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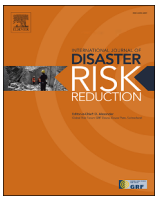

# Evacuation decisions of tourists in wildfire scenarios

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ABSTRACT

This paper investigates the factors affecting evacuation behaviour of tourists in wildfire scenarios by conducting a scoping review using the Preferred Reporting Items for Systematic reviews and Meta-Analysis approach - here using only its extension for scoping reviews. A total of 524 scientific papers were identified in the Web of Science and Scopus and 23 studies were fully reviewed. Key variables affecting the evacuation behaviour of tourists included property attachment, past experience and preparedness, safety culture, risk perception, individual and group socio-demographics, interaction with authorities, place of residence/length of stay, transportation mode and emergency information. These variables were used to apply archetypes of evacuation behaviour related to the decision to evacuate or stay based on expected tourist behaviour.

## 1. Introduction

Wildfires are a natural hazard that can cause negative consequences for properties and people. Their projected severity and frequency are negatively impacted by several factors such as climate change [1], increased urbanization in close proximity to forests [2] and poor forest management [3]. Wildfires pose a serious threat to populations in the wildland-urban interface, where vegetated areas and populations meet [4]. Emergency managers and incident commanders/controllers should carefully consider different strategies when a wildfire approaches a populated area. It is important to consider the behaviour of people when deciding the most suitable emergency strategies, as these can include *wait-and-see*, *stay-and-defend*, *shelter-in-place*, and *leave early* ([5]; [6]). Such strategies may be adopted differently by emergency managers, and while a "*leave early*" strategy may minimize the impact of wildfires on human lives [7], delays in evacuation decisions by threatened populations often occur [8]. The adoption of an evacuation strategy relies on a carefully designed plan, in which the human factor can play a fundamental role [9]. Evacuation or other strategies can improve response to wildfires as long as populations engage in training and education about evacuation. However, certain populations, such as tourists and other transient people, may miss out on local preparedness opportunities and may lack knowledge of the risks associated with fires and the appropriate protective actions to be taken [10].

Severe wildfire events have occurred around the world in tourist areas. Notable examples include the 2016 Madeira fire in Portugal [11], the 2023 Maui Fire in the USA [12] and the 2023 Rhodes Fire in Greece [13]. Those events have highlighted that tourists may face several challenges when exposed to a wildfire event and are potentially a vulnerable group in such situations. This aspect is particularly important in communities where the economy relies on tourism; wildfires can negatively impact such economies [14].

Examples of factors affecting tourist vulnerability to wildfires during evacuation include their limited access to information, potential language barrier, and their general lack of awareness of the fire risks/situation and the area. Anecdotal information concerning such issues can be identified in case studies [15] and is supported by current wildfire evacuation theory [8]. Nevertheless, while

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the scientific literature has explored wildfire evacuation behaviour more generally [7,16–18], to date, no comprehensive evidence-based knowledge on tourist evacuation behaviour has been created. The present paper reduces this knowledge gap by conducting a scoping review of the existing literature related to this domain. This is an important step towards holistic evacuation planning which explicitly considers the human factors associated with different types of populations present in touristic areas. Given the potential impact of wildfires on tourist-based economies, this work is deemed an important step forward towards safer tourist locations.

It should be noted that current vulnerability assessment methods are mostly focused at the household level and they generally rely on static, physical-based factors such as weather-related and fuel-related vulnerability factors [19]. The present work is based on the assumption that the human factor should play a fundamental role in vulnerability assessment [20]. This is in line with recent modelling efforts which integrated human behaviour in simulation frameworks to perform vulnerability assessments [21–25,26]. Evacuation models rely on accurate calibration of the human behaviour-related inputs [27]. In addition, verification and validation strongly affect the accuracy of their predictive capabilities [28,29]. A useful approach for model calibration is the definition of modelling evacuation archetypes, a concept introduced by Strahan et al. [30] based on Jung [31] to characterise and categorise common types of people which can be modelled within an evacuation simulator. The concept of an archetype is used here with the goal of facilitating a more comprehensive and accurate assessment of vulnerability in touristic areas. In other words, a list of factors affecting tourist evacuation behaviour is first identified in existing literature, and it is then used to apply Strahan et al.'s archetypes to tourist behaviour in relation to their key evacuation decisions.

## 2. Scoping review methodology

The method used in this work to determine applicable research papers related to tourists' evacuation in a wildfire is the Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) (no meta-analysis was conducted, i.e. only a scoping review). This method was adopted as it provides a structured checklist and workflow to ensure clear and consistent scoping reviews [32,33].

The scoping review conducted in this paper involves searching papers from two scientific literature databases, namely Scopus and Web of Science. These databases were selected because they are considered key sources of reliable information in the domain under study. Given the limited number of papers related to the topic of tourist evacuation behaviour in wildfires, additional papers were selected that relate to either evacuation or tourist behaviour in general (i.e., in non-emergency conditions) or tourist evacuation behaviour in other disasters. Furthermore, a compilation of papers was identified by scanning the reference lists of the initially selected papers. This means that while not all papers reviewed are explicitly focusing on tourist behaviour during wildfire evacuation, they could all provide relevant information for such populations and scenarios. Fig. 1 illustrates the steps involved in the review to ensure a thorough and systematic selection of papers.

Various search strings were employed during the identification stage to find pertinent papers in the two databases. Initially, a combination of keywords including 'wildfire,' 'bushfire,' 'forest fire,' 'campfire,' 'brush fire,' 'tourist∗,' and 'evacuation' was used. Next, the search incorporated additional keywords such as 'transient', 'decision-making', 'behavior', and 'behaviour' to further refine the selection of papers. More details about the results from the search strings used and dates of the search for each database are provided in Appendix A. The identification stage involved removing duplicate papers without screening them. The subsequent stage, known as the screening stage, consisted of three steps. First, a set of four inclusion criteria was applied by screening the title and the abstract of each paper. Papers were considered eligible for the next selection if they provided: 1) insights into tourists' behaviour in an emergency context; 2) insights into human behaviour in wildfires; 3) insights into disaster communication or management; and/or 4) discussion about archetypes in the context of wildfires. Second, the remaining records were assessed in full text and papers were excluded based on the following criteria: 1) no English full text available; 2) solely focusing on modelling; and 3) review articles that do not present meaningful insights for locations with tourists. In the third step, papers were regarded as relevant if their content remained applicable and aligned with any of the following categories: 1) tourists and wildfire evacuation; 2) tourist behaviour in other hazard evacuations; 3) human behaviour in wildfires; and/or 4) tourist behaviour in a general decision-making (non-emergency) context.

During the screening process, the citations within the selected papers were also scanned using a *snowball* approach (i.e. screening references within references), and were considered relevant if their content matched the inclusion criteria mentioned earlier. If the citation was deemed relevant, it was then checked to see whether it had been previously identified. The main findings from the selected sources of evidence were extracted using a dedicated review template (see Table 1). The template was developed to extract information from the papers in a consistent manner. It includes twenty-five questions that outline the relevant criteria or information needed to be extracted during the review process. This approach was used to ensure a consistent and thorough review of the papers and systematic storage of the information.

## 3. Key variables affecting tourist evacuation behaviour in wildfires

In this section a list of the key variables that have been identified in the literature is presented (i.e., Question #22 in Table 1). A summary of key information about the selected papers: type of paper, method of data collection, sample size and country of study is provided in Table 2. Following the literature review, all variables identified across the literature were extracted into a list. This list was further narrowed down using two main criteria: 1) selecting the variables that were more frequently mentioned in the reviewed material (this was done along with identifying variables with a wider scope); and 2) where possible, combining variables into the most pertinent variable to the purpose of this research. This was done to keep the number of variables manageable. The variables identified in the context of tourist evacuation behaviour in wildfires were complemented with those from four seminal reviews on res-

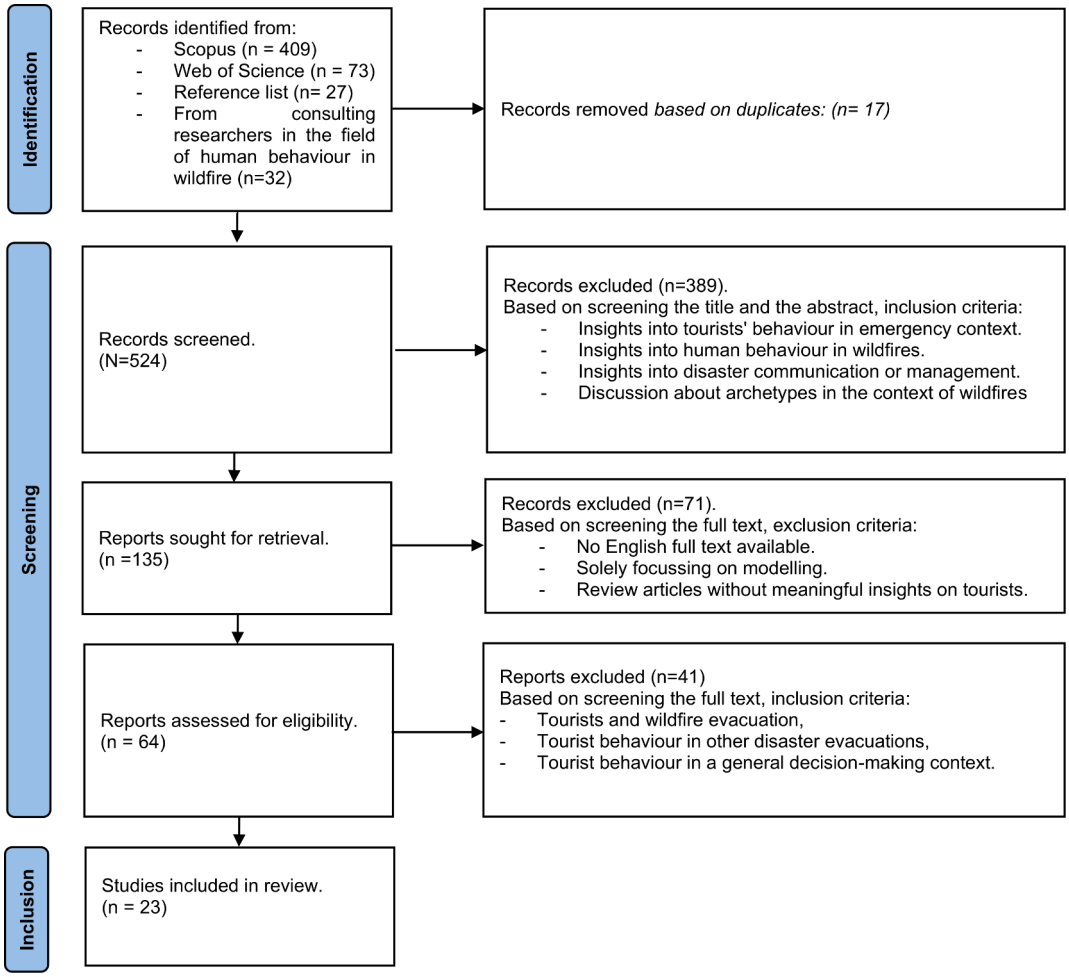


**Fig. 1.** Scoping review flow chart, including the steps of identification, screening and final inclusion based on exclusion/inclusion criteria.

ident evacuation behaviour [7,8,34,35]. These reviews were screened primarily to determine which variables previously identified as affecting resident evacuation behaviour are relevant for tourists. The process then included checking which variables had not yet been found in the reviewed articles related to tourists. The following ten variables were eventually identified, as shown in Table 3: property attachment, past experience and preparedness, safety culture, individual socio-demographic factors, interaction with authorities, place of residence and length of stay, transportation mode, and information. It is important to note that "individual socio-demographic variables" include the six most commonly occurring factors (i.e., education, race and ethnicity, functional limitations, gender, age, and income).

In the following section, each variable will be defined and discussed, along with a list of findings associated with the reviewed material. Table 3 presents a summary of the selected variables and the associated literature sources where they are mentioned.

### *3.1. Property attachment*

This variable relates to the concept of people owning or having an emotional attachment to an object or a place. Property attachment may have a significant negative relationship with evacuation [8,35]. International tourists generally exhibit lower property attachment compared to local residents thus they may be more likely to evacuate [35]. The higher property attachment by residents is associated with concern about the monetary value of their property, i.e., they may want to protect it from looters [8] and their evacuation decisions may be affected by the likely impact of the wildfire on their property [54]. This finding implies that people who do not own a property may be more likely to proceed with an evacuation (i.e., to comply with an evacuation order) compared to locals [8].

### *3.2. Past experience and preparedness*

This variable relates to past experience and preparedness, meaning that experience from prior wildfire events or the level of preparedness for wildfires can affect decision-making. This can be observed either in terms of the "cry wolf effect" (or the decrease in compliance with evacuation orders in cases where prior evacuations were deemed unnecessary), which can negatively impact evacuation decisions, or evacuation training, which can positively influence such decision making [8,42]. Preparedness, in this context, can

**Table 1**
The review template adopted to extract information related to tourist evacuation behaviour from the selected papers.

| | |
|---|---|
| **1** | Author(s) |
| **2** | Year |
| **3** | Title |
| **4** | Short description |
| **5** | Type of paper |
| **6** | Method of data collection |
| **7** | Method of data analysis |
| **8** | IF Data paper, type of data |
| **9** | IF Data paper, is data available openly/upon request? |
| **10** | IF Data paper, sample size |
| **11** | Country(ies) of study and/or region |
| **12** | Is the area of study prone to wildfires? |
| **13** | Does the peak wildfire season coincide with the peak tourism season? |
| **14** | Is the area investing in wildfire resilience[a]? |
| **15** | Is the study area explicitly mentioned as prone to tourism in general? High/low levels? Domestic/international tourism? |
| **16** | Any specific mention of tourists in the paper? |
| **17** | Any information about the characteristics/demographics of the population involved (e.g., age, language, experience with wildfires, income, household types/size education, safety culture, etc.) |
| **18** | Does the study differentiate among recurrent vs seasonal[b] vs first-time tourists? |
| **19** | If tourists are mentioned, summarize content (including inferring type of tourists) |
| **20** | Reference to a behavioural theory(ies)? |
| **21** | Main findings of study of interest to define archetypes, such as behaviours reported, issues associated with evacuation or shelter/defend-in-place behaviour, or physical state of populations; in other words, what qualitative observations were used in the study that can help us think about the archetypes? |
| **22** | List of variables which can be identified through this study |
| **23** | Possible archetype categorizations identifiable through this study; if the study has identified archetypes, what are they? |
| **24** | Study limitations (summary)/perceived study limitations |
| **25** | Paper(s) in the reference list to be screened |

[a] This question was added to check if the area considered wildfire safety as a priority. Knowledge on investments on wildfire safety and/or regulatory efforts were used as a proxy to investigate this issue.

[b] Recurrent is intended as someone who travels to a place at any time of the year (e.g., someone owning a summer house), seasonal can be recurrent or not, but just in a given season.

**Table 2**
Summary of key information related to the papers included in the review.

| Sources | Type of paper | Method of data collection | Sample size | Country of study |
|---|---|---|---|---|
| [36] | Qualitative | Review | – | – |
| [37] | Quantitative | Interview and Questionnaire | 827 interviews, 523 questionnaires | USA |
| [38] | Quantitative | Interview and Questionnaire | 827 interviews, 523 questionnaires | USA |
| [39] | Quantitative | Survey | 430 + 297 | Singapore and USA |
| [40] | Qualitative | Interview | 183 | USA |
| [41] | Quantitative | Survey | 402 + 443+342 | Australia |
| [42] | Quantitative | Survey | 448 | USA |
| [43] | Quantitative | Survey | 306 | Thailand |
| [44] | Quantitative | Survey | 434 | USA |
| [45] | Quantitative | Survey | 533 | USA |
| [46] | Quantitative | Survey | 533 | USA |
| [9] | Qualitative | Case studies | 18 | – |
| [35] | Quantitative | Review | – | – |
| [47] | Quantitative and qualitative | Interview, survey, field visit | 4 interviews, 163 survey responses | Japan |
| [34] | Qualitative | Review | – | – |
| [8] | Quantitative | Review (including surveys) | – | North America and Australia |
| [48] | Quantitative | Survey | 439 | Japan |
| [49] | Qualitative | Interview | 31 | Canada |
| [50] | Quantitative and qualitative | Interview and survey | 8 interviews, 98 survey responses | France |
| [7] | Qualitative | Review | – | – |
| [51] | Quantitative | Survey | 450 | France and Australia |
| [52] | Quantitative | Survey | 152 | Greece |
| [53] | Qualitative | Review and Case study | – | – |

**Table 3**
*Summary of variables identified and the associated literature source. The "x" is used in the table to refer to the variables identified in the review papers related to resident evacuation behaviour. The tick mark ✓ is used in the table to refer to the variables in research papers other than review papers. The papers are presented by chronological order (from older to newer).*

| Variables / Sources | Property attachment | Past experience and preparedness | Safety culture | Risk perception | Individual socio-demographic variable | Collective behaviour | Interaction with authorities | Place of residence and length of stay | Transportation mode | Information |
|---|---|---|---|---|---|---|---|---|---|---|
| 43 | | | | | ✓ | | | | | |
| 16 | | | | | | | | | | ✓ |
| 17 | | | | | | ✓ | | | | ✓ |
| 54 | | | | | ✓ | | | | | |
| 12 | | | | | ✓ | | | | ✓ | |
| 55 | | | | | | | | ✓ | | |
| 42 | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | |
| 34 | | | | | ✓ | | | ✓ | ✓ | |
| 56 | | | | ✓ | | ✓ | | | ✓ | |
| 10 | | | | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| 9 | | ✓ | | | ✓ | | | | | ✓ |
| 51 | | | | | | | ✓ | | | |
| 23 | x | | | x | | | | | | |
| 2 | | | | | | | | | ✓ | ✓ |
| 18 | | | | x | | | | | | |
| 53 | x | x | | x | | | | | | |
| 1 | | | | ✓ | | | | ✓ | | |
| 11 | | | | | ✓ | | | | | ✓ |
| 57 | | ✓ | ✓ | | ✓ | | ✓ | | | |
| 33 | | | | x | | | | | | |
| 58 | | ✓ | | | | | | ✓ | | ✓ |
| 31 | | | | ✓ | ✓ | ✓ | | | | |
| 3 | | ✓ | | ✓ | | | ✓ | | | ✓ |

include knowledge of protective measures taken to minimize the hazard's impact (e.g., knowledge of protective actions, evacuation routes and/or procedures aimed at reducing evacuation delays). Considering a study based on hurricanes, tourists with past experience (that did not lead to negative consequences) are less likely to evacuate since their risk perception is lower [42]. This finding also holds true when individuals have experienced fires indirectly, e.g., family members or friends have been previously impacted by the threat [42], as they tend to exhibit a lower risk perception. Yet, a study on cyclones showed that tourists without past experience may be less likely to evacuate due to their curiosity to witness an event they have not encountered before [53]. For instance, tourists without past wildfire experience paused along the evacuation route to capture photographs [50]. In addition, research comparing French and Australian populations has indicated that the influence of preparedness and experience on evacuation likelihood might be dependent on the place of residence, i.e. if tourists normally live in a wildfire-prone area [51]. Moreover, tourists knowledgeable about the area where a wildfire occurs are more likely to follow a route that is familiar to them, i.e., not necessarily the shortest or fastest route [43].

Furthermore, hurricane research shows that past experiences with hurricanes are linked to the perceived credibility of particular information sources [46]; e.g., the local tourism offices and hotel staff for tourist evacuees. This also applies to wildfires, as previous experience can shape tourists' judgment of the information they receive from a particular source, subsequently influencing their decision-making regarding evacuation.

### *3.3. Safety culture*

Safety culture in this context refers to the degree of awareness that tourists have about a wildfire hazard and how safety information is perceived and used. Hurricane research has shown that tourists who did not check for the possibility of this hazard prior to their travel, were less likely to evacuate [42]. This is possible because tourists who neglected to learn about the hazard prior to their arrival may have a limited understanding of the hazard and its consequences. Furthermore, a study concerning wildfires on the island of Corsica showed that safety culture differed between the residents, whose risk-awareness culture is instilled from school, and the tourists, who exhibited a limited understanding of fire hazards [50].

### *3.4. Risk perception*

This variable refers to the individuals' perception that the threat is likely to personally affect them or their loved ones (e.g., via injury or even death) [55]. Risk perception is often a mediator variable, and higher levels of risk perception are strongly associated with the likelihood of evacuation [7,8,34,35,52]. Factors such as past experiences, access to information sources, preparedness levels, and socio-demographic variables all influence this variable, shaping the evacuation decision. Research [42] highlights that tourists who have not previously been affected by hurricanes (either directly or indirectly), had a short trip duration, or did not check for the possibility of hurricanes prior to their trip tend to have higher levels of risk perception. Moreover, first-time tourists perceive higher levels of risk and may be more likely to evacuate [42,45]. Villegas et al. [44] illustrate that the level of being afraid of tourists travelling

with personal vehicles depends on their location (inland or coastal location) with a reduced level of fear observed among coastal tourists. However, this finding is likely mainly applicable to hurricanes and tsunamis, and it is unclear if it can be translated to a wildfire context.

Cahyanto et al. [45] and Villegas et al. [44] assert that tourists with children generally exhibit higher levels of risk perception. Banerjee et al. [53] demonstrated in their paper about cyclones that there is a positive relationship between the tourists' risk awareness and risk perception. In this study, the reason behind the decision to stay was that the tourists' risk perception was not high enough to encourage them to evacuate. However, this issue could potentially be addressed by disseminating the warning message in multiple languages. Indeed, as reported by Banerjee et al. [53], there is a positive relationship between the dissemination of warnings in multiple languages and risk perception of a group of tourists from different countries.

### 3.5. Socio-demographics

This variable focuses on the socio-demographic factors specific to an individual (or group) that can influence tourist evacuation behaviour. It encompasses a wide range of attributes including education, race and ethnicity, functional limitations, gender, age, and income, which influence risk perception and the decision to evacuate. These decisions are also influenced by instructions or orders provided by the emergency managers, but this topic is addressed in a dedicated section (see section 3.7).

Research has found that income is one of the factors that can influence evacuation decisions, as tourists with lower income levels are less likely to evacuate [52,45]. Similarly, low income might be a contributing factor that leads international tourists to opt for shelter accommodations rather than staying in hotels [40].

Based on Matyas et al. [42], there is a positive relationship between age and willingness to evacuate. However, among various groups, older tourists may be the most susceptible to language barriers (although not in all situations), potentially limiting their access to evacuation warning information [49]. Furthermore, female tourists may be more likely to evacuate than men, potentially because they are more likely to perceive higher levels of risk associated with the hazard event [46,45], although the impact of gender may be less prominent in families of tourists since Litvin et al [39] mentioned that they generally make most decisions jointly. In addition, female tourists perceive information sources as more credible and may be more likely to use information from the following sources: family, locals, the local tourism office, and local authority, when compared with male tourists [46].

The race and ethnicity variable refers to the extent to which an individual behaves in an evacuation in relation to the population or group in which they share a common cultural background or descent. While this variable is often understudied in more recent hazard studies, it was discussed in Perry & Green [36]. The study by Perry and Green [36], which was limited to an American context, found that race and ethnicity play a role in risk perception and in turn evacuation decisions. In particular, certain minority population groups may have lower risk perception compared with other majority populations. Also found was that membership in an ethnic minority group increases the chances that an individual will perceive an external locus of control; i.e., a belief that what happens is the result of external factors outside of their control – e.g., due to luck or fate [36]. In turn, they are less likely to evacuate or engage in any type of protective action [50,36]. Furthermore, membership in an ethnic minority group is positively linked with a higher level of community involvement and lower levels of perceived credibility of authorities [36]. These factors can, in turn, influence the information received during a fire event and the subsequent evacuation behaviour taken.

Education levels can also influence evacuation decisions. In their work on tsunami evacuation, Limanond et al. [43] found that international tourists who completed high school or a bachelor's degree were more likely to follow the crowd in their evacuation route choice when compared with those with higher education levels. In fact, those with higher education (Master's/Ph.D.) tended to rely primarily on signage rather than on surrounding crowd behaviour.

People with functional limitations (e.g., related to mobility, sight, hearing, and cognition) are potentially vulnerable during a wildfire evacuation. While most people may be able to self-evacuate using their own means, tourists with functional limitations may encounter challenges and need assistance. These challenges can arise either from a lack of adequate transportation means or from physical or cognitive limitations [7,8].

### 3.6. Collective behaviour

Collective behaviour is associated with the characteristics shared by a group of people and their interactions with one another, potentially influencing the evacuation process. Hurricane research highlights that families with children generally perceive higher risk [45,44], leading to higher chances of evacuation [45]. However, some may choose to remain if they lack knowledge about what actions to take and where to seek refuge. In addition to the presence of children, the number of minors in the household may have a considerable influence over the decision-making process concerning evacuation as Katzilieris et al. [52] found that the number of minors is negatively related to the decision to evacuate. One possible explanation is that large families may not have sufficient time to gather family members or prepare, which could potentially result in delays in deciding or evacuating.

Cahyanto et al. [45] has also found that tourists travelling with older individuals are less likely to evacuate possibly because seniors may be affected by health issues that could worsen during the evacuation process [45]. Furthermore, they found that larger travel groups may be more likely to evacuate than smaller groups. However, the interaction among emerging groups of tourists may lead to evacuation delays due to debates about the preferred actions to pursue [38].

Moreover, Cohn et al. [40] indicated that while residents avoid evacuation shelters and prefer to stay with friends and families, people without a personal network who cannot afford to stay in hotels tend to choose shelters.

### 3.7. Interaction with authorities

This variable mainly focusses on the interaction between tourists and the authorities. This interaction encompasses various aspects such as communication and compliance with evacuation orders. In their work [9,59], distinguished the distrust in government and emergency instructions between different types of WUI resident archetypes. Furthermore, Vaiciulyte et al. [50] showed that while tourists may be more rule-obedient compared to local residents in the presence of authority, some tourists may display disregard for authorities' orders and delay their evacuation to capture footage of the wildfire [50]. The inter-dependence between the members of a tourist group can affect evacuation decisions where certain individuals within the group may exhibit resistance to evacuation policies [53].

### 3.8. Place of residence and length of stay

The place of residence refers to the original location from where the tourists travelled. Understanding the behaviour of tourists and their evacuation likelihood may be connected to their place of origin, particularly when considering factors such as language and cultural differences. For instance, Vaiciulyte et al. [51] highlighted the link between the place of residence of locals and evacuation likelihood. When considering only international tourists and national tourists, studies found that international tourists are more likely to evacuate compared to national tourists [42,45]. Moreover, the relationship between tourists' information needs and the resulting intention to seek for information may be dependent on the place of residence [48]. One possible explanation is that tourists from a *collectivist* country, for example, which often prioritizes the group over the individual tend to be influenced by social norms and act in a socially appropriate manner which may lead them to seeking more information [41]. It is possible to conclude that tourists from such collectivist countries might be more likely to seek information and therefore likely comply with official evacuation orders.

The length of stay is also a potential factor in predicting evacuation behaviour of tourists during hazards. In connection with hurricanes, Matyas et al. [42] argued that a shorter length of stay and/or visiting for the first time may lead to a higher likelihood of evacuation given their unfamiliarity with the area. Furthermore, the length of stay might also have an impact on the chosen evacuation route. For instance, Limanond et al. [43] found that during a tsunami event, most international tourists who stayed in the area for less than six months were more likely to follow the crowd, while most international tourists who stayed longer than six months took a an evacuation route that was more familiar to them. They also highlighted that tourists with a long duration of stay (6 months to more than one year) at the destination are more likely to choose a familiar route [43].

### 3.9. Transportation mode

Transportation mode refers to the relationship between the tourists' means of transportation and their resulting evacuation behaviour. The availability of private vehicles can affect the chosen evacuation route taken by tourists. It has been argued that the mode of transportation may influence risk perception in the event of a hurricane [44]. For instance, travelling with a personal vehicle may reduce the level of perceived risk due to a decrease in negative imagery of the potential outcomes [44]. However, Cahyanto et al. [45] found that tourists with a personal vehicle may be more likely to evacuate compared to those with rented vehicles due to property attachment.

Furthermore, the preferred transportation mode during an evacuation (e.g., on foot or using a vehicle) may depend on the type of hazard and its location [47]. Limanond et al. [43] showed that in the case of a tsunami, international tourists who use public transport in the area are more likely to follow the crowd when making decisions about evacuation routes. Similarly, international tourists who drive private or rented vehicles are more likely to follow evacuation instructions [43].

### 3.10. Information

The information variable encompasses various factors that influence how tourists receive, understand, and access information during an emergency. On one hand, Arce et al. [47] found that tourists often expect to receive evacuation warnings through official channels or the media, the internet, and the news rather than unofficial sources. On the other hand, international tourists demonstrate a greater willingness to approach hotel staff for information compared to national tourists and use social networks more than national tourists [46]. For instance, tourists may be notified about the hazard from temporary neighbours or from others they met informally [38]. Additionally, international tourists are also more likely to seek information in general [46]. Nevertheless, seeking additional information may lead to evacuation delays. The presence of environmental cues, either alone or in combination with social cues, could decrease individuals *wait-and-see* attitude [51]. Additionally, international tourists may see local tourism offices as highly credible as they tend to use their services while they are on vacation [46]. Moreover, international tourists may be more likely to use local authorities as an information source compared to national tourists [46].

In their paper on tsunamis, Arce et al. [47] indicate that the access to information through signage directed to international tourists may depend on language, visibility, location, relevance of information, size and materials of the signage. Furthermore, the presentation of information needs to be consistent to effectively encourage tourists to evacuate. In other words, if the information is inaccurately presented, tourists may not comply with evacuation orders [37]. This also includes the dissemination of warnings in multiple languages [53].

### 3.11. Summary of impact of variables

A summary of the impact that each variable is likely to have on tourists' evacuation decisions can be found in Table 4. It should be noted that certain variables may have both a positive and negative effect on evacuation and lead to contrasting outcomes. For instance, greater experience and lower preparedness levels can lead to staying while greater experience and higher preparedness levels

**Table 4**
Variables as extracted from the scoping review with corresponding key likely impact on evacuation decisions.

| Variables | Likely impact on evacuation decisions |
|---|---|
| Property attachment | Tourists are more likely to evacuate than residents since they display lower property attachment. The influence of property attachment is less pronounced among tourists. |
| Past experience and preparedness | Experience with "cry wolf" (i.e. unnecessary evacuations) contribute to tourists being less likely to evacuate |
| | Evacuation training and knowledge of fire consequences increase likelihood of evacuation. Influence of past experience and preparedness is less pronounced among tourists than residents. |
| Safety culture | Tourists' safety culture may be different to residents' |
| | Tourists are less likely to understand consequences of fire |
| Risk Perception | Risk perception mediates behaviour through past experiences, information access, preparedness and socio-demographics |
| | When tourists' risk perception is higher than residents', they will be more prone to evacuate |
| Socio-demographics | Tourists with lower income are less likely to evacuate than high income tourists. |
| | Female tourists are more likely to evacuate than men. |
| | Minority tourist groups perceive an external locus of control; have higher community involvement in evacuation decisions. |
| | Educated tourists rely more on signage rather than the crowds when evacuating. |
| | Tourists with functional limitations may need assistance to evacuate. |
| Collective behaviour | Tourist groups with older individuals are less likely to evacuate. |
| | Larger tourist groups rather than smaller ones are more likely to evacuate |
| Interaction with authorities | Tourists may be more rule-obedient when compared to residents |
| | Some tourists may disregard authorities' orders |
| Place of residence and length of stay | International tourists are more likely to evacuate when compared to national tourists |
| | Tourists' information needs depend on place of residence |
| | Shorter length of stay for tourists leads to a higher likelihood of evacuation |
| Transportation mode | Availability of private vehicles for tourists affects evacuation decisions |
| Information | Tourists expect to receive evacuation warnings through official channels |
| | Tourists are less likely to comply with information from unofficial sources |
| | Language use and tourist knowledge of language in use for emergency communications affect evacuation decisions |

are linked with evacuating. Such cases may need to be addressed in future research with a detailed case-by-case evaluation. A summary of the likely impact on evacuation decisions associated with each variable is presented in Table 4. The readers are referred to the detailed description of the list of variables in the previous section for further understanding the description of each variable.

## 4. Archetypes of tourists in wildfire evacuation

Based on the key variables identified in the scoping review, this section reviews the archetypes defined by Strahan et al. [30], based on the original concept of archetypes [31,60]. In their work, Strahan et al. defined seven archetypes based on a cluster and discriminant function analysis from a dataset involving 457 residents who experienced a bushfire. They also provided a table presenting a list of factors (variables) representing a complexity of attitudes, values, and beliefs related to evacuation decisions simplified into a Boolean (yes/no) representation of similarities and differences between archetypes. The goal of the present paper is to review how the original work done by Strahan et al. can be adapted to represent tourists in wildfire evacuation scenarios. This was performed by matching the archetypes of Strahan et al. with the likely impact on tourist evacuation decisions obtained in our review (see Table 4). When no specific information is found about tourists (i.e. how their behaviour would differ from residents in terms of their evacuation decisions), the archetype from Strahan et al. (or the portion of it related to a given variable) is kept as is. If a variable or information related to the original resident archetypes is not relevant to tourists (e.g. preparatory actions for property protection), this has been removed from the archetype description. The tourist evacuation archetypes are therefore an updated version of the Strahan et al.'s archetypes applied to tourist behaviour developed by implementing the key findings of our review. It should be noted that the main outcome considered in both this work as well as Strahan et al.' s paper relates to the evacuation decision (i.e., stay or evacuate and associated short or long pre-evacuation delays).

In their work on self-evacuation of resident archetypes in Australia (K. [30]), defined seven archetypes namely, 1) *Responsibility deniers* who believe they are not responsible for their personal safety or for their property, 2) *Dependent evacuators* who expect the emergency services to protect them and their property because they are incapable of taking responsibility for themselves, 3) *Considered evacuators* who are carefully considering evacuation and are committed to it as soon as they are aware of a wildfire threat, 4) *Community guided* that seek guidance from neighbours, media and members of the community who they see as knowledgeable, well informed and providing reliable advice, 5) *Worried waverers* who prepare, equip their property and train to defend it but worry they lack practical experience to fight a wildfire (potentially putting their personal safety at risk), 6) *Threat deniers* who do not believe that their personal safety or property is threatened by a wildfire, and 7) *Experienced independents* who are highly knowledge, competent and experienced and are perceive themselves as responsible and self-reliant when fighting wildfire.

The following section presents the updated description of the tourist archetypes considering the findings of our review.

**Archetype 1**. Threat deniers (Tourist denying the threat)

This type of archetype can be referred to the tourists who do not believe that the wildfire will impact their safety. This will result in them disregarding the information received about the incoming wildfire threat received from emergency services, media, residents or other tourists. This type of tourist has very little experience about wildfires, limited safety culture and low risk perception. They are not familiar with the area and the wildfire safety procedure.

Outcome: The archetype of *Tourists denying the threat* is committed to remain in case of evacuation.

**Archetype 2**. Responsibility deniers (Tourist denying responsibility)

As for the case of residents, this type of tourist does not believe they are responsible for their own safety. They do not feel that they need to rely on themselves, and therefore expect that others (e.g., authorities or tourist managers) take care of their safety. They have limited experience with wildfires, no training, limited safety culture, and limited preparedness. They are not influenced by media, residents or other tourists.

Outcome: The archetype of *Tourists denying responsibility* assumes others should take care of their evacuation. This may imply long evacuation delay, depending on the actions of others. They are neither aware of the best route nor are familiar with the area and procedures.

**Archetype 3**. Experienced Independent (Experienced Tourist)

This type of tourist has experienced wildfires before and has a good level of preparedness, safety culture and training. They are familiar with the protective actions to be taken when a wildfire is in the area, having extensive knowledge of wildfire safety from their place of residence or previous travels to the area. They rely mostly on themselves and are strategically prepared on what actions to take. They are not largely affected by the decisions of others. They consider themselves more knowledgeable about wildfires than emergency services, media, residents or other tourists.

Outcome: The archetype of *Experienced Tourist* will decide to evacuate quickly, are aware of the best route/procedures and are familiar with the area.

**Archetype 4**. Community Guided (Community Guided Tourist)

This archetype refers to tourists that are strongly affected in their decisions by their positive perceptions of the knowledge of emergency services, media, residents and other tourists. They have limited wildfire experience and are not self-reliant despite being aware of the situation.

Outcome: The archetype of *Community Guided Tourist* is strongly influenced by the evacuation decisions of the community.

**Archetype 5**. Worried waverer (Worried Tourist)

This archetype refers to tourists that are concerned about the wildfire threat and its impact on their safety. These tourists are knowledgeable about wildfires and informed/prepared about the event, and they are torn between the decision to remain or the evacuate. They consider information from emergency services, media, residents or other tourists as useful.

Outcome: The archetype of *Worried Tourist* is uncertain about the decision to remain or evacuate.

**Archetype 6**. Dependent evacuator (Dependent Tourist)

This archetype refers to tourists that rely on emergency services to protect their personal safety due to functional limitations. The largely rely on emergency services rather than media, residents or other tourists. This group of tourists had no previous experience with the wildfire threat, lack knowledge and information about wildfires and no training.

Outcome: The archetype of *Dependent Tourist* is committed to evacuating and due to their functional limitations relies extensively on emergency services in their decisions.

**Archetype 7**. Considered evacuator (Considered Tourist)

This archetype refers to tourists that perceive wildfires as a current and future threats since they have them extensively in their lives from their place of residence or previous travels to the area. They had experience of evacuation in the past and had some limited training. They are influenced by information in the media, but to a smaller extent by emergency services, residents or other tourists.

Outcome: The archetype of *Considered Tourist* is strongly committed to evacuation as soon as they become aware of the threat.

### *4.1. Operationalisation of variables for the definition of archetypes*

In this section, we present an operationalisation of the key variables identified in the review related to tourists in wildfire evacuation. The variables have been operationalised by defining a set of possible characteristics (see Table 5) associated with each variable to facilitate the identification of the most suitable archetype(s) (and their proportion) for a given population. It should be noted that this is only meant as an example, and variables could be operationalised in many alternative manners. In this simple example, variables can be assessed using a Boolean answer (e.g. yes/no), a qualitative answer (e.g. large/medium/small) or quantitative answer (e.g. a numerical value).

Following the categories of variables in Table 5 and their likely impact on evacuation decision of tourists presented in Tables 4 and it is possible to identify the correspondence between the characteristics of tourists and the subsequent archetypes to be represented.

## 5. Discussion

Via the scoping review, a set of key variables was identified which can affect evacuation behaviour during a wildfire and subsequently define a set of tourist evacuation archetypes based on the work by Strahan et al. [30]. This work is deemed to be useful to those who perform vulnerability assessments in tourist areas explicitly considering the impact of human behaviour. Such assessments

**Table 5**
Operationalisation of the identified 10 variables related to tourists in wildfire evacuation. The individual socio-demographic variables have been divided into a set of sub-categories.

| Variable | Categories of variables |
|---|---|
| *Property attachment* | Boolean (Yes/No), Qualitative scale (large/medium/small), Quantitative scale (numerical scale) |
| *Past experience and preparedness* | Boolean (Yes/No), Qualitative scale (large/medium/scarce), Quantitative scale (numerical scale) |
| *Safety culture* | Boolean (Yes/No), Qualitative scale (large/medium/small), Quantitative scale (numerical scale) |
| *Risk perception* | Qualitative scale (high/medium/Low), Quantitative scale (numerical scale) |
| *Socio-demographics* | |
| Education | Qualitative scale (large/medium/low), Quantitative scale (numerical scale) |
| Income | Boolean (Yes/No), Qualitative scale (large/medium/low), Quantitative scale (numerical scale) |
| Age | Qualitative scale (Adult/Older/Minor, Quantitative scale (exact age) |
| Gender | Male/Female/Non-binary |
| Functional limitations | Boolean (with/without), Qualitative scale (proportion of limitations), Quantitative scale (detailed list of limitations) |
| Ethnicity | Boolean (majority/minority), Qualitative scale (large/medium/low), Quantitative scale (proportion of populations) |
| *Collective behaviour* | Boolean (affected by others in their group (senior, children)/not affected by others), Qualitative scale (large/medium/small impact of others in their group), Quantitative scale (detailed proportion of people affected) |
| *Interaction with authorities* | Boolean (compliant/non-compliant), Qualitative scale (largely compliance, medium compliance, low compliance), Quantitative scale (detailed proportion of people's compliance) |
| *Place of residence and length of stay* | Boolean (familiar with place of residence/unfamiliar with place of residence), Qualitative scale (overall large/medium/small familiarity), Quantitative scale (proportion of people who are familiar/not familiar with the area) |
| *Transportation mode* | Boolean (access to private vehicle/no access to private vehicle), Qualitative scale (large/medium/small access to vehicles), Quantitative scale (detailed proportion of people's access to vehicles) |
| *Information* | Boolean (access to information/no access to information), Qualitative scale (large amount of info/medium/limited amount of info), Quantitative scale (detailed proportion of people's access to information) |

could be performed using a variety of different approaches, ranging from simpler checklists to more sophisticated wildfire evacuation modelling tools [25,57].

The scoping review also facilitated the identification of a set of research gaps. For instance, while language barriers have been identified as a critical aspect in previous case studies involving wildfire evacuation [28], this is not a widely discussed topic in the scientific literature and the data is lacking on behaviours of tourists whose first language is not English. Similarly, the specific issues related to the ability of tourists to reach an area of safety (e.g., a shelter or refuge) has received little scientific attention [58]; this includes the limited discussion around the tourists' route choice in case of an emergency. Research studies have also looked into the willingness to share resources during evacuation [56], although there seems to be no dedicated studies concerning tourists on this issue. Residents' unwillingness to share transportation with tourists is an important factor to take into consideration as it can result in tourist evacuation delays. In fact, Wong et al. [61] and Wong et al. [56] showed that trust of strangers, trust of neighbours, and non-selfish compassion greatly increase the willingness to share transportation. Another known knowledge gap in the wider field of fire evacuation is the limited information available on the impact of functional limitations on evacuation performance [62,63] based on data on peoples' limited mobility, hearing, vision and cognitive abilities. For instance, the impact of several types of functional limitations (e.g., cognitive limitations) on evacuation decisions is largely unknown, both at the individual as well as group levels. This is a growing issue given the trends towards an ageing and less fit population [64]. The impact of the behaviours exhibited by tourist groups deserve a more thorough investigation too, as they may in themselves present a degree of variation in size, age, shared safety culture and above all mixed experiences, preparedness and knowledge. In fact, while it may appear evident that recurrent tourists who spend longer times at locations in which they have local contacts may be more aware of wildfire risk and have more access to information, there is no research which particularly addresses the scope and purpose of these touristic travels. So, it is of interest to investigate if different types of trip purposes (e.g., family holiday, young group of friends) are associated with different types of archetypes. Different factors may play a role in this assessment, such as intoxication, which may be more likely for specific types of tourists.

The review highlighted that the place of residence, or tourists' 'home' residence, may be a key factor in the decision-making process of tourists in the event of wildfire evacuation. This is due to its impact on the perceived credibility of the information source and risk perception [48,41], while potentially revealing information about safety culture.

An important issue is that often communities may have limited information regarding the types of tourists they host, making it difficult to assess potential human vulnerabilities associated with tourist populations. For this reason, we hope that the present study could be a starting point towards an increased level of awareness of such vulnerabilities among heterogeneous tourist populations. This information could be helpful to a wide array of key actors involved in the safety of tourists (e.g., tourist infrastructure managers, emergency managers, etc.).

This work is also a useful starting point to characterise archetypes of tourists by considering the impact of variables affecting tourist evacuation decisions by integrating the likely impact of those variables with the existing archetypes defined by Strahan et al. [30]. This can be facilitated by the operationalisation of the variables into a set of Boolean, qualitative or quantitative categories, as proposed in the present paper. It should be noted that a one-to-one translation of all resident archetypes to tourists would need further scrutiny, since certain archetypes originally designed for residents may be less applicable to tourists. An example is the case of Worried Waverer (translated as Worried Tourist) that could even decide not to travel at all to a tourist area if there was a wildfire threat.

Future work should also focus on testing how the composition of a population comprised of different archetypes can affect the vulnerability of tourists or the overall vulnerability of a community. This could be performed by calibrating wildfire evacuation models with different populations and systematically investigating the resulting evacuation processes. Such an exercise may be useful not only to perform a vulnerability assessment of existing tourist communities, but also to investigate vulnerability of communities throughout the year. In other words, an operationalised understanding of what types of population (including tourists) are present in a given area is indeed useful for a range of activities such as the calibration of simulation tool inputs and the assessment of the impact of seasonal population variation on vulnerability to wildfire or even other hazards. A key limitation of this work would be inherent to the use of archetypes, or 'archetyping' as this may be seen as an over-generalization or simplification of people into groups. However, this is crucial despite acknowledging individual preferences within the field of psychology, where it is recognized that personal choices are not rigid and decision-making processes can undergo significant shifts.

It is important to note that this work does not assume linear relationships between variables because some of the variables such as safety culture and risk perception are related. This applies also to the relationship between the presence of children and risk perception, and the interaction with authorities and experience. Therefore, this work could be treated as a series of conceptual models that could be tested using real life wildfire evacuation decision data to validate the outcomes of evacuation or staying.

## 6. Conclusion

This paper presents a set of key variables affecting tourist behaviour in wildfire evacuation based on a scoping review conducted using the PRISMA methodology. Ten key variables affecting the evacuation behaviour of tourists were identified, namely property attachment, past experience and preparedness, safety culture, risk perception, individual socio-demographics, group dynamics, interaction with authorities, place of residence/length of stay, transportation mode and information. This paper also demonstrates how to use the information collected related to tourists to update existing archetypes of evacuation behaviour originally designed for residents. This work is deemed useful for performing vulnerability assessment of tourist areas exposed to the wildfire threat. The definition of the archetypes is also likely to facilitate future wildfire evacuation modelling studies that involve communities in which tourists are present.

## CRediT authorship contribution statement

**Amina Labhiri:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation. **Sandra Vaiciulyte:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Formal analysis. **Erica Kuligowski:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis. **Enrico Ronchi:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

None.

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## Data availability

Data will be made available on request.

## Appendix A. Search strings of the scoping review

**Scopus**.

Date: June 20, 2023

wildfire OR bushfire OR forest fire OR campfire OR brush fire AND tourist* AND evacuation AND PUBYEAR > 1997 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE,"English"))

Date: June 21, 2023

wildfire **OR** bushfire OR forest AND fire OR camp AND fire OR brush AND fire OR outdoor AND fire AND tourist* OR transiant AND evacuation AND behavior OR behaviour AND decision-making AND PUBYEAR > 1997 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE, "English"))

Date: June 23, **2023**

wildfire OR **bushfire** OR forest AND fire OR campfire OR brush AND fire AND transient AND evacuation AND PUBYEAR > 1997 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE, "English"))

**Web of Science**.

Date: June 28, 2023.

(((((((((ALL = (Wildfire)) OR ALL = (forest fire)) OR ALL = (camp fire)) OR ALL = (bush fire)) AND ALL = (tourist)) OR ALL = (tourists)) OR ALL = (touristic)) OR ALL = (short-term resident*)) AND ALL = (evacuation)) AND ALL = (behavior)

Date: June 29, 2023.

(((((((ALL = (Wildfire)) OR ALL = (bush fire)) OR ALL = (forest fire)) OR ALL = (camp fire)) AND ALL = (short-term resident)) OR ALL = (tourists)) OR ALL = (touristic)) AND ALL = (response)) AND ALL = (evacuation)

## References


[1] W.M. Jolly, M.A. Cochrane, P.H. Freeborn, Z.A. Holden, T.J. Brown, G.J. Williamson, D.M. Bowman, Climate-induced variations in global wildfire danger from 1979 to 2013, Nat. Commun. 6 (2015).

[2] M. McNamee, B. Meacham, P. Van Hees, L. Bisby, W.K. Chow, A. Coppalle, R. Dobashi, B. Dlugogorski, R. Fahy, C. Fleischmann, J. Floyd, E.R. Galea, M. Gollner, T. Hakkarainen, A. Hamins, L. Hu, P. Johnson, B. Karlsson, B. Merci, B. Weckman, IAFSS agenda 2030 for a fire safe world, Fire Saf. J. 110 (2019) 102889, https://doi.org/10.1016/j.firesaf.2019.102889.

[3] D.B. Lindenmayer, R.M. Kooyman, C. Taylor, M. Ward, J.E.M. Watson, Recent Australian wildfires made worse by logging and associated forest management, Nature Ecology & Evolution 4 (7) (2020) 898–900, https://doi.org/10.1038/s41559-020-1195-5.

[4] N. Benichou, M. Adelzadeh, J. Singh, I. Gomaa, N. Elsagan, M. Kinateder, C. Ma, A. Gaur, A. Bwala, M. Sultan, National Guide for Wildland-Urban Interface Fires: Guidance on Hazard and Exposure Assessment, Property Protection, Community Resilience and Emergency Planning to Minimize the Impact of Wildland-Urban Interface Fires, National Research Council of Canada, 2021.

[5] T.J. Cova, F.A. Drews, L.K. Siebeneck, A. Musters, Protective actions in wildfires: evacuate or shelter-in-place? Nat. Hazards Rev. 10 (4) (2009) 151–162.

[6] K. Strahan, An archetypal perspective on householders who 'wait and see' during a bushfire, Progress in Disaster Science 7 (2020) 100107, https://doi.org/10.1016/j.pdisas.2020.100107.

[7] E. Kuligowski, Evacuation decision-making and behavior in wildfires: past research, current challenges and a future research agenda, Fire Saf. J. 103129 (2020), https://doi.org/10.1016/j.firesaf.2020.103129.

[8] J. McLennan, B. Ryan, C. Bearman, K. Toh, Should we leave now? Behavioral factors in evacuation under wildfire threat, Fire Technol. 55 (2) (2019) 487–516, https://doi.org/10.1007/s10694-018-0753-8.

[9] T.B. Paveglio, C. Moseley, M.S. Carroll, D.R. Williams, E.J. Davis, A.P. Fischer, Categorizing the social context of the wildland urban interface: adaptive capacity for wildfire and community "archetypes.", For. Sci. 61 (2) (2015) 298–310.

[10] T.E. Drabek, Disaster responses within the tourist industry, Int. J. Mass Emergencies Disasters 13 (1) (1995) 7–23, https://doi.org/10.1177/028072709501300102.

[11] E. Ronchi, G. Rein, S. Gwynne, R. Wadhwani, P. Intini, A. Bergstedt, E-sanctuary: open multi-physics framework for modelling wildfire urban evacuation, Fire Protection Research Foundation (2017) 1–608.

[12] G. Gupta, The Maui fires are more deadly than Hawaii's 1960 tsunami, The New York Times (2023) 1-1.

[13] E. Bubola, N. Kitsantonis, Greek hotels fear a burning Future:'Even the animals are moving away', International New York Times (2023) 1-1.

[14] G. Boustras, N. Boukas, Forest fires impact on tourism development: a comparative study of Greece and Cyprus, Manag. Environ. Qual. Int. J. 24 (4) (2013) 498–511, https://doi.org/10.1108/MEQ-09-2012-0058.

[15] E. Ronchi, S. Wong, S. Suzuki, M. Theodori, R. Wadhwani, S. Vaiciulyte, S. Gwynne, G. Rein, M. Kristoffersen, R. Lovreglio, others, Case studies of large outdoor fires involving evacuation. International Association of Fire Safety Science-Large Outdoor Fire & the, 2021, p. 155 4504853.

[16] A. Rohaert, E.D. Kuligowski, A. Ardinge, J. Wahlqvist, S.M.V. Gwynne, A. Kimball, N. Bénichou, E. Ronchi, Traffic dynamics during the 2019 Kincade wildfire evacuation, Transport. Res. Transport Environ. 116 (2023) 103610, https://doi.org/10.1016/j.trd.2023.103610.

[17] N. Wetterberg, E. Ronchi, J. Wahlqvist, Individual driving behaviour in wildfire smoke, Fire Technol. 57 (3) (2021) 1041–1061.

[18] S.D. Wong, J.C. Broader, J.L. Walker, S.A. Shaheen, Understanding California wildfire evacuee behavior and joint choice making, Transportation (2022), https://doi.org/10.1007/s11116-022-10275-y.

[19] P. Intini, E. Ronchi, S. Gwynne, N. Bénichou, Guidance on design and construction of the built environment against wildland urban interface fire hazard: a review, Fire Technol. 56 (5) (2020) 1853–1883, https://doi.org/10.1007/s10694-019-00902-z.

[20] S. Gwynne, E. Ronchi, N. Bénichou, M. Kinateder, E. Kuligowski, I. Gomaa, M. Adelzadeh, Modeling and mapping dynamic vulnerability to better assess WUI evacuation performance, Fire Mater. 43 (6) (2019) 644–660, https://doi.org/10.1002/fam.2708.

[21] T.J. Cova, P.E. Dennison, T.H. Kim, M.A. Moritz, Setting wildfire evacuation trigger points using fire spread modeling and GIS, Trans. GIS 9 (4) (2005) 603–617, https://doi.org/10.1111/j.1467-9671.2005.00237.x.

[22] S. Grajdura, S. Borjigin, D. Niemeier, Fast-moving dire wildfire evacuation simulation, Transport. Res. Transport Environ. 104 (2022) 103190, https://doi.org/10.1016/j.trd.2022.103190.

[23] N. Kalogeropoulos, H. Mitchell, E. Ronchi, S. Gwynne, G. Rein, Design of stochastic trigger boundaries for rural communities evacuating from a wildfire, Fire Saf. J. 140 (2023) 103854, https://doi.org/10.1016/j.firesaf.2023.103854.

[24] D. Singh, K. Strahan, J. McLennan, J. Robertson, B. Wickramasinghe, What will they do? Modelling self-evacuation archetypes, arXiv Preprint arXiv:2105.12366 (2021) 1-33.

[25] J. Wahlqvist, E. Ronchi, S.M.V. Gwynne, M. Kinateder, G. Rein, H. Mitchell, N. Bénichou, C. Ma, A. Kimball, E. Kuligowski, The simulation of wildland-urban interface fire evacuation: the WUI-NITY platform, Saf. Sci. 136 (2021) 105145, https://doi.org/10.1016/j.ssci.2020.105145.

[26] P.E. Dennison, T.J. Cova, M.A. Mortiz, WUIVAC: a wildland-urban interface evacuation trigger model applied in strategic wildfire scenarios, Natural Hazards 41 (2007) 181–199.

[27] E. Ronchi, S. Gwynne, Computational evacuation modeling in wildfires, in: S.L. Manzello (Ed.), Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer International Publishing, 2019, pp. 1–10, https://doi.org/10.1007/978-3-319-51727-8_121-1.

[28] E. Ronchi, J. Wahlqvist, A. Rohaert, A. Ardinge, S.M.V. Gwynne, G. Rein, H. Mitchell, N. Kalogeropoulos, M. Kinateder, N. Benichou, E. Kuligowski, A. Westbury, A. Kimball, WUI-NITY 2: the integration, verification, and validation of the wildfire evacuation platform WUI-NITY, Fire Protection Research Foundation (2021) 1–117.

[29] E. Ronchi, J. Wahlqvist, A. Ardinge, A. Rohaert, S.M.V. Gwynne, G. Rein, H. Mitchell, N. Kalogeropoulos, M. Kinateder, N. Bénichou, E. Kuligowski, A. Kimball, The verification of wildland–urban interface fire evacuation models, Nat. Hazards (2023), https://doi.org/10.1007/s11069-023-05913-2.

[30] K. Strahan, J. Whittaker, J. Handmer, Self-evacuation archetypes in Australian bushfire, Int. J. Disaster Risk Reduc. 27 (2018) 307–316, https://doi.org/10.1016/j.ijdrr.2017.10.016.

[31] C.G. Jung, The Archetypes and the Collective Unconscious, 0 ed., Routledge, 2014, https://doi.org/10.4324/9781315725642.

[32] M.D. Peters, C.M. Godfrey, H. Khalil, P. McInerney, D. Parker, C.B. Soares, Guidance for conducting systematic scoping reviews, JBI Evidence Implementation 13 (3) (2015) 141–146.

[33] A.C. Tricco, E. Lillie, W. Zarin, K.K. O'Brien, H. Colquhoun, D. Levac, D. Moher, M.D.J. Peters, T. Horsley, L. Weeks, S. Hempel, E.A. Akl, C. Chang, J. McGowan, L. Stewart, L. Hartling, A. Aldcroft, M.G. Wilson, C. Garritty, S.E. Straus, PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation, Ann. Intern. Med. 169 (7) (2018) 467–473, https://doi.org/10.7326/M18-0850.

[34] L.H. Folk, E.D. Kuligowski, S.M. Gwynne, J.A. Gales, A Provisional Conceptual Model of Human Behavior in Response to Wildland-Urban Interface Fires, Fire Technology, 2019, pp. 1–29.

[35] S.-K. Huang, M.K. Lindell, C.S. Prater, Who leaves and who stays? A review and statistical meta-analysis of hurricane evacuation studies, Environ. Behav. 48 (8) (2016) 991–1029.

[36] R.W. Perry, M.R. Green, The role of ethnicity in the emergency decision-making process, Socio. Inq. 52 (4) (1982) 306–334, https://doi.org/10.1111/j.1475-

682X.1982.tb01257.x.
[37] T.E. Drabek, Understanding tourists during disaster, Aust. J. Emerg. Manag. 11 (4) (1996) 14–18.
[38] T.E. Drabek, Disaster evacuation responses by tourists and other types of transients, Int. J. Publ. Adm. 22 (5) (1999) 655–677.
[39] S.W. Litvin, G. Xu, S.K. Kang, Spousal vacation-buying decision making revisited across time and place, J. Trav. Res. 43 (2) (2004) 193–198.
[40] P.J. Cohn, M.S. Carroll, Y. Kumagai, Evacuation behavior during wildfires: results of three case studies, West. J. Appl. For. 21 (1) (2006) 39–48.
[41] V.A. Quintal, J.A. Lee, G.N. Soutar, Risk, uncertainty and the theory of planned behavior: a tourism example, Tourism Manag. 31 (6) (2010) 797–805.
[42] C. Matyas, S. Srinivasan, I. Cahyanto, B. Thapa, L. Pennington-Gray, J. Villegas, Risk perception and evacuation decisions of Florida tourists under hurricane threats: a stated preference analysis, Nat. Hazards 59 (2011) 871–890.
[43] T. Limanond, H. Kim, S. Siridhara, C. Tipakornkiat, C. Chermkhunthod, S. Uttra, Decision on tsunami evacuation route in tourism area: a case study of Had Patong, Phuket, Journal of the Eastern Asia Society for Transportation Studies 9 (2011) 16–30.
[44] J. Villegas, C. Matyas, S. Srinivasan, I. Cahyanto, B. Thapa, L. Pennington-Gray, Cognitive and affective responses of Florida tourists after exposure to hurricane warning messages, Nat. Hazards 66 (2013) 97–116.
[45] I. Cahyanto, L. Pennington-Gray, B. Thapa, S. Srinivasan, J. Villegas, C. Matyas, S. Kiousis, An empirical evaluation of the determinants of tourist's hurricane evacuation decision making, J. Destin. Market. Manag. 2 (4) (2014) 253–265.
[46] I. Cahyanto, L. Pennington-Gray, Communicating hurricane evacuation to tourists: gender, past experience with hurricanes, and place of residence, J. Trav. Res. 54 (3) (2015) 329–343, https://doi.org/10.1177/0047287513517418.
[47] R.S.C. Arce, M. Onuki, M. Esteban, T. Shibayama, Risk awareness and intended tsunami evacuation behaviour of international tourists in Kamakura City, Japan, Int. J. Disaster Risk Reduc. 23 (2017) 178–192.
[48] G. Aliperti, A.M. Cruz, Investigating tourists' risk information processing, Ann. Tourism Res. 79 (2019) 102803.
[49] A.C. Christianson, T.K. McGee, Nation 459, W. L. F., Wildfire evacuation experiences of band members of whitefish lake first nation 459, alberta, Canada, Nat. Hazards 98 (1) (2019) 9–29.
[50] S. Vaiciulyte, E.R. Galea, A. Veeraswamy, L.M. Hulse, Island vulnerability and resilience to wildfires: a case study of Corsica, Int. J. Disaster Risk Reduc. 40 (2019) 101272, https://doi.org/10.1016/j.ijdrr.2019.101272.
[51] S. Vaiciulyte, L.M. Hulse, E.R. Galea, A. Veeraswamy, Exploring 'wait and see'responses in French and Australian WUI wildfire emergencies, Saf. Sci. 155 (2022) 105866.
[52] K. Katzilieris, E.I. Vlahogianni, H. Wang, Evacuation behavior of affected individuals and households in response to the 2018 Attica wildfires: from empirical data to models, Saf. Sci. 153 (2022) 105799.
[53] S. Banerjee, I. Ghosh, R. Rastogi, Evacuation of the Transient Population: Review of the Behavioral Aspects and Challenges, vol. IV, Fifth World Congress on Disaster Management, 2023, pp. 187–197.
[54] K.W. Strahan, J. Whittaker, J. Handmer, Predicting self-evacuation in Australian bushfire, Environ. Hazards 18 (2) (2019) 146–172, https://doi.org/10.1080/17477891.2018.1512468.
[55] M.T. Kinateder, E.D. Kuligowski, P.A. Reneke, R.D. Peacock, Risk perception in fire evacuation behavior revisited: definitions, related concepts, and empirical evidence, Fire Science Reviews 4 (1) (2015) 1, https://doi.org/10.1186/s40038-014-0005-z.
[56] S.D. Wong, M. Yu, A. Kuncheria, S.A. Shaheen, J.L. Walker, Willingness of Hurricane Irma evacuees to share resources: a multi-modeling approach, Transportmetrica: Transport Science 19 (2) (2023) 2017064.
[57] E. Ronchi, S.M.V. Gwynne, G. Rein, P. Intini, R. Wadhwani, An open multi-physics framework for modelling wildland-urban interface fire evacuations, Saf. Sci. 118 (2019) 868–880, https://doi.org/10.1016/j.ssci.2019.06.009.
[58] R. Blanchi, J. Whittaker, K. Haynes, J. Leonard, K. Opie, Surviving bushfire: the role of shelters and sheltering practices during the Black Saturday bushfires, Environ. Sci. Pol. 81 (2018) 86–94, https://doi.org/10.1016/j.envsci.2017.12.013.
[59] K. Strahan, Factors influencing householder self-evacuation in two Australian bushfires. Mathematics and GeoScience, RMIT University, Melbourne, Australia, 2017 [PhD Thesis].
[60] R. Hull, S. Shamdasani, C. Jung, Four Archetypes: Mother, Rebirth, Spirit, Trickster (Bollingen Series), Princeton University Press, 2012.
[61] S.D. Wong, J.L. Walker, S.A. Shaheen, Trust and compassion in willingness to share mobility and sheltering resources in evacuations: a case study of the 2017 and 2018 California Wildfires, Int. J. Disaster Risk Reduc. 52 (2021) 101900.
[62] O. Bukvic, G. Carlsson, G. Gefenaite, B. Slaug, S.M. Schmidt, E. Ronchi, A Review on the Role of Functional Limitations on Evacuation Performance Using the International Classification of Functioning, Disability and Health, Fire Technology, 2020, https://doi.org/10.1007/s10694-020-01034-5.
[63] P. Geoerg, F. Berchtold, S. Gwynne, K. Boyce, S. Holl, A. Hofmann, Engineering egress data considering pedestrians with reduced mobility, Fire Mater. 2736 (2019) https://doi.org/10.1002/fam.2736, fam.
[64] M. Spearpoint, H.A. MacLennan, The effect of an ageing and less fit population on the ability of people to egress buildings, Saf. Sci. 50 (8) (2012) 1675–1684, https://doi.org/10.1016/j.ssci.2011.12.019.