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Clarification and explanation of experimental design and mechanistic dose-response effects for significant radioecological impacts

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The study on the detrimental effects of Chernobyl on insects by Moller and Mousseau represents a very interesting and unexpected conclusion, which conflicts with the vast knowledge regarding ionizing radiation effects and the principles of dose-response in the field of toxicology and radiation biology. In addition, the experimental design does not appear to hold to contemporary, rigorous standards.

As for the experimental design, two obvious problems are apparent to us. The first is that the scientific observations and data collected during the field sampling were carried out by an individual that had knowledge of the environmental conditions and "treatment" groups during those periods. Pre-selected plots were assessed for insect and avian presence and activity by a potentially biased observer instead of an individual blinded to the environmental conditions under study. This is particularly problematic in an ecological survey that relies so heavily on the observer for results. Perhaps concern for a blinded individual's safety and health was a primary concern. That said, the lack of potential objectivity or some real, independent measure to guard against such bias should have been explicitly declared. In addition, information required to allow independent replication of their study is inadequate. For example, no GPS or UTM coordinates are given for their field sites. Therefore, it would be impossible for an independent researcher to study these same sites. This would seem to be an obvious shortcoming especially in a field-based ecological survey study.

As for the conclusions regarding the biological and ecological impacts on insects, the authors should have explained the biological or radiotoxicological process by which such phenomenally low dose rates can produce such "significant" effects. Dose-rates reported in the published study are several orders of magnitude lower than those carefully reconstructed in several studies examining small mammals within the exclusion zone, which have not found evidence of biological, population genetic, or molecular genetic effects [1-6]. It is worth noting that the studies on mammals also find highly variable doses and dose-rates among specimens collected from the same location [7-8]. Moller and Mousseau report apparent "biologically effective" radiation dose-rates that are essentially equivalent to radiation dose-rates human populations might experience living along the Gulf Coast of the United States (their low radiation sites, 0.4uGy/hr) or those they may experience living on the Colorado plateau and in the Rocky Mountain West (their high radiation sites, 0.6uGy/hr). These dose-rate estimates for U.S. human population exposures are from the United States Nuclear Regulatory Commission and the National Council on Radiation Protection and Measurements. Recalling that insects, on average, are relatively radioresistant in comparison to humans, would this indicate that people living in high radiation sites in the U.S. are at a significantly elevated health risk because of this almost imperceptible increase in dose? The biological plausibility of this conclusion is not obvious and, therefore, the authors should provide a detailed, mechanism-based explanation for their findings. Is it possible the results are "statistical" findings and not truly "biological" findings? We feel this last question should be addressed in the context of the rich and deep scientific literature on radiation genetics, radiation biology, and radioecology that does not to support their conclusions. It remains difficult to understand how the dramatic ecological changes brought about by the disaster, and the unprecedented exclusion of humans and human activity, do not remain the best and strongest predictors of effects on invertebrate and vertebrate populations. This is especially true in areas that received negligible to very low levels of contamination.
For clearer answers to emerge from research conducted at Chernobyl, rigorous experimental design and standards must be adhered to. In addition, apparent biological effects attributed solely to radioactive contamination must have a logical, mechanistic explanation derived to some extent from existing knowledge to support those conclusions.


