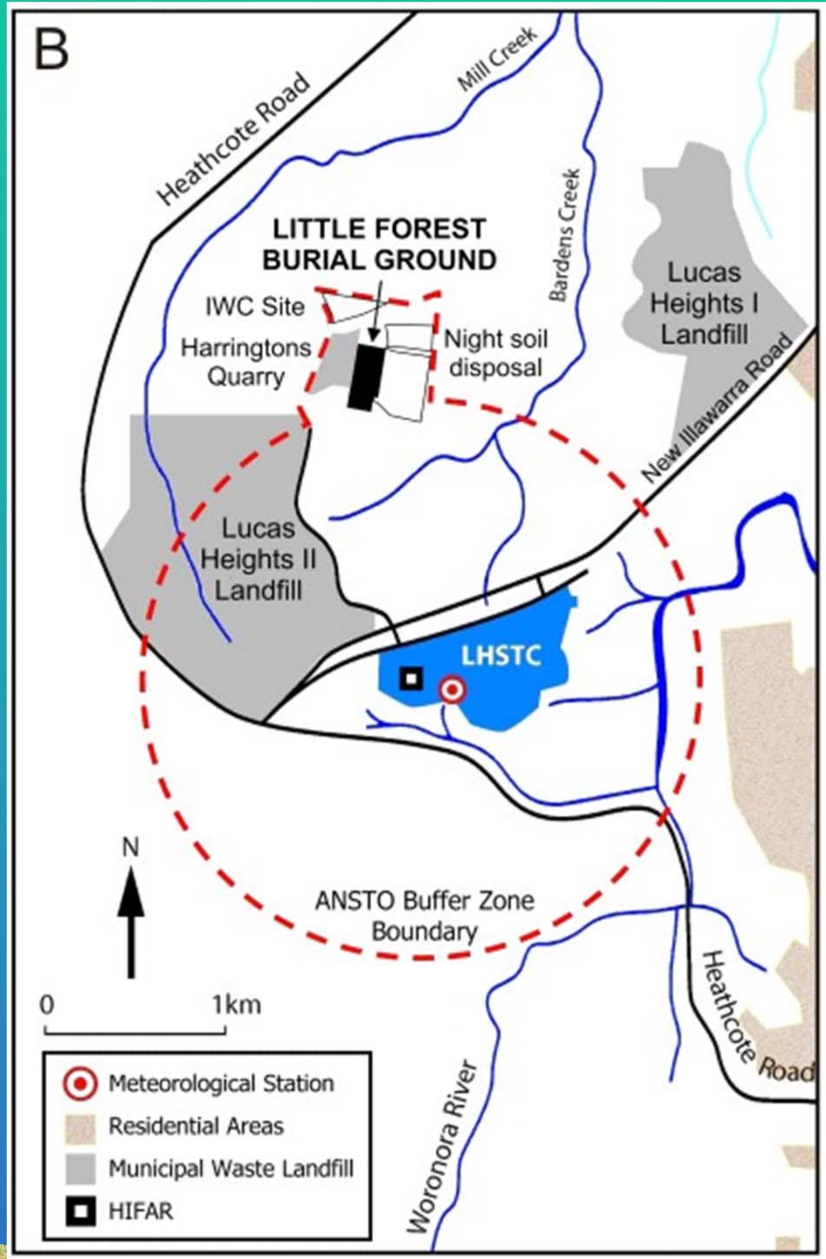
Biota Modelling Group (WG4)

Little Forest Burial Ground (ANSTO)

Site Location

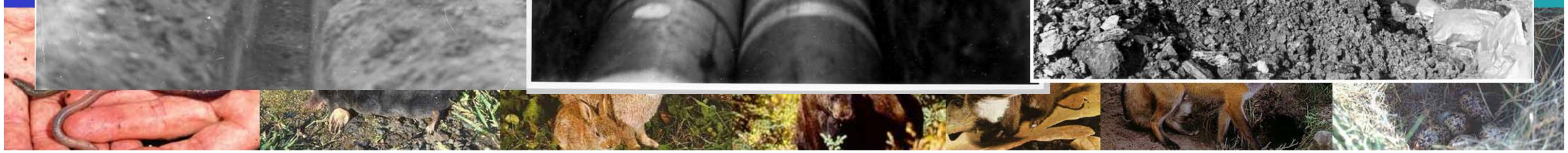
- Located near Sydney, New South Wales, Australia.



Waste Disposal

- Waste disposed in 1960-68.
- Waste was from reactor, medical, other academic research.
- 79 trenches extending from ~1.0 to ~3.0 m below the ground surface.
- ~150 GBq of radionuclides, including many short-lived isotopes as well as H-3, Co-60, Sr-90, Cs-137, Th-232, U-233, -235, -238, Pu-238/240, Am-241 among others
- various forms and types of packaging.

1960-68 Disposal at LFBG



Present state

- Grass-dominated vegetation cover,
- Bordered by low forest & scrub representative of original vegetation.
- Site is maintained with fencing, signage, grass mowing, and regular monitoring.

Plant – Grass

Plant, tree – Acacia

Plant, root crop – Yam

Annelid – Earthworm

Arthropods - Insects (grasshopper)

Reptile – goanna

Bird - raven

Mammal, monotreme – Echidna

Mammal, placental canine – Fox

Mammal, marsupial macropod – Wallaby

Plant – Grass

Plant, tree – Acacia

Plant, root crop – Yam

Annelid – Earthworm

Arthropods - Insects (grasshopper)

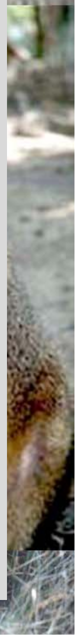
Reptile – goanna

Bird - raven

Mammal, monotreme – Echidna

Mammal, placental canine – Fox

Mammal, marsupial macropod – Wa



Participants

SCK·CEN, Belgium

CEH, UK

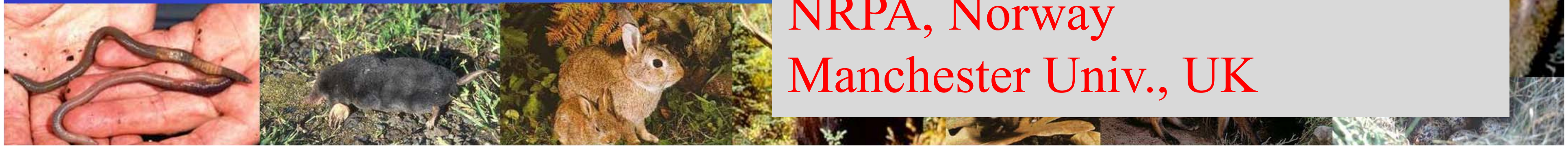
ANL, USA

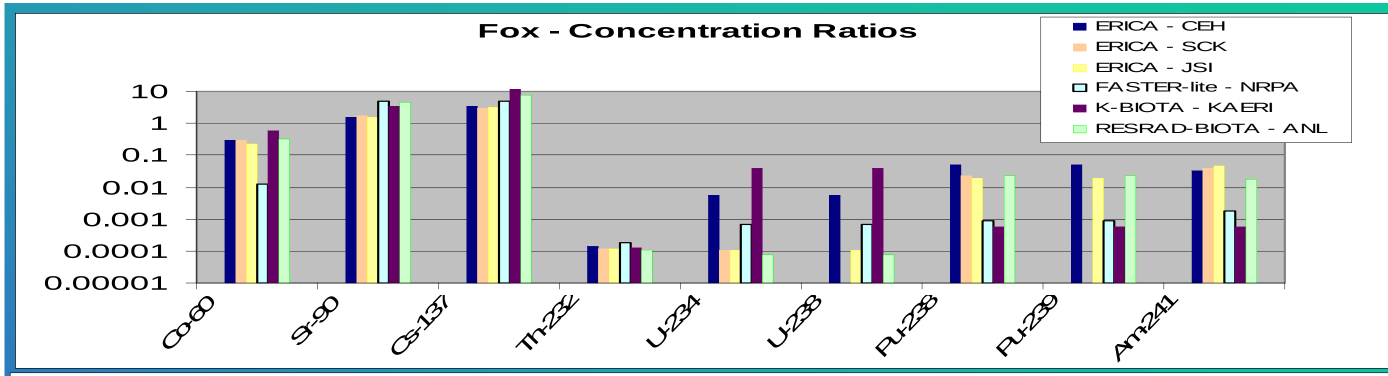
KAERI, Korea

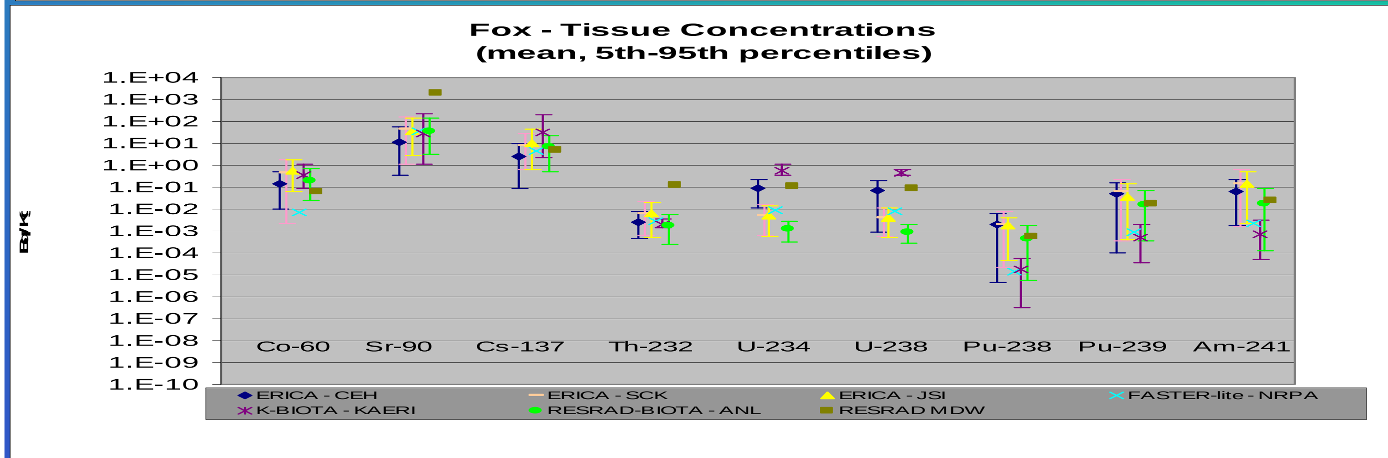
Jozef Stefan Institute, Slovenia

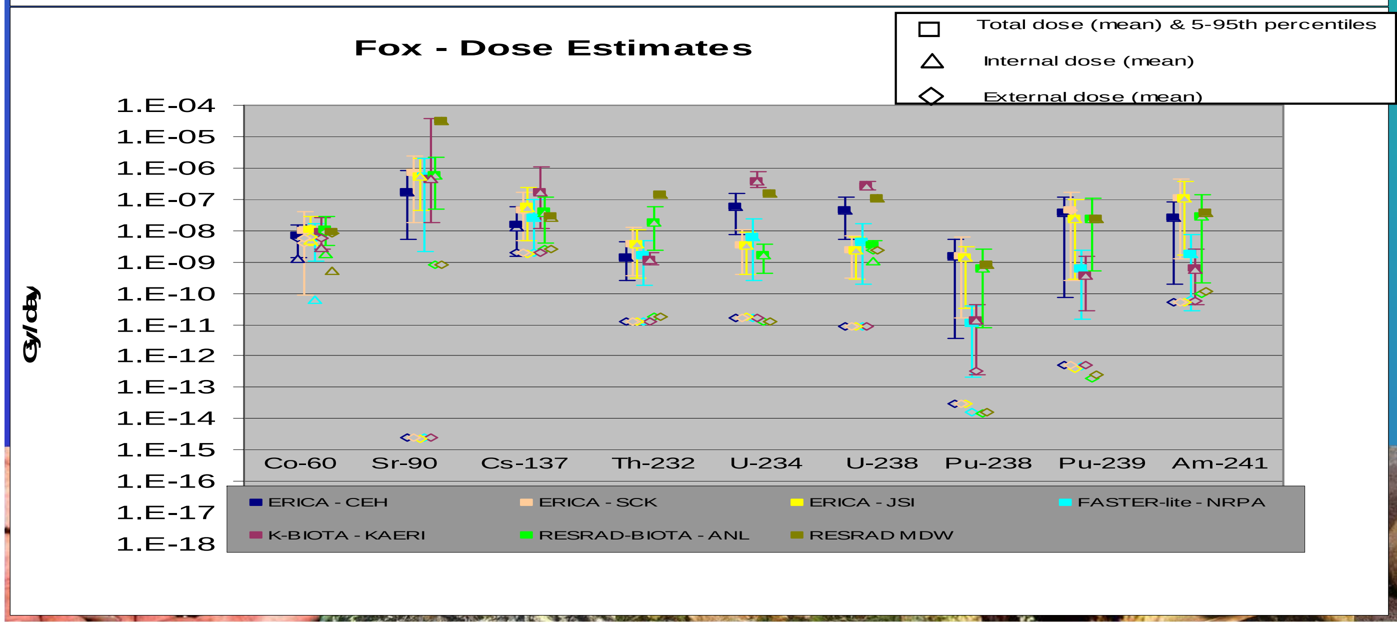
NRPA, Norway

Manchester Univ., UK

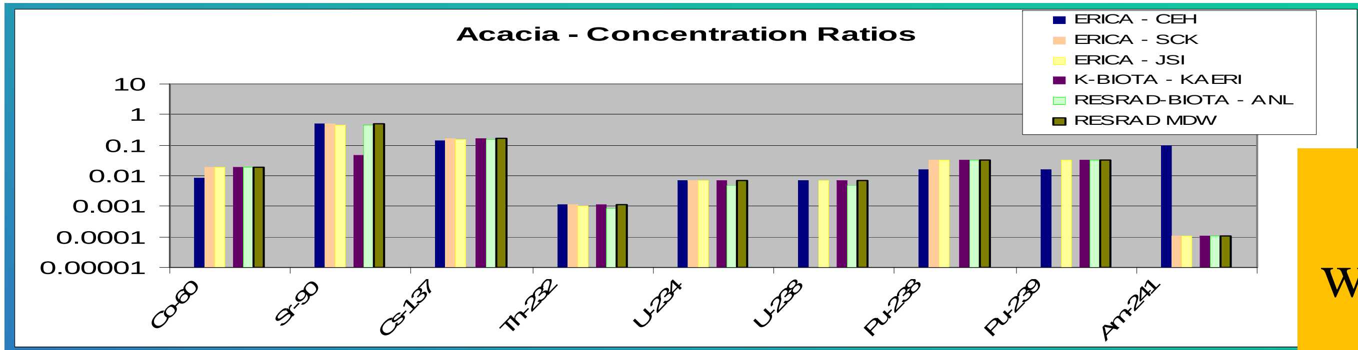


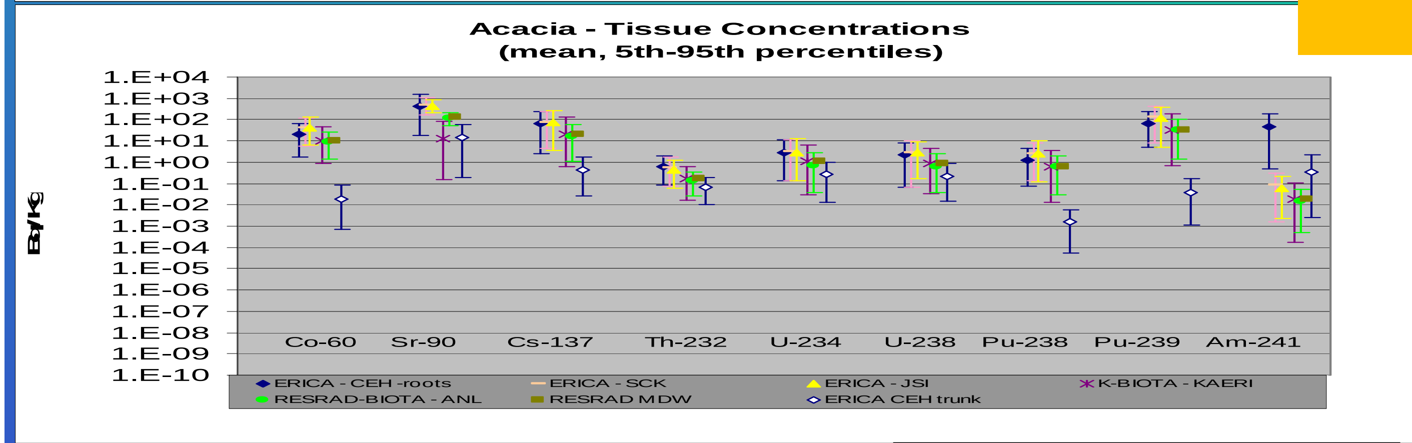

Fox - Concentration Ratios
ERICA - CEH
ERICA - SCK
ERICA - JSI
FASTER-lite - NRPA
K-BIOTA - KAERI
RESRAD-BIOTA - ANL
10
1
0.1
0.01
0.001
0.0001
0.00001
Co-60
Sr-90
Cs-137
Th-232
U-234
U-238
Pu-238
Pu-239
Am241

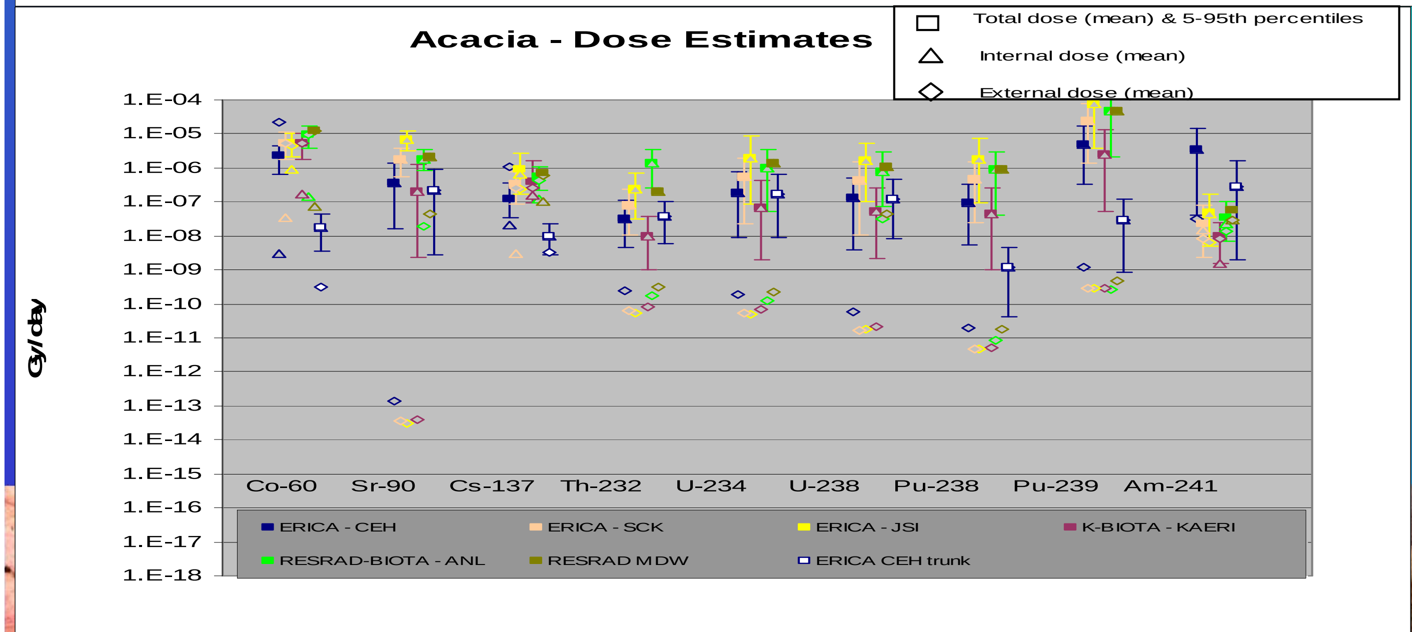

Fox - Tissue Concentrations
(mean, 5th-95th percentiles)
Bq/kg
1.E+04
1.E+03
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
Co-60
Sr-90
Cs-137
Th-232
U-234
U-238
Pu-238
Pu-239
Am-241
ERICA - CEH
ERICA - SCK
ERICA - JSI
FASTER-lite - NRPA
K-BIOTA - KAERI
RESRAD-BIOTA - ANL
RESRAD MDW


Fox - Dose Estimates
Total dose (mean) & 5-95th percentiles
Internal dose (mean)
External dose (mean)
Gy/day
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
1.E-12
1.E-13
1.E-14
1.E-15
1.E-16
1.E-17
1.E-18
Co-60
Sr-90
Cs-137
Th-232
U-234
U-238
Pu-238
Pu-239
Am-241
ERICA - CEH
ERICA - SCK
ERICA - JSI
FASTER-lite - NRPA
K-BIOTA - KAERI
RESRAD-BIOTA - ANL
RESRAD MDW

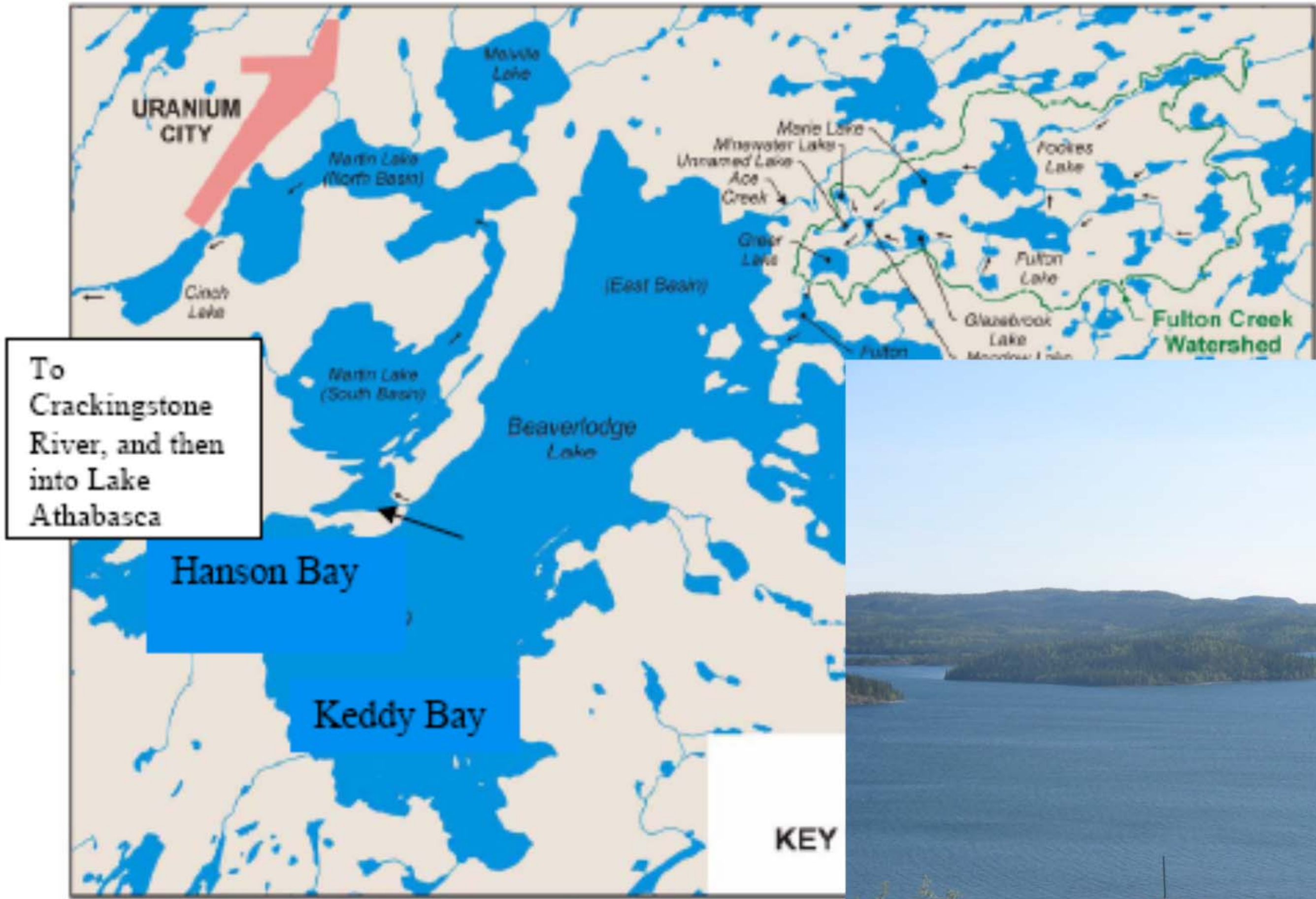
Plant geometries - what are we trying to predict?





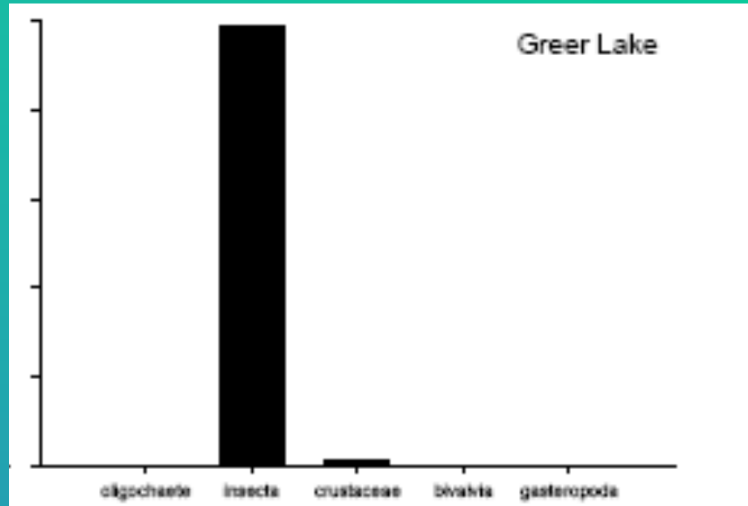


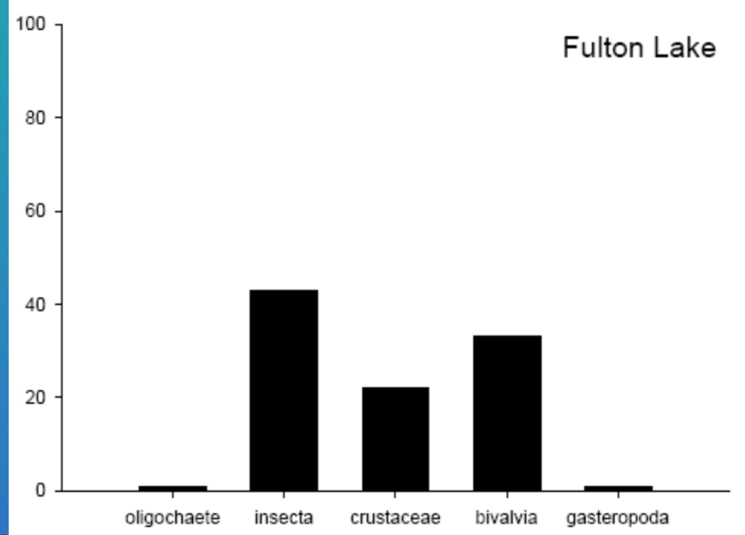
Beaverlodge uranium mine (CNSC)



Beaverlodge

- Sediment, water & fish data available over a number of years [enables model-data comparison] – for U-238 series radionuclides
- Reduced invertebrate populations/effects in fish/multi-contaminants (interaction with WG6)
- Provide informed opinion on real issue





Scenario

- Six Uranium Mining Facilities currently operating or decommissioned
- Near Field: 7
- Far-field Sites: 5
- Reference: 3
- Species: 3 fish & 3 invertebrate species
- Data available – mixed sediment, water, fish species (U-238, Th-230, Ra-226, Po-210, Pb-210)

Scenario

- Six Uranium Mining Facilities currently operating or decomm
- Near Field: 7
- Far-field Sites: 5
- Reference: 3
- Species: 3 fish & 3 i
- Data available – mix fish species (U-238, 210, Pb-210)

Participants

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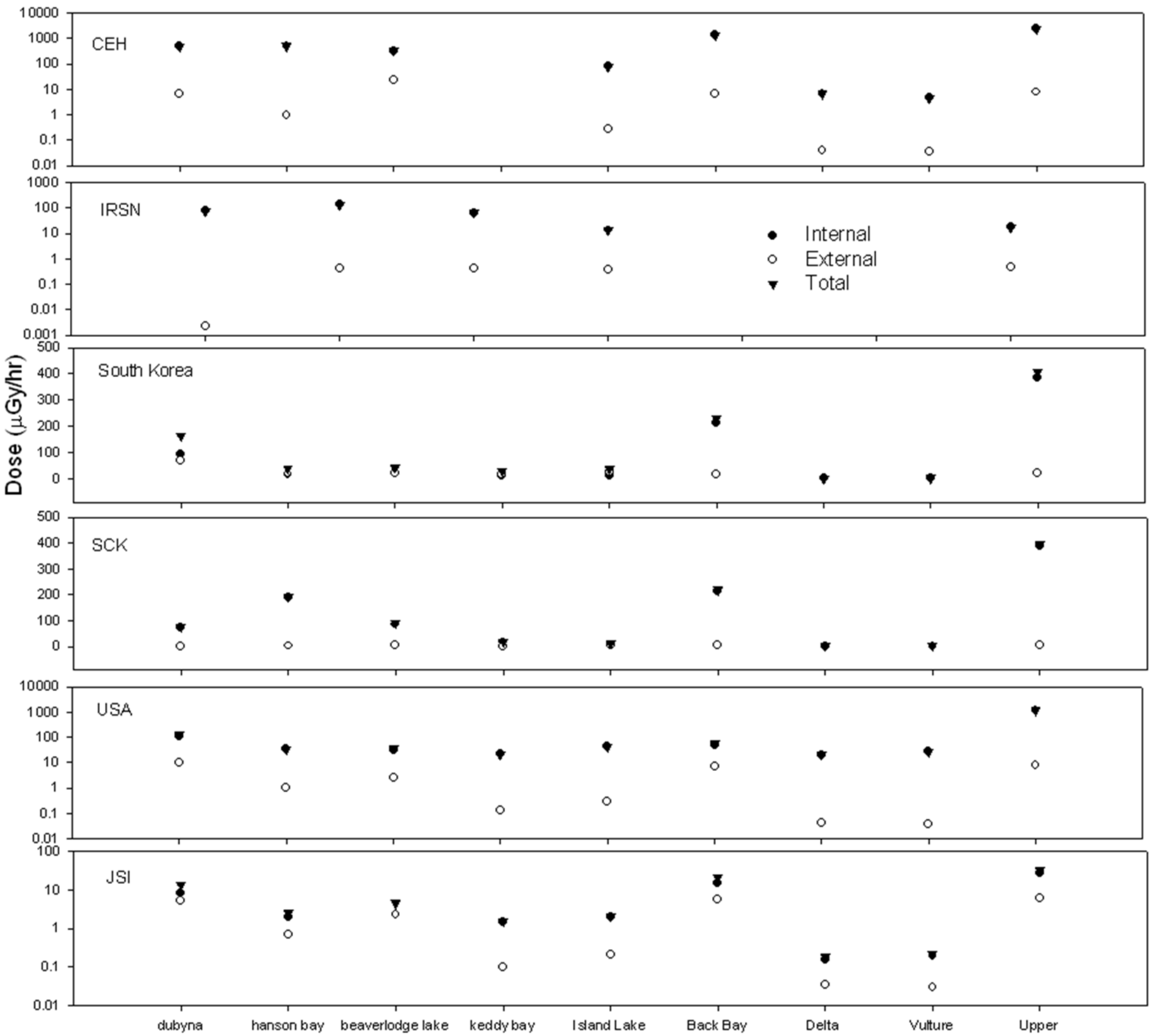
CEH, UK
EA, UK
ANL, USA
BARC, India
IRSN, France
SUJB, Czech Republic
CNSC, Canada
KAERI, Korea
Jozef Stefan Institute, Slovenia

Dose to pisidium



Dose to pisidium

Considerable variability:

Transfer parameter values

K_d

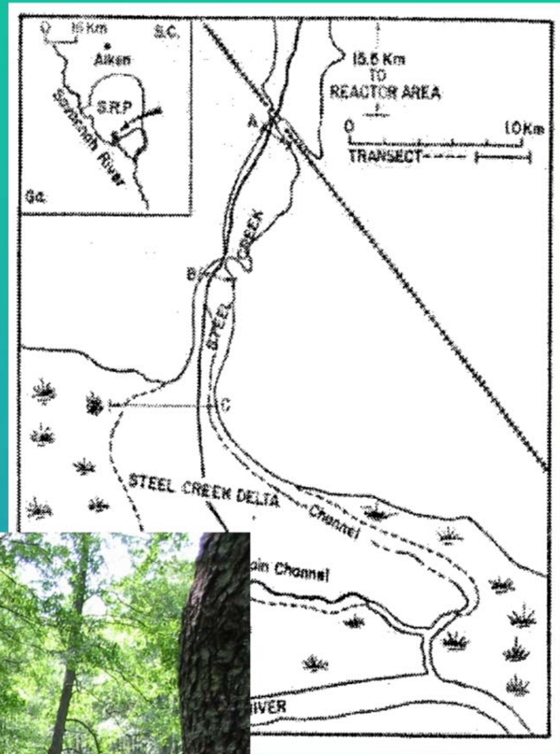
Secular equilibrium assumptions

How address missing input data

- Can we agree ‘best approach’ ?
  - Hopefully we did

Wetland scenario (SU, SSM)

- Scenario derived from three wetlands in USA, Sweden and Canada
- Range of organisms
- How conduct 'mixed' ecosystem assessment
- Test C-14 models
- Scenario agreed – results for mid-term meeting



Dynamic modelling (?)

- Assess the need and demand for dynamic models
- Review available (adaptable) models
- Achieved via questionnaire
  - To date 13 responses from regulators, industry, model developers/users
  - More responses requested by end Feb. 2011 (jvibatll@SCKCEN.BE or nab@ceh.ac.uk)

Dynamic modelling

- Needed: no current approaches fit for purpose
  → yes for specific purposes
- Availability of data to parameterise/validate?
- Models developed for human foodchain assessment can be adapted for wildlife assessment
- Guidance on what is required to adapt available (human) models

Radiat Environ Biophys
DOI 10.1007/s00411-010-0346-5

ORIGINAL PAPER

The estimation of absorbed dose rates for non-human biota: an extended intercomparison

J. Vives i Batlle · K. Beaugelin-Seiller · N. A. Beresford · D. Copplestone · J. Horyna · A. Hosseini · M. Johansen · S. Kamboj · D.-K. Keum · N. Kurosawa · L. Newsome · G. Olyslaegers · H. Vandenhove · S. Ryufuku · S. Vives Lynch · M. D. Wood · C. Yu

Received: 28 June 2010 / Accepted: 14 November 2010

Abstract An exercise to compare 10 approaches for the calculation of unweighted whole-body absorbed dose rates was conducted for 74 radionuclides and five of the ICRP's Reference Animals and Plants, or RAPs (duck, frog, flatfish egg, rat and elongated earthworm), selected for this exercise to cover a range of body sizes, dimensions and exposure scenarios. Results were analysed using a non-parametric method requiring no specific hypotheses about the statistical distribution of data. The obtained unweighted absorbed dose rates for internal exposure compare well between the different approaches, with 70% of the results falling within a range of variation of ±20%. The variation is greater for external exposure, although 90% of the estimates are within an order of magnitude of one another. There are some discernible patterns where specific models over- or under-predicted. These are explained based on the methodological differences including number of daughter products included in the calculation of dose rate for a parent nuclide; source–target geometry; databases for discrete energy and yield of radionuclides; rounding errors in integration algorithms; and intrinsic differences in calculation methods. For certain radionuclides, these factors combine to generate systematic variations between approaches. Overall, the technique chosen to interpret the data enabled methodological differences in dosimetry calculations to be quantified and compared, allowing the

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Published online: 27 November 2010