

Commentary

Revisiting the March 11, 2011 Earthquake and Tsunami: Resilience and Restoration

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Ten months have passed since the earthquake and tsunami on March 11, 2011. However, many people living in the seacoast areas of the Tohoku region are still being forced to inconvenient life, with profound sadness due to loss of houses, families, friends, and/or communities. In addition, the great earthquake and tsunami seriously damaged the Fukushima nuclear power plant, causing long-standing health risks in Japan and globally (Butler 2011). As a witness of the complex disasters, I would like to recall the tragic consequences of the natural disaster and a part of the disaster responses on March 11, 2011.

Tsunami as "All or Nothing" disasters

On March 11, 2011 at 14:46, a magnitude-9.0 earthquake attacked large areas of the Tohoku and Kanto regions, northeastern Japan. The massive earthquake generated catastrophic tsunamis, leading to unprecedented disasters in the seacoast areas of the Tohoku region, including the Sanriku coast (Shibahara 2011). The Sanriku coast is characterized by its ria structure that enhances the power of tsunami (Fig. 1). In fact, the 2011 tsunami wiped out people who evacuated to refuge buildings. According to the National Police Agency, the numbers of dead and missing persons were 15,842 and 3,481, respectively (as of December 19, 2011). Almost all of victims died by the tsunami.

I extend my heartfelt condolence to the victims and their families of the Great East Japan Earthquake and Devastating Tsunami on March 11, 2011. I also extend my heartfelt sympathy to all the people who were affected by this earthquake and tsunami and by the subsequent nuclear radiation from damaged reactors in Fukushima.

A large-scale tsunami with a 1000-year recurrence interval

According to the historical documents, Nihon Sandai Jitsuroku, a large-scale earthquake and subsequent tsunami attacked the northeast Japan on July 13, 869, causing the loss of 1,000 lives. The tsunami in the year of 869 was named the Jogan tsunami, after the name of the then emperor. Analyzing the tsunami deposits and employing hydrodynamic simulation, Minoura and colleagues concluded that the distance of seawater inundation by the Jogan tsunami was about 2.5 km inland from the present coast of the Sendai plain (Minoura et al. 2001). Moreover, the recurrence interval of a large-scale tsunami was estimated as 800 to 1,000 years. With advancing urbanization, however, the seacoast

areas inundated by the Jogan tsunami have been developed as residential areas. Unfortunately, many of the towns, developed in those areas, were attacked by the 2011 tsunami.

Disaster responses on March 11, 2011

It was a cold Friday afternoon. Upon the magnitude-9.0 earthquake at 14:46, my seventh-floor office of Building 1, Tohoku University School of Medicine, shook greatly for about 3 min with awful creaking sound. Tohoku University School of Medicine is located in the Seiryō Medical Campus near the center of Sendai City. The massive earthquake caused the full-scale blackout in Sendai (Shibahara 2011). In addition, the earthquake stopped gas supply and/or water supply. Thanks to our periodic fire drills and preparedness, staff members and students smoothly evacuated from buildings to the refuge areas appointed in the Seiryō Medical Campus.

Around 15:30 on March 11, the disaster headquarter for Tohoku University School of Medicine was temporarily set up at the entrance hall of Building 1 (Fig. 2A), because the entrance hall is convenient for rapid evacuation from

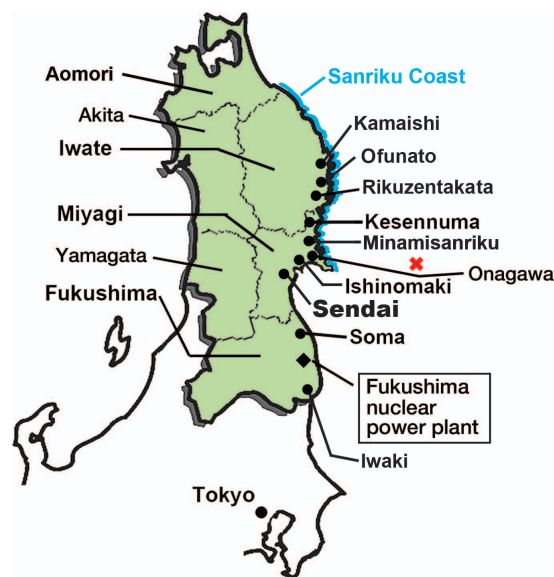


Fig. 1. The Sanriku coast of the Tohoku region. Shown are Sendai and neighboring cities that were attacked by the 2011 Earthquake and Tsunami. Its epicenter is schematically indicated (red): 130 km off the Pacific coast of Tohoku region and 24-km depth. The Tohoku region is shown as green. The Sanriku coast is shaded along the seacoast (blue). This figure is modified from the original (Shibahara 2011).

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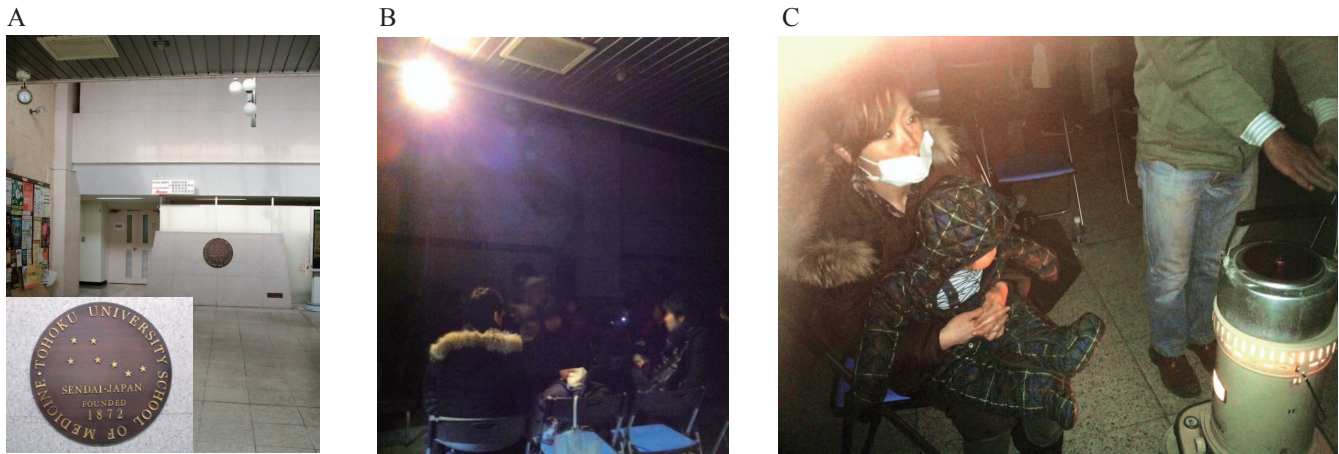


Fig. 2. The entrance hall of Building 1 on the night of March 11, 2011.

A. The entrance hall of Building 1 of Tohoku University School of Medicine. This photo was taken in December 2011 from the angle similar to that in B. Note the emergency lamp on the ceiling (top left corner). The School Logo is enlarged, showing the image of Big Dipper. B and C. The entrance hall on the night of the March 11 earthquake (at 21:00; outside temperature, $\sim 4^{\circ}\text{C}$). Students sat around a small oil stove. Note a functioning emergency lamp.

the shaking building upon aftershocks. In addition, a backup generator of small capacity was available at the Security Office located next to the entrance hall. Staff members worked hard for safety confirmation of students and employees, without any communication tools. The presence of staff members might have attracted many students and their families to the entrance hall, where some of them eventually stayed overnight (Fig. 2B, C). It was fortunate that we were able to use toilets, because the well water system was functional even after the great earthquake. Moreover, other groups of students gathered at the School Gym in the Seiryō Medical Campus, and they voluntarily helped faculty members for safety confirmation. They also participated in serving foods for evacuated people, including those unrelated to Tohoku University. In the course of the post-earthquake activities, the School Gym became a temporal evacuation center.

Even under the full-scale blackout after the earthquake, Tohoku University Hospital (1,308 beds) appeared to retain most of the ordinary functions with its own electric power system. The activities of Tohoku University Hospital have been summarized in a recent article (Satomi 2011).

By noon on March 12, the electricity supply was restored in the Seiryō Medical Campus. Thereafter, the disaster headquarter of Tohoku University School of Medicine was formally set up at the conference room on the second floor of Building 1.

Moving forward on the Restoration in Tohoku University

Thanks to the quake-resistant or the quake-absorbing buildings with the good fortune, there were no deaths and injuries among students and employees in all campuses of Tohoku University, including the Onagawa Field Center for marine science (Normile 2011) (Fig. 1). On the other hand, the earthquake damaged many buildings and instruments. Moreover, the earthquake and the subsequent blackout

resulted in the loss of enormous numbers of invaluable human materials that are never available (blood samples and tumor tissues, etc.). Even under such serious circumstances, Tohoku University School of Medicine has started to move forward immediately after March 11 on the restoration (<http://www.med.tohoku.ac.jp/english/emg/>). A relevant article was published for librarians, students, and researchers living in the earthquake-prone zones (Sakamoto et al. 2011).

Concluding remarks

Ideally, every building should be constructed in a quake-absorbing structure with its own electric power system. It is also important for us to record and publish various aspects of the disaster responses.

As a resident in Sendai, Miyagi, I would like to express my gratitude to many teams from all over Japan and foreign countries for kind and warm supports to people living in the Tohoku region. I also admire the patience and politeness (the Tohoku Spirit) of people who were affected by the March 11 disaster, and I believe their resilience.

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