Beaverlodge scenario: Informed user application of RESRAD-BIOTA

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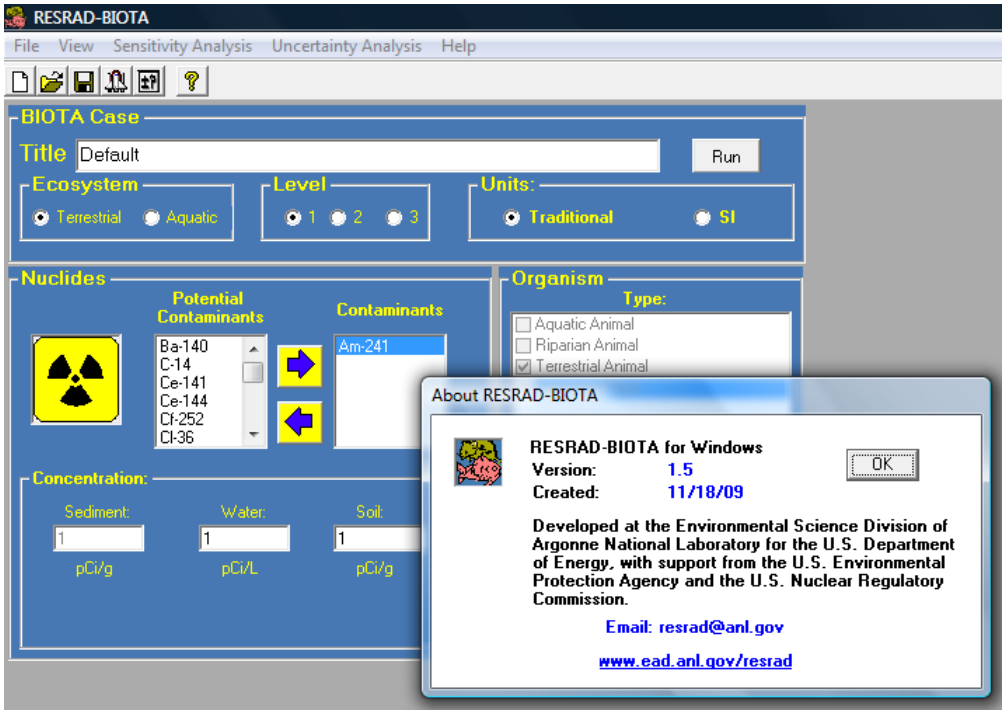
RESRAD-BIOTA

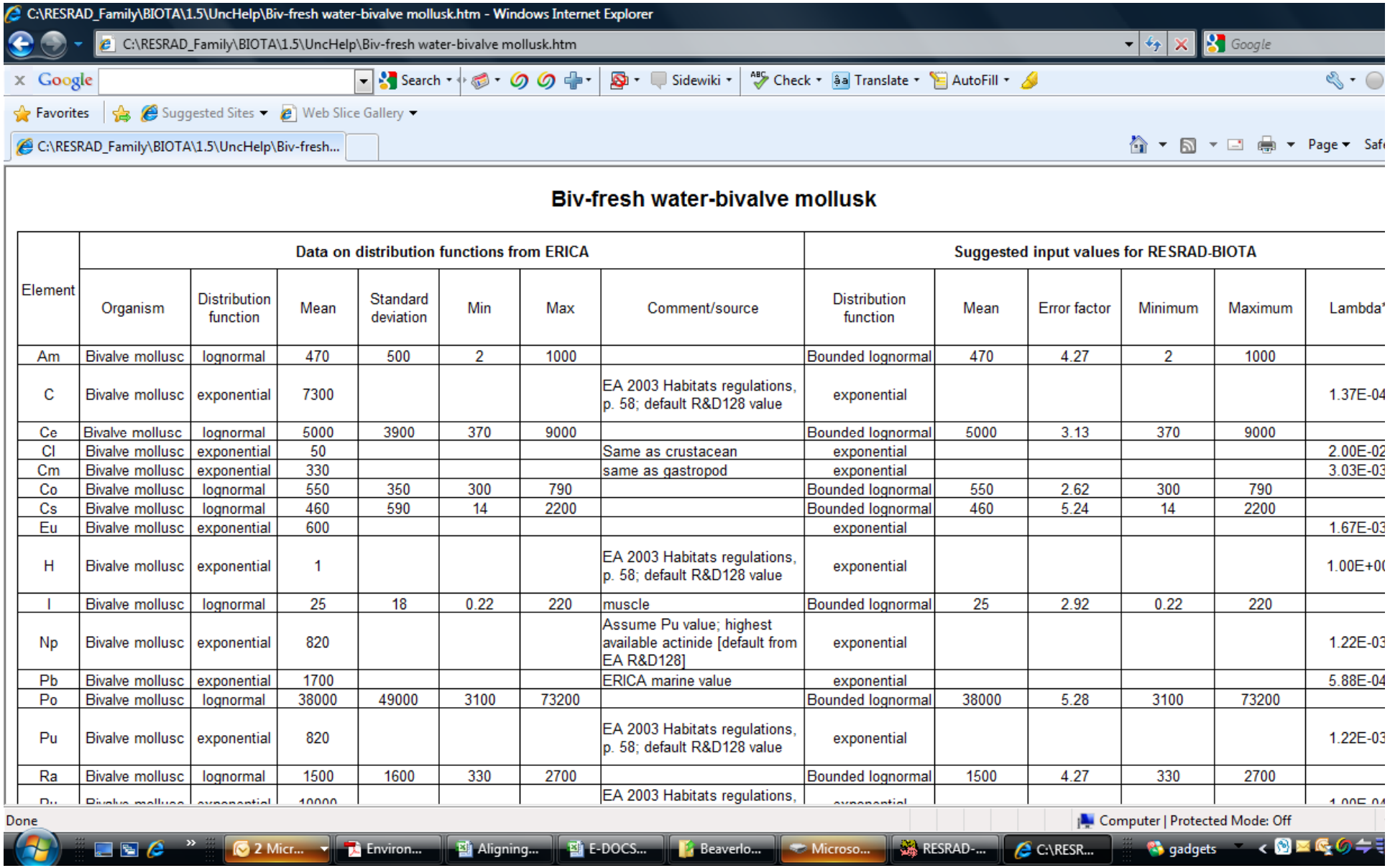
- Level 3 assessment using the RESRAD-BIOTA v1.5



- Applied by radioecologist involved with development of other tools but <u>not</u> a developer of RESRAD-BIOTA
  - Simulating informed user application (Wood *et al.*, 2009)

Model parameters used

- RESRAD-BIOTA 1.5 includes an uncertainty analysis module
- Default BiV values in model for generic aquatic animal
- Help file suggests Biv values (ERICA CR values) for input
  - Po and Ra in bivalve molluscs
  - Ra, Th and U in benthic fish
- Suggested organism-specific Bivs available – used these
- Bivs for mollusc higher than RESRAD-BIOTA default – used for chironomids
  - only applied to Po-210
- No organism-specific Bivs available – used default RESRAD-BIOTA aquatic animal Bivs



Biv-fresh water-bivalve mollusk

Element	Data on distribution functions from ERICA							Suggested input values for RESRAD-BIOTA					
	Organism	Distribution function	Mean	Standard deviation	Min	Max	Comment/source	Distribution function	Mean	Error factor	Minimum	Maximum	Lambda*
Am	Bivalve mollusc	lognormal	470	500	2	1000		Bounded lognormal	470	4.27	2	1000	
C	Bivalve mollusc	exponential	7300				EA 2003 Habitats regulations, p. 58; default R&D128 value	exponential					1.37E-04
Ce	Bivalve mollusc	lognormal	5000	3900	370	9000		Bounded lognormal	5000	3.13	370	9000	
Cl	Bivalve mollusc	exponential	50				Same as crustacean	exponential					2.00E-02
Cm	Bivalve mollusc	exponential	330				same as gastropod	exponential					3.03E-03
Co	Bivalve mollusc	lognormal	550	350	300	790		Bounded lognormal	550	2.62	300	790	
Cs	Bivalve mollusc	lognormal	460	590	14	2200		Bounded lognormal	460	5.24	14	2200	
Eu	Bivalve mollusc	exponential	600					exponential					1.67E-03
H	Bivalve mollusc	exponential	1				EA 2003 Habitats regulations, p. 58; default R&D128 value	exponential					1.00E+00
I	Bivalve mollusc	lognormal	25	18	0.22	220	muscle	Bounded lognormal	25	2.92	0.22	220	
Np	Bivalve mollusc	exponential	820				Assume Pu value; highest available actinide [default from EA R&D128]	exponential					1.22E-03
Pb	Bivalve mollusc	exponential	1700				ERICA marine value	exponential					5.88E-04
Po	Bivalve mollusc	lognormal	38000	49000	3100	73200		Bounded lognormal	38000	5.28	3100	73200	
Pu	Bivalve mollusc	exponential	820				EA 2003 Habitats regulations, p. 58; default R&D128 value	exponential					1.22E-03
Ra	Bivalve mollusc	lognormal	1500	1600	330	2700		Bounded lognormal	1500	4.27	330	2700	
Ru	Bivalve mollusc	exponential	10000				EA 2003 Habitats regulations,	exponential					1.00E-04

Input data

Water

Area	Site	Date		Pb210	Po210	Ra226	Th230	U-238
				Bq/L	Bq/L	Bq/L	Bq/L	Bq/L
Ace Creek Watershed	Dubyna Lake deep	2002	mean	5.00E-02	3.00E-02	1.00E-01	1.00E-02	7.16E+00
			std					
			min	5.00E-02	3.00E-02	1.00E-01	1.00E-02	7.16E+00
			max	5.00E-02	3.00E-02	1.00E-01	1.00E-02	7.16E+00
Ace Creek Watershed	Schmoo Lake Deep	2002	mean	2.00E-02	5.00E-03	5.00E-03	1.00E-02	9.77E-03
			std					
			min	2.00E-02	5.00E-03	5.00E-03	1.00E-02	9.77E-03
			max	2.00E-02	5.00E-03	5.00E-03	1.00E-02	9.77E-03

Sediment

Area	Site	Date		Pb210	Po210	Ra226	Th230	U-238
				Bq/kg dw	Bq/kg dw	Bq/kg dw	Bq/kg dw	Bq/kg dw
Ace Creek Watershed	Dubyna Lake deep	2002	mean	3.06E+04	2.98E+04	5.48E+03	1.74E+03	4.65E+05
			std	1.30E+04	1.26E+04	1.16E+03	5.68E+02	2.61E+05
			min	1.90E+04	1.90E+04	4.40E+03	1.20E+03	2.41E+05
			max	4.80E+04	4.40E+04	7.30E+03	2.70E+03	7.75E+05
Ace Creek Watershed	Schmoo Lake Deep	2002	mean	3.96E+02	4.10E+02	6.00E+01	4.25E+01	2.38E+02
			std	1.56E+02	1.18E+02	7.07E+00	5.00E+00	8.51E+01
			min	2.30E+02	2.80E+02	5.00E+01	4.00E+01	1.20E+02
			max	6.30E+02	5.40E+02	7.00E+01	5.00E+01	3.60E+02
Beaverlodge Lake	Hanson Bay	2004	mean	1.75E+03		9.71E+02	7.27E+03	1.83E+04
			std	1.46E+03		6.51E+02	6.13E+03	1.63E+04
			min	2.20E+02		2.30E+02	1.00E+03	5.01E+02
			max	4.50E+03		2.00E+03	2.00E+04	5.03E+04

Input data cont.

- Many water data appear to be LOD values
- May well be single samples
- No information on how water samples collected
  - likely to be surface water samples
  - depth of water between surface and benthic sediments not provided
- *Chironomus sp.* and *Pisidium sp.* are both benthic detritivores
- Lake white fish and white sucker both feed on benthic invertebrates.
- Therefore
  - Took conservative approach
  - all calculations based on sediment activity concentrations
  - default RESRAD-BIOTA kd values used to estimate water activity concentrations

Running the model

- Lots of predictions required
- Very time consuming to run in RESRAD-BIOTA
- Performed calculations in MS Excel
- QC'd by cross-checking a selection of predictions with RESRAD-BIOTA model runs