

## The existence effects of coastal forest by damages caused by the 2011 of the Pacific Coast of Tohoku Earthquake Tsunami

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The purpose of this study is to verify and evaluate the protective effect of coastal forests against damage caused by the March 11, 2011 earthquake and tsunami on the Pacific Coast of Tohoku and to propose a tentative plan for strategic planting of coastal forests.

This field survey was carried out in Nagahama, Ishinomaki City, and Miyagi prefecture, where the coastal forest contains Japanese Red Pines (*Pinus densiflora*) and Japanese Black Pines (*Pinus thunbergii*). There are the residential areas around the coastal forest, and many buildings in these residential areas were washed away and destroyed by the tsunami.

We used aerial photo and local damage investigations to confirm the extent of damage to buildings around the coastal forest. During the aerial photo investigation, we analyzed the sites of the buildings that were washed away and the locations of rubble by comparing aerial photos taken in June 2010 (before the tsunami) with those taken between 12?18 March, 2011 (after the tsunami), in the study area (1,000 x 700 m). During the local damage investigation in August 2011, we performed ground-level surveys and classified buildings into 8 damage grades and by checking the water line marks left by the tsunami. The positions of the building pulled down after the August investigation were checked in October 2011.

In the areas with coastal forest (area of the coastal forest and the back of coastal forest) and those without the coastal forest (buildings behind the tide embankment), the height above the sea level and height of the tsunami water were almost the same and the landform was flat. However, buildings in coastal forest areas suffered less damage than those in areas without the coastal forest. Thus, the wave force-reducing effect of coastal forest was verified. Areas without coastal forest had many washed-out buildings and rubble (particularly within 200 m of the tide embankment). The presence of coastal forests restricts land use near the seashore, where tsunami damage is greatest. Thus, it can be suggested that coastal forests reduce the damage caused to the buildings, which would have otherwise existed near the seashore, and reduce the inflow of rubble into the land. Buildings pulled down after the August investigation were checked in both areas in October; the degree of damage to the buildings in these 2 areas was varied. Therefore, it can guess that the evaluation of effect against the tsunami of a coastal forest by residents is not enough, and a coastal forest is expected the preservation and practical use which gives many functions (existing reason) besides the disaster prevention effect.

Keywords: coastal forest, tsunami, existense effect, multiple functions