Natural Radiation Dose of People in Aomori Prefecture and Development of the Dose Evaluation Method for the Forest Ecosystem in Rokkasho

Yoshihito OHTSUKA, Takashi IYOGI, Yuichi TAKAKU, Shun'ichi HISAMATSU
Department of Radioecology

Abstract

The natural background radiation dose is important for evaluating the significance of the dose from the small amounts of radionuclides that are being released from the first commercial spent nuclear fuel reprocessing plant in Rokkasho, Japan. In this study, the background radiation dose of Aomori Prefecture residents was assessed and a dose evaluation method for the forest ecosystem in Rokkasho was developed to study environmental protection.

Although we previously measured environmental γ-ray dose rates throughout the prefecture, measurement points around Rokkasho were scarce. In this study, the dose rates were measured in areas surrounding Rokkasho to get their detailed distribution. The internal dose rate was also evaluated by analyzing radionuclides in the so-called total diet and individual food item samples collected in Rokkasho and Aomori City. The cumulative γ-ray dose at five locations in the southwestern area of Shimokita Peninsula was measured using glass dosimeters in FY 2010. The dose rates were within the range of the dose rates in Aomori Prefecture.

The sums of the committed effective dose due to annual ingestion of natural radionuclides in the total diet samples and the effective dose rate from ^{40}K cited in the literature were estimated to be 0.55 mSv for livestock farm workers in a study done in FY 2010 and 0.58 mSv for office workers in a study done during FYs 2006-2010. Household-numbers weighted mean dose for Aomori Prefecture was evaluated as 0.58 mSv from the doses for fishery, agricultural, livestock and office workers in Aomori Prefecture in a study done during FYs 2006-2010. Analytical results of edible wild plants and beverages including seasoning, confectioneries and pickles showed that the committed effective doses from natural radionuclides ingested annually through the products were 0.023 and 0.020 mSv for the farm and office workers, respectively.

Mice, moles, and the fox as their predator were selected as representative animals of the forest ecosystem in this study, and their radiation doses derived from natural sources, i.e. environmental γ-rays, Rn and internal radionuclides, were measured during FYs 2006 - 2010. The study for the fox starting in FY 2009 was continued in FY 2010. Environmental γ-ray dose rates and Rn concentrations were measured in burrows for medium-sized mammalians, presumably foxes, in the northern part of Rokkasho during June-November 2010. A female Japanese red fox (*Vulpes vulpes japonica*) and a female raccoon dog (*Nyctereutes procyonoides viverrinus*) were caught with traps set around some of the burrows. After sacrificing them, their body burdens of natural radionuclides were analyzed. The environmental γ-ray dose rates ranged from 15 to 61 nGy h^{-1} in the burrows, and the dose in the burrows decreased with distance from their entrance. Ranges of the mean ^{222}Rn concentrations in the burrows were 4.1E+1 - 2.1E+3 Bq m^{-3}. The radon equilibrium factor varied from 0.18 to 0.27 around the burrows. Mean ^{210}Pb and ^{210}Po concentrations in the body of the raccoon dog were two and eight times higher than that in the red fox, respectively, while mean ^{40}K concentrations in both animals were similar to each other.

Radiation dose rates from ^{222}Rn and its progenies in the lung of mouse (*Apodeums argenteus*), shrew mole (*Urotrichus talpoides*) and middle-size mammalians were calculated on the assumption of their

circadian life history as 1.1E+2 nGy h^{-1}, 1.7E+2 nGy h^{-1} and 1.2E+2 nGy h^{-1}, respectively, and the dose rates of bronchus were 1.4E+2 nGy h^{-1}, 2.3E+2 nGy h^{-1} and 2.0E+2 nGy h^{-1}, respectively.

External dose rates of the mouse, the shrew mole and Japanese red fox were evaluated by using the respective phantoms that had been constructed in FY 2009 and a Monte Carlo radiation dose calculation code (EGS4). Respective mean external dose rates were evaluated as 51 nGy h^{-1}, 51 nGy h^{-1} and 34 nGy h^{-1} for the mouse, the shrew mole and the red fox. Mean internal dose rates of the mouse, shrew mole, red fox and raccoon dog were estimated as 37 nGy h^{-1}, 4.0E+2 nGy h^{-1}, 50 nGy h^{-1} and 2.3E+2 nGy h^{-1}, respectively.