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“Burn Baby Burn” – Controlling the Risk of Wildfires in Greece

Discussion paper prepared for the annual meetings of the Agricultural Economics Society at Warwick University, U.K., April 15-17 2019

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Abstract

Due to climatic and other factors, Greece is likely to face increasing challenges in managing the risk of wildfires. Available data suggest that while the annual number of fires has tended to decline, the average area burned has tended to increase. If risk of damage and potential loss of life are to be addressed, there will need to improvements in both fire prevention and suppression. Many of the challenges are associated with the development of human settlements and associated changes in land use that increase wildfire risk. Institutional constraints relating to property rights and the implementation of fire risk reduction measures, e.g. limitations on controlled burning, construction of fire breaks, and the management of vegetative types that increase fire risk, as well as the elimination of unregulated building are important. Improved land management in high risk areas needs to be accorded high priority. A recent committee report on wildfire risk reduction and management prepared for the Greek government proposes a number of measures to avoid a repeat of the loss of life experienced in 2018. Some of these measures have been proposed before but never implemented. Consequently, whether necessary changes will be actually be made is an open question.

Keywords: *Greece; wildfires; prevention; suppression; land management; institutional constraints*

JEL classifications: *Q23. Q24. Q54*

1. Introduction

Wildfires in North America and Europe were in the news in 2018. In North America, major forest fires occurred in several western U.S. states and in the Canadian province of British Columbia. The 2018 wildfire season in California was the deadliest and most destructive on record. More than 8,500 fires burned over 750,000 hectares. The Camp Fire in Northern California killed at least 86 people and destroyed more than 18,000 structures, virtually eliminating the town of Paradise – a community with over 26,000 residents. Total costs to the U.S. economy from the 2018 California fires have been estimated to be as high as \$350 billion, when property losses, reductions in business activity, and health costs are added to the costs of fighting the fires and cleaning up their aftermath (Accuweather.com, 2018). In Europe, in 2018 there were significant fires in countries that are not normally considered to be at risk, including Sweden and the United Kingdom, due to the effects of an unusually warm and dry summer. A fire during a period of low humidity and very high winds in Greece in July 2018 resulted in the tragic deaths of 100 people in the coastal town of Mati (northeast of Athens in the region of Attica) – the second largest global death toll this century after bushfires in Australia in 2009

¹ Thanks are expressed to Katharine Hassapoyannes for translation of documents and in interviews, and for discussions of many of the issues addressed in this paper. Any misinterpretations or errors remain the author's sole responsibility.

that killed 180 people. Additional wildfires to the west of Athens resulted in significant economic disruption and property damage.

Due to climatic and other factors, the countries of the Mediterranean basin have traditionally been susceptible to wildfires. A study for the European Commission (de Rigo et al., 2017) predicts that global warming (even if limited to a 2°C rise in temperature) will reduce vegetative moisture levels significantly in susceptible areas, resulting in an increased risk of wildfires in the Mediterranean and beyond (in central Europe). This paper reviews the characteristics of wildfires in Greece and assesses what measures might be taken to reduce the risk of wildfires and the potential damage and loss of human life that they cause.

2. Characteristics of Wildfires in Greece

Wildfires are not uncommon in Greece. During 2001-2017 an average of roughly 55,000 hectares (0.4% of the total land area) was affected annually (Figure 1).² However, the total area burned is much smaller than in some other Mediterranean countries. Romania had an average burned area of roughly 190,000 hectares each year; roughly 1.5% of the land area of Portugal was burned annually on average during 2001-2017.

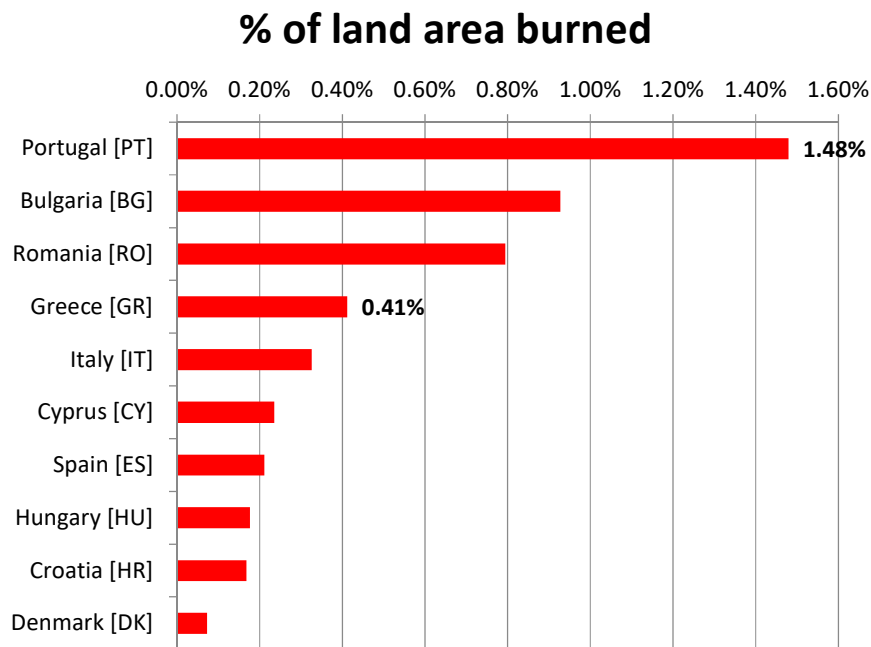
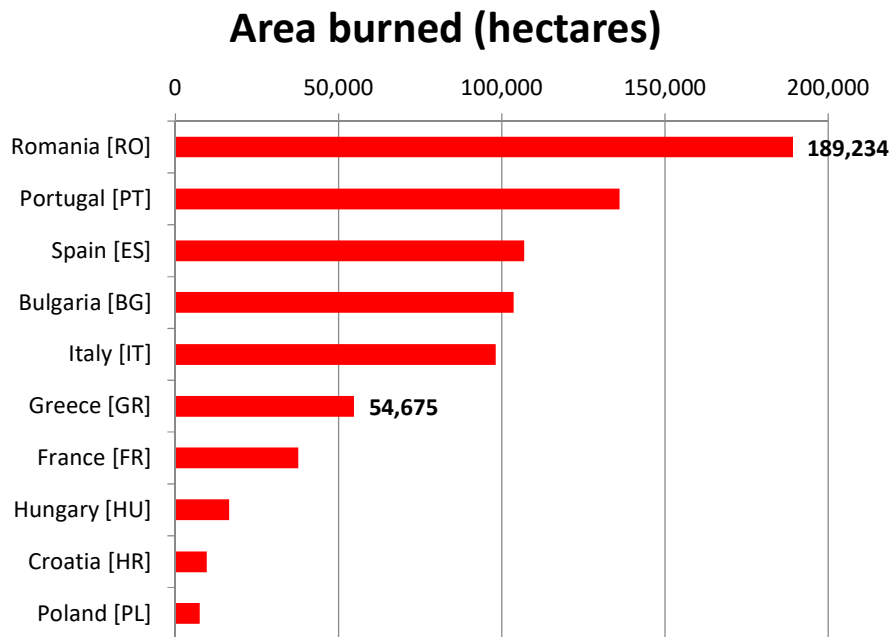
Such averages conceal considerable year-to-year fluctuations in the incidence of fires and the area affected in Greece (Figure 2). Years with limited incidence involve less than 600 fires, while high activity years involve over 2,500. High activity years can involve substantial differences in the average size of fires. For example, the total number of fires in 1992 and 2000 was virtually identical (2,582 and 2,581, respectively) but the average area burned in 2000 (56 hectares) was double that in the earlier year. Total fire activity in 2001 was similar to 2000, but the average size of fires was small, with only 7 hectares of burned area. The worst year for forest fires ever recorded in Greece (2007) had less than 2,000 fires, but their average size was 114 hectares. That was a year in which 7 major fires, 5 of which were in the Peloponnese (the peninsular region of southern mainland Greece), burned a total area of almost 200,000 hectares. As a result of those fires, 69 civilians and 11 firefighters lost their lives and over 1,700 buildings were destroyed or rendered uninhabitable.

The severity of the 2007 fire season is reflected in data on the number of fires by size for the period for which comparable data are available (2004-2016) in Figure 3. Those data also show that there has been a downward trend in the number of small fires (less than 5 hectares in area), and that larger fires (over 5 hectares) have tended to account for a larger share of the total.

Fires affect both forested and non-forested areas in Greece. Data in Figure 4 show that in most years forested areas dominate the burned area, but in some years non-forested land is a major part of the total (e.g. 2005, 2006). In the severe fire season of 2007, for example, over 29,000 hectares of non-forested land were burned (13% of the total area affected). Although data are not yet available for the 2018 season, the deadly Mati fire probably affected an area of less than 5,000 hectares. But the area involved was a mixture of highly combustible woodland (primarily pines) and buildings (many involving wooden construction) so the damage and loss of life from the fire were considerable.

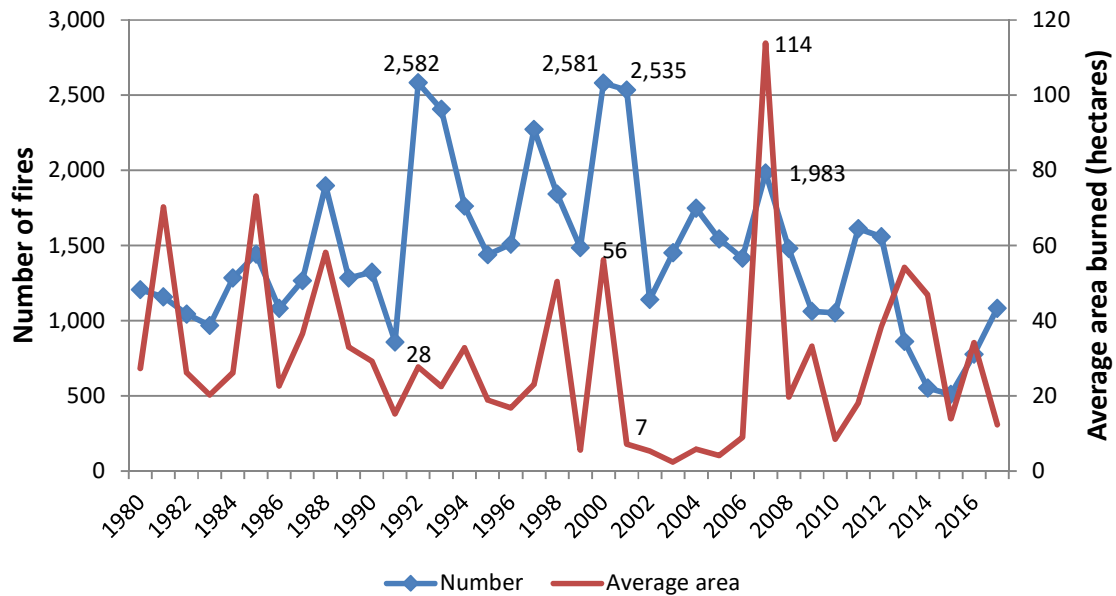
² The majority of the data used in this paper is supplied to the European Forest Fire Information System (EFFIS) by the government of Greece. Changes in the responsibility for fighting fires in 1998 that reduced the role of the Forest Service also resulted in changes in the collection of data on fires. Questions have been raised about the accuracy and completeness of Greek data since 1998 and its comparability to earlier years (GFMC, 2019).

Figure 1. Top ten European countries by area burned by wildfires and percentage of total land area burned, averages 2001-2017



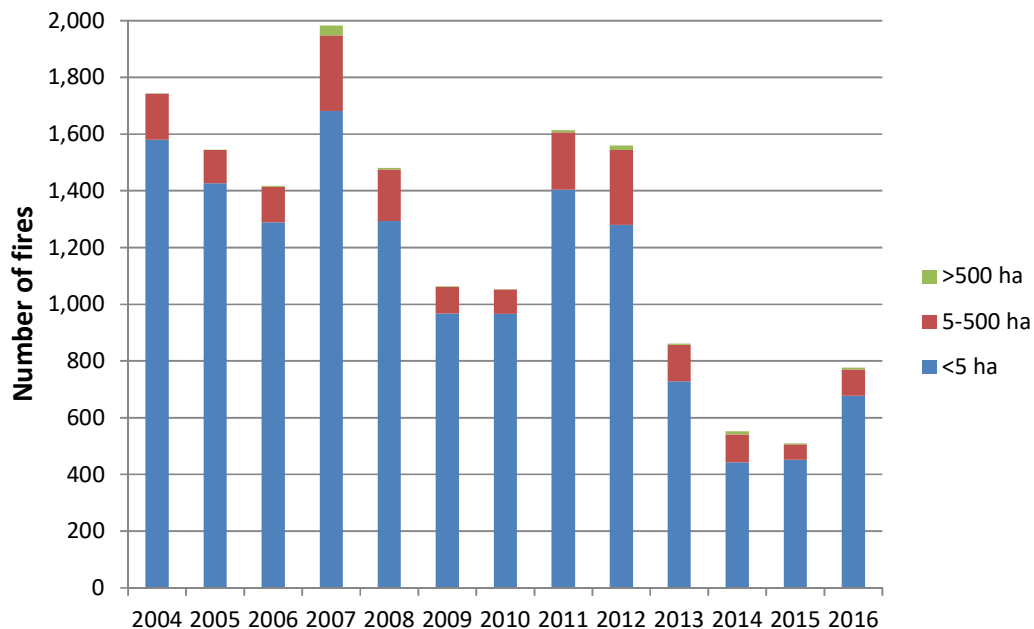
Source: European Union, Global Wildfire Information System.
http://gwis.jrc.ec.europa.eu/static/gwis_stats/. Accessed October 13, 2018.
 Country size for CY from <https://en.wikipedia.org/wiki/Cyprus>

Figure 2. Greece: number of wildfires and average area burned, 1980-2017



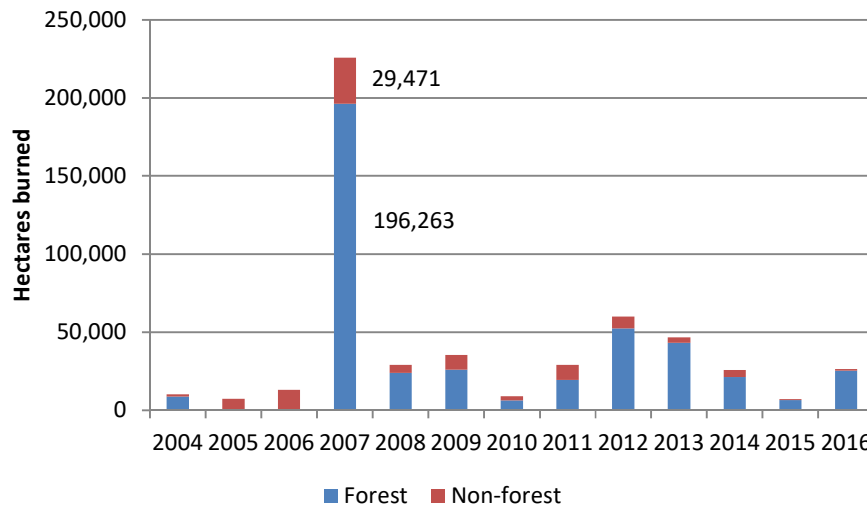
Source: Data for 1980 to 2016 downloaded October 13, 2018 from European Forest Fire Information System (EFFIS) <http://effis.jrc.ec.europa.eu/>. 2017 from EFFIS annual report on forest fires in Europe, the Middle East and North Africa published in 2018.

Figure 3. Greece: number of fires by burned area, 2004-2016



Source: Compiled from annual reports of the European Forest Fire Information System.

Figure 4. Greece: fires by forest and non-forest area burned, 2004-2016



Source: Compiled from annual reports of the European Forest Fire Information System.

3. Land Use and Wildfire Risk in Greece

The amount of woodland in Greece varies significantly with topography and climate. The FAO (2010) estimates that in 2010 there were roughly 3.9 million hectares of forest in Greece and 2.6 million hectares of other wooded land.³ Collectively these accounted for just over 50% of the total land area of the country (excluding the area occupied by inland water bodies). Recent estimates of the amount of wooded land by type of ownership are not available, but the FAO estimated that in 1992 roughly 77% of forested land and 87% of other woodland was in public ownership, i.e. owned by the State, administrative units of the public administration or institutions or corporations owned by the public administration.⁴ In terms of the forested area, the FAO estimates that 96% was naturally regenerated with the balance composed of planted forest (composed of trees established through planting and/or deliberate seeding). The FAO also estimates that roughly two thirds of the wood harvested in Greece is used for fuel. Unlike some other Mediterranean countries, Greece does not have large plantations for industrial forestry (e.g. eucalyptus plantations in Portugal used to produce pulp for papermaking). In some areas in Greece resin collectors play a role in the maintenance of pine stands (Zagas et al. 2001). Fir and pine trees are common in the alpine part of Greece in the north of the country and at high altitudes in other areas, e.g. the Peloponnese. At lower altitudes, poplars, plane trees, oaks and cypress are common. Pines are commonly found in many parts of the urban-rural interface (e.g. in the coastal areas affected by the 2018 fires in Attica). Pines are inexpensive to plant and maintain, grow rapidly and are resistant to high temperatures and drought. Unfortunately, they are also highly flammable.

³ Forested land refers to parcels spanning more than 0.5 hectares with trees higher than 5 metres and canopy cover of more than 10%. Other wooded land covers parcels of more than 0.5 hectares with cover of 5-10% by trees able to reach 5 metres or with a mixture of shrubs, bushes and trees in excess of 10% of the area. Both categories exclude land that is predominantly under agricultural or urban uses.

⁴ Greece is in the process of conducting a cadastral survey to codify land ownership. The planned completion date for the land registry is 2022, but this may be delayed due to ongoing legal challenges to ownership claims. The lack of clear title for land can complicate the management of fire risk, as discussed below.

Fire is a natural part of the ecology of the Mediterranean area. The hot, dry summers make much of the region fire prone, and lightning strikes are a natural source of ignition. Many plants are fire-loving (pyrophytes) that are adapted to fires or depend on them for reproduction. Fire also places a role in removing dead or dying vegetation, controlling underbrush, and recycling nutrients. The amount of time that it takes for a burned area to recover varies with climate and the severity of burning. Recovery is more rapid from surface fires that scorch but do not destroy trees. It takes longer with crown fires that destroy individual trees and even longer still for canopy fires that destroy the forest canopy as an entity.⁵ On average, the sustainable recovery of a burned area in Greece takes between 15 and 20 years. If fire reoccurs before regeneration is complete, even fire-adapted species may fail to recover and the forested area can become degraded.

While natural ignition plays a role in some fire events, the primary ignition sources are related to human activity. A recent study estimates that less than 5% on average of the burned area in Greece is due to lightning strikes and other natural causes (GFMC, 2019). Settlement per se can increase fire risk through the presence of vehicular traffic and overhead power lines that can create sparks, as well as accidental ignition due to outside cooking, campfires and the burning of garden and other waste. But in many cases ignition is purposeful. Farmers and pastoralists in the Mediterranean area have traditionally used fire to thin or clear vegetation. Although data on the causes of fires in Greece are limited, many of the relatively small fires (less than 5 hectares in terms of burned area) shown in Figure 3 are likely associated with the burning of undergrowth to generate grazing for goats and sheep. When such burning is controlled, e.g. used in the wetter periods to limit its potential spread, this can actually help to reduce the risk of much larger fires fed by the accumulation of excessive amounts of potentially combustible vegetative material. Rural depopulation and the abandonment of land previously used in agriculture has contributed to increasing fire risk by reducing the management of land in settled areas, particularly with the migration of many Greeks from rural to urban areas (particularly Athens) since the 1970s. In the Peloponnese, for example, depopulated villages that used to be surrounded by plots of land used for crops or livestock are now surrounded by scrubland that is more susceptible to increased fire risk and fire intensity.

Although uncontrolled burning can result from controlled burning if it is ill-managed or weather conditions are unfavourable, it can also be the result of fires set intentionally for more sinister purposes. As in some other Mediterranean countries (e.g. Italy), fires have been used in Greece to destroy forest and woodland in order to facilitate illegal building and the expansion of settlements or the creation of pasture for livestock. Houses or hotels are built, without permits on plots of public land that have been cleared through burning. This is particularly prevalent in areas with significant tourist activity. In November 2018, for example, 22 fires were reported simultaneously on the Ionian island of Zakynthos. Many of the fires that destroyed around 1,000 hectares of forest and brushland were in the northern part of the island where there is currently a lot of land speculation and the development of hotels for tourists (Ekathimerini, 2018). While arson is undoubtedly a factor in some of the fires that result in the loss of life and property, government officials tend automatically to attribute the cause to arson,

⁵ The wildfire that caused the fatalities in Mati in 2018 was classified as a crown fire. While stands of Aleppo pines surrounding houses were totally burned, groves of olive trees were practically untouched (see Lekkas et al., 2018). This provides a clear example of how vegetative management discussed later in this paper could reduce fire risk.

although this is often shown ex post not to be the case. The deadly fire in Mati in 2018 was most probably caused by the negligence of a homeowner in burning garden waste. Sparking from damaged power lines has also been suspected as a cause of other fires in Attica. Unlike some Mediterranean countries (e.g. Italy) very little forensic analysis of the causes of individual fires is conducted in Greece, with the exception of those that result in significant loss of life. For example, a recent study undertaken after the Mati fire (GFMC, 2019) reports that wildfires started by unknown causes account for roughly 60% of the area burned each year. Other Mediterranean countries use forensic analysis of the causes of wildfires to inform fire prevention efforts, but such efforts are extremely limited in Greece.

4. Reducing the Risk of Property Damage and the Loss of Life

Large and intense wildfires have many negative consequences. These include emissions of greenhouse gases (carbon dioxide, carbon monoxide, ozone, nitrous oxide and methane), the destruction of valuable nature areas and reduction of biodiversity, and negative implications for human health from smoke and particulates in addition to direct loss of life. Large fires can generate significant property losses and reductions in economic activity. While the risk of such damaging wildfires cannot be eliminated, it would seem to be important to reduce the risks of damage and loss in cost-effective ways. Viewed from the perspective of the overall economic costs of fires, reducing the probability of destructive fires in settled areas and in adjacent woodland areas would seem to be particularly important.

In the short-term, several measures relating to the control of vegetation could be used to reduce the risk of damaging fires at the urban-rural fringe. These are as follows:

1. Professional management of controlled burning. As noted above, controlled burning can help to reduce the risk of large fires, but if it is not managed professionally it can also increase that risk. The burning of vegetative matter by private individuals is (effective 2019) prohibited in Greece. Mechanical means (e.g. shredding) must be used in future to thin scrub and woodland, and without burning or composting this can serve to increase fire risk by preserving combustible material in situ. Given the history of arson, the prohibition of burning is understandable. However, prohibition is too severe. Regulated burning on private land (through the use of permits) performed professionally or under fire service supervision could help to reduce the risk of large and uncontrollable fires in the vicinity of settlements. Controlled burning on public land could also be used by firefighters to limit the potential for future fires and their spread (backburning to eliminate combustible material in the path of advancing fires). For settlements located in hilly and mountainous areas gaining access to scrub and woodland for mechanical thinning equipment can be difficult, if not impossible. In such cases, the choice is between the sustained accumulation of combustible material or its management using controlled burning. Regulations could be used to strengthen scrub and woodland management for areas in close proximity to settlements, particularly where these areas involve highly flammable vegetation (see point 3 below).
2. Use of fire breaks. Fire breaks to limit the spread of fires are rarely used in Greece. Areas under some powerlines, particularly major ones, are cleared of vegetation, particularly trees, but this is often not the case for smaller transmission lines. Minor lines are often closer to the ground than major lines and are often carried on wooden

poles, rather than steel posts, so that they pose a greater risk of damage and sparking. In addition, the maintenance of cleared areas under powerlines can be sporadic. The management of transmission lines during period of fire emergencies, i.e. cutting off the power to selected lines to reduce the risk of sparking has been used in California, but this can pose problems for the maintenance of essential services, such as water supplies and medical facilities. Features, such as roads, that could serve as fire breaks are often compromised by planting trees along road margins or failure to clear roadside vegetation. For example, after improvements were made to some roads in Attica in preparation for the summer Olympic games in 2004 pine trees were planted alongside the roads for scenic effect, thereby reducing their effectiveness as barriers to the spread of fires (Lekkas et al., 2018).

3. Selective replacement of vegetative cover. As noted earlier, conifers such as various species of pines, are commonly found in Greece. In Mati, houses were interspersed with pine trees many of which had been preserved or were self-propagated. Pines are attractive for the year-round shade they can provide and for their aesthetic qualities. They are inexpensive to establish and do not require irrigation, unlike some broadleaved plantings in an urban setting. Unfortunately, pines are highly flammable. While it would be impractical (and undesirable, for reasons other than the reduction of fire risk) to eliminate plantings of conifers in Greece, steps could be taken to remove pines within or close to settlements where their presence is identified as posing a high risk of spreading fire. Regulations could be used to achieve this aim as well as the provision of incentives to replace existing trees with less flammable alternatives. An independent committee appointed by the Government to review the lessons from the 2018 wildfires has proposed amending legislation to permit intervention in the management of natural vegetation on private property in the wildland-urban interface areas (GFMC, 2019). However, the lack of a complete land registry in Greece that codifies private ownership rights to land is currently an impediment to the use of such legislation.

While the measures identified above could help to reduce the risk of the loss of property and life from wildfires at the urban-rural interface, the management of settlement activity per se could also play a major role. As noted earlier, unregulated construction is a major problem in Greece. Steps have been taken from time to time to strengthen the monitoring of land use (for example, by using satellite imagery) and to give public authorities the power to regulate construction and illegal development of land in forested or wooded areas. But these powers are often not enforced. Demolishing illegally constructed buildings is not without political costs and public administrations have often take the approach of applying fines to generate government revenue and then providing post-construction legality (retroactive permits) for illegal construction. It is estimated that an average of 31,000 illegal houses and apartments were constructed in Greece annually (25% of the total) between 1991 and 2001. Many of these were in Attica (not far from Athens) and along the coastline (Lalenis, n.d.). Many of the buildings destroyed or damaged in the Mati fire were constructed without building permits and were not fire resistant. As noted earlier, Greece does not yet have a complete land registry. This complicates the identification of land ownership and increases the possibility of arson to effect surreptitious changes in land use in forested areas.

In addition to fire risk, illegal construction has been identified as contributing to flooding in urban areas, for example, floods that killed 20 people on the outskirts of Athens in 2017 (Smith, 2017). Illegal construction in Mati, resulted in many narrow and dead-end streets that made evacuation impossible for many of the victims of the 2018 fire. In addition, buildings that were not fire resistant (e.g. with wooden construction) were disproportionately affected (Lekkas et al., 2018). As in California, fire-resistant construction combined with management of surrounding vegetation can play a major role in reducing the risk of property loss and loss of life. There have been repeated calls to strengthen the enforcement of building regulations in Greece. Some changes have been made in legislation and there have been legal rulings that would prevent the “regularization” of illegal buildings, but little effective action has been taken. The independent committee established to evaluate how to address fire risk following the fires in 2018 recommended strengthening the enforcement of building codes (GFMC, 2019) But as one analyst observes: “political initiatives up to now have been dealing with this phenomenon by having as the main goal, the maximization of economic and political profit, contrary to the wellbeing of citizens, the protection of the urban and rural environment, and sustainability in general” (Lalenis, p. 11).

5. Challenges in Fire Suppression

The Hellenic Fire Service (HFS) currently has the primary responsibility for fighting wildfires in Greece, although other bodies, such as the military, also provide assistance for some large fires (e.g. in 2007 and 2018). In 2016, there were roughly 14,000 personnel in the HFS, of which roughly 9,000 were permanent employees; the rest were employed seasonally or on short-term contracts. An additional 1,750 volunteers assisted with firefighting activities. The Service has roughly 1,800 firefighting vehicles. Aerial means are an important part of fire suppression. In 2016, Greece had 40 fixed wing aircraft and 8 helicopters for firefighting, but only 29 of the aircraft were operational at any given time. An additional 10 helicopters were leased for firefighting activities.

As has been the case with most public services in Greece, the economic recession that resulted from the global financial crisis in 2007/08 has had a major impact on the capability of the country to fight wildfires. The fire service budget has been cut by over 20% since 2009. As a result, the number of firefighters has declined by roughly 10%. Many of the fire trucks are over 15 years old and up to 25% are immobilized at any given time due to mechanical problems or lack of tyres (Koukakis, 2018). The out-of-service rate for many of the aircraft reflects their age – most date back the 1970s – and the challenge of maintaining their airworthiness.

Although aging equipment presents a challenge for the suppression of wildfires, institutional issues appear to pose even greater challenges. The recent committee report (GFMC, 2019) identifies a number of systemic institutional failures that contribute to the risk of the loss of life. The most important of these are:

1. A lack of planning at the national and local levels with the absence of reliable indicators of fire risk and early warning systems. There are no evacuation plans, no designated escape routes, no shelters or first aid stations, and no plans for managing humanitarian needs in the aftermath of fire. The current system involves a proliferation of bodies and agencies involved in different aspects of fire prevention and suppression without rules for collective operation and coordination.

2. The lack of a clear chain of command for fire protection. The report identifies 45 agencies involved in fire protection, and 17 agencies spread among six government ministries involved in fire-fighting. Previous efforts to provide an early warning system to the public for fires have been ineffective.
3. Political intervention in appointing the leadership of the various bodies and assigning responsibilities. The 1998 decision to transfer the responsibility for fighting wildfires from the Forestry Service to HFS is singled out in this respect, as fire-fighters trained to fight fires in urban areas lack the training and know-how for combating fires in forested areas.

Of major significance, the report is critical of the current allocation of resources primarily for fire prevention rather than fire suppression. Fire prevention activities are a major part of efforts to reduce the risk of wildfires in many Mediterranean countries, but this is not the case in Greece. The HFS is not equipped to conduct educational campaigns, for example, targeting residents in the rural-urban interface on how to avoid the risk of fires, but behavioural change would be part of reducing such risk in these areas.

6. Conclusions

Due to climatic and other factors, the countries of the Mediterranean basin have traditionally been susceptible to wildfires. Recent analysis by the EU's Joint Research Centre suggests that climate change will lead to a major increase in the risk of wildfires in many European countries, including Greece. Data available through the European Forest Fire Information System (EFFIS) suggests that while the annual number of wildfires has tended to decline in Greece in recent years, the average area burned with each fire has tended to increase. Greece, like many other countries in the Mediterranean basin, seems destined to face increasing challenges in managing wildfire risk. Wildfires not only pose a threat to private property, public infrastructure, and human and animal life, they can also pose a threat to the conservation of areas of high environmental value and contribute to climate change through the release of greenhouse gas emissions.

If Greece is to address the challenges posed by the increased risk of damage and loss of life from wildfires, in addition to improvements in the coordination and management of firefighting activity, issues relating to land management will need to be addressed. Many of these are associated with the development of human settlements and associated changes in land use that increase wildfire risk. Institutional constraints relating to property rights and to fire risk reduction measures (e.g. limitations on controlled burning, construction of fire breaks in vulnerable areas, management of vegetative types that increase fire risk) are important. Consequently, improved land management in areas subject to high risk of property damage and to potential loss of life from wildfires needs to be accorded high priority.

Given the likelihood of continued severe financial constraints, due to the large national debt and weakness of the Greek economy and the limitations that these impose on public expenditure and the provision of public services, it is particularly important that cost-effective measures, such as effective fire prevention activities, be used to reduce wildfire risk. The need for institutional change in Greece to address wildfire risk has been highlighted by the disastrous Mati fire in 2018. But calls for change have been made before (e.g. following the major fires

in 2007) with little effect. Consequently, whether necessary changes will be actually be implemented is an open question.

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