Treating risk as relational on shore platforms and implications for public safety on microtidal rocky coasts

Peter Kamstra[1]*, Brian Cook [1], David M. Kennedy[1] and Barbara Brighton[2]

[1]School of Geography, The University of Melbourne, Parkville, Vic 3010, Australia

[2]Surf Life Saving Australia, Rosebery, NSW 2018, Australia

*** Corresponding author peter.kamstra@unimelb.edu.au**

[2] Barbara.Brighton@syd.catholic.edu.au

Abstract

Drowning on rocky coasts is a problem with global significance, but it is a particularly acute issue in Australia where rocky coasts account for 19% of coastal drownings. The risk of drowning is often framed as a consequence of waves washing over shore platforms, which sweep unsuspecting victims into the sea. Although the physical processes of 'wave overtopping' are understood, few studies have investigated which elements of shore platform environments are perceived as being hazardous. Using coastal regions of Victoria, Australia as the case, this study explores how Victoria's lifesaving community perceives risk on shore platforms. These perceptions are then compared to quantitative risk ratings to analyse whether physical risk assessments designed by coastal risk experts align with lifesavers' perceptions. Lifesavers are non-certified risk 'experts', whose safety training and exposure to hazardous situations informs their ‘experiential-expertise’, which is contrasted with the more common quantitative and science-based ‘expert’ risk assessments. The aim is to explore lifesavers perceptions of risk and to contrast two different ‘expert’ constructions of risk; one of which is experience-based and the other a more traditional quantitative output of modelling. Exploration of this type of ‘expert’-expert hazard contrast is lacking with a management focus on lay perceptions. To understand how lifesavers perceive risk on shore platforms, the authors explore risk as relational. This conceptual approach takes an important first step towards thinking about risk as more than the simple combination of physical wave overtopping process and social perceptions. Instead, it seeks to understand the socio-environmental interactions that are perceived as hazardous. Data for this analysis was collected via an online questionnaire of Surf Life Saving Australia (SLSA) membership whose patrols are within 1 km of a shore platform in Victoria, Australia (n=4683). By thinking about risk as relational, ‘slipping’ emerges as an under-explored hazard on shore platforms, despite being the main contributor to how lifesavers, themselves, unintentionally entered the sea. This study shows that the prevailing way of framing risk – perpetuated by the media and expert risk models – is often divorced from how risk is perceived by ‘experiential-experts’. This suggests coastal risk policy needs to integrate perceptions of the socio-environmental interactions that produce risk with the aim of accommodating the relational ways people perceive risk on shore platforms.

1.0 Introduction

Rocky coasts are hazardous environments and a leading site of coastal drownings in Taiwan, New Zealand, and Australia (Tsai et al., 2004; Moran, 2008; Brighton et al., 2013). This problem is globally significant, but drowning is a particularly acute issue in Australia, where 25 drownings occurred on rocky coasts between 2015-2016, which was 19% of all coastal drownings (Surf Life Saving Australia, 2015). Rocky coasts are characterized by cliffs that often have ledges at their bases termed shore platforms, which are the focus of this study. The risk of drowning on shore platforms is predominantly framed as a consequence of waves washing over platforms, termed ‘wave overtopping’. In these locations waves sweep victims off the shore platform and into the sea (Jones, 2003; Shand et al., 2009; Kennedy et al., 2013). Framing waves as the principle hazard is particularly evident on microtidal coastal regions, where the seaward edge of a shore platform is the main area of wave energy dissipation (Beetham and Kench, 2011) and the preferred location of

recreationalists that range from sightseers to rock fishers (Fig. 1). The co-occupation of people in locations where high energy waves overtop contributes to a significant number of people being at risk.

Fig. 1- Rock fishing off the seaward edge of shore platforms at Artillery Rocks in, Victoria Australia.

To manage risk, knowledge of how individuals respond to risk, their knowledge of a hazard, and their perceptions of and experiences with that hazard are required (Adams, 1995, Jasanoff, 1998, Renn, 1998). While analysis of these social dimensions are common in the context of sandy beaches (Brander et al., 2011; Drozdzewski et al., 2012; McCarroll et al., 2014; Drozdzewski et al., 2015), few have attempted such analyses on rocky coasts. Instead, analyses of rocky coasts have remained predominantly scientific, with an emphasis on the physical dimensions of wave overtopping (Kennedy et al., 2017) or on safety practices via perception-based analyses of rock fishers in New Zealand (Moran, 2008, 2011, 2017). In nearly all cases, physical coastal processes and social perceptions remain separated and analysed independently. This separation has long been criticised for neglecting interactions between people and their environment (Adams, 1995; Renn et al., 2011), which is the underlying basis of risk (Castree, 2003; Aven and Renn, 2009). Therefore, given the regularity of drownings on Australia's rocky coasts, there is a need to expand risk analysis beyond site-specific ratings towards analyses of how people interact with their environment and the resultant hazard perceptions.

To understand how lifesavers perceive risk on shore platforms, the authors consider risk as 'relational'. This exploratory conceptual approach takes an important first step towards thinking about risk as more than the simple combination of physical wave overtopping process and social perceptions. Instead, it seeks to understand the spatial and temporal configuration of interrelated socio-environmental interactions that are perceived as being hazardous. In other words, by treating risk as relational, risk perceptions are driven by the interactions between people and coastal environments (Manson, 2001), rather than on individual physical elements (Kennedy et al., 2013) or perceptual analyses (Moran, 2008) that are subsequently integrated. For example, an individual's 'relational' perception of being swept off a platform manifests from the interplay between their footwear, the practices they deploy when moving over uneven surfaces, and the spatio-temporal scale used to anticipate, whether or not, the incoming wave energy will affect their footing near the edge of the platform. The aim of adopting this approach is to explore how people's interactions with shore platform environments are perceived as being hazarodus and how closely these perceptions align with how risk is typically understood (i.e., wave overtopping). To accomplish this, Surf Life Saving Australia (SLSA) lifesavers' experience-based 'expert' perceptions of risk are compared with expert-derived risk ratings produced using quantitative modelling. Data for this analysis was collected via an online questionnaire of Surf Life Saving Australia (SLSA) membership whose patrols are within 1 km of a shore platform in Victoria, Australia that includes photo-perception methods. Although the authors acknowledge that exploring the 'relational' ways lifesavers perceive risk from still photographs is methodologically challenging, this paper takes an important first step towards exploring how people's interactions with environments are perceived as being hazarodus and how this knowledge can contribute to public safety.

2.0 Treating risk as relational

2.1 Contrasting physical hazards and social perceptions

Little has changed since Otway and Thomas (1982) argued that risk can be analysed as either a physical (i.e., measurable) or socially-constructed phenomenon. In the former, risk is understood through empirical indicators by, for example, calculating the site-specific probability of exposure to wave overtopping (Kennedy et al., 2017). For risk as a socially-constructed phenomenon, multiple realities exist based on an individual's construction and experiences, in this case surf lifesavers. Each interpretation of risk emphasizes different types of knowledge and assumptions about the nature of risk (Kuhn, 1962). Much to the concern of some risk scientists, analyses that prioritize physical measurements tend to be privileged within risk management (Fischhoff et al., 1982; Renn, 2008). This means that, in many cases, risk management focuses solely on calculating a partial construction of risk, often ignoring the important ways that individuals perceive, experience, respond to, and construct risk. For example, Jasanoff (1998) argues that physical risk analyses follow a reductionist understanding, whereby socio-environmental systems are subdivided into individual elements with fixed relationships. When these independent elements are reintegrated, the approach cannot account for changing coastal conditions or consider how individuals respond to variable conditions. Separating physical risk analyses from social perceptions in this manner can neglect interactions between people and their environments (Adams, 1995; Renn et al., 2011). This central critique has resulted in many calls for 'interdisciplinarity', 'integration', or 'holistic' approaches (Horlick-Jones and Sime, 2004; Petts et al., 2008), to which this research contributes by thinking about risk as relational.

2.2 Risk as relational

To begin exploring an understanding of risk that is 'relational', we treat a shore platform as a complex system that is characterized by non-linear interactions between peoples and their environments, which can emerge as hazardous situations (i.e., risk). For example, the interplay between an individual's sensorial experience of waves breaking over rocks, the practices they deploy when standing where waves typically break, and their perception of whether waves will wash over them is considered in this study a 'relational' perception of risk. Perceptions of risk are considered a psychological construct signifying the process of collecting, selecting, and interpreting signals about uncertain impacts or activities (Boholm, 1998). By treating the interactions between physical and social elements as part of a complex system, the commonly-detached elements that characterise reductionist approaches can be reassembled. This addresses our aim of better understanding the socio-environmental interactions that are perceived as being hazardous. Over time, knowledge of these interactions accrete, contributing to knowledge developed through experience (Jasanoff, 2004; Renn, 2008). Experience with hazards is divided into two sub-components: direct and indirect. Direct experience is first-hand (e.g. unintentionally entering the sea) and tends to reinforce precautionary behavioural change (Barnett and Breakwell, 2001; Wachinger et al., 2013). In some situations, behavioural change from direct experience is linked to the severity of the consequences experienced (Kasperson et al., 1988). Indirect experience, such as reading a news report about drowning, can also influence perceptions (Wachinger et al., 2013). This means that perceptions are not homogenous across or within communities (Adger et al., 2009) or 'within' individuals.

3.0 Methods

Lorne is a popular tourist destination on the Otway Ranges in south-west Victoria, located 140 km south west of Melbourne on the Great Ocean Road (Fig. 2). It is the 7th most popular destination in regional Victoria and received 1,238,693 visitors between 2015-2016, with the top reported activity being visiting the coast (75%) (South Coast Shire, 2016). Lorne is surrounded by shore platforms that range up to several hundred meters in width, although most commonly they are < 80 m wide (Jutson, 1953; Kennedy and Milkins, 2015). Lorne's coast is microtidal and exposed to south-west swell with a mean significant wave height of 2.4 m and wave period of 8.4 seconds (Hughes and Heap, 2010). Shore platforms near Lorne are mainly non-carbonaceous sandstone (Birch, 2003) and semi-horizontal in their midsection with a ramp-up that slopes to 8° on their landward side (Jutson, 1953; Kennedy and Milkins, 2015). These shore platforms, in particular, were selected for analysis because of their popularity, close proximity to Melbourne and because they were exposed to significant and variable wave overtopping (Kennedy et al., 2013).

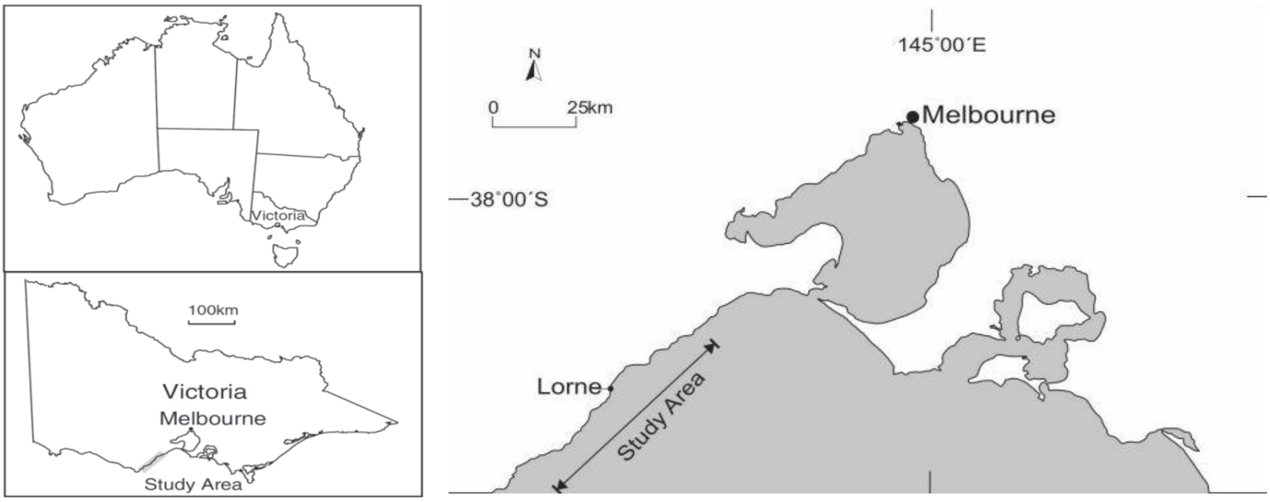


Fig. 2- The study site, Lorne, is located south west of Melbourne at the southern edge of mainland Australia and is where the geotagged photos were taken.

All SLSA lifesavers (i.e., lifeguards) in Victoria, Australia who patrol on behalf of surf clubs within 1km of a shore platform were invited to complete the questionnaire (Fig.3). This sampling strategy targeted participants who were most likely to have first-hand experience with risk on rocky coasts. It was also assumed that the SLSA clubs sampled would be representative of Victoria's lifesaving community, as opposed to generalising results national-wide, where different lithology and shore platforms would generate different results. The sampled population includes 23 surf clubs and 4683 members with 358 responses received (7.6% response rate).

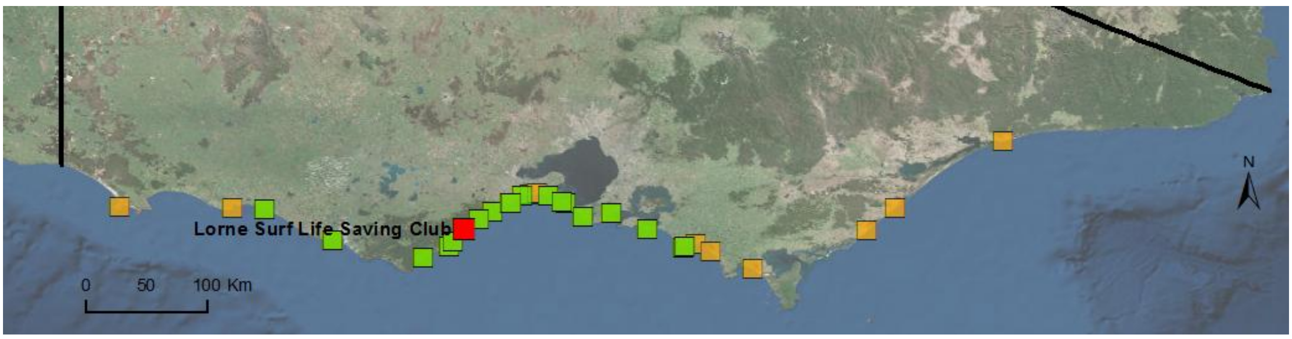


Fig. 3- Geographical distribution of surf clubs in Victoria. Most surf clubs' membership that met the sampling criteria (green squares) are west of Melbourne along Victoria's rocky coastline, while surf clubs located on Victoria's sandy beaches environments (orange) were not included (author's image).

SLSA membership categories class lifesavers by their safety certification and patrol proficiency. In this study, 'active patrol and rescue' was the most frequent status of respondents (73%), which means that under SLSA

Regulation 6.3, respondents hold a Bronze Medallion qualification and fulfil annual patrol obligations (Surf Life Saving Australia, 2010). This includes entry level safety certification, knowledge of the surf, local beach council laws, and basic first-aid training; all of which are maintained through annual knowledge and fitness tests (Fenner, 2005) (Fig. 4). The ensuing most frequent membership types were 'Life Member' (13%) and 'Past Active' (7%) meaning 93% of respondents have either experience on patrol or are actively patrolling.

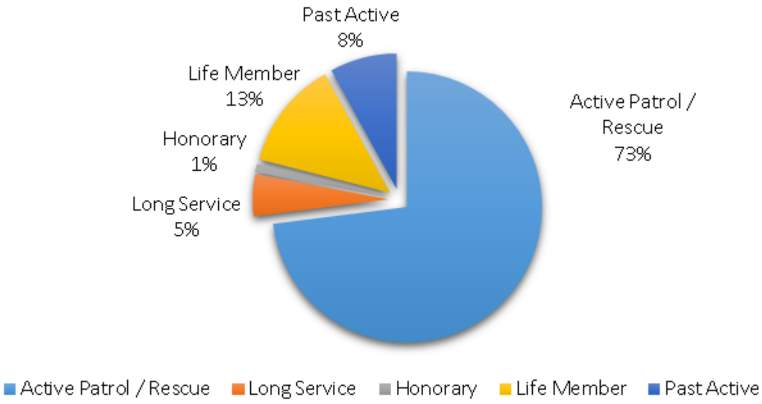


Fig. 4- Distribution of respondent's SLSA membership as lifesavers.

Being listed as a life member, past-active, or on active patrol and rescue does not guarantee that lifesavers have extensive experience on shore platforms. Thus, members were also asked if they held an additional safety certification, a 'Silver Medallion'. This certification requires proficiency in rocky coast safety including knowledge of proper techniques for entering or exiting the sea from a shore platform, extended emergency skills that include the use of defibrillation and advanced emergency care (Surf Life Saving Australia, 2013a, 2013b). One fifth (n=71) of respondents possessed the Silver Medallion. The high number of respondents with the Bronze (73%) and Silver (20%) Medallion(s) led the authors to conclude that respondents are highly likely to possess the desired experience on shore platform related safety (i.e., experience-based expert perceptions) with which to compare with expert-modelled risk ratings.

Data was collected using an online self-completion questionnaire that can be broken down into three sections: Firstly, demographic information includes lifesavers safety training, length of experience, and number of patrol hours. Secondly, photo perception methods are used in a mixed methodology to contrast experts' perceptions with risk ratings. Three photographs were used for the perception questions (Fig. 5). Each was taken on the seaward edge of a platform to replicate the vantage of someone standing in a typical rock fishing location. These locations were chosen based on observations of fishers at each of the sites. Two photos were taken, with one image capturing waves breaking on the seaward edge as control to explore a hypothesized connection between risk perceptions and wave energy (Fig. 5B & 5C). Thirdly, seven targeted hazards were rated on a 1-7 Likert scale ranging from 1 (not hazardous at all) - 7 (extremely hazardous) including: the morphological characteristics that underpin M_e, the weather, tide, seaweed, rock pools and wave overtopping.

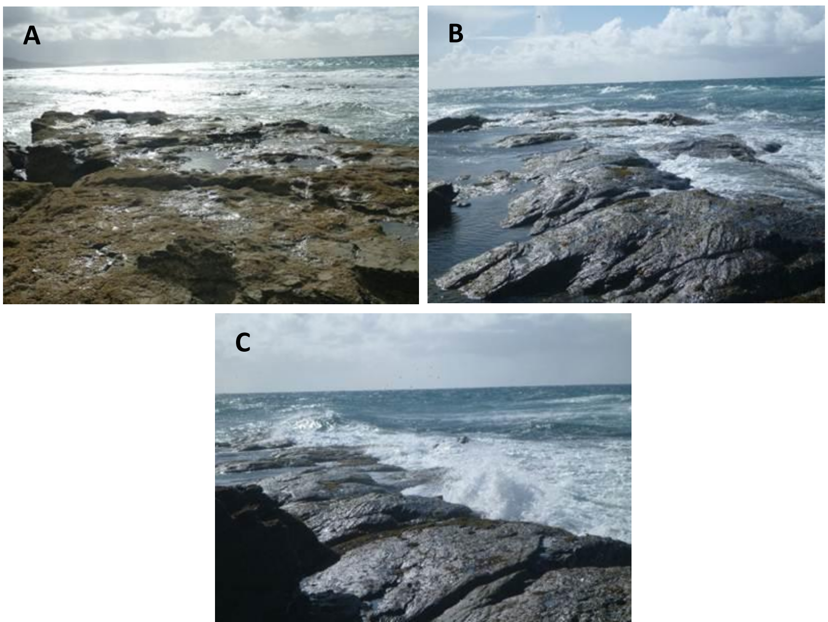


Fig. 5- Geotagged photos A, B and C were used for analysis in the online questionnaire and were taken on the seaward edge of a shore platform to replicate the vantage of someone standing in an observed rock fishing location. Photo A is in the top left corner, photo B is in the top right and photo C is the bottom photo.

The physical construction of risk was calculated by modelling wave exposure using the relationship between morphological platform elevation (SP_e) and frontal water depth (FD), where SP_e is the elevation with respect to mean low water neap (MLWN) elevation and FD, being front depth in metre below MLWN (Kennedy et al., 2017). Wave exposure ratings are separated into seven categories that range from 1 (low-risk) to 7 (high-risk). These values were calculated from cross-sections derived from a high-resolution (2.5 m grid) LiDAR data, following Kennedy et al., (2017):

$$M_e = \log (SP_e/FD)$$

Qualitative data is taken from an open-ended question that asked respondents to identify the most hazardous feature of the shore platform presented in the photos. The advantage of this approach is its ability to elicit whether perceived socio-environmental interactions affect perceptions. Content analysis was used to interpret and categorise the qualitative data, which signify the socio-environmental interactions that underpin perceptions, without being limited by targeted hazards or ratings. Inter-coder reliability was completed by a colleague in the School of Geography, who systemically coded the qualitative responses, using the same code book as the lead author, to cross check the data. The result was an adequate 81% similarity between codes (Krippendorff, 2012). In order to understand how or what socio-environmental interactions are perceived as hazarodus, a 'relational' perception of risk was drawn from the cumulative effect of the three most identified hazards for each photo. In psychometric studies, three factors typically explain around 80% of variance in risk perceptions (Sjöberg, 2000). Similarly, this approach assumes that the cumulative effect of the three most commonly identified hazards explain around 80% of variance in 'relational' risk perceptions. In other words, the three most identified hazards are assumed to interact in non-linear ways to produce what the authors describe as a 'relational' perception of risk. Although coding qualitive data limits the ability to truly understand the relational ways people perceive risk, this exploratory approach accomplishes our aim of taking a first step towards understand how people's interactions with shore platforms environments are perceived.

Using still photos presents an important methodological challenge when exploring the relational ways people perceive risk because photographs are unable to depict spatial and temporal changes in swell height, wave period, and wind direction; all of which are critical dimensions associated with the risk posed by waves breaking over and inundating shore platforms. Video data could provide lifesavers with a greater opportunity to assess how the dynamic coastal conditions will interact with them, affecting perceptions. Nevertheless, photos perception methods of coastal hazards are commonly used to provide a more consistent representation of the desired hazards under investigation (Sherker et al., 2010; Brannstrom et al., 2014) as opposed to respondents potentially assessing other aspects of the environment that are not important to the analysis, including: the weather, day light, tide, etc. Similarly, models only capture a small part of the dynamic wave processes and morphological conditions that affect the probability of wave overtopping. Thus, it is important to note that the methodology contrasts uncertain models with uncertain perceptions from photos, providing a starting point for analysing what is perceived by to be hazarodus on shore platforms and if those perceptions differ with how another category of risk experts construct risk using models.

4.0 Results

Most respondents (64%) were male and were over-represented in all age categories, except the youngest (18-29 years old) where females accounted for 51%. Approximately one-third (33%) of respondents held a university degree and 21% a post-graduate degree. Respondents tended to live close to the coast with just under half (48%) living within 10 km, 36% living within 100 km, and 16% living more than 100 km away. Approximately one third of respondents had 15 years' experience as a volunteer, while 5% had < 1 year. Most volunteers had been on a safety patrol (86%) while only one third (n= 120) of respondents had experience in a real-time rescue scenario.

4.1 Platform description and risk rating

Photo A (Fig. 5A) is a narrow 65 m wide intertidal platform with a gradual sloping profile that is characterized by a rampart 25 m in length. Its front depth is 1.2 m with a platform elevation of 0.9 m above mean low water neap (MLWN) giving it the lowest M_e value (3) among the photographed platforms (see Table 1). Photo B (Fig. 5B) and C (Fig. 5C) are 105 m wide near horizontal platforms. They have a terraced frontal depth of 2.1 m and 2.3 m, and an elevation of 1.3 m and 1.4 m, respectively. Photo A and B received the same mean perceived mid-risk rating (4), despite having different morphologies. Photo C, however, depicts waves breaking on the seaward edge and was rated high-risk (6).

Table 1 – Morphological exposure (M_e) and risk perception ratings for the three photographed platforms (Figure 5).

Photograph	Platform elevation (SP_e) (m above MLWN)	Frontal depth (FD) (m)	M_e = log (SP_e/FD) (m below MLWN)	Physical risk (1-7)	Risk perception (1-7)
A	0.9	1.2	1.3	3	4
B	1.3	2.1	1.6	4	4
C	1.4	2.3	1.6	4	6

The higher risk perception rating from photo B to C shows that certain elements identified in photo C changed the socio-environmental interactions that were perceived as being hazardous. These elements appear to be the perceived risk of wave overtopping where the percentage of wave overtopping hazards identified from photo B to photo C increased from 25% to 36%, respectively (Fig. 6). In other words, the breaking wave energy on the platform increased the perceived risk of wave overtopping hazards and a hazarodus situation. The use of photographs A and B (i.e. with no waves breaking on the shore platform) may have prompted participants in the survey to overstate slipping as a hazard. More importantly, the change of rating suggests, empirically, that context influences perception and that lifesavers differentiated risk from one photo to the next. In terms of the research, this confirmed that the methodology elicited responses and suggested that the respondents were considering risk factors as the research intended.

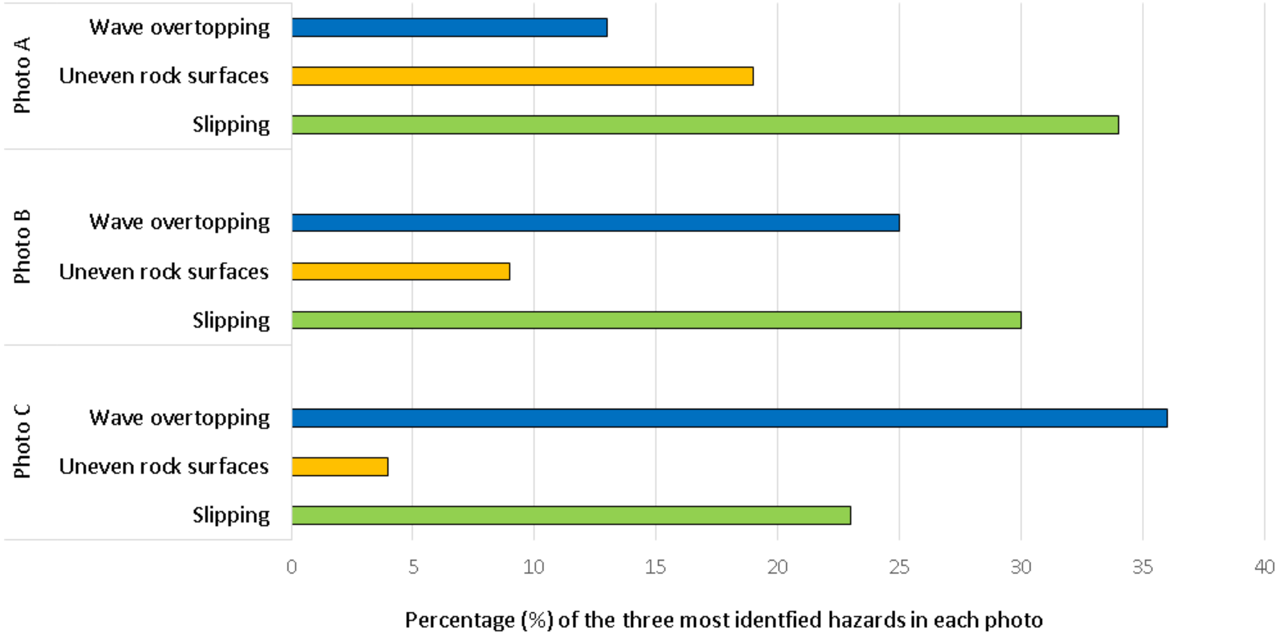


Fig. 6- The percentage of the three most identified coded hazards for each geotagged photo (Figure 5).

4.2 Modelled and perceived risk

Platform elevation and frontal water depth, were rated very to extremely hazardous by only 13% and 15% of respondents, respectively (Fig. 7). Such an incongruence between perceptions and the quantitative-based hazard estimates is not a surprise, but it draws attention to their divergent underlying assumptions about the nature of risk (Otway and Thomas, 1982). For example, wave overtopping is understood in models as the relationship between platform elevation and frontal water depth while social perceptions of wave overtopping seem to be produced by an individual's sensorial anticipation of whether, or not, waves breaking over rocks will emerge as a hazarodus situation. Platform elevation and frontal water depth are difficult geomorphic features for people to see while on shore platforms, which is most likely why they were rated low risk. These ratings however are important because they identify one of many potential ways people's perceptions of hazarodus situations differ from how risk is modelled.

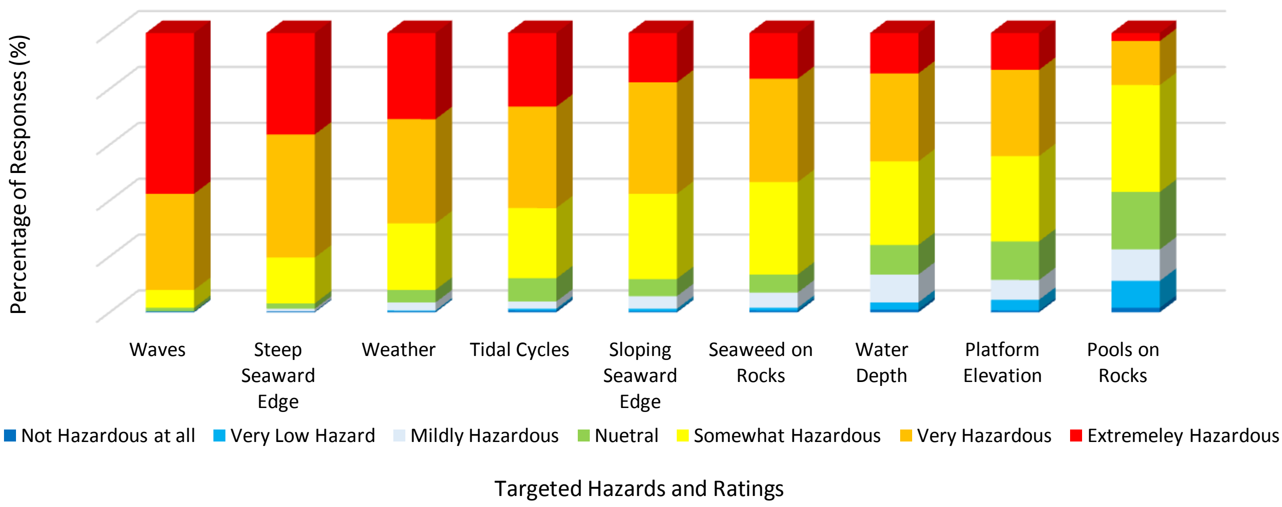


Fig. 7 – Targeted hazards ratings ranging from waves being rated as 'very' to 'extremely' hazardous by over 60%, while water depth and platform elevation, the two characteristics underpinning exposure to wave overtopping rated very to extremely hazardous by only 13% an d 15%.

Both the physical (i.e., quantitative risk models) and social constructions (i.e., perceptions) identify wave overtopping as most hazardous, but their understanding of 'wave overtopping' differs. It is the latter that is perceived by an anticipated and imagined interaction between the individual and the incoming wave energy. It is this perceived interaction between a lifesaver and incoming wave energy that determines how they would act when standing in an area where waves may overtop, and the spatio-temporal scale they use to anticipate, whether or not, the incoming wave energy will interact with them. Although the photos presented to lifesavers are static images, their perceptions change between each photo in response to a perceived interaction between themselves and the sea. This means that thinking about risk as something that is always shifting and anticipated is productive because it recognises that risk perceptions are produced, at least in part, by experiencing perceived socio-environmental interactions that produce a risky situation instead of a fixed or static relationship between elements. This suggests that social constructions and perceptions of risk can accommodate the non-linear ways hazarodus situations can emerge, which is additional knowledge, developed through experience, that can expand how we think about risk.

4.3 Experiencing risk

A total of 1458 hazards were coded and tallied as part of the analysis of risk perceptions. Slipping was the most commonly identified individual hazardous feature (29%), followed by waves (24%), and uneven rock surfaces (11%) (Fig. 8). Drawing from our understanding of a risk perception that is 'relational', the three most commonly identified hazards that appear to drive lifesavers risk perceptions are the interactions between slipping, waves and uneven rock surfaces. This finding contradicts the dominant framing of wave overtopping-related risk, but does not confirm slipping is the greatest hazard, either. Instead, it shows lifesavers identify the risk of slipping as a potential hazardous outcome most often, amongst the array of socio-environmental interactions that perceived as hazarodus from the photos presented.

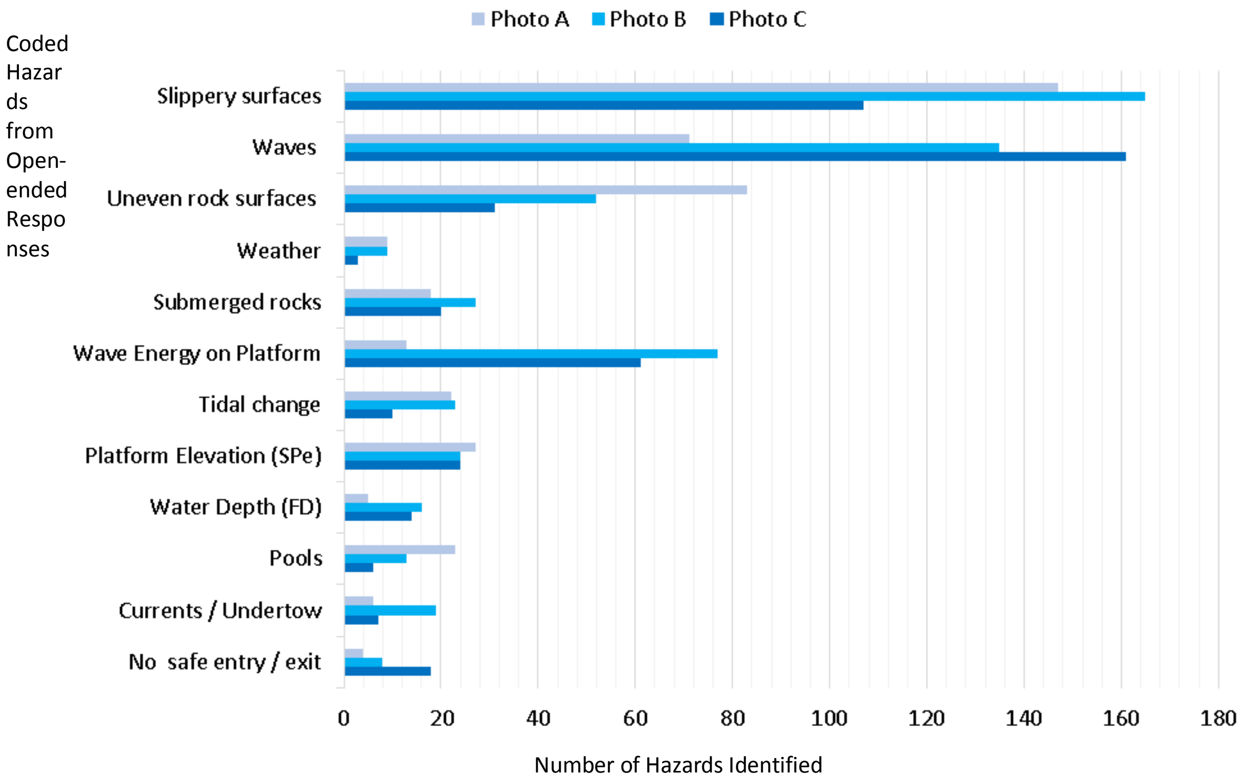
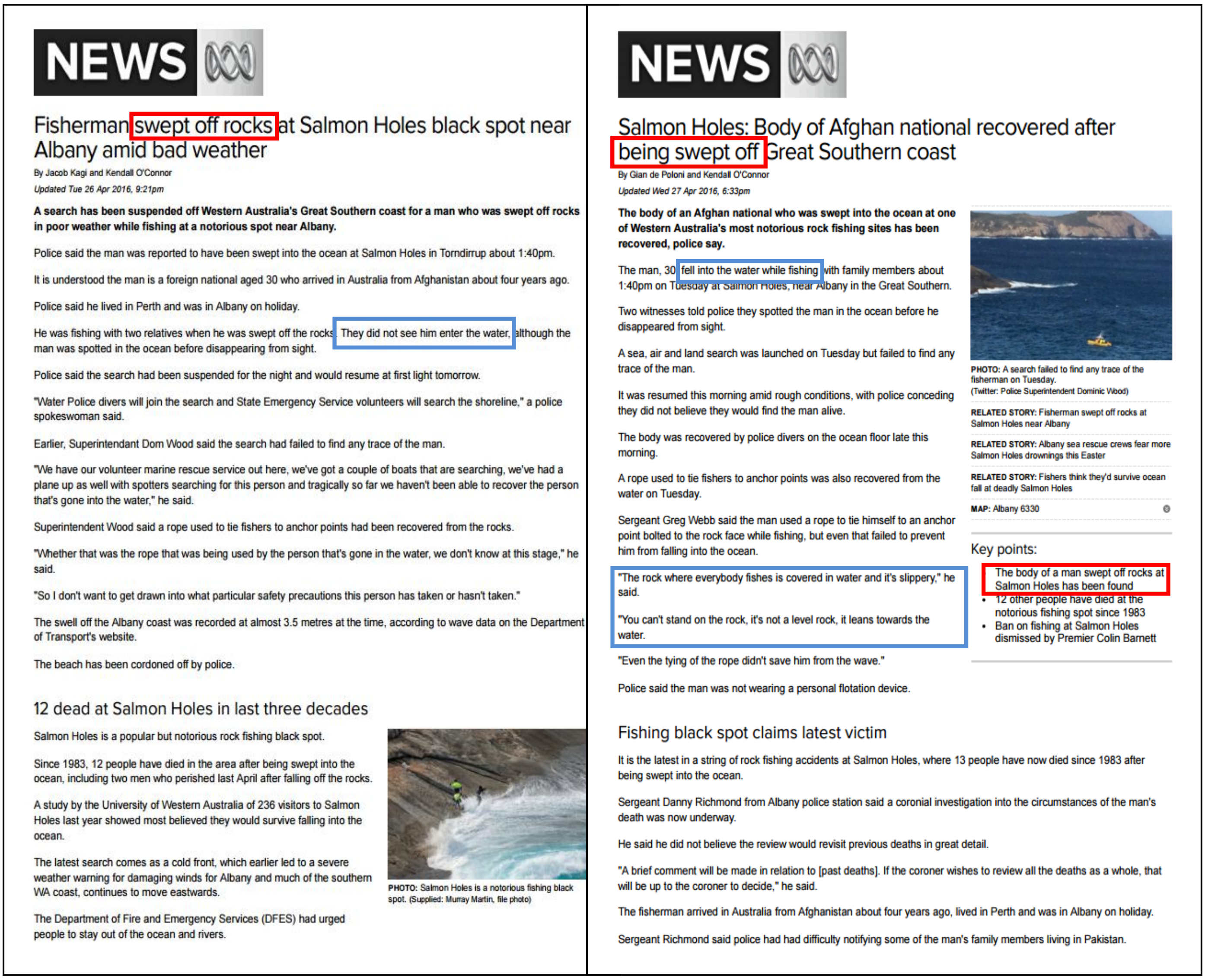


Fig. 8 – Identified Hazards in photo A (n= 462), B (n= 568) and photo C (n= 428). Hazards are ordered from most (slipping) to least (no safe entry / exit) identified aggregated across all 3 photos.

In photo A, for example, slipping was the most commonly identified hazard (34%), followed by uneven surfaces (20%) and a low frequency of wave hazards (15%). This corresponds with low M_e predictions but does not explain the high frequency of identified slipping hazards. Interestingly, the principle hazard in photo B was also identified as slipping (29%), but in this case, followed by waves (24%). This means that the socio-environmental interactions that could cause a slipping related hazard must have change from what was observed from photo A to B. Moreover, while slipping was identified as the principle hazard in both photo A and B, the mean risk perception rating was consistently mid-risk (4). This suggests the potential risk of slipping was perceived to be similar in both photos, but the means or the socio-environmental interactions that produce a type of slipping hazard changed. Perhaps slipping was the main concern of what is perceived as a calm platform (i.e., without waves breaking over shore platforms) as represented in photo A and B. On these calm days, people could be more likely to wander close to the edge of the platform, increasing the risk of slipping in, and is why they identify slipping as the chief hazard. On the other hand, on a day with a high wave period, the offshore wave conditions can appear calm but can be more hazarodus. For example, these perceived calm conditions with a high wave period can often mean that wave energy is building offshore and result in fewer, but larger waves that can be difficult to anticipate without knowledge of how the wave period affects wave conditions in a particular location. There are numerous ways to interrogate the socio-environmental interactions that people perceive as hazarodus within this limited dataset. However, the authors argue that this exploratory study demonstrates that risk perceptions do fluctuate between all three photos suggesting that individual lifesavers' perceptions are attuned to changing coastal conditions and how those changing conditions affect risk in different ways. Their attunement and fluctuating risk ratings show, empirically, that context affects the relational ways lifesavers perceive risk on shore platforms, which expands our understanding of how hazarodus situations can emerge on shore platforms that does not fit quantitative risk models.

Most of the respondents (86%) reported being injured on a shore platform, either as a part of their lifesaving duties or as a member of the public. The severity of the injury and whether a trip to the hospital was required was not collected, however, those who could recall their injury noted that slipping was the most frequent contributor (34%), followed by wave overtopping (31%). This means that lifesavers had more often unintentionally slipped into the sea as opposed to being washed off a platform. This suggests that it is more likely to slip on uneven surfaces that waves had previously overtopped than being swept off a platform as suggested in the predominate way risk is framed. In addition to direct experience, almost all (93%) lifesavers surveyed had heard of or indirectly experienced a drowning on shore platforms somewhere in Australia (n=334). In contrast to personal injuries and unintentional water entry, however, 65% attributed the drowning to wave overtopping. This suggests that the risk of slipping into the sea is the most recognized and experienced hazard by lifesavers, but is perceived as low-risk relative to the perceived risk of waves overtopping. A possible explanation could be that waves are commonly associated with drowning deaths by multiple news stories that emphasize uncontrollable waves sweeping people off platforms (Brewer, 2014; Christian, 2015; Hunjan, 2016). This likely increases the availability of wave hazards in people's memory. This bias towards waves is important for the development of public safety because experts and risk managers are subject to this pattern as well, but that they have the ability to then 'make risk real' because of their influence on what is 'known' and done (Flynn et al., 1994). As a result of this particular framing, public safety is shaped by what the authors believe to be a simplification of risk that results in neglect the key interactions between people and their environments that create risk (i.e., slipping). Importantly, this simplification is powerful, materializing elsewhere as is shown in Fig. 9, which is a report of a recent drowning in Australia.

Article A Article B



NEWS

Fisherman swept off rocks at Salmon Holes black spot near Albany amid bad weather

By Jacob Kagi and Kendall O'Connor

Updated Tue 26 Apr 2016, 9:21pm

A search has been suspended off Western Australia's Great Southern coast for a man who was swept off rocks in poor weather while fishing at a notorious spot near Albany.

Police said the man was reported to have been swept into the ocean at Salmon Holes in Torndirrup about 1:40pm.

It is understood the man is a foreign national aged 30 who arrived in Australia from Afghanistan about four years ago.

Police said he lived in Perth and was in Albany on holiday.

He was fishing with two relatives when he was swept off the rocks. They did not see him enter the water, although the man was spotted in the ocean before disappearing from sight.

Police said the search had been suspended for the night and would resume at first light tomorrow.

"Water Police divers will join the search and State Emergency Service volunteers will search the shoreline," a police spokeswoman said.

Earlier, Superintendant Dom Wood said the search had failed to find any trace of the man.

"We have our volunteer marine rescue service out here, we've got a couple of boats that are searching, we've had a plane up as well with spotters searching for this person and tragically so far we haven't been able to recover the person that's gone into the water," he said.

Superintendent Wood said a rope used to tie fishers to anchor points had been recovered from the rocks.

"Whether that was the rope that was being used by the person that's gone in the water, we don't know at this stage," he said.

"So I don't want to get drawn into what particular safety precautions this person has taken or hasn't taken."

The swell off the Albany coast was recorded at almost 3.5 metres at the time, according to wave data on the Department of Transport's website.

The beach has been cordoned off by police.

12 dead at Salmon Holes in last three decades

Salmon Holes is a popular but notorious rock fishing black spot.

Since 1983, 12 people have died in the area after being swept into the ocean, including two men who perished last April after falling off the rocks.

A study by the University of Western Australia of 236 visitors to Salmon Holes last year showed most believed they would survive falling into the ocean.

The latest search comes as a cold front, which earlier led to a severe weather warning for damaging winds for Albany and much of the southern WA coast, continues to move eastwards.

PHOTO: Salmon Holes is a notorious fishing black spot. (Supplied: Murray Martin, file photo)

The Department of Fire and Emergency Services (DFES) had urged people to stay out of the ocean and rivers.

NEWS

Salmon Holes: Body of Afghan national recovered after being swept off Great Southern coast

By Gian de Poloni and Kendall O'Connor

Updated Wed 27 Apr 2016, 6:33pm

The body of an Afghan national who was swept into the ocean at one of Western Australia's most notorious rock fishing sites has been recovered, police say.

The man, 30 fell into the water while fishing with family members about 1:40pm on Tuesday at Salmon Holes, near Albany in the Great Southern.

Two witnesses told police they spotted the man in the ocean before he disappeared from sight.

A sea, air and land search was launched on Tuesday but failed to find any trace of the man.

It was resumed this morning amid rough conditions, with police conceding they did not believe they would find the man alive.

The body was recovered by police divers on the ocean floor late this morning.

A rope used to tie fishers to anchor points was also recovered from the water on Tuesday.

Sergeant Greg Webb said the man used a rope to tie himself to an anchor point bolted to the rock face while fishing, but even that failed to prevent him from falling into the ocean.

"The rock where everybody fishes is covered in water and it's slippery," he said.

"You can't stand on the rock, it's not a level rock, it leans towards the water.

"Even the tying of the rope didn't save him from the wave."

Police said the man was not wearing a personal flotation device.

PHOTO: A search failed to find any trace of the fisherman on Tuesday. (Twitter: Police Superintendent Dominic Wood)

RELATED STORY: Fisherman swept off rocks at Salmon Holes near Albany

RELATED STORY: Albany sea rescue crews fear more Salmon Holes drownings this Easter

RELATED STORY: Fishers think they'd survive ocean fall at deadly Salmon Holes

MAP: Albany 6330

Key points:

- The body of a man swept off rocks at Salmon Holes has been found
- 12 other people have died at the notorious fishing spot since 1983
- Ban on fishing at Salmon Holes dismissed by Premier Colin Barnett

Fishing black spot claims latest victim

It is the latest in a string of rock fishing accidents at Salmon Holes, where 13 people have now died since 1983 after being swept into the ocean.

Sergeant Danny Richmond from Albany police station said a coronial investigation into the circumstances of the man's death was now underway.

He said he did not believe the review would revisit previous deaths in great detail.

"A brief comment will be made in relation to [past deaths]. If the coroner wishes to review all the deaths as a whole, that will be up to the coroner to decide," he said.

The fisherman arrived in Australia from Afghanistan about four years ago, lived in Perth and was in Albany on holiday.

Sergeant Richmond said police had had difficulty notifying some of the man's family members living in Pakistan.

Fig. 9- This example illustrates how the media reinforces a scientific framing of wave overtopping related risk. The article on the left (article A) was published the day a man went missing (26/04/16) while the article on the right (article B) was published the following day after his body was found (27/04/16). Both state the man was swept off a platform in their headlines (highlighted in red), despite family witnesses' – as well as a local police sergeant – describing the relational influence of 'falling in slippery areas' as the mechanism of how the individual unintentionally entered the sea (highlighted in blue) (Kagi, 2016; Poloni, 2016).

5.0 Discussion

5.1 Thinking about risk as relational

Surf Life Saving Australia members' risk perceptions appear heavily influenced by the idea of wave energy breaking on the edge of a shore platform. This results in an increase in both risk perception ratings when waves are observed in images and the identification of wave overtopping hazards. Both the M_e and risk perception magnitudes ranked mid-risk and high-risk platforms in the same order, indicating that lifesavers' assessments correlate with scientific estimates, or *vice versa*. By thinking about risk as relational, lifesavers perceptions, however, appear to accommodate the complexity of coastal environments by adjusting what is perceived as hazardous to both the changing environmental conditions and shore platform morphology. In the context of public safety, this is important because it helps explain why, in some situations, people unwittingly participate in hazardous behaviour, despite being aware of particular 'risk ratings' assigned to a site. For example, breaking waves on the seaward edge of a platform can prompt the behavioural response of seeking safety, such as moving from a perceived high-risk area that will soon be overcome by waves. While in other situations, breaking waves on the edge of a platform may signify that a platform is 'safe' from wave overtopping because there is not enough energy to move waves overtop the platform edge. These interpretations, though, can be problematic as tidal changes of only 0.25 m in height can significantly change the potential wave energy for a platform, often preceding noticeable changes in waves breaking on the platform edge (Shand et al., 2009). This multiplicity of risk perceptions connects people with their environment and helps to reveal the ways that lifesavers interact with hazardous situations, as they emerge. Furthermore, this knowledge expands our understanding of how site-specific wave overtopping probabilities can be used by risk managers to not only predict where wave overtopping is the most likely, but to also consider its relational influence on behaviour.

By thinking about risk relationally, the SLSA data shows a cumulative temporal effect of slipping, wave overtopping, and uneven surfaces (Manson, 2001): where the relational risk of slipping is the emergent property of (at least) these three commonly identified elements. Contextual elements of a platform such as slope, roughness, wetness, and algae, each affect the potential for slipping. However, an individual's perception of slipping – and their associated behaviour – manifests from the interplay between algae, the practices they deploy when moving over uneven wet surfaces, and the spatio-temporal scale used to anticipate, whether or not, the incoming wave energy will affect the stability of their footing. The risk of slipping is a kinaesthetic hazard determined by a self-perceived ability to stay upright on slippery surfaces, which also involves footwear, fitness, past experience on slippery rocks, and a host of other uncertain relations, which does not neatly fit quantitative frameworks for understanding risk. No matter how well these individual elements of risk can be 'known', their interactions are often unpredictable and inconsistent: they are non-linear. Just as a behavioural response to a volcanic eruption is not a product of fixed decisions, but instead, emerges from complex interactions between perceptions of risk, expected consequences, and past experience (Paton et al., 2000), coastal risk is shown to be similarly 'relational'. In the context of existing risk policy on rocky coasts – which emphasizes prediction (Shand et al., 2009; Kennedy et al., 2013), safety education campaigns and the installation of angel rings or life buoys at popular rock fishing spots across Australia, (Bradstreet et al., 2012) – this research shows that a scientific framework of 'knowing' risk does not currently account for the mode of unintentional entry into the sea identified by experienced-based 'expert' lifesavers (i.e., slipping). Instead, the wider context and process underlying entering the sea are neglected and contribute to a dangerous over-simplification of risk (Donovan and Oppenheimer, 2015) (i.e., person on platform, waves overtopping, swept into the sea and drown).

5.2 Challenges in coastal public safety

The socio-environmental interactions that emerge as 'slipping' hazards appears to be a predictable – and even obvious – hazard on coastal platforms, but one that is seemingly overlooked due to a predisposition towards physical wave overtopping hazards. Lifesavers are clearly 'aware' of slipping, and yet they characterize the risk of slipping and drowning as 'low' when, paradoxically, most lifesavers who unintentionally entered the sea did so by slipping. Given that direct experience is often a key precursor to an increase in risk perception and precautionary behaviour (Wachinger et al., 2013), this suggests direct experience with slipping may have had the opposite effect. Existing risk research argues that if the severity of experienced consequences is considered low (Östberg, 1980) or under personal control (Starr, 1969; Newman et al., 2014), then perceptions of risk are unlikely to become more precautionary, often due to desensitization (Richardson et al., 1987). Understanding that lifesaver perceptions are driven by a predisposition towards waves, despite their direct experience, highlights a potential challenge facing both rip safety practitioners and those developing a framework for risk management on shore platforms.

On sandy beaches, Brannstrom et al. (2014) found that areas where waves are present were perceived as high-risk by 87% of respondents, when in reality, a lack of waves in the surf zone is indicative of rip currents. These rips are where the majority of beach drownings occur (Sherker et al., 2010). Other studies of beachgoer's perceptions, beliefs, and behaviours also reveal 'inaccurate' understandings of rip hazards (Ballantyne et al., 2005; Sherker et al., 2010; Hatfield et al., 2012, Williamson et al., 2012; Brannstrom et al., 2014; Moran and Willcox, 2013; Shaw et al., 2014, ,). Sometimes referred to as the 'rip current myth' (Gallop et al., 2016), these studies show the difficulty of communicating the risk of rip hazards to beachgoers because of a predisposition towards waves. Similarly, the findings in this study suggest that slipping is the more likely culprit contributing to hazardous outcomes (i.e., unintentional entry into the sea) and has a more immediate impact on putting people at risk, but in a way that goes under-appreciated in favour of a predisposition towards waves. Hospitalization statistics indicate that 75% of injuries on shore platforms are the result of falls rather than waves overtopping (Mitchell et al., 2014). Rock fishers, in particular, were hospitalized from slipping more often than from wave-induced submersion. Furthermore, a recent coronial inquest found that less than 50% of drownings on rocky coasts were the result of wave overtopping (Coroner, 2015). Yet, the coastal risk literature and the Australian media frame risk on platforms as a function of wave overtopping, with little mention of the relational and related ways waves affect people's footing, behavioural response to wave energy and other uncertain mechanisms that lead to people entering the sea.

There has been increasing agreement across the behavioural sciences that behaviour is significantly affected by environmental factors (Dolan et al., 2014), but showing this empirically has been difficult. In this study, fluctuating accounts of risk ratings show, empirically, how lifesavers' perceptions are attuned to changing conditions that affect their geographical imaginations of how risk can emerge. By thinking about risk relational, it allowed the authors to understand the dominant socio-environmental interactions that are perceived as hazardous. Thinking about risk perceptions as relational also can help identify the critical socio-environmental interactions that shape perceptions, while risk is being experienced by lifesavers with safety training. Knowledge of the socio-environmental relations that are perceived as hazardous can then be applied to what others – with less experience – are blind to because they lack the experience or relational understanding to anticipate hazards, as they emerge (Ingold, 1993, 2000). By no means is this study arguing that wave overtopping does not pose a significant risk to people on platforms. Instead, thinking about risk as relational expands the way we can think about and relate the dynamic risk of wave overtopping with more widely experienced 'slipping' hazards. In other words, modelling the risk of wave overtopping and communicating it to the public through safety campaigns and media releases currently overlooks the important relational ways people experience risk on shore platforms, which appears to be unintentionally slipping into the sea on wet uneven surfaces instead of isolated wave overtopping events that sweep them off platforms.

6.0 Conclusion

Lifesavers' perceptions of risk on shore platforms are shaped by the anticipated socio-environmental interactions in the context of waves breaking on the seaward edge of a platform. It is likely that perceptions change with every incoming wave, but most importantly, this fluctuating account between photographed locations is driven by how people perceive their interactions with incoming wave energy, which may better represents the dynamic nature of risk on shore platforms than either modelling physical features or perception-based analysis. By emphasising how people perceive their interactions with their environment, the commonly-severed physical and social elements within scientific or perception-based analysis were reassembled, providing new insights into how risk is perceived and experienced by lifesavers. The advantage of this approach is thinking about risk perceptions as emergent, which accommodates contextual changes in hazardous environments and thus, the ability to anticipate risk rather than assuming it is static. This suggests that knowledge developed by experiencing risk (i.e., experienced-based 'expert' perceptions) offers new ways of rethinking risk perceptions as both contingent and emergent in the context of environmental hazards. If the goal of risk management is to promote safe decision-making in risky situations, then understanding how hazards are perceived, as they emerge, is vital.

By exploring how risk is perceived on shore platforms by experience-based ‘experts’, we found that lifesavers, costal risk literature, media, and coronial reports all ‘know’ risk as a function of wave overtopping, but both lifesavers surveyed and hospitalization data show slipping is more likely the culprit. By thinking about risk as relational, it was discovered that slipping, uneven surfaces and waves collectively contribute to the risk drowning but the under-estimation of slipping, despite the prevalence of lifesavers that unintentionally slipped into the sea. A possible explanation for why is that incorporating slipping and other socio-environmental relations that emerge do not ‘fit’ a quantitative approach to risk easily, making it under-valued because of the scientific-quantitative preferences of the management community. This suggests a need to reframe what ‘counts’ in coastal risk management. Incorporating socio-environmental relations into a conceptual framework for understanding risk exposes and addresses the limitations of the traditional focus on risk and the resulting preoccupation with waves.

Despite ‘slipping’ being a critically important hazard on shore platforms, the implications of thinking about ‘risk as relational’ is discouraging because of its associated challenges for management. For governments, as an example, this means exploring how relational analyses can offer opportunities for reducing the over-simplification of risk in models and encouraging risk management strategies to become more attuned to how changing conditions affect individual perceptions and behaviour. In this study, the identification of slipping hazards challenges the prevailing assumption that wave overtopping is the principle hazard on platforms and instead, suggests slipping is also an important aspect of how risk is most often experienced, but rarely incorporated into shore platform risk assessments, morphological models, or coastal safety programs.

Further research is required to analyse risk perceptions amongst a wider range of rocky coast users, including rock fishers, surfers, and other recreationalists on platforms. This will contribute to identifying the elements that are perceived as hazardous and move closer towards understanding the relations that contribute to risk perceptions and risk experiences along shore platforms. Three photographs enabled an analysis of emergent properties that affect perceptions without exhausting respondents, but this balance is untested and requires further study. Photo perception studies are also limited in their ability to truly understand the nature of relational risk perceptions, which is why semi-structure interviews and on site participatory action research is required in further research.

Acknowledgements

This project is funded by the Australian Research Council Linkage Program (LP130100204). We thank the Department of Environment and Primary Industries coordinated imagery program for access to the geo-registered aerial photography and the Future Coasts Program for access to the LiDAR data.

References

Adams, J. 1995. *Risk,* London, Routledge.

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., Naess, L. O., Wolf, J. & Wreford, A. 2009. Are there social limits to adaptation to climate change? *Climatic Change,* 93**,** 335-354.

Aven, T. & Renn, O. 2009. On risk defined as an event where the outcome is uncertain. *Journal of risk research,* 12**,** 1-11.

Ballantyne, R., Carr, N. & Hughes, K. 2005. Between the flags: an assessment of domestic and international university students' knowledge of beach safety in Australia. *Tourism Management,* 26**,** 617-622.

Barnett, J. & Breakwell, G. M. 2001. Risk perception and experience: hazard personality profiles and individual differences. *Risk Analysis,* 21**,** 171-178.

Beetham, E. P. & Kench, P. S. 2011. Field observations of infragravity waves and their behaviour on rock shore platforms. *Earth Surface Processes and Landforms,* 36**,** 1872-1888.

Birch, W. D. 2003. *Geology of Victoria,* Melbourne, Special Edition 23: Geological society of Australia.

Boholm, A. 1998. Comparative studies of risk perception: a review of twenty years of research. *Journal of Risk Research,* 1**,** 135-163.

Bradstreet, A., Sherker, S., Brighton, B., Weir, A. & Thompson, M. 2012. Research review of rock fishing safety in New South Wales: a report by Surf Life Saving Australia to the NSW Department of Primary Industries. Sydney: Surf Life Saving Australia.

Brander, R., Bradstreet, A., Sherker, S. & MacMahan, J. 2011. Responses of swimmers caught in rip currents: perspectives on mitigating the global rip current hazard. *International Journal of Aquatic Research and Education,* 5**,** 476-482.

Brannstrom, C., Trimble, S., Santos, A., Brown, H. L. & Houser, C. 2014. Perception of the rip current hazard on Galveston Island and North Padre Island, Texas, USA. *Natural Hazards,* 72**,** 1123-1138.

Brewer, F. 2014. *The search continues for a missing fisherman who was swept off a remote rock platform during dangerous surf conditions at Seal Rocks yesterday* [Online]. Available: http://www.abc.net.au/local/stories/2014/05/08/4000335.htm [Accessed 14/04 2016].

Brighton, B., Sherker, S., Brander, R., Thompson, M. & Bradstreet, A. 2013. Rip current related drowning deaths and rescues in Australia 2004–2011. *Natural Hazards and Earth System Sciences,* 13**,** 1069-1075.

Castree, N. 2003. Environmental issues: relational ontologies and hybrid politics. *Progress in Human Geography,* 27**,** 203-211.

Christian, B. 2015. *Malaysian man's death off WA coast from freak wave accident sparks call for more warning signs* [Online]. Available: http://www.abc.net.au/news/2015-12-22/inquest-into-malaysian-mans-drowning-death-from-wave-wa-coast/7049124 [Accessed 14/05 2016].

Coroner, N. D. S. 2015. Coroners Court New South Wales: inquest into rock fishers deaths. Glebe: Coroners Court New South Wales.

Dolan, P., Hallsworth, M., Halpern, D., King, D. & Vlaev, I. 2014. Influencing behaviour: the mindspace way. *Journal of Economic Psychology,* 33**,** 264-277.

Donovan, A. R. & Oppenheimer, C. 2015. Modelling risk and risking models: The diffusive boundary between science and policy in volcanic risk management. *Geoforum,* 58**,** 153-165.

Drozdzewski, D., Roberts, A., Dominey-Howes, D. & Brander, R. 2015. The experiences of weak and non-swimmers caught in rip currents at Australian beaches. *Australian Geographer,* 46**,** 15-32.

Drozdzewski, D., Shaw, W., Dominey-Howes, D., Brander, R., Walton, T., Gero, A., Sherker, S., Goff, J. & Edwick, B. 2012. Surveying rip current survivors: preliminary insights into the experiences of being caught in rip currents. *Natural Hazards and Earth System Science,* 12**,** 1201-1211.

Fenner, P. 2005. Surf Life Saving Australia. *South Pacific Underwater Medicine Society,* 35**,** 33-43.

Fischhoff, B., Slovic, P. & Lichtenstein, S. 1982. Lay foibles and expert fables in judgments about risk. *The American Statistician,* 36**,** 240-255.

Flynn, J., Slovic, P. & Mertz, C. K. 1994. Gender, race, and perception of environmental health risks. *Risk Analysis,* 14**,** 1101-1108.

Gallop, S. L., Woodward, E., Brander, R. W. & Pitman, S. J. 2016. Perceptions of rip current myths from the central south coast of England. *Ocean & Coastal Management,* 119**,** 14-20.

Hatfield, J., Williamson, A., Sherker, S., Brander, R. & Hayen, A. 2012. Development and evaluation of an intervention to reduce rip current related beach drowning. *Accident Analysis & Prevention,* 46**,** 45-51.

Horlick-Jones, T. & Sime, J. 2004. Living on the border: knowledge, risk and transdisciplinarity. *Futures,* 36**,** 441-456.

Hughes, M. G. & Heap, A. D. 2010. National-scale wave energy resource assessment for Australia. *Renewable Energy,* 35**,** 1783-1791.

Hunjan, R. 2016. *Sydney missing rock fisherman search is a 'body recovery mission', police say* [Online]. Available: http://www.abc.net.au/news/2016-03-18/police-search-for-body-rock-fisherman-swept-off-kurnell-rocks/7257020 [Accessed 24/05 2016].

Ingold, T. 1993. The temporality of the landscape. *World Archaeology,* 25**,** 152-174.

Ingold, T. 2000. *The perception of the environment: essays on livelihood, dwelling and skill*, Psychology Press.

Jasanoff, S. 1998. The political science of risk perception. *Reliability Engineering & System Safety,* 59**,** 91-99.

Jasanoff, S. 2004. *States of knowledge: the co-production of science and the social order,* London, Routledge.

Jones, M. 2003. *Investigation into the coronial files of rock fishing fatalities that have occurred in New South Wales between 1992 and 2000,* Sydney, NSW Water Safety Taskforce.

Jutson, J. T. The shore platforms of Lorne, Victoria, and the processes of erosion operating thereon. Proceedings of the Royal Society of Victoria, 1953. 125 –134.

Kagi, J., O'Conner, Kendall. 2016. *Fisherman swept off rocks at Salmon Holes black spot near Albany amid bad weather* [Online]. Available: http://www.abc.net.au/news/2016-04-26/search-suspended-man-swept-off-rocks-at-salmon-holes-albany-wa/7360508 [Accessed 29/04 2016].

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X. & Ratick, S. 1988. The social amplification of risk: a conceptual framework. *Risk Analysis,* 8**,** 177-187.

Kennedy, D. M., Ierodiaconou, D., Weir, A. & Brighton, B. 2017. Wave hazards on microtidal shore platforms: testing the relationship between morphology and exposure. *Natural Hazards,* 2**,** 741-755.

Kennedy, D. M. & Milkins, J. 2015. The formation of beaches on shore platforms in microtidal environments. *Earth Surface Processes and Landforms,* 40**,** 34-46.

Kennedy, D. M., Sherker, S., Brighton, B., Weir, A. & Woodroffe, C. D. 2013. Rocky coast hazards and public safety: moving beyond the beach in coastal risk management. *Ocean and Coastal Management,* 82**,** 85-94.

Krippendorff, K. 2012. *Content analysis: an introduction to its methodology,* London, Sage Publications.

Kuhn, T. S. 1962. *The structure of scientific revolutions,* Chicago, University of Chicago Press.

Manson, S. M. 2001. Simplifying complexity: a review of complexity theory. *Geoforum,* 32**,** 405-414.

McCarroll, R. J., Brander, R. W., MacMahan, J. H., Turner, I. L., Reniers, A. J., Brown, J. A., Bradstreet, A. & Sherker, S. 2014. Evaluation of swimmer-based rip current escape strategies. *Natural Hazards,* 71**,** 1821-1846.

Miller, J. D., Pardo, R. & Niwa, F. 1997. *Public perceptions of science and technology: a comparative study of the European Union, the United States, Japan, and Canada*, Fundación BBV.

Mitchell, R. J., Ware, L. & Bambach, M. R. 2014. The role of evidence, standards and education in rock fishing safety in New South Wales, Australia. *Australian and New Zealand Journal of Public Health,* 38**,** 579-584.

Moran, K. 2008. Rock-based fishers' perceptions and practice of water safety. *International Journal of Aquatic Research and Education,* 2**,** 128-139.

Moran, K. 2011. Rock-based fisher safety promotion: five years on. *International Journal of Aquatic Research and Education,* 5**,** 164-173.

Moran, K. 2017. Rock-based fisher safety promotion: a decade on. *International Journal of Aquatic Research and Education,* 10**,** 1.

Moran, K. & Willcox, S. 2013. Water safety practices and perceptions of 'new' New Zealanders. *Internaitonal Journal of Education,* 7**,** 136-146.

Newman, S. M., Carroll, M. S., Jakes, P. J., Williams, D. R. & Higgins, L. L. 2014. Earth, wind, and fire: wildfire risk perceptions in a hurricane-prone environment. *Society and Natural Resources,* 27**,** 1161-1176.

Östberg, O. 1980. Risk perception and work behaviour in forestry: implications for accident prevention policy. *Accident Analysis & Prevention,* 12**,** 189-200.

Otway, H. & Thomas, K. 1982. Reflections on risk perception and policy. *Risk Analysis,* 2**,** 69-82.

Paton, D., Smith, L. M. & Johnston, D. 2000. Volcanic hazards: risk perception and preparedness. *New Zealand Journal of Psychology,* 29**,** 86-91.

Petts, J., Owens, S. & Bulkeley, H. 2008. Crossing boundaries: Interdisciplinarity in the context of urban environments. *Geoforum,* 39**,** 593-601.

Poloni, G., O'Conner, K. 2016. *Salmon Holes: body of Afghan national recovered after being swept off Great Southern coast* [Online]. Available: http://www.abc.net.au/news/2016-04-27/body-found-salmon-holes-wa-fisherman-swept-off-rocks/7361206 [Accessed 29/04 2016].

Renn, O. 1998. The role of risk perception for risk management. *Reliability Engineering & System Safety,* 59**,** 49-62.

Renn, O. 2008. *Risk governance: coping with uncertainty in a complex world,* London, Earthscan Publications.

Renn, O., Klinke, A. & van Asselt, M. 2011. Coping with complexity, uncertainty and ambiguity in risk governance: a synthesis. *Ambio,* 40**,** 231-246.

Richardson, B., Sorensen, J. & Soderstrom, E. J. 1987. Explaining the social and psychological impacts of a nuclear power plant accident. *Journal of Applied Social Psychology,* 17**,** 16-36.

Shand, T. D., Peirson, W. L., Cox, R. J. & Banner, M. L. 2009. Predicting hazardous conditions on coastal rock platforms. *Coasts and Ports 2009: in a dynamic environment* [Online]. Available: http://search.informit.com.au/documentSummary;dn=864205448694665;res=IELENG.

Shaw, W. S., Goff, J., Brander, R., Walton, T., Roberts, A. & Sherker, S. 2014. Surviving the surf zone: towards more integrated rip current geographies. *Applied Geography,* 54**,** 54-62.

Sherker, S., Williamson, A., Hatfield, J., Brander, R. & Hayen, A. 2010. Beachgoers' beliefs and behaviours in relation to beach flags and rip currents. *Accident Analysis & Prevention,* 42**,** 1785-1804.

Shire, S. C. 2016. *Visitor Insights 2016* [Online]. Surf Coast Shire. Available: www.surfcoast.vic.gov.au.

Sjöberg, L. 2000. Factors in risk perception. *Risk Analysis,* 20**,** 1-12.

Starr, C. 1969. Social benefit versus technological risk. *Readings in Risk***,** 183-194.

Surf Life Saving Australia. 2013a. *Silver medallion aquatic rescue*. Surf Life Saving Australia. Retrieved on April 5 2015 from: http://www.sawtellsurfclub.com.au/ckfinder/userfiles/files/Learner%20Guide%20(SMAR).pdf.

Surf Life Saving Australia. 2013b. *Surf life saving safety* [Online]. SLSA website. Available: lifesaving.com.edu [Accessed 04052015.

Surf Life Saving Australia 2015. 2015 National Coastal Safety Report. Sydney, Australia

Tsai, C.-H., Su, M.-Y. & Huang, S.-J. 2004. Observations and conditions for occurrence of dangerous coastal waves. *Ocean Engineering,* 31**,** 745-760.

Wachinger, G., Renn, O., Begg, C. & Kuhlicke, C. 2013. The risk perception paradox—Implications for governance and communication of natural hazards. *Risk Analysis,* 33**,** 1049-1065.

Williamson, A., Hatfield, J., Sherker, S., Brander, R. & Hayen, A. 2012. A comparison of attitudes and knowledge of beach safety in Australia for beachgoers, rural residents and international tourists. *Australian and New Zealand Journal of Public Health,* 36**,** 385-391.