Transfer and Accumulation of Tritium and Radiocarbon in Forest

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Abstract

The operation of the spent nuclear fuel reprocessing plant in Rokkasho, Japan, is accompanied by the discharge of a small amount of tritium (T) and ^{14}C mainly in the form of HTO and $^{14}CO_2$. In terrestrial ecosystems around the reprocessing plant, both radionuclides are incorporated into organic compounds in plants mainly due to photosynthesis, followed by supply to soil as dead plant parts such as dead leaves and roots. This raises the concern about accumulation of those radionuclides in soil, because soil organic matter is recognized as the largest carbon pool in terrestrial ecosystems. In order to predict the accumulation of those radionuclides in terrestrial ecosystems, a model dealing with the plant photosynthesis, the supply of litter from plants to the soil, and the decomposition of litter and soil organic matter needs to be established.

We selected a forest of Japanese black pine (*Pinus thunbergii*) as our target, because this type of forest is common around the reprocessing plant as windbreaks. In FY 2015, a 50 × 50 m quadrat was established ~5 km east of the reprocessing plant in the forest, and the diameter of trunk at breast height (DBH), which is an important index of biomass of tree parts, of each tree was measured. Fallout rates of above-ground litter were also measured for obtaining input of H and C to soil in this route. Total basal area, which is the sum of the cross-sectional area of a tree's trunk at breast height for each tree, in the quadrat was obtained from the measured DBH. The results showed that Japanese black pine contributed 94% of the total basal area of all tree species in the quadrat, indicating that biomass of other trees such as deciduous trees was negligible. On the other hand, 30% of the above-ground litter from July 2015 to January 2016 was supplied by deciduous trees, showing a significant contribution of deciduous trees to total leaf biomass and above-ground litter production in the study site. We are planning to estimate forest photosynthesis based on more data of the temporal changes in whole-plant biomass of Japanese black pine and in leaf biomass of deciduous trees.

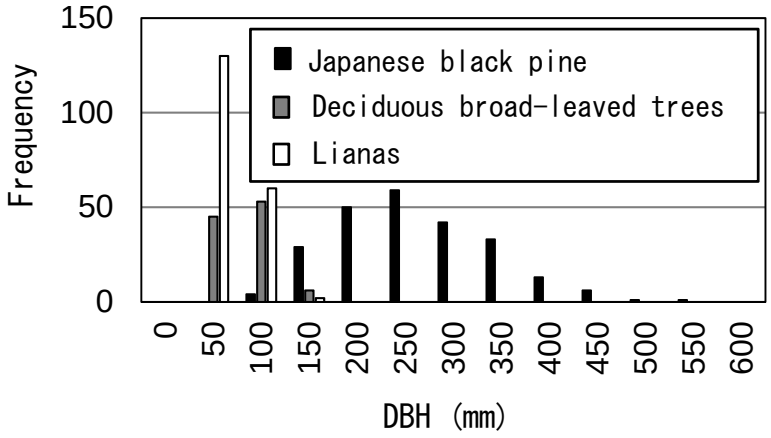

Fig. 1 Frequency distributions of diameter at breast height (DBH) in a 50 × 50 m quadrat of a Japanese black pine forest.

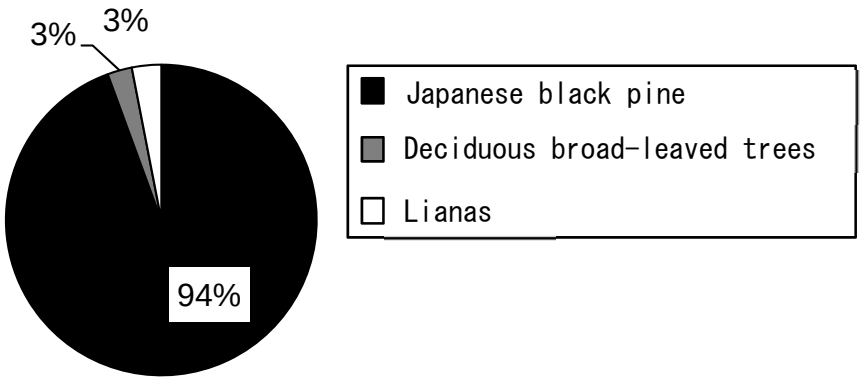

Fig. 2 Occupancy of basal areas in a 50 × 50 m quadrat of a Japanese black pine forest.

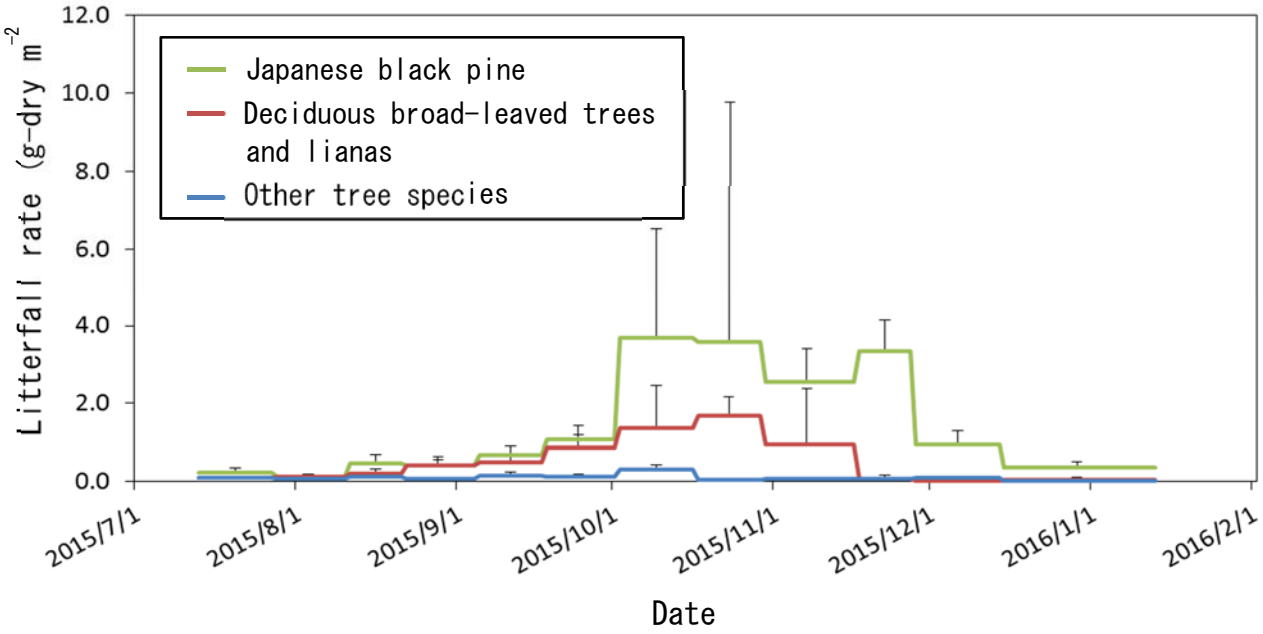

Fig. 3 Litterfall rates in a 50 × 50 m quadrat of a Japanese black pine forest. Vertical bars indicate a standard deviation of 10 samples.