

Task Group 72: Radiation Weighting for Reference Animals and Plants

The degree of biological impact on an organism resulting from a given absorbed dose (in gray, Gy) of ionising radiation can vary depending upon the type of radiation involved. This difference has been experimentally quantified and reported as Relative Biological Effectiveness (RBE). RBE values are experimentally determined and are the ratio of doses of a test radiation and a low-LET reference radiation that produce the same level of observed effect. Studies have shown that the magnitude of a biological effect depends not only on dose and the type and energy of the radiation delivering the dose, but also on the rate at which the dose is delivered and, most importantly, the endpoint under study. The report reviews RBE data relevant to biota for one low energy beta emitter (tritium) and for alpha-emitting radionuclides.

Derived Consideration Reference Levels

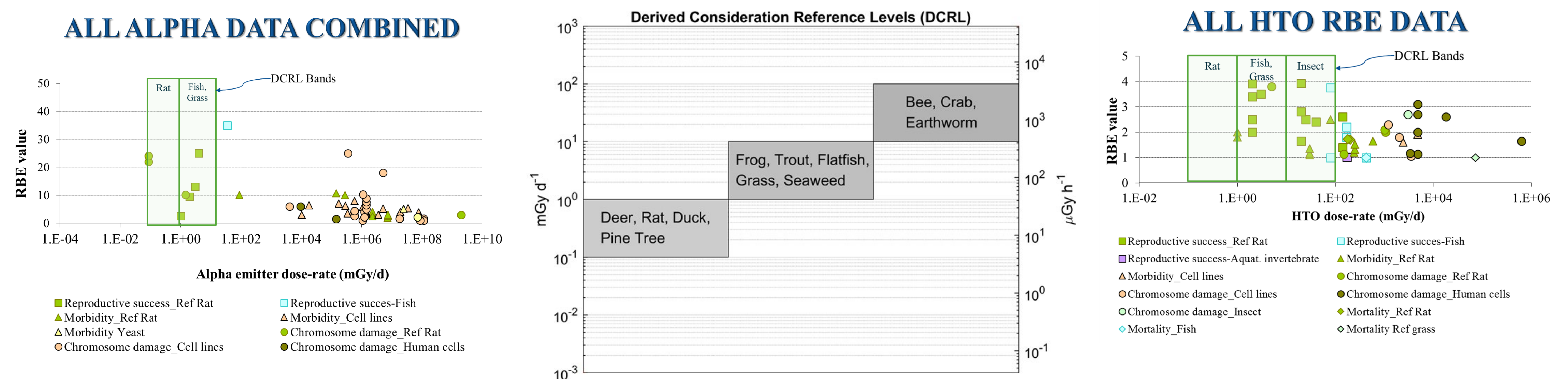


Table 1. Identification and description of RAPS as first introduced in Publication 108 (ICRP, 2008)

| Reference organism | Environment | Description |
|--------------------|-------------|----------------------------|
| Deer | Terrestrial | A large terrestrial mammal |
| Rat | Terrestrial | A small terrestrial mammal |
| Duck | Aquatic | An aquatic bird |
| Frog | Aquatic | An amphibian |
| Trout | Aquatic | A freshwater fish |
| Flatfish | Aquatic | A marine fish |
| Bee | Terrestrial | A terrestrial insect |
| Crab | Aquatic | A marine crustacean |
| Earthworm | Terrestrial | A terrestrial annelid |
| Pine tree | Terrestrial | A large terrestrial plant |
| Wild grass | Terrestrial | A small terrestrial plant |
| Brown seaweed | Aquatic | A seaweed |

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Main Points

- This report reviews data from studies of the Relative Biological Effectiveness (RBE) of: (a) low energy beta particle emissions from tritium and (b) alpha particle emitting
- RBE values showed no clear pattern of differences between species. For tritium, reported values centred around 1.5 – 2 compared with x-rays and 2 – 2.5 compared with gamma rays. Values for alpha particles were generally higher, of the order of 10
- For protection purposes, it was considered reasonable on the basis of current knowledge to specify RBE weightings of absorbed dose for biota to apply to all population relevant endpoints as single values for all RAPS (Reference Animal or Plant).
- RBE weighted absorbed dose rates to RAPS (Table 1) should be calculated using values of 1 for all low-LET radiations and 10 for alpha particles for comparison with the relevant DCRL

Conclusions

It is proposed that for protection purposes, that an RBE weighted absorbed dose be used, with an RBE weighting for biota of 1 for all low-LET radiations and 10 for alpha particles. Use of a single value of 1 for all low-LET radiations is consistent with the approach taken to protection of humans. However, if exposures to tritium beta particles or other low-energy, low-LET radiations are estimated to be within or close to the Derived Consideration Reference Level (DCRL), the use of higher RBE values may be warranted.