Reference 7-3

# Estimation of radiocesium concentration in forest soil

Shinji Kaneko
Forestry and Forest Products Research Institute

Radiocesium concentration in forest soil significantly varies in the vertical direction. The concentration is high in the fallen leaf layer. In the soil surface layer (0-5 cm from the surface), the concentration is one tenth of that in the fallen leaf layer. It further decreases along with the increase of depth of the soil (Figure 1). The weight per unit area of the fallen leaf layer is as small as one tenth of that of soil (Figure 2). During forestry work, it is unlikely that only fallen leaves will be collected. Therefore, it is practical to evaluate the concentrations of radiocesium in the soil down to a certain depth.

The weighted average radioactivity concentration was calculated at each depth (5 cm, 10 cm, 15 cm and 20 cm) when fallen leaves and soil under the leaf layer were mixed, based on the data in the press release from the Ministry of Agriculture, Forestry and Fisheries on 27 December 2011, and the concentration ratios of the mixture of leaves and soil at each depth to the mixture of leaves and the soil from the surface down to the 5 cm depth were determined. The ratios obtained in relation to the depth of the soil were plotted as power approximations (Figure 3).

Then, the weighted average concentration of radiocesium (A) in the mixture of fallen leaves and soil (0-5 cm) was determined based on the data in the press release from the Ministry on 1 March 2012, “Radiocesium concentrations contained in the soil and so measured at 391 locations in Fukushima Prefecture”. As seen from the approximation formula in Figure 3, the concentration decreases to 28.8% when leaves are mixed with soil down to 15 cm in depth. Then the radiocesium concentration of the mixture with soil down to 15 cm was estimated from (A) multiplied by 0.288, and the relationship between the concentrations and the ambient dose rates was compared (Figure 4).

From the approximation formula in Figure 4, the relationship between the radiocesium concentration (kBq/kg) in soil down to 15 cm in depth and the ambient dose rate (μSv/h) is shown as:

$$\text{Radiocesium concentration} = (\text{Ambient dose rate}) \times 3.38 - 0.19 \qquad (1)$$

From formula (1), the radiocesium concentration at the ambient dose rate (2.5 μSv/h) is determined to be 8.26 (kBq/kg).

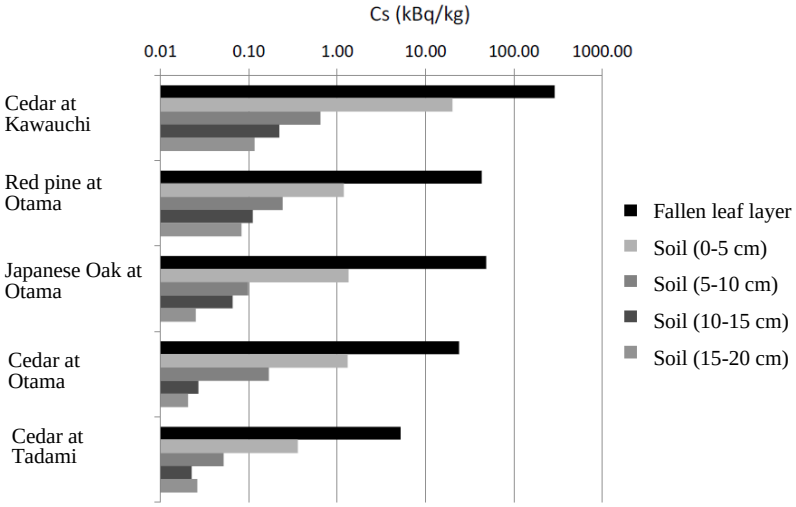


Figure 1 Concentration of radiocesium ($^{134}$Cs and $^{137}$Cs) in fallen leaf layer (L) and the soil in each forest surveyed (kBq/kg).

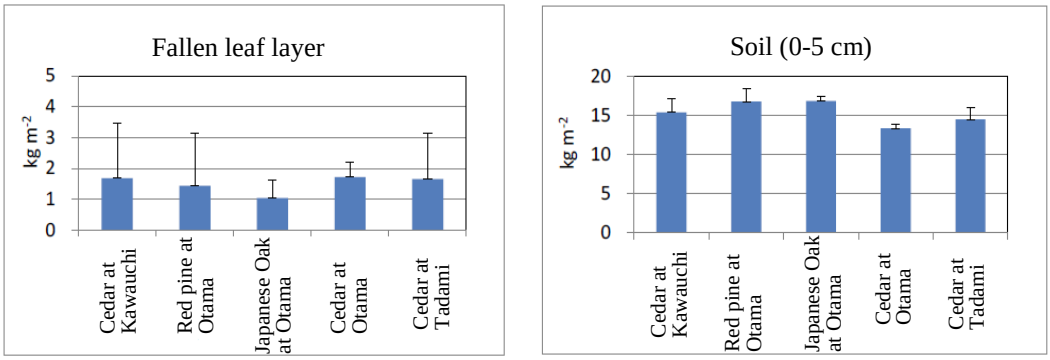


Figure 2 Weights of fallen leaf layer and the soil (0-5 cm in depth) per 1 m$^2$.

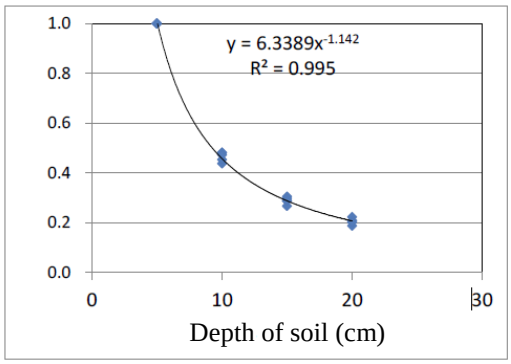


Figure 3 Relationship between the radiocesium concentration decreasing rate* in the soil and the soil depth.
*The ratio of the radiocesium concentration (weighted average) in the mixture of fallen leaves and soil at different depths to that of the mixture of fallen leaves and soil (0-5 cm in depth) (calculated from the measured values at five forests locations in Fukushima Prefecture).

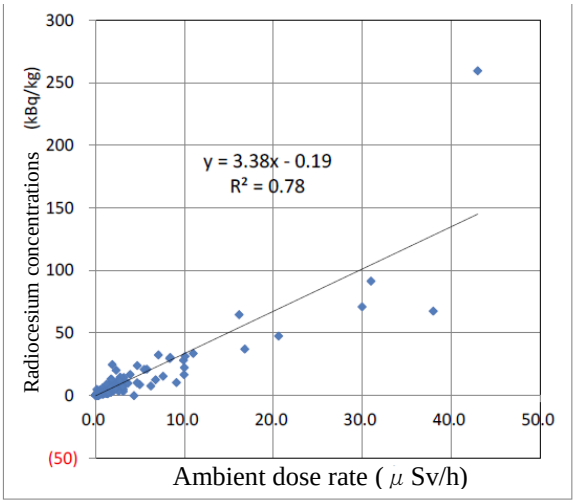


Figure 4 Relationship between the radiocesium concentrations in the fallen leaf layer/surface soil (0-15 cm in depth) and the ambient dose rates.