Role of Ornamental Vegetation in the Propagation of the Rognac Fire, 2016

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Abstract—In August 2016, a fire caused by negligence during leisure activities started in the wildland-urban interface (WUI) of Rognac (NE of Marseille, southeast France). The fire was driven by a strong wind and exceptionally dry and warm climatic conditions, burning almost 3,000 ha, mostly in an urbanized area, in a few hours. These severe meteorological conditions led to difficult firefighting operations, already hampered by a lack of resources due to several aircraft being grounded for maintenance and by six other fires burning at the same time in the area. The fire impacted seven communities, ending up in the outskirt of Marseilles, some 15 km away from its ignition point. The Rognac Fire mostly spread in WUI burning primarily ornamental vegetation such as hedges located along the roads that led to buildings. Homes were damaged or destroyed often because of the poor positioning of ornamental vegetation, sometimes combined with a lack of clear-cutting (however mandatory in WUI). This exceptional fire event underlines the need to better understand fire propagation through WUI vegetation. In order to improve fire prevention in WUI under climatic conditions more and more conducive to fire, it is thus necessary to adapt the fire behavior modelling to ornamental vegetation.

Keywords: large fire; fire propagation, ornamental vegetation, wildland-urban interface, fire damage

INTRODUCTION

Around the world, and especially in the Mediterranean region, concerns about the impact of wildland fires are increasingly focusing on the wildland-urban interface (WUI) (Cohen 2000; Lampin-Maillet 2009). Because this region's climate conditions (dry and warm summers, often with strong winds) favor fire ignition and propagation, plants were selected by the influence of fire for thousands of years (Keeley 2012) and thus, today, the resulting fire-prone ecosystem is characterized by fire-prone species (pyrophytic species). Furthermore, in this high fire risk area, human population has considerably increased wildfire frequency (Syphard et al. 2007), especially in the WUI. These areas are constantly increasing in several parts of the world with growing urbanization (Keeley et al. 1999; Lampin-Maillet 2009) and where the risks to human lives and property, and thus the assets to defend, are greatest (Bar Massada et al. 2009). Southeastern France is one of these regions and is also the area most affected by wildfires compared to the rest of the country (Ganteaume and Guerra 2018); most fires here are human-caused (Ganteaume and Jappiot 2013) and occur in the WUI (Ganteaume and Long-Fournel 2015). WUI vegetation differs from that of typical wildland, especially by its structure, which is heterogeneous, composed of isolated plants and of groups of plants, sometimes lining up thereby providing horizontal fuel continuity. This WUI vegetation is also called ornamental vegetation as it is located around housing. It is composed of both native and strictly ornamental species and can act as a vector for fire propagation from the wildland to housing in WUI, and then from house to house, possibly entailing

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significant damage to structures. Furthermore, the ongoing higher incidence of extreme climate events (e.g. high summer temperatures, strong winds, and drought) is expected to worsen under climate change and will increase the fire risk, with more catastrophic fires such as those that happened in Portugal in 2017.

This work describes one of these severe fires that has occurred in the WUI in southeast France and highlights the major role of the ornamental vegetation in fire propagation, as well as the damage to structures. Some insights are also provided, attempting to explain the scale reached by this fire.

THE FIRE DETAILS

The Rognac Fire ignited in the afternoon on August 10, 2016 and spread mostly in the wildland-urban interface (2,200 ha burned in WUI and urban area) and was caused by sparks emitted by an electric saw used by a resident working outdoors (i.e., negligence during private works). The fire burned almost 3,000 ha, threatening more than 2,000 buildings located at less than 50m from the flame front.

The largest fire size obtained every year in southeast France shows a decreasing trend since 1973, especially since the 1990s. The Rognac Fire is actually the largest fire that occurred in 2016. Its size is in the same range as that of the fires in 2009 and 2010 but its impact on structures was much higher, and more or less similar to that of the fires in 2003.

Study Area

The fire area is located in the Département Bouches du Rhône which is one of the 15 administrative districts composing southeast France (fig. 1a). This département is one of the most affected by wildfires and the fire area has already been impacted by six large fires (≥ 300 ha) since 1967, most of them occurring in the Arbois forested massif located east of the fire area. The 2004 fire perimeter overlapped the North of the Rognac Fire perimeter.

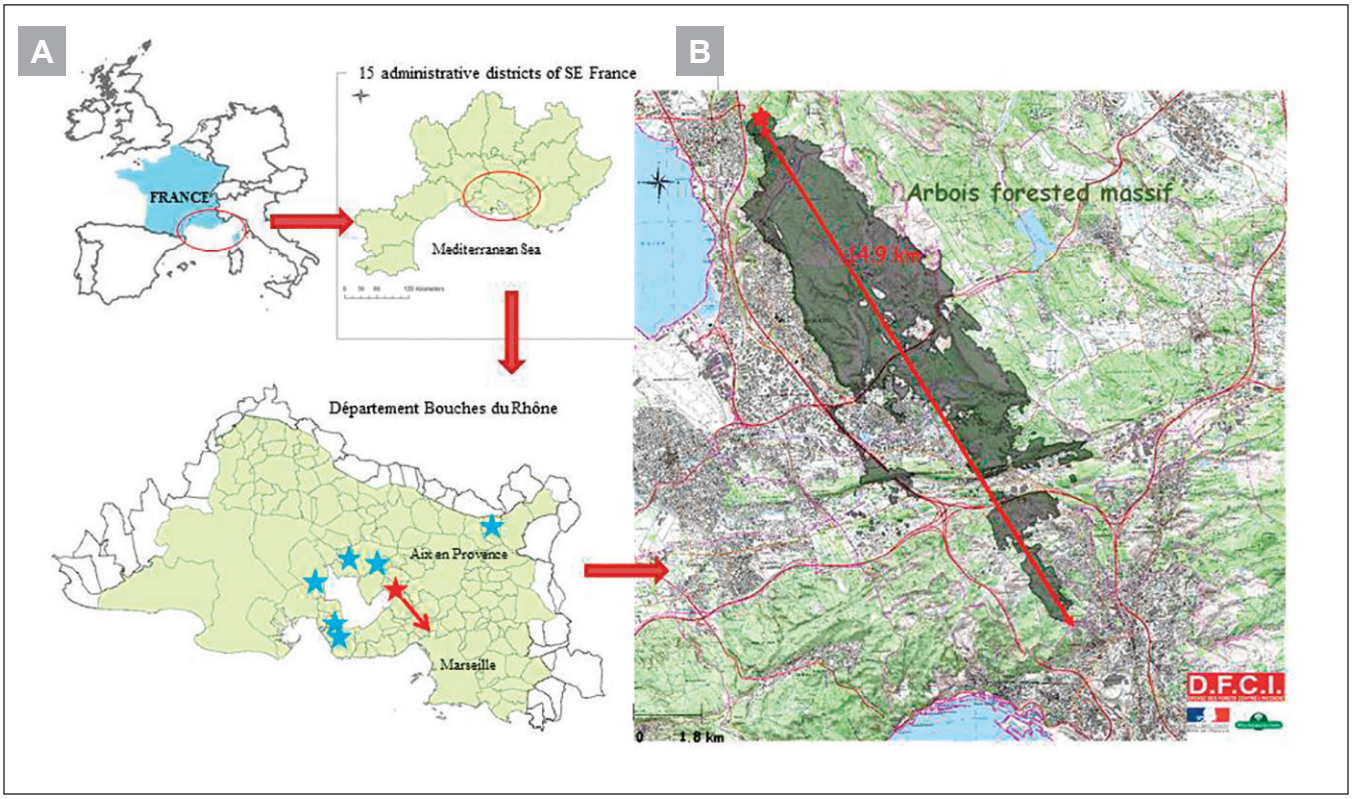

Figure 1—(A) Location of the Rognac Fire (red star and arrow showing the fire spread) and of the other concomitant ignitions that occurred nearby the same day (blue stars), and (B) fire perimeter (dark gray) highlighting that most of the fire propagation occurred in WUI and in urban areas.

The fire spread in the wind direction with a maximum rate of spread of 5.3 kmh^{-1} and ended up 15 km from its initial ignition zone, affecting seven communities, especially Vitrolles (1648 ha) and Les Pennes-Mirabeau (676 ha).

The Context

Different reasons can explain the extent of the fire size and of the subsequent damage: (1) a limited suppression force, (2) extreme weather conditions and (3) high proportion of WUI.

When the fire ignited, the firefighting force available was limited due to unexpected firefighting aircraft maintenance that grounded most aircraft, but also because of several other fires that burned the same day in nearby locations (fig. 1a), including the critical fire in Fos/Mer (more than 1,000 ha burned) that threatened the oil terminals (one of the main assets of the area). These concomitant fire outbreaks caused the splitting of the firefighting force to different locations. Because of this cascade of events, the fire was not contained soon enough as the early and full attack on the fire could not be achieved (usually the firefighting tactic consists of attacking the fire within the first 10 minutes after ignition with full force).

With the attack delayed, the fire grew rapidly due to the extreme weather conditions occurring that day. At the time of the ignition, temperature was at the highest (around 26 °C) and the relative humidity at the lowest (25%) generating a high fire weather index. Moreover, a very strong Mistral wind, blowing from the northwest and gusting at 85 km/h, allowed the fire propagation to increase and the fire to spot in several locations. This high wind speed varied spatially in the fire area, mostly due to topography, making it even more difficult and dangerous for the firefighters.

HOW THE FIRE SPREAD AND IMPACTED THE WUI

History of the Fire

Besides the large size of the fire, what mostly characterized the Rognac Fire was its propagation through WUI to the core of an urban area, becoming sometimes more an "urban fire" than a "WUI fire." The fire ignited at 3:09 pm and spread quickly in the direction of the wind, then to the flanks, reaching the highway to the west of the fire area, and spotting several times. About 4 hours and 50 minutes after ignition, the fire had already burned 2,000 ha. One hour later, the fire spotted over the highway located South of Les Pennes-Mirabeau and spread towards Marseille where it was extinguished, almost 10 hours after ignition, having burned 2,669 ha and impacted more or less severely seven communities (fig. 1b).

Fire Severity and Damage

The fire severity varied spatially within the fire perimeter; the area showing higher severity mostly corresponded to pine forest, but in some areas it was due to damage to structures in WUI.

In total, 181 structures were impacted by the fire (fig. 2), mostly in the two communities of Vitrolles and Les Pennes-Mirabeau. The damage varied in severity from outside damage, which was the most frequent and consisted of burned vegetation around houses or burned vehicles located close to housing, to houses impacted without being destroyed (burned wooden decks or sheds, window glass broken, PVC gutters and shutters melted, for instance). The fire completely destroyed 26 structures, mostly in Les Pennes-Mirabeau. These structures belonged mostly to residents living in the WUI area, but schools and a car dealership were also destroyed.

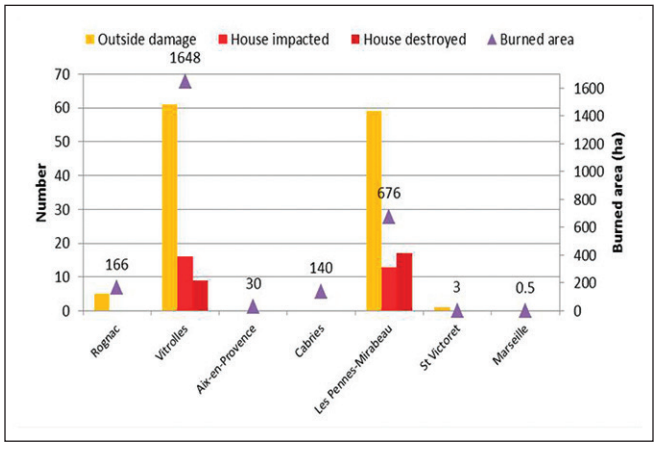

Figure 2—Number of buildings damaged by the fire according to the type of damage and total burned area in each community affected by the Rognac Fire.

Role of Ornamental Vegetation in Fire Propagation and Damage to Structures

The role of the ornamental vegetation in fire propagation was clear as the fire spread using the horizontal fuel continuity provided by the ornamental hedges around residents' properties and along the roads, damaging and even destroying buildings when they were located to close to this vegetation. The role of the ornamental vegetation was sometimes combined with a lack of clearing vegetation around housing, which is mandatory for the buildings located less than 200 m from forest/shrubland areas. The Rognac Fire was characterized by its propagation mostly throughout WUI, even reaching the urban area using this network of vegetation (76% of the burned area was located outside the wildland areas).

The role of this vegetation in the damage to structures was also very clear and often highlighted that the vegetation was too close to the houses. One of the most significant examples was the Chateau des Barnouins, which was completely destroyed because of large trees overhanging the roof in several places and two huge cypress hedges located on each side of the house. The damage resulted from strong radiant heat emitted by the burning vegetation surrounding the buildings as well as to the massive shower of firebrands generated by this vegetation, eventually provoking the collapse of the roof and the burning of the mansion. To worsen the situation, the vegetation was poorly maintained around the property. In several other cases, the destruction of buildings was also due to large trees (usually pines) overhanging the roof or being located very close to the house (usually Italian cypress). In one case, the house was destroyed because of a window left open, this allowed the firebrand shower to reach the inside of the building and set it on fire.

Why Did This Happen?

This fire provoked such an extent of damage because most of the people living in the WUI lacked awareness of the fire risk. Residents, but also land planners, need to be more educated about the fire risk as very often they simply do not understand the role of the mandatory brush-clearing (in force in WUI areas of southeast France) on fire mitigation. Consequently, this regulation is often not well implemented, resulting at times in catastrophic consequences during a fire.

Besides this lack of awareness, people need a better knowledge of the ornamental vegetation they can use and how to use it around their home. They need to know how it burns in order to be able to choose the less flammable species for "firewise" landscaping and to avoid planting species that present a large amount of dead fuel, such as Italian cypress. Because of this dead fuel, this plant results in a high intensity fire when burning, which thus damages or destroys the structures if they were too close, as often has been witnessed by the firefighters.

CONCLUSIONS

The Rognac Fire was one of the most destructive since the fires of 2003, spreading through ornamental vegetation and damaging or destroying structures from the WUI to the city center. This exceptional fire event, both in terms of burned area and damage to structures, underlines the need to better understand fire propagation through WUI vegetation. This propagation differs from that in wildland vegetation especially because of its strong heterogeneous structure and of the presence of exotic species whose fire behavior, for the most part, is unknown. In order to improve fire prevention in WUI areas under climatic conditions more and more conducive to fires because of ongoing global change, it is necessary to adapt fire behavior modelling for this type of vegetation.

During this fire, the limited suppression force hampered firefighting, but the extreme fire spread was mainly the result of extreme weather conditions. Even with a full firefighting force, this large fire would have been very difficult to contain, as sadly happened in Portugal with the extreme fires that occurred in 2017.

REFERENCES

Bar Massada, A.; Radeloff, V.C.; Stewart, S.I.; Hawbaker, T.J. 2009. Wildfire risk in the wildland-urban interface: a simulation study in northwestern Wisconsin. Forest Ecology and Management. 258: 1990–1999. doi:10.1016/J.FORECO.2009.07.051.

Cohen, J.D. 2000. Preventing disaster: home ignitability in the wildland-urban interface. Journal of Forestry. 98: 15–21.

Ganteaume, A.; Guerra, F. 2018. Explaining the spatio-seasonal variation of fires by their causes: The case of southeastern France. Applied Geography. 90: 69–81.

Ganteaume, A.; Long-Fournel, M. 2015. Driving factors of fire density can spatially vary at the local scale in south-eastern France. International Journal of Wildland Fire. 24: 650–664. doi.org/10.1071/WF13209.

Keeley, J.E. 2012. Ecology and evolution of pine life histories. Annals of Forest Science. 69: 445–453.

Keeley, J.E.; Fotheringham, C.; Morais, M. 1999. Reexamining fire suppression impacts on brushland fire regimes. Science. 284: 1829–1832.

Lampin-Maillet, C. 2009. Caractérisation de la relation entre organisation spatiale d'un territoire et risque d'incendie: le cas des interfaces habitat-forêt du sud de la France. PhD thesis, Université de Provence, Marseille.

Syphard, A.D.; Radeloff, V.C.; Keeley, J.E.; Hawbaker, T.J.; Clayton, M.K.; Stewart, S.I.; Hammer, R.B. 2007. Human influence on California fire regimes. Ecological applications. 17: 1388–1402.