New detectors for live-monitoring of radionuclides in wildlife

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1. Why are new methods needed?
In the UK, most environmental radiological risk assessments focus on protected species in accordance with the EC Birds and Habitats Directives [1]. To help with these assessments, various modelling tools have been developed [e.g. 2].

Modelling tools predict whole body radionuclide activity concentrations, generally using simple concentration ratios (Crbody organs). In terrestrial environments, CRbody organs is determined by:

\[
CR_{body} = \frac{\text{Biota whole-body activity concentration}}{\text{Soil activity concentration (Bq kg}^{-1} \text{dry mass)}}
\]

For the purposes of compliance monitoring, it would be beneficial to verify predicted whole body activity concentrations. As many assessment species are protected, there is growing interest in non-lethal monitoring techniques such as live-monitoring.

Limitations of current live-monitoring methods
- Not specifically designed for animal monitoring and requires some samples to be destroyed [3] or transported [4] in order to verify results.
- Usually large and often impractical [5] or has serious limitations [6] making it unsuitable for long term field research.

2. Project Aim
Develop new methods and technologies for measuring radionuclide activity concentrations in wildlife, without the need to destroy the target organism.

3. Designing the detector
Key design considerations include wildlife and site characteristics (Box 4), range of radionuclides (Box 5), detector materials (Box 6) and data processing (Box 7).

4. Wildlife and site characteristics
Target species
- Selection of UK wildlife, with a focus on protected species [1].
- Target sizes will cover a range of protected species geometries.

Target environments
- Selected from review of Natura 2000 sites [1].
- Consider site conditions such as humidity and temperature.
- Animal behaviour
- Minimisation of animal stress requires short scan times.
- Animal species will influence counting time as well as design of holding apparatus.

5. Radionuclides to consider
Target radionuclides
- Those currently present in UK regulated discharges with a focus on beta and gamma emitting radionuclides.
- Will need to consider discharge profiles and the influence of background radiation.

Detection limits
- Likely radionuclide activity ranges need to be identified to assist with material selection.
- Theoretical approach using data collected in wildlife studies [7][8]
-ERICA tool used to back-calculate whole-body activity concentrations giving rise to a screening dose rate of 10 µSv h\(^{-1}\) [2]
- Detection limit will be below this back-calculated value.

6. Processing
Processing requirements
- Properties of radionuclides (Box 5) and selected detector materials (Box 6) will inform processing requirements.
- An evaluation of available (small) microprocessors will identify the most suitable.
- Small size and low power draw will be limiting factors.

7. Testing
Test of device without organisms
- Initial testing and calibration of a fully constructed prototype will be competed using radioactive phantoms that have been constructed using animal and radionuclide parameters identified in boxes 4 and 5.

Test of device using live organisms
- Comparison of measurements collected using the device on live animals under field conditions to measurements collected by laboratory based gamma detectors.
- The laboratory analysis will require destructive sampling of some organisms.

References

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