EMRAS II, Working Group 6; Biota Effects

Vienna, 28 January 2011

...interested in understanding radiological impacts to the environment...

5 SUBTASKS

TASK 1: FREDERICA Update

Almudena REAL, CIEMAT

To update FREDERICA we went through 3 steps:

- Literature survey
- Add new data to FREDERICA database
- QA/QC and score new entries

Belgium (SCK-CEN): Nele Horeman; Hildegarde Vandenhove
Germany (BfS): Christine Willdrot
Japan (NIRS): Satoshi Yoshida, Drs Fuma and Maruyama
Russian Federation (Ecomod; RIARAE): Tatiana Sazykina, Stanislav Geraskin
Spain (CIEMAT): Almudena Real
Sweden (Vattenfall & SU): Synnove Sundell-Bergman, Karolina Stark
United Kingdom (EA): Laura Newsome; David Copplestone

EMRAS-II (WG6): FREDERICA Update

FREDERICA Radiation Effects Database
Around 1,500 references

EMRAS-II efforts:

218 references

66 Russian literature (S. Geras'kin)

71 "potentially" useful for dose-response analysis

(special thanks to D. Copplestone)

EMRAS-II (WG6): FREDERICA Update

- International Conference on Radioecology & Environmental Radioactivity. June 2011 Hamilton, Canada

FREDERICA Effects Database Update within the EMRAS-II Programme: Contributing to evaluate the environmental impact of Ionizing Radiation.

Real A., Horemans N, Newsome L., Oudalova A., Stark k., Willrodt C., Yoshida S., Hinton T.

TASK 2: Develop dose-response relationships and species sensitivity curves

Jacqueline Garnier-Laplace, IRSN

Table 6. Proposed organism group and generic ecosystems HDR_5 values (µGy h^{-1}) estimated using SSD.

	Number of species	Lowest EDR_{10}	Most sensitive wildlife group (*species*)	SSD_HDR_5* (µGy/h)	r^2	Protect SSD_HDR5** (µGy/h)
plants	9	514	Plant (*Solanum tuberosum*)	192 (79-721)	0.924	n/a
invertebrates	10	35.8	Annelid (*Ophryotrocha diadema*)	43.0 (5.53-744)	0.960	505 (55-4447)
vertebrates	11	2.87	Mammal (*Capra hircus*)	1.4 (0.25-13)	0.951	2.1 (0.3-62)
Generic ecosystems	30	2.87	Mammal (*Capra hircus*)	9.55 (2.00 - 47.2)	0.976	17 (2-211)

*HDR_5 estimated using SSD : best estimate and associated 95 % confidence limits (in parenthesis)

***see Garnier-Laplace et al., 2010 for details

Table 7. Proposed organism group and generic ecosystems HD_5 values (mGy) estimated using SSD.

Group	Number of species	Lowest ED_{10}	Most sensitive wildlife group (*species*)	SSD_HD_5* (mGy)	r^2
Plants	9	970	Plant (*Vitis vinifera*)	630 (193-4009)	0.946
Invertebrates	10	53.2	Annelid (*Ophryotrocha diadema*)	50.1 (6.74-414)	0.985
Vertebrates	11	2.45	Mammal (*Mus musculus*)	2.56 (0.32-52.3)	0.956
Generic ecosystem	30	2.45	Mammal (*Mus musculus*)	18.4 (0.30-117)	0.973

*HD_5 estimated using SSD : best estimate and associated 95 % confidence limits (in parenthesis)

Draft paper in Feb 11 chronic
Draft paper in Sep 11 acute

Task 3: Canadian Benthic Data Set

Steve Mihok,

WG-4 and WG-6

Uranium mining regions with co-located benthos sampling & organic depositional sediments

132 Ontario & Saskatchewan sites

190 genera and/or species

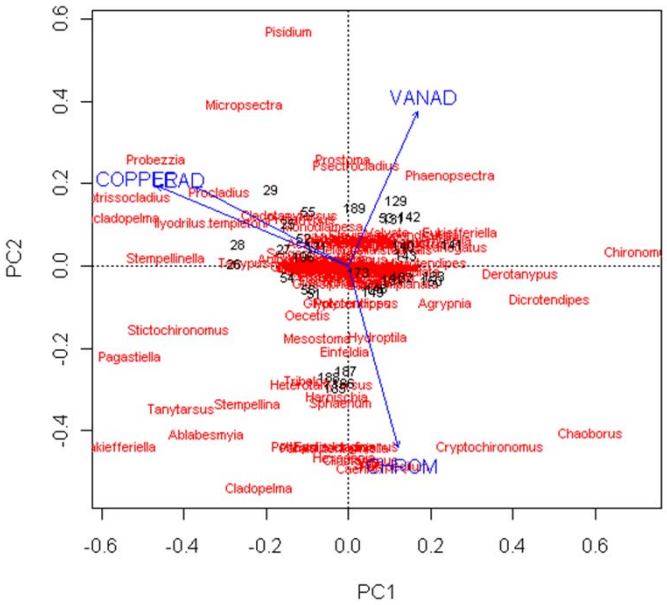
12 contaminants: As, Cr, Cu, Mo, Ni, Pb, Se, U, V, Pb-210, Po-210, Ra-226

ANALYSIS OF THE CANADIAN BENTHIC DATABASE

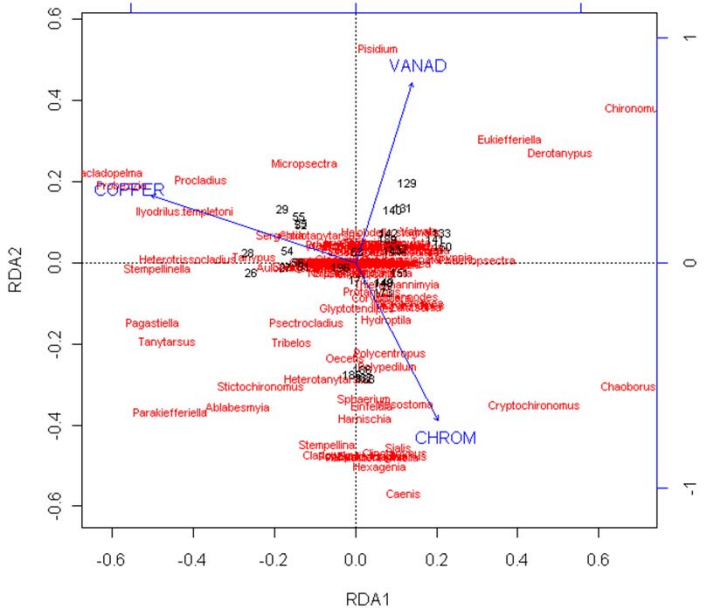
Claire Della - Vedova (magelis company)

Principal Components Analysis vs Redundancy Analysis

PCA and vectors fitting



RDA



TASK 4: Multiple Stressors Task Group

Hildegarde Vandenhove; SCK-CEN

Literature Survey: Multi-stressor data with radiation being one of the stressors

- **Terrestrial plants**
  - Before QC analysis: 6
  - After QC analysis: **5**
- **Aquatic plants**
  - Before QC analysis: 1
  - After QC analysis: **1**
- **Terrestrial animals**
  - Before QC analysis: 22
  - After QC analysis: **10**
- **Aquatic animals**
  - Before QC analysis: 4
  - After QC analysis: **4**
- **Freshwater microcosm**
  - Before QC analysis: 1
  - After QC analysis: **0**
- **Marine estuarine**
  - Before QC analysis: 19
  - After QC analysis: **13**

1) Draft paper: '**Review on the state of multiple stressor research in radioecology**' (publish by year-end).

2) Review of approaches in ecotoxicology for effects assessment in multiple stressor scenarios and their usefulness for environmental radiation protection. This will include a short overview of experimental set ups for studying multiple stressor effects.

TASK 5: Population Models and Alternative Methods

Tatiana Sazykina, TYPHOON, Russia

Benchmark scenario ”Population response to chronic irradiation”

populations of

- mice;
- hare/rabbit;
- wolf/wild dog;
- deer.

subjected to chronic low-LET radiation exposures with dose rates 10, 20, 30, 50 mGy/day:

Before irradiation, each population was in a stable state, consisted of 1000 animals, which corresponded to the carrying capacity of the ecosystem.

The duration of exposure was 5 years; followed by an end of irradiation to examine recovery.

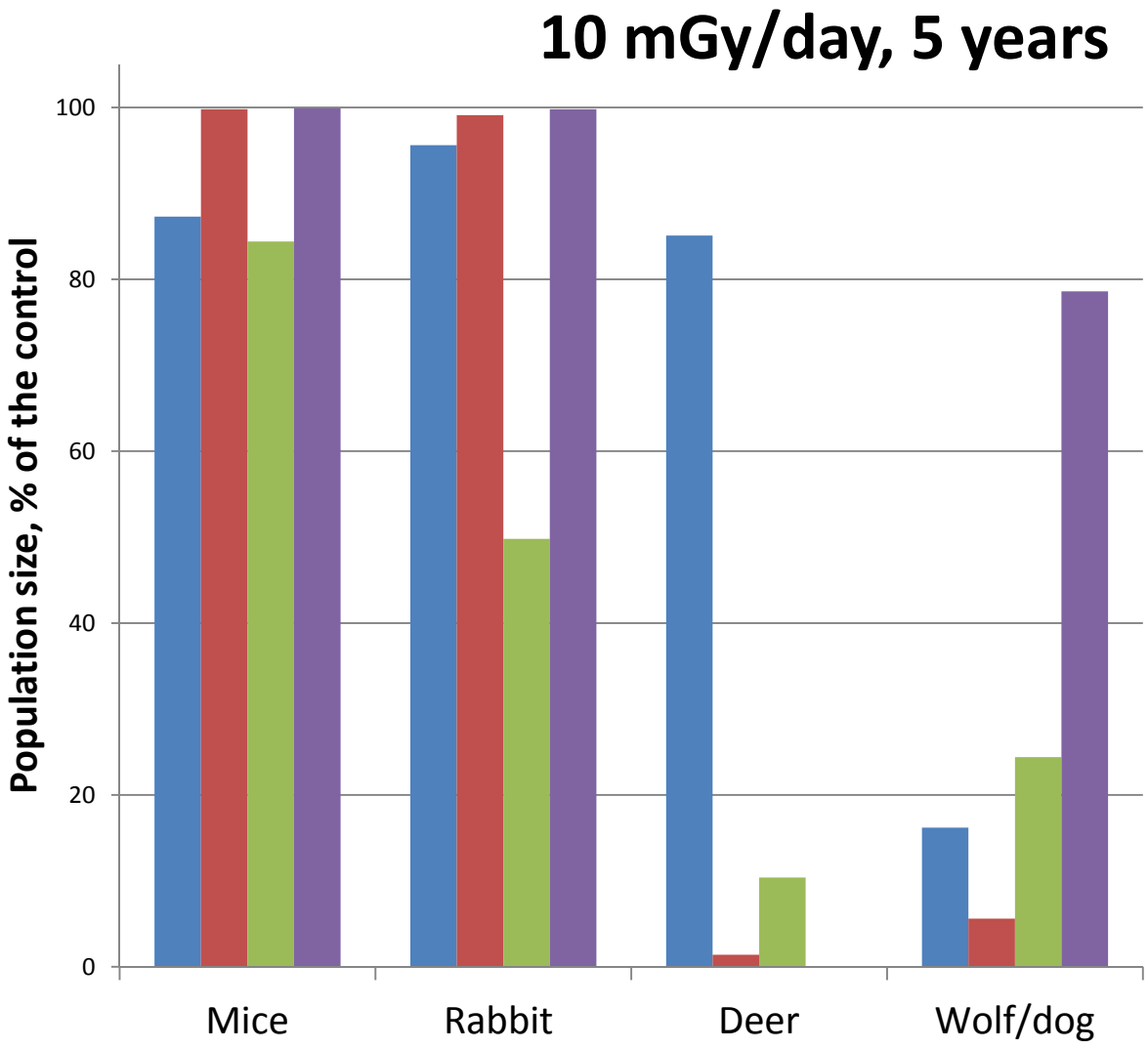
Jordi Vives,

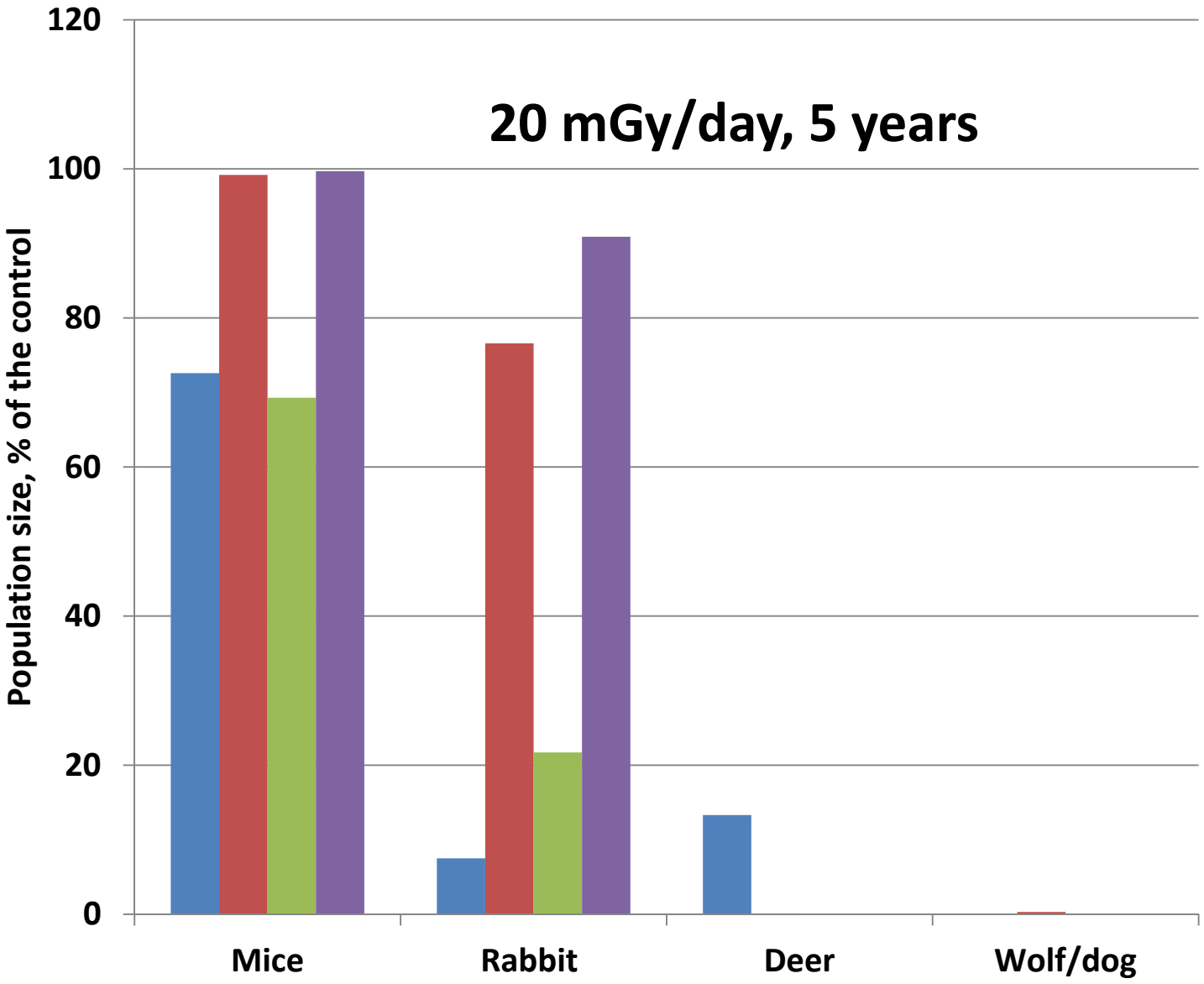
Luigi Monte,

Isao Kawaguchi,

Tatiana Sazykina,

Alexander Kryshev


10 mGy/day, 5 years
Population size, % of the control
100
80
60
40
20
0
Mice
Rabbit
Deer
Wolf/dog


20 mGy/day, 5 years
Population size, % of the control
120
100
80
60
40
20
0
Mice
Rabbit
Deer
Wolf/dog

…at 20 mGy/day all models predicted wolf and deer populations die out…

larger animals = greater longevity = slower reproduction rate = populations with greater sensitivity to radiation.

<u>During 2011</u>

a) Address the problematic issue of extrapolation from acute to chronic levels
b) Establish a generic model, simple enough to be used across species
c) Use this model to help direct future research on radiation effects to biota
d) Discuss the potential usefulness of population modelling tools for regulators.