

# MORE ECOLOGY INTO RADIOECOLOGY !

## Overview on Recommendations from the 2015 Miami Consensus Symposium on Ecological Impact of Radiation

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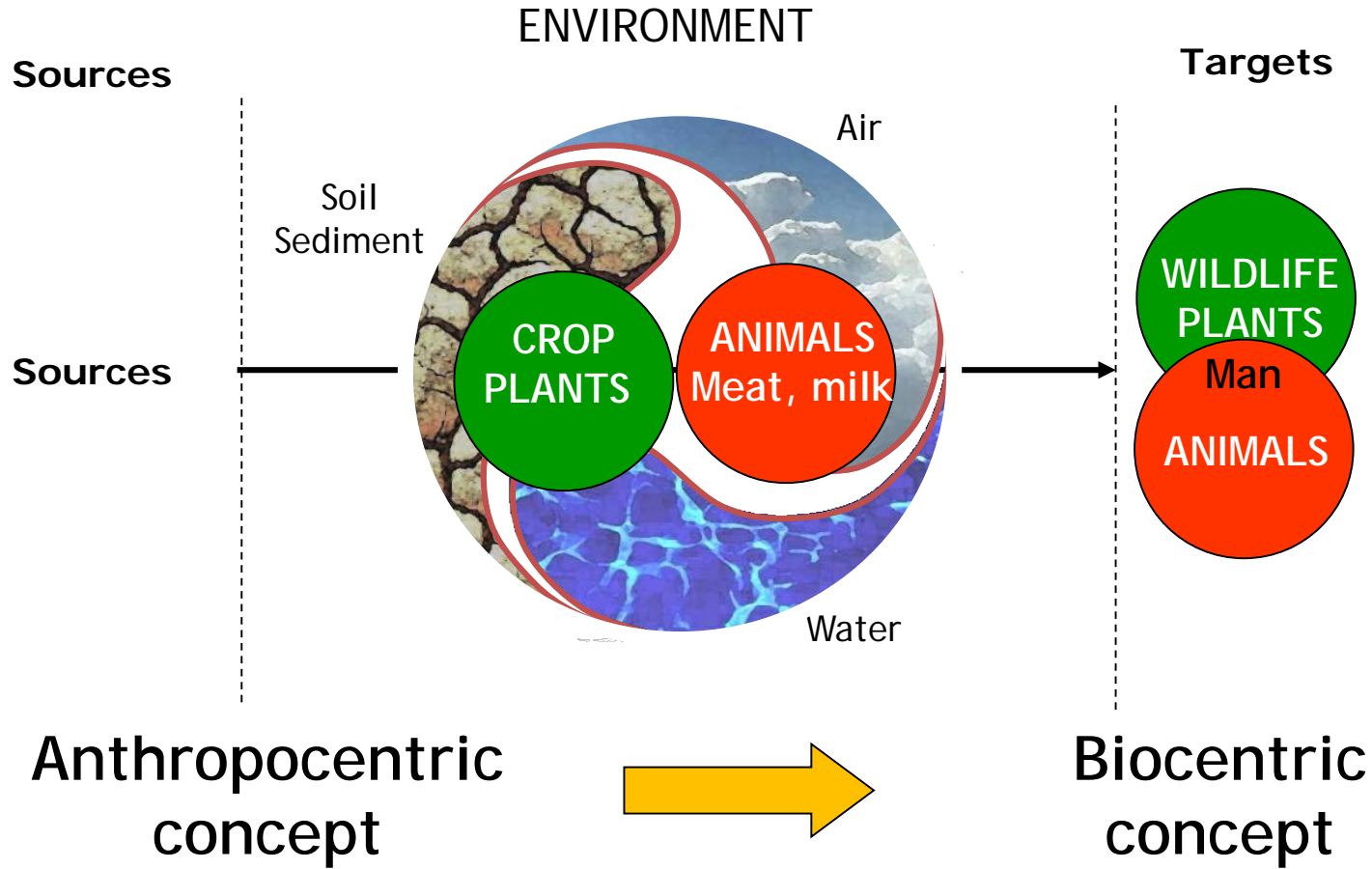
\*International Union of Radioecology ([www.iur-uir.org](http://www.iur-uir.org))

# Why more ecology into radioecology ?

- **Origin of radioecology clearly grounded in ecology**
- **Next, radioecology largely dominated by anthropocentrism**
  - Focus largely on transfers to man through the environment (models)
  - Radioecology shaped to support the « environmental » requirements for human radiation protection
  - Radiation protection first aimed at protecting human beings
- **IUR promotes an evolution towards (back to) ecocentrism**
  - Need to widen the scope to environmental radiation protection itself
  - Need to integrate human and environment protection in a coherent framework... requires to adopt an « ecosystem approach »

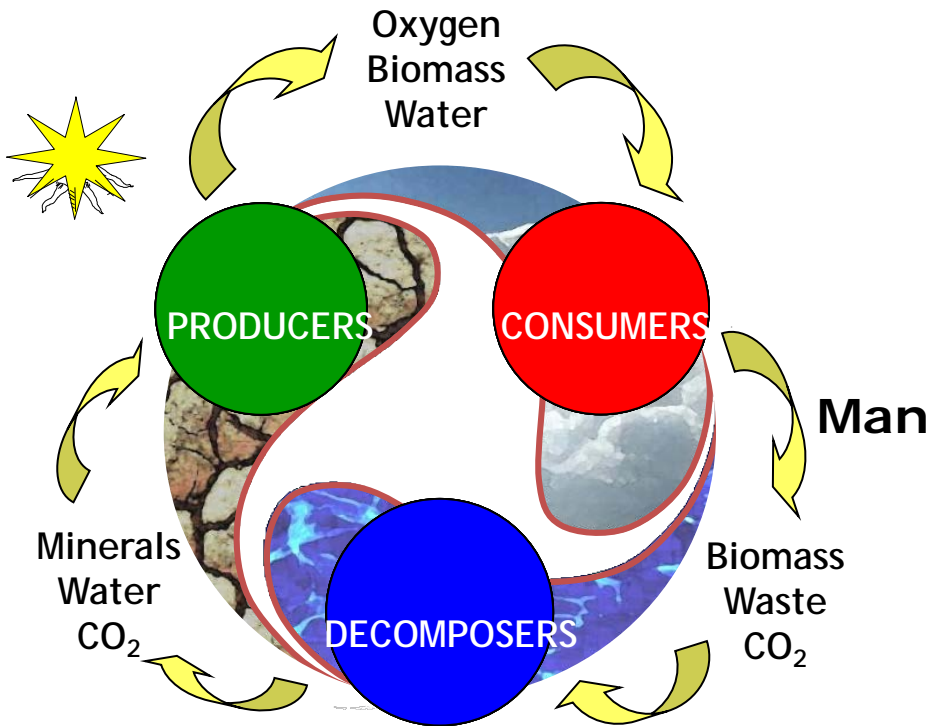
# Evolution of radioecology

Beyond protection of man, protecting the environment itself



# Evolution of radioecology

Protecting the environment including man requires moving to an ecocentric concept



## *Environment including man*

- **Ecosystem** = Biotope + Biocenose

Air	Animals (man)
Water	Plants
Soil/Sedim.	Microbes

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

# Miami Consensus Symposium

## « Ecological effects of radiation on populations and ecosystems »

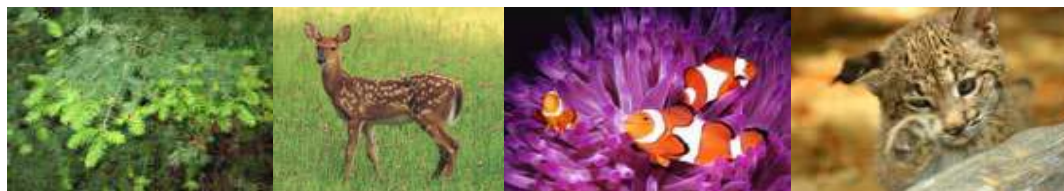
(Miami Beach, USA, 16-19 November 2015)

- **Why convening a consensus Symposium ?**

- For ecosystems and wildlife, there is **poor consensus** within the scientific community on the ecological impacts from radiation

- **The Miami international Consensus Symposium**

- Review the various studies yielding contrasting interpretations of the results
- Identify to which extent we have consensus, and what are the issues of concern (methodological, conceptual, experimental...)
- Collectively elaborate possible directions for improving consensus
- Draft an agreed set of statements to take stock of the situation and to take responsibility for initiating improvement





# Miami Consensus Symposium

## The actors originating from diverse horizons ...



# Miami Consensus Symposium

... produced a set of agreed statements and recommendations to improve protection of the environment

Bréchignac et al., 2016. *Journal of Environmental Radioactivity* 158-159: 21-29

*Journal of Environmental Radioactivity* 158-159 (2016) 21–29



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Review

Addressing ecological effects of radiation on populations and ecosystems to improve protection of the environment against radiation: Agreed statements from a Consensus Symposium<sup>☆</sup>



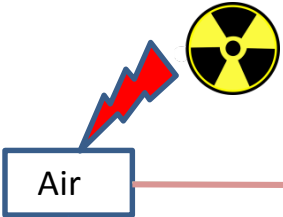
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# Miami Consensus Symposium Recommendations

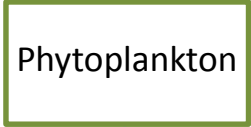
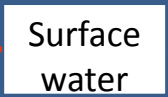
- **Improve the conceptualization and terminology of protection goals**
  
- **An ecosystem approach provides a fully integrated conceptual model**
  - ❖ Systems-level research emphasizing interactive responses to radiation exposure, propagation of effects, delayed effects, indirect effects, resistance and resilience of ecological systems
  
  - ❖ Environmental protection criteria : population and ecosystem attributes involving more integrated and functional endpoints such as population dynamics, biodiversity, decomposition, primary productivity, energy transfer or nutrient flow



Climate change,  
other stressors

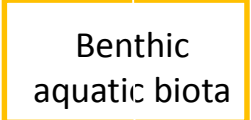
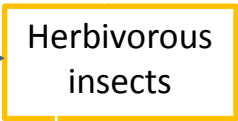
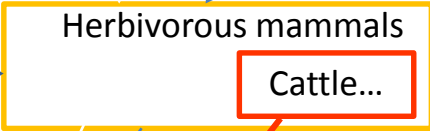
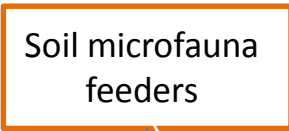
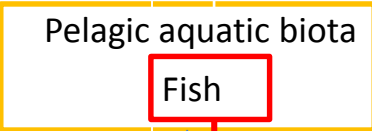


External irradiation



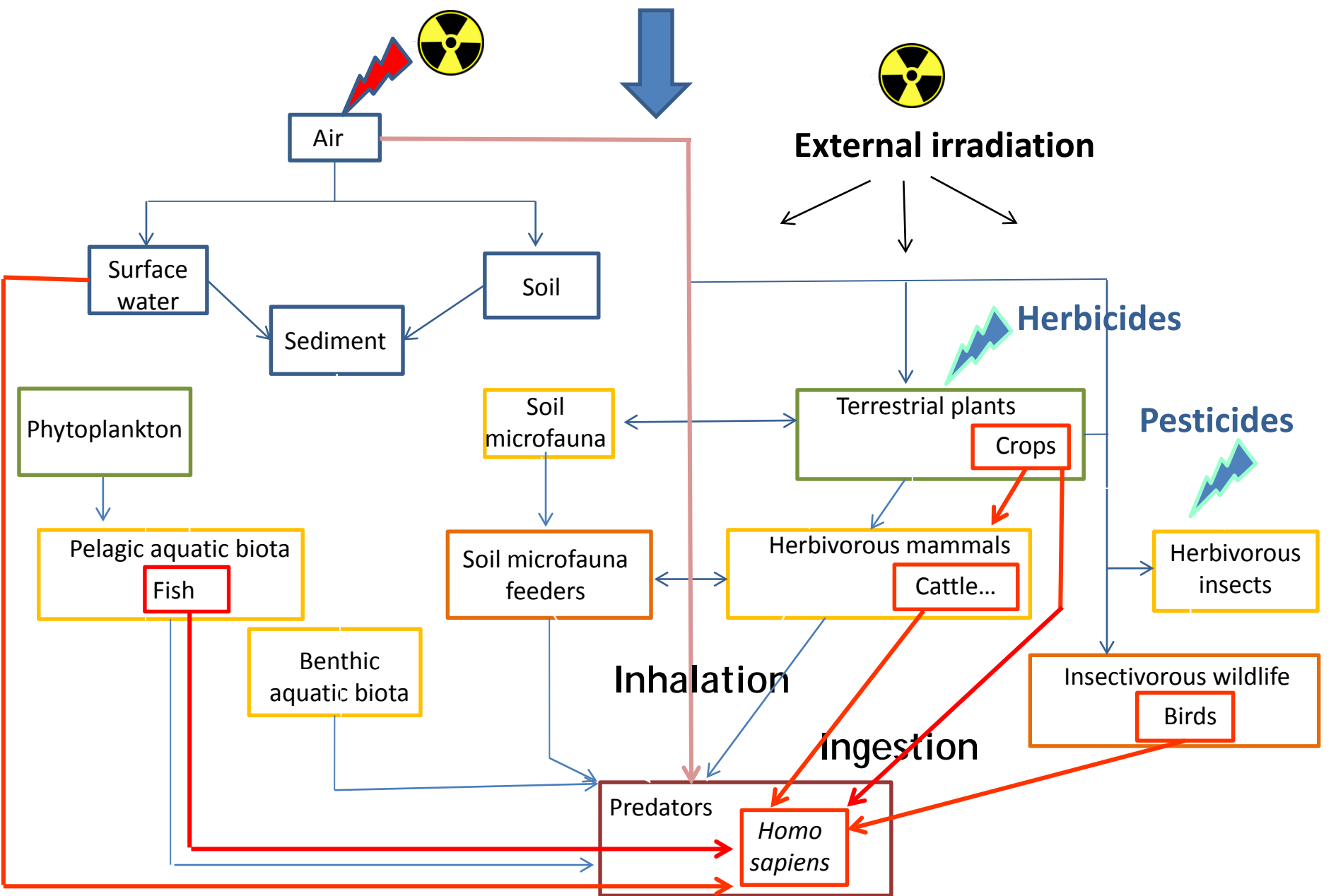
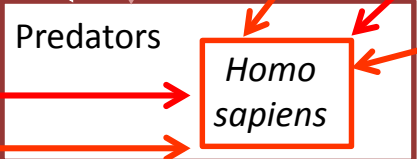
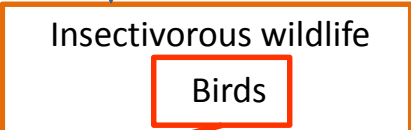
Herbicides

Pesticides



Inhalation

Ingestion



# There is no man without an ecosystem to support him

- **A fully integrated conceptual model :**
  - ❖ Depicts what are the respective positions of man and other species within the ecosystem
  - ❖ Explains that man is but one of many species interacting within the ecosystem
  - ❖ Captures the relationships of relevance to radiation that relate them all within the ecosystem (pathways of exposure, leading next to potential effects)

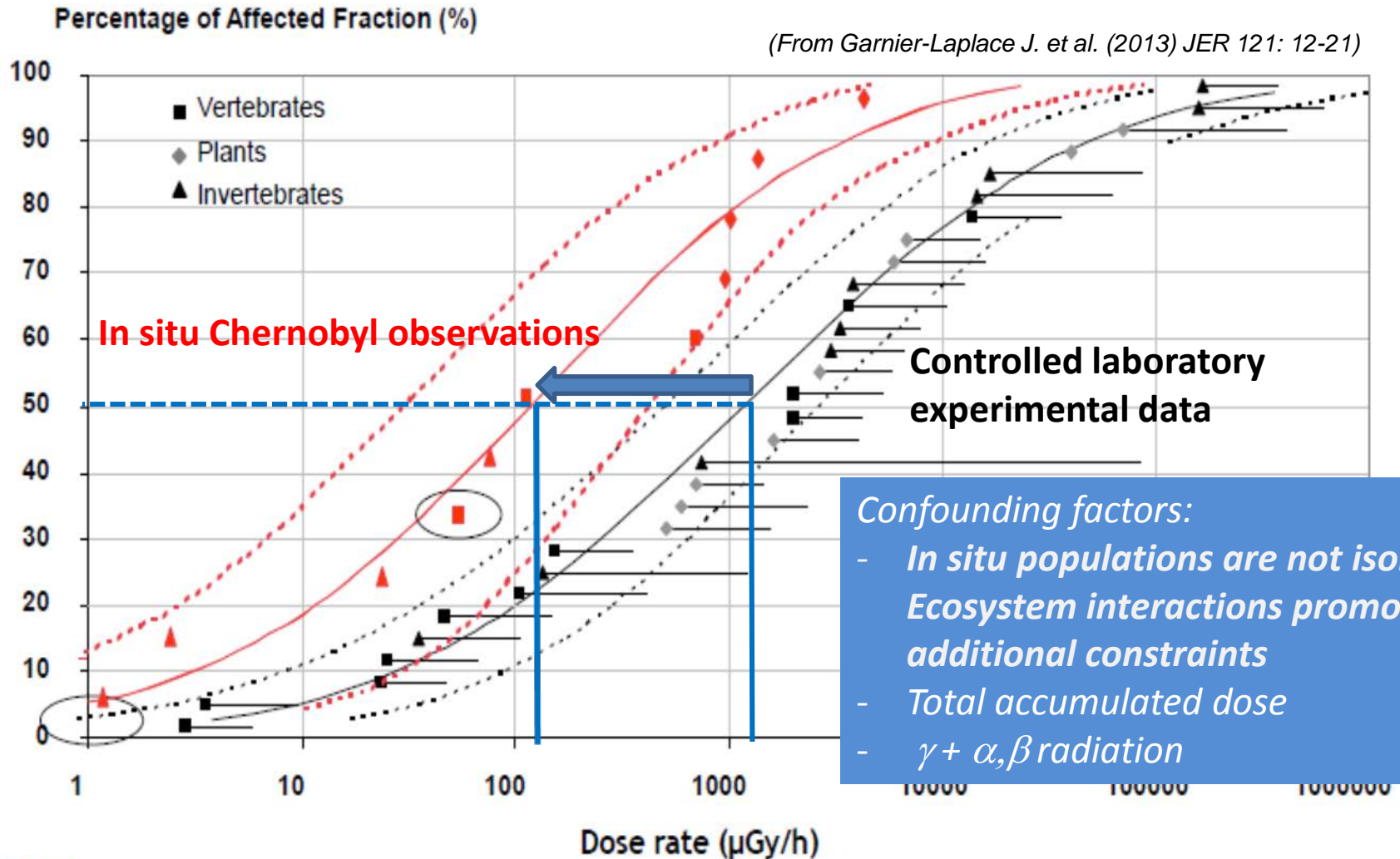
# Miami Consensus Symposium Recommendations

- **Linking field and laboratory studies and modeling**
  - ❖ Long-term monitoring studies at contaminated sites... with the goal of carrying out field experiments with a decent level of replication
  - ❖ Development of ecosystem conceptual models depicting network of interactions and important nodes/pathways/subnetworks ... with the goal of providing an integrated picture (biological/ecological impacts) to be confronted to real data
  - ❖ Develop micro-mesocosm studies to help bridging the gap between field and laboratory studies... with the goal of integrating genetics and other biological tools



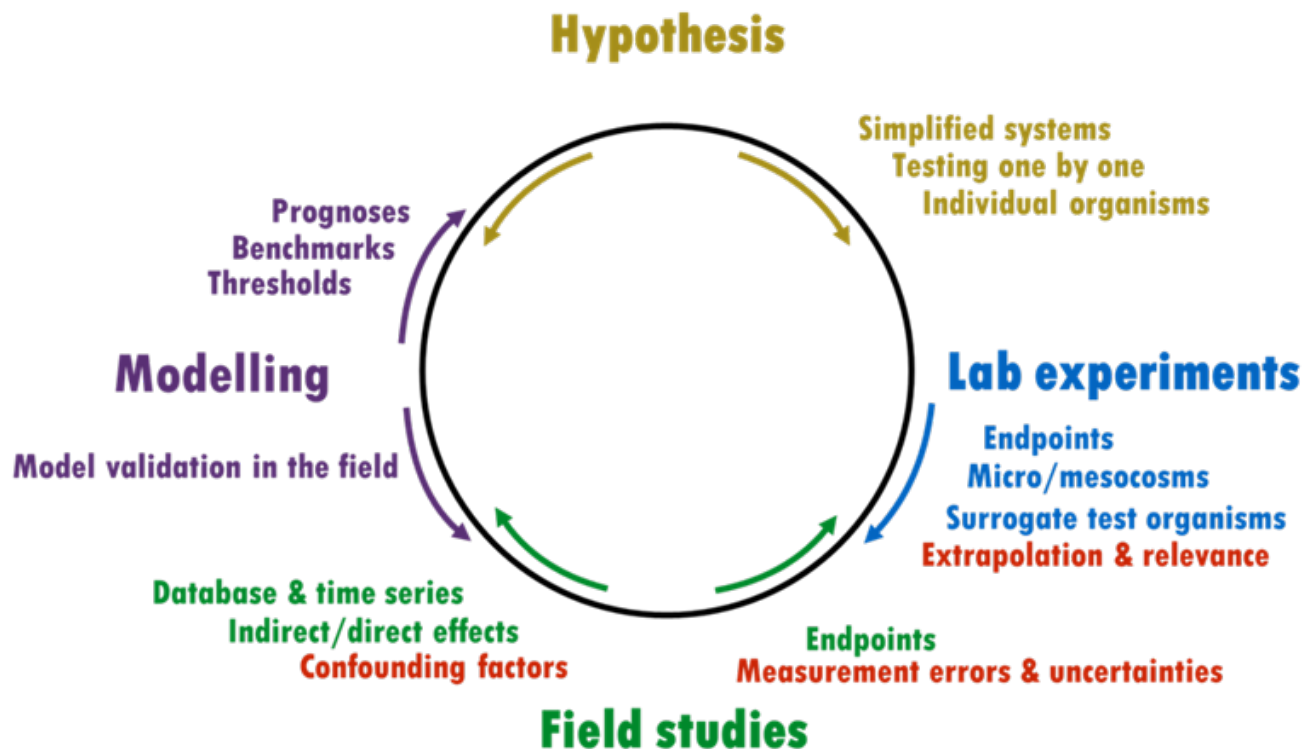
# Field/laboratory

## What data using to derive standards for risk assessment?



# One Miami Consensus Symposium Statement

« Better continuity between laboratory and field studies should be developed to advance protection of the environment. Hypotheses should ideally be tested through an iterative strategy integrating field and laboratory studies, and modeling efforts »





# Miami Consensus Symposium Recommendations

- **Improve realism: multiple stressors, confounding factors**
  - ❖ Importance of interspecific interactions and of designing field studies that integrate different trophic levels and look at higher ecosystem levels
  - ❖ Field experiments should consider testing and replication of published information on chemical or metal exposure and effects on species in ecosystems of interest
  - ❖ Special attention to experimental designs and statistical methods not appropriate to resolving confounding factors

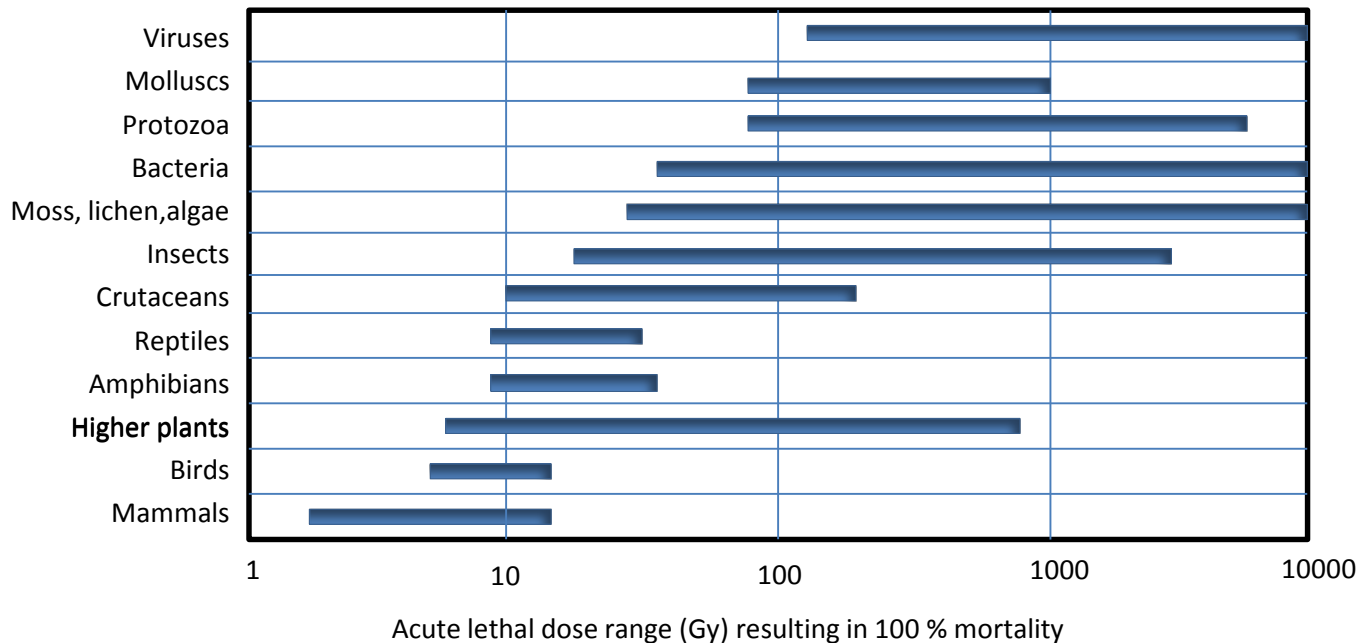


# Miami Consensus Symposium Recommendations

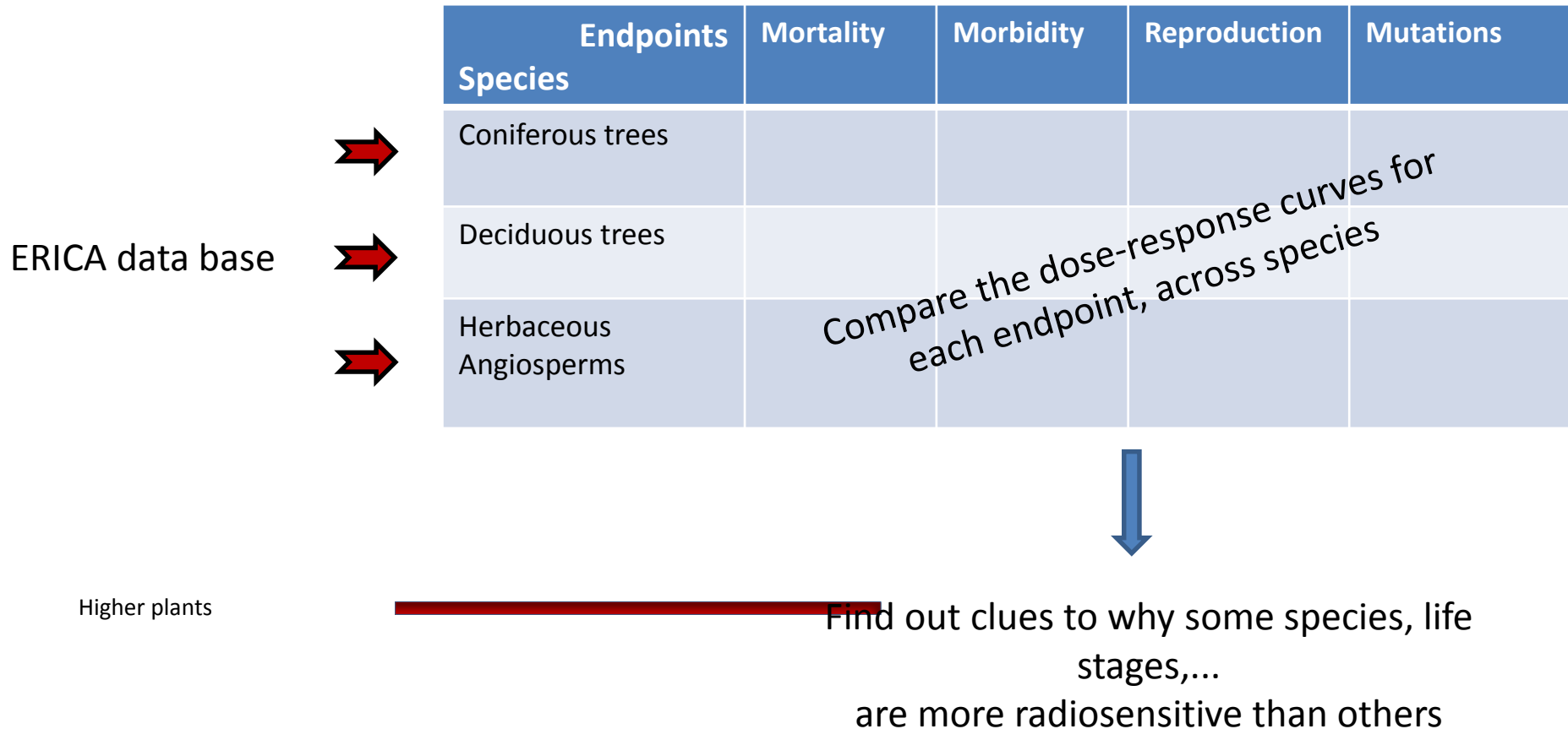
- **Improve characterization of dose and exposure**
  - ❖ Improve efforts of quantifying dose, especially for field experiments where exposure is often very complex (different radiation types, different exposure routes internal/external, different radiosensitivities across the life cycle of organisms)
  - ❖ Revisit the relative radiosensitivities of different species and endpoints



# Revisit species radiosensitivity, but at chronic low doses and specifically for each endpoint



# Revisit species radiosensitivity, but at chronic low doses and specifically for each endpoint



# Miami Consensus Symposium Recommendations

## ■ Improve field studies methods

- ❖ Promote multidisciplinary and make full use of methods and approaches established in ecology
- ❖ Exploit a wider variety of sites, presenting different ecosystem situations with complex variables, to advance our understanding of radiation effects at population and ecosystem levels and how these are mediated through biological effects at the organismal level
- ❖ Renew effort of historical data assembly and mining (grey literature available in various locations)



**All these recommendations provide a starting point for brainstorming during this workshop**





***Environmental protection has become paramount, not only to economically advanced societies, but to all inhabitants of the planet Earth that we all share***

***It is a duty for scientists to explain society why, and to provide decision makers with sound, robust and demonstrated understanding of anthropogenic ecological impacts, such as to help elaborating the most appropriate decisions***

**Thank you for your attention**

# Some references highlighting ecosystem approaches for environmental radiation protection of the environment

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