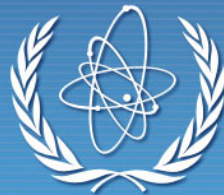


**IAEA ANSN / ISSC - REGIONAL WORKSHOP ON
“Volcanic, Seismic, and Tsunami Hazard Assessment Related
to NPP Siting Activities and Requirements”
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Protection of the Environment

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IAEA

International Atomic Energy Agency

Protection of the Environment

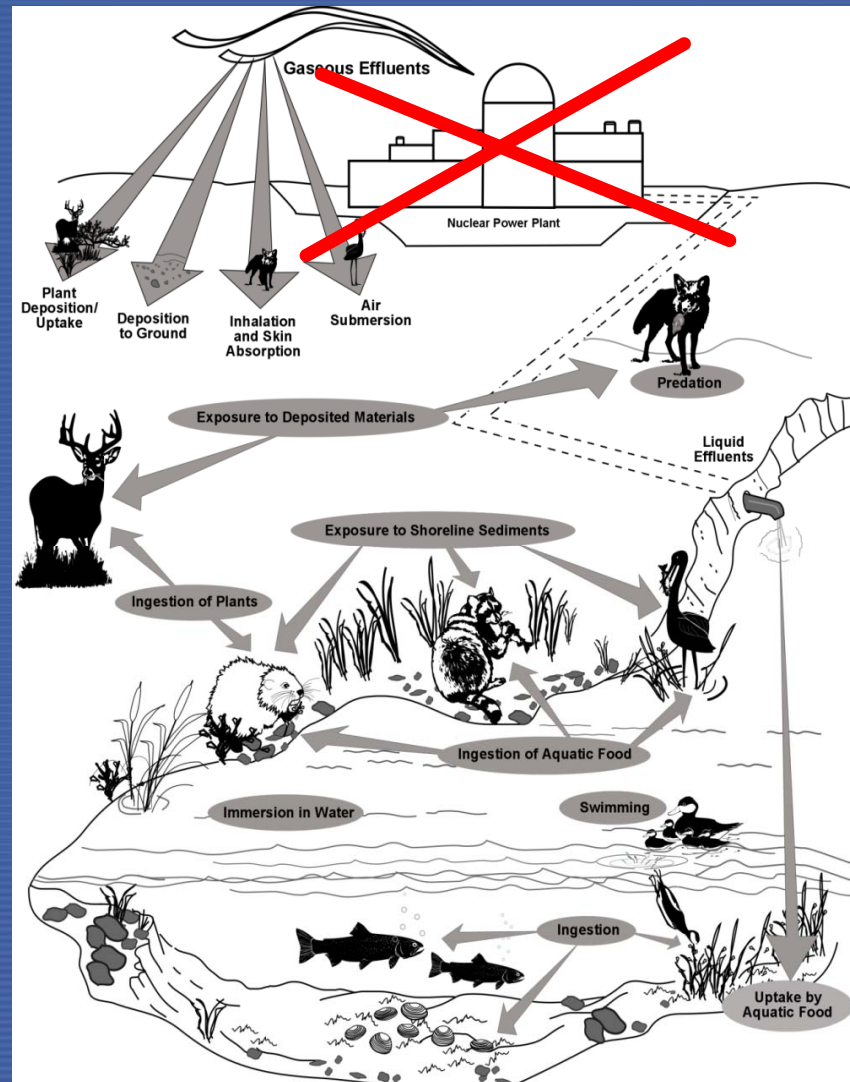
ICRP 60 (1990)

The standards of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk.

ICRP 103 (2007)

The Commission does however subscribe to the total needs and efforts required to maintain biological diversity, to ensure the conservation of species, and to protect the health and status of natural habitats and communities. It also recognises that these objectives may be met in different ways, that ionising radiation may be only a minor consideration – depending on the environmental exposure situation – and that a sense of proportion is necessary in trying to achieve them.

Protection of the Environment: Protection Goals



KAKADU NATIONAL PARK, AUSTRALIA



Mining began in the 1920s (gold) and since 19502 for Uranium

Uranium Mining and Processing in Canada



Protection of the Environment: Goals, Evaluation

Environment

Individuum

Protection Goals

- Protection of Species
- Maintaining functionality of the ecosystem
- Protection of the individuum
- ⇒ Exposure limits

Evaluation Targets

- Deterministic effects
 - Morbidity, Mortality
 - Reduced reproduction ability
 - Genetic defects
- Stochastic effects

Effects of Ionising Radiation to Biota

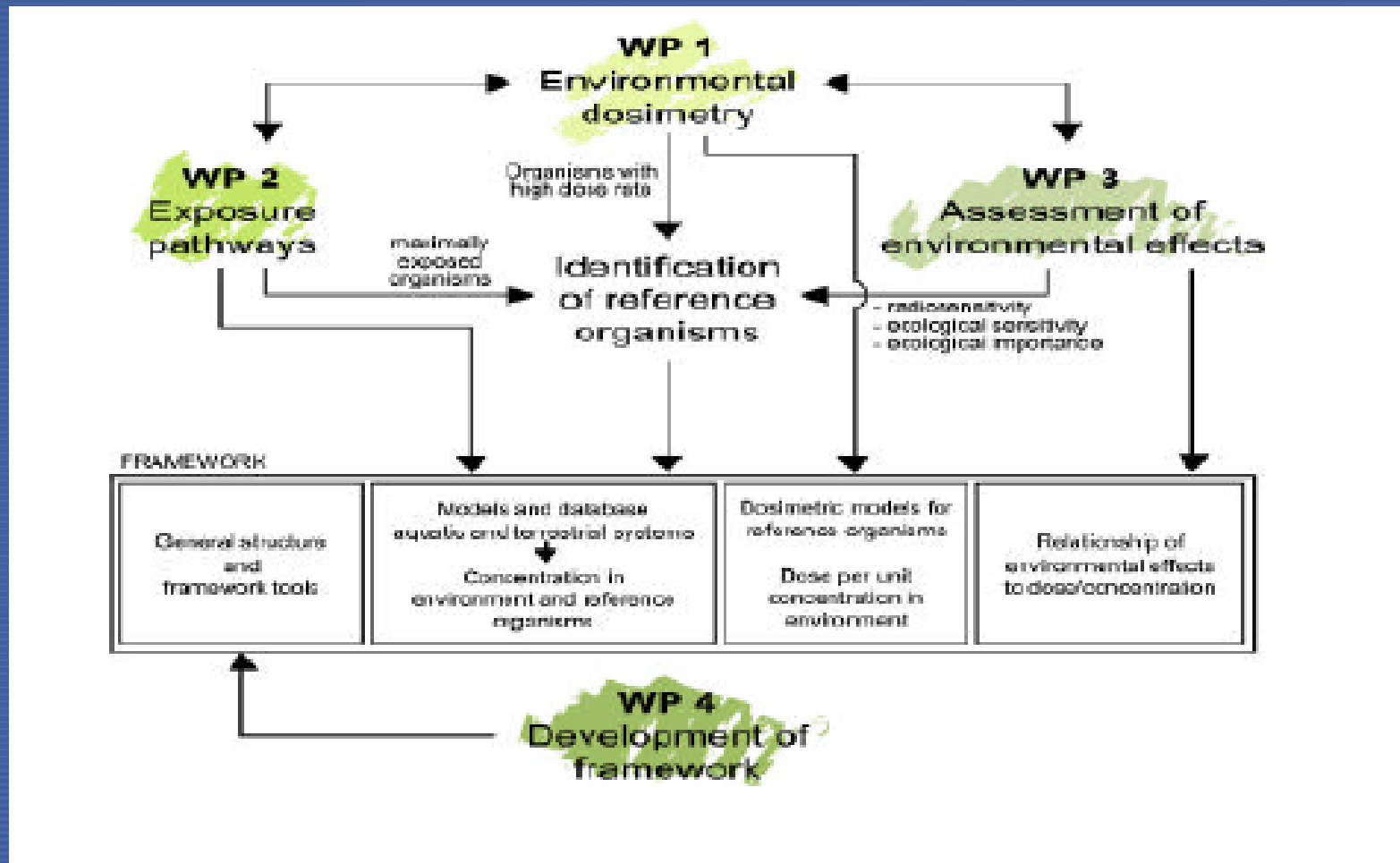
Threshold of statistical significant effects

- 100 $\mu\text{Gy/h}$ (ca. 1 Gy/a)

Clear effects

- Chronic exposure (exposure time \sim lifetime)
- Doserate $> 1000 \mu\text{Gy/h}$ (about 10 Gy/a)

FASSET: Framework for Assessment of Environmental Impact





Selection of Reference Animals and Plants

- Type, species
- Size, shape
- Living area
- Potential of accumulation of radionuclides
- Potential of high external exposure
- Potential of high radio sensitivity
- Function in the ecosystem

Determination of Reference Organism

- Terrestrial living areas
 - Forrest
 - Agriculture
 - extensive
 - intensive
 - Wetland
- Aquatic living areas
 - Rivers, lakes
 - Sea



Selected Reference Organism

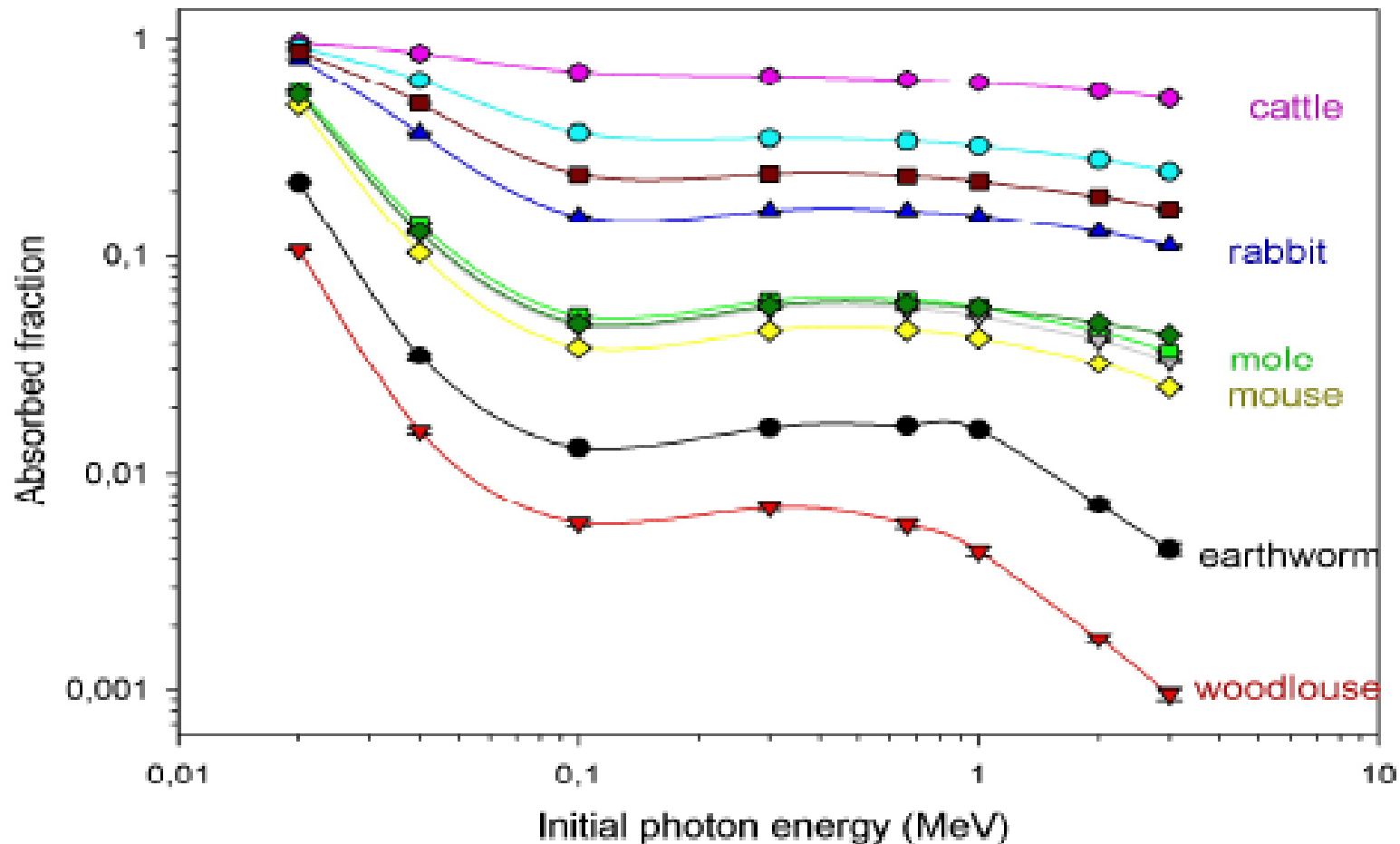
Terrestrial ecosystems	Aquatic ecosystems
Soil micro-organisms Soil invertebrates, 'worm' Plants and fungi Burrowing mammals Bryophytes Grasses, herbs and crops, shrubs Above ground invertebrates Herbivorous mammals Carnivorous mammals Reptiles Vertebrate eggs Amphibians Birds Trees, invertebrates	Benthic bacteria Benthic invertebrates, 'worm' Molluscs Crustaceans Vascular plants Amphibians Fish Fish eggs Wading birds Sea mammals Phytoplankton Zooplankton Macroalgae Fish Sea mammals

Natural Background

Radio- Nuclide	Soil acti- vity (Bq/kg)	Organism on soil				
		Earth- worm	Mouse	Fox	Row deer	Cattle
		DCC ($\mu\text{Gy/h}$ per Bq/kg)				
K-40	400	1.2E-2	1.2E-2	1.0E-2	8.3E-3	3.8E-3
Po-210	35	6.1E-8	6.0E-8	5.0E-8	4.0E-8	1.6E-8
Pb-210	35	1.2E-5	1.2E-5	9.1E-6	5.1E-6	9.9E-7
Ra-226	35	1.2E-2	1.2E-2	1.0E-2	8.1E-3	3.6E-3
Th-232	30	2.9E-6	2.8E-6	2.1E-6	1.2E-6	2.3E-7
Th-228	30	8.7E-3	8.6E-3	7.4E-3	6.0E-3	2.8E-3
Th-234	35	1.6E-4	1.6E-4	1.3E-4	1.0E-4	3.9E-5
U-234	35	4.1E-6	4.0E-6	3.1E-6	1.7E-6	3.2E-7
U-238	35	3.0E-6	3.0E-6	2.3E-6	1.2E-6	2.1E-7
		Total dose ($\mu\text{Gy/h}$)				
All nuclides		3.3E-02	3.3E-2	2.8E-2	2.3E-2	1.0E-2
		Total dose (mGy/a)				
All nuclides		0.29	0.24	0.24	0.2	0.09



Absorbed Fractions of Photons



Exposure of Perch in a Finnish lake

Observation of Cs-137 in water and perch from 1987 to 2000 (Okasanen et al.)

- Exposure: 1987: 3 mGy/a
2000: 0.3 mGy/a
- Exposure is dominated by internal exposure
 - High accumulation in perch
 - Shielding effect of water

Exposures in the 30 km zone of Chernobyl

Deposition

- Cs-137: 1 MBq/m²
- Sr-90: 0,4 MBq/m²

Activities in small mammals

- Cs-137 (soft tissues): 1-30 kBq/kg
- Sr-90 (bone): 2-5 kBq/kg

Exposure, external+internal

- Cs-137: 24-57 mGy/a
- Sr-90: 4-10 mGy/a

Bondarkov et al.

Exposure in the Vicinity of a Goldmine (SA)

Contamination

- Ra-226: about 1000 Bq/kg
- U-238

RBE α : 20

Exposition

- Bush: 100 $\mu\text{Gy/h}$
- Fungus (mushroom): 300-400 $\mu\text{Gy/h}$
- Herbivorous mammals: 500 $\mu\text{Gy/h}$

Petr and Tsela (2003)

Acknowledgement

Parts of this lecture refer to a publication of Mr. G. Pröhl, presented at the 4. Experts Meeting for radiological Protection, Bad Kohlgrub (Germany), 26. März 2004



International Atomic Energy Agency



Thank you for your attention

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