21st Conference of the Canadian Nuclear Society
Toronto, Ontario, Canada / June 11-14, 2000

ECODOSIMETRY WEIGHTING FACTOR FOR NON-HUMAN BIOTA

N.E. Gentner and A. Trivedi
Health, Chemistry and Environment Division
AECL, Chalk River, Ontario, Canada

Radiological protection of non-human biota is being addressed by several national jurisdictions, including Canada, which is soon to set guidelines for radiation protection of the environment in accordance with the principle of sustainable development. The development of regulatory policies and standards recognizes the environment as a complex system, and now incorporates explicitly the objective of protecting all species. Methodologies such as ecological risk assessment and environmental effects monitoring have been evaluated to develop and assist in implementing an environmental radiological program for non-human biota.

The doses of interest for non-human biota almost always represent chronic rather than acute exposures (such as occurred immediately after the Chernobyl accident). Most exposures are from naturally occurring radionuclides; others (generally much smaller) are due to releases of radionuclides from nuclear facilities. Radiation exposure of non-human biota, if substantial, can potentially interfere with their growth, reproduction and survival. The UNSCEAR report on *Effects of Radiation on the Environment* (1996) concluded that detrimental effects on the most sensitive populations would not be expected at dose-rates below 1-2 mGy d^{-1} for low-LET radiation. Despite such judgments in regard to low-LET radiation, insufficient information exists to establish dose-rate limits for other types of radiation for plants and animals.

In human radiological protection, the International Commission on Radiological Protection (ICRP, 1990) has indicated that it is the absorbed dose, averaged over a tissue or organ and weighted for the radiation quality, that is of interest for setting dose limits. The radiation weighting factor (w_R) is used for this purpose, and is selected for the type and energy of the radiation incident on the body or, in the case of sources within the body, emitted by the source. The value of w_R for specified types and energies of radiation are prescribed by the ICRP, and reflect to some degree values of the relative biological effectiveness (RBE) of that radiation in inducing stochastic effects at low doses. The values for w_R are also broadly comparable with the values of quality factor (Q), which are related to the quantity linear energy transfer (LET), a measure of the density of ionization along the track of an ionizing particle.

No similar weighting factor exists for the dosimetry of non-human biota. A need for a similar dosimetric factor is indicated by RBE values of more than unity observed for alpha- and very weak beta-emitters (e.g., tritium) at dose-rates relevant in ecological risk assessment. We propose an "ecodosimetry weighting factor", e_R, for non-human biota to fill a role equivalent to that occupied by w_R in human radiation protection. The question we address is: what is the proper basis for choosing values for an "equivalent" weighting factor for ecodosimetry of non-human biota? It should not reflect values for stochastic effects at low doses, as not all non-human species develop cancer or receive doses that are considered low. Obviously, the value for e_R should reflect in part the RBE of a specific type of radiation with respect to biological endpoints and dose-rates most relevant for radiological protection of non-human biota. The "e_R" for application to biota dosimetry should allow one to derive the weighted dose as sum of the doses from different types of radiation, or sources of exposure (both external and internal) in an organism. In general, the e_R value should: (a) consider, but not be limited to, the RBE values for effects from environmental levels of doses; and (b) be representative of the w_R values in order to relate the health effects to individuals, populations or communities in an ecosystem. The presentation will illustrate the approach taken by recommending e_R values for tritium and alpha-emitting radionuclides.

This work is supported in part by the CANDU Owners Group (COG).