Radiocesium redistribution dynamics in a forested ecosystem in Fukushima after the nuclear power plant accident in March 2011

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The accident at the Fukushima Daiichi Nuclear Power Plant (F1NPP) in March 2011 emitted 1.2 × 10^{16} Bq of cesium-137 (¹³⁷Cs) into the surrounding environment. Radioactive substances, including ¹³⁷Cs, were deposited onto forested areas in the northeastern region of Japan. To clarify the mechanisms of dispersion and export of 137 Cs, within and from a forested ecosystem, we conducted intensive observations on the ¹³⁷Cs movement and storage in a forested headwater catchment in an area about 50 km from F1NNP. Two major pathways of ¹³⁷Cs transport were investigated as follows: 1) by moving water via dissolved and particulate or colloidal forms, and 2) by dispersion through the food web in the forest-stream ecological continuum. The ¹³⁷Cs concent-rations of stream waters were monitored. Various aquatic and terrestrial organisms were periodically sampled to measure their ¹³⁷Cs concentrations. The results indicate that the major form of exported ¹³⁷Cs is via suspended matter in the streamflow. Particulate organic matter may be the most important carrier of ¹³⁷Cs. High water flows generated by a storm event accelerated the transportation of ¹³⁷Cs from forested catchments. Estimation of ¹³⁷Cs export from the forested catchments requires precise evaluation of the high water flow during storm events. The results also suggested that because the biggest pool of ¹³⁷Cs in the forested ecosystem is the accumulated litter and detritus, ¹³⁷Cs dispersion is quicker through the detritus food chain than through the grazing food chain. Bioaccumlation of ¹³⁷Cs through the food chain was not detected. ¹³⁷Cs concentration of leaves (1.1k Bq/kg), barks (4.4-22.5 kBq/kg) woods (0.1-0.6 kBq/kg) and litters (1.3 kBq/kg) of a dominant deciduous tree (Quercus serrata) suggested that transport and redistribution of ¹³⁷Cs have actively occurred from bark and litter layer on the forest floor to woods and fresh leaves.