Community resilience in response to the 2010 tsunami in Chile: The survival of a small-scale fishing community

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ABSTRACT

This paper examines the role of community resilience during the emergency response after the 2010 Chile earthquake and tsunami. El Morro – a fishing community that managed to survive the tsunami in the Talcahuano region – is used as a case study. Despite the magnitude of the catastrophe and the mistaken tsunami warning, there were no reports of casualties. We conducted qualitative research over a six-month period consisting of: semi-structured interviews; observation; informal conversations; documentary and social media review; to explore the resilience capacities and resources that were activated in the community to cope with the disaster. Our findings show that community resilience played an important role during the response period, especially in the absence of external aid. Communities are not merely passive victims of disasters, they are active agents. Resilience capacities such as sense of community, local knowledge, social capital, organisation, cooperation, and trust contributed to the survival of the entire community during the first days after the disaster. The lessons from the El Morro community can be useful for improving emergency management and disaster response in small-scale communities.

1. Introduction

The number of worldwide disasters has been increasing over the past two decades. Between 1996 and 2015, EM-DAT, the Emergency Events Database, recorded 7056 disasters globally, which caused the loss of more than 1.35 million lives [36]. Earthquakes killed more people than all the other types of disasters altogether, which claimed 750,000 lives in the same period [36]. The same database shows that tsunamis were 16 times more deadly than ground movements in terms of the proportion of victims killed per event. Chile is one of the most earthquake-prone countries in the world. At the end of 2017, The National Oceanic and Atmospheric Administration (NOAA) registered 192 significant earthquakes in the 498-year history of the country [82]. In the last century, one earthquake struck every 7.1 years, a frequency much higher than in Japan, California, Mexico, and other seismic areas [13]. Furthermore, the history of the country includes the largest earthquake ever recorded in the world, the great 1960 Valdivia earthquake and tsunami rating 9.5 M_W [26]. In the present century, 25 major earthquakes have been recorded in Chile, including the 2010 earthquake and tsunami, rating 8.8 M_W, the most powerful after the great 1960 earthquake [82].

The 2010 Chile earthquake and tsunami is considered the sixth largest earthquake ever recorded in the history of humanity. The disaster occurred on Saturday, 27 February 2010, at 03:34 a.m. local time. The epicentre was located off the coast of Maule Province in south-central Chile, with a magnitude of 8.8 M_W [106]. The earthquake triggered a series of tsunami waves that devastated many coastal areas of the country. It impacted Chile from Valparaiso to Araucanía region, which is home to 75% of the Chilean population and caused the death of 500 people [72]. The disaster caused damage estimated at US$30 billion; this represents 18% of the GDP of Chile [93]. Over 15,000 people lost their jobs [43] and more than 200,000 houses were destroyed or seriously damaged [92]. Basic services collapsed, including electricity, gas, water, and telecommunications making the scenario even worse for the affected population [89]. Deprived people suffered the most dramatic impact, people from the poorest income quintiles were affected by the major destruction of houses [70]. The tsunami was particularly devastating for the traditional small-scale fishermen; the livelihoods of more than 24,000 fishermen were directly or indirectly affected [67].

The long history of earthquakes in Chile could give the impression that the country was well prepared to respond to disasters. Yet, the

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2010 catastrophe showed that this was not the case [15]. The disaster revealed serious deficiencies in the national emergency warning system. The Chilean Navy made a mistake by not issuing a tsunami warning immediately after the earthquake [29]. The initial warning was cancelled by The Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) and announced on the radio by the president of the Nation [43]. This mistake was later admitted by the Defence Minister at that time [8]. The deaths of 156 people and the disappearance of 25 more could have been prevented by a prompt tsunami warning [18]. Additionally, the vague information and the central government's slow emergency response led to looting and breakdown in civic order in the first 24 h after the disaster, adding more stress to the already tragic situation [90].

Community resilience, understood as adaptive capacities to deal with disturbance [83] can counteract the negative impact of a disaster, especially during the first 72 h, known as the 'critical period' for disaster response [63,9]. In this period, external assistance can be limited or non-existent due to the mismatch of demand and supply of support. Therefore, communities have to rely on their own resources and resilience capacities to deal with such events. This was the case of the Chilean communities after the 2010 earthquake and tsunami. The absence of government response, the mistaken tsunami alarm, and the delay in aid delivery [94] forced communities to use their local resources to deal with the event [51, p. 18]. The activation of resilience capacities was crucial for the survival of the communities [47,51], especially in coastal areas. Despite the mistaken tsunami alarm, only 12 fishermen died. Moreover, most of these victims died while attempting to rescue other people in their boats [34, p. 9]. The small number of casualties in fishing communities was the result of the spontaneous activation of collective actions due to the government's slow response [53,75]. However, despite these facts, a research gap still exists regarding the process of activation of resilience capacities in small-scale communities. This paper addresses this gap by analysing the resilience capacities that are deemed as the most relevant for the survival of communities in disasters of great magnitude, particularly by identifying them and describing how they are deployed.

The case of the El Morro community, a small-scale fishing community located in Talcahuano region, was exceptional; the critical period for this community extended for more than five days. People survived at the top of a hill without any external help [77]. This was one of the few communities in Talcahuano - one of the regions most heavily affected by the disaster - that survived the impact of the tsunami entirely, as people dismissed the cancellation of the tsunami warning and evacuated to the closest hill in less than 20 min [75]. By using community resilience as a conceptual framework we explore the process of activation of resilience capacities in El Morro that allowed the survival of the entire community during the first days of the emergency response. The theoretical considerations are firstly introduced and then the data collection methods and analysis are described. The findings from the El Morro case study are then provided, leading to a discussion of the study's theoretical contributions, and practical implications for emergency responders and planners.

2. Community resilience in disaster management

The term 'resilience' originates in the Latin word *resilio*, which means 'to jump back' [58, p. 35]. Community resilience is "the ability of a social system to respond to and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as the post-event" [37, p. 599]. The concept of resilience became popular with the Hyogo Framework for Action (HFA) 2005–2015 which highlights the need to build the resilience of nations and communities to disasters and ways to achieve this [104]. Resilience has gained extensive acceptance in disaster management since then. In this context, resilience can be seen as spanning both, pre-event measures that seek to prevent hazard-related damage and losses,

and post-event strategies designed to cope with and minimise disaster impacts [22, p. 735]. Resilience is a term that will probably remain relevant in disaster management since the evidence shows that "resilient communities are far less vulnerable to hazards and disasters than less resilient places" [37, p. 601]. This can be observed in the agreement following the HFA, The Sendai Framework for Disaster Risk Reduction 2015–2030, which advocates for "investing in disaster risk reduction for resilience" [103].

Nonetheless, the growing popularity of the resilience concept has not been exempt from criticism. The inability of scholars to agree on a single definition causes confusion and ambiguity. There are some divergences about the use of resilience as either an outcome or a process [37,56,109]. Resilience can also be investigated at different levels: individual, community, organisation or ecosystem [16, p. 601], making it difficult to analyse and operationalise the term. A frequent criticism is that resilience is only an expression, complementing the use of other disaster terms, such as vulnerability or risk [66, p. 434] and adaptive capacity [37, p. 600]. Despite these divergences, there is a common understanding that resilience is essential for disaster management, including mitigation, preparation, response, and recovery [33]. Resilience is seen as cost-effective in saving lives, preventing and reducing losses and ensuring an effective recovery [103]. Resilience can also counteract people's vulnerability to disasters [110] and bring new opportunities and social changes to communities [75].

2.1. Resilience capacities at the community level

Community resilience is a process linking a network of adaptive capacities or resources to adaptation after a disturbance or adversity [83]; these resources have been conceived as inherent conditions of people and communities [19,60] that can be activated in the face of a disaster. Several frameworks have emerged proposing a variety of capacities, resources and/or characteristics of disaster-resilient communities (e.g., [22,37,54,101,105], 2008). Nevertheless, despite these efforts, challenges remain in the development of consistent factors or standard metrics that can be used to assess the resilience of communities [37, p. 598], and contribute to the development of operational tools for policy and management [58, p. 41]. At the community level, social capacities emerge as critical for dealing with disasters, including social networks [23,3], participation [12], organisation [57], and co-operation [10,14,4] as they allow collective action [31,32,88] towards the satisfaction of basic needs threatened by a disaster. However, these capacities are often overlooked by emergency planners, who often overemphasise the physical and economic aspects of resilience over the social ones [68,79].

Community responses to disasters around the world have shown the importance of resilience capacities to deal with emergency response, including the rescue and evacuation operations. In the case of the 1995 Kobe earthquake in Japan, neighbours were the ones who saved most of the victims. Some of the main remarkable activities carried out by the Kobe community were extinguishing fires, rescuing victims, followed by the establishment of a community kitchen and the provision of night guards [80]. Similarly, during the Hurricane Mitch in 1998, a group of women spontaneously organised rescue boats and established an emergency committee [45]. Community-based organisations enable people to respond to emergencies rapidly, efficiently and fairly [102, p. 51]. Collective and personal interests and needs are channelled through these organisations. Communities can define problems, prioritise and implement response measures accordingly to the cultural characteristics of an area [102]. After the 2000 Walkerton E. coli disaster in Ontario, Canada, one-third of the people involved in community activities indicated that they relied on community organisations for assistance during the crisis [79, p. 309]. Similarly, during the 1994 Northridge earthquake in California, Bolin and Stanford [17, p. 22] found that local organisations provided assistance to vulnerable households with unmet needs.

Collective actions during the response period are usually embedded with principles of cooperation and solidarity [21,48,71,74]. A study conducted after the 2004 tsunami in the Ampara District, Sri Lanka found that people helped each other more and cooperated more with social organisations and other communities right after the disaster struck [71, p. 553]. Moore et al. [74] observed the innumerable accounts of 'neighbours helping neighbours' in the aftermath of 1999 Hurricane Floyd, United States. Likewise, in the context of the 2004 tsunami in Thailand cooperative actions were observed such as debris removal, beach clean-up, repair of damaged fishing gear and temporary housing repair [10, p. 310]. In flood management the Netherlands provide strong examples of citizen participation, volunteerism, and commitment [62]. During the winter storms in 2014 in the UK, examples of cooperative actions included neighbours checking in on each other, particularly if they were elderly [46].

The evidence shows that communities with strong networks face disasters in a better way during the response and recovery periods [27,3,41,85]. Nakagawa and Shaw [80] explored the vital role of social capital in managing and recovering from the earthquakes in Gujarat, India in 2001 and Kobe, Japan in 1995. Similarly, in the context of the 1934 Kathmandu Valley earthquake in Nepal, Bhandari [14] found that people relied on social networks at different stages of the earthquake response and recovery. Correspondingly, a study carried out after Hurricane Katrina concluded that residents, especially those with low incomes, relied on all levels of social capital for individual, family, and community survival [50]. The role of community leaders has also been found to be the most effective in utilising social capital after a disaster and in facilitating collective decision-making [80, p. 5]. However, community resilience may not always lead to positive outcomes. For example, socially isolated individuals who lack social networks are less likely to be rescued, seek medical help, take preventative action, or receive assistance from others [42]. Furthermore, community cohesion in disaster response may encourage members to remain in vulnerable locations because they have a false sense of security or desire to maintain community solidarity [85].

Despite the pivotal role of community resilience during emergencies, local capacities are usually overshadowed by emergency planners and responders who tend to operate through a top-down approach [40]. Community members are a natural support system with many advantages over external providers [59]. Therefore, their participation should be considered actively during the emergency management [107,79,86] and recovery process [61]. Understanding the capacities triggered in communities in the absence of external support could provide key insights into better emergency management practices that consider community members as active decision-making agents.

3. Study design

3.1. Case selection

El Morro, a small fishing community located in the Talcahuano region, on the south-central coast of Chile, was selected as a case study. El Morro is a low-income community comprising around 170 families with a population of over 550. The majority of families have been involved in fishing for many generations. Fishermen develop a small-scale fishing practice, most of them working as traditional fishermen in their small boats [77]. The community was founded at the beginning of the 20th century and owes its name to the fact that is located at the foot of the hill called El Morro. Its location, facing the sea on the Concepcion Bay, was the perfect place for fishing but not for resisting a tsunami (see Fig. 1). The totality of houses and fishing boats were swept away by the tsunami waves in 2010 [75]. However, despite this fact, there were no reported casualties.

El Morro is one of the few coastal communities in the country in which all residents survived the tsunami impact despite the mistaken emergency alarm. Local authorities from Talcahuano called off a

tsunami alert and erroneously advised people to return home informing that there was no tsunami risk. Consequently, many people who were in the hills of Talcahuano came back to their houses, where they died [76]. Official records show that the first tsunami wave crashed the coast of Talcahuano within 18 min after the earthquake, at 3:52 a.m. [82]. Yet, people from El Morro dismissed the cancellation of tsunami warning and in less than 18 min evacuated to the closest hill, where they survived.

The unique nature of the El Morro community led us to define a single case methodology [111]. The *how* and *why* questions of the resilience process [111] were examined in the specific context of the case [1, p. 66]. A qualitative approach was used to enquire the resilience capacities activated during the emergency period. People's 'lived experiences' were explored to understand the survival of the community during the first days of the response period. The inductive nature of the research involved the analysis of the hidden meanings of resilience and how participants make sense of them which led us to the discovery of a pattern of resilience in the disaster event.

3.2. Data collection

The data was collected within six months through methods based on semi-structured interviews, observation, informal conversations, documentary review, and social media. According to Yin [111, p. 14], case study inquiry relies on multiple sources of evidence, where data need to converge in a triangulation fashion. The use of different methods increased the validity of the study [1] and enabled methodological triangulation [39]. Before beginning the data collection, ethical approval was granted from the research ethics committee in which the study took place.

Semi-structured interviews were the main data collection method for the case study [1]. Purposive sampling [6, p. 183] was used to select the research participants. The inclusion criteria for the participants required people who had experienced the disaster while living in El Morro and who had remained in the community for at least three months after the event. Participants who did not meet the inclusion criteria were not invited to take part. Key informant technique [99] was used to access to the community and to learn about its culture prior to fieldwork. The first author (JM), approached two officers from Talcahuano municipality who worked during the emergency period in El Morro. They provided the contact details of two community leaders who helped the researcher find knowledgeable and reliable participants most efficiently [95]. Additionally, a *snowball* technique [6] was used to identify other participants who had not been mentioned by the key informants in order to achieve a high degree of interpretation from multiple sources [99].

In total, 32 semi-structured interviews [64] were conducted with 20 female and 12 male participants ranging in age from 20 to 82 years. All the interviews were conducted once by the female researcher (J.M), who had five years of qualitative research experience and three years of working experience with people in crisis situations. Thirty interviews took place in the participants' homes and two in a community centre. Using participant's homes as an interview setting [49] provided a more comfortable and friendly environment for the participants. Interviews were audio-recorded and lasted between 45 and 90 min. All participants were informed of the purpose of the study, assured of confidentiality, and provided written informed consent agreeing to participate in the study. A semi-structured topic guide [55] was used in all interviews which encompassed three main topics and 20 predetermined questions that extensively covered the objectives of the study, including the impact of the disaster (e.g., physical and economic damage), collective actions (e.g., rescue operations), and resilience capacities (e.g., organisation and cooperation). The interview guide was adapted during the research process to include new topics suggested by the participants [44]. The questions were formulated with words familiar to people to facilitate an understanding of informants' perspectives and experiences
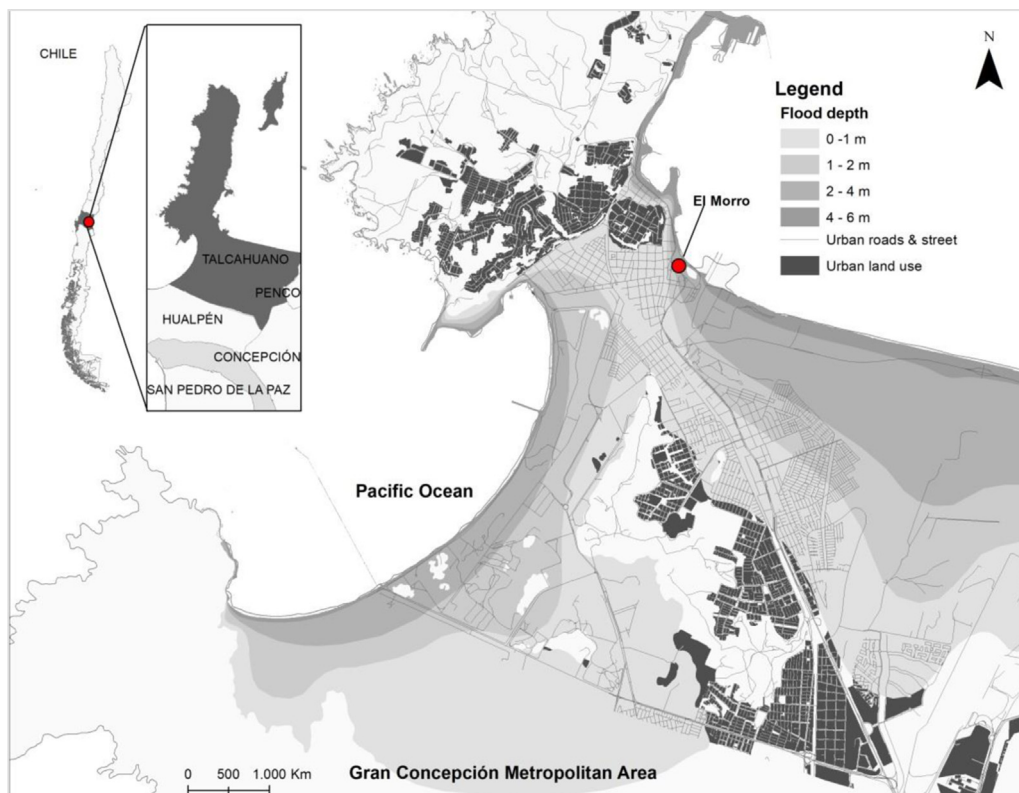
Fig. 1. Flood hazard map for the 2010 tsunami event in Talcahuano city and El Morro. Source: Based on data from SHOA and UGIT GORE Biobío, developed by Matías Medel.

of the disaster expressed in their own words [97, p. 98].

Direct observation [44] was applied during and after the interviews by one researcher (JM) to observe other aspects of the community that were not covered by the interviews such as daily routines, social interactions, and physical settings. This contributed to understanding people's actions and behaviour [78] during the emergency. Field notes were written to record observations and reflections of the interviews. As an alternative to this, the field researcher (JM) engaged in 'incidental ethnographic encounters' [7] which involved the use of informal conversations as sources of data. They provided insights and meanings that could not be obtained in an interview setting [65, p. 106], such as social conflicts and emotional narratives. Furthermore, they took place mainly during the field visits and emerged spontaneously after the interviews or when the researcher was walking in the community. In order to keep the spontaneity and flow of these conversations they were not recorded, but field notes were made. Twelve informal conversations took place and they varied in length, from 15 to 120 min.

Documentary sources [91] were used to contrast and verify the primary data obtained from the interviews and informal conversations. These sources included 4 municipal reports, 12 newspaper publications, 50 digital photographs and 3 video clips related to the emergency period in El Morro. Online resources from social media [7, p. 196], particularly *Facebook* and *YouTube* were valuable sources of data. El Morro community created a *Facebook* group called "Yo soy Morrino[1]" (I am from El Morro) where people shared stories, pictures and activities before and after the disaster. *YouTube* videos allowed us to observe the first days after the disaster as a Peruvian talk show reported the event in situ [28].

3.3. Data analysis

The data collected from transcriptions, field notes, documents and social media were subject to a qualitative examination using an inductive thematic analysis approach, whereby the codes and themes emerged from within the data [20]. In the first stage of analysis, we applied an open coding process in which we segmented the data into broad themes [35]. For example, sharing food was coded under a theme called "solidarity". Similar codes were then grouped around categories and sub-categories. We then refined our categories by conducting axial coding which identified links between the categories and led us to find similarities and differences across the data. The final step involved a selective coding process which enabled us to identify the dominant themes leading to the formulation of the story of the case [44]. To increase the validity of the methods and findings, we used the consolidated criteria for reporting qualitative research (COREQ) [98]

4. Findings

Five main themes emerged from the resilience capacities and were identified from the data analysis: (i) local knowledge; (ii) sense of community; (iii) social capital; (iv) cooperation and organisation; and (v) trust. Additionally, we provide a general contextualisation of the issues that influenced the process of activation of these capacities and coping strategies, comprising the mistaken tsunami alarm, the absence of external aid, and looting. The themes are described in the following section with illustrative data excerpts, including interview quotes and field notes from observation and informal conversations. Pseudonyms are used to safeguard the anonymity of research participants.

4.1. Self-evacuation: mistaken tsunami alarm versus local knowledge

Local knowledge is what the residents know about natural hazard

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[1] The demonym of the inhabitants of El Morro is "Morrinos".

risks and what they believe and do about them in a given situation [38, p. 5]. After the earthquake struck Talcahuano, people in El Morro immediately felt the danger of an imminent tsunami and evacuated to the hill. Pedro, a 56-year-old fisherman, recalled: "I could not stand up, it was so strong, I cannot forget it…I opened the window of my house and I started shouting at my neighbours, Go to the hill! Go the hill!" At the same time, *Morrinos* heard the mistaken announcement from authorities who were calling off the tsunami alert by loudspeakers. Ana, a mother of two, recounted: "They told us to return home because there was no tsunami danger but we did not listen to them and run away". They completely relied on the experience of their fishermen and ignored this official alarm. As Juan, a 55-year-old fisherman, said: "We did not believe in this alarm, we knew that a tsunami would come… we are fishermen, so we know the sea". This knowledge made fishermen almost instinctively go to the coast and observe the 'behaviour of the sea' after the earthquake. Manuel, one of the most experienced fishermen in El Morro, described: "We checked out that no one stayed in the community and we went to observe the sea, the water level drop and we heard a loud roaring sound from the ocean, I knew that something bad will happen". Fishermen also had specialised knowledge related to the tsunami danger period. They were aware that the first tsunami wave may come within minutes or even after several hours. Daniel, a 40-year-old fisherman, reported: "We were aware that the earthquake would bring a tsunami, we did not know when; it could be immediately or after many hours, but it would come". This specialised knowledge proved to be right. According to official reports, at least four tsunami waves arrived in Talcahuano at different times between 03:52 a.m. and 06:40 a.m. [82]. *Morrinos* reported that they remained together on the hill and did not come back home until the afternoon of the next day when the tsunami danger had passed.

The importance of local knowledge has also been highlighted in other disasters [52,69]. For instance, indigenous knowledge was crucial for the survival of residents of Tikopia Island struck by 2002 Cyclone Zoe [5]. Interviewees in El Morro reported that it was their trust of their own knowledge that saved their lives. Patricia, a mother of three, described: "In other communities, people died because they followed the warning from authorities: 'Go back home, there is no tsunami risk!' So people went back home and died. In El Morro, no one returned to their houses until the next day and no one died…" Neighbouring non-fishing communities had access to the same hill as El Morro but did not use it as an evacuation zone. Unlike El Morro, people from those communities remained in their houses or ran away to other sectors, which brought deadly consequences. Fishermen in El Morro feel proud of the expertise they demonstrated after the earthquake despite the mistaken alarm. "No one died in El Morro" is the common phrase that is proudly repeated by *Morrinos* any time when they share their stories about the disaster.

4.2. Collective memory of past disasters and emergency response protocol

Remembering disasters helps to increase risk awareness and builds resilience for future disasters [108]. The strong collective memory of past events was part of the local knowledge that contributed to the survival of the El Morro community. The warning that after a major earthquake strikes, people have to evacuate to high ground has been transmitted from one generation to another. Karen, a mother of two, recalled: "I remember that our parents always told us: 'When a strong earthquake comes that it does not allow you to stand on your feet, you have to run away immediately to the hill, and you do not have to come back home". The tsunami risk was very well known by people, as Julian, a 52-year-old fisherman, informed: "We knew that someday a tsunami would come here". *Morrinos* grow up with the awareness of a tsunami risk because their parents and grandparents transmitted them their experiences of past earthquakes. This coincides with reports following the 2004 Indian Ocean tsunami that indicated that groups of fishing people in Andaman Islands and Sumatra had a social memory of

tsunamis that was used to avoid fatalities [2]

El Morro was hit by two other major earthquakes that affected the country in the past century, the 1960 Valdivia earthquake (9.0 M_w) and the 1985 Algarrobo earthquake (8.0 M_w). In both disasters, *Morrinos* evacuated to the hill and, similarly to the 2010 disaster, there were no casualties. They have memories of the timely reaction of fishermen in these past events. Francisco, a 55-year-old fisherman, gave an account of his experience in the 1960 and 1985 earthquakes: "In 1960, we had a tsunami and all of us ran away to the hill and in 1985 we had another one and we also went to the hill… and as usual, fishermen were waiting on the beach, observing the sea level". They also remember that the tsunami in 1960 did not come immediately. Jacinto, a 54-year-old fisherman, recalled: "In 1960 all day had passed and the sea did not come, it came in the afternoon of the next day". The delay of the first tsunami wave in 1960 was the experience that gave *Morrinos* the knowledge about the tsunami danger period which led them to wait in the hill until the next day in 2010. The community actions carried out by *Morrinos* in these events led them to develop an orally transmitted 'Community Emergency Response Protocol' which included specific procedures for a safe reaction to earthquakes and tsunamis. This protocol was part of the daily conversations. Liliana, a 37-year-old mother of three, described: "In my family, we always talked about what to do in case of earthquakes; we have to run away to the hill, we will meet there". Through memory, disasters become a shared past and can enhance social identity [108]. The culture of disaster preparedness in El Morro was the most distinctive resilience capacity perceived by the interviewees in the first hours after the disaster. This protocol was also accompanied by certain specific actions such as shutting off electricity and gas, and picking emergency supplies such as blankets, tents, food, water, and flashlights.

4.3. Rescue operations: sense of community and social capital

Rescue operations were facilitated by a strong sense of community and tight-knit networks. People knew exactly who lived in every house in El Morro. Maria, a mother of two, declared "We know each other very well; if you are looking for someone, we will help you find the person, we can take you to the house where the person lives… we know who lives here and who does not". Interviewees reported that without this knowledge, it would have been impossible for them to rescue all the neighbours. Rescue operations in El Morro show a similar pattern to those reported during the 1995 Kobe earthquake in Japan where most of the victims were saved by neighbours [80, p. 12]. Many neighbours in El Morro were trapped in their houses because the doors were jammed after the earthquake. Many women were alone because their husbands were fishing on the high sea. *Morrinos* put their lives at risk by rescuing them, as it can be observed from the words of this woman: "After my husband, along with other neighbours rescued my mum, he said 'Go to the hill!'; 'I said yes, but you have to come with us'… He told me that he could not come with us because he could hear people trapped in their houses because they could not open their doors; they were shouting and pleading for help…I cried and I told him 'But you have to come with us! You always say that we are a family!' He went to rescue a pregnant woman who was alone with her mum; they could not open the door, so they had to rescue her through the window" [77, p. 59].

Rescuing a pregnant woman is just one example of the sense of community that arose in the middle of the emergency. There are also other examples that were registered such as helping elderly and disabled people to arrive at the hill. Oscar, a 52-year-old fisherman, recounted: "In our community, we have many elderly and we had to look after them, we took elderly people in cars to move them faster to the foot of the hill, we picked blankets to keep them warm at night". To ensure that all the people were evacuated, the most experienced fishermen checked several times in each house of the community. Manuel, a 63-year-old fisherman, declared: "We did not leave the community

until all our neighbours were safe on the hill; we went down many times to double check the houses, shouting to see if someone was inside". Once on the hill, the leader of the Neighbourhood Council, Cristian (a 58-year-old fisherman) tried to verify that all people were alive and safe by using a counting system. In his words: "We were at the top of the hill, there were 600 people approximately, all the families and… I do not like to remember it… [tears in his eyes] and I stood up in the fort and I said to my neighbours 'Families of El Morro, count yourselves in order to see if we are all here or if someone is missing', so each family was counted one by one…. Then, we calculated and we were all safe, no one was seriously injured, some neighbours had only minor injuries, but no one died".

Bonding social capital prevailed over bridging and linking during the rescue operations. This was characterised by strong family bonds and positive ties of friendship that contributed to increasing the sense of community. Hawkins and Maurer [50] found similar results following Hurricane Katrina. They found that bonding social capital was important for immediate support. This also coincides with Bhandari [14] in the context of the 1934 Nepal earthquake. The closeness in the El Morro community is so marked that people even identify themselves as 'a big family'. As Eliana, a 45-year-old housewife, said: "We are a world apart, we are not like other communities where people fight or do not know each other, we are friends, we are a big family". The common fishing practice and low rate of emigration from the community have preserved strong social ties. This created positive relationships among neighbours leading to efficient evacuation and rescue operations. Mario, a 63-year-old fisherman, explained: "The fact is that we have lived here our entire lives, we work and live here, so we know our community very well, I risked my life to save my family, friends, neighbours because they are all my family".

4.4. Absence of external aid: cooperation and organisation

The successful evacuation and rescue operations revealed the level of preparedness of the community when facing disasters. Evacuating to the hill was part of the protocol orally transmitted from one generation to another. However, people did not have any protocol for facing the aftermath of the 2010 earthquake. They expected the tsunami to flood the houses as it happened in the previous disasters. In 1960, the tsunami waves were only one-metre high and the houses resisted: "none of the houses fell", as one of the interviewees recalled. Yet, in 2010 the waves reached heights of 2,34 m (7,7 feet) [82]. Houses completely collapsed and many of them were washed away hundreds of meters from their original location. Community leaders went to Talcahuano municipality to ask for help, but they found the municipal building and the city centre destructed by the tsunami. Adrian, a 56-year-old fisherman, recounted: "By chance, I met the mayor, who was greatly affected, he told me: 'Look at me, I do not know what to do', I had to accept the sad reality: we were alone and without any hope of receiving help". Interviewees reported that they did not receive external assistance until five days after, therefore, they had to organise themselves: "I immediately told my people: 'We have an emergency; we are all in shock, but we have to organise ourselves…'" These were the first words of Cristian, the president of the Neighbourhood Council once he realised that the arrival of external aid would take a long time.

People were starving and they did not have food because the tsunami swept away all their provisions. Cooperation emerged as a spontaneous survival strategy. Searching for food and drinking water was the first task undertaken. This task was organised by gender. Men were in charge of searching for food and drinking water, while women remained on the hill looking after their children [75]. Men of diverse ages went down to the community and dug through the rubble to find food as well as blankets and medicines. Rodrigo, a 45-year-old fisherman, recalled: "Our possessions were bogged down in mud and scattered on the beach, we could only rescue some dishes, cutlery, and a few provisions, but these were not enough for feeding people". Finding

drinking water was even more difficult. The water supply was cut off because the power plants were damaged due to the disaster. *Morrinos* went to ruined seafood companies to find water storage tanks. Alan, a 45-year-old fisherman, recounted: "I was desperate for water and I looked at all seafood companies but the tanks were empty…Then, I found one, I was so happy, then I informed my people and they came with buckets to collect water". *Morrinos* were able to work together for a common benefit: survival. Similar findings on cooperation were also observed by Minamoto [71] in the aftermath of the 2004 tsunami in Sri Lanka; during the 1995 Kobe earthquake in Japan [80, p. 16]; and in San Pedro de la Paz, after the 2010 Chilean earthquake [48].

People were desperate for food and went to destroyed shops to get basic items such as milk for children, flour, sugar, rice, pasta and other essential goods including diapers and medicines for collective consumption. They also went to fishing companies to take canned fish and seafood. The interviewees reported that the food collected was approved for community consumption. Women quickly organised the food items and installed a very basic community kitchen. Similarly, during floods in Prakasam District in India, community kitchens were used to feed the victims [81]. Nevertheless, the community kitchen in El Morro was insufficient to feed the people, so they had to prioritise and allocate the scarce resources according to general criteria. Lorena, a 45-year-old woman, described: "We distributed the food by family, paying special attention to the elderly, pregnant women, and children… we thought of the worst scenario in which the external aid would take a very long time, so we had to ration the food and reduce the daily intake at a minimum level… it was so critical that one day we had to survive with one spoon of rice". The food scarcity was depressing. However, this was not an impediment to showing solidarity with others. They shared whatever food they had. As Karin, a 35-year-old mother of one, said: "…even if we had just a few things, we shared them, sugar, coffee, rice…"

4.5. Looting and chaos: trust, security guards, and emotional support

The vague information and the central government's slow emergency response led to looting and crime in the first 24 h after the disaster throughout the most affected regions of the country [30]. People in El Morro were concerned about outsiders coming into their community to loot. In this uncertainty and fear, *Morrinos* reported that they had to take quick actions to protect their community and their scarce supplies. They organised groups of men who had to play the role of security guards. They applied a 24-h shift system in order to protect the community all the time. These guards were armed with improvised weapons, mostly sticks, and knives. The self-defence weapons were considered dangerous, as Alicia, a 45-year-old mother of three, reported: "It was taken to the extreme; they even attached knives to one end of the sticks for protection". But for others, this action was justified. Mauricio, a security guard, reported: "Nothing is extreme when it comes to defending your family". Security guards were located at strategic points of the community in order to control all possible entrances to the hill. Carlos, a security guard, described: "We organised ourselves by groups; there was one group down, and others were located in the corner and at the main entrance of the hill…every time we saw an outsider we had to ask them: 'What are you doing here? Where are you going? Which family are you going to visit?' … We had to work different shifts… We could not sleep, even if we did not have to work, we woke up many times at night with our flashlights, we were afraid that someone could come". Fortunately, no mobs attacked the community, as it occurred in other cities. Despite this fact, the security guards in El Morro played an important role in the maintenance of peace and security inside the community.

The disaster and looting had a psychological impact on people; they did not receive mental health support after several days. Thus, their only support was their "own neighbours" and" trusting each other". This finding is compatible with the positive relationship between

mutual help and trust reported by Cassar et al. [25]. Leticia, a 52-year-old mother of two, recalled: "We did not have material goods but we had each other, the strongest became the therapists for those who were more affected… we suffered the same problems and we supported each other". Likewise, in the 2000 Walkerton E. coli disaster in Ontario, Canada, people reported that they relied mostly on strong ties with family and friends for support during the emergency [79, p. 309]. This generated a more powerful sense of community; "we are not alone, we are together" were the words they continuously used to describe that period. The most memorable moment by the interviewees was when a group of neighbours decided to sing the community anthem in front of the television cameras of the Peruvian talk show [28]. The recording shows that they sang the anthem passionately, loudly and proudly. They informed that they wanted to demonstrate their strength in the middle of difficulties. The sense of community reached its peak of expression in the first days of the emergency.

5. Discussion and Conclusions

The primary purpose of this paper was to analyse the most relevant resilience capacities that were activated to help cope with the 2010 earthquake and tsunami in Chile. The case study of El Morro showed that resilience capacities – including local knowledge, sense of community, cooperation, organisation, social capital, and trust – contributed to a successful evacuation and rescue operation. Our findings expand the current understanding of community resilience by observing how these capacities were unfolded in a small-scale community, and the critical role played by resilience in the survival of the community. This fills an important gap in the literature.

5.1. The process of activation of resilience capacities

Resilience capacities can be understood as those resources activated to cope with and recover from disasters. Our case showed that some capacities acted as a catalyst for other resilience capacities, including social capital and local knowledge, which unveiled the dynamic nature of resilience. Social capital can facilitate the mobilisation of resilience capacities and therefore, promote the collective action to deal with the new tasks originated from a disaster. Dynes [41, p. 7] highlights that social capital is the form of capital that serves as the primary base for a community response. Our case indicates that bonding social networks were predominant during the emergency support; it was helpful to promote a sense of community, trust, and cooperation among neighbours. People relied on their strong community ties to evacuate, to rescue neighbours, to organise community kitchens, security guards and to provide mutual emotional support. Social capital triggered the organisation of people that helped keep the control inside the community but more importantly, they constituted formal spaces where the needs of people (food and water) were channelled. This coincides with Twigg [102] and the idea of communities as problem-solving entities in the context of disasters. Cooperation was also intrinsically connected to social capital. The acts of solidarity amongst neighbours were crucial for the survival of people and for keeping the sense of community and union. This sense of community was also encouraged by the formation of strong bonding social capital. People looked after each other and kept a sense of union and collaboration during the evacuation and rescue operations. Sense of community refers to an attitude of bonding (trust and belonging) with other members of one's group or locale, including mutual concerns and shared values [87]. This bonding attitude in El Morro led to an increased sense of trust among neighbours. People trusted in the knowledge of their fishermen rather than the mistaken tsunami alarm raised by authorities. Trust also contributed to collaboration and mutual support, both emotionally and materially.

Local knowledge was one the most remarkable resilience capacities in El Morro. Fishermen's experience and the collective memory of past disasters literally saved the lives of *Morrinos*. Fishermen were able to

notice warning signs of the tsunami which encouraged a quick evacuation to the hill. The successful evacuation of El Morro and strategies applied by fishermen validated the local knowledge accumulated over nearly 50 years. Furthermore, local knowledge acted as a catalyst capacity in the immediate emergency period because it activated other resources such as cooperation, organisation, social capital, and trust. Learning to live with uncertainty requires building a memory of past events which can increase the capability to learn from crisis [11]. This was observed in the orally transmitted emergency response protocol existing in El Morro before the disaster. The beliefs about the risk of tsunami and how to react were transmitted generation to generation and became a 'disaster belief system' validated by the entire community.

5.2. The social nature of resilience

The resilience capacities found in El Morro relate to the social components of communities. This finding suggests the social and intangible nature of resilience. Although the value of social resources for coping with and recovering from disasters has been observed in the literature, there is still a reticence to invest in those resources for emergency planning. Both social and physical resilience interact to withstand and adapt to disasters. However, most of the disaster risk reduction programmes focus on investing in physical resilience, including both natural environment and built systems [96]. While material-based assistance is important, it will not contribute in itself to long-term resilience in communities [3]. Investment also goes into increasing the response capacity in local government and other agencies, but limited resources are allocated to strengthen the capacities of communities at a micro-scale. The primary level of disaster risk reduction is based on neighbourhoods or villages, as they have the primary knowledge of their own risks and capacities [110]. El Morro revealed that social capacities were crucial for the survival of the entire community. Nevertheless, difficulties arise in measuring this type of capacities; social and subjective indicators are usually dismissed in disaster impact measures [84] which is probably the main hindrance to promoting social resilience in disaster risk reduction programmes. Our qualitative research allowed us to observe the dynamic of these capacities by unveiling community understanding of the resilience phenomenon and the meaning they assigned to it. Yet, quantitative measures of these capacities can complement qualitative evidence.

Our case showed that disasters of great magnitude can pose extreme challenges for communities; the absence of external aid, the mistaken tsunami alarm, and the destruction of houses and local agencies buildings was the context faced by the El Morro community. In this extreme context, where no material goods were left, people were more likely to put into action their shared knowledge to survive and recover from the event. In these conditions, it is more likely to use social resilience capacities which may be more readily available than material ones. People at risk do make rational choices about protecting themselves from disasters [100, p. 20], and the survival of people from El Morro is an example of this. Yet, this does not release the government from responsibility for providing assistance to people. El Morro was able to survive during the first days without external aid, but their needs were barely satisfied. People did not have enough food nor water, and they also required other emergency supplies such as clothes and medicines. Social resources proved to be the foundation for resilience and recovery, at least on the same scale as material resources [3]. Therefore, material and social resilience are complementary and necessary to reduce the impact of a disaster, but promoting social resources could increase the survival chances for communities during the critical hours after a disaster.

5.3. Communities are active agents

Community resilience can be observed in the set of capacities

mobilised after the impact of a disaster. Social resilience can reduce people's vulnerability to disasters by the activation of local resources which could eventually reduce human losses and damage after a disaster event. The activation of social capacities in El Morro demonstrates that communities can take concrete actions to deal efficiently with disasters. This breaks the traditional paradigm of seeing communities as merely passive victims or 'recipients of aid': communities are active agents. This implies that communities define their own capabilities [110] as well as how and when to activate them. Communities have the potential to become resilient. Resilience capacities are likely to vary from one context to another but; theoretically, a community always has these capacities. This suggests that resilience has an inherent nature [60], and everyone has some capacities for resilience [110].

Resilient communities at the local level need to have capacities to withstand external shocks and to sustain the local dwellers before the arrival of external aid [96, p. 1129]. Yet, not everyone can activate their inner resilience due to vulnerability conditions and limitations of access to resources. This has profound policy implications as efforts should be directed not only to identify local resilience resources but also to counteract the conditions and factors that can block their activation. Then, it is important to consider the pattern of access to both tangible and intangible resources [24]. This can be cost-effective in saving people's lives, as we observed in this case. Morrow [73, p. 11] emphasises that planners and managers who make full use of citizen expertise and energy will more effectively improve both safety and survival chances of their communities. A bottom-up approach could guide this process by integrating people's capacities in disaster risk reduction planning from a local level. This can bring more contextualised programs to the real needs of communities. People are a support system which can contribute to the development of more resilient and sustainable communities.

Acknowledgements

References

[1] I. Aaltio, P. Heilmann, Case study as a methodological approach, in: E. WIebe, G. Durepos, A.J. MIlls (Eds.), Encyclopedia of Case Study Research. SAGE Publications, Thousand Oaks, United States, 2010.
[2] W.N. Adger, T.P. Hughes, C. Folke, S.R. Carpenter, J. Rockström, Social-ecological resilience to coastal disasters, Science 309 (2005) 1036–1039.
[3] D.P. Aldrich, Building Resilience: Social Capital in Post-Disaster Recovery, University of Chicago Press, Chicago, 2012.
[4] D.P. Aldrich, The power of people: social capital's role in recovery from the 1995 Kobe earthquake, Nat. Hazards 56 (2011) 595–611.
[5] L. Anderson-Berry, C. Iroi, A. Rangi, The Environmental and Societal Impacts of Cyclone Zoe and the Effectiveness of the Tropical Cyclone Warning Systems in Tikopia and Anuta. Report for the Centre for Disaster Studies, James Cook University, Cairns, 2003.
[6] E.R. Babbie, The Practice of Social Research, Wadsworth Publishing Co Inc., Belmont, CA, United States, 2004.
[7] R.S. Barbour, Introducing Qualitative Research: A Student's Guide, Sage Publications Ltd, London, United Kingdom, 2014.
[8] BBC. Chile Troops Tackle Earthquake Looters [Online]. BBC News, 2010. Available: ⟨http://news.bbc.co.uk/1/hi/world/americas/8542789.stm⟩ (accessed 14 February 2016).
[9] M. Benson, K.L. Koenig, C.H. Schultz, Disaster triage: START, then SAVE – a new method of dynamic triage for victims of a catastrophic earthquake, Prehosp. Disaster Med. 11 (2012) 117–124.
[10] P.R. Berke, R. Chuenpagdee, K. Juntarashote, S. Chang, Human-ecological dimensions of disaster resiliency in Thailand: social capital and aid delivery, J. Environ. Plan. Manag. 51 (2008) 303–317.
[11] F. Berkes, Understanding uncertainty and reducing vulnerability: lessons from resilience thinking, Nat. Hazards 41 (2007) 283–295.
[12] F. Berkes, N.J. Turner, Knowledge, learning and the evolution of conservation practice for social-ecological system resilience, Human. Ecol. 34 (2006) 479–494.
[13] A. Bernal, Earthquake Engineering, in: Proceedings of the Tenth World Conference on Earthquake Engineering, Madrid, Spain, Taylor & Francis, 19–24 July, 1992.
[14] R.B. Bhandari, Social capital in disaster risk management; a case study of social capital mobilization following the 1934 Kathmandu Valley earthquake in Nepal, Disaster Prev. Manag. 23 (2014) 314–328.
[15] S. Bitar, Doce lecciones del terremoto chileno. Estado, gobierno, gestión pública: Revista Chilena de Administración Pública, (In Spanish), 7–18, 2010.
[16] H.J. Boon, A. Cottrell, D. King, R.B. Stevenson, J. Millar, Bronfenbrenner's bioecological theory for modelling community resilience to natural disasters, Nat. Hazards 60 (2012) 381–408.
[17] R. Bolin, L. Stanford, The Northridge earthquake: community-based approaches to unmet recovery needs, Disasters 22 (1998) 21–38.
[18] P. Bonnefoy, Chilean Judge Upholds Manslaughter Charges Linked to 2010 Tsunami, The New York Times, May 16, 2013.
[19] E. Boyd, H. Osbahr, P.J. Ericksen, E.L. Tompkins, M.C. Lemos, F. Miller, Resilience and 'climatizing' development: examples and policy implications, Development 51 (3) (2008) 390–396.
[20] V. Braun, V. Clarke, Using thematic analysis in psychology, Qual. Res. Psychol. 3 (2006) 77–101.
[21] R. Brouwer, J. Nhassengo, About bridges and bonds: community responses to the 2000 floods in Mabalane District, Mozambique, Disasters 30 (2006) 234–255.
[22] M. Bruneau, S.E. Chang, R.T. Eguchi, G.C. Lee, T.D. O'rourke, A.M. Reinhorn, M. Shinozuka, K. Tierney, W.A. Wallace, D. Von Winterfeldt, A framework to quantitatively assess and enhance the seismic resilience of communities, Earthq. Spectra 19 (2003) 733–752.
[23] E. Buikstra, H. Ross, C.A. King, P.G. Baker, D. Hegney, K. Mclachlan, C. Rogers-Clark, The components of resilience-perceptions of an Australian rural community, J. Community Psychol. 38 (2010) 975–991.
[24] T. Cannon, Vulnerability analysis and disasters, in: D. Parker (Ed.), Floods, Routledge, London, 2000, pp. 43–55.
[25] A. Cassar, A. Healy, C. Von Kessler,, Trust, Risk, and Time Preferences After a Natural Disaster: Experimental Evidence from Thailand, University of San Francisco Working Paper, 2011.
[26] H. Castaños, C. Lomnitz, Earthquake Disasters in Latin America: A Holistic Approach, Springer, United States, 2012.
[27] E. Chamlee-Wright, V.H. Storr, Social capital as collective narratives and post-disaster community recovery, Sociol. Rev. 59 (2011) 266–282.
[28] Chile Se Levanta, Reportaje Laura en Talcahuano, Chile después del Terremoto Parte 4 de 4, Canal Azteca [Online], 2010. Available: ⟨https://www.youtube.com/watch?V=xCeW2VqNlyM&src_vid=qglyC3AAUmI&feature=iv&annotation_id=annotation_565544⟩ (accessed 12 June 2017).
[29] CIPER. Tsunami paso a paso: los escandalosos errores y omisiones del SHOA y la ONEMI [Online]. Centro de Investigación Periodística CIPE, 2012. Available: ⟨http://ciperchile.cl/2012/01/18/tsunami-paso-a-paso-los-escandalosos-errores-y-omisiones-del-shoa-y-la-onemi/⟩(accessed 11 February 2018).
[30] CNN. In Chile, Looters are Leaving the Biggest Aftershocks [Online], 2010. Available: ⟨http://edition.cnn.com/2010/WORLD/americas/03/01/chile.earthquake.obrien/⟩ (accessed 22 January 2018).
[31] COAG. National Strategy for Disaster Resilience [Online]. Australi, 2009. Available: ⟨https://www.coag.gov.au/sites/default/files/national_strategy_disaster_resilience.pdf⟩(accessed 18-12 2015).
[32] E. Coles, P. Buckle, Developing community resilience as a foundation for effective disaster recovery, Aust. J. Emerg. Manag. 19 (2004) 6–15.
[33] L. Comfort, A. Boin, C. Demchak, Designing Resilience: Preparing for Extreme Events, University of Pittsburgh Press, Pittsburgh, Pa, 2010.
[34] M. Contreras, P. Winckler, Pérdidas de vidas, viviendas, infraestructura y embarcaciones por el tsunami del 27 de Febrero de 2010 en la costa central de Chile, Obras. Y Proy. 14 (2013) 6–19.
[35] J.M. Corbin, A.L. Strauss, Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory, Sage Publications, Inc, Thousand Oaks, United States, 2008.
[36] CRED, Poverty & Death: Disaster Mortality 1996–2015, The Centre for Research on the Epidemiology of Disasters, 2015.
[37] S.L. Cutter, L. Barnes, M. Berry, C. Burton, E. Evans, E. Tate, J. Webb, A place-based model for understanding community resilience to natural disasters, Glob. Environ. Change-Hum. Policy Dimens. 18 (2008) 598–606.
[38] J. Dekens, Local Knowledge for Disaster Preparedness: A Literature Review, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal, 2007.
[39] N.K. Denzin, The Research Act: a Theoretical Introduction to Sociological Methods, Transaction Publishers, Somerset, United States, 2009.
[40] L. Dominelli, The opportunities and challenges of social work interventions in disaster situations, Int. Social. Work 58 (2015) 659–672.
[41] R.R. Dynes, Community social capital as the primary basis for resilience (Preliminary paper 344), University of Delawere. Disaster Research Centre, 2005.
[42] R.R. Dynes, Social capital: Dealing with community emergencies. Homel. Secur. Aff. 2 (2006) 1–26.
[43] EERI, The Mw 8.8 Chile Earthquake of February 27, 2010, Special Earthquake Report: The Earthquake Engineering Research Institute, 2010.
[44] U. Flick, An Introduction to Qualitative Research, SAGE Publications, London, United Kingdom, 2009.
[45] J. Gaillard, M. Fordham, K. Sanz, Culture, gender and disaster: from vulnerability to capacities, Cultures and Disasters: Understanding Cultural Framings in DisasterRisk Reduction, Taylor & Francis, London, 2015, pp. 222–234.
[46] D.A. Ghanem, S. Mander, C. Gough, "I think we need to get a better generator": household resilience to disruption to power supply during storm events, Energy Policy 92 (2016) 171–180.

[47] C. Gonzalez-Muzzio, V. Sandoval Henriquez, Resilient Responses from Communities and Companies After the 2010 Maule Earthquake in Chile, United Nations Office for Disaster Risk Reduction (UNISDR), 2016.

[48] C. Gonzalez-Muzzio, El rol del lugar y el capital social en la resiliencia comunitaria posdesastre: aproximaciones mediante un estudio de caso después del terremoto del 27/F, *EURE* (Santiago) 39 (2013) 25–48 (In Spanish).

[49] K. Hämäläinen, S. Rautio, Participants home as an interview context when studying sensitive family issues, J. Comp. Soc. Work 2013 (2013) 1.

[50] R.L. Hawkins, K. Maurer, Bonding, bridging and linking: how social capital operated in New Orleans following Hurricane Katrina, Br. J. Soc. Work 40 (2010) 1777–1793.

[51] R. Hinrichs, L. Jones, E.M. Stanley, M. Kleiner, Report on the 2010 Chilean Earthquake and Tsunami Response. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey, and American Red Cross. Open-File Report 2011–1053, v. 1.1, p. 68, 2010.

[52] L. Hiwasaki, E. Luna, Syamsidik, J.A. Marçal, Local and indigenous knowledge on climate-related hazards of coastal and small island communities in Southeast Asia, Clim. Change 128 (2015) 35–56.

[53] N. Holloway, C. Landaida, G. López, M. Olguín, Reconstruyéndonos: nuestra memoria, nuestras voces, nuestro futuro. Educación y Comunicaciones: Universidad de Concepción, y ECO. Concepción, Chile (In Spanish), 2012.

[54] IFRC, IFRC Framework for Community Resilience, International Federation of Red Cross and Red Crescent Societies, Geneva, 2014.

[55] H. Kallio, A.-M. Pietilä, M. Johnson, M. Kangasniemi, Systematic methodological review: developing a framework for a qualitative semi-structured interview guide, J. Adv. Nurs. 72 (2016) 2954–2965.

[56] H.B. Kaplan, Toward an understanding of resilience: a critical review of definitions and models, in: M. Glantz, J.L. Johnson (Eds.), Resilience and Development: Positive life adaptations. Kluwer Academic/Plenum Publishers, New York, 1999.

[57] D. King, Organisations in disaster, Nat. Hazards 40 (2007) 657–665.

[58] R.J.T. Klein, R.J. Nicholls, F. Thomalla, Resilience to natural hazards: how useful is this concept? Glob. Environ. Change Part B: Environ. Hazards 5 (2003) 35–45.

[59] J. Landau, J. Saul, Family and community resilience in response to major disaster, in: F. Walsh, M. Mcgoldrick (Eds.), Living Beyond Loss: Death in the Family, 2nd ed., WW Norton & Co, New York, 2004.

[60] J. Landau, Enhancing resilience: Families and communities as agents for change, Family Process 46 (2007) 351–365.

[61] A. Lara, L.F. Reyes, J. Moreno, P. Quilodrán, K. Sánchez, Designing happiness? A close-up to the housing reconstruction process after the Chile earthquake and tsunami, on 27 February 2010, Nat. Hazards 91 (2018) 537–551.

[62] A. Lara, D. Saurí, A. Ribas, D. Pavón, Flood management in a Mediterranean area (Costa Brava, Spain), Nat. Hazards Earth Syst. Sci. 10 (2010) 2081–2091.

[63] J.D. Lichterman, A "community as resource" strategy for disaster response, Public Health Rep. 115 (2000) 262–265.

[64] R. Longhurst, Semi-structured interviews and focus groups, Key Methods Geogr. (2003) 117–132.

[65] L.S. Luton, Qualitative Research Approaches for Public Administration, Taylor & Francis Inc, Armonk, United States, 2015.

[66] S.B. Manyena, The concept of resilience revisited, Disasters 30 (2006) 433–450.

[67] A. Marín, S. Gelcich, G. Araya, G. Olea, M. Espíndola, J.C. Castilla, The 2010 tsunami in Chile: devastation and survival of coastal small-scale fishing communities, Mar. Policy 34 (2010) 1381–1384.

[68] S.A. Martin, A framework to understand the relationship between social factors that reduce resilience in cities: application to the City of Boston, Int. J. Disaster Risk Reduct. 12 (2015) 53–80.

[69] J. Mercer, I. Kelman, L. Taranis, S. Suchet-Pearson, Framework for integrating indigenous and scientific knowledge for disaster risk reduction, Disasters 34 (2010) 214–239.

[70] MIdeplan, Encuesta Post Terremoto: principales resultados/Efectos en la calidad de vida de la población afectada por el terremoto/tsunami, Ministry of Planning and Cooperation, Chile, 2010 (In Spanish).

[71] Y. Minamoto, Social capital and livelihood recovery: post-tsunami Sri Lanka as a case, Disaster Prev. Manag. 19 (2010) 548–564.

[72] R. Morales Muñoz, Terremoto y tsunami del 27 de febrero de 2010. Efectos urbanos en localidades de la provincia de Arauco. Urbano Octubre 43-62 (In Spanish), 2010.

[73] B.H. Morrow, Identifying and mapping community vulnerability, Disasters 23 (1999) 1–18.

[74] S. Moore, M. Daniel, L. Linnan, M. Campbell, S. Benedict, A. Meier, After hurricane floyd passed – investigating the social determinants of disaster preparedness and recovery, Fam. Community Health 27 (2004) 204–217.

[75] J. Moreno, D. Shaw, Women's empowerment following disaster: a longitudinal study of social change, Nat. Hazards 92 (2018) 205–224.

[76] J. Moreno, The role of communities in coping with natural disasters: lessons from the 2010 Chile Earthquake and Tsunami, Procedia Eng. 212 (2018) 1040–1045.

[77] M. Moussard, Prácticas y conocimientos territoriales, determinantes de la sobrevivencia ante situaciones de riesgo en la Caleta El Morro de Talcahuano, Anthropologist, University of Concepcion, 2011 (In Spanish).

[78] A. Mulhall, In the field: notes on observation in qualitative research, J. Adv. Nurs. 41 (2003) 306–313.

[79] B.L. Murphy, Locating social capital in resilient community-level emergency management, Nat. Hazards 41 (2007) 297–315.

[80] Y. Nakagawa, R. Shaw, Social capital: a missing link to disaster recovery, Int. J. Mass Emerg. Disasters 22 (2004) 5–34.

[81] J.K. Newport, G.G.P. Jawahar, Community participation and public awareness in disaster mitigation, Disaster Prev. Manag.: Int. J. 12 (2003) 33–36.

[82] NOAA , The Significant Earthquake Database United States: The National Oceanic and Atmospheric Administration, 2017.

[83] F.H. Norris, S.P. Stevens, B. Pfefferbaum, K.F. Wyche, R.L. Pfefferbaum, Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness, Am. J. Community Psychol. 41 (2008) 127–150.

[84] A. Oliver-Smith, S. Hoffman, The Angry Earth: Disasters in Anthropological Perspective, Routledge, New York, 1999.

[85] O. Patterson, F. Weil, K. Patel, The role of community in disaster response: conceptual models, Popul. Res. Policy Rev. 29 (2010) 127–141.

[86] P. Perez-Sales, P. Cervellon, C. Vazquez, D. Vidales, M. Gaborit, Post-traumatic factors and resilience: the role of shelter management and survivors' attitudes after the earthquakes in El Salvador (2001), J. Community Appl. Social. Psychol. 15 (2005) 368–382.

[87] D.D. Perkins, J. Hughey, P.W. Speer, Community psychology perspectives on social capital theory and community development practice, Community Dev. 33 (2002) 33–52.

[88] B. Pfefferbaum, D. Reissman, R. Pfefferbaum, R. Klomp, R. Gurwitch, Building resilience to mass trauma events, in: L.S. Doll, S.E. Bonzo, J.A. Mercy, D.A. Sleet (Eds.), *Handbook on Injury and Violence Prevention*, Springer-Verlag New York Inc, New York, United States, 2005.

[89] H. Rudnick, S. Mocarquer, E. Andrade, E. Vuchetich, P. Miquel, Disaster management, IEEE Power Energy Mag. 9 (2011) 37–45.

[90] M. Sanzana Calvet, Desastre natural y acción colectiva de los sectores populares en Chile: los saqueos en Concepción tras el 27/F, OSAL, Año XI, 145-157 (In Spanish), 2010.

[91] J. Scott, A Matter of Record: Documentary Sources in Social Research, Polity Press; Cambridge, MA, USA: B. Blackwell, Cambridge, UK, 1990.

[92] Segpres, Balance de Reconstrucción. A un año del 27-F, Chile Ministerio Secretaría General de la Presidencia (In Spanish), 2011.

[93] W. Siembieda, L. Johnson, G. Franco, Rebuild fast but rebuild better: Chile's initial recovery following the 27 february 2010 earthquake and tsunami, Earthq. Spectra 28 (2012) S621–S641.

[94] J.W. Simon, K. Valenzuela-Fuentes, Civil society reconstruction: popular organizations in postearthquake concepción, Lat. Am. Perspect. 44 (2017) 41–61.

[95] G.W. Snedecor, Design of sampling experiments in the social sciences, J. Farm Econ. 21 (1939) 846–855.

[96] W. Tang, J. Li, Z. Lei, E. Wang, W. Shen, Creating social–physical resilience to natural disasters: lessons from the Wenchuan earthquake, Nat. Hazards 79 (2015) 1111–1132.

[97] S.J. Taylor, R. Bogdan, M.L. Devault, Introduction to Qualitative Research Methods: A Guidebook and Resource, John Wiley & Sons Inc, New York, United States, 2016.

[98] A. Tong, P. Sainsbury, J. Craig, Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups, Int. J. Qual. Health Care 19 (2007) 349–357.

[99] M.D.C. Tongco, Purposive sampling as a tool for informant selection, Ethnobot. Res. Appl. 5 (2007) 147–158.

[100] J. Twigg, The human factor in early warnings: risk perception and appropriate communications, in: J. Zschau, A. Küppers (Eds.), *Early Warning Systems for Natural Disaster Reduction*, Springer, Berlin Heidelberg, 2003.

[101] J. Twigg, Characteristics of a Disaster-resilient Community: A Guidance Note (Version 2), DFID Disaster Risk Reduction NGO Interagency Group, Teddington, UK, 2009.

[102] J. Twigg, The age of accountability? Future community involvement in disaster reduction, Aust. J. Emerg. Manag. 14 (1999) 51–58.

[103] UNISDR, The Sendai Framework for Disaster Risk Reduction 2015–2030, United Nations Office for Disaster Risk Reduction, 2015.

[104] UNISDR, Hyogo Framework for 2005–2015: Building the Resilience of Nations and Communities to Disasters, United Nations International Strategy for Disaster Risk Reduction, 2012.

[105] UNISDR. Making Cities Resilient Report 2012 My City is Getting Ready! A Global Snapshot of How Local Governments Reduce Disaster Risk [Online], The United Nations Office for DisasterRisk Reduction (UNISDR), 2012. Available: 〈http://www.unisdr.org/files/28240_rcreport.pdf〉 (accessed 10 October 2017).

[106] USGS. M 8.8 – Offshore Bio-Bio, Chile [Online], U.S. Geological Survey, 2010. Available: 〈https://earthquake.usgs.gov/earthquakes/eventpage/official20100227063411530_30#region-info〉 (accessed 15 November 2017).

[107] F. Walsh, Traumatic loss and major disasters: strengthening family and community resilience, Fam. Process 46 (2007) 207–227.

[108] Elke Weesjes, Disasters and social memory, Nat. Hazards Obs. XL (1) (2015) 1–35.

[109] G. Winkworth, C. Healy, M. Woodward, P. Camilleri, Community capacity building: learning from the 2003 Canberra bushfires, Aust. J. Emerg. Manag. 24 (2009) 5–12.

[110] B. Wisner, P.M. Blaikie, T. Cannon, I. Davis, At Risk: Natural Hazards, People's Vulnerability, and Disasters, Taylor & Francis Ltd, London, United Kingdom, 2004.

[111] R.K. Yin, Case Study Research: Design and Methods, Sage Publications, Thousand Oaks, United States, 2003.