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**Protecting museum objects from the threat of natural
disasters.**

Abstract

The wisdom and lessons left behind by our predecessors are instructive from various perspectives for our modern efforts in disaster preparedness and mitigation. Voltaire wrote "A Poem on the Great Lisbon Earthquake" about the situation after the Great Lisbon Earthquake in 1755, describing how to respond to a major disaster; the 1854 Ansei-Nankai Earthquake in Wakayama, Japan, resulted in the immortal disaster textbook "Inamura no hi (The Fire in the Rice Paddies)", in which the villagers sacrificed their precious personal property to save lives. Both Portugal and Japan are earthquake-prone countries due to faults that occur at plate boundaries, but the Japanese archipelago has a history of being struck by various large-scale natural disasters such as typhoons and floods in addition to earthquakes due to its geographical environment. In this disaster-prone country, various disaster mitigation measures for cultural heritage have been steadily established over the past 30 years through a combination of administrative policies and private sector activities, such as the Red Cross concept for cultural heritage, cultural heritage rescue operation, historical resource networks, and the cultural property registration system etc. Specific measures and responses will be introduced, along with examples such as the effectiveness of wooden preservation boxes, subsidized activities by private organizations, radioactive contamination, stabilization treatment, and inland water flooding.

Keywords

Inherited wisdom; Natural disasters; Disaster preparedness; Disaster mitigation; Stabilization processing.

Introduction

Starting with the Lisbon earthquake. At the bottom of the Strait of Gibraltar is a plate boundary where the African and Eurasian plates collide, and there is the Azores-Gibraltar fault. On November 1, 1755, All Saints' Day, this fault shifted significantly for 300 kilometres, and a major earthquake, estimated to be around 9.0 on the Richter scale, struck Lisbon. Tens of thousands of people lost their lives in the massive earthquake, tsunami, and ensuing fires, and Lisbon, a major European city, was instantly destroyed. Sebastião José de Carvalho e Melo (Marquês de Pombal), the prime minister of the time, was quick to issue an order to "bury the dead and provide food for the survivors," and led the city's recovery from the disaster under a rational urban planning system. This is considered to have been the first response to an urban disaster that is still relevant today. Voltaire's "Poem on the Great Lisbon Earthquake," which describes the situation at that time, is famous as an epoch-making text in the context of that period, although it has generated a lot of controversy (Voltaire, 1756).

Next, I would like to discuss the famous Japanese anecdote "Inamura no hi (The Fire in the Rice Paddies)". When Gohei, a village headman living on high ground, senses a tsunami coming, he sets fire to bundles of freshly harvested rice straw piled up in the rice paddies to warn the villagers in the foothills near the coast of the imminent danger. The villagers, seeing the flames of the rice straw, mistakenly believe that the village headman's house is on fire, and rush to the house, only to be saved in the nick of time from the tsunami that rushes in and engulfs the village shortly after. This story of Gohei, who sacrificed his personal fortune to save the lives of the villagers, is based on Lafcadio Hearn's English work "A Living God" (Hearn, 1897) based on the events of the November 5, 1854 Ansei-Nankai Earthquake, which measured over 8 on the Richter scale, and was retold by Nakai Tsunezo as "Inamura no hi (The Fire in the Rice Paddies)", which was popular among children before the war and is still a timeless disaster teaching tool. It has been popular among children since before World War II and is still used in textbooks as an enduring teaching material on disasters. In 2015, the United Nations General Assembly designated November 5, the original date of this

anecdote, as "World Tsunami Day" because of its popularity around the world. It serves as a catalyst for education to raise people's awareness about the risk of tsunamis.

I would like to introduce one more topic of tsunami awareness. In the Sanriku region, there is an old saying, "If a tsunami happens, you must be prepared for it." In the same way, there is a motto, "Life Tendenko," which means to protect one's own life by oneself, and "Tendenko" or "each one for himself" has been handed down for a long time and deeply engraved in the minds of people. The importance of this motto was reaffirmed as "Tsunami Tendenko" in a panel discussion at the first "National Coastal Municipal Tsunami Summit" held in Miyako City, Iwate Prefecture, in 1999 (Yamashita, 2008).

It is fitting to conclude this section with what physicist Torahiko Terada had to say about human habit, who wrote the following in his book "Tsunami and Human Beings" about the Sanriku Tsunami that hit the Sanriku coast on June 15, 1896, caused by an earthquake exceeding 8 on the Richter Scale. He said "But the trouble is that 'nature' is faithful to its past habits. Earthquakes and tsunamis do not care about new fads of thought, but come in stubbornly, conservatively, and vindictively. If these natural phenomena are so recurring, it seems to me that the local residents should have thought of some countermeasures long ago to prepare for them and prevent disasters from occurring. This is what everyone would think at this time, but in fact it is a human natural phenomenon of the human world that this is not the case" (Terada, 1933).

1. The Japanese Archipelago is prone to large-scale natural disasters

In this section, the natural environment and disasters surrounding the Japanese Islands will be discussed. The formation of volcanoes is related to three factors: the Central

Ridge, where continental plates separate from each other on the seafloor; subduction zones, where plates collide and one is pushed under the other continent; and hot spots, where the mantle is hotter than the surrounding mantle. Volcanic activity occurring at the Central Ridge is rarely visible because of the ocean floor, but Iceland is an extremely rare place where the Central Ridge and hotspot are in the same place, and Hawaii is an island formed by hotspot volcanoes. The circum-Pacific volcanic belt, with its numerous volcanoes, lies on a plate subduction zone, and the Japanese archipelago is located there. Mount Vesuvius in Italy, which erupted as far back as 79AD, and the Tongan volcano Funga, which erupted as recently as January 15, 2022, are both volcanoes that formed in the subduction zone. This subduction zone is also the site of earthquakes caused by fault displacement. It is a well-known fact that Japan, which is located in a subduction zone, is one of the most earthquake-prone countries in the world (Fig. 1). 10-15% of the world's earthquakes, and 20% of those with a magnitude of 6.0 or greater, occur in Japan (Japan Meteorological Agency, 2022a).

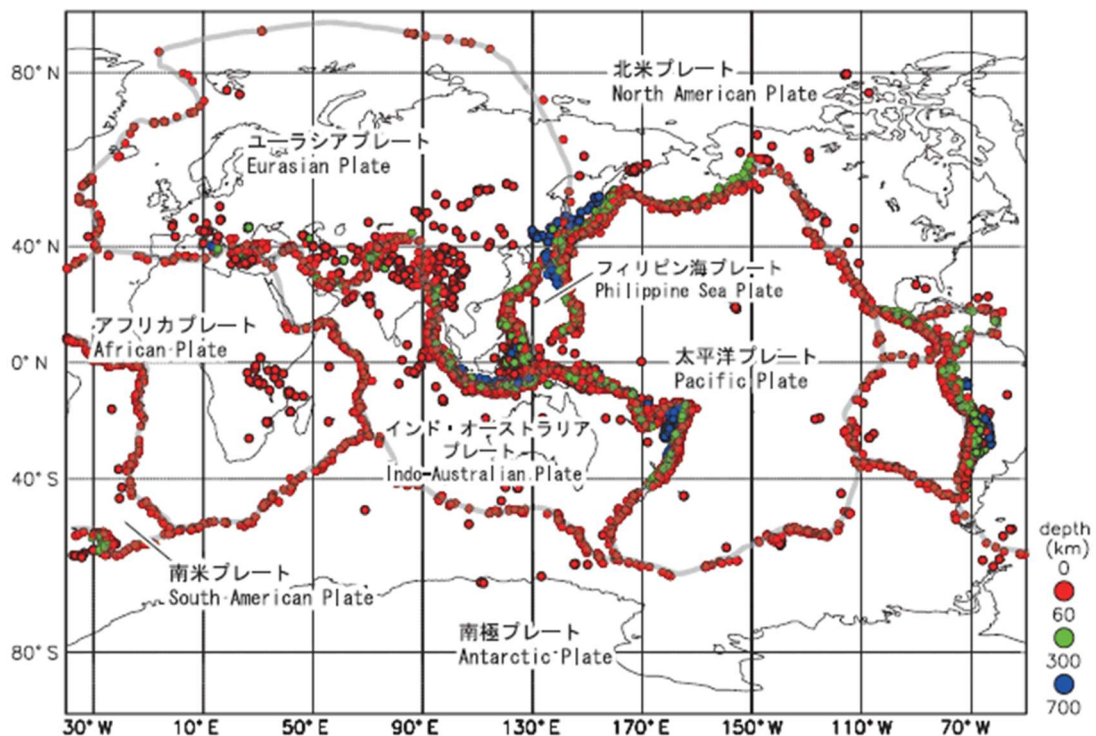


Fig. 1. Distribution of epicenters and plates in the world (Government of Japan, 2017).

In addition to volcanic eruptions and earthquakes, large-scale typhoon and flood disasters also occur frequently in the Japanese archipelago. The archipelago is in a monsoon zone, and the rainy season usually lasts from June to July. In recent years, however, rain clouds called "linear precipitation zones" frequently form, which dump large amounts of rain locally for long periods of time. In addition, typhoons that originate near the equator, move northward, and approach or traverse the archipelago from summer to autumn tend to become larger and larger, resulting in significantly higher maximum wind speeds and rainfall, and a wider range of typhoon power, making them more likely to cause large-scale disasters.

Three examples of natural disasters in recent years are presented below. As an example of an earthquake disaster, the Great East Japan Earthquake should be introduced that occurred at 14:46:18 on March 11, 2011, 130 km off the coast of Sanriku in the Pacific Ocean, causing seismic tremors and large tsunami waves over a wide area from Tohoku to Kanto along the Pacific coast and inland. The Japan Meteorological Agency named the earthquake "The 2011 off the Pacific coast of Tohoku Earthquake" and the name of the disaster brought by the earthquake was decided as "Great East Japan Earthquake (Japan Meteorological Agency, 2022b). The earthquake not only caused extensive damage to human life, social infrastructure, and industry, but also inflicted unprecedentedly severe damage to cultural heritage-related facilities and their collections, as well as to private collections of cultural heritages. In addition to the damage and deformation caused by the earthquake, the tsunami that immediately followed destroyed the facilities, and some of the collections were lost in the outflow. Although they escaped being washed away, most of the cultural objects were submerged in dirty seawater, and a vast number of objects were in danger of rapid deterioration. In addition, the core meltdown at TEPCO's Fukushima Daiichi Nuclear Power Plant, which was operating in Okuma-cho, Futaba-gun, Fukushima Prefecture, released a large amount of radioactive materials, and as a result, access to the surrounding area was severely restricted.

The example of a volcanic eruption is the eruption of Mt. Ontake. Since 1978, there have been many earthquakes at the southeastern foot of Mt. Ontake. In 1984, the western Nagano Prefecture earthquake recorded a magnitude of 6.8, causing large-scale landslides and slope failures on and around Mt. Most recently, a small phreatic eruption occurred in 2007, and ash ejected from the crater was found in an area about 200 m northeast of the crater (Japan Meteorological Agency, 2022c). Despite these conditions, many climbers and tourists visited Ontake, which has long been considered a sacred mountain and is one of the 100 most famous mountains in Japan. The eruption site was on the southwest side of Kenganbō, and pyroclastic flows were observed flowing down the south slope for more than 3 km. The eruption caused human suffering with 63 dead or missing and 69 injured.

And an example of an intensifying typhoon: Typhoon No. 19 (Fig. 2), which originated near Minamitorishima on October 6, 2019, moved northward south of Japan, and made landfall on the Izu Peninsula with large and strong force just before 19:00 on October 12 (Japan Meteorological Agency, 2022d).

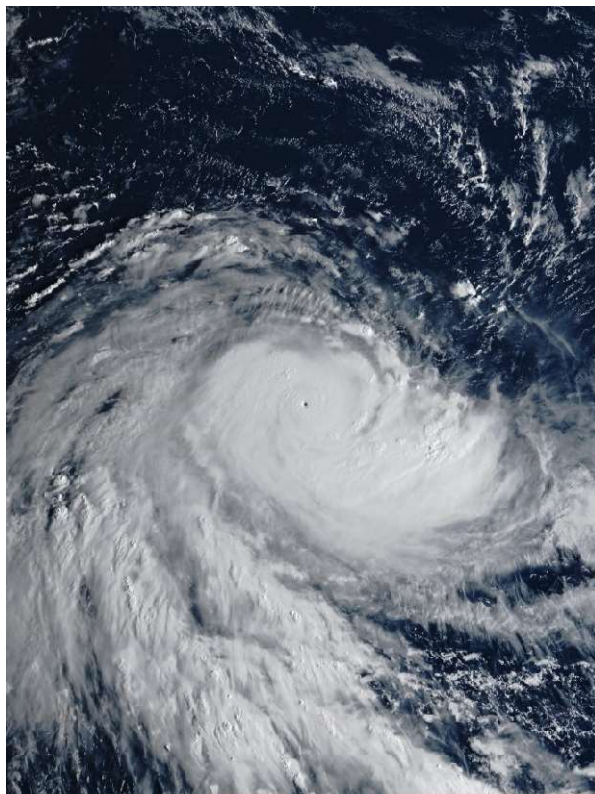


Fig. 2. Typhoon Hagibis, known in Japan as Typhoon No.19. This typhoon originated at 3:00 a.m. on October 6, 2019, off the eastern coast of the Mariana Islands and made landfall in Japan on October 12. It brought record-breaking rainfall to Shizuoka Prefecture and the Kanto, Koshinetsu, and Tohoku regions, causing extensive damage. (Advanced Himawari Imager. Japan Meteorological Agency's Himawari-8 satellite - Hagibis 2019-10-07 0600Z.jpg. Public Domain).

It then passed over the Kanto region and changed to an extratropical cyclone east of Japan at 12:00 pm on the 13th. With the approach and passage of Typhoon No. 19, heavy rain, storms, high waves, and storm surges were observed over a wide area, and total precipitation from the 10th to the 13th reached 1,000 mm at Hakone, Kanagawa Prefecture, and exceeded 500 mm at 17 locations mainly in eastern Japan. In particular, many locations in Shizuoka and Niigata prefectures, the Kanto Koshin region, and the Tohoku region experienced record-breaking rainfall. In terms of winds, the maximum instantaneous wind speed of 43.8 meters at the Edogawa waterfront in Tokyo was the highest in recorded history, and the maximum instantaneous wind speed exceeded 40 meters at seven locations in the Kanto region. Record high waves were observed at Irozaki, Shizuoka Prefecture, with wave heights of 13 meters, and at Kyogamisaki, Kyoto Prefecture, with heights exceeding 9 meters. In some places in Shizuoka Prefecture, Kanagawa Prefecture, and the Izu Islands, the storm surge exceeded the highest level ever recorded, including Miyakejima Island in Tokyo, where the tide level was 230 cm. The heavy rainfall caused a series of rivers to overflow over a wide area, as well as landslides and flooding damage. These heavy rain disasters and windstorms caused human casualties, damage to homes, and damage to lifelines such as electricity, water, roads, and railroad facilities. In addition to damage to cultural heritages caused by rivers overflowing their banks or bursting their banks, the storage rooms of art museums were submerged due to internal flooding.

2. Disaster prevention and mitigation measures for cultural heritage constructed over the past 30 years

2.1. Red Cross concept for cultural heritage

The late Japanese-style painter Ikuo Hirayama felt the need to protect the world's cultural heritage and was an early proponent of specific activities. He expressed this desire as the "Red Cross of Cultural Heritages" (Hirayama et al., 1997). He devoted

himself to the conservation and restoration of the Dunhuang Grottoes, Japanese art works in abroad, and the Angkor monuments, and in 1988 he established the Foundation for the Promotion of Cultural Heritage Protection, moving full steam ahead toward the realization of the Red Cross Organization for Cultural Heritages. This was Japan's first attempt to organize such a private organization to protect the world's cultural heritage in times of peace and in times of emergency. Currently, the foundation's main effort is to provide donation grants to projects that work for the protection of cultural properties.

2.2. Cultural property rescue

The magnitude 7.3 Hyogo-ken Nanbu Earthquake that occurred on January 17, 1995, was a typical urban disaster that hit the Hanshin area, one of the economic and industrial centers of Japan, and was named the Great Hanshin-Awaji Earthquake. This disaster led to the organization of Japan's first cultural property rescue service. This activity involved moving damaged cultural heritage from public facilities and private residences to safe locations and giving necessary treatment to preserve them. The Agency for Cultural Affairs took the lead in the rescue activities, forming a committee of researchers from universities and national institutions, private conservation and restoration technicians, and academic societies related to cultural heritages, with its secretariat at the National Research Institute for Cultural Properties, Tokyo. As this was the first project of its kind, the scope was limited to nationally designated objects, and the project ended the following year with many issues left unresolved.

On March 31, 2011, about three weeks after the Tohoku-Pacific Ocean Earthquake of magnitude 9.0 occurred, the Agency for Cultural Affairs established the implementation guidelines for the Cultural Properties Rescue Project, and the Rescue Committee was formed in early April (Fig. 3).

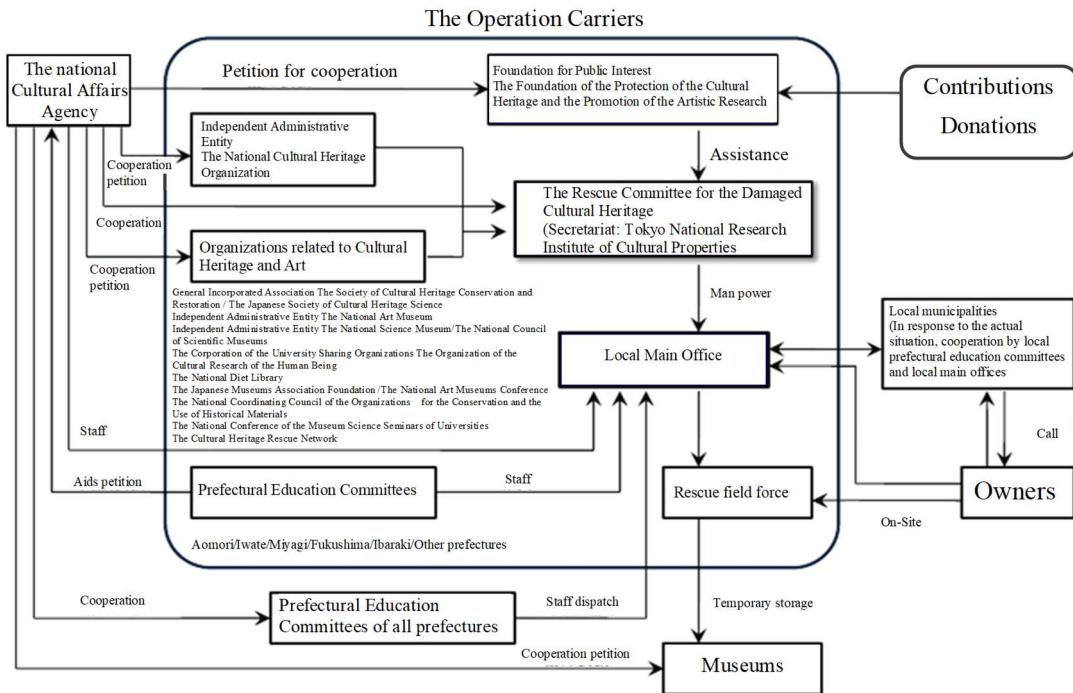


Fig. 3. Project of salvaging cultural properties affected by the 2011 earthquake off the Pacific Coast of Tohoku and related disasters (Committee for Salvaging Cultural Properties Affected by the 2011 Earthquake Off the Pacific Coast of Tohoku and Related Disasters, 2012).

Upon receiving a request, the Rescue Committee set up a local headquarters in the affected prefecture, and the committee headquarters, the local headquarters, and the prefectural board of education worked together to provide support. Since it was difficult to enter the affected areas in Fukushima Prefecture due to the nuclear power plant accident, specific activities began two years after it became possible to enter the area (Kamba, 2012).

2.3. Historical resource network

Around the same time as the cultural property rescue activities, the "Information Network for the Conservation of Historical Materials" was established mainly by historical societies based in the west Japan region for the conservation of historical

materials damaged in the Great Hanshin Earthquake. The organization, in which university faculty members, students, staff of historical archives preservation institutions, and historical researchers participated as volunteers, was formed with the main purpose of rescuing historical heritage, mainly documents in private collections, etc. In May 2002, it was reorganized as a nationwide organization, the Historical Materials Network, and currently has about 30 member organizations nationwide, which are working to protect cultural heritage. It has become a major force for the protection of cultural heritage (Rekishishiryō Network, 2022).

2.4. Cultural heritage registration system

When a nationally designated building is damaged, a roadmap for reconstruction is quickly laid out, and restoration work begins at an early stage of disaster recovery. Although there are many cultural heritages other than those designated as such that should be preserved, there is an extremely high risk that these undesignated properties will disappear along with the rubble removal in the event of a disaster. According to the Hyogo Prefectural Board of Education, 800 of the approximately 1,200 undesignated historical and cultural structures surveyed were damaged in the 1995 Great Hanshin-Awaji Earthquake, and 30% of them disappeared from the city within a few months of the disaster. Taking advantage of this lesson learned, a "cultural property registration system" was established in 1996. The aim of this system was to protect a wide variety of modern and early modern buildings that were difficult to designate under the existing national cultural property system. In 2004, the system was revised to include a wide range of fields, including arts and crafts (Ministry of Cultural Affairs, 2022a).

2.5. International Committee of the Blue Shield

Just as the International Committee of the Red Cross (ICRC) stands for humanitarian protection, the International Committee of the Blue Shield (ICBS) stands for the protection of cultural heritage. The ICBS is a symbol of cultural heritage protection. During the Yugoslav civil war of the 1990s, member states and UNESCO, faced with the reality that the Hague Convention alone was not effective, conceived of a private, expert organization to serve as a Red Cross for cultural heritage. The ICBS encourages the preservation and respect of cultural heritage and provides advice and assistance in crisis management and other specific activities. In 1999, ICBS was also given the mandate to respond to natural disasters, which have been on the rise on a global scale in recent years. A national committee has not yet been organized in Japan (Blue Shield International, 2022).

2.6. Project for rebuilding disaster-affected museums

A large amount of cultural heritage damaged by the 2011 Great East Japan Earthquake was brought to temporary storage by Cultural Heritage Rescue. However, there is a high risk of further deterioration and damage if they remain contaminated by the tsunami, and urgent conservation measures, such as cleaning, must be taken (Fig. 4).



Fig. 4. Cleaning and stabilization process of natural history specimens damaged by the tsunami was carried out by local experts and collaborators in 2011.

Photo courtesy of Rikuzentakata City Museum.

Furthermore, since it is difficult to store cultural properties contaminated by tsunami-contaminated seawater in the storage rooms of museum facilities, closed schools and other facilities were exclusively used for temporary storage, and the environment of storage facilities had to be improved urgently. In addition to these emergency measures, full-scale treatment of the large amount of damaged cultural properties had to be carried out in a systematic manner. In order to ensure the long-term and stable implementation of such work, the Agency for Cultural Affairs has implemented the "Restoration of Damaged Museums Project" to subsidize the cost of conservation treatment of cultural objects in the affected prefectures from FY2012 to FY2020, with some projects receiving extended subsidies thereafter (Ministry of Cultural Affairs, 2022b).

2.7. Project to promote cultural property disaster prevention network

From April 2014 to March 2020, the Agency for Cultural Affairs and the National Institutes for Cultural Heritage will take the initiative in the "Cultural Property Disaster Prevention Network Promotion Project" to build Japan's cultural property disaster prevention system by utilizing the network of many related organizations cultivated through the rescue of cultural heritages after the Great East Japan Earthquake, and to establish local cultural heritage disaster prevention systems and conduct training related to rescue activities. The project was implemented from April 2014 to March 2020 under the leadership of the Agency for Cultural Affairs and the National Institutes for Cultural Heritage. Specifically, the project aims to: (1) Conduct research on how the National Institutes for Cultural Heritage should perform disaster prevention and rescue operations for cultural properties; (2) Collect information on cultural property disaster prevention and rescue; (3) Provide guidance, advice, and training on cultural property disaster prevention and rescue; (4) Research on the storage environment, stabilization and repair of damaged cultural properties based on conservation science; (5) Establishment of a network for disaster prevention and rescue of cultural properties in

an emergency; and (6) International collaboration on disaster prevention and rescue of cultural properties in line with the Sendai Framework for Disaster Prevention of the United Nations Conference on Disaster Reduction. During this period, there have been frequent natural disasters such as the Kumamoto earthquake, flooding in northern Kyushu, torrential rains in western Japan, typhoon damage in Chiba, and flooding along the Kuma River (Cultural Heritage Disaster Risk Management Center, 2021).

2.8. Sendai Framework for Disaster Reduction 2015-2030

The Sendai Framework for Disaster Reduction is an international guideline for disaster reduction through 2030 adopted by United Nations (UN) member states at the 3rd UN World Conference on Disaster Reduction held in Sendai, Japan from March 14 to 18, 2015, and approved by the UN General Assembly in June 2015. It is the successor to the Hyogo Framework for Action 2005-2015, which was the most comprehensive international agreement on disaster risk reduction. It emerged from three years of consultations among UN Member States, non-governmental organizations (NGO), and other stakeholders, supported by the UN International Secretariat for Strategy for Disaster Reduction (UNISDR), and highlights the need for Member States to address disaster risk reduction and climate change adaptation (United Nations Office for Disaster Risk Reduction, 2022).

2.9. Cultural Heritage Disaster Risk Management Center

On October 1, 2020, the Cultural Heritage Disaster Risk Management Center was established as a new organization within the National Institutes for Cultural Heritage, with its headquarters located at the Nara National Research Institute for Cultural Properties. This means that the "Cultural Properties Disaster Prevention Network Promotion Project," which has been implemented since FY2014, has progressed to the

establishment of a permanent organization. The mission of the Center is to establish a system to protect cultural properties in various fields such as buildings, arts and crafts, and folk cultural properties from disasters (Cultural Heritage Disaster Risk Management Center, 2022).

2.10. Regional disaster prevention plans

In addition to the strengthening of systems at the national level, local governments are also expanding their efforts to strengthen their resilience against disasters. For example, in the "Tono City Regional Disaster Prevention Plan," in Iwate Prefecture, which provided logistical support as a supply base to assist disaster areas after the Great East Japan Earthquake, an item "(5) Matters related to damage assessment of cultural heritages" is already clearly stated as a matter related to implementation of emergency measures for cultural properties in the event of disaster. In the wake of the Great East Japan Earthquake, a new item "(2) Support for Education" was added to the logistical support activities section of the "Tono City Regional Disaster Prevention Plan" and cultural heritage rescue was officially included (Tono City, 2022).

2.11. National Treasury subsidies

The "Guidelines for National Treasury Subsidies for Restoration, Disaster Prevention, and Public Utilization of Important Cultural Properties" established under the Law for the Protection of Cultural Properties enacted in 1950 stipulates government subsidies for the management and restoration of important cultural properties and for the public utilization of important cultural properties. In recent years, subsidies have been added to the Guidelines to cover the cost of "installation of seismic isolation platforms and seismic isolation devices," and earthquake countermeasures for Important

Cultural Properties have been actively implemented (Fig. 5) (Ministry of Cultural Affairs 2022c).



Fig. 5. Government subsidy for national treasury have been expanded to cover the cost of "installation of seismic isolation measures and seismic isolation devices," and earthquake countermeasures have been actively implemented. Photo courtesy of Ideal Brain Co. Ltd.

3. Case studies

3.1. Effects of storage boxes

The direct effects of earthquakes on cultural objects are the tipping over of objects due to shaking and damage caused by falling from a height. To prevent objects from falling in storage rooms, many storage shelves are equipped with fall protection fences, and doors and screens are attached to the front of shelves to prevent falling. While these measures undoubtedly reduce the risk of objects falling, one way to increase safety is to use wooden storage boxes, as has been done traditionally. Wooden boxes are excellent preservation containers because of their shock-absorbing

properties that protect the objects inside from impact; during the Great Hanshin-Awaji Earthquake of 1995, some ceramics in paulownia boxes fell nearly 2 meters from shelves without damage, while other pots left naked on storage shelves were all wrecked when they collided (Fig. 6) (Kamba, 2022).



Fig. 6. Wooden boxes which have been traditionally used to keep objects are excellent preservation containers because of their shock-absorbing properties that protect the objects inside from impact.

3.2. Subsidized activities by private institutions

In the aftermath of the Great East Japan Earthquake that occurred on March 11, 2011, the Foundation for Cultural Properties Protection and Art Research, in cooperation with the Agency for Cultural Affairs, has been supporting rescue projects for damaged cultural properties from the beginning, using donations of over 450 million yen from individuals, corporations, and other organizations. For example, the Foundation supported the restoration of the Otokoyama Sake Brewery in Kesenuma City, Miyagi

Prefecture, with the cooperation of Hermes Japan. The tsunami's loss and damage to ritual implements makes it difficult to resume the festivals handed down in the community. Recognizing the healing and enlivening power of festivals, the foundation has also provided funds for intangible cultural assets to help revive festivals. In addition, a donation to the Foundation from writer Kyogoku Natsuhiko, has subsidized the restoration of the "Yoshida Family Documents" in Rikuzentakata City, in line with his request that it be used to preserve cultural properties made of paper damaged by the tsunami (Foundation for Cultural Heritage and Art Research, 2022).

3.3. Radioactive contamination

The accident at Fukushima Daiichi Nuclear Power Plant of the Tokyo Electric Power Company (TEPCO) resulted in strict restrictions on entry into the surrounding area, depending on the level of radiation, in order to prevent the spread of health problems caused by the released radioactive materials. The facilities for cultural properties left behind in the restricted area had been without electricity supply for nearly a year without any staff to manage the facilities, but as of December 2011, the Fukushima Prefectural Board of Education and the Agency for Cultural Affairs conducted a survey on radiation levels inside the facilities, and found that the inside of the Futaba Town Museum of History and Folklore was 0.2 $\mu\text{Sv/h}$ or less inside the Futaba Town Museum of History and Folklore as of December 2011. Similar radiation levels have since been reported from other towns. Since the radiation levels were lower than those outdoors, though by no means safe, a decision was made to conduct rescue activities for the cultural properties left behind in the facility. Rescue operations were carried out in accordance with the manuals, which included the following: workers whose cumulative radiation dose exceeded 1 mSv/year were not allowed to engage in any further work, and work was stopped when the radiation level inside the facility exceeded 2.5 $\mu\text{Sv/h}$. The radiation doses of the cultural property materials to be removed were also measured in advance, and only those with a figure of 1,300 cps or

less as measured by a scintillation survey meter were targeted for movement. The actual dose was reported to be around 100 to 200 cps. About 6,000 items from the collections of the Futaba Town Museum of History and Folklore, the Tomioka Town Museum of History and Folklore, and the Okuma Town Folk Lore Museum were moved to a building once used as Fukushima Prefectural Soma Girls High School (Fig. 7) (Kamba, 2019).



Fig. 7. The rescue operations within a restricted area were carried out in accordance with the manuals. This allowed the relocation of approximately 6,000 items from the museum collection to safer facilities (© artscape, 2013).

3.4. Stabilization treatment

The damage caused by seawater from a large tsunami or storm surge is called "seawater loss." On April 2 and 3, 2011, many of the archives rescued from the Rikuzentakata City Library and brought to the Iwate Prefectural Museum were not only

covered in sediment and other materials, but also had fungal infections and smelled putrid even though the daily average outside temperature was below 10 degrees Celsius. Many of the documents were found to have fungal infections and smells of decomposition. In order to control the rapid deterioration of paper cultural objects such as old documents damaged by seawater, it is essential to remove sludge from the seafloor containing chemical substances, sterilize and remove fungi and bacteria contained in wastewater, desalinate seawater to remove salt, and degrease oil and fat contained in frozen fish and other materials discharged from fishing ports. Water washing is the simplest and most effective way to ensure the removal of mud, bacteria, salt, and grease, and is most effective for ancient documents written in ink on Japanese paper, but simple water washing may be difficult depending on the materials and techniques of the cultural properties. For example, there is a high possibility that the paint layer of oil paintings will peel off, and watercolour paintings, dye and pigment inks, and immersed ink will dissolve, making it necessary to devise various methods for cleaning. Partial removal by dry cleaning without water, temporary sterilization by fumigation, and control of deterioration by frozen storage are possible, but ultimately salt, oil, and sludge must be removed to a safe level and returned to a condition where they can be stored as before in a normal museum storage environment. This process of restoring cultural objects to their normal storage environment by controlling rapid deterioration is called stabilization treatment. The Great East Japan Earthquake was the first example of a stabilization treatment technology that needs to be implemented before full-scale repairs can be made to damaged cultural objects, and further development is still required (The Committee for the Multi-Organizational Co-Operative Project for Preserving and Restoring Cultural Assets Damaged by Tsunami, 2014).

3.5. Inland flooding

Typhoon No. 19 caused internal flooding in Kawasaki city on October 12, 2019, flooding all nine underground storage rooms of the Kawasaki City Museum, as well as the unpacking room and electrical room. In the vaults, which were flooded with 50,000 cubic meters of water, even the sturdy steel doors were destroyed by the water pressure, and paper objects swollen with water destroyed the shelves. The electrical room was damaged and the air conditioning in the storeroom was completely shut down, so the soaking wet collection had to wait in the high humidity environment for the start of the cultural heritage rescue operation. The outside temperature at the time was around 20 degrees Celsius, and the environment inside the storehouse was ideal for the growth of mold. Normally, rainwater collected through storm drains would have flowed into the river, but the water flowed back from the river and overflowed through manholes in the low ground around the museum. The overflowing water cascaded down to the lower underground parking lot and dry area of the museum, flooding the underground storage rooms. This phenomenon is known as internal flooding. From October 14, when the Cultural Heritage Disaster Risk Management Center was contacted, in cooperation with the Agency for Cultural Affairs and related organizations, provided advice from many experts and engaged in removal and emergency treatment of the approximately 230,000 artifacts that had been damaged by the water. On June 19, the removal of the damaged collection from the storehouse was completed, and after that, the works and materials were removed from the storehouse after disinfection and mold removal were completed. After July, the main work shifted to the stabilization process, which is still ongoing (Kawasaki City, 2022).

Final considerations

We are reminded that learning from the lessons of the past has great significance and practical value. Especially in the disaster-prone Japanese archipelago, disaster mitigation measures need to be constantly updated and made more effective by learning from the past. The rescue of damaged cultural heritage sites has become more efficient as experience has been gained. However, in order to rescue more cultural assets faster, it is necessary to collaborate with experts in disaster response, such as the Self-Defense Forces and fire departments. In order to accurately assess the damage to cultural heritage at the site of a disaster, it is necessary to acquire the ability to quantify the scale of damage, not to mention the importance of networking among experts. To move forward on these issues, we need to organize a Blue Shield National Committee in Japan that can respond more quickly to natural disasters.

Acknowledgement

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Nobuyuki Kamba was born in Japan in 1954.

He has a BS in physics at Tokyo Metropolitan University in 1977 and obtained a MA in conservation science at postgraduate course at Tokyo National University of Fine Arts and Music in 1979. He obtained his PhD based on his research into microclimate control at Tokyo National University of Fine Arts and Music in 1997 while he was working at National Museum of Japanese History as an associate professor.

He started his career as a conservator at the conservation studio of Sokei School of Fine Art in Tokyo for five years, then became an associate research fellow of the Museum Science Department of National Museum of Japanese History in Chiba Pref. in 1984 and became an associate professor in 1992. He did fundamental research about museum climate, transport, and scientific analysis of museum objects.

Since 1998 he had been head of the conservation section at the Tokyo National Museum from 1998 to 2015. He practiced practical conservation by utilizing his experiences and experiments. During 1985 he joined International Center of Conservation in Rome as a research fellow by obtaining UNESCO Fellowship. In 1989 he went to Courtauld Institute of London University as a research fellow of Japanese Ministry of Education for one year. He has been focusing on preventive conservation in the museum and the practical conservation for the museum objects. Current research includes establishment of primary care system for museum objects, and development of disaster preparedness. He is a member of the Japan Society for the Conservation of Cultural Properties, International Institute for Conservation, International Council of Museums. He wrote many articles concerning conservation science.