



UNITED NATIONS
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Technical Report



Mediterranean wildfires

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2021/2022



Interconnected

Disaster

Risks

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1. Introduction

In the summer of 2021, drought and low humidity combined with record-breaking heat of up to 48.8°C (119.8°F), leading to fire outbreaks across Mediterranean countries, including Italy, Greece, Algeria and Turkey¹, killing more than 100 people and burning more than 620,000 ha of land in July and August. The intensity of these fires was unprecedented; on 29 July, the wildfires in Turkey generated an astonishing peak of 18.6 gigawatts in fire radiative power (a measure of heat output). For context, the previous highest daily average in July since records began in 2003 was 1.2 gigawatts (Smith, 2021).

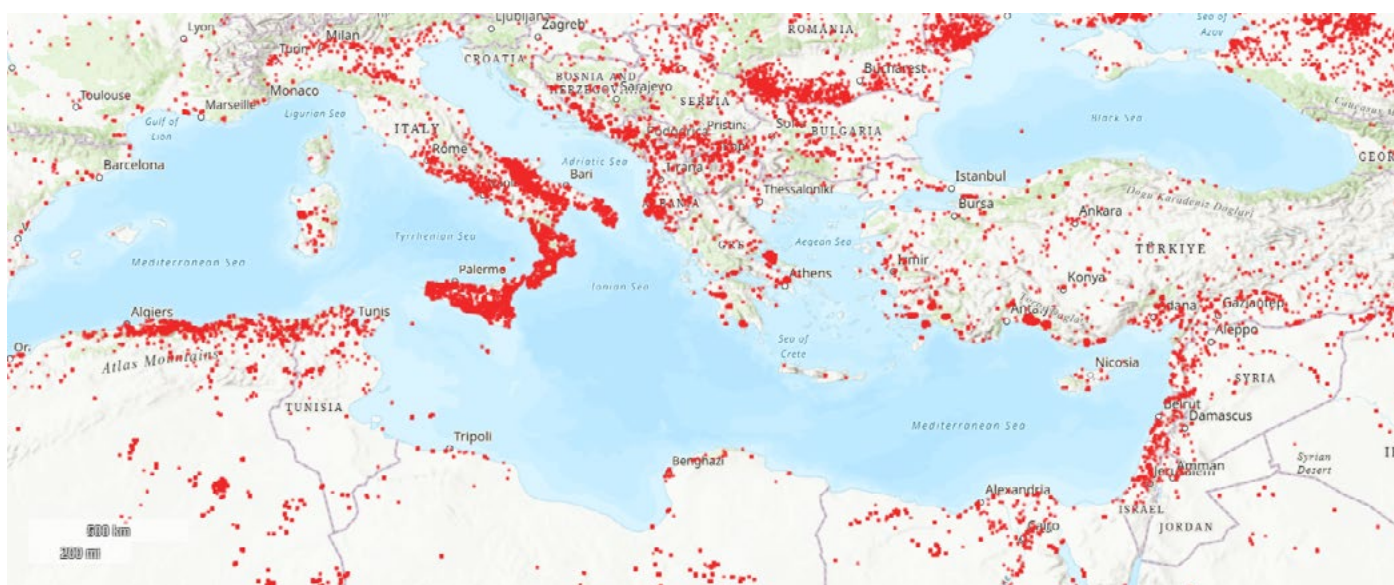


Figure 1: Map of active fires from 14 July – 13 August 2021, (NASA FIRMS, 2021)

2. Impacts

2.1 Loss of life, health impacts, and displacement

More than 100 hundred people were killed during the 2021 wildfire season in the Mediterranean. In Algeria, as many as 90 people died, including 28 soldiers who died while supporting wildfire control responses (Haddad & Hussein, 2021; Bouandel, 2021). Three people died in Greece, four people died in Italy and at least eight people were killed in Turkey (Sullivan, 2021; Gristwood, 2022). Many more people suffered from fire-related injuries, such as burns and respiratory problems from smoke inhalation (CBS, 2021; Abnett, 2021; Castelfranco, 2021). Even as infections rose from the delta variant of the COVID-19 virus, vaccination campaigns were halted as centres closed due to fire risks (Schwartzstein, 2021). Thousands of people were evacuated as homes were destroyed, forcing them to find alternative accommodation as they attempted to rebuild or relocate (Psaropoulos, 2021; Kakissis, 2021).

¹“Italy” refers to the Republic of Italy, “Greece” refers to the Hellenic Republic, “Algeria” refers to the People’s Democratic Republic of Algeria, and “Turkey” refers to the Republic of Türkiye.”



A woman wearing a mask walks in front of her burnt house following a wildfire at the village of Neos Voutzas, near Athens, on July 26, 2018. (Image credit: Angelos Tzortzinis/ AFP)

2.2 Infrastructure damage

Hundreds of homes and businesses burned across the region (Al Jazeera, 2021; Agence France-Presse (AFP), 2021; Kakissis, 2021). Rolling blackouts were implemented in Athens, even amid sweltering heat, as the fires destroyed vital sections of electricity infrastructure (Schwartzstein, 2021). The fires also cut off and damaged the major highway connecting Athens to Thessaloniki and multiple road networks across Turkey (Schwartzstein, 2021; Fitch Ratings, 2021).

2.3 Loss of livelihoods

The wildfires impacted many tourist destinations, including Athens and Evia in Greece, Muğla and Antalya in Turkey, and the Italian islands of Sicily and Sardinia (Caglayan and Erkoyun, 2021). The fires engulfed hotels and resorts, forcing many residents and tourists to flee at the height of the tourist season. For example, in Sicily, police had to rescue more than 200 people stranded at beach resorts (Castelfranco, 2021). Additionally, with the destruction of picturesque landscapes surrounding many tourist destinations, there are likely to be lasting impacts on the region (Kakissis, 2021; Caglayan and Erkoyun, 2021).

Thousands of century-old olive trees burned to ashes as the wildfires spread through thousands of hectares of olive groves across the region (Shahzad, 2021). Villagers in Cuglieri, Sicily, worked tirelessly to save a nearly 2,000-year-old olive tree known as “the Patriarch,” a vital part of the social and cultural identity of the municipality, as more than 90 per cent of the olive trees in the town were lost (Pianigiani, 2021). The loss of pine forests also caused a significant blow to livelihoods, such as resin harvesting, beekeeping, shepherding and timber production. The resin industry on Evia island in Greece, for example, has brought in €5.5 million annually. Additionally, these impacts will likely continue far into the future, as new olive trees take at least five years to become productive and pine trees must be at least 20 years old before resin can be collected (Lavelle, 2021). Honeybees may not return to the pine forests for decades (Elgendy, 2021).



A shepherd with his sheep sits on the ground near Pefki village on Evia (Euboea) island during a wildfire on August 8, 2021. (Image credit: Angelos Tzortzinis/ AFP)

2.4 Ecosystem damage

More than 620,000 ha of land were burnt in the Mediterranean in the summer of 2021, including more than 102,000 ha of protected areas that serve as home to endangered plant and animal species (European Forest Fire Information System (EFFIS), 2021; San-Miguel-Ayanz and others, 2022). In Mediterranean ecosystems, fire is part of a natural process of ecological balance, becoming integrated into the evolution of the grasslands and forests in the region (Naveh, 1975). However, the recent trend in megafires has led to impacts beyond what these ecosystems can cope with (Moreira and others, 2020).

3. Drivers

3.1 Heat and drought

These wildfires occurred under conditions of extreme heat and drought. A powerful heat dome, nicknamed “Lucifer,” descended on the Mediterranean. A heat dome occurs when an area of high pressure traps hot air underneath it, increasing temperatures until it dissipates. Warmed by solar radiation, the air expands into the atmosphere as the area of high pressure pushes the warm air down. As the air is pushed down, it compresses and heats up, trapping even more heat underneath. The high-pressure dome keeps clouds and wind at bay, increasing the heat even more (Culbertson, 2021). This heat dome was formed by a weakened jet stream that dipped south across Europe and warm air from the Sahara that trapped the high-pressure zone in place (Culbertson, 2021). Temperatures were exceptionally high; on August 11, Syracuse, Sicily, set a new provisional temperature record for Europe at 48.8°C, breaking the previous record of 48.0°C set in Athens in 1977. The heatwave lasted for over two weeks in Italy, Greece and Turkey, and continued for over a month in parts of northern Africa (Copernicus, 2021a). Drought conditions were equally as severe, reaching among the driest since 1991, when records began. For much of the summer, the water content of topsoil in Italy and Greece was at critically low levels, and the number of days they remained critical was higher than average. Additionally, reduced water availability meant the effect of plant transpiration was reduced, further exacerbating the heatwave (Copernicus, 2021a).

3.2 Urbanization

In the past, farmland and open grazing land served as fire buffer areas in the vicinity of the Mediterranean villages (Bergmeier and others, 2021). However, the region is nowadays characterized as an intermingling of wildlands with human settlements, called wildland-urban interfaces (WUI) (Ganteaume and others, 2021). Modernization and population growth have recently increased the incidence of WUI areas, leading to more urban development adjacent to forest lands and shrublands (Moreira and others, 2020; Bergmeier and others, 2021).

Moreover, WUIs’ formation increases exposure and the likelihood of wildfire disaster risk (Stephens and others, 2013). The Mediterranean WUIs are hotspots for wildfire ignition, given that more than 90 per cent of them were triggered by deliberate human actions, such as industrial development, hunting, resettlement, land burning-based clearing for urban purposes, arson and negligence (Curt and others, 2020; Elvan and others, 2021). Similarly, tourism development in many Mediterranean WUI has led to a doubling of fire events since 1970 (Xanthopoulos and others, 2006). Thus, higher human population density and built infrastructure in fire-prone landscapes exacerbated the impacts of the 2021 wildfires (Bergmeier and others, 2021).

3.3 Underprepared firefighting force

During the wildfires of 2021, the low capacity of Mediterranean countries to efficiently deal with fires of that magnitude was evident in both limited trained personnel and insufficient aerial firefighting. For instance, in the case of Algeria, the government sent soldiers to contain the blaze despite their lack of both training and adequate equipment (Bouandel, 2021). Moreover, the lack of firefighting planes facilitated a rapid spread of fire through the Kabylie region (Allouche, 2021). Likewise, in Turkey, the mountainous terrain where the fires started required aerial interventions, but the government had only a few helicopters and no water-dropping planes available for use (Ganteaume and others, 2021; Khalid, 2021). The region's firefighting capacity also suffers from underfunding. For example, in the 1990s, Greece had a force of 4,500 permanent firefighters reinforced with thousands of seasonal hires. However, after the country's economic crisis in 2008 – and following economic guidelines from the European Union – the government reduced the firefighting budget by more than €100 million.

4. Root causes

4.1 Human-induced greenhouse gas emissions

Over the past few decades, the increase in global greenhouse gas emissions has been changing climatic conditions around the globe (Intergovernmental Panel on Climate Change (IPCC), 2021a). In the Mediterranean, the changing climate has increased the duration and intensity of hot and dry periods, exacerbating forests' natural flammability and thereby favouring fast-developing fires throughout the region (Plana and others, 2016; Copernicus, 2021b; Ganteaume and others, 2021; Science Media Centre, 2021). Consequently, high concentrations of greenhouse gases from human activities have strengthened fire regimes in the Mediterranean, leading to a prevalence of extreme wildfire events or megafires (Moreira and others, 2020). Additionally, wildfires worldwide caused an estimated 1.76 billion tonnes of carbon emissions in 2021, or 148 per cent more than total EU fossil fuel emissions in 2020, making such fires a significant driver of climate change (Copernicus, 2021b).

4.2 Undervaluing environmental costs

In the 1950s, Mediterranean rural areas suffered an exodus driven by macroeconomic reasons and rapid urbanization (Clapp, 2021; Bergmeier and others, 2021). Shepherds and farmers who formerly worked the land and maintained vegetation cover moved to urban areas, allowing abandoned arable lands to be covered with forests and shrubs (Curt and others, 2020; Clapp, 2021; Bergmeier and others, 2021). In many Mediterranean countries, following misplaced forestry policies (see chapter 4.3), reforestation and afforestation abandoned farmland went largely unplanned or managed for years (Curt and others, 2020; Bergmeier and others, 2021). At the same time, without any criteria for keeping or removing vegetation, the presence of herbivores was not allowed in the new forest lands, facilitating a spread of understorey vegetation and, ultimately, an accumulation of flammable material serving as fuel for wildfires (Plana and others, 2016). Furthermore, interspecific competition made the forests more vulnerable to pests and diseases, accentuated drought events, and led to a high generation of woody material (Plana and others, 2016). Thus, such an incomplete conservation strategy turned naturally regenerated forest lands and shrubland into denser and more extensive areas, favouring ignitable material accumulation and exacerbating fire conditions in the Mediterranean (Curt, Aini and Dupire, 2020; Bergmeier and others, 2021).



A fireman walks in a partly burned house during a wildfire in the Panorama Voulas area, south of Athens on June 4, 2022. (Image credit: Louisa Gouliamaki/ AFP)

4.3 Insufficient risk governance

In the past few decades, the backbone of fire management policies in Mediterranean countries has been built on fire suppression (Duane and others, 2019). This type of policy focuses on controlling small fires reactively rather than addressing the primary conditions of fire environments (Zagas and others, 2013). Each suppressed small- or medium-sized wildfire does not allow other combustible biomass to be burned, which both forms and connects spots of accumulated fuel (Plana and others, 2016). Hence, paradoxically, the fire suppression policy has allowed the continuity of burnable landscapes and favours fuel accumulation in forested areas. Additionally, fire suppression policies do not account for the effects of climate change and its influences on the flammability of wildlands (Braun, 2021). While one part of the year in the Mediterranean has become wetter, promoting biomass productivity, the other part of the year has become hotter and drier, creating a suitable fire environment (Moreira and others, 2020). As a result, fire spread capacity surpasses the regional extinction capacity (Plana and others, 2016), producing megafires with unprecedented devastating impacts (Bergmeier and others, 2021). Therefore, a fire suppression policy has been insufficient and ineffective in preventing extreme wildfire events, worsened by the changing regional climatic conditions (Brotons and others, 2013; Duane and others, 2019; Moreira and others, 2020; Bergmeier and others, 2021). Only 2 per cent of fires in the Mediterranean region often account for over 80 per cent of the burned area (Plana and others, 2016).

The entangled division of responsibilities among national institutions is another factor that reflects the limited firefighting capacity of Mediterranean countries. For instance, in Greece, forest management responsibility is not assigned to the same entity in charge of firefighting tasks, which traps fire management efforts in bureaucracy (Clapp, 2021). Furthermore, bureaucratic traps can arise from ambiguous rules. For example, in Italy, national law does not mention using fire for ecological and management purposes. Therefore, each regional authority can decide whether to include preventive techniques such as prescribed burning into their respective fire management plans (Xanthopoulos and others, 2006). Other countries, such as Turkey, even outlaw the practice (Khalid, 2021).

4.4 Inequality of development and livelihood opportunities

In ancient times, open multipurpose woodland and pasture land dominated the Mediterranean landscape (Bergmeier and others, 2021). However, land cover changed during the 20th century due to demographic growth, urbanization, industrialization and agricultural intensification (Plana and others, 2016; Bergmeier and others, 2021). Additionally, the transition to a fossil fuel model, replacing wood and vegetable coal with gas, oil and its derivatives, made Mediterranean wood less profitable and less in demand on the global market, provoking a shift in economic activities (Plana and others, 2016). Similarly, subsistence pastoralism and other traditional activities became less attractive with the lucrative growth of tourism and related services in Mediterranean towns and villages (Bergmeier and others, 2021). Altogether, this led to a rural exodus, after which abandoned farmland turned into dense and extensive fire-prone forest areas in the vicinity of human settlements throughout the landscape (Bergmeier and others, 2021).

5. Big picture

It is predicted that the Mediterranean will experience increased fire weather conditions by the middle of the century due to increasing global temperatures (Sutanto and others, 2020; IPCC, 2021b). Estimations show that burned areas will increase in size by about 200 per cent by 2090 relative to 2000 under a “no adaptation” scenario in Europe (Khabarov and others, 2016). Similar increased frequency, size and severity of forest fires are expected worldwide, including in Australia, Canada, Russia and the United States (Stephens and others, 2013).

However, as in the Mediterranean, many of the extreme wildfires around the globe result from ineffective policies, miscarried planning and poor governance related to land use, demographic dynamics and changing climatic conditions (Kemper, 2020). Therefore, we must cultivate a healthy relationship with fire before it becomes even more dangerously uncontrollable.

6. Solutions

6.1 Let nature work

Fire is a natural and essential part of many ecosystems around the globe. In the Mediterranean, some plants have specific adaptations to fire, such as the thick bark of the black pine tree or resprouting capacity of the cork oak, whereas others actually need fire to complete their life cycle, such as the fire germination trait of some *Cistus* flowers (Moreira and others, 2010; He and others, 2012; Catry and others, 2012). Certain animals also benefit from open spaces created after a fire, such as the vulnerable ortolan bunting (Kelly and others, 2017). Rather than implementing a fire suppression policy that deprives ecosystems of a natural process, introducing management strategies that use fire as a tool can be a significant and mutually-beneficial way to reduce the incidence of megafires. One way to do this is to let naturally occurring fires do the work for us by implementing a “let it burn” or “point protection” strategy. This refers to a management technique that protects certain assets, such as homes or heritage sites, without completely stopping the spread of a wildfire (National Wildfire Coordinating Group (NWCG), 2022). Certain conditions may need to be met for this to be done effectively and safely, such as the fire occurring naturally from a lightning strike, being far away from people or property, and taking place during optimal weather conditions (Rott, 2018). Alternatively, fire can be used in preventive measures, such as prescribed burning plans, which means strategically burning key areas (Piñol and others, 2005; Moreira and others, 2020; Kemper, 2020). Using fire to prevent massive wildfires is a cost-effective practice in reducing hazard probability or intensity while meeting ecological and conservation goals by enhancing forest resiliency. For example, through prescribed burnings, the Mediterranean can reduce annual burned area by an average of 74 per cent by 2090 (Khabarov and others, 2016). However, there are significant barriers due to a lack of experience, mistrust or fear of using fire that prevents the adoption of these techniques that must be overcome with education and outreach (Xanthopoulos and others, 2006). It is also worth noting that prescribed burning is not a new phenomenon; indigenous peoples, such as the Karuk Tribe in northern California and Aboriginal Australians, have historically used fire as a tool to maintain trails and help selected plants grow, or for hunting purposes (Irfan, 2021; Kimberley Land Council (KLC), 2022). These are sometimes called “cool fires” that burn slowly, reduce fuel loads and create a mosaic landscape that acts as a firebreak to prevent future fires from spreading (KLC, 2022).

Similarly, another sustainable fire prevention practice is woodland management through grazing, or “agrosilvopastoralism” that integrates crops and livestock into forests (Duane and others, 2019). Allowing goats, sheep, cattle or pigs to feed on the forest’s understorey is a nature-based wildfire control tool that is widely socially accepted since it supports local economies, maintains local jobs, preserves cultural landscapes, contributes to habitat conservation and sustains local food production (Duane and others, 2019; Bergmeier and others, 2021). Grazing as a tool for wildfire control in the Mediterranean goes back centuries but decreased over time as populations moved from rural to urban areas (Colantoni and others, 2020; Bergmeier and others, 2021). Nomadic pastoralists, such as the Sarıkiçililer Yörüks, often use goats as livestock that eat the ground shrubbery that otherwise provides fuel for wildfires, and trample forest surfaces, creating corridors that provide small firebreaks (Zogib, 2014). Of course, this can’t be done too intensely as negative consequences of overgrazing pressures, such as soil compaction or species selectivity, can occur (Duane and others, 2019). Other places, such as California and Australia, are also using goats as an institutionalized management strategy – with a company in California even renting out goat herds to clients as a means of removing unwanted and invasive plants (Iovenko, 2022).

6.2 Plan for risks

Landscape diversification is fundamental for avoiding extreme fire events. In the past, agricultural fields and grazing lands in the Mediterranean served as “fire-resisting zones” around villages that ensured wildfires couldn’t spread into town (Bergmeier and others, 2021). By mixing different land uses (i.e. agriculture, silviculture and pastoralism), nature can substantially inhibit the spread of fire. Green belts consisting of vineyards, orange and lemon orchards, or well-managed olives groves can act as firebreaks by separating more flammable forest fuels with less flammable managed areas (Xanthopoulos and others, 2006; Khabarov and others, 2016). For instance, in Spain, agroforestry systems (i.e., Dehesa) of woodland interspersed with agricultural cultivation have effectively stopped fire development across the landscape (Bergmeier and others, 2021). Similarly, sustainable forestry practices can provide “defensible spacing” within and around forests by cutting down trees within a certain distance from each other and clearing branches and shrubs with a given height limit. This technique keeps fire from spreading through the trees as easily and can also provide multiple co-benefits, such as supporting local livelihoods through timber production (Kelly and others, 2017).

Given that WUIs are fire-prone areas, wildfire management should also focus on land-use planning and building regulations (Moreira and others, 2020). To regulate the expansion of WUIs, governments can make use of various fire-safe development strategies, such as eliminating incentives that promote fire-triggering practices (e.g. land clearing through fire), limiting the rights to build in specific areas, and introducing regulations about building materials and adapting building codes for those areas (Stephens and others, 2013; Moreira and others, 2020; Kemper, 2020). Defensible space, for example, is required by law in parts of California, requiring homeowners to keep certain landscape conditions around their houses to help prevent fires from damaging them (Ready for Wildfire, 2022).



Firefighters work to put out a wildfire in Anavyssos, south of Athens, on September 9, 2020. (Image credit: Aris Messinis/ AFP)

6.3 Strengthen governance

Switching fire policy perspectives from suppression-based management to landscape-based fire mitigation will help the Mediterranean significantly reduce the adverse socioeconomic and ecological effects of future wildfires (Moreira and others, 2020; Kemper, 2020). Fire and forestry departments must coordinate to improve the capacity to prevent and respond to future extreme events (Bouandel, 2021). Improving communication between departments will allow for more effective response plans, such as exchanging wildfire data, integrating practices and tools into respective management strategies, and co-creating risk maps and prevention measures (Kemper, 2020; Bouandel, 2021).

6.4 Work together

The solutions mentioned above require some level of working together beyond a single discipline or stakeholder. Involving multiple stakeholders at various levels in fire management planning is fundamental for effectively enhancing fire risk preparedness and reducing damage (Kemper, 2020; Curt and others, 2020). Engaging the private sector, civil society organizations and local communities at WUIs in designing wildfire responses and mitigation actions helps establish clear roles and tasks in preventive fire management (Kemper, 2020; Moreira and others, 2020).

6.5 Conclusion

The solutions listed above are only a brief overview of possible solutions for wildfire management in the Mediterranean context. Some of these solutions may apply in other situations, and others may not work under certain conditions, even in the Mediterranean. Prescribed burning, for example, is more likely to be effective when fuels are the primary driver of fire and not as beneficial when climate and weather conditions contribute more to the spread (Kelly and others, 2017). Additionally, other solutions are necessary to work together as a package, addressing all aspects of the issue. Education, early warning, social protection schemes and climate change mitigation are equally crucial in reducing fire risks and increasing resilience. Notably, while it is not possible to completely eliminate fire risk, more holistic management strategies that incorporate a combination of solutions and coexist with fire can more effectively protect people and ecosystems and prevent high-intensity fires from getting out of control.

Acknowledgements

We'd like to thank Austin Gonzales for his support in this research.

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A helicopter drops water over a forest to extinguish a wildfire in the village of Villa, northwestern Athens, on August 18, 2021.

<https://doi.org/10.53324/VCEB1752>

e-ISBN:978-3-944535-70-8

e-ISSN: 2304-0467