AN INTRODUCTION TO DOSE RATE MODELLING IN NON-HUMAN BIOTA WITH

The ERICA tool

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The ERICA tool

Environmental
Risk from
Ionising
Contaminants:
Assessment and Management

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The ERICA consortium

Developed by a number of European Radioecology ALLIANCE members

Project partners: SSM, SKB, SUC, AFRY, GSF, CIEMAT, IRSN, EDF, EA, WSC, UniLiv, CEH, UMB, STUK & DSA

The ERICA tool timeline

First release – 2007

Version 1.2 – 2014

Version 1.3 – 2019

Version 2.0 – 2021

Current: v.2.0.221

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Use of the ERICA tool

Modelling of radiological risk to **non-human biota**

Simple concept: Uses **activity concentrations** in media/tissues to calculate dose rate

Application/situation entirely depends on your input data and/or conceptual design

Tiered approach options

Spatial and temporal data supported

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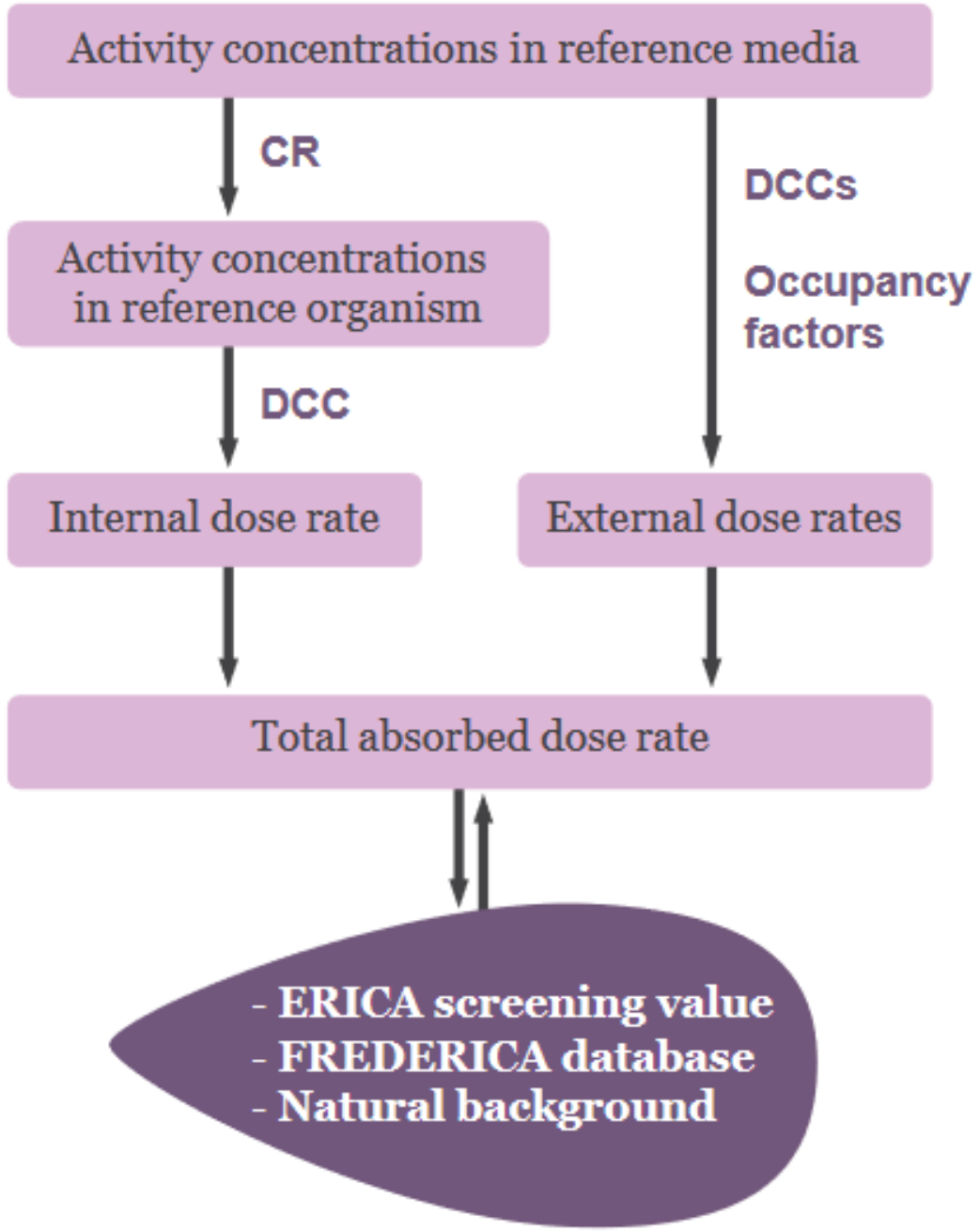
Calculations

CR – Concentration ratio

DCC – Dose conversion coefficient

Reference organism (similar concept to RAPs)



Reference organisms

13 different **Reference organism** types in each of three ecosystems

Terrestrial, freshwater and marine

Represent the **diversity** of organisms likely to exist at a typical site*

*Focus on European environments

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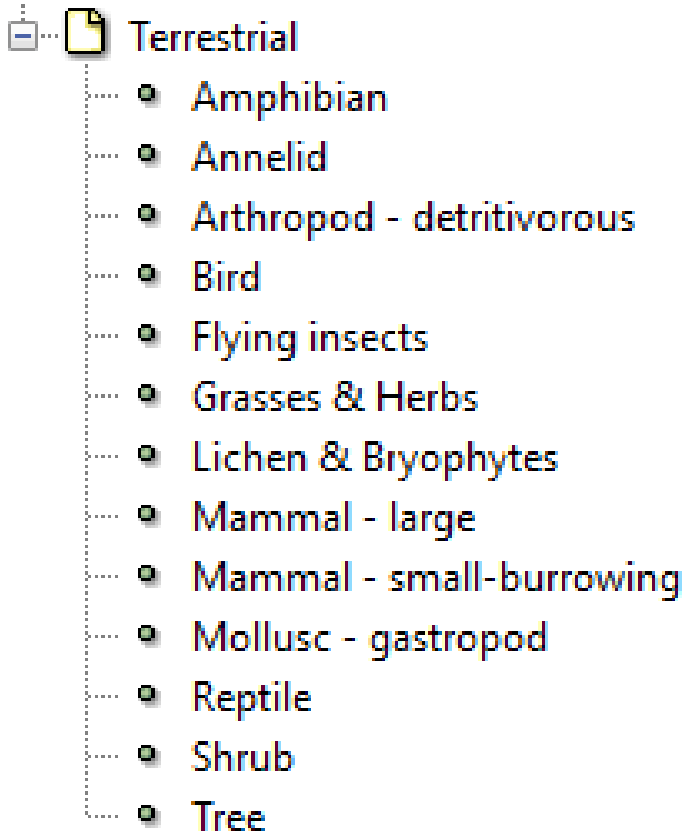
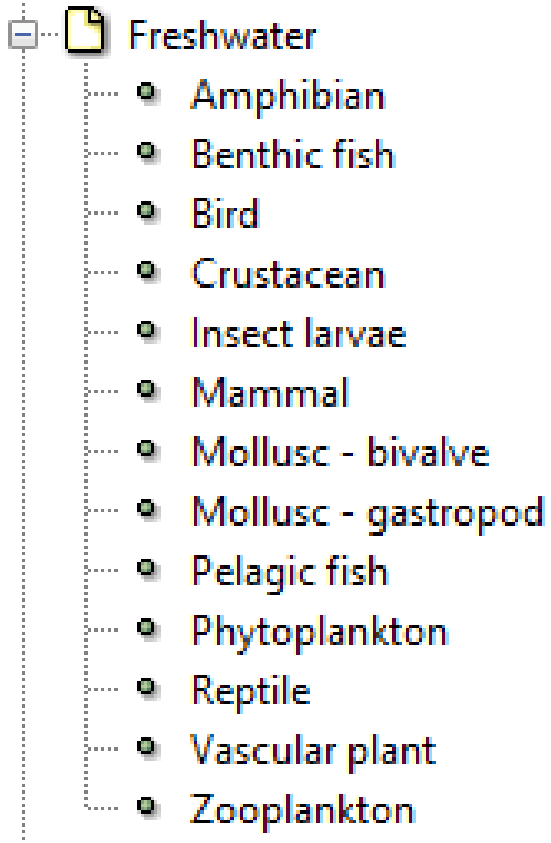
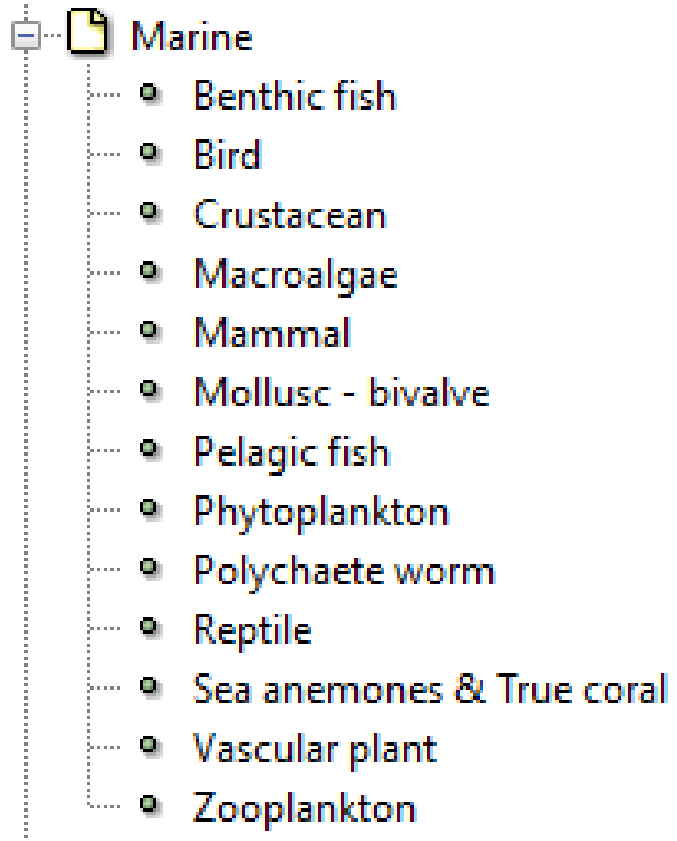
Reference organisms







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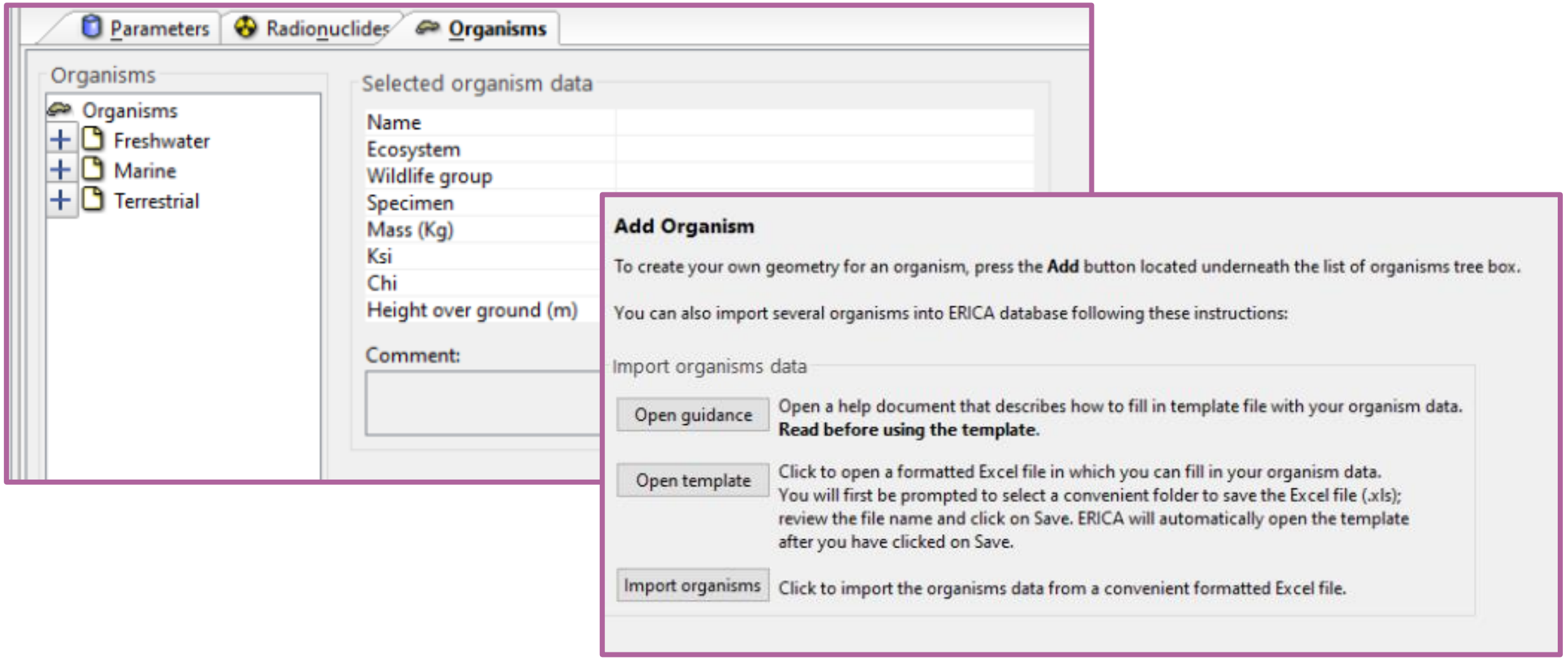
Add custom organisms



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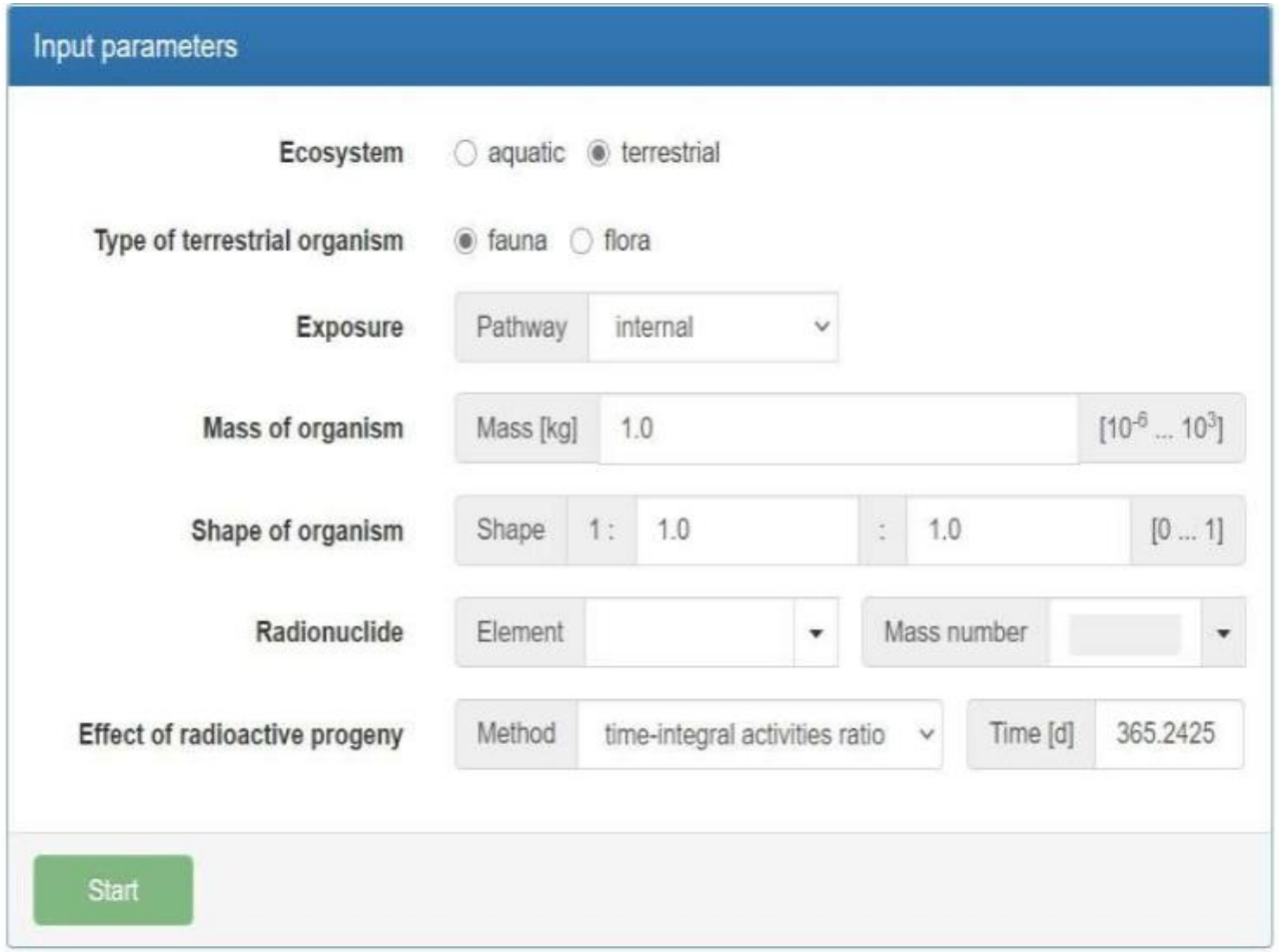
Integrated DCC calculation

Integration of **BiotaDC**

(ICRP-136 methodology)

Collaboration between AFRY and ICRP BiotaDC developer

(Alexander Ulanovsky)



ICRP, 2017. Dose coefficients for nonhuman biota environmentally exposed to radiation. ICRP Publication 136. Ann. ICRP 46(2).

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Radionuclides

Starts pre-loaded with **101 radionuclides**

- ’**Add radioisotope**’ feature to include and parameterise an additional 711
- Includes noble gases

Radionuclide progeny is automatically generated and included in the calculations

- Includes branching ratio

Next update will include the **automatic** generation and inclusion of **radon/thoron** from radium

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Integrated transport models

IAEA SRS-19 dispersion models

Can be used if activity concentration data in environmental media are unavailable

Terrestrial

- Air

Freshwater

- Small lake
- Large lake
- Estuary
- River

Marine

- Coastal
- Estuary

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Databases of parameters

Concentration ratios – collaboration with the UK CEH **Wildlife Transfer Database**

- **CR gap-filling tool** helps give the next-best solution for where data is absent

DCCs included and generated within the tool (from BiotaDC)

All databases can be user-edited for **site-specific data**

FREDERICA **effects-database** integration

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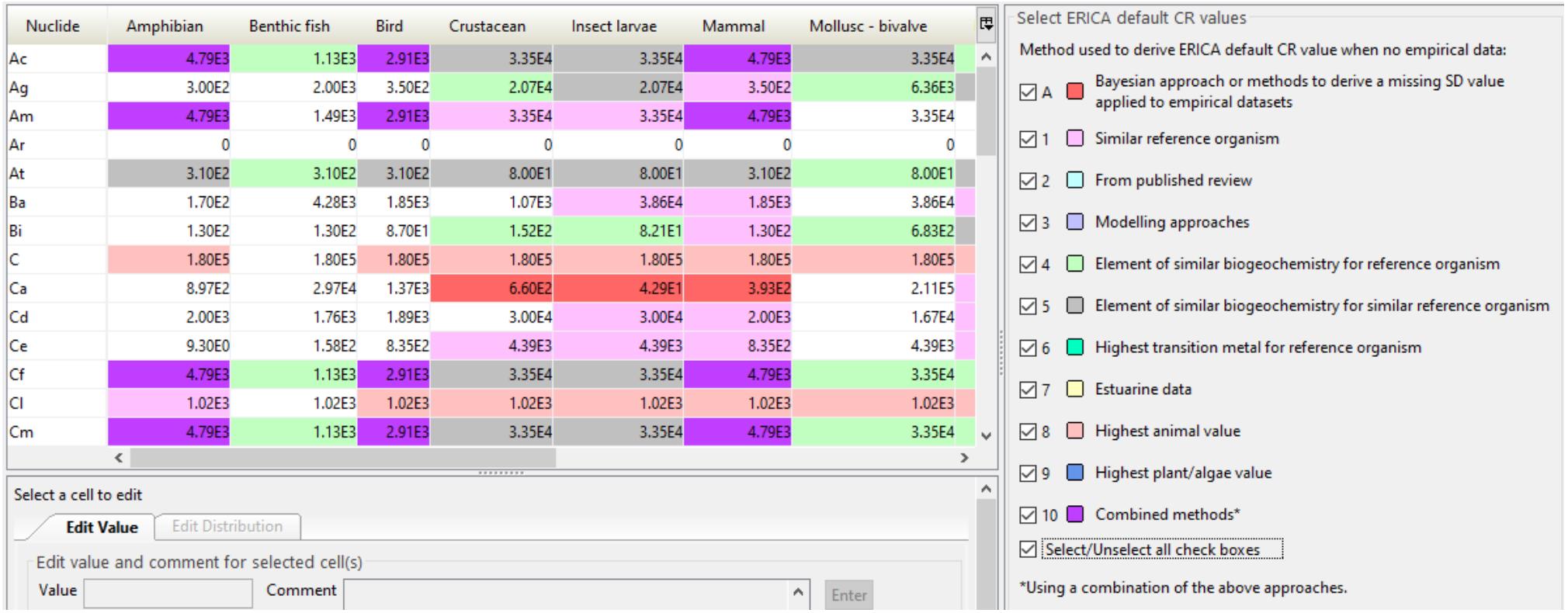
Concentration ratio gap-filling



Nuclide	Amphibian	Benthic fish	Bird	Crustacean	Insect larvae	Mammal	Mollusc - bivalve
Ac	4.79E3	1.13E3	2.91E3	3.35E4	3.35E4	4.79E3	3.35E4
Ag	3.00E2	2.00E3	3.50E2	2.07E4	2.07E4	3.50E2	6.36E3
Am	4.79E3	1.49E3	2.91E3	3.35E4	3.35E4	4.79E3	3.35E4
Ar	0	0	0	0	0	0	0
At	3.10E2	3.10E2	3.10E2	8.00E1	8.00E1	3.10E2	8.00E1
Ba	1.70E2	4.28E3	1.85E3	1.07E3	3.86E4	1.85E3	3.86E4
Bi	1.30E2	1.30E2	8.70E1	1.52E2	8.21E1	1.30E2	6.83E2
C	1.80E5	1.80E5	1.80E5	1.80E5	1.80E5	1.80E5	1.80E5
Ca	8.97E2	2.97E4	1.37E3	6.60E2	4.29E1	3.93E2	2.11E5
Cd	2.00E3	1.76E3	1.89E3	3.00E4	3.00E4	2.00E3	1.67E4
Ce	9.30E0	1.58E2	8.35E2	4.39E3	4.39E3	8.35E2	4.39E3
Cf	4.79E3	1.13E3	2.91E3	3.35E4	3.35E4	4.79E3	3.35E4
Cl	1.02E3	1.02E3	1.02E3	1.02E3	1.02E3	1.02E3	1.02E3
Cm	4.79E3	1.13E3	2.91E3	3.35E4	3.35E4	4.79E3	3.35E4

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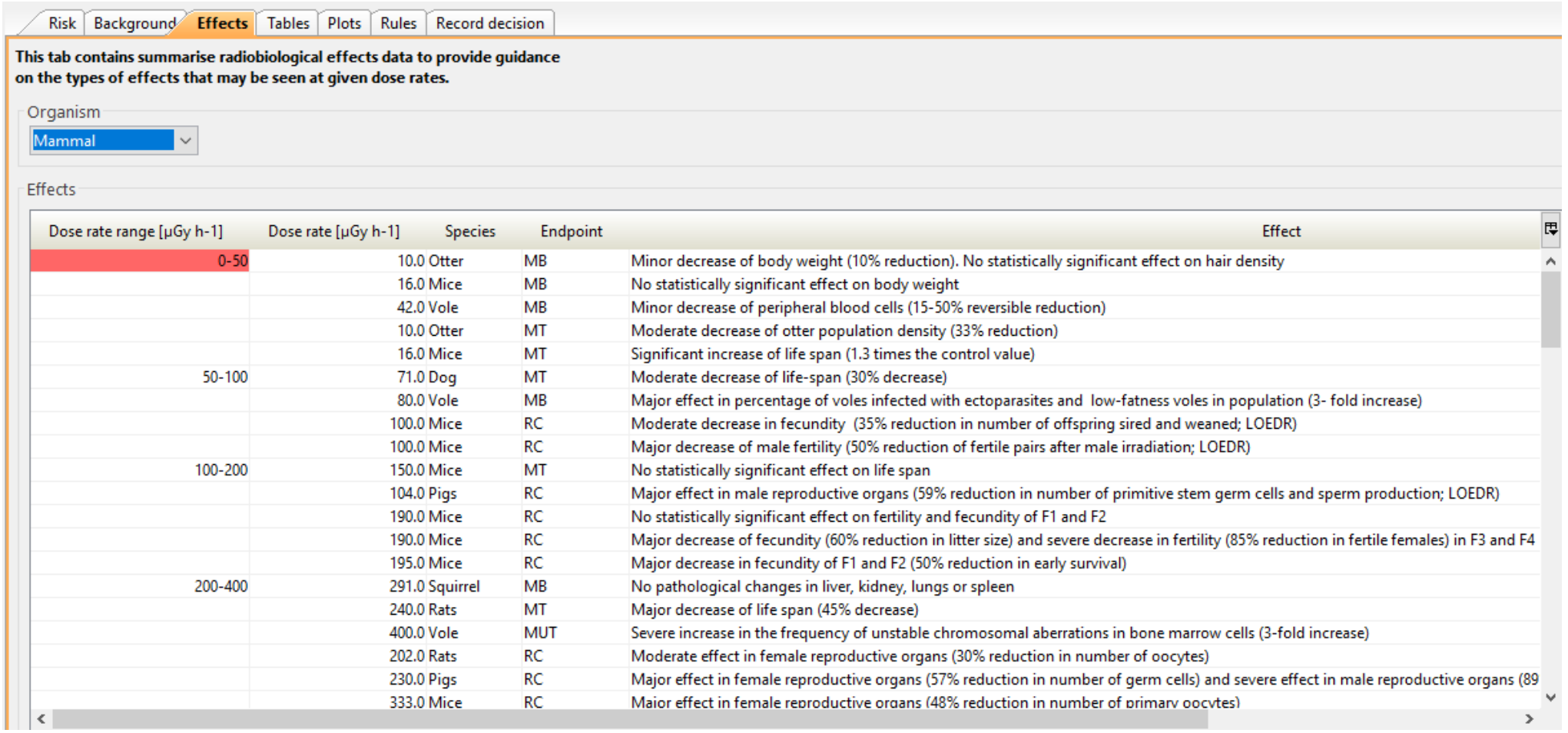
FREDERICA effects database



Dose rate range [µGy h-1]	Dose rate [µGy h-1]	Species	Endpoint	Effect
0-50	10.0	Otter	MB	Minor decrease of body weight (10% reduction). No statistically significant effect on hair density
	16.0	Mice	MB	No statistically significant effect on body weight
	42.0	Vole	MB	Minor decrease of peripheral blood cells (15-50% reversible reduction)
	10.0	Otter	MT	Moderate decrease of otter population density (33% reduction)
	16.0	Mice	MT	Significant increase of life span (1.3 times the control value)
50-100	71.0	Dog	MT	Moderate decrease of life-span (30% decrease)
	80.0	Vole	MB	Major effect in percentage of voles infected with ectoparasites and low-fatness voles in population (3- fold increase)
	100.0	Mice	RC	Moderate decrease in fecundity (35% reduction in number of offspring sired and weaned; LOEDR)
	100.0	Mice	RC	Major decrease of male fertility (50% reduction of fertile pairs after male irradiation; LOEDR)
100-200	150.0	Mice	MT	No statistically significant effect on life span
	104.0	Pigs	RC	Major effect in male reproductive organs (59% reduction in number of primitive stem germ cells and sperm production; LOEDR)
	190.0	Mice	RC	No statistically significant effect on fertility and fecundity of F1 and F2
	190.0	Mice	RC	Major decrease of fecundity (60% reduction in litter size) and severe decrease in fertility (85% reduction in fertile females) in F3 and F4
	195.0	Mice	RC	Major decrease in fecundity of F1 and F2 (50% reduction in early survival)
200-400	291.0	Squirrel	MB	No pathological changes in liver, kidney, lungs or spleen
	240.0	Rats	MT	Major decrease of life span (45% decrease)
	400.0	Vole	MUT	Severe increase in the frequency of unstable chromosomal aberrations in bone marrow cells (3-fold increase)
	202.0	Rats	RC	Moderate effect in female reproductive organs (30% reduction in number of oocytes)
	230.0	Pigs	RC	Major effect in female reproductive organs (57% reduction in number of germ cells) and severe effect in male reproductive organs (89
	333.0	Mice	RC	Major effect in female reproductive organs (48% reduction in number of primary oocytes)

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Thank you

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