Beaverlodge Scenario
BIOTA WG

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Introduction

The purpose:

Predicting impacts from ionizing radiation to species of lakes in the Beaverlodge and Athabasca Region

➔ **To estimate output activity concentration in reference species from given radionuclide concentrations in water and sediment**

➔ **To conduct an initial radiological assessment**

➔ **To determine absorbed weighted dose rates for reference species**

➔ **To interpretate the results in terms of risk**

Approach

The fresh weight activity concentrations of radionuclides in biota are predicted from water activity concentrations using equilibrium concentration ratios (CR)

$$CR = \frac{\text{Activity concentration in biota (Bq kg}^{-1}\text{ fresh weight)}}{\text{Activity concentration in water (Bq l}^{-1})}$$

Approach

The weight activity concentrations of radionuclides in sediment could be predicted from water activity concentrations using distribution coefficients (K_d) given as ratio of activity concentrations in sediment and in water:

$$K_d \ (l \ kg^{-1}) = \frac{\text{Activity concentration in sediment } (Bq \ kg^{-1} \ dry \ weight)}{\text{Activity concentration in water } (Bq \ l^{-1})}$$

Input Data

Geometry and mass of species of interest in the Phase I modeling exercise

	Geometry (mm)	Mass (g)
	lengthxwidthxdepth	
White Sucker	450x150x100	1191 ww
Lake whitefish	436x140x100	1362 ww
Chironomus riparius	3.4x1.7x1.5	0.00012-0.0002 dw
Pisidium sp.	2.5x1.5x1	0.0009-0.0016 dw

Input Data

> **Radionuclide concentrations in water-summary**

[Bq/L]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	7.5E-02	2.4E-02	2.8E-01	3.4E-02	1.9E+00
median	5.0E-02	2.0E-02	4.0E-02	1.5E-02	1.9E+00
minimum	2.0E-02	5.0E-03	5.0E-03	1.0E-03	2.4E-03
maximum	3.4E-01	6.0E-02	2.2E+00	1.2E-01	7.2E+00

Input Data

> **Radionuclide concentrations in sediment-summary**

[Bq/kg]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	1.1E+04	1.2E+04	6.8E+03	1.1E+04	4.0E+04
median	4.7E+03	2.1E+03	1.2E+03	9.1E+02	1.5E+03
minimum	6.0E+01	5.0E+01	1.0E+01	2.0E+01	1.3E+01
maximum	5.3E+04	5.1E+04	5.8E+04	5.9E+04	7.8E+05

Adopted Input Data

➔ Concentration ratios and distribution coefficients have been adopted for purposes of the exercise from ERICA Database

➔ ERICA have contained no explicit data for species followed within the Beaverlodge scenario

➔ ERICA CR`s have been adopted for taxonomically similar organisms of the scenario

Adopted Input Data

Scenario organism =>	ERICA organism
White Sucker	Benthic/Pellagic Fish
Lake Whitefish	Benthic/Pellagic Fish
Chironomus riparius	Insect Larvae
Pisidium sp.	Bivalve Mollusc

Adopted Input Data

> **Concentration ratios for White sucker and Lake Whitefish as taken from ERICA database**

Benthic/Pelagic Fish	Distribution	mean	stdev	*median*	
Pb	exponential	300		*210*	
Po	exponential	240		*170*	
Ra	lognormal	80	120	*44*	
Th	lognormal	110	110	*78*	
U	lognormal	30	60	*13*	

Adopted Input Data

➢ **Concentration ratios for Pisidium sp. as taken from ERICA database**

Bivalve mollusc	Distribution	mean	stdev	*median*	
Pb	exponential	1700		*1200*	
Po	lognormal	38000	49000	*23000*	
Ra	lognormal	1500	1600	*1000*	
Th	exponential	100		*69*	
U	exponential	180		*130*	

Adopted Input Data

➢ **Concentration ratios for Chironomus sp. as taken from ERICA database**

Insect larvae	Distribution	mean	stdev	*median*	
Pb	exponential	10000		*6900*	
Po	exponential	9900		*6900*	
Ra	exponential	1500		*1000*	
Th	exponential	100		*69*	
U	exponential	500		*350*	

Results Summary

> **Calculated Radionuclide concentrations in fishes**

[Bq/kg]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	3.9E+01	8.9E+00	2.7E+01	6.1E+00	8.7E+01
median	9.4E+00	1.7E+00	1.7E+00	1.1E+00	4.1E+00
minimum	1.5E-01	2.9E-02	2.3E-02	1.0E-02	5.4E-03
maximum	3.7E+02	5.6E+01	4.7E+02	6.5E+01	1.1E+03

Results Summary

> **Calculated Radionuclide concentrations in Pisidium sp.**

[Bq/kg]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	2.0E+02	2.2E+03	7.6E+02	5.8E+00	6.2E+02
median	2.4E+01	3.8E+02	5.8E+01	6.9E-01	1.7E+01
minimum	8.0E-01	2.1E+01	9.5E-01	2.4E-03	2.1E-02
maximum	2.1E+03	1.3E+04	1.3E+04	6.4E+01	7.5E+03

Results Summary

➢ **Calculated radionuclide concentrations in Chironomus sp.**

[Bq/kg]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	1.2E+03	3.7E+02	5.4E+02	5.8E+00	1.7E+03
median	3.1E+02	6.9E+01	3.5E+01	6.9E-01	*4.7E+01*
minimum	4.9E+00	1.2E+00	1.8E-01	2.4E-03	5.9E-02
maximum	1.2E+04	2.3E+03	9.6E+03	6.4E+01	2.1E+04

Results Summary

> **Calculated distribution coefficients of radionuclides**

[L/kg]	Pb-210	Po-210	Ra-226	Th-230	U-238
mean	1.7E+05	3.4E+05	3.9E+04	3.0E+05	2.2E+04
median	4.4E+04	8.2E+04	2.5E+04	1.0E+05	7.5E+03
minimum	2.4E+03	5.0E+03	2.0E+03	2.5E+02	3.2E+01
maximum	9.6E+05	1.5E+06	2.2E+05	2.0E+06	1.2E+05

Thank you for your attention

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