Re-casting experience and risk along rocky coasts: A relational analysis using qualitative GIS

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This study invites readers to experience risk on Australia's hazardous rocky coasts with the rock fishing community. In the paper, we offer an understanding of risk that is relational, a process that emerges within human–environment interactions in a dynamic coastal space that is constantly changing. Exploring the in situ and ongoing sensory attunement of the fishers, we contend, expands upon the quantitative understandings that tend to be deployed by risk managers, offering an innovative approach to conceptualising risk. In identifying how fishers perceive and experience a rocky coastal location in Sydney, Australia, we track rock fishers' movements using global positioning systems (GPS), undertake participant observation, and draw on video footage, semi-structured interviews and participatory sketch maps. In doing so, fishers' perceptions of socio-environmental stimuli were spatially represented in a GIS, with sketch mapping being the proxy and/or the window into perception–environment relations that produce risk. We contend that the findings show that experienced fishers are more capable of anticipating and reacting to hazardous situations "safely" because they are more attuned to how changing coastal conditions affect risk. This study draws attention to the spatial and temporal phenomena that drive risk perceptions as well as the implications for future perception-oriented research that adopt a relational understanding.

KEYWORDS
attunement to risk through experience, Australia, conceptualising risk perceptions as relational, mixed methods and qualitative GIS, risk as an emergent phenomenon, spatio-temporal processes that emerge as hazardous, Sydney

1 | INTRODUCTION

Rock fishing is enjoyed by over a million Australians (Surf Life Saving Australia, 2017). Participants cast fishing lines from rocky coasts, typically standing on "shore platforms" below steep cliffs (Figure 1). Each shore platform has a distinct morphological profile, attracting different fish species and fishing enthusiasts. The popularity of rock fishing is grounded in the pleasures offered by interacting with complex coastal environments, experiences of expansive coastal views, and the challenge of "landing a big fish," while also providing an affordable deep-water fishing alternative to chartering a boat (Kennedy et al., 2013; Moran, 2017). The pursuit of rock fishing is also accompanied by the presence of potential hazards that demand anticipation about dynamic coastal processes, such as rising tides, changing swell directions, and swell height, which influence whether incoming waves will overtop the platforms on which fishers stand. While not all fishers are acutely attuned to how coastal conditions affect site-specific risk, as this paper demonstrates, most experienced rock fishers are continuously aware of these emergent hazards. Accordingly, we consider rock fishers as non-certified risk "experts": their first-hand "experiential-expertise" informs their approach to risk. We explore the relational ways in which socio-environmental interactions are anticipated by these "experts," with findings that can contribute to how risk is "known" and managed. The goal of exploring how fishers become attuned to hazards in situ and over time seeks to expand upon the quantitative understandings that are typically deployed by risk managers, offering an innovative approach to conceptualising risk.

Relational thinking construes space as inseparable from social processes and refuses any division between individual and environment. In the context we explore, the interplay between an individual's sensory experience of waves overtopping platforms, their practice of casting in such situations, and their anticipations about how waves may overtop and affect them constitutes a "relational" perception of risk (Kamstra et al., 2018). Treating risk as relational emphasises perceptions of *non-linear* interactions between people and their environment, which some consider the *source* of risk (Aven & Renn, 2009; Castree, 2003). Indeed, Boholm and Corvellec (2011) have developed a "relational theory" to understand risk as a social phenomenon in which there is a relational perception between a "risk object" and an "object at risk," with the relationship between these two elements emerging from the "culturally situated cognition and social practice" of the observer. This echoes Renn and Rohrmann's (2000) description of the "cognition" and "practices" that influence risk perception as a nested contextual system, operating at both collective and personal levels (Dobbie & Brown, 2014). Yet both accounts display little understanding about how particular perceptions influence people's responses to hazards as they emerge, for instance, in exploring the distance at which people perceive hazards and thus the time they have to assess and respond to them. This paper seeks to address this gap by exploring the spatio-temporal processes that drive the risk perceptions of rock fishers and how those perceptions influence their risk management practices.

We begin by introducing the conceptual framework through which risk is construed as relational. We subsequently discuss the innovative mix of methods we deploy to examine how risk is conceived and experienced by rock fishers. This is followed by a discussion of empirical findings to investigate how we might incorporate the previously neglected relational ways that risk is perceived, experienced and managed on rocky coasts into more nuanced practices of risk management.

2 | THEORISING RISK AS RELATIONAL

Over 30 years ago, Otway and Thomas (1982) argued that risk can be analysed as either a social phenomenon constructed through individual experience, or as a quantifiable physical phenomenon. Since then, little has changed; risk is considered

FIGURE 1 Rock fishers in Little Bay, New South Wales standing and casting on the seaward edge of a shore platform.

social, with innumerable perceptions based on an individual's experiences, whereas a physical risk is knowable through measurement of discrete environmental factors (Kennedy et al., 2017). Such varying understandings of the nature of risk accentuate the different types of knowledge and assumptions at play in how it is constructed.

In a historical context, the separation of physical from social risks has provided a useful "boundary" for risk management (Gieryn, 1983). This boundary enables analyses of hazard probabilities (for instance, of wave overtopping) and perceptions of risk (for example, about locating dangerous areas in which to stand) to contribute differently to knowledge and management decisions. Problematically, however, analyses have tended to privilege physical measurements (Renn, 2008), producing risk management that focuses solely on calculating the threat of particular hazards while ignoring the ways in which individuals perceive, experience, conceive and react to risk.

Jasanoff (1998) argues that such reductionist analyses isolate physical from social phenomena and interpret them as discrete elements with static relationships. When such physical elements with static relationships are reintegrated with an individual's constructions, the reductionist approach to risk is unable to consider how changing conditions influence an individual's response to risk. This separation of physical risk from social construction thus fails to capture the ongoing interactions between people and their environments, which is the underlying basis of risk (Renn et al., 2011). Critics of a reductionist approach to risk analyses have responded by advocating more "holistic" and "interdisciplinary" risk research to be practised that equally incorporates the physical and social sciences (Horlick-Jones & Sime, 2004; Petts et al., 2008). In emphasising that risk is relational, we aim to build upon such critiques.

Diverging from the myriad of existing risk definitions, this research applies a relational understanding of risk that exists in people's geographical imaginations; inescapably subjective, risk exists in the minds of those trying to anticipate it (Adams, 1995). Relational thinking conceives of space not only as a location for physical phenomena but as inseparable from social processes (Massey, 1999), with no division between individual and environment. Accordingly, most relations perceived as hazardous remain implicit and emerge from non-linear socio-environmental elements that are constantly changing (Callon & Law, 2004). Conceptualising risk as relational disavows structure–agency dichotomies, advancing an understanding that risk is perceived, experienced and fluid (Jones, 2009), thereby fostering a perspective that is attuned to the multiplicity of human–environment interactions that might be perceived as hazardous.

Habitual experience shapes this emergent, ongoing performance of regular practices that change one's capacity to move, sense, perceive and attend to potentially hazardous events (Dewsbury & Bissell, 2015). These deeply situated interactions developed through first-hand experience (Epstein, 1994; Haraway, 1988) are the focus of this study; they accommodate the ways in which understandings of risk are co-produced in situ (Jasanoff, 2004), relationally constituted through spontaneously aligning emergent interactions between people and environment. Over time, for example, anticipating the influence that rising tides have on where and when waves will begin to overtop becomes an almost instinctual response to risk (i.e., habit). Differences in perception between those who are experienced and inexperienced emerge in divergent responses to socio-environmental stimuli and understandings of high-risk space. It is this dynamic and ongoing first-hand individual and collective experience that offers the potential for identifying engrained practices, and what Epstein (1994) refers to as "experiential-expertise" towards risk. Investigating this "experiential-expertise" can be critical for risk management because it provides a way of identifying how, where and for how long risk is perceived as hazardous, if at all. Most risk research supports the role that experience has in helping people become attuned to environmental conditions and the likely risks that may emerge, but in many cases, this experience is thought to breed complacency. In this paper, we provide an empirical understanding of the elements that drive the perceptions of rock fishers who are experienced in particular spatial contexts, and identify those spatio-temporal hazards to which others are unaware because they lack the experiential-expertise to anticipate risk. Thinking about risk as an emergent phenomenon in this way better represents how it is experienced, a dimension that the modelling or quantification of traditional risk assessments are unable to access (Kamstra et al., 2018).

3 | METHODS

3.1 | Geographical context of risk

Rock fishing is "Australia's deadliest sport" (Bradstreet et al., 2012). Since 2004, there have been 149 reported rock-fishing related drownings in Australia, which ranks it as the third highest individual coastal activity for drownings in Australia (Ryan et al., 2018). "Wave overtopping" – the physical processes by which wave energy inundates shore platforms, washing coastal users off balance and into the ocean – frames most discussions regarding the risk of drownings on rocky coasts. This is most evident on micro-tidal coastal areas, where the seaward-most edge is both the ideal location for rock fishing and the area where wave overtopping most frequently occurs. While the probability of wave overtopping is known (Kennedy et al., 2017), few studies investigate fishers' risk perceptions of shore platform environments and how those perceptions influence their behaviour.

3.2 | Sample

Data were sampled from 25 rock fishers over 18 months (September 2016–March 2018) to capture seasonal variation in coastal conditions as well as diversity among rock fishers, whose activity often coincides with seasonal fish migrations. The study site is a shore platform in Little Bay, New South Wales, located in Randwick council roughly 15 km from Sydney's city centre (Figure 2). This platform was selected due to its proximity to Sydney and because it is a "black spot" for rock fishing (Ryan et al., 2018). In fact, five reported rock fishing fatalities have occurred at this site since 2004. High numbers of fatalities, with 104 reported deaths since 2004 in New South Wales, have prompted local government to enforce the wearing of life jackets by rock fishers, fining those without them (New South Wales Government, 2016). In addition, Surf Life Saving Australia have targeted "occasional" (inexperienced) rock fishers in their most recent Rock Fishing Coastal Safety Brief (Ryan et al., 2018). These recent changes in policy and safety targets make analyses focused on

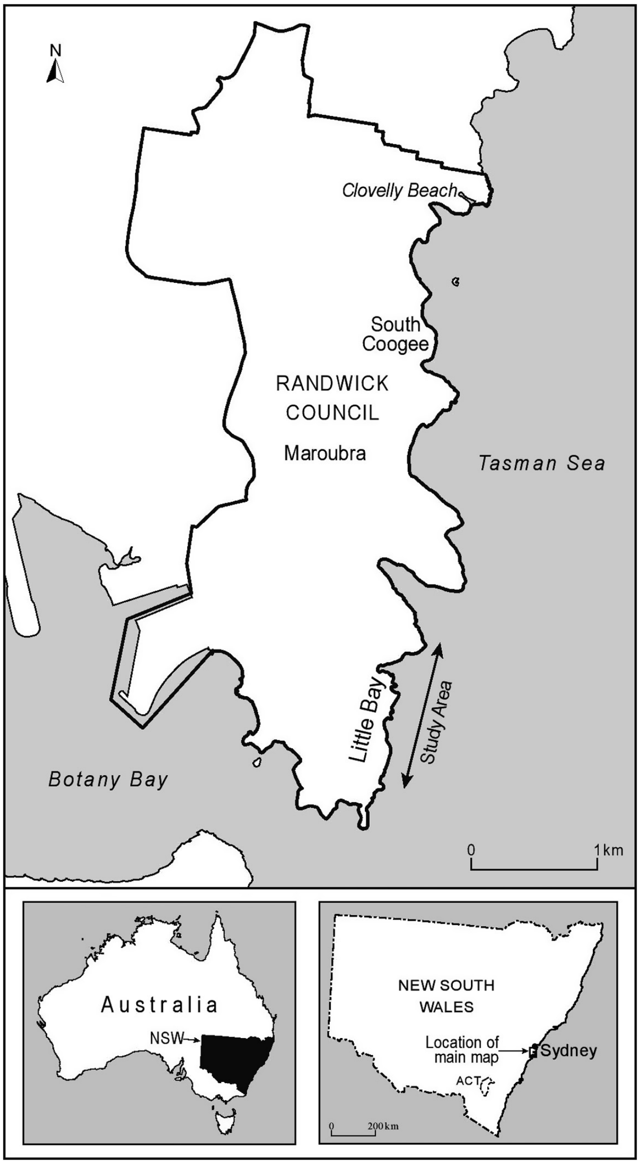

FIGURE 2 The study site, Little Bay, is located south-east of Sydney located on the south coast of Australia.

experienced and inexperienced rock fishers' geographical approaches to risk particularly important, yet to date there have been no studies that differentiate the forms of knowledge possessed by these distinct fishers.

Of the sampled fishers, one-quarter have less than one year's experience at the field site, with three visiting for only the first or second time. Another quarter of participants have between one and three years' experience, with the remaining half having either three to 10 years or over 10 years' experience. Fortunately, our sample provides a wide range of fishers with varying levels of experience. Of note, the sample is not representative, but it does allow us to analyse based on experience. All participants ($n = 25$) indicated that they check coastal conditions before arrival. However, of the individuals with less than one year's experience, 71% said they check one isolated coastal condition, namely swell height, before fishing. This contrasts with the 43% of participants with one to three years' experience and all participants with over three years' experience, who highlight the importance of checking multiple inter-related site-specific coastal conditions. They seek information about the daily relationships between swell direction, swell height, wave period, tides and wind direction.

3.3 | Data collection

In this study, we map how and where human–environment interactions are perceived as hazardous by drawing from Cope and Elwood's (2009) discussion of mixed methods. They define "mixed" methods as those that weave different research techniques together to inform one another, as opposed to a "multi-method" approach that uses multiple independent research techniques to contrast different perspectives and constructions. A mixed dataset provides inter-related understandings of risk to explore the relational way(s) that risk is perceived. Analytically, we relate rock fishers' global positioning system (GPS) tracks with their sketch maps, participant observation, video footage and semi-structured interviews. Overlaying GPS movement with sketch maps offers an innovative strategy to interrogate how participants move and understand their practices, while interviews and participant observations account for the spatial qualities, sensations and intersubjective practices that participants believe affect their behaviour.

Data were collected using six different methods. First, information including length of experience fishing at the site and the coastal conditions checked before fishing was collected via a self-completion questionnaire. Second, quantification of spatio-temporal movement data were collected from rock fishers wearing a GPS. GPS point positions were recorded every three seconds and imported into ArcGIS 10.4.1 overtop aerial photos of the case study site. Third, participant observation data were recorded on site in a field notebook, which was accompanied by the fourth method, a low-resolution video camera designed to record any pertinent events that were missed or needed to be revisited during data analysis. The fifth method was an inductive sketch-mapping interview process that involved participants sketching points, lines and polygons (i.e., areas) on paper maps to record where they spend time during their usual fishing practice and which areas they avoided, believing them to be hazardous. During the sketching process, rock fishers were also asked individually to map how they had experienced risk either first hand or indirectly, and requested to describe the "visual cues" or changing environmental conditions that they believed signalled an emergent hazardous situation. Lastly, semi-structured interviews were conducted with fishers, lifesavers and members of the community who had witnessed fatalities to understand the behaviours that they associated with drownings.

Sketches were drawn on georeferenced paper maps of the field site. This allowed participants to move across the study site, with many indicating specific areas that they perceived to be hazardous. This flexible mapping was essential for encouraging rich accounts of where and how particularly risky incidents had occurred. For improved accuracy, digitisation of sketch maps was assisted by an audio and video recording of the sketch mapping process using an iPhone positioned above the map. The result is a map of fishers' recounting their everyday practices, the spatio-temporal processes that they perceive as being hazardous, and where they have experienced risk. In some cases, the spatio-temporal phenomena that caused someone to enter the sea and drown were also mapped, providing a detailed account of how risk had emerged. It is important to note that the size of a sketched area is not a measure of magnitude or "greater" concern, for example, the size of shapes is strictly where fishers anticipated risk.

Sketched features and their associated "spatial narratives" (Kwan & Ding, 2008) were then georeferenced and transferred into ArcGIS in a simplified geographic format. Only when the data were georeferenced would any sophisticated analysis occur, similar to other research using paper-based maps that were shown to minimise distortion (Vajjhala, 2005). Perceptions of socio-environmental stimuli were then spatially represented in a GIS, with sketch mapping being a proxy, and/or window into perceptions of how hazardous situations can emerge, as well as how fishers directly or indirectly experienced risk.

4 | FINDINGS: PERCEIVING RISK AS RELATIONAL

4.1 | Anticipating risk as relational: The partial utility of apps

Anticipatory preparedness of risk is frequently organised around calculability and quantitative data (Anderson, 2010) and is typically transmitted through institutionalised risk management. All fishers in this study approach their perceived risk by first checking the daily coastal conditions before arriving on site ($n = 25$), using various apps to anticipate the risks that might arise once they commence fishing. Only those with more than three years' experience, however, described the importance of checking multiple inter-related coastal conditions to anticipate how they might shift throughout the day to accommodate changing risk(s). Though they certainly utilise these apps to anticipate risk on the coast, these more experienced fishers mobilise a more complex set of factors to anticipate hazards that are based on their own experiences, describing the relational influence of swell direction, swell height, wave period and tide to assess whether the daily conditions are (safely) "fishable." Rather than separating coastal conditions into individual, discretely located, physical processes (Jasanoff, 1998), experienced rock fishers accommodate the influence that multiple conditions have on site-specific risk. An example of this process is described by Alf,[1] a fisher with over eight years of experience:

> Well, I first look at the direction of the swell and if it is hitting the platform head on [i.e., the orientation of the platform matches the swell direction], then I know it will be more dangerous. Once I know the direction, I look at the swell height to see how much water will be coming over the platform. Then, I look at the tidal cycle and what time I'll be there. If there is a big wave period, I kind of know how often, like every 40 minutes for a wave period over 10 seconds, a massive wave will come over. You have to think about all of these things to decide when to go and where you want to stand. (2018)

This site-specific understanding is developed through practice and through experiencing how different coastal conditions influence where and how often wave energy leads to overtopping. Many fishers emphasise that "every day is different" and develop an understanding about when, for example, a swell height of 0.6 m is "unfishable" compared with when a swell of 0.8 m or 1 m is "unfishable." This is achieved through an understanding of how coastal conditions relate and mutually constitute a different "fishable" environment. Accordingly, if someone lacks experiential-expertise and instead relies on a purely physical understanding, then they may be at a greater risk. This is because predictions of offshore swell heights, for example, do not account for how swell changes as it moves inland, nor can quantitative models account for how to anticipate and react "safely" to overtopping waves. This form of anticipating risk separates physical processes from social perceptions, overlooking the important ways that waves interact with other environmental factors in situ as well as with fishers (Jasanoff, 2004). As Bill (2016) explained:

> I look at the angle of the swell. The angle of these conditions, where you stand, how long you stand there and how waves approach specific platforms, as well as reflect off of local topography, have a greater influence on the amount of potential wave energy that overtops a specific part of the platform than offshore predictions. (2016)

These anticipatory habits developed through longstanding experience of dynamic conditions are used to supplement the more authoritative, but less contextually attuned information provided by apps. Multiple cell phone applications, for example, receive data from different quantitative models to predict sea and swell conditions. This means that on any particular day, certain applications can communicate a swell height of 1.5 m, which is perceived as risky, while another app may draw from a different dataset or modelling technique and predict the swell as 0.9 m (Figure S1; Figures denoted S are found in the Supporting Information online).

An example of an inexperienced fisher put at greater risk by following a non-relational understanding communicated through physical data is described by Ali:

> I always trust the apps. I check different websites with different numbers but 0.8 m is usually safe. I take their advice very seriously. I follow them every time and that's how I know the swell was safe today. (2017)

This does not mean that inexperienced fishers who rely on cell phone applications to assess levels of risk are unaware that other coastal conditions are influential. Yet more experienced fishers tend to arrive at the site and relate their perceptions to the local conditions to anticipate hazardous waves, while those without experience often rely on the phone applications and unintentionally enter hazardous situations. One experienced fisher, Cuthbert, goes as far as to describe the availability of "apps" as being the biggest risk:

> Apps have changed a lot. In the past, we had to come at lunch, sit and watch for 30 minutes and chat about whether or not we felt it was fishable. Now, accessible cell phone applications encourage more inexperienced fishers who live over 50 kilometres away to fish spots they are unfamiliar with because they think they know what the conditions will be like. Then, when they arrive, they are not only unable to anticipate how risky it is but are less likely to go home if it is dangerous because they drove so long. (2018)

Experienced fishers show that risk is relational and that better anticipatory approaches accommodate how changing coastal conditions affect "safe" thresholds and influence site-specific risk. An anticipatory capacity to understand the relational influence of conditions is especially critical since more hazardous conditions are often related to more desirable fishing conditions. A moderate swell disturbs the shallower seabed near the edge of the platform, releasing food for smaller fish species, in turn, attracting larger predatory species sought by human fishers. This paradoxical relationship between hazardous but improved fishing conditions is described by Steven:

> Yeh, when it's too calm you won't catch anything out here. You need just a bit of swell to stir up the sand at the bottom and that gets the little fish here. Then we hope that the bigger fish will come in closer from deeper water to feed and take our line. If the swell is too big, like 1.6 m, I just don't come but if it is like 0.3 m I don't expect to catch very much. (2018)

4.2 | Charting the engrained logic of risk perceptions

Experienced fishers think about risk as relational and whether a particular platform is "fishable," but even in the most high-risk situations, their critical focus remains selective. As Matthew Hannah emphasises, "our attentional resources are ineluctably finite" Hannah (2013, p. 235) and the key issue is how directional and embodied attention is shaped. Here, attentional engagement emerges through habitualised awareness, which engenders a focus on selective elements that might warn of impending risk in the ever-changing coastal environment. Anticipating and moving according to waves perceived as hazardous is a function of such directional attention (Adams, 1995). While safety messages encourage fishers to "never turn their back to the sea" and "read waves before fishing" (Bradstreet et al., 2012), little is known about how rock fishers come to visualise patterns in the surf or anticipate some assemblages of patterns as hazardous. To explore this, rock fishers were asked to describe the visual cues that trigger a cognitive response to an anticipated hazardous situation. In scanning the sea to anticipate risk, experienced fishers appear to identify cues that are constituted at four spatial and temporal scales (Figure 3).

The first and most immediate spatial cue used to anticipate risk is the "wave trough." This risk perception emerges immediately in front of the fisher standing on the seaward edge of the platform and is described by Arthur:

> Well I look for the water to suck out, if that space in front of you is full of water than generally the waves do not come over the rocks. If the water level is low you know the next wave will come over. It's right in front of you and you can see the water move down. It kinda looks like a mini-tsunami. (2017)

The second spatial scale, slightly further away from the edge of the platform, is watching and judging the height of waves in the "near shore" or roughly 50 m offshore and is described by David:

> Ahh I look probably 30 m off the edge and look at the height of the wave (the top of the wave or crest). One way I try and tell if it is going to be too big is if the wave is up to my belly button (i.e., wave height relative to someone standing on seaward edge is perceived to be at the same height of their stomach). If the wave is bigger than my belly-button I know it is going to come over. (2017)

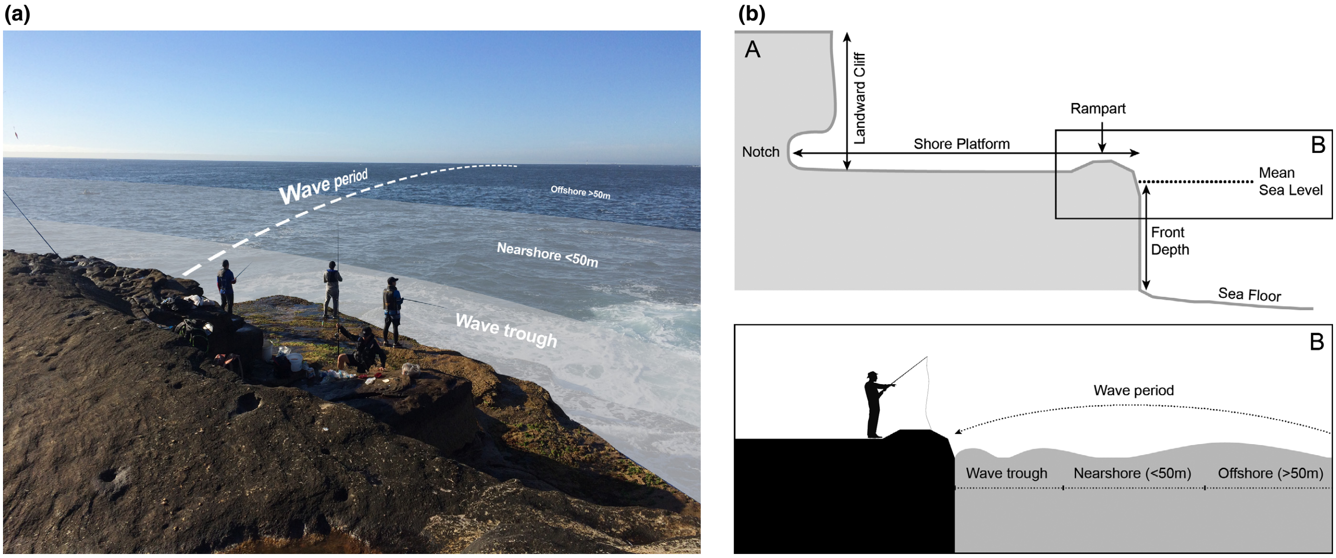

FIGURE 3 The image on the left shows rock fishers at the field site and the different spatial scales used to anticipate risk, while the images on the right show a cross-section of shore platform morphology (a) and the spatial scales used to anticipate risk (b).

The third spatial scale, further away still, is constituted by "offshore waves," which are also described as offering a "relative wave height to the platform." Here, Craig describes how he anticipates a hazardous wave roughly 200 m offshore.

> I usually look, like, 200 m offshore, almost to the edge of the horizon so I have more than enough time to reel in my line, and get out if the wave looks too big and I need to get off the edge. (2018)

Finally, the largest spatial scale was the "wave period"; this perception spans the visible surface of the sea within view, and that which is anticipated as hazardous is described by Colin:

> I look at the entire surface of the sea and whether it looks calm, with no breaking waves. When there are waves constantly breaking I know the wave period is low and big waves will not sneak up. With a high wave period, though, the sea looks like a lake and then I know a huge wave is coming soon! Okay, these are the different ways to think about. If it is a six-second period it looks choppy, at eight-seconds slightly bigger waves break every few minutes, at 10 seconds the sea can look calm but massive waves will come over the top every 30 to 40 minutes when the period is 10 seconds. (2018)

An understanding of how rock fishers perceive the risk of incoming waves at different spatial scales in proximity to where they are standing offers new insights into the ways that those with less experience may be unaware of hazardous situations. This includes linking the spatial scales that fishers with particular levels of experience use to anticipate risk. The further away a wave is perceived as hazardous, for example, the more time there is for a fisher to react. The "wave trough" occurs immediately in front of the fisher, giving them little time to react when a hazardous large wave overtops the platform, while "near shore" perceptions provide slightly more time to see waves 50 m away from the platform's edge. Watching waves "offshore" occurs at a longer temporal scale and seemingly gives fishers adequate time in which to retrieve their line and walk safely back to the landward cliff. The perception described as the "wave period" has the largest temporal scale and involves periodic wave overtopping events that increase as the length of the wave period increases, but requires a significant observable spatial and temporal change in sea surface conditions. Rock fishers' relational understanding of risk can be applied to other natural hazards, including the ways in which large bush fires are anticipated as hazardous. Similar to the rock fishers' anticipation of the inter-relationships that emerge in changing coastal conditions, inhabitants of areas prone to bush fires anticipate the relational risk of fire according to the time of year, temperature, local wind direction, proximity of vegetation to buildings and the absence of localised fires (Eriksen & Gill, 2010). In our case, identifying hazards that occur over longer temporal scales – perhaps up to one wave every 40 minutes – is difficult for inexperienced fishers who are likely to lack the anticipatory understanding of how a longer wave period influences larger but less frequent waves overtopping when the sea looks calm.

We suggest that this is why large waves are often referred to as "freak" and "rogue" waves, terms that imply that wave overtopping is unpredictable. By contrast, for the experiential-experts, "freak" waves do not exist but are a function of more energy being stored in fewer, larger waves. To contextualise this claim, we draw on Brannstrom et al. (2014) study of risk on sandy beaches. This study found that despite most beach drownings occurring in rip currents, which are distinguishable by the lack of wave activity, 87% of respondents identified areas of high wave energy to be the more dangerous parts of the beach. Other studies have also shown similar "inaccurate" perceptions of rip hazards, which Gallop et al. (2016) terms the "rip current myth." Perhaps a "freak rogue myth" persists on rocky coasts, where inexperienced fishers misjudge a calm looking sea as "safe," whereas this may merely indicate a longer wave period (greater than 10 seconds) and result in less frequent, but more powerful wave-overtopping events with severe consequences; further research is required on this topic.

5 | ATTUNEMENT TO RISK THROUGH PRACTICE

As Humberstone contends in discussing the particular sensory capacities that water-based action sports enthusiasts come to develop, ways of knowing the liquid world of the sea involve the emergence of a body that "reacts to and anticipates (the sea's) mobility and fluidity" (2011, p. 498). In becoming attuned to the multiple conditions of the coastal realms in which they regularly fish, rock fishers appear to develop a sense of risk in which their capacity to sense, perceive, move and attend to potentially hazardous events is enhanced (Dewsbury & Bissell, 2015). They develop an attuned and habitual skill that is captured by Ingold as "the embodiment of capacities of awareness and response by environmentally situated agents" (2000, p. 5) that emerges from a process of "incorporation rather than inscription" (ibid, p. 193). This attuned skilfulness is not merely the reiteration of learned manoeuvres but involves continuous adaptation and improvisation to unfolding events (Ingold, 2018). We have already considered the ways in which experienced fishers become attuned to risk via the diurnal and seasonal tidal rhythms of the sea, and that fishers rhythmically align their bodies and practices with these rhythms (Edensor, 2016), as do farmers on estuarine land and seafarers (Jones, 2010). Attunement to the risks that inhere in the non-human rhythms of each incoming wave is entangled with casting practices, as experienced fishers also scan the surface of the sea for splashing fish, a rare event that signals that they are being pushed to the surface by larger, predatory species and provides a desired casting target.

The experience of rock fishing is further sensed through the taste of salty sea spray, the sounds of the waves, and bright flickering lights reflecting off rolling waves, all of which are related to fishing practice. The sound of violent crashing waves on particular parts of the platform, for example, signal to experienced fishers that the tide is rising and that waves will soon overtop parts of the platform hitherto unaffected. Perhaps the most important sensory connection between fishers and their environment is through their feet, since stable footing is critical to remaining upright while moving over rough, uneven, and slippery rocky surfaces that are often covered in sharp shells and overtopping wave energy. As a risk mitigation strategy, fishers wear removable cleats to maintain their balance. This allows them to become attuned to the environment and was described by a fisher who purposefully wet his feet in order to feel connected to the landscape as an important safety measure:

> You know what the most dangerous thing is about rock fishing? People trying to avoid getting wet. I see so many guys out here running from waves, avoiding being splashed and stepping into areas they shouldn't, all because they don't want to get wet! If you are fishing on the sea expect to get wet or don't come out here. (James, 2017)

5.1 | Attunement to risk in coastal space

To map the knowledge that informs experiential-expertise, we analysed how the length of fishers' experience influenced their movement patterns and mapped perceptions of hazardous space and their reactions to hazardous situations. We mapped the density of rock fishers' movement, mainly concentrated on the seaward edge of the platform where most fishers cast their lines into the sea (Figure S2). An additional lower density of movement towards the landward cliff is also evident; it is where fishers usually rest and leave their equipment because it is protected from overtopping waves.

We then sub-sampled movement using GPS data to visualise whether fishers' length of experience aligned with where they stand. The analysis shows that the density of movement is more dispersed with less experience, suggesting that inexperienced fishers move more often than the most experienced fishers, whose behaviour is concentrated on the seaward edge of the platform (Figure S3). We surmise that more experienced fishers move less because they are more attuned to where the most productive fishing environments are, while inexperienced fishers may lack this knowledge and thus constantly, and more riskily, move in search of a "good spot."

When we asked fishers to map the areas that they perceive as hazardous, perceptions of wave-overtopping hazards spanned most of the platform, while perceptions of a fast-flowing channel – flowing from right to the left behind the most densely occupied casting location – were concentrated between seaward edge and landward cliff (Figure 4). This channel was described as a location of fast-flowing water passing over a slightly lower part of the platform where overtopping wave energy was concentrated, making it the deepest and highest energy space when waves overtop from a southerly swell direction. The distribution of wave overtopping hazards suggests that rock fishers are aware that they occupy spaces where waves typically overtop as well as having to move through a potentially more hazardous channel to access the area where they spend most of their time.

To understand if areas mapped as hazardous were also affected by fishers' length of experience, the average length of experience of rock fishers who mapped the hazardous "channel" was calculated (Table S1). For experiential-experts, the average length of experience was six years, suggesting that they are more attuned to the different ways in which risk can emerge. Experienced fisher Alex describes his attunement to the hazardous channel:

> We actually stay out there (seaward edge) because when a wave hits, it is higher water through here [i.e., the channel] and I think the wave can hit you here. The water is deeper, moves faster and is worse to stand in and get hit by than staying out on the edge. You have to be 'strong' and look at the waves but DO NOT PANIC and run. It's the worst move because it is very easy to slip in there [i.e., the channel] and the water take you out. (2018)

Conversely, less experienced fishers did not recognise or note the channel, suggesting that they lack the prior experience of seeing, feeling, hearing and moving through this channel when waves overtop. The significance of perceiving the hazardous channel was confirmed during the mapping interview process where two fishers mapped how they were unintentionally washed into the sea while retreating from the seaward edge – through this channel – in response to waves that they anticipated as hazardous. Moreover, 10 fishers who witnessed other fishers entering the sea also identified a mistaken retreat from waves through the channel as the main contributing factor. Indeed, two fishers witnessed fatalities (Figure S4).

In capturing how experiential-experts respond to waves as opposed to "panicking and running," we were also able to draw on participant observation and video footage. By doing so, we revealed one important response mechanism used by many fishers to cope with incoming wave energy (Video S1). The act of lifting one leg when waves overtop demonstrates fishers' attunement to when and where this will occur. Depending on their assessment, experiential-experts watch waves offshore to give them sufficient time to anticipate risk, and if they consider it appropriate, to reduce their exposure to the wave, and prevent it from carrying them into a hazardous, deep, fast-flowing channel, they lift one leg.

5.2 | Attunement to risk through collective action

In considering risk as relational, we also identified examples of human–human interactions that expand how we might think about risk. Fishers' attunement to risk is not only developed through individual actions and experiences with non-human agencies but also through human–human interactions, within a community of experiential experts and those less habituated to the rhythms and risks of the sea. For example, while fishers remain attuned to the sea and risk through their own rod and feet, the unmistakeable sound of another fishers' line being pulled offshore by a large fish captures the collective attention. This collective attunement to each other is demonstrated by fishers typically reeling in their lines to give the fisher with a hooked fish more space. This practice is described as having a "fish-on" and appears to be partly what motivates rock fishers to co-occupy hazardous spaces. The shared desire to retrieve a fish successfully from the ocean encourages most fishers to be a part of the "experience" of landing the fish safely. During this process, multiple collective relations influence fishers' movement, including critical attention to risk. This is mitigated by fishers with more experience helping others to reel in the fish. Video S2 shows an experienced fisherman (i.e., 15 years of experience) on the left watching a less experienced fisher (i.e., less than 1 year) reeling in what is perceived as a large fish, and one minute later, standing behind

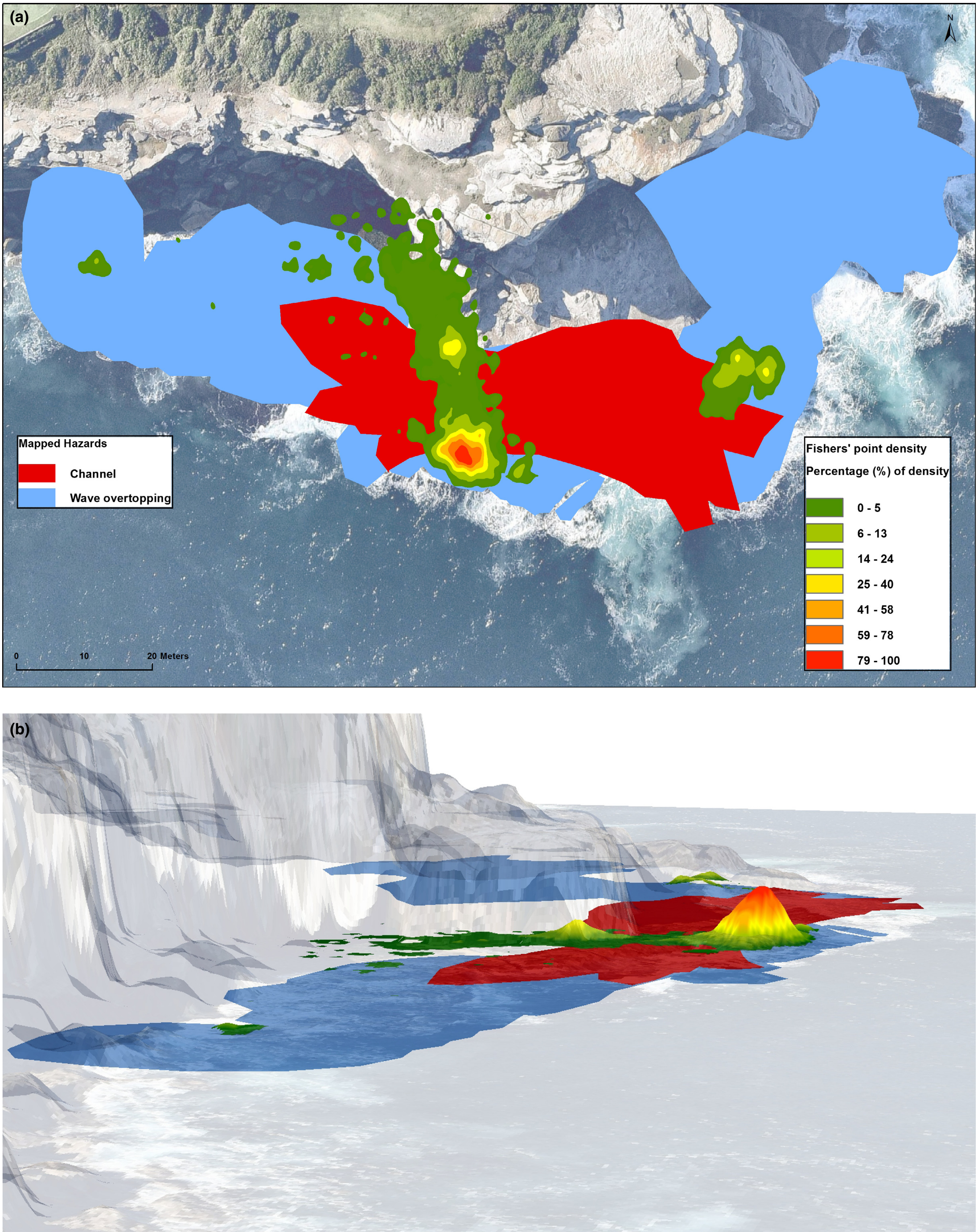

FIGURE 4 The map on the left (a) shows where wave-overtopping hazards are perceived as hazardous (light blue) as well as where a deep, fast-flowing channel cuts across the platform. Importantly, image (b) shows a three-dimensional view of this channel and how it separates where fishers spend most of their time and the landward side of the platform protected from overtopping waves.

them, holding their life vest from the back, to prevent them losing their balance and falling in the sea. This technique is accompanied by the third fisher watching waves offshore in case a hazardous situation should emerge, providing evidence of the collective ways that risk is mitigated. Among risk managers there is little understanding of how such understandings of risk and responses are collectively produced (Dobbie & Brown, 2014).

6 | SUMMARY AND CONCLUSIONS

In this paper, we have adopted a relational understanding of risk that cannot be reduced to a set of relationships or interactions passed on via safety messages; it is relational, inescapably subjective, and exists in the embodied understandings and sensations of those trying to anticipate it (Adams, 1995). Differences in the degree to which fishers are attuned to coastal spaces between those who are experienced and inexperienced eventuates in divergent responses to socio-environmental stimuli. By understanding risk through a highly attuned experiential-expertise, we have shown how scientific advice about areas as "safe" or "unsafe" may influence fishers' geographical imaginations and put them at a greater risk. We suggest that coastal risk managers need to consider experiential-experts' perceptions of which human–environment interactions produce risk in order to grasp the relational ways in which people anticipate and react to risk while rock fishing. We have identified three crucial areas through which a situated attunement to the hazards of the coast could inform more nuanced strategies for risk management.

First, we have accounted for how experienced fishers' perceptions are driven by four different spatial and temporal scales, and this has offered new insights into the ways that people with less experience may contrastingly understand hazardous situations. Fishers with less than 1 year of experience observed waves in the nearshore, anticipating risk differently compared with more experienced fishers. In the same way that novice drivers look too closely in front of their car but learn over time how to scan the road for distant hazards, this places them at a greater risk than the experiential-experts who watch waves hundreds of metres offshore. Recognition of these differences offers alternative ways to engage inexperienced or "occasional" fishers concerning risk, which expands prevailing approaches based on signage and life jacket legislation.

Second, we have also highlighted that there is a potential "freak wave myth" on rocky coasts, where inexperienced fishers, not attuned to daily wave period effects, may misjudge the look of a calm sea as safe, when this illusory appearance creates a false sense of security. However, when the wave period is over 10 seconds, wave energy that typically breaks is stored offshore in less frequent but higher-energy waves that appear to be "freak" waves but are merely a function of long wave periods. Future research is required to analyse risk perceptions among a wider range of shore platform environments to identify other examples of how experiential-expertise can inform assessments of site-specific risk. Moreover, the social relations among fishers require further analysis to understand better the collective ways in which they influence each other's responses to relational risks, as they emerge.

Third, our analysis suggests that the riskiest behaviour on this shore platform is moving from the seaward edge, through a fast-flowing channel. This was reinforced by two fishers who mapped how and where they were impacted by water flowing through the channel, which resulted in them unintentionally entering the sea. This understanding of risk was then triangulated by 10 fishers describing how the retreat of other rock fishers from the seaward edge through the "channel" was the cause of them entering the sea, and in some cases, drowning. Evidence of how experiential-experts cope with overtopping waves – as opposed to retreating through a hazardous channel – helps contextualise the types of strategy that fishers may develop to respond to risks as they emerge.

Besides potentially informing innovative risk management strategies, we argue that investigations into the multiple ways in which risk is invariably relational must be undertaken in diverse settings. Thinking about risk as emergent better represents how it is experienced, and reconfigures risk as not merely that which can be quantitatively identified. We maintain that it is by drawing on the sensory expertise of expert practitioners, whose skills have been developed through long immersion in particularly risky situations and are highly attuned to the hazards that emerge, that is best placed to advance more sophisticated understandings of risk.

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ENDNOTE

[1] Participants requested to be anonymous so all names of interviewees are pseudonyms.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. Cell phone app screens providing data on sea condition.

Figure S2. Images of where fishers' density of movement is concentrated.

Figure S3. Point densities separated by length of experience.

Figure S4. Map showing the location of where two fishers directly experienced the risk of drowning by unintentionally entering the sea.

Table S1. Rock fishers and their length of experience that mapped the channel as hazardous.

Video S1. This video titled "Attunement to risk," showing a rock fisher demonstrating how to safely respond to hazardous waves.

Video S2. This video shows an experienced fisher helping to prevent an inexperienced fisher fall into the sea.

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