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ORIGINAL PAPER

Reducing the vulnerability of tourists to tsunami: challenges for decision-makers

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Abstract

A near source or local tsunami, because of its close proximity to an affected area, cannot usually be predicted soon enough to mitigate many of the risks posed. The limited notice time in local tsunamis poses greater challenges for decision-makers than distant source tsunamis. Tsunamis affect coastal regions, where many of these areas are visited by tourists who often lack adequate knowledge of the hazards of the region. This study focuses on the risks tourists face during a local tsunami and discusses how to best protect tourists. Initially, a thematic literature analysis was performed to identify research gaps. Then, a case study methodology was adopted to obtain an in-depth understanding of how emergency management officials consider the management of tourists in evacuation planning. Napier, New Zealand, was used as a case study because it is a tourist town and vulnerable to tsunamis. Key decision-makers in the disaster management and tourist management sector were interviewed. The results outline three major initiatives that could lead to better tourist management and create better tsunami awareness for tourists. First, the risks posed to tourists can be reduced if emergency management officials collaborate with tourism agencies. Second, developing accurate evacuation simulations can show what would happen to tourists in a tsunami so that emergency management officials can be better prepared, and councils can improve evacuation planning and infrastructure to evacuate tourists and local communities safely. Third, educating tourists about evacuation plans will increase their readiness and enhance their safety.

Keywords Tourist evacuation · Tsunami evacuation · Emergency management challenges

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1 Introduction

Distant tsunamis are usually generated by earthquakes far away from the coastline, usually thousands of kilometres away. They travel across oceans and can take several hours to reach the coastlines (Lindell et al. 2022). Distant tsunamis are typically much larger in scale but may lose some energy as they propagate across an ocean, resulting in less damage and fewer casualties when they eventually reach the far coast (Chacon-Barrantes and Arozarena-Llopis 2021). On the other hand, local tsunamis are usually generated by an earthquake or other event that occurs very close to the coastline, within a few hundred kilometres. Local tsunamis can arrive at the coast within minutes and can cause significant damage and casualties to the immediate coastal areas (Chacon-Barrantes and Arozarena-Llopis 2021). Also, assessing the impact of local tsunamis following earthquakes is more challenging than distant sources since casualties and damages are often reported as a single figure rather than being divided based on events that caused them unless the earthquake's epicentre is located in the nearby ocean where there are no immediate casualties associated with the earthquake.

Tsunamis are low-probability high-impact disasters that can decimate coastal regions and populations, causing widespread injuries and deaths (Clark et al. 2019). Analysis by Imamura et al. (2012) of pedestrian movements under tsunami conditions over the last 25 years showed that the energy of a tsunami wave is able to destabilise a person, causing them to fall and impede their ability to reach safety, possibly leading to death or injury. The Sumatra–Andaman earthquake and the consequent tsunami in the Indian Ocean in December 2004 resulted in 227,899 reported dead or missing (Gusiakov et al. 2019). The Tohoku earthquake and tsunami in Japan in 2011 resulted in 18,487 recorded deaths, 6157 injured, and 2594 people reported missing (Murata et al. 2018).

Emergency planning for tsunamis has always been difficult for decision-makers, especially for local tsunamis in which the notice time is short. The plans on how to respond to tsunamis differ based on the distance of the earthquake epicentre to the coastline. In the case of local tsunami risk, immediate evacuation is typically recommended as the primary response (HBEM 2021).

Multiple studies address different aspects of tsunami evacuation (Sun et al. 2017; Yamato et al. 2019; Yasufuku et al. 2017). Payne et al. (2020) studied the influential factors in evacuating local residents, and the findings indicated that residents benefit most from community leadership in an event since local leaders generally know their community better than response agencies. Tourists are not considered local residents and are often neglected in evacuation planning. However, tourists are usually unfamiliar with the geo-environmental complexity of a destination, including what natural hazards exist, what to do in an emergency, and who is available to help (Dynes 1997). Evacuation plans play an essential role in disaster management for events such as tsunamis (Arce et al. 2017; Sun et al. 2017). Gray-Graves et al. (2010) stated that in terms of vulnerability to localised disaster events, tourists could be more vulnerable than permanent residents. Tourists may lack local knowledge and ignore or misunderstand warning signs (Yasufuku et al. 2017), especially in the case of local tsunamis, where normally there is no official warning or siren.

Tsunami evacuation plans differ according to geo-environmental features, the feasibility of access to high ground and expected human behaviour during a tsunami event (Matyas et al. 2011). In popular tourist destinations that are particularly susceptible to tsunamis, it is crucial to develop evacuation and emergency plans to minimise risks and ensure the safety of tourists (Takabatake et al. 2018). Most evacuation management plans give little or no

attention to tourists, preferring to focus on permanent residents. A review of international literature on tsunami evacuation processes identified a knowledge gap and lack of consideration of tourists in tsunami emergency planning, and a lack of specific plans for tourist risk reduction in main tsunami evacuation plans.

This study aims to identify the challenges decision-makers face in reducing risks posed to tourists during a tsunami. The current paper addresses this issue through a qualitative research methodology discussed in the following sections and offers solutions for mitigating or minimising risks. (MBIE 2020) Napier City, New Zealand, was chosen as a case study due to its high vulnerability to tsunamis and its status as a popular tourist destination. The city is located on the coast, and as such, it is exposed to the threat of tsunamis. According to the Ministry of Business, Innovation, and Employment, Napier has a thriving tourism industry with annual revenue of $300 million (MBIE 2020). The Hawkes Bay Tourism Organisation (RTO) reported a 3% increase in tourist spending in August 2019, indicating that the city's tourism industry was on the rise. Despite the challenges posed by the COVID-19 pandemic, the New Zealand government expects tourism in Napier to recover to pre-COVID-19 numbers, making Napier an ideal case study for examining how to improve tourist safety to tsunami risk.

2 Background

Over the past decades, there has been an awareness of the need to incorporate tourists in tsunami management plans. Over time, various researchers have identified different factors resulting in tourists are often not included in evacuation planning. Figure 1 provides a summary of clusters that researchers have identified relevant to tsunami evacuation management for tourists.

As shown in Fig. 1, in the early 2010s, researchers mostly focused on the tourist's characteristics, population, tourists evacuation knowledge, and different classifications of tourists. More recently, there is more focus on what is available for tourists to use and what

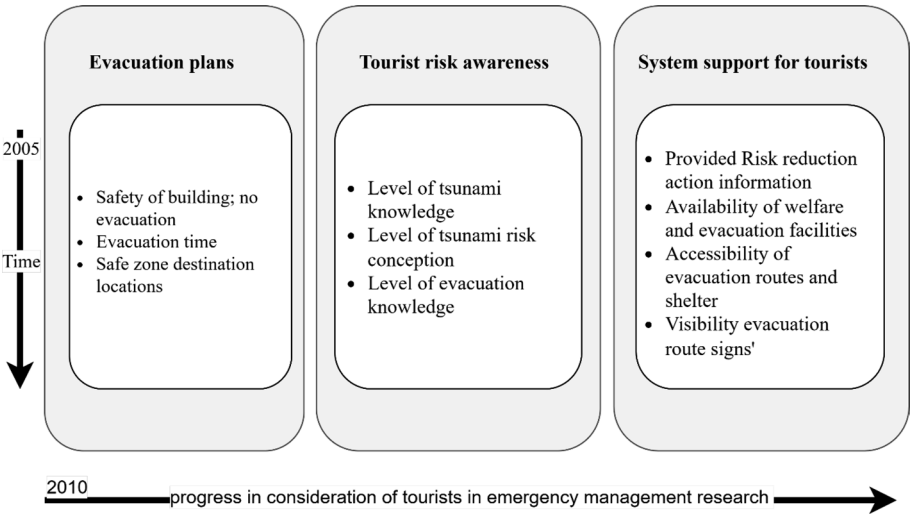

Fig. 1 Progress in consideration of tourists in emergency management research

arrangements and facilities have been provided for tourists in a tsunami event, focusing on the evacuation routes and shelters and safe zone locations.

The literature review highlighted the critical role of emergency management professionals in reducing tourist risks, also claiming that there is a lack of information concerning risk reduction for tourists. The literature highlighted critical features for tourist safety in tsunamis, including the need for evacuation plans, better awareness of tourist's risks, and the system's support for tourist's safety.

2.1 Evacuation plans

Before 2011, many tsunami evacuation plans were based on structural design to strengthen buildings during a tsunami (ASCE 2005; Heintz and Mahoney 2008). However, the Great Eastern Japan Earthquake and Tsunami emphasised the need for evacuation plans, including evacuation destinations and safe zones on high ground (Shibayama et al. 2013; Suppasri et al. 2013). Generally, evacuation plans focus on people's ability to evacuate from a location. According to the Intergovernmental Oceanographic Commission's guide provided by UNESCO, evacuation policy requires all stakeholders, including hotels and businesses, to share information on tsunami awareness and evacuation. However, some confusion exists as the UNESCO/IOC also has outlined that an evacuation plan for the management of tourists and staff is the hotels' responsibility (UNESCO/IOC 2020). The evacuation plan needs a specific plan according to its infrastructure capability, terrain morphology, and tsunami frequency. (Shibayama et al. 2013).

Yun and Hamada (2012) showed that one of the most critical factors for improving the survival rate of people in a disaster is the evacuation time required to reach safe zones. Within the context of local tsunamis, evacuation time is one of the most influencing factors due to the relatively short time frame between a sign of an imminent tsunami and the time for the tsunami wave to reach the shoreline (Darienzo et al. 2005). Tsunami risk assessment reports have shown that the inundation time can be as short as 52 min in Napier City (Fraser et al. 2014). Various factors are involved in the overall evacuation time (Lindell and Perry 2012), (1) response time, (2) time spent in movement (Sun and Sun 2019). Response time is the time from a tsunami warning alert notification when people need to comprehend and understand what has happened, take their essentials, get out of a building, or leave a risky location. The "time spent in movement" refers to the time it takes for evacuees to leave their risk location and reach their respective evacuation destination. It should be noted in local tsunamis where the notice time is short, there may not be an evacuation warning, and the evacuation time should be considered from the time an individual feels a strong or long earthquake.

The main focus of evacuation plans is to coordinate and manage the situation. Regarding local tsunami management, the evacuation plan focuses on reducing individuals' evacuation time. The reduction in the response time can be managed in different ways. For instance, the government erected tsunami warning towers at beaches in Thailand to provide early audible warnings for potential tsunami events (Birkland et al. 2006). Movement time can vary depending on the distance from the safe zone, traffic congestion, personal behaviour, and the Methods individuals use to evacuate (Harnantyari et al. 2020; Takabatake et al. 2020). Constructing infrastructure and buildings in or near safe zones can enhance evacuation options Beban and Fraser (2012).

Research shows that evacuation is harder and more time-consuming for older adults and children (Sun and Sun 2019). While the natural evacuation destination is high ground,

other safe zone options should be available in circumstances where people may not be able to cover distances to reach high ground in time. Vertical evacuation, including high-raised buildings, has been a solution in many cities (Birkland et al. 2006; McCaughey et al. 2017). These buildings are often public, such as hospitals, fire stations, or private evacuation buildings. For instance, Ishigaki City advises hotels with more than five stories to be used as evacuation destinations since the inundation height is anticipated to be below 30 m (Nguyen et al. 2018).

Some countries have purpose-built evacuation- buildings only used to protect people from the incoming waves during a tsunami event (Fraser et al. 2012). Birkland et al. (2006) suggested nominating one secure tall building in the evacuation zone to act as a vertical evacuation shelter. Conversely, while vertical safe zones may protect people from some tsunami waves, they can also pose a risk if the height of the incoming wave exceeds the building's design limits. In the Great East Tsunami, Tohoku City faced a tsunami wave higher than predicted, and the vertical evacuation options were inundated, causing many fatalities (Suppasri et al. 2013).

2.2 Tourist preparedness, awareness, and behaviour

Tourists will face greater challenges in evacuating to a safe zone effectively, as they will likely be uncertain about the best course of action to take (Matyas et al. 2011). Lack of tsunami awareness directly impacts tourist evacuation behaviour (Arce et al. 2017). At the same time, tourist's knowledge of the evacuation plan is critical to a successful evacuation (Fountain and Cradock-Henry 2020).

Tourist's behaviour varies from residents; since they have less awareness of the situation and less understanding of spatial features and route choice (Dynes 1997). Wachtel et al. (2021) clustered tourist behaviour into three groups. (1) Cautious tourist behaviour, (2) Risky tourist behaviour, (3) Cautious unaware tourist behaviour. According to Wachtel et al. (2021), the risks of tourists making mistakes vary depending on the particular category of tourist to which they belong. In addition, by analysing survey data, Cahyanto et al. (2014) recognised that tourists with higher risk beliefs (cautious tourists) are more likely to evacuate. Also, first-time tourists are more likely to evacuate. Research has shown that tourists with children prefer to evacuate earlier, while elderly adults tend to stay and wait for advice (Dynes 1997), and tourists travelling in personal vehicles are more likely to evacuate.

According to Dengler (2005), tourists rely on the local government to prepare and distribute evacuation plans and provide support during tsunamis. However, Rittichainuwat and Chakraborty (2012) noted that local governments are reluctant to distribute and emphasise strict evacuation plans since there are concerns about the potential discouragement of tourists from visiting tsunami-prone areas, thereby adversely affecting the tourism industry. Finding a delicate balance between increasing risk awareness and avoiding unnecessary alarm among tourists is crucial.

A study on tourist tsunami awareness in Indonesia by Hall et al. (2019) showed that around 70% of tourists were unaware of tsunami risks. Also, in Thailand, a high proportion of tsunami victims after the Indian Ocean tsunami were tourists (Birkland et al. 2006). The lack of awareness was a significant issue for tourists as they were unaware of what they should do in the event of a tsunami. Other countries had similar experiences. For instance, Arce et al. (2017) showed that Japan's tsunami awareness plan does not cover tourists. Esteban et al. (2018) showed a lack of tourist awareness through research in Japan and

America, claiming that despite the government's widespread knowledge, individuals who had not faced a disaster in their lifetime would, at most, have a moderate awareness of the situation. Informed tourists are more likely to evacuate (Cahyanto et al. 2014), so there is a need to focus on communication methods about tsunamis, including what to do during a tsunami and how best to prepare tourists..

Despite an array of tsunami awareness projects in New Zealand, tourists in Kaikoura stated they had limited information about evacuation plans (Fountain and Cradock-Henry 2020). Likewise, Hall et al. (2019) showed that, although evacuation information was made available to tourists in Indonesia, tourists mostly neglect to read this information. Even with tourists reviewing the evacuation information, there is still a reduced chance of making it safely to designated safe zones due to the unfamiliarity with their location.

Aliperti and Cruz (2018) showed that the evacuation processes of tourists could be boosted with proper communication, with Sakurai and Adu-Gyamfi (2020) highlighting that social media is believed to be a good choice for governments to spread evacuation information. One new method of communicating with tourists in disasters such as tsunamis is deploying technologies such as Bluetooth Low Energy sensors. This service guides tourists to reach the safe zones by making tourists aware of their deviation from recommended evacuation routes as soon as they have chosen the wrong route (Cahyanto and Pennington-Gray 2015; Yoshimura et al. 2014; Zualkernan et al. 2019). A study in Japan indicated that lack of communication in languages other than Japanese also is a barrier to helping tourists evacuate (Nguyen et al. 2019).

2.3 Support for tourist evacuation

Tourists are typically unaware of the destination's characteristics and often rely on information from their temporary accommodation facilities. In these circumstances, Rittichainuwat (2013) mentioned that tourists staying at guest houses are more vulnerable to a tsunami than tourists staying at big hotels. This is because hotels tend to have more awareness and better systems for evacuation. However, Nguyen et al. (2018) studied Japanese hotels' barriers in preparing tourists for a potential disaster, showing that evacuation training and evacuation supplies require significant investment, resources and preparations, which are particularly hard for smaller hotels to provide. Likewise, Brown et al. (2021) identified that while hotels need to prepare beforehand for a disaster (Orchiston 2013), there is a low tendency to prepare for a low-frequency event such as a tsunami. This reluctance is due to hotels' resource limits and a belief that there is no apparent benefit for them to prepare (Nguyen et al. 2021). For example, in Japan, the past practice required hotels to supply essential services such as water and food. Hotels in Japan considered providing water and food to evacuees but claimed that maintaining supplies cannot last for prolonged durations (Nguyen et al. 2018).

Accommodation providers can play a significant role in disasters by providing accommodation and other support (food etc.). Accommodation providers can also maintain tourist's safety by creating awareness of risks (Wilks et al. 2013). In circumstances where tourists are required to leave their accommodation and travel to designated safe zones, the mode they travel can significantly reduce risk. Tsunami evacuation methods usually include on foot, by bicycle, by private scooters or public transport, by car vehicles (Sun and Sun 2019). Tourists usually evacuate on foot or using private or hired cars (Cahyanto et al. 2014).

The mode of transport used for evacuation can result in differences in evacuation timing. The perceived benefits of evacuating via a faster mode of transport, such as by car, may not be the most effective way of reaching a safe location. Although a vehicle may allow an individual to cover greater distances over a short amount of time, adding extra vehicles to the roads can cause more congestion, lead to road blockages, and impede the evacuees' movement (Takabatake et al. 2020). Santos et al. (2016) showed that tourists, as well as residents, mostly used cars to evacuate. The morphology characteristics of the city often cause hardship for a tourist to make their way to a safe zone. Unknown places and unrecognisable street names mean tourists are more vulnerable. Hence, evacuation signs should be designed for tourists to find a safe zone faster. In Indonesia, Rezaldi and Soewardikoen (2016) noticed that there is no uniformity in evacuation signs. There is a need to educate tourists on how to read signs or unify signage to make it easier for tourists to read and comprehend.

The visibility and accessibility of the evacuation signs have been investigated (Arce et al. 2017) and shown that marking evacuation routes and shelters depend on many factors, from the landscape and vegetation to the signage orientation. Lonergan et al. (2015) developed a 3D model enabling real-time visibility assessment, and in another study, Yasufuku et al. (2017) examined the route sign's noticeability. The results showed that since the visibility of the signage is much lower during the night-time, enlarging the signage and adding flashlights significantly increase the sign noticeability. In addition, a projection on how difficult different evacuation scenarios are can help decision-makers to plan and reduce the risks of tourists. Evacuation models are valuable tools for highlighting what would happen in a tsunami and can provide recommendations to evacuation decision-makers. Evacuation models can encompass tourist's behaviour, evacuation destinations and routes and demonstrate potential mistakes tourists make in route choice. Kinugasa and Nakatani (2011) developed a system that estimated moving speeds and crowd densities to take tourist's behaviour into consideration. Takabatake et al. (2017) considered tourist's behaviour by decreasing their moving speed in the evacuation simulation model.

Evacuation modelling also helps to demonstrate new safe zones and shelters. Power (2019) used an agent-based evacuation model in three business districts in New Zealand to propose the best locations for vertical evacuations. In Yogyakarta, Sarwidi et al. (2019) projected tourist numbers on Indonesia's beaches were used to evaluate the required evacuation times and optimum ground height to be safe. In addition, studying coastal disasters in Honolulu showed that although the start and endpoint of some routes were located in safe zones, in some scenarios, the route crossed the inundation zone, so there is a need to exclude these routes from the evacuation plans (Kim et al. 2018). (Fraser et al. 2014; Hawke's Bay Emergency Management (XXXX); MBIE 2020; Taylor 2016); Urata and Pel (2018); (Power 2019).

3 Research methodology

This study focuses on the risks tourists face during a local tsunami and discusses how to best protect tourists. Examination of the literature provided some major themes of gaps in the area of the study, an in-depth case study. In order to answer the research gaps, a case study approach was selected for this study (Yin 2017), as the approach provides an in-depth examination. Results from the study identify the emergency management challenges in assisting tourists to reduce their risks and identify effective evacuation methods.

Napier City was selected, and a study area was identified as it meets the tourist destination criteria and also is at risk of major tsunami events. Key decision-makers and authorities in the study area dealing with emergencies, disasters, and tourists were interviewed. Analysis was undertaken and used to generalise and interpret the results of the case study in planning for tourist evacuation. Thematic analysis was undertaken to understand critical stakeholders' views (Kiger and Varpio 2020; Nojavan et al. 2018). Thematic analysis assists with segmenting, categorising, summarising, and reconstructing the pattern of themes in qualitative data (Zhang and Wildemuth 2012). Finally, recommendations for emergency management and the tourism industry are proposed.

3.1 Study area

Napier City is vulnerable to tsunamis and is a well-known tourist hotspot. Although studies have examined tsunami evacuation in Napier City (Fraser et al. 2013; Power 2019), so far, tourist evacuation has not been considered in Napier City's evacuation assessments.

Napier is a coastal city located in the eastern part of the North Island, Hawkes Bay region, New Zealand, situated geographically on 39°28′ 59″ S latitude and 176°55′00″ E longitude. Napier City is bounded by the north's main outfall channel and the Tutaekuri River in the south. The city's elevation is 57 m above sea level, and the annual average precipitation is 879 mm. Hawkes Bay Tourism Organisation (RTO) published a 3% increase in tourist's total spending in a year-to-year evaluation in August 2019. Napier City has approximately $300 million annually in revenue from the tourism industry. The majority of tourists visit Napier City in the summer, from November to March (MBIE 2020).

Napier City has a mild climate, generally warm and temperate, with a resident population of 62,800, according to 2018's population statistics (Taylor 2016). Napier City is vulnerable to various disasters triggered by natural hazards such as liquefaction, earthquake, flooding, volcanoes, and tsunami. The city has suffered from many disastrous events, including a destructive earthquake in 1931, which destroyed most of the city, and tsunamis of different heights. Although this study focuses on the local tsunami events, Table 1 provides a history of different types of tsunami hazards (local and distant) which has affected Napier City since 1850.

Various tsunami risk assessment maps are available on the Hawke's Bay regional website (Hawke's Bay Emergency Management), which is the region where Napier City is situated. Figure 2 shows the tsunami evacuation zones according to the recent risk assessment models provided by the Hawkes Bay emergency management team (Hawke's Bay Emergency Management). The red zone indicates the areas that have to be evacuated in any tsunami event. People in the orange and yellow zones must evacuate if a long and strong earthquake is felt. The main difference between the orange and yellow zones is that orange zones are areas where the tsunami source is less than one hour of travel time away from the mapped location. In contrast, the yellow zone indicates areas at risk of local tsunamis. Unfortunately, most of the hotels, motels, and tourist recreation centres, such as the National Aquarium of New Zealand, are located in the red zone.

Around Napier, the Hikurangi Fault is thought to produce earthquakes, and subsequently a tsunami, every 70 years. The last earthquake and tsunami occurred 92 years ago, in 1931, so there is concern that an earthquake and earthquake-generated tsunami might occur in the near future (Fraser et al. 2014). In the case of an Hikurangi Earthquake, Napier City is likely to face its worst tsunami scenario, in which the inundation time for people would be

Table 1 Summary of tsunami history in Napier City

Year	Earthquake area of region	Earthquake magnitude	Distance from source	Max water height (m)	Remarks
1855	Wairarapa	8.2	Local earthquake (Wellington)	10	N/A
1868	Chile	8.5	Distant-15 h	8	N/A
1947	Poverty bay	7	Local (Gisborne)	10	Houses, bridges and roads were damaged
1960	Chile	9.5	Distant-15 h	4	Foot-bridge and power and gas-line was damaged
2010	Chile	8.8	Distant-15 h	1.42	All port vessels and coastal residents were evacuated

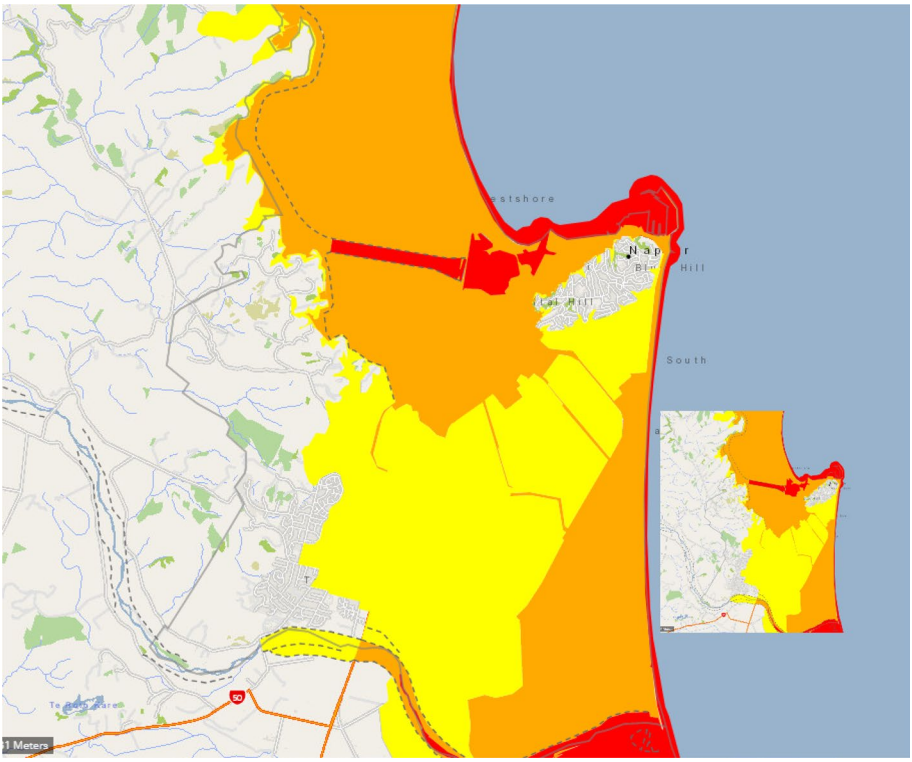

Fig. 2 Napier City Tsunami Evacuation Map [extracted from HBEM website (Hawke's Bay Emergency Management)]

as short as 52 min (Power 2019). A short time for evacuation is obviously concerning, for a city with a high international tourist population, especially in the summer months.

3.2 Expert interviews

Semi-structured open-ended interviews were conducted to study the challenges emergency management teams face in the evacuation process of tourists in Napier. This method gives in-depth structured results and has substantial flexibility in data collection (Kvale 2008). Textual data gathered in the interviews were recorded and coded via Assisted Qualitative Data Analysis Software (CAQDAS) NVivo; 12. The challenges decision-makers face in preparing tourists to survive a tsunami were identified by decoding the data.

The questions were clustered into three sections based on the knowledge identified in the literature; this provided control over the scope of the project and allowed the investigators further to investigate any strategic key issue for this study. All relevant themes concerning the research question were investigated (Jelodar et al. 2022). First, all interviewees were asked general questions mainly to understand the current tsunami evacuation plan and how a tourist would benefit from this plan. The following section involved questions regarding the respondent's expertise and involvement in evacuation planning. Each interviewee also responded to follow-up questions based on their answers. Table 2 gives an

Table 2 A simplified representation of the interview plan used to probe the study respondent

Section 1: Familiarity level with the tsunami evacuation plan
How do you describe the current evacuation tsunami management plan? What does evacuation planning look like for a tourist?
Section 2: Involvement/role in the tsunami evacuation plan
What is your role in the evacuation plan? (Probe: Planning decision maker, plan writer, response executor, etc.) Do you think the plan considers tourists sufficiently? (if no), how can you seek improvement in your department in improving the evacuation plan to cover tourist's requirements better?
Section 3: Follow-up questions
(Probe: based on the answers to the previous section, ask the following). What are the challenges for not indicating the suggested improvement? Who can help to ease the policy amendment?

overview of the question structure. The follow-up questions aimed to address the identified shortfalls in tourist tsunami evacuation management literature.

The expert interviewee's selection process involved finding experts who have a broad knowledge of the risks tourists face during a local tsunami and how to protect tourists best. Therefore, the following criteria were used for interviewee selection:

- The interviewee must have been in emergency management for over ten years (considered an expert).
- The interviewee must currently be working in a vulnerable tsunami environment (in Napier City).
- The interviewee was a local or national decision-maker (such as a council emergency management employee, local or national government employee or emergency management professional with local knowledge, e.g. with a charity such as Red Cross)

Napier City Council outlined the most relevant departments and the stakeholders to be interviewed. Stakeholders were identified according to purposive sampling (Patton 2014). The interviewees were selected from different decision-makers and leaders who have been working in emergency management and/or disaster risk reduction or the tourism industry in New Zealand for at least 15 years with high ranks in the hierarchy and have in-depth details in their area of expertise. Seven organisations were selected, and interviews were carried out with their representative. The selected organisations were the (1) East Coast Lab, (2) Hakurangi Response Planning Team, (3) Hawke's Bay Emergency Management Department, (4) Napier City Council, (5) Transportation Agency, (6) Institute of Geological and Nuclear Sciences, and (7) Hospitality New Zealand. A wide range of emergency management expertise was used in this research. This research used a total of 225 years of experience from the eleventh interviewee, which achieved theoretical saturation (Glaser and Strauss 2017). Theoretical saturation determined the interview sampling requirements for this study; where no more new information could be derived from the interviews, the interview process was closed (Glaser and Strauss 2017; Jelodar et al. 2016). Theoretical saturation determines the appropriateness of the sample for the interviews and whether further interviews would add to the investigation's findings (Jelodar et al. 2016).

All key decision-makers in Napier City emergency planning, plus experts from the central government, were interviewed. In addition, experts from the city tourism sector were also interviewed. The interviewee details are included in Table 3. The interviewees provided a rich dataset, enabling an in-depth analysis of the risks tourists face during a local tsunami and how to best protect tourists. After each interview, the transcripts were

Table 3 Stakeholder interviewee details

Stakeholder	Position	Experience (years)	Organisation
R1	Asset manager	+20	Napier city council
R2	Team leader	+30	TA[a]
R3	Project leader	+15	Eastcoast Lab
R4	Researcher	+30	GNS[b]
R5	Project leader	+15	HBEM[c]
R6	Team leader-risk reduction	+25	HBEM
R7	Communication manager	+20	HNZ[d]
R8	Project leader	+15	HRPT[e]
R9	Welfare services leader	+15	NZEMA[f]
R10	Data analyst-infrastructure management	+15	Napier city council
R11	Hotel manager	+25	HNZ

[a]Transportation agency

[b]Geological and nuclear sciences

[c]Hawke's bay emergency management

[d]Hospitality New Zealand

[e]Hakurangi response planning team

[f]New Zealand national emergency management agency

reviewed in detail and new themes and information were identified and recorded. After the 11th interview, no new theme emerged; therefore, theoretical saturation was achieved. This saturation level is aligned with Guest et al. (2006) study on evaluating the sample size using purposive sample sizes. Due to Covid-19, all the interviews were conducted online from February to August 2020.

The semi-structured interview approach and the pool of high-profile experts provided a strategic pathway to achieve more depth for the study and allowed the researchers more flexibility in navigating key issues. (Glaser and Strauss 2017; Jelodar et al. 2016).

3.3 Content analysis

The results of the interviews were transcribed and summarised via NVivo; 12. Subsequently, research themes were identified by examining and evaluating the content within their contexts using the thematic content analysis method (Jelodar et al. 2016). This method analyses the transcribed interview data linkage with the study questions based on the measurement of criticality, citation, and significance of the literature. The evaluation is a numerical value based on the terminology and language performed by Nvivo, with 1 (uncritical) to 5 (extremely critical). The significance of a theme in the study (as Eq. 1) is determined by dividing the frequency of mention for each theme by the total number of respondents in the interview process.

$$\text{Significance in study} = \frac{\text{Theme frequency of mention}}{\text{Total number of respondent}} \tag{1}$$

According to the results of data analysis using NVivo, a bubble chart is created to represent the significance of these factors/themes visually. The vertical axis of the chart displays the number of respondents who mentioned each theme, while the horizontal axis represents the level of importance expressed by the respondents. The size of each bubble indicates the theme's overall significance in the study, with larger bubbles representing major factors and smaller ones representing less significant ones that may be merged in the decoding phase.

4 Results and findings

4.1 Content analysis

The results of the content analysis are summarised in Table 4. As an overview, most respondents highlighted the effects of the required evacuation time, tsunami awareness, and the modes of evacuation. Experts are considering potential evacuation destinations for tourists, which also considers the evacuation routes and signs. Further analysis highlighted a link between the IoTs and evacuation modes to be used to enhance the decision-making and evacuation process. The results of the coding described in Table 4 are depicted in Fig. 3. After analysing and re-coding the attributes and theories uncovered from the literature, broader clusters for tourist evacuation management were classified into nine clusters: evacuation time, destination, tourist behaviour, tourist awareness accommodation role, evacuation modes, evacuation signs, and evacuation models (Fig. 4). These clusters are represented in three major themes evacuation plans, tourists preparedness, awareness and behaviour and support for tourists evacuation (Table 4).

The interviewees identified 20 factors that impact the planning of tourist evacuation, with "moving time" and "tsunami wave arrival time" being the most significant. All respondents have highlighted these factors as the top priorities factors that must be considered, placing them as the largest bubbles at the top-right side of Fig. 3. On the other hand, decision-makers appear to show relatively lower interest in vertical evacuation and accounting for group behaviour of tourists, as indicated by their positioning towards the bottom of the bubble chart in Fig. 3.

Re-coding the clusters and re-analyzing the related data revealed eight highly significant clusters, as shown in Fig. 4. As Fig. 4 shows, the most significant theme that causes the challenges for decision-makers to consider tourists in local tsunami evacuation plans is regarding evacuation time (shown as the largest bubble on the top right of the graph). Following the evacuation mode tourists use, the least mentioned attribute in tourist evacuation management is evacuation signs and tourist behaviour during catastrophic events, respectively.

4.2 4.2 Research themes

Three major themes emerged from the analysis of the research. These three themes were: Evacuation policy, Tourists preparedness and awareness, Support to support tourists in evacuation. Figure 5 shows the dimensions contributing to the tsunami evacuation for tourists.

Table 4 Coding and re-coding of the interview responses

Theme	Identified by	Factor	Criticality	Theme frequency	Significance in study	Avg criticality	Total theme frequency	Significance in study	Cluster
Evacuation plans	All	Movement time	4.2	11	100	4.6	11	100	Evacuation time
	All	Tsunami arrival time	5	11	100				
	R2, R6, R4, R5, R3	Tsunami hazard area	4.8	5	45	3.9	6	34	Evacuation destination
	R1, R3, R6	Safe zone accessibility	3.8	4	36				
	R4, R6	Vertical shelter	3.2	2	18				
Tourist preparedness and awareness	R2, R3, R5, R6, R7, R11	Tourist preparedness	2.8	6	55	2.4	6	33	Tourist behaviour
	R5, R3, R7, R11	Tourist reaction to tsunami	2	4	36				
	All except R1	Tourist awareness	3.5	10	90	3.7	11	49.5	Tourist awareness
	R2, R3, R7, R11	Tsunami knowledge	4	5	45				
	R11, R7, R2, R3	Evacuation knowledge	3.5	4	36				
	R7, R1, R4	IoTs in evacuation	3.8	3	27				
System support	R7, R1, R6, R5, R3	Government-based support	3	5	45	4	6	36	Accommodation role
	R11, R6, R7	Tourist industry	4	3	27				
	R11, R7, R3, R6	Hotels and accommodation centres	5	4	36				
	R3, R6, R5	Walk or car	4.8	11	100	3.7	11	58	Evacuation methods
	R3, R5, R2, R4, R	Traffic in evacuation	4.5	6	55				
	R2, R1	Group evacuation	2	2	18				
	R1, R2, R3, R5, R6 R10	Direction to safe zones	5	6	55	4.6	3	41	Evacuation signs
	R1, R2, R5	Route signage	4.3	3	27				
	R3, R4, R6, R10	Evacuation simulation	4	4	36	4	4	36	Evacuation models

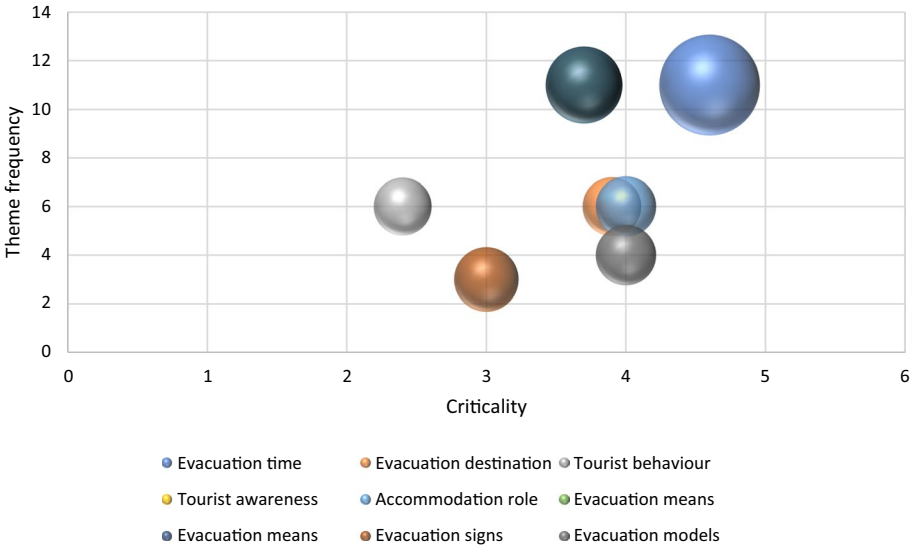

Fig. 3 Clusters of coding in tourist evacuation management

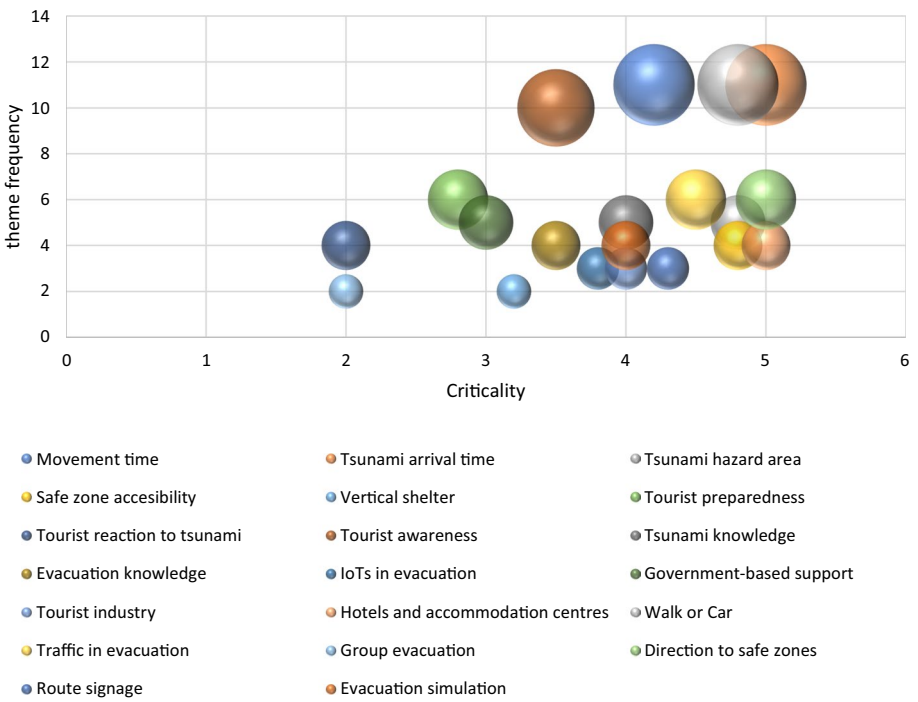

Fig. 4 Clusters of re-coding in tourist evacuation management

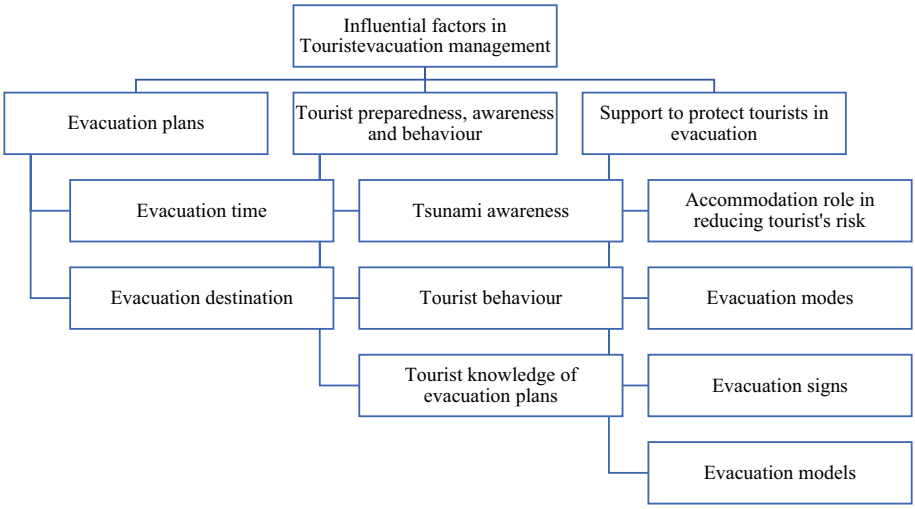

Fig. 5 Dimensions involved in tsunami evacuation management for tourists

4.2.1 Evacuation plans

The current evacuation recommendation in New Zealand is to not wait for an official evacuation warning but to go to high ground or as far inland as possible immediately after feeling a long and strong earthquake (HBEM 2021). R6 confirmed Hawke's Bay Emergency Management (HBEM) advice: to "*wait until the shake stop and get the hell out of there*". In cases where non-local individuals, such as tourists, do not know where to go, they are expected to follow residents and wait for an official announcement. There is some belief that tourists are catered for in emergency management plans, although any specific tourist evacuation details were hard to find and some confusion on where responsibility for tourists lay existed.

R3 indicated that "… *Some attention must be on tourism businesses that can provide guidance, but I am not sure what guidance is provided*." R5 also added that "*if it were a long and strong earthquake, we would be having police officials to help to evacuate, … so it wouldn't be a case of managing the tourists*". On the other hand, Hospitality New Zealand advised that "*The plans are really up to the civil defence organisations. Our role is, and has been, to be involved in some of the planning at the national level, essentially to remind civil defense organisations they need to think about the visitor to their region as well as their residents*" (R7).

4.2.1.1 Evacuation time A local tsunami creates a short period of time to make any decisions and safely evacuate. This time includes delays caused before moving to evacuation zones, which could include waiting for the shaking to stop, people trying to collect belongings, or waiting for family and friends. R3 believed that "… *the shaking could be two-plus minutes, plus some decision-making time on top of that, so I think you are looking at five minutes plus, really*."

R1, R8, and R6 believe that tourists would prefer to stay in their hotels as they might be unaware of where to go and afraid of not reaching the safe zone.

4.2.1.2 Evacuation destination An earthquake prior to the tsunami would cause damages and block some routes and consequently reduce the accessibility to reach safe zones.

R2 stated that "*The southern part of Napier City is the main area of concern in evacuation since most schools are located in this area*". Consequently, road congestion will cause difficulties for evacuees to reach the safe zone. Respondents generally agreed that the timing of a tsunami event could lead to different evacuation management strategies. Respondents were considering vertical evacuation options in congested areas. R6 said that "*we say if you are on your way to a safe location and you think you can't get there in time, well then you can consider vertical evacuation in buildings, and you should look for strong concrete buildings. But that's very much a last-minute option, not to be your preferred option*." However, there were potential options around Napier City that were considered safe and could be potentially advertised as safe locations which R6 proposed a potential option: "*One shelter for Napier could be Napier Mclean Park.*".

4.2.2 Tourist preparedness, awareness and behaviour

Respondents all agreed that although there is no consensus on how a tourist would behave. R3 replied that "*Yeh, I think there is definitely still a lot of work to be done in that space.*" Likewise, R5 supported the fact by adding, "*Understanding international studies on tourist's behaviour during a tsunami could assist Napier City in reducing risk*".

However, in terms of tourist's awareness of tsunamis, all respondents believed that since Napier City is famous for the 1931 Earthquake, many tourists visit the heritage sites and understand the impact of the 1931 earthquake. For some tourists, a general understanding of risks might be assumed. R3 commented on this, "*… Most tourists are aware because that's the main reason they come to Napier,*." In addition, R7 believed that "*the awareness of earthquake is high among New Zealand Tourists, but probably less about the tsunami*." She also added, *"No matter how aware a tourist is, in a crisis, they need to be told what to do".*

There is a comprehensive disaster management plan in Napier City, and much effort has been made to educate the residents, even as early as preschool. R5 indicated when it comes to tourists, and it is difficult for the emergency management team to fully understand the potential impact "*…by considering tourists, the numbers can add up to 5000 additional people in the Napier area that don't have that understanding. Some attention must be on tourism or businesses that can provide that guidance, but I am not sure what guidance is provided*". R7 added that "*… the information is available if they (tourists) want to look, but it's probably not pushed at them…, but we have no measures on how many visitors look through the available compendium and take on board that message*".

R7 and R11 believed that the recent AI technologies could improve evacuation management for tourists, mentioning that*"… the notion of having mobile apps or GPS lead sirens to navigate individuals in short-notice mass evacuation like tsunamis is not far from mind*."

4.2.3 Support for tourist's evacuation

4.2.3.1 Accommodation's role in reducing tourist's risks R9, among others, was of the belief that there is a need to continue to work with the Tourist Industry Agency (Hospitality New Zealand) to provide information and guidance to tourists as the government and emergency

management officials are not involved in providing specific details for tourist evacuation. Most respondents stated that hotels would be a reliable place to provide this information.

Hospitality providers felt that individual accommodation providers should implement procedures related to distributing evacuation plan information to tourists. R6 also thought that "*Most of these hotels are in the CBD, so it would be a fairly simple procedure, but as far as I'm aware, there's very few that have actually done it*." However, R7 claimed that "*Most of the accommodation providers have a compendium in the room, and it pretty much always includes information about what to do in an earthquake and quite often that would pick up on the tsunami that comes out on the Ministry of Civil Defense messaging*". R11 also confirmed that "*There is information on what to do after a strong shake and how to get out of the building in every room*. "Hospitality New Zealand mentioned that the information is provided in English, so it is less likely that those who have English as their second language would take on board the recommended actions.

4.2.3.2 Evacuation modes Regarding evacuation means, the interviewees all mentioned that although the recommendation is to evacuate on foot, people would also consider evacuating by bike or car. R3 said that "*Most people's immediate thinking is to evacuate by car, but we know that there's going to be other hazards after the earthquake that will make it really difficult for people to evacuate by car*."

In addition, it should be considered that tourist who has travel accompanies, such as children and elderly adults, may prefer to take cars, and this is a challenge; as R2 said," *The chaotic situation that arises when individuals attempt to reconnect with their group members leads some to believe that cars can speed up the evacuation process. But this only exacerbates the traffic*."

4.2.3.3 Evacuation signs The interviewees all agree there is a need for more signs, labels and brochures to inform tourists what actions to take in the event of a local tsunami. However, there was also a concern that an excessive amount of risk information could potentially induce anxiety among tourists and negatively impact the local tourism industry.

Respondents indicated that currently, there are no evacuation route signs installed in Napier City. The Council plans to establish evacuation routes and signages in collaboration with the Transportation Agency. R2 mentioned that *"… we have a plan to place these signs in the next five years*."

The strategy of the Napier City Council (Council 2018) focuses on enhancing the quality of infrastructure for both tourists and residents, which aligns with Hospitality New Zealand's objective to attract more tourists. While ensuring safe evacuation is a crucial aspect of this infrastructure, the current challenges faced by this project primarily revolve around its cost. (Council 2018) R1 outlined this challenge as "*The evacuation infrastructure needs more investment, and we are considering this in our long-term plan. In this vein, the identification and approach to implementing suitable evacuation corridors to Napier Hill, and the engineered infrastructure that should go into them to maximise evacuation capacity and evacuee safety is something we are really interested in."*

4.2.3.4 Evacuation models Napier City Council and Hawkes Bay Emergency Management team understood the benefits of evacuation simulation models. R6 said that "*What we are learning from all the evacuation modellings is that we need vertical evacuation locations throughout the city that are robust and we know will stand up and be safe*." R4 has simulated the evacuation process in Napier CBD via an agent-based model. He sug-

gested that "*They (the models) show likely congestion areas during daytime and nighttime scenarios and look at options such as vertical evacuation. In some cases, they had mapped routes that weren't possible in real life, and other routes that were possible were then added."*

Evacuation models aim to offer insights into pedestrian dynamics during a local tsunami. However, The models have not yet reached a level of maturity where they can be considered sufficiently reliable for practical use in evacuation management. For instance, R4 expressed that "*Some factors, such as the road blockages caused by the earthquake's damage, were not available to be fed into the model. … Also, tourist's behaviour was not included in the model.*" While R10 agreed with the benefits of evacuation simulations, she was also worried about how the road blockages would be considered and how the models would be validated.

5 Discussion

In the event of a local tsunami evacuation, the aim is to mitigate potential risks; however, the distance of the epicentre of the earthquake with the potential area of effect is a determinant of the notice time and likely evacuation response time. The situation will be highly critical for the more localised earthquake events. There are major concerns about planning and managing evacuation processes for tourists who have a higher level of uncertainty in what tsunami risks are, deciding what is the best course of action to take, and what things to collect in only a few minutes. In a tsunami evacuation event, even though tourists decide to evacuate, they may get confused and make route choice mistakes due to unfamiliar spatial features (Wachtel et al. 2021).

The results showed that tsunami-vulnerable coastal cities are often filled with tourists, and tsunami awareness reduces the risk towards tsunamis. While increased tsunami awareness can mitigate the risk for tourists, it remains essential to provide clear instructions on the appropriate course of action, regardless of their level of awareness. In addition, decision-makers need to expand their capacity to support tourists should a tsunami occur. Likewise, other researchers have pointed out multiple factors, such as tourist's awareness and preparedness (Mikami et al. 2020) and the system's capacity and capability to support tourists (Igualt et al. 2017), should be considered during disasters.

Tourist's awareness varies according to their knowledge, background and experiences (Esteban et al. 2018). Relying on assumptions that tourists have prior knowledge can potentially expose them to higher levels of risk. For the evacuation process involving tourists in Napier City, there is a need for a more cohesive and coordinated communication system among agencies. This statement is necessary due to the lack of clarity regarding which agency should be responsible for providing specific information. Accommodation centres have been shown to play a significant role in broadening disaster awareness (Rittichainuwat 2013; Wilks et al. 2013). They are also able to assist in familiarising tourists with evacuation plans (Fountain and Cradock-Henry 2020). For instance, which buildings are safe and considered vertical shelters (Fraser et al. 2012). Most of Napier City's hotels are three-story buildings that could potentially be used for vertical evacuation, but this information is not currently available or distributed to tourists. These buildings can provide a safe place higher than the maximum predicted wave height of 10 m for tsunami evacuation, but they also need to withstand the wave impact, so some further research is required.

In the case that tourists are not in their hotels, evacuation route signs are essential guides for reducing risks and allowing tourists to reach a safe zone (Rezaldi and Soewardikoen 2016). Napier City recognises a need to improve and add evacuation route signage. Research shows that this signage needs to be appropriate for international audiences and to be seen during the day and night-time.

Although there have been efforts to consider tourist dimensions in evacuation planning (Dynes 1997; Orchiston 2013), more research is required on the best ways to consider tourists, including tourist population rises, in evacuation models (Takabatake et al. 2017). The prediction of average tourist flows in Napier City is known, but currently, tourists and increasing tourist numbers are not considered in the tsunami evacuation modelling.

5.1 Recommendation

According to the data gathered from the research, multiple recommendations can be proposed to decision-makers to consider in evacuation planning. The recommendations is classified into two sections, (1) for the case study location Napier City and also (2) general recommendations to be considered by any evacuation management decision-maker in a tsunami-vulnerable city.

5.1.1 Recommendations for Napier city

- Safe and durable buildings for vertical evacuation should be identified based on the maximum tsunami wave height. Considering vertical evacuation structures, where available and sufficiently resistant to tsunami, as safe zones in highly visited areas would benefit tourists unfamiliar with the city's designated tsunami safe zones. Considering vertical evacuations instead of travelling inland could increase the survival rate.
- Emergency management officials and city council advisors should evaluate the durability status of the current high-rise building in high-density areas and/or invest in a new building with the required standards to withstand a tsunami.
- Tourism industry officials and accommodation providers can collaborate to boost tsunami awareness among tourists. It would be beneficial to provide awareness information via different media such as in-room brochures, video clips, social media, etc.

5.1.2 General recommendations

This section provides general recommendations based on the study's findings, which expand beyond the case study conducted in this article. The recommendations are provided in correspondence with the main stakeholders and potentially responsible authorities.

- Coastal cities should include a section about tourists in city evacuation plans. Emergency managers can draft a subsection to accommodate tourists in the evacuation plan.
- Advanced simulation modelling can provide an understanding of the potential impacts of hazards on populations, including tourists. Modelling can be done by considering different factors such as (1) route closure due to the earthquake debris; (2) uncertainty in tourist's routes choice; (3) the rate of tourists to residents in each area; (4) variation in walking speed due to environmental factors such as terrain slope or individual factors such as age; and (5) considering that a percentage of people would evacuate via cars or other transport forms. Emergency management officials, alongside the tourism

industry, should gather data to be used as input data for modellers to conduct evacuation simulations.
- City Council and tourism industry officials should collaborate to make tourists aware of the location of safe zones and vertical evacuation places.
- The evacuation signage must become a non-linguistic standard globally, regardless of the home country's official language, to assist all sorts of language-speaking tourists in any country.
- The tourism industry sectors, including accommodation providers and food and restaurant outlets in highly visited areas, should participate in evacuation planning, taking actions such as providing evacuation information for tourists and regularly monitoring the relevance of the required information to tourists.
- Any evacuation plan must have clear instructions and advice on the preferred evacuation mode deployed for tsunami evacuation in different suburbs and zones. Accordingly, these plans and details must be publicly available and easily accessible. Local government, different agencies and hospitality providers are responsible for communicating the plan to tourists.
- Decision-makers will benefit from considering evacuation modelling and simulation model outputs in developing alternative evacuation scenarios, plans and routs. This can be used in developing policies to enhance evacuation processes for tourists.

6 Conclusion

Effective evacuation plays a significant role in increasing survival rates during catastrophic events such as local tsunamis. Where cities are tourist centres, there is mounting pressure to ensure that the residents and the transient population are all safe. Unfortunately, tourists have been overlooked in planning for tsunamis. Since tourists are not as familiar as other residents with a city's hazards, they are more vulnerable. Tourists can miss, underestimate, or not understand the evacuation requirements because of the language barrier, misreading signage, and misunderstanding evacuation options. By focusing on a case study of a tsunami-vulnerable city (Napier City in New Zealand), this study has shown the barriers a city faces when it comes to understanding and providing for tourist's need in an emergency tsunami evacuation. The study has also highlighted some key recommendations and provided actual approaches in which any coastal city can enhance their disaster management and evacuation plans. The recommendation to tsunami-prone cities is that City Council officials work alongside emergency management and tourism industry officials to understand the requirements of tourists during possible evacuations and analyse their evacuation behaviour. Based on the results, there is a need to make sure tourists are considered in evacuation planning, for instance, incorporating required infrastructure and education to tourists in the planning process. These recommendations will also be critical to other tsunami-prone areas where tourists congregate and stay.

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