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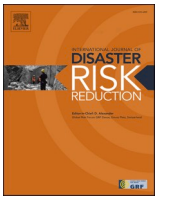

Understanding memory transmission in disaster risk reduction practices: A case study from Japan

Paola Fontanella Pisa [a,b,c]

[a] Global Mountain Safeguard Research Program (GLOMOS), United Nations University Institute for Environment and Human Security (UNU-EHS), Bolzano, Italy
[b] Centre for Global Mountain Safeguard Research (GLOMOS), Eurac Research, 1 Viale Druso, Bolzano, 39100, Italy
[c] Graduate School of Environmental Studies, Tohoku University, Sendai, Japan

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ABSTRACT

"Disasters strike when they have faded from memory", is a powerful quote from the Japanese geophysicist Terada Torahiko (1878–1935). This sentence, often used when addressing the need to improve disaster resilience, is a powerful reminder of the role that local memories of past disasters play in ensuring the safety of communities exposed to hazards. Twelve years from the Great East Japan Earthquake and Tsunami (GEJET) that hit Japan Tohoku's East Coast, this article aims at understanding how the transmission of local knowledge and experiences of past disasters contributes to increasing community resilience to tsunami risks. Based on field research along the coast of the Japanese prefectures of Iwate, Miyagi and Fukushima, this study analyses 11 semi-structured in-depth interviews, to investigate the role of memory transmission in preparing for tsunami risks such as the GEJET. The data was analysed following a narrative approach and through thematic coding with the use of NVivo. Coding structures led to the identification of disaster memory transmission practices in the case study areas and allowed the testing of the relevance of the theoretical framework to community disaster resilience studies. Results are aligned with the theoretical framework and show that disaster memorials are more likely to influence community resilience if passed down using a combination of oral transmission and interpretation together with the use of backup memory archives and physical objects. Such practices are recommended as they allow both the communicability and durability of lessons-learned. Transmitting and maintaining a constant interaction between these two forms of memory is the responsibility of those institutions that oversee the keeping alive of memories, by continuously repurposing and renewing them while engaging with exposed communities.

1. Introduction

"Disasters strike when they have faded from memory". This quote from the Japanese geophysicist Terada Torahiko (1878–1935) highlights that risk management is a constantly repeating process of identifying risks, analysing them, and finding solutions by incorporating feedback and learning [65]. Resilience has often been defined as the capacity of a system to absorb disturbances [22] and the term is originally associated to the concept of "bouncing back" to an original state [2]. However, the process of building community resilience is not limited to returning to an initial status and relies on communities' capacity to integrate feedback and learnings into disaster risk management plans, based on the history of interactions with the ecosystems in which they live [14,23]. Appropriate

E-mail address: fontanella.pisa@ehs.unu.edu.

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integration of lessons-learned and memories of past disaster experiences into disaster risk reduction measures contributes to the implementation of the Sendai Framework for Disaster Risk Reduction Priority for Action 1 "Understanding disaster risk" and Priority for Action 3 "Investing in disaster risk reduction for resilience" [7,47,67]. Understanding disaster risk for disaster resilience also means having a good understanding of historical records of past events and being aware of the geographical characteristics of the addressed areas [35]. Disasters play a role in modifying and generating heritage, informing future generations about determined dramatic processes and events [23]. This knowledge can help identify patterns of occurrence of hazards and, if appropriately shared within communities, increases a community's risk perception, thereby influencing the effectiveness of disaster risk management plans [54, 68]. Heritage and local knowledge additionally contribute to increasing community resilience through increasing community members' sense of place and identity [23].

Connecting communities to the creation and use of collective memories first requires a process of selection of significant memories. The generation of stories related to these memories contributes to social dialogue and to the creation of common values among citizens [64]. The transmission of these stories can be done in various ways, giving materiality to memory with street plaques, preserved urban ruins, memorials (etc.) that represent traces of catastrophes [32]. Heritage plays a key role in the institutionalization of disaster memories and has the power of increasing or decreasing vulnerability of communities towards disaster risk [1,28].

The role of heritage and specifically of local knowledge in decreasing disaster vulnerability has gained popularity over the last decades [28,50,63,68]. Many examples are found in the experience of the Indian Ocean Tsunami on 26th December 2004 [35]. There are several studies about the high level of risk perception of the Simeulue Island community (Banda Aceh, Indonesia), where a lullaby passed down from generation to generation saved the life of most of inhabitants [1,33,44]; Rahman, Sakurai and Munadi, [45]; Rahman, Sakurai and Munadi, [46]). Similarly, many from the Moken communities in Surin Island, Thailand, also survived the tsunami thanks to their cultural heritage, whereas tourists did not [35]. Another example, which is widely known in Japan, is the *Inamura-no-hi* legend, which translates as "The fire of rice sheaves". This story is related to a tsunami wave that hit the Japanese Kii Peninsula on December 23rd and 24th 1854 [3,28,57]. According to this legend, an old man understood a tsunami was coming based on his past experience and saved the inhabitants of his village by setting his own rice field on fire and attracting them far from the coast [20].

Simply remembering disasters does not however automatically guarantee a high level of awareness or enable community resilience, and in many cases local heritage can even represent a factor which increases vulnerability [23,35]. For this reason, a better understanding of the dynamics influencing memory transmission and its interrelation with disaster risk management is required, even though its study is often challenged by its context specificity and changing nature. Remembering disasters often goes beyond the disaster itself, and can be shaped by contrasting intentions, such as mourning, recovering and oblivion [32]. In the process of institutionalizing memories for disaster risk reduction, emotional and cognitive implications must be considered along with an understanding of how collective memory and memory transmission work.

This paper analyzes the dynamics guiding disaster memory transmission in the areas hit by 2011's Great East Japan Earthquake and Tsunami, in association with their role as risk perception drivers. On Friday 11th March 2011, at 02:46:23 p.m. JST, a magnitude 9.0 Mw (moment magnitude scale) earthquake occurred at the level of the Japan Trench, approximately 130 km east from Sendai and at a depth of 32 km [24,49]. The quake generated a tsunami that inundated 516km2 of the eastern coastline of Japan [43,49]. The tsunami reached a wave height of 40 m [58]. The three prefectures of Iwate, Miyagi and Fukushima were the most impacted [24]. This disaster, also remembered for the nuclear meltdown caused by the tsunami at the Fukushima Dai-Ichi Power Plant [49], is known as the Great East Japan Earthquake and Tsunami (GEJET) [66], or sometimes as 3/11 [49]. In some scientific papers it is also referred to as Tohoku-oki Earthquake and Tsunami [37]. It was the first disaster ever recorded with such a cascade of events including tsunami, earthquake, and power plant disaster [47]. It caused the death of 19,727 people, of which 2559 are still missing [41]. Approximately 300,000 people were evacuated [49].

It was the strongest earthquake ever recorded in Japan, nonetheless the number of victims directly caused by the collapse of buildings was limited due to the advanced quake-resistant buildings in the area, which was the result of centuries living with earthquakes and developing resistant infrastructure [24]. Several studies investigating the lessons-learned from this multiple disaster have concluded that most of the victims died by drowning [56] as many people delayed the evacuation from coastlines, for reasons that variate from an over-reliance on structural measures to a lack of awareness and underestimation of tsunami risk [47]. The impact of the GEJET was uneven along the Sanriku coast and the Sendai Plain, due both to the run-up wave and people's experience dealing with the hazard [58].

By investigating the case of 2011's Great East Japan Earthquake and Tsunami's memorialization efforts, this research aims at understanding: 1) the types of tsunami memorials developed in response to past tsunamis along Japan's East Coast, and 2) existing narratives concerning these tsunami memorials and their purpose to increase community resilience. The research ultimately links to memory studies and provides considerations and recommendations on how disaster memory transmission efforts can contribute to community resilience to tsunamis and low-frequency extreme events.

2. Theoretical framework

Remembering is an active orientation towards the past, otherwise seen as an individual act of thinking of things in their absence, interdependent to external factors and social constraints [11,36]. Memory as something that can be socially organized and mediated is defined as "collective memory" [19,64]. Collective memories are maintained through generations, directing behaviours and experience in the interactive framework of a society [6]. Although generated at the individual level within people's mind, collective memory is transmitted through communication and social interactions (Assmann Jan [5]). Collective memory can be divided into

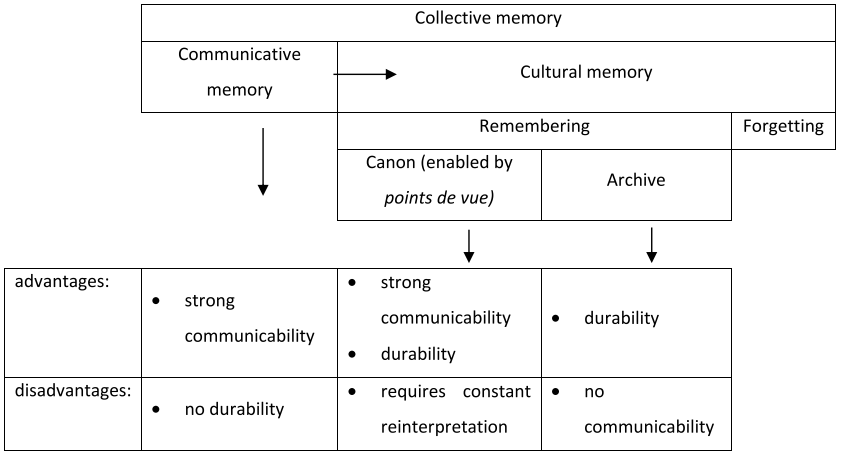
"communicative memory", based on everyday communication and at the origins of oral history, and "cultural memory" [6,29]. Understanding the difference between these two forms of memory, and the way they are transmitted within communities, is the first step towards understanding how memory transmission can play a role influencing community resilience towards disaster risks.

Independent from the support of any institutions of learning, transmission, or interpretation (Assmann Jan [5]), "communicative memory" is generally held in "households", with no structured organization, back-up archive or symbolism to ensure its continuity [6, 10,11]. Its time depth is very limited, with a maximum of an eighty-year time span of three interacting generations (Assmann Jan [5]). Since it is generally transmitted within households, the decline of extended multi-generational families is an increasing threat to this form of transmission [36].

To perpetuate through time, memories need to be institutionalized. In opposition to communicative memory, cultural memory is an "institutionalized" form of memory including the realm of traditions, transmissions, and transferences, constructing people's relation with the past (Assmann Jan [5]; [36]. The introduction of reusable texts, images, and rituals [70] serves to stabilize and convey events in the history of the collective meant for the *longue durée* [29]. Institutionalization, however, takes distance from the everyday, as opposite to the communicative memory [6].

Cultural memory can be subject to many changes throughout time, related to the levels of interaction between the memorial object and its carriers. Collective cultural memory is a process of (voluntary or involuntary) selection between remembering and forgetting [69]. Ernst Renan, in his essay "What is a Nation" [48], insists on the importance of forgetting as part of the process of selecting and creating new memories [36]. Forgetting can be either active or passive and is caused by a change of frames and values in which social bonds have faded (Assmann Jan [5]). To describe the process of remembering, this research borrows from Aleida Assmann's theory on the Canon and the Archive (2008). This theory differentiates between memories with an inactivated potential to have an impact on community everyday lives (memories of the Archive) and memories which full potential is expressed within societies, and which is constantly renewed and adapted to new social historical contexts (Assmann Aleida, 2008; [29]. Memories of the Archive are not forgotten and can be accessed at any moment, but neither are they actively used, and therefore lose their purpose. Writing, for example, has always been a fundamental tool for creating and remembering physical data. However, most of written heritage ends up simply archived, initiating what Georg Simmel defined "the tragedy of culture" [11], as only a minimal part of the written heritage is actively transferred into everyday life. Plato also considered writing as both the remedy and the poison, as it causes an overreliance on it [32]. An abuse of writing as mnemonic practice limits the communication - and therefore the transmission - of written memories, whose potential is archived, waiting for new use. The most recent technology (e.g.,audiovisual recording) has allowed for the creation of a more dynamic and accessible form of institutionalized memory, partially solving this issue [71]. Time also represents a threat to memories of the Archive, as memories in archives easily lose their function, relevance, and fall into a position between remembering and forgetting, between "no longer and not yet" (Assmann Aleida, [4]). Archived and unused memories can also serve new purposes and be adapted to new realities, whereas active memories can lose their status and fall into the Archive [36]. Memories can exist independently from their carriers as memories of the Archive, but their impact at the social level is only realized if articulated and capable of being actively transmitted [36]. Memories of the Canon fall into this second category and can be myths, places, artifacts and stories that are actively circulated and communicated (Assmann Aleida, [4]). A depiction of the past as past represents the Archive, whereas an interpretation of the past as present generates active memories [36]; Assmann Aleida, [4]). As memorial objects do not have embedded memories on their own, memories of the Canon strongly rely on a transmission process based on a constant interaction and reinterpretation enabled by what Halbwachs calls the *point de vue* (Assmann Aleida, [4]; [11]. The past can therefore be embodied in material objects, but it is only through language and dialogue that it can be revived and transmitted [12]. This view is also reinforced by other studies attributing the cultural significance of heritage to the role it plays in society, suggesting an ongoing adaptation to changing circumstances over time [23]. Cultural institutions play a fundamental role in this process, strongly influencing memorial

Table 1
Summary of the processes of memory transmission identified in this study.



objects' position either in the Canon or in the Archive. The process of selection is called "canonization" (Assmann Aleida, [4]).

When applied to disaster studies, cultural memory responds to the need to institutionalize collective memory to ensure its durability through generations and thereby contribute to building resilience [23,28]. For this reason, distinguishing memories of the Archive from memories of the Canon (see Table 1) already provides critical tools to assess which kind of memorial objects or practices are likely to have an impact on those communities exposed to disaster risk. However, as shown above, changes in social bonds can also lead to different types of changes in the memorial objects' meanings throughout time [10,70], which is the reason why simply remembering is often not enough [32]. Remembering past disasters may lead to different outcomes, on the one hand increasing community resilience, for example by raising awareness and educating exposed communities on safe behavior, or on the other hand decreasing community resilience [23,35], for instance by creating a false sense of safety or by repeatedly reproducing the trauma for those who experienced the disaster. In addition, the intentions behind remembering disasters should also be considered. For example, some people might find comfort in generating memorials in order to release themselves from the responsibility of proactively communicating their memories and experiences [32]. This theoretical framework is further developed and analysed within the results and discussion sections, with the aim to testing its validity and relevance to disaster resilience studies.

3. Methodology

This study is based on field research along the coast of Iwate, Miyagi and Fukushima prefectures in Japan, and analyses 11 semi-structured in-depth interviews, investigating the role of memory transmission in preparing for tsunamis. The research's aim is to understand the narratives guiding disaster memory transmission and their implication on building resilience.

The field research corresponds to a first phase of participant observation in the areas listed in Fig. 1, followed by interviews, which were recorded with the consent of the interviewee. Interviews were conducted between November and December 2017, targeting tsunami memorials and community centers active in tsunami memory transmission in the aftermaths of the GEJET. The listed areas are in the three prefectures most impacted by the GEJET and have been selected non systematically among a wider range of memorialization efforts currently in place along the coastline of the three prefectures. Selected tsunami memorials and community centers coincide with the willingness of informants to support the research process. There was general willingness from all key informants to contribute to the research. However, in several cases the greatest challenge was a lack of depth of the responses, attributed to two main issues: 1) a lack of trust relationship with the researcher, and 2) intimidation from the scientific nature of the interview. For this reason, the research was subsequently limited to 11 key informants, and the research methods shifted from a more structured and systematic surveying method to a participant observation and in-depth interview approach. Such approach deepened the researcher-informant trust relationship, in addition to overcoming informants' self-consciousness concerning their contribution to the research. In contrast to structured interviews, this approach allowed the informants to share their personal experience and perceptions without the limits of a pre-determined structure, which had previously affected the depth of answers and the reliability of the results. However, this approach also required investing a considerable amount of time in building a trusting relationship with key informants, limiting their number and representativity of the study. All interviews were conducted in Japanese by the researcher-author.

The 11 selected key informants are not representative of all tsunami memorialization of the three addressed prefectures (Iwate, Miyagi and Fukushima). No discrimination of age and gender has been made, while the only specific criteria for the sample to be included was that they had an attachment to the study area, and that they had experienced the GEJET.

Key informants belonged to these three categories:

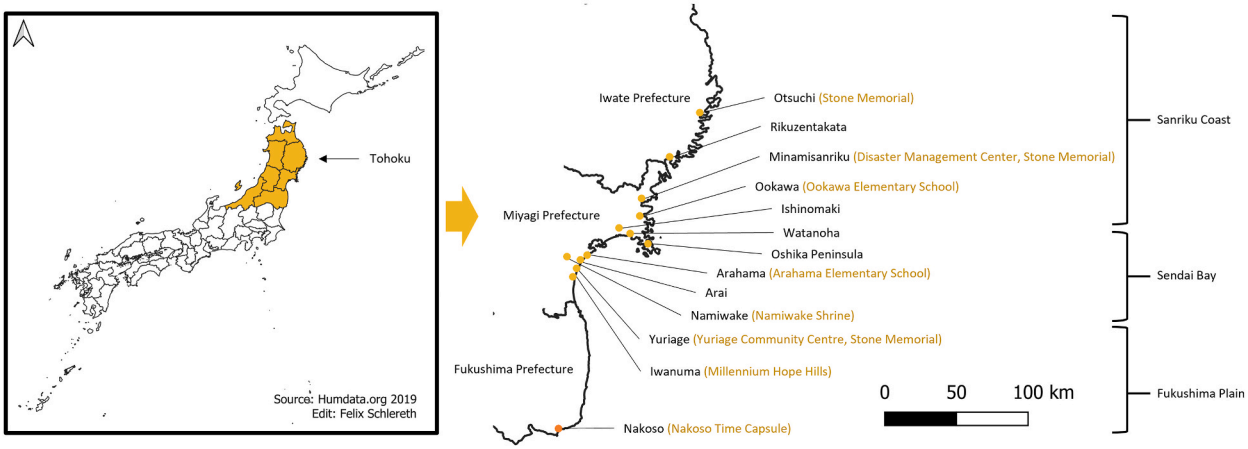


Fig. 1. Sites covered during the field research along Japan's Tohoku East Coast: the figure locates (from left to right) Japan's Tohoku region, the three prefectures subject of investigation (Iwate, Miyagi and Fukushima), mentioned areas and main memorials addressed in this study, the three main coastal areas (the Sanriku Coast, Sendai Bay and Fukushima Plain).

- *Kataribe* (story tellers): locals that decided to share the burden of surviving the disaster by narrating their personal experience and local knowledge with visitors. Although aware of the cultural and social implications of the tsunami, they are usually not directly involved in reconstruction process.
- *Leading figures in community centers:* locals that cooperate with municipalities and local governments, and work in centers of disaster memory. They often have a less in-depth understanding of their land but are more aware of local post-disaster projects.
- *Figures working for municipalities*: as professionals, they are aware of the reconstruction projects and represent the decision-making point of view of heritage interpretation.

A total of 11 valid interviews (see Table 2) were collected, transcribed, and analysed following a life history narrative approach. The life histories method is useful for gathering information about changes in the material and social networks within which people construct their lives [8].

For the interviews to be considered valid, informants had to cover the following points:

1. Their knowledge on past tsunamis and related practices carried out pre-GEJET.
2. Their experience of the GEJET, investigating the role played by past tsunami memorials and disaster risk reduction practices adopted in response to the GEJET.
3. Their perception on how lessons learned post-GEJET can be transmitted to inform and warn future generations.

The interviews have then been analysed to co-create narratives connecting the following themes:

- Identification of past disasters and human-nature interactions.
- Identification of past mnemonic practices.
- Identification of post-GEJET mnemonic practices.
- Identification of perceived needs and challenges for memory transmission of disasters in contribution to resilience building.

Data analysis was done through coding and categorizing [51] with the use of NVivo. The initial coding structure led to the identification and categorization of the different mnemonic practices developed before and after the GEJET. A second level of coding structure mirrored the theoretical framework (Table 1) and tested its validity in understanding how these practices' transmission is likely to impact the level of resilience of their related community.

4. Results

Because of its location on the Pacific Ocean along the "Ring of Fire", Tohoku has a long history of dealing with earthquakes, often accompanied by structural damage, fires and tsunamis [24] (see Fig. 2). Investigation of tsunami deposits started in the 1980s and allowed the investigation of tsunami events that occurred before historical literature [57]. Later, archives of records of past disasters have often been introduced to ensure these memories will outlive time (Informant 8).

Tohoku's East Coast provides strong examples in understanding how disaster memory transmission can impact community resilience. Tsunami events have repeatedly impacted the region, leading to the establishment of several memorialization efforts throughout the centuries. This results section presents the four main themes addressed in this research (see methodology) and is divided in two main parts: the first part presents the identified types of memorialization that have been established along the case study area in response to the tsunami events listed in Fig. 2; the second part addresses considerations shared by the informants on challenges related to memory transmission and resilience building.

4.1. Identified types of tsunami memorials

This chapter presents identified memorialization practices conveniently divided into two main categories: measures mainly adopted prior to the GEJET, and measures that became popular only after the GEJET.

Pre-GEJET tsunami memorials are:

- *Stone memorials (tsunami kinenhi*): stone memorials were frequently built along the Tohoku East Coast. Their purpose was to commemorate tsunamis by marking the furthest point reached by the tsunami, and they were often accompanied by messages

Table 2
List of informants with the category they represented and target area.

Informant	Category	Area (see also Fig. 1)	Interview Date
Informant 1	Community center	Otsuchi, Rikuzentakata	2nd December 2017
Informant 2	*Kataribe*	Minamisanriku	19th November 2017
Informant 3	*Kataribe*	Minamisanriku	18th November 2017
Informant 4	Community Center	Ishinomaki, Ookawa, Watanoha	20th December 2017
Informant 5	*Kataribe*	Ishinomaki, Ookawa	18th December 2017
Informant 6	Community Center	Arai, Sendai	24th November 2017
Informant 7	Community Center	Arahama	12th December 2017
Informant 8	*Kataribe*	Yuriage	11th December 2017
Informant 9	Municipality	Iwanuma	11th December 2017
Informant 10	Community Center	Iwanuma	11th December 2017
Informant 11	Community Center	Nakoso	16th December 2017

Jogan Tsunami	Keicho Tsunami	Meiji Sanriku Tsunami	Showa Sanriku Tsunami	Chilean Tsunami	GEJET
869	1611	1896	1933	1960	2011
• 8.6 M • 1000 casualties ca. • 40 m tsunami ca. • Sendai Bay	• 8.1 M • 5000 casualties ca. • 20 m tsunami • Sendai Bay, Fukushima Plain	• 8.5 M • 21888 casualties • 38 m tsunami • Sanriku Coast	• 8.4 M • 2995 casualties • 29 m tsunami • Sanriku Coast	• 9.4 M • 142 casualties • 6 m tsunami • Sanriku Coast	• 9.0 M • 19727 casualties (2559 missing) • Up to 40 m tsunami • Sanriku Coast, Sendai Bay, Fukushima Plain

Fig. 2. Overview of past tsunamis along Tohoku's East Coast: the figure presents an overview of past tsunamis recorded along Tohoku's East Coast, specifying (from top to bottom) the name these events are known as, the year, the magnitude of the earthquake that cause the event, casualties, highest tsunami wave, impacted area [24,37,43,49,57].

inviting people to not forget, or even suggesting safe routes of evacuation based on past experiences [17,62]. Many of these stones were erected following the Meiji (1896) and the Showa (1933) Sanriku Tsunamis [60,62], as well as after the Chilean Tsunami in 1960 [30].

- *Shrines and associated myths:* Similar to stone memorials, built heritage such as shrines have also been referred to as life-hazard-maps, guiding people towards safe areas in case of tsunami-evacuation. Shrines along coastlines in Japan are often connected to the history of past disasters [21]. Stories on the origins of these shrines are part of legends and myths, that see shrines as exceptionally sacred places, miraculously spared by the destruction of tsunamis and other hazards [21]. In some of these cases, shrines were built at locations that were regarded as safe on the basis of historical tsunamis and left as a warning message to future generations [60]. This probably explains why several shrines along the Pacific coast of Iwate, Miyagi and Fukushima prefectures were not destroyed by the GEJET [60].
- *Written memories:* In the past, archives of records of past disasters have often been adopted to ensure these memories will outlive time (Informant 8; [20,53].
- *Landscapes:* Places can provide essential information on tsunami risk, becoming important carriers of memories of past disasters [9]. Changes in the environment are intentional and unintentional memorials of past disasters, and if appropriately interpreted can convey strong warning meanings. Elements like the age of buildings or vegetation can be used as indicators of safety. Houses with a two-hundred-year history or more, for example, may indicate that they survived the last four tsunamis prior the GEJET, and that that area was considered to be safe [53]. Forests' age have also long been used as an indicator to understand the history of a certain area [53].
- *Place names:* Place naming itself has also often been used to mark areas that have been historically exposed to tsunami risk [21,26]. Examples of place names which recall past tsunamis can be found almost everywhere along the Sendai Bay and Sanriku Coast. Ishinomaki's Watanoha (渡波), for instance, is located between the city of Ishinomaki and the Oshika Peninsula. Its name means "place of the passing wave" clearly referring to exceptional waves that hit the village in the past. Similarly, the Hadenya valley (波伝谷), located on the Tokura Peninsula along the ria-structured coast of Minamisanrikuin Miyagi Prefecture [61], can be literally translated as the "valley that transmits (the story) of the wave" [21].

Stone memorials (*tsunami kinenhi*) [17,30,60,62] and shrines built along coastline [21,60] are among the most known memorials, and gained in popularity after the Great East Japan Earthquake and Tsunami. One of the reasons they gained popularity was, paradoxically, the striking evidence that, despite their existence, they had been forgotten and disregarded, and mainly failed to serve as warning system to exposed communities. Such realization raised concerns on how to memorialize disasters for a better outcome. Some of these memorials and mnemonic practices were also lost during the 2011 tsunami [30].

New forms of memorialization have been generated following the GEJET, including:

- *Disaster ruins (shinsai ikou):* The conservation of damaged structures had never been used as memorials before the GEJET in Tohoku [58]. Remains and ruins of buildings damaged by the tsunami correspond to one of the most recent forms of memorialization in Tohoku. Known in Japanese with the name *shinsai ikou*, they are as much of a powerful tool for memory transmission, as they are criticized by local communities [58].
- *Storytelling (kataribe):* Following the GEJET, many people who survived the tsunami became *kataribe,* meaning storytellers, and started to provide interpretations in disaster areas by reviving their experience for the public [15].
- *Audiovisual media:* The GEJET was one of the first tsunamis to be so widely recorded with digital cameras and cell phones. In 2009, the city of Sendai founded a collection of digital memories of past disasters, including photographs, documents, and other forms of memorials. Collected memories have been shared online, through exhibitions, and through booklets [42]. This project, called 20th Century Sendai, aims to encourage people to share their experiences and to communicate more, and is one of the many projects that have been generated since 2011's tsunami.
- *Time capsules:* Time capsules are an archiving method used for transmitting disaster memories to future generations [21].
- *Memorial parks:* Memorial parks have been built within many relocated areas along Japan's Tohoku East coast, with the aim of maintaining a high level of risk awareness and give new purpose to places exposed to tsunamis where urbanization is no longer permitted. Cities like Rikuzentakata, Ishinomaki, Iwanuma and Nakoso have committed to measures to discourage communities to return to the coast, as well as to actively commemorate the disaster.

4.2. Considerations on memory transmission in Tohoku

The following subchapters present the main considerations that were raised by the key informants concerning lessons-learned and main challenges related to identified tsunami memorialization and memory transmission (see also Table 3).

Table 3
List of addressed tsunami memorials in the field research.

Type of disaster memorialization		Addressed in this study (see also Fig. 1)	Informant	Literature
Pre-GEJET	***Stone memorials (tsunami kinenhi)***	Stone memorial in Otsuchi	Informant 1	[17,30,60,62]
		Stone memorial in Minamisanriku	Informant 3	
		Stone memorial in Yuriage	Informant 8	
	Shrines and associated myths	Namiwake Shrine	Informant 6	[21,60]
	Written memories	General references to archives and written memories	Informant 2; Informant 6; Informant 8;	[20,53]
	Landscapes	Rikuzentakata's reconstruction landscape	Informant 1	[53]
		Yuriage's reconstruction landscape	Informant 8	
	Place names	Namiwake shrine (Sendai)	Informant 6	[21,26,61]
		Watanoha town (Ishinomaki)	Informant 4; Informant 5	
Post-GEJET	***Disaster ruins (shinsai ikou)***	Minamisanriku's Disaster Management Center	Informant 2; Informant 3	[58]
		Arahama Elementary School	Informant 7	
		Ookawa Elementary School	Informant 4; Informant 5	
	Storytelling (kataribe)	Talks with *kataribe*	Informant 2; Informant 3; Informant 5; Informant 8	[15]
	Audiovisual media	Different examples of digital archives and audiovisual media along Japan's East Coast	Informant 2; Informant 4; Informant 6; Informant 11	[16,42]
	Time capsules	Nakoso's Time Capsule	Informant 11	[21]
	Memorial parks	Millennium Hope Hills Memorial Park	Informant 9; Informant 10	[31]

4.3. The intentions behind memorialization

Disasters leave scars leading to a need to convey lessons-learned to future generations through memorialization. This process marks the institutionalization of memory, in which the shift from communicative to cultural memory occurs (Assmann Jan [5]). The reasons that motivate memorialization can be various. In the past, stone memorials had been erected with the purpose to commemorate tsunamis and their victims, while warning future generations to escape and save themselves in case of tsunami. Messages on stone memorials recite similar messages such as "run quickly to higher ground" (*sugu koudai he nigeyo*), "don't build any house from here onward" (*koko yori shita ni ie wo tateruna*) and many more [62].

> All informants agreed on the need to transmit memories of the GEJET and past tsunamis to future generations. Some of them mentioned that it was necessary to always keep in mind the uniqueness and fragility of life (e.g., Informant 6; Informant 8). Many of the informants are *kataribe*, storytellers, who have decided to share their stories with the public. Informant 8 from the Memoire de Yuriage community center, explains how they find comfort from being a *kataribe* by sharing their own experience with others. They hope to serve the purpose of raising awareness on disaster risk and transmit how precious human life is (Informant 8).

There are also cases in which memorialization was motivated by the need to promote good examples and behavioral responses, such as for the conservation of Arahama Elementary School. This *shinsai ikou* is along the Sendai Bay and is the only building that resisted the GEJET in Arahama city (Informant 7). Designated as an evacuation building in case of emergency, it saved 320 lives, including students and other citizens who took refuge on the rooftop as the tsunami inundated the first two floors [55]. The ruins of the building have been preserved with two main purposes: to keep alive memories of Arahama, whose inhabitants have been completely relocated, and to commemorate the importance of resilient infrastructure and safe behaviors (Informant 7). The first two floors have been maintained in a state of ruin, whereas the other floors have become an exhibition center raising awareness on safety and tsunami risk. It opened in April 2017 (Informant 7).

At the time of the field research, there was a recurrent narrative associating tsunami memorial (especially *shinsai ikou)* to the Hiroshima Genbaku Dome, the nuclear bomb memorial. Informants who were asked to comment on it agreed to a certain extent that such comparison could be done, although a core difference lies in the intention of showing and reminding of the power of nature, while in the case of the Hiroshima Genbaku Dome the message is directed at condemning the power of a human choice with devastating outcomes (Informant 7).

4.3.1. Beyond simply remembering

Simply remembering disasters cannot automatically guarantee effective disaster risk reduction [32]. While some informants claimed to be aware of the existence of this institutionalization of past disasters even prior to the GEJET (Informant 1; Informant 2), having memories of past tsunamis, such as the Keicho tsunami of 1611, doesn't necessarily mean that there was awareness of the risks to which they were exposed (Informant 4; Informant 6). A great majority of informants, when asked whether they were aware of tsunami risk, answered negatively. Objects like stone memorials had been built to encourage people not to forget past disasters and their victims, and "since there's written not to forget, we all forgot of course" (Informant 1; Original: 忘れるなだけでは、忘れてしまいますね, *wasureruna dake dewa, wasureteshimaimasu ne)*. Most of stone memorials *(tsunami kinenhi)* and archives, collectors of memories of tsunamis prior to the GEJET have failed to actively warn communities and to transmit safe behaviors in case of tsunami. Similarly, written memories of past disasters have also played a limited role in informing communities about tsunami risks (Informant 5; Informant 11) due to their lack of accessibility and lack of role in community's everyday lives (Informant 11). The adoption of digital archives is regarded to be a possible solution to this issue (Informant 8), and currently many institutions, research centers, and community centers have collected memories and experiences of the tsunami survivors.

Neglected memories are also known to have gained new importance and new roles within society. The Namiwake shrine is located at approximately 5 km from the ocean, not far from where Sendai city was built before 1611 Keicho Tsunami inundated it, despite its distance from the coast [60]. Its name, meaning "shrine where the wave breaks", refers to a legend according to which the tsunami stopped its course exactly in that location. This fact has been associated to the intervention of the god of the sea and has for centuries been a symbol of tsunami prevention [21,60] although it was forgotten with time. Archaeological deposits from the 1869 Jogan tsunami were also found a few meters from the shrine. The location of this shrine also happens to correspond with the point where the GEJET also stopped its course [60]. It is for this reason that its value as an attempt of the ancestors to warn about tsunami risk has been revived [21,59]. The Namiwake shrine is now known by most locals, and its story is being told in digital archives, exhibitions, and community centers (Informant 6; [55]. Similarly, *tsunami kinenhi* have also gained a renewed value after the GEJET and are now more widely regarded as efforts of previous generations to warn about tsunami risk [18].

4.3.2. Remembering does not guarantee resilience

For the same reasons that simply remembering does not guarantee resilience, there are several examples showing how transformed memories have led to increased vulnerability of the exposed community. One of the main reasons identified in the research was a false sense of safety, amplified by the advancement of disaster risk reduction measures (such as seawalls) which is increasingly seen as a substitution to the role previously played by stone memorials (Informant 1). However, the magnitude of future tsunamis is hardly predictable, and preparing for the unexpected caused by residual risk is one of the most important lessons-learned from the GEJET [47].

A false sense of safety was also due to changing interpretations of tsunami memorials. Most of the stone memorials pre-GEJET were established along the Sanriku coast, due to the impact of the most recent Meiji, Showa and Chilean tsunamis that mainly hit that area

(see also Fig. 2). The Sendai Bay area did not witness any major tsunami during the previous century. One of the only remains of a stone memorial commemorating the 1933 tsunami can be found in the fishing harbor of Yuriage. At the time of the field study, the stone was left to lay near the *Memoire de Yuriage* community center (Memoire de Yuriage, [34]) at the feet of Hiyoriyama Hill. Its inscription is barely visible because of the erosion of the stone, and barely understandable because of its antiquated language. Its message says: "the course of the tsunami has been blocked by the Oshika Peninsula" (Informant 8; From original: 津波の勢いは、牡鹿半島に遮断された, *Tsunami no ikioi wa, Oshikahantō ni shadan sareta*). Referring to the Showa Sanriku Tsunami that hit the Sanriku coast in 1933, this memorial suggests that Yuriage could be considered a safe area. During that tsunami event, Yuriage had been protected by the Oshika Peninsula, and the waves did not reach its shores. Informant 8, born and raised in Yuriage, explains how all inhabitants had unconsciously believed their area to be safe, in part because of the memories transmitted by this stone memorial. During the GEJET, 750 people lost their lives in Yuriage, where the level of risk awareness was very low (Informant 8). Informant 8 states that, because of its detachment with the community's daily life, in addition to the incomprehensible language and the poor status of conservation, this specific stone memorial had been neglected, and its meaning altered. This example is a reminder of the importance of constant interpretation and renewal. Informant 8 suggests to periodically reproduce the memorials, using wood instead of stones, so as to maintain the memory alive and ensure that the right messages are reported (Informant 8).

Another issue raised by the informants is the risk that some memorials, especially *shinsai ikou* (building remains) can play on individuals. The municipal Disaster Management Center of Minamisanriku, for example, is a 12-m-tall building, originally designated as an evacuation center in case of tsunami and whose ruins have been conserved as a memorial. The building was washed away by the 15-m-high tsunami wave on 11th March 2011. That day, 53 people took refuge on top of that building, and only ten of them could save themselves. Informant 3 is one of the survivors from that building, and explained the ongoing debates on the conservation of the skeleton of this building are due to the feelings of relatives of the 43 victims. Informant 3 agrees on there being value for such a structure to be preserved in order to maintain a high level of awareness. However, the community is divided on whether such memorials should be kept or not, as their memory might trigger those who have witnessed the tsunami first-hand (Informant 3).

Similar concerns have been raised for the case of Ookawa Elementary School, located along the Kitakami River between Ishinomaki and Onagawa, Miyagi prefecture. The school, whose ruins have been designated as monument [25], did not have proper guidelines or instructions on how to prepare for and respond to a tsunami. It is still not clear what happened that day, but when the 2011 tsunami arrived, 74 students (out of 108) and 10 teachers and office workers lost their lives, washed away by the wave [39]. According to the reconstruction of what happened, a lack of evacuation directories led to teachers and pupils waiting in the playground of the school for over 50 min, without acting by moving to the nearby hill. As the group decided to move towards the bridge of the river, the tsunami arrived following the course of the river (Informant 4; [39]. Informant 4 and Informant 5 shared some reflections on the reasons behind conserving the building. The ruins of the school are today a painful reminder of the consequences of poor preparation to tsunami risk and lack of awareness. They are preserved – not without opposition – to warn future generations against committing the same mistakes (Informant 5). Informant 4 expressed their concerns on the sort of tourism that the ruins of this school might trigger in the future, as not all visitors necessarily share the same level of respect or empathy towards the memorial. Some people would pose smiling in front of the school for a memory picture, others would laugh with friends while walking around. An appropriate interpretation of this site's memories is therefore critical both to fulfil its educational purposes, and to avoid examples of disrespect that might trigger relatives of those who lost their lives in this place. For this reason, some parents of the children of Ookawa Elementary School have chosen to become *kataribe,* guiding visitors through the right interpretation of the site (Informant 4).

4.3.3. The role of emotional attachment

Orally transmitted memories, otherwise known in Japanese as "kouten" (Informant 5), develop among communities, at a local level or in households [36]. Survivors and witnesses of tsunamis generate this form of memory, sharing their experiences in daily life. It is a powerful form of communication of disaster risk, as it reflects the living society and is based on human interactions. Emotional attachment to memories plays a critical role in determining their role at the level of the individual. Some of the informants claimed that only a few people along the coast remembered these *tsunami kinenhi* before the GEJET, mainly due to the lack of incorporation of these memorials in communities' everyday life (Informant 1; Informant 3; Informant 11). They suggested that if these forms of memories do not generate any sort of emotional involvement with the commemorated past disasters, they are more likely to induce the visitor to simply acknowledge that something has happened (Informant 11). Furthermore, several cases of successful evacuation during the GEJET have been attributed to either personal memories of experiencing the 1960 Chilean tsunami, or to recalling stories narrated within their households that have motivated their prompt reaction when the GEJET occurred (Informant 2; Informant 5; Informant 11).

Emotional attachment is greatly linked to the communicative status of memories, shared either within households or by *kataribe.* However, the more the memory is institutionalized, the harder it will be to maintain its active role within society, generating emotional attachment. In order to overcome this issue, memory transmission requires the recurrence of events or ceremonies (Informant 8). The adoption of digital archives has also been regarded as a powerful tool to maintain a high level of emotional attachment through the collection of audiovisual data. When asked to express their opinion on the best way to actively convey memories of the GEJET to future generations, many informants expressed their confidence in the power of pictures and videos (Informant 2; Informant 7; Informant 10). Informant 2, a photographer from Minamisanriku, was holding an exhibition of pictures of the area from during and after the tsunami, when the author approached them for an Informant. Aware of the fact that with their carriers, memories also fade, they hope to transmit the memories of the GEJET to future generations so to avoid a similar outcome (Informant 2).

Nakoso's Time Capsule Project is another example that aims at combining the potential of audiovisual media with the role played by ceremonies and recurring events. Starting in 2011, the city of Nakoso in the Fukushima Prefecture began collecting experiences of

the tsunami in the form of video and audio recordings, *memoires*, drawings, and pictures. School children, for example, were asked to draw their perception of themselves after the tsunami, and elders have been asked to record narrations on their personal experience (Informant 11; Nakoso Machizukuri Support Center, Tsukuba for 3.11, and Nakoso Fukkou Project, [38]). Upon completion of the collecting process, these memories have been archived in a metal box and buried in a memorial park along the coast on 16th September 2018. It will be reopened 20 years after, and memories will be distributed among the relatives of those who recorded, generating emotional attachment between older and new generations (Informant 11). According to Informant 11, the emotional attachment to these memories will make people more conscious of future tsunami risk, for they will remember how to behave in case of tsunami warnings (Informant 11).

4.3.4. Overcoming the challenge of time

Time represents a challenge to the durability of tsunami memories over time (Informant 1; Informant 2; Informant 3). The role of *kataribe,* for example, is extremely vulnerable to time, and their in-person experience will inevitably be replaced by other supporting measures. One of the methods that will allow the experiences of *kataribe* to overcome time is the adoption of audiovisual data, as presented in the paragraph above. Similarly, *shinsai ikou* are also not likely to be preserved for more than a few decades, due to the high conservation costs and the perishability of materials (Informant 7).

Most informants refer to human nature as inclined to forget about bad and painful memories (Informant 1; Informant 2; Informant 4; Informant 5; Informant 7). This tendency to forget about past disasters over time leads people to rebuild in areas previously destroyed by disaster events, similarly to what had happened along the Sanriku coast despite the relatively recent experience of the Meiji, Showa and Chilean tsunami (Informant 1). The current city reconstruction plans are also considered to have an impact on the landscape, inevitably reminding people about what has happened in the past (Informant 8). Many are the municipalities along Tohoku coastline that have decided to entirely relocate cities on artificial ground of from three to 6 m higher, in order to reduce the exposure of those cities that were not relocated far from the coast. This is what has been done both in Rikuzentakata (Informant 1) and along the Sendai Bay and Fukushima Plain) (Informant 8). Although this infrastructural measure has the potential of leading once again to a false sense of safety, such a drastic change on the landscape is hoped to remind both visitors and locals, serving as a constant reminder of the 2011 tsunami and inherent risks (Informant 8).

In some of those areas where it has been decided not to rebuild, other solutions have been found to discourage new urbanization along the coast during the next decades, due to fading memories. The Millennium Hope Hills Park (in Japanese: *Sennen Kibou no Oka*), in Iwanuma (along the Sendai Bay), is a memorial park that officially opened in 2015 with the continuous support of local communities and visitors (Informant 10). The project consists of a 10 km-long park, separated from the ocean by a 2.7 m high seawall. A rich forest of trees has been planted by all the stakeholders, local communities, and visitors of the park to slow down future tsunamis [31], while people can seek refuge on the 15 hills distributed along the flat surface of the park (Informant 9; Informant 10; [59]. The height of these artificial hills varies from 10 to 5 m, and foundations are made using debris from the tsunami [58]. The idea came from the experience of Matsushima Bay, whose islands served as a buffer, blocking, and redirecting the wave energy and protecting coastal cities along the bay [31]. The activities undertaken by the Millennium Hope Hills, involving local communities, stress the role (as well as the limits) played by protection forests [49]; Informant 9; Informant 10). Memorial parks, besides serving as "expedient" to discourage future generations to move back in proximity to the coastline, also have a role in slowing the impact of future tsunamis and changing people's mindset on the efficiency of these physical measures (Informant 10). The community center of the Millennium Hope Hills that co-ordinates activities and its management, often actively involves the community of Iwanuma in educating on benefits and risks, while offering children and adults an opportunity to communicate during the volunteering events for the management of the protective forest and other activities (Informant 10).

5. Discussion

The main issues and concerns shared by the key informants in relation to the tsunami memorialization efforts along Tohoku East Coast find some correspondence with the proposed theoretical framework explaining the dynamics guiding memory transmission at a community level.

5.1. Communicative memory

Communicative memory is regarded as a highly effective way of actively sharing values and memories among communities maintaining a high level of awareness (Informant 5; Informant 11). Without a backup archive, this memory requires constant engagement for transmission through communication (Assmann Jan [5]) and it only exists as long as its carriers communicate it effectively. Time has a strong impact on communicative memory which is considered to only last up to 80 or 100 years (Assmann Aleida, [4]); this concern was shared by the key informants who attributed the lack of living memories of past tsunamis to humans tending to forget with time (Informant 1; Informant 2; Informant 4; Informant 5; Informant 7). Communicative memories of the GEJET are currently shared at a local level both in an informal way (within communities and households) and in a semi-institutionalized form (through *kataribe*), and their communicative nature acts upon emotional attachment, considered to effectively trigger safe behaviors in case of an emergency (Informant 5; Informant 4; Informant 11).

5.2. Cultural memory and the Archive

The institutionalization of communicative memories meets the needs for the *longue durée* [29] and overcomes the limits of time. The process of institutionalization of communicative tsunami memories along Japan's East Coast is seen as a necessary step to enable the

transmission of memories of the GEJET to future generations with the purpose of preventing a similar outcome from repeating itself (Informant 2; Informant 5; Informant 11). The process is however delicate as past memorialization efforts, such as stone memorials or archives, had mainly failed to warn exposed communities (Informant 1; Informant 2; Informant 4; Informant 5; Informant 6; Informant 11). This consideration finds its correspondence within the theoretical framework referring to memories of the Archive, as their memories were available but not accessed [11]. It would not be a bold assumption to say that the reason why most of pre-GEJET memorials failed to trigger safe behavior when the tsunami arrived is because these memorials were transmitted as element of the past belonging to the past (Assmann Aleida, [4]). This is due to a lack of communication, false sense of safety, mythicization and misinterpretation of the memories in everyday life:

- *Lack of communication*: although most of the *kataribe* find comfort from sharing their stories (Informant 3; Informant 4; Informant 8), it was recognized that it is in human nature to forget painful experiences (Informant 1; Informant 2; Informant 4; Informant 5; Informant 7). The majority of those who have experienced a disaster might therefore choose to release themselves as carriers of memories by relying on memorials [32], as reliving these memories might trigger trauma (Informant 3). Lack of communication around disaster memorials can lead visitors to simply acknowledge that there has been a tsunami in the past, without a direct association with their warning message (Informant 11).
- *False sense of safety:* especially in the case of low-frequency hazards such as tsunamis, the advancement of technological and infrastructural disaster risk reduction measures can jeopardize the messages behind warnings of past tsunamis and induce a sense of safety that allocated tsunami-related risks to the past (Informant 1; Informant 9; Informant 10; Informant 8).
- *Mythicization and misinterpretation:* memories are not embedded in objects [11], and appropriate interpretation is always needed to avoid significant changes in the messages being conveyed to future generations (Informant 8).

5.3. Memories of the canon

The results agree that neither communicability (main characteristic of communicative memory) nor durability (main characteristic of memories of the Archive) are likely to positively impact active memory transmission of past disasters. A constant interaction of these two characteristics can give tsunami memorials an ever-present status, placing these memories into the Canon (Assman, Aleida, 2008; Informant 8; Informant 11). Even when direct witnesses of the GEJET won't be there anymore, future generations will benefit from *kataribe*'s stories conveyed through audiovisual recordings saved in digital archives [16]; Informant 1; Informant 2; Informant 4; Informant 5; Informant 7). Similarly, *shinsai ikou* (disaster ruins) will also one day likely be substituted with digital records of them (Informant 2; Informant 7). The transmission and exhibition of these records should always be associated with active engagement of interested communities through periodic events (Informant 8; Informant 10) or by acting on emotional attachment (Informant 11). This is for example what happened in the case of Smong lullaby passed down within households and from one generation to another in the Simeulue Island community in Indonesia [1,33,44]; Rahman, Sakurai and Munadi, [45]; Rahman, Sakurai and Munadi, [46]). This form of memory transmission has proven to increase community resilience when the 2004 tsunami occurred, and it confirms the relevance played by actively transmitted disaster memories with a role in everyday society. The Nakoso Time Capsule (Informant 11) is probably the closest effort among those identified that aima at responding to these needs by acting directly on the long-term memory, fostering intergenerational communication and exchanges, while transmitting cultural disaster memory.

The *points de vue,* defined by Halbwachs as agents of interpretation (Erll, Nünning, and Young), are the ones responsible for constantly reinterpreting, renewing, and actively involving local communities to maintain an active status of the memories. In areas hit by the GEJET, the role of *points de vue* is currently played by community centers, *kataribe* (storytellers) and other institutions that take up the responsibility of conveying the memories of the GEJET and adapting the message to contemporary needs. It is also their responsibility to foster a process of renewal and adaptation of memories to new social historical contexts [29].

Recommendations for an active reinterpretation of disaster memories are:

- Stone memorials should be restored on a 20-year basis, as a form of renewal of their messages (Informant 8).
- For enabling a comprehensive approach on disaster risk reduction, structural measures and awareness raising approaches should be interconnected, so as to actively involve and educate communities on adopted disaster risk management (Informant 4; Informant 9; Informant 10).
- Family education should be encouraged, as a powerful tool to connect generations and transmit memories embedded with emotional attachment. This can be done with the support of institutions and periodic ceremonies (Informant 8; Informant 11).
- Encouraging the adoption of audiovisual digital archives to the interpretation of objectified memories could be a smart way to maintain an active interpretation of memories when direct witnesses of the disaster will not be able to transmit their experience personally (Informant 2).

6. Conclusion

The narrative developed based on the experiences of the key informants in relation to the proposed theoretical framework allowed a better understanding of how disaster memory can be actively transmitted to future generations, with the aim of contributing to the strengthening of their resilience with respect to tsunamis. This research is not comprehensive of all the dynamics that influence the impact of disaster memorials in community resilience, especially due to the in-depth approach and the context specificities that characterize every case study, but it still provides valuable insights on what kind of memory transmission efforts are likely to positively impact future generations. It resulted that tsunami disaster memories need to play an active role in the everyday life of those who are exposed to tsunami-related risks, in order to maintain their communicative value which is regarded to be the main strength of

communicative memory. Similarly, these memories should also have an institutional back-up to withstand the adversities of time and intergenerational changes. An approach solely aimed at storing memory is however likely to place these memories into what Aleida Assman (2008) calls the Archive, which would make these memories unlikely to play a critical role in influencing community disaster resilience.

> If cultural resilience is an adaptive and transformative process always evolving through time [23], it is critical that *points de vue*, the agents of interpretation of memories, continue to adapt and transform these memories in order for them to always find their "place" in contemporary society and cultural context [29].

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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