Application of radiological protection measures to meet different environmental protection criteria

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ICRP Committee 5
To ensure that the development and application of ICRP’s approaches to environmental protection are:

- compatible with those for radiological protection of man; and
- compatible with those for protection of the environment from other potential hazards.
Environmental Protection Drivers

- International Summits, Protocols & Treaties
- National Legislation and Regulation
- Goal is to achieve adequate environmental protection
- International Organisations
Outcomes of Summits and Conventions

**RAMSAR Convention 1971**: an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

**RIO 1992**: established a framework for future development of policies to address environmental protection and socio-economic development such as climate change and biological diversity.

**KYOTO adopted 1997**: set legally binding targets for 37 industrialised countries and the European community for reducing greenhouse gas (GHG) emissions.
Examples of National Environmental Policies

**Australia:** Environment Protection and Biodiversity Conservation Act 1999 provides a legal framework to protect and manage flora, fauna, ecological communities and heritage places.

**New Zealand:** “Environmental Governance – Resource Management” is the main legislation that details how the environment should be managed.

**China:** Environmental Protection is enshrined in law to protect and improve the environment for people and ecology; prevent / control pollution; integrate the environment with economic and social objectives.

**USA:** Environmental policy seeks to regulate activities that impact on the environment, protecting the environment for future generations, yet mitigating commercial impacts on industry.
A condition or state desired to be brought about through a course of action program. They are usually qualitative statements that provide direction for plans and projects. Goals are not specific numerical limitations, but conditions or states which can be obtained through careful planning and implementation.
Clear goals shape Swedish environmental policy

The overall goal is to pass on to the next generation a society in which the major environmental problems have been solved.
The **water use goal** for the fishery, established by the Hamilton Harbour Stakeholder Group, is "that water quality and fish habitat should be improved to permit an edible, naturally-reproducing fishery for warm water species, and water and habitat conditions in Hamilton Harbour should not limit natural reproduction and the edibility of cold water species."
Issues

- Aspirational in nature
- Often do not explicitly mention radioactive substances, ionising radiation or even chemicals
- Consider ‘environmental impacts’ in broadest sense
- Need to define criteria for assessment
Environmental Policies

**European Union:** The Directorate-General for the Environment seeks to protect, preserve and improve the environment for present and future generations.

**UK:** “The natural environment is the whole of the living world. Our natural environment underpins our economic prosperity, our health and our wellbeing”.

ICRP
INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION
Key selection of directives incorporated into UK law:

- Environmental Damage (Prevention and Remediation) Regulations, 2009 (amendment in 2010)


- Habitats Directive (Conservation of Habitats and Species Regulations 2010)
Habitats & Wild Birds Directives
UK Environment Agencies

- Have a duty to comply with the EU Birds and Habitats Directives
- There are obligations to review:
  - Existing authorisations, consents, licences and permissions for chemicals
  - All requests for variations to existing or new applications
  - Ensure that no authorised activity or permission results in an adverse effect, either directly or indirectly on the integrity of identified European sites (Natura 2000 sites)

Pressure is from conservation not radiological protection
International Basic Safety Standards

- Protection of people and the environment
- Prevention of radiological effects on human health and on flora and fauna.
- Adopt an integrated perspective to ensure the sustainable use of natural resources for agriculture, forestry, fisheries and tourism - now and in the future.
ICRP’s environmental protection objectives: Prevent / reduce the frequency of deleterious radiation effects to a level where they would have a negligible impact on:

- the maintenance of biological diversity
- the conservation of species
- the health and status of natural habitats, communities and ecosystems
Member States **shall** include, in the legal framework for radiation protection, provision for the radiation protection of non-human species in the environment; this legal framework shall introduce **environmental criteria** aiming at the protection of populations of vulnerable or representative non-human species with regard to their significance as part of the ecosystem. Where appropriate, practices shall be identified for which regulatory control is warranted to implement the requirements in this legal framework and take account of appropriate environmental assessment criteria.
So...

The key is to **DEMONSTRATE** environmental protection from ionising radiation
Individual organism data collection of reference organisms may yield results that are too restrictive to one type of species and are unable to be translated into a wider environmental context.

An Ecosystem approach would allow analysis of the properties of ecological systems and particularly the interactions among the various components, resistance and resilience to stressors and effects up and down the trophic levels.
Levels of Biological Organisation

- DNA
- Cells
- Tissues
- Individuals
- Populations
- Ecosystems
Ways to assess goal achievement

• Biological surveillance e.g. Monitor population parameters like population density, age distribution, sex ratio, biodiversity index etc.

• Monitor media activity concentrations
  • Relatively straightforward and possibly conducted within existing monitoring programmes
  • Monitor activity concentrations in biota
    • But how if/when the species is protected?
UNEP

Through the “Millennium Ecosystem Assessment Report (2005)” their Ecosystem Management Programme looks to protect human well-being by concentrating on sustaining ecosystems due to the services that they provide.

IUCN also endorsed the ecosystem approach whereby anthropogenic development and needs is a key part of biodiversity management so that sustainable development is executed in an equitable manner.
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Reference ‘organism type’ refers to the ICRPs reference animals and plants.
Protection at community or ecosystem level

Population status of species typical of the ecosystem

Key biological parameters affecting population status of typical species

Concentrations of chemicals likely to affect such biological parameters in such types

Typical biotic types of major ecosystems
Protection at community or ecosystem level

Population status of species typical of the ecosystem

Representative Organisms

Key biological parameters affecting population status of typical species

(Mortality, morbidity, reduced reproductive success, chromosomal damage)

Derived Consideration Reference Levels

Concentrations of chemicals likely to affect such biological parameters in such types

Reference Animals and Plants

Typical biotic types of major ecosystems
A particular species or group of organisms selected during a site specific assessment. In many cases the representative organisms chosen for this purpose may be the same as, or very similar to, the Reference Animals and Plants; but in some cases they may be very different.
Differences between ROs and RAPs

- From ICRP 108
  - Biology
  - Exposure pathway
  - Dosimetry (quantifiable)
  - Effects (likely to be similar)
  - Consequences
Concluding remarks

- Environmental protection can be regarded as
  - Threat to business due to over regulation and additional costs
  - Advantageous addressing the challenge of climate change
- ICRP are seeking to deliver effective and efficient assessment techniques that
  - Demonstrate adequate protection of our ecosystems
  - Benefit our economic growth and human wellbeing
  - Proportionate with the radiological risk
Caveats

Adapted text in the older documents from NCRP (1991), IAEA (1992) and UNSCEAR (1996) is given as follows:

- NCRP Aquatic organisms: it appears that a chronic dose rate of no greater than 0.4 mGy h$^{-1}$ to the maximally exposed individual in a population of aquatic organisms would ensure protection for the population. If modelling and/or dosimetric measurements indicate a level of 0.1 mGy h$^{-1}$, then a more detailed evaluation of the potential ecological consequences to the endemic population should be conducted.
Adapted text in the older documents from NCRP (1991), IAEA (1992) and UNSCEAR (1996) is given as follows:

- IAEA Terrestrial organisms: irradiation at chronic dose rates of 10 mGy d\textsuperscript{-1} and 1 mGy d\textsuperscript{-1} or less does not appear likely to cause observable changes in terrestrial plant and animal populations respectively. Aquatic organisms: it appears that limitation of the dose rate to the maximally exposed individuals in the population to <10 mGy d\textsuperscript{-1} would provide adequate protection for the populations.
Caveats (cont’d)

Adapted text in the older documents from NCRP (1991), IAEA (1992) and UNSCEAR (1996) is given as follows:

- UNSCEAR Terrestrial plants: chronic dose rates less than 400 μGy h⁻¹ (10 mGy d⁻¹) would have effects, although slight, in sensitive plants but would be unlikely to have significant deleterious effects in the wider range of plants present in natural plant communities. Terrestrial animals: for the most sensitive animal species, mammals, there is little indication that dose rates of 400 μGy h⁻¹ to the most exposed individual would seriously affect mortality in the population. For dose rates up to an order of magnitude less (40–100 μGy h⁻¹), the same statement could be made with respect to reproductive effects. Aquatic organisms: for aquatic organisms, the general conclusion was that maximum dose rates of 400 μGy h⁻¹ to a small proportion of the individuals and, therefore, a lower average dose rate to the remaining organisms would not have any detrimental effects at the population level.