

Protection of the Environment

Activities of Committee 5

IUR Consensus Symposium

On the ecological effects of radiation on populations and ecosystems

Miami Beach

16-19 November 2015

Kathryn Higley

Professor and Head, School of Nuclear Science and Engineering, Oregon State University

ICRP Committee 5

OVERVIEW of ICRP

- **ICRP is an independent, international organization that advances for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionizing radiation.**
- **ICRP is a Registered Charity (a not-for-profit organisation) in the United Kingdom, and has a Scientific Secretariat in Ottawa, Canada.**
- **ICRP is comprised of a Main Commission, a Scientific Secretariat, five standing Committees (on Effects, Doses, Medicine, Application, and the Environment), and a series of Task Groups and Working Parties.**

ICRP Main Commission

Scientific Secretariat

Committee 1
Effects

Committee 2
Doses

Committee 3
Medicine

Committee 4
Application

Committee 5
Environment

Task Groups

Working Parties

ICRP Management

- **Main Commission (MC) and Scientific Secretariat direct, organize, and oversee ICRP.**
- **Main Commission approves all reports for publication.**
- **Committees advise MC and direct Task Groups.**
- **Task Groups**
 - Established to undertake a specific task, such as production of a single ICRP report.
 - Generally comprised of a mixture of Committee members and other experts in the field.
- **Working Parties**
 - Normally formed of Committee members to explore particular issues,
 - May become Task Groups if work is to result in an ICRP publication.

Committee 5 Membership

Carl-Magnus Larsson, Australia, Chair

Kathryn A. Higley, USA, Vice-Chair

Almudena Real, Spain, Secretary

David Copplestone, UK

Jacqueline Garnier-Laplace, France

Jianguo Li, China

Kazuo Sakai, Japan

Per Strand, Norway

Alexander Ulanovsky, Germany

Jordi Vives I Batlle, Belgium

C5 Mission

“C5 is concerned with radiological protection of the environment. It will aim to ensure that the development and application of approaches to environmental protection are compatible with those for radiological protection of man, and with those for protection of the environment from other hazards”

ICRP 91 (2003)

Review of ethics and principles, recommending that the System for Environmental Protection should

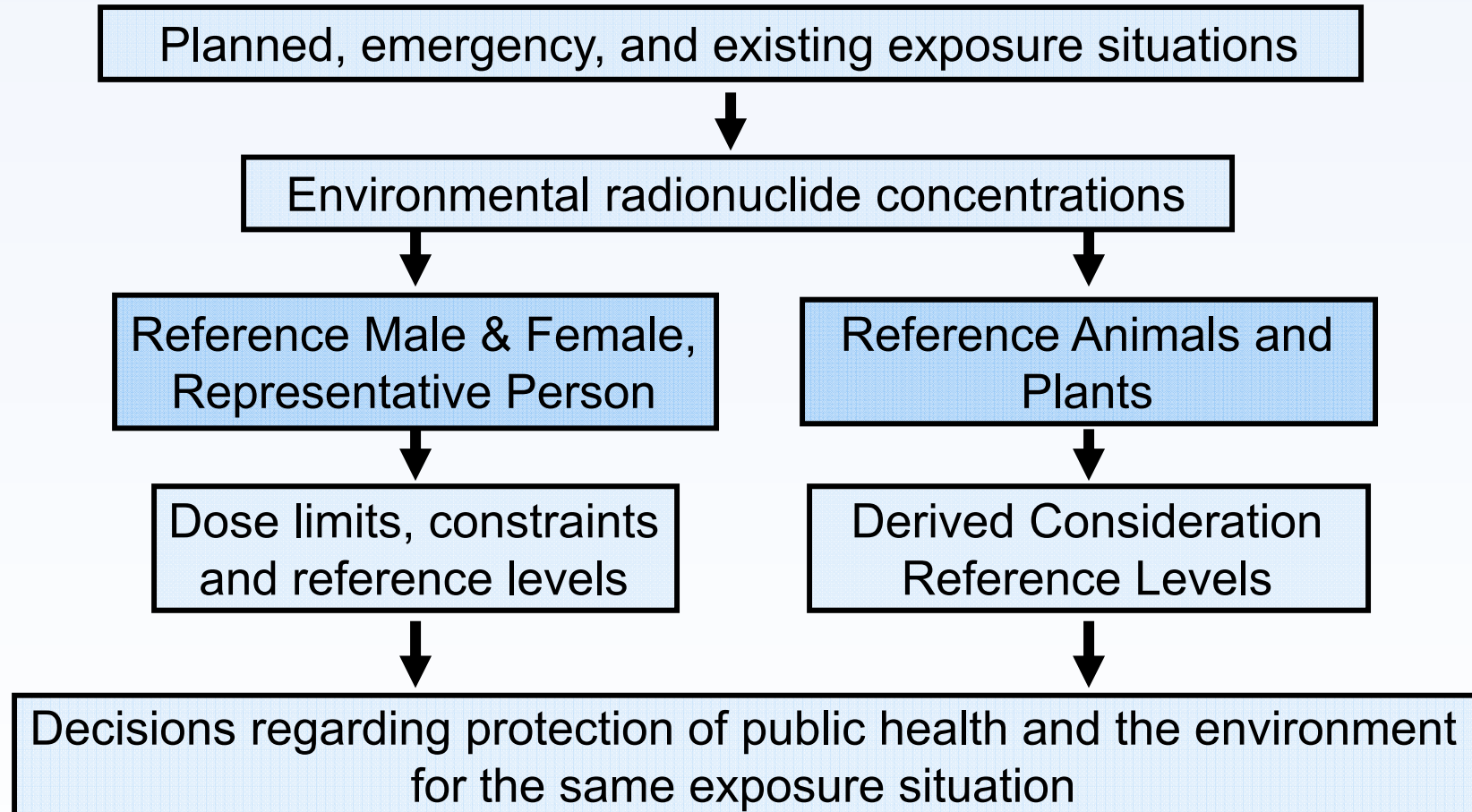
- *focus on biota;*
- *consider **adequate protection** on the basis of understanding of effects;*
- *identify reference animals and plants (RAPs); and*
- *let the RAPs guide the derivation of*
 - *exposure scenarios (CFs and DCFs)*
 - *effects data*
 - *dose rates benchmarks*

ICRP103

(30)aim is...preventing and reducing the frequency of deleterious radiation effects to a level where they would have negligible impact on the maintenance of **biological diversity**, the **conservation of species**, or the health and status of **natural habitats, communities** and **ecosystems**.

(366)Reference Animals and Plants.....

Parallel pathways



ICRP 108



WILDLIFE GROUP	RAP
Large terrestrial mammals	Deer
Small terrestrial mammals	Rat
Aquatic birds	Duck
Amphibians	Frog
Freshwater pelagic fish	Trout
Marine fish	Flatfish
Terrestrial insects	Bee
Marine crustaceans	Crab
Terrestrial annelids	Earthworm
Large terrestrial plants	Pine tree
Small terrestrial plants	Wild grass
Seaweeds	Brown seaweed

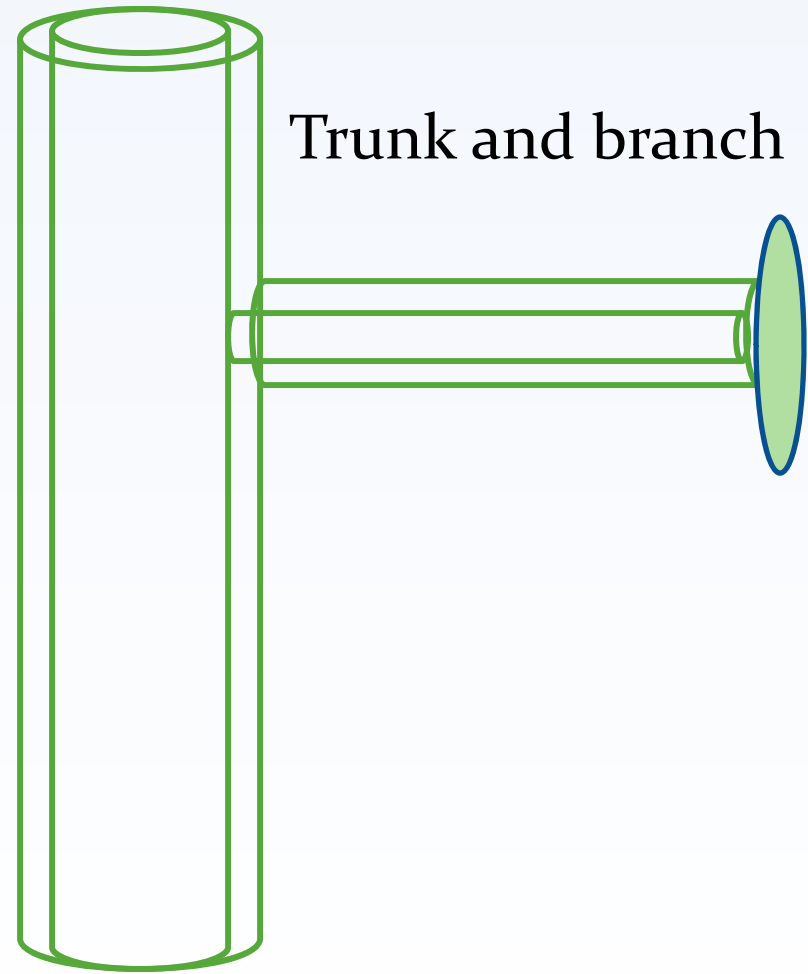
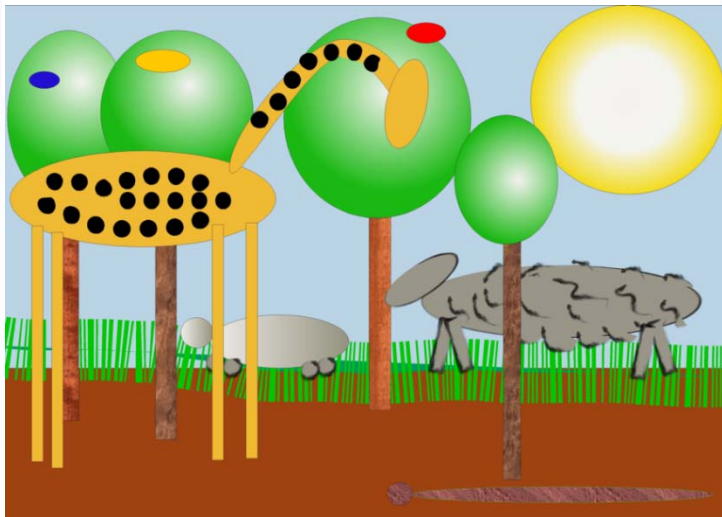
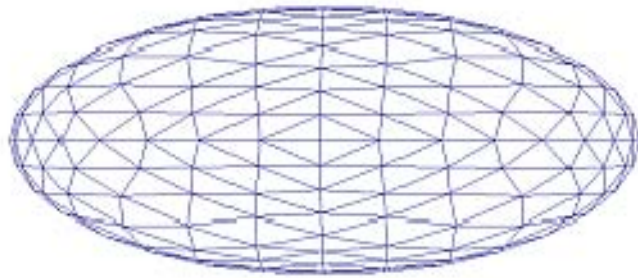
ICRP 108

ICRP 108 reviews biological characteristics

- *Occurrence*
- *Taxonomy*
- *Life cycle and life span*
- *Reproductive strategy*
- *Physiology*
- *Ecology*
- *.....other factors.....*

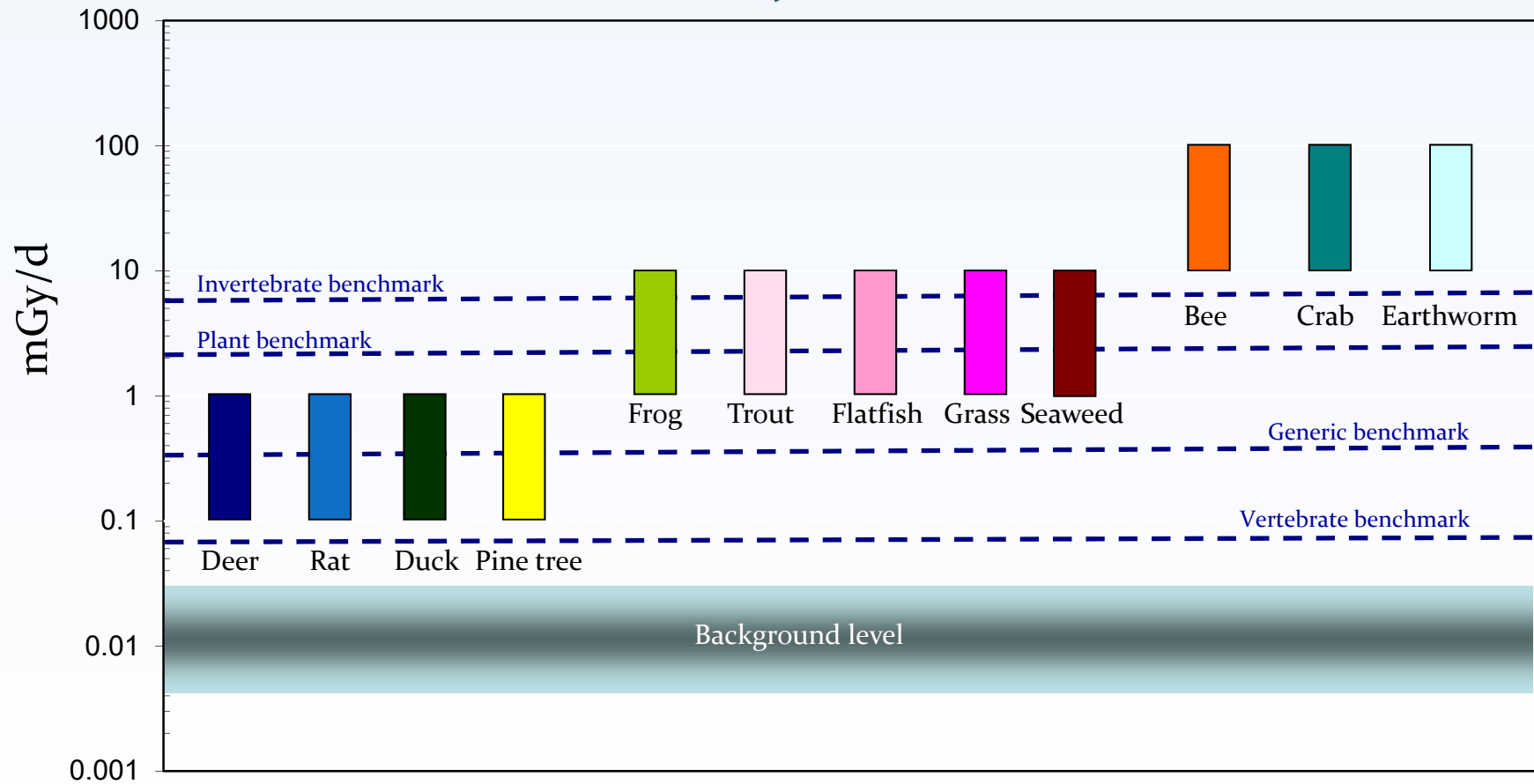
ICRP 108

DCCs for simple geometries



ICRP 108

Derived Consideration Reference Levels, DCRLs

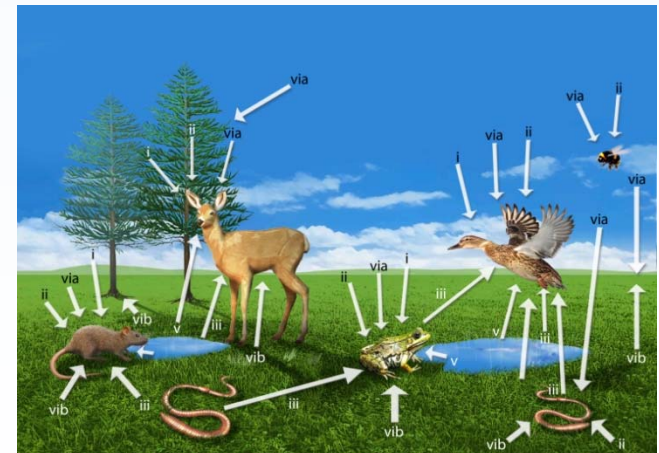


Benchmarks from other studies/systems

ICRP 114

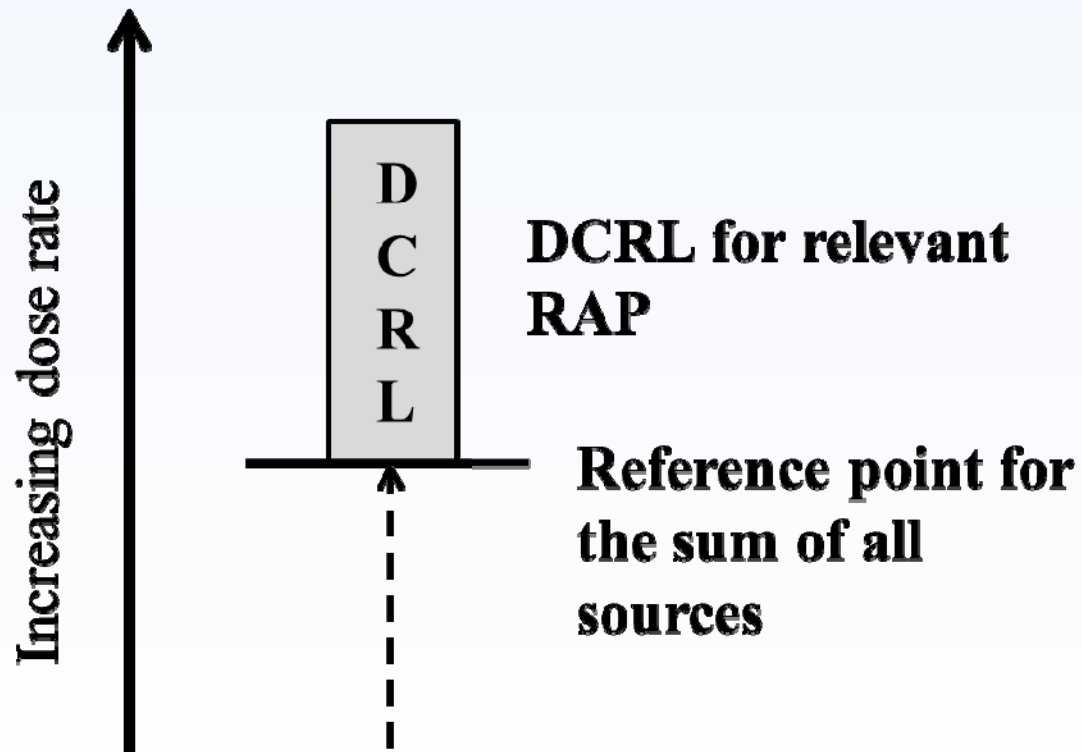
Concentration Ratios for 39 elements and 12 RAPs

- *with associated statistics;*
- *based on existing field and laboratory data;*
- *using new methodology to derive data ('surrogate data') where such are missing;*
- *taking in to account life cycle stages and habitats, when possible; and*
- *discussing the robustness of the data*



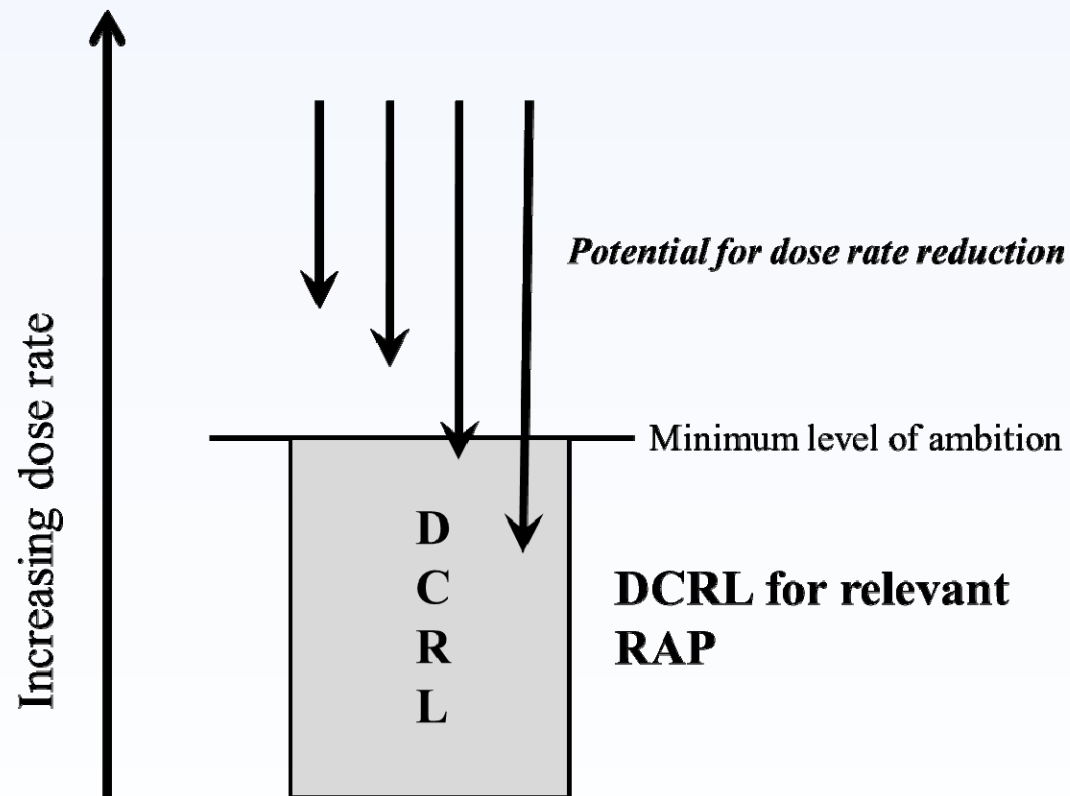
ICRP 124

Application in planned exposure situations



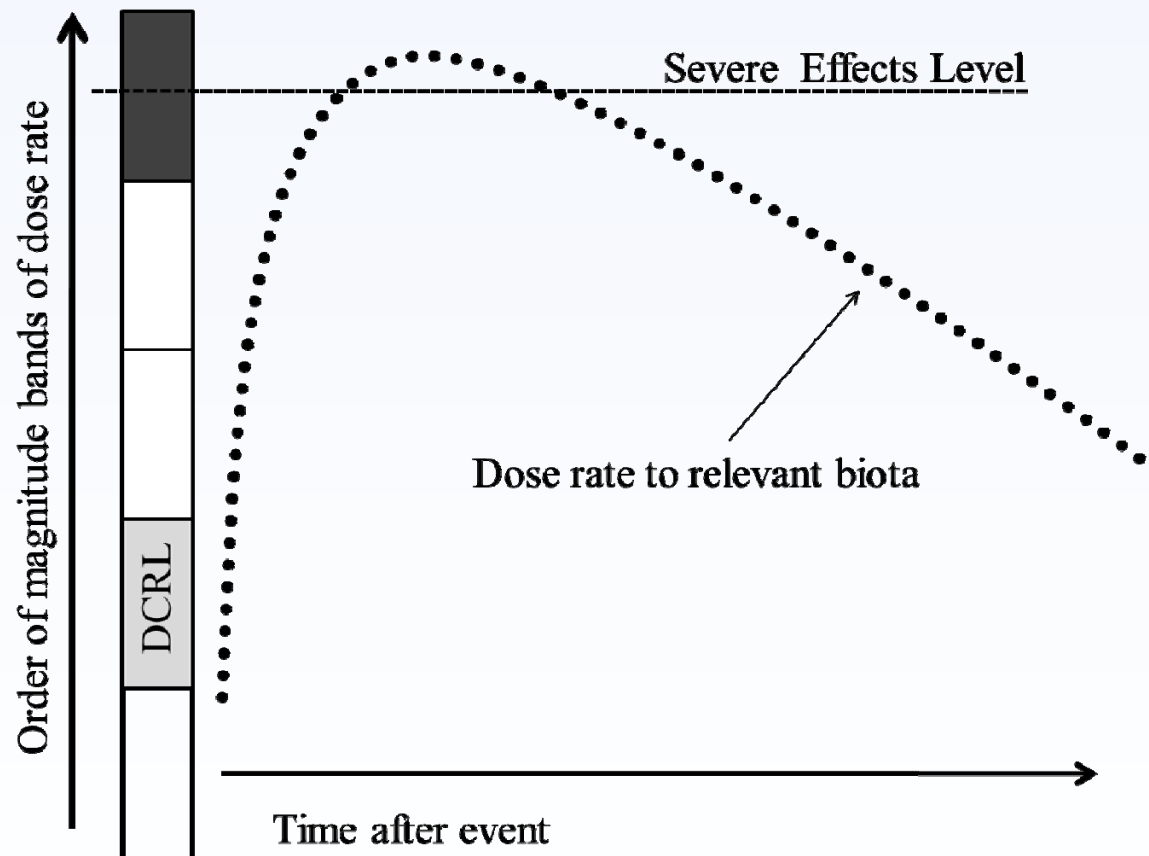
ICRP 124

Application in existing exposure situations



ICRP 124

Application in emergency exposure situations



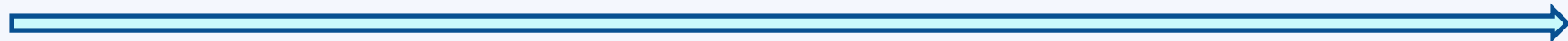
RAPs and DCRLs

Wildlife group	Ecosystem ¹	RAP	DCRL, mGy d ⁻¹ (shaded)		
			0.1-1	1-10	10-100
Large terrestrial mammals	T	Deer	■		
Small terrestrial mammals	T	Rat			
Aquatic birds	F, M	Duck			
Large terrestrial plants	T	Pine tree			
Amphibians	F, T	Frog		■	
Pelagic fish	F, M	Trout			
Benthic fish	F, M	Flatfish			
Small terrestrial plant	T	Grass			■
Seaweeds	M	Brown seaweed			
Terrestrial insects	T	Bee			
Crustacean	F, M	Crab			
Terrestrial annelids	T	Earthworm			

¹T, terrestrial; F, freshwater; M, marine

ICRP EP system components

Assessment



EXPOSURE	EFFECT	CONCERN	APPLICATION
Transfer	Mortality Morbidity	Derived Consideration Reference Level DCRL	Planned
Ext/Int exposure & RBE	Reproduction		Emergency
DCC	'Cytogenetic'		Existing
RAP biology	RAP biology	RAP biology	RAP biology



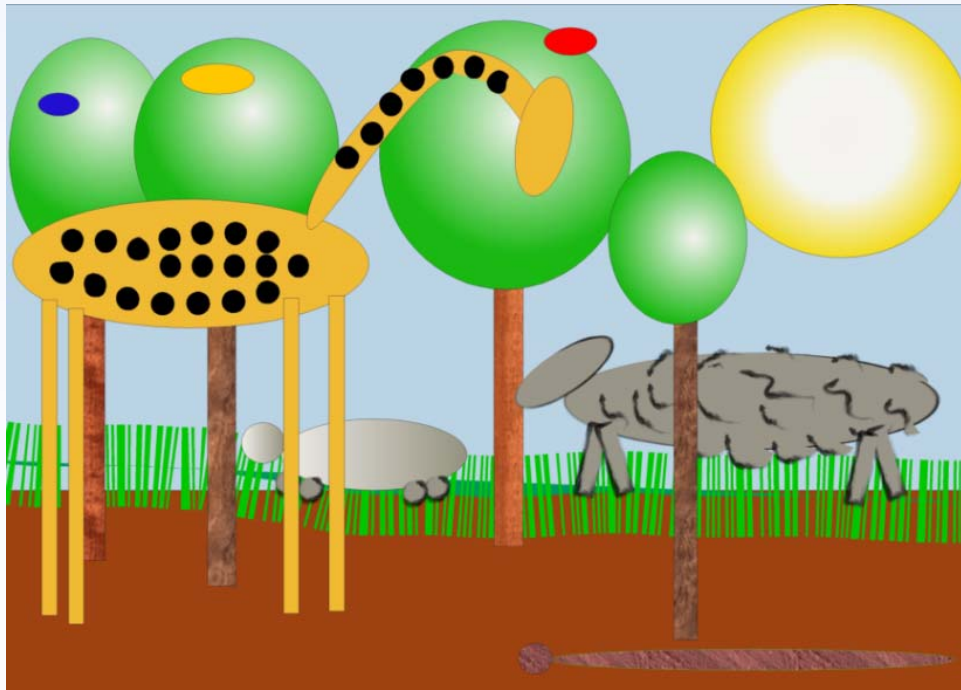
Protection

[Publications 91, 103, 108, 114, 124; TGs 72, 74, 99, x]

TGs 72 & 74 Dosimetry

Feature	Status
Quantity	absorbed dose (rate) whole body-averaged
Radiation protection endpoints	populations/individuals, mostly but not only 'deterministic' effects
RBE	at moderate and higher doses and dose rates, paucity of data for many RAPs and ecologically relevant endpoints (‘mammalian chauvinism’)
Weighting (quality)	no recommendation from ICRP, factors proposed by others
Reference levels for radiation protection purposes	Derived Consideration Reference Levels (DCRL) in terms of absorbed dose rates (mGy d ⁻¹)

Improved Dosimetry, TG74



- **Purpose**

- Expand data to *Publication 107*
- Expand exposure scenarios
- Explore allometric relationships
- Develop a 'DCC calculator'

Software tool BiotaDCC

BiotaDCC.net v1.2.1

Home

About

Warning! Test version - subject to change without notice!

- Simple
- Flexible
- Fast
- Web-based

Input parameters

Ecosystem aquatic terrestrial

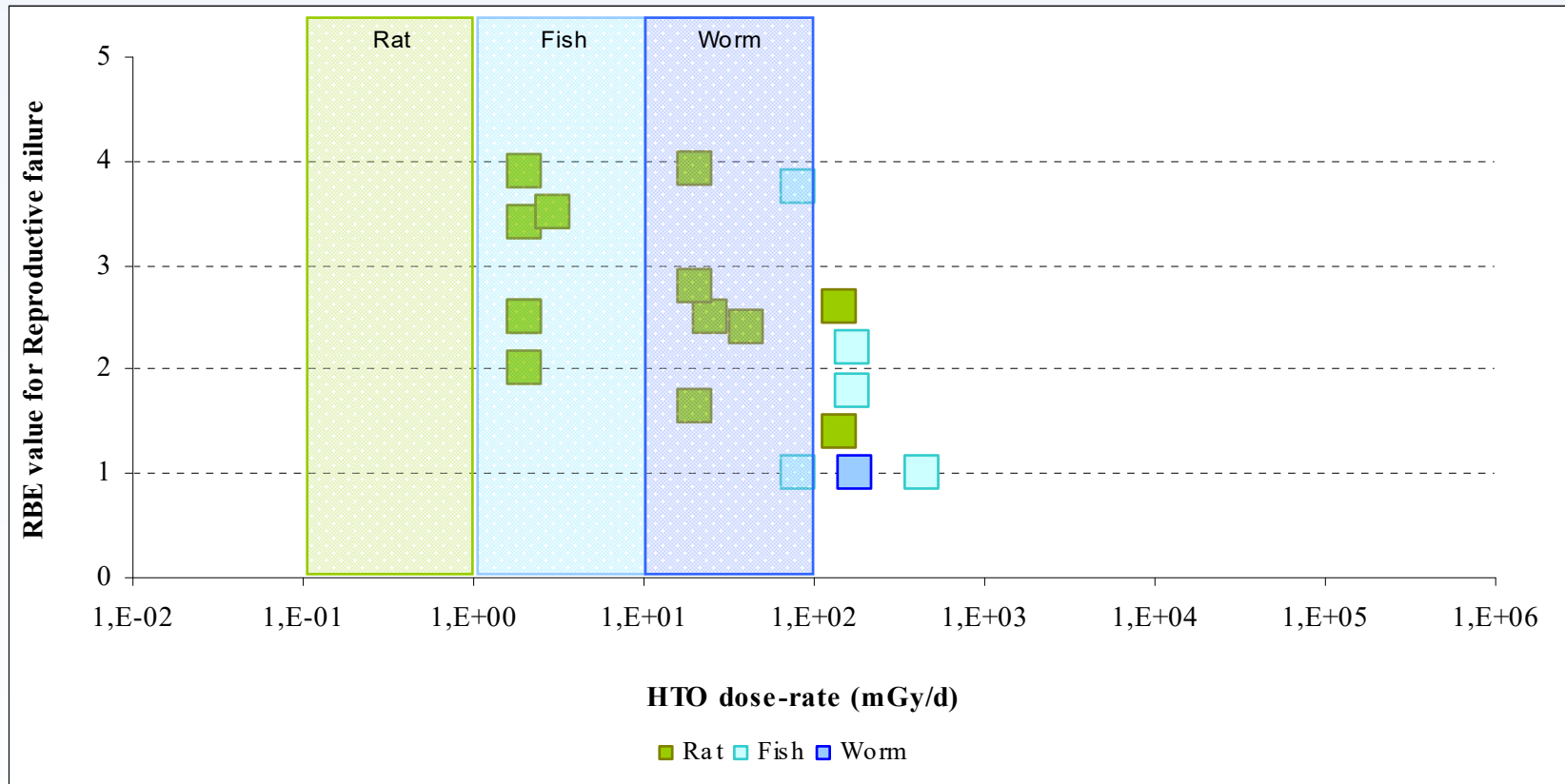
Type of terrestrial organism fauna flora

Exposure Pathway: internal

Mass and shape of organism
Mass [kg]: 1.0 [10⁻⁶ ... 10³]
Shape: 1 x .2 x .3 [0 ... 1]

Radionuclide
Element: U Mass number: 238
Topt: 0 Time [d]: 36525

TG 72 on RBE



TG72 & 74 Reports

Annals of the ICRP

ICRP PUBLICATION XXX

RBE and Reference Animals and Plants

- **TG72 Main Report**
 - Annex A: RBE – general
 - Annex B: Tritium
 - Annex C: Alpha

Annals of the ICRP

ICRP PUBLICATION XXX

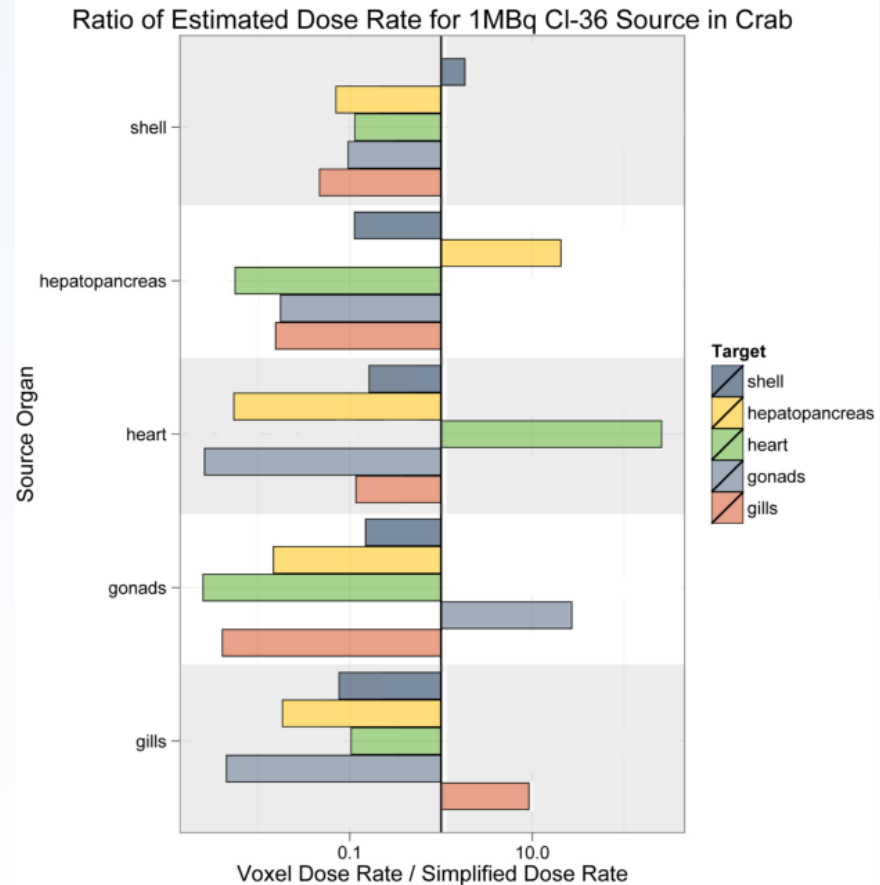
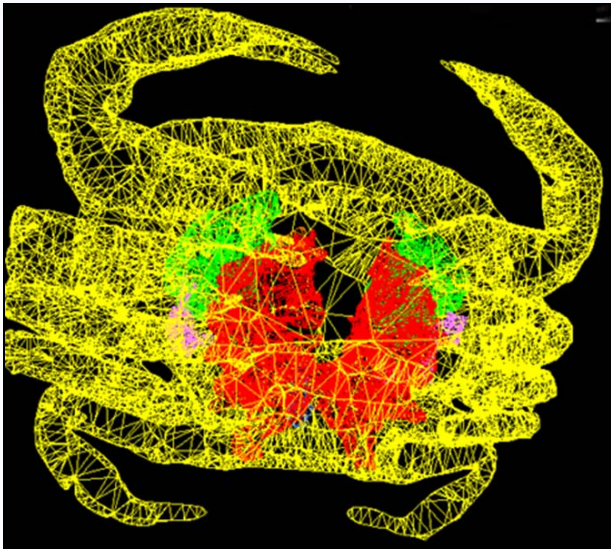
Dose Conversion Coefficients for Non-human Biota
Environmentally Exposed to Radiation

- **TG74 Main Report**
 - Annex A: Radon
 - Annex B: Allometric relationships
 - Appendix C: DCCs

TG99 'monographs'

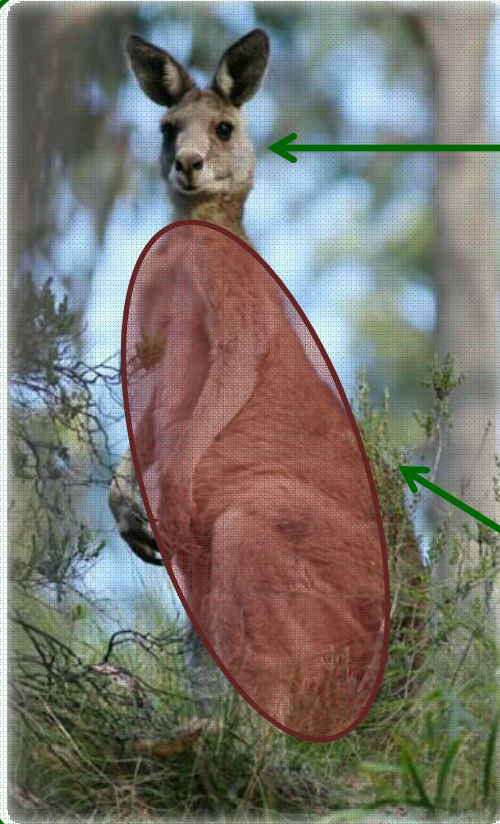
Compilation of data on biology, life cycle, stable element ratios, exposure scenarios, transfer, effects, models, conclusions.

Vlad the crab



Higley et al. *Ann ICRP* 44 (2015) pp 313-330

Application TG?



Representative Organism:

A typical organism representative of its environment (kangaroo).

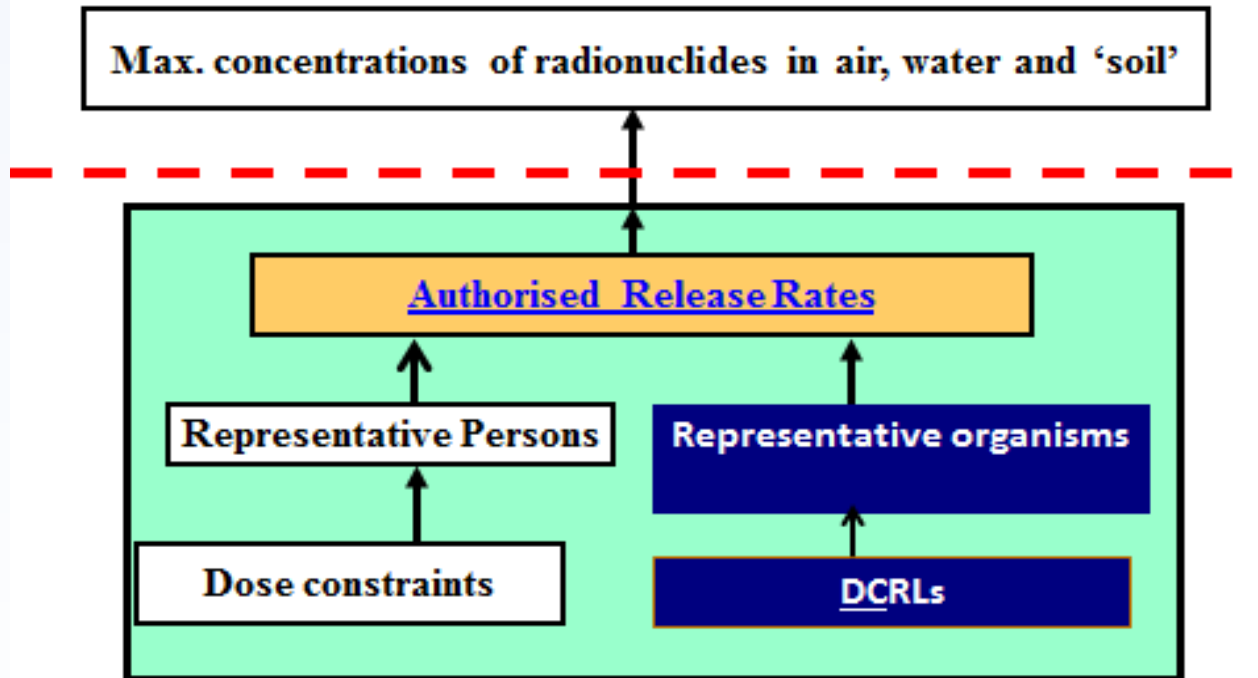
Reference Animal:

A numerical approximation of organisms within a certain group of wildlife (large herbivorous mammal)

[ARPANSA Safety Guide SG-1(draft 2015)]

Application TG?

Planned situations



[Source: Jan Pentreath]

Summary – the *evolution* of ICRP EP

Element	P91	P108	P114	P124	TG72	TG74	TG99	TGx
Ethics/systems	X							
RAPs biology		X					X	
Transfer			X				X	
Exposure/DCC		X				X	X	
RBE/'weighting'					X		X	
Effects		X					X	
Application				X				X

Conclusions

- **A initial system has evolved that is compatible with the RP system for man and the EP system developed for other hazards**
- **Considering the environment in its own right is appropriate and facilitates communication**
- **Simple to apply using default RAPs databases – but can also cope with complex exposure situations**
- **Priority during this term to**
 - Consolidation
 - Broadening the scientific basis
 - Improving applicability

ICRP

www.icrp.org