

Carbon Transfer and Accumulation in Forest Ecosystem

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Abstract

The operation of the spent nuclear fuel reprocessing plant in Rokkasho, Japan, is accompanied with the release of ^{14}C mainly in the form of $^{14}\text{CO}_2$, which will transfer and circulate in terrestrial ecosystems. Since the duration of the normal operation of the plant is planned to be 40 years, it is of large concern among the neighboring people whether ^{14}C will accumulate in the surrounding environment. In order to forecast the fate of ^{14}C released from the plant, it is necessarily needed to develop a mathematical transfer and accumulation model of carbon in terrestrial ecosystems, taking into account the photosynthetic fixation of carbon and the decomposition of organic matter. The terrestrial ecosystems, especially forests and wetlands are widespread around the reprocessing plant. For the estimation of plant biomass in forests, four study sites were set up at deciduous broad-leaved forests (*Fagus crenata*-dominated and *Quercus crispula*-dominated) and *Cryptomeria japonica* plantations (64-year-old and 18-year-old), where heights and diameters of all trees with a diameter at breast height (DBH) ≥ 5 cm were measured. The above-ground biomass was estimated by allometric correlations to the tree height and DBH. The results showed that average DBH and tree height of both deciduous broad-leaved forests and *C. japonica* plantations were within the ranges of those previously reported in Japan. The above-ground biomass of *C. japonica* plantations was also within the range reported, but that of deciduous broad-leaved forests was slightly smaller than the lower limit of the figures previously reported in Japan. Based on these fundamental data, the net primary productivity in the forests will be estimated next year. In addition, ^{13}C -labelled plant parts of *F. crenata*, *Q. crispula*, *C. japonica* and *P. australis*, were prepared with ^{13}C concentrations of 2.705, 2.681, 0.662 and 2.814 atom%, respectively. These ^{13}C -labelled plant samples will be used for decomposition experiments next year.

Table 1 Fundamental characteristics of deciduous broad-leaved forests and *Cryptomeria japonica* plantations

Study site	Average DBH ^{**} (cm)	Average height (m)	Above-ground biomass (kg-dry m ⁻²)
Deciduous broad-leaved forests in Japan [*]	8.9–37.6	8.5–30	14.3–67.7
<i>Fagus crenata</i> -dominated deciduous forest	17.1	10.4	14.1
<i>Quercus crispula</i> -dominated deciduous forest	16.4	9.7	11.7
<i>Cryptomeria japonica</i> plantations in Japan [*]	5.0–48.6	4.4–35.2	1.3–51.2
64-year-old <i>C. japonica</i> plantation	23.8	16.8	48.5
18-year-old <i>C. japonica</i> plantation	17.6	12.6	49.9

^{*}: Ranges were estimated by the reviewed articles in references (安藤, 1968; 只木ほか, 1969; Tadaki, 1970; 中根, 1980; 玉井ほか, 1983; 片桐ほか, 1985; 根岸ほか, 1988; 只木ほか, 1988; 丹下ほか, 1990; Hiura, 2005; Jia and Akiyama, 2005; Kubota *et al.*, 2005; Yoshida *et al.*, 2005; 市川ほか, 2006; 渡邊・茂木, 2007).

^{**}: DBH stands for diameter at breast height.