Wildlife Transfer Database – REML analyses

N.A. Beresford[1,2], M.D. Wood[2], T. Yankovich[3], C.L. Barnett[1], N. Willey[4], B. Penrose[1]

[1]NERC Centre for Ecology & Hydrology, UK; [2]University of Salford, UK; [3]IAEA, Vienna; [4]University of the West of England, UK

Abstract

The assessment of the exposure wildlife to ionising radiation for planned, existing and accidental scenarios requires predictions to be made of the transfer of a wide range of radionuclides to a diversity of species. Most models assessing the exposure of wildlife use a simple concentration ratio ($CR_{wo\text{-}media}$) relating the whole organism activity concentration to that in the environmental medium (i.e. soil, air or water). Recently, both the ICRP and IAEA have produced compilations of $CR_{wo\text{-}media}$ values for application in environmental assessment. However, the $CR_{wo\text{-}media}$ approach has many limitations most notably that the transfer of most radionuclides is largely determined by site-specific factors (e.g. water or soil chemistry). Furthermore, there are few, if any, values for many radionuclide-organism combinations.

In Beresford et al. (2013) we proposed an alternative approach and, as an example, demonstrated and tested this for caesium and freshwater fish. Using a Residual Maximum Likelihood (REML) mixed-model regression we analysed a dataset comprising 597 entries for 53 freshwater fish species from 67 sites. The REML analysis generated a mean value for each species on a common scale after REML adjustment taking account of the effect of the inter-site variation. Using an independent dataset, we subsequently tested the hypothesis that the REML model outputs can be used to predict radionuclide (in this case radiocaesium) activity concentrations in unknown species from the results of a species which has been sampled at a specific site. From the outputs of the REML analysis we accurately predicted ^{137}Cs activity concentrations in different species of fish from 26 Finnish lakes using ^{137}Cs activity concentrations in *Perca fluviatilis* as our model input; these data had not been used in our initial analyses to establish our model. Subsequently the model has been applied to predict stable Cs concentrations in fish from three UK lakes (Beresford et al. 2015).

In this presentation we expand the application of the REML approach to consider:

1) Cs transfer to all freshwater organisms
2) Transfer of radionuclides to terrestrial wildlife

Provisional results will be presented and discussed as will plans for the future development of the approach.

Acknowledgement

Initial method development was largely funded under the EU EURATOM funded STAR network of excellence in radioecology (www.star-radioecology.org). On-going studies are largely supported by the NERC RATE programme TREE project (https://wiki.ceh.ac.uk/x/PwZgD), in part, in collaboration with the EURATOM COMET project (www.comet-radioecology.org).