D12: Report on operational recommendations to enhance communities and municipalities involvement in wildfire risk management through communication actions

Efficient fire risk communication for resilient societies (eF**I**RECOM)

Project co-funded by ECHO -Humanitarian Aid and Civil Protection

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Executive Summary

The aim of this document is to establish common recommendations in wildfire risk management through communication actions applicable in the eFIRECOM consortium countries. These common recommendations help to enhance resilience in communities and municipalities.

The approach of this report is divided in three different levels or scales: plot, settlement and massif.

After giving general recommendations in pre-crisis phase of wildfire risk communication applicable in all kind of communication actions, it is exposed in two steps how it's possible to improve the citizens' participation in risk management through the communication: (1) Through inform the public, and (2) Promote actions. In order to inform the public, it is important to understand and raise awareness through giving information related forest fires prevention. For promote actions it is recommended to promote responsible consumption of certain products, in the individual and collective way.

Then, on one hand are exposed general recommendations intended to homeowners for the plot level, such as maintaining an adequate defensible space and, by toughening your home by using fire resistant building materials. In order to understand these risk recommendations, it is important transfer knowledge related heat transfer and fire behavior.

On the other hand, intended to local entities and municipalities, are exposed general recommendations addressed to increase the wildfire resilience in settlements and in massifs. In the massif level it's introduced the Fire types concept.

1. INTRODUCTION

Communication is a two-way process in which there is an exchange of thoughts, opinions, or information by speech, writing, or symbols towards a mutually accepted goal or outcome.[i]

It is necessary to understand that communication is vital for transformation success of communities and municipalities, last ones as government agencies, which expand and improve their services, they often undergo a fundamental transformation of mission, strategy, operations, and technology. If managed effectively, these changes can increase the quality of government services and reduce costs. Often, **there is strong resistance to change within an organization because it requires that people change not only the way they work, but their attitudes and beliefs**. This is challenging, but such transformation is essential if government agencies are to provide the high quality of service expected by citizens and mandated by legislators.

While there are many types of disasters, most planners try to take an all-hazards approach. Most planners create general plans that are designed such that they can be adapted to specific situations, rather than trying to plan separately for every possible type of disaster. In addition, all disasters are managed locally until local resources are overwhelmed, at which point state, regional, national, and international resources are deployed. While an all-hazards approach works in operational response, there will be important distinctions in the way communication is executed by type of disaster and these differences require consideration during planning.

The increasing of population density in high-risk area concretely regions subject to wildfires, is becoming a problem. Disaster-prone areas, such as in urban interface forest areas in the Mediterranean region, areas that become more densely populated, and more potential victims are at risk when a wildfire strikes.

Through risk communication, the communicator hopes to provide the audience with information about the expected type (good or bad) and magnitude (weak or strong) of an outcome from a behavior or exposure. Typically, risk communication involves a discussion about adverse outcomes, including the probabilities of those outcomes occurring. In some instances, risk communication has been used to help an individual make a decision in response to many questions, including the following:

- Would have to apply a treatment of vegetation in my garden?

- What are the risks of living next to a forest?

- Do I elect the treatment the vegetation and the building materials of my house against forest fire?

In some cases, risk communication is used to help individuals adjust to something that has already occurred, such as to live a forest fire.

Risk communication would prepare people for that possibility. If warranted, the communication would offer steps to take to lower their chance of affectation by a forest fire.

2. OBJECTIVES

The main objective of this deliverable is to develop operational recommendations of fire risk communication with two different approaches:

- one being addressed to homeowners and,

- the other addressed to local entities and municipalities included local technicians and authorities.

The countries from the eFIREcom partners shall integrate this double approach in order to promote and get resilient societies. It will comprise a guide on basic urban planning for mitigating fire risk.

A communication campaign should be based on the results of risk analysis, and should be adapted to the social context of the target group.

3. APPROACH

Understanding the pattern of a crisis or a risky event can help communicators anticipate problems and appropriately respond. For communicators, it's vital to know that every emergency, disaster, or crisis evolves in phases. The communication, too, must evolve through these changes. By dividing the crisis into the following phases, the communicator can anticipate the information needs of the media, agencies, organizations, and the general public. For each of these phases, specific types of information need to be created and delivered to your audience.

According to the objectives, the current report will provide different operational recommendation based on the pre-crisis phase in forest fire event:

In order to enhance communities and municipalities involvement in wildfire risk management through communication actions, it's important to identify the impact on different risk management scales or territorial levels. They are the followings from lower to large territorial scale:

- plot with or without building
- settlements
- massif

4. GENERAL OPERATIONAL RECOMMENDATIONS RELATED TO COMMUNICATION

Communication objectives during the pre-crisis phase target communication and education campaigns. These campaigns inform the public and the response community. The communicator's job is to be prepared by facilitating the following:

- Monitor and recognize wildfire risks.
- Educate the general public about the risks.
- Prepare the public for the possibility of an adverse forest fire.
- Increase self-efficacy by suggesting actions that reduce the likelihood of harm.
- Provide warning messages regarding an imminent threat of fire.
- Collaborate and cooperate by developing alliances with agencies, organizations, and groups.
- Develop consensus recommendations by experts and first responders.
- Create messages and test them for use in later stages.

The pre-crisis phase is where the planning and preparation work is done. During this phase, the organization will:

- Predict and address the types of forest fire you are most likely to face.
- Anticipate and develop likely preliminary answers to audience questions.
- Draft initial messages; specific details can be filled in later.
- Identify spokespersons, resources, and resource mechanisms well ahead of time.
- Practice following the response plan, using the messages you have already created, followed by refining the plan and messages as needed.

Foster alliances and partnerships to ensure that experts are speaking in a coordinated manner (using one voice).[ii]

> **During the Pre-Crisis Phase:**
>
> - Be prepared.
> - Foster alliances.
> - Develop consensus recommendations.
> - Test messages

Seven Cardinal Rules of Risk Communication *(Covello and Allen 1988)[iii]*

1. *Accept and involve the public as a partner*. Your goal is to produce an informed public, not to defuse public concerns or replace actions.

2. *Plan carefully and evaluate your efforts*. Different goals, audiences, and media require different actions.

3. *Listen to the public's specific concerns*. People often care more about trust, credibility, competence, fairness, and empathy than about statistics and details.

4. *Be honest, frank, and open*. Trust and credibility are difficult to obtain; once lost, they are almost impossible to regain.

5. *Work with other credible sources*. Conflicts and disagreements among organizations make communication with the public much more difficult.

6. *Meet the needs of the media*. The media are usually more interested in politics than risk, simplicity than complexity, danger than safety.

7. *Speak clearly and with compassion*. Never let your efforts prevent your acknowledging the tragedy of an illness, injury, or death. People can understand risk information, but they may still not agree with you; some people will not be satisfied.

In addition to the principles of risk communication, such as expressing empathy and being respectful, it's important to consider **how the situation changes during a crisis and how risk communication can be applied during Pre-Crisis phase.**

Important information and assumptions are set during the pre-crisis stage. Develop plans and establish open communication during this phase.

- Provide an open and honest flow of information to the public: Generally, more harm is done by officials trying to avoid panic by withholding information or over-reassuring the public, than is done by the public acting irrationally in a crisis. Pre-crisis planning should assume that you will establish an open and honest flow of information.
  - Messages should be developed that anticipate and consistently answer expected questions.
  - Messages can be tested by audiences to ensure they are culturally and demographically appropriate.

  Resist talking down to an audience before a crisis by telling them they have nothing to worry about, especially when there is little action they can take before a crisis.

- Emphasize that there is a planning process: Define the forest fire response process, describe the roles and responsibilities for response, and outline possible solutions. Helping people understand the process before a forest fire will make it easier for them to coordinate and take appropriate actions. It also gives you greater credibility.

4.1. What is essential to communicate?

How to improve the participation of citizens in the risk management through the communication:

In 2 steps:

- **Inform the public**. Understanding and raising awareness through giving information related to forest fires prevention.
- **Promote actions**. Promote responsible consumption of certain products, the individual and collective way.

Inform the public. Understanding and raising awareness through giving information.

1. Understanding the key concepts related forest fires:

The control of fire by early humans was a turning point in the cultural aspect of human evolution. Fire provided a source of warmth, protection, and a method for cooking food. These cultural advancements allowed for human geographic dispersal, cultural innovations, and changes to diet and behavior. Additionally, creating fire allowed the expansion of human activity to proceed into the dark and colder hours of the night.

Fire has been an important part of all cultures and religions from pre-history to modern day and was vital to the development of civilization.

Fire has been burning ecosystems for hundreds of millions of years, helping to shape global biome distribution and to maintain the structure and function of fire-prone communities. Fire is also a significant evolutionary force, and is one of the first tools that humans used to re-shape their world.

Although usually treated as a disturbance, fire differs from other disturbances, such as cyclones or floods, in that it feeds on complex organic molecules (as do herbivores) and converts them to organic and mineral products. Fire differs from herbivory in that it regularly consumes dead and living material and, with no protein needed for its growth, has broad dietary preferences. Plants that are inedible for herbivores commonly fuel fires.

There is an added incentive for greater understanding of fire as a globally important consumer. Climate change, habitat fragmentation, the unprecedented transport of highly flammable plants to novel settings, and the ubiquitous overlay of human impacts on fire regimes demand a new level of synthetic understanding for our peaceful coexistence with this charismatic beast.[iv]

Forest fires are natural disturbances in Mediterranean climate

The Mediterranean climate is characterized by the coincidence in the same season with warmer drier times, and the presence of dry thunderstorms. For this reason, annually Mediterranean climate there was so natural forest fires. So much of Mediterranean plants have acquired a series of adaptive strategies that allow to persist recurring fires.

Each species is adapted to a particular fire regime (fire regime sustainable ecologically) with a frequency, intensity and seasonality of forest fires. Therefore, wildfires in itself are not harmful to biodiversity, although there may be fire regimes that can affect it. By nature, conservation is important to promote environmentally sustainable fire regimes, and avoid unsustainable ecologically fire regimes.

Why there are more forest fires? What has changed?

During the 20th century, fire regimes in temperate latitudes changed in diverse ways related to both ecosystem characteristics and changes in land use. In Mediterranean Europe, industrialization led to people's movement from rural settings into industrial centers, and thus the sudden abandonment of farms and a concomitant reduction in livestock grazing pressure (without replacement by natural grazers). This shift in land use, coupled with growth of tree plantations (mainly dense coniferous stands), has greatly increased fuel buildup, resulting in anomalously large, catastrophic wildfires, as reflected in the great increase in the last few decades in the amount of area burnt annually (Pausas 2004).[v]

At the same time, in Europe, North America, Australia, and elsewhere, urban areas have steadily expanded into wildland areas, producing more ignition sources (arson and accidental) and exposing more people to wildfires. Where populations have expanded into naturally high-intensity crown fire eco - systems, such as in many Mediterranean-climate regions, the result has often been catastrophic. Witness, for example, the recent loss of human lives and property in Greece, California, Chile, and Australia.[vi]

The agricultural, forestry and livestock have a direct relationship with the risk of forest fires already affecting the amount and distribution of vegetation, which acts as fuel for the flames.

Climate change

Precipitation and temperature are the main environmental factors that influence the state of the vegetation and so the behavior of forest fires (intensity, speed, fire breaks, ...)
Forest fires and their characteristics (frequency, seasonality, severity, etc.), are undergoing profound changes caused by the expansion of forests, and the change in weather conditions affected by the climate change.

All indications are that climate change will bring a decrease in precipitation during the spring season, this along with earlier entry of heat waves, will contribute to the environmental conditions involving a fire behavior more virulent and intense.

Present situation of forest fires: small to large wildfires.

Forests have also experienced an increase in hazardous fuels as a result of a highly effective fire-suppression policy that excluded fires. This "success," coupled with questionable logging practices, has caused unusually high fuel accumulation.

The paradox of extinction occurs when too much pressure is applied to reduce the forest fire burn surface. Historic high-frequency, low-severity surface fire regimes are now being replaced with low-frequency, high-intensity crown fires that are outside the historical range of variability for these ecosystems.

2. What can we do as citizens? How to improve the participation of citizens in the risk management

First of all, understand and respect the firefighter's knowledge and work.
Nowadays exist a conflict with public opinion in the execution of some solutions and activities that experts in the fire ecology try to apply for revert and solve the problem. These ideas are explained in the following points:

- **Low intensity fires as management opportunity.**[vii]

The ecological benefits of wildland fires often outweigh their negative effects. Fire that is low in intensity and does not grow out of control benefits our forests and is actually vital to the survival of several species.

A regular occurrence of fires can reduce the amount of fuel build-up thereby lowering the likelihood of a potentially large wildland fire.

Under optimum conditions, when wildfires do start, the result is a low intensity fire that remains on the ground burning grasses and vegetation, but causing less damage to trees.

Fire removes low-growing underbrush, cleans the forest floor of debris, opens it up to sunlight, and nourishes the soil. Reducing this competition for nutrients allows established trees to grow stronger and healthier.

Fires often remove alien plants that compete with native species for nutrients and space, thereby supporting the growth of native species.

The ashes that remain after a fire add nutrients often locked in older vegetation to the soil for trees and other vegetation.

Fires can also provide a way for controlling insect pests by killing off the older or diseased trees and leaving the younger, healthier trees.

Change is important to a healthy forest. Some species of trees and plants are actually fire dependent. They must have fire every 3-25 years in order for life to continue. Some trees have fire resistant bark and cones that require heat to open and release seeds for regeneration. Without fire, these trees and plants would eventually succumb to old age with no new generations to carry on their legacy.

In addition to all of the above-mentioned benefits, burned trees provide habitat for nesting birds, homes for mammals and a nutrient base for new plants. When these trees decay, they return even more nutrients to the soil.

Overall, fire is a catalyst for promoting biological diversity and healthy ecosystems. It fosters new plant growth and wildlife populations often expand as a result.[viii]

- **Prescribed fires to increase the landscape resilience to face forest fires.**

As other type of activity in forest management, like cuts, pasture... prescribed fires are a good solution to apply a fuel reduction in order to decrease the intensity of a possible forest fire.

Benefits of Prescribed Fire

- **Hazardous fuel reduction**: Forest fuels accumulate rapidly and pose a serious threat from wildfire. Prescribed fire is the most practical way to reduce dangerous accumulation of combustible fuels. Wildfires that burn in areas where fuels have been reduced by prescribed fire cause less damage and are much easier to control.
- **Wildlife habitat improvement**: Prescribed fire is highly recommended for wildlife habitat management. Periodic fire tends to favor under story species that provide browse for wildlife. Deer, dove, quail, and turkey are some of the game species that benefit from prescribed fire.
- **Insect and disease control**: Prescribed fire is the most effective and practical means of controlling diseases and insects such as beetles.
- **Aesthetic appearance enhancement**: Prescribed fire improves recreation and aesthetic values by increasing occurrence and visibility of flowering annuals and biennials and maintains open spaces for vistas.
- **Native vegetation improvement:** Use of prescribed fire encouraging the new growth of native vegetation, and maintaining the many plant and animal species whose habitats depend on periodic fire.
- **Grazing improvement**: Prescribed fire improves grazing by increasing availability, palatability, quality, and quantity of grasses and forbs.
- **Seeding and planting preparation**: Prescribed fire is useful when regenerating. On open sites, prescribed fire can expose mineral soil and control competing vegetation until seedlings become established.

Promote actions. Promote responsible consumption of certain products, the individual and collective way.

1. **By encouraging forest management activities and their resulting products**.

Consumers are key to driving sustainable production and play a central role in sustainable development.

Products from forest fire prevention:

This concept englobes products that are produced from the forest fire prevention activities, such as fuel treatments focused on reduce the biomass accumulation, or another kind of activities directly related to promote forest fire prevention, always in a sustainability way.

As well, buyers should prioritize the purchase of products made from raw materials that originate from sustainably managed sources, and have the least overall impact on the environment.

Promoting sustainable consumption and production are important aspects of sustainable development, which depends on achieving long-term economic growth that is consistent with environmental and social needs.

Most government policies in this area focus on stemming the environmental impacts of unsustainable practices, primarily through regulations and taxes. Promoting sustainable consumption is equally important to limit negative environmental and social externalities as well as to provide markets for sustainable products.

Examples:

- **Biomass Energy resources**: [ix]

Biomass fuels and woodfuel can be used in a variety of different forms, and can be produced in many different ways.

- Logs and firewood: The simplest form of woodfuel, requiring little specialist equipment to prepare. Consequently, lends itself well to self-supply. However, does not lend itself to an automated heating system.
- Wood chips: Allows a fully automated heating system, and also potential for self-supply, however a specialist, woodfuel quality chipper is required, and large volume storage.
- Pellets: Clean, free flowing, high energy density, allowing a fully automated heating system with sophistication on a par with the best fossil fuel systems. Delivered by tanker, but no option for self-supply.
- Briquettes: An alternative to firewood that is dryer, denser and cleaner, especially suitable for those with limited storage space. Lacks the "natural" look of traditional firewood.

  Domestic heating & District heating: Woodfuel can be used to provide heat in a number of different ways. The simplest way of using many forms of biomass for energy is simply burning it. Doing so in an enclosure, in which the airflow is restricted, will be far more efficient than burning it in the open. This enclosure can be used to provide heat for the room it stands in (a stove) or, by heating water and pumping it through pipes, it can provide heat to several rooms, and/or domestic hot water (a boiler). This can even be extended to provide heat to several buildings from the same boiler, which is known as district heating. Also can be used in industry.

- **Pasture products**:

Meat, milk, cheese, wool, yogurt and their derivatives, which come from animals grazing in forest fire prevention structures (areas with fuel treatments to reduce the potential of forest fires, wildland urban interface strips…)

- **Other agricultural and forestry products.**

Wine, Olive Oil, vegetables, fruits, cereals... from worked crops located in areas where it reduces the potential of forest fires.

5. OPERATIONAL RECOMMENDATIONS OF WILDFIRE RISK MANAGEMENT THROUGH COMMUNICATION ACTIONS ADDRESSED TO HOMEOWNERS

Related to the terrain scale, this section is focused on plots with or without buildings in wildland urban interface, and the recommendations are addressed to homeowners (a person who owns the house in which he or she lives), but can be a house or a building with another use, and also addressed to people who live or work in wildland urban interface in general, for example in a rental house or another kind of building.

In order to reduce the vulnerability of a house or plot, two general recommendations of wildfire risk management are given: [x]

- **Maintaining an adequate defensible space and**
- **By toughening your home by using fire resistant building materials.**

Defensible space is the buffer created by removing dead plants, grass and weeds. This buffer helps to keep the fire away from a home. This space is needed to slow or stop the spread of wildfire and it protects a home from catching fire—either from direct flame contact or radiant heat. Defensible space is also important for the protection of the firefighters defending a home

Toughening a home means using construction materials that can avoid the ignition through spot fires, and can help a home withstand flying embers finding weak spots in the construction, which can result in a house catching fire.

It takes the combination of both Defensible space and the toughening of a home to really give a house the best chance of surviving a wildfire.

1.1 Methods of hot transfer and factors involved in fire behaviour.

First of all, in order to understand how the fire moves and develops it is important to know the methods of hot transfer and what are the factors that affect the Fire behavior.

Heat transfer is the process of heat moving from one location to another, often involving more than one object. It's important to focus on the transfer of enough heat from a burning object to ignite a second object. Awareness of the methods of heat transfer may not allow us to always control a fire, but it will help us to better predict where the fire may go and how fast. For example, we can use principles of heat transfer to help predict which fuels in the fire area will ignite and which will not.

When discussing the following three methods of heat transfer, remember that they are not mutually exclusive but can and do often work together. The radiation and convection heat transfer principally determine preheating to ignition and thus, a fire's spread rate. Conduction continues heating into the fuel after ignition and thus sustains flaming until consumption.

Radiation: Thermal radiation occurs when heat is transferred from one object to a second object through the air without direct contact by the two objects. it allows fuels in a wildland fire to be preheated for ignition.

Convection: Heat transfers by convection when it flows in a current from a hotter area to a cooler area. If an object is on a steep slope above intense flaming, the object may be heated by convection. This will reduce the time needed for ignition as the fire moves closer to the object.

Conduction: This heat transfer occurs through the contact of two solids or within a solid object. For the context of wildland/urban fire, conduction is important for transferring energy from an object's surface to its interior.

Fire behavior depends on three components: weather, topography and fuel, which are break down in the following main factors:

The three components that control the fire behavior are meteorology, topography and fuels. *See figure 1*. The fire behavior depends on the conditions presented by the three components at a given time. The triangle shows this dependency relationship and can be evaluated in terms of the relative importance of each component. In an area where fuels are abundant and dry, the weather is hot, dry and windy, and the disposition of the winds and fuels on the ground is favorable, there is a possibility that a fire shows extreme behavior.
The rate of fire propagation, its intensity, and other characteristics respond to these factors. At the same time, some of these factors are influenced by the fire itself. This process evolves and changes constantly. In all fires you must expect that your conditions change with time and space.
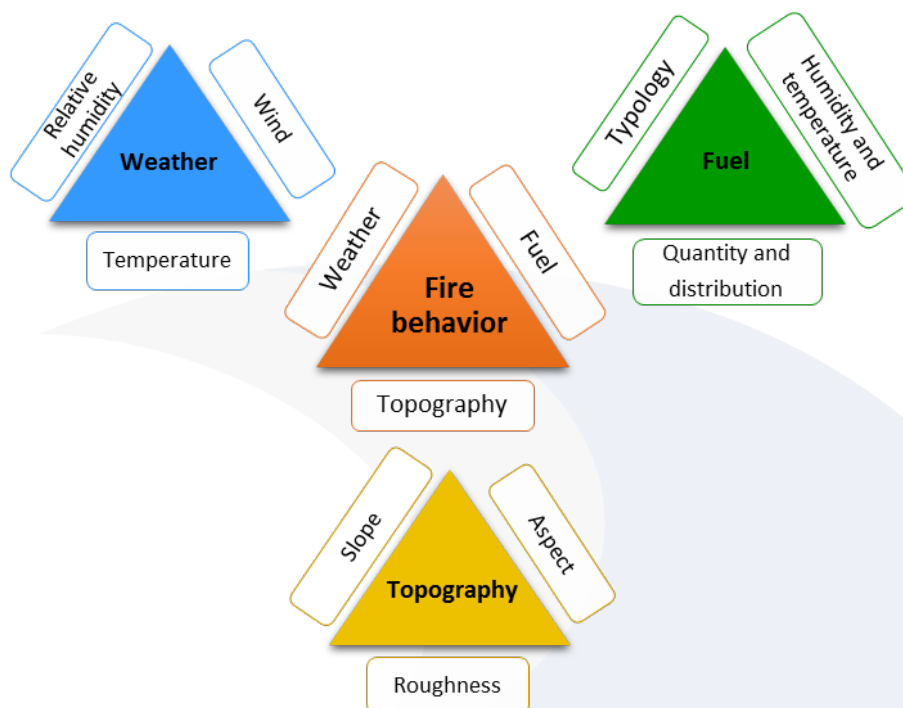
Figure 1: Fire triangles

Regarding the triangle, fire behavior changes depend on Fuel, Weather and Topography, these factors are broken down into other sub factors represented by sub triangles. It is important taking into account the sub factors in which we can influence or change to create a defensible space.

The sub factors influenced fire behavior and in choosing the appropriate fuel treatment applied in order to create a defensible space are:[xi]

- Slope:

The angle of incline on a hillside is called slope. The importance of slope is that the steeper the slope, the faster a fire burns up the slope. Slope increases the radiation and convection heat transfer up the slope. The steeper the slope the greater the up-slope heat transfer and thus, the higher the fire spread rate and intensity.

Burning material on steep slopes can also roll downhill to start other ignitions.

A slope that rises at a 45-degree angle is said to have a 100% grade.

Daytime winds tend to move up the faces of slopes; nighttime winds tend to move down-slope. This means that a fire occurring at the bottom of a slope in daytime can be expected to move uphill at a rapid pace because of the usual slope preheating and also because of the slope winds. The same fire starting at the top of the slope would not spread as fast because there would be less preheating from below due to radiation and convection, and the fire would be backing into the upslope winds.

But a fire at the top of a slope is in danger of running down that slope at night due to the down-slope winds.

As a general rule, for every 10° slope, a fire will double its speed as it travels uphill. If a fire is travelling at 5km/h along flat ground and it hits a 10° slope it will double in speed to 10km/h up that hill.

As wind passes over a hill it can create turbulence ahead of the fire front causing the fire to behave erratically.

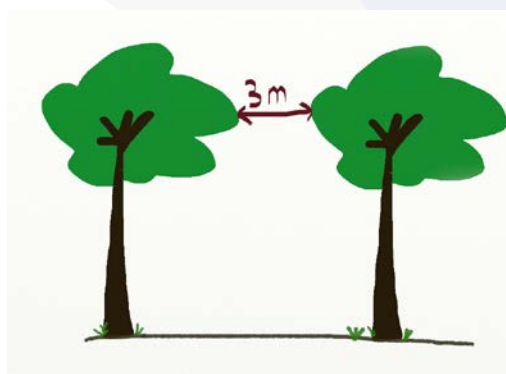In general, more pronounced slope needs more spacing between canopies:
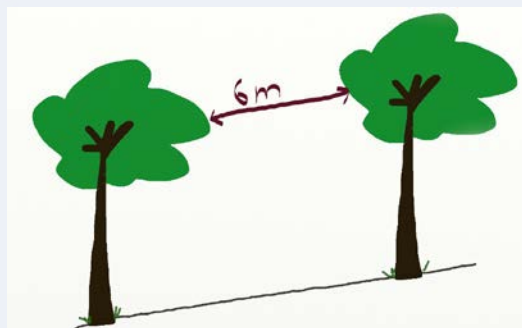

Figure 2: flat slope.
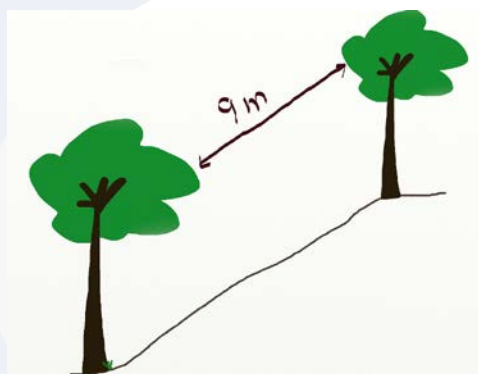

Figure 3: medium slope.

Figure 4: high slope.

- Aspect:

Aspect describes the direction in which a slope faces and relates to the degree of solar exposure. For example, in the northern hemisphere a north-facing slope faces away from the sun and thus is generally cooler and moister than south-facing slopes. Aspect influences the vegetation found on the slope and the daily range of temperature and relative humidity.

More direct sunlight generally falls on the south and southwest slopes, with resulting higher temperatures, lower humidity, lower fuel moisture, and sparser and lighter fuel loadings. These areas are critical in terms of wildland fire starts and spread.

North aspects of slopes are more shaded and have heavier fuel loadings. This shady side has lower temperatures, higher humidity, and higher fuel moistures.
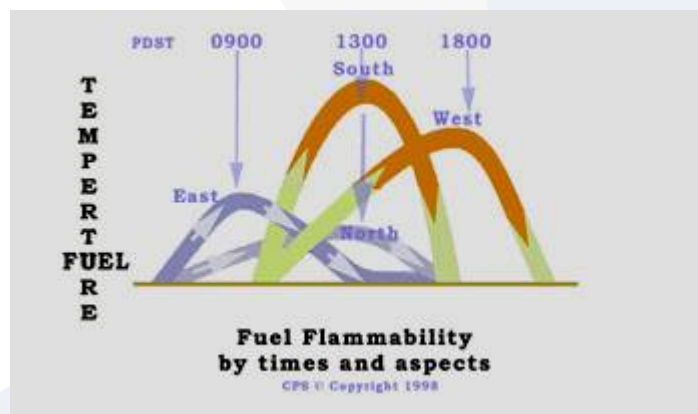
Figure 5: Fuel flammability by times and aspects. Campbell prediction system.

- Wind:

Wind is one of the most important factors influencing fire behavior; the higher the wind speed, the greater a fire's spread rate and intensity. Wind contributes to fire behavior in five principal ways:

- It increases the fuel preheating for ignition.
- It contributes to fuel drying
- It increases the supply of oxygen to the fire.
- It influences the direction of the fire.
- It increases fire spotting potential by carrying firebrands ahead of the fire.

Fire generated winds occur as hot gases rise above a fire. This causes lower pressure at the fire that allows the surrounding air to rush into it. The larger and more intense the fire, the stronger and more erratic will be the fire generated winds.

- Fuel

The arrangement of fine and coarse fuels over a certain area affects their rate of ignition and spread. For discussion, we can use the two categories of distribution: horizontal continuity and vertical.

Horizontal Continuity

Horizontal continuity describes the arrangement of fuels across the surface in horizontal terms. Continuous fuels describe an arrangement where the fuels are in contact with each other and provide a continuous path for fire spread. This condition includes both fine and coarse fuels. Because continuous fuels do not have gaps, fire is not halted by and/or does not have to spread around the discontinuities. In general, for a given fuel type, discontinuities will decrease spread rates and fire intensities compared to a continuous arrangement.

Patchy fuels have gaps with no fuels. These non-fuel areas, include bare ground, rock outcroppings, and perhaps areas of a specific fuel that is much more resistant to fire ignition and spread.

Vertical Continuity

Vertical arrangement refers to the upward distribution of fuels in a vertical dimension. Any fuel situated above a burning fuel is subject to strong convection heating as well as to radiant heating. The progression of vertical fuel arrangement can be described in three categories: ground fuels (deep duff, roots, and buried logs), surface fuels (pine needles, leaves, grass, and downed woody materials), and aerial fuels (all of the green and dead vegetation that is situated in the shrub and forest canopy).

The vertical fuel arrangement can increase airflow to the flame as well as increase exposure to wind. Crown fires can spread rapidly, producing high intensities, i.e., big flames.

Ladder Fuels

Ladder fuel is the term that describes material on or near the ground that will spread fire to the crown of the tree, e.g. flammable shrubs, large amounts of dead surface wood, branches, and dead foliage, conifer limbs touching or close to the ground, and dead lower branches with foliage attached.[xii]

1.2 General recommendations to create a defensible space. [xiii]

- Keep a strip of land free of vegetation and forest residue at least 2 meters wide around the building and 10 meters wide around the plot.
- In the garden, a minimum distance of 6 meters between the trees is recommended (increase the distance if the plot is on a slope). The branches must not touch each other.
- Dry grass and shrubs are fuel for wildfire so keep your lawn hydrated and maintained. If it is brown, trim it to reduce fire intensity, and don't let debris and lawn cuttings linger. Dispose of these items quickly to reduce fuel for fire.

- Fire can spread to tree tops. If you have tall trees on your property, prune low hanging branches 1.8 to 3 meters from the ground and for smaller trees, prune low hanging branches no more than a third of the tree's height. Remove tall grasses, vines and shrubs from under trees.
- Remove items stored under decks or porches; replace vegetation in these areas with rock or gravel.
- Replace mulch with hardscaping, including rock, gravel or stone. If it can catch fire, don't let it touch your house, deck or porch.
- Store firewood away from the house.
- Be careful with the chimney! Protect it to prevent sparks or embers falling down it into the house.
- Have a hose long enough to go round the house.
- Store fuel (gas bottles, gasoil containers, etc.) in ventilated and protected enclosures.
- Don't use dry heather fences: they are highly flammable.
- Give priority to evergreen vegetation and high wood density trees (box, ivy, Holm oak, oak and olive).
- You can use barbecues, but only if they are made of brick, fitted with fireguards and surrounded by a strip of land free of vegetation
- It is forbidden to light any kind of fire. If you want to burn plant residue or any other type of activity involving fire (fireworks, soldering…) check the legislation and apply for authorization from the authorities with these competences.

1.3 General recommendations to toughening a home.

- Keep the roof, gutters, eaves, porches and decks clear of dry leaves, branches and other organic matter. This reduces the chances of embers igniting your home.
- To reduce ember penetration, replace or repair loose or missing roof shingles or tiles, and caulk any gaps or openings on roof edges.
- Cover exterior attic vents, and enclose under-eave and soffit vents with metal wire mesh no larger than 0.32 cm to prevent embers from entering the home.
- Be careful with the chimney! Protect it to prevent sparks or embers falling down it into the house.
- Have multipurpose ABC fire extinguishers for different classes of fire, especially in the kitchen, the attic and garage.
- Don't use synthetic materials to build exterior walls, doors and windows (polycarbonates, methacrylate, PVC, etc.).

6. OPERATIONAL RECOMMENDATIONS OF FIRE RISK COMMUNICATION ADDRESSED TO LOCAL ENTITIES AND MUNICIPALITIES

Related to the terrain scale, this section is focused on settlements in general and massifs, and the recommendations are addressed to local entities or communities, and municipalities.

6.1. General recommendations in settlements:[xiv]

General recommendations in the streets of housing developments and at isolated houses

- Streets must be signposted at every junction. Streets without exit must also be well signposted.
- Houses must be numbered correctly and visibly.
- The housing development must be equipped with fire hydrants.
- Do not park on roundabouts or in narrow streets so that emergency vehicles can get through.
- Street trees must not encroach on plots of land and must be cut back up to a height of 3.5 meters so that fire engines can get by.

Housing developments, isolated houses and surrounding areas

- Perimeter protection strips are legally mandatory strips of land that must surround housing developments, isolated buildings and installations in contact with the forest.
- In these strips nearly all scrub must be removed and trees partly cut back to reduce the strength of fires and prevent them from reaching the houses.
- They must be at least 25metres wide and free of dry vegetation and with any trees pruned and cleared.
- Vacant plots must comply with the same conditions as the perimeter protection strips.

Access to housing developments and isolated houses

- Access roads must allow for the passage of fire engines and the evacuation of people.
- Wherever possible there should be two different public roads, one for entering and the other for leaving, each with a minimum useful width of at least 3 meters. If there is only one access road, it must be at least 5 meters wide plus the verges.
- Access roads and ditches must be kept clear of dry vegetation.

Infocat. Emergency Plan for Forest Fires. Protecció Civil. Generalitat de Catalunya.

6.2. General recommendations in massifs.[xv]

The term massif is used to refer to a group of mountains. For planners and authorities are essential to prevent forest fires in a massif scale:

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In order to implement forest fire prevention planning in a certain area, first it's necessary to answer the basic questions, which are essential to anticipate:

- Probability of having a large wildfire in a specific area
- Expected movement of the fire in the area

A new tool to master this step is necessary to classify, organize and typify wildfires that occur in a specific area. The basis for this is the observation that fires under the same topography and weather conditions follow similar spread patterns (5, 10), with only fire intensity changing due to varying fuel availability (greater accumulated drought stress, fuel accumulation, etc.).

The qualitative approach to fire spread patterns clearly reveals typical spread patterns for a region (topographic, wind-driven and convection dominated fires), which show particular features and geographical variation in terms of occurrence. This may give the idea that each individual wildfire is different and does not follow a certain pattern. However, by using an analytical approach it can be seen that reality is quite different, and that it is possible to simplify the study of wildfires by establishing a set of different Fire Types.

The Fire Types Concept

When analyzing historical fires, it becomes obvious that under the same topography and weather (synoptic situation) conditions, fire spreads following similar spread schemes. The Fire Types are derived from the analysis of common factors in these spread schemes.

A certain Fire Type does not necessarily implicate a certain fire behaviour. It is the difference in the fuel structure, land use or in ignition points that causes variation in fire behaviour. However, the spread scheme typically is maintained. Also the types of suppression opportunities and points where fire behaviour changes will be the same when the relief is taken into account.

The starting point to determine whether a Fire Type follows a common spread scheme is the spread pattern as the dominant factor in the wildfire. The concept of spread patterns refers to the key element to outline the way in which the fire spreads over the terrain. Depending on the spread pattern, three main types of fire can be distinguished, *see table 1*:

Table 1: Classification of fires according to spread pattern and the dominant factors

Classification of fires according to spread patterns	Dominant factor
Topographic pattern	Local topographic winds, fuel heating and slope
Wind-driven pattern	Wind speed and direction, as well as duration of the meteorological window that produces the fire conditions
Convection/Plume dominated fires	Accumulation of highly available fuel.

The type of spread pattern determines the fire behaviour and the effective suppression opportunities for the suppression services.

The Fire Types Concept as a planning element. Planning levels and fields of application

The spread of a potential wildfire is still not entirely predictable but there is a series of tools that helps to reduce uncertainty, to understand the fire when observing it and to anticipate the most likely fire behaviour. Among these tools the knowledge transfer of operational experience accumulated by the suppression system using the Fire Types Concept should be highlighted. This is a key tool for the field of prevention in the conceptual design, planning and placement of infrastructure that are essential for tackling wildfires (firebreaks, fuelbreaks, auxiliary strips, tracks, etc.).

The implementation of the Fire Types Concept in the planning process is an attempt to take this line of work further, paying more attention to the main characteristics of a large wildfire most likely to affect a more specific area, based on the model of anticipating its expected movement and its spread pattern. For forestry policy and public administration planning bodies, different fields of application of the Fire Types Concept were derived for different planning and organizational levels, *see table 2.*

Table 2: Planning levels of preventive actions.

Level	Allows to...	Applications
Regional planning	Determine the degree of vulnerability of an area to large wildfires and identify risk levels.	o Evaluation of appropriateness and self-protection measures of landscape and land use types o Determination of the **expected fire type** in each **Homogeneous Fire Regime Zone**, and set out of general criteria for limiting spread potential.
Landscape planning	Determine a series of basic guidelines to limit the range of a large wildfire and reduce the vulnerability of an area on the level of a wildfire prevention plan.	o Determination of **Strategic Management Points (SMPs)** to prepare suppression opportunities during potential large wildfires for the suppression systems. o Determination of **Management Priority Areas (MPA)** to reduce the spread potential of large wildfires. o Determination of the **respective model fire for a landscape unit** by specifying conspicuous landscape features in addition to the general fire type to adjust criteria for placing and dimensioning wildfire prevention and pre-suppression measures: SMPs, MPAs, sensitive points, access, water points, etc.
Forest planning	Manage forests according to the vulnerability of individual stands to the movement of large wildfires in an area.	

For more information, see: https://issuu.com/paucostafoundation/docs/guia_paradox_eng_compr

Methodology for the development and application of the Fire Types Concept.

The main phases of the methodology are:

- Creation of a Geodatabase of historical fire perimeters.
  - Reconstruction of perimeters.
  - Back dating and characterization.
  - Breaking down and synthesis of initial information.

- Identification of meteorological situations at synoptic level for the back dated fires.

- Reconstruction of fire spread.
  - Examination of spread schemes and meteorological situations:
    - o Cataloguing of perimeters according to spread pattern.

        o   Determining the Fire Type.
        o   Classifying the fires in terms of the Fire Types concept.
- • Characterization of fire spread for each landscape unit.

- Location and characterization of zones with homogeneous fire regimes.

7. HOW TO DISSEMINATE THE RECOMMENDATIONS

In the following section appears different dissemination methods for the communication programmes and tools for and with communities and municipalities developed as a result of this document or related with it.

Publications

Publications presenting and describing the recommendations are the common method to communicate the results. The dissemination materials are addressed to local technicians, authorities and municipalities.

There are associated with this deliverable three publications: two guides and one booklet:

- *Guidelines for the self-evaluation of properties to the wildfire risk in wildland urban interface.* A risk self-assessment guide will be capitalized with common events where the results are shared, discussed and can act as an indicator for monitoring the compliance with best practices.

- *Guidelines for the assessment of wildfire risk in the municipality and recommendations for community involvement and urban planning.* It will comprise a guide on basic urban planning for mitigating fire risk, which will have a highly visual and didactic format and will include key aspects of fire behaviour patterns when interacting with homes, and related recommendations. In addition, the guide will include a list of best practices to promote community participation in the shared management of fire risk through participatory forums and framework action documents.

- *A booklet with operational recommendations to enhance citizens' involvement in wildfire risk management through communication actions.* It will comprise a common booklet with recommendations on how to make an efficient communication on the fire risk. The booklet will be built based on the conclusions from the international workshop as well as on the specific communication tools developed for the different target audiences at local level (Actions A3.2, A4.2 and A5.2). This report will be useful for planning and developing strategic communication on fire risk at regional and local level throughout the Mediterranean region. Although the recommendations will be focused to the Mediterranean context, they could be transferred to other EU countries or regions with similar communication issues and transversal topics applicable to other natural disasters. Two major common (and opposed) situations will be taken into account: (1) "fire as the enemy to fight against" (Mediterranean areas with large urban development, dry weather conditions and largely affected by urban pressure); (2) "fire as a management tool" (grassland maintenance in mountain regions and Mediterranean countries affected by strong environmental pressure from the primary sector). Regions historically affected by wildfires and these areas where wildfires are more recent due to climate change or changes in use will be also considered. Each

situation requires different communication strategies. These recommendations will arise from the capitalization process and development of knowledge held throughout the project.

Other dissemination methods are used:

Collaborative events

The possibility of organizing a festive day as awareness-raising event on this issue, with incentive measures as a "competition for the most fire resilient house".

Conferences and workshops

An international workshop was celebrated where the community learns from the eFIRECOM achievements, and that the outputs are embedded and taken up. This capitalization workshop with invited experts was organized in order to present and discuss about existing knowledge, practices and innovations on the communication and perception of wildfire risk. It also offers the advantage that communication can go in both directions: members of the target community can be invited to contribute ideas and brainstorm about ways to make use of the project results. Thinking early in the project about the use of results will maximize the impact of dissemination and the sustainability of its outputs.

Website

Through web site http://efirecom.ctfc.cat/ is created in the *task F. Publicity, communication and dissemination*, in *Action A6.3. Creation and maintenance of the project website*. In the website is explained the project aims and objectives and to disseminate information about the project activities and results. As a dissemination vehicle, the website can include publicity the project has created, journal articles, publications, and presentations at workshops and the deliverables.

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8. CONCLUSIONS

It is intending to draw some conclusions for the eFIRECOM project by suggesting two different fire risk communication, one being addressed to homeowners and the other to local entities and municipalities.

In general:

- It is essential to give a common message to the public of all actors and agencies involved in all phases of forest fire management in order to create a coherent message for giving credibility and, as a consequence, to raise awareness in risk management.
- Inform the public, give forest fires key concepts. Understand the fire as a natural process in our Mediterranean climate, and to know that the forest fires can increase in extension and intensity due to the landscape changes and the climate change.
- It is possible to increase the landscape resilience in front of forest fires through respect and understand the fire services actions, such as use low intensity fires as management opportunity, and prescribed fires to increase the landscape resilience to face forest fires.

Remarkable recommendations addressed to homeowners are:

- The domestic consumption of products from forest fire prevention: Biomass Energy resources, Pasture Products and other Agricultural and Forestry products.
- It is important to understand concepts related the spread of forest fires, such as heat transfer and fire behaviour and the factors which affected it, in order to understand the direct actions that homeowners can apply in their plot to create a defensible space and, which building materials are less vulnerable in front of forest fires.

Remarkable recommendations addressed to local entities and municipalities:

- To promote and stimulate markets of products from forest fire prevention.
- The consumption of products from forest fire prevention in the community or municipality level: Schools, hospitals, sport clubs, public buildings… Such as install district heating in municipal buildings using biomass, include food from forest fire prevention in the menu of schools and hospitals...
- To follow the general recommendations in settlements: Perimeter protection strips, reduce the vegetation, a correct signposted, a correct house numeration, hydrants' installation…
- To apply the general recommendations in massifs: Fire types concept and their methodology (exist the example of Catalonia in the bibliography)

Other recommendations to improve the participation and dialogue and the application of the recommendations above:

- The different approaches and specific mechanisms that can be established to improve participation and dialogue between firefighters, civil protection, organizations and community actors can include:

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Create local community safety committees in forest fires, which include representatives of different sectors of the community, citizens, neighborhood associations, including organizations working in the territory (forestry agents, ADF in Catalonia ...), Civil Protection, firefighters, police, and municipal technicians in the field - and which have a specific mandate to reduce the risk of fire. Such committees can serve as important forums for sharing information and views on how to improve risk management and community security against forest fires, for example by conducting a risk assessment within the community; Raising awareness and providing training (eg doing drills, and reviewing emergency plans).

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