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Rural fires – Causes of human losses in Portugal

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Abstract

Wildfires are the cause of many fatalities in Portugal and around the world. Extreme fire phenomena are increasingly rising to intense and uncontrolled fires, with dimension and destructive potential greater than what was used to be seen and dealt with.

In the past, “rural communities” had a history of peaceful coexistence with fire, and the population consider themselves to be prepared to fight it. However, the widespread abandonment of rural landscape, the decrease of the agricultural activities around the villages and the aging population, lead to villages no longer naturally protected and the wildfires get closer to the houses with increasing intensity. Generally, population still has a poor awareness of fire risk, making, sometimes, wrong last-minute decisions. Therefore, it is crucial to protect rural communities that are now more vulnerable to wildfire threat.

2017 comes with a milestone in the history of wildfires in Portugal due to the high number of fatalities, in two different occurrences spaced in time, but geographically close. In both events 92% of deaths occurred in urban forest interface areas. Analysing the location of mortal victims, it is possible to identify risk factors that lead to the death civilians in rural fires. This paper presents an analysis of the characteristics and causes of death of the victims of the June and October 2017 fires in Portugal, recognizing risk factors that led to their death.

1. Introduction

Rural fires with extreme and unpredictable behaviour are a growing and critical problem around villages, often requiring mass evacuations to protect people and ensure safety (Manzello, 2018). However, the application of these actions in Portugal needs a more detailed analysis because the type of construction is mostly safe. Severe fires cause high devastation in communities, which could include the loss of human lives. The safety of populations at risk depends on accurate risk assessment, emergency planning and the emergency management.

Portugal, like other Southern European countries, faces unparallel circumstances nowadays, where large and uncontrollable fires are becoming more frequent, exceeding the capabilities of existing suppression resources and increasing community exposure (Fernandes, 2017). Sociodemographic changes in rural areas, climate change issues and vegetation changes lead to unprecedented circumstances that require the adjustment of fire use strategies and planning tools (Oliveira, 2021).

Zones where humans and their development, as infrastructures, meet or intermix with wildland fuel, has the designation of urban-forest interface (UFI); called also by urban-rural interface (URI) by some authors due to the translation from the Anglo-Saxon bibliography, as wildland-urban interface (WUI) (Fidalgo, 2012). The UFI areas present the typical problems of urban management, simultaneously with those of forest land management, due to the interaction between the two types of land that in the absence of fires, would be advantageous. However, these areas also have high risk of rural fires. UFI Communities hardly recognise the potential for destruction of forest fires, before experience the fire approaching (Fidalgo, 2012). In Portugal, the interface problem is also an emerging problem, with increasing importance due to the increase of the various

factors associated with it: the aggravation of forest fires, the growth in population on the outskirts of large cities and the frequency of extreme risk situations of a meteorological nature (Ribeiro, 2016).

A recent study reviewed the susceptibility and danger of forest fires in Portugal, introducing new data and extending the study period (Oliveira et al., 2021). This study indicates that in Portugal about 2% of the municipalities have more than 90% of their territory classified as dangerous, while 32% of the municipalities have, on the contrary, less than 10% of classified dangerous area.

Until 2003, rural fires in Portugal were known for the destruction of large areas of forests that affected the population only indirectly through high income losses due to loss of eucalyptus or pine trees, but which only occasionally affected buildings leading to loss of dwellings and consequently of human lives. 2003 and 2005 were as remarkable years due to the civilian's losses. Until then, human losses in rural fires were mainly combatants. Loss of civilian lives as a result of forest fires is a recent reality in Portugal.

The study and discussion of the type of victim, and the conditions that led to their death, is essential for a better understanding of this phenomenon and, from there, to infer the processes of change to be adopted so that these types of situations do not happen again. This paper aims to identify the factors that lead to the loss of human lives during rural fires, studying the characteristics of the fatal victims of the 2017 fires in Portugal, trying to identify their last actions and their last choices, based on analysis of data from the Independent Technical Commission and from the Centre for Studies on Forest Fires of the University of Coimbra from both June and October fires of 2017.

2. Change in the paradigm of rural fires in Portugal

Climatic conditions related to the environment and meteorological surroundings have proved to be of great importance in the development of fire and its propagation conditions. Under certain optimal weather conditions, the probability of massive wildfires increases significantly, as in the case of Pedrógão Grande in 2017 in Portugal (Viegas et al, 2017). Extreme meteorological phenomena appear with increasing frequency giving rise to this type of fire. They are known to be severe and complex, capable of reaching a very large size and high intensity, causing major environmental and socio-economic impacts.

Portugal, like other Mediterranean countries, is experiencing a confluence of two long-term trends: the widespread abandonment of the rural landscape that has become economically irrelevant, together with a strong reluctance by governments to create effective policies to deal adequately with the fire.

According to the legislation of the Portuguese government, in Ordinance n. 301/2020 of 24 December, it is recognized that the divestment in forestry, which contributed to the emergence of a monocultural landscape with a high fuel load and fire risk potential, with *“when in the presence of severe meteorological episodes, this situation has resulted in large fires, devastating extensive forest and agricultural areas, infrastructure and heritage and putting human life at risk. These episodes, in turn, feed the vicious circle of abandonment, with consequences in terms of ecosystem degradation and the social and economic vulnerability of these territories.”* (Portaria nº 249/2020, 2020). It is assumed that the policies implemented so far have not been enough and that populations are increasingly vulnerable to both the social and economic aspects.

Additionally, Portugal is also characterised by dispersed urban agglomerations, mainly in the countryside. Thus, it is essential that rural fire risk assessments consider not only hazard and exposure, but also social vulnerability (Oliveira et al., 2021). Dispersed urban agglomeration was synonymous of small villages of compact construction, but isolated in the landscape. Especially in the north and centre of Portugal, there are other types of villages called *“Avulso”* and *“Espreado”* settlements that also contributed to this dispersed urban agglomeration. *“Espreado”* settlement is briefly characterised by being consolidated in a network of rural paths spread out in all directions and is also characterised by having a vegetable garden or farm at the back; while *Avulso* settlement is characteristically off-center, presenting a loose building on a rural matrix., many of them are used as second homes, without permanent occupation.

In the scope of rural fire risk, the affected people are generally in rural areas, but recent cases have shown that this is not always the case, and the fire has been increasingly taking on such a dimension that it crosses borders, incoming urban areas as well. In 2005, a fire devastated the outlying of Coimbra, even going into the urban area due to spotting. The fire started on August 19 in Vila Nova de Poiares, but it was a re-ignition that gave rise to

a new fire, which, covering several kilometres, entered the city of Coimbra on August 21. Ten years earlier, in August 1995, a similar event also affected the same city, causing the damage of an apartment and of some vehicles.

These events highlight a change in the exposure of populations to danger, as it is no longer just a problem in rural areas but also in some urban areas, where this risk is not yet considered. People who live in urban or residential areas, among patches of forests, hardly recognise the potential for destruction of forest fires, before experiencing a situation of an approaching fire (Fidalgo, 2012).

In rural areas, despite the high risk of exposure, residents are used to live with forest fires and over the years have developed ways to protect themselves against this problem. The villages were protected by surrounding natural containment strips (agricultural fields) and in case of fire the active population came together to protect the distressed housing. However, with the abandonment of agricultural practices and the exodus of younger people to urban areas, this natural protection is decreasing. Quite often the abandoned agricultural areas are replaced by forest plantations, bringing trees closer to the houses.

Additionally, elderly residents keep the same feeling that they are safe, but the context in which they live has changed. In this way, we can consider that the inhabitants of these villages may have a false sense of security, which will make them stay close to the houses and refuse to evacuate their village, thus increasing their vulnerability.

If, on the one hand, there is urban expansion in rural areas towards forested areas in some areas of the country, especially in the north and centre of Portugal, due to tourism and demand for country houses for second homes, on the other hand, the abandonment of activities such as agriculture and grazing, the depopulation of rural areas and the continuous exodus to large urban environments by young people, lead to the abandonment of these areas, leaving elderly populations vulnerable, even on the outskirts of cities, making the forest and areas of bush to get closer and closer to the buildings.

3. Human losses in wildfires in Portugal

The loss of a human life due to forest fires will always be the greatest loss regardless of the area burned by the fire or the cumulative number of fires each year. In Portugal, records of the loss of human lives due forest fires are available since 1966.

3.1. Historical wildfire deaths around the world

Year after year, wildfires are killing people around the world and some of the fires led to the loss of a large number of people in a single occurrence. In Greece in 2018, around 100 people died in just one event in the town of Matti; in Australia in 2009 at least 173 people died in several fires that occurred in what became known as Black Saturday and in Russia in 2010 where, during one of the hottest summers ever registered, wildfires killed 60 people in July. There would be many other examples, even in the more distant past, but the fire known as “Peshtigo Firemost” that killed at least 1200 people in the United States of America in 1871 has being recognized as the deadliest event in history.

In Portugal, this is a recent reality. Over the years, there are negative milestones in history, remembering the years of 2003 and 2005 where respectively 21 and 23 people died (Viegas, 2004) and the fateful year of 2017, with the loss of a total of 66 casualties in June and 57 in October. The year of 2017 was a milestone in history due to the high number of fatalities, in two different occurrences spaced in time, but geographically close, where most deaths occurred in urban forest interface areas.

Australia's Country Fire Authority (CFA) conducted a retrospective study of civilian deaths that occurred in the fires in Victoria. The investigation used the coroners' reports to determine the circumstances of each death. Many of the case studies illustrate the risk resulting from late evacuation and poor understanding of fire behaviour. Three categories of victims were identified:

- victims who recognized the real threat to their safety with enough time to save their lives, but chose an ineffective survival strategy;
- victims who did not recognize the real threat to their security in time to implement an effective survival strategy; and

- victims physically unable to implement effective survival strategies. (Handmer, 2005)

These victim typologies, according to the analysis of deaths related to the 2017 fire in Portugal, are remarkably similar.

3.2. Analysis of fatalities in the June 2017 occurrence in Portugal

The June 2017 fire complex will go in the history of rural fires in Portugal, as it caused 66 fatalities, making it one of the most serious fire disasters in our country, and one of the worst in Europe. It consisted of several events, the most critical being those that started in Pedrógão Grande, and in Góis, which were associated with three other fires that consumed a total area of 45,328 ha (Viegas et al, 2017).

Following these fires, the Portuguese government created, through Law n° 49-A/2017, of 10 July, the Independent Technical Commission (ICT) with a mandate to carry out an independent assessment of those fires. At the same time the Government requested to The Centre for Studies on Forest Fires (CSFF- ADAI) of the University of Coimbra to also carry out a study on the conditions of occurrence, initiation, and propagation of fire, with particular emphasis on the study of its propagation and the analysis of fatal accidents (Viegas et al, 2017). Both studies led in the same direction, and they are complementary.

The ICT report identified 64 fatalities due to the fire and carried out an exploratory analysis of the conditions and particularities of the human victims who died because of this fire. Note that the ADAI report counts one more victim accounting 65 victims because this report counted one victim who died two days later, following serious injuries. This victim was the only firefighter among the other victims, all civilians. Neither of the two studies count the number of injuries. Later one other injured person died in the hospital bringing the total number of fatalities to 66.

Analysing the age of the victims, most were between 30 and 70 years old, active people, without limitations in the process of escape or risk perception (figure 1). As for gender, the number of victims is very close, so it was not considered a risk factor or characteristics related to the cause of death.

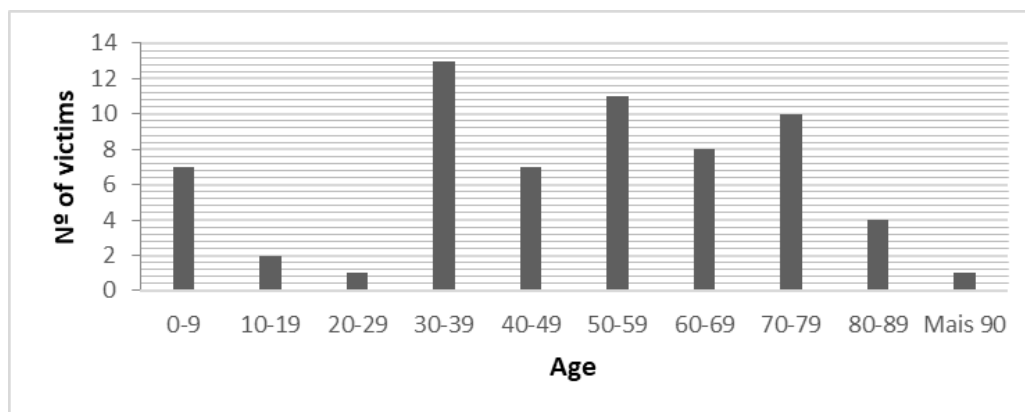


Figure 1- Distribution of the age of the victims– June 2017 (CSFF- ADAI 2017)

An important factor in this analysis is the relationship of the victims with the place where they died. According to the data of CTI report, half of the victims were residents of the villages affected by the fire. However, it is the high number of occasional visitors that needs special attention (figure 2).

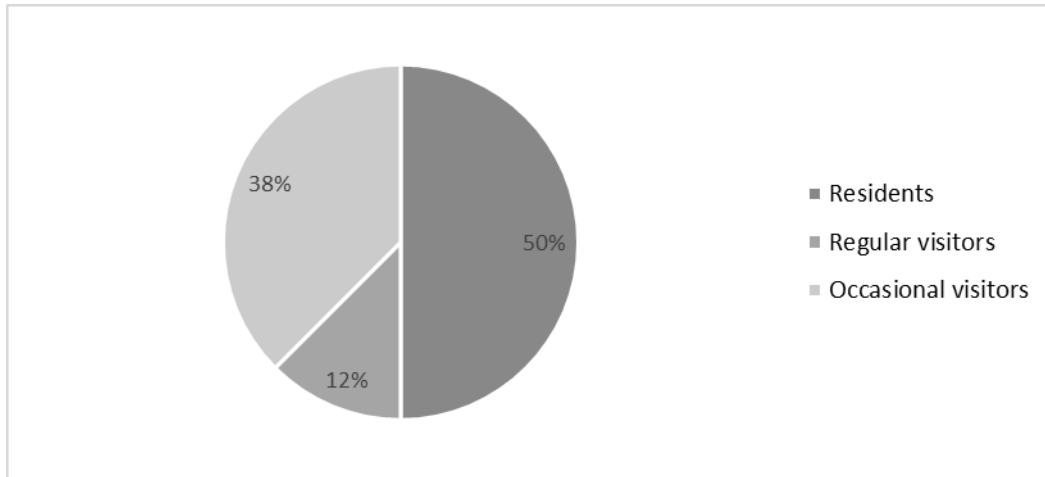


Figure 2- Relationship between the residence for the victims and the place of death – June 2017(ICT 2017)

It should be noted that this is a very popular zone in the summer, mainly for its river beaches and for leisure activities. The violence of the fire, the lack of knowledge of escape routes, self-protection measures for rural fire situations, combined with the lack of the presence of competent authorities to give indications, significantly increase the panic of these people, looking for escape routes became their way to death. Only 4 of the 66 victims died inside their homes.

Regarding the distance from the place of death to the victims' homes, 47% die more than 5 km from home. These victims are tourists and visitors, who, whether or not they have a relation with this zone, they were on an occasional visit (figure 3).

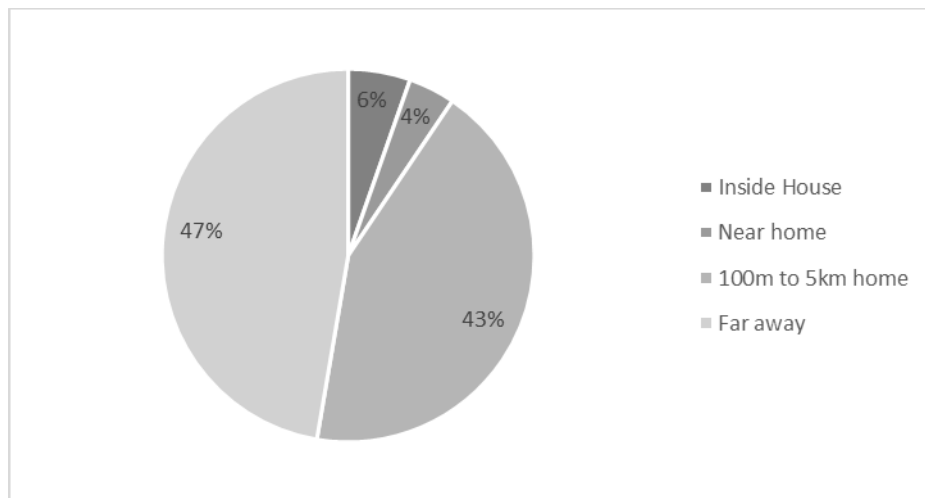


Figure 3- Relationship between the victims and the place of death – June 2017 (ICT 2017)

However, 43% of the victims died between 100 meters and 5 km away from their homes, which indicate that the victims tried to run away in the face of the approaching fire, considering that they were going to get safety. Additionally, regarding the circumstances of death, from the analysis of data, it is considered that 70% of the victims were running away from the fire (figure 4).



Figure 4- Relationship between leave and stay on the number of deaths - June 2017 (ICT 2017)

In the group of victims who did not run away the fire, the report identified evidence that, in addition to the 4 victims who remained in their homes and who were caught by the fire there, the remaining victims who were not running away were passing through that area, returning home or to their accommodation after a day of sightseeing in the mountains. Regarding how the victims fled the fire, the CSFF- ADAI report identifies that 89% of victims chose the car as a means of escape.

3.3. Analysis of fatalities in the October 2017 occurrence in Portugal

In the sequence of the June fires, also in the 15 October fires, the Portuguese Parliament also requested the constitution of the Independent Technical Commission and the Portuguese Government requested to CSFF- ADAI a study of the most relevant facts of these fires, with the Country still in the aftermath of the June fires and still in shock from this new disaster.

Although both reports work in the same direction, the number of victims identified in both is not coincident, and the CSFF- ADAI report identifies and analyses 51 fatalities and the ICT only recognize 48 victims. This discrepancy is mainly due to the fact that the ICT report considers the direct victims of the fire (and that were investigated by the Judiciary Police) only, while CSFF- ADAI report analysed victims directly and indirectly related to the fire, based on 40 accidents that resulted in these deaths.

While in the fires of June 2017, all victims perished in a short time and limited zone, in October 2017 the victims were dispersed for a complex of different fires. In the October fire, more than 50% of the victims were 50 years of age or older (Figure 5). This fact, important in the following analyses, shows that the victims of these fires were mostly elderly, in many cases with health problems and mobility difficulties. As for gender, in this complex of fires, 65% of the victims were men and 35% women.

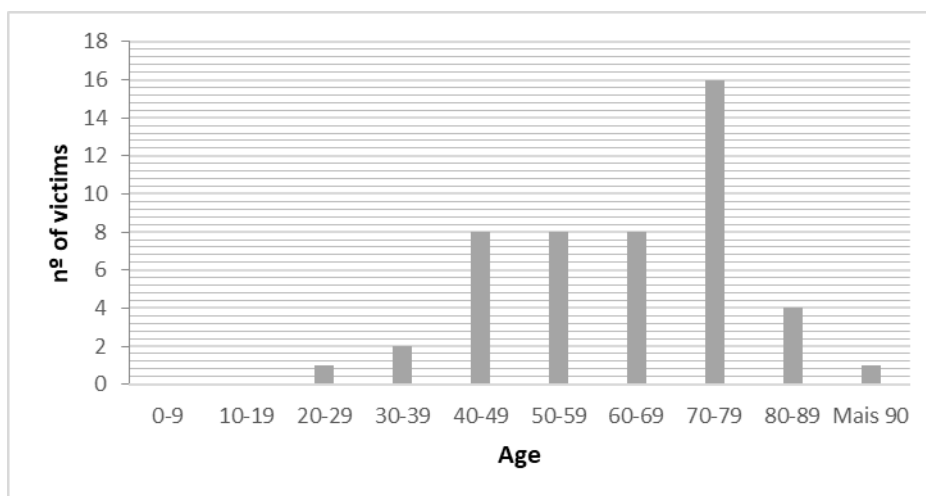


Figure 5- Distribution of the age of the victims - October 2017 (ICT 2018)

The analysis of the relationship of the victims with the place of death shows that 86% of the victims were residents in the area. In addition, since most victims were old people, they end up dying either inside their homes or nearby. (Figure 6).

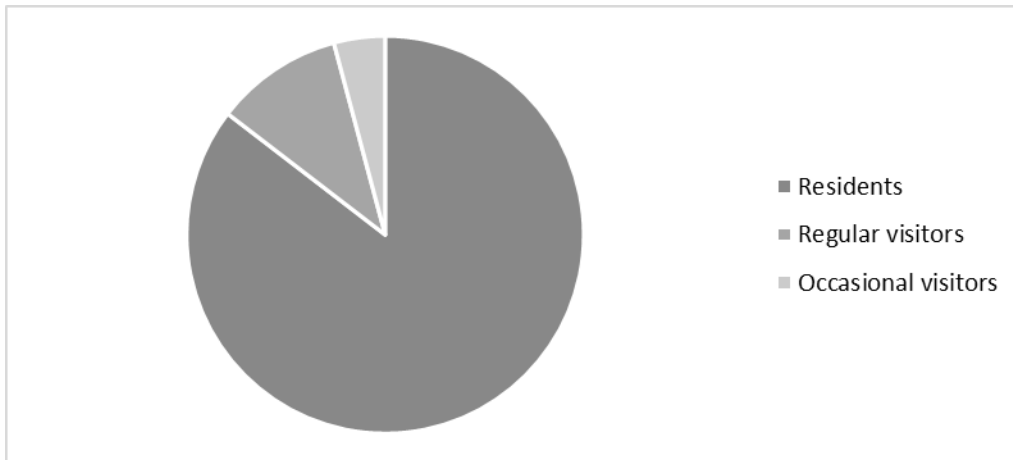


Figure 6- Relationship between the residence for the victims and the place of death - October 2017 (ICT report 2018)

The distribution of distances from the place of death to the home is more heterogeneous in October fire (Figure 7), allowing to conclude that there were different circumstances and decision-making by the victims.

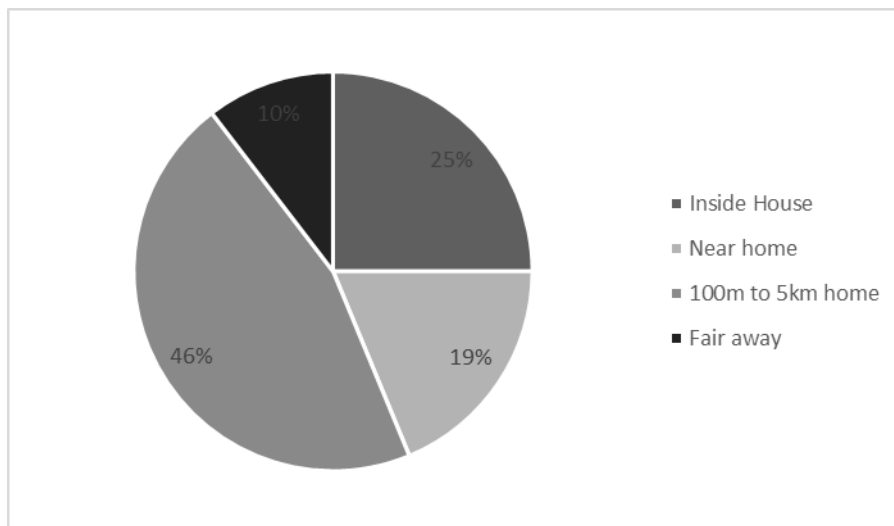


Figure 7- Distance between the residence for the victims and the place of death - October 2017 (ICT report 2018)

There are about 44% of victims who died inside or near houses, but a large percentage of people, about 46% tried to run away. It should be noted that, according to the ICT report, 60% of the houses of the victims of this fire did not burn. In this case, 63% of the people tried to run away (figure 8).

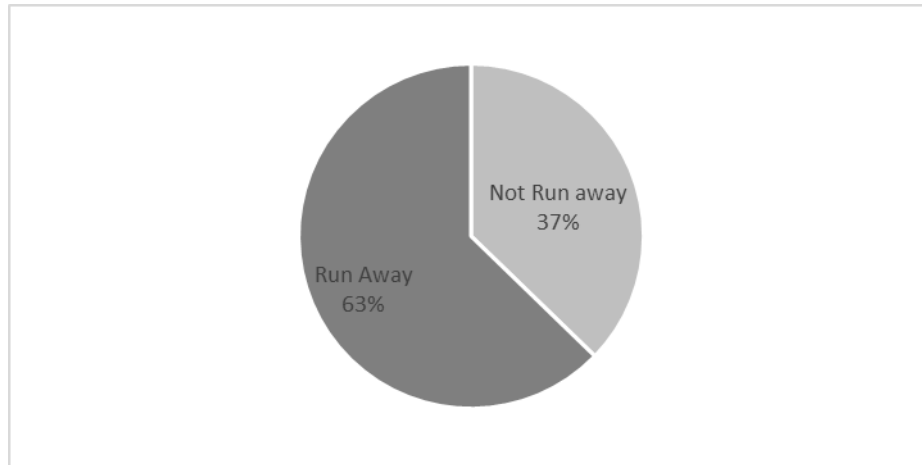


Figure 8- Relationship of leak with the death process – October 2017 (Viegas et al 2018)

After the June fires it was expected that people would have learned and chosen to stay in their homes and not choose to run away. But even so, a large percentage of people died while trying to run away.

4. Discussion of results

The analysis and discussion of the type of victims, and the conditions that led to their death, is an essential tool for a better understanding of this phenomenon and, from there, to infer the processes of change to be adopted in order to avoid such disastrous events. In this study and from both analysed fires, it was observed that the victims have very different characteristics.

The fire of June 2017 is a fire with great severity on the surface (CTI, 2017), and the fatalities were mostly young people and adults, who took advantage of a weekend for leisure activities. Many of them, faced with the imminence of a major fire, decided to use their vehicles and move away from the scene of the fire. With limited information about the area, they followed the only path they knew and were caught by the front of the fire along the way. Regarding the victims who lived in the area of the fire, it is observed that none of the houses of the victims who decided to flee were affected, and staying at home would have been the best option. These people would be safe, and the option of escape became their exposure factor, leading to their death.

From the analysis of both reports, the conclusions stated that after June 2017, the population would have been left with the idea that fleeing would be the most dangerous option. However, and not contradicting the validity of this thesis, it is important to understand here that the typology of victims is different in the occurrence of October 2017.

The victims of October 2017 were elderly people, some of them with limitations in perception and reaction to danger as well as in mobility. Thus, according to the reading and analysis of the survivors' reports, contained in the CEIF-ADAI report, a large number of victims were surprised by the flames already in the vicinity of their home or during the night.

It is also important to point out that, with the change in the fire paradigm, as mentioned above, the elderly populations maintain their belief that they are safe in the villages, not recognizing the risk situation they are in. Adding to this idea, the disbelief in the authorities of fire fighting forces, make the populations stay to the limit near their homes with the idea of protecting them.

In this way, and as a way of summarising the conclusions stated above, the following risk factors were identified:

- **Growing demand for nature-based tourism:** With the change in the dynamics of fires in Portugal, they take on more and more proportions and dynamics that are difficult to identify in advance. The high demand for rural and forested areas for tourism and leisure, essentially by residents of urban areas, significantly increases the number of people dispersed in these spaces. In addition, visitors are mostly people who are poorly prepared and unaware of the risk of forest fire, thus increasing their vulnerability.

- False feeling of inhabitants in rural areas: inhabitants in rural areas have become used to living with fires. With the abandonment of rural areas, the forest tends to invade the villages, significantly increasing the urban-forest interface. The feeling of safety that the inhabitants had before is no longer real and currently the rural settlements are very vulnerable to fires, being a relevant risk for their inhabitants.
- Demand for rurality and nature-based experience: although the exodus of permanent inhabitants from the villages in the countryside in recent decades, there is an increasing demand for accommodation and/or housing in rural areas, essentially by foreigners. There is also an increase in the return of retired people to their origins, in search of an end of life in the tranquillity of the countryside. This factor has further contributed to the fact that, in addition to the forest entering the alleys, new construction often “enters” the forest in search of tranquillity through contact with nature;
- Strong exposure of vulnerable communities to risk: With the exodus of young people to cities, villages become increasingly aged. The sense of neighbourhood ceased to exist, and it is increasingly common for the elderly to be debilitated in their homes, cared for and often visited by employees of social solidarity institutions. In the face of a fire situation, and in addition to the difficulties associated with age and illness, indirect fire products such as smoke and gases substantially affected these people;
- Understanding the escape process: The lack of preparation and awareness make the population wait for the fire to arrive at the houses. In the face of very intense fire phenomena, combined with poor information and the lack of competent authorities on the ground to guide their exit process, last-minute self-evacuation will increase people's exposure to the fire from which they are fleeing.

5. Conclusions

Forest fires continue to be the source of many fatalities both in Portugal and around the world.

The analysis of fatalities resulting from the 2017 fires in Portugal shows that people still have a poor perception of fire risk, making wrong last-minute decisions that lead to death. The lack of awareness combined with the lack of credible information means that, in the face of a fire, people make decisions based on what they know from their experience on past events. The discrepancy in public policies and in action also increase it.

With the analysis of the location and of some characteristics of the mortal victims it is possible to identify risk factors that lead to the death of civilians due to wildfires, such as the increase in demand for rurality, both for permanent and tourist housing, of inhabitants coming from urban areas, which are not familiar with wildfires.

Another problem, very evident in the October fires, is the false sensation of security of elderly population. The inhabitants in rural areas have a history of peaceful coexistence with fire and consider that they are prepared to face it. However, the abandonment of rural areas, abandonment of the agricultural activities that were developed around the villages, mean that villages are no longer naturally protected and that a fire gets closer to the houses with greater intensity. The strong relationship of belonging to their place of residence means that specially the elderly people want to stay close to their homes, believing that they are naturally protected, something that used to happen in the past. This fact makes these populations even more exposed and vulnerable.

Finally, the lack of preparation and awareness make the population wait for the fire to arrive at their homes. In the face of very intense fire phenomena, combined with poor information and the lack of competent authorities on the ground to guide their exit process, last-minute self-evacuation will increase people's exposure to the fire from which they are fleeing.

The conclusions obtained with this study are intended to be the stepping stone for future work on the creation of methodologies for the protection of civilians in the face of forest fires.

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