



# Towards an ecosystem based approach in radioecology for environment protection

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IUR Workshop

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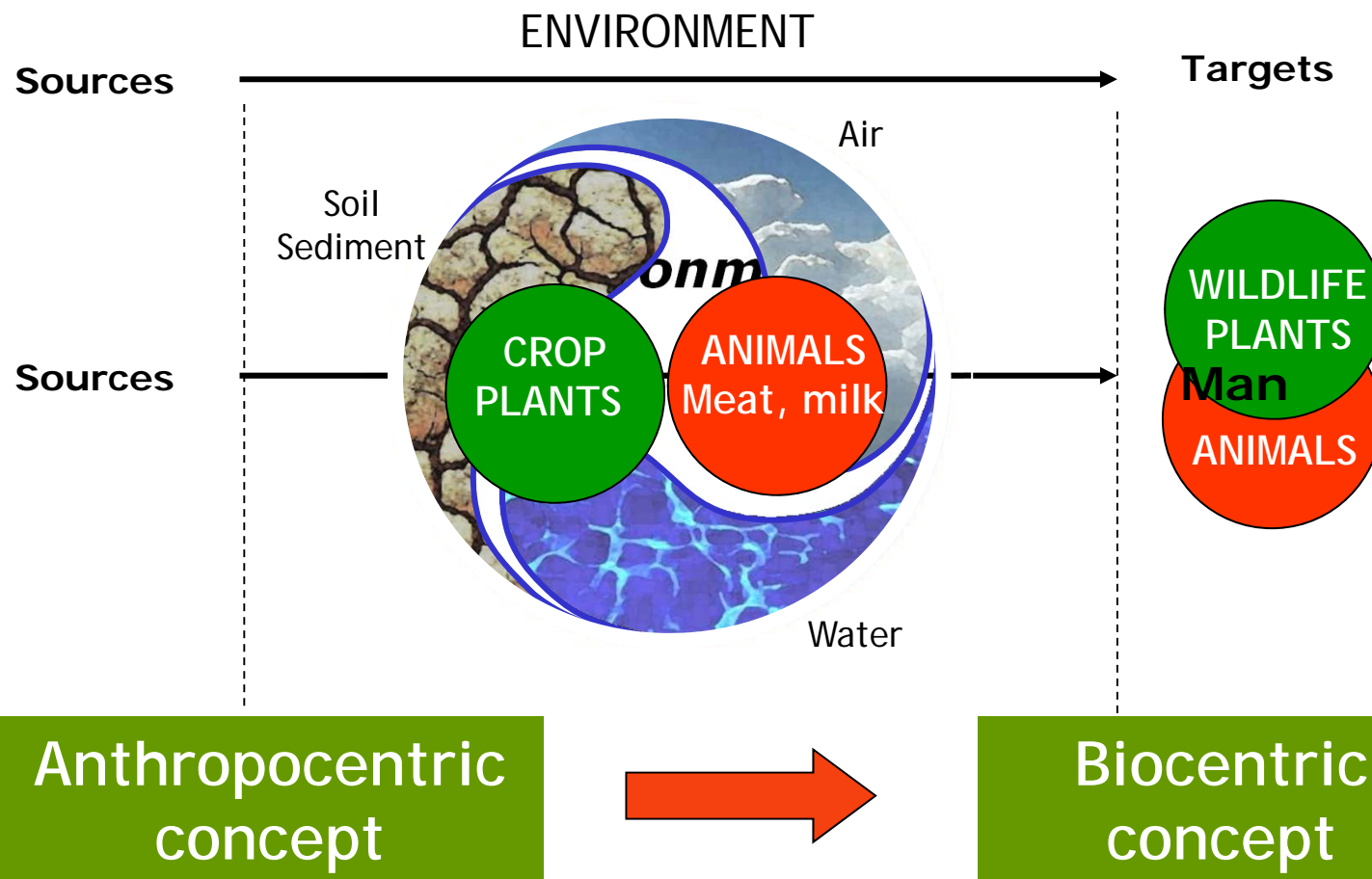
# Today's radiation protection framework

- Legislation, existing or upcoming, requires environment protection measures for all stressors, with no exception for radioactivity
- Need to be able to demonstrate that the environment is indeed adequately protected
- Need to reconsider the anthropocentric ICRP paradigm « Human protection indirectly ensures adequate protection of the environment »



Today's radiation protection framework is based upon « reference organisms »

# « Reference organism approach »: biocentric



## What are « reference organisms »

- Given the very large number of biota species, need to simplify by selecting a reduced number to settle the assessment methodology
- Concept inspired from « reference man » used in human radiation protection. ICRP selected 12 RAPs to be documented and used as reference for comparison purposes
- Concept also evolves from traditional methods of toxicology and ecotoxicology where dose-responses are documented for individual organisms (man/surrogate, eco-test species)



« Reference organisms » restrict the scope of risk assessments to individuals (leads to extrapolations)

# Conceptual method entirely built upon individual organisms responses

RN distribution  
(actual/modelled)

**EXPOSURE**

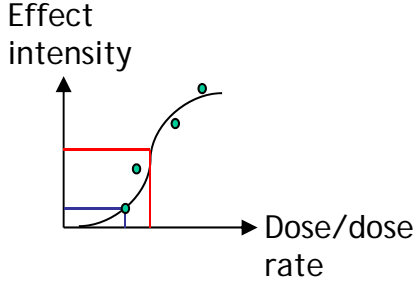
CR, TF  
Dosimetry

Dose or dose  
rate (Gy.d<sup>-1</sup>)

Most knowledge incorporated in the system comes from isolated organisms tested in ideal experimental conditions

- For each ref. org./RAP
- For each radionuclide

**EFFECT**



For effect endpoints  
**IN INDIVIDUALS**

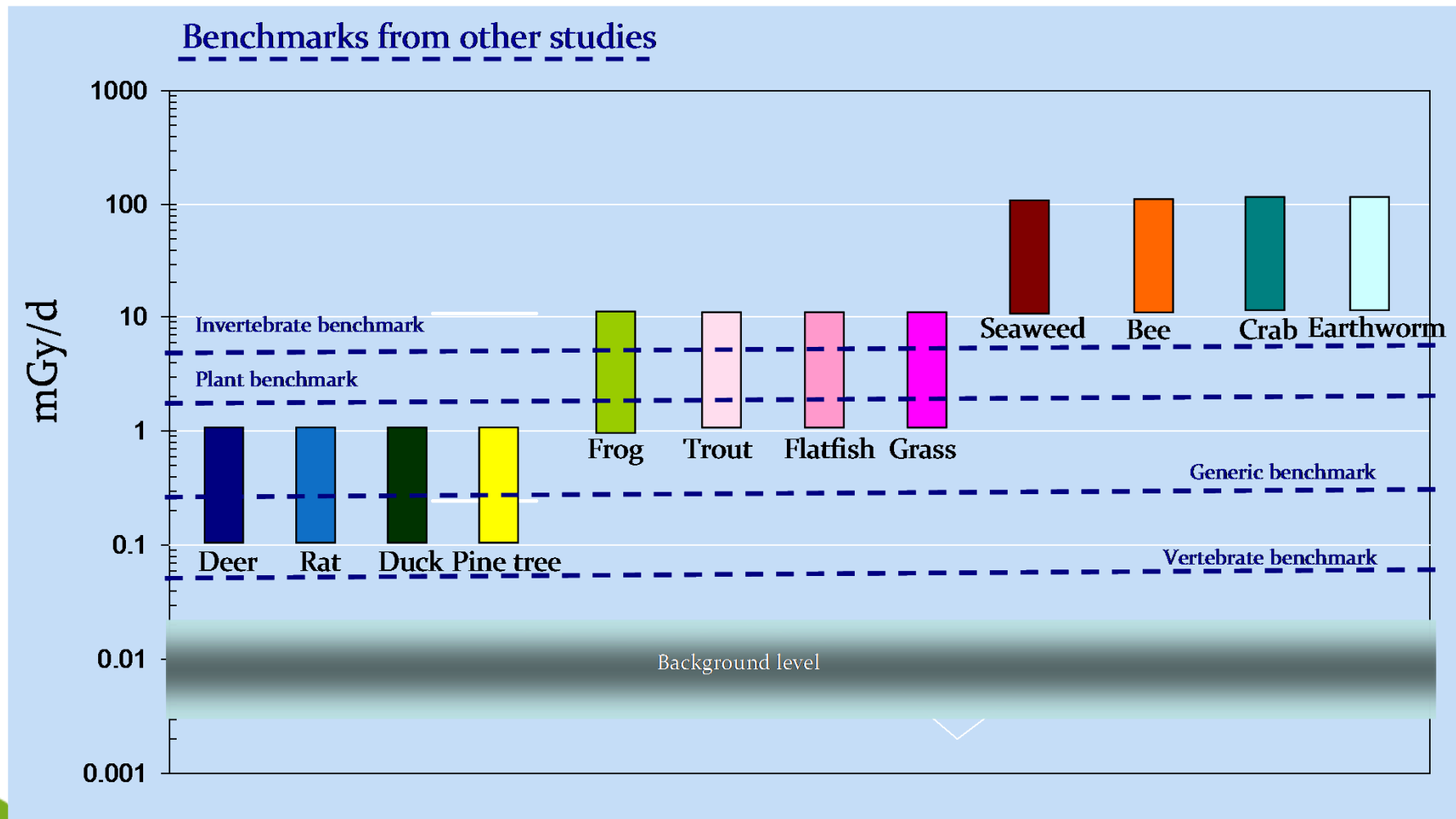
**SCALE OF RISK**

Literature  
compilation

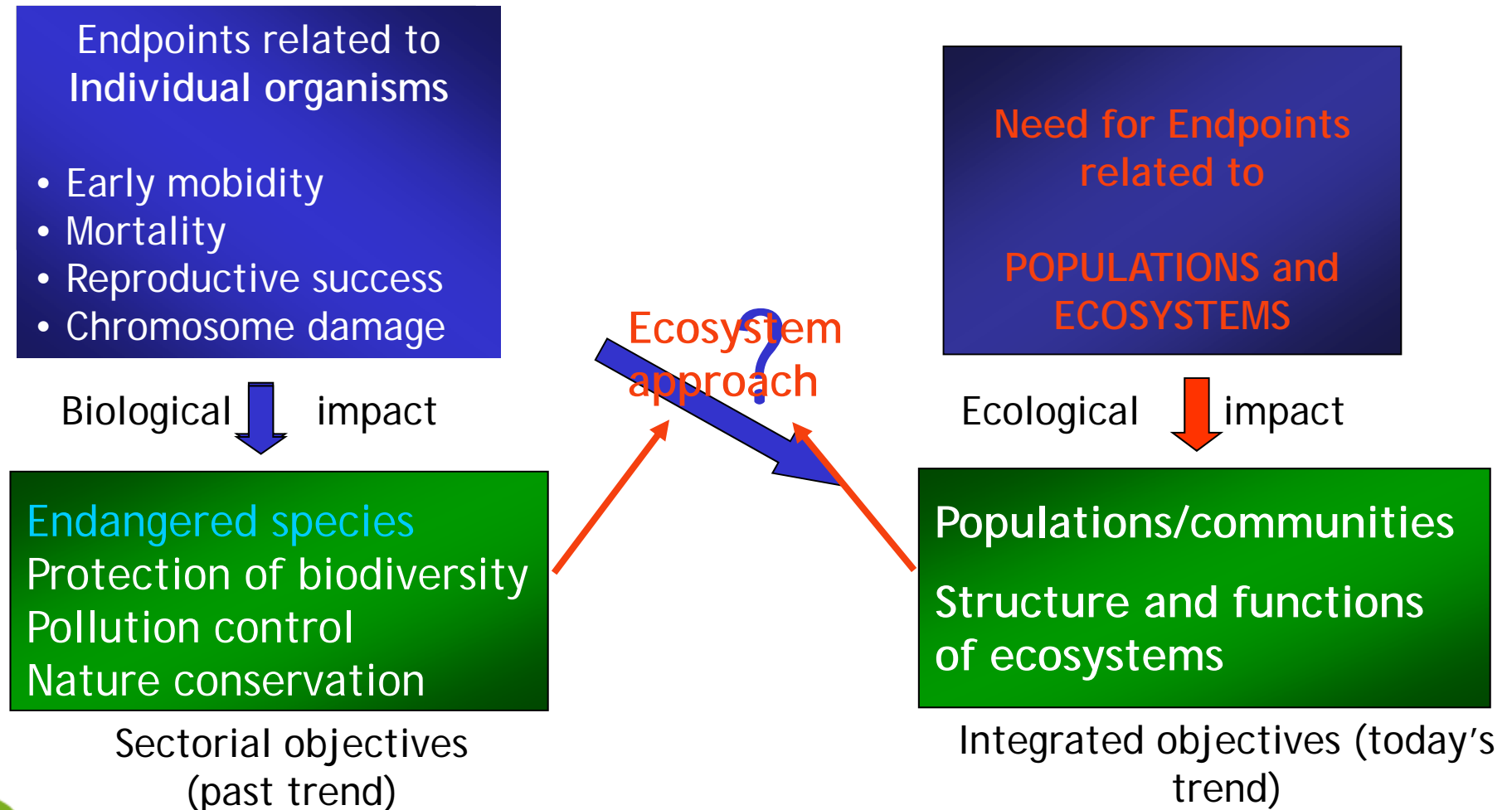


International Union of Radioecology

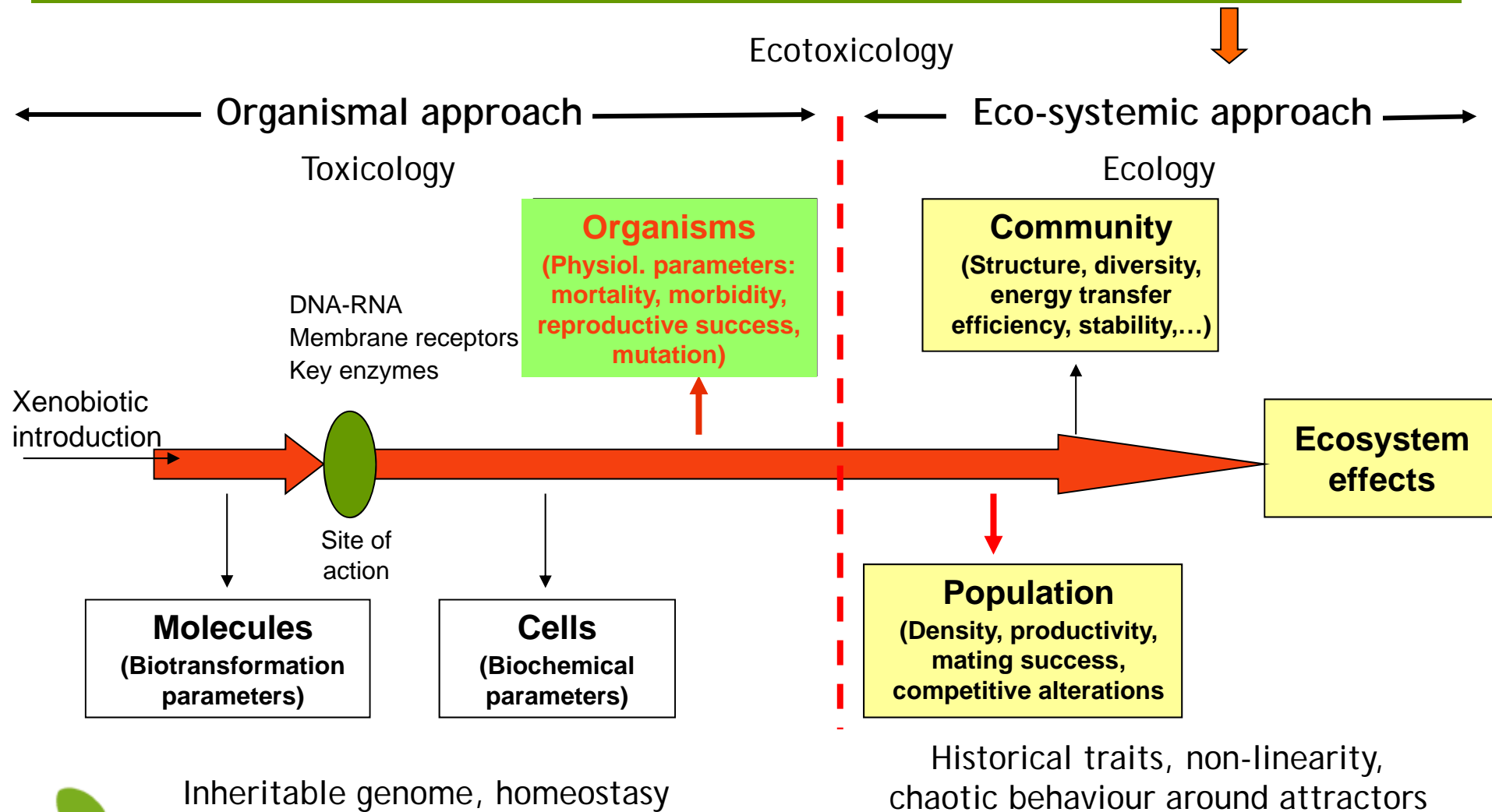
# Scale of risk, based on dose-responses from individuals ( for 4 endpoints)



# Objectives of protection / targets of protection: an issue of endpoints consideration



# Biocentric approach partially meets EP objectives

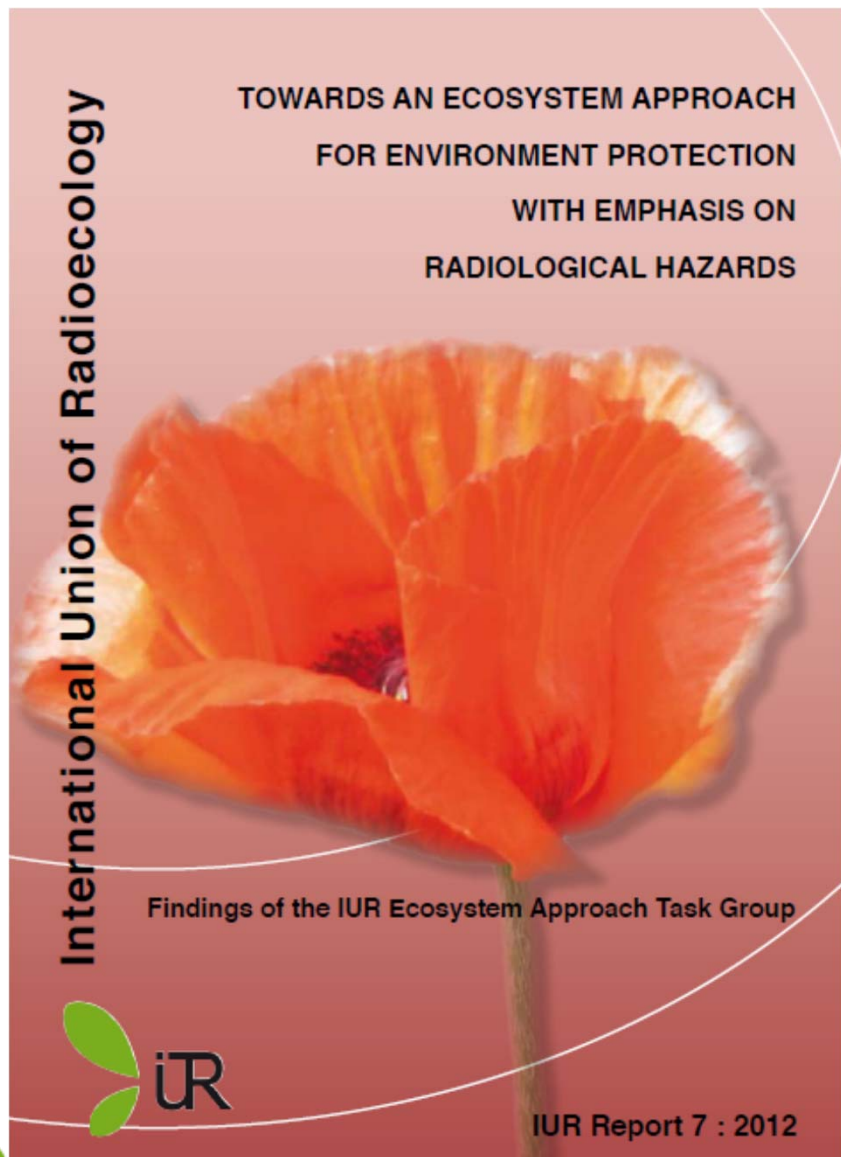




# Biocentric approach does not meet general environment protection objectives

« Reference organism approach » is totally grounded upon **individual responses** to radiation, with no consideration of higher levels of organisation where ecological impacts occur

- Methodology is **mismatched** with regard to the objectives of protection it is meant to support (protection of populations and beyond... not only individual organisms)
- Methodology ignores **interactions between species** which govern impacts at system level
- Methodology cannot account for **ecosystem-level effects** :
  - indirect effects, « cascade effects»
  - trans-generation propagation of effects
  - propagation from individuals up to populations and ecosystem



First IUR Task Group gathering wide radiation proficiencies

Report now published with recommendations

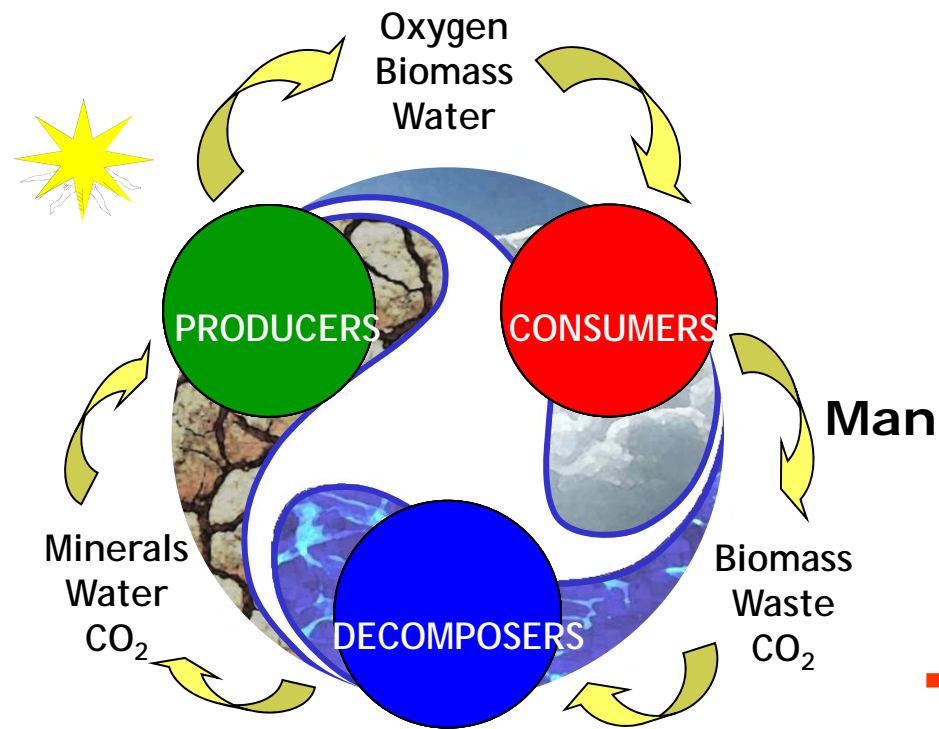
Order at: [www.iur-uir.org](http://www.iur-uir.org)

Now: 2d IUR Task group to follow up upon recommendations

# The « ecosystem approach » is applied in a number of domains, outside the radiation field

- **Recommended by users and environmental risk managers**
  - Fisheries (FAO, 2003; NOAA, 2003)
  - Marine coasts (English nature, 2004)
  - Forestry (IUCN, 2004)
  
- **Recommended within international agreements and conventions**
  - Convention on Biological Diversity (UNEP-CBD, 2004)
  - Water Framework Directive (EC, 2000)
  - OSPAR (Bergen statement, sept 2010)
  - UNEP(in relation to IAEA revision of IBSS, June 2010)

# What is the « ecosystem approach » ? Enlarging the framework to an ecocentric vision



## *Environment including man*

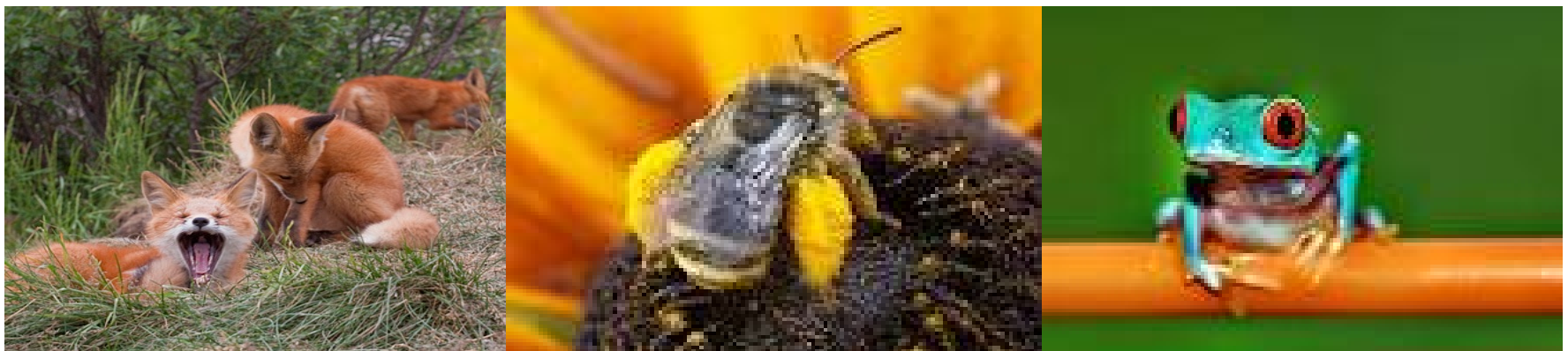
- Ecosystem = Biotope + biocenose

Air	Animals
Water	(man)
Soil	Plants
Sedim.	Microbes

- Services (waste recycling, provision of resources, ...)
- Life support (water recycling, air bioregeneration, biomass production, ...)

# Recommendations for radiation protection

- **Develop more integrated and functional endpoints to expand beyond the organism-level**
- Incorporate more **ecological contextualisation** in the Reference organism approach
- Promote **overall consistency** across the broad spectrum of ecological research and environmental management
- Promote the **dialogue** between environmental assessors and environmental managers



# What kind of endpoints to support an ecosystem approach ?



- Endpoints related to ecosystem structure:
  - Biotic indexes (trophic structure)
  - Biodiversity indexes (genetic structure)
- Endpoints related to ecosystem functioning:
  - Rate of primary productivity (photosynthesis)
  - Rate of energy cycling
  - Rate of N cycling

# Research priorities identified



- Study of impacts at **ecosystem level** (top-down): interactions between populations, sensitivity to population changes, ...
- Improve studies at individual organisms/species level (bottom-up) by focusing more on **ecologically relevant effects**: functional groups/taxa missing, differences in radiosensitivity,...
- Promote field studies and cross-cutting disciplines and approaches: Chernobyl, mines, Fukushima, « gradient » instead of « control » studies, gathering collaboration from geneticists, molecular biologists, systems and landscape ecologists,...