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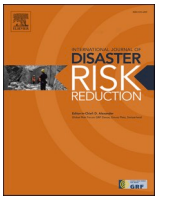

Is early evacuation the best and only strategy to protect and mitigate the effects of forest fires in WUI areas? A qualitative research on the residents' response during the 2021 forest fires in NE Attica, Greece

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ABSTRACT

Greece, a South-East European country located in the Mediterranean basin, faces every year disastrous and occasionally fatal forest fires. During the 2021 fire season and after the 2018 Mati forest fire, the authorities warned people to evacuate early at almost every forest fire which threatened WUI areas throughout the country, irrespective of the fire's severity. Fortunately, during these events, no loss of human life occurred. However, residents and the municipalities' civil protection officials expressed strong opposition to this policy claiming that is not the most efficient for the protection of property. The qualitative research presented here aims to explore the residents' fire risk perception, assess critical issues regarding early evacuation and the extent to which alternatives could be utilized in Greece. The findings, confirm that while early evacuation is the safest option during a forest fire offers maximum safety to human life, it is not the only viable option. Early evacuation is not a one-size-fits-all solution since there will always be residents who decide to stay and protect, or are forced to stay due to the fire conditions. It is anticipated that the analysis presented here will be used to improve fire response outcomes.

1. Introduction

1.1. Forest fires in Greece

Every year, and especially during the summer period, Greece is affected by forest fires. The diversity of vegetation, the topology and the climate of the Mediterranean interact with each other and produce an abundance of flammable fuel and ideal fire conditions [1]. It is a fact that in the European South and especially in the Mediterranean countries such as Italy, Spain, Portugal, France and Greece, an average of 85% of the total burned areas of Europe is recorded every year [2,3]. Specifically, for Greece, the socio-economic environment exacerbates and complicates the risks [1], as more than 80% of the total population of the country is concentrated in the Mediterranean climate zone along the coasts or at low altitudes (e.g., Attica, Halkidiki, Rhodes, Crete) [4]. The Mediterranean regions are characterized by areas where forest vegetation is mixed with human structures, the so-called Wildland-Urban Interfaces (WUI) [5,6], and in the event of a forest fire they can potentially interact with each other [7].

These WUI areas are very vulnerable to the risk of forest fire [8] as it is extremely likely that if a fire breaks out in such an area it will

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threaten human lives and property [9]. In the past, catastrophic fires have affected many communities in several countries [8], having caused fatalities, infrastructure damages and had a severe socio-economic impact [10,11]. Risk management in such areas is a difficult challenge, especially if we consider the values of each community as well as the community's fire-culture [12]. Fire managers and civilians face an ever-increasing concern that any suppression strategy, no matter how many resources it uses, cannot adequately curtail the danger as the fire intensity usually exceeds the capacity of these resources [8]. Protecting human life during a fire is always the top priority, that is why fire policies in many countries suggest 'early' evacuation as the safest option for residents when threatened by a forest fire [8].

It is worth noting that the 2007 fire season was one of the worst in Southern Europe over the past 14 years (see Fig. 1). Greece was severely affected due to a series of forest fires in Peloponnesus [13,14]. Seventy-eight (78) people, mostly civilians, lost their lives. The forest fires affected 110 villages while damaging more than 3000 homes [15]. Despite the tragedy and severity of the 2007 fires no one expected the tragedy and events that would unfold in Mati, Attica 2018 [16]. In 2018, the fire season in Greece that spans from 1 May to 31 October, started smoothly, with rainfall above average and lack of strong winds or heat waves. However, on July 23, 2018 for the first time during the fire season, the fire risk index in Attica was set to 'very high' with a value of 4 (scale 1–5) [17]. That day in East Attica, a wildland fire started that rapidly spread and consumed WUI areas. Factors that contributed to the rapid spread of fire included, to the effect of topography, high temperatures of over 39° Celsius, the low relative humidity of 19% and the very strong westerly wind, that was blowing for over 10 h [18]. During this incident the residents' inability to appreciate the danger and severity of the fire, the lack of applied evacuation procedures, erroneous instructions by people of authority and late evacuation, proved fatal and a large number of people lost their lives. Severe traffic jams led to entrapments while in an attempt to seek refuge at the sea, many people drowned [19]. The effects of the fire rank it as the second deadliest forest fire in the world since the start of the last century, causing 102 casualties, 150 people injured, more than 1650 homes destroyed, and 1431 ha of agroforestry-urban land burned [19].

Fatal forest fires around the world have caused the adjustment of the fire management and evacuation policies in the affected countries. For example, policy changes took place after the 2009 Victorian bushfires in Australia, with 173 fatalities [20,21]; the 2017 Portugal forest fires, with 66 fatalities [22]; the 2018 Camp Fire in California, with 85 fatalities [23].

In the aftermath of the 2018 Mati forest fire [24], there was a series of actions at national level in order to improve disaster management policy which included, among others: the establishment of an Independent Commission to investigate the prospects of future forest and rural fires in Greece (Prime Ministerial Decision Υ60 Government Gazette 3937/΄ Β/2018), the issuance of a legislative decree on the Establishment of a National Mechanism for Crisis Management and Risk Management, the reorganization of the General Secretariat for Civil Protection and the Fire Brigade, the upgrade of civil protection volunteering (Law 4662/20/07-02-2020), but also the establishment of the Ministry of Climate Crisis and Civil Protection (Presidential Decree 70/2021) which is now responsible for the management of natural disasters and crises and the response to climate change.

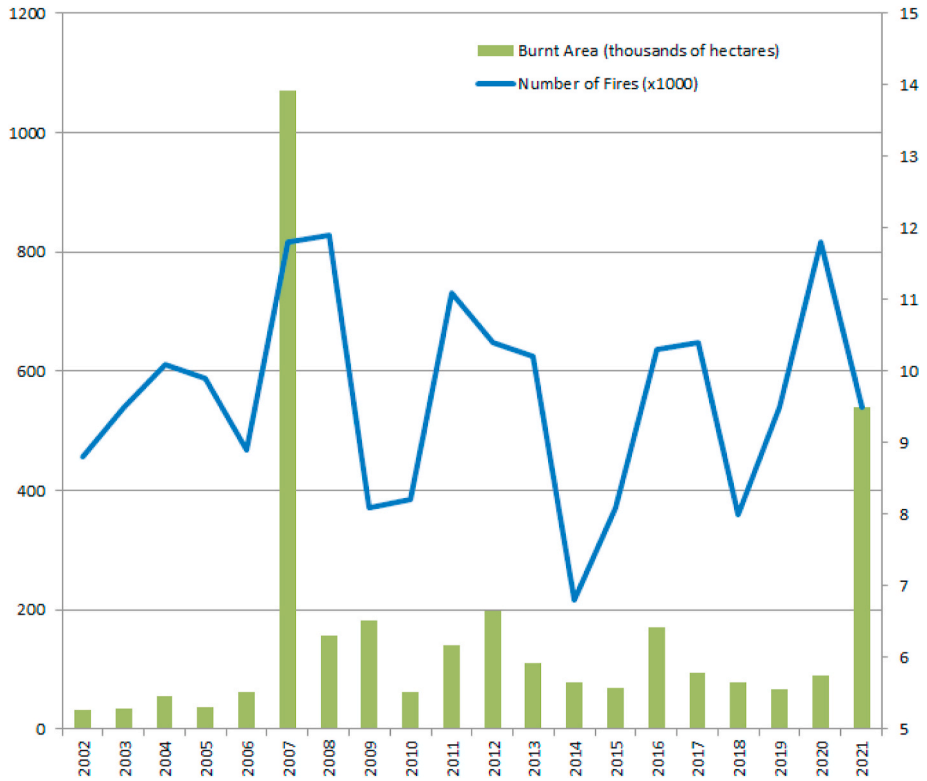

Fig. 1. Number of forest fires and burnt hectares from 2002 to 2021 in Greece [27].

1.2. Early evacuation policy in Greece

In Greece, the decision-making process for early evacuation was instituted a few months after the fatal forest fires of 2007. Early evacuation is the only official Directive when an ongoing or imminent disaster threatens a residential area, it is non-mandatory and it is activated when the risk of staying in place is high (Law 3613/2007 article 18). The US, for example, under most circumstances during wildfire threats implements mandatory evacuations, Canada follows the same policy with certain exceptions (i.e. First Nations reserves), while in Australia early evacuation is recommended, recognizing that evacuation is not always desirable, forcing the residents at high risk areas to have a contingency plan for sheltering in place [25].

More recently after the Mati fire, the responsibility of the decision-making process was confirmed to be based on the suggestions of the fire brigade officer who is in charge *in situ* (Law 4662/2020). Locally, the Mayor is responsible to activate the evacuation plan after considering the suggestions of the Fire Brigade officer who is in charge *in situ* and given that the safe movement of the population has been ensured (see Fig. 2). In facilities such as hotels, hospitals, children's camps, etc. the facilities' managers make the decision whether to evacuate or not in accordance with the evacuation plans of those facilities, provided they have been informed about the progress of the fire by the fire brigade officer. In Greece, early evacuation is not mandatory, unless people face imminent danger, however the authorities are obliged to inform citizens about the risk of staying in place. In case there are people in immediate danger, the fire brigade is obliged by law to activate rescue plans and evacuate them even against their will.

The 2018 Mati fire had a significant effect on evacuation policy, leading to the widespread use of early evacuation as the most appropriate measure to deal with the effects of forest fires. The universality of this policy was evident during the 2021 fire season where instructions for mass evacuations were issued for almost every forest fire that threatened a WUI area irrespective of its severity or risk posed to the community (e.g. 2.000 people evacuated by sea during the Evia fire on 03 August alone).

1.3. The 2021 NE Attica forest fires

From the beginning of 2021 until the end of October 2021, 8.728 fires broke out throughout Greece. Most of the fires took place during August amid unprecedented heat [26], burn a total of 540.000 acres. According to the Hellenic Fire Service forest fire statistics, during the 2021 fire season there wasn't any anomaly regarding the number of forest fires; on the contrary the total area burned was extremely high (see Fig. 1). The period between May and September 2021 was the least windy of the past twenty years, the average temperature was 1.6° Celsius higher than the period's average, and the relative humidity was between 23% and 35% at 15:00 each day. The anticyclonic circulation established in the southwest of Greece resulted in the advection of hot air masses from northern Africa towards Greece causing a heatwave that influenced most of Greece [27]. The present study explores the residents' behavior during a forest fire which broke out on August 03, 2021, at 13:25 at the foothills of Parnitha mountain in Varympompi, NE Attica. The fire destroyed large areas of forest, rural, WUI and urban areas [26]. On the day of the fire in Varympompi the maximum air temperature recorded by the Meteorological station in Tatoi, reached 42.6° Celsius [26]. According to the National Observatory of Athens (NOA) during the first 2 h of the incident, winds with average intensities of 2–4 Beaufort and gusts of 5 Beaufort were blowing in the wider area. The fire spread to the northern suburbs of Athens (i.e., Varympompi, Thrakomakedones, Adames and Tatoi) which belong to the Municipality of Acharnes. According to the national population census of 2021, 108.130 residents live in the Municipality of Acharnes. In Varympompi the fire reached the city square, burning dozens of houses, businesses as well as the forest around the community. The fire got under partial control in the morning hours of August 05. However, on this day, a new forest fire broke out in the area of Vasilika Parnitha near the previous fire and it spread very quickly towards Afidnes burning the entire forest area around the town. The fire reached the Athens-Thessaloniki highway, which failed as a fire break, crossing it and spreading towards Agios Stefanos, Polidendri, Kapandriti and the Marathon reservoir. Furthermore, in Agios Stefanos and Stamata, the fire destroyed dozens of homes and businesses, while a plastics factory was completely consumed. A total area of 79,334 acres was burned (see Fig. 3). and the fire was mostly characterized by Moderate-High burn severity 57.28% [27]. The burned areas were predominantly transitional woodland–shrub (24.17%) and mixed forest (22.16%) areas (see Fig. 4).

The fire affected even those buildings that had a reinforced concrete frame and infill walls once their roofs caught fire and

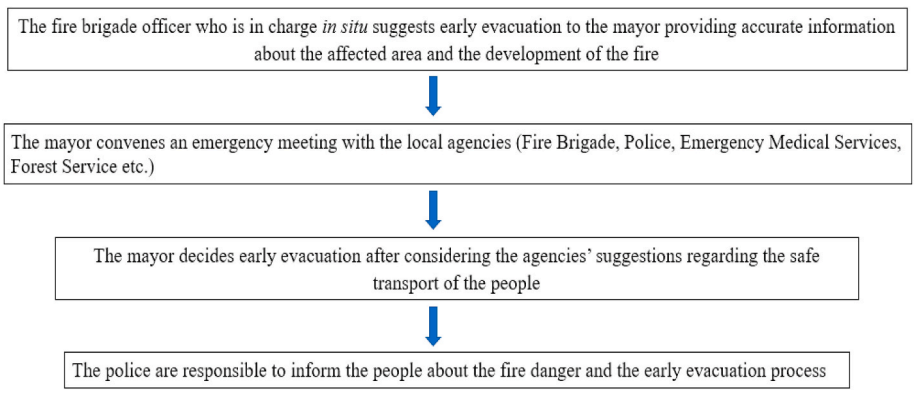

Fig. 2. Flow chart for the early evacuation decision-making process.

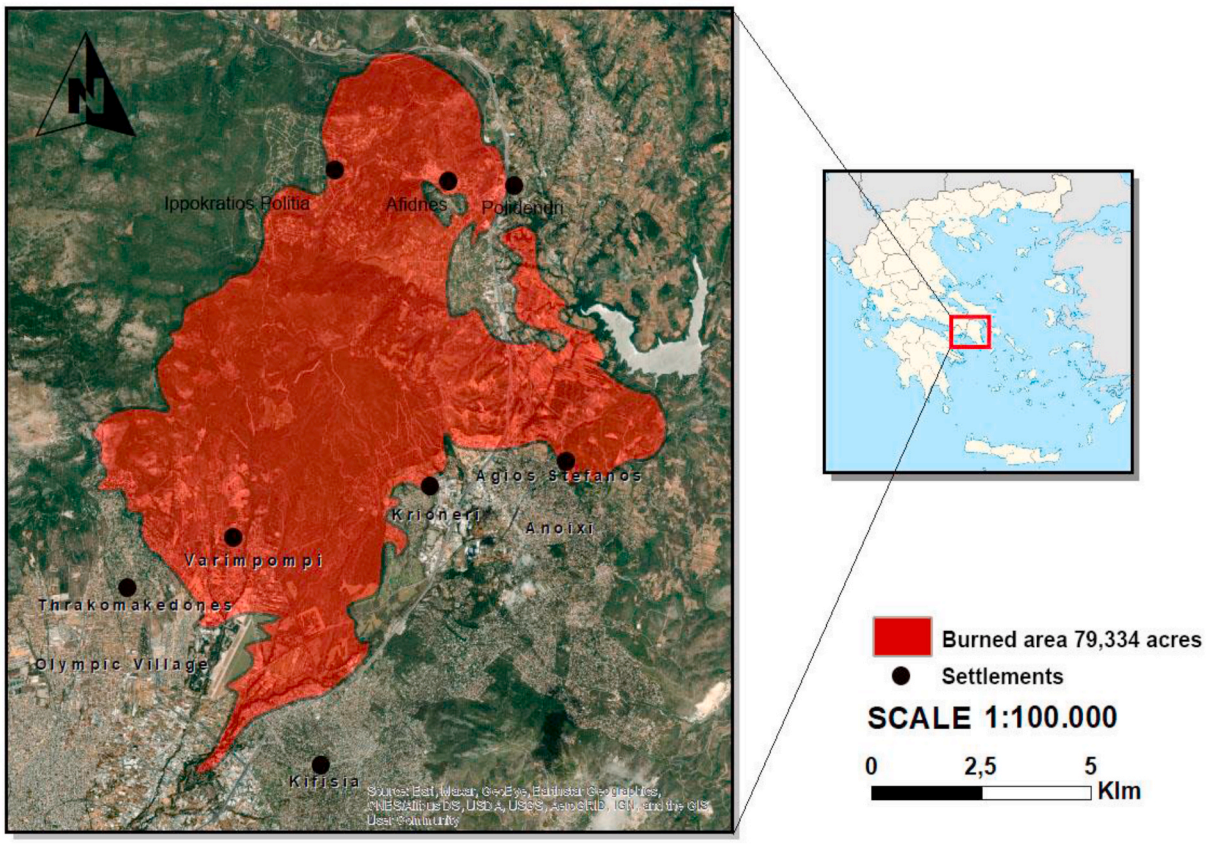

Fig. 3. Map of study area and the footprint of the 2021 NE Attica forest fire (areas shaded red), Attica, Greece.

collapsed, resulting in the burning of the building interior and damage to the household furnishing (see Fig. 5). The damage was attributed to firebrand's attack, radiant heat and/or direct contact with flames due to the existence of high trees in their surroundings [26]. The number of burned liquified petroleum gases (LPG) tanks, also cars and trucks and the melting of the aluminum parts, wheel rims and car windows is indicative of the high temperatures developed during the course of the fire (see Fig. 6). There was no civilian life loss as consequence of the fire, but unfortunately 2 volunteer firefighters were fatally injured due to accidents during the fire and another 2 suffered burns. Whenever an evacuation instruction was issued the evacuation process was carried out smoothly and without incident. The capacity of the local road network was such that no bottlenecks occurred while the fact that the National highway (Athens-Thessaloniki) was nearby helped in the overall movement of people.

1.4. Early evacuation alert messages

In 1991 the Council of the European Union adopted a decision to introduce the 112 pan-European emergency phone number. This

Fig. 4. Example of the land cover that consisted mainly of forest with mature Pinus halepensis trees with thick understory, with many houses built within thick forestland. In several patches the canopy has partially burned [26].

Fig. 5. Building with reinforced concrete frame totally burned after the collapse of the wooden part of the tiled roof, several hours after the fire front had passed.

Fig. 6. Burned tanks with Liquified Petroleum Gas (LPG), also cars and trucks and the melting of the aluminum parts, wheel rims and car windows is indicative of the high temperatures developed during the course of the fire [26].

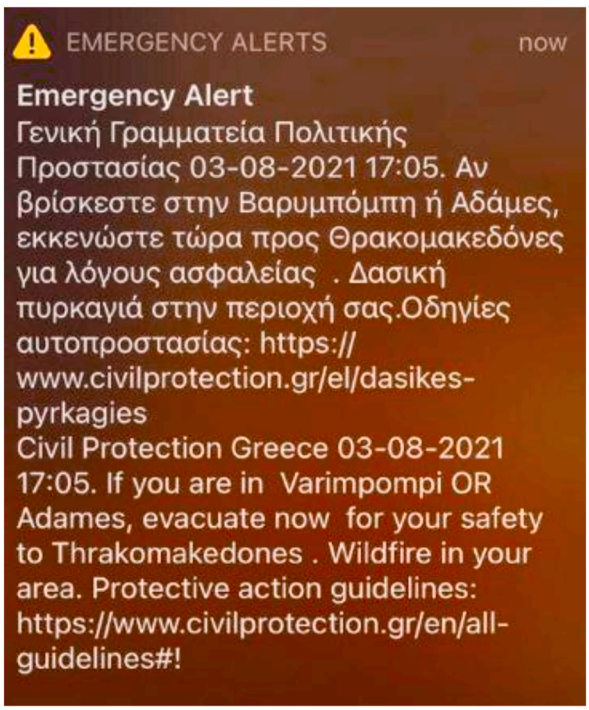

Fig. 7. Emergency alert message sent via 112. The text is written in both Greek and English, asking citizens located in areas approached by forest fire to evacuate, giving specific instructions. «https://twitter.com/112greece/status/1422561070988812291» (accessed March 5, 2022).

service would operate, free of charge, alongside the existing emergency national numbers and both a free of charge inbound component and an outbound component for broadcasting emergency alerts. In 2018 a joint Directive of the European Parliament and of the European Council required that, as of June 2022, public authorities should be able to use mobile networks to alert the population through 112 for an ongoing crisis or an upcoming threat [28]. The 112 service was fully activated in Greece on January 10, 2020, after a 10-month trial period [26].

During the fire season of 2021, the Greek Civil Protection Agency sent 76 text alert messages through the 112 service to warn the communities about the forest fire threat. Out of these 76 messages, 66 of them instructed early evacuation [27]. The Greek Civil Protection Agency sent the text alert messages to warn people to evacuate right after the Mayor of the affected area decided to activate the evacuation plan. The alert messages urged the population of 21 communities of NE Attica to leave their homes immediately and move to safer areas, an example of such a message can be seen in Fig. 7. The messages are always sent in both Greek and English.

The relatively new policy of early evacuation seeks to minimize the possibility of human loss due to forest fires and fortunately, during the 2021 fire season, this goal was achieved. While this policy proved successful, there was strong opposition from residents and the municipalities' civil protection officials claiming that the universal implementation of early evacuation was not the most effective tactic for every incident. Their claims were based on the high likelihood of damage to infrastructure [29], the strong desire of the residents to save their properties, and their potential benefit of utilising human resources along with their equipment during the incidents. This view was later reinforced as people who stayed behind and successfully managed to defend their properties testified that they saw homes of belonging to people that evacuated earlier, being destroyed by small fires as nobody was there to suppress them in time and save their property. While the official guidelines instructed for early evacuation and the alert messages sent through the 112 service instructed recipients to evacuate early, the strong desire to stay and protect, led to variety of different behaviors to be reported.

1.5. Research objectives

This qualitative study is the first part of a two-phase research looking into the evacuation policy in Greece during the 2021 and the 2022 forest fire season and how this was perceived of followed by the recipient citizens. The second phase of the study, reported separately, will focus on a quantitative survey to explore the evacuation planning, field experiences, potential opportunities and strategies to improve future planning of the Municipalities affected by the 2021 and 2022 fires. The current study is looking into peoples' experiences during the 2021 NE Attica forest fire, aiming to enhance the existing knowledge, i.e., why residents disregard official warnings about early evacuation during a forest fire and choose alternatives [30,31], considering in particular the peculiarities of the social and cultural context of Greece. There are always residents who decide to stay and defend or just shelter in place [32] and given the non-mandatory nature of the evacuation instructions, the authorities must accommodate for these behaviors and provide guidance to the residents on how to be prepared and remain safe.

The current lack of understanding of what drives and determines forest fire behavior in residents living in WUI areas in Greece justifies further research, especially in terms of how different indications during the fire influence the decision to evacuate [8] and do not only affect firefighting activities but also how to manage the population.

After examining the events and behaviors of the NE Attica residents that were reported following the 2021 NE Attica forest fire, the following research questions arose:

- What is the residents' risk perception for forest fire hazards?
- What is the residents' preparedness level for a major forest fire event?
- What are the residents' experiences during the 2021 forest fire?
- Is early evacuation the only safe option during a forest fire?
- Why did residents disregard official evacuation instructions during the forest fire and choose alternatives actions?
- Can alternatives to early evacuation be utilized in Greece and if so, under what circumstances?

It is anticipated that a better understanding of people's behaviors as a response to forest fires and improved instructions to accommodate the needs of the residents, from first responders and authorities will produce improved procedures, guidelines, preparedness and community resilience that will provide greater safety to both life and property.

2. Literature review

2.1. Early evacuation and alternatives

Currently, in Greece, the only officially sanctioned strategy for the protection of a community threatened by a forest fire is early evacuation. However, evacuation may not always be the optimal choice for every situation. For example, authorities in other countries apply a different crisis management approach [33]. The term "evacuation alternative" is used to describe any strategy other than evacuation which may include staying and defending, staying and sheltering (i.e., Shelter in Place) or even moving to specifically designated zones which are considered safe (i.e., safety zones) [20]. *Shelter-in-place* can be divided into *refuge shelters* referring to structures that are capable of protecting people from a forest fire, such as schools, shopping centers, sport arenas etc., and *in-home shelters* referring to homes that are built with materials that are not vulnerable to forest fires [33].

The shift to evacuation alternatives reflected a growing body of evidence indicating that (a) many people would not be able to quickly evacuate fire-affected areas, (b) the majority of injuries or deaths due to fire occur during a delayed evacuation, and (c) some residents believe they could protect themselves and their property from excessive damage through deliberate actions before, during and after the passage of a flame front [20]. In addition, implementation of early evacuation tactics from communities which often have

a limited number of exit roads, e.g., townships in mountainous regions or located by the sea [33] can be extremely difficult to organize and very risky to evacuate and therefore alternatives need to be determined.

In Australia, when threatened by a forest fire (bushfire), citizens are given the opportunity to choose between leaving early or staying to defend a well-prepared property [34]. The latter option of staying is only advisable under certain circumstances where the residents are physically and mentally prepared to do so [21]. Contrary to the Australian policy, the US and European policies continue to promote early evacuation as the safest and only measure [35] while discouraging citizens from pursuing other diverging strategies [20].

Adopting alternatives to early evacuation reduces (without completely eliminating) the need for costly and unsustainable forest firefighting practices [36]. However, even if the authorities start to formally promote the alternatives, they must still clearly stress out, in all communications, that early evacuation is the safest option for human life [20]. However, the availability of many alternatives, including people's desire to save their properties, has been shown to discourage early evacuation [21] and therefore putting them at risk at a later stage when evacuation becomes a necessity. In many past incidents people that did not leave early, eventually decided to evacuate due to deteriorating conditions [21]. This delay in evacuation has been shown to be more dangerous than options such as shelter in place [12]. For example, in the catastrophic bushfires of 2009, many Australians lost their lives choosing to stay in their homes but later deciding to evacuate, leading to fatalities; Subsequently, the authorities reviewed their policy, placing emphasis on instructing citizens to leave early instead of staying in place, while improving public wildfire education, weather forecast and emergency alert tactics [37,38].

While the issues associated with finding safe alternatives to early evacuation have troubled the United States and Australia long before the devastating fires of 2009 [26], it is worth mentioning that the instructions to citizens have been transformed many times, usually after every major incident. The unprecedented bushfires that broke out in Southeastern Australia in 2009 prompted, among other things, a careful review of the US and Australian evacuation protocols while suggesting alternatives [20] at the same time. In Europe, after the fires of Portugal in 2017 and Greece in 2018, the need for preparation and better education of the general population about the required forest fire preparation and response actions was highlighted [22,24]. A review of forest fire deaths in Australia and the United States shows that even policies that provide detailed guidance to the public on safeguards and alternatives cannot mitigate all the uncertainty caused by a forest fire [20]. So, every policy, must be examined carefully for its consequences before it is put into practice [33].

2.2. Human behavior

The impact of hazards on the human environment is not easy to separate from the effects of human choices and actions [39]. For this reason, during the emergency planning stage, the authorities should carefully consider the public's likely response to a hazard [40]. According to Auf der Heide [41], the practice of studying human behavior in disasters and forming a plan based on observations, is considered more effective than establishing a specific plan and then requiring people to comply with it.

The choice of a person to live in an area that is more prone to hazards puts the person at higher risk [42]. In WUI areas that are extremely vulnerable to the risk of forest fires, citizens are forced to answer the crucial question to leave or stay to protect their properties. The question for citizens arises because, in many countries, evacuation is not mandatory and the desire to protect their 'life's investments' or their neighbor's is very strong.

Contrary to the advice of fire experts for early evacuation [8,21], some people choose to stay and actively defend their homes or find shelter inside a building or in an open space [43,44]. As a result, the authorities cannot assume that the residents will evacuate swiftly after receiving the warning message [45,46]. Furthermore, the resident's response time depends on the quality and the flow of information and peoples' trust in the civil protection authorities and their ability to respond to the crisis [47–49].

However, in addition to the obligation to warn residents to flee as soon as possible, the authorities must take care to ensure the protection of those who choose an alternative option [8]. Lack of acknowledgement of human choices when they are threatened by fire, as well as what affects them, deprives crisis managers of valuable information to reduce the risk to civilians as well as first responders [8]. Previous research suggests that there are two predominant categories that influence human evacuation behaviors: (1) Preparedness levels before a fire occurs, (2) how the residents perceive the severity of the fire and how they interpret and respond to the authorities' instructions [50,51].

Research has increasingly shown that different local contexts of residents living in areas vulnerable to forest fires can influence their preferences for evacuation or alternatives, including employment in nature-related occupations, previous fire experience, risk perceptions, housing development patterns, community standards or practices and relations with emergency management professionals [30,52–55].

Evacuation alternatives are also found in cases where the residents are affected either by the preventive actions of the neighbours (cleanings, firefighting systems, etc.) or by other people's reactions at the time of the fire [55–59], or when the fire conditions change, and evacuation is not the safest option [60].

Few studies have been able to correlate the decision to stay with mitigation measures [8]. The researchers found that those who planned to stay and defend their property were more likely to have taken some precautionary measures [31,61,62]. The better prepared residents seem to know more about fires and are more capable of adopting protective measures for themselves and their property than those that are not prepared [63]. Experience from past fires can have a positive effect on future protective actions [8]. Those who survived previous fires are less inclined to leave and evacuate in the future incidents [64,65]. Those who were late to evacuate were found to be less prepared than those who stayed but fought [65]. The residents' perception of the fire conditions in combination with the warnings of the authorities for early evacuation is crucial for them to leave on time [51], however there is little literature that connects the development of events with peoples' decision [63].

Residents of WUI areas stated that they have thought about what actions they will take, but it depends on the conditions of the fire and their perceived danger [66,67]. It is very common to employ the tactic of waiting and evaluating the situation (wait and see) [67] both for those who chose to stay and fight and fleeing as their last resort [68], and for those who remain passive without having taken any preventive measures. However, a large evidence base of research has shown that last-minute evacuation results in human loss or entrapment [69,70]. The part of the population who "wait and see" or don't take precautionary measures requires further assessment because they face greater risk [68,71].

3. Research methodology

3.1. The qualitative research

This research will expand the knowledge about the way people in Greece respond to official warnings for early evacuation in order to improve the evacuation policy and the procedures for the next forest fire seasons. It is worth mentioning that early evacuation is habitually applied in Greece after the 2018 Mati fire, so there are not relative publications.

A qualitative research methodology is chosen because of the necessity to explore and gain an in-depth understanding of subjective perceptions, beliefs, feelings and experiences of the individuals affected by forest fire, in order to create a deeper, more complete and more elaborate knowledge of human behavior during a forest fire [73,74]. Furthermore, the qualitative approach allows for the identification of non-typical and unexpected behaviors, information which is extremely useful to emergency managers in their effort to continuously improve contingency plans.

The advantage of a quantitative approach is that it gives the opportunity to measure the reactions of a great many people to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This gives a broad, generalizable set of findings presented succinctly. By contrast, qualitative methods typically produce a wealth of detailed information about a much smaller number of people and cases [72]. This increases the depth of understanding of the cases and situations studied (understanding uniqueness of the human experience) but reduces generalizability [72]. Qualitative inquiry typically focuses on an in-depth analysis of relatively small samples, even single cases (N = 1) selected purposefully [72], while quantitative methods typically depend on larger samples selected randomly. Qualitative findings may be presented alone or in combination with quantitative data. Ideally, qualitative analysis can be favorably supported with quantitative data, thereby facilitating the possibility of applying aspects of the method to other similar studies.

This article proposes that narrative approaches [75], can help us address the issues raised above, contributing to the ongoing discussion on the subject. Narratives can capture ambiguity, complexity and multiplicity; they can illuminate a great deal about the personal but also the social and cultural context [76]. Narrative style describes in more expressive terms the subject's experience of a phenomenon and doesn't remain in the impersonal, abstract language of statistics and formalistic models.

This form of interview is based on people's everyday competencies to narrate their own experiences and its main goal is to generate genuine, authentic and detailed accounts rather than brief answers, or general statements [77]. The present study aims to explore the residents' experiences, response, and concerns during the 2021 NE Attica forest fire, whose voices might otherwise go unheard or unnoticed [78].

Table 1
Participant demographics and summary behaviors.

Variable name	Variable definition	Descriptive statistics			
		N	Range (response frequency)	Mean (SD)	
Age	Age of respondent	12	24–77	53,5	14,98
Sex	Sex of respondent	12	Male (83,3%) Female (16,7%)		
Education	High school	12	3 (25%) 9 (75%)		
Residency	Full-time resident (years)	12	1-10 (25%) 11-20 (66,7%) Above 20 (8,3%	14	9.01
Training	Fire prevention, evacuation Firefighting	12	No (100%)		
Fire experience		12	Yes = 2 (16,7%) No = 10 (83,3)		
Evacuation-based cues	Evacuate early Stay and defend Went home and evacuated later Went home and stayed to defend Evacuated early but later went back home to defend Went home, evacuated nearby but then went back home to defend	12	3 (25%) 2 (16,7%) 1 (8,3%) 1 (8,3%) 3 (25%) 2 (16,7%)		
Trust in Evacuation	Trust in Municipality agencies' ability to orchestrate evacuation	12	12 No = 11 (91,7%)		

3.2. The sample

The strategy of purposeful or judgmental sampling was applied in order to best serve the purpose and questions of the research [74, 77], i.e., to identify what Patton (2002:230) calls *information-rich cases* [72]. Studying *information-rich cases* yields insights and in-depth understanding rather than empirical generalizations [72].

The sample size includes twelve (N = 12) semi-structured interviews from residents of NE Attica communities who had been warned to evacuate early during the 2021 NE Attica forest fire. The aim is to conduct an in-depth analysis of the residents' behaviors [79] to answer the six research questions which were mentioned in section one.

Snow-ball or chain sampling technique [79,80] was used, looking for key-individuals with the same characteristics i.e., NE Attica residents who had experienced the 2021 NE Attica forest fire that refused to evacuate and possessed the social network to enable us to locate other people who acted in a similar way.

The process began by asking a well-situated person ″Who else experienced the 2021 NE Attica forest Fire? Whom should we talk to? ″. By asking a number of people, the snowball gets bigger and bigger as we accumulated new *information-rich cases* [72], without knowing though in advance who would provide us with significant information. We acknowledge the differences between genders in decision about evacuation [82]; however, the snow-ball technique didn't lead us to interviewees proportional in gender to the general population but rather to the ones who disregarded official warnings to early evacuation. As a result, gender pattern didn't affect the scope of this study. The study was completed when the sample provided sufficient and quality information (saturation) [81] in answer to the six research questions.

While the analysis is not quantitative, the data presented in Table 1 serves to form a better picture of the participant demographics and their summary behaviors.

3.3. Thematic analysis

Initially, two recorded pilot interviews were conducted, which were not included in the study, in order to familiarize researchers with the process, improve the details of the interview [83] and correct the interview guide [84].

Then, six (6) interviews were conducted with pre-arranged visits to the interviewees' homes while the other six (6) interviews were conducted via telephone. The mean duration of the interviews was 1 h and 20 min, the minimum time recorded was 1 h and 09 min and the maximum 1 h and 30 min.

All participants answered all questions. The first interview was taken in person, in Polydendri on 17-08-2021 and the last in Afidnes on 20-09-2021. The selected participants were briefed on the subject and purpose of the research, the researchers' commitment to anonymity and adherence to the code of ethics [83].

Informal conversation was conducted as a warm-up before each interview. Once the interview was over, an informal debriefing took place. An interesting point, that also shows the engagement and interest of the participants on the subject, was that at the end of the interview almost all of the participants asked about guidance on how to prepare their property, family, and themselves from future forest fires.

The interview started with a general question about the 2021 NE Attica forest fire that was formulated in a way that invited extended narration and encouraged residents to begin relating their stories (chronological order optional) about experiences, events and insights that were meaningful to them. The participants were not interrupted, and they took longer turns talking than what is expected in ordinary conversations. The interviews were conducted by one of the researchers who tried to listen in an emotionally

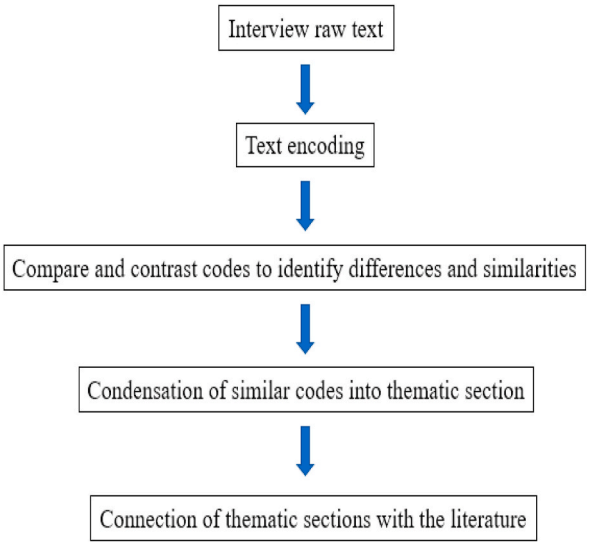

Fig. 8. Flow chart for the thematic analysis. The present study adopted a case-centered thematic analysis of individual stories placing primary attention on content [76].

attentive and engaged way.

The interviews were digitally recorded and later transcribed verbatim into Greek for further analysis. The data consists of verbatim quotations with sufficient context to be interpretable, it does not include judgments but just describes what occurred during the interview [72].

In constructing the transcripts, there was an effort to capture both the tone of voice and visual expressions of the participants as well as the interactional context which was important in analyzing and interpreting the stories [76].

For the safe conduct of the research and for scientific documentation, an interview guide was prepared, which contained indicative questions. For the purposes of the interviews, the researchers focused and attempted to address a list of seven (7) points to provide some structure and obtain the required information from the participants. This was necessary to prevent both participants and researchers from being distracted by the flow of the interview and veer off topic. Nevertheless, the discussion was open in order to record information that might strengthen the research [74].

In particular, the seven (7) points in the list were:

1 demographic information, 2. Fire prevention measures taken by the participants, 3. Self-evacuation plan, 4. Receiving-providing information during the fire 5. The fire chronicle, 6. The contribution of the municipality while implementing the evacuation plan, 7. Improvement measures – proposals.

After the completion of the interview process, the audio recordings were transcribed into written text. At the transcription stage, the participants' oral speech was accurately reproduced without correcting errors, digressions or repetitions. The written material was then moved to the next research stage, that of qualitative content analysis (text encoding) in an attempt to interpret the data and give it a conceptual definition [74,77,85]. The research material was analyzed and evaluated according to the process of thematic analysis (see Fig. 8), which was used to explore perspectives among interviewees and identify common themes [79,85,86]. To do so, it was important to examine carefully the texts transcribed, get familiar with them and identify the critical points which provide information about each research question (see example in Table 2). Finally, condensation of similar codes into thematic section was conducted and this was then connected with the literature.

3.4. Limitations

This study, conducted regarding the 2021 NE Attica forest fire, is limited by a sample consisting mostly of men. However, it is worth noting that the size of the sample was also dictated by practical reasons, as the cost and especially the time required to collect and analyze the qualitative data would make a very large sample extremely difficult to manage. The findings should be applied with

Table 2
Text coding (example).

Text	Codes
Q: What did you do after you received the warning message to evacuate early? A: *We received the message and then gathered a couple of basic things and left immediately. I took my mother to a relative's house in Athens, wanting to make sure she would not stress. She is old, and if we were together, we would be afraid and not able to help each other. We did not stay because there was danger; I was not interested in anything but my own life. I didn't evacuate early because when I received the message, I saw the fire very far away. I did not decide to leave the house because I had my pets there; until the last moment I thought that the fire would*	Early evacuation without delay Concerns about family members' safety High risk perception/self-protection Low risk perception Concerns about animals' care safety Wait and see
stop, it would not arrive at my house and we would not have to leave. *The policeman who came was screaming saying'' that I did not understand, the fire would surround me, and I would not be able to leave''. I got into the car and went three plots further, and I was sitting there, hiding, to see the development of the situation. When the police went elsewhere, I returned to fight the fire.*	Low risk perception despite police warnings Hiding from the police in the fire zone waiting to see Hiding from the police and returning home to defend

caution, as the experiences of residents who experienced evacuation in other geographic areas were not represented in this study. What would strengthen this research would be a quantitative survey with a bigger sample from other Greek regions compared with findings from other studies in other countries with similar conditions regarding the occurrence of forest fires. It is also limited by the fact that the authors did not have the opportunity to validate the information that was provided by the interviewees.

4. Results

4.1. Main themes and subthemes

The oral narratives of the residents include seven main themes and five subthemes (see Fig. 9). The subsequent sections will examine each theme in turns. The translations are as close as possible to the Greek original.

4.1.1. Theme 1: the residents' risk perception of forest fire danger

The participants interviewed in this research live in predominately WUI areas of NE Attica. Fires are part of their lives, especially during the summer. However, the degree to which fires affect people and at the same time raise their awareness of fire protection issues varies. Ten out of the twelve participants were found to anticipate that at some point during the forest fire period (May 1st to October 31st), a forest fire would likely start at their place of residence or reach and consume it as it progresses. The thought that a fire can spread uncontrollably and threaten themselves, their families and their property causes continual concern and constant stress, however, it seems that the evolution of the 2021 NE Attica forest fire in particular surprised most residents. More specifically with

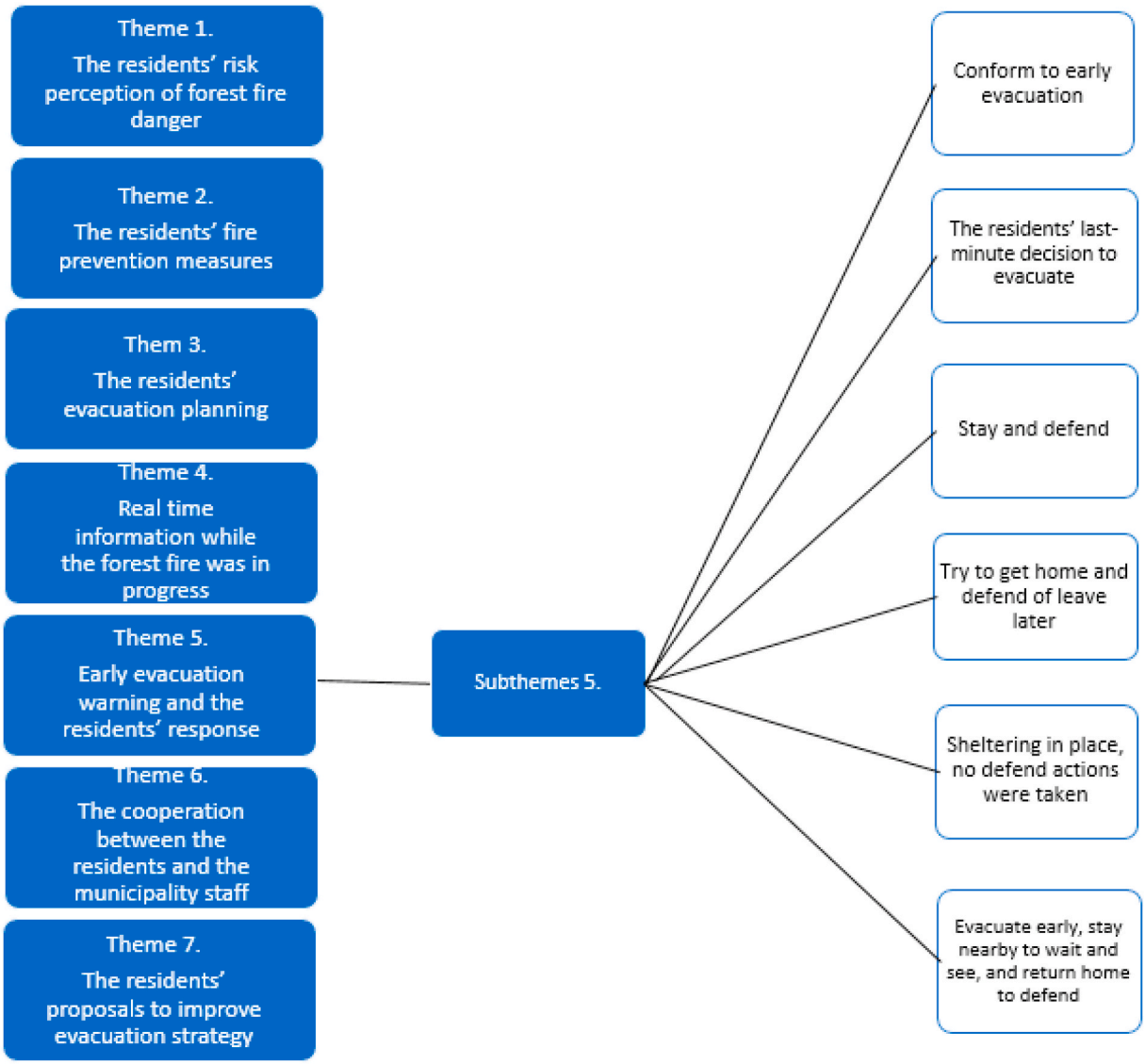

Fig. 9. Main themes and subthemes. *The oral narratives of the residents.*

Fig. 10. Concrete dwelling, the land around was clean from vegetation. There were no house damages from the fire despite nobody staying to defend. In addition, the panic room in the basement worked well but the residents decided not to use it out of concern about their safety.

Fig. 11. The fire front was moving downhill to the village of Afidnes.

> Right away, my wife and I went to the village square. There was a fire engine and we begged the firefighters to come with us. They refused, claiming that it was useless and very risky to go and save our house. Then we told them that we would go for sure to defend and they decided to came with us. Also, with us came a neighbor who was a volunteer firefighter. When we arrived at the house, the firefighter jumped the fence because the door was electric and out of order and in about 5 minutes he put out the fire. We entered the house, turned on the generator and saved the house. If we hadn't returned the house would be burned (see Fig. 12). (male, Ippokratios Politia).

regards to residents' risk perception, they reported (samples):

> *I had thought that the forest would definitely catch fire at some point. As the property was in the woods* (male, Afidnes).
>
> *I was constantly anxious and aware of the possibility of fire* (male, Polidendri).
>
> *I had always been afraid of fires, I had always thought of where the fire would probably come from, but I never expected this development* (male, Thrakomakedones).

In addition to densely forested areas, the 2021 NE Attica forest fire spread into plains with relatively sparse forest vegetation. This development troubled even those who felt 'safe' in their chosen location of residency, as it has been characteristically mentioned:

Fig. 12. House saved at the last-minute by firefighters and the owners. The resident suppressed the fire using his own fire pump and hoses.

> *We chose to live in the plain because we feel very safe, we know the roads, we have options; if you go to live in the mountains or in the forest you risk being burned. I did not feel that I was in danger because I had a water tank, 25-meter fire hoses and because there were no pine trees close to home either. However, other trees that I did not expect caught fire* (male, Kapandriti).

> *I had thought for sure that at some point it would catch fire, but it had not even crossed my mind what eventually happened, that is, to be extinguishing fires for hours* (male, Afidnes).

Some participants describe themselves and their neighbours as "indifferent", refusing to admit that they are in danger, not because the environment is actually safe or because they have confidence in the authorities, but because they seek to avoid negative thoughts and are in denial of probable danger. Despite the fact that forest fires are a recurring phenomenon affecting large communities, when a fire breaks out in their area, the event is described as "unexpected" and therefore surprises them. What is of extreme interest is the testimonies indicating that some people remain indifferent despite the neighbours' prompts for the need to upgrade the level of fire protection and preparedness.

More specifically, they mentioned:

> *Those who go to live in forest areas, usually do not care about fires, the fear does not work in them; even though they live in a country that has been burning for 200 years, they consider fires to be something unexpected. I did not feel that I could be in danger, but that did not mean that I had faith in the authorities. "Man does not want to make negative thoughts." Few neighbors are aware* (male, Kapandriti).

4.1.2. Theme 2: the residents' fire prevention measures

All interviewees, when asked about fire protection measures, answered that the first thing they did was to clear their plot of vegetation (fuel). They all pointed out the importance of land clearing, which is mandatory by law while at the same time they expressed their strong dissatisfaction for non-compliant residents. A general feeling of frustration emerged from the interviews because of the Municipalities' inefficacy to address the issue of the residents who did not clear their plots/or gardens. Land-owners within organized communities are obliged to have their plots cleared every year by April 30, otherwise the municipality must impose a fine (Fire Provision 20/2020). Furthermore, the municipality itself is not exempt from clearing public land for the same reasons.

In Greece some Municipalities do not include any forested areas whatsoever whereas others are entirely made up of forests. Low public funding for land clearings in Municipalities with WUI areas, lack of personnel and resources towards this purpose in conjunction with the inherent difficulties in cases of fenced properties (the authorities need a District Attorneys warrant to enter the property) make the issue problematic and everlasting.

> I had cleared my plot (see Fig. 10); that was the main reason my house was saved (male, Afidnes).

> We had been studying what to do, we knew we had to clear our plot for that and this year in May and July we had cleaned twice. What we did, thought there was no response, was to call the Municipality several times and pressure them to clear the surrounding plots with our most recent attempt being 3 days before the fire of 03/08/2021 (male, Afidnes).

> We called the neighbours last year and again this year to persuade them to clear their plots but there was no response; this issue is critical (female, Afidnes).

Some citizens had even installed fire protection systems in their homes (e.g., sprinklers, water hoses) but their use turned out to be ineffective for the circumstances of the 2021 NE Attica forest fire. The residents believe that some of the factors that contributed to their ineffective efforts to protect their homes were the inadequate preparation, which was mainly due to the lack of guidance from experienced professionals. Furthermore, coincidental positive experience feeds confidence (without proper experience), confidence feeds compliance and this can lead to tragedy. The following accounts attest to this issue:

> I had thought of how to deal with the fire, to be supplied a pump with a water tank of three cubic meters, which I had connected to a generator. In the process it turned out that in this fire I was not prepared to fight the fire with hoses; I was also scared and decided to leave (male, Thrakomakedones).
>
> In case I needed to, I had a swimming pool and a pump, which, as I saw in practice, had no chance of success. We cannot do much if we are not well-trained (male, Tatoi).
>
> The neighbours turned out to be inferior; while they had swimming pools, no one was prepared to deal with an actual fire. Of the 25 houses there are here, we can't be the only ones to try to fight the fire. There is absolutely no official information on what we should do when there is a fire (male, Kapandriti).

For some residents, concrete dwellings and open deforested areas were seen as shelters to resort to in the event that firefighting efforts would not work and last-minute evacuation would put them at greater risk. However, they did not get to test this measure because they evacuated early, as indicated by the following account:

> What I had done was build a concrete panic room that seals. It worked fine because, while ten days after the fire the whole house smelled of smoke, it was the only room in the house (see Fig. 10) that did not smell. My brother and I intended to stay until the last minute and, in case we had a respiratory problem, enter the room. Of course, we did not use it because we needed to leave earlier (male, Afidnes).

4.1.3. Theme 3: the residents' evacuation planning

Most residents prioritized the transfer of vulnerable members of their family while assuming the responsibility of staying to fight the fire, for example:

> *I had moved the family early; there was no evacuation plan for me; I would not leave because I had the basement, it was all cleaned-up, the smoke and fire would be extremely difficult to get there* (male, Afidnes).

The experience of previous fires that had had a less severe course and did not force citizens to leave, acted as a deterrent to having evacuation as an option for the August 03, 2021 NE Attica fire, for example:

> *I had never thought that I would leave, we had experienced a fire and the only thought we had was that maybe we would have to leave by making the decision ourselves; we had not reached the point of such an intense fear of evacuation that the authorities would ask as to walk away* (male, Thrakomakedones).
>
> *I had imagined that we would need to evacuate, but I did not expect that we would have a problem in the center of the village* (female, Afidnes).

Residents who in the first theme described themselves and their neighbours as "indifferent", when asked about the evacuation plan answered:

> *I had not taken any preventive action, neither I, nor the other residents of the area; I did not want to think that I would ever have to leave. It had never crossed my mind that I would have to leave my house in order to* save *my self; maybe I would have had the evacuation plan as an option if before the fire someone had informed me of the dangers and guided me towards drawing up a family evacuation plan* (male, Polidendri).

There was also the conviction of being able to flee at the last minute, which was attributed either to the good knowledge of the area, the availability of escape routes, the excessive confidence in their abilities and the means of firefighting they had engaged in or to the fact that there was a shelter that they could use in case of entrapment. For example:

> *I could never have imagined it. I would never leave; it is a matter of my mentality. Certainly, the plan was and still is for the two women to be ready to leave with the cars and go wherever they thought they would be safe and for me and my sons to stay and fight the fire. To be alone would not make sense. The only case that I would have given up was if I hadn't had water, gasoline, and if the pump had malfunctioned; there was no way I could have remained passive* (male, Kapandriti).

It is worth mentioning that his wife and daughter evacuated early by car. They didn't have an evacuation plan to find refuge, so they were driving nearby the fire zone. At some point they believed that suspicious-looking people were scanning the area, fearing attempts of looting, so they decided to drive back home and shelter in the house.

4.1.4. Theme 4: real-time information while the forest fire was in progress

During the 2021 NE Attica forest fire, television, radio, websites, social media as well as the European emergency number (112) provided only general information relating to the incident, forcing residents to also turn to informal sources for information, such as people they perceived as trustworthy, relatives, neighbours or even firefighters they knew. The great problem of the official warning lies in the clarity of the message and the instructions that should be given at the time of the evacuation by the authorities. Another critical issue is the failure of electricity and telecommunications infrastructure during fires, meaning that people may not receive warnings and information. Almost all of the interviewees had used the tactic of "wait and see" before they actually acted upon the fire cues and the information they received. This tactic was extremely dangerous because the decisions they made were mostly taken at the last minute and were based on their instinct and not on the official warnings for early evacuation. This tactic inadvertently limited their

available options when the conditions had already worsened when they attempted to start evacuating. Example accounts include:

> The only way we were informed was through a neighbor who often went near the fire front in his car and watched the fire unfold. We had received many messages from 112 for evacuation but there was no information on where to go (male, Ippokratios politia).

> *The information I had was from watching TV, the emergency alert from 112, the internet and because I personally drove and walked in order to see how far the fire was, so that I could estimate how much time I had at my disposal* (male, Thrakomakedones).

> *We tried to exchange information with the neighbours; I was also informed on the phone by friends who lived in the area were the fire was already in progress* (male, Polidendri).

> *There was no official source to get proper information from, (e.g., emergency hotline), social media is not reliable; I called my son, who is an adult and was on vacation at the time. He then contacted a friend of his who was a firefighter candidate for advice and afterwards instructed us what we should do, which was contrary to the neighbors' opinion* (male, Polidendri).

4.1.5. Theme 5: Early evacuation warning and the residents' response

The residents' behaviors after the official warning for early evacuation are varied.

These behaviors include:

4.1.5.1. Subtheme 1: conform to early evacuation

> *We received the message and then gathered a couple of basic things and left immediately. I took my mother to a relative's house in Athens, wanting to make sure she would not stress. She is old, and if we were together, we would be afraid and not able to help each other* (male, Thrakomakedones).

> *We did not stay because there was danger; I was not interested in anything but my own life* (female, Afidnes).

> *My neighbor has a swimming pool, a pump and fire hoses ready for use, but left because he was not totally sure about his safety while fighting the fire* (male, Afidnes).

4.1.5.2. Subtheme 2: the residents' last-minute decision to evacuate

> *Psychologically I was affected by the whole surrounding atmosphere; I knew I had to leave, I had received a message but I waited until the last minute; I was trying to delay it so that the fire would not reach me or that I could* save *something* (male, Polidendri).

> *I didn't evacuate early because when I received the message, I saw the fire very far away. I did not decide to leave the house because I had my pets there; until the last moment I thought that the fire would stop, it would not arrive at my house and we would not have to leave* (male, Kapandriti).

4.1.5.3. Subtheme 3: stay and defend. All interviewees ensured the removal of their family members out of the dangerous area before staying to defend their properties.

> *The policeman who came was shouting at me for not understanding, saying that the fire would surround me and I would not be able to leave. I got into the car and went three plots further, and I was sitting there, hiding, to see the development of the situation. When the police went elsewhere, I returned to fight the fire* (male, Afidnes).

> *I drove them all away; my sister, the children, my brother-in-law. My brother-in-law is the same age as me, but he is not used to this kind of situations. When I saw him sweating, I drove him away; I could not take care of him as well* (male, Afidnes).

4.1.5.4. Subtheme 4: try to get home and defend or leave later

> *I could not stay in a relative's house and leave my property exposed. When I returned, I saw hot spots and put them out so they would not develop* (male, Thrakomakedones).

> *The first time we got back without a problem, picked up a few things, our pet and two luxury cars we had in the garage and left for a safe place. The second time, we were stopped by the police, but we found another way back home through the fields. We had put wet towels on our faces and tried to find ways to minimize the exposure of the house to the fire. The police passed by four-five times in a span of twenty minutes, we hid from them, but we left later; the fire had got very close, and it was really scary* (male, Afidnes).

> *Surely other houses would have been saved; the area is a plain, there was only low vegetation and no trees, you would have been able to extinguish any spot fire with just a branch. the houses got on fire from the grass and spot fires* (male, Afidnes).

> *I returned home, removed my family and then went back. The police came 5–6 times and did not tell me anything because I was wearing Civils Protection jacket. If I had left the house unprotected after the fire front had passed, the house would have burned down* (male, Tatoi).

> *A neighbor of mine who was well-equipped saved his property. When the police arrived at his house, he ignored them and didn't even open the door* (male, Afidnes).

4.1.5.5. Subtheme 5: sheltering in place, no defend actions were taken. There were testimonies of residents who remained locked inside their homes without giving signs of life to the calls of the police, ignoring the development of the fire.

> My husband, who is the village doctor and at the same time a municipal councilor, was among the last to leave. Together with the police they went to forcibly remove people with disabilities, who refused to leave. They were patients of his, so he knew they had a problem, called ambulances and arranged their transportation with the help of the police (female, Afidnes).

> After the warning, Thrakomakedones was like a ghost city; many had left, and others had been locked in their homes without giving signs of life and without a sense of danger. For example, my neighbor ignored the danger, did not want to leave and decided that she should be locked inside with her children while her husband was away (male, Thrakomakedones).

4.1.5.6. Subtheme 6: evacuate early, stay nearby to wait and see, and return home to defend. A lot of people decided to evacuate early without abandoning the area completely, staying at a spot where they could observe the development of the fire. This tactic, coupled with the low wind intensity (2–4 Beaufort), compelled them to act against police warnings and return to their houses to defend, believing that the slow fire spread would make firefighting possible.

> Around 17:30 to 18:00 the police came and chased us away although the fire was far away, we were in the village of Afidnes and the fire was not even in Drosopigi, not even Ippokratios politia. I left, my wife was driving to come home from Serres (582.2 km North from Athens). They forced me to evacuate temporarily, not far away from home, near the national highway (Athens-Thessaloniki), many residents had parked their vehicles there watching the fire. Three hours later my wife arrived there and we stayed to watch the fire. The next morning around 06:00 the police came again and forced us to evacuate for the second time towards Oropos or Varnavas. Many residents refused to evacuate. We told them that our house was exposed to fire and even if it was burning we wanted to smell it, so we would go to save it. At exactly 06:00 we could see the fire right above our house (see Fig. 11). We could locate where our house was. A neighbor went there with his car to have a better view of the fire and when he returned he told us that our house was on fire (male, Ippokratios Politia).

4.1.6. Theme 6: the cooperation between the residents and the municipality staff

When the degree of the municipality's involvement in managing the crisis was mentioned most of the interviewees reacted in anger, raising their voice, using irony or dismissive language to describe the municipality's actions, for example:

> *I have no demands from the municipality; I would be naïve if I believed that the non-competent could organize me. They cannot find solutions to simple and daily matters; will they be able to guide me in a state of crisis? The mentalities cannot change; even though the whole country is burned every year we still don't take measures* (male, Polydendri).

> *I don't expect much from the municipality; what I can tell you know is that they are completely disorganized. For example, they don't even clean the towns property (land), can they force people to clean theirs?* (male, Afidnes).

4.1.7. Theme 7: the residents' proposals to improve evacuation strategy

There is absolute agreement among the interviewees that the protection of life is the highest priority. However, there is disagreement about the universal use of early evacuation tactic, claiming that many houses were destroyed by small fires many hours after the fire front had passed. Examples statements include:

> *Listen to me, my opinion is that the authorities made a big fuss out of it; they were afraid because of the precedent with the fire in Mati 2018, but this fire was nothing like it. From here you could leave even at the last minute; I wonder whether we would have been able to leave if everyone had stayed there, but at least they could have removed the women and children and let the men stay* (male, Thrakomakedones).

> *I had expected this fire; I had predicted that it would be impossible to extinguish once it ignited. Just think of the possibility of being homeless from one day to the next. If I had left the house after the fire front had passed, the house would have burned to the ground. A lot of houses burned after the main front of the fire had passed, because things that were slowly burning around; A wooden fence, a wooden piece of furniture, a pergola, a water hose that was slowly melting, a lot of damage was done after the fire. Honestly, I was annoyed to see damage and spot fires after the main fire. There were spot fires and a house was burning; that's just wrong, it's tragic. Many properties were lost like that, I lived it, I saw it in front of my eyes, I put out spot fires, I did this job for 4–5 hours* (male, Afidnes).

> *It's just that with evacuations, I think they should not be done in this way and so universally. Let the children go, let the women go, let the elderly go, but for some people under 40–50 years of age who have experienced fires in the past, who have been past members of civil protection, at least let them protect their home; let me tell you something; truth is, if you force someone to leave their house against their will, they are likely to return, and it is more dangerous to drive back through the flames* (male, Tatoi).

The proposal that prevails is the timely removal of the vulnerable population and that the people who have the ability (skills, equipment, training etc.) should stay, defend their properties or assist the fire brigade.

5. Discussion

The present study adopted a narrative perspective and analysis to explore the residents' behavior during the 2021 NE Attika forest fire. People's stories portrayed a variety of experiences, beliefs, practices and concerns about forest fire risk and evacuation strategy,

confirming the findings of other studies [8,46,51,55,57]. The data analysis offered insights into human behavior which on several occasions does not comply with the authorities' expectations and instructions, into the people's lack of trust in those instructions, and into understanding the 'wait and see' tactic and the reason why people don't take fire prevention measures.

Furthermore, this study contributes to the research literature offering information about how a sample of residents affected by forest fire in Greece respond to official warnings for evacuation and can provide a basis for examining personal choices and information about social and cultural differences.

We found that the residents of NE Attica know very well that they live in a vulnerable area, and most of them believe that at some point they and their houses will be exposed to great danger due to a major forest fire. However, although the residents recognize that they live in a dangerous area, they don't take protective measures at all or the ones they had taken proved inadequate during the 2021 NE Attica forest fire.

According to the research findings, the residents' fire protection measures weren't effective because they were lacking in the necessary fire experience and training. Another important significant factor was that there hadn't been any form of instructions on behalf of the authorities prior to the fire regarding house strengthening, use of firefighting equipment and the appropriate skills to develop in case of adopting the stay to defend strategy. Residents with fire experience who weren't well-trained to stay and protect their houses evacuated at the last minute to save their lives, but they ran a greater risk in doing so. An interviewee realized that if he had stayed to defend his house alone without his two sons' help, his efforts would have been ineffective and very risky. In fact, team work during firefighting is the best approach for people who decide to stay and defend, especially in case they use firehoses to suppress the fire. In some cases, people stayed and defended their house without taking any preventive measures, just using a garden hose or a bucket, suppressing spot fires for hours. They figured out that they were lucky regarding the development of the 2021 NE Attica forest fire and if the fire conditions had been different, they could have lost their lives.

As a point of reference, in the Black Saturday bushfires (Australia 2009), around 20% of people who were fatally injured had taken the appropriate fire prevention measures (vegetation clearing, water hoses etc.). However, the effectiveness of such measures is questioned by the fire experts as they require fire training, experience and physical and mental preparedness [20]. Another study claims that if somebody believes that the fire prevention measures, resources and time available to mitigate the consequences are not enough, then they will not do anything for fire protection [42].

In Greece, land clearing before every new fire season is mandatory not only for land owners but also for the Municipalities who are responsible for public land. Individuals are required by law to clear their plots from vegetation, otherwise the Municipality has to clean up for them and impose a fine (0,50 euros/m2) for this service.

In the US, the policy of fuel management has led to the creation of collective efforts at community level (Firewise USA) to reduce the vegetation (fuel) in WUI areas [87]. In addition, preparedness in the US means that the house is fireproof and that a fireproof field of 30–60 m around it which is called ignition zone [88]. In Greece, the law which will oblige residents in WUI areas to make their houses fireproof is under development.

Residents with high fire risk perception tend to clear their plots more than once during the fire season however, residents living in other areas do not and neither does the Municipality agency responsible for this action to perform their duties. Furthermore, the inadequacy of the Municipalities to clear public lands or to enforce the relevant legislation (clear private plots and then impose a fine) makes the residents question the ability of the Municipality agencies to manage, under the pressing circumstances, a forest fire, seeing that they can't cope with daily routine matters. It is worth noting that in Greece most of the Municipalities' Civil protection departments are understaffed and there are too many responsibilities to manage.

An analysis of the residents' behavior confirms and reinforces the existing literature [8,50,51]. Many studies argue that the residents' compliance to early evacuation warning messages depends on the flow of information and the degree of trust to the sender [8]. NE Attica residents do not completely trust the official emergency alert messages from the number 112 because they were not familiar with it, while at the same time the message provided only general instructions. The aforementioned challenges forced the residents to search for information that they perceived as more reliable through people they already trusted (neighbours, relatives, firefighters) or by themselves. Adopting this approach for obtaining information is time-consuming and, in many cases, led to a last-minute evacuation. An official source to get appropriate and relevant information regarding the incident (e.g., emergency hotline) would complement existing official channels.

Some people chose last-minute evacuation as they were more confident about the preventive measures they had already taken, they were more familiar with the topography and the road network allowing them to have confidence in their ability to leave at a later stage, or they believed that the fire would change direction and would not affect their property. It is very common to employ the tactic of waiting and evaluating the situation (wait and see) [67] both for those who chose to stay and fight and fleeing is their last resort [68], and for those who remain passive without having taken any preventive measures. A large body of research has shown that last-minute evacuation results in human loss or entrapment [69,70] and it is more dangerous than sheltering in a refuge [89].

This study found that in the2021 NE Attica forest fire some people, despite the warnings of the police, used unconventional methods to avoid leaving early (e.g., finding a hiding place until the police left or wearing civil protection clothing to disguise themselves), while other people who were not home tried to trespass police check points to get home and secure their family. Also, a small group of people, especially women, decided to totally ignore the fire development and stayed at home with their children. This attitude reinforces the need to further explore human behavior and the individual choices people take in the event of a forest fire, putting in greater danger both themselves and every person involved in fire and rescue operations, not to mention causing the fire authorities to alter the firefighting tactics.

Residents with young children or members with disabilities chose first to secure them far away from the fire zone and then returned to defend. Also, there were some unique cases where residents (mostly women) and their children preferred to stay in their house and

totally ignored the development of the fire. This decision was very risky and should be under further investigation in the future. In the opposite, people who were not at home when the fire started disregarded official warnings and police check point, in an attempt to reach their homes to secure their family that was located there. Officials must consider this type of behaviors as they can alter evacuation and firefighting tactics.

Both the financial and sentimental values of the properties played an important role in the residents' decision-making process. In some cases, people whose houses had been burned to the ground in an earlier forest fire chose to stay and defend without ensuring first the safety of the other members of their household (women, children, older relatives), forcing the authorities to alter their tactic and stay to protect them.

A lot of people believe that early evacuation was wrong because the 2021 NE Attica forest fire did not develop rapidly, and they could have saved their houses. This perspective is very risky for future forest fires because every forest fire is different, and people may get into more dangerous situations compared to their previous experiences. In addition, there were a lot of residents who evacuated early and moved temporarily to a location from which they could wait and see the fire development. This decision, in combination with the false self-assessment of the fire risk, compelled the residents to return and defend their houses and consequently changed the fire brigade's suppression strategy i.e., the firefighters were forced to prioritize protecting the people who returned as well as their properties.

The police, in order to save people's lives, in contrast to what the law says in Greece, forced the residents to evacuate early. That is the reason why some people tried to hide from the police somewhere close to their property in order to return later and defend it. Furthermore, in some cases people stayed inside their homes with doors locked and no lights without revealing their presence, in an attempt to avoid the police so that they could later defend their property. Others left temporarily and returned from another route for the same reason. It is worth noting that some residents used civil protection or volunteer firefighter attire to disguise themselves and be able to trespass police check points and stay in place unhindered.

The residents agreed that human life comes first and early evacuation is the safest option but on the other hand property loss might also have detrimental consequences to people's lives. Without a doubt many houses were burned several hours after the fire front had passed because no one was there to put out spot fires. Most homes were burned to the ground because airborne firebrands ignited spot fires inside the houses, which continued to burn after the fire front had passed.

Most residents in WUI areas in Greece lack fire training so naturally they cannot evaluate the vulnerability of their house, the appropriate fire protection measures and decision-making process during a forest fire. It's crucial for emergency managers to conduct a range of outreach and engagement activities to help the population to understand their respective roles and responsibilities for early evacuation and shelter in place.

6. Conclusion

In summary, an important part of the emergency planning review process is not only the analysis of new emerging risks at a local level, but also the expected behavior of the populations affected according to the latest scientific studies and demographic characteristics of the area under consideration. This study reinforces other research findings about people's fire risk perception and behavior, looking into people's experiences during the 2021 NE Attica forest fires and aiming to enhance the existing knowledge, i.e., why residents disregard official advice about evacuation during a forest fire and choose alternatives [30,31]. It is a challenge for contingency planners to make sure that people at risk are aware of the seriousness of the situation and of the risks involved as a result of their personal choices. If this goal is not achieved, then individuals will not be able to properly prepare and act to protect themselves, their family or their property.

Forest fire experts assert that the safest option for the public under the threat of fire is early evacuation [8,91], and at the same time they are concerned about the risk of having the authorities provide any advice other than early evacuation [92]. A one-size-fits-all approach cannot ensure continual safety in all situations [91] as residents affected by fire follow in many cases their own agenda and this has to be reflected in safety plans. In extreme conditions, any level of planning and preparation may not be enough to ensure safety within a property. The intensity of the fire, the public perception of the danger and the individual circumstances have an important effect on the decision-making process [89]. There are cases in which the decision to stay or leave was clear initially, but the particular characteristics of the fire, the quality of the information received and of other factors led to more dangerous behaviors later during the unfolding of the incident [45]. This means that the best choice to follow result from the specific development of the fire and the conditions that will be created.

People during a forest fire need specific information and guidance. In Greece during a major forest fire the telecommunication centers of Fire Brigade (dial number 199) and Civil Protection (dial number 112) are overloaded so it is critical to establish another official emergency hotline, ensuring that this will not be overloaded and providing specific instructions on how they should respond. The Municipality's civil protection agency needs to gain the citizens' trust through precautionary measures such as timely land clearing and encouraging residents to do the same for their own properties. It is necessary to better organize the local community so that the residents can actively contribute in forest fires which threaten their areas.

The examined, and past, fire disasters illustrate that the options of evacuation and shelter in place are viable. However, it is a challenge trying to tailor the protective actions to best address a variety of factors, including a community's demographics, location, infrastructure, resources, authorities, decision-making processes [90] and the characteristics of specific forest fires.

The choice of stay and defend while the fire is in full development should be done only under certain conditions and after the proper preparation. More specifically, it is imperative that people who decide to stay and defend their property should have the appropriate fire protection equipment, the knowledge and the skills to deal with the fire in collaboration with first responders and other individuals

(team-work), while at the same time contingency plans should be drawn up for instant sheltering in a safe place if conditions deteriorate to life-threatening levels. A lower risk operational procedure which can at the same time ensure life and property in a more rational manner is the one that evacuates people early while distinguishing the people who can support fire suppression operations and people who cannot. People who can deal with the fire can find shelter close to the burning area, so they can have the opportunity to return immediately after the fire front passes and protect their properties from spot fires following the guidance of fire service crews. People who believe that they can disregarded the official warnings about early evacuation and fight the fire alongside fire professionals and other citizens or shelter in place must definitely be better prepared.

It is anticipated that seminars and training for citizens and educational programs for schools will strengthen community resilience. In this way, individuals and families could fully understand the importance of such concepts as early evacuation and shelter in place before a forest fire breaks out so that they can take proactive action and make educated and informed decisions in the event of a fire [90].

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2023.103612.

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