(Attachment 2)

[Survey 2] Results of FY2019 Survey on Radioactive Cesium in Forests in Difficult-to-Return and Adjacent Areas

1. Purpose of Survey

The past studies on radioactive cesium suggest the total quantities of radioactive cesium accumulated in forests have not changed more than its physical decay, and the amount of release via mountain steam water is infinitesimal. As the majority of radioactive cesium settled in a forest ecosystem remains in the ecosystem, investigation of its dynamics needs to be continuously conducted from a long-term viewpoint. Considering entry into areas with extremely high air dose rates is still restricted, in 2017, the Forestry Agency started surveys to understand the dynamics of radioactive cesium in forests in difficult-to-return and adjacent areas. The results of the FY2019 survey (third year) are shown below.

Photo 1　Sampling branches

Photo 2　Sampling trunk xylem

2. Survey Method

The survey was conducted at eight sites, one site less than the previous year (Figure 1; a landslide caused by Typhoon 19 (Hagibis) prevented access to one site). These sites were selected from the sites in Fukushima Prefecture used for surveying radioactive cesium contained in male flowers of cedar in FY2019. At each monitoring site, from October to November 2019, air dose rates were measured at a height of 1 m from the ground, and samples were collected for cedar leaves, branches, bark, and trunk (sapwood, heartwood). For the litter layer and soil, samples were collected in June to July 2019.

Samples were treated indoors after collecting, and subjected to gamma-ray spectrometry using a germanium semiconductor detector to measure radioactive cesium (Cs-134 and Cs-137) concentrations. This year’s measurements were normalized to September 1, 2019.

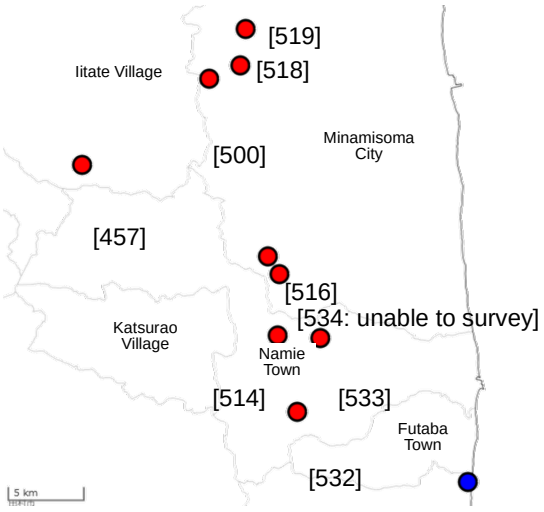


Figure 1 Location of Monitoring Sites (Numbers in parentheses indicate site IDs. Created using GSI tiles.)

Table 1 Air Dose Rate at Monitoring Sites (μSv/h)

Site ID	FY2019	FY2018	FY2017
457	2.29	2.79	2.87
500	1.42	1.64	1.68
514	7.08	8.64	9.07
516	2.20	2.93	3.05
518	0.57	0.73	0.77
519	0.51	0.66	0.70
532	2.60	3.05	2.65
533	2.59	3.13	3.25

3. Results

The air dose rates decreased by 14-25% from the previous year in all eight sites, which is greater than the physical decay that is estimated to be about 10% (Table 1). This result is likely attributable to the heavy rain caused by Typhoon 19 (Hagibis) that hit immediately before the survey, resulting in a greater amount of moisture in the soil and the water shielded some radiation. The radioactive cesium concentrations (sum of Cs-134 and Cs-137) in trees and the soil were, similar to previous surveys, high in the litter layer and surface soil, and low in the sections of trees (Figure 2, Figure 3).

The quantities of radioactive cesium accumulated in the litter layer and surface soil (underground) continue to be larger at higher air dose rate locations (Figure 4). However, the quantities of radioactive cesium accumulated underground tend to vary significantly, and the accumulated quantities of radioactive cesium at site ID 514 dropped by 59% from the previous year. The trend of changes in quantities of radioactive cesium accumulated underground requires continued monitoring and careful consideration.

Comparing within the same site, similar to the past survey results, the radioactive cesium concentrations in heartwood were slightly higher than those in sapwood (Figure 5). This trend has been observed for cedar in past studies, except for immediately after the accident, and therefore it may be a characteristic common in cedar.

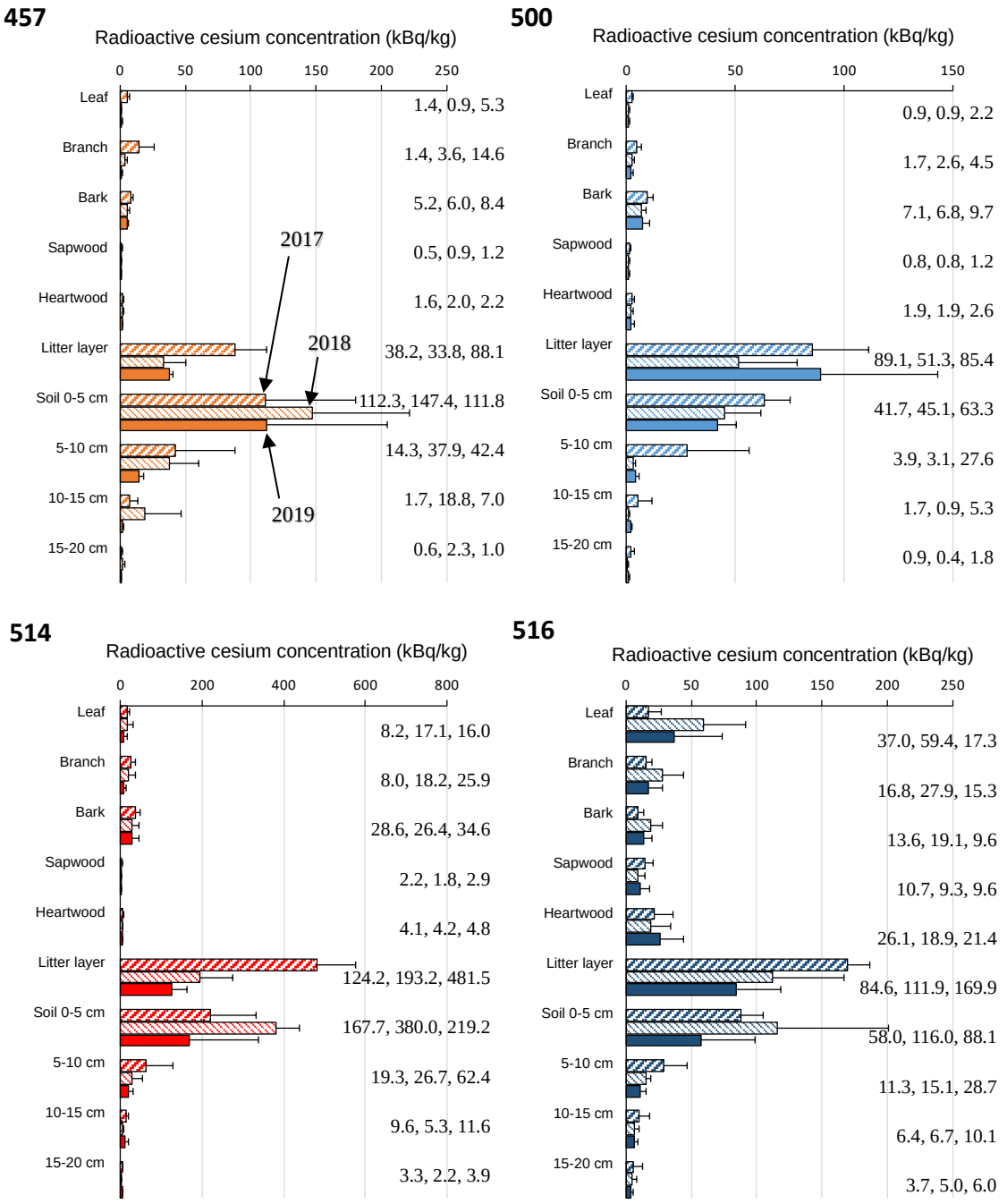


Figure 2 Radioactive Cesium Concentrations in Forest at Site IDs 457, 500, 514, and 516

(Data points and error bars indicate average and standard deviation of radioactive cesium concentration, respectively, at each section. The three numbers shown at the right of each data set are average radioactive cesium concentrations (in kBq/kg) at each section in FY2019, FY2018 and FY2017, from left to right.)

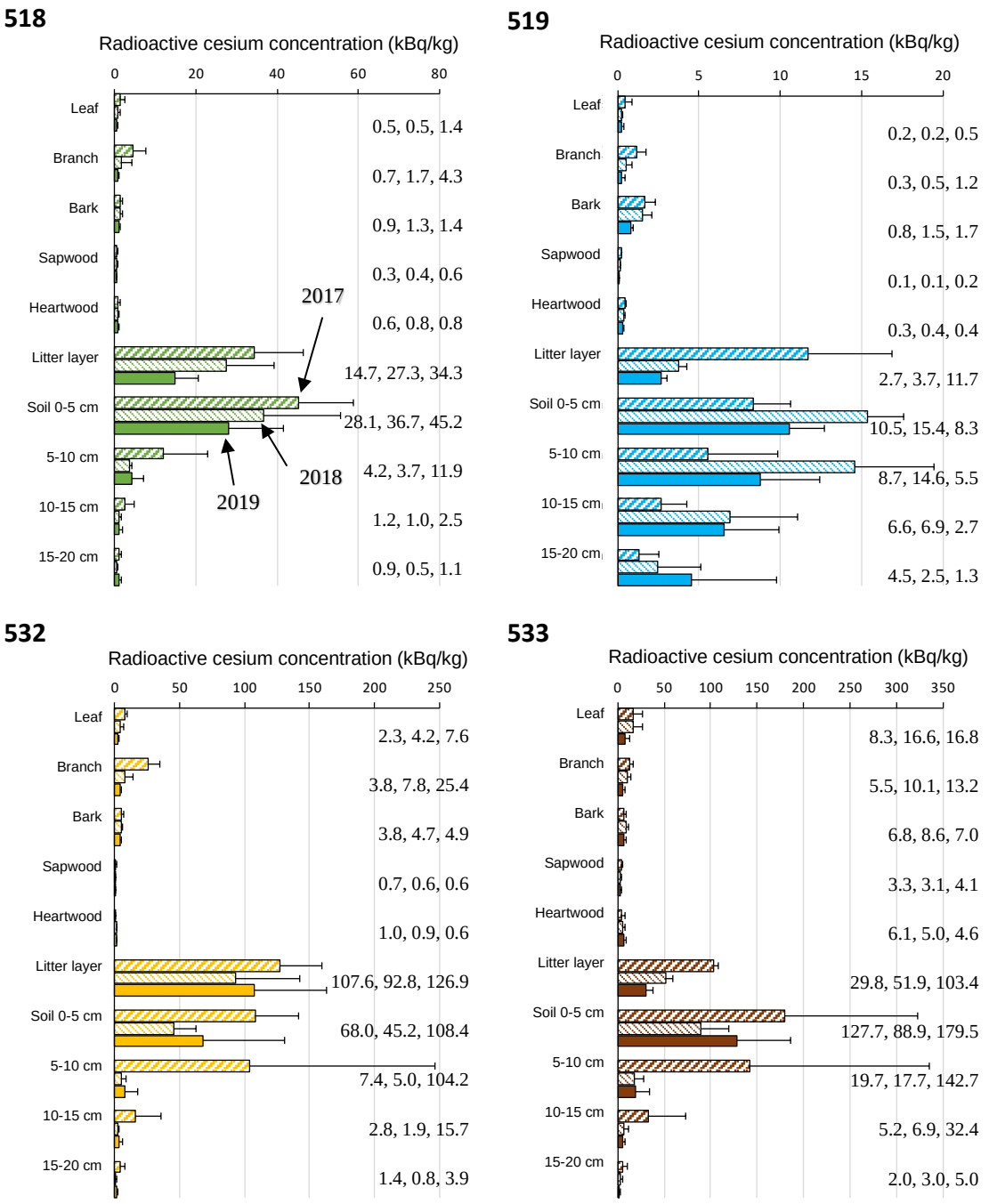
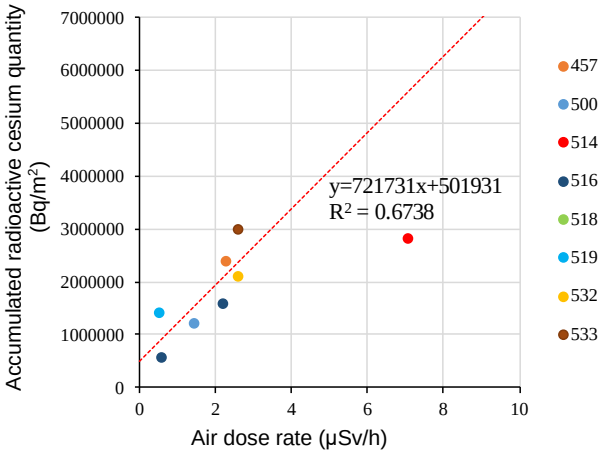


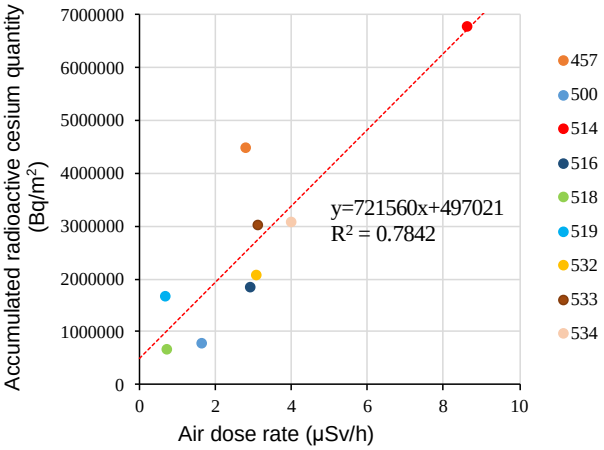
Figure 3 Radioactive Cesium Concentrations in Forest at Site IDs 518, 519, 532, and 533

(Data points and error bars indicate average and standard deviation of radioactive cesium concentration, respectively, at each section. The three numbers shown at the right of each data set are average radioactive cesium concentrations (in kBq/kg) at each section in FY2019, FY2018 and FY2017, from left to right.)

FY2019



FY2018



FY2017

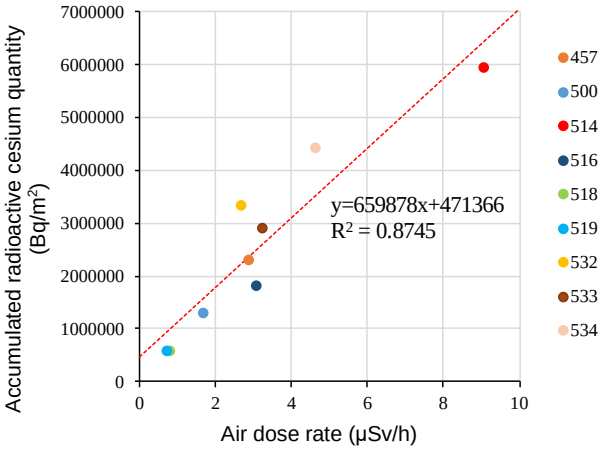
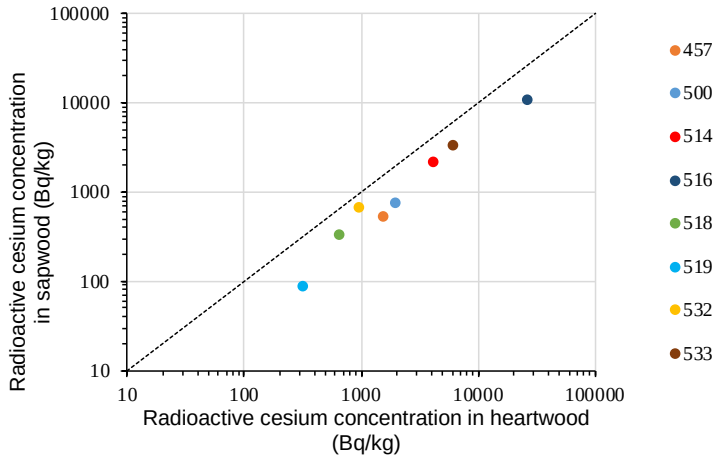


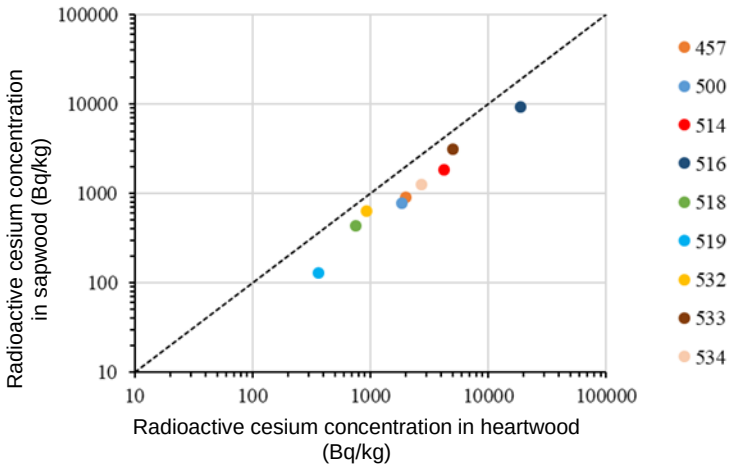
Figure 4 Correlation between Air Dose Rates and Quantities of Radioactive Cesium Accumulated Underground

(Dotted line indicates the regression line. The regression line for FY2019 is derived with omitting the site ID 514, The data for FY2018 have been corrected (error was found in data for site ID 532).)

FY2019



FY2018



FY2017

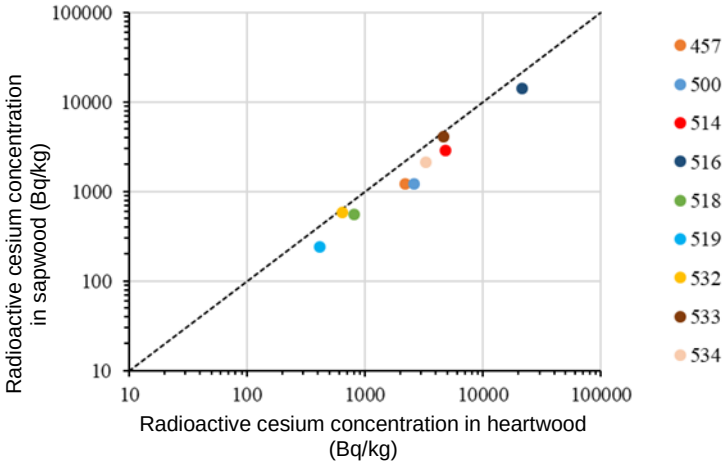


Figure 5 Correlation between Radioactive Cesium Concentrations in Heartwood and Sapwood of Cedar
(Dotted line is the 1:1 line.)