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Ornamental vegetation

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Synonyms

Landscape plants, residential fuel

Definition

Any vegetation, native of the area, exotic or bred only for horticulture purposes, as well as dead fuel material and organic mulches used for landscaping near structures.

Introduction

The wildland-urban interface (WUI) is a complex fuel environment, consisting of an intermix of both vegetation and housing. The WUI vegetation is a very heterogeneous fuel compared to that of wildland, composed of individuals and clusters of plants spread around housing or of hedges often used to delimit the property.

In WUIs, the fire risk is high and, regularly, numerous wildland fires threaten local communities and their assets. Fire propagation in these areas is a big concern in many countries, e.g. in the USA and Canada (Cohen 2000 ; Syphard et al. 2012, 2013; Johnston & Flannigan 2018) as well as in Europe and Australia (Bradstock & Gill 2001 ; Bianchi et al. 2006 ; Lampin-Maillet et al. 2010). These WUI fires can have devastating effects on human

life and local economy because of the significant damage and loss of lives that had already occurred during such events (Blanchi et al. 2010; Cohen 2000; Maranghides & Mell 2011). Numerous studies underline the key role of the ornamental vegetation (and of other fuel elements such as wood pile, wood fences, sheds, etc.) in the fire behavior in WUI (Ramsay et al. 1987; Monroe et al. 2003; Etlinger and Beall 2004; Leonard & Blanchi 2005). Indeed, this vegetation is the main fuel source located between wildland vegetation and housing and, once structures and ornamental vegetation are burning, they have the potential to contribute significantly to continued fire spread through the WUI community.

As there are no ‘fireproof’ plants, they will burn when exposed to the extreme conditions generated by a wildland fire (Behm et al., 2004). However, it was demonstrated that individual homeowners can reduce the vulnerability of their houses to wildland fire, this include the creation of a defensible space (Bell et al. 2007) and the choice of less flammable species for landscaping. Species differ in their ability to ignite and combust (Randall & Duryea 2011; Ganteaume 2018) as well as to produce firebrands (Manzello et al. 2009) and, consequently, the role of the ornamental vegetation in fire propagation must be well understood for a better fire prevention in these areas.

The different types of ornamental vegetation

Native vs exotic live vegetation

Due to the nature of WUIs, native plant species naturally exist near urban development and around houses. In addition, native species are popular with residents wishing to promote local wildlife and natural surroundings (Behm et al. 2004). In the Mediterranean area, for instance, these species are adapted to drought, thus require less watering. However, exotic species are often favored, for various purposes that encompass esthetic, windbreak or screening purposes.

The structure of the ornamental vegetation around housing varies and can be composed of individual trees and shrubs, scattered clusters of plants, lines of plants forming hedges that can be located at various distances from housing, layers of vegetation such as lawn, etc. These two latter fuel structures create a horizontal fuel continuity that can become deleterious during a fire if they are located too close from housing, along with overhanging trees.

Landscaping mulches

The importance and role of landscaping mulches in wildland urban interface fires is well recognized as they are widely used adjacent to buildings. These mulches encompass shredded hardwood, different sizes of pieces (nuggets) of pine bark, pine straw, cocoa shell, shredded cypress wood, hay, etc. (Fig. 1). They represent a potential threat to the building as a layer of fuel that can propagate fire or ignite during a firebrand shower (Stewart et al. 2003; Manzello et al 2006a, 2006b, 2008, 2017; Quarles & Smith 2004; Rogstad et al. 2007; Long et al. 2006a; Zipperer et al. 2007; Beyler et al 2014, Suzuki et al 2015), as often happened during a WUI fire. Organic mulches being dead surface fuel, their moisture content depends directly on the local climatic conditions (relative humidity and temperature) and their ignition also depends on the number and the size of firebrands which can cause smoldering or flaming ignition.



Figure 1: Mulches used in residential landscapes

The role of the ornamental vegetation in fire propagation

Ornamental vegetation can ignite houses and other buildings during a wildland fire in different ways:

At short distance (Fig. 2): (i) through direct contact between flames and combustible wood decks or siding when plants are in contact with the building or growing very close to it, (ii) through radiant heat which is produced by the burning vegetation, even though the flames may not actually touch the structure. In both cases, the primary way to protect buildings is by a proper landscaping and plant selection, removing flammable vegetation and fuel continuity near the structure (maintaining spaces between plant crowns and between plant crowns and

buildings). Creating a defensible space surrounding a house allows an easy access for firefighting but also increases the level of self-protection if the firefighters cannot step in.

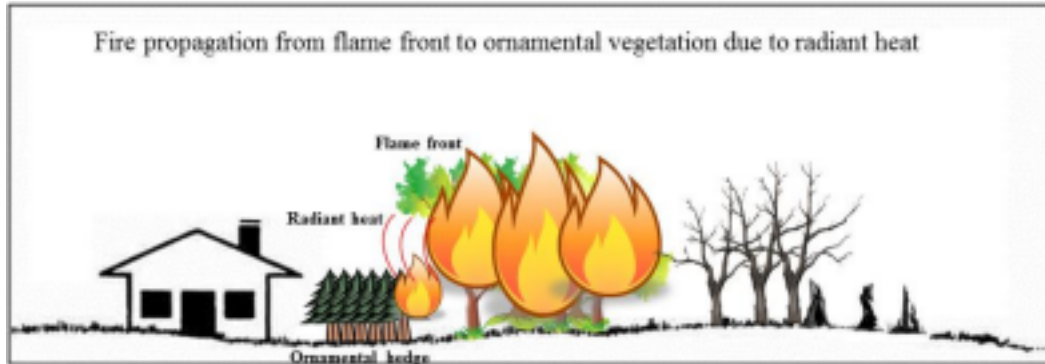


Figure 2: Fire propagation from flame front to ornamental vegetation due to radiant heat.

At long distance: showers of firebrands are produced by trees and buildings burning during WUI fires (Fig. 3). These firebrands are transported ahead the flame front by the winds. There, they can start secondary fires (e.g. "spot fires") when landing on or under decks, in eaves or gutters, on wood shingles or on other plants/mulches acting as receptor fuel (Manzello et al. 2006a, 2006b, 2007, 2017; Etlinger & Beall 2004; Barrow 1945; Wilson & Ferguson 1986; Abt et al. 1987; Maranghides & Mell 2009; Suzuki et al 2015). The frequency of ignition of houses and other buildings due to such spot fires seems to increase over time (Foote et al. 2011). Depending on their type and on wind speed, firebrands can be transported up to several kilometers ahead the flame front (Manzello et al. 2007; Ganteaume et al. 2011).

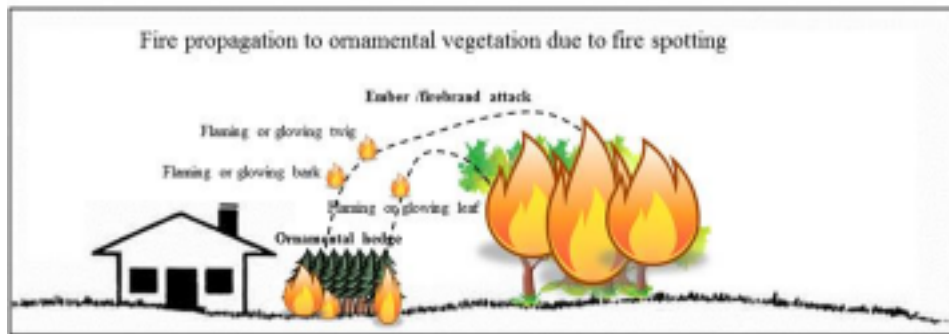


Figure 3: Fire propagation to ornamental vegetation due to fire spotting.

Conversely, before flaming, plants can act as a protective screen against radiant heat, also trapping firebrands in their canopy (Fig. 4). In that case, the barrier effect will depend on plant distribution patterns or on their capacity to resist fire (Leonard 2003; Ramsay & Rudolph 2003; Blanchi et al. 2006).

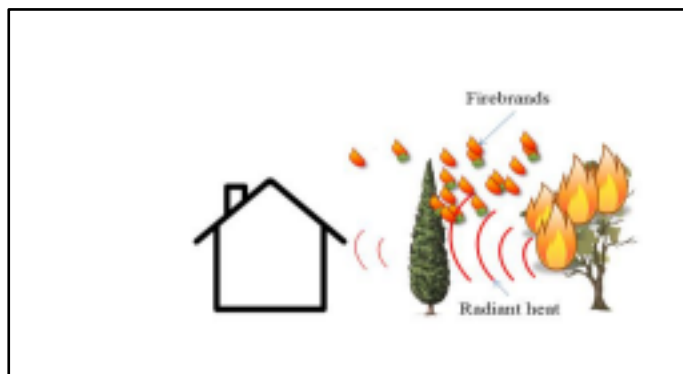


Figure 4: Role of protective screen against radiant heat and firebrand shower.

Selecting and locating the proper ornamental vegetation to mitigate fire propagation

Risk-reduction methods for ornamental fuels are analogous to risk reduction in wildland fuels in that both involve fuel treatments. In these fuels, the goal is to decrease the likelihood of housing ignition by acting on the structure of vegetation, for instance (Mell et al. 2010). Fuels

too close from buildings, especially when their maintenance is poor, facilitate the contact with flames and increase radiant heat that leads to higher housing vulnerability.

Although all plants burn, some species are less flammable than others. These less flammable plants must be favored in a landscaping adapted to fire-prone areas and their list available to homeowners. These lists are most helpful when they include local plants adapted to local climate and soils e.g. drought resistant species; however the characteristics of such species can often make them more flammable (mainly because of lower moisture content). Knowledge of how species differ in their flammability is thus needed to develop more reliable lists of plants recommended for landscaping in WUI of a given region. Moreover, people also need information on how to perform a proper maintenance (watering, pruning, thinning, cleaning dead fuel, etc.), especially when this vegetation presents multiple usages that can be conflicting. Indeed, ornamental vegetation planted to create privacy could increase the fire risk at the same time (presence of ladder fuel, fuels too close to buildings, etc.). However, these plant lists are often based on casual information rather than scientific data or may only consider a few characteristics for ignition-resistant plants (White & Zipperer 2010). Although it can be tested under controlled environment in a laboratory, plant flammability can vary during a fire, where the conditions are often unpredictable. Besides plant fuel moisture content (FMC), structural (e.g. leaf size, shape, thickness, etc.) and chemical (e.g. resins, waxes, oils) leaf characteristics can make plants more flammable than others, some being highly ignitable but burning slowly or the opposite. Likewise, dead surface fuel (e.g. litter) can propagate surface fire or act as receptor fuel for spot fires; the litter structure and composition also influences flammability, thus must be taken into account in the choice of species. Several works agreed, for instance, that the ornamental species *Pittosporum tobira* was among the less flammable species (Long et al. 2006b; Ganteaume et al. 2013a, 2013b; Ganteaume 2018). Furthermore, the plant structure (branching pattern, leaf density in the

canopy, capacity to retain dead fuel) contributes to the overall flammability. Indeed, some species present high amounts of dead fuel within their canopy (Ganteaume et al. 2013a), due to the shape of the tree (as for the pencil cypress: *Cupressus sempervirens* var. *pyramidalis*) or to frequent trimming of hedges that increases the amount of dead fuel and thus the fire risk. Choosing less flammable species also means selecting those burning with the lowest fire intensity (e.g. plants with the lowest biomass, especially for landscaping close to housing).

In contrast to wildland vegetation whose flammability has been extensively studied, a few scientific works investigated the flammability of ornamental vegetation, providing lists of desirable plants based on their fire related characteristics (Doran et al. 2004; Behm et al. 2004; Hansen et al. 2007; Hermansen-Báez 2011; Moritz & Svihra 1998) and ranking species according to their flammability (Frommer & Weise 1995; White et al. 1996; Irby et al. 2000; Beall 2001; White et al. 2002; Moritz 2003; Etlinger & Beall 2004; Behm et al. 2004; Weise et al. 2005; Long et al. 2006b, White & Zipperer 2010, Bartoli et al. 2011; Ganteaume 2018).

Besides taking the flammability of plant species used for landscaping into account, a landscaping taking into account plant flammability is important. Allowing wildland vegetation to grow too close to housing or placing flammable plants near a house or other structure increases the probability of building ignition. So, the plant location is just as important as the species itself. Spacing between trees and shrubs is important so that fire cannot jump from a plant to housing, nor from one plant to another and finally to housing. This spacing depends on the species selected and must anticipate the reduction of this distance as the plants grow larger. In general, breaking the fuel continuity (horizontal as well as vertical) is of the utmost importance in order to mitigate fire impacts on housing by decreasing fire propagation and fire intensity in the vicinity of buildings (Fig. 5).

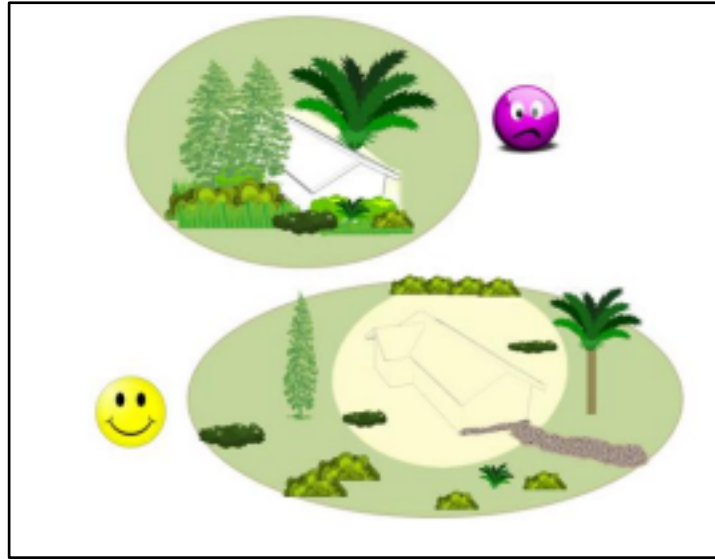


Figure 5: Bad vs good landscaping in WUI

Because of the flammability characteristics of the ornamental species and of the heterogeneous structure of this vegetation (differing from those of wildland vegetation), an adapted modelling of fire propagation in WUI is needed. This modelling would help to have a better understanding of the processes involved in the fire propagation in this complex fuel and their impact on housing vulnerability. The safest landscaping scenario (considering both species and spatial patterns) must be chosen to improve fire prevention in these areas.

Maintaining the ornamental vegetation

Even before homeowners consider the proper trees, shrubs and ground covers, other landscape issues should be considered. For example, a dry lawn can burn and carry a fire to housing. Lawns should be watered and dead lawn litter should be raked and either removed from the property or composted. A green lawn will not easily carry a fire and will typically serve as a protective barrier around the house, highlighting the role of watering, especially when the fire risk is high. Conversely, landscaping natural vegetation or a lawn that has become very dry allows a wildland fire to spread and make the house at risk.

In order to prevent the fire to reach the fire to the plant crown, trees have to be pruned and be cleared of their litter. For instance, conifers that have branches growing close to the ground can provide “ladder fuels” for a surface fire to climb into the canopy. Should this happen, the radiant heat given off could set a nearby house or other structure on fire.

Conclusion

The amount of fuel available for a fire and fuel distribution patterns increase burning risk of housing. It is thus important to understand how this ornamental vegetation influences fire behavior when planning a garden. Consequently, adapting fire behavior modelling to the heterogeneous structure of the ornamental vegetation is needed given the impact these fires have in WUI. Furthermore, this vegetation presents numerous exotic (or horticultural) species whose flammability is still unknown. Moreover in WUI fires, the scale at which they spread is smaller than for usual wildland fires. These species’ flammability should be taken into account, especially through its characteristics (leaves, branch, or litter), avoiding near housing species presenting, for instance, high amount of dead fuel within their canopy (such as cypress, palm tree, or Eucalypt with loose bark) that can release a high fire intensity when burning.

Cross-references

Spotting/spot fire, fire propagation, surface to crown transition, wildland-urban interface, residential fuel treatments

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