226).

Of the total burnt area mapped in 2021, 21 668 ha occurred on Natura2000 sites, corresponding to 24% of the total area burnt, and 0.157% of the Natura2000 areas in Spain.

Table 84 presents the distribution of the mapped burnt area by land cover type.

Table 84. Distribution of burnt area (ha) in Spain by land cover type in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	5997	6.6
Coniferous forest	11195	12.3
Mixed forest	986	1.1
Transitional	4320	4.7
Sclerophyllous vegetation	23801	26.1
Other Natural Land	39014	42.7
Agriculture	5803	6.4
Artificial Surfaces	123	0.1
Other Land Cover	56	0.1
TOTAL	91295	100

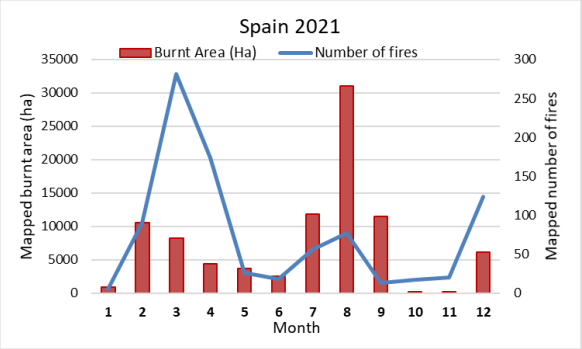


Figure 225. Monthly mapped burnt area and number of fires in Spain in 2021.

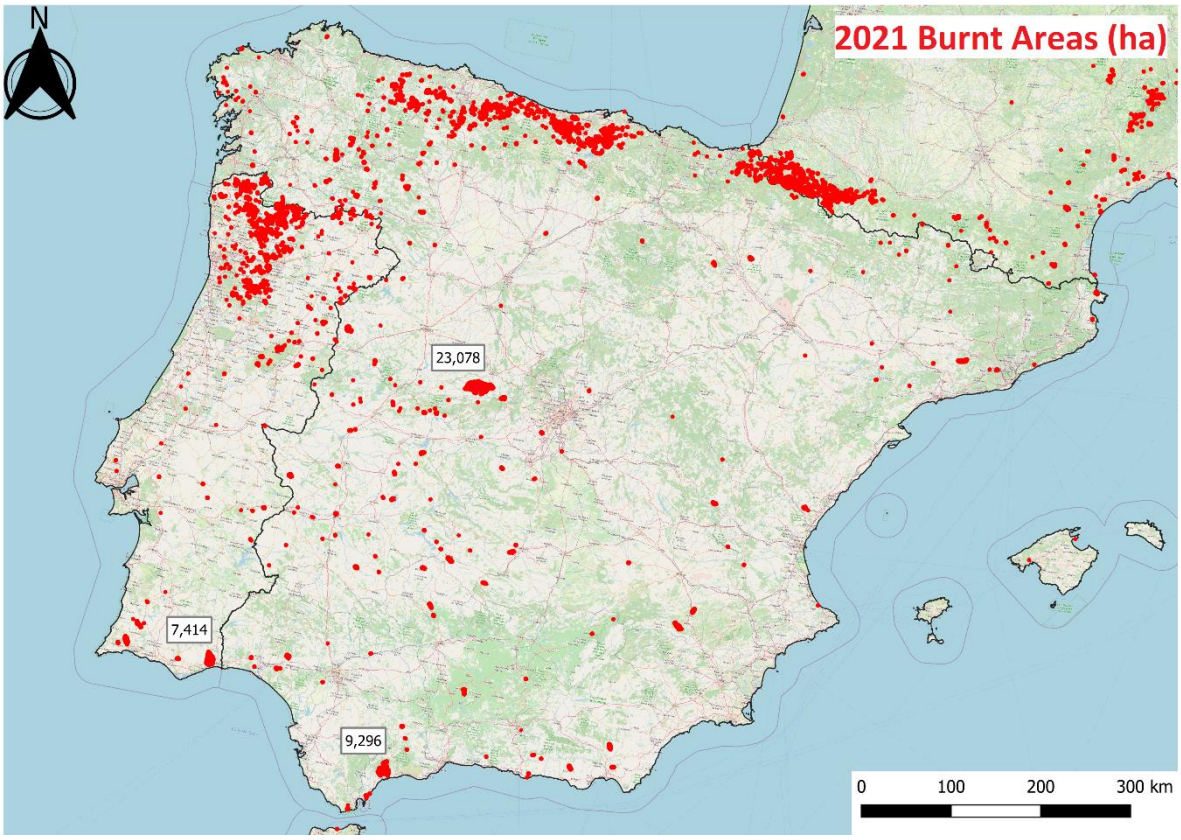


Figure 226. Burnt area scars in Spain in 2021. Largest fires are indicated in ha.

2.2.29 Sweden

48 fires were mapped in Sweden in 2021, resulting in a total burnt area of 1 287 ha. Fires were mapped between March and August but almost all of the damage occurred in June/July. 447 ha of the total was in Natura2000 sites, amounting to 35% of the total and 0.008% of the Natura2000 area of the country. Burnt area scars mapped in 2021 can be seen in Figure 210 above.

Table 85. Distribution of burnt area (ha) in Sweden by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	514	39.9
Mixed forest	52	4.0
Transitional	140	10.9
Other Natural Land	520	40.4
Other Land Cover	61	4.8
TOTAL	1287	100

2.2.30 Switzerland

Two fires were mapped in Switzerland in April, covering a total of 12 ha.

Table 86. Distribution of burnt area (ha) in Switzerland by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	8	64.3
Mixed forest	4	35.7
TOTAL	12	100

2.2.31 Turkey

It was the worst fire season in Turkey for more than a decade. The total burnt area from 612 fires was 206 013 ha, the highest amount recorded across Europe, Middle East and North Africa in 2021.

Fires were mapped in every month of the year, but the worst period was in July, when two-thirds of the annual total was mapped (Figure 227). This included the largest fire mapped across the whole area covered by EFFIS, which burned more than 54 000 ha in Antalya at the end of the month. There were also 5 other fires over 10 000 ha, 16 fires over 1 000 ha and 17 fires over 500 ha. Coniferous Forest was particularly impacted (Table 87).

Table 87. Distribution of burnt area (ha) in Turkey by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	10814	5.2
Coniferous forest	79432	38.6
Mixed forest	5172	2.5
Transitional	50552	24.5
Sclerophyllous vegetation	4296	2.1
Other Natural Land	23663	11.5
Agriculture	28565	13.9
Artificial Surfaces	546	0.3
Other Land Cover	2973	1.4
TOTAL	206013	100

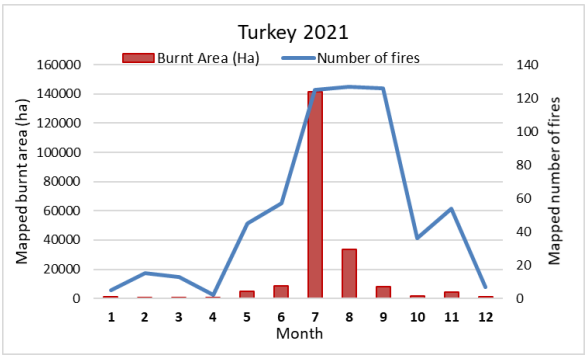


Figure 227. Monthly mapped burnt area and number of fires in Turkey in 2021.

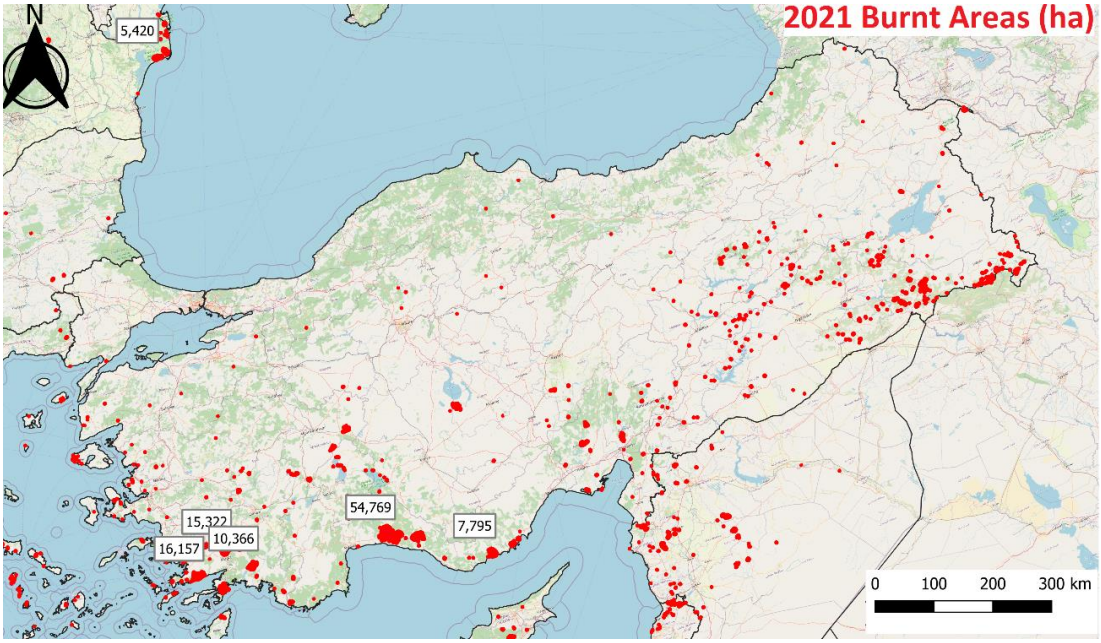


Figure 228. Burnt area scars in Turkey in 2021. Largest fires are indicated in ha.

2.2.32 Ukraine

After an extreme year in 2020, the 2021 season in Ukraine was much quieter. 128 fires were mapped, burning 27 866 ha, around 11% of 2021's total. The season started in March, but the largest fires of the year occurred at the end of the season in October with one fire over 2 000 ha and two over 1 000 ha mapped on the same day. There were also 5 other fires over 1 000 ha and four over 500 ha during the year. Other Natural Land made up over 40% of the total burnt area (Table 88).

Table 88. Distribution of burnt area (ha) in Ukraine by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	3681	13.2
Coniferous forest	1516	5.4
Mixed forest	216	0.8
Transitional	2142	7.7
Other Natural Land	11956	42.9
Agriculture	8211	29.5
Artificial Surfaces	52	0.2
Other Land Cover	92	0.3
TOTAL	27866	100

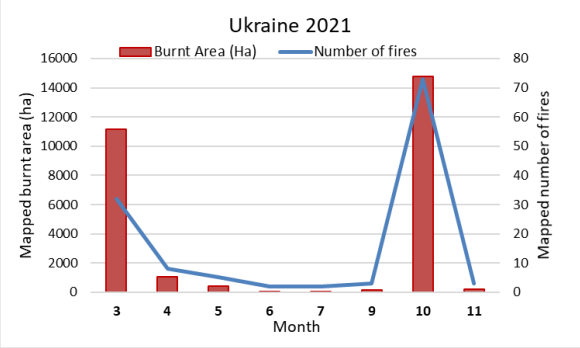


Figure 229. Monthly mapped burnt area and number of fires in Ukraine in 2021.

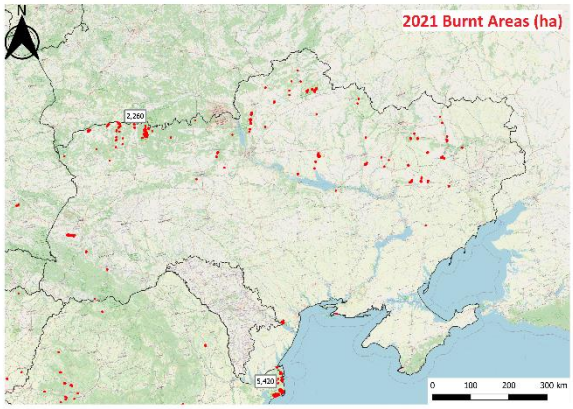


Figure 230. Burnt area scars in Ukraine in 2021. Largest fires are indicated in ha.

2.2.33 United Kingdom

The 2021 fire season in the United Kingdom was lighter than the previous three years, with a total of 8 098 ha mapped from 234 fires. 94% of the damage was recorded between February and April, although a small number of fires were mapped from January to November. No large fires (>500 ha) were mapped (Figure 232).

Of the total, 1 139 ha occurred on Natura2000 land, amounting to 14% of the total burnt area and 0.064% of the Natura2000 land in the UK. Other Natural Land was by far the most affected land type (Table 89).

Table 89. Distribution of burnt area (ha) in the UK by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	87	1.1
Mixed forest	10	0.1
Transitional	68	0.8
Other Natural Land	7887	97.4
Agriculture	20	0.3
Artificial Surfaces	12	0.1
Other Land Cover	14	0.2
TOTAL	8098	100

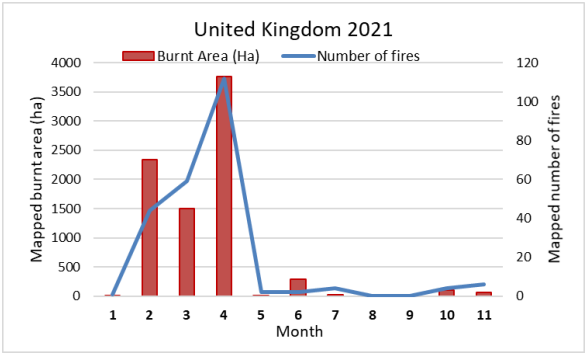


Figure 231. Monthly mapped burnt area and number of fires in the United Kingdom in 2021.

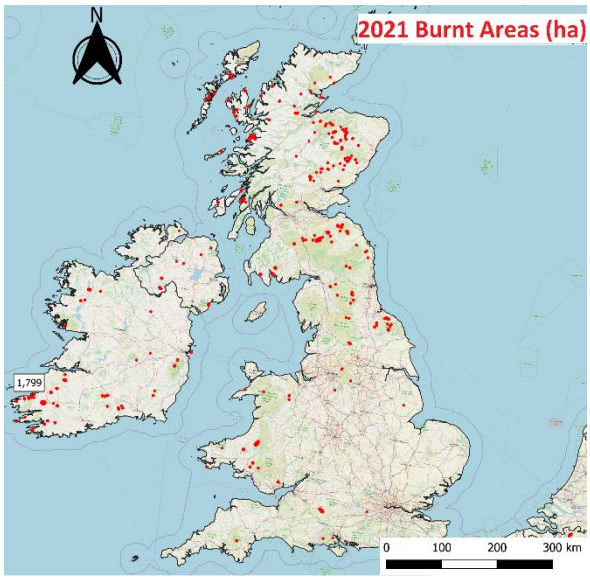


Figure 232. Burnt area scars in the United Kingdom and Ireland in 2021.

2.3 Middle East and North Africa

The total burnt area mapped across North Africa and the Middle East was very similar to that of 2020 and somewhat worse than the long-term average, but with large differences within individual nations. Israel and Tunisia had a worse year than in 2020, while Libya's season was better. The most affected country in the region was Algeria, accounting for 69% of the total burnt area

2.3.1 Algeria

The total mapped burnt area in Algeria was the highest since 2012. 295 fires were mapped, giving a total burnt area of 31 275 ha, two-thirds of which was on Agricultural Land. The first fire of the season was mapped in February and the last in November, but 85% of the damage was in August.

The largest fire of the season was over 25 000 ha, and there were 20 other fires over 1 000 ha and 15 that exceeded 500 ha (Figure 233).

Of the total, 2738 ha of protected areas were burnt, amounting to 1.64% of the protected land of Algeria. The Globcover land cover map from ESA was used to split the burnt area into different land type categories, harmonised with CLC terminology, and the distribution of burnt area by these land cover types is given in Table 90.

Table 90. Distribution of burnt area (ha) in Algeria by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	20466	15.2
Coniferous forest	3171	2.4
Mixed forest	105	0.1
Transitional	19711	14.7
Other Natural Land	4720	3.5
Agriculture	85934	64.0
Artificial Surfaces	161	0.1
Other Land Cover	6	0.0
TOTAL	134273	100

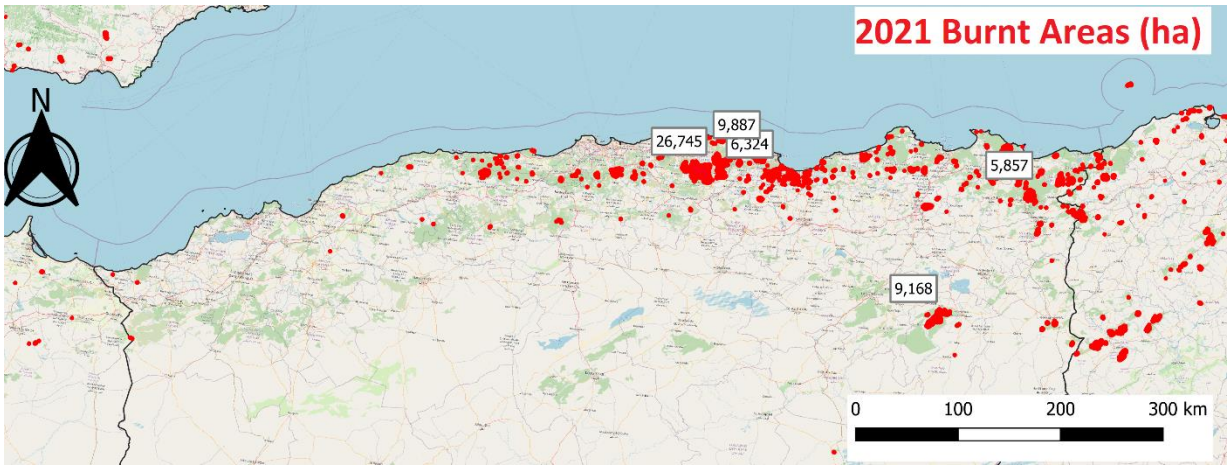


Figure 233. Burnt area scars in Algeria in 2021. Largest fires are indicated in ha.

2.3.2 Iraq

A fire of 25 ha was mapped in Iraq in July, mostly affecting Sclerophyllous Vegetation.

Table 91. Distribution of burnt area (ha) in Iraq by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2	9.5
Sclerophyllous vegetation	23	90.5
TOTAL	25	100

2.3.3 Israel

In Israel there were 32 fires mapped, burning a total of 4 021 ha. Fires were mapped from May to November, but around three-quarters of the damage occurred in July and August, and almost half of the annual total came from two large fires in this period: one of 1 230 ha and the other of 529 ha. 57% of the total burnt area was in Agricultural Land.

Table 92. Distribution of burnt area (ha) in Israel by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Coniferous forest	40	1.0
Transitional	1418	35.3
Other Natural Land	237	5.9
Agriculture	2306	57.3
Other Land Cover	21	0.5
TOTAL	4021	100

2.3.4 Lebanon

50 fires were mapped in Lebanon, resulting in a total burnt area of 2 360 ha, somewhat less than the previous two years. There was one large fire of 882 ha in Andaket province, Akkar Governorate in July, making this the most affected month (Figure 234). Mapped burnt area scars can be seen in Figure 238 below. Table 93 presents the distribution of the mapped burnt area by land cover type using the Globcover land cover map, harmonised with CLC.

Table 93. Distribution of burnt area (ha) in Lebanon by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	57	2.4
Coniferous forest	303	12.8
Transitional	705	29.9
Other Natural Land	303	12.8
Agriculture	992	42.0
TOTAL	2360	100

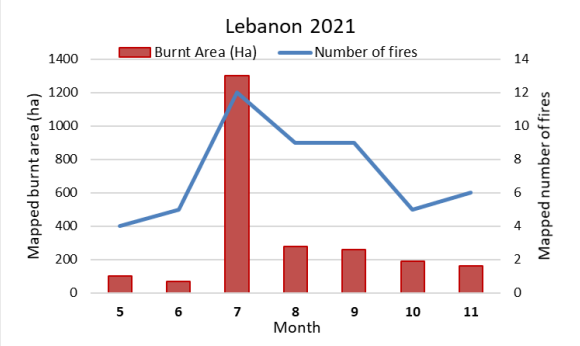


Figure 234. Monthly mapped burnt area and number of fires in in Lebanon in 2021.

2.3.5 Libya

The fire season in Libya was relatively quiet. 11 fires were mapped, resulting in a total burnt area of 377 ha, most of which occurred in June/July.

Table 94 presents the distribution of the mapped burnt area by land cover type using the Globcover land cover map, harmonised with CLC.

Table 94. Distribution of burnt area (ha) in Libya by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Transitional	198	52.4
Other Natural Land	9	2.4
Agriculture	170	45.2
TOTAL	377	100

2.3.6 Morocco

The 2021 fire season in Morocco was somewhat better than that of 2020. The total mapped burnt area was 6 083 ha from 81 fires. Over 80% of the damage occurred in July/August, in part because of the largest fire of the year which covered over 2 000 ha in Bab Taza, Chefchaouen Province (Figure 236). There was one other fire over 500 ha.

Of the annual total, 544 ha occurred in Protected Areas. This amounts to 9% of the total burnt in the year and 0.075% of the total protected areas of the country. The distribution of burnt area by land cover types, using Morocco's own land cover map but with terminology harmonised with CLC, is in Table 95.

Table 95. Distribution of burnt area (ha) in Morocco by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2050	33.7
Coniferous forest	725	11.9
Mixed forest	649	10.7
Transitional	890	14.6
Other Natural Land	493	8.1
Agriculture	1273	20.9
Artificial Surfaces	4	0.1
TOTAL	6083	100

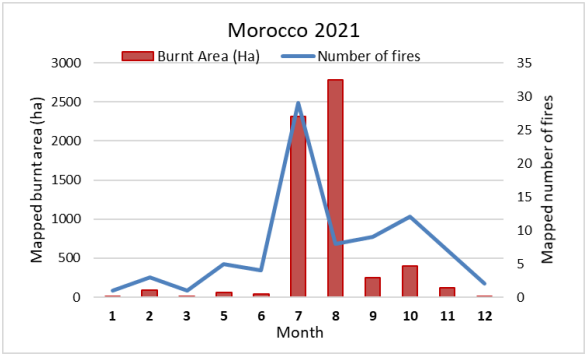


Figure 235. Monthly mapped burnt area and number of fires in Morocco in 2021.

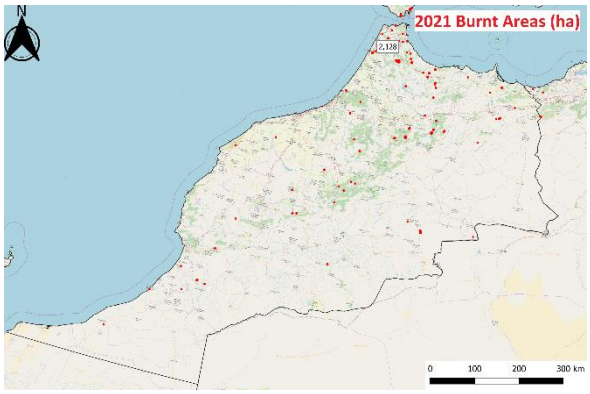


Figure 236. Burnt area scars in Morocco in 2021. Largest fire is indicated in ha.

2.3.7 Palestinian Territory

There were two fires mapped in the Palestinian Territory, one in May and the second in June, burning a total of 143 ha.

Table 96. Distribution of burnt area (ha) in Palestinian Territory by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Transitional	9	6.3
Other Natural Land	40	27.9
Agriculture	94	65.8
TOTAL	143	100

2.3.8 Syria

The total mapped burnt area in Syria was 18 798 ha from 118 fires, less than half the total for 2020. The peak of the fire season came relatively early, in May when half the annual burnt area was mapped (Figure 237). There were four fires of over 1 000 ha and a further five over 500 ha.

The Globcover land cover map, harmonised with CLC, was used to split the burnt area into different land type categories (Table 97).

Table 97. Distribution of burnt area (ha) in Syria by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	27	0.1
Coniferous forest	851	4.5
Mixed forest	16	0.1
Transitional	1674	8.9
Other Natural Land	8936	47.5
Agriculture	7275	38.7
Other Land Cover	19	0.1
TOTAL	18798	100

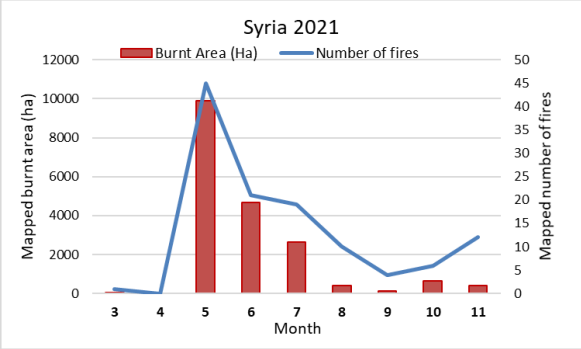


Figure 237. Monthly mapped burnt area and number of fires in Syria in 2021.

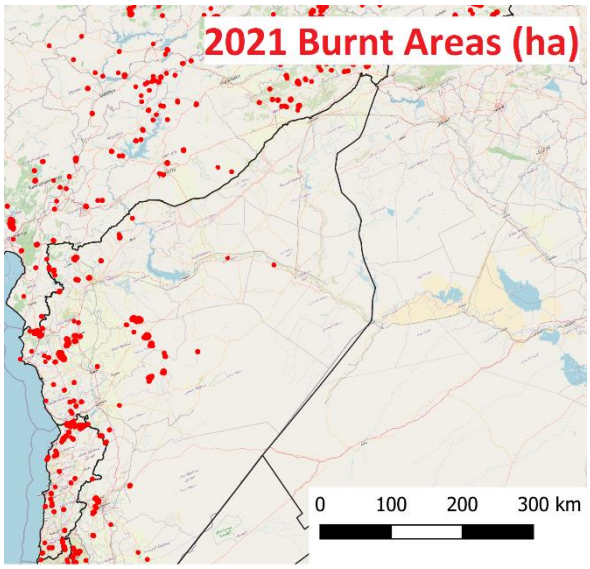


Figure 238. burnt area scars in Syria and Lebanon in 2021.

2.3.9 Tunisia

The 2021 fire season in Tunisia was the most severe for at least 12 years. A total of 29 009 ha of burnt area were mapped from 98 fires, mostly between June and August (Figure 240). There were 8 fires over 1 000 ha and a further 7 over 500 ha (Figure 239). Coniferous Forest was particularly impacted.

The distribution of burnt area by land cover types using Tunisia's own land cover map but with terminology harmonised with CLC, is given in Table 98.

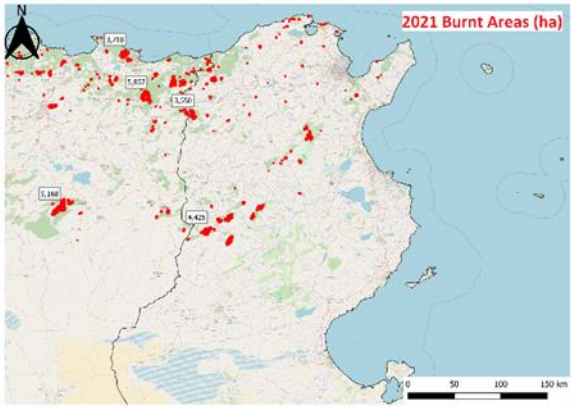


Figure 239. Burnt area scars in Tunisia in 2021. Largest fires are indicated in ha.

Table 98. Distribution of burnt area (ha) in Tunisia by land cover types in 2021.

Land cover	*Area burnt*	*% of total*
Broadleaf forest	2183	7.5
Coniferous forest	17700	61.0
Mixed forest	410	1.4
Transitional	4497	15.5
Sclerophyllous vegetation	1546	5.3
Other Natural Land	682	2.4
Agriculture	1905	6.6
Artificial Surfaces	18	0.1
Other Land Cover	69	0.2
TOTAL	29009	100

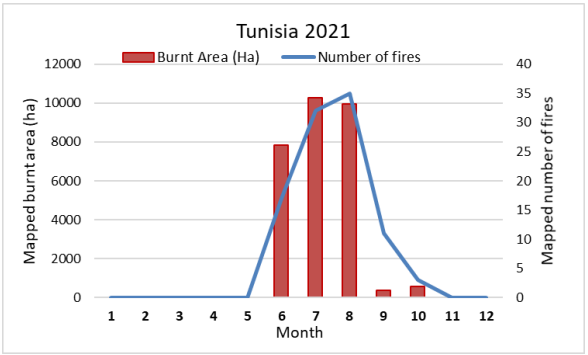


Figure 240. Monthly mapped burnt area and number of fires in Tunisia in 2021.

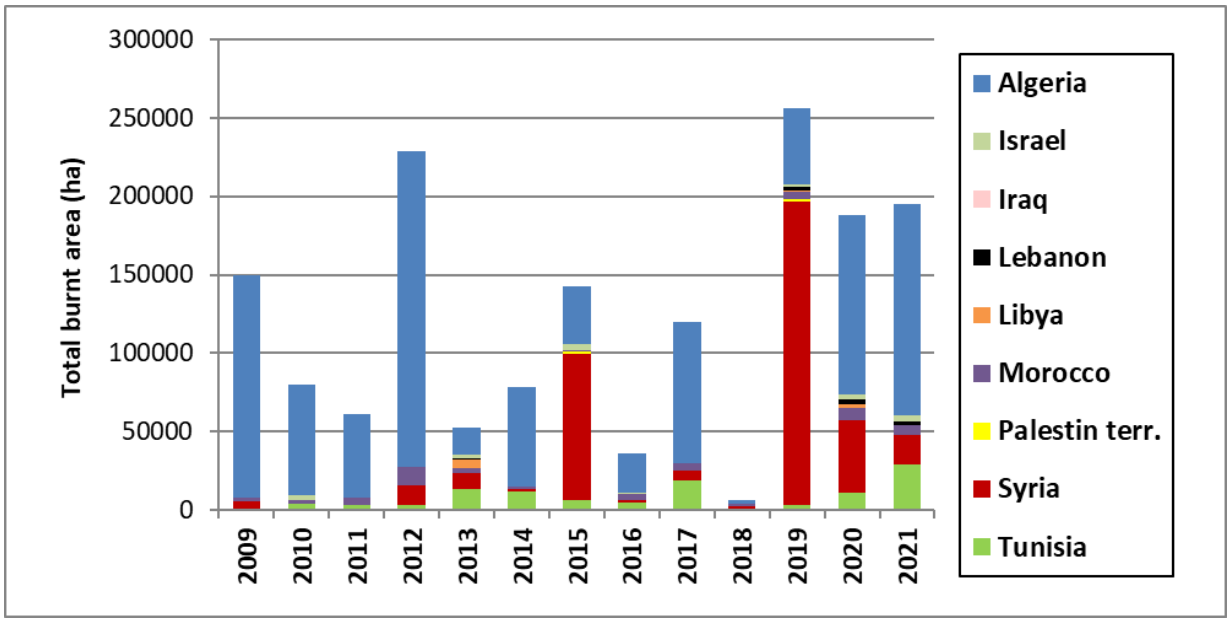


Figure 241. Overview of fires in the MENA region in the last 13 years.

2.4 Conclusions

The 2021 fire season was marked by a number of very large fires in August, particularly in Turkey and Greece, making this the most destructive month and accounting for almost half of the annual total area burnt. Protected areas were overall slightly less affected than in the previous two years, mostly because of better conditions in the Danube Delta, but Italy and Spain both showed sharp increases from 2020.

2.5 List of acronyms

ECHO European Civil Protection and Humanitarian Aid Operations

ECMWF European Centre for Medium Range Forecast

EFFIS European Forest Fire Information System

ERCC Emergency Response Centre

FWI Fire Weather Index

MENA Middle East and North Africa

RDA Rapid Damage Assessment

3 EFFIS Applications

3.1.1 The Current Situation Application

The current situation enables the user to view and query map layers, with the most up to date information on the current fire season in Europe and in the Mediterranean area. This includes current date meteorological fire danger maps and forecast up to 9 days, daily updated maps of hot spots and fire perimeters. The application can also be used to view the situation in past years.

In the Fire Danger Forecast section ① two different sources and 8 different indices can be displayed, for the current day plus up to 8 days in the future.

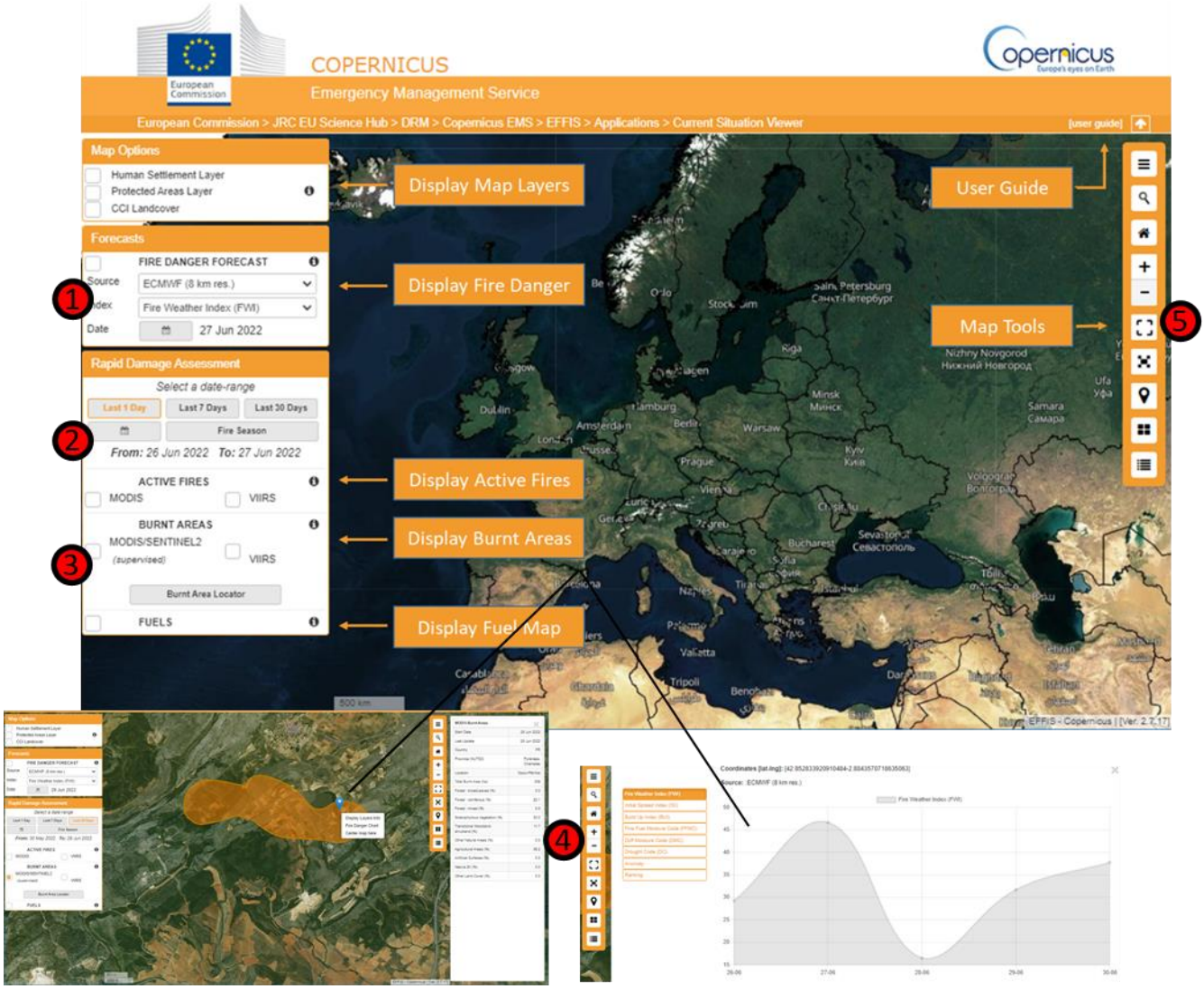
The Rapid Damage Assessment ② allows the user to display active fire information and burnt area information for various time periods from two sources (Modis and VIIRS).

The Burnt area locator ③ shows the burnt area for the whole area or for a given country/region. A close-up view of the individual fire perimeter is shown if the user clicks on a specific fire ④.

A tool bar ⑤ has a number of controls for changing the view and displaying the legend.

This application can be accessed at

https://effis.jrc.ec.europa.eu/apps/effis_current_situation/



3.1.2 The Fire News Application

The purpose of this application is to display geo-located news items about forest fires from a number of sources. News items are added to the map daily by team members during the fire season.

[**N.B.** *It is important to note that not all fires are displayed here: only those reported in the media with an identifiable location. Fires are not always reported individually (or at all) in the press, and the space devoted to them depends on other current world events*].

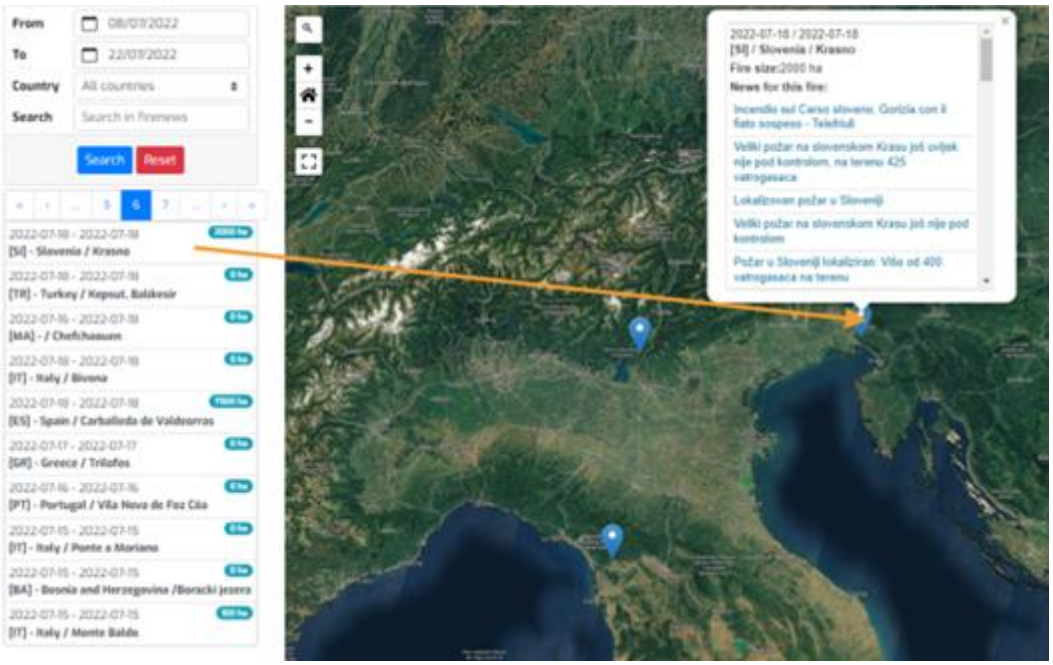
Clicking on a point on the map gives a link to the original news item associated with that point.

Clicking on the name in the list gives a table with details of the fire and a close-up of the map.

By default, the display shows fires occurring in the last week, but the **From** and **To** boxes can be used to select other times. The results can be filtered by country, and the Search box allows the user to narrow down the display to a specific location of interest.

This application can be accessed at https://effis.jrc.ec.europa.eu/apps/firenews.viewer/

Clicking on a specific fire will zoom in to that spot. Clicking on the spot will bring up all the news items linked to the fire.



3.1.3 The EFFIS Statistics Portal

Statistics are provided at national level and for 3 groups: EU, European non-EU countries, and Middle East and North Africa countries. The portal provides information on the current fire season through the provision of the following information:

- Current statistics of burnt areas and number of fires, as compared to the average of the last 14 years. Statistics of the current year can be compared to a single year or a period in the past.
- Seasonal cumulative trend in burnt areas and number of fires as compared to the average of the last 14 years.
- Number of thermal anomalies detected by the VIIRS sensor as compared to the average of thermal anomalies for the last 10 years (2012-2021).
- Number of thermal anomalies detected by the MODIS sensor as compared to the average of the thermal anomalies for the last 10 years (2012-2021).

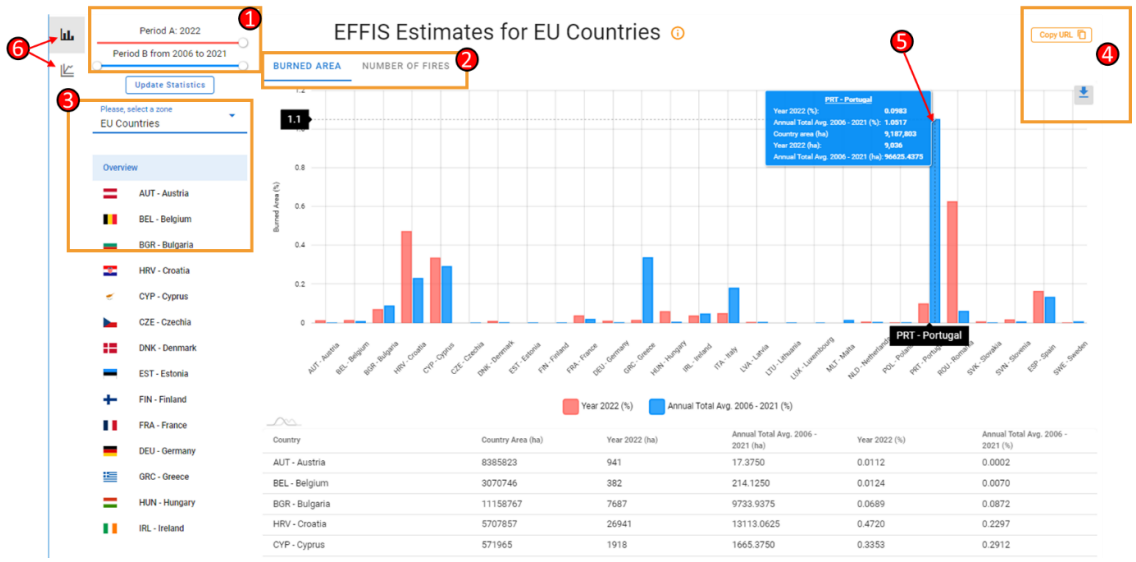
There are two parts to the Portal: EFFIS estimates and the Seasonal trend.

EFFIS Estimates

In this section the user can display the burnt area or numbers of mapped fires for two periods. The first is a single year (default is the current fire season), and the second can be defined by the user to be any range between 2006 and the year before the current season. The countries are grouped by region and displayed in alphabetical order in the graph.

The values displayed on the graph are provided in table format below the graph. Extra information is also provided when the "overview" option is selected, including the country size and the percentage of the total country area that has been burned.

In each case the statistics can be displayed for the entire region of interest, or for any of the individual countries in the group.

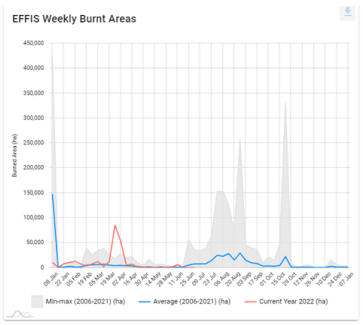
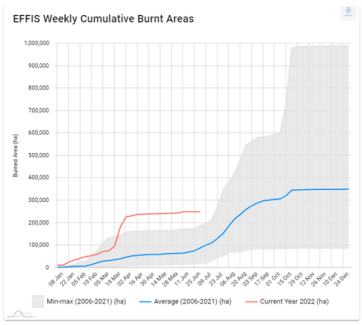
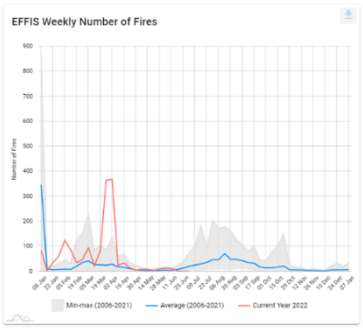
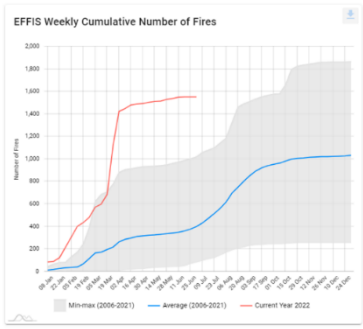
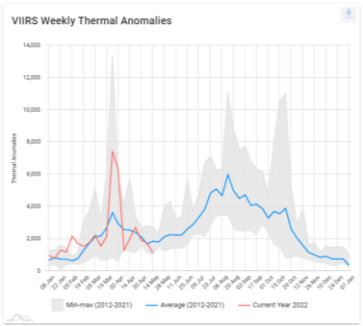
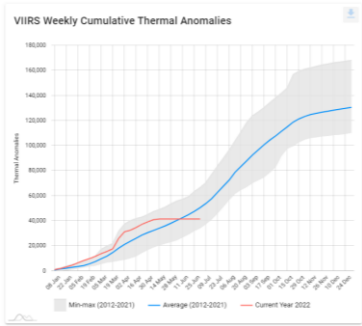
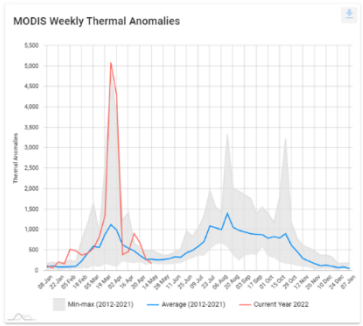
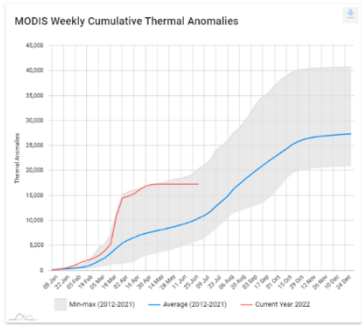


1. Use the sliders to select individual year of interest and period for comparison.
2. Choose Burned Area or Number of Fires.
3. Choose region of interest (EU countries, European Non-EU countries, Mena countries) and either the overview or an individual country.
4. Download the results or copy the url.
5. Hover the mouse over individual points to get their statistics.
6. Switch between the EFFIS Estimates and Seasonal Trends.

Seasonal Trends

In this section are 8 charts in 4 pairs. There are three main groups of countries (EU countries, European Non-EU countries, Mena countries) and the information can be displayed for the group as a whole or for individual countries in the same way as for the Estimates.

The first of each pair displays values comparing the current year's progress against the long term average (2006-2021) and the minimum/maximum values. The second displays the same information but displayed cumulatively through the year

.Burnt areas EFFIS weekly burnt areas comparing the current year's progress against the long term average (2006-2021) and the minimum/maximum values.	 
Numbers of fires EFFIS weekly burnt areas comparing the current year's progress against the long term average (2006-2021) and the minimum/maximum values.	 
VIIRS Weekly Thermal Anomalies VIIRS weekly thermal anomalies comparing the current year's progress against the long term average (2006-2021) and the minimum/maximum values.	 
MODIS Weekly Thermal Anomalies MODIS weekly thermal anomalies comparing the current year's progress against the long term average (2006-2021) and the minimum/maximum values.	 

3.1.4 The EFFIS Fire Database

The Fire Database is an important component of EFFIS, containing the forest fire information compiled by countries in Europe, Middle East and North Africa.

The Regulation EEC No 804/94 [11] (now expired) established a Community system of information on forest fires for which a systematic collection of a minimum set of data on each fire occurring, the so called "Common Core", had to be carried out by the Member States participating in the system. This regulation was replaced by the Forest Focus regulation in 2003.

Following the Forest Focus regulation (EC) No 2152/2003 [7], concerning monitoring of forests and environment interactions in the Community, the forest fire common core data was continued to be recorded in order to collect comparable information on forest fires at Community level.

Since 2000 the forest fire data provided each year by individual EU Member States and other countries in Europe, Middle East and North Africa have been checked, stored and managed by JRC within EFFIS.

In 2012 the 4 MENA countries submitted data for entry into the database, bringing the number of countries now contributing at least once to 27:

Algeria, Bulgaria, Croatia, Cyprus, Czech, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Lebanon, Morocco, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia and Turkey. The database currently contains around 3 million individual fire event records (over 2 million forest fires).

Access to the information

The individual records are not made available as they are owned by the country authorities who supply the data; however, users can request custom annual or monthly summaries of burnt area or number of fires by country, NUTS2 or NUTS3 region from the point of contact.

More detailed information about the database can be found in the technical report "*The European Fire Database: Technical specifications and data submission*" EUR26546 EN [12], which can be downloaded from:

https://effis.jrc.ec.europa.eu/reports-and-publications/effis-related-publications

Table 99. Information requested for each fire event.

ID	Unique Fire identifier	FIREID
TIME OF FIRE	Date of first alert [YYYYMMDD]	DATEAL
	Time of first alert [HHMM]	TIMEAL
	Date of first intervention [YYYYMMDD]	DATEIN
	Time of first intervention [HHMM]	TIMEIN
	Date of fire extinction [YYYYMMDD]	DATEEX
	Time of fire extinction [HHMM]	TIMEEX
LOCATION OF FIRE	Province Code (national nomenclature)	PROVCODE
	NUTS3 code	NUTS3
	Commune Code (national nomenclature)	CODECOM
	Commune Name (national nomenclature)	NAMECOM
	Latitude [decimal degrees]	NORTH
	Longitude [decimal degrees]	EAST
SIZE OF FIRE (Ha)	Burnt Area FOREST	BAFOR
	Burnt Area OTHER WOODED LAND	BAOW
	Burnt Area OTHER NON WOODED NATURAL LAND	BAONW
	Burnt Area AGRICULTURE AND OTHER ARTIFICIAL LAND	BAAGR
CAUSE OF FIRE	Certainty of knowledge of Presumed Cause (New EU code)	CAUSE_KNOWN
	Presumed Cause (New EU categories code)	CAUSE_EU
	Presumed Cause (Country detailed categories code)	CAUSE_CO

General notes on Table 100: 2021 data are still undergoing validation checks and are not presented.

The totals given in this table do not always match the published number of fires for a number of reasons:

1. Purely agricultural fires are stored in the database if submitted by the country, but are excluded from forest fire calculations;
2. Some countries do not report detailed records for the whole of their territory and the information is only available in summary form.

Table 100. Summary of data records stored in the Fire Database.

	BG	CH	CY	CZ	DE	EE	ES	FI	FR	GR	HR	HU	IT	LT	LV	NL	PL	PT	RO	SE	SI	SK	TR	DZ	LB	MA	TN
1980		87																2349									
1981		153																6730									
1982		86																3626									
1983		120								945								4542									
1984		183								1184								7356									
1985		114					12235		3732	1417			12931					8441									75
1986		87					7514		2657	1088			6115					5036									89
1987		121					8816		2116	1234			8506					7705									207
1988		79					9440		2240	1798			9785					6131									158
1989		189					20250		3321	1203			8328					21896									70
1990		257					12914		3297	1283			11560					10745									118
1991		152					13529		2372	1036			7580					14327									97
1992		86					15956		2708	2008			10044					14954									182
1993		83					14253		4766	2707			14317					16101									183
1994		86			706		19249		4728	1955			7153				24361	19983									131
1995		96			525		25557		6539	1494			5505				23816	34116			44						13
1996		130			822		16586		6401	1527	2363		6064				23582	28626		4854	47						13
1997		179			276		22320		8001	2271	2648		11608				25068	23497		7057	55						98
1998		121			592		22003		6289	605	4096		9565				21342	34676		2503	143						-
1999		50			794		17943		4881	513	2592		6956				32646	25477		4707	55						-
2000		70	285		930		23574		4343	1469	5477		8609				31809	34109		4708	100						-
2001		67	299		373		19099		4259	1313	2505		7227				24511	28915		4831	60						-
2002		117	243		278		19929		4097	572	3428	429	4607				38154	28993		6490	64						-
2003		304	427		1238		18616		7023	622	4904	373	9716				79013	28087		8282	227						-
2004		94	221	957	300		21396		3767	739	1704	104	6341	430	647		36315	27829	34	4955	50	153					-
2005	251	110	185	653	299	65	25492	2631	4698	718	2180	150	7918	267	365		46542	41689	64	4573	74	287	1530				-
2006	393	110	172	697	717	248	16334	6314	4608	764	2210	97	5651	1444	1929		35630	24243	105	4618	106	238	2227			347	216
2007	1479	120	111	809	435	64	10932	2813	3382	1226	3759	603	10736	245	426		31303	25133	478	3787	129	463	2706			304	292
2008	582	63	114	470	560	71	11656	3161	2781	1071	228	502	6648	272	716		35786	18958	91	5420	68	182	2135			267	259
2009	314	103	91	520	575	47	15642	2746	4808	354	181	608	5423	471	890		30912	29783	190	4180	122	347	-			487	199
2010	222	88	133	731	525	30	11722	3100	3828	540	131	109	4884	106	319		24443	26113	70	3120	33	123	1861			597	264
2011	635	114	85	1341	515	24	16417	2871	4283	953	279	2021	8181	137	373		39011	29782	340	3534	114	303	-			568	262
2012	876	75	78	1555	451	5	15978	1050	3713	-	570	2657	10345	81	162		53907	25352	911	2213	168	517	2449	5036	99	484	493
2013	408	58	135	671	355	15	10797	2864	2061	-	137	761	2077	119	420		25652	23129	118	4907	75	233	3755	-	-	411	-
2014	151	60	68	870	251	91	9806	3637	1729	-	43	1042	1821	155	695		38115	9388	83	4374	35	153	-	-	-	460	-
2015	439	166	87	1738	594	67	11810	1644	2891	-	176	1069	5424	247	704		60176	19643	250	2700	93	242	-	-	-	425	-
2016	584	82	119	899	407	84	-	2101	2761	-	176	452	-	98	641		25791	16104	174	5454	90	136	-	-	-	422	-
2017	513	110	92	988	176	61	-	2263	3201	-	328	1454	-	80	423	321	25193	21006	447	5276	108	162	-	-	-	437	-
2018	222	153	131	2033	1216	230	-	4401	1616	-	57	530	-	211	972	949	33227	12273	158	8181	32	262	-	-	-	343	-
2019	668	-	99	1964	845	143	-	3046	2886	-	123	2088	-	280	1107	547	41488	10832	425	5483	84	-	-	-	-	529	-
2020	-	-	-	-	684	24	-	2780	2658	-	-	1239	-	157	581	724	31061	9619	627	5305	120	-	-	-	-	514	-

4 References and background documentation

[1] European Commission, 2017. **Proposal for a DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Decision No 1313/2013/EU on a Union Civil Protection Mechanism**. No. COM(2017) 772 final in COM – legislative proposals, and documents related. *Publications Office of the European Union*, Luxembourg. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:0772:FIN

[2] European Commission, 2017. **Communication from the Commission to the European Parliament, the Council and the Committee of the Regions - Strengthening EU Disaster Management: rescEU Solidarity with Responsibility Solidarity with Responsibility**. No. COM(2017) 773 final in Communication from the Commission to the European Parliament, the Council and the Committee of the Regions. *Publications Office of the European Union*, Luxembourg. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:0773:FIN

[3] European Parliament, Council of the European Union, 2014. **Regulation (EU) No 377/2014 of the European Parliament and of the Council of 3 April 2014 establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010 Text with EEA relevance**. *Official Journal of the European Union 57* (L 122), 44-66. http://data.europa.eu/eli/reg/2014/377/oj

[4] Council of the European Union, 2002. **Council Regulation (EC) No 2012/2002 of 11 November 2002 establishing the European Union Solidarity Fund**. *Official Journal of the European Union 45* (L 311), 3-8. http://data.europa.eu/eli/reg/2002/2012/oj

[5] de Rigo, D., Libertà, G., Houston Durrant, T., Artés Vivancos, T., San-Miguel-Ayanz, J., 2017. **Forest fire danger extremes in Europe under climate change: variability and uncertainty**. *Publication Office of the European Union*, Luxembourg. ISBN:978-92-79-77046-3 , https://doi.org/10.2760/13180

[6] European Commission, 2013. **Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An EU Strategy on adaptation to climate change**. No. COM(20173) 216 final. *Publications Office of the European Union*, Luxembourg. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2013:0216:FIN

[7] European Parliament, Council of the European Union, 2003. **Regulation (EC) No 2152/2003 of the European Parliament and of the Council of 17 November 2003 concerning monitoring of forests and environmental interactions in the Community (Forest Focus)**. *Official Journal of the European Union 46* (L 324), 1-8. http://data.europa.eu/eli/reg/2003/2152/oj

[8] Di Giuseppe, F., Pappenberger, F., Wetterhall, F., Krzeminski, B., Camia, A., Libertà, G., San Miguel, J., 2016. **The potential predictability of fire danger provided by numerical weather prediction**. *Journal of Applied Meteorology and Climatology 55* (11), 2469-2491. https://doi.org/10.1175/jamc-d-15-0297.1

[9] Büttner, G., Kosztra, B., Maucha, G., Pataki, R., 2012. **Implementation and achievements of CLC2006**. Tech. rep., European Environment Agency. Data available at https://www.eea.europa.eu/ds_resolveuid/DAT-37-en

[10] Bossard, M., Feranec, J., Otahel, J., 2000. **CORINE land cover technical guide - Addendum 2000**. Tech. Rep. 40, European Environment Agency. https://www.eea.europa.eu/publications/tech40add/

[11] European Commission, 1994. **Commission Regulation (EC) No 804/94 of 11 April 1994 laying down certain detailed rules for the application of Council Regulation (EEC) No 2158/92 as regards forest-fire information systems**. *Official Journal of the European Union 37* (L 93), 11-15. http://data.europa.eu/eli/reg/1994/804/oj

[12] Camia, A., Houston Durrant, T., San-Miguel-Ayanz, J., 2014. **The European Fire Database: technical specifications and data submission**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-35929-3, https://doi.org/10.2788/2175

Background information: the series "Forest fires in Europe, Middle East and North Africa"

[13] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Branco, A., de Rigo, D., Ferrari, D., Maianti, P., Artés Vivancos, T., Oom, D., Pfeiffer, H., Grecchi, R., Niujten, D., Onida, M., Löffler, P., Benchikha, A., Abbas, M., Humer, F., Vacik, H., Müller, M., Heil, K., Konstantinov, V., Pešut, I., Kaliger, A., Petkoviček, S., Papageorgiou, K., Petrou, P.,Toumasis, I., Pecl, J., Ruuska, R., Fargeon, H., Chassagne, F., Duché, Y., Gonschorek, A., Panteli, M., Debreceni, P., Nagy, D., Nugent, C., Zaken, A., Di Fonzo, M., Sciunnach, R., Micillo, G., Fresu, F., Marzoli, M., Pompei, E., Ferlazzo, S., Ascoli, D., Romano, R., Leisavnieks, E., Jaunķiķis, Z., Mitri, G., Repšienė, S., Glasko, Z., Assali, F., Mharzi Alaoui, H., Kok, E., Stoof, C., Timovska, M., Botnen, D., Piwnicki, J., Szczygieł, R., Moreira, J., Cruz, M., Sbirnea, R., Mara, S., Milanović, S., Longauerová, V., Jakša, J., Lopez-Santalla, A., Sandahl, L., Andersson, S., Beyeler, S., Sautter, M., Conedera, M., Pezzatti, B., Dursun, K. T., Baltaci, U., Gazzard, R., Moffat, A., Sydorenko, S. 2021. **Forest fires in Europe, Middle East and North Africa 2020**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-76-42350-8, https://data.europa.eu/doi/10.2760/216446

[14] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Branco, A., de Rigo, D., Ferrari, D., Maianti, P., Artés Vivancos, T., Oom, D., Pfeiffer, H., Grecchi, R., Niujten, D., Leray, T., Benchikha, A., Abbas, M., Humer, F., Vacik, H., Müller, M., Heil, K., Konstantinov, V., Pešut, I., Kaliger, A., Petkoviček, S., Papageorgiou, K., Petrou, P.,Toumasis, I., Pecl, J., Ruuska, R., Fargeon, H., Chassagne, F., Duché, Y., Gonschorek, A., Panteli, M., Debreceni, P., Nagy, D., Nugent, C., Zaken, A., Di Fonzo, M., Sciunnach, R., Micillo, G., Fresu, F., Marzoli, M., Pompei, E., Ferlazzo, S., Ascoli, D., Romano, R., Leisavnieks, E., Jaunķiķis, Z., Mitri, G., Repšienė, S., Glasko, Z., Assali, F., Mharzi Alaoui, H., Kok, E., Stoof, C., Timovska, M., Botnen, D., Piwnicki, J., Szczygieł, R., Moreira, J., Pereira, T., Cruz, M., Sbirnea, R., Mara, S., Longauerová, V., Jakša, J., Lopez-Santalla, A., Sandahl, L., Beyeler, S., Sautter, M., Conedera, M., Pezzatti, B., Dursun, K. T., Baltaci, U., Gazzard, R., Moffat, A., Sydorenko, S. 2020. **Forest fires in Europe, Middle East and North Africa 2019**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-76-23209-4, https://doi.org/10.2760/468688

[15] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Branco, A., de Rigo, D., Ferrari, D., Maianti, P., Artés Vivancos, T., Oom, D., Pfeiffer, H., Niujten, D., Leray, T., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Pešut, I., Kaliger, A., Petkoviček, S., Papageorgiou, K., Toumasis, I., Pecl, J., Ruuska, R., Chassagne, F., Joannelle, P., Gonschorek, A., Theodoridou, C., Debreceni, P., Nagy, D., Nugent, C., Zaken, A., Di Fonzo, M., Sciunnach, R., Micillo, G., Fresu, F., Marzoli, M., Pompei, E., Ferlazzo, S., Ascoli, D., Leisavnieks, E., Jaunķiķis, Z., Mitri, G., Repšienė, S., Glasko, Z., Assali, F., Mharzi Alaoui, H., Kok, E., Stoof, C., van Maren, AJ., Timovska, M., Botnen, D., Piwnicki, J., Szczygieł, R., Moreira, J., Pereira, T., Cruz, M., Sbirnea, R., Mara, S., Eritsov, A., Longauerová, V., Jakša, J., Lopez-Santalla, A., Sandahl, L., Beyeler, S., Conedera, M., Pezzatti, B., Dursun, K. T., Baltaci, U., Gazzard, R., Moffat, A., Sydorenko, S. 2019. **Forest fires in Europe, Middle East and North Africa 2018**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-76-12591-4, https://doi.org/10.2760/561734

[16] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Branco, A., de Rigo, D., Ferrari, D., Maianti, P., Artés Vivancos, T., Lana, F., Loffler, P., Niujten, D., Ahlgren, A., Leray, T., Benchikha, A., Abbas, M., Humer, F., Baetens, J., Konstantinov, V., Pešut, I., Petkoviček, S., Papageorgiou, K., Toumasis, I., Pecl, J., Valgepea, M., Kõiv, K., Ruuska, R., Timovska, M., Michaut, P., Joannelle, P., Lachmann, M., Theodoridou, C., Debreceni, P., Nagy, D., Nugent, C., Zaken, A., Di Fonzo, M., Sciunnach, R., Leisavnieks, E., Jaunķiķis, Z., Mitri, G., Repšienė, S., Assali, F., Mharzi Alaoui, H., Botnen, D., Piwnicki, J., Szczygieł, R., Almeida, R., Pereira, T., Cruz, M., Sbirnea, R., Mara, S., Eritsov, A., Longauerová, V., Jakša, J., Enriquez, E., Lopez, A., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., Dursun, K. T., Baltaci, U., Moffat, A., 2018. **Forest fires in Europe, Middle East and North Africa 2017**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-92832-1, https://doi.org/10.2760/27815

[17] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Branco, A., de Rigo, D., Ferrari, D., Maianti, P., Artés Vivancos, T., Schulte, E., Loffler, P., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Pešut, I., Petkoviček, S., Papageorgiou, K., Toumasis, I., Kütt, V., Kõiv, K., Ruuska, R., Anastasov, T., Timovska, M., Michaut, P., Joannelle, P., Lachmann, M., Pavlidou, K., Debreceni, P., Nagy, D., Nugent, C., Di Fonzo, M., Leisavnieks, E., Jaunķiķis, Z., Mitri, G., Repšienė, S., Assali, F., Mharzi Alaoui, H., Botnen, D., Piwnicki, J., Szczygieł, R., Janeira, M., Borges, A., Sbirnea, R., Mara, S., Eritsov, A., Longauerová, V., Jakša, J., Enriquez, E., Lopez, A., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., Dursun, K. T., Baltaci, U., Moffat, A., 2017. **Forest fires in Europe, Middle East and North Africa 2016**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-71293-7, https://doi.org/10.2760/17690

[18] San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Boccacci, F., Di Leo, M., López Pérez, J., Schulte, E., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Pešut, I., Szabo, N., Papageorgiou, K., Toumasis, I., Kütt, V., Kõiv, K., Ruuska, R., Anastasov, T., Timovska, M., Michaut, P., Joannelle, P., Lachmann, M., Alexiou, E., Debreceni, P., Nagy, D., Nugent, C., Piccoli, D., Micillo, F., Colletti, L., Di Fonzo, M., Di Liberto, F., Leisavnieks, E., Mitri, G., Glazko, Z., Assali, F., Alaoui M'harzi, H., Botnen, D., Piwnicki, J., Szczygieł, R., Janeira, M., Borges, A., Mara, S., Sbirnea, R., Eritsov, A., Longauerová, V., Jakša, J., Enriquez, E., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., 2016. **Forest fires in Europe, Middle East and North Africa 2015**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-62958-7 , https://doi.org/10.2788/29061

[19] Schmuck, G., San-Miguel-Ayanz, J., Houston Durrant, T., Boca, R., Libertà, G., Petroliagkis, T., Di Leo, M., Rodriguez-Aseretto, D., Boccacci, F., Schulte, E., Benchikha, A., Abbas, M., Humer, F., Baetens, J., Konstantinov, V., Pešut, I., Szabo, N., Papageorgiou, K., Kütt, V., Kõiv, K., Ruuska, R., Anastasov, T., Timovska, M., Michaut, P., Joannelle, P., Lachmann, M., Alexiou, E., Debreceni, P., Nagy, D., Nugent, C., Piccoli, D., Micillo, F., Colletti, L., Di Fonzo, M., Di Liberto, F., Leisavnieks, E., Mitri, G., Glazko, Z., Assali, F., Alaoui M'harzi, H., Botnen, D., Piwnicki, J., Szczygieł, R., Janeira, M., Borges, A., Mara, S., Sbirnea, R., Eritsov, A., Longauerová, V., Jakša, J., Enriquez, E., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., 2015. **Forest fires in Europe, Middle East and North Africa 2014**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-50446-4 , https://doi.org/10.2788/224527

[20] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Houston Durrant, T., Boca, R., Libertà, G., Petroliagkis, T., Di Leo, M., Rodriguez-Aseretto, D., Boccacci, F., Schulte, E., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Pešut, I., Szabo, N., Papageorgiou, K., Kütt, V., Kõiv, K., Ruuska, R., Anastasov, T., Michaut, P., Joannelle, P., Lachmann, M., Alexiou, E., Debreceni, P., Nagy, D., Nugent, C., Capone, M., Di Liberto, F., Colletti, L., Leisavnieks, E., Mitr, G., Glazko, Z., Assali, F., Alaoui M'harzi, H., Botnen, D., Piwnicki, J., Szczygieł, R., Janeira, M., Borges, A., Mara, S., Sbirnea, R., Eritsov, A., Longauerová, V., Jakša, J., Enriquez, E., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., Kisa, A., 2014. **Forest Fires in Europe, Middle East and North Africa 2013**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-39628-1 , https://doi.org/10.2788/99870

[21] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Houston Durrant, T., Boca, R., Libertà, G., Schulte, E., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Szabo, N., Rožić, R., Papageorgiou, K., Kütt, V., Kõiv, K., Ruuska, R., Timovska, M., Michaut, P., Deblonde, P., Lachmann, M., Alexiou, E., Debreceni, P., Nagy, D., Nugent, C., Capone, M., Di Liberto, F., Colletti, L., Leisavnieks, E., Mitri, G., Glazko, Z., Assali, F., Alaoui M'harzi, H., Botnen, D., Piwnicki, J., Szczygieł, R., Janeira, M., Borges, A., Mara, S., Sbirnea, R., Longauerová, V., Eritsov, A., Jakša, J., Enriquez, E., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., Kisa, A., 2013. **Forest fires in Europe, Middle East and North Africa 2012**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-32369-0 , https://doi.org/10.2788/58397

[22] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Houston Durrant, T., Boca, R., Whitmore, C., Libertà, G., Corti, P., Schulte, E., Benchikha, A., Abbas, M., Humer, F., Konstantinov, V., Papageorgiou, K., Kütt, V., Kõiv, K., Ruuska, R., Anastasov, T., Michaut, P., Deblonde, P., Lachmann, M., Debreceni, P., Nugent, C., Capone, M., Colletti, L., Gashi, F., Leisavnieks, E., Mitri, G., Glazko, Z., Assali, F., Cherki, K., Alaoui M'harzi, H., Botnen, D., Szczygieł, R., Piwnicki, J., Sacadura, P., Mateus, P., Mara, S., Irimie, D., Eritsov, A., Longauerová, V., Jakša, J., Gomez del Alamo, R., Enriquez,

E., Sandahl, L., Reinhard, M., Conedera, M., Pezzatti, B., Kol, M., 2012. **Forest fires in Europe, Middle East and North Africa 2011**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-26175-6 , https://doi.org/10.2788/44558

Background information: older reports

[23] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Houston Durrant, T., Santos de Oliveira, S., Boca, R., Whitmore, C., Giovando, C., Libertà, G., Corti, P., Schulte, E., *et al.*, 2011. **Forest Fires in Europe 2010**. *Publications Office of the European Union*, Luxembourg. ISBN:978-92-79-20919-2 , https://doi.org/10.2788/46294

[24] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Houston Durrant, T., Santos de Oliveira, S., Boca, R., Whitmore, C., Giovando, C., Libertà, G., Schulte, E., *et al.*, 2010. **Forest Fires in Europe 2009**. *Publication Office of the European Union,* Luxembourg. ISBN:978-92-79-16494-1 , https://doi.org/10.2788/74089

[25] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Oehler, F., Santos de Oliveira, S., Houston Durrant, T., Kucera, J., Boca, R., Whitmore, C., Giovando, C., Amatulli, G., Libertà, G., Schulte, E., Bucki, M., *et al.*, 2009. **Forest Fires in Europe 2008**. *Office for Official Publications of the European Communities*, Luxembourg. https://doi.org/10.2788/48648

[26] Schmuck, G., San-Miguel-Ayanz, J., Camia, A., Kucera, J., Libertà, G., Boca, R., Houston Durrant, T., Amatulli, G., Schulte, E., Bucki, M., *et al.*, 2008. **Forest Fires in Europe 2007**. *Office for Official Publications of the European Communities*, Luxembourg. https://doi.org/10.2788/76413

[27] Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Camia, A., Kucera, J., Libertà, G., Amatulli, G., Boca, R., Schulte, E., Dierks, H.H., *et al.*, 2007. **Forest Fires in Europe 2006**. *Office for Official Publications of the European Communities*, Luxembourg. https://doi.org/10.2788/3667

[28] Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Camia, A., Kucera, J., Libertà, G., Schulte, E., Colletti, L., Martin, H., Toussaint, M., *et al.*, 2006. **Forest Fires in Europe 2005**. *Office for Official Publications of the European Communities*, Luxembourg. https://doi.org/10.2788/33243

[29] Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Camia, A., Kucera, J., Libertà, G., Bucella, P., Flies, R., Schulte, E., Colletti, L., *et al.*, 2005. **Forest Fires in Europe 2004**. *Office for Official Publications of the European Communities*, Luxembourg. SPI 05.147 , JRC32050

[30] Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Camia, A., Kucera, J., Libertà, G., Bucella, P., Schulte, E., Flies, R., Colletti, L., *et al.*, 2004. **Forest Fires in Europe: 2003 fire campaign**. *Office for Official Publications of the European Communities*, Luxembourg. SPI 04.124, JRC28093

[31] Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Libertà, G., Schulte, E., *et al.*, 2003. **Forest Fires in Europe: 2002 fire campaign**. *Office for Official Publications of the European Communities*, Luxembourg. SPI 03.83 , JRC25649

[32] Schulte, E., Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Libertà, G., *et al.*, 2002. **Forest Fires in Europe: 2001 fire campaign**. *Office for Official Publications of the European Communities*, Luxembourg, SPI 02.72 , JRC23649

[33] Barisich, A., Schulte, E., Maier, L., Flies, R., Meyer-Roux, J., Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., *et al.*, 2001. **Forest fires in Southern Europe: Report No. 1, July 2001**. *Office for Official Publications of the European Communities*, Luxembourg. SPI 01.95, JRC22065

[34] Barisich, A., Schulte, E., Anz, C., Flies, R., Meyer-Roux, J., Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., *et al.*, 2001. **Forest Fires in Southern Europe: Bulletin of the 2000 fire campaign**. SPI 01.85, JRC21876

All reports from past years can be found in

https://effis.jrc.ec.europa.eu/reports-and-publications

Annex – Summary Tables of Fire Statistics

Table 101. Number of forest fires in five Southern Member States (1980-2021)

Table 102. Burnt area (hectares) in five Southern Member States (1980 – 2021)

Table 103. Number of forest fires in other countries (1990-2021)

Table 104. Burnt area (hectares) in other countries (1990 – 2021).

Statistics on burnt area divided into forest and non-forest area are supplied in the individual country reports, where available.

NOTE

Every effort is made to ensure that the published figures are correct. However, at the time of printing some data are provisional and may be changed in the future. Where there is a discrepancy between figures published in different reports, the later report should be taken as the definitive version.

Table 101. Number of forest fires in five Southern Member States (1980-2021).

Year	*PORTUGAL*	*SPAIN*	*FRANCE*	*ITALY*	*GREECE*	*TOTAL*
1980	2 349	7 190	5 040	11 963	1 207	27 749
1981	6 730	10 878	5 173	14 503	1 159	38 443
1982	3 626	6 545	5 308	9 557	1 045	26 081
1983	4 539	4 791	4 659	7 956	968	22 913
1984	7 356	7 203	5 672	8 482	1 284	29 997
1985	8 441	12 238	6 249	18 664	1 442	47 034
1986	5 036	7 570	4 353	9 398	1 082	27 439
1987	7 705	8 679	3 043	11 972	1 266	32 665
1988	6 131	9 247	2 837	13 588	1 898	33 701
1989	21 896	20 811	6 763	9 669	1 284	60 423
1990	10 745	12 913	5 881	14 477	1 322	45 338
1991	14 327	13 531	3 888	11 965	858	44 569
1992	14 954	15 955	4 002	14 641	2 582	52 134
1993	16 101	14 254	4 769	14 412	2 406	51 942
1994	19 983	19 263	4 618	11 588	1 763	57 215
1995	34 116	25 827	6 563	7 378	1 438	75 322
1996	28 626	16 771	6 401	9 093	1 508	62 399
1997	23 497	22 320	8 005	11 612	2 273	67 707
1998	34 676	22 446	6 289	9 540	1 842	74 793
1999	25 477	18 237	4 960	6 932	1 486	57 092
2000	34 109	24 118	4 603	8 595	2 581	74 006
2001	28 915	19 547	4 309	7 134	2 535	62 440
2002	28 993	19 929	4 097	4 601	1 141	58 761
2003	28 087	18 616	7 023	9 697	1 452	64 875
2004	27 829	21 396	3 775	6 428	1 748	61 176
2005	41 689	25 492	4 698	7 951	1 544	81 374
2006	24 243	16 354	4 615	5 634	1 417	52 263
2007	25 133	10 936	3 383	10 639	1 983	52 058
2008	18 958	11 655	2 818	6 486	1 481	41 389
2009	29 783	15 643	4 888	5 422	1 063	56 799
2010	26 113	11 721	3 861	4 884	1 052	47 632
2011	29 782	16 414	4 290	8 181	1 613	60 280
2012	25 352	17 503	3 928	8 252	1 559	56 593
2013	23 129	10 626	2 223	2 936	862	39 776
2014	9 388	9 771	2 799	3 257	552	25 746
2015	19 643	11 928	4 439	5 442	510	41 963
2016	16 104	8 817	4 406	5 818	777	35 801
2017	21 006	13 793	4 429	7 855	1 083	48 140
2018	12 273	7 143	3 027	3 220	793	26 434
2019	10 832	10 883	5 728	4 351	657	32 158
2020	9 619	7 745	7 961	4 865	1 060	30 661
2021	8 186	8 780	4 739	5 989	1 250	28 944
% of total in 2021	**28%**	**30%**	**16%**	**21%**	**4%**	**100%**
Average 1980-1989	7 381	9 515	4 910	11 575	1 264	34 645
Average 1990-1999	22 250	18 152	5 538	11 164	1 748	58 851
Average 2000-2009	28 774	18 369	4 421	7 259	1 695	60 517
Average 2010-2019	19 362	11 860	3 913	5 420	946	41 501
Average 2020-2021	8 903	8 263	6 350	5 427	1 155	30 097
Average 1980-2021	18 940	14 178	4 774	8 691	1 401	47 984
TOTAL (1980-2021)	795 477	595 479	200 512	365 027	58 826	2 015 321

Table 102. Burnt area (hectares) in five Southern Member States (1980 – 2021).

Year	*PORTUGAL*	*SPAIN*	*FRANCE*	*ITALY*	*GREECE*	*TOTAL*
1980	44 251	263 017	22 176	143 919	32 965	506 328
1981	89 798	298 288	27 711	229 850	81 417	727 064
1982	39 556	152 903	55 145	130 456	27 372	405 432
1983	47 811	108 100	53 729	212 678	19 613	441 931
1984	52 710	165 119	27 202	75 272	33 655	353 958
1985	146 254	484 476	57 368	190 640	105 450	984 188
1986	89 522	264 887	51 860	86 420	24 514	517 203
1987	76 269	146 662	14 108	120 697	46 315	404 051
1988	22 434	137 734	6 701	186 405	110 501	463 775
1989	126 237	426 693	75 566	95 161	42 363	766 020
1990	137 252	203 032	72 625	195 319	38 594	646 822
1991	182 486	260 318	10 130	99 860	13 046	565 840
1992	57 011	105 277	16 593	105 692	71 410	355 983
1993	49 963	89 267	16 698	203 749	54 049	413 726
1994	77 323	437 635	24 995	136 334	57 908	734 195
1995	169 612	143 484	18 137	48 884	27 202	407 319
1996	88 867	59 814	11 400	57 988	25 310	243 379
1997	30 535	98 503	21 581	111 230	52 373	314 222
1998	158 369	133 643	19 282	155 553	92 901	559 748
1999	70 613	82 217	15 906	71 117	8 289	248 142
2000	159 605	188 586	24 078	114 648	145 033	631 950
2001	117 420	93 297	20 642	76 427	18 221	326 007
2002	130 849	107 464	30 160	40 791	6 013	315 277
2003	471 750	148 172	73 278	91 805	3 517	788 522
2004	151 370	134 193	13 711	60 176	10 267	369 717
2005	346 718	188 697	22 135	47 575	6 437	611 562
2006	83 706	155 345	7 972	39 946	12 661	299 622
2007	36 413	86 122	8 574	227 729	225 734	584 571
2008	19 897	50 322	6 046	66 329	29 152	171 746
2009	92 126	120 094	17 033	73 355	35 342	337 953
2010	140 953	54 770	10 538	46 537	8 967	262 545
2011	77 104	102 161	11 751	72 004	29 144	292 181
2012	117 985	226 125	8 318	130 814	59 924	543 181
2013	160 388	58 985	3 608	29 076	46 676	298 733
2014	22 820	46 721	7 698	36 125	25 846	139 005
2015	67 200	103 200	11 546	41 511	7 096	230 167
2016	167 807	65 817	16 395	65 503	26 540	341 760
2017	539 921	178 234	26 641	161 987	13 393	919 913
2018	44 578	25 162	5 193	19 481	15 464	109 808
2019	42 084	83 963	24 133	36 034	9 153	194 710
2020	67 170	65 923	18 451	55 656	9 300	215 126
2021	**28 360**	**87 880**	**15 114**	**151 964**	**108 418**	**494 082**
% of total in 2021	**7%**	**22%**	**4%**	**39%**	**28%**	**100%**
Average 1980-1989	73 484	244 788	39 157	147 150	52 417	556 995
Average 1990-1999	102 203	161 319	22 735	118 573	44 108	448 938
Average 2000-2009	160 985	127 229	22 363	83 878	49 238	443 693
Average 2010-2019	138 084	94 514	12 582	63 907	24 220	333 307
Average 2020-2021	47 765	76 902	16 782	103 810	58 859	304 118
Average 1980-2021	115 312	153 150	23 855	103 398	43 275	438 990
TOTAL (1980-2020)	4 843 096	6 432 302	1 001 928	4 342 697	1 817 544	18 437 565

Table 103. Number of forest fires in other countries (1990-2021).

Country / Year	Algeria	Austria	Bulgaria	Croatia	Cyprus	Czech Rep.	Estonia	Finland	Germany	Hungary	Latvia	Lebanon	Lithuania	Morocco	Netherlands	North Macedonia	Norway	Poland	Romania	Serbia	Slovakia	Slovenia	Sweden	Switzerland	Turkey	Ukraine
1990	-	-	-	-	-	-	-	-	-	-	604	-	-	179	-	-	-	5756	131	-	-	-	-	257	1750	-
1991	-	-	73	-	-	-	-	-	1846	-	225	-	-	247	-	-	-	3528	42	-	-	-	-	152	1481	-
1992	-	-	602	325	-	-	-	-	3012	-	1510	-	1180	182	-	-	-	11858	187	-	-	-	-	86	2117	-
1993	-	112	1196	372	-	-	-	-	1694	-	965	-	634	187	-	-	-	8821	159	-	-	-	-	83	2545	-
1994	-	105	667	181	-	-	-	-	1696	-	763	-	715	417	-	-	-	10705	121	-	366	-	-	86	3239	-
1995	-	54	114	109	-	1331	-	-	1237	-	582	-	472	528	-	-	-	7678	62	-	254	-	-	96	1770	-
1996	-	26	246	305	-	1421	-	1475	1748	-	1095	-	894	220	-	-	-	7923	72	-	662	-	-	130	1645	-
1997	-	42	200	305	-	1398	-	1585	1467	-	768	-	565	391	-	-	-	6817	37	-	535	-	-	179	1569	-
1998	-	71	578	441	-	2563	-	370	1032	-	357	-	258	416	-	-	-	6165	59	-	1056	-	2503	121	1932	-
1999	-	16	320	223	-	1402	-	1528	1178	229	1196	-	1022	385	-	-	-	9820	138	-	426	-	4707	50	2075	-
2000	-	42	1710	706	285	1499	158	826	1210	811	915	-	654	321	-	-	-	12426	688	-	824	-	4708	70	2555	-
2001	-	54	825	299	299	483	91	822	587	419	272	-	287	327	-	-	117	4480	268	-	311	-	4831	67	2631	-
2002	-	108	402	176	243	604	356	2546	513	382	1720	-	1596	202	-	-	213	10101	516	-	570	60	6490	117	1471	-
2003	-	238	452	532	427	1754	111	1734	2524	375	900	-	885	392	-	-	198	17087	203	-	872	224	8282	304	2177	-
2004	-	72	294	204	221	873	89	816	626	104	647	-	468	714	-	-	119	7006	34	-	153	51	4955	94	1762	-
2005	-	85	241	147	185	619	65	1069	496	150	365	-	301	662	-	-	122	12049	64	-	287	73	4573	110	1530	-
2006	-	133	393	181	172	697	248	3046	930	97	1929	-	1545	381	-	-	205	11541	105	-	237	112	4618	110	2227	-
2007	-	256	1479	345	111	805	64	1204	779	603	425	-	251	340	-	652	65	8302	478	-	463	140	3737	120	2829	5024
2008	-	185	582	275	114	470	71	1456	818	502	700	-	301	273	-	573	171	9090	91	-	182	74	5420	63	2135	3231
2009	-	138	314	181	91	514	47	1242	763	608	823	-	471	501	-	80	109	9162	190	67	347	120	4180	103	1793	4922
2010	-	144	222	131	133	732	30	1412	780	109	316	-	104	629	-	99	62	4680	70	3	127	32	3120	88	1861	2368
2011	2487	267	635	280	85	1337	24	1215	888	2021	360	-	142	606	-	523	49	8172	340	211	303	114	3534	114	1954	1761
2012	5110	259	876	569	78	1549	5	417	701	2657	162	-	81	484	-	483	24	9265	911	318	513	168	2213	75	2450	1743
2013	2443	199	408	137	135	666	15	1452	515	761	422	-	123	411	-	186	42	4883	116	46	233	75	4878	58	3755	806
2014	4629	146	151	43	68	865	91	1660	429	1042	698	-	155	460	-	62	133	5245	83	23	153	35	4374	60	2149	1486
2015	2383	280	429	177	87	1748	67	745	1071	1069	704	107	247	425	-	106	29	12257	250	68	242	93	2700	166	2150	2225
2016	3150	141	584	151	119	892	84	933	608	452	641	260	98	422	-	60	345	5286	174	45	136	90	5454	82	3188	945
2017	2992	278	513	329	92	966	61	881	424	1454	423	92	80	433	321	301	264	3592	447	222	162	108	5276	110	2411	2371
2018	797	174	222	54	131	2033	230	2427	1708	530	972	41	211	343	949	19	887	8867	158	62	262	32	8181	153	2167	1297
2019	2278	244	668	123	99	1963	143	1458	1523	2088	1107	194	279	529	548	251	261	9635	425	189	210	84	5483	79	2688	1261
2020	3493	234	499	142	108	2081	24	1260	1360	1239	581	251	157	514	724	48	609	6627	627	81	221	120	5305	78	3399	2598
2021	1631	164	349	116	111	1517	32	1231	548	1154	448	131	46	435	212	113	653	3295	278	75	101	73	4087	85	2793	659

Table 104. Burnt area (hectares) in other countries (1990 – 2021).

Country / Year	Algeria	Austria	Bulgaria	Croatia	Cyprus	Czech Rep.	Estonia	Finland	Germany	Hungary	Latvia	Lebanon	Lithuania	Morocco	Netherlands	North Macedonia	Norway	Poland	Romania	Serbia	Slovakia	Slovenia	Sweden	Switzerland	Turkey	Ukraine
1990	-	-	-	-	-	-	-	-	-	-	258	-	-	2118	-	-	-	7341	444	-	-	-	-	1723	13742	-
1991	-	-	511	-	-	-	-	-	920	-	69	-	-	3965	-	-	-	2567	277	-	-	-	-	96	8081	-
1992	-	-	5243	11131	-	-	-	-	4908	-	8412	-	769	2579	-	-	-	43755	729	-	-	-	-	65	12232	-
1993	-	85	18164	20157	-	-	-	-	1493	-	570	-	274	3078	-	-	-	8290	518	-	-	-	-	37	15393	-
1994	-	80	18100	7936	-	-	-	-	1114	-	326	-	279	6072	-	-	-	9325	312	-	-	-	-	408	30828	-
1995	-	43	550	4651	-	403	-	-	592	-	535	-	321	7018	-	-	-	5403	208	-	-	-	-	446	7676	-
1996	-	8	906	11214	-	2043	-	433	1381	-	927	-	478	1185	-	-	-	14537	227	-	-	-	-	293	14922	-
1997	-	28	595	11122	-	359	-	1146	599	-	448	-	226	3845	-	-	-	6766	68	-	-	-	-	1785	6517	-
1998	-	101	6967	32056	-	1132	-	131	397	-	211	-	93	1855	-	-	-	4222	137	-	-	-	422	274	6764	-
1999	-	6	8291	6053	-	336	-	609	415	756	1544	-	494	1688	-	-	-	8629	379	-	557	-	1771	30	5804	-
2000	-	32	57406	68171	8034	375	684	266	581	1595	1341	-	352	4064	-	-	-	7089	3607	-	904	-	1552	70	26653	-
2001	-	20	20152	16169	4830	87	62	187	122	-	311	-	113	1806	-	-	895	3466	1001	-	305	-	1254	21	7394	-
2002	-	112	6513	4853	2196	178	2082	590	122	1227	2222	-	746	593	-	-	221	5210	3536	-	595	161	2626	681	8514	-
2003	-	122	5000	27091	2349	1236	207	666	1315	845	559	-	436	2858	-	-	942	21551	762	-	1567	2100	4002	673	6644	-
2004	-	19	1137	3378	1218	335	379	358	274	247	486	-	253	8660	-	-	117	3782	124	-	157	138	1883	31	4876	-
2005	-	13	1456	3135	1838	227	85	495	183	3531	120	-	51	6198	-	-	346	5713	162	-	524	280	1562	67	2821	-
2006	-	54	3540	4575	1160	53	2638	1617	482	625	3387	-	1199	5360	-	-	3829	5657	946	-	280	1420	5710	127	7762	-
2007	-	54	42999	20209	4483	316	292	576	256	4636	272	-	38	1367	-	32665	128	2841	2529	-	679	128	1090	337	11664	12731
2008	-	20	5289	7343	2392	86	1279	830	539	2404	364	-	112	1127	-	5915	3174	3027	373	-	118	75	6113	68	29749	4521
2009	-	58	2271	2900	885	178	59	576	262	6463	646	-	287	3108	-	1307	1329	4400	974	712	510	177	1537	60	4679	4575
2010	-	36	6526	1121	2000	205	25	520	522	878	92	-	22	5511	-	737	769	2126	206	4	192	121	540	27	3517	1239
2011	13593	67	6883	15555	1599	337	19	580	214	8055	115	-	293	3460	-	17308	121	2678	2195	5003	403	288	945	225	3612	612
2012	99061	48	12730	24804	2531	634	3	86.5	269	14115	90	-	20	6695	-	10021	60	7235	6624	13226	1683	1006	483	30	10455	3311
2013	13396	102	3314	1999	2835	92	79	461.4	199	1955	217	-	25	2207	-	3027	47	1289	421	1132	270	66	1508	29	11456	220
2014	43125	92	916	188	669	536	77	881	120	4454	591	-	162	1540	-	846	770	2690	217	599	192	18	14666	46	3117	16677
2015	13010	114	4313	9416	652	344	83	143	526	4730	615	753	71	992	-	1798	143	5510	1671	1474	353	65	594	47	3219	2625
2016	18370	23	6340	7100	3205	141	123	310	283	974	467	1871	26	2585	-	450	1884	1451	675	843	175	526	1288	454	9156	1101
2017	53975	25	4569	48543	428	170	33	460	395	4933	265	264	53	2414	232	5619	525	1023	2459	4757	295	441	1433	118	11992	5474
2018	2312	19	1453	1506	1136	492	430	1228	2349	906	2864	643	110	841	639	95	3279	2696	1341	1502	248	20	24310	69	5644	1367
2019	21048	20	5620	2180	733	520	69	565	2711	6541	805	3155	200	3232	250	4834	3077	3572	2496	9872	462	154	1233	31	11332	1065
2020	43918	60	5258	23994	1305	484	191	719	368	2895	309	1851	64	5569	1072	68	363	8417	5152	1417	477	118	821	26	20971	74623
2021	100101	117	3143	6660	6612	411	33	785	148	2413	504	1508	11	3064	18	6796	653	894	2101	1630	159	124	861	35	139503	289

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

— by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

— at the following standard number: +32 22999696,

— via the following form: european-union.europa.eu/contact-eu/write-us_en.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

Open data from the EU

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
joint-research-centre.ec.europa.eu

 @EU_ScienceHub

 EU Science Hub - Joint Research Centre

 EU Science, Research and Innovation

 EU Science Hub

 EU Science

Publications Office
of the European Union