

Conference or Workshop Item

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Exposure of biota in England and Wales to natural radionuclides

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PROJECT BACKGROUND

A number of approaches have been developed to assess the exposure of wildlife to radioactivity (e.g. by E&W EA, USDOE, Canadian organisations and European projects). Some of these are now being used to assess licensed sites.

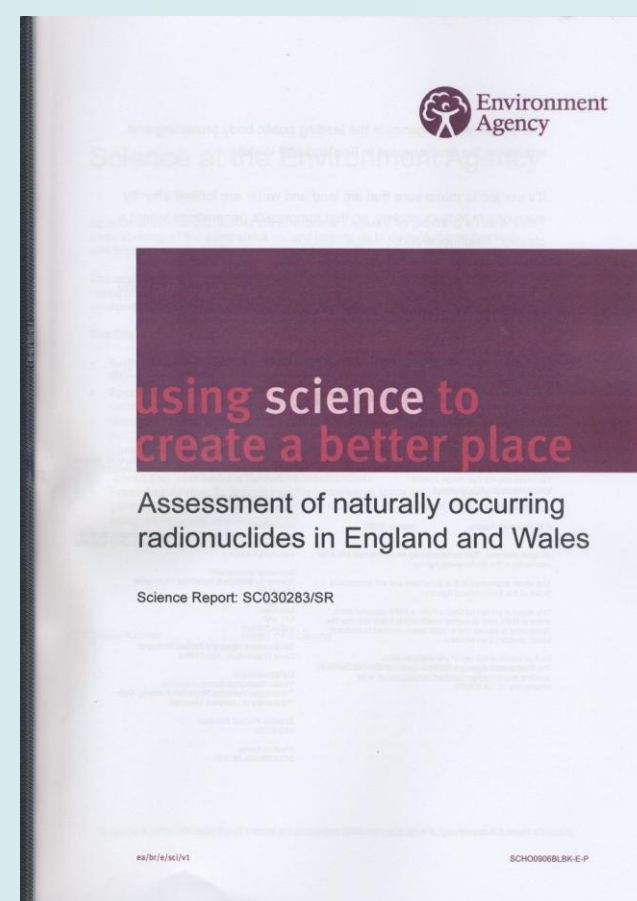
To date there has been no consistent approach for addressing background exposure rates within these various approaches. In part this is because data on exposure of wildlife to natural series radionuclides have not been collated.

This collaborative project, between CEH, BGS and The University of Liverpool has collated data for England and Wales targeted towards terrestrial and freshwater ecosystems. The data are summarised according to the list of reference animals and plants (RAPs) as proposed by ICRP.

DATA REVIEW

Sources:

- ❖ Grey literature (e.g. RIFE series).
- ❖ Refereed literature (few relevant papers found).
- ❖ In house data (e.g. CEH post Chernobyl surveys).



Number of data identified for ⁴⁰K, ²¹⁰Po, ²¹⁰Pb, ²²⁶Ra, ²²⁸Th, ²³⁰Th, ²³²Th, ²³⁴U, ²³⁵U and ²³⁸U for all of the UK (summarised by ICRP RAP)

Deer	Rat	Total Mammals*	Duck	Frog	Bee	Earthworm	Pine tree	Wild grass	Salmonid
73	0	245	27	0	0	0	53	1237	44

*Total mammals includes available data for deer and rat in addition to that for other mammalian species

- ❖ No specific data identified for most RAPs so surrogate organisms were included (e.g. flying insects rather than bees).
- ❖ Much of the data was for Scotland.
- ❖ Few data for Wales.

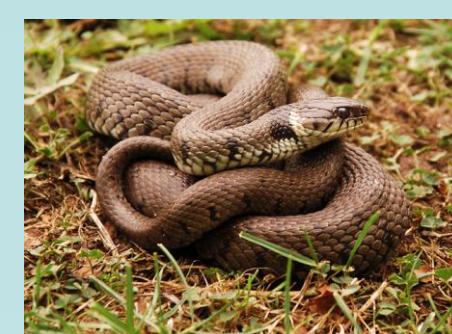
The final report is available to download from:

www.environment-agency.gov.uk via their publications catalogue

TARGETED SAMPLING

Following the data review an additional targeted sampling programme was undertaken. Existing sample archives from CEH's Predatory Birds Monitoring Programme, Lakes Monitoring Scheme and Environmental Change Network sites were used where possible. Samples were analysed by ICP-MS and gamma spectroscopy.

Samples obtained included:



Snakes



Toads

Heron (liver)



Flying insects (mainly moths)

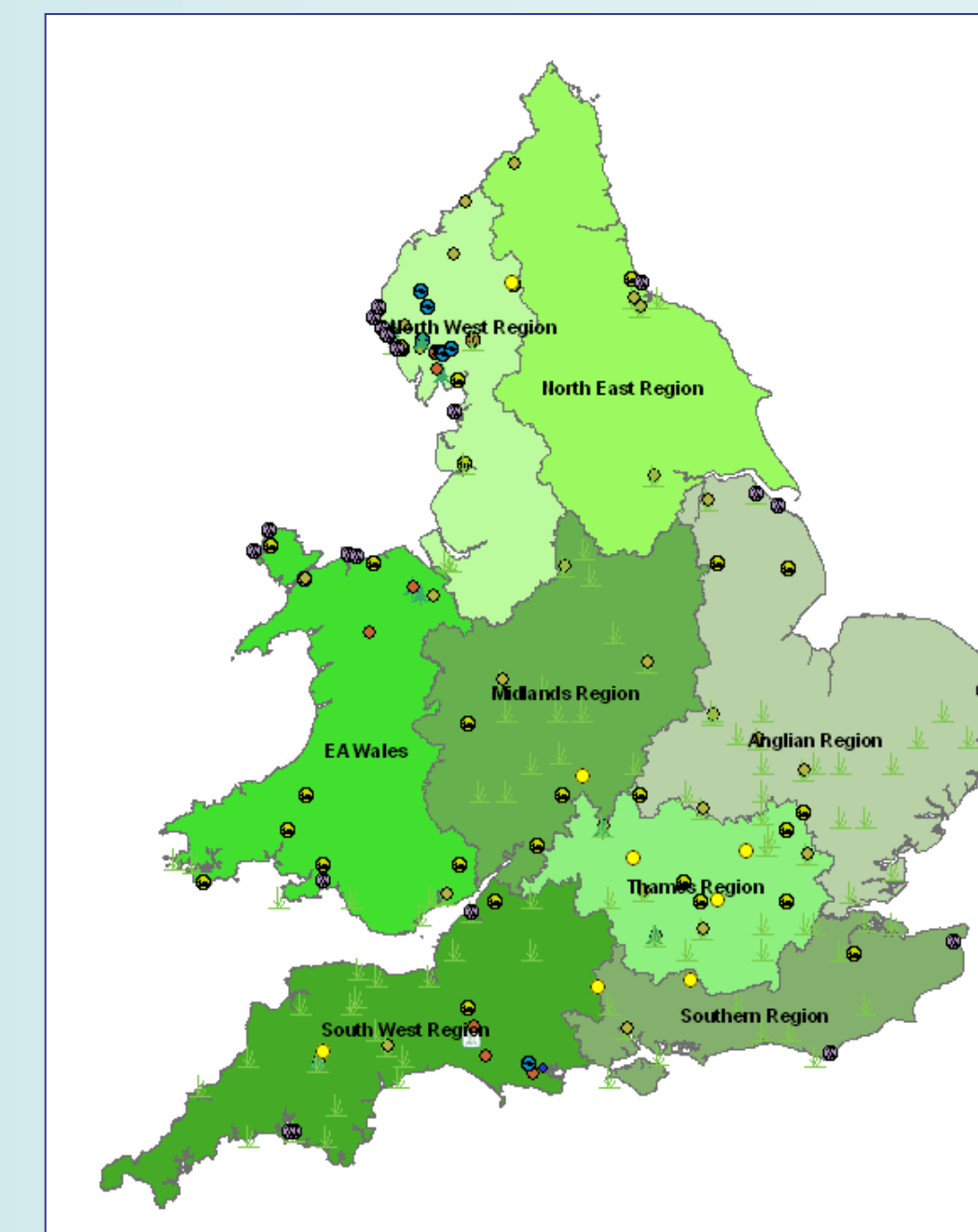
Pine trees (wood & cones)

Earthworms

Rabbits

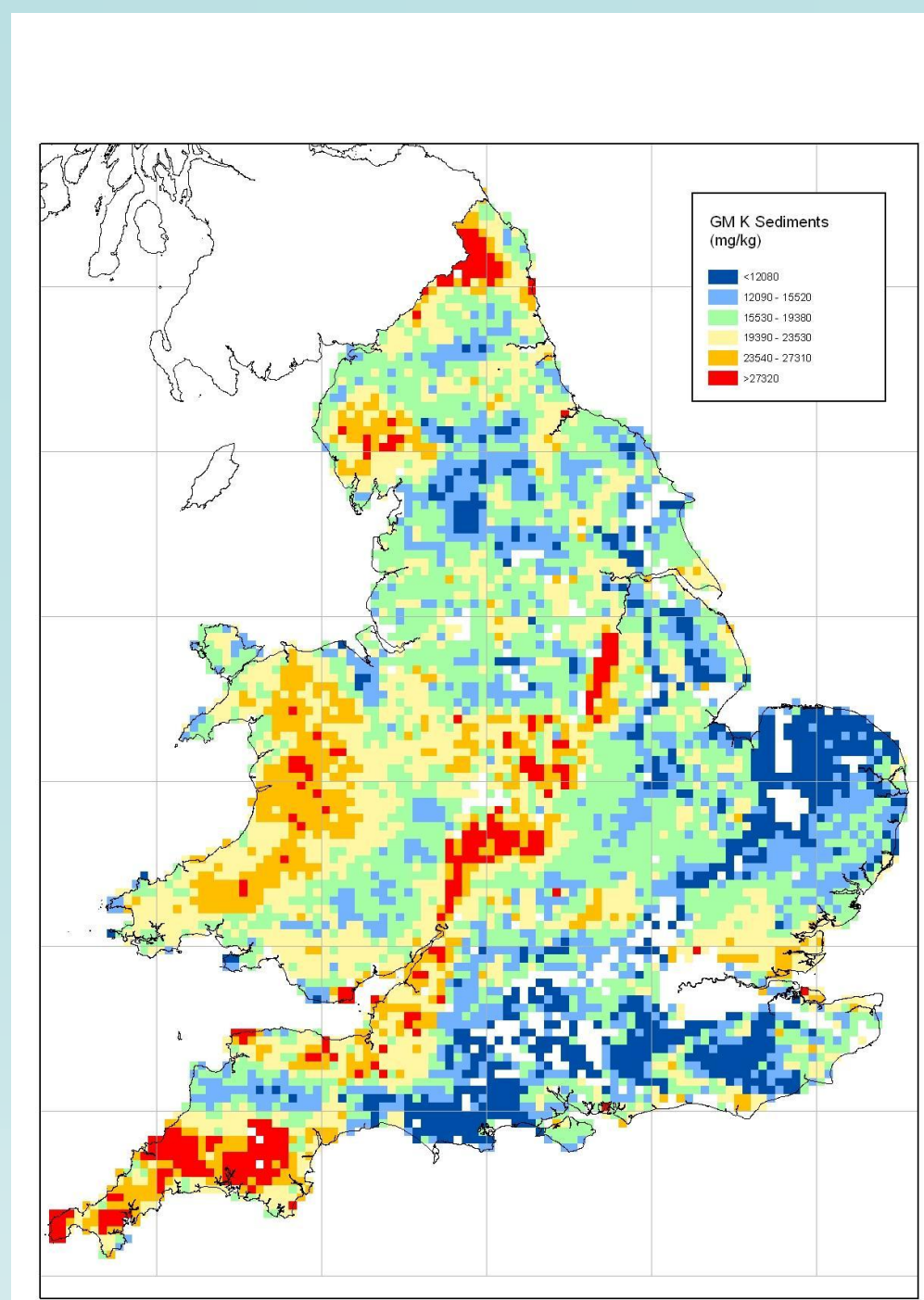
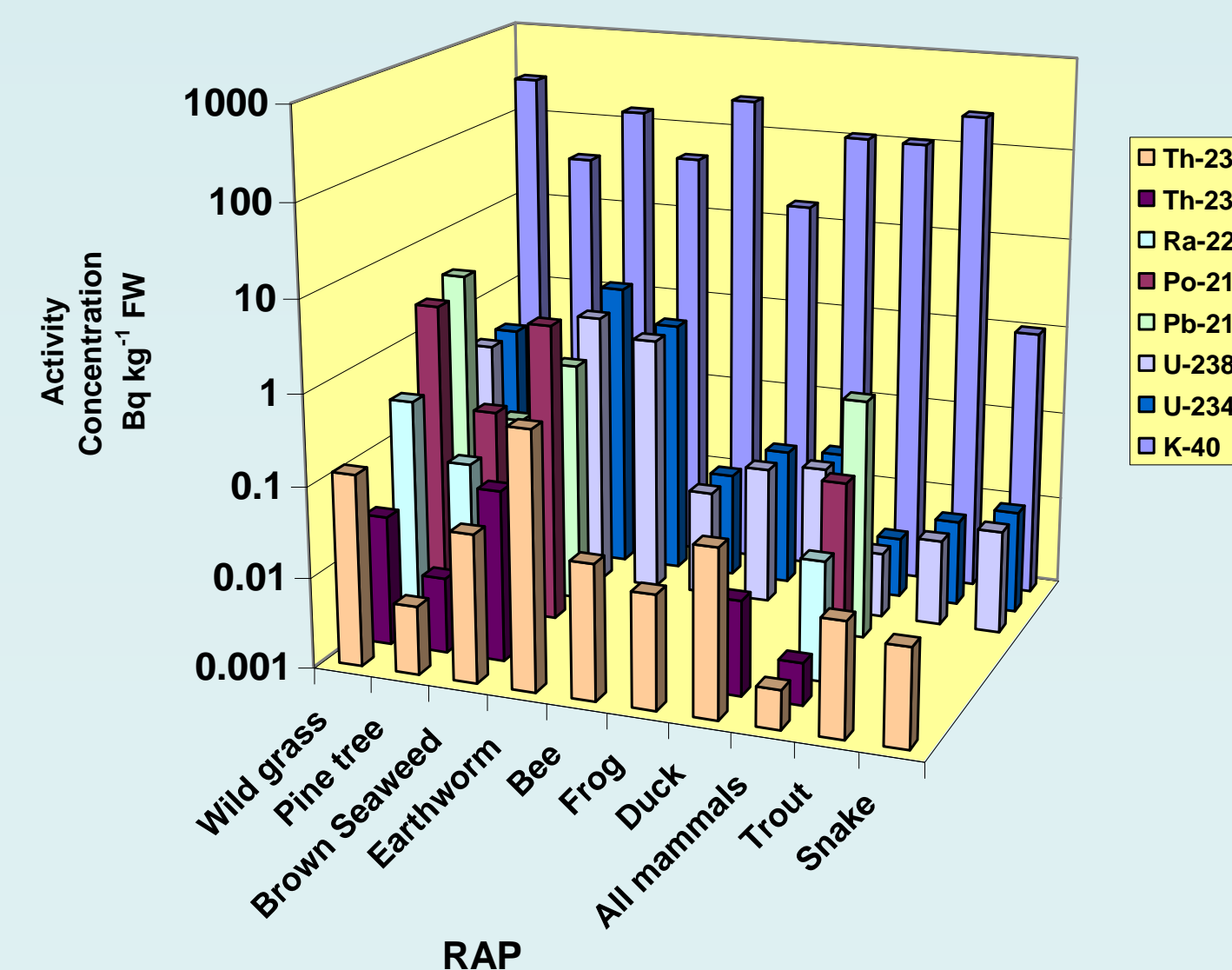
Ducks (whole body & liver)

Freshwater fish (pike, salmonids)

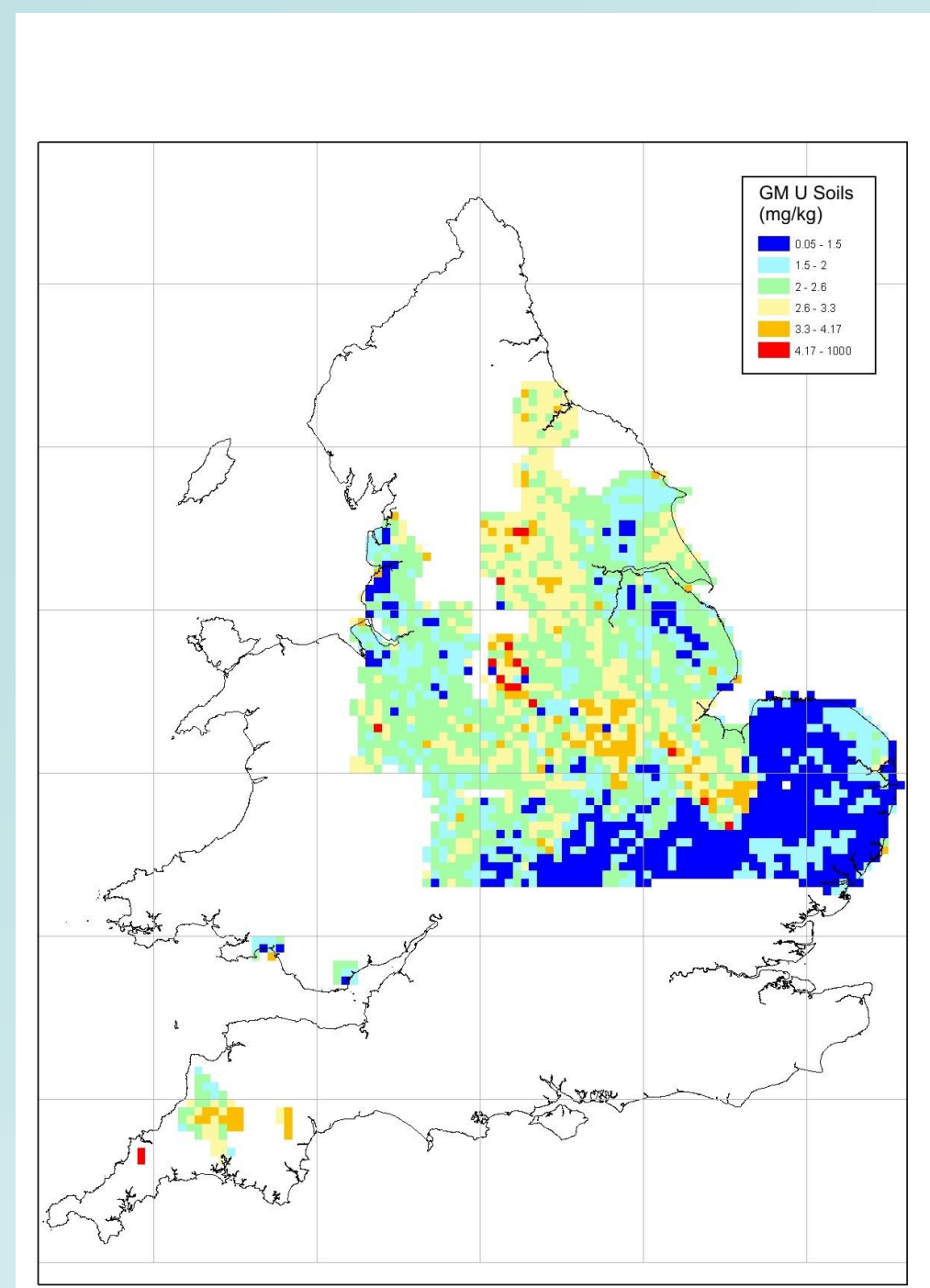


Location of all available data (shown by EA region)

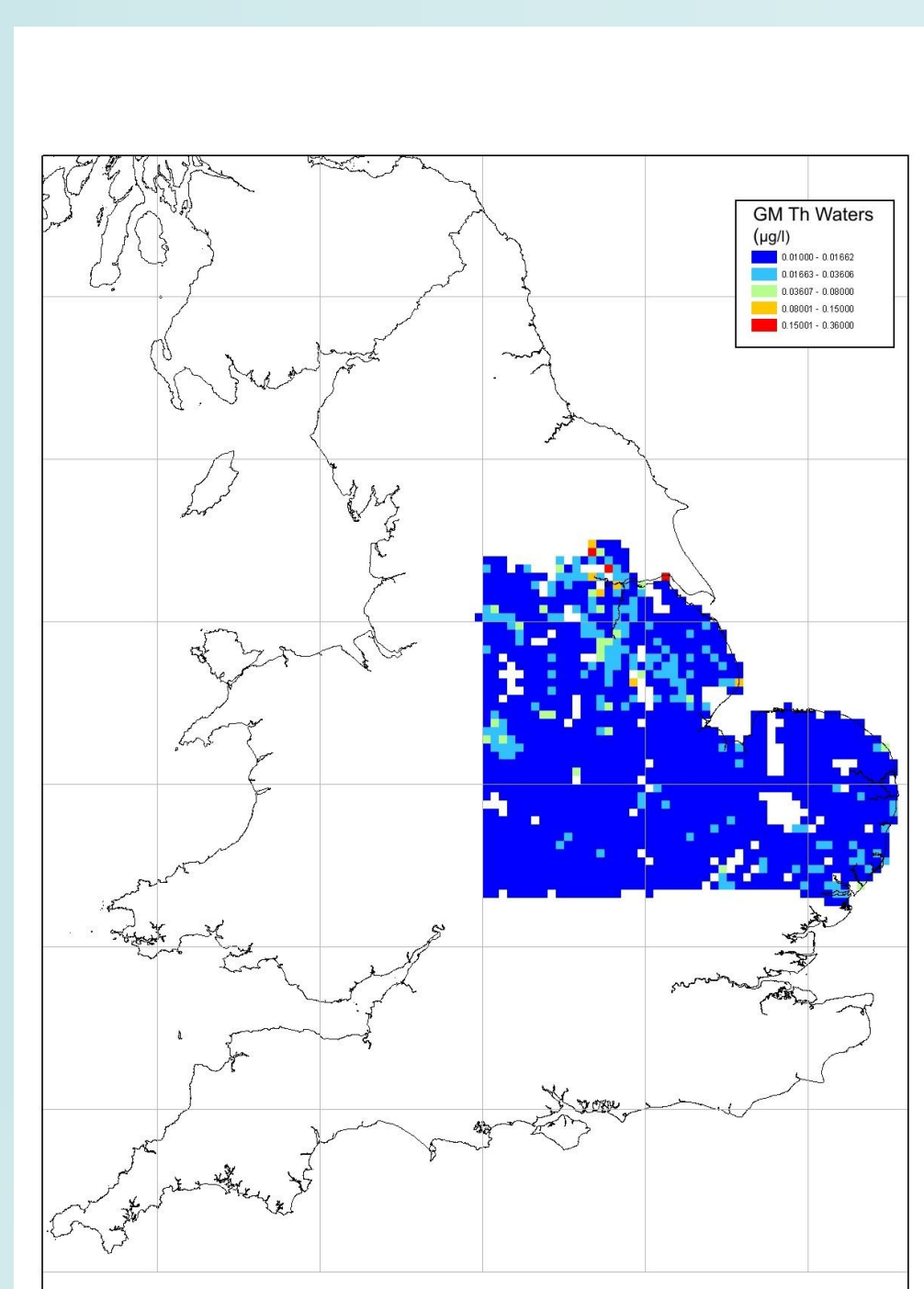
Summary of natural radionuclide activity concentrations (Bq kg⁻¹) FW in the UK



Geometric mean K concentrations (mg kg⁻¹) in stream sediments (combined G-Base and Wolfson datasets)



Geometric mean U concentration (mg kg⁻¹) in soils (G-Base dataset)



Geometric mean Th concentration (μg l⁻¹) in waters (G-Base dataset)

ENVIRONMENTAL MEDIA

- ❖ BGS is responsible for geological mapping of the UK (G-Base) and as such has more than 5 million individual element determinations for K, U & Th (amongst others).
- ❖ These were used to provide estimates of natural series radionuclide concentrations assuming isotopic equilibrium. Data are presented on a 5x5km grid square basis.
- ❖ Coverage is not complete – data for southern England are generally lacking.
- ❖ Other datasets (e.g. Wolfson) and relationships to geology are being investigated as methods of gaining a full coverage.

ESTIMATES OF EXPOSURE

- ❖ Dose Conversion Coefficients (DCC's) have been derived for the ICRP RAPs by the EC funded project ERICA and have been used to estimate exposure.

RAP	Internal absorbed dose estimated from measured activity concentrations (μGy hr ⁻¹)			
	⁴⁰ K	²¹⁰ Po	²³² Th	²³⁸ U
Wild grass	7.9x10 ⁻²	8.0x10 ⁻³	3.2x10 ⁻⁴	9.6x10 ⁻⁴
Pine tree	1.3x10 ⁻²	5.9x10 ⁻⁴	1.3x10 ⁻⁵	1.8x10 ⁻⁵
Brown seaweed	3.5x10 ⁻²	6.5x10 ⁻³	9.9x10 ⁻⁵	2.8x10 ⁻³
Earthworm	1.3x10 ⁻²		1.6x10 ⁻³	1.9x10 ⁻³
Bee	6.0x10 ⁻²		7.1x10 ⁻⁵	3.6x10 ⁻⁵
Duck	3.7x10 ⁻²		1.6x10 ⁻⁴	9.8x10 ⁻⁵
Rat	3.4x10 ⁻²	6.2x10 ⁻⁴	1.0x10 ⁻⁵	1.1x10 ⁻⁵
Deer	3.9x10 ⁻²	6.2x10 ⁻⁴	1.0x10 ⁻⁵	1.1x10 ⁻⁵
Trout	8.0x10 ⁻²		4.1x10 ⁻⁵	2.2x10 ⁻⁵

- ❖ ⁴⁰K was the largest contributor to external dose rates.
- ❖ External dose rates for ²²⁸Th and ²²⁸Ra were within a factor of two of the ⁴⁰K estimates.
- ❖ External dose rates were not estimated for radionuclides which could not be assumed to be in equilibrium with series parent (e.g. ²¹⁰Pb).

The datasets of natural radionuclide concentrations in biota and media will enable significantly improved assessments of the background exposure of non-human species within England and Wales.