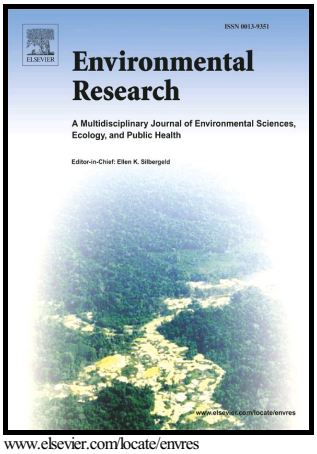

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Transgenerational Effects of Historic Radiation Dose in Pale Grass Blue Butterflies Around Fukushima Following the Fukushima Dai-ichi Nuclear Power Plant Meltdown Accident

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Abstract

Low dose radiation effects have been investigated in Chernobyl for many years but there is uncertainty about initial doses received by many animal species. However, the Fukushima Dai-ichi Nuclear Power Plant accident opens an opportunity to study the effects of the initial low historic dose on directly exposed species and their progeny during a time where the contaminating radionuclides are decaying. In this paper, it is proposed that historic acute exposure and its resulting non-targeted effects (NTEs) may be partially involved in the high mortality/abnormality rates seen across generations of pale grass blue butterflies (*Zizeeria maha*) around Fukushima. Data from Hiyama et al. (2012) on the morphological abnormality frequencies in *Z. maha* collected around Fukushima and their progeny were used in this paper. Two dose reconstruction methods based on the Gaussian plume model were used to determine the external absorbed dose to the first exposed generation from both ground shine and plume shine. One method involved the use of the dose rate recorded at the time of collection and only took Cs-137 into account. The other involved using release rates and atmospheric conditions to determine the doses and considered Cs-137 and Cs-134. The reconstructed doses were plotted against the mortality rates and abnormality frequencies across generations. The mortality rates of the progeny from irradiated progenitors increased linearly with the increasing historic radiation doses reconstructed using both Cs-137 and Cs-134 sources. Additionally, a higher level of morphological abnormalities was observed in progeny than in the progenitors. The mean abnormality frequencies also increased throughout generations. As these results are a sign of NTEs being involved, it can be suggested that increasing mutation levels across generations may result, in part, from NTEs induced by the initial low dose received by the first exposed