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Impacts of the 2011 tsunami on vegetation in coastal areas of northeast Japan and subsequent recovery processes

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The Great East Japan Earthquake of 11th March 2011 and subsequent huge tsunami caused widespread damage along the Pacific Ocean coast of the Kanto and Tohoku regions of eastern Japan. Topographically, the Pacific Ocean side of the Tohoku Region consists of the Kitakami and Abukuma Mountain Ranges, with the Sendai Plain in between. The Sanriku coastal area occurs where the Kitakami Mountains meet the sea, and is characterized by an extremely complicated, deeply indented rias coastline. South of the Sanriku Coast is the extensive Sendai Plain and coastal landforms in this region consist primarily of sandy beaches. Various types of vegetation are found in this area, including sandy beach and coastal cliff vegetation, coastal forests, back-marshes, and evergreen broad-leaved forests, which reach the northern limit of their distribution in the Sanriku area, on the islands and inlets.

This earthquake and tsunami resulted in immense ecological damage, caused by the enormous physical impact of the tsunami, as well as the physiological impact of inundation by seawater. The disaster, however, occurred in March, before vegetation in this region had entered the spring growth season. As a result, the damage to vegetation varied widely between woody and herbaceous plants. For example, herbaceous plants distributed in a narrow belt along the edge of the splash zone on rias rocky coasts have evolved to withstand pressure from breaking waves and being showered by salt spray, and thus suffered only some minor physical damage from soil wash-out and rock break. In contrast, along the shores of the Sendai Plain the vegetation distributes in a series of contiguous ecological zones running from the outer beach through the wetlands and on inland to the rice paddies. The powerful tsunami crashed over this coast, disturbing and mixing the soil in the various zones, filling the rice paddies with sediment, and uprooting and breaking pine trees in the coastal forests. In this region, traditional land uses such as rice paddies and forestry plantations were practiced in areas inland or on slightly higher ground. Rice paddies inundated by seawater can no longer be cultivated, and the vegetation in many paddies changed to a pattern dominated by Echinochloa crus-galli var. caudate grass. In paddies that were inundated for long periods of time even this vegetation disappeared. Sugi cedar (Cryptomeria japonica) timber standards that were inundated changed color and wilted.

The brunt of the damage from the tsunami was taken by the vital ecotones linking the ocean and terrestrial ecosystems. The ecotones of the alluvial and Rias coastlines, however, differ in structure, and the nature and extent of damage suffered thus differed accordingly. Two years after the disaster, the open areas created by felled or wilted trees in the pine woods of the Sendai Plain coastal area are being filled by alien species such as Robinia pseudoacacia and Phytolacca americana, etc. In the remaining pine woods, however, seedlings of Pinus spp. have sprouted naturally, and the plant communities on the outer beaches are also starting to recover. On the other hand, reconstruction works, including planting of new plantations and civil engineering projects such as building levees, now pose a new threat to the native vegetation communities that have survived and are in the process of recovering on their own power. The need to prioritize prevention and mitigation of damage due to future disasters is obvious, but this work should be implemented in a sustainable manner, while protecting the regional ecosystems and biodiversity. Japan has recently hosted the meeting of the 10th Conference of Parties to the Convention on Biological Diversity (COP10), and the current large-scale reconstruction work offers an excellent chance to put the principles developed at this meeting into practical use, by implementing the public works in an ecologically sensitive manner.

キーワード: The Great East Japan Earthquake, tsunami, vegetation, damage, biodiversity