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Transfer parameters for ICRP reference animals and plants collected from a forest ecosystem

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Abstract The International Commission on Radiological Protection (ICRP) have suggested the identification of a series of terrestrial, marine and freshwater sites from which samples of each Reference Animal and Plant (RAP) could be systematically collected and analysed. We describe the first such study in which six of the eight terrestrial RAPs, and associated soil samples, were collected from a site located in a managed coniferous forestry plantation in north-west England. Adult life-stages of species representing six of the terrestrial RAPs (Wild Grass, Pine Tree, Deer, Rat, Earthworm and Bee) were sampled and analysed to determine concentrations of 60 elements and gamma-emitting radionuclides. The resultant data have been used to derive concentration ratios ($CR_{wo\text{-}soil}$) relating element/radionuclide concentrations in the RAPs to those in soil. This paper presents the first reported transfer parameters for a number of the RAP-element combinations. Where possible the derived $CR_{wo\text{-}soil}$ values are compared with the ICRPs recommended values and any appreciable differences discussed.

Keywords

Reference Animals and Plants, concentration ratio, transfer, radionuclide, biota, ICRP

Introduction

The International Commission on Radiological Protection (ICRP) published their framework for radiation protection of the environment in Publication 108 (ICRP 2008); this describes the concept and use of 'Reference Animals and Plants' (RAPs) as the basis for the framework. A RAP is defined by the ICRP as: "a hypothetical entity, with the assumed basic biological characteristics of a particular type of animal or plant, as described to the generality of the taxonomic level of 'Family', with defined anatomical, physiological, and life-history properties, that can be used for the purposes of relating exposure to dose, and dose to effects, for that type of living organism". Eight terrestrial (Table 1), three marine and three freshwater RAPs were defined in ICRP (2008). Dose coefficients for a selection of RAPs were also presented and data on the effects of ionising radiation reviewed to suggest Derived Consideration Reference Levels ('a band of dose rate within which there is likely to be some chance of deleterious effects of ionising radiation occurring to individuals of that type of reference plant or animal' (see ICRP (2008) for an extended definition)).

A further ICRP report (Publication 114) presenting transfer parameter values for adult life-stages of the RAPs has subsequently been published (ICRP 2009). The equilibrium whole organism concentration ratio ($CR_{wo\text{-}soil}$) approach was used to estimate radionuclide activity concentration in RAPs to enable the subsequent calculation of internal dose rates. The $CR_{wo\text{-}soil}$ is defined as:

$$\mathrm{CR_{wo-soil}} = \frac{\text{Activity concentration in whole organism (Bq kg}^{-1}\text{ fresh mass)}}{\text{Activity concentration in soil (Bq kg}^{-1}\text{ dry mass)}}$$

The $CR_{wo\text{-}soil}$ values for the RAPs were derived from the database described by Copplestone et al. (in-press) which has also been used to derive $CR_{wo\text{-}media}$ values for a forthcoming IAEA handbook presenting radionuclide transfer values for wildlife (Howard et al. 2013; Yankovich et al. in-press).

To derive $CR_{wo\text{-}soil}$ values for the ICRP RAPs only those data specifically for species falling within the taxonomic family at which the RAP was defined were used (see Table 1 for terrestrial RAPs) (ICRP 2009). Data were only available to derive $CR_{wo\text{-}soil}$ for 25 % of the required 546 radionuclide (n=39) - RAP (n=14) combinations (ICRP 2009). For example, data for 10 or fewer elements were available for Reference Deer, Duck and Rat, while there were no data for Reference Bee. To address this lack of data, the ICRP (2009) raised the possibility of identifying a series of terrestrial, marine and freshwater sites from which samples of each RAP (and their different life-stages) could be systematically collected and analysed. These data would then serve as ‘points of reference’. It was also suggested that measurements for individual tissues of interest, notably gonads, should be included within any such sampling and analysis programmes.

Here the sampling of terrestrial RAPs from a forest site, conducted between August 2010 and February 2011, is described. Samples were analysed to determine concentrations of stable elements and gamma-emitting radionuclides.

Materials and Methods

Site description and species sampled

The study site was located in a managed coniferous forestry plantation (*circa* 25 km^2) in north-west England (Ordinance Survey National Grid Reference 3325 4917). The main study site was *circa* 0.4 km^2 in area (Fig. 1). It was largely a mixture of coniferous plantation (largely established 1940-1955) with an understory of predominantly grass and sedge species. On wetter areas, *Molinia caerulea* (Purple moor grass) clumps dominated with some shrubs and small broad leaf trees. Soil types in the area of the plantation where the study site was located are predominantly slowly permeable wet acid upland soils with a peaty surface (Jarvis et al. 1984; National Soil Resources Institute 2013). All samples were collected from this site with the exception of those of *Capreolus capreolus* (Roe deer) which were collected from within the forest at distances of less than 2 km to the north and east of the main study site. All sampling sites are identified on Fig. 1. The site had previously been used to estimate the absorbed dose rates to burrowing mammals from ^{222}Rn and daughter products (Beresford et al. 2012).

It was possible to sample the adult life-stage of species which represent the terrestrial RAPs with the exception of Reference Frog and Duck. The representative species of each terrestrial RAP sampled are given in Table 1.

Sample collection and preparation

The locations of all sampling sites were recorded using a hand held GPS (accuracy approximately 5 m) and are shown on Fig. 1. Information on sample collection methods and sample preparation are given below.

Bees (Bombus spp.)

Bees were collected during August and September 2010 using 30 pan traps (21 cm diameter plastic bowls) which were coloured white, fluorescent yellow or fluorescent blue (see Westphal et al. (2008) for a discussion of this trapping method). Where possible, the traps were located close to flowers of similar colours. Traps were largely located on the ground surface although some were placed on the top of *Molinia caerulea* hummocks or dead tree stumps. The traps were filled with water, to which a small amount of non-perfumed washing-up liquid was added to prevent evaporation, and covered with a wire cage. Traps were emptied every 2-4 days, depending upon weather conditions. After sieving, bee species were separated from other invertebrates, bulked into one sample for each collection day and then freeze dried. The fresh mass (FM) of each of 20 randomly selected individuals were recorded (0.07-0.28 g) along with their body dimensions prior to freeze drying. The ranges in length, width and depth were 0.8-1.8 cm, 0.5-0.8 cm and 0.4-0.8 cm respectively. The species identified were *Bombus lucorum*, *Bombus terrestris* and *Bombus (Psithyrus) vestalis*. Ecologically, these three species are similar, feeding on thistles and brambles (prevalent in the sampling area) although *B. vestalis* parasitises *B. terrestris* nests.

Earthworms (Lumbricidae)

Three composite samples, each containing 11-15 worms belonging to the *Lumbricidae* family, were collected between August and September 2010 by digging to approximately 30 cm. After rinsing in distilled water the worms were placed in aerated containers with damp tissue paper to allow gut evacuation. Subsequently, the fresh mass (0.13-1.90 g) and dimensions (length 6.9-15.2 cm, width 0.1-0.4 cm and depth 0.1-0.5 cm) of 15 randomly selected individuals were recorded prior to freeze drying.

Sitka spruce (Picea sitchensis)

Three, similar sized approximately 15 year old, self-seeded Sitka spruce trees were felled in August 2010. Samples of trunk, branches (up to 1 cm wide) and needles (stripped from along the entire length of a number of branches) were collected from each tree. A sample of immature cones present on one tree only, was also retained. All sample types were air dried at approximately 20^{o}C. The needles and branches were approximately 45% dry mass (DM), the cones 40% DM and the trunk 59% DM. During air drying, immature seeds fell from the cones and these were retained for analysis. To avoid any external contamination which may be present on bark, the samples of trunk submitted for analyses where taken from the heart wood.

Wood mice (Apodemus sylvaticus)

A total of 100 'Longworth' traps were placed, at approximately 10 m intervals, along six sampling transects. As mice prefer to move along linear features, where possible, the traps were positioned along wall lines, beside fallen trees or on tracks to maximise the collection rate. The traps were baited overnight with oats, carrot and insect pupae; grass hay was added as bedding material. Baited traps were left for three days to familiarise animals to them before trapping began. Trapping then took place on six occasions over an eight day period in mid-September 2010. Traps were inspected in the mornings and baited and reset in the early evening.

A total of 10 males and 10 female Wood mice (an omnivorous species) were trapped from within an area of 0.25 km^2 within the main sampling area (see Fig. 1) in mid-September 2010. A number of Bank voles (*Myodes glareolus*) were also trapped; although these do not fall within the definition of the 'Rat' RAP they have been retained frozen for possible subsequent analysis. Any shrews (*Sorex* spp.) which were trapped were released.

The live-mass of 20 Wood mice was measured (12.9-27.5 g) and their dimensions recorded (length (not including tail) 7-10 cm, width 1.8-2.9 cm and depth 1.5-2.5 cm) prior to dissection. They were then skinned and their gastrointestinal tract removed; the pelt comprised 13-23 % of live mass and the gastrointestinal tract (including contents) comprised 15-29 %.. After washing and weighing the carcass (7.4-15.3 g FM), the gonads (male 0.08-1.8 g FM, female 0.06-1.2 g FM), liver (0.3-1.9 g FM), hind-leg (dissected to obtain muscle and bone samples) and a composite sample comprising spleen, kidney and lung (composite sample mass 0.3-0.7 g FM) were removed. All samples were weighed and retained frozen prior to analysis. To obtain estimates of total muscle and bone the carcasses from three individuals were placed in a beetle (*Dermestes maculatus*) colony to clean the bone of all soft tissue. The range in total fresh muscle mass estimated in this manner was approximately 41-59 % of live-mass whilst bone comprised 2-5 %.

Purple moor grass (Molina caerulea)

Three samples of Purple moor grass (a deciduous species) were collected in August 2010 from within the main sampling area (see Fig. 1); they were air-dried at *circa* 20^{o}C for subsequent analysis.

Roe deer (Capreolus capreolus)

Three female Roe deer (two pregnant adults and one juvenile) were shot in February 2011 from three sites within approximately 2 km of the main sampling area as part of the wildlife control programme operating within the forest. After recording their live-mass (13-22 kg) the deer were skinned and had their gastrointestinal tract and internal organs removed, weighed and retained (see Barnett et al. 2013). The carcass was then divided down the spine and all muscle, fat and bone removed from one half of the carcass to estimate the total mass of each of these components for each animal. To clean the bone samples of residual soft tissue they were placed in a beetle (*D. maculatus*) colony. Muscle, bone, liver and ovaries were subsequently analysed (see below); the range in total fresh muscle mass was 36-38 % of live-mass, bone comprised 7-8 %, liver 2-3 % and ovaries 0.004-0.006 %.

Soils

Soil samples (top 10 cm (as specified in ICRP 2009)) were collected in August/September 2010 and February 2011 to correspond with sites from which animal and plants were sampled.

Soils were collected from the location of each Sitka spruce, earthworm and Purple moor grass sample. As the bees were sampled from within the Purple moor grass sampling area, no additional soil samples were collected for them. For the three Wood mice three soil samples were collected along each transect line (sampling sites being at each end and approximate centre of each transect).

Three soil samples were collected in February 2011 from the general vicinity (within approximately 500 m) of where each Roe deer had been shot (Fig. 1) ; sampling sites were selected on the basis of there being evidence of deer activity (signs of grazing, faeces and/or tracks) (Fig. 1). The typical home range of female Roe deer is <0.5 km^2 (Best Practice Guidance 2012).

All soil samples were separated into two sub-samples. One sub-sample was dried at 20^{o}C (for ease of subsequent manual homogenisation and to avoid loss of volatile elements) for ICP-MS analysis; the other at 60^{o}C for gamma analysis.

In February 2011, fresh soil samples were collected (n=25) from across the sampling areas to measure pH.

Sample analyses

Elemental analysis

Concentrations of metals/metalloids were determined by ICP-MS by the Food and Environment Research Agency using methods accredited by the United Kingdom Accreditation Service[1].

Three replicate samples were analysed for each RAP, or RAP tissue if not analysed as the whole organism, as follows: a) Purple moor grass (air-dried) – composite sample of stems and leaves, b) Sitka spruce (air dried) – heartwood, needles, branches, cones and seeds[2] , c) Bees (freeze-dried) – individual animals, d) Earthworms (freeze-dried) – individual animals, e) Wood mice (fresh) – hind-leg muscle, hind-leg bone, liver, testes and composite sample comprising kidney, lung and spleen, and f) Roe deer (fresh) - hind-leg muscle, hind-leg bone, liver and ovaries.

A total of 12 air dried soil samples were also analysed, these comprised: a) one sample corresponding to each Purple moor grass sample (these also coincided with the bee sampling areas), b) three samples associated with the Sitka spruce and earthworm samples, c) one sample for each trapping line from which the three Wood mice analysed were trapped (a composite sample was made from the three individual samples collected along each trapping line), d) one sample associated with each of the Roe deer (the sample for each deer being a composite of three individual samples).

Care was taken to minimise contact with metallic instruments when preparing samples for analysis. Where required, samples were homogenised prior to analysis using ceramic blades or by placing the sample in a sealable plastic bag and then crushing by hand or using a roller pin.

Aliquots of each sample and certified reference materials (selected to be reasonable matrix matches and the widest range of certified and indicative values) were digested in a mixture of nitric acid and hydrochloric acid using quartz high-pressure closed vessels and microwave

[1] See http://www.ukas.org/testing/schedules/Actual/1642Testing%20Single.pdf for full schedule
[2] Only one replicate of both cone and seed were analysed as they were only available from one tree

heating (Perkin Elmer Multiwave). For the analysis of plant and animal materials the following reference materials were used: National Institute of Standards and Technology (NIST) 1547 (peach leaves); NIST 1548s (total diet); NIST 1566b (oyster tissue) and China National Analysis Center for Iron and Steel (NCS) ZC73013 (spinach). For the analysis of soil the following reference materials were used: Community Bureau of Reference (BCR) 141R (calcareous loam soil); BCR 143 (trace elements in a sewage sludge amended soil) and International Atomic Energy Agency (IAEA) soil-7 (soil). Quantification of 60 elements was made using an Agilent 7500ce ICP-MS with collision cell. Reagent blanks and a reagent blank spiked with a known amount of each analyte were analysed with the test samples for recovery estimation purposes. For further quality assurance replicate analyses were conducted on random samples.

Concentrations for 60 elements were reported together with an indication of data quality. The following categorisations were given: a) analysis agreed within ±20% of certified value of average of all controlled reference material (CRM) data (Q±20); b) analysis agreed within ±40% of certified value of average of all controlled reference material data (Q±40); c) analysis was within a factor of two of the average of all CRM data; this was defined as qualitative (QL); d) analysis was outside a factor of two of the average of all CRM data; this was suggested to be unreliable (U); e) if no controlled reference material was available for an element, the estimated concentrations were considered to be qualitative (No CRM). These categorisations are reported with the data in the Tables 2-4.

Gamma analysis

Samples which were sufficiently large were also analysed to determine the activity concentrations of gamma-emitting radionuclides. Sub-samples of air dried Sitka spruce (needles and branches), air dried Purple moor grass and oven dried soil samples were homogenised by grinding to approximately 2 mm. Sitka spruce trunk samples were ashed at 450^{o}C. Fresh samples of Roe deer (muscle and liver) were diced into approximately 3cm chunks and thoroughly mixed; tissues from the Wood mice were too small for analysis. After homogenisation all the samples were weighed into suitably sized containers of *circa* 130 or 700 ml (Dormex Ltd.). Samples were analysed for typically four days on hyper-pure germanium detectors. These were calibrated for efficiency using a certified reference solution (National Physics Laboratory product code: R08-04 'Mixed nuclide standard solution' (see http://www.npl.co.uk/upload/pdf/mixed_nuclide_standard_solutions.pdf)) which covered an energy range of approximately 59-1850 keV. The reference solution was added to materials of various densities (FWHM at 661 keV = 1.41; minimum detectable activity concentration (MDA) of ^{137}Cs approximately 1 Bq kg^{-1}). The resultant spectra were analysed using Canberra Apex-Gamma software and the estimated activity concentrations (and a 2σ counting error) of any identified radionuclides were decay corrected to the day of sampling. Replicate analyses were conducted on random samples and process blanks for quality assurance purposes. The method is accredited by the UK Accreditation Service (methods SOP4504 and SOP4505[3]).

Loss on ignition and pH

Percentage loss on ignition (LOI) was measured by ashing soil samples at 450ºC for 4 h. The method as described by Allen (1989) was used to determine pH (in distilled water) in the 25 fresh soil samples collected in February 2011.

Results

Analytical results

A summary of the data is presented here; all analytical and supporting data are freely available in an accompanying on-line database (Barnett et al. 2013; see also below). Data for individual biota samples are presented in Tables 3-6; the order of individual biota samples is kept consistent within and between the tables (e.g. the second data value for Wood mouse is always for the same animal etc.).

Elemental concentrations

Concentrations in soil

Elemental concentrations in soil samples collected in the vicinity of where the Roe deer were shot were in the range of those determined in samples from the main sampling area from which all other species had been collected. Therefore, for presentation purposes, in Table 2 elemental concentrations in air-dried soil samples have been summarised across all samples; individual sample results are available on-line (Barnett et al. 2013).

[3] See http://www.ukas.org/testing/schedules/Actual/2506Testing%20Single.pdf for full schedule

Most elemental concentrations in soils were above limits of detection (LOD). Exceptions were: Ir, Pt, Re, Ru, Te and W where more than half of the determinations were below the LODs; Pd for which one sample had concentrations below the LOD; and Au which was not detectable in any soil sample. In Table 2 for a given element if any soil sample had concentrations below the LOD only the range is presented (i.e. no mean is calculated).

Replicate samples were analysed for all ‘Roe deer’ soil samples as part of the laboratory control procedures. There was good agreement between the replicates with typically <10% difference between the minimum and maximum values.

Concentrations in RAP samples

Concentrations of stable elements in RAP samples are presented in Table 3 on a fresh mass basis; where required these concentrations have been estimated from dry mass concentrations using information recorded during sample preparation. All subsequent discussion of concentrations refers to fresh mass values. Detectable concentrations were determined for 37 of the 60 stable elements for all sample types; the remaining elements were only detectable in some sample types. As for soil, concentrations of Au were below the LOD (<0.004 - <0.05 mg kg^{-1} FM) in all sample types (Au is not included in Table 3).

For Wood mice and Roe deer whole body concentrations were determined assuming that the tissue analysed (liver, bone, muscle and gonad for both species and in addition, for Wood mice, a composite sample comprising kidney, lung and spleen) represented the whole animal (i.e. the total elemental concentration in each of the tissues was combined to estimate the total element in the whole body which was divided by the total mass of the sampled tissues to derive a whole body concentration estimate). Concentrations in individual tissues can be found in Barnett et al. (2013).

In some instances, an element was not detectable in all of the tissues for a given animal. Where this was the case the LOD value was used to estimate the total element content for that tissue. If the contribution to the total body content of an element was estimated to be ≥10% from tissues which had concentrations below the LOD then the whole body concentration is reported in Table 3 as a ‘less than’ value. Where the contribution from tissues for which concentrations were below the LOD constituted <10% of the body burden then the estimated whole body concentration was assumed to be a reasonable approximation and the value in Table 3 is not reported as a ‘less than’ but is instead identified in italic text (38 individual whole body elemental concentrations for Wood mice and 34 for Roe deer were estimated in this way). This approach will add little to the overall uncertainty involved in estimating transfer to wildlife.

Table 4 presents concentrations determined in reproductive organs of the three male Wood mice and the three female Roe deer. Of those elements detectable in reproductive organs the only noticeable differences to whole body concentrations were for the bone seeking elements Ca, Sr and Ba which were all more than two orders magnitude lower in the gonads than in the whole body.

Values in Table 3 for Purple moor grass and Sitka spruce trunk each represent the mean of three replicate analyses. In a few instances some replicates had concentrations below the LOD, the results for these samples are reported in Table 3 as a 'less than' values (individual replicate values can be found in Barnett et al. (2013)). For most elements there was good agreement between replicates (the range between the minimum and maximum concentrations being less than a factor of three) for all elements except Yb and Dy. However, for one Sitka spruce trunk sample variation between the three replicates was *circa* an order of magnitude or more for Co, Cr, Fe, Mo, Ni and Sn; in Table 3 this sample appears as the second result for each element for Sitka spruce.

For Sitka spruce Table 3 presents results for trunk only (which is the ICRP geometry for Reference Pine tree (ICRP 2008)). For most elements concentrations within the trunk were within an order of magnitude of those in needles and branches. The only exceptions were Al, La and Nd for which concentrations were consistently 10 times higher in needles than in trunk. Concentrations in the cones and seeds available from the one tree from which they could be sampled (for reference results for this tree are shown as the third data line for Sitka spruce in the Table 3) were generally similar to each other. Compared to trunk, concentrations in seeds were more than an order of magnitude higher for Al, Mg, Zn, Cu, Rb, Cs and Ta, whilst they were an order of magnitude lower for Ti, Cr, Sr, Pd, Ba, Eu and W. For the cone sample Ni, Rb and Cs concentrations were more than an order of magnitude higher than in trunk, whereas, concentration of Ti, Sr, Pd, Ag, Ba, Eu and W were more than an order of magnitude lower. Results for all tree parts are available on-line (Barnett et al. 2013).

<u>Gamma emitting radionuclides</u>

Caesium-137 and ^{238}U and ^{232}Th series decay products were detectable in some soil samples, whilst ^{40}K was detectable in all soil samples. Potassium-40 and ^{137}Cs were routinely measured in the Purple moor grass, Sitka spruce trunk and Roe deer muscle samples, with ^{7}Be often being determined in the tree and grass samples. Table 5 presents data for these three isotopes in biota and associated soil samples. In a number of soil samples ^{7}Be was undetectable and reported with high MDA values because of the delay between sampling and analyses and the comparatively short physical half live of ^{7}Be (*circa* 53 d). Consequently, ^{7}Be activity concentrations for soil samples are not presented in Table 5; where detectable (n=4 soils) ^{7}Be activity concentrations ranged from 13-51 Bq kg^{-1} DM.

<u>Soil loss on ignition and pH</u>

The geometric mean percentage LOI determined from all individual soil samples was 33 % (range 7 to 87 %). The range in soil pH measurements was 3.9-8.1 with a geometric mean of 5.5.

<u>On-line dataset</u>

Within this paper individual results for metal/metalloid concentrations estimated for whole organism biota samples are presented and results for other sample types and determinants are summarised. All underlying data from the study are given on-line (Barnett et al. 2013) including: ICP-MS results for all individual animal tissue samples and plant parts; all soil samples and QA replicates; complete gamma-spectroscopy results; organism and tissue mass and dimensions where available; soil pH and LOI; and individual sample information (e.g. collection date and co-ordinates, percentage dry matter etc. as appropriate to sample type and processing). Subsamples of RAP samples were also analysed to determine their C and N concentrations; these are not reported here but are available from Barnett et al. (2013).

Concentration Ratios

Elemental concentration ratios

Concentration ratios ($CR_{wo\text{-}soil}$; see Eq. 1) are presented in Table 6 for 59 stable elements for the six RAPs. For each organism the most appropriate soil sample (individual or bulk) was used to calculate each $CR_{wo\text{-}soil}$ (see above). For example, to calculate the $CR_{wo\text{-}soil}$ for each of the Roe deer the average of all three soil samples collected in the vicinity of where each individual was shot was used; for Wood mouse the average of all nine soil samples collected from each of the three trapping lines where the mice were trapped was used, whereas, for each Purple moor grass sample an individual soil sample was used. Details of which soil sample(s) were used to calculate each $CR_{wo\text{-}soil}$ are given in Barnett et al. (2013). Where a $CR_{wo\text{-}soil}$ is presented as a 'less than' value the concentration in soil sample was above the LOD whilst that in the RAP sample was below the LOD. No $CR_{wo\text{-}soil}$ values were estimated if the concentration in soil was below the LOD. Gold is not included in Table 6 as all samples of soil and biota were below the limits of detection.

The $CR_{wo\text{-}soil}$ values for the two mammal species were similar for the majority of elements. However, for Ba the $CR_{wo\text{-}soil}$ for Roe deer was approximately an order of magnitude higher than that estimated for Wood mouse. This is the consequence of higher concentrations in Roe deer bone (*c*. 160 mg kg^{-1} FM) than those in Wood mouse bone (10-40 mg kg^{-1} FM). Whole organism concentration ratios for the other Group 2 alkaline earth metals, Sr, Ca and Mg were also lower for Wood mouse than for Roe deer although not to the same degree as those for Ba (Table 6). The Rb $CR_{wo\text{-}soil}$ for Wood mouse was approaching an order of magnitude higher than that for Roe deer due to consistently higher Rb concentrations in all tissues of Wood mice compared with those of Roe deer. Whole organism concentration ratios for Cs were also lower for Roe deer than those for Wood mice although not to the same extent as for Rb. Conversely, $CR_{wo\text{-}soil}$ values for other alkali metals (K, Li and Na) were similar for the two species.

As for mammals, $CR_{wo\text{-}soil}$ values for the two plant RAPs were also generally similar, although, values for Purple moor grass were *circa* two orders of magnitude higher than those for Sitka spruce trunk for Mg, Ti and Rb. Conversely, the Ag $CR_{wo\text{-}soil}$ value for Sitka spruce trunk was *circa* one order of magnitude higher than that for Purple moor grass.

Radionuclide concentration ratios

For those RAPs in which ^{137}Cs was detectable $CR_{wo\text{-}soil}$ values have been estimated (Table 7); although $CR_{wo\text{-}soil}$ values are not normally estimated for ^{40}K (see ICRP 2009) it was done here for comparative purposes. Whereas stable element $CR_{wo\text{-}soil}$ values for Roe deer were calculated from whole body concentrations those for radionuclides have been calculated using the concentration in muscle. As the two elements considered are relatively homogenously distributed throughout the body (Yankovich et al. 2010) this assumption will add little uncertainty to the comparison. For caesium many of the entries in existing databases (e.g. Beresford et al. 2008a, Yankovich et al. in-press) assume that the muscle concentration is equivalent to that in the whole body.

Discussion

The study described here significantly enhances the availability of $CR_{wo\text{-}soil}$ values for terrestrial RAPs, presenting data for 24 of the 39 elements considered by the ICRP (2009). Because of lack of data, the ICRP (2009) were only able to give $CR_{wo\text{-}soil}$ values derived from field measurements for: 16 elements for Reference Wild grass (*Poaceae)*; 15 for Pine tree (*Pinaceae)*; 17 for Earthworm (*Lumbricidae)*; ten for Rat (*Muridae)*; four for Deer (*Cervidae)* and none for Bee (*Apidea)*. Given the limitations of the data presented by the ICRP (2009) only 43 comparisons are possible between the ICRP recommended $CR_{wo\text{-}soil}$ values and those presented here (Figs. 2-6; note the figures do not present comparisons where the measured data were below the MDA). The tables clearly give an indication of data quality for each element-sample type (see above). There are a few instances where results for appropriate controlled reference materials differed by more than 40% from the certified value (these are designated QL and U in the Tables 2-4). We have used these data to generate $CR_{wo\text{-}soil}$ values given: (i) the overall uncertainty in estimating transfer to wildlife is greater than the uncertainty on these results (e.g. see Beresford et al. 2008b); and (ii) the general paucity of data for the RAPs. However, users of the $CR_{wo\text{-}soil}$ values presented here may want to consider the data quality before applying them.

Below, we highlight and discuss where there is *circa* an order of magnitude or more difference between the values presented here and those recommended by ICRP (2009).

The data presented here, derived from ICP-MS measurements, are *circa* an order of magnitude, or more, lower than the value recommended in ICRP (2009) based upon available data for 19 RAP-element combinations, namely:

- Wild grass - Cd, Cs, Ni, Pb, Sb, Se, Sr, Th, U, Zn (Fig. 2)
- Pine tree - Cs, La, Pb (Fig. 3)
- Rat - Co, Cs, Sr (Fig. 4)
- Deer - Cs (Fig. 5)

Whilst some $CR_{wo\text{-}soil}$ values presented in Table 6 were higher than those recommended in ICRP (2009), only those for Ce, Nb and Sr for Earthworm were *circa* an order of magnitude or more higher (Fig. 6).

Where useful comment can be made, potential reasons for the observed differences between the recommended values of ICRP and those presented here are discussed in the sub-sections below. There is no sub-section for Deer (Fig. 5); results for stable and radioactive Cs for all organisms are discussed in a separate section. The reader should note that the recommended ICRP values are geometric means (when the ICRP data base had three or more values). Wood et al. (in-press) have recently demonstrated that the approach used to derive geometric statistics within the database (Copplestone et al. in-press) used to derive the ICRP values, tends to over-estimate (by up to a factor of three for the examples investigated).

Wild grass

For wild grass the difference between the ICRP recommended $CR_{wo\text{-}soil}$ value for Sb and the values reported here is approximately four orders of magnitude (Fig. 2). However, the original reference used by ICRP (2009) considers an operating nuclear fuel reprocessing plant (Ghuman et al. 1993) and the source of ^{125}Sb in plant samples appears to be predominantly aerial deposition. The appropriateness of data from this reference for inclusion in compilations of 'equilibrium' $CR_{wo\text{-}soil}$ values has previously been questioned by Brown et al. (in-press).

Adherent soil can contribute significant proportions of the radionuclide/elemental concentrations of sampled herbage. For elements with comparatively low root uptake adhered soils can be the dominate source of the element in plant samples as measured if there is no pre-treatment to remove soil (Beresford and Howard 1991, Hinton, 1992). However, the Purple moor grass sampled had comparatively low concentrations of Ti (Table 3), which is a common soil marker (Beresford and Howard 1991), suggesting little adherent soil contaminating the samples. Little adherent soil in the Purple moor grass samples may contribute to apparent comparatively low $CR_{wo\text{-}soil}$ values for some of the elements reported here (e.g. Cd, Pb, U and Th (see Fig. 2)). The low adherent soil content of the Purple moor grass samples is likely to be due to the grass sampled being relatively tall, with leaf lengths of *circa* 60 cm, combined with the fact that they were growing on an organic soil (>60% organic matter).

The majority of data used by ICRP for the Wild Grass $CR_{wo\text{-}soil}$ value for Ni, originates from a long-term study with soils to which ^{63}Ni had been added (Mascanzoni 1989). The $CR_{wo\text{-}soil}$ values from Mascanzoni as used within the ICRP review are based on dry matter plant concentrations which would explain most of the difference between the ICRP value and that derived here.

Pine tree

For Pine tree (Fig. 3), data in ICRP (2009) for La and Pb both originated from single studies with little replication. Therefore, it is difficult to draw any meaningful conclusions on the difference between values in ICRP (2009) and those in Table 6. The ICRP geometry for Pine tree equates to the trunk (ICRP 2008) and hence only results for trunk are presented in this paper. However, data are more often available in the literature for plant parts other than trunk and these are used in existing CR databases (e.g. Beresford et al. 2008a; ICRP 2009; IAEA in-press). Concentrations in needles and branches are presented in Barnett et al. (2013) for individual Sitka spruce trees as are those in trunk. Concentrations in branches were generally similar to those in trunk (i.e. within an order of magnitude). Concentrations in needles were higher than those in trunk samples for approximately half of the elements considered in this paper. Notably, concentrations of Al, La and Nd were more than an order of magnitude higher in needles than trunk for all three samples. Because concentrations of a number of elements are below the LOD for trunk but are measurable in needles it is not possible to comment on the magnitude of difference for many elements. For radionuclides of most elements considered here the sampling and analyses of needles should give conservative or similar estimates of transfer (and subsequently risk) to Pine tree compared to estimates if the trunk were sampled. This is in general agreement with the observations of Yoshida et al. (2011) for *Pinus sylvestris*.

Rat

The Co $CR_{wo\text{-}soil}$ values for Rat used in ICRP (2009) originate from a study of ^{60}Co on the Enewetak Atoll (Marshall Islands) conducted 9-15 years after the last nuclear bomb test (Bastian and Jackson 1975). This was a unique ecosystem and source-term combination which may contribute to the $CR_{wo\text{-}soil}$ values being 1-3 orders to magnitude higher than those estimated here (Fig. 4). Furthermore, the data of Bastian and Jackson had to be manipulated from tissue-specific activity concentrations to generate whole body concentrations for the database underpinning ICRP (2009) (Beresford et al. 2008a) which may have introduced some uncertainty into the estimated $CR_{wo\text{-}soil}$. However, the Co $CR_{wo\text{-}soil}$ values reported in

Table 6 for Rat are similar to those estimated for owls in the United Kingdom from stable element measurements (Barnett et al. 2011).

All of the Sr $CR_{wo\text{-}soil}$ data used to derive the recommended value in ICRP (2009) for Rat originated from observations of ^{90}Sr within the Chernobyl Exclusion Zone. The Chernobyl studies used live-monitoring (Bondarkov et al. 2011) and hence whole body activity concentrations would have included contributions from ^{90}Sr in the gastrointestinal tract. Although the values reported here for Sr are one to two orders of magnitude lower than that in ICRP (2009) they are within the range of ^{90}Sr $CR_{wo\text{-}soil}$ values for omnivorous mammals in the database described by Copplestone et al. (in-press) which underlies the ICRP collation.

Earthworm

Data for Ce, Sr and Nb in ICRP (2009) for earthworms (Fig. 6) are for single values from the laboratory study of Yoshida et al. (2005). These appear to have been included in error as ICRP (2009) states laboratory data were not included in the derivation of $CR_{wo\text{-}soil}$ values presented for RAPs (note this reference is cited for additional elements in ICRP 2009).

Bee

Subsequent to the publication of ICRP (2009), $CR_{wo\text{-}soil}$ values for ‘honey bees’ have become available from a study conducted in Canada (Sheppard (personal communication) based on data reported in Sheppard et al. (2010)). The data of Sheppard are from measurements of stable element concentrations and the $CR_{wo\text{-}soil}$ values for each element are the average of two samples. Data are available from the Canadian study for 38 of the elements reported here. The majority of $CR_{wo\text{-}soil}$ values are similar (within an order of magnitude) between the two studies. The only exceptions are: the $CR_{wo\text{-}soil}$ values for Mn reported in Table 6 which are approximately 20-times higher than the value of Sheppard and; the $CR_{wo\text{-}soil}$ values for Pb and Sn which are at least one to two orders of magnitude lower than those of Sheppard. Because of the paucity of data for this organism it is not possible to suggest reasons for these few differences.

Stable Cs compared with ^{137}Cs

Whilst, the $CR_{wo\text{-}soil}$ values for stable Cs in Table 6 are considerably lower in all cases than those reported in ICRP (2009), $CR_{wo\text{-}soil}$ values for ^{137}Cs (Table 7) are more similar (^{137}Cs

$CR_{wo\text{-}soil}$ values are presented in Figs. 2, 3 and 5 for comparison). Radiocaesium in the study area will have originated from aerial deposition following the 1986 Chernobyl accident, above ground weapons tests (predominantly late 1950's to early 1960's) and the 1957 Windscale accident (Wright et al. 2003) whereas stable caesium will largely originate from parent rocks. Table 7 also presents estimated $CR_{wo\text{-}soil}$ values for ^{40}K, these are comparable to those derived for stable potassium. In the case of potassium, unlike caesium, the stable and radioisotope are likely to have originated from the same source. Sheppard (in-press)[4] also reports lower $CR_{wo\text{-}soil}$ values than those recommended in ICRP (2009) for Deer estimated from stable element concentrations for a number of elements including Cs. Sheppard suggests that the bioavailability of 'indigenous' (i.e. stable) elements is likely to be lower than that of radioisotopes deposited from atmospheric bomb tests and/or accidental releases. For terrestrial RAPs, data used in ICRP (2009) largely originate from studies of ^{137}Cs from the Chernobyl accident and weapons fallout.

ICP analyses, and neutron activation, are increasingly being used to provide wildlife $CR_{wo\text{-}soil}$ values for a large number of elements from the same samples (e.g. Beresford 2010; Higley 2010; Tagami and Uchida 2010; Takata et al. 2010; Sheppard in-press). Such analyses are a cost effective way of addressing the need for data. However, there needs to be some consideration of the appropriateness of applying stable element data to estimate radionuclide transfer for different types of assessment. This is probably especially true of the terrestrial environment where the source of radionuclides and stable elements may differ. Initial analyses of the database (Copplestone et al. in-press) underlying the ICRP (2009) recommendations by Beresford et al. (2013) and Wood et al. (in-press) have demonstrated differences between stable and radioisotope $CR_{wo\text{-}media}$ values although the authors note that there may be a variety of reasons for these observations (e.g. geographical bias in the data).

Conclusions

This study has improved the availability of $CR_{wo\text{-}soil}$ values for RAP-radionuclide combinations for which there are currently few, or no, data. Even where concentrations are

[4] Sheppard reports muscle to soil CR values for Whitetailed deer (*Odocoileus virginianus*), however, CR for muscle for Cs is generally taken to approximate to that for the whole body (Yankovich et al. 2010).

reported to be below detection limits the resultant $CR_{wo-soil}$ values (Table 6) are useful in setting benchmark $CR_{wo-soil}$ values for the RAPs in the absence of any other data. To our knowledge this is the first completed study responding to the ICRP's (2009) suggestion that RAPs be sampled from single sites to help address the current lack of data.

The $CR_{wo-soil}$ values derived from this work will be determined by the characteristics of the sampling site. How such site specific 'reference' data will be utilised within the ICRP's framework requires further elaboration and we understand that the ICRP are in the process of doing this. Beresford et al. (2013) suggest an alternative approach to the CR using a residual maximum likelihood mixed model regression to derive relative values for different taxonomic groups taking into account inter-site variation. They hypothesise that the radionuclide activity concentration in a given species could be estimated from the known concentration in a different species removing the need to base predictions on media concentrations and the consequent effect of site-specific factors such as soil or water chemistry.

This study highlights the need to evaluate the applicability of stable element data to radiological assessments which is likely to depend upon ecosystem, element and radionuclide source term (e.g. deep repository versus aerial discharge).

The site used here could, with appropriate permissions and revisiting at the correct times of year, provide data for species of Reference Frog (including the different life-stages) and possibly also Reference Duck. Furthermore, additional samples to those analysed and reported here were archived. These include additional samples of many RAPs, tissues other than though analysed for Deer (e.g. foetuses, thyroid, etc.), and non-target species such as *Myodes glareolus* (Bank vole) and various invertebrates (collected in the bee sampling pots). These could be analysed to provide further data on the elements considered here or for additional analytes.

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Mice (and voles) were euthanised immediately upon being found using the appropriate humane method given in Schedule 1 of the Animals (Scientific Procedures) Act (1986) (UK Parliament 1994). As noted above, any shrews caught were released and trapping was conducted in accordance with Natural England general licence WML-GL01 (Natural England 2012). Deer samples were obtained via a culling scheme operated by the site owner (animals were shot by marksmen).

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Table 1. Terrestrial Reference Animals and Plants (RAP; as defined in ICRP (2008)) and the species sampled during this study.

RAP	Family	Family/species sampled
Bee	*Apidea*	*Bombus spp.(Bumblebees)*
Deer	*Cervidae*	*Capreolus capreolus (Roe deer)*
Duck	*Anatidae*	Not sampled
Earthworm	*Lumbricidae*	*Lumbricidae*
Frog	*Ranidae*	Not sampled
Pine Tree	*Pinaceae*	*Picea sitchensis* (Sitka spruce)
Rat	*Muridae*	*Apodemus sylvaticus* (Wood mouse)
Wild Grass	*Poaceae*	*Molinia caerulea* (Purple moor grass)

Table 2. Arithmetic means and (ranges) in stable element concentrations measured in soil.

Element	Data quality#	Concentration in soil (mg kg^{-1} (dry mass))	Element	Data quality#	Concentration in soil (mg kg^{-1} (dry mass))
Li	Q±40	$2.5x10^{1}$ $(0.4-4.8)x10^{1}$	**Sb**	U	$5.8x10^{-1}$ 0.2-1.8
Be	Q±20	$9.5x10^{-1}$ 0.4-1.5	**Te**	No CRM	$(<0.3-1.3)x10^{-1}$
B	Q±20	$1.4x10^{1}$ $(0.7-2.0)x10^{1}$	**Cs**	Q±20	2.9 0.6-3.6
Na	Q±40	$2.8x10^{3}$ $(2.0-5.8)x10^{3}$	**Ba**	QL	$1.4x10^{2}$ $(0.9-1.7)x10^{2}$
Mg	Q±20	$6.7x10^{3}$ $(0.2-1.5)x10^{4}$	**La**	Q±20	$2.4x10^{1}$ $(1.2-3.2)x10^{1}$
Al	Q±40	$4.2x10^{4}$ $(1.3-5.6)x10^{4}$	**Ce**	Q±20	$5.9x10^{1}$ $(0.2-1.0)x10^{2}$
K	Q±40	$3.3x10^{4}$ $(0.6-4.8)x10^{4}$	**Pr**	Q±20	5.4 2.7-7.7
Ca	Q±40	$3.3x10^{3}$ $(0.1-1.2)x10^{4}$	**Nd**	Q±20	$2.1x10^{1}$ $(1.1-3.0)x10^{1}$
Ti	U	$1.5x10^{2}$ $(0.8-2.3)x10^{2}$	**Sm**	Q±40	3.6 1.8-5.1
V	Q±20	$6.5x10^{1}$ $(3.6-8.2)x10^{1}$	**Eu**	Q±20	$7.2x10^{-1}$ 0.3-1.1
Cr	Q±20	$6.2x10^{1}$ $(1.5-8.8)x10^{1}$	**Gd**	Q±20	3.3 1.5-4.6
Mn	Q±20	$7.4x10^{2}$ $(0.1-1.4)x10^{3}$	**Tb**	Q±20	$4.0x10^{-1}$ $(1.8-5.7)x10^{-1}$
Fe	Q±20	$3.4x10^{4}$ $(1.2-4.5)x10^{4}$	**Dy**	Q±40	2.1 1.0-3.0
Co	Q±20	9.2 $(0.3-1.9)x10^{1}$	**Ho**	Q±40	$3.6x10^{-1}$ $(1.7-5.2)x10^{-1}$
Ni	Q±20	$3.1x10^{1}$ $(1.2-7.7)x10^{1}$	**Er**	Q±20	$9.9x10^{-1}$ 0.5-1.4
Cu	Q±20	$2.6x10^{1}$ $(1.6-5.1)x10^{1}$	**Tm**	Q±40	$1.3x10^{-1}$ $(0.6-1.7)x10^{-1}$
Zn	Q±20	$8.0x10^{1}$ $(0.5-1.3)x10^{2}$	**Yb**	QL	$7.7x10^{-1}$ 0.4-1.0
As	Q±20	$3.3x10^{1}$ $(0.9-8.7)x10^{1}$	**Lu**	QL	$1.1x10^{-1}$ $(0.5-1.4)x10^{-1}$
Se	Q±20	2.1 0.4-4.6	**Hf**	U	$3.2x10^{-1}$ $(0.9-4.8)x10^{-1}$
Rb	Q±40	$6.1x10^{1}$ $(0.1-1.1)x10^{2}$	**Ta**	U	$2.2x10^{-2}$ $(1.0-8.0)x10^{-2}$
Sr	Q±20	$2.0x10^{1}$ $(0.9-5.7)x10^{1}$	**W**	No CRM	$(<0.1-2.5)x10^{-1}$
Y	Q±40	9.6 $(0.4-1.6)x10^{1}$	**Re**	No CRM	$<3.0x10^{-2+}$
Zr	U	$1.3x10^{1}$ $(0.3-1.9)x10^{1}$	**Ir**	No CRM	$<6.0x10^{-3+}$
Nb	U	$6.9x10^{-2}$ $(0.2-1.3)x10^{-1}$	**Pt**	No CRM	$(<0.6-4.1)x10^{-2}$
Mo	QL	1.0 0.3-3.0	**Au**	No CRM	$<3.0x10^{-2}$
Ru	No CRM	$<1.6x10^{-2+}$	**Hg**	Q±40	$2.4x10^{-1}$ $(0.4-5.0)x10^{-1}$
Pd	No CRM	$(<1.7-4.1)x10^{-1}$	**Tl**	Q±20	$6.2x10^{-1}$ $(2.7-8.6)x10^{-1}$

Element	**Data quality#**	**Concentration in soil (mg kg^{-1} (dry mass))**	**Element**	**Data quality#**	**Concentration in soil (mg kg^{-1} (dry mass))**
Ag	No CRM	2.6x10^{-1} (0.7-2-6.6)x10^{-1}	**Pb**	Q±20	2.4x10^{2} (0.3-6.7)x10^{2}
Cd	Q±20	5.5x10^{-1} 0.2-2.1	**Th**	Q±20	4.8 0.9-6.8
Sn	No CRM	7.7 (0.1-1.6)x10^{1}	**U**	QL	9.5x10^{-1} 0.6-1.2

#An indication of the data quality for each element is presented: if the analysis of the controlled reference material (CRM) was within ±20% of the certified value the data quality is defined as Q±20; if it was within ±40% it is defined as Q±40; if it is within factor of two it is defined as QL (qualitative); if it is outside a factor of two it is defined as U and suggested to be unreliable; if no CRM was available it is defined No CRM and should be considered to be qualitative (see also text). +Highest limit of detection (LOD) presented, some samples had measurable concentrations for these elements but the values were in the range of reported LOD for other samples. < denotes the minimum detectable activity concentration (MDA).

Table 3. Stable element concentrations (mg kg^{-1} (fresh mass)) measured in [RAP] species.

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Li	Q±20	<1.2x10^{-2} <1.4x10^{-2} <1.2x10^{-2}	<4.9x10^{-2} *4.4x10^{-2}* *3.6x10^{-2}*	<3.0x10^{-2} <1.8x10^{-2} <3.5x10^{-2}	5.8x10^{-1} 1.8x10^{-1} 2.8x10^{-1}	5.0x10^{-3} 5.6x10^{-3} 4.7x10^{-3}	<8.8x10^{-3} <5.6x10^{-3} <5.8x10^{-3}
Be	Q±20	<1.6x10^{-3} <2.5x10^{-3} <1.6x10^{-3}	<8.4x10^{-4} <8.3x10^{-4} <9.4x10^{-4}	<5.6x10^{-3} <3.3x10^{-3} <6.6x10^{-3}	1.8x10^{-2} 4.3x10^{-3} 8.2x10^{-3}	<5.5x10^{-4} <5.5x10^{-4} <5.3x10^{-4}	<1.4x10^{-3} <1.1x10^{-3} <1.1x10^{-3}
B	Q±40	*3.6* <1.0 *3.1*	7.1x10^{-1} *5.2x10^{-1}* 7.9x10^{-1}	4.8 4.7 5.5	3.9x10^{-1} 1.4x10^{-1} 2.6x10^{-1}	1.7 3.0 2.8	1.5 1.3 1.4
Na	Q±20	1.1x10^{3} 1.4x10^{3} 1.1x10^{3}	1.5x10^{3} 1.4x10^{3} 1.5x10^{3}	2.3x10^{2} 3.0x10^{2} 3.6x10^{2}	6.7x10^{2} 8.9x10^{2} 5.7x10^{2}	3.9x10^{2} 2.5x10^{2} 2.9x10^{2}	6.1 <3.9 2.3
Mg	Q±20	3.8x10^{2} 4.6x10^{2} 3.4x10^{2}	8.7x10^{2} 7.8x10^{2} 1.0x10^{3}	3.5x10^{2} 2.1x10^{2} 3.1x10^{2}	2.7x10^{2} 1.2x10^{2} 1.9x10^{2}	4.3x10^{2} 3.4x10^{2} 3.2x10^{2}	4.4x10^{1} 4.5x10^{1} 3.3x10^{1}
Al	Q±20	*5.9* *3.6* <8.6x10^{-1}	*1.5* <8.5x10^{-1} <1.7	7.6 <1.7 <3.5	6.5x10^{2} 1.2x10^{2} 3.1x10^{2}	3.3 2.0 1.9	1.3 7.8x10^{-1} 8.4x10^{-1}
K	Q±20	3.1x10^{3} 4.1x10^{3} 3.2x10^{3}	3.1x10^{3} 2.8x10^{3} 2.8x10^{3}	2.8x10^{3} 2.0x10^{3} 3.2x10^{3}	1.6x10^{3} 1.2x10^{3} 1.5x10^{3}	3.5x10^{3} 2.4x10^{3} 2.4x10^{3}	3.1x10^{2} 2.5x10^{2} 3.0x10^{2}
Ca	Q±20	1.5x10^{4} 1.4x10^{4} 1.4x10^{4}	4.2x10^{4} 3.7x10^{4} 4.4x10^{4}	4.2x10^{2} 2.8x10^{2} 4.9x10^{2}	6.2x10^{2} 3.6x10^{2} 6.0x10^{2}	7.8x10^{2} 9.5x10^{2} 8.9x10^{2}	2.6x10^{2} 3.7x10^{2} 2.3x10^{2}

Element	**Data quality[#]**	**[Rat] Wood mouse (whole body)**	**[Deer] Roe deer (whole body)**	**[Bee] *Bombus spp.* (whole body)**	**[Earthworm] *Lumbricidae* (whole body)**	**[Wild grass] Purple moor grass (leaf)**	**[Pine Tree] Sitka spruce (trunk)**
Ti	Q±40	*8.3x10^{-1}* <6.8x10^{-1} <1.8x10^{-1}	*5.2x10^{-1}* <4.5x10^{-1} <4.4x10^{-1}	4.8 4.9x10^{-1} <7.5x10^{-1}	6.1 1.8 5.0	6.8x10^{-1} 5.6x10^{-1} 5.6x10^{-1}	1.3x10^{1} 9.7x10^{-1} 9.1x10^{-1}
V	Q±20	<3.9x10^{-2} <6.6x10^{-2} <3.9x10^{-2}	<3.0x10^{-2} <2.3x10^{-2} <2.3x10^{-2}	<1.4x10^{-1} <8.5x10^{-2} <1.7x10^{-1}	8.6x10^{-1} 1.7x10^{-1} 5.8x10^{-1}	<1.3x10^{-2} <1.3x10^{-2} <1.3x10^{-2}	<3.4x10^{-2} <4.5x10^{-2} <2.6x10^{-2}
Cr	Q±20	<7.8x10^{-2} *1.7x10^{-1}* *1.4x10^{-1}*	<4.9x10^{-2} <1.6x10^{-2} *1.1x10^{-1}*	<5.5x10^{-2} <3.3x10^{-2} <6.4x10^{-2}	1.0 2.1x10^{-1} 5.1x10^{-1}	1.9x10^{-2} 1.3x10^{-2} 1.4x10^{-2}	4.7x10^{-1} 8.3x10^{-1} 9.1x10^{-2}
Mn	Q±20	<2.0 <2.9 <2.0	<1.3 <1.4 <1.3	1.6x10^{2} 8.3x10^{1} 1.0x10^{2}	1.6x10^{1} 7.2 2.1x10^{1}	1.6x10^{2} 1.2x10^{2} 1.2x10^{2}	3.7x10^{1} 5.7x10^{1} 3.5x10^{1}
Fe	Q±20	5.1x10^{1} 6.3x10^{1} 5.0x10^{1}	2.5x10^{1} 4.5x10^{1} 3.4x10^{1}	6.7x10^{1} 5.0x10^{1} 5.7x10^{1}	5.7x10^{2} 1.0x10^{2} 2.9x10^{2}	1.8x10^{1} 1.3x10^{1} 1.3x10^{1}	4.1x10^{2} 8.9x10^{2} 4.0x10^{1}
Co	Q±20	1.1x10^{-2} 1.4x10^{-2} <1.2x10^{-2}	6.7x10^{-3} 6.7x10^{-3} *6.5x10^{-3}*	2.7x10^{-1} 3.3x10^{-2} <1.2x10^{-2}	5.9x10^{-1} 2.3x10^{-1} 3.5x10^{-1}	8.7x10^{-3} 3.7x10^{-3} 3.6x10^{-3}	3.1x10^{-2} 4.7x10^{-2} 8.1x10^{-3}
Ni	Q±20	<2.7x10^{-2} *1.5x10^{-1}* 4.8x10^{-2}	<3.0x10^{-1} *8.4x10^{-1}* 2.9x10^{-1}	<9.2x10^{-2} 1.7x10^{-1} <1.1x10^{-1}	7.9x10^{-1} 1.8x10^{-1} 3.8x10^{-1}	1.8x10^{-1} 8.7x10^{-2} 8.8x10^{-2}	1.5x10^{-1} 2.4x10^{-1} 2.8x10^{-2}
Cu	Q±20	2.3 2.9 2.3	2.5 4.0 3.0	3.0x10^{1} 1.7x10^{1} 1.5x10^{1}	1.4 1.3 1.9	1.9 1.3 1.3	6.0x10^{-1} 5.1x10^{-1} 4.0x10^{-1}
Zn	Q±20	2.7x10^{1} 2.7x10^{1} 2.6x10^{1}	4.7x10^{1} 2.7x10^{1} 2.7x10^{1}	5.7x10^{1} 2.3x10^{1} 3.4x10^{1}	6.0x10^{1} 8.9x10^{1} 4.8x10^{1}	1.1x10^{1} 8.5 8.8	6.1 4.4 2.4

Element	Data quality$^{\#}$	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
As	Q±20	<7.0x10^{-3} <6.2x10^{-3} <3.5x10^{-3}	<1.3x10^{-3} *1.3x10^{-2}* *4.5x10^{-3}*	1.5x10^{-1} 3.2x10^{-2} 3.2x10^{-2}	7.2x10^{-1} 2.1x10^{-1} 7.3x10^{-1}	2.0x10^{-2} 1.5x10^{-2} 1.4x10^{-2}	2.8x10^{-2} <7.8x10^{-2} <3.2x10^{-3}
Se	Q±20	2.8x10^{-1} 3.4x10^{-1} 3.9x10^{-1}	9.5x10^{-2} 2.4x10^{-1} 1.2x10^{-1}	4.8x10^{-2} 3.9x10^{-2} 8.0x10^{-2}	3.2 1.8 3.2	1.4x10^{-2} 9.6x10^{-3} 1.0x10^{-2}	<6.1x10^{-3} <4.5x10^{-3} <4.7x10^{-3}
Rb	Q±20	1.2x10^{1} 2.1x10^{1} 1.7x10^{1}	1.6 3.2 2.3	1.1 2.1 1.9	1.3 7.7x10^{-1} 1.2	7.2 6.2 6.3	1.5x10^{-1} 1.4x10^{-1} 4.4x10^{-1}
Sr	Q±20	3.7 6.4 2.1	1.7x10^{1} 2.1x10^{1} 1.7x10^{1}	6.5x10^{-1} 2.2x10^{-1} 8.9x10^{-1}	1.3 9.9x10^{-1} 1.5	3.5 3.7 3.5	3.4 5.9 4.1
Y	Q±40	*8.8x10^{-4}* <8.1x10^{-4} <4.2x10^{-4}	<5.5x10^{-4} <6.5x10^{-4} <5.0x10^{-4}	2.3x10^{-3} <9.5x10^{-4} <1.9x10^{-3}	1.7x10^{-1} 4.1x10^{-2} 7.3x10^{-2}	5.6x10^{-3} 4.6x10^{-3} 4.4x10^{-3}	<4.1x10^{-4} 9.1x10^{-4} <4.2x10^{-4}
Zr	No CRM	*5.8x10^{-3}* *6.8x10^{-3}* <1.7x10^{-3}	*3.2x10^{-3}* 1.6x10^{-3} *1.9x10^{-3}*	1.0x10^{-1} 4.5x10^{-3} <5.8x10^{-3}	2.1x10^{-1} 4.1x10^{-2} 1.4x10^{-1}	5.0x10^{-2} 4.5x10^{-2} 4.6x10^{-2}	3.7x10^{-3} 2.8x10^{-3} <1.5x10^{-3}
Nb	Q±40	*2.7x10^{-3}* *3.0x10^{-3}* *2.1x10^{-3}*	*2.9x10^{-3}* *2.4x10^{-3}* *3.0x10^{-3}*	<1.4x10^{-3} <8.5x10^{-4} <1.7x10^{-3}	1.0x10^{-2} 3.9x10^{-3} 1.1x10^{-2}	3.6x10^{-4} 3.0x10^{-4} 2.5x10^{-4}	1.9x10^{-2} 3.1x10^{-3} 2.0x10^{-3}
Mo	U	7.6x10^{-2} 1.4x10^{-1} 1.1x10^{-1}	*4.0x10^{-2}* 3.8x10^{-2} *4.0x10^{-2}*	2.0x10^{-1} 1.4x10^{-1} 2.2x10^{-1}	1.1x10^{-1} 4.5x10^{-2} 1.7x10^{-1}	9.2x10^{-2} 2.7x10^{-1} 2.7x10^{-1}	3.4x10^{-2} 6.3x10^{-2} 1.4x10^{-2}
Ru	No CRM	<2.1x10^{-4} <5.6x10^{-4} <2.3x10^{-4}	<8.1x10^{-2} <3.9x10^{-4} <3.0x10^{-4}	<8.1x10^{-4} <4.9x10^{-4} 1.6x10^{-3}	<8.3x10^{-5} <9.2x10^{-5} 2.0x10^{-4}	<6.4x10^{-5} <1.6x10^{-4} <6.6x10^{-5}	<2.0x10^{-4} <1.7x10^{-4} <2.1x10^{-4}

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Pd	No CRM	*2.4x10^{-3}* *3.7x10^{-3}* *1.9x10^{-3}*	*8.0x10^{-3}* *8.1x10^{-3}* *7.9x10^{-3}*	<1.1x10^{-3} 7.4x10^{-4} <1.3x10^{-3}	4.6x10^{-3} 1.9x10^{-3} 3.0x10^{-3}	2.9x10^{-3} 2.6x10^{-3} 2.8x10^{-3}	3.4x10^{-3} 4.4x10^{-3} 3.0x10^{-3}
Ag	Q±20	<8.5x10^{-4} <1.7x10^{-3} <8.9x10^{-4}	<9.6x10^{-4} <2.2x10^{-3} <1.2x10^{-3}	1.2x10-^{2} 1.0x10^{-2} <3.6x10^{-3}	3.0x10^{-2} 1.3x10^{-2} 1.1x10^{-1}	1.7x10^{-3} 9.8x10^{-4} 8.9x10^{-4}	5.5x10^{-2} 3.4x10^{-2} 1.9x10^{-2}
Cd	Q±20	<1.4x10^{-2} <1.2x10^{-2} *8.4x10^{-2}*	*1.9x10^{-2}* *6.6x10^{-2}* <1.2x10^{-2}	7.2x10^{-2} 4.7x10^{-2} 6.7x10-^{2}	2.6 2.6 1.4	5.6x10^{-2} 2.2x10^{-2} 2.2x10^{-2}	1.0x10^{-1} 6.3x10^{-2} 3.3x10^{-2}
Sn	Q±40	<4.5x10^{-3} <1.1x10^{-2} *8.2x10^{-2}*	<3.8x10^{-3} <2.3x10^{-3} <2.5x10^{-3}	2.1x10^{-2} 9.9x10^{-3} <1.5x10^{-2}	2.9x10^{-2} 8.3x10^{-3} 4.0x10^{-2}	1.1x10^{-2} 1.1x10^{-2} 9.9x10^{-3}	1.6x10^{-2} 2.1x10^{-2} 7.2x10^{-3}
Sb	Q±20	*1.9x10^{-3}* <2.3x10^{-3} <5.0x10^{-3}	<1.4x10^{-3} <6.8x10^{-4} <8.7x10^{-4}	<3.7x10^{-3} 2.5x10^{-3} 6.8x10^{-3}	1.4x10^{-2} 3.7x10^{-3} 2.3x10^{-2}	3.7x10^{-3} 2.3x10^{-3} 2.3x10^{-3}	8.0x10^{-3} 4.7x10^{-3} 2.7x10^{-3}
Te	No CRM	<2.6x10^{-3} <4.3x10^{-3} <2.3x10^{-3}	<1.3x10^{-3} <2.4x10^{-3} <1.3x10^{-3}	<9.2x10^{-3} <5.3x10^{-3} <1.1x10^{-2}	4.6x10^{-3} 1.5x10^{-3} 4.6x10^{-3}	<1.3x10^{-3} <1.3x10^{-3} <1.6x10^{-3}	<3.4x10^{-3} <1.7x10^{-3} <1.6x10^{-3}
Cs	Q±40	1.7x10^{-2} 4.4x10^{-2} 1.0x10^{-1}	*3.5x10^{-3}* 2.3x10^{-2} 5.0x10^{-3}	6.0x10^{-3} 3.6x10^{-2} 5.1x10^{-3}	4.2x10^{-2} 1.1x10^{-2} 1.9x10^{-2}	4.7x10^{-2} 3.5x10^{-2} 3.6x10^{-2}	<7.4x10^{-4} <6.1x10^{-4} <6.3x10^{-4}
Ba	Q±20	*8.3x10^{-1}* *1.1* *2.4*	2.6x10^{1} 2.3x10^{1} 2.8x10^{1}	1.2 5.0x10^{-1} 2.0	2.8 6.6x10^{-1} 2.0	1.0x10^{1} 7.3 7.3	1.1x10^{1} 1.2x10^{1} 9.4
La	Q±20	<8.7x10^{-4} <2.3x10^{-3} <7.1x10^{-4}	<1.0x10^{-3} <9.1x10^{-4} <8.3x10^{-4}	3.2x10^{-3} 1.8x10^{-3} 4.0x10^{-3}	3.4x10^{-1} 7.5x10^{-2} 1.8x10^{-1}	7.6x10^{-3} 4.3x10^{-3} 4.1x10^{-3}	1.2x10^{-3} 7.5x10^{-4} 8.8x10^{-4}

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Ce	Q±40	<1.4x10^{-3} <4.3x10^{-3} <1.4x10^{-3}	<1.4x10^{-3} <1.1x10^{-3} <1.9x10^{-3}	<4.9x10^{-3} <2.9x10^{-3} <5.8x10^{-3}	8.2x10^{-1} 1.9x10^{-1} 3.6x10^{-1}	7.3x10^{-3} 4.5x10^{-3} 3.9x10^{-3}	<2.4x10^{-3} <1.1x10^{-3} <1.1x10^{-3}
Pr	Q±20	<2.0x10^{-4} <5.4x10^{-4} <2.0x10^{-4}	<1.2x10^{-4} <1.3x10^{-4} <2.2x10^{-4}	8.4x10^{-4} <4.6x10^{-4} <8.7x10^{-4}	8.6x10^{-2} 1.8x10^{-2} 4.5x10^{-2}	8.1x10^{-4} 5.5x10^{-4} 4.4x10^{-4}	<2.0x10^{-4} <2.8x10^{-4} <1.6x10^{-4}
Nd	Q±20	<6.5x10^{-4} *1.8x10^{-3}* *4.1x10^{-4}*	<7.6x10^{-4} <6.2x10^{-4} <3.3x10^{-4}	4.2x10^{-3} 8.8x10^{-4} 3.3x10^{-3}	3.1x10^{-1} 6.5x10^{-2} 1.5x10^{-1}	3.1x10^{-3} 1.6x10^{-3} 1.4x10^{-3}	7.0x10^{-4} 6.0x10^{-4} 4.9x10^{-4}
Sm	Q±20	<4.6x10^{-4} <6.6x10^{-4} <3.9x10^{-4}	<3.0x10^{-4} <3.6x10^{-4} <3.5x10^{-4}	<1.5x10^{-3} <8.5x10^{-4} <1.7x10^{-3}	5.8x10^{-2} 1.2x10^{-2} 2.0x10^{-2}	7.4x10^{-4} 3.9x10^{-4} 3.5x10^{-4}	<3.4x10^{-4} <2.8x10^{-4} <2.6x10^{-4}
Eu	Q±20	*1.5x10^{-4}* *2.1x10^{-4}* *4.9x10^{-4}*	*3.4x10^{-3}* *3.0x10^{-3}* *3.7x10^{-3}*	4.1x10^{-4} 8.8x10^{-5} 6.45x10^{-4}	1.2x10^{-2} 3.0x10^{-3} 5.4x10^{-3}	1.9x10^{-3} 1.3x10^{-3} 1.3x10^{-3}	2.1x10^{-3} 2.1x10^{-3} 1.8x10^{-3}
Gd	Q±20	*1.7x10^{-4}* *3.3x10^{-4}* <8.5x10^{-5}	*2.0x10^{-4}* *4.0x10^{-4}* *2.6x10^{-4}*	4.4x10^{-4} 1.8x10^{-4} 8.3x10^{-4}	5.6x10^{-2} 1.3x10^{-2} 2.4x10^{-2}	6.9x10^{-4} 3.6x10^{-4} 3.7x10^{-4}	2.1x10^{-4} 2.1x10^{-4} 2.0x10^{-4}
Tb	Q±20	<5.5x10^{-5} <8.0x10^{-5} <5.3x10^{-5}	<2.5x10^{-5} <3.0x10^{-5} <3.6x10^{-5}	<1.9x10^{-4} <1.1x10^{-4} <2.2x10^{-4}	6.9x10^{-3} 1.7x10^{-3} 2.9x10^{-3}	7.5x10^{-5} 5.9x10^{-5} 3.4x10^{-5}	<4.7x10^{-5} <3.4x10^{-5} <3.7x10^{-5}
Dy	Q±40	*2.3x10^{-4}* <4.1x10^{-4} <1.8x10^{-4}	<1.6x10^{-4} <1.5x10^{-4} <1.3x10^{-4}	<6.3x10^{-4} <3.7x10^{-4} <7.4x10^{-4}	3.6x10^{-2} 8.0x10^{-3} 1.6x10^{-2}	3.1x10^{-4} <2.5x10^{-4} 1.8x10^{-4}	<1.5x10^{-4} <1.3x10^{-4} <1.2x10^{-4}
Ho	Q±40	<5.5x10^{-5} <1.2x10^{-4} <5.3x10^{-5}	*3.0x10^{-5}* <3.0x10^{-5} <3.8x10^{-5}	<1.9x10^{-4} <1.1x10^{-4} <2.2x10^{-4}	6.8x10^{-3} 1.5x10^{-3} 2.9x10^{-3}	6.1x10^{-5} 3.9x10^{-5} 3.4x10^{-5}	<4.1x10^{-5} <6.1x10^{-5} <3.7x10^{-5}

Element	**Data quality**[#]	**[Rat] Wood mouse (whole body)**	**[Deer] Roe deer (whole body)**	**[Bee] *Bombus spp.* (whole body)**	**[Earthworm] *Lumbricidae* (whole body)**	**[Wild grass] Purple moor grass (leaf)**	**[Pine Tree] Sitka spruce (trunk)**
Er	Q±20	$<6.3\times10^{-5}$ $<1.0\times10^{-4}$ $<6.9\times10^{-5}$	$<4.0\times10^{-5}$ $<5.2\times10^{-5}$ $<4.2\times10^{-5}$	$<2.3\times10^{-4}$ $<1.4\times10^{-4}$ $<2.8\times10^{-4}$	1.7×10^{-2} 3.7×10^{-3} 7.6×10^{-3}	1.6×10^{-4} 1.1×10^{-4} 9.1×10^{-5}	$<1.3\times10^{-4}$ $<1.8\times10^{-4}$ $<4.2\times10^{-5}$
Tm	Q±40	$<1.6\times10^{-5}$ $<2.3\times10^{-5}$ $<1.5\times10^{-5}$	*9.3×10^{-6}* $<8.1\times10^{-6}$ $<1.2\times10^{-5}$	$<5.2\times10^{-5}$ $<3.1\times10^{-5}$ $<6.1\times10^{-5}$	2.2×10^{-3} 4.8×10^{-4} 9.0×10^{-4}	2.3×10^{-5} 1.8×10^{-5} $<2.2\times10^{-5}$	$<1.2\times10^{-5}$ $<5.5\times10^{-5}$ $<1.7\times10^{-5}$
Yb	Q±40	$<1.1\times10^{-4}$ $<1.7\times10^{-4}$ $<9.4\times10^{-5}$	*1.4×10^{-4}* $<7.5\times10^{-5}$ $<1.0\times10^{-4}$	$<3.4\times10^{-4}$ 3.8×10^{-4} $<4.0\times10^{-4}$	1.2×10^{-2} 3.4×10^{-3} 5.8×10^{-3}	1.1×10^{-4} 1.3×10^{-4} 1.1×10^{-4}	$<1.2\times10^{-4}$ 1.5×10^{-4} $<6.3\times10^{-5}$
Lu	Q±40	$<7.8\times10^{-5}$ $<1.2\times10^{-4}$ $<7.6\times10^{-5}$	$<5.4\times10^{-5}$ $<5.7\times10^{-5}$ $<4.7\times10^{-5}$	$<2.8\times10^{-4}$ $<1.7\times10^{-4}$ $<3.3\times10^{-4}$	1.9×10^{-3} 3.4×10^{-4} 8.6×10^{-4}	$<4.2\times10^{-5}$ $<3.2\times10^{-5}$ $<2.6\times10^{-5}$	$<7.4\times10^{-5}$ $<7.8\times10^{-5}$ $<5.3\times10^{-5}$
Hf	U	$<2.7\times10^{-4}$ $<3.1\times10^{-4}$ $<2.0\times10^{-4}$	$<2.8\times10^{-4}$ $<1.1\times10^{-4}$ $<1.4\times10^{-4}$	2.1×10^{-3} $<4.2\times10^{-4}$ $<8.7\times10^{-4}$	5.5×10^{-3} 1.2×10^{-3} 3.5×10^{-3}	9.1×10^{-4} 9.3×10^{-4} 9.6×10^{-4}	$<2.0\times10^{-4}$ $<1.1\times10^{-4}$ $<1.6\times10^{-4}$
Ta	No CRM	$<3.8\times10^{-4}$ $<5.2\times10^{-4}$ $<3.5\times10^{-4}$	$<2.2\times10^{-4}$ $<2.1\times10^{-4}$ $<2.2\times10^{-4}$	$<1.2\times10^{-3}$ $<7.0\times10^{-4}$ $<1.4\times10^{-3}$	$<1.3\times10^{-4}$ $<1.2\times10^{-4}$ $<1.6\times10^{-4}$	$<1.3\times10^{-4}$ $<1.3\times10^{-4}$ $<9.9\times10^{-5}$	$<3.4\times10^{-4}$ $<2.2\times10^{-4}$ $<2.1\times10^{-4}$
W	No CRM	$<1.2\times10^{-4}$ *4.8×10^{-4}* *7.7×10^{-4}*	*2.3×10^{-3}* $<1.4\times10^{-4}$ $<2.6\times10^{-4}$	$<4.5\times10^{-4}$ $<2.6\times10^{-4}$ $<5.3\times10^{-4}$	4.5×10^{-4} 2.0×10^{-4} 8.1×10^{-4}	1.4×10^{-4} 6.9×10^{-5} $<8.2\times10^{-5}$	$<2.1\times10^{-4}$ 3.7×10^{-4} 5.3×10^{-4}
Re	No CRM	$<1.4\times10^{-5}$ $<2.2\times10^{-5}$ $<1.4\times10^{-5}$	$<7.7\times10^{-6}$ $<7.2\times10^{-6}$ $<8.1\times10^{-6}$	$<4.9\times10^{-5}$ $<2.9\times10^{-5}$ $<5.8\times10^{-5}$	6.6×10^{-6} $<5.2\times10^{-6}$ $<7.0\times10^{-6}$	$<4.8\times10^{-6}$ $<4.9\times10^{-6}$ $<4.6\times10^{-6}$	$<2.6\times10^{-5}$ $<9.5\times10^{-6}$ $<1.5\times10^{-5}$
Ir	No CRM	$<1.0\times10^{-4}$ $<1.7\times10^{-4}$ $<1.5\times10^{-4}$	$<7.0\times10^{-5}$ $<5.9\times10^{-5}$ $<5.9\times10^{-5}$	$<3.7\times10^{-4}$ $<2.2\times10^{-4}$ $<4.3\times10^{-4}$	$<3.5\times10^{-5}$ $<3.8\times10^{-5}$ $<5.2\times10^{-5}$	$<5.8\times10^{-5}$ $<5.5\times10^{-5}$ $<3.3\times10^{-5}$	$<8.8\times10^{-5}$ $<9.5\times10^{-6}$ $<1.5\times10^{-5}$

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Pt	No CRM	<1.4x10^{-3} <2.2x10^{-3} <1.4x10^{-3}	<7.7x10^{-4} <7.2x10^{-4} <8.1x10^{-4}	<4.9x10^{-3} <2.9x10^{-3} <5.8x10^{-3}	1.8x10^{-3} 7.3x10^{-4} <7.0x10^{-4}	<4.8x10^{-4} <4.5x10^{-4} <4.6x10^{-4}	<1.1x10^{-3} <9.5x10^{-4} <9.5x10^{-4}
Hg	Q±20	<1.3x10^{-2} <1.2x10^{-2} <3.1x10^{-2}	<4.2x10^{-3} <5.4x10^{-3} <3.4x10^{-3}	<2.8x10^{-2} <1.6x10^{-2} <3.2x10^{-2}	1.4x10^{-1} 4.0x10^{-2} 1.7x10^{-1}	4.7x10^{-3} <2.6x10^{-3} <2.6x10^{-3}	<6.1x10^{-3} <5.0x10^{-3} <5.3x10^{-3}
Tl	Q±20	<5.8x10^{-3} <9.4x10^{-3} <5.9x10^{-3}	<4.9x10^{-3} <3.5x10^{-3} <3.7x10^{-3}	<2.1x10^{-2} 3.6x10^{-2} <2.5x10^{-2}	1.4x10^{-2} 5.8x10^{-3} 1.4x10^{-2}	<1.6x10^{-2} <2.3x10^{-3} <7.3x10^{-3}	<7.4x10^{-3} <8.9x10^{-3} <3.7x10^{-3}
Pb	Q±20	*7.0x10^{-1}* *1.9x10^{-1}* *7.2x10^{-1}*	<8.2x10^{-2} *9.4x10^{-2}* *2.3x10^{-1}*	<9.9x10^{-2} <5.3x10^{-2} <1.2x10^{-1}	7.5 9.3x10^{-1} 3.6x10^{1}	2.5x10^{-1} 5.2x10^{-1} 5.1x10^{-1}	1.6x10^{-1} 1.7x10^{-1} 6.3x10^{-2}
Th	Q±20	*3.4x10^{-4}* *4.8x10^{-4}* <1.7x10^{-4}	<1.3x10^{-4} <9.4x10^{-5} <2.7x10^{-4}	<8.1x10^{-4} <3.6x10^{-4} <7.1x10^{-4}	6.9x10^{-2} 1.2x10^{-2} 3.7x10^{-2}	6.4x10^{-4} 2.9x10^{-4} 2.3x10^{-4}	<3.0x10^{-4} <1.3x10^{-4} <4.0x10^{-4}
U	Q±40	<2.2x10^{-4} <2.7x10^{-4} <1.7x10^{-4}	<9.8x10^{-5} <9.4x10^{-5} <1.7x10^{-4}	6.9x10^{-4} <3.6x10^{-4} <7.1x10^{-4}	3.6x10^{-2} 8.0x10^{-3} 2.2x10^{-2}	2.9x10^{-4} 2.4x10^{-4} 1.8x10^{-4}	<3.4x10^{-4} <1.2x10^{-4} <1.2x10^{-4}

Values in italics denote where the whole body concentration was estimated using some tissue(s) data below the limit of detection (LOD) as described in the text. Each value represents an individual biota sample other than each of the three Purple moor grass and Sitka spruce sample concentrations which are the mean of three replicate determinations. For Purple moor grass and Sitka spruce if all three replicates of a given sample had a concentration below the LOD then the highest 'less than' is presented (preceded by a '<' symbol) if there was a mixture of measurable and below LOD concentrations then the highest measurable value, or LOD value if higher is presented (preceded by a '<' symbol). [#]An indication of the data quality for each element is presented: if the analysis of the controlled reference material (CRM) was within ±20% of the certified value, the data quality is defined as Q±20; if it was within ±40% it is defined as Q±40; if it is within factor of two it is defined as QL (qualitative); if it is outside a factor of two it is defined as U and suggested to be unreliable; if no CRM was available it is defined No CRM and should be considered to be qualitative (see also text).

Table 4. Stable element concentrations (mg kg^{-1} (fresh mass)) measured in the reproductive organs of [RAP] mammal species.

Element	Data quality[#]	[Rat] Wood mice Testes	[Deer] Roe deer ovaries[*]	Element	Data quality[#]	[Rat] Wood mice testes	[Deer] Roe deer ovaries
Li	Q±20	<5.0x10^{-3} <6.0x10^{-3} <4.0x10^{-3}	<7.0x10^{-3} <1.4x10^{-2} <1.2x10^{-2}	**Sb**	Q±20	<6.0x10^{-4} <8.0x10^{-4} 6.0x10^{-4}	<8.0x10^{-4} 1.8x10^{-3} 2.7x10^{-3}
Be	Q±20	<9.0x10^{-4} <1.2x10^{-3} <8.0x10^{-4}	1.8x10^{-3} <2.6x10^{-3} <2.3x10^{-3}	**Te**	No CRM	<1.0x10^{-3} <2.0x10^{-3} 1.0x10^{-3}	<2.0x10^{-3} 1.3x10^{-2} <4.0x10^{-3}
B	Q±40	<1.0x10^{-1} <1.0x10^{-1} <1.0x10^{-1}	2.0x10^{-1} 4.5x10^{-1} 3.0x10^{-1}	**Cs**	Q±40	1.5x10^{-2} 4.2x10^{-2} 6.9x10^{-2}	2.3x10^{-3} 1.7x10^{-2} 3.6x10^{-3}
Na	Q±20	8.5x10^{2} 9.0x10^{2} 8.2x10^{2}	2.1x10^{3} 2.5x10^{3} 2.3x10^{3}	**Ba**	Q±20	<1.0x10^{-2} 1.4x10^{-2} <9.0x10^{-3}	2.8x10^{-2} 2.1x10^{-1} 1.2x10^{-1}
Mg	Q±20	1.7x10^{2} 1.7x10^{2} 1.3x10^{2}	1.4x10^{2} 1.9x10^{2} 1.8x10^{2}	**La**	Q±20	<4.0x10^{-4} <5.0x10^{-4} <4.0x10^{-4}	<5.0x10^{-4} 1.5x10^{-3} <1.0x10^{-3}
Al	Q±20	6.0x10^{-1} 6.0x10^{-1} 4.0x10^{-1}	6.0x10^{-1} 6.3 1.2	**Ce**	Q±40	<8.0x10^{-4} <1.1x10^{-3} <7.0x10^{-4}	<1.1x10^{-3} 4.1x10^{-3} <2.1x10^{-3}
K	Q±20	3.1x10^{3} 3.7x10^{3} 2.9x10^{3}	2.8x10^{3} 3.9x10^{3} 3.9x10^{3}	**Pr**	Q±20	<1.0x10^{-4} <2.0x10^{-4} <1.0x10^{-4}	<2.0x10^{-4} <4.0x10^{-4} <3.0x10^{-4}
Ca	Q±20	6.8x10^{1} 1.3x10^{2} 5.0x10^{1}	6.4x10^{1} 1.3x10^{2} 6.5x10^{1}	**Nd**	Q±20	<1.0x10^{-4} <2.0x10^{-4} <1.0x10^{-4}	<2.0x10^{-4} 1.5x10^{-3} <3.0x10^{-4}
Ti	Q±40	<1.0x10^{-1} <1.0x10^{-1} <1.0x10^{-1}	<1.0x10^{-1} <7.8x10^{-1} 3.0x10^{-1}	**Sm**	Q±20	<2.0x10^{-4} <3.0x10^{-4} <2.0x10^{-4}	<3.0x10^{-4} <7.0x10^{-4} <6.0x10^{-4}
V	Q±20	<2.0x10^{-2} <3.0x10^{-2} <2.0x10^{-2}	<3.0x10^{-2} <7.0x10^{-2} <6.0x10^{-2}	**Eu**	Q±20	<1.0x10^{-5} <2.0x10^{-5} 1.0x10^{-5}	7.0x10^{-5} <1.4x10^{-4} <4.0x10^{-5}
Cr	Q±20	2.3x10^{-2} 3.2x10^{-2} 1.8x10^{-2}	<1.2x10^{-2} <4.7x10^{-2} 3.0x10^{-2}	**Gd**	Q±20	<5.0x10^{-5} 2.4x10^{-4} <4.0x10^{-5}	<6.0x10^{-5} <5.1x10^{-4} <1.2x10^{-4}
Mn	Q±20	<1.0 <1.0 <1.0	2.0 <3.0 <3.0	**Tb**	Q±20	<3.0x10^{-5} <4.0x10^{-5} <3.0x10^{-5}	8.0x10^{-5} 1.0x10^{-4} <8.0x10^{-5}
Fe	Q±20	1.9x10^{1} 1.9x10^{1} 1.7x10^{1}	2.9x10^{1} 6.1x10^{1} 4.0x10^{1}	**Dy**	Q±40	<1.0x10^{-4} <1.3x10^{-4} <9.0x10^{-5}	1.8x10^{-4} <2.9x10^{-4} <2.6x10^{-4}
Co	Q±20	1.2x10^{-2} 5.0x10^{-3} 1.5x10^{-2}	1.6x10^{-2} 2.3x10^{-2} 1.3x10^{-2}	**Ho**	Q±40	<3.0x10^{-5} <4.0x10^{-5} <3.0x10^{-5}	<4.0x10^{-5} <9.0x10^{-5} <8.0x10^{-5}
Ni	Q±20	5.0x10^{-2} 2.0x10^{-2} 2.0x10^{-2}	<2.0x10^{-2} <4.0x10^{-2} 1.4x10^{-1}	**Er**	Q±20	<4.0x10^{-5} <5.0x10^{-5} <3.0x10^{-5}	<5.0x10^{-5} <1.1x10^{-4} <1.0x10^{-4}
Cu	Q±20	1.4 1.7 1.4	2.8 2.1 1.9	**Tm**	Q±40	1.4x10^{-5} <1.1x10^{-5} <8.0x10^{-6}	5.4x10^{-5} <2.4x10^{-5} <2.2x10^{-5}
Zn	Q±20	6.0x10^{1} 2.8x10^{1} 2.8x10^{1}	1.6x10^{1} 2.4x10^{1} 2.2x10^{1}	**Yb**	Q±40	<6.0x10^{-5} <7.0x10^{-5} <5.0x10^{-5}	3.1x10^{-4} <1.6x10^{-4} <1.4x10^{-4}
As	Q±20	6.0x10^{-3} <2.0x10^{-3}	<2.0x10^{-3} <5.0x10^{-3}	**Lu**	Q±40	<5.0x10^{-5} <6.0x10^{-5}	1.1x10^{-4} <1.3x10^{-4}

Element	Data quality#	[Rat] Wood mice Testes	[Deer] Roe deer ovaries*	Element	Data quality#	[Rat] Wood mice testes	[Deer] Roe deer ovaries
		$2.0x10^{-3}$	$6.0x10^{-3}$			$<4.0x10^{-5}$	$<1.2x10^{-4}$
Se	Q±20	$6.1x10^{-1}$ $7.8x10^{-1}$ $7.1x10^{-1}$	$2.2x10^{-1}$ $3.2x10^{-1}$ $1.7x10^{-1}$	**Hf**	U	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $<1.0x10^{-4}$	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<3.0x10^{-4}$
Rb	Q±20	$1.3x10^{1}$ $2.2x10^{1}$ $1.6x10^{1}$	1.5 4.6 3.7	**Ta**	No CRM	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$2.9x10^{-3}$ $<1.4x10^{-3}$ $<5.0x10^{-4}$
Sr	Q±20	$3.1x10^{-2}$ $6.1x10^{-2}$ $1.0x10^{-2}$	$6.1x10^{-2}$ $1.5x10^{-1}$ $1.0x10^{-1}$	**W**	No CRM	$<7.0x10^{-5}$ $<1.0x10^{-4}$ $<7.0x10^{-5}$	$<1.0x10^{-4}$ $<2.1x10^{-4}$ $3.8x10^{-3}$
Y	Q±40	$<3.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$<4.0x10^{-4}$ $<9.0x10^{-4}$ $<7.0x10^{-4}$	**Re**	No CRM	$<8.0x10^{-6}$ $<1.1x10^{-5}$ $<7.0x10^{-6}$	$4.8x10^{-4}$ $1.6x10^{-4}$ $<2.0x10^{-5}$
Zr	No CRM	$<8.0x10^{-4}$ $1.4x10^{-3}$ $<7.0x10^{-4}$	$1.6x10^{-3}$ $6.8x10^{-3}$ $<2.0x10^{-3}$	**Ir**	No CRM	$<6.0x10^{-5}$ $<8.0x10^{-5}$ $8.0x10^{-5}$	$<8.0x10^{-5}$ $<1.7x10^{-4}$ $<1.5x10^{-4}$
Nb	Q±40	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$<3.0x10^{-4}$ $<3.1x10^{-3}$ $<6.0x10^{-4}$	**Pt**	No CRM	$<8.0x10^{-4}$ $<1.0x10^{-3}$ $<7.0x10^{-4}$	$<1.1x10^{-3}$ $<2.3x10^{-3}$ $<2.0x10^{-3}$
Mo	U	$8.9x10^{-2}$ $5.1x10^{-2}$ $4.5x10^{-2}$	$<3.0x10^{-3}$ $2.9x10^{-2}$ $<5.0x10^{-3}$	**Au**	No CRM	$<7.0x10^{-3}$ $<9.0x10^{-3}$ $<6.0x10^{-3}$	$<9.0x10^{-3}$ $<2.0x10^{-2}$ $<1.7x10^{-2}$
Ru	No CRM	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $2.0x10^{-4}$	$<2.0x10^{-4}$ $<1.4x10^{-3}$ $<3.0x10^{-4}$	**Hg**	Q±20	$<4.0x10^{-3}$ $<6.0x10^{-3}$ $1.0x10^{-2}$	$<6.0x10^{-3}$ $<1.3x10^{-2}$ $<1.1x10^{-2}$
Pd	No CRM	$<2.0x10^{-4}$ $<2.0x10^{-4}$ $<2.0x10^{-4}$	$<2.0x10^{-4}$ $<6.0x10^{-3}$ $<4.0x10^{-4}$	**Tl**	Q±20	$<3.0x10^{-3}$ $<4.0x10^{-3}$ $5.0x10^{-3}$	$<5.0x10^{-3}$ $<1.0x10^{-2}$ $<9.0x10^{-3}$
Ag	Q±20	$7.0x10^{-4}$ $<7.0x10^{-4}$ $<5.0x10^{-4}$	$<7.0x10^{-4}$ $5.1x10^{-3}$ $4.5x10^{-3}$	**Pb**	Q±20	$<2.0x10^{-2}$ $<2.0x10^{-2}$ $<1.0x10^{-2}$	$2.0x10^{-2}$ $<5.0x10^{-2}$ $<4.0x10^{-2}$
Cd	Q±20	$<3.0x10^{-3}$ $<4.0x10^{-3}$ $7.0x10^{-3}$	$3.1x10^{-2}$ $8.5x10^{-2}$ $9.0x10^{-3}$	**Th**	Q±20	$<1.0x10^{-4}$ $<1.3x10^{-4}$ $<9.0x10^{-5}$	$<1.3x10^{-4}$ $5.3x10^{-4}$ $<2.5x10^{-4}$
Sn	Q±40	$<2.0x10^{-3}$ $<3.0x10^{-3}$ $<2.0x10^{-3}$	$<3.0x10^{-3}$ $1.3x10^{-2}$ $<6.0x10^{-3}$	**U**	Q±40	$<1.0x10^{-4}$ $<1.3x10^{-4}$ $<9.0x10^{-5}$	$5.3x10^{-4}$ $<2.8x10^{-4}$ $<2.5x10^{-4}$

Each value represents an individual biota sample. #An indication of the data quality for each element is presented; see text and the footnote to Table 3 for explanation. *Duplicate analyses were conducted on the ovaries of Roe deer 2; where both results were below the limit of detection (LOD) the maximum value is presented (preceded by a '<'), where one replicate was above the LOD and one below the highest value is presented (preceded by a '<').

Table 5. Activity concentrations of ^{7}Be, ^{40}K and ^{137}Cs in [RAP] and soil samples.

[RAP]: species (tissue)	**Activity concentration (± 2 σ counting error) Bq kg^{-1} (fresh mass) in RAP samples; Bq kg^{-1} (dry mass) in soil**		
	^{7}Be	**^{40}K**	**^{137}Cs**
[Wild grass]: Purple moor grass (leaf)	(1.1±0.2)x10^{2} (1.5±0.1)x10^{2} (1.7±0.1)x10^{2}	(9.7±3.0)x10^{1} (9.0±2.5)x10^{1} (9.2±2.3)x10^{1}	8.9±1.7 (1.5±0.2) x10^{1} 7.1±0.7
[Pine Tree]: *Sitka spruce* (trunk)	(2.7±0.1)x10^{-1} <2.4x10^{-1} <1.9x10^{-1}	(1.2±0.3)x10^{1} (1.3±0.3)x10^{1} (1.4±0.3)x10^{1}	(5.0±2.0)x10^{-2} (4.0±1.0)x10^{-2} (9.0±1.0)x10^{-2}
[Pine Tree]: Sitka spruce (branches)	(2.4±0.5)x10^{2} (2.8±0.5)x10^{2} (4.3±0.9)x10^{2}	(3.7±1.2)x10^{1} (7.5±1.8)x10^{1} (4.6±1.6)x10^{1}	<8.5x10^{-1} <8.4x10^{-1} <1.1
[Pine Tree]: Sitka spruce (needles)	<4.5x10^{1} (3.6±2.0)x10^{1} <6.5x10^{1}	(5.5±1.4)x10^{1} (9.0±2.1)x10^{1} (6.3±1.6)x10^{1}	<3.7x10^{-1} <3.6x10^{-1} <1.1
[Deer]: Roe deer (muscle)	<1.5 <2.4 <1.6	(9.9±1.1)x10^{1} (1.1±0.1)x10^{2} (9.3±1.0)x10^{1}	(6.9±0.5)x10^{-1} 8.7±1.7 1.1±0.1
[Deer]: Roe deer (liver)	<4.5 <3.4 <3.6	(7.8±1.8)x10^{1} (6.8±1.6)x10^{1} (6.9±1.7)x10^{1}	<1.10 2.6±0.3 (5.2±1.5)x10^{-1}
Soil (range)*	n/r	(0.5-5.3)x10^{2}	(0.3-1.5)x10^{2}

< denotes the minimum detectable activity concentration (MDA). *For illustrative purposes the activity concentration ranges are given for the soils associated with the Purple moor grass, Sitka spruce and Roe deer samples. n/r – not reported (see text).

Table 6. Range in concentration ratios ($CR_{wo\text{-}soil}$) in [RAP] species (expressed for the whole organism for Wood mice and Roe deer).

Element	[Rat] Wood mice*	[Deer] Roe deer*	[Bee] *Bombus Spp.*	[Earthworm] *Lumbricidae*	[Wild Grass] Purple moor grass#	[Pine Tree] Sitka spruce trunk#
Li	<4.3x10^{-4} <4.9x10^{-4} <4.3x10^{-4}	<2.1x10^{-3} *2.5x10^{-3}* *8.4x10^{-4}*	<2.5x10^{-3} <1.5x10^{-3} <3.0x10^{-3}	1.4x10^{-2} 4.3x10^{-3} 6.8x10^{-3}	2.7x10^{-4} 1.4x10^{-3} 3.6x10^{-4}	<1.8x10^{-4} <1.2x10^{-4} <5.1x10^{-4}
Be	<1.9x10^{-3} <2.9x10^{-3} <1.9x10^{-3}	<1.1x10^{-3} <1.2x10^{-3} <8.0x10^{-4}	<5.1x10^{-3} <3.0x10^{-3} <6.0x10^{-3}	1.2x10^{-2} 3.0x10^{-3} 5.7x10^{-3}	<4.3x10^{-4} <7.4x10^{-4} <4.1x10^{-4}	<9.1x10^{-4} <7.2x10^{-4} <2.4x10^{-3}
B	*2.2x10^{-1}* <6.2x10^{-2} *1.9x10^{-1}*	5.3x10^{-2} *4.4x10^{-2}* 5.1x10^{-2}	3.4x10^{-1} 3.4x10^{-1} 3.9x10^{-1}	2.5x10^{-2} 8.9x10^{-3} 1.7x10^{-2}	1.0x10^{-1} 4.3x10^{-1} 1.5x10^{-1}	1.1x10^{-1} 9.4x10^{-2} 1.1x10^{-1}
Na	5.5x10^{-1} 7.0x10^{-1} 5.5x10^{-1}	6.2x10^{-1} 5.6x10^{-1} 6.5x10^{-1}	5.6x10^{-2} 6.9x10^{-2} 8.3x10^{-2}	3.3x10^{-1} 4.5x10^{-1} 2.9x10^{-1}	1.0x10^{-1} 7.6x10^{-2} 5.0x10^{-2}	1.9x10^{-3} <2.0x10^{-3} 5.3x10^{-4}
Mg	5.2x10^{-2} 6.1x10^{-2} 4.5x10^{-2}	1.6x10^{-1} 1.9x10^{-1} 8.2x10^{-2}	1.5x10^{-1} 9.1x10^{-2} 1.4x10^{-1}	2.1x10^{-2} 8.8x10^{-3} 1.5x10^{-2}	1.4x10^{-1} 2.1x10^{-1} 1.5x10^{-1}	4.0x10^{-3} 4.1x10^{-3} 1.1x10^{-2}
Al	*1.2x10^{-4}* *7.0x10^{-5}* <1.7x10^{-5}	*3.3x10^{-5}* <2.2x10^{-5} <3.3x10^{-5}	3.2x10^{-4} <7.4x10^{-5} <1.5x10^{-4}	1.2x10^{-2} 2.2x10^{-3} 5.7x10^{-3}	1.1x10^{-4} 1.6x10^{-4} 6.9x10^{-5}	2.3x10^{-5} 1.4x10^{-5} 3.3x10^{-5}
K	7.6x10^{-2} 1.0x10^{-1} 7.8x10^{-2}	7.8x10^{-2} 8.6x10^{-2} 6.5x10^{-2}	2.5x10^{-1} 1.8x10^{-1} 2.8x10^{-1}	4.3x10^{-2} 3.3x10^{-2} 4.1x10^{-2}	2.0x10^{-1} 4.0x10^{-1} 2.0x10^{-1}	9.6x10^{-3} 7.6x10^{-3} 1.3x10^{-2}
Ca	1.6x10^{1} 1.5x10^{1} 1.5x10^{1}	4.1x10^{1} 4.7x10^{1} 1.1x10^{1}	1.5x10^{-1} 9.8x10^{-2} 1.8x10^{-1}	2.2x10^{-1} 1.3x10^{-1} 2.2x10^{-1}	9.9x10^{-2} 7.9x10^{-2} 9.2x10^{-2}	9.3x10^{-2} 1.3x10^{-1} 1.4x10^{-1}
Ti	*6.7x10^{-3}* <5.4x10^{-3} <1.4x10^{-3}	*2.6x10^{-3}* <2.8x10^{-3} <2.6x10^{-1}	4.3x10^{-2} 4.4x10^{-3} <6.7x10^{-3}	3.5x10^{-2} 1.0x10^{-2} 2.9x10^{-2}	5.6x10^{-3} 7.5x10^{-3} 4.0x10^{-3}	6.4x10^{-2} 4.9x10^{-3} 7.7x10^{-3}
V	<5.2x10^{-4} <8.8x10^{-4} <5.1x10^{-4}	<3.7x10^{-4} <3.3x10^{-4} <3.4x10^{-4}	<3.5x10^{-3} <2.1x10^{-3} <4.1x10-^{3}	1.4x10^{-2} 2.7x10^{-3} 9.2x10^{-3}	<3.5x10^{-4} <3.3x10^{-4} <2.9x10^{-4}	<5.3x10^{-4} <7.0x10^{-4} <5.8x10^{-4}
Cr	*1.0x10^{-3}* *2.2x10^{-3}* *1.8x10^{-3}*	<7.0x10^{-4} <2.7x10^{-4} *1.3x10^{-3}*	<2.1x10^{-3} <1.3x10-^{3} <2.5x10^{-3}	1.3x10^{-2} 2.7x10^{-3} 6.5x10^{-3}	6.1x10-^{4} 9.0x10^{-4} 4.5x10^{-4}	6.1x10^{-3} 1.1x10^{-2} 2.6x10^{-3}
Mn	<2.6x10^{-3} <3.8x10^{-3} <2.6x10^{-3}	<2.5x10^{-3} <2.5x10^{-3} <1.0x10^{-3}	2.2x10^{-1} 1.2x10^{-1} 1.4x10^{-1}	1.6x10^{-2} 7.2x10^{-3} 2.1x10^{-2}	5.4x10^{-1} 8.4x10^{-2} 2.7x10^{-1}	3.7x10^{-2} 5.7x10^{-2} 2.7x10^{-1}
Fe	1.2x10^{-3} 1.5x10^{-3} 1.2x10^{-3}	7.5x10^{-4} 1.4x10^{-3} 9.2x10^{-4}	2.5x10^{-3} 1.9x10^{-3} 2.1x10^{-3}	1.3x10^{-2} 2.4x10^{-3} 6.6x10^{-3}	1.5x10^{-3} 3.4x10^{-4} 4.4x10^{-4}	9.6x10^{-3} 2.1x10^{-2} 2.5x10^{-3}
Co	1.1x10^{-3} 1.4x10^{-3} <1.2x10^{-3}	1.2x10^{-3} 1.2x10^{-3} *4.7x10^{-4}*	3.7x10^{-2} 4.5x10^{-3} <1.6x10^{-3}	3.2x10^{-2} 1.2x10^{-2} 1.9x10^{-2}	1.4x10^{-3} 3.6x10^{-4} 6.3x10^{-4}	1.7x10^{-3} 2.6x10^{-3} 2.5x10^{-3}
Ni	<8.8x10^{-4} *4.8x10^{-3}* 1.6x10^{-3}	<1.4x10^{-2} *4.4x10^{-2}* 5.5x10^{-3}	<5.3x10^{-3} 1.0x10^{-2} <6.2x10^{-3}	1.1x10^{-2} 2.6x10^{-3} 5.5x10^{-3}	8.1x10^{-3} 7.0x10^{-3} 5.1x10^{-3}	2.4x10^{-3} 3.9x10^{-3} 2.0x10^{-3}
Cu	1.1x10^{-1} 1.4x10^{-1} 1.1x10^{-1}	1.5x10^{-1} 2.3x10^{-1} 7.3x10^{-2}	7.2x10^{-1} 4.0x10^{-1} 3.6x10^{-1}	6.4x10^{-2} 5.7x10^{-2} 8.7x10^{-2}	3.9x10^{-2} 3.5x10^{-2} 3.5x10^{-2}	3.4x10^{-2} 2.9x10^{-2} 2.2x10^{-2}
Zn	3.4x10^{-1} 3.4x10^{-1} 3.3x10^{-1}	6.8x10^{-1} 5.3x10^{-1} 2.2x10^{-1}	8.2x10^{-1} 3.3x10^{-1} 4.9x10^{-1}	5.6x10^{-1} 8.3x10^{-1} 4.4x10^{-1}	1.3x10-^{1} 1.6x10^{-1} 1.3x10^{-1}	5.5x10^{-2} 4.0x10^{-2} 5.1x10^{-2}
As	<2.0x10^{-4} <1.8x10^{-4} <1.0x10^{-4}	<4.0x10^{-5} *4.8x10^{-4}* *1.3x10^{-4}*	2.8x10^{-3} 6.0x10^{-4} 6.1x10^{-4}	6.2x10^{-2} 1.8x10^{-2} 6.3x10^{-2}	1.8x10^{-3} 1.7x10^{-4} 2.3x10^{-4}	1.3x10^{-3} <5.2x10^{-3} <1.8x10^{-4}

Element	**[Rat] Wood mice***	**[Deer] Roe deer***	**[Bee] *Bombus Spp.***	**[Earthworm] *Lumbricidae***	**[Wild Grass] Purple moor grass#**	**[Pine Tree] Sitka spruce trunk#**
Se	$1.4x10^{-1}$ $1.7x10^{-1}$ $2.0x10^{-1}$	$5.1x10^{-2}$ $1.1x10^{-1}$ $7.7x10^{-2}$	$1.2x10^{-2}$ $1.0x10^{-2}$ $2.1x10^{-2}$	4.4 2.4 4.3	$3.9x10^{-3}$ $2.7x10^{-3}$ $2.2x10^{-3}$	$<5.7x10^{-3}$ $<4.2x10^{-3}$ $<2.3x10^{-3}$
Rb	$1.6x10^{-1}$ $2.8x10^{-1}$ $2.3x10^{-1}$	$1.8x10^{-2}$ $4.1x10^{-2}$ $3.1x10^{-2}$	$7.3x10^{-2}$ $1.4x10^{-1}$ $1.2x10^{-1}$	$2.9x10^{-2}$ $1.8x10^{-2}$ $2.7x10^{-2}$	$2.7x10^{-1}$ 1.0 $4.4x10^{-1}$	$3.3x10^{-3}$ $3.1x10^{-3}$ $1.2x10^{-2}$
Sr	$3.2x10^{-1}$ $5.4x10^{-1}$ $1.8x10^{-1}$	1.5 2.4 1.1	$1.3x10^{-2}$ $4.5x10^{-3}$ $1.9x10^{-2}$	$6.7x10^{-2}$ $5.2x10^{-2}$ $7.8x10^{-2}$	$8.0x10^{-2}$ $6.5x10^{-2}$ $7.9x10^{-2}$	$1.6x10^{-1}$ $2.8x10^{-1}$ $2.4x10^{-1}$
Y	*$9.1x10^{-5}$* $<8.3x10^{-5}$ $<4.3x10^{-5}$	$<7.1x10^{-5}$ $<9.5x10^{-5}$ $<4.3x10^{-5}$	$1.8x10^{-4}$ $<7.7x10^{-5}$ $<1.5x10^{-4}$	$1.5x10^{-2}$ $3.5x10^{-3}$ $6.2x10^{-3}$	$5.2x10^{-4}$ $4.2x10^{-4}$ $2.8x10^{-4}$	$<3.2x10^{-5}$ $7.2x10^{-5}$ $<9.9x10^{-5}$
Zr	*$3.6x10^{-4}$* *$4.3x10^{-4}$* $<1.1x10^{-4}$	*$2.2x10^{-4}$* $1.3x10^{-4}$ *$1.3x10^{-4}$*	$1.7x10^{-2}$ $7.5x10^{-4}$ $<9.6x10^{-4}$	$1.5x10^{-2}$ $3.0x10^{-3}$ $1.0x10^{-2}$	$6.3x10^{-3}$ $1.7x10^{-2}$ $6.2x10^{-3}$	$2.8x10^{-4}$ $2.1x10^{-4}$ $<1.8x10^{-4}$
Nb	*$1.2x10^{-1}$* *$1.3x10^{-1}$* *$9.2x10^{-2}$*	*$4.3x10^{-2}$* *$2.3x10^{-2}$* *$3.6x10^{-2}$*	$<1.4x10^{-2}$ $<8.2x10^{-3}$ $<1.6x10^{-2}$	$1.9x10^{-1}$ $7.1x10^{-2}$ $2.0x10^{-1}$	$3.6x10^{-3}$ $2.3x10^{-3}$ $3.2x10^{-3}$	$2.4x10^{-1}$ $3.9x10^{-2}$ $5.0x10^{-2}$
Mo	$8.3x10^{-2}$ $1.5x10^{-1}$ $1.2x10^{-1}$	*$5.0x10^{-2}$* $4.9x10^{-2}$ *$6.2x10^{-2}$*	$8.9x10^{-2}$ $6.3x10^{-2}$ $1.0x10^{-1}$	$2.6x10^{-1}$ $1.1x10^{-1}$ $4.1x10^{-1}$	$6.0x10^{-2}$ $9.1x10^{-2}$ $1.3x10^{-1}$	$6.6x10^{-2}$ $1.2x10^{-1}$ $1.3x10^{-2}$
Ru	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	$<1.3x10^{-2}$ n/a n/a	n/a n/a n/a
Pd	*$1.2x10^{-2}$* *$1.8x10^{-2}$* *$9.1x10^{-3}$*	*$3.5x10^{-2}$* n/a *$2.1x10^{-2}$*	$<4.2x10^{-3}$ $2.8x10^{-3}$ $<4.8x10^{-3}$	$2.0x10^{-2}$ $8.1x10^{-3}$ $1.3x10^{-2}$	$1.3x10^{-2}$ $1.2x10^{-2}$ $8.4x10^{-3}$	$1.4x10^{-2}$ $1.8x10^{-2}$ $2.7x10^{-2}$
Ag	$<4.0x10^{-3}$ $<8.3x10^{-3}$ $<4.2x10^{-3}$	$<4.6x10^{-3}$ $<9.7x10^{-3}$ $<5.5x10^{-3}$	$2.3x10^{-2}$ $2.0x10^{-2}$ $<6.9x10^{-3}$	$3.13x10^{-1}$ $1.40x10^{-1}$ 1.2	$3.6x10^{-3}$ $2.4x10^{-3}$ $1.4x10^{-3}$	$4.5x10^{-1}$ $2.8x10^{-1}$ $5.7x10^{-2}$
Cd	$<5.9x10^{-2}$ $<5.2x10^{-2}$ *$3.6x10^{-1}$*	*$7.3x10^{-2}$* *$2.6x10^{-1}$* $<3.8x10^{-2}$	$4.4x10^{-2}$ $2.8x10^{-2}$ $4.1x10^{-2}$	6.2 6.2 3.4	$2.6x10^{-2}$ $1.7x10^{-2}$ $1.4x10^{-2}$	$2.0x10^{-1}$ $1.2x10^{-1}$ $8.1x10^{-2}$
Sn	$<4.2x10^{-4}$ $<1.0x10^{-3}$ *$7.5x10^{-3}$*	$<5.1x10^{-4}$ $<3.5x10^{-4}$ $<5.2x10^{-4}$	$1.9x10^{-3}$ $9.1x10^{-4}$ $<1.4x10^{-3}$	$1.5x10^{-2}$ $4.2x10^{-3}$ $2.1x10^{-2}$	$1.3x10^{-3}$ $1.1x10^{-3}$ $7.0x10^{-4}$	$6.3x10^{-3}$ $8.0x10^{-3}$ $8.3x10^{-4}$
Sb	*$3.5x10^{-3}$* $<4.3x10^{-3}$ $<9.4x10^{-3}$	$<3.2x10^{-3}$ $<1.8x10^{-3}$ $<3.3x10^{-3}$	$<2.9x10^{-3}$ $2.0x10^{-3}$ $5.4x10^{-3}$	$4.7x10^{-2}$ $1.3x10^{-2}$ $7.9x10^{-2}$	$4.8x10^{-3}$ $1.3x10^{-3}$ $1.8x10^{-3}$	$1.9x10^{-2}$ $1.1x10^{-2}$ $3.7x10^{-3}$
Te	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a $<2.7x10^{-2}$	n/a n/a n/a
Cs	$5.3x10^{-3}$ $1.3x10^{-2}$ 3.1x10-2	*$1.0x10^{-3}$* $6.9x10^{-3}$ $1.4x10^{-3}$	$4.0x10^{-3}$ $2.4x10^{-2}$ $3.4x10^{-3}$	$1.6x10^{-2}$ $4.1x10^{-3}$ $7.3x10^{-3}$	$1.9x10^{-2}$ $5.7x10^{-2}$ $2.4x10^{-2}$	$<2.4x10^{-4}$ $<1.9x10^{-4}$ $<2.7x10^{-4}$
Ba	*$5.8x10^{-3}$* *$7.7x10^{-3}$* *$1.7x10^{-2}$*	$1.8x10^{-1}$ $2.0x10^{-1}$ $1.7x10^{-1}$	$9.3x10^{-3}$ $3.8x10^{-3}$ $1.6x10^{-2}$	$2.1x10^{-2}$ $5.0x10^{-3}$ $1.5x10^{-2}$	$6.9x10^{-2}$ $7.3x10^{-2}$ $5.0x10^{-2}$	$8.7x10^{-2}$ $9.2x10^{-2}$ $1.0x10^{-1}$
La	$<3.5x10^{-5}$ $<9.3x10^{-5}$ $<2.8x10^{-5}$	$<4.4x10^{-5}$ $<4.4x10^{-5}$ $<2.6x10^{-5}$	$1.7x10^{-4}$ $9.6x10^{-5}$ $2.1x10^{-4}$	$1.2x10^{-2}$ $2.6x10^{-3}$ $6.2x10^{-3}$	$4.7x10^{-4}$ $3.0x10^{-4}$ $1.6x10^{-4}$	$4.1x10^{-5}$ $2.6x10^{-5}$ $7.2x10^{-5}$
Ce	$<2.1x10^{-5}$ $<6.4x10^{-5}$ $<2.1x10^{-5}$	$<2.5x10^{-5}$ $<2.1x10^{-5}$ $<2.5x10^{-5}$	$<1.4x10^{-4}$ $<8.3x10^{-5}$ $<1.7x10^{-4}$	$8.7x10^{-3}$ $2.0x10^{-3}$ $3.8x10^{-3}$	$2.2x10^{-4}$ $2.0x10^{-4}$ $7.8x10^{-5}$	$<2.3x10^{-5}$ $<1.0x10^{-5}$ $<4.2x10^{-5}$
Pr	$<3.4x10^{-5}$ $<9.2x10^{-5}$ $<3.4x10^{-5}$	$<2.2x10^{-5}$ $<2.7x10^{-5}$ $<3.0x10^{-5}$	$2.1x10^{-4}$ $<1.1x10^{-4}$ $<2.1x10^{-4}$	$1.3x10^{-2}$ $2.6x10^{-3}$ $6.6x10^{-3}$	$2.3x10^{-4}$ $1.8x10^{-4}$ $7.9x10^{-5}$	$<3.0x10^{-5}$ $<4.1x10^{-5}$ $<5.8x10^{-5}$

Element	[Rat] Wood mice[*]	[Deer] Roe deer[*]	[Bee] *Bombus Spp.*	[Earthworm] *Lumbricidae*	[Wild Grass] Purple moor grass[#]	[Pine Tree] Sitka spruce trunk[#]
Nd	$<2.9\times10^{-5}$ *7.7×10^{-5}* *1.8×10^{-5}*	$<3.6\times10^{-5}$ $<3.4\times10^{-5}$ $<1.1\times10^{-5}$	2.6×10^{-4} 5.5×10^{-5} 2.1×10^{-4}	1.2×10^{-2} 2.4×10^{-3} 5.8×10^{-3}	2.2×10^{-4} 1.3×10^{-4} 6.2×10^{-5}	2.6×10^{-5} 2.2×10^{-5} 4.6×10^{-5}
Sm	$<1.2\times10^{-4}$ $<1.7\times10^{-4}$ $<1.0\times10^{-4}$	$<8.8\times10^{-5}$ $<1.2\times10^{-4}$ $<7.1\times10^{-5}$	$<4.9\times10^{-4}$ $<2.8\times10^{-4}$ $<5.7\times10^{-4}$	1.2×10^{-2} 2.5×10^{-3} 5.6×10^{-3}	2.6×10^{-4} 1.7×10^{-4} 9.1×10^{-5}	$<6.8\times10^{-5}$ $<5.6\times10^{-5}$ $<1.5\times10^{-4}$
Eu	*2.0×10^{-4}* *2.9×10^{-4}* *6.5×10^{-4}*	*5.7×10^{-3}* *5.6×10^{-3}* *3.9×10^{-3}*	5.6×10^{-4} 1.2×10^{-4} 8.8×10^{-4}	1.2×10^{-2} 3.1×10^{-3} 5.6×10^{-3}	2.9×10^{-3} 2.2×10^{-3} 1.3×10^{-3}	1.9×10^{-3} 2.0×10^{-3} 5.4×10^{-3}
Gd	*4.8×10^{-5}* *9.5×10^{-5}* $<2.5\times10^{-5}$	*6.1×10^{-5}* *1.5×10^{-4}* *5.9×10^{-5}*	1.4×10^{-4} 6.1×10^{-5} 2.7×10^{-4}	1.3×10^{-2} 3.0×10^{-3} 5.5×10^{-3}	2.6×10^{-4} 1.5×10^{-4} 9.3×10^{-5}	4.7×10^{-5} 4.6×10^{-5} 1.4×10^{-4}
Tb	$<1.3\times10^{-4}$ $<1.9\times10^{-4}$ $<1.3\times10^{-4}$	$<7.4\times10^{-5}$ $<9.8\times10^{-5}$ $<6.9\times10^{-5}$	$<4.7\times10^{-4}$ $<2.8\times10^{-4}$ $<5.5\times10^{-4}$	1.3×10^{-2} 3.1×10^{-3} 5.4×10^{-3}	2.1×10^{-4} 1.8×10^{-4} 6.4×10^{-5}	$<8.3\times10^{-5}$ $<5.9\times10^{-5}$ $<2.0\times10^{-4}$
Dy	*1.1×10^{-4}* $<1.9\times10^{-4}$ $<8.3\times10^{-5}$	$<9.8\times10^{-5}$ $<1.0\times10^{-4}$ $<5.2\times10^{-5}$	$<2.8\times10^{-4}$ $<1.6\times10^{-4}$ $<3.3\times10^{-4}$	1.3×10^{-2} 2.9×10^{-3} 5.5×10^{-3}	1.6×10^{-4} $<1.3\times10^{-4}$ 6.1×10^{-5}	$<4.9\times10^{-5}$ $<4.4\times10^{-5}$ $<1.3\times10^{-4}$
Ho	$<1.5\times10^{-4}$ $<3.2\times10^{-4}$ $<1.4\times10^{-4}$	*1.0×10^{-4}* $<1.1\times10^{-4}$ $<8.2\times10^{-5}$	$<4.6\times10^{-4}$ $<2.7\times10$-^{4} $<5.5\times10^{-4}$	$<1.4\times10^{-2}$ $<3.3\times10^{-3}$ $<6.2\times10^{-3}$	1.7×10^{-4} 1.2×10^{-4} 6.6×10^{-5}	$<7.9\times10^{-5}$ $<1.2\times10^{-4}$ $<2.2\times10^{-4}$
Er	$<6.1\times10^{-5}$ $<1.0\times10^{-4}$ $<6.6\times10^{-5}$	$<4.8\times10^{-5}$ $<7.2\times10^{-5}$ $<3.4\times10^{-5}$	$<2.2\times10^{-4}$ $<1.3\times10^{-4}$ $<2.6\times10^{-4}$	1.4×10^{-2} 2.9×10^{-3} 5.9×10^{-3}	1.6×10^{-4} 1.2×10^{-4} 6.9×10^{-5}	$<9.3\times10^{-5}$ $<1.3\times10^{-4}$ $<8.8\times10^{-5}$
Tm	$<1.1\times10^{-4}$ $<1.7\times10^{-4}$ $<1.1\times10^{-4}$	*8.7×10^{-5}* $<6.5\times10^{-5}$ $<7.5\times10^{-5}$	$<3.9\times10^{-4}$ $<2.3\times10^{-4}$ $<4.6\times10^{-4}$	1.3×10^{-2} 2.9×10^{-3} 5.5×10^{-3}	1.9×10^{-4} 1.7×10^{-4} $<1.3\times10^{-4}$	$<7.2\times10^{-5}$ $<3.2\times10^{-4}$ $<2.9\times10^{-4}$
Yb	$<1.3\times10^{-4}$ $<2.1\times10^{-4}$ $<1.1\times10^{-4}$	*2.0×10^{-4}* $<1.3\times10^{-4}$ $<1.1\times10^{-4}$	$<4.4\times10^{-4}$ 4.8×10^{-4} $<5.1\times10^{-4}$	1.3×10^{-2} 3.5×10^{-3} 5.9×10^{-3}	1.5×10^{-4} 2.0×10^{-4} 1.1×10^{-4}	$<1.2\times10^{-4}$ 1.5×10^{-4} $<1.7\times10^{-4}$
Lu	$<6.5\times10^{-4}$ $<1.0\times10^{-3}$ $<6.3\times10^{-4}$	$<5.7\times10^{-4}$ $<6.7\times10^{-4}$ $<3.6\times10^{-4}$	$<2.5\times10^{-3}$ $<1.5\times10^{-3}$ $<3.0\times10^{-3}$	1.4×10^{-2} 2.6×10^{-3} 6.4×10^{-3}	$<4.1\times10^{-4}$ $<3.6\times10^{-4}$ $<1.9\times10^{-4}$	$<5.5\times10^{-4}$ $<5.8\times10^{-4}$ $<1.1\times10^{-3}$
Hf	$<6.5\times10^{-4}$ $<7.4\times10^{-4}$ $<4.7\times10^{-4}$	$<7.6\times10^{-4}$ $<3.9\times10^{-4}$ $<3.6\times10^{-4}$	1.2×10^{-2} $<2.4\times10^{-3}$ $<2.5\times10^{-3}$	1.6×10^{-2} 3.4×10^{-3} 1.0×10^{-2}	$<8.2\times10^{-3}$ $<9.3\times10^{-3}$ $<5.3\times10^{-3}$	$<5.8\times10^{-4}$ $<4.7\times10^{-4}$ $<6.6\times10^{-4}$
Ta	$<5.1\times10^{-2}$ $<7.2\times10^{-2}$ $<4.7\times10^{-2}$	$<9.1\times10^{-3}$ $<3.5\times10^{-3}$ $<9.4\times10^{-3}$	$<7.0\times10^{-2}$ $<4.1\times10^{-2}$ $<1.5\times10^{-1}$	$<1.3\times10^{-2}$ $<1.3\times10^{-2}$ $<1.1\times10^{-2}$	$<7.1\times10^{-3}$ $<8.6\times10^{-3}$ $<6.6\times10^{-3}$	$<2.4\times10^{-2}$ $<1.6\times10^{-2}$ $<1.5\times10^{-2}$
W	n/a n/a n/a	n/a n/a n/a	$<3.6\times10^{-3}$ $<2.1\times10^{-3}$ $<4.2\times10^{-3}$	n/a n/a n/a	3.4×10^{-3} 2.8×10^{-4} $<9.2\times10^{-4}$	$<1.0\times10^{-2}$ 1.9×10^{-2} 1.8×10^{-2}
Re	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a $<4.9\times10^{-4}$ n/a	n/a n/a n/a
Ir	n/a n/a n/a	n/a n/a n/a	$<2.5\times10^{-1}$ $<1.5\times10^{-1}$ $<2.9\times10^{-1}$	$<1.8\times10^{-2}$ $<1.9\times10^{-2}$ $<2.6\times10^{-2}$	$<2.9\times10^{-2}$ n/a $<3.3\times10^{-2}$	$<4.4\times10^{-2}$ $<3.4\times10^{-2}$ n/a
Pt	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	$<2.8\times10^{-2}$ $<2.3\times10^{-2}$ n/a
Hg	$<5.3\times10^{-2}$ $<5.0\times10^{-2}$ $<1.3\times10^{-1}$	$<2.5\times10^{-2}$ $<2.6\times10^{-2}$ $<2.4\times10^{-2}$	$<6.3\times10^{-2}$ $<3.7\times10^{-2}$ $<7.3\times10^{-2}$	1.7 4.7×10^{-1} 2.0	1.1×10^{-2} $<6.6\times10^{-3}$ $<5.3\times10^{-3}$	$<4.7\times10^{-2}$ $<3.9\times10^{-2}$ $<1.2\times10^{-2}$
Tl	$<8.3\times10^{-3}$ $<1.4\times10^{-2}$ $<8.5\times10^{-3}$	$<6.8\times10^{-3}$ $<5.8\times10^{-3}$ $<5.9\times10^{-3}$	$<2.9\times10^{-2}$ 5.0×10^{-2} $<3.4\times10^{-2}$	4.5×10^{-2} 1.9×10^{-2} 4.6×10^{-2}	$<2.5\times10^{-2}$ $<3.6\times10^{-3}$ $<8.4\times10^{-3}$	$<2.2\times10^{-2}$ $<2.6\times10^{-2}$ $<8.2\times10^{-3}$

Element	**[Rat] Wood mice***	**[Deer] Roe deer***	**[Bee] *Bombus Spp.***	**[Earthworm] *Lumbricidae***	**[Wild Grass] Purple moor grass#**	**[Pine Tree] Sitka spruce trunk#**
Pb	*$3.4x10^{-3}$* *$8.9x10^{-4}$* *$3.4x10^{-3}$*	$<5.4x10^{-4}$ *$6.2x10^{-4}$* *$1.1x10^{-3}$*	$<1.2x10^{-4}$ $<9.5x10^{-5}$ $<1.9x10^{-4}$	$1.9x10^{-1}$ $2.3x10^{-2}$ $8.9x10^{-1}$	$5.6x10^{-4}$ $7.8x10^{-4}$ $7.6x10^{-4}$	$3.0x10^{-3}$ $3.1x10^{-3}$ $3.7x10^{-4}$
Th	*$6.0x10^{-5}$* *$8.4x10^{-5}$* $<2.9x10^{-5}$	$<2.4x10^{-5}$ $<2.1x10^{-5}$ $<4.2x10^{-5}$	$4.2x10^{-4}$ $<1.9x10^{-4}$ $<3.7x10^{-4}$	$1.1x10^{-2}$ $1.9x10^{-3}$ $5.7x10^{-3}$	$2.7x10^{-4}$ $3.1x10^{-4}$ $9.5x10^{-5}$	$<4.9x10^{-5}$ $<2.2x10^{-5}$ $<1.6x10^{-4}$
U	$<2.0x10^{-4}$ $<2.4x10^{-4}$ $<1.5x10^{-4}$	$<1.1x10^{-4}$ $<1.2x10^{-4}$ $<1.4x10^{-4}$	$8.3x10^{-4}$ $<4.3x10^{-4}$ $<8.5x10^{-4}$	$3.4x10^{-2}$ $7.6x10^{-3}$ $2.2x10^{-2}$	$3.4x10^{-4}$ $4.3x10^{-4}$ $1.6x10^{-4}$	$<3.0x10^{-4}$ $<1.1x10^{-4}$ $<1.9x10^{-4}$

Each value represents an individual biota sample other than each of the three Purple moor grass and Sitka spruce samples where each value is the mean of three replicates. # See the legend of Table 3 for information on '<' values for Purple moor grass and Sitka spruce. *Values in italics denote where the whole body concentration (used to estimate the $CR_{wo-soil)}$ was estimated using some tissue(s) data below the limit of detection (LOD) as described in the "Results section", "Concentrations in RAP Samples". n/a – no $CR_{wo-soil}$ values presented as soil concentration was below limit of detection LOD.

Table 7. Comparison of the range in stable element and radionuclide concentration ratios ($CR_{wo\text{-}soil}$) for selected [RAP] species for Cs and K.

[RAP]:Species	n	Element			
		Cs^+	**^{137}Cs**	**K^+**	**^{40}K**
[Wild grass]: Purple moor grass (leaf)	3	$(1.9\text{-}5.7)\times10^{-2}$	$(0.6\text{-}1.3)\times10^{-1}$	$(2.0\text{-}4.0)\times10^{-1}$	0.3-1.8
[Pine Tree]: Sitka spruce (trunk)	3	$<2.4\times10^{-4}$	$(1.0\text{-}1.4)\times10^{-3}$	$(0.8\text{-}1.3)\times10^{-2}$	$(2.3\text{-}4.6)\times10^{-2}$
[Deer]: Roe deer[+]	3	$(1.0\text{-}6.9)\times10^{-3}$	$(0.1\text{-}1.2)\times10^{-1}$	$(6.5\text{-}8.6)\times10^{-2}$	$(1.9\text{-}3.9)\times10^{-1}$

[+]The stable element $CR_{wo\text{-}soil}$ value for Roe deer is derived using estimated whole body concentrations whereas the radionuclide $CR_{wo\text{-}soil}$ value is estimated from muscle concentrations only (see text).

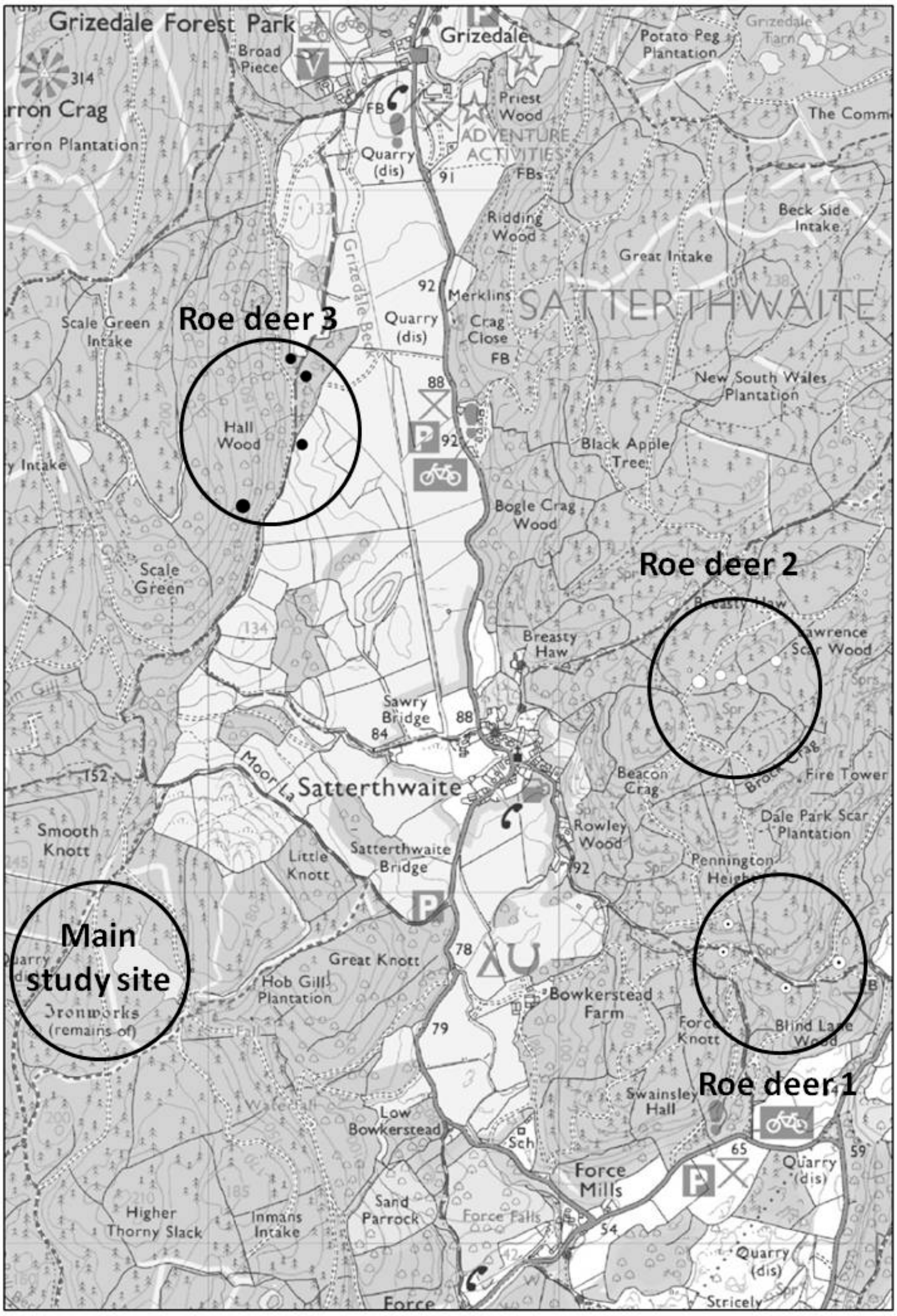

Fig 1 Location of the main study site where Wood mice, earthworms, bees, Sitka spruce and Purple moor grass, and their associated soil samples were collected. Also identified are the locations of each of the three Roe deer (large dots) and their associated soil samples (small dots) (© NERC (CEH) 2013, © Crown copyright and database rights Ordnance Survey 100017572).

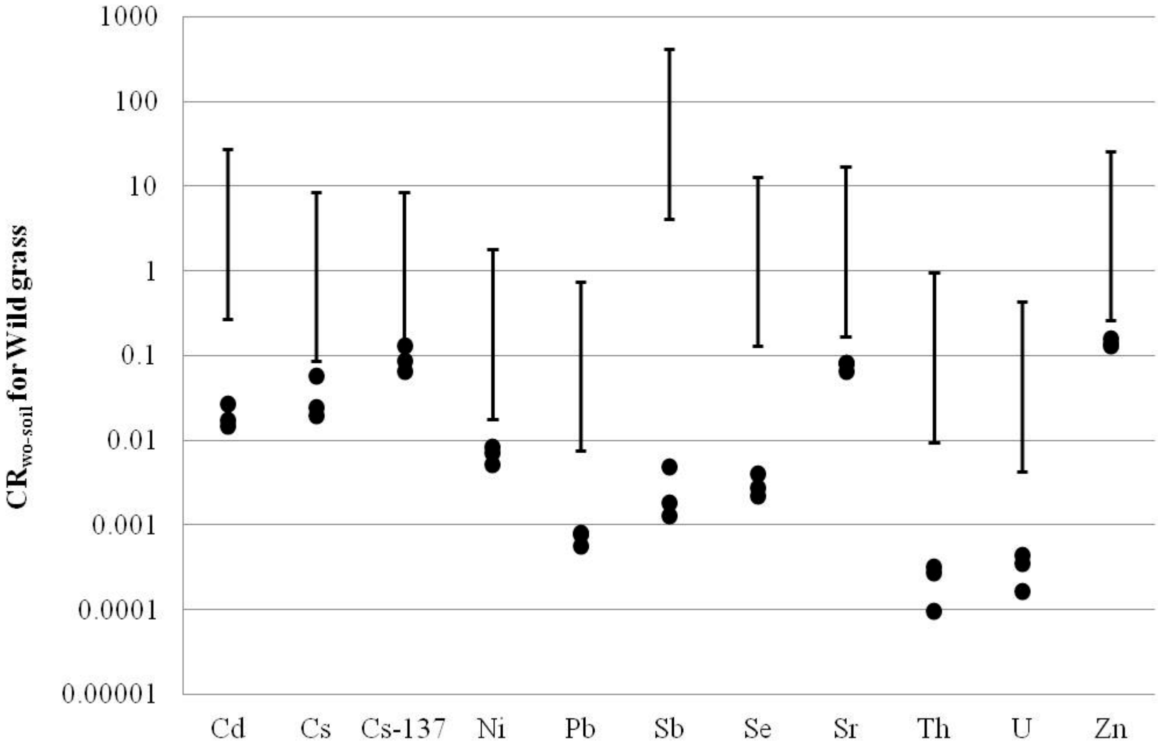

Fig 2 Comparison of the $CR_{wo\text{-}soil}$ values measured in this study for Wild grass (each 'dot' represents an individual sample) with those recommended by ICRP (2009) (represented as an order of magnitude range above and below the recommended value to be consistent with discussion within the text).

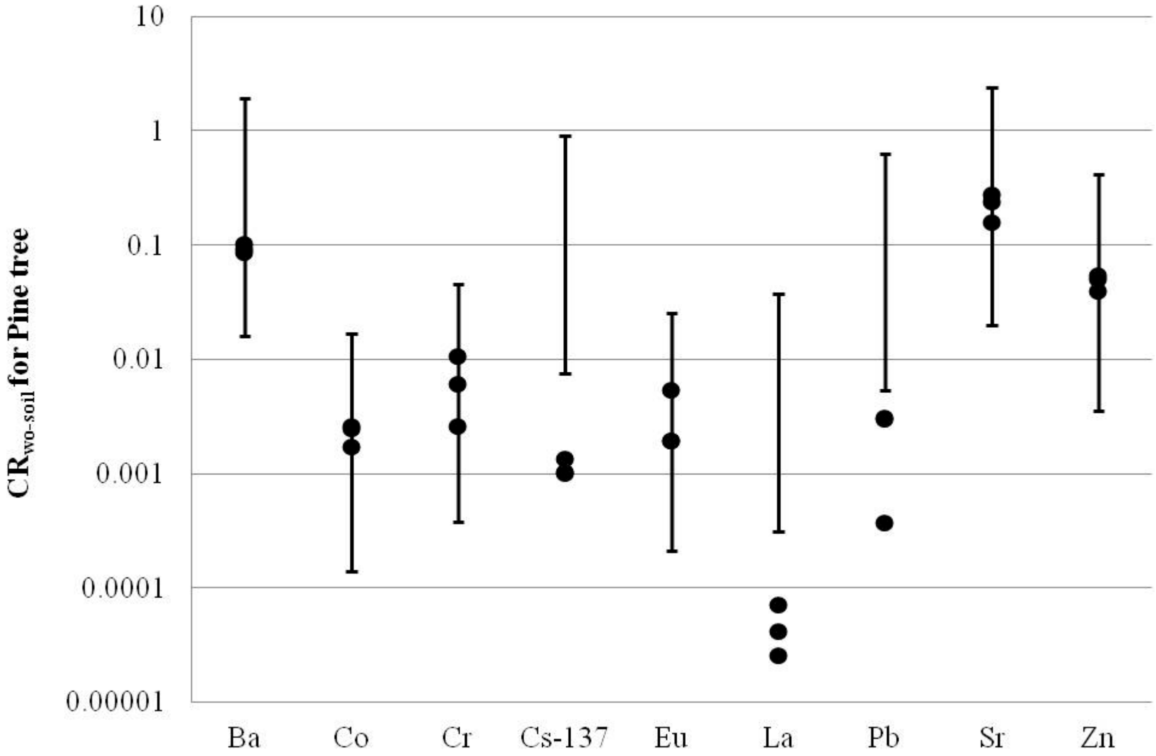

Fig 3 Comparison of the $CR_{wo\text{-}soil}$ values measured in this study for Pine tree (each 'dot' represents an individual sample) with those recommended by ICRP (2009) (represented as an order of magnitude range above and below the recommended value to be consistent with discussion within the text).

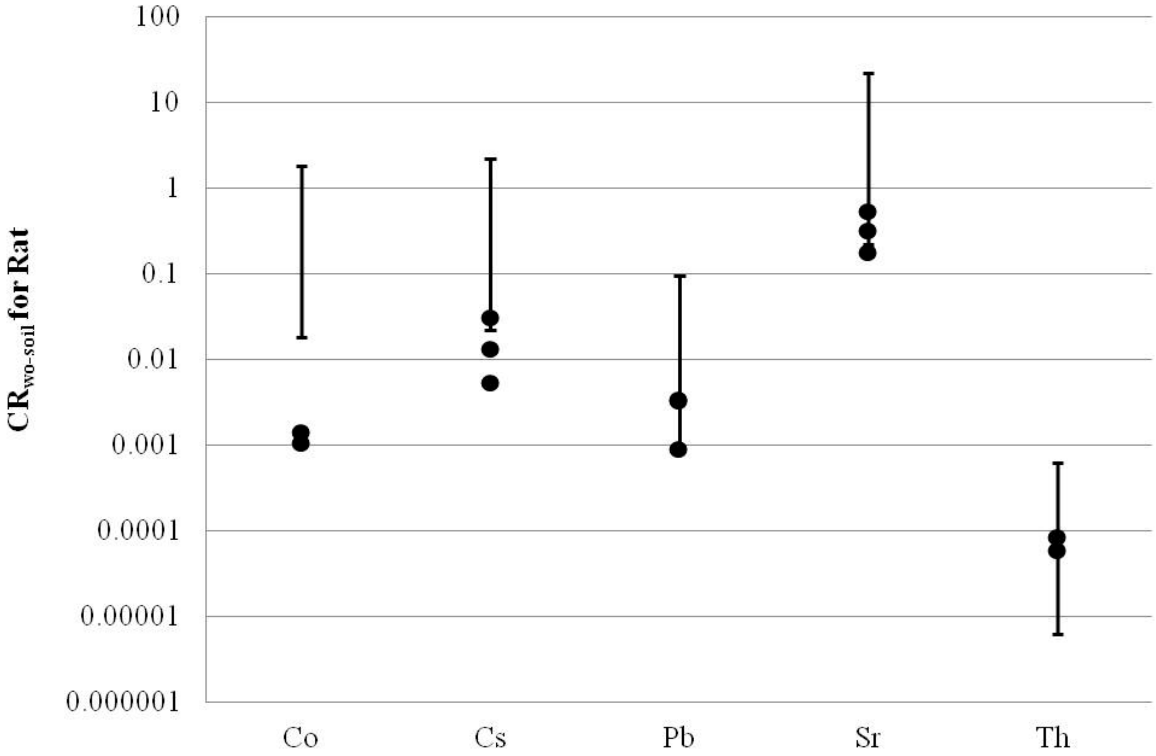

Fig 4 Comparison of the $CR_{wo\text{-}soil}$ values measured in this study for Rat (each 'dot' represents an individual sample) with those recommended by ICRP (2009) (represented as an order of magnitude range above and below the recommended value to be consistent with discussion within the text).

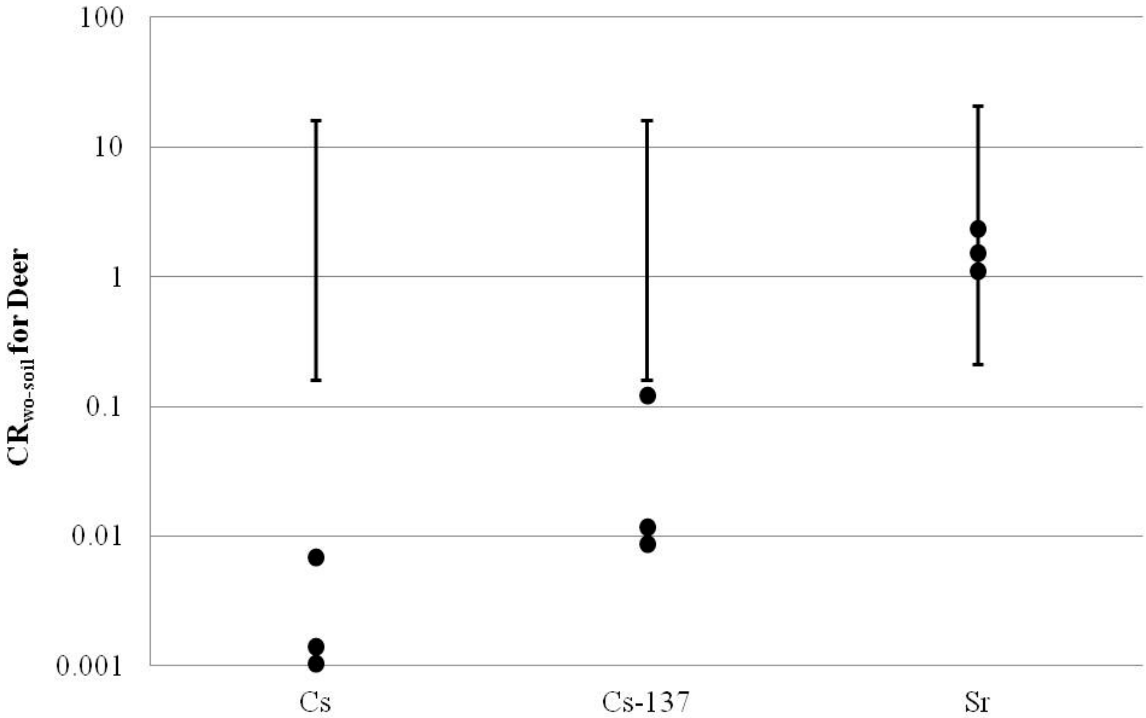

Fig 5 Comparison of the $CR_{wo\text{-}soil}$ values measured in this study for Deer (each 'dot' represents an individual sample) with those recommended by ICRP (2009) (represented as an order of magnitude range above and below the recommended value to be consistent with discussion within the text).

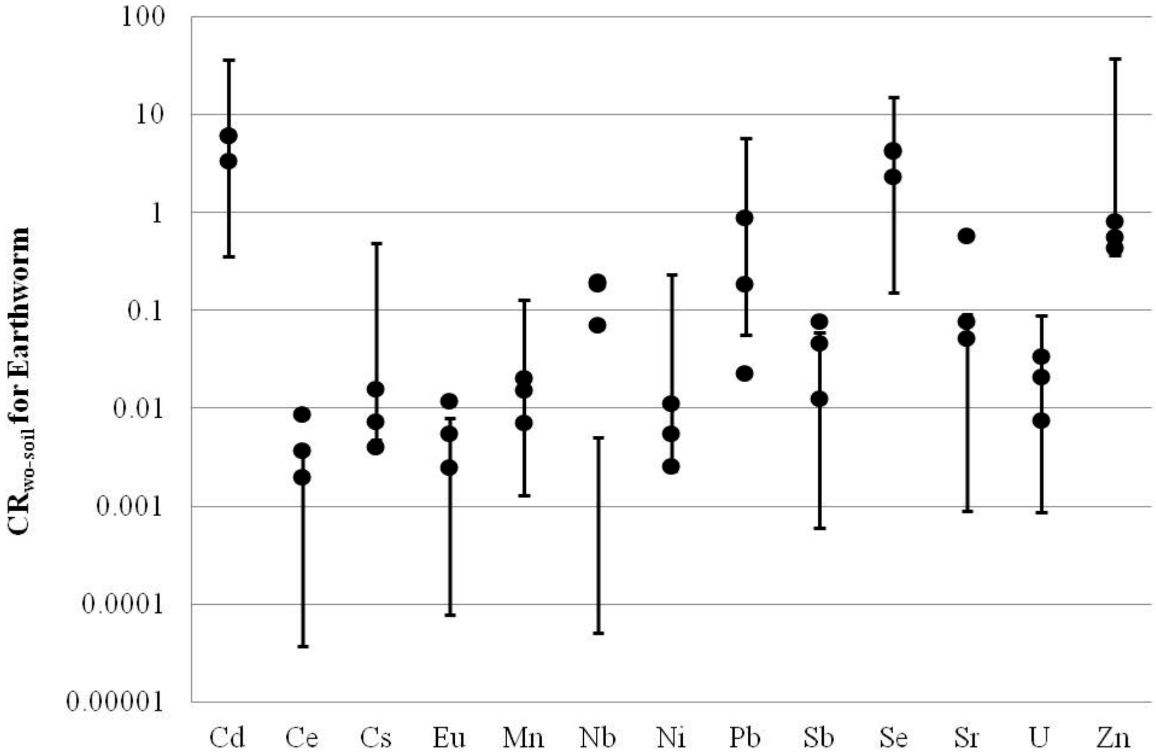

Fig 6 Comparison of the $CR_{wo\text{-}soil}$ values measured in this study for Earthworm (each 'dot' represents an individual sample) with those recommended by ICRP (2009) (represented as an order of magnitude range above and below the recommended value to be consistent with discussion within the text).

Table 1. Terrestrial Reference Animals and Plants (RAP; as defined in ICRP (2008)) and the species sampled during this study.

RAP	Family	Family/species sampled
Bee	*Apidea*	*Bombus spp.*(Bumblebees)
Deer	*Cervidae*	*Capreolus capreolus* (Roe deer)
Duck	*Anatidae*	Not sampled
Earthworm	*Lumbricidae*	*Lumbricidae*
Frog	*Ranidae*	Not sampled
Pine Tree	*Pinaceae*	*Picea sitchensis* (Sitka spruce)
Rat	*Muridae*	*Apodemus sylvaticus* (Wood mouse)
Wild Grass	*Poaceae*	*Molinia caerulea* (Purple moor grass)

Table 2. Arithmetic means and (ranges) in stable element concentrations measured in soil.

Element	Data quality#	Concentration in soil (mg kg^{-1} (dry mass))	Element	Data quality#	Concentration in soil (mg kg^{-1} (dry mass))
Li	Q±40	$2.5x10^{1}$ $(0.4\text{-}4.8)x10^{1}$	**Sb**	U	$5.8x10^{-1}$ 0.2-1.8
Be	Q±20	$9.5x10^{-1}$ 0.4-1.5	**Te**	No CRM	$(<0.3\text{-}1.3)x10^{-1}$
B	Q±20	$1.4x10^{1}$ $(0.7\text{-}2.0)x10^{1}$	**Cs**	Q±20	2.9 0.6-3.6
Na	Q±40	$2.8x10^{3}$ $(2.0\text{-}5.8)x10^{3}$	**Ba**	QL	$1.4x10^{2}$ $(0.9\text{-}1.7)x10^{2}$
Mg	Q±20	$6.7x10^{3}$ $(0.2\text{-}1.5)x10^{4}$	**La**	Q±20	$2.4x10^{1}$ $(1.2\text{-}3.2)x10^{1}$
Al	Q±40	$4.2x10^{4}$ $(1.3\text{-}5.6)x10^{4}$	**Ce**	Q±20	$5.9x10^{1}$ $(0.2\text{-}1.0)x10^{2}$
K	Q±40	$3.3x10^{4}$ $(0.6\text{-}4.8)x10^{4}$	**Pr**	Q±20	5.4 2.7-7.7
Ca	Q±40	$3.3x10^{3}$ $(0.1\text{-}1.2)x10^{4}$	**Nd**	Q±20	$2.1x10^{1}$ $(1.1\text{-}3.0)x10^{1}$
Ti	U	$1.5x10^{2}$ $(0.8\text{-}2.3)x10^{2}$	**Sm**	Q±40	3.6 1.8-5.1
V	Q±20	$6.5x10^{1}$ $(3.6\text{-}8.2)x10^{1}$	**Eu**	Q±20	$7.2x10^{-1}$ 0.3-1.1
Cr	Q±20	$6.2x10^{1}$ $(1.5\text{-}8.8)x10^{1}$	**Gd**	Q±20	3.3 1.5-4.6
Mn	Q±20	$7.4x10^{2}$ $(0.1\text{-}1.4)x10^{3}$	**Tb**	Q±20	$4.0x10^{-1}$ $(1.8\text{-}5.7)x10^{-1}$
Fe	Q±20	$3.4x10^{4}$ $(1.2\text{-}4.5)x10^{4}$	**Dy**	Q±40	2.1 1.0-3.0
Co	Q±20	9.2 $(0.3\text{-}1.9)x10^{1}$	**Ho**	Q±40	$3.6x10^{-1}$ $(1.7\text{-}5.2)x10^{-1}$
Ni	Q±20	$3.1x10^{1}$ $(1.2\text{-}7.7)x10^{1}$	**Er**	Q±20	$9.9x10^{-1}$ 0.5-1.4
Cu	Q±20	$2.6x10^{1}$ $(1.6\text{-}5.1)x10^{1}$	**Tm**	Q±40	$1.3x10^{-1}$ $(0.6\text{-}1.7)x10^{-1}$
Zn	Q±20	$8.0x10^{1}$ $(0.5\text{-}1.3)x10^{2}$	**Yb**	QL	$7.7x10^{-1}$ 0.4-1.0
As	Q±20	$3.3x10^{1}$ $(0.9\text{-}8.7)x10^{1}$	**Lu**	QL	$1.1x10^{-1}$ $(0.5\text{-}1.4)x10^{-1}$
Se	Q±20	2.1 0.4-4.6	**Hf**	U	$3.2x10^{-1}$ $(0.9\text{-}4.8)x10^{-1}$
Rb	Q±40	$6.1x10^{1}$ $(0.1\text{-}1.1)x10^{2}$	**Ta**	U	$2.2x10^{-2}$ $(1.0\text{-}8.0)x10^{-2}$
Sr	Q±20	$2.0x10^{1}$ $(0.9\text{-}5.7)x10^{1}$	**W**	No CRM	$(<0.1\text{-}2.5)x10^{-1}$
Y	Q±40	9.6 $(0.4\text{-}1.6)x10^{1}$	**Re**	No CRM	$<3.0x10^{-2+}$
Zr	U	$1.3x10^{1}$ $(0.3\text{-}1.9)x10^{1}$	**Ir**	No CRM	$<6.0x10^{-3+}$
Nb	U	$6.9x10^{-2}$ $(0.2\text{-}1.3)x10^{-1}$	**Pt**	No CRM	$(<0.6\text{-}4.1)x10^{-2}$
Mo	QL	1.0 0.3-3.0	**Au**	No CRM	$<3.0x10^{-2}$
Ru	No CRM	$<1.6x10^{-2+}$	**Hg**	Q±40	$2.4x10^{-1}$ $(0.4\text{-}5.0)x10^{-1}$
Pd	No CRM	$(<1.7\text{-}4.1)x10^{-1}$	**Tl**	Q±20	$6.2x10^{-1}$ $(2.7\text{-}8.6)x10^{-1}$

Element	**Data quality**[#]	**Concentration in soil (mg kg^{-1} (dry mass))**	**Element**	**Data quality**[#]	**Concentration in soil (mg kg^{-1} (dry mass))**
Ag	No CRM	2.6x10^{-1} (0.7-2-6.6)x10^{-1}	**Pb**	Q±20	2.4x10^{2} (0.3-6.7)x10^{2}
Cd	Q±20	5.5x10^{-1} 0.2-2.1	**Th**	Q±20	4.8 0.9-6.8
Sn	No CRM	7.7 (0.1-1.6)x10^{1}	**U**	QL	9.5x10^{-1} 0.6-1.2

[#]An indication of the data quality for each element is presented: if the analysis of the controlled reference material (CRM) was within ±20% of the certified value the data quality is defined as Q±20; if it was within ±40% it is defined as Q±40; if it is within factor of two it is defined as QL (qualitative); if it is outside a factor of two it is defined as U and suggested to be unreliable; if no CRM was available it is defined No CRM and should be considered to be qualitative (see also text). [+]Highest limit of detection (LOD) presented, some samples had measurable concentrations for these elements but the values were in the range of reported LOD for other samples.

Table 3. Stable element concentrations (mg kg^{-1} (fresh mass)) measured in [RAP] species.

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Li	Q±20	<1.2x10^{-2} <1.4x10^{-2} <1.2x10^{-2}	<4.9x10^{-2} *4.4x10^{-2}* *3.6x10^{-2}*	<3.0x10^{-2} <1.8x10^{-2} <3.5x10^{-2}	5.8x10^{-1} 1.8x10^{-1} 2.8x10^{-1}	5.0x10^{-3} 5.6x10^{-3} 4.7x10^{-3}	<8.8x10^{-3} <5.6x10^{-3} <5.8x10^{-3}
Be	Q±20	<1.6x10^{-3} <2.5x10^{-3} <1.6x10^{-3}	<8.4x10^{-4} <8.3x10^{-4} <9.4x10^{-4}	<5.6x10^{-3} <3.3x10^{-3} <6.6x10^{-3}	1.8x10^{-2} 4.3x10^{-3} 8.2x10^{-3}	<5.5x10^{-4} <5.5x10^{-4} <5.3x10^{-4}	<1.4x10^{-3} <1.1x10^{-3} <1.1x10^{-3}
B	Q±40	*3.6* <1.0 *3.1*	7.1x10^{-1} *5.2x10^{-1}* 7.9x10^{-1}	4.8 4.7 5.5	3.9x10^{-1} 1.4x10^{-1} 2.6x10^{-1}	1.7 3.0 2.8	1.5 1.3 1.4
Na	Q±20	1.1x10^{3} 1.4x10^{3} 1.1x10^{3}	1.5x10^{3} 1.4x10^{3} 1.5x10^{3}	2.3x10^{2} 3.0x10^{2} 3.6x10^{2}	6.7x10^{2} 8.9x10^{2} 5.7x10^{2}	3.9x10^{2} 2.5x10^{2} 2.9x10^{2}	6.1 <3.9 2.3
Mg	Q±20	3.8x10^{2} 4.6x10^{2} 3.4x10^{2}	8.7x10^{2} 7.8x10^{2} 1.0x10^{3}	3.5x10^{2} 2.1x10^{2} 3.1x10^{2}	2.7x10^{2} 1.2x10^{2} 1.9x10^{2}	4.3x10^{2} 3.4x10^{2} 3.2x10^{2}	4.4x10^{1} 4.5x10^{1} 3.3x10^{1}
Al	Q±20	*5.9* *3.6* <8.6x10^{-1}	*1.5* <8.5x10^{-1} <1.7	7.6 <1.7 <3.5	6.5x10^{2} 1.2x10^{2} 3.1x10^{2}	3.3 2.0 1.9	1.3 7.8x10^{-1} 8.4x10^{-1}
K	Q±20	3.1x10^{3} 4.1x10^{3} 3.2x10^{3}	3.1x10^{3} 2.8x10^{3} 2.8x10^{3}	2.8x10^{3} 2.0x10^{3} 3.2x10^{3}	1.6x10^{3} 1.2x10^{3} 1.5x10^{3}	3.5x10^{3} 2.4x10^{3} 2.4x10^{3}	3.1x10^{2} 2.5x10^{2} 3.0x10^{2}
Ca	Q±20	1.5x10^{4} 1.4x10^{4} 1.4x10^{4}	4.2x10^{4} 3.7x10^{4} 4.4x10^{4}	4.2x10^{2} 2.8x10^{2} 4.9x10^{2}	6.2x10^{2} 3.6x10^{2} 6.0x10^{2}	7.8x10^{2} 9.5x10^{2} 8.9x10^{2}	2.6x10^{2} 3.7x10^{2} 2.3x10^{2}

Element	**Data quality[#]**	**[Rat]** **Wood mouse** **(whole body)**	**[Deer]** **Roe deer** **(whole body)**	**[Bee]** ***Bombus spp.*** **(whole body)**	**[Earthworm]** ***Lumbricidae*** **(whole body)**	**[Wild grass]** **Purple moor grass (leaf)**	**[Pine Tree]** **Sitka spruce** **(trunk)**
Ti	Q±40	*$8.3x10^{-1}$* $<6.8x10^{-1}$ $<1.8x10^{-1}$	*$5.2x10^{-1}$* $<4.5x10^{-1}$ $<4.4x10^{-1}$	4.8 $4.9x10^{-1}$ $<7.5x10^{-1}$	6.1 1.8 5.0	$6.8x10^{-1}$ $5.6x10^{-1}$ $5.6x10^{-1}$	$1.3x10^{1}$ $9.7x10^{-1}$ $9.1x10^{-1}$
V	Q±20	$<3.9x10^{-2}$ $<6.6x10^{-2}$ $<3.9x10^{-2}$	$<3.0x10^{-2}$ $<2.3x10^{-2}$ $<2.3x10^{-2}$	$<1.4x10^{-1}$ $<8.5x10^{-2}$ $<1.7x10^{-1}$	$8.6x10^{-1}$ $1.7x10^{-1}$ $5.8x10^{-1}$	$<1.3x10^{-2}$ $<1.3x10^{-2}$ $<1.3x10^{-2}$	$<3.4x10^{-2}$ $<4.5x10^{-2}$ $<2.6x10^{-2}$
Cr	Q±20	$<7.8x10^{-2}$ *$1.7x10^{-1}$* *$1.4x10^{-1}$*	$<4.9x10^{-2}$ $<1.6x10^{-2}$ *$1.1x10^{-1}$*	$<5.5x10^{-2}$ $<3.3x10^{-2}$ $<6.4x10^{-2}$	1.0 $2.1x10^{-1}$ $5.1x10^{-1}$	$1.9x10^{-2}$ $1.3x10^{-2}$ $1.4x10^{-2}$	$4.7x10^{-1}$ $8.3x10^{-1}$ $9.1x10^{-2}$
Mn	Q±20	<2.0 <2.9 <2.0	<1.3 <1.4 <1.3	$1.6x10^{2}$ $8.3x10^{1}$ $1.0x10^{2}$	$1.6x10^{1}$ 7.2 $2.1x10^{1}$	$1.6x10^{2}$ $1.2x10^{2}$ $1.2x10^{2}$	$3.7x10^{1}$ $5.7x10^{1}$ $3.5x10^{1}$
Fe	Q±20	$5.1x10^{1}$ $6.3x10^{1}$ $5.0x10^{1}$	$2.5x10^{1}$ $4.5x10^{1}$ $3.4x10^{1}$	$6.7x10^{1}$ $5.0x10^{1}$ $5.7x10^{1}$	$5.7x10^{2}$ $1.0x10^{2}$ $2.9x10^{2}$	$1.8x10^{1}$ $1.3x10^{1}$ $1.3x10^{1}$	$4.1x10^{2}$ $8.9x10^{2}$ $4.0x10^{1}$
Co	Q±20	$1.1x10^{-2}$ $1.4x10^{-2}$ $<1.2x10^{-2}$	$6.7x10^{-3}$ $6.7x10^{-3}$ *$6.5x10^{-3}$*	$2.7x10^{-1}$ $3.3x10^{-2}$ $<1.2x10^{-2}$	$5.9x10^{-1}$ $2.3x10^{-1}$ $3.5x10^{-1}$	$8.7x10^{-3}$ $3.7x10^{-3}$ $3.6x10^{-3}$	$3.1x10^{-2}$ $4.7x10^{-2}$ $8.1x10^{-3}$
Ni	Q±20	$<2.7x10^{-2}$ *$1.5x10^{-1}$* $4.8x10^{-2}$	$<3.0x10^{-1}$ *$8.4x10^{-1}$* $2.9x10^{-1}$	$<9.2x10^{-2}$ $1.7x10^{-1}$ $<1.1x10^{-1}$	$7.9x10^{-1}$ $1.8x10^{-1}$ $3.8x10^{-1}$	$1.8x10^{-1}$ $8.7x10^{-2}$ $8.8x10^{-2}$	$1.5x10^{-1}$ $2.4x10^{-1}$ $2.8x10^{-2}$
Cu	Q±20	2.3 2.9 2.3	2.5 4.0 3.0	$3.0x10^{1}$ $1.7x10^{1}$ $1.5x10^{1}$	1.4 1.3 1.9	1.9 1.3 1.3	$6.0x10^{-1}$ $5.1x10^{-1}$ $4.0x10^{-1}$
Zn	Q±20	$2.7x10^{1}$ $2.7x10^{1}$ $2.6x10^{1}$	$4.7x10^{1}$ $2.7x10^{1}$ $2.7x10^{1}$	$5.7x10^{1}$ $2.3x10^{1}$ $3.4x10^{1}$	$6.0x10^{1}$ $8.9x10^{1}$ $4.8x10^{1}$	$1.1x10^{1}$ 8.5 8.8	6.1 4.4 2.4

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
As	Q±20	$<7.0x10^{-3}$ $<6.2x10^{-3}$ $<3.5x10^{-3}$	$<1.3x10^{-3}$ *$1.3x10^{-2}$* *$4.5x10^{-3}$*	$1.5x10^{-1}$ $3.2x10^{-2}$ $3.2x10^{-2}$	$7.2x10^{-1}$ $2.1x10^{-1}$ $7.3x10^{-1}$	$2.0x10^{-2}$ $1.5x10^{-2}$ $1.4x10^{-2}$	$2.8x10^{-2}$ $<7.8x10^{-2}$ $<3.2x10^{-3}$
Se	Q±20	$2.8x10^{-1}$ $3.4x10^{-1}$ $3.9x10^{-1}$	$9.5x10^{-2}$ $2.4x10^{-1}$ $1.2x10^{-1}$	$4.8x10^{-2}$ $3.9x10^{-2}$ $8.0x10^{-2}$	3.2 1.8 3.2	$1.4x10^{-2}$ $9.6x10^{-3}$ $1.0x10^{-2}$	$<6.1x10^{-3}$ $<4.5x10^{-3}$ $<4.7x10^{-3}$
Rb	Q±20	$1.2x10^{1}$ $2.1x10^{1}$ $1.7x10^{1}$	1.6 3.2 2.3	1.1 2.1 1.9	1.3 $7.7x10^{-1}$ 1.2	7.2 6.2 6.3	$1.5x10^{-1}$ $1.4x10^{-1}$ $4.4x10^{-1}$
Sr	Q±20	3.7 6.4 2.1	$1.7x10^{1}$ $2.1x10^{1}$ $1.7x10^{1}$	$6.5x10^{-1}$ $2.2x10^{-1}$ $8.9x10^{-1}$	1.3 $9.9x10^{-1}$ 1.5	3.5 3.7 3.5	3.4 5.9 4.1
Y	Q±40	*$8.8x10^{-4}$* $<8.1x10^{-4}$ $<4.2x10^{-4}$	$<5.5x10^{-4}$ $<6.5x10^{-4}$ $<5.0x10^{-4}$	$2.3x10^{-3}$ $<9.5x10^{-4}$ $<1.9x10^{-3}$	$1.7x10^{-1}$ $4.1x10^{-2}$ $7.3x10^{-2}$	$5.6x10^{-3}$ $4.6x10^{-3}$ $4.4x10^{-3}$	$<4.1x10^{-4}$ $9.1x10^{-4}$ $<4.2x10^{-4}$
Zr	No CRM	*$5.8x10^{-3}$* *$6.8x10^{-3}$* $<1.7x10^{-3}$	*$3.2x10^{-3}$* $1.6x10^{-3}$ *$1.9x10^{-3}$*	$1.0x10^{-1}$ $4.5x10^{-3}$ $<5.8x10^{-3}$	$2.1x10^{-1}$ $4.1x10^{-2}$ $1.4x10^{-1}$	$5.0x10^{-2}$ $4.5x10^{-2}$ $4.6x10^{-2}$	$3.7x10^{-3}$ $2.8x10^{-3}$ $<1.5x10^{-3}$
Nb	Q±40	*$2.7x10^{-3}$* *$3.0x10^{-3}$* *$2.1x10^{-3}$*	*$2.9x10^{-3}$* *$2.4x10^{-3}$* *$3.0x10^{-3}$*	$<1.4x10^{-3}$ $<8.5x10^{-4}$ $<1.7x10^{-3}$	$1.0x10^{-2}$ $3.9x10^{-3}$ $1.1x10^{-2}$	$3.6x10^{-4}$ $3.0x10^{-4}$ $2.5x10^{-4}$	$1.9x10^{-2}$ $3.1x10^{-3}$ $2.0x10^{-3}$
Mo	U	$7.6x10^{-2}$ $1.4x10^{-1}$ $1.1x10^{-1}$	*$4.0x10^{-2}$* $3.8x10^{-2}$ *$4.0x10^{-2}$*	$2.0x10^{-1}$ $1.4x10^{-1}$ $2.2x10^{-1}$	$1.1x10^{-1}$ $4.5x10^{-2}$ $1.7x10^{-1}$	$9.2x10^{-2}$ $2.7x10^{-1}$ $2.7x10^{-1}$	$3.4x10^{-2}$ $6.3x10^{-2}$ $1.4x10^{-2}$
Ru	No CRM	$<2.1x10^{-4}$ $<5.6x10^{-4}$ $<2.3x10^{-4}$	$<8.1x10^{-2}$ $<3.9x10^{-4}$ $<3.0x10^{-4}$	$<8.1x10^{-4}$ $<4.9x10^{-4}$ $1.6x10^{-3}$	$<8.3x10^{-5}$ $<9.2x10^{-5}$ $2.0x10^{-4}$	$<6.4x10^{-5}$ $<1.6x10^{-4}$ $<6.6x10^{-5}$	$<2.0x10^{-4}$ $<1.7x10^{-4}$ $<2.1x10^{-4}$

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Pd	No CRM	*$2.4x10^{-3}$* *$3.7x10^{-3}$* *$1.9x10^{-3}$*	*$8.0x10^{-3}$* *$8.1x10^{-3}$* *$7.9x10^{-3}$*	$<1.1x10^{-3}$ $7.4x10^{-4}$ $<1.3x10^{-3}$	$4.6x10^{-3}$ $1.9x10^{-3}$ $3.0x10^{-3}$	$2.9x10^{-3}$ $2.6x10^{-3}$ $2.8x10^{-3}$	$3.4x10^{-3}$ $4.4x10^{-3}$ $3.0x10^{-3}$
Ag	Q±20	$<8.5x10^{-4}$ $<1.7x10^{-3}$ $<8.9x10^{-4}$	$<9.6x10^{-4}$ $<2.2x10^{-3}$ $<1.2x10^{-3}$	1.2x10-^{2} $1.0x10^{-2}$ $<3.6x10^{-3}$	$3.0x10^{-2}$ $1.3x10^{-2}$ $1.1x10^{-1}$	$1.7x10^{-3}$ $9.8x10^{-4}$ $8.9x10^{-4}$	$5.5x10^{-2}$ $3.4x10^{-2}$ $1.9x10^{-2}$
Cd	Q±20	$<1.4x10^{-2}$ $<1.2x10^{-2}$ *$8.4x10^{-2}$*	*$1.9x10^{-2}$* *$6.6x10^{-2}$* $<1.2x10^{-2}$	$7.2x10^{-2}$ $4.7x10^{-2}$ 6.7x10-^{2}	2.6 2.6 1.4	$5.6x10^{-2}$ $2.2x10^{-2}$ $2.2x10^{-2}$	$1.0x10^{-1}$ $6.3x10^{-2}$ $3.3x10^{-2}$
Sn	Q±40	$<4.5x10^{-3}$ $<1.1x10^{-2}$ *$8.2x10^{-2}$*	$<3.8x10^{-3}$ $<2.3x10^{-3}$ $<2.5x10^{-3}$	$2.1x10^{-2}$ $9.9x10^{-3}$ $<1.5x10^{-2}$	$2.9x10^{-2}$ $8.3x10^{-3}$ $4.0x10^{-2}$	$1.1x10^{-2}$ $1.1x10^{-2}$ $9.9x10^{-3}$	$1.6x10^{-2}$ $2.1x10^{-2}$ $7.2x10^{-3}$
Sb	Q±20	*$1.9x10^{-3}$* $<2.3x10^{-3}$ $<5.0x10^{-3}$	$<1.4x10^{-3}$ $<6.8x10^{-4}$ $<8.7x10^{-4}$	$<3.7x10^{-3}$ $2.5x10^{-3}$ $6.8x10^{-3}$	$1.4x10^{-2}$ $3.7x10^{-3}$ $2.3x10^{-2}$	$3.7x10^{-3}$ $2.3x10^{-3}$ $2.3x10^{-3}$	$8.0x10^{-3}$ $4.7x10^{-3}$ $2.7x10^{-3}$
Te	No CRM	$<2.6x10^{-3}$ $<4.3x10^{-3}$ $<2.3x10^{-3}$	$<1.3x10^{-3}$ $<2.4x10^{-3}$ $<1.3x10^{-3}$	$<9.2x10^{-3}$ $<5.3x10^{-3}$ $<1.1x10^{-2}$	$4.6x10^{-3}$ $1.5x10^{-3}$ $4.6x10^{-3}$	$<1.3x10^{-3}$ $<1.3x10^{-3}$ $<1.6x10^{-3}$	$<3.4x10^{-3}$ $<1.7x10^{-3}$ $<1.6x10^{-3}$
Cs	Q±40	$1.7x10^{-2}$ $4.4x10^{-2}$ $1.0x10^{-1}$	*$3.5x10^{-3}$* $2.3x10^{-2}$ $5.0x10^{-3}$	$6.0x10^{-3}$ $3.6x10^{-2}$ $5.1x10^{-3}$	$4.2x10^{-2}$ $1.1x10^{-2}$ $1.9x10^{-2}$	$4.7x10^{-2}$ $3.5x10^{-2}$ $3.6x10^{-2}$	$<7.4x10^{-4}$ $<6.1x10^{-4}$ $<6.3x10^{-4}$
Ba	Q±20	*$8.3x10^{-1}$* *1.1* *2.4*	$2.6x10^{1}$ $2.3x10^{1}$ $2.8x10^{1}$	1.2 $5.0x10^{-1}$ 2.0	2.8 $6.6x10^{-1}$ 2.0	$1.0x10^{1}$ 7.3 7.3	$1.1x10^{1}$ $1.2x10^{1}$ 9.4
La	Q±20	$<8.7x10^{-4}$ $<2.3x10^{-3}$ $<7.1x10^{-4}$	$<1.0x10^{-3}$ $<9.1x10^{-4}$ $<8.3x10^{-4}$	$3.2x10^{-3}$ $1.8x10^{-3}$ $4.0x10^{-3}$	$3.4x10^{-1}$ $7.5x10^{-2}$ $1.8x10^{-1}$	$7.6x10^{-3}$ $4.3x10^{-3}$ $4.1x10^{-3}$	$1.2x10^{-3}$ $7.5x10^{-4}$ $8.8x10^{-4}$

Element	Data quality[#]	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Ce	Q±40	<1.4x10^{-3} <4.3x10^{-3} <1.4x10^{-3}	<1.4x10^{-3} <1.1x10^{-3} <1.9x10^{-3}	<4.9x10^{-3} <2.9x10^{-3} <5.8x10^{-3}	8.2x10^{-1} 1.9x10^{-1} 3.6x10^{-1}	7.3x10^{-3} 4.5x10^{-3} 3.9x10^{-3}	<2.4x10^{-3} <1.1x10^{-3} <1.1x10^{-3}
Pr	Q±20	<2.0x10^{-4} <5.4x10^{-4} <2.0x10^{-4}	<1.2x10^{-4} <1.3x10^{-4} <2.2x10^{-4}	8.4x10^{-4} <4.6x10^{-4} <8.7x10^{-4}	8.6x10^{-2} 1.8x10^{-2} 4.5x10^{-2}	8.1x10^{-4} 5.5x10^{-4} 4.4x10^{-4}	<2.0x10^{-4} <2.8x10^{-4} <1.6x10^{-4}
Nd	Q±20	<6.5x10^{-4} *1.8x10^{-3}* *4.1x10^{-4}*	<7.6x10^{-4} <6.2x10^{-4} <3.3x10^{-4}	4.2x10^{-3} 8.8x10^{-4} 3.3x10^{-3}	3.1x10^{-1} 6.5x10^{-2} 1.5x10^{-1}	3.1x10^{-3} 1.6x10^{-3} 1.4x10^{-3}	7.0x10^{-4} 6.0x10^{-4} 4.9x10^{-4}
Sm	Q±20	<4.6x10^{-4} <6.6x10^{-4} <3.9x10^{-4}	<3.0x10^{-4} <3.6x10^{-4} <3.5x10^{-4}	<1.5x10^{-3} <8.5x10^{-4} <1.7x10^{-3}	5.8x10^{-2} 1.2x10^{-2} 2.0x10^{-2}	7.4x10^{-4} 3.9x10^{-4} 3.5x10^{-4}	<3.4x10^{-4} <2.8x10^{-4} <2.6x10^{-4}
Eu	Q±20	*1.5x10^{-4}* *2.1x10^{-4}* *4.9x10^{-4}*	*3.4x10^{-3}* *3.0x10^{-3}* *3.7x10^{-3}*	4.1x10^{-4} 8.8x10^{-5} 6.45x10^{-4}	1.2x10^{-2} 3.0x10^{-3} 5.4x10^{-3}	1.9x10^{-3} 1.3x10^{-3} 1.3x10^{-3}	2.1x10^{-3} 2.1x10^{-3} 1.8x10^{-3}
Gd	Q±20	*1.7x10^{-4}* *3.3x10^{-4}* <8.5x10^{-5}	*2.0x10^{-4}* *4.0x10^{-4}* *2.6x10^{-4}*	4.4x10^{-4} 1.8x10^{-4} 8.3x10^{-4}	5.6x10^{-2} 1.3x10^{-2} 2.4x10^{-2}	6.9x10^{-4} 3.6x10^{-4} 3.7x10^{-4}	2.1x10^{-4} 2.1x10^{-4} 2.0x10^{-4}
Tb	Q±20	<5.5x10^{-5} <8.0x10^{-5} <5.3x10^{-5}	<2.5x10^{-5} <3.0x10^{-5} <3.6x10^{-5}	<1.9x10^{-4} <1.1x10^{-4} <2.2x10^{-4}	6.9x10^{-3} 1.7x10^{-3} 2.9x10^{-3}	7.5x10^{-5} 5.9x10^{-5} 3.4x10^{-5}	<4.7x10^{-5} <3.4x10^{-5} <3.7x10^{-5}
Dy	Q±40	*2.3x10^{-4}* <4.1x10^{-4} <1.8x10^{-4}	<1.6x10^{-4} <1.5x10^{-4} <1.3x10^{-4}	<6.3x10^{-4} <3.7x10^{-4} <7.4x10^{-4}	3.6x10^{-2} 8.0x10^{-3} 1.6x10^{-2}	3.1x10^{-4} <2.5x10^{-4} 1.8x10^{-4}	<1.5x10^{-4} <1.3x10^{-4} <1.2x10^{-4}
Ho	Q±40	<5.5x10^{-5} <1.2x10^{-4} <5.3x10^{-5}	*3.0x10^{-5}* <3.0x10^{-5} <3.8x10^{-5}	<1.9x10^{-4} <1.1x10^{-4} <2.2x10^{-4}	6.8x10^{-3} 1.5x10^{-3} 2.9x10^{-3}	6.1x10^{-5} 3.9x10^{-5} 3.4x10^{-5}	<4.1x10^{-5} <6.1x10^{-5} <3.7x10^{-5}

Element	Data quality#	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Er	Q±20	<6.3x10^{-5} <1.0x10^{-4} <6.9x10^{-5}	<4.0x10^{-5} <5.2x10^{-5} <4.2x10^{-5}	<2.3x10^{-4} <1.4x10^{-4} <2.8x10^{-4}	1.7x10^{-2} 3.7x10^{-3} 7.6x10^{-3}	1.6x10^{-4} 1.1x10^{-4} 9.1x10^{-5}	<1.3x10^{-4} <1.8x10^{-4} <4.2x10^{-5}
Tm	Q±40	<1.6x10^{-5} <2.3x10^{-5} <1.5x10^{-5}	*9.3x10^{-6}* <8.1x10^{-6} <1.2x10^{-5}	<5.2x10^{-5} <3.1x10^{-5} <6.1x10^{-5}	2.2x10^{-3} 4.8x10^{-4} 9.0x10^{-4}	2.3x10^{-5} 1.8x10^{-5} <2.2x10^{-5}	<1.2x10^{-5} <5.5x10^{-5} <1.7x10^{-5}
Yb	Q±40	<1.1x10^{-4} <1.7x10^{-4} <9.4x10^{-5}	*1.4x10^{-4}* <7.5x10^{-5} <1.0x10^{-4}	<3.4x10^{-4} 3.8x10^{-4} <4.0x10^{-4}	1.2x10^{-2} 3.4x10^{-3} 5.8x10^{-3}	1.1x10^{-4} 1.3x10^{-4} 1.1x10^{-4}	<1.2x10^{-4} 1.5x10^{-4} <6.3x10^{-5}
Lu	Q±40	<7.8x10^{-5} <1.2x10^{-4} <7.6x10^{-5}	<5.4x10^{-5} <5.7x10^{-5} <4.7x10^{-5}	<2.8x10^{-4} <1.7x10^{-4} <3.3x10^{-4}	1.9x10^{-3} 3.4x10^{-4} 8.6x10^{-4}	<4.2x10^{-5} <3.2x10^{-5} <2.6x10^{-5}	<7.4x10^{-5} <7.8x10^{-5} <5.3x10^{-5}
Hf	U	<2.7x10^{-4} <3.1x10^{-4} <2.0x10^{-4}	<2.8x10^{-4} <1.1x10^{-4} <1.4x10^{-4}	2.1x10^{-3} <4.2x10^{-4} <8.7x10^{-4}	5.5x10^{-3} 1.2x10^{-3} 3.5x10^{-3}	9.1x10^{-4} 9.3x10^{-4} 9.6x10^{-4}	<2.0x10^{-4} <1.1x10^{-4} <1.6x10^{-4}
Ta	No CRM	<3.8x10^{-4} <5.2x10^{-4} <3.5x10^{-4}	<2.2x10^{-4} <2.1x10^{-4} <2.2x10^{-4}	<1.2x10^{-3} <7.0x10^{-4} <1.4x10^{-3}	<1.3x10^{-4} <1.2x10^{-4} <1.6x10^{-4}	<1.3x10^{-4} <1.3x10^{-4} <9.9x10^{-5}	<3.4x10^{-4} <2.2x10^{-4} <2.1x10^{-4}
W	No CRM	<1.2x10^{-4} *4.8x10^{-4}* *7.7x10^{-4}*	*2.3x10^{-3}* <1.4x10^{-4} <2.6x10^{-4}	<4.5x10^{-4} <2.6x10^{-4} <5.3x10^{-4}	4.5x10^{-4} 2.0x10^{-4} 8.1x10^{-4}	1.4x10^{-4} 6.9x10^{-5} <8.2x10^{-5}	<2.1x10^{-4} 3.7x10^{-4} 5.3x10^{-4}
Re	No CRM	<1.4x10^{-5} <2.2x10^{-5} <1.4x10^{-5}	<7.7x10^{-6} <7.2x10^{-6} <8.1x10^{-6}	<4.9x10^{-5} <2.9x10^{-5} <5.8x10^{-5}	6.6x10^{-6} <5.2x10^{-6} <7.0x10^{-6}	<4.8x10^{-6} <4.9x10^{-6} <4.6x10^{-6}	<2.6x10^{-5} <9.5x10^{-6} <1.5x10^{-5}
Ir	No CRM	<1.0x10^{-4} <1.7x10^{-4} <1.5x10^{-4}	<7.0x10^{-5} <5.9x10^{-5} <5.9x10^{-5}	<3.7x10^{-4} <2.2x10^{-4} <4.3x10^{-4}	<3.5x10^{-5} <3.8x10^{-5} <5.2x10^{-5}	<5.8x10^{-5} <5.5x10^{-5} <3.3x10^{-5}	<8.8x10^{-5} <9.5x10^{-6} <1.5x10^{-5}

Element	Data quality#	[Rat] Wood mouse (whole body)	[Deer] Roe deer (whole body)	[Bee] *Bombus spp.* (whole body)	[Earthworm] *Lumbricidae* (whole body)	[Wild grass] Purple moor grass (leaf)	[Pine Tree] Sitka spruce (trunk)
Pt	No CRM	<1.4x10^{-3} <2.2x10^{-3} <1.4x10^{-3}	<7.7x10^{-4} <7.2x10^{-4} <8.1x10^{-4}	<4.9x10^{-3} <2.9x10^{-3} <5.8x10^{-3}	1.8x10^{-3} 7.3x10^{-4} <7.0x10^{-4}	<4.8x10^{-4} <4.5x10^{-4} <4.6x10^{-4}	<1.1x10^{-3} <9.5x10^{-4} <9.5x10^{-4}
Hg	Q±20	<1.3x10^{-2} <1.2x10^{-2} <3.1x10^{-2}	<4.2x10^{-3} <5.4x10^{-3} <3.4x10^{-3}	<2.8x10^{-2} <1.6x10^{-2} <3.2x10^{-2}	1.4x10^{-1} 4.0x10^{-2} 1.7x10^{-1}	4.7x10^{-3} <2.6x10^{-3} <2.6x10^{-3}	<6.1x10^{-3} <5.0x10^{-3} <5.3x10^{-3}
Tl	Q±20	<5.8x10^{-3} <9.4x10^{-3} <5.9x10^{-3}	<4.9x10^{-3} <3.5x10^{-3} <3.7x10^{-3}	<2.1x10^{-2} 3.6x10^{-2} <2.5x10^{-2}	1.4x10^{-2} 5.8x10^{-3} 1.4x10^{-2}	<1.6x10^{-2} <2.3x10^{-3} <7.3x10^{-3}	<7.4x10^{-3} <8.9x10^{-3} <3.7x10^{-3}
Pb	Q±20	*7.0x10^{-1}* *1.9x10^{-1}* *7.2x10^{-1}*	<8.2x10^{-2} *9.4x10^{-2}* *2.3x10^{-1}*	<9.9x10^{-2} <5.3x10^{-2} <1.2x10^{-1}	7.5 9.3x10^{-1} 3.6x10^{1}	2.5x10^{-1} 5.2x10^{-1} 5.1x10^{-1}	1.6x10^{-1} 1.7x10^{-1} 6.3x10^{-2}
Th	Q±20	*3.4x10^{-4}* *4.8x10^{-4}* <1.7x10^{-4}	<1.3x10^{-4} <9.4x10^{-5} <2.7x10^{-4}	<8.1x10^{-4} <3.6x10^{-4} <7.1x10^{-4}	6.9x10^{-2} 1.2x10^{-2} 3.7x10^{-2}	6.4x10^{-4} 2.9x10^{-4} 2.3x10^{-4}	<3.0x10^{-4} <1.3x10^{-4} <4.0x10^{-4}
U	Q±40	<2.2x10^{-4} <2.7x10^{-4} <1.7x10^{-4}	<9.8x10^{-5} <9.4x10^{-5} <1.7x10^{-4}	6.9x10^{-4} <3.6x10^{-4} <7.1x10^{-4}	3.6x10^{-2} 8.0x10^{-3} 2.2x10^{-2}	2.9x10^{-4} 2.4x10^{-4} 1.8x10^{-4}	<3.4x10^{-4} <1.2x10^{-4} <1.2x10^{-4}

Values in italics denote where the whole body concentration was estimated using some tissue(s) data below the limit of detection (LOD) as described in the text. Each value represents an individual biota sample other than each of the three Purple moor grass and Sitka spruce sample concentrations which are the mean of three replicate determinations. For Purple moor grass and Sitka spruce if all three replicates of a given sample had a concentration below the LOD then the highest 'less than' is presented (preceded by a '<' symbol) if there was a mixture of measurable and below LOD concentrations then the highest measurable value, or LOD value if higher is presented (preceded by a '<' symbol). #An indication of the data quality for each element is presented: if the analysis of the controlled reference material (CRM) was within ±20% of the certified value, the data quality is defined as Q±20; if it was within ±40% it is defined as Q±40; if it is within factor of two it is defined as QL (qualitative); if it is outside a factor of two it is defined as U and suggested to be unreliable; if no CRM was available it is defined No CRM and should be considered to be qualitative (see also text).

Table 4. Stable element concentrations (mg kg^{-1} (fresh mass)) measured in the reproductive organs of [RAP] mammal species.

Element	Data quality[#]	[Rat] Wood mice Testes	[Deer] Roe deer ovaries[*]	Element	Data quality[#]	[Rat] Wood mice testes	[Deer] Roe deer ovaries
Li	Q±20	$<5.0x10^{-3}$ $<6.0x10^{-3}$ $<4.0x10^{-3}$	$<7.0x10^{-3}$ $<1.4x10^{-2}$ $<1.2x10^{-2}$	**Sb**	Q±20	$<6.0x10^{-4}$ $<8.0x10^{-4}$ $6.0x10^{-4}$	$<8.0x10^{-4}$ $1.8x10^{-3}$ $2.7x10^{-3}$
Be	Q±20	$<9.0x10^{-4}$ $<1.2x10^{-3}$ $<8.0x10^{-4}$	$1.8x10^{-3}$ $<2.6x10^{-3}$ $<2.3x10^{-3}$	**Te**	No CRM	$<1.0x10^{-3}$ $<2.0x10^{-3}$ $1.0x10^{-3}$	$<2.0x10^{-3}$ $1.3x10^{-2}$ $<4.0x10^{-3}$
B	Q±40	$<1.0x10^{-1}$ $<1.0x10^{-1}$ $<1.0x10^{-1}$	$2.0x10^{-1}$ $4.5x10^{-1}$ $3.0x10^{-1}$	**Cs**	Q±40	$1.5x10^{-2}$ $4.2x10^{-2}$ $6.9x10^{-2}$	$2.3x10^{-3}$ $1.7x10^{-2}$ $3.6x10^{-3}$
Na	Q±20	$8.5x10^{2}$ $9.0x10^{2}$ $8.2x10^{2}$	$2.1x10^{3}$ $2.5x10^{3}$ $2.3x10^{3}$	**Ba**	Q±20	$<1.0x10^{-2}$ $1.4x10^{-2}$ $<9.0x10^{-3}$	$2.8x10^{-2}$ $2.1x10^{-1}$ $1.2x10^{-1}$
Mg	Q±20	$1.7x10^{2}$ $1.7x10^{2}$ $1.3x10^{2}$	$1.4x10^{2}$ $1.9x10^{2}$ $1.8x10^{2}$	**La**	Q±20	$<4.0x10^{-4}$ $<5.0x10^{-4}$ $<4.0x10^{-4}$	$<5.0x10^{-4}$ $1.5x10^{-3}$ $<1.0x10^{-3}$
Al	Q±20	$6.0x10^{-1}$ $6.0x10^{-1}$ $4.0x10^{-1}$	$6.0x10^{-1}$ 6.3 1.2	**Ce**	Q±40	$<8.0x10^{-4}$ $<1.1x10^{-3}$ $<7.0x10^{-4}$	$<1.1x10^{-3}$ $4.1x10^{-3}$ $<2.1x10^{-3}$
K	Q±20	$3.1x10^{3}$ $3.7x10^{3}$ $2.9x10^{3}$	$2.8x10^{3}$ $3.9x10^{3}$ $3.9x10^{3}$	**Pr**	Q±20	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $<1.0x10^{-4}$	$<2.0x10^{-4}$ $<4.0x10^{-4}$ $<3.0x10^{-4}$
Ca	Q±20	$6.8x10^{1}$ $1.3x10^{2}$ $5.0x10^{1}$	$6.4x10^{1}$ $1.3x10^{2}$ $6.5x10^{1}$	**Nd**	Q±20	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $<1.0x10^{-4}$	$<2.0x10^{-4}$ $1.5x10^{-3}$ $<3.0x10^{-4}$
Ti	Q±40	$<1.0x10^{-1}$ $<1.0x10^{-1}$ $<1.0x10^{-1}$	$<1.0x10^{-1}$ $<7.8x10^{-1}$ $3.0x10^{-1}$	**Sm**	Q±20	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$<3.0x10^{-4}$ $<7.0x10^{-4}$ $<6.0x10^{-4}$
V	Q±20	$<2.0x10^{-2}$ $<3.0x10^{-2}$ $<2.0x10^{-2}$	$<3.0x10^{-2}$ $<7.0x10^{-2}$ $<6.0x10^{-2}$	**Eu**	Q±20	$<1.0x10^{-5}$ $<2.0x10^{-5}$ $1.0x10^{-5}$	$7.0x10^{-5}$ $<1.4x10^{-4}$ $<4.0x10^{-5}$
Cr	Q±20	$2.3x10^{-2}$ $3.2x10^{-2}$ $1.8x10^{-2}$	$<1.2x10^{-2}$ $<4.7x10^{-2}$ $3.0x10^{-2}$	**Gd**	Q±20	$<5.0x10^{-5}$ $2.4x10^{-4}$ $<4.0x10^{-5}$	$<6.0x10^{-5}$ $<5.1x10^{-4}$ $<1.2x10^{-4}$
Mn	Q±20	<1.0 <1.0 <1.0	2.0 <3.0 <3.0	**Tb**	Q±20	$<3.0x10^{-5}$ $<4.0x10^{-5}$ $<3.0x10^{-5}$	$8.0x10^{-5}$ $1.0x10^{-4}$ $<8.0x10^{-5}$
Fe	Q±20	$1.9x10^{1}$ $1.9x10^{1}$ $1.7x10^{1}$	$2.9x10^{1}$ $6.1x10^{1}$ $4.0x10^{1}$	**Dy**	Q±40	$<1.0x10^{-4}$ $<1.3x10^{-4}$ $<9.0x10^{-5}$	$1.8x10^{-4}$ $<2.9x10^{-4}$ $<2.6x10^{-4}$
Co	Q±20	$1.2x10^{-2}$ $5.0x10^{-3}$ $1.5x10^{-2}$	$1.6x10^{-2}$ $2.3x10^{-2}$ $1.3x10^{-2}$	**Ho**	Q±40	$<3.0x10^{-5}$ $<4.0x10^{-5}$ $<3.0x10^{-5}$	$<4.0x10^{-5}$ $<9.0x10^{-5}$ $<8.0x10^{-5}$
Ni	Q±20	$5.0x10^{-2}$ $2.0x10^{-2}$ $2.0x10^{-2}$	$<2.0x10^{-2}$ $<4.0x10^{-2}$ $1.4x10^{-1}$	**Er**	Q±20	$<4.0x10^{-5}$ $<5.0x10^{-5}$ $<3.0x10^{-5}$	$<5.0x10^{-5}$ $<1.1x10^{-4}$ $<1.0x10^{-4}$

Element	**Data quality**[#]	**[Rat] Wood mice Testes**	**[Deer] Roe deer ovaries**[*]	**Element**	**Data quality**[#]	**[Rat] Wood mice testes**	**[Deer] Roe deer ovaries**
Cu	Q±20	1.4 1.7 1.4	2.8 2.1 1.9	**Tm**	Q±40	$1.4x10^{-5}$ $<1.1x10^{-5}$ $<8.0x10^{-6}$	$5.4x10^{-5}$ $<2.4x10^{-5}$ $<2.2x10^{-5}$
Zn	Q±20	$6.0x10^{1}$ $2.8x10^{1}$ $2.8x10^{1}$	$1.6x10^{1}$ $2.4x10^{1}$ $2.2x10^{1}$	**Yb**	Q±40	$<6.0x10^{-5}$ $<7.0x10^{-5}$ $<5.0x10^{-5}$	$3.1x10^{-4}$ $<1.6x10^{-4}$ $<1.4x10^{-4}$
As	Q±20	$6.0x10^{-3}$ $<2.0x10^{-3}$ $2.0x10^{-3}$	$<2.0x10^{-3}$ $<5.0x10^{-3}$ $6.0x10^{-3}$	**Lu**	Q±40	$<5.0x10^{-5}$ $<6.0x10^{-5}$ $<4.0x10^{-5}$	$1.1x10^{-4}$ $<1.3x10^{-4}$ $<1.2x10^{-4}$
Se	Q±20	$6.1x10^{-1}$ $7.8x10^{-1}$ $7.1x10^{-1}$	$2.2x10^{-1}$ $3.2x10^{-1}$ $1.7x10^{-1}$	**Hf**	U	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $<1.0x10^{-4}$	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<3.0x10^{-4}$
Rb	Q±20	$1.3x10^{1}$ $2.2x10^{1}$ $1.6x10^{1}$	1.5 4.6 3.7	**Ta**	No CRM	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$2.9x10^{-3}$ $<1.4x10^{-3}$ $<5.0x10^{-4}$
Sr	Q±20	$3.1x10^{-2}$ $6.1x10^{-2}$ $1.0x10^{-2}$	$6.1x10^{-2}$ $1.5x10^{-1}$ $1.0x10^{-1}$	**W**	No CRM	$<7.0x10^{-5}$ $<1.0x10^{-4}$ $<7.0x10^{-5}$	$<1.0x10^{-4}$ $<2.1x10^{-4}$ $3.8x10^{-3}$
Y	Q±40	$<3.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$<4.0x10^{-4}$ $<9.0x10^{-4}$ $<7.0x10^{-4}$	**Re**	No CRM	$<8.0x10^{-6}$ $<1.1x10^{-5}$ $<7.0x10^{-6}$	$4.8x10^{-4}$ $1.6x10^{-4}$ $<2.0x10^{-5}$
Zr	No CRM	$<8.0x10^{-4}$ $1.4x10^{-3}$ $<7.0x10^{-4}$	$1.6x10^{-3}$ $6.8x10^{-3}$ $<2.0x10^{-3}$	**Ir**	No CRM	$<6.0x10^{-5}$ $<8.0x10^{-5}$ $8.0x10^{-5}$	$<8.0x10^{-5}$ $<1.7x10^{-4}$ $<1.5x10^{-4}$
Nb	Q±40	$<2.0x10^{-4}$ $<3.0x10^{-4}$ $<2.0x10^{-4}$	$<3.0x10^{-4}$ $<3.1x10^{-3}$ $<6.0x10^{-4}$	**Pt**	No CRM	$<8.0x10^{-4}$ $<1.0x10^{-3}$ $<7.0x10^{-4}$	$<1.1x10^{-3}$ $<2.3x10^{-3}$ $<2.0x10^{-3}$
Mo	U	$8.9x10^{-2}$ $5.1x10^{-2}$ $4.5x10^{-2}$	$<3.0x10^{-3}$ $2.9x10^{-2}$ $<5.0x10^{-3}$	**Au**	No CRM	$<7.0x10^{-3}$ $<9.0x10^{-3}$ $<6.0x10^{-3}$	$<9.0x10^{-3}$ $<2.0x10^{-2}$ $<1.7x10^{-2}$
Ru	No CRM	$<1.0x10^{-4}$ $<2.0x10^{-4}$ $2.0x10^{-4}$	$<2.0x10^{-4}$ $<1.4x10^{-3}$ $<3.0x10^{-4}$	**Hg**	Q±20	$<4.0x10^{-3}$ $<6.0x10^{-3}$ $1.0x10^{-2}$	$<6.0x10^{-3}$ $<1.3x10^{-2}$ $<1.1x10^{-2}$
Pd	No CRM	$<2.0x10^{-4}$ $<2.0x10^{-4}$ $<2.0x10^{-4}$	$<2.0x10^{-4}$ $<6.0x10^{-3}$ $<4.0x10^{-4}$	**Tl**	Q±20	$<3.0x10^{-3}$ $<4.0x10^{-3}$ $5.0x10^{-3}$	$<5.0x10^{-3}$ $<1.0x10^{-2}$ $<9.0x10^{-3}$
Ag	Q±20	$7.0x10^{-4}$ $<7.0x10^{-4}$ $<5.0x10^{-4}$	$<7.0x10^{-4}$ $5.1x10^{-3}$ $4.5x10^{-3}$	**Pb**	Q±20	$<2.0x10^{-2}$ $<2.0x10^{-2}$ $<1.0x10^{-2}$	$2.0x10^{-2}$ $<5.0x10^{-2}$ $<4.0x10^{-2}$
Cd	Q±20	$<3.0x10^{-3}$ $<4.0x10^{-3}$ $7.0x10^{-3}$	$3.1x10^{-2}$ $8.5x10^{-2}$ $9.0x10^{-3}$	**Th**	Q±20	$<1.0x10^{-4}$ $<1.3x10^{-4}$ $<9.0x10^{-5}$	$<1.3x10^{-4}$ $5.3x10^{-4}$ $<2.5x10^{-4}$
Sn	Q±40	$<2.0x10^{-3}$ $<3.0x10^{-3}$ $<2.0x10^{-3}$	$<3.0x10^{-3}$ $1.3x10^{-2}$ $<6.0x10^{-3}$	**U**	Q±40	$<1.0x10^{-4}$ $<1.3x10^{-4}$ $<9.0x10^{-5}$	$5.3x10^{-4}$ $<2.8x10^{-4}$ $<2.5x10^{-4}$

Each value represents an individual biota sample. [#]An indication of the data quality for each element is presented; see text and the footnote to Table 3 for explanation. [*]Duplicate analyses were conducted on the ovaries of Roe deer 2; where both results were below the limit of detection (LOD) the maximum value is presented (preceded by a ‘<’), where one replicate was above the LOD and one below the highest value is presented (preceded by a ‘<’).

Table 5. Activity concentrations of ^{7}Be, ^{40}K and ^{137}Cs in [RAP] and soil samples.

[RAP]: species (tissue)	**Activity concentration (± 2 σ counting error) Bq kg^{-1} (fresh mass) in RAP samples; Bq kg^{-1} (dry mass) in soil**		
	^{7}Be	**^{40}K**	**^{137}Cs**
[Wild grass]: Purple moor grass (leaf)	(1.1±0.2)x10^{2} (1.5±0.1)x10^{2} (1.7±0.1)x10^{2}	(9.7±3.0)x10^{1} (9.0±2.5)x10^{1} (9.2±2.3)x10^{1}	8.9±1.7 (1.5±0.2) x10^{1} 7.1±0.7
[Pine Tree]: *Sitka spruce* (trunk)	(2.7±0.1)x10^{-1} <2.4x10^{-1} <1.9x10^{-1}	(1.2±0.3)x10^{1} (1.3±0.3)x10^{1} (1.4±0.3)x10^{1}	(5.0±2.0)x10^{-2} (4.0±1.0)x10^{-2} (9.0±1.0)x10^{-2}
[Pine Tree]: Sitka spruce (branches)	(2.4±0.5)x10^{2} (2.8±0.5)x10^{2} (4.3±0.9)x10^{2}	(3.7±1.2)x10^{1} (7.5±1.8)x10^{1} (4.6±1.6)x10^{1}	<8.5x10^{-1} <8.4x10^{-1} <1.1
[Pine Tree]: Sitka spruce (needles)	<4.5x10^{1} (3.6±2.0)x10^{1} <6.5x10^{1}	(5.5±1.4)x10^{1} (9.0±2.1)x10^{1} (6.3±1.6)x10^{1}	<3.7x10^{-1} <3.6x10^{-1} <1.1
[Deer]: Roe deer (muscle)	<1.5 <2.4 <1.6	(9.9±1.1)x10^{1} (1.1±0.1)x10^{2} (9.3±1.0)x10^{1}	(6.9±0.5)x10^{-1} 8.7±1.7 1.1±0.1
[Deer]: Roe deer (liver)	<4.5 <3.4 <3.6	(7.8±1.8)x10^{1} (6.8±1.6)x10^{1} (6.9±1.7)x10^{1}	<1.10 2.6±0.3 (5.2±1.5)x10^{-1}
Soil (range)*	n/r	(0.5-5.3)x10^{2}	(0.3-1.5)x10^{2}

< denotes the minimum detectable activity concentration (MDA). *For illustrative purposes the activity concentration ranges are given for the soils associated with the Purple moor grass, Sitka spruce and Roe deer samples. n/r – not reported (see text).

Table 6. Range in concentration ratios ($CR_{wo\text{-}soil}$) in [RAP] species (expressed for the whole organism for Wood mice and Roe deer).

Element	[Rat] Wood mice*	[Deer] Roe deer*	[Bee] *Bombus Spp.*	[Earthworm] *Lumbricidae*	[Wild Grass] Purple moor grass#	[Pine Tree] Sitka spruce trunk#
Li	$<4.3\times10^{-4}$ $<4.9\times10^{-4}$ $<4.3\times10^{-4}$	$<2.1\times10^{-3}$ *2.5×10^{-3}* *8.4×10^{-4}*	$<2.5\times10^{-3}$ $<1.5\times10^{-3}$ $<3.0\times10^{-3}$	1.4×10^{-2} 4.3×10^{-3} 6.8×10^{-3}	2.7×10^{-4} 1.4×10^{-3} 3.6×10^{-4}	$<1.8\times10^{-4}$ $<1.2\times10^{-4}$ $<5.1\times10^{-4}$
Be	$<1.9\times10^{-3}$ $<2.9\times10^{-3}$ $<1.9\times10^{-3}$	$<1.1\times10^{-3}$ $<1.2\times10^{-3}$ $<8.0\times10^{-4}$	$<5.1\times10^{-3}$ $<3.0\times10^{-3}$ $<6.0\times10^{-3}$	1.2×10^{-2} 3.0×10^{-3} 5.7×10^{-3}	$<4.3\times10^{-4}$ $<7.4\times10^{-4}$ $<4.1\times10^{-4}$	$<9.1\times10^{-4}$ $<7.2\times10^{-4}$ $<2.4\times10^{-3}$
B	*2.2×10^{-1}* $<6.2\times10^{-2}$ *1.9×10^{-1}*	5.3×10^{-2} *4.4×10^{-2}* 5.1×10^{-2}	3.4×10^{-1} 3.4×10^{-1} 3.9×10^{-1}	2.5×10^{-2} 8.9×10^{-3} 1.7×10^{-2}	1.0×10^{-1} 4.3×10^{-1} 1.5×10^{-1}	1.1×10^{-1} 9.4×10^{-2} 1.1×10^{-1}
Na	5.5×10^{-1} 7.0×10^{-1} 5.5×10^{-1}	6.2×10^{-1} 5.6×10^{-1} 6.5×10^{-1}	5.6×10^{-2} 6.9×10^{-2} 8.3×10^{-2}	3.3×10^{-1} 4.5×10^{-1} 2.9×10^{-1}	1.0×10^{-1} 7.6×10^{-2} 5.0×10^{-2}	1.9×10^{-3} $<2.0\times10^{-3}$ 5.3×10^{-4}
Mg	5.2×10^{-2} 6.1×10^{-2} 4.5×10^{-2}	1.6×10^{-1} 1.9×10^{-1} 8.2×10^{-2}	1.5×10^{-1} 9.1×10^{-2} 1.4×10^{-1}	2.1×10^{-2} 8.8×10^{-3} 1.5×10^{-2}	1.4×10^{-1} 2.1×10^{-1} 1.5×10^{-1}	4.0×10^{-3} 4.1×10^{-3} 1.1×10^{-2}
Al	*1.2×10^{-4}* *7.0×10^{-5}* $<1.7\times10^{-5}$	*3.3×10^{-5}* $<2.2\times10^{-5}$ $<3.3\times10^{-5}$	3.2×10^{-4} $<7.4\times10^{-5}$ $<1.5\times10^{-4}$	1.2×10^{-2} 2.2×10^{-3} 5.7×10^{-3}	1.1×10^{-4} 1.6×10^{-4} 6.9×10^{-5}	2.3×10^{-5} 1.4×10^{-5} 3.3×10^{-5}
K	7.6×10^{-2} 1.0×10^{-1} 7.8×10^{-2}	7.8×10^{-2} 8.6×10^{-2} 6.5×10^{-2}	2.5×10^{-1} 1.8×10^{-1} 2.8×10^{-1}	4.3×10^{-2} 3.3×10^{-2} 4.1×10^{-2}	2.0×10^{-1} 4.0×10^{-1} 2.0×10^{-1}	9.6×10^{-3} 7.6×10^{-3} 1.3×10^{-2}
Ca	1.6×10^{1} 1.5×10^{1} 1.5×10^{1}	4.1×10^{1} 4.7×10^{1} 1.1×10^{1}	1.5×10^{-1} 9.8×10^{-2} 1.8×10^{-1}	2.2×10^{-1} 1.3×10^{-1} 2.2×10^{-1}	9.9×10^{-2} 7.9×10^{-2} 9.2×10^{-2}	9.3×10^{-2} 1.3×10^{-1} 1.4×10^{-1}
Ti	*6.7×10^{-3}* $<5.4\times10^{-3}$ $<1.4\times10^{-3}$	*2.6×10^{-3}* $<2.8\times10^{-3}$ $<2.6\times10^{-1}$	4.3×10^{-2} 4.4×10^{-3} $<6.7\times10^{-3}$	3.5×10^{-2} 1.0×10^{-2} 2.9×10^{-2}	5.6×10^{-3} 7.5×10^{-3} 4.0×10^{-3}	6.4×10^{-2} 4.9×10^{-3} 7.7×10^{-3}
V	$<5.2\times10^{-4}$ $<8.8\times10^{-4}$ $<5.1\times10^{-4}$	$<3.7\times10^{-4}$ $<3.3\times10^{-4}$ $<3.4\times10^{-4}$	$<3.5\times10^{-3}$ $<2.1\times10^{-3}$ $<4.1\times10\text{-}^{3}$	1.4×10^{-2} 2.7×10^{-3} 9.2×10^{-3}	$<3.5\times10^{-4}$ $<3.3\times10^{-4}$ $<2.9\times10^{-4}$	$<5.3\times10^{-4}$ $<7.0\times10^{-4}$ $<5.8\times10^{-4}$
Cr	*1.0×10^{-3}* *2.2×10^{-3}* *1.8×10^{-3}*	$<7.0\times10^{-4}$ $<2.7\times10^{-4}$ *1.3×10^{-3}*	$<2.1\times10^{-3}$ $<1.3\times10\text{-}^{3}$ $<2.5\times10^{-3}$	1.3×10^{-2} 2.7×10^{-3} 6.5×10^{-3}	$6.1\times10\text{-}^{4}$ 9.0×10^{-4} 4.5×10^{-4}	6.1×10^{-3} 1.1×10^{-2} 2.6×10^{-3}
Mn	$<2.6\times10^{-3}$ $<3.8\times10^{-3}$ $<2.6\times10^{-3}$	$<2.5\times10^{-3}$ $<2.5\times10^{-3}$ $<1.0\times10^{-3}$	2.2×10^{-1} 1.2×10^{-1} 1.4×10^{-1}	1.6×10^{-2} 7.2×10^{-3} 2.1×10^{-2}	5.4×10^{-1} 8.4×10^{-2} 2.7×10^{-1}	3.7×10^{-2} 5.7×10^{-2} 2.7×10^{-1}
Fe	1.2×10^{-3} 1.5×10^{-3} 1.2×10^{-3}	7.5×10^{-4} 1.4×10^{-3} 9.2×10^{-4}	2.5×10^{-3} 1.9×10^{-3} 2.1×10^{-3}	1.3×10^{-2} 2.4×10^{-3} 6.6×10^{-3}	1.5×10^{-3} 3.4×10^{-4} 4.4×10^{-4}	9.6×10^{-3} 2.1×10^{-2} 2.5×10^{-3}
Co	1.1×10^{-3} 1.4×10^{-3} $<1.2\times10^{-3}$	1.2×10^{-3} 1.2×10^{-3} *4.7×10^{-4}*	3.7×10^{-2} 4.5×10^{-3} $<1.6\times10^{-3}$	3.2×10^{-2} 1.2×10^{-2} 1.9×10^{-2}	1.4×10^{-3} 3.6×10^{-4} 6.3×10^{-4}	1.7×10^{-3} 2.6×10^{-3} 2.5×10^{-3}
Ni	$<8.8\times10^{-4}$ *4.8×10^{-3}* 1.6×10^{-3}	$<1.4\times10^{-2}$ *4.4×10^{-2}* 5.5×10^{-3}	$<5.3\times10^{-3}$ 1.0×10^{-2} $<6.2\times10^{-3}$	1.1×10^{-2} 2.6×10^{-3} 5.5×10^{-3}	8.1×10^{-3} 7.0×10^{-3} 5.1×10^{-3}	2.4×10^{-3} 3.9×10^{-3} 2.0×10^{-3}
Cu	1.1×10^{-1} 1.4×10^{-1} 1.1×10^{-1}	1.5×10^{-1} 2.3×10^{-1} 7.3×10^{-2}	7.2×10^{-1} 4.0×10^{-1} 3.6×10^{-1}	6.4×10^{-2} 5.7×10^{-2} 8.7×10^{-2}	3.9×10^{-2} 3.5×10^{-2} 3.5×10^{-2}	3.4×10^{-2} 2.9×10^{-2} 2.2×10^{-2}
Zn	3.4×10^{-1} 3.4×10^{-1} 3.3×10^{-1}	6.8×10^{-1} 5.3×10^{-1} 2.2×10^{-1}	8.2×10^{-1} 3.3×10^{-1} 4.9×10^{-1}	5.6×10^{-1} 8.3×10^{-1} 4.4×10^{-1}	$1.3\times10\text{-}^{1}$ 1.6×10^{-1} 1.3×10^{-1}	5.5×10^{-2} 4.0×10^{-2} 5.1×10^{-2}

Element	[Rat] Wood mice[*]	[Deer] Roe deer[*]	[Bee] *Bombus Spp.*	[Earthworm] *Lumbricidae*	[Wild Grass] Purple moor grass[#]	[Pine Tree] Sitka spruce trunk[#]
As	$<2.0x10^{-4}$ $<1.8x10^{-4}$ $<1.0x10^{-4}$	$<4.0x10^{-5}$ *$4.8x10^{-4}$* *$1.3x10^{-4}$*	$2.8x10^{-3}$ $6.0x10^{-4}$ $6.1x10^{-4}$	$6.2x10^{-2}$ $1.8x10^{-2}$ $6.3x10^{-2}$	$1.8x10^{-3}$ $1.7x10^{-4}$ $2.3x10^{-4}$	$1.3x10^{-3}$ $<5.2x10^{-3}$ $<1.8x10^{-4}$
Se	$1.4x10^{-1}$ $1.7x10^{-1}$ $2.0x10^{-1}$	$5.1x10^{-2}$ $1.1x10^{-1}$ $7.7x10^{-2}$	$1.2x10^{-2}$ $1.0x10^{-2}$ $2.1x10^{-2}$	4.4 2.4 4.3	$3.9x10^{-3}$ $2.7x10^{-3}$ $2.2x10^{-3}$	$<5.7x10^{-3}$ $<4.2x10^{-3}$ $<2.3x10^{-3}$
Rb	$1.6x10^{-1}$ $2.8x10^{-1}$ $2.3x10^{-1}$	$1.8x10^{-2}$ $4.1x10^{-2}$ $3.1x10^{-2}$	$7.3x10^{-2}$ $1.4x10^{-1}$ $1.2x10^{-1}$	$2.9x10^{-2}$ $1.8x10^{-2}$ $2.7x10^{-2}$	$2.7x10^{-1}$ 1.0 $4.4x10^{-1}$	$3.3x10^{-3}$ $3.1x10^{-3}$ $1.2x10^{-2}$
Sr	$3.2x10^{-1}$ $5.4x10^{-1}$ $1.8x10^{-1}$	1.5 2.4 1.1	$1.3x10^{-2}$ $4.5x10^{-3}$ $1.9x10^{-2}$	$6.7x10^{-2}$ $5.2x10^{-2}$ $7.8x10^{-2}$	$8.0x10^{-2}$ $6.5x10^{-2}$ $7.9x10^{-2}$	$1.6x10^{-1}$ $2.8x10^{-1}$ $2.4x10^{-1}$
Y	*$9.1x10^{-5}$* $<8.3x10^{-5}$ $<4.3x10^{-5}$	$<7.1x10^{-5}$ $<9.5x10^{-5}$ $<4.3x10^{-5}$	$1.8x10^{-4}$ $<7.7x10^{-5}$ $<1.5x10^{-4}$	$1.5x10^{-2}$ $3.5x10^{-3}$ $6.2x10^{-3}$	$5.2x10^{-4}$ $4.2x10^{-4}$ $2.8x10^{-4}$	$<3.2x10^{-5}$ $7.2x10^{-5}$ $<9.9x10^{-5}$
Zr	*$3.6x10^{-4}$* *$4.3x10^{-4}$* $<1.1x10^{-4}$	*$2.2x10^{-4}$* $1.3x10^{-4}$ *$1.3x10^{-4}$*	$1.7x10^{-2}$ $7.5x10^{-4}$ $<9.6x10^{-4}$	$1.5x10^{-2}$ $3.0x10^{-3}$ $1.0x10^{-2}$	$6.3x10^{-3}$ $1.7x10^{-2}$ $6.2x10^{-3}$	$2.8x10^{-4}$ $2.1x10^{-4}$ $<1.8x10^{-4}$
Nb	*$1.2x10^{-1}$* *$1.3x10^{-1}$* *$9.2x10^{-2}$*	*$4.3x10^{-2}$* *$2.3x10^{-2}$* *$3.6x10^{-2}$*	$<1.4x10^{-2}$ $<8.2x10^{-3}$ $<1.6x10^{-2}$	$1.9x10^{-1}$ $7.1x10^{-2}$ $2.0x10^{-1}$	$3.6x10^{-3}$ $2.3x10^{-3}$ $3.2x10^{-3}$	$2.4x10^{-1}$ $3.9x10^{-2}$ $5.0x10^{-2}$
Mo	$8.3x10^{-2}$ $1.5x10^{-1}$ $1.2x10^{-1}$	*$5.0x10^{-2}$* $4.9x10^{-2}$ *$6.2x10^{-2}$*	$8.9x10^{-2}$ $6.3x10^{-2}$ $1.0x10^{-1}$	$2.6x10^{-1}$ $1.1x10^{-1}$ $4.1x10^{-1}$	$6.0x10^{-2}$ $9.1x10^{-2}$ $1.3x10^{-1}$	$6.6x10^{-2}$ $1.2x10^{-1}$ $1.3x10^{-2}$
Ru	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	$<1.3x10^{-2}$ n/a n/a	n/a n/a n/a
Pd	*$1.2x10^{-2}$* *$1.8x10^{-2}$* *$9.1x10^{-3}$*	*$3.5x10^{-2}$* n/a *$2.1x10^{-2}$*	$<4.2x10^{-3}$ $2.8x10^{-3}$ $<4.8x10^{-3}$	$2.0x10^{-2}$ $8.1x10^{-3}$ $1.3x10^{-2}$	$1.3x10^{-2}$ $1.2x10^{-2}$ $8.4x10^{-3}$	$1.4x10^{-2}$ $1.8x10^{-2}$ $2.7x10^{-2}$
Ag	$<4.0x10^{-3}$ $<8.3x10^{-3}$ $<4.2x10^{-3}$	$<4.6x10^{-3}$ $<9.7x10^{-3}$ $<5.5x10^{-3}$	$2.3x10^{-2}$ $2.0x10^{-2}$ $<6.9x10^{-3}$	$3.13x10^{-1}$ $1.40x10^{-1}$ 1.2	$3.6x10^{-3}$ $2.4x10^{-3}$ $1.4x10^{-3}$	$4.5x10^{-1}$ $2.8x10^{-1}$ $5.7x10^{-2}$
Cd	$<5.9x10^{-2}$ $<5.2x10^{-2}$ *$3.6x10^{-1}$*	*$7.3x10^{-2}$* *$2.6x10^{-1}$* $<3.8x10^{-2}$	$4.4x10^{-2}$ $2.8x10^{-2}$ $4.1x10^{-2}$	6.2 6.2 3.4	$2.6x10^{-2}$ $1.7x10^{-2}$ $1.4x10^{-2}$	$2.0x10^{-1}$ $1.2x10^{-1}$ $8.1x10^{-2}$
Sn	$<4.2x10^{-4}$ $<1.0x10^{-3}$ *$7.5x10^{-3}$*	$<5.1x10^{-4}$ $<3.5x10^{-4}$ $<5.2x10^{-4}$	$1.9x10^{-3}$ $9.1x10^{-4}$ $<1.4x10^{-3}$	$1.5x10^{-2}$ $4.2x10^{-3}$ $2.1x10^{-2}$	$1.3x10^{-3}$ $1.1x10^{-3}$ $7.0x10^{-4}$	$6.3x10^{-3}$ $8.0x10^{-3}$ $8.3x10^{-4}$
Sb	*$3.5x10^{-3}$* $<4.3x10^{-3}$ $<9.4x10^{-3}$	$<3.2x10^{-3}$ $<1.8x10^{-3}$ $<3.3x10^{-3}$	$<2.9x10^{-3}$ $2.0x10^{-3}$ $5.4x10^{-3}$	$4.7x10^{-2}$ $1.3x10^{-2}$ $7.9x10^{-2}$	$4.8x10^{-3}$ $1.3x10^{-3}$ $1.8x10^{-3}$	$1.9x10^{-2}$ $1.1x10^{-2}$ $3.7x10^{-3}$
Te	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a $<2.7x10^{-2}$	n/a n/a n/a
Cs	$5.3x10^{-3}$ $1.3x10^{-2}$ 3.1x10-2	*$1.0x10^{-3}$* $6.9x10^{-3}$ $1.4x10^{-3}$	$4.0x10^{-3}$ $2.4x10^{-2}$ $3.4x10^{-3}$	$1.6x10^{-2}$ $4.1x10^{-3}$ $7.3x10^{-3}$	$1.9x10^{-2}$ $5.7x10^{-2}$ $2.4x10^{-2}$	$<2.4x10^{-4}$ $<1.9x10^{-4}$ $<2.7x10^{-4}$
Ba	*$5.8x10^{-3}$* *$7.7x10^{-3}$* *$1.7x10^{-2}$*	$1.8x10^{-1}$ $2.0x10^{-1}$ $1.7x10^{-1}$	$9.3x10^{-3}$ $3.8x10^{-3}$ $1.6x10^{-2}$	$2.1x10^{-2}$ $5.0x10^{-3}$ $1.5x10^{-2}$	$6.9x10^{-2}$ $7.3x10^{-2}$ $5.0x10^{-2}$	$8.7x10^{-2}$ $9.2x10^{-2}$ $1.0x10^{-1}$
La	$<3.5x10^{-5}$ $<9.3x10^{-5}$ $<2.8x10^{-5}$	$<4.4x10^{-5}$ $<4.4x10^{-5}$ $<2.6x10^{-5}$	$1.7x10^{-4}$ $9.6x10^{-5}$ $2.1x10^{-4}$	$1.2x10^{-2}$ $2.6x10^{-3}$ $6.2x10^{-3}$	$4.7x10^{-4}$ $3.0x10^{-4}$ $1.6x10^{-4}$	$4.1x10^{-5}$ $2.6x10^{-5}$ $7.2x10^{-5}$

Element	**[Rat] Wood mice***	**[Deer] Roe deer***	**[Bee] *Bombus Spp.***	**[Earthworm] *Lumbricidae***	**[Wild Grass] Purple moor grass#**	**[Pine Tree] Sitka spruce trunk#**
Ce	<2.1x10^{-5} <6.4x10^{-5} <2.1x10^{-5}	<2.5x10^{-5} <2.1x10^{-5} <2.5x10^{-5}	<1.4x10^{-4} <8.3x10^{-5} <1.7x10^{-4}	8.7x10^{-3} 2.0x10^{-3} 3.8x10^{-3}	2.2x10^{-4} 2.0x10^{-4} 7.8x10^{-5}	<2.3x10^{-5} <1.0x10^{-5} <4.2x10^{-5}
Pr	<3.4x10^{-5} <9.2x10^{-5} <3.4x10^{-5}	<2.2x10^{-5} <2.7x10^{-5} <3.0x10^{-5}	2.1x10^{-4} <1.1x10^{-4} <2.1x10^{-4}	1.3x10^{-2} 2.6x10^{-3} 6.6x10^{-3}	2.3x10^{-4} 1.8x10^{-4} 7.9x10^{-5}	<3.0x10^{-5} <4.1x10^{-5} <5.8x10^{-5}
Nd	<2.9x10^{-5} *7.7x10^{-5}* *1.8x10^{-5}*	<3.6x10^{-5} <3.4x10^{-5} <1.1x10^{-5}	2.6x10^{-4} 5.5x10^{-5} 2.1x10^{-4}	1.2x10^{-2} 2.4x10^{-3} 5.8x10^{-3}	2.2x10^{-4} 1.3x10^{-4} 6.2x10^{-5}	2.6x10^{-5} 2.2x10^{-5} 4.6x10^{-5}
Sm	<1.2x10^{-4} <1.7x10^{-4} <1.0x10^{-4}	<8.8x10^{-5} <1.2x10^{-4} <7.1x10^{-5}	<4.9x10^{-4} <2.8x10^{-4} <5.7x10^{-4}	1.2x10^{-2} 2.5x10^{-3} 5.6x10^{-3}	2.6x10^{-4} 1.7x10^{-4} 9.1x10^{-5}	<6.8x10^{-5} <5.6x10^{-5} <1.5x10^{-4}
Eu	*2.0x10^{-4}* *2.9x10^{-4}* *6.5x10^{-4}*	*5.7x10^{-3}* *5.6x10^{-3}* *3.9x10^{-3}*	5.6x10^{-4} 1.2x10^{-4} 8.8x10^{-4}	1.2x10^{-2} 3.1x10^{-3} 5.6x10^{-3}	2.9x10^{-3} 2.2x10^{-3} 1.3x10^{-3}	1.9x10^{-3} 2.0x10^{-3} 5.4x10^{-3}
Gd	*4.8x10^{-5}* *9.5x10^{-5}* <2.5x10^{-5}	*6.1x10^{-5}* *1.5x10^{-4}* *5.9x10^{-5}*	1.4x10^{-4} 6.1x10^{-5} 2.7x10^{-4}	1.3x10^{-2} 3.0x10^{-3} 5.5x10^{-3}	2.6x10^{-4} 1.5x10^{-4} 9.3x10^{-5}	4.7x10^{-5} 4.6x10^{-5} 1.4x10^{-4}
Tb	<1.3x10^{-4} <1.9x10^{-4} <1.3x10^{-4}	<7.4x10^{-5} <9.8x10^{-5} <6.9x10^{-5}	<4.7x10^{-4} <2.8x10^{-4} <5.5x10^{-4}	1.3x10^{-2} 3.1x10^{-3} 5.4x10^{-3}	2.1x10^{-4} 1.8x10^{-4} 6.4x10^{-5}	<8.3x10^{-5} <5.9x10^{-5} <2.0x10^{-4}
Dy	*1.1x10^{-4}* <1.9x10^{-4} <8.3x10^{-5}	<9.8x10^{-5} <1.0x10^{-4} <5.2x10^{-5}	<2.8x10^{-4} <1.6x10^{-4} <3.3x10^{-4}	1.3x10^{-2} 2.9x10^{-3} 5.5x10^{-3}	1.6x10^{-4} <1.3x10^{-4} 6.1x10^{-5}	<4.9x10^{-5} <4.4x10^{-5} <1.3x10^{-4}
Ho	<1.5x10^{-4} <3.2x10^{-4} <1.4x10^{-4}	*1.0x10^{-4}* <1.1x10^{-4} <8.2x10^{-5}	<4.6x10^{-4} <2.7x10-^{4} <5.5x10^{-4}	<1.4x10^{-2} <3.3x10^{-3} <6.2x10^{-3}	1.7x10^{-4} 1.2x10^{-4} 6.6x10^{-5}	<7.9x10^{-5} <1.2x10^{-4} <2.2x10^{-4}
Er	<6.1x10^{-5} <1.0x10^{-4} <6.6x10^{-5}	<4.8x10^{-5} <7.2x10^{-5} <3.4x10^{-5}	<2.2x10^{-4} <1.3x10^{-4} <2.6x10^{-4}	1.4x10^{-2} 2.9x10^{-3} 5.9x10^{-3}	1.6x10^{-4} 1.2x10^{-4} 6.9x10^{-5}	<9.3x10^{-5} <1.3x10^{-4} <8.8x10^{-5}
Tm	<1.1x10^{-4} <1.7x10^{-4} <1.1x10^{-4}	*8.7x10^{-5}* <6.5x10^{-5} <7.5x10^{-5}	<3.9x10^{-4} <2.3x10^{-4} <4.6x10^{-4}	1.3x10^{-2} 2.9x10^{-3} 5.5x10^{-3}	1.9x10^{-4} 1.7x10^{-4} <1.3x10^{-4}	<7.2x10^{-5} <3.2x10^{-4} <2.9x10^{-4}
Yb	<1.3x10^{-4} <2.1x10^{-4} <1.1x10^{-4}	*2.0x10^{-4}* <1.3x10^{-4} <1.1x10^{-4}	<4.4x10^{-4} 4.8x10^{-4} <5.1x10^{-4}	1.3x10^{-2} 3.5x10^{-3} 5.9x10^{-3}	1.5x10^{-4} 2.0x10^{-4} 1.1x10^{-4}	<1.2x10^{-4} 1.5x10^{-4} <1.7x10^{-4}
Lu	<6.5x10^{-4} <1.0x10^{-3} <6.3x10^{-4}	<5.7x10^{-4} <6.7x10^{-4} <3.6x10^{-4}	<2.5x10^{-3} <1.5x10^{-3} <3.0x10^{-3}	1.4x10^{-2} 2.6x10^{-3} 6.4x10^{-3}	<4.1x10^{-4} <3.6x10^{-4} <1.9x10^{-4}	<5.5x10^{-4} <5.8x10^{-4} <1.1x10^{-3}
Hf	<6.5x10^{-4} <7.4x10^{-4} <4.7x10^{-4}	<7.6x10^{-4} <3.9x10^{-4} <3.6x10^{-4}	1.2x10^{-2} <2.4x10^{-3} <2.5x10^{-3}	1.6x10^{-2} 3.4x10^{-3} 1.0x10^{-2}	<8.2x10^{-3} <9.3x10^{-3} <5.3x10^{-3}	<5.8x10^{-4} <4.7x10^{-4} <6.6x10^{-4}
Ta	<5.1x10^{-2} <7.2x10^{-2} <4.7x10^{-2}	<9.1x10^{-3} <3.5x10^{-3} <9.4x10^{-3}	<7.0x10^{-2} <4.1x10^{-2} <1.5x10^{-1}	<1.3x10^{-2} <1.3x10^{-2} <1.1x10^{-2}	<7.1x10^{-3} <8.6x10^{-3} <6.6x10^{-3}	<2.4x10^{-2} <1.6x10^{-2} <1.5x10^{-2}
W	n/a n/a n/a	n/a n/a n/a	<3.6x10^{-3} <2.1x10^{-3} <4.2x10^{-3}	n/a n/a n/a	3.4x10^{-3} 2.8x10^{-4} <9.2x10^{-4}	<1.0x10^{-2} 1.9x10^{-2} 1.8x10^{-2}
Re	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	n/a <4.9x10^{-4} n/a	n/a n/a n/a
Ir	n/a n/a n/a	n/a n/a n/a	<2.5x10^{-1} <1.5x10^{-1} <2.9x10^{-1}	<1.8x10^{-2} <1.9x10^{-2} <2.6x10^{-2}	<2.9x10^{-2} n/a <3.3x10^{-2}	<4.4x10^{-2} <3.4x10^{-2} n/a

Element	[Rat] Wood mice*	[Deer] Roe deer*	[Bee] *Bombus Spp.*	[Earthworm] *Lumbricidae*	[Wild Grass] Purple moor grass#	[Pine Tree] Sitka spruce trunk#
Pt	n/a	n/a	n/a	n/a	n/a	<2.8x10^{-2}
	n/a	n/a	n/a	n/a	n/a	<2.3x10^{-2}
	n/a	n/a	n/a	n/a	n/a	n/a
Hg	<5.3x10^{-2}	<2.5x10^{-2}	<6.3x10^{-2}	1.7	1.1x10^{-2}	<4.7x10^{-2}
	<5.0x10^{-2}	<2.6x10^{-2}	<3.7x10^{-2}	4.7x10^{-1}	<6.6x10^{-3}	<3.9x10^{-2}
	<1.3x10^{-1}	<2.4x10^{-2}	<7.3x10^{-2}	2.0	<5.3x10^{-3}	<1.2x10^{-2}
Tl	<8.3x10^{-3}	<6.8x10^{-3}	<2.9x10^{-2}	4.5x10^{-2}	<2.5x10^{-2}	<2.2x10^{-2}
	<1.4x10^{-2}	<5.8x10^{-3}	5.0x10^{-2}	1.9x10^{-2}	<3.6x10^{-3}	<2.6x10^{-2}
	<8.5x10^{-3}	<5.9x10^{-3}	<3.4x10^{-2}	4.6x10^{-2}	<8.4x10^{-3}	<8.2x10^{-3}
Pb	*3.4x10^{-3}*	<5.4x10^{-4}	<1.2x10^{-4}	1.9x10^{-1}	5.6x10^{-4}	3.0x10^{-3}
	8.9x10^{-4}	*6.2x10^{-4}*	<9.5x10^{-5}	2.3x10^{-2}	7.8x10^{-4}	3.1x10^{-3}
	3.4x10^{-3}	*1.1x10^{-3}*	<1.9x10^{-4}	8.9x10^{-1}	7.6x10^{-4}	3.7x10^{-4}
Th	*6.0x10^{-5}*	<2.4x10^{-5}	4.2x10^{-4}	1.1x10^{-2}	2.7x10^{-4}	<4.9x10^{-5}
	8.4x10^{-5}	<2.1x10^{-5}	<1.9x10^{-4}	1.9x10^{-3}	3.1x10^{-4}	<2.2x10^{-5}
	<2.9x10^{-5}	<4.2x10^{-5}	<3.7x10^{-4}	5.7x10^{-3}	9.5x10^{-5}	<1.6x10^{-4}
U	<2.0x10^{-4}	<1.1x10^{-4}	8.3x10^{-4}	3.4x10^{-2}	3.4x10^{-4}	<3.0x10^{-4}
	<2.4x10^{-4}	<1.2x10^{-4}	<4.3x10^{-4}	7.6x10^{-3}	4.3x10^{-4}	<1.1x10^{-4}
	<1.5x10^{-4}	<1.4x10^{-4}	<8.5x10^{-4}	2.2x10^{-2}	1.6x10^{-4}	<1.9x10^{-4}

Each value represents an individual biota sample other than each of the three Purple moor grass and Sitka spruce samples where each value is the mean of three replicates. # See the legend of Table 3 for information on ‘<’ values for Purple moor grass and Sitka spruce. *Values in italics denote where the whole body concentration (used to estimate the $CR_{wo\text{-}soil}$) was estimated using some tissue(s) data below the limit of detection (LOD) as described in the “Results section”, “Concentrations in RAP Samples”. n/a – no $CR_{wo\text{-}soil}$ values presented as soil concentration was below limit of detection LOD.

Table 7. Comparison of the range in stable element and radionuclide concentration ratios ($CR_{wo\text{-}soil}$) for selected [RAP] species for Cs and K.

[RAP]:Species	n	Element			
		Cs^{+}	^{137}Cs	K^{+}	^{40}K
[Wild grass]: Purple moor grass (leaf)	3	$(1.9\text{-}5.7)\times10^{-2}$	$(0.6\text{-}1.3)\times10^{-1}$	$(2.0\text{-}4.0)\times10^{-1}$	0.3-1.8
[Pine Tree]: Sitka spruce (trunk)	3	$<2.4\times10^{-4}$	$(1.0\text{-}1.4)\times10^{-3}$	$(0.8\text{-}1.3)\times10^{-2}$	$(2.3\text{-}4.6)\times10^{-2}$
[Deer]: Roe deer[+]	3	$(1.0\text{-}6.9)\times10^{-3}$	$(0.1\text{-}1.2)\times10^{-1}$	$(6.5\text{-}8.6)\times10^{-2}$	$(1.9\text{-}3.9)\times10^{-1}$

[+]The stable element $CR_{wo\text{-}soil}$ value for Roe deer is derived using estimated whole body concentrations whereas the radionuclide $CR_{wo\text{-}soil}$ value is estimated from muscle concentrations only (see text).