Challenges for radioecology for the next 20 years

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Reviews of radioecology programmes (FUTURAE) in Europe indicated problems

- a decreasing funding base
- fragmentation with poor coordination among national programmes
- poor recruitment of young scientists
- retirement of key personnel, and closing of important infrastructures
8 organizations recognized these problems signed a Memorandum of Understanding in June 2009
Goals

• to address **scientific and educational challenges** relative to the **impact of radioactive substances on humans and the environment**

• to bring together part of their respective R&D **programmes** into an **integrated trans-national programme**
In April 2010, ALLIANCE members (with Stockholm University and the University of Life Sciences in Norway) submitted a proposal to the European Commission to establish a

**Network of Excellence in Radioecology**
Towards an SRA

- STAR and ALLIANCE members recognised that
  - their INTEGRATION could be enhanced through shared Radioecological Research
  - their shared research could be strengthened by prioritising efforts along common themes of mutual interests
- A discipline-wide, internationally agreed upon Strategic Research Agenda was needed to efficiently focus radioecological research
STAR produced the first *draft* Strategic Research Agenda in Radioecology

The SRA consists of 3 Challenges and 15 associated research lines
CHALLENGE ONE

To Predict Human and Wildlife Exposure More Robustly by Quantifying the Key Processes that Most Influence Radionuclide Transfers

(4 lines of research)
CHALLENGE ONE

A. Identify and mathematically represent key processes that make significant contributions to the environmental transfers of key radionuclides and resultant exposures of humans and wildlife

B. Acquire data necessary to parameterise key processes that control radionuclides transfer

C. Develop transfer and exposure models that incorporate physical, chemical and biological interactions, and enable predictions to be made spatially and temporally

D. Represent radionuclide transfer and exposure at a landscape level with indication of the associated uncertainty
CHALLENGE TWO

To Determine Ecological Consequences under Realistic Exposure Conditions

(5 lines of research)
CHALLENGE TWO

E. Mechanistically understand how processes link radiation induced effects in wildlife from molecular to individual levels of biological complexity

F. Understand what causes intra- and inter-species differences in radiosensitivity (among cell types, tissues, life stages, influence of ecological characteristics including habitats, behaviour, feeding regime)

G. Understand the interactions between ionising radiation and other co-stressors

H. Understand mechanisms underlying multi-generational responses to long-term ecologically relevant exposures (hereditary effects, adaptive responses, genomic instability, epigenetic processes)

I. Understand how radiation effects combine at higher levels of biological organisation (population dynamics, trophic interactions, indirect effects at the community level, and consequences for ecosystem functioning)
CHALLENGE THREE

To Improve Human and Environmental Protection by Integrating Radioecology

(6 lines of research)
CHALLENGE THREE

J. Integrate uncertainty and variability from transfer modelling, exposure assessment and effects characterisation into risk characterisation

K. Integrate human and environmental protection frameworks

L. Integrate the risk assessment frameworks for ionising radiation and chemicals

M. Provide a multi-criteria perspective in support of optimised decision-making

N. Integrate ecosystem services, ecological economics and ecosystem approaches within radioecology

O. Integrate Decision Support Systems
Questionnaire - Web-consultation

● Sent out to 4000 people

● Of the 15 lines of research proposed, which three do you think are the most important to address? Why?

● Which of the above lines of research do you think will be most difficult to achieve? Why?

● Other research challenges which should have been included. Why?

● General things
  ● Interest/activities on radioecology of the responders.
  ● Type of organization, country, answers on behalf of their organisation or as individuals.
The Responders

Total number of questionnaires received: 110
Total number of countries covered by responses: 36
Number of total which are in EU: 19

Bar chart showing the number of respondents by country:
- Australia: 1
- Belarus: 1
- Belgium: 3
- Bosnia and Herzegovina: 1
- Brazil: 2
- Canada: 1
- Croatia: 1
- Cyprus: 1
- Czech Republic: 3
- Egypt: 3
- Finland: 6
- France: 3
- Germany: 1
- Greece: 3
- Hungary: 3
- India: 1
- Iran: 1
- Ireland: 1
- Italy: 1
- Japan: 1
- Kuwait: 1
- Lithuania: 1
- P.R. China: 1
- Philippines: 1
- Poland: 1
- Portugal: 1
- Romania: 1
- Russia: 4
- Slovakia: 2
- Slovenia: 1
- Spain: 1
- Sweden: 1
- UK: 1
- Ukraine: 1
- USA: 12

Pie chart showing the distribution of respondents:
- Industry: 10
- NGO: 1
- Consultants: 7
- Other: 10
- Research: 68
- Regulators: 14
Most important lines of research (choose only 3)

CHALLENGE- 1
Quantify key processes that most influence RN transfer and exposure (40%)

- A. Identify key processes
- B. Parameterise key processes
- C. Develop models
- D. Model at a landscape level
Most important lines of research (choose only 3)

Nº of responders who chose a given research line

CHALLENGE- 2
Determine ecological consequences under realistic conditions (30%)

- E. How processes link effects from molecular to individuals
- F. What causes intra- and inter-species differences
- G. Understand multiple contaminants
- H. Understand multi-generational responses
- I. Understand how radiation effects interact at higher biological levels
Most important lines of research (choose only 3)

CHALLENGE- 3
Improve radiation protection by integrating radioecology (30%)

J. Integrate uncertainty and variability into risk characterization
K. Integrate human and environmental protection frameworks
L. Integrate risk assessment framework for radiation and chemicals
M. Provide a multi-criteria perspective in support of optimised decision-making
N. Integrate ecosystem approaches, ecosystem services and ecological economics
O. Integrate decision support systems
Which lines of research will be the most difficult to achieve?

**CHALLENGE- 1**
Quantify key processes that most influence RN transfers (10%)

**CHALLENGE- 2**
Determine ecological consequences under realistic conditions (58%)

**CHALLENGE- 3**
Improve radiation protection by integrating radioecology (32%)

- G) Multi-stressor interactions
- H) Multi-generational responses
### Research challenges that should have been included

56 responders suggested “other” items that should be in the SRA

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<tr>
<th>STAKEHOLDERS</th>
<th>INTEGRATION</th>
<th>RESEARCH</th>
<th>RESEARCH</th>
<th>METHODS</th>
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<td>• Need to build public confidence in the assessment models</td>
<td>• <strong>Emergency preparedness &amp; radioecology</strong>&lt;br&gt;• Need management tools for Response, Remediation and Restoration</td>
<td>• Urban environments&lt;br&gt;• Model validation&lt;br&gt;• Radionuclides as tracers&lt;br&gt;• Effects from internal versus external exposure&lt;br&gt;• Economic consequences&lt;br&gt;• Biomarkers&lt;br&gt;• Remediation strategies</td>
<td>• Global change (climatic) and radioecology&lt;br&gt;• U mining (past and future) is not adequately covered.&lt;br&gt;• $^{241}$Am&lt;br&gt;• Marine environment&lt;br&gt;• Dosimetry&lt;br&gt;• Low dose effects&lt;br&gt;• Effects to populations</td>
<td>• To quickly and easily identify radionuclides in soils&lt;br&gt;• To improve lower limits of detection&lt;br&gt;• Non-lethal sampling methods are needed</td>
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<td>• Focus activities on <strong>stakeholder engagement</strong>&lt;br&gt;• Public education in radioecology&lt;br&gt;• Social acceptance and risk perception&lt;br&gt;• Improve communication with stakeholders</td>
<td>• <strong>Radiobiology &amp; Radioecology</strong>&lt;br&gt;• DSSs RODOS and ARGOS: improvements from a radioecology perspective</td>
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“The SRA is clearly the product of substantial international discussion and evaluation of different perspectives on the medium-term future of radioecology. The result is a logical collection of research themes that, if addressed fully, would not only revolutionise radioecology but also ecotoxicology and ultimately integrated environmental management.”
Developing the SRA is a continuous process

- Build international consensus on the SRA
  - Stakeholder workshop on SRA, Paris (Nov ‘12)
    - International Organizations (IAEA, ICRP, UNSCEAR, IUR)
    - Other Networks of Excellence (DoReMi, NERIS, NCoRE)
    - Larger radioecology community
    - Interested stakeholders

- Include remarks web-consultation & workshop: Sept ‘13

- Develop first phase RTD implementation plan – Oct ‘13

- Develop other aspects of the Strategic Agenda
  - Education
  - Recruitment
  - Maintenance of key infrastructures
  - Knowledge management
Thanks for your attention!!

Radioecology towards 2013+20
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