# Community Understanding of Tsunami Risk and Warnings Systems in Australia

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## Executive Summary

The Eastern Australian coastline faces some 8,000km of active tectonic plate boundary that is capable of generating tsunami that could reach Australia in 2-4 hours. Australia also faces risk from events occurring in the Indian and Pacific Oceans, with warning times of some 4-8 hours. In New South Wales; some 330,000 people are living at or below a height of 10 metres above sea-level and within 1km of the coast or a coastal river. Recognition of this risk promoted the development of the Australian Tsunami Warning System (ATWS). The effectiveness of a warning system is a function of its ability to detect a threat, issue a warning, and facilitate timely and effective action in those at risk. This project adopted a qualitative approach to assessing people's view about tsunami warnings and their ability to act on them.

Interviews with volunteer, community, and maritime groups and organizations revealed that tsunami are perceived as a non-existent or very low probability event throughout Australia. A belief that no tsunami events had occurred in Australia (at least since colonial times), that major causes (e.g., seismic, volcanic) were absent, and a lack of regular government (local and national) and media discussion of tsunami reinforced this view. Consequently, the predominant belief about tsunami was characterized by risk rejection. Risk rejection resulted in respondents believing that no resources or effort should be directed to tsunami risk reduction strategies. Rectifying this view involves more than training.

Training was found to increase knowledge of tsunami characteristics and behavior, but it did not translate into acceptance of a need for action. Consistent with the literature on risk, respondents discussed the need to increase the public profile of tsunami, and to do so in ways that localize risk reduction activities. In general, the diversity (e.g., in terms of geographic location, topography, demographics, length of residence etc.) of areas susceptible to experiencing tsunami around Australia reinforced the need to develop local level initiatives and develop local warning and community response capabilities. The existence of several volunteer and community groups in susceptible areas makes it feasible to consider the development of local strategies.

The research discussed the availability and use of the "Tsunami: The ultimate guide" resource. With the exception of those respondents who had had some involvement in its development, those interviewed were largely unaware of its availability. This was more a function of the fact that tsunami are not a high profile hazard in school curricula. When made aware of the Guide, the consensus was that it appeared to be a useful resource. The uptake of the Guide will be influenced by the degree to which tsunami are seen as a phenomenon that makes a significant contribution to the Australian hazard-scape. The availability of the Guide means that it can be used to complement a risk acceptance strategy (see above) and ensure that community members and schools have ready access to an informative resource to support local risk reduction planning and actions.

# Contents

# Section A: Introduction and Report Objectives

The aim of the project was to identify the nature and origins of current community tsunami beliefs and knowledge and examine how beliefs/knowledge can inform the development of, implementation of, and evaluation of tsunami risk communication, warnings systems and tsunami preparedness in Australia. Since commencement of the first qualitative study, the project grew through active engagement between end-user stakeholders and researchers, to include two qualitative pilot studies and a tsunami risk communication literature review.

## Report Structure

This report details the findings of the initial qualitative study as well as the two follow up pilot studies. The report also includes recommendations for the provision of evidence-based warnings strategies and practices for at-risk coastal communities for the project's participating end users: The Australian Tsunami Advisory Group, Surf Life Saving Australia, and NSW SES.

Each of these studies are covered in the following sections:

- **Section A - Introduction**
- **Section B - Community Awareness of Risk and Warnings**
- **Section C - Risk Perception, Awareness, and Community Engagement for Coastal and Marine Groups**
- **Section D - Tsunami: The Ultimate Guide – Uptake and Usage**

As some of the content and issues identified in the interviews as well as the objectives overlap, the project objectives and their related report sections are identified as:

- **PO1 -** Identify factors that influence how people are interpreting tsunami risk and warnings processes and identify how to influence behaviour and reactions for tsunami events. *(Section B)*
- **PO2 -** Identify how community groups are using the "*Tsunami: The Ultimate Guide*" resource (from here also referred to as The Tsunami Guide or the Guide) and develop a framework for developing a community engagement framework to increase utilization of the Guide. *(Section C & D)*
- **PO3 -** Identify how teachers are using the Guide and whether there are accessibility issues with the location of the Guide. *(Section D)*
- **PO5 -** Identify how (selected) coastal and marine groups interpret warnings, and develop approaches for risk communication with these groups about the risks and actions related to them in the event of a tsunami, including those relating to land versus marine tsunamis. *(Section B & C)*

## Sampling for the Project

Interviewees for this project were recruited through a combination of:

- Advertisements on participating agency and organisation websites (exp. Red Cross Australia, SLSA, and WA SES members website/newsletter, Teachers associations),
- Email invitations (NSWSES, all community groups/workplaces),
- Social media (SLSA, Red Cross),
- At community group/organisation committee meetings.

Coastal community group members and volunteers were chosen as a group of interest because they would represent a "best case example" of current community levels of tsunami awareness, knowledge of warnings, and readiness for a tsunami threat. This is because these individuals are embedded in the community and so will provide insight into the community contexts that inform tsunami risk perceptions.

Also, due to their coastal or emergency-related volunteering activities, they were more likely to have been exposed to tsunami risk communications and knowledge than other community members. These individuals therefore they would have had opportunity to develop their understanding of tsunami risk despite infrequent and unpredictable nature of tsunami events. By learning of the processes and contexts by which these volunteers have developed their understandings of tsunami risks and warnings, the project was able to determine potential means for communicating and engaging with coastal community members about tsunami risk and warnings.

Participating community groups were identified either by researchers' knowledge of hazard/coastal community groups or as specific coastal and groups of interest to the project's end users (ATAG, SLSA, and NSWSES). These groups included marine workers, fisherman and boaters, as well as teachers, Surf lifesavers and SES community educators.

A Google search was also used to help identify community groups, associations, and organisations for further recruitment. This was completed using the following keyword search terms: *Fishing club*, *boat club*, *sailing club*, *water sports*, *NSW coastal community groups*, *sea scouts*, *marine work*, and *maritime work*. The results of these searches were restricted to webpages for the NSW coastal area.

The above recruitment and study promotion strategies were used because these groups were identified as high traffic areas commonly used for disseminating information on coastal risk. This strategy was also adopted to increase the likelihood of their knowing of/using materials such as *The Tsunami Guide.*

More generally, these groups and their members would represent a "best case scenario" with regard to examining prevailing levels of tsunami risk awareness and knowledge within the coastal areas of interest.

All community groups, emergency management agencies, organisations, and marine workplaces approached to participate in the project or that promoted the study to its members and staff include:

Akolele Coastcare
Ausport Marine
Australian NSW Scouts Water Activities Centre
Australian Shipowners Association
Bass Sydney Fishing Club Inc
Blacksmiths Beach Dunecare
Boat Owners' Association of NSW
Burwood Beach Coastcare
Coastcare T.E.N.
Denhams Beach Coastcare
DP World
Fingal Head Coastcare
Gosford RSL Fishing Club
Hankerchief Coastcare
Harbour City Ferries
Jenny Dixon Coastcare
Landcare/Coastcare Australia
Maritime Union of NSW
Newcastle Landcare
Norah Head Coastcare
NSW Fishing Clubs Association Inc.
NSW Ports
NSW Rod Fishers' Society
NSW Scouts Branch
NSW SES
NSW Sport Fishing Association
Port Hacking Game Fishing Club
Ports Authority of NSW
Pottsville Fishing Club
Recreational Fishing Alliance of NSW
Shipping Australia
SLSA State Branches
Solitary Islands Game Fishing Club
South Sydney AFA
Southern Coastcare Association of Tasmania
Svitzer
TAS SES
Teachers Associations
The Amateur Fishermen's Association of NSW
The Dragon Boats NSW Inc
Vic SES
Volunteer Marine Rescue NSW
WA SES
Western Sydney Bream & Bass

## Method and Analysis

Information was collected using semi-structured telephone interviews with open ended questions. This permitted opportunities for the interview process to be shaped by the participants' responses and allowed for further elaboration and exploration of content and topics by participants as the interview progressed. This approach made it possible to explore people's views in depth and to discuss the origins and nature of their knowledge, understanding and beliefs.

Participants were invited to review the transcript of their interview to check for errors and to provide an opportunity for them to comment on the transcript to make sure that it was representative of their views and/or provide clarification of any issues. Interview responses and summaries were analysed using a thematic analysis approach (Braun & Clark, 2002; Guest, MacQueen & Namey, 2011).

The object of this analysis was not to quantify peoples' views about tsunami risk and warnings, but to develop understanding of the knowledge and beliefs about tsunami risk and warnings. The importance of understanding knowledge and beliefs derives from the fact that it provides the background detail necessary to develop appropriate knowledge and beliefs about tsunami risk and warnings. The development of appropriate knowledge and beliefs provides the context for developing, implementing and evaluating tsunami risk management and warnings processes.

# Section B: Community Awareness of Tsunami Risk and Warnings

The purpose of this study was to give an initial overview of participants' tsunami awareness. The interview data were used to identify enablers and inhibitors for developing community knowledge of tsunami risk and warnings systems, to assess views on levels of preparedness, and identify factors (that influence preparedness and the development, or otherwise) of effective community response capability.

## Participants

A total of 31 interviews (see Table 1) were conducted with volunteers and staff affiliated with organisations with an emergency management and response focus, as well as those with coastal interests. This included Red Cross Australia, Surf Life Saving Australia, Coastcare, and SES. Members of these groups were targeted because of their volunteer interests and/or have experience with coastal and community safety and emergencies make them a population that represent a "best case example" of current community tsunami knowledge. That is, they represent a population most likely to be knowledgeable about tsunami hazards. This provides a "best case" baseline of knowledge of tsunamis and their warning and preparedness implications. Sampling from these sources made it easier to explore the source of beliefs and knowledge, and also to examine issues about people's understanding of tsunami risk and its implications.

***Table 1. Organisations Targeted and Interview Numbers For Study 1.***

| **Interviewee Groups** | | **No.** |
|---|---|---|
| SES | NSW | 6 |
| | TAS | 3 |
| | WA | 2 |
| SLSA | SA/NSW/NT | 7 |
| Red Cross | NSW/TAS | 7 |
| Coastcare/Landcare | NSW/TAS | 6 |
| | | |
| | **Overall** | **31** |

## Findings

### Perceived risk

*General tsunami knowledge: mechanics, science*

Tsunamis were described in relation to four themes:

- their impact,
- the description of the wave movement itself,
- causes of tsunamis, and
- the places where tsunami occur.

Respondents reflected that they did not know as much as they thought they did, or as much as they should, about tsunami. This was most commonly stated for those in the Coastcare groups, but was also discussed by some Red Cross and Surf Life Saving participants.

Most commonly, tsunamis were described as a large wave event that involved a large body of water moving towards land, or hitting the coastline. However, views about other aspects of tsunami were more varied. Tsunamis were often characterised as fast moving, able to travel far distances, however, only a few acknowledged that they slow down and increase in height when they be closer to the shore or as the travel through shallower water.

Interviewees often used descriptors such as “destructive,” “devastating”, “unexpected”, and emphasised the size and scale of these events based on what they had seen of past tsunami events in the media. This was most often the case when interviewees referred to the news sources such as radio and TV as their primary sources of tsunami knowledge. However, some drew on their own experiences living/working in areas affected by large scale tsunami events. The importance of these descriptions is heightened in the context of the degree of “Risk Rejection” (see below) in interviewee’s accounts. A combination of risk rejection and the perception of events “destructive” will increase the belief that risk management for tsunami hazards is a waste of time (Paton & McClure, 2013).

Respondents who applied more scientific terminology to their descriptions of tsunami, and described in more detail the causes and mechanisms involved with tsunami origins and actions, were predominantly SES members. This included, acknowledging that tsunamis may be a series of waves or as a ripple effect, that tsunami are influenced and change in size in relation to underwater topography. These participants acknowledged an interest in science and/or had undertaken higher education. It is, however, important to note that while training increased levels of knowledge of tsunami and related processes, this did not necessarily translate into a perceived need for action to deal with tsunami risk. The latter issue is discussed in more detail below.

For one Surf Life Saver/Masters student and a Red Cross interviewee the shallower waters around the areas where they lived (Burnie and Darwin respectively) meant that if there was a tsunami event it would see a reduced intensity compared to other areas affected by the tsunami event. Furthermore, those interviewees acknowledged that tsunamis created not just land inundation, but could also affect waterways and impact on people engaged in working or recreation activities near/in the water due to changes in swells and currents as well as surge events.

Participants also discussed natural “warning signs” that could occur beyond sighting the tsunami wave. These included, for example, receding tides, a roaring sound, changes in animal behaviour, trembling ground/shaking, and wind. Some participants described learning about these natural warning signs during their school education. Others learnt about them through their work/volunteer roles, in particular SES members. Mostly though, natural warning signs were not discussed by interviewees. Receding tides were described most often as a warning sign.

Earthquake/seismic activity was acknowledged as a cause for tsunamis in 24 interviews. Volcanic activity was identified as a potential cause in 8 interviews, with landslides (4) and asteroid impacts (2) being cited less frequently. The only cause elaborated on by participants was earthquakes, as the plate

boundaries and subduction zones were raised often as a source of tsunamis while others acknowledged smaller faults could also cause tsunami, including those that triggered Newcastle 1974 earthquake, and the 2015 earthquakes off the Queensland's coast. The latter were described by a Coastcare member with an environmental science background and by SES members.

Several Coastcare members raised concerns that tsunamis could also be caused or influenced by man-made issues such as nuclear and war activity, as well as drilling and mining activity off coastlines. One felt that, in particular, drilling and mining activity might change the seismic activity in these areas and therefore needed to be considered when looking at onshore and off shore development of the Australian coast. Red Cross and surf club members tended to elaborate less on the causes, and cited fewer causes than their SES counterparts.

"Tsunami historical references" – history was often a common justification for reasoning about tsunami causes and consequences. Only SES members regularly identified Australian specific historical tsunami events when talking about tsunami. This reflected the training they had received which included exposure to information on historical occurrences. As with other aspects of tsunami-related training, this did not translate into seeing tsunami as a source of risk that needed to be attended to. Amongst other interviewees, history was discussed in more general sense, with the focus of these discussions being on the perceived belief that there was no history of tsunami in Australia.

Places described as at risk from tsunami impacts tended be areas interviewees identified as being characterised by earthquake and volcanic activity and/or that were known to have had past tsunami events (e.g., the December 26$^{th}$, 2004 Indian Ocean earthquake/tsunami and Japanese tsunami events). Australia's distance from similar sources and from places recognised as being more at risk served to heighten beliefs that Australia did not face tsunami risk.

Only one participant identified the potential for tsunami to originate in Australian coastal areas (Table 2). Typically, Australia was typically identified as a place where a tsunami "could" happen, but they had not occurred, at least not since colonial times. This is incorrect, but reflects the lack of coverage of and knowledge of Australian tsunami occurrences and more recent events that triggered warnings.

***Table 2. Identified Tsunami Source Event Locations.***

| | Potential sources for an Australian tsunami |
|---|---|
| Australia/Australian Waters | 1 |
| South East Asia: Indonesia/Thailand | 2 |
| New Zealand | 6 |
| Antarctica | 1 |
| Chile | 2 |
| Pacific Ocean | 2 |

It is important to note that participants differentiated a) knowledge of tsunami characteristics (which reflected general knowledge and/or training) from b) perceiving risk that tsunami could pose for Australian coastal water. Further explanation of this and the perception of tsunami risk in Australia is discussed further below. Discussion first covers participant's views about tsunami characteristics and behaviour. The discussion of the latter serves to emphasise how knowledge of tsunami hazard characteristics and behaviours does not necessarily translate into recognition of the potential for tsunami to occur in Australia or to a need to include tsunami in Australian coastal hazard-scapes.

## Severity/Impacts

### *Characteristics of Impacts*

Respondents recognized how impacts would be affected by wave heights above sea level. One Red Cross respondent stated that a tsunami event would have to be a 200-300m event to affect him and where he lived. The same interviewee though also went on to say that, should a tsunami occur, it would still have a huge impact on his community in terms of those in low lying areas and the impacts of people, animals and infrastructure. One Surf Life Saving participant discussed how, as they live near the beach and spends a lot of time in the ocean, felt that a tsunami would affect his home, SLS club and local suburbs.

Some participants described tsunamis to be large destructive and catastrophic events that would take on apocalyptic like characteristics. For example, Red Cross and Coastcare participants expressed the view that it is hard to conceptualise the levels of destruction that would occur and how helpless it would leave people (based on past tsunami events shown on TV). This resulted in the expression of fatalistic attitudes about what they could do in the event of a tsunami.

Those from the SES and Coastcare with some training or experience, adopted a more "it depends" approach to describing the impacts of a tsunami and provided more detail on differing levels of potential impacts. This included coastal/sea- level consequences and different levels of inundation with more places further inland being affected.

Smaller scale "marine tsunami threat" events and their related impacts were discussed by SES affiliated participants, although this was not consistent across SES members. SES members from the NSW region who were employed rather than volunteers, or that had directly acknowledged tsunami related training in their interviews tended describe marine related impacts. Whereas those outside of the NSW area did not.

***Table 3. Predisposing Characteristics for Personal Risk in the event of a Tsunami***

| **Themes** | **Characteristics** |
|---|---|
| Local area/community: Geographical characteristics | Shape of the coastline and waterways (exp. Bays, Inlets/Rivers, Heads) |
| | Height of the coastline (exp. Height above/below sea level, cliffs, sand dune, global warming related changes to these) |

| | |
|---|---|
| | Closeness to tsunami/earthquake prone zones (tectonic plates, Pacific Rim, NZ etc.) |
| Home/place of residence | Closeness/distance from the coast (exp. Greater/less than 10km) |
| | Height (exp. 10m above sea level, I live on a hill) |
| Temporal factors | Place @ time of event Home/work/commute/@beach |
| | Weather conditions but not related to weather events |
| | Time of event: night, day, weekend etc. |

### *Predisposing characteristics to impact and or likelihood*

When interviewee's described tsunami risk as "it depends," the factors they identified contingent impact factors such as: the originating source event for the tsunami (i.e. the earthquake, seismic, volcanic catalyst event), the size of the tsunami event, and the geographical characteristics of where they resided. Another factor for determining if they would be personally affect or impacted was where they were at the time of the event. The latter comprised characteristics of the location of their home, as well as the characteristics and location of their community/local area. Examples for each can be seen in Table 3. A term used regularly to define those who would be affected versus who would not be in the event of a tsunami was the term "low lying areas." SES participants highlighted how the impact on everyday life is dependent would change depending on where they are at the time of the event.

## Likelihood

Overall, the perceived likelihood of a tsunami event affecting the participant's local area or community was low or very low/no chance. However, participants differed regarding the basis of this judgment. Some referred to the absence of historical records of tsunami impacts. Others referred to the lack of any personal knowledge of any tsunami occurrence affecting Australian coastal regions. Beliefs about low likelihood/risk were reinforced by the fact that other people, government agencies and the media do not talk about tsunami as an issue around Australia.

One respondent perceived the likelihood to be low to non-existent because they did not believe that any relevant pre-disposing factors/characteristics for tsunami risk were present in Australia's coastal regions. Experience or training on tsunami risk had contradictory implications for perceptions of risk. That is, while training could increase knowledge of tsunami characteristics (see above), it did not necessarily translate into greater risk acceptance or knowledge of the specific sources of risk that have and could affect Australian coastal areas.

One participant who had firsthand tsunami experience stated that she was unsure about the likelihood of a tsunami event in Australia. She thought that living in a coastal region was enough to mean they were exposed, particularly to New Zealand earthquake and Indonesian volcano activity. Another participant echoed these views. While they did not know the likelihood of a tsunami event occurring per

se, they acknowledged that it was probably more likely than people realised. It is possible that these views may have arisen from participating in an interview about tsunami risk (i.e., the assumption that this signalled the existence of risk).

This view is consistent with the earlier comment (see above) that the level of community discussion of a hazard was regarded by a number of interviewees as being an important precursor to risk acceptance. When asked about tsunami likelihood in general, several participants emphasised the difficulty of stating how likely a tsunami event would be in an Australian context. While the interviews discussed in this paragraph demonstrated basic awareness of likelihood, this was not an automatic consequence of training or experience.

Several SES participants who had directly received tsunami training or information and several Red Cross and Coastcare community volunteers voiced the strong opinion that that there was no chance or a very limited chance of a tsunami occurring. Those holding these views also emphasised that they were more likely to talk about other more frequent/more important hazards. For example, they stressed that more should be done about more frequently occurring hazards such bushfire, or that they were more inclined to listen to people asking them to prepare or to take preparedness action towards more frequently occurring hazards. This is an important issue as it describes highly polarised views about risk and increases the likelihood of those who do not believe tsunami will occur being unlikely to attend to issues about tsunami. The fact that they think resources should not be directed to highly unlikely events may reinforce their opposition to tsunami risk reduction activities.

### Likelihood of them being personally affected

The prevailing view amongst participants was that tsunami are of little concern or low risk for them personally. In addition to the core risk beliefs outlined above, reasons for this ranged from the relative distance from the coastline (e.g., “residing in Sydney”) to, even those that had experienced tsunami warnings in the past, expressing the view that a tsunami was unlikely to affect them in the future.

#### *Likelihood of event happening to their area*

The majority of interviewees referred to lack of tsunami events affecting Australia in the last 200 years/ or since colonial settlement as a reason to believe that the likelihood of a tsunami occurring was very low or was an event with no chance of occurring. As introduced above, these views underpinned the popular view that it was more important to focus on more commonly occurring natural hazard events in Australia such as bushfire, flood and cyclones.

Many respondents described tsunamis to be very unlikely due to the lack of earthquake or volcanic activity in Australia, compared with places like Japan. Beliefs about likelihood were also informed by knowledge of local conditions. Some participants based their beliefs about the low to no likelihood of a tsunami event occurring in their local area in terms of the characteristics of the area itself (similar to how geographical, topological etc. features were used to estimate the potential severity of the tsunami events).

At a general level, the most common explanation for the role of local circumstances in reducing (or eliminating) the likelihood of impact was the relative distance of their home area (and Australia in general) from tsunami/earthquake “prone” areas. Beliefs regarding likelihood were also influenced by

perceptions of the ability of local features to mitigate or reduce risk. For example, a Darwin participant commented that the distance of Darwin from a tsunami source area, coupled with the view that the land mass and islands offshore from Darwin and the shallower water depths near Darwin would act as barrier to events from what he referred to as the South East Asian tsunami region.

Similarly, a Red Cross volunteer from Burnie Tasmania referred to the shallowness of the Bass Strait mitigating risk because it would prevent it from being able to carry a tsunami wave, so reducing the likelihood of a tsunami affecting their locality. This view was echoed by another Red Cross volunteer (who also worked in emergency services in Hobart) who believed that the likelihood of a tsunami affecting her community was very slight due to the shape of the Derwent River. However she was not sure about this, and believed that this perceived likelihood was due to her having heard of potential mapping of the tsunami risk for her area.

### *Likelihood of differing tsunami events (small/marine versus large/land threat)*

Those with personal experiences with small tsunami events, but without formal tsunami information from their community group or SES training, were less certain about tsunami likelihood. SES members were more likely not only to raise marine-threat/small scale tsunami as a topic but also rated them are more frequently occurring than land threat tsunamis, using language to describe land threat tsunamis as more rare, and marine based to be unlikely but present. For example, one NSW SES participant stated the belief not only that tsunamis were unlikely for his area, but if they did occur they would be relatively minor events and he/they (SES) would be able to deal with any consequences.

### *Risk: A combination of likelihood and devastation*

Some respondents did identify the potential for a tsunami event to occur and acknowledged that it could present a risk to their community and/or to describe the potential vulnerability of their communities. These interviewees had environmental or natural hazard-related university level qualifications. For example, a Coastcare respondent discussed how although she thought that a tsunami event was unlikely, her community was in what she called an “at risk area.”

Similarly, one Surf Life Saving interviewee highlighted that although a tsunami was unlikely in Australia in general, it could not be assumed that Australia was safe as it is not easy to predict when natural disasters like tsunami will occur (with occurrence and impacts being affected by a range of factors). She discussed this in terms of a need to consider the changing nature of the earth, and the consequent fact that disasters don’t always occur in the same places and can occur in unexpected locations. Another Surf Life Saving respondent, having experienced a tsunami event, thought that although she was unsure of the likelihood of a tsunami occurring in Australia, said that she had not sought out more information, and felt it was important for tsunami risk to be discussed more within the community in general.

This echoes earlier comments regarding the fact that the lack of such discussions was identified as a major reason why people believe the risk of tsunami occurrence is low or very low (see above). The reiteration of such comments throughout the interviews highlights a need to facilitate (knowledgeable) discussion of tsunami hazards and their (local) sources and implications in future DRR strategies.

### *Arguments for why tsunami is a concern for preparedness or warning measures varied in how participants' used risk to justify their positions.*

The influence of the prevailing view about the risk being low (to non-existent) resurfaced in statements about preparedness and warnings. The non-existent/very low frequency of tsunami events in Australia, compared to other hazard events (in particular, bushfires and floods) was seen as justification for questioning the need for any resources to be directed to tsunami risk management. At the very least, the majority view that, if any efforts are directed to tsunami risk management, there was a need to balance efforts directed to preparing themselves or the community for tsunamis with a correspondingly greater level of emphasis being directed to more commonly occurring hazard events.

People's view about tsunami preparedness was also informed by their knowledge the effectiveness of preparedness activities for other hazards. For example, participant's position on the cost-effectiveness of tsunami preparedness was backed up by comments such as "if people aren't prepared for other [more commonly occurring] hazards, why should they do so for tsunami when it's less likely." However, such views were not evident from SES interviewees, nor from those who believed that tsunami could occur. This reiterates the diversity of positions on tsunami risk and preparedness and the consequent need to development DRR strategies that can accommodate this diversity.

Respondents who believed that tsunami were possible rather than just improbable, and who believed that potentially severe impacts could occur within Australian coastal areas, were more likely to describe preparing communities for tsunami as important (though, as we shall see below [integrating preparedness information in warnings], the low likelihood of tsunami was reflected in how participants believed this should occur). Those expressing these views came from a SES background, and one Coastcare worker with a strong environmental science background. For the latter groups of respondents, a need to consider warnings also emerged from their interviews.

## Warnings

### *Knowledge*

With regard to warnings, while SES members were able to regularly refer to the institutions involved with tsunami warning such as the BOM and SES itself, other respondents were less likely to acknowledge either these sources or the formal warning process facilitated by the JATWC. It also is important to note that when responding to questions about warning systems, those that were not from the SES or who had not had previous experiences with tsunami warnings more often expressed that they were guessing about sources and/or were unsure as to how they would receive a tsunami warning. Those with past experiences with tsunami/warnings had only been made aware of the events through the receipt of a formal warning. However, participants expressed uncertainty about how they had, or would, receive a tsunami warning. Participants also had mixed views about how warnings should be disseminated (and in doing so, only a minority discussed the urgency with which warning may need to be disseminated by authorities and acted upon by people in coastal communities). Respondents did have view about how warnings should be disseminated.

Interviewees discussed the need for warning delivery methods to include TV and radio communications. Less certainty was expressed for text message warnings particularly in regards to their source and

trustworthiness. This medium was acknowledged as popular way for people to receive warnings (with reference to its use for bushfire warnings being a common justification). It is a form of communication people were using throughout the day. Other media, such as TV, radio and social media were specific to different times of the day. For example, radio while travelling in the car to/from places, TV when at home in the eventing.

Other suggestions for communicating warnings was the use of sirens particularly on beaches and in public places such as city/community centres. However, several respondents thought it important to highlight that people probably wouldn't understand what to do. For example, one Red Cross interviewee stated that older people might benefit from a siren system as they may have had experiences with war raid sirens, particularly as they were seen as less technologically minded and less likely to have mobile phones.

Some participants suggested that using the shark alarm on beaches might work, as people already associate that with getting out of the water and that there is danger. However, one SLS club member discussed how people often ignore the shark alarm, reducing the likelihood of this device being effective if applied to tsunami warnings and being of little or no use for warning people. Furthermore, the fact that its use would not necessarily motivate people to leave the beach and head to higher ground or vertically evacuate using nearby buildings was also mentioned as a constraint on using shark warnings for tsunami warnings. Some SLS members described that using a siren would include SLS members driving up the beach and going into the water to help explain the need for people to get out of the water.

Some interviewees questioned whether warnings would/could be relayed at all, or in time. These individuals were often critical of the ability of emergency services to get warnings out in time. They also questioned the ability of the public to respond (based on their experience of warnings for other, more commonly occurring, hazards). Cynicism about tsunami warnings was, for some respondents, was influenced by their not having been informed about warning systems in their area, and/or by their belief that information about and explanations of the national tsunami plan were superficial and more about political public image than about doing anything productive. Interviewees also raised issues about warning content.

### *Anticipated warning content*

Warnings were identified as needing to contain several pieces of information: what areas were likely to be affected by the tsunami event; what were appropriate actions people should take; how long until the tsunami arrived (with respect to the specific location of warning recipients); where to evacuate to (e.g., location of evacuation centres) for the specific location of warning recipients. It's important to note that warning expectations were largely described in terms of major land-threat tsunami events, although surf lifesaving members who described warnings for smaller scale events likely to affect the beach area, these focussed on land inundation events, rather than marine-threat and water current related events. Given the issues raised about preparedness (see above), warning processes were also discussed in terms of their acting as substitutes for pre-event preparedness.

### *Warning information: Substitute for Education*

Some interviewees emphasised the difficulty in engaging and communicating with people to help them be better informed and prepared for infrequent and relatively unknown hazards such as tsunami. Discussion of issues in this context were framed in terms of suggesting that public education and engagement for infrequent/low likelihood tsunami being seen as expensive, time consuming, and more likely to be ignored by people and/or not seen as relevant as other hazards. Red Cross volunteers, in particular, emphasised the view that people would be considerably less likely to consider offers of information on preparing for tsunami compared with their receiving information about, for example, bushfire. SES volunteers took a similar position, but added that this problem could be offset by incorporating preparedness (response) information in warnings processes and information. That is, warning messages should be complemented with information that would advise people about what to do at the same time as issuing the warning. This was seen as being useful for action messages such as "get to higher ground" which would be easy to incorporate into the warnings.

This preference for including "actionable information" when issuing warnings was highlighted in other interviews. Several interviewees anticipated/wanted the warning (they would receive) to contain information about what they should do. Their belief that pre-event education for such low (no) likelihood events influenced their belief that they would use such "actionable information" to inform their actions in the event of a tsunami. However, not all respondents felt that a focus on actionable information within warnings would be sufficient for an effective public safety response.

Others were of the view and they (and others) would want/need to be able to receive more specific and detailed action information regarding for example, evacuation routes and blockages, designated safe places/evacuation centres etc. that were specific to their location. No interviewee commented on how this would accomplished (e.g., no discussion of how local information needs would be sourced, how local media/communication channels would be developed and used etc.). This discussion was also informed by some appreciation of the challenges of information management in this context. One resource that was identified as important here concerned the availability of visual aids, such as maps, to assist people's understanding of their risk and exposure, as long as these covered local areas.

Maps and locally specific information were identified as important. Both Coastcare and Surf Life Saving interviewees discussed how maps (particularly interactive maps) and being able to see potential local areas of impact and to be able to plot evacuation routes were important for helping people to plan and prepare for tsunamis. One interviewee commented on how interactive maps enable people to highlight or manipulate different potential tsunami ocean sources and sizes and see things like how far inland it would travel, at what heights, and what it might do to the landscape. In particular, she thought this would be useful to help people understand how to develop their tsunami response plans. For example, people would be able to think beyond, "I'll just get out" and instead factor in information that will affect their response such as access to roads out of the area.

In contrast, the provision of generalised risk information was identified as likely to hinder people's understanding and preparedness. People need to connect with the information and think about what it might be like to experience a tsunami and what they might potentially do in the event of a tsunami. This

is consistent with the risk literature that highlights the crucial role personalizing information plays in preparedness planning and actions (Paton and McClure, 2013).

Red Cross respondents discussed the importance of including local information about where warnings information would come from, what warnings might look like, and what they can do to prepare. In the absence of local information, she thought reliance on general news and social media sources would not motivate people. She believed that general information would increase people's anxiety. Therefore having local information was also seen to help people to have power over their situations and cope. Local information was identified as very important.

### Preparing without Local Risk Information

One Coastcare interviewee discussed how their community had sought to prepare in the past for tsunami. At the time of planning for a potential tsunami event, because people were unsure of their local risk and shared a fatalistic understanding of tsunamis, the outcome was their not following through with their planning exercise. The scenario was poorly developed, not based on scientific information, and run for only 30 minutes. The scenario focused on a high level of destruction, with this leading the belief that for such an event the participants' felt there was nothing that they could do, so they wouldn't be able to do anything. In hindsight he thought it would've been better to have involved neighbouring councils in the scenarios and committee as they would most likely be the ones that would have to come in and clean up as there would be nothing left.

He also commented on the value of good scenarios. He found the planning undertaken for bushfire and flood an eye opening experience. It gave him better insights into what would happen and changed his original layperson way of thinking about the events. He thought that they had no answer for how to deal with tsunami but did for other events as they had already seen past events/experiences with the other events close to home. The importance of doing something similar for tsunami was reinforced by seeing coverage of tsunami events that illustrated that they were hard to grasp and so much bigger than the other events they were planning for (e.g., bushfire).

## Response/Course of Action

Most interviewees described required actions as including getting to/staying at a place away from the water, generally through getting to higher ground. Participants acknowledge that in an environment in which many people would be trying to evacuate (and/or panicking), roads would be jammed and likely to result in people becoming trapped, or hurt/killed by panicking motorists. Recognition of this possibility was used by some interviewees as justification for staying put in their homes. For example, one respondent stated that being inside a building was better than being exposed to the conditions. The importance of "higher ground" type messages was generally acknowledged.

The action of "getting to higher ground" was generally described as involving driving away from the location of tsunami impacts (usually the beach, but also coastal rivers etc.) for the majority of interviewees. However, two referred to trying to run up hill or head up a multi-storey building. It is also important to accommodate the challenges people could face with respect to identifying where higher

ground is and how to get there (e.g., from home, work etc.) and ensuring that all family members have this knowledge (especially if, during the day, this could mean evacuating to different locations). It would also be important to ensure that parents know where and how their children would be evacuated to should an event occurring during school hours. Issues regarding knowing what to do when in unfamiliar locations or locations where evacuation needs would not normally be considered (e.g., shopping malls) are also relevant here, as is the need to consider signage in public places where people were more likely to be disoriented and/or stressed also deserve future consideration.

When participants felt that they were likely to get to a safe place easily/or were already safe, their first course of action was likely to be to communicate with family and/or friends to check if they were aware of the warning and to offer to help them. Only those that had roles in evacuation/response (e.g., on duty surf lifesaving members or on call SES members) discussed staying/going into low lying areas as a part of role in warning people or helping people to get out. The exception to this was a Coastcare volunteer who intended to warn people on her beach (which was a short distance from her home) to evacuate up hill to near her property (this was, however, dependent on how much time was available – it was expected that at least an hour would be required).

Furthermore, when interviewees identified the tsunami to be likely to arrive in 6-12 or 24 hours' (these estimates were not always realistic) time they were more likely to try and check on and contact people around them to see if they needed help evacuating. Most commonly though, respondents expected shorter warning time spans, and those that expected to have only minutes to a couple of hours to respond focussed more on contacting people first via phone and social media and then evacuating. A common response on receiving a warning (for rare events) is to seek verification of the warning or impending event before acting (Gregg et al., 2007).

For the most part when children or pets were involved, they were identified as likely to be already in safe areas, if not then children would be collected. Interviewees did not generally see this as an additional source of risk. For those that did, those respondents believed that is was one that could be managed by discussing what schools would do.

With regard to their wider circle of friends and family members, respondents anticipated that their predominant course of action would be to contact them to check that they were safe and to determine if they had received warnings. Likely courses of action were limited to contacting them rather than more significant actions, such as helping them evacuate. However, respondents did discuss that they would offer help with evacuation to more vulnerable neighbours (e.g., older people and others on the street or "around the corner") and/or those likely to be less mobile in their immediate area.

As introduced above, seeking more information, rather than acting immediately, was described as the most likely first response. That is, confirmation of any formal warning would be sought before taking action to evacuate themselves and before offering to help others. However, no interviewee considered whether there would be time to do this (e.g., in the event that a tsunami originated in New Zealand waters). Absence of actionable information in warnings (within warnings processes they were familiar with) was described as a reason for people anticipating why they believed they would first seek out more information.

When warnings lacked actionable information, respondents anticipated that this would prompt them to seek more information either by monitoring the situation on the radio, going online doing a google search, or by monitoring what others were saying on social media. Seeking out more information was described as something that would occur to confirm the warning with information from a more trusted source (such as the ABC, BOM). If people described themselves to be unlikely to be personally affected or believed that they would be safe where they were, they would still be likely to seek more information, but out of curiosity.

Only SES interviewees differentiated between what they would do in terms of a marine-threat and land-threat tsunami.

It's worth acknowledging, and consistent with the points discussed above regarding the views that preparedness efforts for tsunami would represent wasted resources, that asking interviewees about preparing for tsunamis and the information and sources they'd like to have available/would use, interviewees discussed preparedness as something they would do immediately after receiving a warning, rather than something that would happen in advance of a tsunami event. The exception to this were some SES members who endorsed the value of planning and training.

However, in doing so, they distinguished between community preparedness/ agency preparedness and personal preparedness. The discussed how community and agency preparedness should happen prior to warnings, with the goal being to increase response capability. However, they felt that "personal preparedness" (e.g., household) was something that should be left to people "in the moment."

Respondents believed that people should take responsibility for seeking out information to plan their own tsunami response after receiving the warning, instead of it being something that is planned for before the event. Preparing one's property was not included as a component of preparedness, but again was seen as something people should take responsibility for when promoted by receiving a warning. Likewise, evacuation planning and action and collecting survival goods, medicines, and valuables etc. were seen as activities to be considered as part of the response to a tsunami warning, unless interviewees already had these organised ahead of time for other hazards like bushfires.

## Recommendations

1. It is important to accept that people do not perceive tsunami as a salient hazard and, in many cases, reject the attention and resources being directed to this hazard. This means that at-risk populations can be characterised as having high levels of risk rejection or, in some cases, low risk acceptance for tsunami hazards.
2. It was evident that the training provided on tsunami hazards and risk has been effective with regard to increasing levels of knowledge of tsunami and their associated consequences. However, this knowledge did not necessarily translate into risk acceptance and recognition of a need for tsunami risk reduction strategies. More work needs to be directed to increasing acceptance of tsunami risk.
3. Following from #2, high levels of risk rejection, and generally low risk acceptance amongst those who did acknowledge Australia's potential tsunami exposure, means that community

engagement DRR strategies must accommodate this and first develop some general level of risk acceptance before communicating about warnings and preparedness.

4. A key element of doing so involves encouraging discussion of tsunami and tsunami risk in agencies and in community groups in areas susceptible to experiencing tsunami.
5. Discussion should be based on first providing detailed information about Australian tsunami risk and its implications for warnings and preparedness. The following is an example of the kinds of information that could be disseminated. It is intended to increase appreciation of a) the distribution of tsunami risk around Australia, b) the potential magnitude of events that could occur, and c) the travel times and warning times that could occur (and that vary depending on the point of origin.
    - The main sources of tsunami that can affect Australia are the subduction zones in the Indian and Pacific Oceans (Attorney-General's Department 2008). To the north of Australia earthquake generated of the southern coast of Indonesia can produce tsunami impacting Western Austrailia (Burbidge et al. 2008).

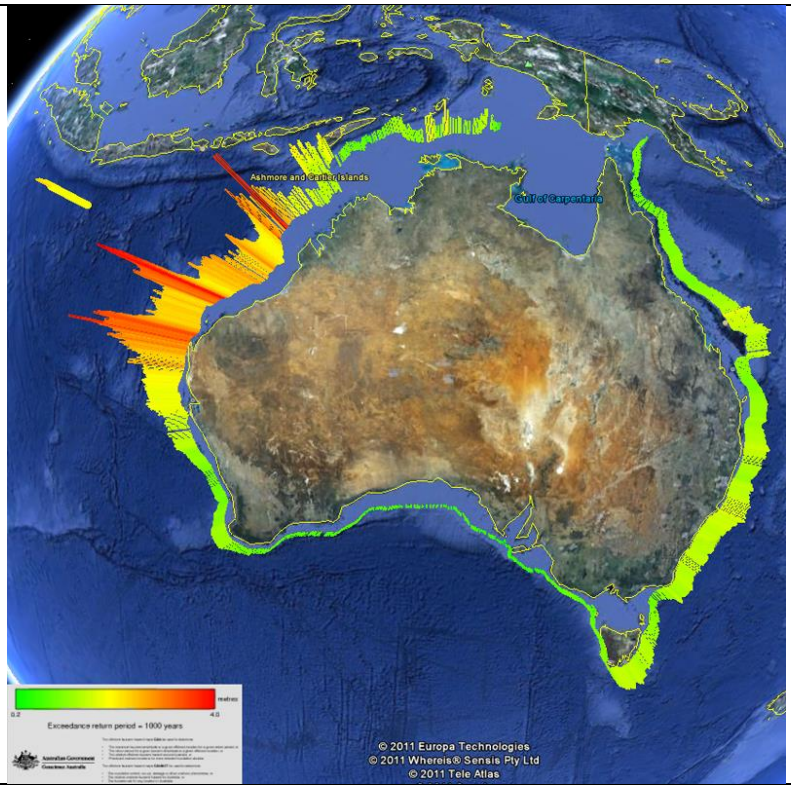


Figure 1
2011 National offshore Probabilistic Tsunami Hazard Assessment (PTHA). Retrieved from http://www.ga.gov.au/scientific-topics/hazards/tsunami/australia#heading-1

- The eastern coastline of Australia is vulnerable from tsunamis generated from from the subduction zones from Papua New Guinea through the Solomon Islands and Vanuatu to

New Zealand and other further afield (eg. North and South America) (Attorney-General's Department 2008).

- Geoscience Australia has developed a national offshore Probabilistic Tsunami Hazard Assessment (PTHA) (Figure 1 – 2011 version) showing magnifude and frequence of the tsunmai hazard. To date, no national risk has been undertaken, however several location-specifc risk assessments have been completed (eg. Sydney; Dall'Osso et al. 2009). The travel times for tsunami from the closesst sources(the Puysegur Trench, south of New Zealand, and the Java Trench, south of Java) is approximately 2 hours. Allowing for detection and message formation this would give warning times as little as 90 minutes. Further sources with greater travel times also exist, and they will havelonger warning times.
- The information portrayed above is intended to increase appreciation of tsunami risk. It is, however, too general. The degree of "risk rejection" evident in the responses (see above) makes it important to first challenge the low/non-existent risk beliefs that were prevalent amongst respondents. This can be supported by more localised maps and simulations that can be used to assist.
- The need for and benefit from developing local maps and simulations was identified by participants as central to any effective risk reduction and warning strategy.
- However, while maps will increase the opportunities for residents to appreciate the nature of their local risk and the impacts they could experience, additional steps should be included in tsunami DRR programs to increase the level of targeted public discussion.

6. Maps (general and local) should be complemented with steps to encourage more discussion of the risk within agencies (at all levels) and within communities (Paton and McClure, 2013). Risk acceptance is more likely to emerge if discussion focuses people's attention on what the consequences could mean for them. How this can be done will vary form group to group. I am happy to discuss how this might be done with any interested party.
7. Regular public discussion of tsunami hazards has been recognised in preparedness and warning research (e.g., Paton & McClure, 2013), and was recognised by participants in this regard, as essential for more general community acceptance of the reality of tsunami hazards.
8. The effectiveness of this strategy can be further facilitated by inviting community members and households (separately and collectively) to consider the implications tsunami hazard consequences would have for them, their families, their communities, their livelihoods, and what they value. Personalising risk by relating hazards and hazard consequences to what people value is essential to developing a foundation for risk acceptance, and personal, household and community risk reduction strategies (Paton & McClure, 2013).
9. Risk acceptance may also be facilitated by building discussions of tsunami risk and associated issues where community engagement strategies focus on integrating tsunami risk understanding and response with those concerned with more regularly occurring coastal and ocean hazards. If tsunami risk is accepted, this lays the foundation for the development and delivery of risk reduction/preparedness strategies designed to increase responsiveness to tsunami warnings. This issue is discussed in more detail in the next section.

10. The predominant view was that, given the perceived low to non-existent risk, no effort or resources should be directed to tsunami preparedness. Even amongst those for whom some low level of tsunami risk was accepted, the prevailing view was that a) no attention should be directed to preparedness and rather, b) the warning process itself should be used to provide information on actions and preparedness.
    - This strategy should not be pursued.
        - The potentially low lead and warning times for tsunami (along the eastern seaboard) makes this approach untenable.
        - The need for local information and specific family plans for effective response to warnings also makes linking warning and preparedness untenable as an effective strategy.
11. Information on warnings, response to warnings and preparedness should either be introduced into DRR strategies after a baseline level of tsunami risk acceptance has been developed and/or be developed from warning and preparedness processes that exist or are being developed to facilitate community readiness/response capability for other coastal and marine hazards.
12. Any strategy must accommodate differences in needs, goals, expectations and capabilities across all professional, volunteer, and community stakeholders.
13. Strategies to plan for tsunami risk reduction in the context of such stakeholder diversity exist. They include using methods such as scenario planning.

# Section C: Risk perception, Awareness and Community Engagement for Coastal and Marine Groups

This section discusses the findings from interviews with "at-risk" coastal groups to identify how members of each group interpret tsunami risk, differentiate between different types of tsunami, and how that translates into tsunami related responses and behaviour. This section of the report:

- Describes how target volunteer groups and community groups are interpreting their risk and whether and how they are communicating this within their community.
- A discussion of whether and how each group is using the Tsunami Guide (and why or why not) and use these data to develop recommendations for developing the use of the Guide to support warning and preparedness programs.
- Identifies similarities and differences between internal and external stakeholders and between high and low adopters of tsunami education.
- Describes stakeholder expectations of the roles of SES and how SES and community roles are distributed.

## Participants

Forty-one interviews were conducted with volunteers and staff affiliated with organisations with an emergency management and response focus as well as coastal interest groups. These included Red Cross Australia, Surf Life Saving Australia, Coastcare/Landcare, SES (NSW, Tasmania, WA), as well as boating and fishing clubs. Some interviews came from multiple community groups or organisations.

***Table 4. Interview Numbers from Organisations and Community Groups for Pilot Study 1.***

| **Interviewee Groups** | | **No.** |
|---|---|---|
| SES | NSW | 7 |
| | TAS | 3 |
| | WA | 2 |
| | | |
| SLSA | SA/NSW/NT | 7 (+1 RSLSA, QLD) |
| Red Cross | NSW/TAS | 7 |
| Coastcare/Landcare | NSW/TAS | 6 |
| | | |
| NSW Community Groups | Fishing Clubs | 2 |
| | Boating Clubs | 2 (+1 TAS) |
| | Marine Workers | 5 |
| | **Overall** | **41** |

It proved difficult to recruit interviewees that either worked in maritime occupations, or that were a part of marine recreational groups. However, several interviewees from other groups included people who engaged in recreational activities in coastal areas. A full list of groups and organisations approached to participate in the project can be found in Section C.

# Findings

## Target volunteer groups and community groups: Risk Perception and Communication

As introduced in Section B, a majority of participants believed that, despite accepting that the potential impact and devastation of a tsunami event could be considerable, this was, as a result of the low perceived likelihood/risk attributed to tsunami, this overruled as a reason to avoid DRR action. This type of argument was expressed by members of all the groups that participated in this project.

There were however, some individual differences within groups. The level of risk acceptance of tsunami was informed by people's own exposure to the media, their knowledge of risk modelling for their area, and from conversations with others. SES interviewees, in particular, had access to risk modelling for their local area. This access increased their capacity to recognize and differentiate the likelihood of different types of tsunami events, as well as the probabilities of occurrence and their ability to differentiate between areas that would be affected based on their height above sea level.

Participants from other agencies identified their interest in wanting to know the local likelihood for tsunami and its potential impact. However, their lack of past event exposure or knowledge, coupled with the lack of acknowledgement of tsunami risk by formal authorities (e.g., the government and emergency management agencies do not have regularly occurring tsunami DRR programs or regularly brief agencies, the media etc. about tsunami risk in the way that they do for other hazards) they assume the risk to be low.

Those that acknowledge that it *could* (albeit with a low probability of occurrence) happen, and that tsunami is a hazard that should be planned for, were more likely to have, a) discussed the issue within their social networks and have, b) either had direct interactions with people affected by tsunami in the past, or have personal experience with tsunami and access to expert knowledge/opinions/contacts. A theme that emerged across all groups was their belief in the key role that social factors played in influencing whether they (and others) sought to improve their knowledge of tsunamis in Australia.

Social network-based discussions also influenced whether they had undertaken some form of planning or preparation for a tsunami. This is an important finding, and one that is reinforced in the DRR literature. The nature and level of functional (e.g., about the specific causes and effective mitigation and preparedness measures) discussion in social contexts plays a crucial role in risk acceptance and the conversion of this into knowledge and preparedness (Paton et al., 2010). Another interesting finding derived from participant's interest in applying their knowledge from more mainstream areas of their lives to the tsunami problem.

Although specific tsunami knowledge was limited, participants often used knowledge from other areas of their experience to interpret tsunami risk and impacts. Coastcare groups, for example, focused on how their landscape and local geographic knowledge can assist their understanding tsunami risk. Members of SES and SLS groups drew in knowledge of small scale marine threat to develop ideas about tsunami warnings and response. Members of Red Cross groups drew on their knowledge of recovery issues and trajectories to frame their understanding of how they might respond to tsunami issues. Boaters and maritime/coastal workers used past boating and marine experience and safety knowledge to translate how they would respond to a tsunami threat.

While all interviewees generally acknowledged the need to seek higher ground in the event of a tsunami, SES participants were more likely than members of other groups to include vertical evacuation to the upper floors of a multi-storey building. All groups stated that seeking higher ground would involve driving away, or getting uphill, rather than assessing their immediate surrounds. This reflects the inclusion of the vertical evacuation strategy in SES training.

Despite recognising a need to seek higher ground, several respondents were unsure how far they would need to go to be safe, and would aim to get as far inland as possible or to their place of residence if this was identified as far inland and/or in an elevated location. Interviewees, for the most part, were unsure about what constituted a safe distance inland or vertically. They expected to be able to receive and use information available at the time a tsunami warning was issued to make decisions about their best course of action. Respondents did not consider how this evacuation decision strategy would be adversely affected by for events that would give only 90 minutes warning (e.g., when warning received, knowing possible routes, making a decision, acting on this, the possibility of traffic congestion, the impact of stress on decision making under high demand, low time circumstances). The exceptions to the "seek higher ground" response came from marine workers, boaters and fisherman who added heading out to sea as an evacuation option. Time factors (e.g., from receipt of a warning to getting to a safe location) were not discussed. Acknowledgements of gaps in knowledge also prompted comments on improving understanding.

Face to face workshops, training and meetings were identified as the mechanisms where coastal hazard and group specific interests and operations for each stakeholder groups were discussed most often. Conversations via email, phone or text message, and social media were described as serving to support these meetings, workshops, and operational processes. For example, communicating about and reminding people about local or relevant events, documenting and maintaining records of the group's activities, and promoting their activities or interests to interested people who are unable to regularly attend events or are located geographically far away. This reiterates earlier comments on the role of socially-based discussion for developing ideas. This is especially important when people are dealing with uncertain circumstances (Paton et al., 2008). Social interaction was also discussed in community settings.

Coastcare and marine group (e.g., fishing, port employees) respondents were more likely than members of other groups to report involvement in community groups in their area (outside their core organisation). For example, Coastcare participants discussed their roles in educating local community groups and schools about coastal environments and their dynamic processes. One fishing club

participant discussed their role in educating fishing club members about water safety, but also engaging the general community with information stalls, and was looking into developing fishing and coastal environmental education program to use in schools. One participant discussed how they spend time communicating about port activities, development and environmental management to the general public via social media and various websites. Involvement in and active participation in multiple community groups and committees represent important risk communication and development conduits in communities and act as potentially important links for sharing information between agencies and community groups (Paton et al., 2008; Paton et al., 2010).

While not directly communicating about tsunamis to the community, respondents with active community engagement roles described their being interested in how a tsunami would affect their community, and wanted to know what they could to find out more. Some stated after the interview that they were intending to share the Tsunami Guide resource with others after having learnt about it during the interview. This provides another example of how structured discussions in a social context can lead to participants forging intentions to act.

However, it should not be assumed that involvement in and interest in passing knowledge to others in one's community is a straightforward process. One Coastcare participant discussed how they had begun to do less community education as he found it hard to convince people to go beyond acknowledging environmental issues and to act upon their knowledge. While the findings in the previous paragraph support the benefits that accrue from active, functional (e.g., communicating knowledge about environmental hazards and their management) participation in communities, the comment above identifies the need for community participation and engagement to be a planned and managed process. The fact that this has been identified as crucial to facilitating people taking responsibility for their (individual and collective) risk management makes it important to include this in future tsunami risk management strategies (e.g., Paton et al., 2010).

### *SES*

SES interviewees were the most knowledgeable of the groups that participated and gave the most detailed accounts of tsunami characteristics and risk (in general and in relation to their local community), existing tsunami warning systems, and community and emergency management responses to a tsunami threat. For example, they were able to give specific metrics for determining if they were in a tsunami safe area (10m above sea level, 1 kilometre in land), but also expressed with certainty about how they would receive a tsunami warning, and where it would come from, and what it would require them to do. This reflected training that covered tsunami hazards and warning processes. This training, however, was not uniformly provided within the SES. It was more evident in NSW compared with other areas. Respondents from SES in Tasmania and WA reported relying more the media, with some describing their knowledge of warnings from having seen/received tsunami warning in the past within their work role. With regard to response planning, Tasmanian SES respondents stated that they would rely on communications from the SES Tasmania head office for instructions on how to respond.

SES respondents echoed the Coastcare interviewee's experience regarding levels of community interest and moving people toward action mentioned above. Tasmanian and WA SES participant discussed how, even with the 2004 Tsunami and the associated media coverage, turnout at community meetings was

poor, with community interest in this hazard being low. They discussed how community members were unaware of any tsunami risk communications from emergency services, that they hadn't taken any interest in educating themselves about tsunami, and assume that the absence of these communications meant that tsunamis are a relatively low risk hazard in Australia. This more general community-level rejection of tsunami risk is consistent with the views of the majority of agency representatives (See Section B).

### Communication

Hazard-related communications across SES organisations involved email for less time critical information, whereas warnings and time critical correspondence about a hazard warning, event or emergency was conveyed through mobile phones. Meetings and training were identified as important, especially when it came to sharing knowledge amongst members about SES practices and strategies.

As the SES follows a Command and Control communication structure, unit and regional leaders were the primary sources of information for volunteers on the topics and issues of interest, including what hazards and activities were relevant to a given unit. This top down approach was complemented by a bottom-up approach. Volunteers were identified by regional leaders as important sources of local information about what's happening in the community before and during emergency events. However, it appears that the latter operates at a more ad hoc, informal level. Interviewees identified a lack of clarity regarding unit member roles in providing information. Furthermore, volunteers saw their leaders as determining the hazards they focus on. If tsunami is included in this, through the provision of local risk information, this would become part of their role. This contradicts the perception that tsunami awareness and education is prompted by community interest which was held by some SES regional staff interviewees.

One SES participant responded to this uncertainty about not knowing what their responsibility was for tsunami, and the concern of her unit volunteers, which prompted her to seek out information to help educate herself and her SES unit. Therefore in this case, it was the uncertainty around what their role was for tsunami that prompted them to look into it, not because they knew their local risk for tsunami per se. One NSW SES interviewee discussed that her unit had been educated about tsunami risk for their local area only because her unit was getting involved in educating the public about tsunami. She was unsure of the precedent or who decided that her unit would be involved in this.

Inter-emergency service/region collaboration was seen as important for SES, both by SES members and by members of the public. This underpinned discussion of the potential role that shared training sessions or responses to emergencies with other units within and outside of their regions were beneficial for learning how different units deal with operational issues (such as how they set up their equipment). The importance of the latter was attributed to the need for inter-regional collaboration during large scale emergency events. Shared training and response (with shared after incident review) was seen as a way of sharing and developing means of tackling event response issues. The benefits of this were echoed by Coastcare and boating club participants who added that this was important both for the community and for effective emergency management at local and regional council levels.

A key issue raised by Coastcare and boating club participants was the need for collaboration to work towards ensuring that council and regional tsunami plans were consistent and that regional evacuation and hospital response plans were complimentary. Coastcare participants stated the need for collaborative planning to extend to the kinds of response, support and clean-up work that would arise following a tsunami (and other hazard event) to ensure that resources sourced from outside an area could work more effectively in that area and with those based in a given area.

WA SES participants discussed how involvement in regular community social nights, where families of volunteers and other groups come together, could be made more use of, particularly as, in the past, people were unaware of this SES role in the community. These non-emergency/hazard activities were seen as good for building relationships with the community. These events currently serve to enhance brand awareness and knowledge of SES response roles. However, it should be possible to build on such activities to include planned hazard/tsunami education and to facilitate preparedness.

### Tsunamis and other coastal hazards

SES interviewees acknowledge that their community engagement revolved primarily around hazards such as flood, storms, and coastal erosion, rather than tsunami. These community engagement sessions covered everything from stalls and presentations, to using the TsunamiSafe website, mass media and social media to inform the community about safety and preparedness. These engagement activities included prioritizing and targeting at-risk groups (e.g., boat owners and fisherman).

With regard to tsunami communications, these tended to be internally focused (amongst SES region and unit members) rather than with the community at large. These communications focused on clarifying the SES's responsibility and roles in relation to tsunami response and warning system. In regions that had received local risk modelling assessments, disseminating and explaining these to unit members would also occur. In areas where this information was available, there was only one reported instance of this information being used to inform a targeted community awareness exercise. For example, one NSW SES participant reported that the local tsunami risk information provided through training was incorporated into the information provided through a community awareness booth and for presentations at a community picnic. She reported that her conversations with locals at this event reiterated the issues raised earlier; most people are unaware of either the possible occurrence of a tsunami in Australia or the consequences that could ensue in coastal or urban contexts. Another respondent raised the fact that while their unit does actual response plan drills for other hazards, those for tsunami have occurred in the form of only a table top exercise. Participants from other SES regions reported that they had not received local risk modelling information. Instead focussed on communicating with at risk groups such as boaters about the effect of marine tsunami events, as well as working on correct warning procedures and SEWS usage amongst surf lifesaving clubs.

Interviewees commented on ways to increase awareness of tsunami. Tasmanian SES participants expressed the view that providing tsunami risk and preparedness information available alongside related news events could help increase tsunami awareness in communities. However, they felt that it was hard to get the interest of the media to promote tsunami risk when there are no recent tsunami events for media releases. They also expressed the view that it was difficult to use tsunami events that had occurred to help inform people (e.g., costly to mobilise and run these events at short notice). Using

January as the campaign month for TsunamiSafe was identified as a potential barrier to effective tsunami risk communication. While several NSW SES interviewees referred to using Tsunamisafe materials to educate community groups and share tsunami information, they also reported that community engagement activities were difficult to resource beyond social media and mass media campaigns as most SES unit volunteers are unavailable due to the summer holidays.

One WA SES respondent highlighted how, although the SES are the combat agency for tsunami and it makes sense that though they should include community engagement for tsunami alongside their hazards of concern, she hadn't done any community engagement around tsunami to date. She suggested that Surf Lifesaving Clubs might be better placed to do this, as they are more coastal hazard focussed than the SES.

### *Surf Life Saving Australia/ Royal Surf Life Saving*

Surf club interviewees discussed warnings with regard to their roles in warning beachgoers about beach and coastal safety. Participants' knowledge of tsunami and associated risks from personal experience or through media reports of events and warnings. As highlighted in Section B, Surf lifesavers, like other interviewees, perceived tsunami risk to be low or non-existent.

They expected that they would receive warning through the SurfCom radio about tsunami warnings and that they would be responsible for evacuating the beach and getting people out of the water. The time frame between warning and event was not generally discussed. If not on patrol, they thought that they would receive warnings either via the radio/television or receive an emergency alert text message. Surf Life Saving interviewees discussed using the Beach Safe app as another medium for receiving a warning. Some commented on receiving warning via the Pacific Warning Centre app. For the most part though unless they were on patrol at the beach, surf lifesavers did not expect to be affected by a tsunami threat.

#### Communication

Surf club members typically received information and communicated with each other while on patrol, and occasionally in meetings. Information was either obtained by crossing over with volunteers who were on patrol from the last shift, or directly receiving information through SurfCom radio. A Royal Surf Life Saving participant described that the surf club had direct day to day contact with beach goers and so within his role he takes the opportunity while on patrol to educate beachgoers about local hazards on the beach. He thought it was important to take opportunities when they present themselves (e.g., when a box jelly fish is found on the beach, it is important to show it to the beachgoers in the area and explain the dangers).

#### Tsunamis and other coastal hazards

Hazard and weather warning information was expected to be delivered via SurfCom radio, including information about what to do in response to a tsunami warning. Surf Club members anticipated that they would use their existing beach evacuation and emergency plans to inform their response to a

tsunami warnings. Other forms of communication, such as via social media, seen as being for communicating about surf club events amongst members and to the wider public.

Despite this, when Surf Life Saving interviewees were asked about their tsunami risk management role with the community, they commented in how it could be developed as an extension of their other response roles (e.g., beach warnings, evacuation, search and rescue, triage). A good example of this perception can be seen in the following comment from one Surf Life Saving participant:

> *The role of the SLS clubs in the event of a tsunami includes working with local council to close the beaches. This would involve putting signs up and red flags out if the warning was to occur during weekend beach patrol. They would also watch the beach and rescue those who might get stuck in the conditions. These actions would be taken because the SLS is mandated to maintain beach safety and so during the beach it would be their responsibility to do the above tasks.*

They believed their duty of care would be restricted to small scale tsunami events, and not for large land inundation events. Having existing evacuation maps and plans was seen as important, particularly to assist "panicking tourists." Some Surf Life Saving participants described their responsibilities as extending beyond the remit of the beach they patrol. For examples, some commented that they might also use their Facebook page and website to let people know about a tsunami event and direct them to other sources for more information.

Surf Life Saving interviewees believed that general beach evacuation plans and maps would be used to guide response to a tsunami. Some concerns were raised about the effectiveness of people's response to warnings. This concern was based on experience of local people failing to heed warnings for more regularly occurring hazards. Some talked about reliance on the shark alarm to motivate evacuation. They believed people would associate that with danger and needing to get out of the water quickly. However, some NSW SES interviewees raised concerns about this as reliance on existing warnings (e.g., shark) would limit learning about Tsunami Early Warning System (e.g., over-reliance on an existing system, but one not linked to the SEWS). Hence the concern was people may not be warned in time should a tsunami threat eventuate.

Furthermore, as discussed in Section B, there were concerns that as people don't tend to take shark alarms seriously, it would not act as a trigger for people get out the water (and it would not trigger the need to get to higher ground or vertically evacuate). For the most part surf club volunteers thought that they'd have to patrol the beach and warn people in person, in order to get them to respond to a warning. It will also be important to develop ways of communicating the issuing of a warning to life savers on patrol so they can optimise warning response times.

Outside of tsunami warning events, interviewees had not been involved in conversations or education related to tsunamis within their surf clubs. Surf club members were therefore reliant on other sources of information such as the news and their other roles in the community for tsunami information.

### *Coastcare/Landcare*

Coastcare interviewees expressed their general uncertainty about their knowledge of tsunami risk and warnings. They were also most likely to talk about tsunami in terms of its future and past interactions

with the environment based on evidence of past tsunami events in Australia and to discuss growing levels of societal risk based on infrastructure development in at-risk locations. Tsunamis were identified as a hazard whose management could potentially be addressed alongside issues such as rising sea levels and coastal erosion.

The reasons given for recommending tsunami risk management plans be based on strategies developed for these hazards derived from: a) their awareness that these were existing concerns within their communities, and b) their belief that tsunami would present comparable implications for those living and spending their leisure time in coastal/low lying areas. This link was supported by the view that coastal erosion and rising sea levels would exacerbate the impact of future tsunami events. Another Coastcare respondent discussed the pre-existing concern in their community about the impact of coastal erosion and rising sea levels on local property values. She felt that the issue of property values would also apply in areas that could be affected by tsunamis (and which could be used as a motivator for action).

### Communication

Communications amongst Coastcare group members were largely focussed around their actual working bees themselves and that it was during these activities most of their discussions were had rather than via formal meetings or information sessions. The exception being a Coastcare member whose Coastcare group had been to information sessions and meetings about coastal sustainability and erosion. Topics of discussions for these groups were around vegetation and dune care maintenance and weed control, managing coastal erosion processes, and local government planning. However, conversations also would extend to news events.

### Tsunamis and other coastal hazards

For Coastcare respondents, discussion of coastal hazards focused on climate-change and its implications for erosion-related hazards specific to their coastal landscape. Tsunami was only discussed when there had been tsunami events in the media. Discussion of tsunami events was also driven by members hearing about this project. The latter prompted discussion about the likelihood of a tsunami affecting their areas and considering the potential impacts a tsunami would have in the area, based on their understandings of the local geography, as well as what they had seen in the media.

While contemporary events did prompt discussion of the likelihood and potential impact of a tsunami in their local area, consistent with the findings discussed in Section B, this did not lead to action because group members decided: a) the tsunami risk was low, b) their geography minimised their risk, and c) there were no nearby earthquake or volcano prone areas. Notwithstanding, some Coastcare interviewees still thought it was important to educate people further about tsunami, particular as they have similar implications for communities as does rising sea levels and coastal erosion as mentioned previously.

#### *Red Cross*

For the most part, Red Cross volunteers tended to describe and focus on the social and emotional impact a tsunami would have on communities and the process of response and recovery. They, like their Coastcare counterparts, did not acknowledge receiving information or learning about through their

volunteer roles (unless they had been directly involved in a humanitarian aid for the Boxing Day tsunami as a Red Cross volunteer). For the most part, they were reliant on the media and people they knew who had experienced tsunamis in the past as their sources of information.

### Communication and Tsunami

Red Cross interviewees identified the Red Cross website as the most likely source of general tsunami information. They described themselves as more reliant on the news media, as well as their (direct and indirect) experience of providing humanitarian aid to tsunami and other natural hazard affected areas. The topic of tsunamis in Australia was not something that was identified by these interviewees as something they discussed with other members of the Red Cross.

## At Risk Groups

### *Marine Workers*

Some participants from this group reiterated the views of members of other groups and stated that the limited or lack of historical evidence of a tsunami affecting them and their community meant that the likelihood of a tsunami event was extremely unlikely (similar to the risk of being hit by an asteroid or meteorite). This was justification for focussing on other safety or hazard issues as these were ones that can be prevented or controlled for (see also Section B). The fact that people do not tend to prepare for more common hazards now was used as justification for not expending effort on tsunami issues.

This view was not shared by all members of this group. In contrast, others stated that while a tsunami was unlikely (due to no recent tsunami events large scale affecting the community), they thought it was possible based on the potential evidence of them occurring prior to the period of Australian's European settlement. For example, one participant discussed having read in the news media of a study that identified a 60m tsunami event affecting the NSW coastline in the past, with a return rate of about 600 years (which she thought we were getting closer to the end of). So while she thought that a tsunami was unlikely, it was still a threat to her community.

The same respondent highlighted how events such as the Newcastle earthquakes suggest that even though earthquakes and tsunamis do happen, they are not as regular as cyclones, for example, with emphasis on that they can still happen. She also thought it was important to consider the possibility that the scale of these events may vary and that it was not possible to know how big these events could be. She stated that despite what she knew, she still felt ignorant and thought that more expert knowledge about tsunami risk should be shared with communities.

An interviewee, who lived and worked in Botany Bay, voiced strong concerns that damage to the port's infrastructure would have negative health, employment and environmental impacts for her community. This discussion highlighted how the design of the port made them vulnerable, and this was likely to be amplified by future developments which are based of "perfect day scenario" planning. This sentiment was also shared by some interviewees from other groups (such as Coastcare), as they were participants in a local progress society for their local community and were aware of developers looking at off shore drilling and tourism expansions that might put the area at greater risk of tsunami alongside, their main concerns about maintaining the natural and historical habitat. The latter concerns, however, provides

another possible example of how tsunami risk management could be integrated with and build on people's concerns about other coastal hazards.

One Port worker interviewee believed that the tsunami warning system was the same as that used for other more commonly occurring hazard events. Although mobile phone emergency alerts, radio and television were useful for tsunami warnings, he also thought that more needed to be done to make sure that the media reports on warnings. He did not believe this was mandated for the social media and mass media communications as he thought that the media were less focussed on issues that affect smaller geographic areas and did not consistently broadcast warnings.

This respondent believed that the tsunami warning system was put in place due to community and media pressure in 2009, but did not think that it would be effective. The latter comment was based on his recollection of the national plans described in his newspaper at the time saying that the public should basically "head for the hills." He thought these kinds of messages could not be considered a plan and he wanted to see more locally specific plans developed and shared with the public. These should include planning for the management of vulnerable groups (e.g., nursing homes) and the roles of services such as hospitals.

Another Port worker thought that is was important that warnings used language people would understand. He thought that a many people would not know what a tsunami was, but they would recognise the term tidal wave. He also thought an app that alerts people within a certain radius of the likely tsunami event might be a better way of communication warnings alongside text message emergency alerts. The view was expressed that tsunami information should be included in combination with direct communication about the hazards his organization deals with more regularly (e.g., tidal issues, gas and petrol leaks).

In contrast to the views above, other interviewees felt that the existing designs of infrastructure and development were protective factors against tsunami. One Maritime worker stated that because of existing building restrictions related to flood and storm events (e.g., for a 1 in 100 year flood) that only a small portion of the port and the local community would be affected. This view was echoed by a Surf Life Saving participant, who emphasised the way the coastal developments were coordinated along the Northern Australian coast reduced the potential impacts of tsunamis.

Taken together, these differences in opinion reflect differing levels of trust in government and industry when it comes to changes in local infrastructure. The latter two also highlight the assumptions that existing mitigation strategies for other hazards also help to protect against small scale/marine tsunami threats. This reiterates the importance of including more specific scientific information about tsunami hazards and the nature and intensity of their consequences (e.g., whether structures designed to cope with flood waters would be able to withstand tsunami inundation that would include broken up infrastructure, rocks, trees etc.).

Other Marine Workers raised concerns that a tsunami would potentially put them out of work if it caused enough damage. The threat to livelihood was perceived as a significant one. This represents another possible motivation characteristic. Because threats to livelihood personalise the threat posed by

a tsunami, discussions such those reported here could be used to focus attention on the need for action (Paton & McClure, 2013).

### Communication

Communications for marine workers focused on face to face and radio communications between fellow workers. It was task related. Hazardous situations were dealt with at the time they arise and the response to these would be based on a combination of past experience and what was contained in their written safety procedure manuals. Advice on dealing with hazards was either obtained from the Port Authority or their unions. For general knowledge of what was happening in their local area they relied on the media, but also accessed weather and water condition websites (e.g., the BOM). These activities informed not only their work but also their leisure activities (e.g., boating and surfing). The issues Port worker respondents identified as being the topic of hazard-related discussion included the impacts of global warming, chemical and pollution related fish deaths, flooding, and manmade impacts on the environment. Tsunami are not generally included in discussions about risk.

### Tsunamis and other coastal hazards

Some interviewees discussed that through their work in Port Botany they have to constantly monitor weather and warning conditions throughout their day (including for workplace safety). This is done through Port Authority radio communications, monitoring BOM warnings, and other related weather/ shipping schedule websites. They use a combination of radio/face to face and start of shift meetings was used to monitor, discuss, and manage potential risks on shift, as well as, follow written procedures for conditions that have been risk assessed.

For one Stevedore, the main hazard of concern was wind and its impact on cranes (e.g., need to secure and ensure they do not pose a hazard for moored vessels). For another Port's respondent, the main hazard of concern for him (and his tugboat) were other vessels that did not correctly follow port procedures. However, for the most part though, he felt this crew was experienced and knowledgeable enough to manage these and weather/tidal related hazards as the occurred and to be able to avoid them. If out at sea, his view was that they should stay there rather than return to shore.

With regard to the latter, the decision was seen as one that would be determined by where they were at the time, rather than by any predictions about the impacts or size of the tsunami (e.g., if they were outside the Port, they would stay out). There was no discussion of where they would go should the Port sustain considerable damage in the event of a tsunami.

Because of the established safety procedures in place in Ports, and the level of experience these interviewees felt they and others they worked with had, they were confident they could respond appropriately to a tsunami threat. However, they did not describe any workplace tsunami education or specific procedures intended to inform workers of, for example, potential hazards, how they could be mitigated or responded to, or the respective roles of different employee groups (see above for examples) . Instead, they described how they would apply their knowledge of dealing with dangerous sea conditions to managing tsunami. In the absence of coordinated planning, the approach described would be ad hoc (with respect to tsunami risks) and would be based on expectations derived from more regularly occurring events. The assumption is that a tsunami event would create conditions comparable

to those they would expect in, for example, storm conditions. They were not considering tsunami-specific hazard characteristics and consequences in their deliberations.

All Marine workers interviewed expected tsunami warnings to come through the Port Authority. This would be their official source of tsunami warning information while at work. They anticipated that the Port Authority would also advise them on the appropriate actions to take in response to a tsunami threat (at the time a tsunami warning was issued). Where necessary, they would also apply their existing workplace safety procedures (see above) to the situation. They also discussed their reliance on using their previous experience and knowledge of other hazard events such as unusual swell or current conditions, storm and wind to determine appropriate courses of action should a tsunami event occur. .

One maritime worker's discussed their experience with tsunami information at work following their receiving a tsunami warning in 2014. In this event, they received the warning directly from the Port Authority. It was the Port Authority that issued instruction on how to respond to the warning (e.g., if evacuation is necessary). He remembered booming the cranes so they would not hit other ships, and being instructed to evacuate themselves from the harbour (which they did).

After the warning and response they found the boat unmoved and nothing had happened. Besides that, because tsunamis are so rare they didn't really chat about them at work. A combination of event (tsunami) infrequency and a lack of impact when (rare) warnings are issued tends to reinforce beliefs that tsunami are low risk events. Similar accounts of tsunami warnings being non-events were provided by others in this group. None of the Ports respondents identified being aware of, or being able to use, a set of procedures that had been specifically established to manage tsunami risk.

Another worker discussed their role as one that would focus on keeping other marine and port workers informed of their rights and responsibilities in relation to their workplaces and workplace safety. Therefore his focus was to make sure people felt they could take the actions they saw as necessary to maintain their safety in the event of a tsunami, particularly for workers in the ports who were likely to be most severely affected.

### *Boat Owners/Fishermen*

Interviewees representing this group thought that any impact on their everyday life would depend on the magnitude of the event. If cataclysmic, the damage would be immeasurable, including the loss of lives. It would mean the destruction of community and loss of work. One interviewee also discussed how a large event could led to long term disruption to power and other services, leaving him housebound and without access to or use of the services everyday life relies on.

Meanwhile, another felt that because their home was located 20m above sea level he would not be affected unless he was down near the water or at the beach. As his home was not likely to be affected he had not discussed tsunamis with his children. The perception of (relative) safety was based on the physical location of the respondent's home. This respondent did not consider the implications of widespread damage. This introduces a need to expand modelling of tsunami events to include impacts and potential short and long term consequences for people (e.g., Paton et al., 2014). When it came to being around the water he thought that a tsunami was just a part of the risk you choose to take when you spend time on the coast. That is, the nature and implications of tsunami risk can be underestimated.

Another interviewee acknowledged that he was unsure about the size a wave had to be to be for it to be classified as a tsunami. This provides an example of another misconception; that a tsunami is a wave (bigger than a normal one) rather than a different phenomenon.

However, he thought that is was possible that they could be small enough to go unnoticed by the community as well. He thought that although a far bit of debris would travel with the water in a large event, for the most part the water flow would be dissipated by the objects and landmasses it would collide with before reaching him. Assuming that the wave was travelling at 50 km/hr he thought that it would take 10-15mins to reach his place because of these barriers.

A Tasmanian SES interviewee, who also described himself as a boat owner and a member of a boating group, reported how his SES work meant he differed from other members of this group as a result of having access to tsunami risk modelling for his region. He thought that a small event such as a 10cm wave was more likely but this would have very little impact on his community and would only be risky in summer on the beaches. A large inundation event was seen as having a very slim chance based on historical and paleological evidence. He knew of some past minor tsunamis in his area but the public did not notice these as them were unable to differentiate them from the effects of storms.

When it came to warnings, Fishing interviewees discussed their having access to warnings from radio, television, word of mouth and social media. However, one respondent in this group commented on how, if he was out fishing on the rocks on the coast, he would have no way of knowing about a tsunami (and did not acknowledge the benefit of having a portable radio). He was unsure which government agency would be responsible for tsunami warnings but thought it may be the BOM as they provide forecast information for marine conditions.

A Boater respondent did not think there was any warning system available for his coastal area. This belief was based on the lack of signage or sirens in his local area. Nor had he seen any information distributed to locals or in the local newspaper about tsunami warnings. He did feel that he would like to see some sort of a siren system in place, but thought that the community would need to be educated about it and that some tsunami response plan information would need to be distributed through a combination of letter drops and email. Although he thought emergency alerts for mobile phones, the internet, radio and television could be useful; he thought that sirens were “tried and true” method.

Respondents were uncertain about the thresholds or cut offs for a tsunami event (e.g., when did a wave become a tsunami?). Respondents believed that events that happened closer to shore and had less time to propagate would resemble and be similar in size to large swells. Whereas, if a tsunami travelled from further afield, once it reached the shallow water near the Australian coast, it would become much larger (but still a wave similar to what they are familiar with). Smaller tsunami events, one interviewee thought, would just have a minor effect on the waterways and infrastructure on the coast. He also described other features of tsunami, such as the possibility of their including more than one wave, or the possibility of their being preceded by a receding shoreline. One Boater thought that while a small tsunami event might only create low levels of coastal flooding, it would prompt the local and state government to start developing tsunami plans, warning systems and improving preparedness.

## Communication

Amongst Boaters there was a strong emphasis on teaching and communicating with members about boating and water safety. Similar to other groups, email and social media communications were used to support ongoing activities and to keep members informed between meetings, or when they could not attend them.

## Tsunamis and other coastal hazards

Hazard communications in these groups focused on hazards boaters and fishermen could experience regularly and that members of these groups would most likely have questions or concerns about (e.g., boat safety and OHS, boat training and awareness of the local marine rescue and coastguard, fish weights and traps which damage boats, marine rescue, OHS, provision of rescue services, life jackets and other hazard mitigations, channels and dredging, lightning activity). For the most part, information on these issues were communicated about via email and social media. They were also discussed during group meetings.

When it was covered by members of these groups, tsunami was only ever discussed informally (as part of a general conversation or as a topic to joke about) rather than a serious topic for consideration. This sentiment reflected their view that there had been no tsunami event off the East coast of Australia in the past. Fishing members felt that a tsunami would not happen in their lifetime. For one fisherman's club, hazard events such as coastal erosion and tsunamis were only covered when raised in the media or if people raised it informally during conversations.

The only boating interviewee aware of work on tsunami awareness resulted from his being a Tasmanian SES member. He knew of his fishing club once holding a tsunami presentation that discussed the potential impacts one might have (but he couldn't remember much about it). He thought his club did not discuss or provide regular information and updates on tsunamis though. He thought that this may be due to his club lacking access to relevant information, but if there was a need to communicate about tsunami they had the means to do so. He thought that mariner groups and yacht clubs would be important groups for sharing tsunami information, especially if done at the same time as discussing other boating related issues (e.g., maintenance, power and fuel issues, speed limits, pollution and weather conditions).

Like the marine workers, the members of boating and fishing clubs expressed the view that they would rely on their general boating safety knowledge to deal with tsunami. They commented that what they would do would depend on the size of the wave event and whether or not the wave had already crested (i.e., assumptions that a tsunami is comparable to the waves they are familiar with). Others anticipated having to adjust mooring lines and securing their boats or vessels, if time permitted (e.g., 30min-1hr). This reflects a lack of knowledge of travel times and impact implications.

One Fishing interviewee thought there could be between 30mins and 5 minutes notice for a tsunami. If on land and near the beach he'd look for any way to get to higher ground such as a hill, building or climb a tree. But if he was on his boat his only hope would be to travel out to sea before the wave crested. He thought that 2 km or further would be far enough out to be safe. However, he did acknowledge a need to factor in the capabilities of his boat and thus what he could do would depend on the size of the event.

Other Boater and Maritime worker interviewees did not consider the possibility of their being in their boats or being by the beach/coast when discussing their response to a tsunami warning. One commented that, on receipt of a warning, they planned to stay put away from the coast and contact his family and friends using the landline to see if they were safe, and make them aware of the warning if they were in low lying areas (and advising of the need to get to higher ground). The implications of being on the coast or boating should be included in planning processes to accommodate the possibility of being at sea. For those with marine radios, they may be able to access warning via marine communications (with coastguard and harbour authorities being included as key recipients of warning information for onward transmission to those at sea).

One port worker did not know what he would do. He had ignored a tsunami warning in past. However, he discussed how he had seen rough sea conditions in the past from his home and this was not enough to compel him to act. He thought that rough seas were normal for the Australian coastline and was nothing to be concerned about (compared with conditions in South East Asia where he believed the waters are still for most of the year, except when tsunami events and cyclones occur). Therefore, his belief that the conditions normally prevailing in Australian waters differed from those in regions more prone to experiencing tsunamis, there was no reason to be afraid of rough conditions.

Again (see above), the inappropriate assumption that a tsunami is comparable to rough/high seas is implicated as a reason for not considering tsunami risk. For this respondent, this belief was further fuelled by the specific nature of his past experience. For this respondent, his past tsunami warning experience involved a tsunami that was only 4cm in height and he knew of a lot of people who went down to the shore to watch it. He thought that unless there was a magnitude 9 or 10 earthquake between Australia and the continental shelf he was unlikely to do anything. The kind of reasoning evident here illustrates the complex belief systems that can arise for “unknown” hazards and how they can contribute to risk rejection. The diversity of potential beliefs points to the benefits of starting by making accurate information available.

## SES and Community Role Expectations for Tsunami Preparedness and Response

With the exception of SES respondents, interviewees were generally uncertain about which agency would be responsible for issuing tsunami warnings or managing the response to them (see also Section B). Those living in bushfire prone areas were more likely to identify the police or the fire service as the responsible agency. A WA SES interviewee commented that community members within his jurisdiction were unaware of the SES role in response to events such as tsunami. He believed that the opportunities to elevate knowledge of the SES in the public eye, and for SES to engage with the community, was being affected by changes that were leading to the SES becoming more of a government agency and less of a community based charity organisation. Because of this, he thought that community members were both less likely to seek the SES for help in the event of hazard events and less likely to seek out SES members to develop their understanding of what they could or should do. Nor could it be assumed that SES members understood their response roles.

Some SES interviewees discussed their confusion regarding what the SES as an agency, and SES volunteers themselves, were responsible for in the event of a tsunami. One NSW SES respondent thought that SES was predominantly the combat agency for responding to tsunami, whereas it was the

role of the local council and government to ensure the community was prepared. Others (see Section B) believed that the SES was responsible for developing community capacity, but not responsible for household preparedness. Confusion was also expressed by some SES participants regarding who was responsible for initiating tsunami awareness education and preparedness in their communities. Other NSW SES respondents stated that SES volunteers were responsible for implementing community tsunami programs and education, but only if they chose to do so (rather than this being an agency policy or part of an agency plan).

The latter views defined the SES (as an agency) as the providers of resources and education for volunteers, but the volunteers themselves would determine whether to use these resources and education to help educate and prepare their community. This position was described in terms of their belief that, as SES volunteers, they are expected to know the potential risks and hazards for their community. An extension of this is that they then take responsibility to determine if tsunami is something their (specific) community should work on or learn about. An impediment to this process was described by another NSW SES respondent in that a dislike of thinking or talking about unpleasant things within the general population would reduce community members' willingness to engage in these conversations with the SES. Instead, emergency services such as the SES would need to take the lead in starting (and sustaining) the conversation.

The latter group of interviewees also expected that not only would the SES be responsible for providing warnings, but also be responsible for actively communicating information on existing levels of tsunami risk (e.g., to communicate about existing community plans for responding to a tsunami, where would warnings come from etc.) to their community members. This would include, as introduced in Section B, that warnings would be communicated by the SES through the media and the information they would provide would contain specific information about, for example, the specific local likelihood of impact, the potential extent of inundation, and what community members should do in their local area.

However, as discussed in Section B, it is uncertain how this could be accomplished in the absence of detailed local planning and the development of specific, local suggestions that could provide the level of detail required to ensure this represented a way of providing actionable information. In the absence of the latter, this strategy would amplify risk.

SES members thought that they would be able to seek further tsunami information directly from SES websites about local risk and response information. Other interviewees anticipated being able to with receive more information from the BOM or that "something would come up" in internet searches.

For those interviewees who discussed community preparedness, the need for the SES and other emergency services to take the lead in educating the community about tsunami risk was reiterated. However, it was believed that this should occur only if there was reason for them to consider it. That is, the risk had to be of comparable to other natural hazards, and issues in their lives before it would become an issue requiring action on their part. They would not attempt to seek out risk information unless they received information that convinced them to reconsider their current understanding of tsunami risk and consequences.

Other groups identified as having responsibility for keeping the community informed about tsunami risks and what was being done about them were NSW Ports, and the NSW Port Authority, the government and local councils. Concerns were expressed by Maritime workers and SES interviewees that tsunami issues were not being discussed with or within their communities (with discussions needing to be stimulated by formal authorities – see Section B). Their concerns derived from their belief that the lack of discussion meant that, were a tsunami to occur, people would be confused and be unable to respond quickly to a tsunami warning.

Therefore, they felt it was important that the government, SES and other relevant agencies take responsibility for facilitating public (and tourist) education and preparedness for coastal hazards, including tsunami. They also believe that all agencies need to communicate about the risks to the public in order for communities to be truly prepared. This makes it important to ensure that agencies provide consistent information and recommendations. Interviewees also felt that NSW Ports and port-based companies in particular were reluctant to acknowledge and take on this responsibility. This reluctance was attributed to agency concerns about bad press and social media responses due to increased public visibility of potentially threatening (and, at present, unlikely) events.

Amongst those interviewees who held the view that the likelihood of tsunami occurrence was low, they emphasised that tsunami education and preparation must be cost effective and that the effort and resources directed to it be proportionate to more frequently occurring hazards. That is, it should receive few resources and relatively little attention.

Furthermore, they did not think that support for or action towards tsunami risk management would be likely unless a tsunami event occurred nearby, or there were dramatic changes to the seismic or ocean activity around Australia. In the absence of some event, interviewees stated that they were unlikely to take it upon themselves to self-educate and prepare. These examples provide further illustrations of how (some) knowledge of tsunami hazards does not necessarily translate into a perceived need to act to reduce tsunami risk.

For those interviewees who were aware of the national tsunami plan, they were unsure how that plan had translated to regional and local plans. For example, one Boater thought there was no useful plan for a tsunami or plans to communicate said plans within their area. He noted that after the 2004 Indian Ocean tsunami, the government had developed a plan. However, he considered the plan to be hopeless as it did not appear to factor in the specific needs of key local resources (e.g., hospitals, nursing homes etc.). As such, the plan did not address mobility issues in the community. He feels that the plan is self-serving and intended to provide a way for the government to say that they have a plan.

Similar concerns were expressed by Surf Life Saving participants. They were unsure if some agency was monitoring potential tsunami events so that people could be warned. This was framed in terms of their believing that community awareness of tsunami risk was non-existent and there were no strategies for communication with the community. One Fishing respondent felt that there was some community expectation about the existence of a well thought out tsunami plan that could be rolled out and acted on by the emergency services should a tsunami occur. But in the event of a tsunami he anticipated that there would he high levels of anger and blame directed at emergency services because he did not think such plans and capabilities were in place, much like what was observed for Hurricane Katrina in America.

## Preparing Communities for Tsunami: Who, How and When

### *Perceptions of community levels of preparedness*

Differing levels of concern and uncertainty about levels of community preparedness for a tsunami were expressed by the groups interviewed, with non-SES interviewees being relatively more concerned. This relatively greater level of concern extended to beliefs about the public's ability to respond to a tsunami warning. Interviewees anticipated that most people would be confused and would panic. Part of this concern reflected lack of knowledge of formal plans.

One Red Cross respondent was not sure whether her local council actually had a tsunami response plan, and assumed that if they did it would be limited in its scope. She hoped that local emergency services did have a plan and had thought carefully about getting timely and accurate advice and warnings out. But she felt that their levels of preparedness maybe be less developed for tsunami due to other more frequent hazards being prioritised by emergency services.

One Surf Life Saving respondent believed the lack of tsunami warning buoys in the ocean around South Australia would mean that no warning for a tsunami could be issued, it would just happen. He also thought that more money was needed for developing warning systems and researching the tsunami risk for South Australia. Boating and Coastcare respondents felt that the warning systems for tsunami were questionable in their effectiveness and that the public were not appropriately informed to respond to them if they were used. A Red Cross interviewee shared this view. The lack of attention to tsunami preparedness left people not knowing what to do. Consequently, the severity of a tsunami event would be increased, both in terms of deaths and destruction. However, as introduced in Section B, views on the need for, as well as how to provide, preparedness were mixed.

### *To Prepare or Not to Prepare*

The (very) low perceived likelihood of a tsunami occurring was seen as a barrier to community tsunami preparedness. However, Surf Life Saving and CoastCare interviewees felt that although the likelihood of a tsunami was low, it was still important to discuss with communities and prepare for and that this was informed by their past experiences with tsunami warnings. To pursue this, it will be important to precede it with more general education about tsunami risk, with collective agency action to stimulate discussion of tsunami hazards within the community at large (see above). Respondents had various explanations for their support or otherwise for preparedness.

For example, a Red Cross interviewee who had humanitarian aid experience with the December 26th Tsunami in Banda Aceh, saw the likelihood of the tsunami to be low in Australia compared to Aceh. This comparative likelihood reduced his support for preparedness, especially as the likelihood of a tsunami is very low compared to other hazards such as bushfires and floods. The latter view supported his belief that if you tried to educate and prepare the community it wouldn't work as the community wouldn't see it as a priority against other issues.

One Tasmanian SES interviewee argued that preparedness programs would be more likely to be effective after a tsunami has occurred. He believes that they have not been successful in the past despite publicity about events elsewhere. He reiterated the view that community perceptions of the low likelihood of a tsunami, compared with other hazards and day to day risks, meant that community

members and emergency management agencies alike would assign a low priority to tsunami events and preparedness.

Overall, the prevailing view amongst the majority of interviewees was that the comparatively low frequency of tsunami events in Australia compared to other hazard events in particular, bushfires and floods, was a justification for questioning the need for warnings or for preparing themselves or the community for tsunamis. This view was supported by comments that stressed that community members do not prepare for (high risk) bushfires. So he wondered why we should bother getting them to prepare for something that is less likely, such as a tsunami.

In contrast, those interviewees who believe that tsunami could occur, rather than it being improbable, and who focused on considering the severity of the consequences of a potential tsunami rather than its relative likelihood, were likely to describe preparing communities for tsunami as important. Those that tended to express these views came from a SES background. This suggests it was more than just the availability of training that covered tsunami hazards and additional work is needed to explore why some convert the knowledge gained from their training into a focus on manageable consequences. This is, however, consistent with research indicating that a focus on consequences rather than a hazard event per se is more likely to motivate preparedness actions (Paton & McClure, 2013).

### *Alternatives to Preparing*

A belief in the need for preparedness did not, however, lead to unqualified calls for a preparedness strategy. The possibility of co-locating preparedness information in warnings processes was discussed in Section B. Impediments to preparedness activities being effective were also framed in terms of concerns about finding legitimate/trustworthy sources of information through the internet and the additional problems that could ensue if people consulted inadequate sources.

Recommending that people should access legitimate and trustworthy sites would not necessarily resolve any community access issues. Acknowledged difficulties in engaging and communicating with people, reluctance to spend time and money on infrequent events, and concerns that people would ignore preparedness information, as outlined earlier, acted to constrain support for investment in preparedness (see Section B). At the same time, amongst those who acknowledged the possibility of a tsunami occurrence, it was argued that people should be able to receive more specific action information regarding for example, evacuation routes and blockages, designated safe places/ evacuation centres (within their local areas). Respondents did draw on their experience of preparedness for other hazards to offer some general principles that could be accommodated in preparedness planning.

### *Strategies for Preparing People*

#### Information Access

A common recommendation was that people should be able to access information when it was convenient for them. Resources such as the internet and apps were seen as good ways of supporting this. At the same time, it was acknowledged that people would only access information/seek it out if "they want to." With regard to what might motivates people to want to access information about tsunami, the need for official information and discussion on tsunami risk (to the point where people would see it as a "real" risk) was reiterated (see Section B).

### What Motivates People to Seek Out/Not Seek Out Information about Tsunami

Those who had never sought out information on tsunami risk and who were currently not interested in doing so stated that a tsunami event would have to be imminent, happen nearby, or experience changes in the local environment (seismic, ocean activity) to prompt them to seek information. Some Red Cross, Coastcare and Surf Life Saving respondents discussed their belief that they feel they already know enough to deal with the tsunami if it happened, and had sourced their information from postgraduate studies, or personal tsunami experience. However, the lack of experience in using knowledge or opportunities to apply and develop knowledge and competencies through exercises and simulations increases the possibilities that such assumptions of (untested) capability could increase risk. This phenomenon is well-established in the DRR literature (e.g., Paton & McClure, 2013). These concerns (about overestimating capability) are reinforced by the fact that the low risk and low probability of a tsunami were cited as justification for their not needing to seek out more information or prepare. Furthermore those that actively choose not to seek out information thought that they would be able to seek out trustworthy information if and when they needed to, but did not consider the time frame in which warnings would arise and how this would affect their ability to seek information.

A significant motivator of preparedness was conversations with others (Paton & McClure, 2013). See the Recommendations for Section B. It is worth noting that, for some respondents, the discussion that took place in the interviews was a motivator for developing knowledge of tsunami risk. One Coastcare interviewee discussed how conversations with her children and with geomorphologists and geologists through her Coastcare activities stimulated her interest.

Some Royal Life Saving and Surf Life Saving participants discussed being prompted to seek information out by conversations with people they knew who had survived tsunami in other parts of the world. Conversations with people who were less knowledgeable about tsunami were also prompts for seeking out more information about tsunamis for interviewees so that they could help educate others that were misinformed, or educate people they had responsibility for such as their children.

Media reporting on tsunami events elsewhere in the world were identified as potential prompts for people to seek out information but only if they expressed an interest in geography or disaster events more generally. However, for this to be effective, there must be some measure of risk acceptance (see Section B). Group discussions reiterated the potential value that could accrue from linking tsunami education with other hazard-related activities (see above).

### Tsunami Education and Preparedness Using Other Hazards

Several interviewees thought that the effectiveness of tsunami education and preparedness processes could be enhanced by using approaches they believed had been successful for preparing people for other hazards such as bushfires (it should be noted that others who mentioned these strategies also commented on their lack of effectiveness for more commonly occurring hazards).

Some respondents discussed how encouraging people to talk about tsunami alongside other community hazards and issues that the community is both interested in and have similar implications for parts of the community (e.g., sea-level rise, environmental pollution) would be useful. For example, one Red Cross interviewee stated that rolling out more scientific information about tsunamis, much like what is

already done for bushfires, would help people to become more prepared and respond better to tsunami warnings. She thought her community was well prepared for bushfires and other hazards, but this hasn't translated to being more prepared for tsunamis and that this needed more emphasis.

A Surf Life Saving respondent proposed that tsunami awareness could be better promoted to communities by giving people more information about the likelihood of them occurring, and relating it back to people's local context. This was based on the results he had seen in raising bushfire awareness in places like Victoria. Despite this he also thought it was going to be hard to convince people of the risks and why they should prepare, much like what has been seen with bushfires; as people do not do anything until an event has already happened. He thought that providing people with scientific information about the causes, sources and consequences of tsunami around Australia (particularly using models that people could relate to) might increase awareness and lay the foundations for community preparedness (see Section B). He felt it was important to emphasise the threat and potential destruction rather than the likelihood of the event.

### What Information is Useful for Tsunami Preparedness

Any information provision strategy in the event of a tsunami will need to include having ready access to sources of information, a planned means for contacting and communicating with loved ones, and locally specific risk and response information.

With regard to sources, Red Cross interviewees thought that most people were unaware of where to go for information in the event of emergencies, and were unlikely to know about the ABC's role in being the official emergency information source. One Red Cross interviewee thought it was important to make sure people knew about the ABC, and that they should make sure that they're able to listen in by owning a battery powered or wind-up radio.

One interviewee thought that people would be concerned with contacting loved ones in the event of a tsunami, and it would be important that people have existing plans for how they are going to contact people in the event of a tsunami. Particularly as mobile phone networks tend to become jammed during emergencies. In bushfire events she had personally found Facebook quicker and easier for contacting people as it tended to us less of the phone network. However, she also knew that she would not be able to contact everyone she knew that way as different people are best contacted through different forms of communications. Given the generally expressed predisposition of people to contact family and friends on receiving a warning, it will be important to advise people to plan how they will do this (for different recipients).

### Where Should Information Come From

Learning about tsunami before a warning or while preparing for a tsunami people preferred information to come from a trusted source such as the emergency services, or their local council. Red Cross and Coastcare respondents discussed that they already received regular bushfire and other hazard related information in mail outs from their local council (and tsunami information could be added to this).

Red Cross respondents stressed the importance of providing high quality information and only providing people with "fair dinkum" official information before or in preparation for a disaster. He said it was important to ensure that messages and information were well researched and provide in depth,

explanatory, attention grabbing and scene-setting details. A concern that how emergency services currently try to communicate with the general public was counterproductive.

Interviewees typically acknowledged a need for a range of communication media (e.g., mass media, letterbox drops, social media, internet websites, and mobile phone apps) to ensure that information would reach the maximum number of people. They thought that letterbox drops were one of the few ways that you could ensure all community members would receive tsunami risk and preparedness information (including being better for reaching elderly people).

The internet was seen as a good way for accessing information, especially if people were aware of official sources of information (e.g., the BOM, Red Cross and Tsunami Safe website). It should, however, be noted that passive communication (e.g., letter drop) are ineffective unless delivered when people are seeking information (e.g., as a follow-up to other community engagement activities). Websites, because they afford scope for accommodating different levels of knowledge and interest and for facilitating the progressive development of knowledge and action, are a potentially more effective medium. However, the availability of a website does not guarantee its use. The importance of the latter derives from findings that presenting large quantities of information in one hit are demotivating. People are more likely to engage with sources of information when they can start with basic knowledge and advice and progressively move to more complex activities. It is also important to note that in the absence of risk acceptance, the effectiveness of any resource will be significantly muted.

It is worth noting however that only SES interviewees identified knowing of or using or the Tsunami Safe website, or the ATAG resource, "*Tsunami: The Ultimate Guide*." This is further explored in Section D. The latter resource was only described as having been used by community engagement staff in the NEW SES and those involved in the development of the resource from NSW and Tasmanian SES. No other interviewees knew about the Guide, although a few did express an interest in looking at it after the interview.

The least preferred sources for preparedness information were identified as radio and television as while they would be useful for promoting resources people could seek out, people preferred resources that they could keep or re-access when it was convenient for them.

For the most part communication technologies were seen to be of less value in the context of preparing, but more relevant to providing warnings. Technology was most frequently discussed in terms of being able to better model impact and monitor tsunami threats, such as using drone technology to help observe changes in sea levels. Multi-lingual and interactive risk mapping websites were seen as useful sources of information for people to seek out or be referred to, particularly if the general public could connect with and have Q&As with tsunami experts.

One interviewee thought that Facebook and Twitter would be useful for sharing this information as she thinks that people tend to be responsive to information from these sources. Social networks and the internet were seen as useful for tsunami preparedness because the information remains accessible on these platforms and can be seen by others. She stated that she already shares information about tsunami on social media, and would share information about what she would do in the event of a tsunami, and interesting articles for others to read from trusted scientific sources. Overall, Red Cross

and NSW SES respondents thought the best "technology" for preparedness was connecting people with tsunami information through discussions between individual local community members face to face and fostering relationships.

## Recommendations

1. With rare events, community understanding of risk is sourced predominantly from a mass media that highlights them as rare, catastrophic and that happen elsewhere. It is important to acknowledge that the ensuing belief that tsunami cannot be mitigated adds to problems of risk acceptance (Section B).
2. Taking them together, there exists a substantial resource within agencies that can discuss the difference between events and the consequences of events and by providing a consistent and clear message about the options available to deal with consequences, increase risk acceptance.
3. The actions in #2 can be facilitated by focusing on comparable and more acceptable events, such as storm surges and storm surge education, to add discussion of tsunami as another coastal hazard. Connecting with community's around tsunami through existing topical and related issues that affect the same at risk groups. For example, beach erosion and tide level changes related to global warming as seen as important by CC and RC interviewees.
4. The activities outlined in #3 can build on the fact that many community groups are engaging their members on a range of safety and hazard issues, not only within their community groups but also to the wider public. It is worth encouraging units to identify these people within their communities who have existing interests in promoting community interests and safety. These individuals expressed an interest in communicating to the broader community about tsunami if deemed relevant.
5. Clarification of responsibilities of community and SES in relation to tsunami education and awareness. Particularly around volunteers vs. staff roles in determining hazards of concern for the community. The community assumes that this is the responsibility of the emergency services and additional community engagement and outreach is required to introduce and consolidate the idea of shared responsibility and to use this a foundation for community engagement.
6. Using research as a part of the community engagement process. Volunteers were interested in find out their local community's perception and felt it was important for their practices. Interviewees also identified that by hearing about the study this had prompted them feel they should self-educate and discuss it with other members of the community. This also provides opportunity for citizen empowerment, having locals ask locals about their tsunami knowledge and expectations.
7. Volunteers are motivated to engage with the community but want "hands on" strategies, and to see benefit from these strategies which was deemed easier with face to face interactions with the community rather than through print or digital communications. Some voiced concerns that these opportunities are being lost due changes in focus of groups/agencies and by the limited participation of the agencies in extracurricular activities. Strategies will need to be developed to

accommodate the diversity in needs, goals, capabilities and expectations that exist across stakeholder groups.

8. Websites can be developed to provide both commonly-required information, content tailored to the needs of diverse stakeholders, and can be developed to facilitate the progressive development of knowledge and capability.
9. Review existing safety procedures/manual for Ports and assess if their guidelines for existing general hazards are applicable or contradictory to tsunami advice and adjust accordingly.
10. Explore tourism education as an opportunity to educate people about tsunamis. People thought due to travel habits people are more likely experience a tsunami overseas and so people are more likely to attend to the information if related to travel.
11. Find more opportunities for SES units to engage informally with public. This was seen as important for brand recognition and informal opportunities to discuss tsunami and other related hazards
12. Train Surf Life Saving volunteers about tsunami signs, warnings and marine threats so that they have opportunity to discuss with beachgoers on the ground as a part of their general public education.

# Section D: Tsunami: The Ultimate Guide – Uptake and Usage

This section discusses the analysis of community- and school-based use of the Tsunami Guide. It also includes feedback from these groups of about the Guide's usefulness and accessibility. Interviewees included SES members interviewed in the previous studies, as well as primary (three interviewees) and high school (including years 11 and 12) teachers recruited through national teachers associations. This analysis is followed by a series recommendations for developing the use of the Guide to support warning and preparedness programs.

***Table 5. States of Origin for the 12 SES Volunteers and Staff members, and Six Teachers Interviewed in Pilot Study 2.***

| **Interviewee Groups** | | **No.** |
|---|---|---|
| SES | NSW | 7 |
| | TAS | 3 |
| | WA | 2 |
| | | |
| Teachers | NSW | 2 |
| | ACT | 1 |
| | NT | 1 |
| | QLD | 1 |
| | Vic | 1 |
| | | |
| | **Overall** | **18** |

# Findings

## "Tsunami: The Ultimate Guide" as a Source of Information

Of those interviewed for this project, only six interviewees (of 18) described knowing of and using the Tsunami Guide. Consistently, the reason for not using the Tsunami Guide was because they had not heard of it. Of those that knew about the Guide, all had used it in some capacity. These tended to be those who had helped to develop the resource as well as some of the NSW SES community engagement officers. SES Unit volunteers and WA SES interviewees had not heard of the Tsunami Guide.

Those involved in developing the resource, or who were involved in NSW SES community engagement activities had used it predominantly to help inform themselves about tsunami hazards. They had promoted it to other organisations and groups as a useful resource, and used it to educate their volunteers or community groups. For the most part the resource was shared in presentations.

An exploration of how SES community engagement personnel and School Teacher's conduct hazard-related education is discussed here to help identify ways in which the Tsunami Guide (and future resources) might be developed and integrated into communication strategies with communities.

## Tsunami Education in Schools

The main reason for tsunami being included as topic of study in schools is whether or not it is contained the national curriculum. Although natural hazards (such as earthquakes, volcanoes, bushfire and floods) are covered in the national curriculum, tsunami is considered an optional topic. Tsunami tended to be an "add-on topic" to the content covered around earthquakes and volcanoes. Within the science classes, the focus tended to be on how tsunamis were generated and their physical characteristics. Bushfire and drought were discussed more often because they were seen as the hazards most likely to affect where the children live.

Teachers felt that because there was already a lot to cover in the school year, tsunami was not something that was taught or discussed in their classrooms unless the teacher thought that it was useful for exploring other educational concepts (e.g., teaching geography in an exciting and practical way), or if there had been recent tsunami events in the media. Some benefit for including tsunami emerged if teachers were aware that their students travelled with their families to countries prone to experiencing tsunamis. Such classes were also seen as important for teaching students about being global citizens and learning empathy and charitability.

One teacher thought that if tsunami event happened nearby this would be a great precedent for teaching their students about them. For later primary and secondary school classes tsunami was more likely to be intentionally integrated into geography and science lessons rather than discussed or taught on an ad hoc basis.

Tsunami was at times included in the syllabus when students were interested in the topic. One teacher thought that this interest was generated because, as a generation, his students have memories of the Boxing Day Tsunami. This made tsunami a topic that seemed more personally (relevant than other hazards) to them. Another teacher thought student interest in tsunami was born from a sense of morbid curiosity and their fascination with the scale of destruction. Despite this, tsunamis were often quite challenging for students to learn about (e.g., some students had trouble coming to terms with tsunamis, and their potential scale of destruction, being unpreventable events).

Tsunamis, as a topic of study, was often explored through student lead inquiry projects during late primary school and in high school. Most of what the teachers tended to cover in their class material focussed on how tsunamis occur, and the level of physical and social destruction they can cause. One teacher had their students investigate the impacts on people and its implications for recovery (relating to past tsunami events). Another teacher stated that his students tended to create topics for student inquiry projects that were much more applied, and focused on tsunami mitigation and/or preparedness (e.g., "how to build a tsunami proof barrier" or "how to prepare a home kit for tsunamis and other events"). One teacher highlighted though that although people are taught about tsunamis at school, they tend to assume it will happen elsewhere, and not at home. This is reinforced by schools focussing on international tsunami case studies.

One interviewee mentioned that if emergency services were interested in trying to encourage students to be better motivated or prepared for tsunamis, then tsunami education should occur in the later primary school years. This was seen as a period when children were more open to learning about taking action due to cognitive ability. Once teenagers however they become less interested about such issues. At the same time, another teacher highlighted that primary school aged student's ability to understand a topic as complex as tsunami is limited and so it is difficult to go into the topic in depth, particularly with younger children. This was compounded by the time constraint issues that affect what teachers can cover in the curriculum.

During the interviews, no teacher referred to covering issues about the warning systems in Australia, the history of tsunamis in Australia, or the differences between marine threat and land threat tsunami events. This, coupled with the predisposition to using international case studies, suggests that children receive low exposure to learning about tsunamis in the Australian context, and are not being taught to understand the Australia's tsunami risk and their local risk.

### *Resources used by Teachers*

Of the school teachers interviewed, none had used "*Tsunami: The Ultimate Guide*" or referred to the materials on the TsunamiSafe Website in their interviews. Only one teacher identified knowing about the Tsunami Guide resource. They found out about it through the Australian Geography Teachers' Association conference (Note: he mentioned this after the interview once he had time to look at the Guide). Although he had not used the resource for teaching purposes, he was using materials similar to those included in the Guide that he had found through his own research into Tsunami educational materials (e.g., the YouTube video of Tilly the UK school girl).

Existing and preferred resources for teachers included resources from National Geographic, Geoscience Australia online teaching resources, The BOM website, news stories, textbooks, and videos from educational and trusted sources. Teacher's typically learnt about resources through doing their own Google searches for materials, using curriculum recommended textbooks, and through resources they learnt about due to their hobbies and interests.

One teacher stated that because he was a "bit of a geography geek" he had learnt about resources such as the Pacific Disaster Warning App and related websites. Another teacher said that as a consequence of their having lived in Japan for a short period of time, he was able to identify other useful resources he'd learnt about during his time there. He also mentioned resources obtained from visiting the Geoscience Australia offices during public open days.

The use of personal stories of people who had experienced tsunamis was identified by teachers to be important to help make sure students engage with the topic. From the same teacher, his Japanese connections had allowed his school to be a part of a community exchange program. During this exchange, Japanese students who had been affected by the Japanese tsunami discussed their experiences with the students at his school. He thought this was important for increasing his student's ability to understand what tsunamis were like and to appreciate the impact they can have on someone's life. Another teacher included personal stories in his classes by getting his students to listen to a podcast about the experiences of an engineer based at Fukishima at the time of the 2011 tsunami. The

use of personal stories was also raised by a NSW SES member who thought that one way in which the Tsunami Guide could be improved was through the inclusion of more personal experience stories with tsunami.

Collectively, the teachers interviewed thought that they needed to be told about the Guide and to know more about the guide so that they could use it. Most were interested in the resource. Teachers emphasised that resources such as the Guide should not be heavily text based, and thought that resources that used lots of images and videos were useful.

One interviewee briefly examined the Guide during a break in the interview. She stated that, despite having only glanced at the content, that it was a resource that she'd be strongly considering using in the future. She felt it included many useful images and videos, and the text was easy to read. She also stated that, as her school was looking to make use of iPads in the classroom, the Guide would be an easy resource to incorporate into this strategy. Although some interviewees thought that the Guide sounded like it could be useful, one teacher highlighted that she probably would not use it as she felt that she already had enough resources to use for her classes.

### SES Feedback on Tsunami Guide

For SES interviews, those that had used the Guide in the past felt that the materials were well developed, presented in easy to understand language, and made good use of pictures and videos. They commented that it contained information that was useful to the general public for understanding tsunamis and what to do.

The Guide was promoted by some of the SES interviewees not only to their volunteers, but also to community groups and the broader public through Facebook, mail-outs, and through presentations. One community engagement volunteer commented that the resource was too large and time consuming to review in one sitting or presentation. It was suggested that it was important that people used the resource in sections over time to get the most out of it.

One interviewee felt the information tended to be too general. This comment relates to those presented earlier (Section C) regarding the importance of local information if a resource was to effectively help people to be better prepared for a tsunami event. The lack of local information was seen as something that reduced interest in the Guide as a resource. However, one SES interviewee had come up with a strategy to accommodate this issue. She discussed how she used the Guide in combination with a GIS mapping tool to help educate her unit volunteers about the local tsunami risk. This was part of a strategy to help prepare her local unit volunteers and involve them in a tsunami community engagement program.

Several of those who discussed the Guide were concerned that the guide was not being publicised enough and that teachers, SES volunteers and other groups such as Surf Clubs were not aware of the Guide. One SES interviewee believed that it was a resource that was more likely to stimulate interest in people with a pre-existing interest (work in the area etc.) in tsunami. In its present form, it was believed that it was unlikely to be used by those who have the most need or use for it.

One SES respondent thought that making the resource approachable and interactive is not enough to get people to use the Guide. They suggested ways to help promote the Guide included promoting it through the mass media, and having surf club branches run presentations for surf lifesaving volunteers. This strategy was seen as one whose success would rely on it engaging potential users (e.g., in conjunction with a program covering the scientific aspects of tsunami risk in Australia). Other interviewees suggested making the Guide an integral component of community engagement activities designed to prompt people to think about tsunami risk and what they can do about responding to it. This idea was supported by the observation that this project and its engaging people in the interviews stimulated some interest in tsunami risk and the Guide (particularly amongst Coastcare, Red Cross, and surf club members who did not have the same exposure to tsunami education as their SES counterparts).

A number of interviewees stated that finding out about the study and participating in it had prompted their questioning their knowledge of tsunamis, encouraged them to have conversations with other community members about tsunami risk, and motivated them seek out information about tsunamis both before the interview took place, as well follow it up after the interview.

As a consequence of this type of community engagement, several interviewees, including marine workers and teachers, stated that they were going to now look at the Guide and would seek additional information sources on tsunamis in Australia from the interviewer. When this occurred the interviewer referred these individuals to the Tsunami Guide, the Bureau of Meteorology Joint Tsunami Warning Centre Website, as well as the Tsunami Safe website. This example provides further evidence of the importance of including active community engagement and encouraging community discussion of issues in a community-based DRR strategy.

## Recommendations

Education focusses on the science and impacts of tsunami and tsunamis elsewhere in the world, not on how to respond/prepare or about warnings. Education also focusses on tsunamis elsewhere. Australia is not a current focus for tsunami hazards education.

1. There is a current lack of knowledge about the Guide. The teachers interviewed thought that they needed to be told about the Guide and to know more about the guide so that they could use it. The value of doing so is supported by the fact that even a cursory view of the Guide during or immediately after the interviews was enough to illustrate its usefulness.
2. The use of the Guide can be facilitated by highlighting its availability after the conduct of a risk awareness strategy (see Section B). Tsunami, as a hazard, is not given a high priority at present, with its coverage being linked to personal interest (in students) or its role in assisting teaching other subjects (e.g., geography). A national and local risk acceptance strategy could elevate the importance of tsunami as a hazard and thus increase the perceived need for resources such as the Guide.
3. Tsunami education materials, including the Guide, should include activities that facilitate students' ability to learn about Australian tsunami history (both prehistoric and historic) and include those events that could have impacted Australia and those that could occur in the future.

4. The content could be complemented through the inclusion of more personal experience stories with tsunami. While recognised as an effective device for assisting people to personalise their risk, this activity, if deemed appropriate, would need to occur after a risk acceptance strategy (see Section B) and the reason for the inclusion of stories (especially if sourced from overseas) explained.
5. Education could include coverage of what a tsunami would be like in Australian contexts and the differing implications it would have in different areas. For example, differences between marine and land threat tsunamis and their relative impacts and likelihood.
6. Education could be developed from other coverage of coastal hazards such as storm surge.
7. Education could be developed from discussion of climate change and sea level rises that will increase the losses from any marine hazard, including storms and tsunami.
8. Class content/activities should incorporate more of a pre-tsunami focus, preparedness and warnings so that children focus on what they can do instead of emphasising the response and recovery.
9. It is suggested by interviewees that students are more open to activity/action learning at upper primary age, older students are jaded, younger students don't understand.
10. Personal survivor stories were seen as important tools for children comprehending the impacts of a tsunami. Using examples such as Tilly the UK school girl are important for highlighting what can be done to prepare or respond to a tsunami threat.

The Guide was not considered for use by participating teachers as they have their own resources already. Or, they hadn't heard of the Guide prior to the interview.

11. Need to find new ways of communicating the Guide to teachers. This is a complex issue as its source includes curriculum planning as well as content issues and needs more research.
12. Encourage agencies (SLSA, SES, RLS, etc.) to communicate about The Guide to community members and schools rather than just through teacher associations and conferences. So for example, include it in other emergency services participatory programs run in schools but include teacher education in these programs. Also, from a volunteer or unit perspective, encourage volunteers to discuss tsunamis in the broader community, not just at risk groups. For example, target schools but also children recreational groups such as sea scouts.
13. Develop games, activities and projects that can packaged separately and that focus on coastal activities that rely on consulting The Guide to complete. These could be disseminated through SLS and other groups to beach and coastal habitat users.

The resources in the Guide are considered approachable, engaging and useful. But there was concern that delivery of this resource to the community has been limited.

1. Media campaign identified as one solution (especially if it includes activities that require using The Guide for completion.)
2. More needs to be done to educate volunteers as they did not know about the Guide (only paid staff).
3. Using volunteers could assist not only the dissemination of The Guide, but also facilitate its use by acting as a resource to translate generalist knowledge in the Guide to local conditions

and area and the interests of different groups (e.g., Sea Scouts versus fishing groups versus lifesaving groups).

# Glossary

ACT – Australian Capital Territory

ATAG – Australian Tsunami Advisory Group

BOM – Bureau of Meteorology

Guide – *"Tsunami: the Ultimate Guide"*

NSW – New South Wales

NSW SES – New South Wales State Emergency Service

NT – Northern Territory

QLD - Queensland

RC – Australian Red Cross

RSLSA – Royal Surf Life Saving Association Australia

SA – South Australia

SLSA – Surf Life Saving Australia

TAS – Tasmania

TAS SES – Tasmania State Emergency Service

The Tsunami Guide - *"Tsunami: the Ultimate Guide"*

Vic – Victoria

WA – Western Australia

WA SES - Western Australia State Emergency Service

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