Beaverlodge Scenario Approach Using RESRAD-BIOTA

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Beaver Lodge Exercise Phase II

- Provided water or/and sediment concentrations for five radionuclides (Pb-210, Po-210, Ra-226, Th-230, and U-238).
- Measured activity concentration for fish species provided in some cases
- The samples were collected from 1995 – 2008 at 6 areas at 15 sites
- Six areas are:
  - Beaver lodge Lake
  - Cluff Lake
  - Gunnar Mine Site
  - Key Lake
  - McClean Lake
  - Rabbit Lake
- Calculate whole body activity concentration and weighted absorbed dose rates for fish and invertebrates.

Methodology and Assumptions

- Used Probabilistic RESRAD-BIOTA
- Used distributions for water concentration, sediment concentration, and tissue concentrations (if available)
- If water or sediment concentration not available used conservative Kd values to estimate activity concentrations
- Used probabilistic Biv values

Input Parameters for Model Run

DOSIMETRY - Weighting factors for absorbed dose rates

Internal alpha	1.00E+01	to be consistent with other models
Internal beta gamma	1.00E+00	
Internal low beta	1.00E+00	

DOSIMETRY - Daughters explicitly included

Pb210	Bi-210 (100%)	Po-210 (100%)			
Po210	X	X	X	X	X
Ra226	Rn-222	Po-218	Bi-214	Pb-214 & Po-214	At-218 & Tl-210
Th230					
U-238	Th-234	Pa-234	Pa-234m		
U-235	Th-231				
U-234					

It was assumed U-238, U-234 and U-235 were present in their natural activity concentration ratio of 1:1:0.046.
Pb-210: Bi-210 and Po-210 was assumed to be in secular equilibrium with Pb-210.
Ra-226: Rn-222, Po-218, Bi-214 at the same conc. as Ra-226, Bi-214 and Po-214 at 99.98% of Ra-226 conc. And At-218 and Tl-210 at 0.02% of Ra-226 conc.
U-238: Th-234 at the same concentration as U-238, Pa-234m at 99.8% and Pa-234 at 0.33% of U-238 concentration.
U-235: At 4.6% of U-238 concentration. Th-231 at the same concentration as U-235
U-234: At the same concentration as U-238

Input Parameters for Model Run, cont'd

GEOMETRY, MASS, & OCCUPANCY FACTORS

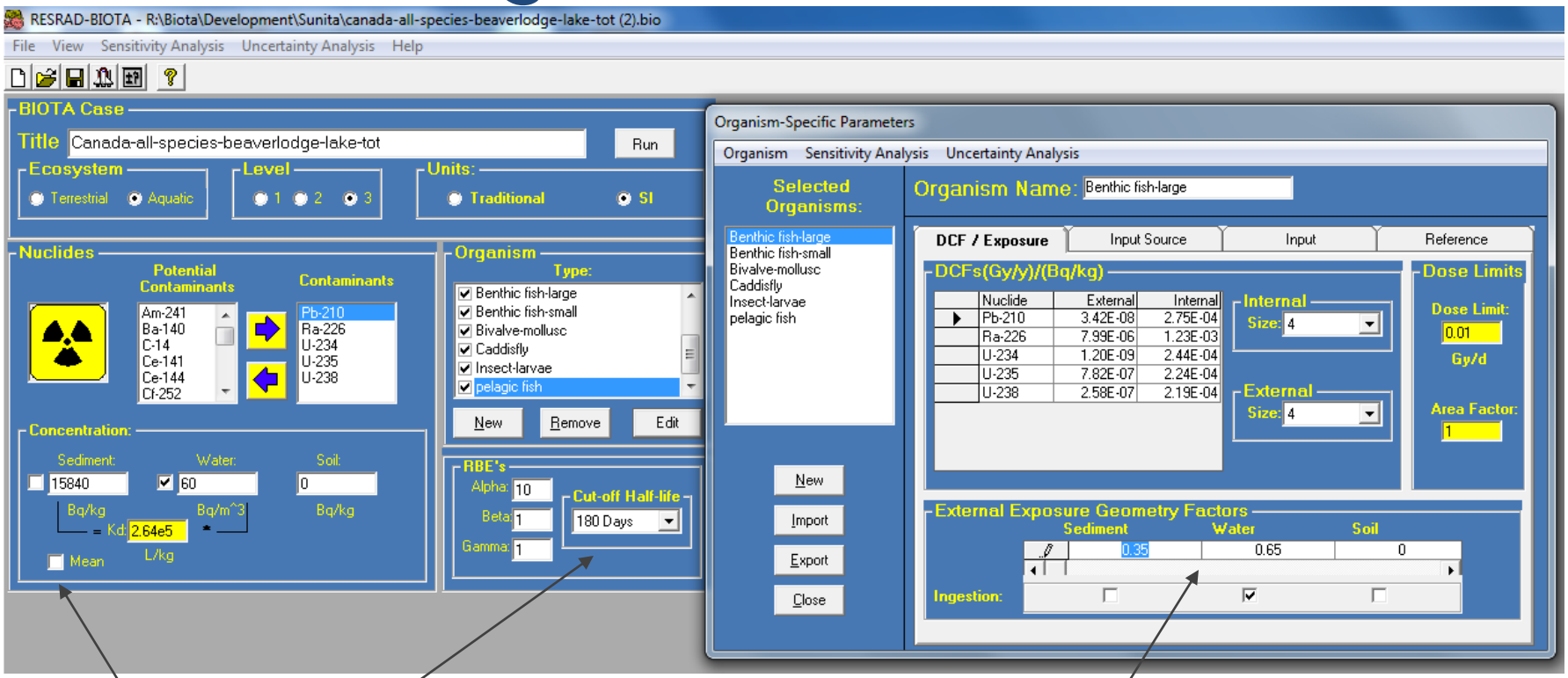
	Geometry (cm)	Mass (g ww)	Occupancy-Biota run	
	Length x height x width		% water / %sediment	Geometry - used
Pelagic (e.g. Northern pike & Lake Trout)	50 x 15 x 10	1200	87.5/12.5	4
Benthic Fish - Large (White sucker & Lake whitefish)	45 x 15 x 10	1191	65/35	4
Benthic Fish - Small (Lake chub)	6.8 x 1.5 x 1	4.5	90/10	Ext -2 and Int -3
Benthic Invertebrates (Chironomus riparius)	0.34 x 0.17 x 0.15	0.12	62.5/37.5	1
Benthic Invertebrates (*Pisidium sp.*)	2.5 x 1.5 x 1	1.6	75/25	2
Benthic Invertebrates (Caddisfly, *Nemotaulius sp.*)	3.5x1.46x1.46	1.75	75/25	2

Assumptions for Model Run

Species	Biv - used	Pb-210	Po-210	Ra-226	Th-230	Uranium
Pelagic (e.g. Northern pike & Lake Trout)	Pelagic fish	Exponential	Exponential	Bounded Lognormal	Bounded Lognormal	Bounded Lognormal
Benthic Fish - Large (White sucker & Lake whitefish)	Benthic fish	Exponential	Exponential	Bonded Lognormal	Bounded Lognormal	Bounded Lognormal
Benthic Fish - Small (Lake chub)	Benthic fish	Exponential	Exponential	Bonded Lognormal	Bounded Lognormal	Bounded Lognormal
Benthic Invertebrates (Chironomus riparius)	Insect Larvae	Exponential	Exponential	Exponential	Exponential	Exponential
Benthic Invertebrates (*Pisidium sp.*)	Bivalve Mollusc	Exponential	Bounded Lognormal	Bonded Lognormal	Exponential	Exponential
Benthic Invertebrates (Caddisfly, *Nemotaulius sp.*)	Insect Larvae	Exponential	Exponential	Exponential	Exponential	Exponential

*For exponential distribution parameter required is lambda (=1/mean) and for bounded lognormal distribution parameter required are mean, error factor, minimum, and maximum

RESRAD-BIOTA Inputs for Contamination at Beaverlodge Lake



RBE and cutoff half-life adjusted

Sediment concentration calculated from Maximum Pb-210 Kd in Beaverlodge lake area

Occupancy factors for water and sediment

Uncertainty Analysis Setup in the RESRAD-BIOTA Code