



Exploring indigenous perspectives of an environmental disaster: Culture and place as interrelated resources for remembrance of the 1960 mega-earthquake in Chile



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ABSTRACT

On May 22, 1960, the most powerful earthquake recorded in history shook the coast of southern Chile: the 'Valdivia Earthquake'. The areas around the Budi Lake, eighty kilometers from the epicenter, are lands of the *Lafkenche-Mapuche* indigenous group. The present study explored the role of culture and place in the remembrance and meaning-making processes of the earthquake in *Lafkenche-Mapuche* community members. Semi-structured qualitative interviews with eighteen participants (N = 18) were completed. Through the use of decolonial narrative analysis, findings were organized around two themes describing how cultural and spatial elements in Mapuche communities can afford systems of meaning to remember and make sense of an extreme environmental event like a devastating earthquake. Results provide insight into how indigenous communities recollect sacred oral histories, tap into reserves of traditional ecological knowledge and adapt to shifting landscapes, which together surfaced as critical dimensions of remembrance, meaning-making and response to environmental hazards and their aftermath.

1. Introduction

On May 22, 1960, the most powerful earthquake ever recorded in human history shook the southern coast of Chile: the 'Valdivia' earthquake (9.5 Mw). The Budi Lake, located approximately eighty kilometers from the epicenter, is a tidal brackish lake whose origin is associated to earthquakes and floods. For more than 500 years, the areas around the Budi have been inhabited by *Lafkenche* communities—a subgroup of the largest indigenous group in Chile: the *Mapuche*.

In the face of traumatic events, such as earthquakes, research shows that survivors may engage in meaning-making processes embedded in core beliefs systems related to the sacred and the mundane [54]. These processes have been characterized as highly dependent on a collective memory that reconstructs the events through narratives grounded in the culture of the groups that remember and in the places and environments of their everyday lives [35,48,51]. Moreover, the relations between reconstructive remembrance, culture and place have

been addressed in indigenous psychologies and social psychiatry through the study of trauma related to indigenous communities' journeys facing histories of colonization and ongoing structural oppression (e.g. [32,39]).

Mapuche cultural processes related to earthquakes and natural disasters, however, have been primarily studied and documented in the social sciences in the past within Eurocentric worldviews and knowledge systems. In previous studies by researchers in Chile (e.g. [29]), strong relations between *Mapuche* cultural elements (such as ancestral knowledge, beliefs and religiosity) and geographical elements and places (such as volcanoes, mountains and the sea) are highlighted. For example, in 1912, Rodolfo Lenz compiled a series of tales, vocabulary and poetry that reflected the traditions of *Mapuche* regarding earthquakes, floods, tsunamis and volcanic eruptions [44]. More recent research (e.g. [15]) explored *Mapuche* religious practices, stories, poems and songs related to indigenous spiritualities and belief systems linked to ecological and geographical spaces and events, stressing the

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salience of interconnections between *Mapuche* culture and ecological environments.

Taking into account these previous studies and strong ecocultural dimensions characterizing *Mapuche* worldviews, there is relatively little contemporary systematic research from indigenous perspectives regarding the ways in which *Mapuche* community members of the Budi Lake remember and interpret the Valdivia earthquake. Therefore, the current study aimed to contribute to understandings of the interplay between culture and place in the remembrance of *Mapuche* participants when processing and making sense of the potentially traumatic events from this 1960 environmental disaster, yet from a transdisciplinary conceptualization and with a qualitative method specifically grounded in perspectives of indigenous community members themselves.

1.1. Conceptual background: culture, place, and memory of disasters in indigenous communities

Collective memory is a reconstruction of the past guided and constrained by cultural tools deployed in the everyday interaction with people and environment [31]. In this sense, reconstruction processes involve narratives, songs, tales, pictures and monuments, which are deployed in the interactions of individuals in their social and ecological contexts [6]. In his classic work on memory in psychology, Bartlett [11] showed how cultural conventions become knowledge structures or schemas that organize the reconstruction of narratives and tales. For example, changes in the re-telling of a Native American folk-tale made by a group of English participants were related to aspects of the tale that don't fit into the cultural environment of this group and the canonical elements and form of Western Eurocentric stories. Also, the cultural determination of memory serves a group in generating and maintaining its identity and sense of unity, for example, when memory devices take the form of rituals and in the transmission of relevant knowledge to subsequent generations [6]. In summary, the conceptualization of collective memory as social reconstruction brings into the foreground the complex dynamics between memory and culture.

The memory of collectives is also situated in the places where the group inhabits. In order to commemorate, some societies build places for memory: concrete physical spaces that are nothing but the materialization of the past. Some of these memorials are built to serve as places for commemoration ceremonies: statues, monuments and even museums [51]. Others are set in the same places where events that groups want to be remembered took place, as when buildings that were used for torture or imprisonment are slightly adapted as museums [35]. But also collective memory can be unintentionally registered in the environment in a subtler way but more permanently at the same time. In fact, ancestors transform space as a result of the way they lived, which in turn constitutes a *landscape* that reflects their forms of living [36]. This situatedness of collective memory underscores the salience of relationships between people and place.

The interrelation between culture, place and memory has been addressed directly when studying remembrance of potentially traumatic events for individuals and social groups, such as natural disasters, political violence, oppression and displacement. Related to memorials, Simpson and De Alwis [60] compared constructions for the 2001 Gujarat earthquake in India and for the 2004 tsunami in Sri-Lanka. Marked differences are attributed to cultures, religions and political processes—for example, in Gujarat memorials were mainly built by people's initiative, whereas in Sri Lanka most of them were built by the government. The memory of political repression is also kept in places such as Robben Island in South Africa, which is currently a museum, yet before served as a place of repression and captive exile for anti-apartheid anti-colonial activists and leaders like Nelson Mandela [35].

Regarding indigenous communities, research from psychology and psychiatry contributes to understandings about issues linking memory, place and culture in colonized groups facing loss of culture and land as a result of histories of genocide, ethnocide and forced displacement

[32]. Memory has been shown to be a critical resource embedded within indigenous resilience processes, providing a pathway for “cultural continuity” in the face of ongoing cultural repression [40]. For example, in a quantitative study by Chandler and Lalonde [17] with indigenous communities in Canada, the authors found that collective remembrance of indigenous culture and the perseverance and promotion of traditional practices and languages were associated with lower suicide rates and school dropout rates. Moreover, Abu Lughod and Sa'di [1] studied the protective role of collective memory and village narratives in indigenous Palestinian communities. Likewise, Atallah [7] found that the reconstructive process of memory emerged as a resilience strategy for indigenous Palestinian families who emphasized the importance of re-gaining ecological capital through direct engagement in native lands and the re-gathering of oral histories and memories of their indigenous villages. In the same vein, Pilgrim et al. [55] identified several pathways for engaging memory, culture and place in community projects in indigenous groups, including *Diet* (increasing consumption of traditional foods), *Education* (transferring traditional knowledge to younger generations through culturally-sensitive curricula) and *Culture* (strengthening ceremonial traditions and reviving key threatened cultural ways of life), among others.

Lastly, it is important to note that the incorporation of indigenous culture, knowledge and practices into research and planning is now acknowledged in the disaster risk reduction literature (e.g. [33,61,64,8]; for a review on this topic see Bohensky and Maru [14]). For example, indigenous architecture in Kashmir is adapted to reduce seismic risk [2] and traditional knowledge provides the ground for resilience in relation to floods in Chadereka and Dambakurima communities in Zimbabwe [46]. Furthermore, indigenous and scientific knowledge can be systematically integrated to reduce risk to natural disasters [34]. In fact, in a recent article by Kwok et al. [41], the authors argued that an essential task for disaster risk reduction remains to increase understandings of structural and cognitive attributes of community resilience (including honing in on exploring local communities' skills, abilities and knowledge; unique qualities of a community; and the relevant community perceptions and processes).

1.2. Contextual background: The 1960 Valdivia earthquake, the Budi Lake and the Lafkenche-Mapuche indigenous community

The 1960 Valdivia earthquake is the biggest one recorded in human history. Its epicenter was in the Pacific Ocean, 80 km from the coast of south-central Chile, with a rupture zone of 1000 km from north to south (see Fig. 1a and b). Its duration was 10 min. An hour after, a tsunami battered the zone, with waves that reached 20 m high. Similar waves also lashed the coasts of Hawaii and Japan [18]. Two days later, the Puyehue volcano erupted at 200 km from the epicenter (see Fig. 1b). For weeks, strong aftershocks were felt reaching up to 7.9 Mw [16]. As a consequence of these events, it is estimated that about 5700 people died, 3000 disappeared and much more were wounded. Many cities were destroyed as a result of the shaking of the earth and the waves of the tsunami.

The Budi Lake is located at 80 km northeast from the epicenter. It is a brackish water lake whose origin is linked to earthquakes: it might have formed after one of the branches of the Imperial River was cut off by an earthquake 2000 years ago (Fig. 1b). The changes of the sea level resulting from the deglaciations of the last glacial cycle also contributed. Indeed, the 1960 Valdivia earthquake played a role in its current configuration: the coastal level fell about two meters, which resulted in the permanent flooding of lands due to the rising water level and created a permanent connection to the sea through a drainage channel, contributing to its further salinization [16]. Picture 1 shows the landscape of Budi Lake from ground level.

The native people of this land are the *Lafkenche*: a subgroup of the *Mapuche*, the most populous indigenous group in Chile. In *Mapudungun* (the language of the *Mapuche*) *Lafkenche* can be translated as ‘people of

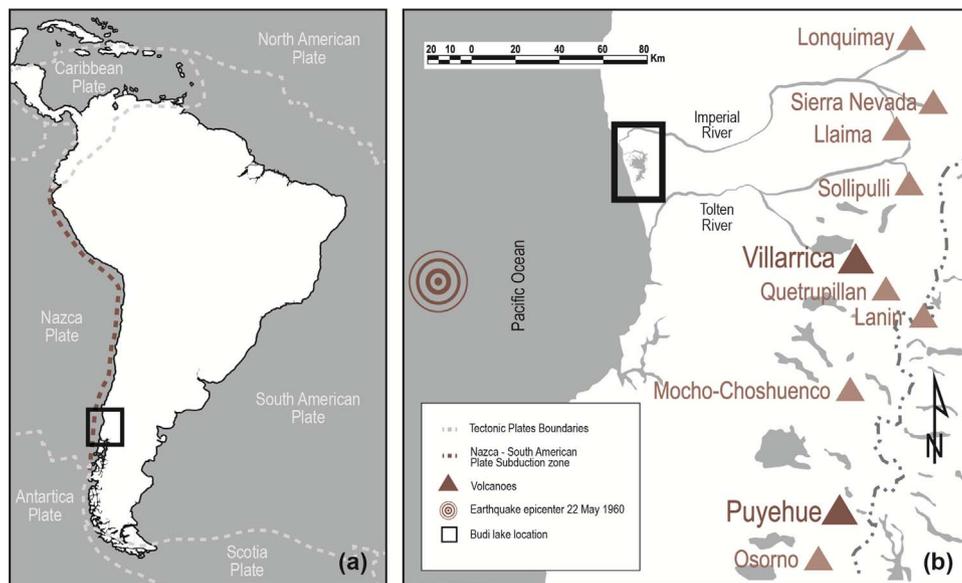


Fig. 1. (a) Location of Budi lake in the South of Chile and tectonic plates; (b) Budi lake, Imperial River and Puyehue and other volcanoes in Los Andes.

the coast’. The 13,275 persons who currently live around the Budi Lake are grouped in 107 communities, or *lof*, which is a territorial unit inhabited by a group with kinship relations. The lands next to the lakeshore consist exclusively of indigenous territories. Livelihoods depend primarily on agriculture (potatoes and chili), small livestock (pigs and chickens) and remittances sent by relatives that migrated to the cities. Overall, Chileans who identify with an indigenous group have higher levels of poverty and the area around the Budi Lake is one of the poorest in Chile [47]. In addition, indigenous groups in Chile suffer from health inequities visible in life expectancy rates, infant mortality, women’s health and mental health [53]. Social epidemiologists and transdisciplinary indigenous scholars have documented the past genocides and ongoing racisms that create complex vulnerabilities in first nation communities internationally [63]. *Lafkenche-Mapuche* groups living in the Budi Lake area, who are the focus of the present

study, have been impacted by these wide-ranging sociopolitical and historical injustices [12].

1.3. The current study

The present study engaged transdisciplinary “ecosocial” conceptualizations of memory, place and culture while aiming to contribute to understandings of disasters from indigenous perspectives by exploring the remembrance and meaning-making processes of a past environmental disaster in a *Mapuche* community. Methodologically, as explained below, this study drew on decolonial narrative inquiry because these critical qualitative methods have been shown to be well-suited to the study of complex phenomena in indigenous communities whose traditional knowledge have been threatened by legacies of colonialism. Therefore, based on a research partnership developed by the research-

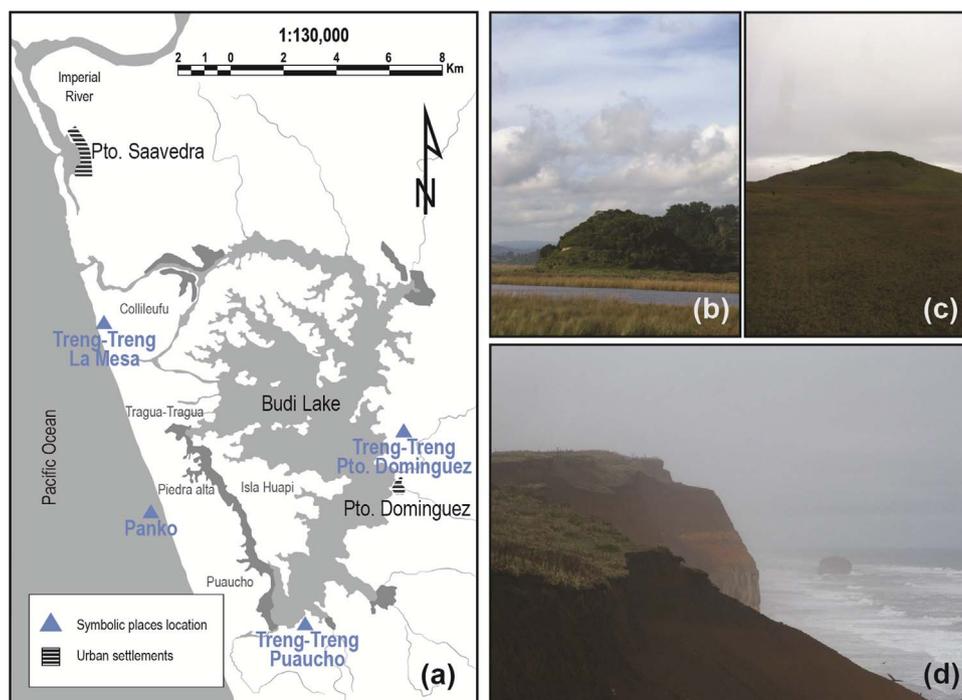


Fig. 2. (a) Lake Budi, Treng-Treng and Panko locations; (b) Picture of Treng-Treng in Puaicho area; (c) Picture of Treng-Treng La Mesa hill; (d) Picture Panko rock.



Picture 1. Lake Budi from ground level.

ers with a *Mapuche-Lafkenche* indigenous community in the Budi Lake that was impacted by the 1960 Valdivia earthquake, our investigation was guided by the following overarching question:

Fifty-three years after, living at a distance of approximately eighty kilometers from its epicenter, how do Lafkenche community members of the Budi Lake remember and make sense of the 9.5 Mw 1960 Valdivia earthquake?

2. Methods

2.1. Narrative methods and decolonial qualitative inquiry

The present research employs narrative (e.g. [57]) and decolonial (e.g. [65]) qualitative methods because these approaches have been shown to improve knowledge of perspectives of indigenous communities. Narratives are stories heavily situated in cultures, geographies, psychosocial and historical contexts. Moreover, cultural narratives related to an extreme event are especially telling because of the ways in which they are particularly embedded in complex eco-social processes and situational elements that frame the contexts and conditions where the event takes place [66].

Furthermore, knowledge of indigenous groups is often limited or even silenced by dominant cultural narratives [28]. In a way, it is not only indigenous peoples' lands that are conquered and occupied, but their narratives and truths as well [58]. Under this perspective, a qualitative decolonial method aims at accompanying indigenous communities in their efforts toward preserving and reclaiming cultural legacies, knowledge and human rights [38,65].

2.2. The participants

Eighteen inhabitants of the Budi Lake were interviewed (N=18). They lived in different areas and communities located at the shore of the lake (see Fig. 2a). The interviews took place between March and June of 2014. Participants of various ages and gender were selected (see Table 1). All 18 participants reported belonging to the *Mapuche* indigenous group. An important dimension across which the sample

Table 1
Participant's gender and age.

Gender	Age range (years – old)				
	40–49	50–59	60–69	70–79	80–89
Female	1	3	2	1	–
Male	–	2	7	–	2

varied was the age at the time of the 1960 earthquake (all but one participant experienced the earthquake directly). Participants shared narratives of their own and also the stories they had heard over the decades from their immediate surroundings.

2.3. Outreach, recruitment and participant selection procedures

In transdisciplinary research, cultural advisors are vital partners in the facilitation and implementation of research at each stage of a project [43]. In line with this, the current project built a collaborative partnership with a cultural advisor who is a member of the *Lafkenche* community from the Budi Lake. She holds a high-level of community credibility, trust and in-depth experience and knowledge of the place and participants. She aided in ensuring the research project engaged the community in culturally-sensitive ways [30].

Participants were selected through a community-based networking procedure guided by the cultural advisor. Outreach began with phone calls to potential participants who were screened for certain characteristics, including that they: were from the Budi Lake, identified themselves as part of the *Lafkenche* indigenous group and have experienced the earthquake directly.

2.4. Ethics

After participants were selected, they were individually asked to confirm their willingness to participate and informed consent was obtained. The consent process was adapted in culturally-meaningful ways. More specifically, requesting that *Mapuche* participants sign a consent form for outside researchers was determined to be culturally-insensitive because of histories of indigenous people in Chile having to sign papers to give up their lands involuntarily, which was a common practice after the military occupation of their lands. In this light, for many *Mapuche*, the experience of signing papers is linked to systemic coercion by the Chilean government. Also, in *Mapuche* culture, giving one's word orally is a contract that is deeply meaningful. Therefore, participants were not asked to sign forms, and instead, information about the study, about confidentiality, and regarding the voluntary nature and parameters of the research relationship, were all conveyed through oral dialogue. All individuals who were approached for participation in the research gave their consent and completed the interviews in their totality. In order to ensure the confidentiality of the participants in the study, several precautions were taken. Once a participant agreed to participate in a qualitative semi-structured interview, they were given a roman numeral which was used on the transcripts. All interview tapes, interview transcriptions, researcher notes and ethnographic observations were coded and de-identified.

2.5. Interviews and ethnographic procedures

2.5.1. Interview protocols

All interviews were semi-structured, in-depth and face-to-face. They were one to two hours in length and took place at the participant's home. Following a research framework sensitive to the sociocultural contexts, we constructed an interview protocol that could be modified so as to focus on certain areas of inquiry mapping onto the central focus of the study. These areas included: participants' understandings and meanings of earthquakes; memories about the 1960 Valdivia earthquake; participants' reactions to the earthquake; participants' thoughts, beliefs and cultural elements and rituals related to their responses to the earthquake; and the meanings and salience of destruction and environmental changes in the places after the earthquake. The researcher addressed the same areas of inquiry in each interview but the specific questions and order was responsive to the emerging stories and responses. All interviews were transcribed verbatim in their totality.

2.5.2. Ethnographic observations and community monitoring

Close ethnographic monitoring [23] was completed of the spatial and cultural contexts with a focus on environmental elements and living conditions. In addition to meeting with participants at their home, the researchers participating in the fieldwork accompanied participants in their natural settings and attended to community events. Daily periods of continuous monitoring were completed which involved visiting and walking different places with additional community informants who shared reflections on historical and daily aspects of living around the Budi Lake.

2.6. Data analysis

Data analysis involved several steps. First, it began during data collection and involved discussions between researcher team members in the field. After the interviews, the team spent time reflecting on what was discussed and observed, and engaged in reflexive memoing with an emphasis on situational elements and exploring cross-cultural dynamics impacting the research process.

Second, after data collection, the research team identified emergent themes through open coding data analysis [23]. When developing initial themes, two elements were considered based on narrative research approaches and analysis: coherence and thematic contents emerging from a particular participant's stories and across interviews [57]. Coherence was helpful when looking for similarities among the data. Then, a focus on contradictions aided in illuminating when participants' perspectives contradicted themselves by taking in two or more point of views [19]. Through this thematic narrative analysis, the researchers put together comprehensive storylines or a portrait of reported lived experiences with the 1960 earthquake, and identified key initial themes in these storylines including: ancestral stories, dreams, creation myths, explanations of the earthquake and commentaries on key places of the earthquake. These codes emerged inductively from the researcher's interpretations of the interviews, the experience of the researchers in the field and the theoretical concepts taken from literature on memory, culture, and place. Throughout this process, and essential to the validity of research conducted under this methodological approach is 'Reflexivity', which comprises awareness and transparency related to the assumptions and institutional obligations of the investigators. Reflexivity is considered to be as an important tool toward evaluating the trustworthiness and accountability of the research process (e.g. [25]). Reflexive memos, dialogue across the authors and consultation with the cultural advisor, aided in ensuring that the perspectives of participants themselves were privileged in the identification of meanings that emerged in the coding. Relational analysis was also completed exploring the relations between emergent themes across the interviews and embedded in complex and changing contexts [19].

Third, because in many indigenous communities stories are deeply valued as vessels of wisdom, the authors recognized how taking these narratives out of context could risk disrespecting indigenous knowledge while contributing to the objectification and misrepresentation of indigenous peoples and cultures. In consideration of such real challenges when presenting the results of the current study, we aimed to contribute to re-conceptualizations of memories of the environmental disaster while directly basing the organization of the data on the rich descriptions and testimonies generated during the interviews and articulated by the participants themselves. In this light, we organized the final themes within two main categories: 1) rethreading earthquake experiences within tapestries of *Mapuche* knowledge, beliefs and religion; and 2) narrating landscape transformations-shifting places, shifting lives.

3. Results

3.1. Rethreading earthquake experiences within tapestries of Mapuche knowledge, beliefs and religion

The first theme that emerged from data analysis is consistent with the narratives of the participants when describing their experiences of the 1960 earthquake in ways that were woven into tapestries of traditional *Mapuche* knowledge and beliefs. These narratives provided insight into meaning-making processes and remembrance of extreme ecological processes, and the sometimes catastrophic relations between humans and the environment, grounded in key *Mapuche* cultural elements. In many ways, which are explored below, *Mapuche* culture provided a system of meaning to help make sense of the earthquake and tsunami. Also, the participants told how *Mapuche* knowledge, beliefs and religion provided foreshadowing and insight into the earthquake and helped with the coordination of collective action in how to respond to the environmental danger and destruction.

First, participants pointed out that the earthquake and the tsunami that followed it were not unexpected: they were revealed by deities and informed by ancestors. The earthquake was previously revealed to the *Machis* — *Mapuche* shamans — through dreams. *Machis* are generally female and are one of the religious authorities in the communities. In *Mapuche* religion, deities communicate with humans through subjective states different from wakefulness. This communication is usually unidirectional because deities are the ones who deliver messages to humans, and not the other way around [27]. Below, a participant told how the *Machi* predicted the earthquake based on dreams:

They say, that the *Machi* dreamed that there would be a huge earthquake, that something big was coming [...] that we had to be prepared, because it was coming. That's what the *Machi* said, that something big was coming [...] (Female participant, 60-years-old, Puerto Domínguez sector).

Furthermore, *Mapuche* knowledge of cyclic patterns in nature [56], helped participants become informed about the ecological processes involving the earthquake. Several participants reported that their ancestors possessed understandings that big earthquakes occur every 100 years and that after earthquakes the sea always run up. This knowledge was directly transmitted through tales or legends by elders. Interestingly, the idea of a cyclic nature of the earthquakes correlates with recent geologic research: four big earthquakes in that zone preceded the 1960 one, with a regularity of approximately 100 years, on 1575, 1657, 1737 and 1837 and much of this evidence comes from sediment patterns left by the tsunamis that follow [18].

Another dimension of the remembrance and the meaning-making process is in relation with the explanations of the earthquake. Some participants reported understanding the 1960 earthquake by making causal explanations, some of them related to the will of an almighty god or *chaodios*. The reasons why a deity might cause an earthquake emerged with diverse and varying narratives, including as a way to punish humans and to make its presence felt. As in other stories collected by Caniguan [15], it is said that the reason of this punishment was specifically the *moving away* of people from their traditions and culture. A participant told:

People now don't even know how to play the instruments any more. Nowadays, the youth are poisoned by so much technology, they all have those things on their ears and they can't even hear when you talk to them. And all of this, we are committing before God. (Female participant, 54 years-old, Collileufu sector).

Also regarding causality, the earthquake was associated with the will of a spirit, *Pillán*, who inhabited the volcanoes. All volcanic activity is related to the will of that spirit. Interestingly, two days after the 1960 earthquake, the Puyehue volcano erupted, located nearby at 210 km of

the Budi Lake (see Fig. 1b). In fact, the close relation between volcanic activity and earthquakes has been documented in the natural sciences. Even Charles Darwin, in his trips through the south of Chile, wrote about the 1835 earthquake, in the same area, and described the eruptions of the Osorno, Calbuco and Puntagudo volcanoes [24] (See Fig. 1b for the location of nearby volcanoes).

Finally, the earthquake and the tsunami were embedded into the *Mapuche* creation story, which is associated with a giant flood that ended an old world and generated a new one. This origin narrative tells of a fight between two snakes: *Cai-Cai* and *Treng-Treng*. *Cai-Cai* represents the serpent that comes from the sea—or, in general, from the water—; it is the ‘bad’ snake. *Treng-Treng* is the serpent from the highlands; it is the ‘good’ snake. Hence, the origin of the *Mapuche* is represented by the fight between good and bad, which, in turn, materializes as the earth, personified by the snake *Treng-Treng*, and as water, personified by the snake *Cai-Cai*. During the fight, the first humans rushed uphill to avoid drowning. The hills went up as the water rose; and they went up so much that it almost touched the sun. Humans—the few that were left—had to protect their heads with vessels (*llepu*). Only a few families were left, and they were the first of the new cycle. This is, the new era of people began in the end of an old world, during a big flood and between shaking and moving of earth and the rising and falling of seas. In this light, participants shared how during the 1960 earthquake and the subsequent tsunami, stories about ‘the end of the world’ resurfaced. For example, in the quote below, while describing the 1960 earthquake, a participant’s narrative shows how the terrifying magnitude of the circumstances interacted with *Mapuche* religious narratives around the world ending and new one beginning:

She told stories like this because, there is a hill, they say, when the sea left [...] the hill rose [...] and people put on those *llepu*, as they call it, and the hill rose and rose until it united with the sky [...] that hill was called *Treng-Treng* [...] and they say that the hill has four legs, like this table here, and so when the strong movement of the earth comes and the sea rises, the hill rises as well. So that is when only the brave escaped, because when the people on top of the hill saw the sea rise and the hill begin to go up to the sky, the fearful people said “ahh!” and they jumped off the hill and died in the sea. The others escaped, the few who were brave enough and remained on the hill. When the hill went back down and the sea receded, there were very few people left, and that is why in the first people, brothers had to marry sisters [...] and well, that is how we came about and that is how this world will end again and a new one will begin [...] (Female participant, 61 years-old, Piedra Alta sector).

In this light, grounded in these cultural and religious understandings of the connection between humans and complex ecological processes, participants reported following the recommendations of the elders and rushed to high ground or the *Treng-Treng* during the 1960 mega-earthquake. After this evacuation to the highlands, *Nguillatun* ceremonies were performed throughout the Budi Lake region. *Nguillatun* are *Mapuche* religious ceremonies serving as connections between humans and the spirit world [27]. These took place in the highest places of the *Treng-Treng*—rather than a name coincidence, the snake and the hill symbolize protection, and for that reason they receive the same name. Participants reported that in response to the 1960 earthquake, there were *Nguillatun*, that consisted of spinning while dancing around a vertical pole or a *canelo* (sacred tree), playing different instruments and crying out loud only in *Mapudungun*. Additionally, animals were sacrificed, and plant products were offered, such as *mudai* (wheat leaven) and herbs. The person in charge of leading prayers during the *Nguillatun* was the *Machi*, who determined the type of song and sacrifice. Participants reported that different *Nguillatun*

lasted from 15 days up to three months. During these rituals, participants told how members of the community slept at the places where the ceremonies took place and returned to their own houses only when they felt they were safe. Below, a participant describes the *Nguillatun*:

And then, all the people from around here, gathered in a place. All the communities left, walking up over there [...] where we made prayer dances [...] as in *Mapuche* language, “*Culue*” is where you make *Nguillatun*. Many people were already there when we arrived, performing *Nguillatun*, all day and all night [...] we were kneeling, asking for everything to be calm [...] for about three days [...] burning our seeds, sacrificing our animals [...] asking god for everything to calm down. (Male participant, 60 years old, Tragua sector).

In summary, the theme entitled ‘Rethreading Earthquake Experiences within Tapestries of Mapuche Knowledges, Beliefs, and Religion’, represents the ways in which participants’ experiences and interpretations of the 1960 natural disaster arose from: 1) traditional ecological knowledge that a devastating event, with similar characteristics to previously narrated events, will happen; 2) the generation of explanations for the events; and 3) pathways for making meaning of the events grounded in *Mapuche* cultural and spiritual beliefs, specifically the creation myth.

3.2. Narrating landscape transformations – shifting places, shifting lives

After the 1960 earthquake, the changes in the landscape around the Budi lake were significant. The displacement of the plates, estimated at 10 m, generated a sinking of the area by approximately 2 m. Consequently, the altitude of the land decreased, several rivers changed their course, some ponds lost their basins and other areas were flooded. These geographical changes affected locations that served different purposes for Budi communities. On the one hand, they had an impact on places with an important cultural and symbolic value, invested with agency, political and cultural implications, and with sacred features. On the other hand, they affected places of daily use where certain activities of everyday life took place, both for subsistence and entertainment.

According to participants, three areas with cultural and symbolic value and agency were profoundly impacted, including: various *Treng-Trengs*, the *Panko* and the *Mallín*. Participants referred to a *Treng-Treng* as a hill with specific features, which easily stands out among flat surroundings and is typically located near the sea or a big mass of water. Participants underscored three *Treng-Trengs*: one from the Puerto Domínguez area, another in the area of Puaucho, and *La Mesa* hill in Collileufu (see Fig. 2a–c). The role that *Treng-Treng* have in participants experiences and interpretations of the earthquake are fundamental for various reasons, including: 1) it is a resource whose action protects those that go up there after an earthquake because of the subsequent rise of water; and 2) it is the safe and sacred place for *Nguillatun*. Concerning its agency and cultural relevance, as it was previously described with respect to the origin myth, the *Treng-Treng* is a hill that gains height as the water level raises, ensuring that those who are on top will not drown. As a result of the earthquake, the *Treng-Treng* of Puerto Domínguez and the one in Puaucho had landslides that were referred as the loss of one of its ‘legs’, impacting its protective role and use for future *Nguillatun* ceremonies.

Another place that has been transformed is the *Panko*, a rock in the sea located at a distance of approximately 100 m from the coast (Fig. 2a and d). It is endowed with the figure of a sort of bull and used to make a loud noise or bellowing which reported changes in weather conditions. Since the earthquake, participants highlighted how the *Panko* no longer bellows. Probably, the sound of *Panko* resulted from the interaction between the shape of the rock and the wind. In the area, certain winds

are linked to rain—for this reason, the sound announced changes in the weather conditions. Perhaps, the rise of the sea level after the earthquake changed the interaction between the wind and the form of the rock, which made the sound disappear. The *Panko* does not make any sound anymore, and it is not known whether the bull left or fell silent:

Before the sixties, my parents always told that the bull (*Panko*) start bellowing and when he bellowed the sky covered [...] but after 1960 the bull no longer bellow. Perhaps it was the scourge gave to him, maybe he was shushed' (Male participant, 55, Piedra Alta sector).

Moreover, another place that changed after the earthquake was the *Mallín*. It refers to the stagnant waters that were formerly used to predict the harvest time. Participants underscored how the *Mallín* of Puaucho dried and had serious consequences for their crops:

[...] and that we would call "*Mallín*". *Mallín* is that standing water, a pool that would fill each year, and at this time of year, in summer would fill, but now there is no water. They had their belief that when the pool would fill, then that meant it would be a good harvest year, good weather, and when the pool would not totally fill up, then *mallín* would tell you that it would be a year of drought and poor harvest. After 1960 *mallín* no longer fills. Now, you just have to go by the news to see about the weather [...] (Male participant, 68 years old, Piedra Alta sector).

Furthermore, these geographical changes resulting from the earthquake also altered places linked to important daily activities involving subsistence and leisure. Participants reported that after the earthquake, the salinity level of the lake had risen because of its now permanent connection with the sea—a connection that previously had been temporary and sporadic. This alteration, along with the flooding of land devoted before to crops, involved a significant reduction in fertile land, and therefore, in the amount and quality of the agricultural products, mainly potatoes and fodder for animals. Even more, the rising of the lake affected areas where harvest activities were made, specifically, lands for wild bird eggs, mushrooms, herbs, and seafood. Moreover, some participants referred to the complete disappearance of a small island nearby *Isla Huapi* (see Fig. 2a). These changes in landscapes, where everyday activities were impacted or even completely interrupted, were spoken about and highlighted by the participants as parts of the causes of the impoverishment of the communities in the area, even decades after the earthquake.

Lastly, these changes not only had devastating consequences for agricultural productivity and harvest; social practices including leisure and communication were also altered. For instance, the meadows where horse races were held completely vanished, while various key roads that connected houses of relatives and improved the level of social capital in the communities were cut off and disappeared.

In summary, the second theme that emerged from data analysis of the interviews and field observations is: *Narrating landscape transformations—Shifting places, shifting lives* and represents the ways in which the land carries memories and understandings of change after the earthquake with complex implications for participants' cultural identities, agricultural practices, and community and individual lives.

4. Discussion

In this study, we explored the remembrance and meaning-making processes of the 1960 Valdivia earthquake in *Lafkenche-Mapuche* community members aiming to improve understandings of indigenous knowledge and to contribute to conceptual frameworks on relations between memory, culture and place. In total, 18 semi-structured interviews with survivors of the 1960 Valdivia mega-earthquake were completed. Based on these interviews, in addition to field observations, the authors co-constructed two main themes that organized remembrance processes of the earthquake: (1) *Rethreading earthquake experi-*

ences within tapestries of Mapuche knowledge, beliefs, and religion; and (2) *Narrating landscape transformations—Shifting places, shifting lives*. These two dimensions reflect how cultural and spatial elements in *Mapuche* communities afford systems of meaning to remember and make sense of ecological events. Findings provide insight into how indigenous communities recollect sacred oral histories, tap into reserves of traditional ecological knowledge and adapt to shifting landscapes, which together surfaced as critical dimensions of collective memory.

The findings from this study show how the 1960 earthquake was announced: it had been revealed in dreams to the *Machis* of the community, and woven into the stories of the ancestors. More drastically, the earthquake updated the original creation myth of the *Mapuche*, by means of which the world and people were created after a big flood that destroyed the old world and uplifted the new. This was not a metaphor: earthquakes and ecological processes are embedded within *Mapuche* religious and spiritual frameworks, particularly related to the beginning and the end of the world, nature and people. Then our findings show the salience of collective, cultural, and religious action, embodied in *Nguillatun* ceremonies which occurred in response to the 1960 earthquake. Furthermore, although it was not the focus of the present study, given the extreme character of the 1960 earthquake, and faced with ongoing tremors that lasted for over a week, in one *Nguillatun*, a ritual involving human sacrifice was completed in order to try to stop the end of the world and was realized in the *Treng-Treng* of *La Mesa* hill (for additional information see [15,49,62]).

Results also showed how participants reported making meaning related to the 1960 earthquake based on the indigenous knowledge of time as circular, according to which disasters are repetitions of other events and correspond to cycles in nature. Knowledge of these previous events is transmitted by elders in the form of stories and tales. This result is in line with Berkes' [13] concept of *Traditional Ecological Knowledge* (TEK) as the body of contextually-rich knowledge, beliefs and practices frequently passed down orally and intergenerationally in indigenous groups with a focus on connections between humans and environments and that is integral to spiritual wisdom and to understandings of ecological processes. In many Native American groups, community storytellers are often leaders of TEK transmission whereby through the use of narratives and oral traditions, storytellers disseminate their communities' indigenous values, knowledge, worldviews and spiritual belief systems [21]. Previous research on indigenous spiritualities have demonstrated similarities in values related to interconnectedness with others, balance and harmony, desire for lifelong learning and growth, and sacredness of the environment and cyclic patterns in nature [40]. Findings from the present study support these theories and previous research on the importance of ecocultural contextually-embedded traditional knowledge in indigenous communities, which holistic character links issues of environment, land, community, identity, beliefs and religion.

Lastly, landscapes are also devices that carry cultural memory, and as such also aid remembrance. In the current study's results, place-based changes where invested with the meanings of the past in a very particular way. In general, research has focused on landscapes that have been built or transformed by humans, such as memorials or settlements [35,51,60][36]. However, our results suggest that geographical elements inspire memory by way of being invested with agency: remembrance of the earthquake is also structured by the changes in places only distinguishable from the lens of indigenous community members of the Budi Lake themselves with intimate knowledge of the land. For example, when talking about the *Panko*, which personalized a bull whose sounds announced changes in weather, after the earthquake, participants underscored how it was never heard again. Likewise, the disappearance of *Mallín*, which predicted the quality of crops; and also the lost leg of a *Treng-Treng* in Puerto Domínguez. All the above suggest that there is no need for the *Lafkenche-Mapuche* of the Budi Lake to build memorials: the landscape changed, constituting itself in the physical and symbolical source of memory; in other words, in a memory

without memorials.

4.1. Implications

Our findings might have implications in the study and conceptualization of the relationship between indigenous traditional knowledge, resilience, and disasters risk reduction in both, research and practice. Indeed, the current study showed how more than half a century after the devastating 1960 earthquake in southern Chile, the land itself of the *Lafkenche-Mapuche* carried memories of the disaster and indigenous knowledge surfaced as key resources for remembrance, meaning-making and response – all of them grounded in *Mapuche* cultural and spiritual understandings and practices. As elaborated on in the introduction of this paper, previous research suggests that ecological capital and connection to the land are important domains of community resilience for many colonized groups [39]. Indigenous cultural systems often emphasize the sacredness in all things and the interdependent relationships between nature and humans [5]. As Kirmayer et al. [39] explain – when citing the research of Feit [26] on the importance of understanding the role of reciprocal relationships between place and life in Native American worldviews – the land carries memories of TEK and also political struggle, which both are necessary for empowering community responses to potentially traumatic events. As Atallah [8] has argued, disaster researchers should consider increasing the focus on investigating historical and intergenerational processes and social power dynamics in disasters, which have emerged as a result of settler-colonialism and yet continue to disrupt pathways to recovery and future resilience, especially in communities of color and indigenous nations. Future research that explores the legacies of trauma, not only from natural disasters, but also from the settler-colonial violence that the *Mapuche* have survived for hundreds of years, might help in understanding their impact on current community perceptions, collective efficacy and resilience processes.

There is a caveat, however, with respect to the overuse of the concept of ‘resilience’ in the disaster management literature and research. Resilience is a Western construct coming from the word *resilio* in Latin, which means to rebound or bounce [3]. However, disaster and social scientists have long noted that resilience resists precise definitions, in part, because it is a concept that engages metaphor and seeks to represent transdisciplinary phenomena linked to the complexity of human suffering [9,40]. Furthermore, social scientists frequently use resilience in apolitical and dehistoricized ways to describe how individuals, communities, or even entire regions respond to adversities (acute, recurrent, and/or chronic). Indeed, defining human resilience without nuanced contextual, cultural, historical and political analyses risks complicating, rather than enhancing, community development efforts after a disaster. And this is even more important when working with indigenous communities. Indeed, resilience is more frequently defined in a top-down manner, asking communities to be resilient but without providing them with the resources: in a way, some discourses based on resilience put the burden on communities without given them the means for developing it. Even more complex, resilience might be regarded as fully privileging the existing social and power relations in a community, factors that might block initiatives tending to contribute to more equitable distributions of material resources (for a critical discussion of the discourses built around the concept of “resilience” see [45]).

In regards to these conceptual implications for resilience research, our study provides examples and helps illustrate nuances related to how indigenous communities face adversities and disasters. In particular, our findings highlight how for *Lafkenche* communities around the Budi Lake, rather than emphasizing ‘bouncing back’, participants focused on ‘enduring through’ [42] the challenges and ongoing changes in their lands and livelihoods. In this light, it can be argued that *endurance* more closely describes how the *Lafkenche* participants in our study responded to the 1960 earthquake. Interestingly, Atallah’s [7] research with

indigenous Palestinian communities facing decades of repeated exposures to recurrent social disasters demonstrated how resilience was better understood within a diverse set of interrelated local constructs, including *Sumoud* (meaning perseverance or endurance in Arabic). In a more recent study with *Mapuche* communities, Atallah et al. [10] completed ethnographic observations and semi-structured in-depth qualitative interviews with participants (N=10) from several districts in Chile where *Mapuche* groups are actively struggling for indigenous resources and rights. Through this research, the authors developed an exploratory framework explaining resilience within four interrelated *Mapuche* constructs, including: (1) *Newen* (meaning – strength and spiritual life force); (2) *Azmapu* (meaning – ancestral systems of social organization and tribal law); (3) *Neitun* (meaning – recollecting something that has been lost, or ‘cultural revitalization’); and (4) *Marichiweu* (meaning – resistance, and the struggle for equitable access to resources and self-determination). In this light, Atallah et al.’s [10] study directly shows the complexity of resilience in *Mapuche* communities, and the importance of conducting increased research that examines understandings of resilience from indigenous frameworks to be able to generate disaster risk reduction plans that are culturally-informed and integrated into existing assets, resources and indigenous ways of responding to the uncertainties and difficulties that characterize their unique conditions.

Finally, in recent years, social capital has been regarded as a key resource for communities facing natural disasters (e.g. [22,4,52]). Researchers argue that social capital is even more critical in cases of communities living in remote places where institutional help might arrive days after the onset of the disaster [59]. Our findings contribute to previous research on social capital, especially related to how communities in disastrous situations may benefit from recollecting and harnessing cultural norms related to reciprocity, in addition to collective rituals, evidenced in, for example, the *Nguillatun* ceremonies held by *Lafkenche-Mapuche* for weeks after the 1960 earthquake. Given its importance, future research should explore how changes in the living conditions of indigenous communities could threaten their social capital. As an example, many lands surrounding *Mapuche* communities – including the areas of the *Lafkenche* near the Pacific coast where this study took place – have been sold to private companies that have transformed the region into a heavy production zone for the forestry industry [20]. This main environmental change has impoverished these communities even more, forcing their members to migrate to cities, which has had a clear detrimental effect on their social capital. In this light, results from our study emphasize how future research is needed towards helping to develop social policies and plans that could address key issues of land rights and self-determination in indigenous communities.

4.2. Limitations

Two limits of the current study should be pointed out. First, even when it was not our aim to generalize and represent *Lafkenche-Mapuche* community experiences, the number of participants in the present study limits the potential use of our results to such a goal. Rather, we aimed to pay a high level of attention to culturally—and contextually—specific narratives and processes allowing for nuanced interpretations of memories of the 1960 Valdivia earthquake with respect for indigenous knowledge and cultural worldviews. In fact, this emphasis on exploring lived experiences from indigenous perspectives can be framed as a strength. Contextually-informed qualitative methodologies permit helpful comparisons across settings [19]. Therefore, although this qualitative research closely examined narratives and collective memories in a small group of participants from the Budi Lake, the findings may be thoughtfully applied to other localities, especially within indigenous communities living in rural settings exposed to severe threats of environmental hazards and changes.

Second, a common challenge of qualitative research grounded in

narrative analysis is validity [43]. Therefore, to enhance validity, the researchers engaged a variety of methods aimed at improving ‘trustworthiness’ [50] through reflexive practices when coding, memoing, and cross verifying interpretations. Although strength of this study was the inclusion of an approach to build collaborative partnerships across disciplines and with *Lafkenche-Mapuche* indigenous community members, it fell short of implementing methods capable of empowering a collective of *Lafkenche-Mapuche* indigenous members in taking leadership in the study and thereby directly impacting discourses themselves, such as, for example, in Community-Based Participatory Research approaches (e.g. [37]). Future inquiry that affords local residents of the Budi Lake the opportunity to share ownership of the research process from beginning to end is recommended.

5. Conclusions

The current study aimed to deepen theoretical and conceptual orientations of the linkages between memory, culture and place in indigenous groups exposed to recurrent environmental disasters. The two main themes that emerged from data analysis in this study provided insight into the ways in which *Lafkenche-Mapuche* communities in southern Chile remember and interpret, 53 years later, the biggest earthquake ever recorded: the 1960 Valdivia mega-earthquake. This catastrophic environmental event is remembered by these indigenous community members of the Budi Lake in a way that is embedded in facts of their symbolical, physical, social and cultural worlds. More specifically, this study provides insight into ecosocial dimensions of remembrance and meaning making of the massive 1960 earthquake, where sacred oral histories and traditional ecological knowledges surfaced as key resources for surviving on a fault line nearby the sea.

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