THE RADIOLOGICAL PROTECTION OF WILDLIFE AND ITS IMPLICATIONS

David Copplestone[1] and Rob Allott[2]
[1]University of Stirling, Institute of Biological and Environmental Sciences, School of Natural Sciences, Stirling, Scotland
[2]Environment Agency, Lutra House, Dodd Way, Bamber Bridge, Preston, England
david.copplestone@stir.ac.uk

INTRODUCTION

It is now generally recognised that there needs to be a system to demonstrate that the environment is protected from ionising radiation. In its latest recommendations, the International Commission on Radiological Protection (ICRP) acknowledged the need for radiological protection of the environment [1] and stated that the Commission "*believes that the development of a clearer framework is required"* for environmental protection. Their framework was subsequently described in ICRP Publication 108 [2]. The International Atomic Energy Agency (IAEA) is revising the international Basic Safety Standards (BSS) to incorporate the IAEAs fundamental safety objective: "*to protect people and the environment from harmful effects of ionizing radiation"* [3]. The European Basic Safety Standards are also being revised and chapter X describes the requirements for environmental protection [4].

There has been considerable international and national effort over the last decade on how to conduct environmental assessments. These have focused on collating relevant information and developing assessment approaches for regulatory purposes [2,5-7]. Validation and comparison of the radioecological and dosimetric components of various approaches has also begun [8]. It is important that the approaches used are practicable, credible to stakeholders and fit for purpose.

One of the main drivers behind the need for radiological protection of the environment has been the need to demonstrate compliance with conservation legislation. In England and Wales, the Environment Agency has a duty to comply with the EU Birds and Habitats Directives (Council Directives 79/409/EEC on the conservation of wild birds and 92/43/EEC on the conservation of natural habitats, and wild flora and fauna) when

planning and undertaking all of its regulatory and operational activities. The Environment Agency must review environmental permits that it has granted – including those for releases of chemicals and radioactive substances – to ensure that these will not result in an adverse effect, either directly or indirectly, on the integrity of identified European Sites. This paper will describe the results of the habitats assessments conducted for 429 Natura sites of conservation value in England and Wales and highlight some of the assumptions, limitations and issues identified.

MATERIAL AND METHODS

The assessment involves the calculation of dose rates to reference organisms and feature species from exposure to permitted discharges of radioactive substances at Natura 2000 sites in England and Wales. The calculated dose rates can then be related to biological effects data (e.g. mortality, morbidity, reproductive effects) to determine the likely risk of impact at the Natura 2000 site. Reference organisms are defined as "*a series of entities that provide a basis for the estimation of radiation dose rate to a range of organisms which are typical, or representative, of a contaminated environment"* [9]. A feature species is a named species that has been identified as requiring protection under one or both of the EU Birds or Habitats Directives. Figure 1 outlines the key steps in the radiological assessment process of a Natura 2000 site.

One key feature of the assessment process is the derivation of some form of numeric criteria to determine the likely risk of radiological impact at a given site. The Environment Agency, Natural England and the Countryside Council for Wales have agreed a dose rate threshold of 40 $\mu Gy\ h^{-1}$, below which it has been concluded that there will be no adverse effect on the integrity of a Natura 2000 site. Full details of the assessment approach and the derivation of this numeric value is given in [10].

A number of assumptions were included in the assessment process:

1) Discharges were assumed to be at the Radioactive Substances Act 1993 authorization limits (now Environmental Permit Limits) but in reality actual discharges are likely to be significantly lower than the discharge limit.

2) The calculated dose rate per unit concentration data used to calculate the dose rate to the reference or feature species are based on the work done in [6]. This work incorporated a number of cautious assumptions because there were data and knowledge gaps at that time. Since [6] there

have been a number of projects which have considered a more extensive list of radionuclides and improved our knowledge and understanding.

3) The dispersion modelling conducted was for current discharges and the assessments do not include concentrations of radionuclides which may have been discharged when historical limits were significantly higher. This is more of an issue for radionuclides with longer physical half lives and which may concentrate in the local environment. The Sellafield site in northwest England is an example of a site which had significantly higher historical discharges than current levels.

4) The total dose rate from releases to air and water to the worst affected organism has been calculated from the terrestrial dose rate and water environment dose rate for the worst affected organism. This is a cautious assumption, as the worst affected organism may not be the same for the terrestrial and aquatic environments.

RESULTS

Of the 429 Natura 2000 sites in England and Wales, there are no Radioactive Substances Act 1993 authorisations (now Environmental Permits) affecting 148 sites. For the remaining Natura 2000 sites, the total dose rates ranged from 7.7×10^{-8} to 520 $\mu Gy\ h^{-1}$ (see Figure 2). There were two Natura 2000 sites with dose rates greater than the agreed threshold of 40 $\mu Gy\ h^{-1}$. These sites were the Ribble and Alt Estuaries Special Protected Area (SPA) at 520 $\mu Gy\ h^{-1}$ and Drigg coast Special Area of Conservation (SAC) at 41 $\mu Gy\ h^{-1}$. However the majority of sites had total dose rates $< 20\ \mu Gy\ h^{-1}$ even with the various conservative assumptions that were made within the assessment.

The highest dose rates for reference organisms in the marine assessment at the Ribble and Alt Estuaries SPA were for seabird (500 $\mu Gy\ h^{-1}$), seal and whale (520 $\mu Gy\ h^{-1}$). For freshwater reference organisms the highest dose rates were amphibian (260 $\mu Gy\ h^{-1}$) and duck (130 $\mu Gy\ h^{-1}$). For the terrestrial assessment the highest dose rate was for fungi at 3.6 $\mu Gy\ h^{-1}$. The radionuclides which provide the greatest contribution to the dose rates to the seabird and seal/whale in the marine assessment are ^{234}Th and other alpha-emitting radionuclides. These radionuclides are also dominant in the freshwater assessment. The source of the discharges of these radionuclides is the Springfields Fuels Ltd site. As the total dose rate for the Ribble and Alt Estuaries SPA was significantly in excess of the agreed 40 $\mu Gy\ h^{-1}$ threshold, this site was taken forward for

further assessment. However, new, lower permit limits for Springfields Fuels Ltd came into effect from January 2008. These lower limits came about for operational reasons on site and were agreed before the results of this habitats assessment were available. When the dose rates to reference organisms and feature species were recalculated using these new limits, monitoring data and the most recent assessment tool [5], the new dose rates were all less than the 40 $\mu Gy\ h^{-1}$ [11].

The total dose rate for the Drigg coast SAC is just above the agreed threshold of 40 $\mu Gy\ h^{-1}$. The coastal assessment is generally cautious and other more detailed assessments had been conducted on the site for other purposes [12]. When all these factors were considered, it was agreed that, subject to continued monitoring and periodic re-assessment, that there was no indication of significant impact from ionising radiation on the sand dune biota.

CONCLUSION

Dose rates to wildlife arising from discharges to the environment from permits granted by the Environment Agency under the Radioactive Substances Act, 1993 (now Environmental Permits) have been assessed for Natura 2000 sites in England and Wales. These assessments considered the potential impact of all sources of discharge to a Natura 2000 site and have cautiously assumed that discharges occur at the permit limits. The overall assessment also has a number of inherent assumptions which, where possible, have been made to be conservative.

The total dose rates to the worst affected organism are less than the agreed threshold of 40 $\mu Gy\ h^{-1}$ for all but two Natura 2000 sites. This threshold represents the level below which it is accepted that there will be no adverse affect on the integrity of a Natura 2000 site. The assessment process followed a staged approach to identify those sites most at risk from the discharges of radioactive substances and effort to completely assess the risk was targeted at those sites (i.e. the Drigg coastal SAC and the Ribble and Alt Estuaries SPA). This is considered to be an approach consistent with the likely level of risk of impact from ionising radiation to wildlife.

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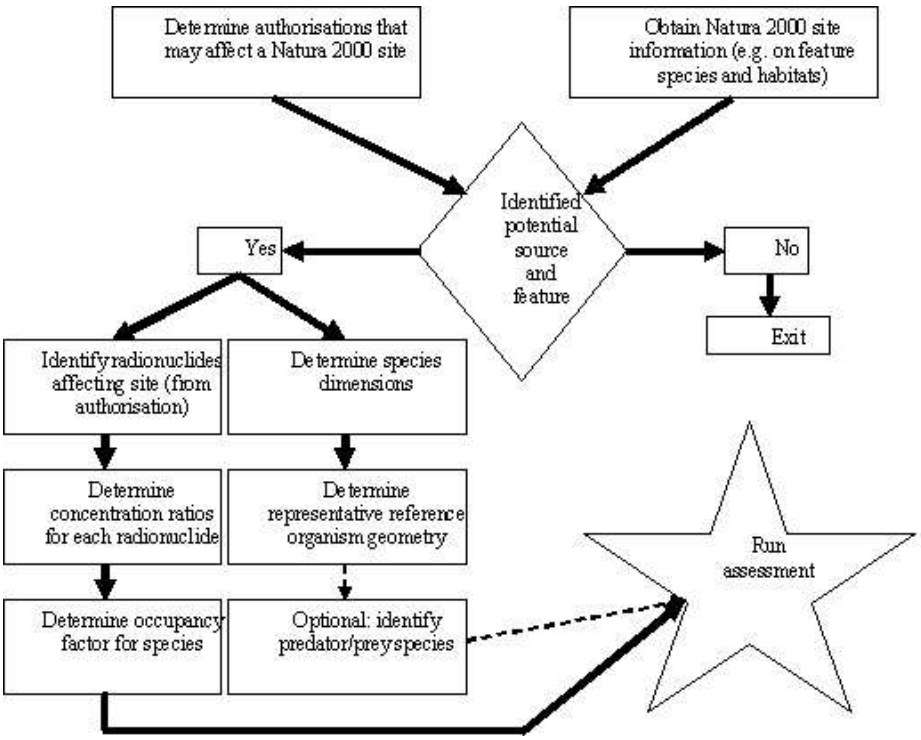

Figure 1. Flow chart of the Natura 2000 assessment process

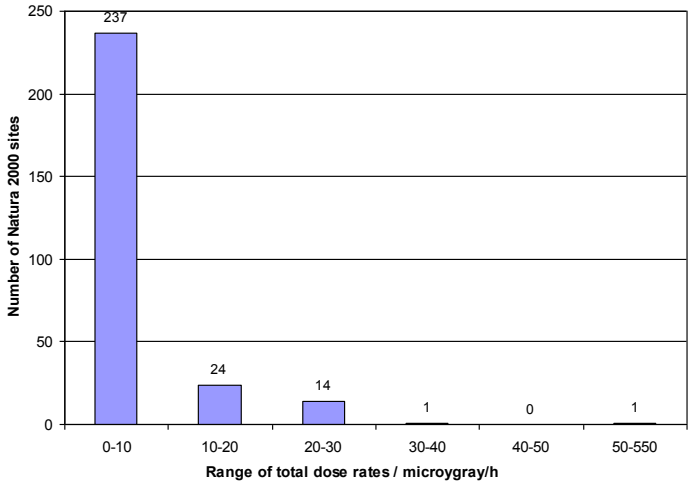

Figure 2. Summary of total dose rate ranges for Natura 2000 sites

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