Increased leaf litter decomposition with increasing radionuclide contamination in the forests of the Chernobyl exclusion zone

Jean-Marc Bonzom*[1], Stephan Hättenschwiler[2], Catherine Lecomte-Pradines[3], Eric Chauvet[4], Sergey Gaschak[5], Karine Beaugelin-Seiller[3], Claire Della-Vedova[3], Nicolas Dubourg[3], Andrey Maksimenko[5], Jacqueline Garnier-Laplace[3], and Christelle Adam-Guillermin[3]

[1]Laboratoire de Radioécologie et d'Ecotoxicologie (LECO) – Institut de Radioprotection et de Sûreté Nucléaire (IRSN) – Cadarache, Bât. 183, BP 3,13115 St Paul-lez-Durance, France
[2]Centre d'Ecologie Fonctionnelle et Evolutive (CEFE) – CNRS : UMR5175 – France
[3]Institut de Radioprotection et de Sûreté Nucléaire (IRSN) – PRP-ENV – France
[4]EcoLab, Université de Toulouse – CNRS : UMR0000 – 118 Route de Narbonne, 31062 Toulouse cedex, France, France
[5]Chernobyl Center for Nuclear safety – Ukraine

Abstract

The effects of radioactive contamination on ecosystem processes such as litter decomposition remain largely unknown. Because radionuclides accumulated in soil and plant biomass can be harmful for organisms, the functioning of ecosystems may be altered by radioactive contamination. We tested the hypothesis that decomposition is impaired by increasing levels of radioactivity in the environment by exposing uncontaminated leaf litter from silver birch and black alder at eleven distant forest sites differing in ambient radiation levels and along a short distance gradient of radioactive contamination within a single forest in the Chernobyl exclusion zone. In addition to measuring ambient external dose rates, we estimated the average total dose rates (ATDRs) absorbed by decomposers for an accurate estimate of dose-induced ecological consequences of radioactive pollution. Taking into account potential confounding factors, the results from the eleven distant forest sites, and from the single forest, showed increased litter mass loss with increasing ATDRs from 0.3 to 150 μGy/h. This unexpected result may be due to overcompensation of decomposer organisms exposed to radionuclides leading to a higher decomposer abundance, and/or from preferred feeding by decomposers on the uncontaminated leaf litter used for our experiment compared to locally produced, contaminated leaf litter. Our data indicate that radio-contamination of forest ecosystems over more than two decades does not necessarily have detrimental effects on organic matter decay. However, further studies are needed to unravel the underlying mechanisms of the results reported here, in order to draw firmer conclusions on how radio-contamination affects decomposition and associated ecosystem processes.

Keywords: Decomposers, Dose rates, Ecosystem functioning, Leaf litter, Decomposition, Ionizing radiation, Nuclear accident, Pollution, Chernobyl, Functional ecology

*Speaker