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NEWS

PROJECT

GUARDIAN - Green Urban Actions for Resilient fire Defence of the Interface Area

Riba-roja de Túria, Spain

TOPIC

Climate adaptation

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Innovative fuel management at GUARDIAN: the green firebreaks

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The main axis on which GUARDIAN's integrated fire management strategy pivots is the construction of green firebreaks, a fire management infrastructure designed to be implemented in certain sections of the perimeter of Riba -Roja de Túria and Paterna wildland-urban interface. This infrastructure is an innovative fire management practice in which fuel treatments are combined with artificial water inputs delivered through prescribed irrigation. In past articles we have been presenting the hydraulic component related to green firebreaks and we have done so by providing a great amount of details along the overall water line. It is now about time to talk about the fuel component and brief you on the background, the hypothesis and the current fuel treatments that are being implemented in order to have these green firebreaks in place! In this article we will firstly discuss on the main fire behaviour drivers coupled with how to manage fires according to those. To this end, classical fuel treatments will be reviewed together with the innovative GUARDIAN approach. Finally, details on fuel treatment works associated to green fire breaks will be reported so that you can have a good understanding about this nice piece of forestry engineering.

Fire behaviour and fuel management

A wildfire behaves according to the environment in which it is burning, with several factors being responsible altogether for its evolution and intensity. Parameters involved in wildfire behaviour can be categorized in three different groups: they can be related to fuels, to weather or to topography. Just like the fire triangle (see web article 2), we could picture the fire behaviour triangle with these three main categories in each side (figure 1). As you may imagine there are many variables under these three major fire environment components. Regarding **weather,** we could talk about the effect of wind pushing flames forward, the role of temperature and relative humidity on the state of the vegetation or about (the lack of) precipitation on soil and fuel moisture. Concerning **fuels,** we could also list a large number of parameters (load, arrangement and continuity, composition, bulk density, moisture, etc.) that play a key role on fire behaviour. Finally, regarding **topography**, we could mention aspect or slope as very important factors on fire propagation. We cannot discuss in here how all these parameters

interact and affect fire behaviour, but, for those interested on receiving a quick master class on that, do not hesitate to watch this great lesson from University of California experts!

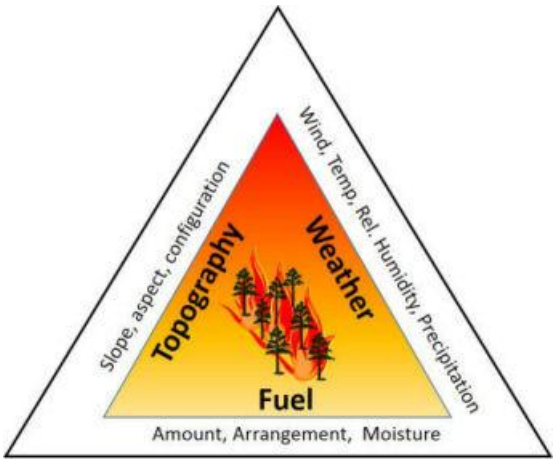

Figure 1. The fire behaviour triangle

A change in any of these environmental parameters will cause a change in the behaviour of the fire, and this change can be either to reduce wildfire spread and intensity or to dangerously increase it. It turns out that the only type of variables that can be managed so that to reduce fire hazard in a particular site before a fire event takes place are obviously those variables related to fuels, as climate and topography cannot be modified by any means! And this is what fuel management consists of: fuel management comprises the implementation of particular treatments to fuels in wildland areas so that to modify potential fire behaviour or fire effects with the final aim of reducing risks to human communities and improve ecosystems' health. As stated by fire management experts from Southern California, by **treating fuels in the present we have the opportunity to determine how the fire will behave in the future!**

> Fuel management is important simply because it gives us the opportunity to modify the pattern of future fire by modification of today's fuel

(Sue Husari, Thomas Nichols, Neil G. Sugihara adnd Scott L. Stephens in "Fire and Fuel Management" (Fire in California's Ecosystems)

Fuel management strategies

The management of fuels has come to play a leading role in fire management as it provides a unique opportunity to modify fire drivers beforehand. Indeed, manipulation of fuels is the most common and effective way to influence future fires and as such classical practices are worldwide extended.

Most commonly applied fuel treatments consist essentially on**modifying the quantity and continuity of fuels**in certain wildlands and are designed and prescribed to achieve particular management goals like reducing potential rate of spread and fire intensity, reducing the severity of fire effects or restoring historic fuel structure.

And here it is! A quick dictionary of classical fuel management strategies to become familiar with GUARDIAN actions and activities!

- **Thinning**: Selective removal of trees to modify the fuel structure in forests that have become denser (i.e. due to fire exclusion).
- **Pruning**: Removal of the lower dead and live branches on trees often referred to as ladder fuels to avoid surface fires jumping up to tree crowns.
- **Clearing**: Removing from designated areas, stumps, plants, brush, fallen wood or debris to eliminate fuel load available to burn.
- **Eliminating** or treating of all remains generated in above-mentioned operations (e.g. mastication of vegetation into small chunks).
- **Grazing**: Vegetation consumption by domestic livestock involving reduction of available surface fuels.
- **Prescribed burning**: Controlled application of fire aimed at removing deadwood or other fuel biomass to reduce fire risk.

GUARDIAN will make use of almost all these practices (excluding grazing!) along its life cycle. Yes! There will be a prescribed fire soon, which I will be delighted to write about! Before that, check some of the results so far achieved in Figure 2. It is certainly true that a picture (two in this case!) is worth a thousand words...

Figure 2. Medi XXI fuel management at GUARDIAN sites: left) before fuel treatment; right) after fuel treatment.

In addition to that, it has to be highlighted that GUARDIAN is pioneering an innovative fuel/fire management practice, the **green firebreak**, which combines some of these mentioned strategies together with the use of prescribed irrigation. Keep on reading to discover more details on this novel infrastructure!

The Guardian approach: combining classic with innovative practices

GUARDIAN is implementing an extensive fuel management program in Riba-Roja and Paterna involving more than 37 hectares to be treated with different techniques to ensure that a fire coming from the wildland will not penetrate into urban areas. Some of these techniques respond to classic fuel management practices as those describe above. Examples of these works have been already presented in Journal 2 (remember the discussion on thinning to reduce tree density values after post-fire natural regeneration or on the importance of eliminating cane fields in Túria NP) and we will not provide further details on those here. What we will comment is on innovative fuel management practices as green fire breaks are, paying special attention to the fuel component of these.

Green firebreaks implemented in GUARDIAN are an eco-hydrological forestry solution (check pastweb article 3 to recall on this innovative concept) in which fuel treatments are combined with artificial water inputs delivered through prescribed irrigation. Although it is a novel technique at European level, there are precedents for green firebreaks (in this case without artificial irrigation) in other areas of the world with forest fire problems (e.g. China) whose designs and lessons learned have served as baseline for the design of this infrastructure within the GUARDIAN framework.

GUARDIAN green firebreaks are designed as 50-60 m-wide perimeter strips of fire-resistant vegetation which will be automatically irrigated by means of hydraulic infrastructure (already described in web article 3 and 4 and Journal 2). Activities regarding the fuel component to set green firebreaks comprise classical fuel management strategies (i.e. thinning, clearing and pruning) combined with the introduction of fire-resilient species and the consideration of the wind factor in the composition and orientation of fringes:

- Thinning, clearing and pruning as baseline conditioning of the green firebreak areas. Selected plots to house green firebreaks are in post-fire natural regenerated areas or in mature forest areas that, in some cases, have to be treated to reduce fuel load and continuity.
- Enrichment planting with the introduction of native vegetation, which has been carefully selected by Medi XXI experts. Selected species have fire-resistance characteristics (e.g. high moisture storage capacity in leaves and stems, low fuel load and low levels of essential oils, little tendency to accumulate dead vegetation, etc.). Some of the selected species are Fraxinus ornus, Celtis australis and Sorbus domestica.
- Introduction of a shrub windbreak barrier made of species of low fire vulnerability (Myrtus communis, Viburnum tinus, Pistacea lentiscus) at the windward edge of the firebreak to reduce surface wind speed. Note that the introduction of the wind factor is probably one of the most innovative aspects regarding green fire breaks design!

GUARDIAN green firebreaks will be multi-layered biodiverse multi-specie structures (made of trees, shrubs and herbaceous plants) that with their configuration and characteristics (fire-resistant, discontinuous, hollow, moist with artificially irrigation etc.) will be able to generate a **particular microclimate** characterized by a large shading capacity, a significant reduction on wind speed and a high degree of relative humidity and temperature control **acting as an amazing barrier to fire spread** (Figure 3).

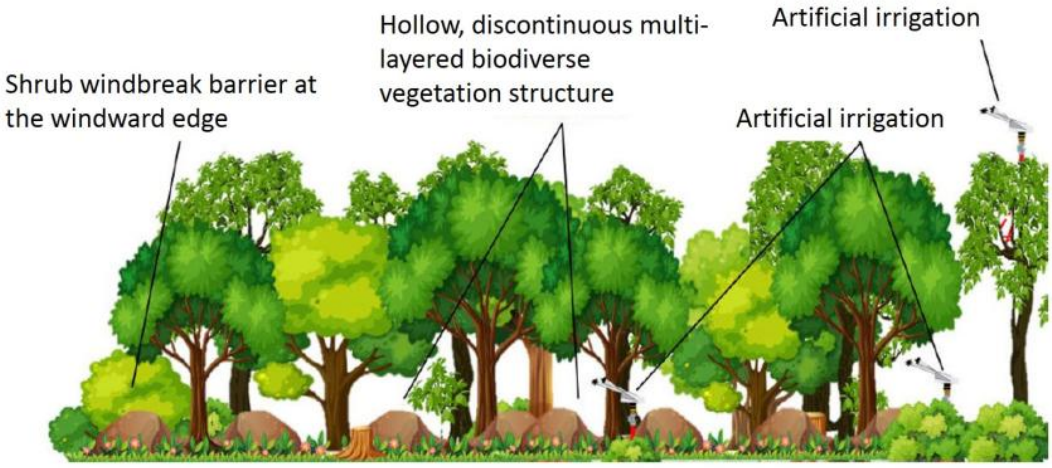

Figure 3. Structure of a green firebreak

What a piece of forestry engineering! Nevertheless, GUARDIAN green firebreaks involve much more than that! Setting up a coherent and effective distribution of GUARDIAN green firebreaks has required landscape engineering, hydraulic engineering, civil engineering and electronic engineering tasks for the design, dimensioning and implementation of the fuel strips combined with the automatic water sprinkler network.

Stay tuned at future GUARDIAN articles, as very soon we will see GUARDIAN green firebreaks becoming a reality as a result of this amazing joint effort!

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