

## **Appendix: Consensus Symposium process, program and discussion questions**

The International Union of Radioecology Consensus Symposium on the ecological effects of radiation on populations and ecosystems took place in Miami, 17-19 November 2015. Participation was upon invitation from the IUR and the Norwegian Radiation Protection Authority. The Program Committee<sup>1</sup> identified 30 scientists representing a broad range of disciplines and experience in diverse regions of the world (Europe, Japan, North America, and Russia).

Each participant prepared and presented a scientific talk, surveying in total a panorama of methods and approaches from within and beyond the traditional radiological protection community. These presentations were sequenced according to theme. After each thematic session, participants broke out into three parallel subgroups to discuss set questions developed by the organizers. The discussion throughout was cordial and free-ranging, touching in depth on both the content of previous presentations, and the scientific and pragmatic experience of the participants. The organizers pre-determined breakout group membership to achieve diversity, and tapped volunteers to chair and to report each discussion in plenary. Breakout group composition was unchanging until the final period of the symposium, when participants grouped by affinity to discuss and refine written statements in view of this publication. The text basis for that final discussion was provided by Deborah Oughton and Per Strand, who had recovered all the reporters' notes and organized them into themes close to the seven consensus statements seen in this publication. After the symposium, the rough draft emerging from the final subgroups was reworked, arranged and referenced by the first authors. All signatories then reviewed and agreed the present document. As per footnote n°2, two participants chose to endorse the shorter IUR (2016) note containing simply the seven statements.

The program of presentations and the intervening breakout questions were as follows. The presentations are available on line at the IUR website ([www.iur-uir.org/](http://www.iur-uir.org/), where interested parties also may submit their IUR membership registration).

### **IUR Consensus Symposium, Miami, 17-19 November 2015**

#### ***Ecological effects of radiation on populations and ecosystems***

##### *Program*

##### **Introduction**

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*Session Chair:* Gene Rhodes

*IUR's introduction to the Consensus Symposium.*

François Bréchnac - IRSN & IUR

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<sup>1</sup> The Program Committee was composed of Dr. François Bréchnac (President of IUR; IRSN, France); Dr. Justin Brown (Senior Scientist, NRPA, Norway); Dr. Carmel Mothersill (Canada Research Chair in Radiobiology, McMaster University, Canada); Dr. Timothy Mousseau (Professor of Biological Sciences, University of South Carolina, USA); and Dr. Olin E. (Gene) Rhodes, Jr. (Director and Professor, University of Georgia's Savannah River Ecology Lab, USA).

*UNSCEAR's assessment of doses and effects for non-human biota following the Fukushima nuclear accident.*

*Short address (on video)*

Malcolm Crick - Secretary, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), Vienna, Austria

*Review presentation*

Per Strand – NRPA, Østerås, Norway

*IAEA's environmental impact assessment after Fukushima.*

Justin Brown - NRPA, Østerås, Norway (presented by Per Strand)

*The 2001 previous consensus statement on environment protection (including ethical and philosophical views over goals of environment protection.*

Deborah Oughton - CERAD, NMBU, Oslo, Norway

*Process aims and tools for discussion. Consultation: individual views on former consensus statement; main question, main objection, main priority for advancing radioecology; major tension structuring enquiry; main ethical/philosophical value position.*

Claire Mays - Institut Symlog, Paris, France - Process Advisor

## **Session 1. What is meant by environmental protection?**

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*(Revisiting previous consensus statement, addressing different protection goals, impact of different protection goals on the methodological approaches... )*

*Session Chair:* Hirofumi Tsukada

What is “environmental protection” and what does it mean in the radiation context?

*Targets of protection and related endpoints (organisms, populations, ecosystems' structure and functions)*

Larry Kapustka - LK Consultancy, Alberta, Canada

Current status of environmental protection systems

*Quantifying exposures to non-radioactive substances*

Larry Barnthouse - LWB Environment Services, Inc., Hamilton, Ohio, USA

*ICRP Reference Animals and Plants (RAPs) approach*

Kathy Higley - University Oregon at Corvallis, USA

*Quantifying exposure from radionuclides for environmental receptors*

Justin Brown - NRPA, Oslo, Norway (presented by Per Strand)

### **Discussion in breakout groups**

*Breakout Chairs:* Larry Barnthouse, Larry Kapustka, Brit Salbu

*Breakout Reporters:* Clare Bradshaw, Kathy Higley, Wendy Kuhne

#### Consensus aim

Identify what has been achieved since 2001 and where system development is still required.

#### Questions proposed for discussion

How are today's system of protection and methodological choices shaped by protection goals?

Are the protection goals well-served by current targets and endpoints?  
- Does environmental protection usually mean protection of populations or of individuals?  
What are the strengths and limitations of the RAPs approach? Should we invest effort in addressing the limitations?  
Can we adequately quantify relevant exposure today? Are further developments needed?  
- In chronic exposure, is accumulated dose more relevant than dose rate?  
- Bearing in mind dosimetry challenges, is there a need to develop dose units for wildlife?

*Report in plenum - Feedback commentary from the Process Advisor*

## **Session 2. Field and laboratory studies**

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*(What are the disagreements, extrapolation issues, confounding factors, various objects of observation to address various targets of protection, etc.)*

*Session Chair: Ulrik Kautsky*

*Background mutation rates across the tree of life.*

Michael Lynch - Indiana University, USA

### Summary of field studies – effects on populations

*Recent Findings from Fukushima*

Timothy Mousseau - University South Carolina, USA

*Some thoughts on statistical difficulties in detecting radiation effects in the natural environment.*

Jim Smith - University of Portsmouth, UK

### Linking field investigations and laboratory experiments

*Fukushima and the pale grass blue butterfly*

Joji Otaki - University Okinawa, Japan

*Effects of radiation on populations and ecosystems, the Chernobyl and Kyshtym cases*

Stanislav Geras'kin - RIARAE, Obninsk, Russia

*Synthesis from the 2013 Workshop on “Uncertainties in field studies on chronic low level effects due to radiation” held at Lancaster (UK)*

Steve Mihok - Russel, Ontario, Canada

## **Discussion in breakout groups**

*Breakout Chairs: Larry Barnthouse, Larry Kapustka, Brit Salbu*

*Breakout Reporters: Clare Bradshaw, Kathy Higley, Wendy Kuhne*

### Consensus aim

Acknowledge the value of scientific strategies that integrate laboratory experiments and field studies

### Questions proposed for discussion:

Are field studies and laboratory experiments addressing the same objects? Do we expect the effects they identify to be comparable/the same?

What effects can be seen in affected field populations ?

Which effects can be attributed to ionizing radiation ?

What are the implications for risk assessment?

What are the most important confounding factors affecting field results? Which factors stem from methodology (dosimetry, statistics...) and which factors are due to ecological phenomena?  
Do the composition and variation of background radiation matter?

*Report in plenum - Feedback commentary from the Process Advisor*

### **Session 3. Ecosystem approach, systems ecology, indirect effects**

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*(Alternative approaches, areas of development and integration, need for systemic view, etc.)*

*Session Chair: Brit Salbu*

#### Summary of field studies – effects on ecosystems

*Ecosystem effects of ionizing radiation*

Anders Møller - CNRS, Orsay, France

*Reaction of water biocenoses to chronic radiation exposure aquatic flora and fauna*

Evgeny Pryakhin - Urals Research Center for Radiation Medicine, Chelyabinsk, Russia

#### Reference organism/biological effects versus ecosystem approach ecological effects

*Alternative conceptual approaches for assessing ecological impact of radiation*

François Bréchnignac - IUR/IRSN, Cadarache, France

*Biological effects versus ecological effects : an ecologist's systems view*

Clare Bradshaw - University of Stockholm, Sweden

#### Chronic low dose range implications

*Non-Targeted Effects of Ionising Radiation - possible implications for Environmental Radiation Protection*

Carmel Mothersill - University McMaster, Hamilton, Canada

### **Discussion in breakout groups**

*Breakout Chairs: Larry Barnthouse, Larry Kapustka, Brit Salbu*

*Breakout Reporters: Clare Bradshaw, Wendy Kuhne, Carmel Mothersill*

#### Consensus Aim

Identifying further research needed to understand the ecological impacts of ionizing radiation

#### Questions for discussion

Can a system of environmental protection be based exclusively on biological effects?

- Is there a difference between ecological and biological effects of radiation?

- Is there a need to develop an understanding of ecological effects of radiation?

What endpoints are needed for studying ecosystem effects?

How to conduct field studies on ecosystem effects?

What are the main uncertainties linked to indirect effects?

*Report in plenum - Feedback commentary from the Process Advisor*

### **Session 4. Consensus building**

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***Session moderator: Deborah Oughton***

*Feedback from the individual consultation. What kind of "consensus"? Commentary from the Process Advisor*

Claire Mays – Institut Symlog, France

***Consensus development in groups by affinity***

*Group leaders: François Bréchnignac, Travis Glenn, Ulrik Kautsky.*

*Discussion and refinement of text notes, drafting statements and conclusions*

*Brief reports in plenary*