Workshop on Uncertainties in field studies on chronic low level effects due to radiation

Lancaster 4-6 February 2013

Radiobiological evidences for effects of chronic low doses on wildlife, with particular focus on field data

Almudena Real

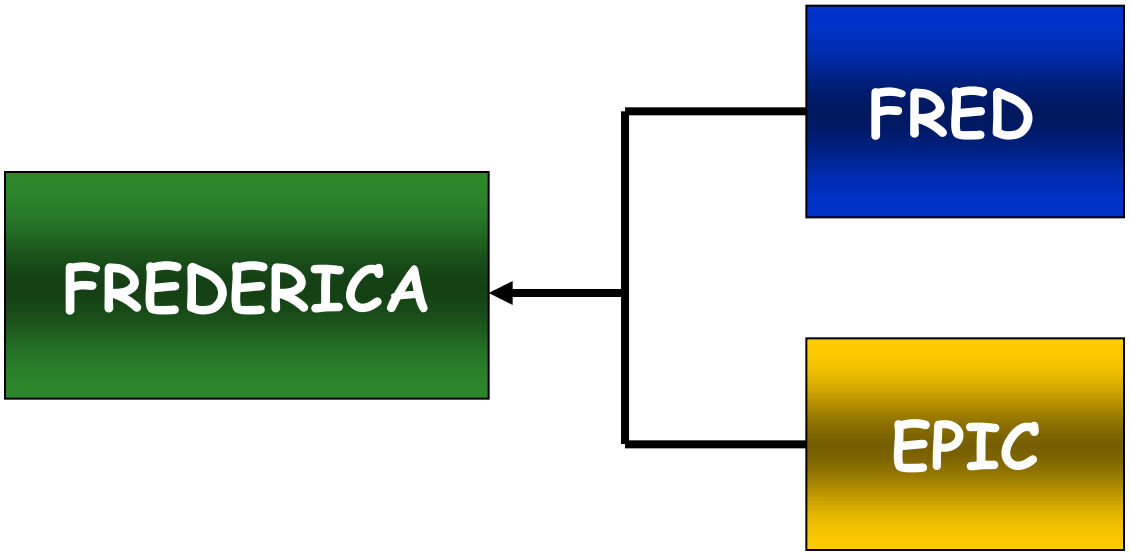
Evidences on effects of chronic low doses

- FREDERICA (www.frederica-online.org)
  - FASSET & ERICA Project (200-2007)
  - EMRAS-II Programme (2009-2011) IAEA

- Papers from peer reviewed journals: English

- Papers from peer reviewed journals: Other lenguages

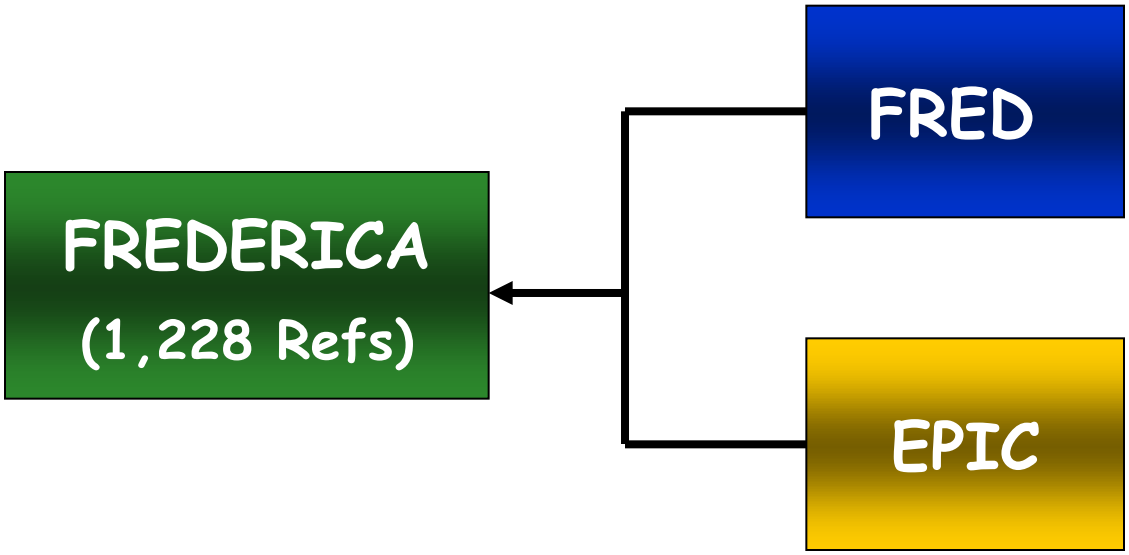
FREDERICA Radiation Effects Database



FRED: references covered biological effects to a range of non-human species following exposure to ionising radiation for studies published within the time period 1945-2001 (FASSET)

EPIC: Russian/Former Soviet Union experimental and field studies of the radiation effects on flora and fauna from the northern/Arctic climatic zone

FREDERICA Radiation Effects Database



- Around 75% for terrestrial ecosystem
- Twice as many data for acute than for chronic exposure.
- Mainly for external gamma irradiation
- More Lab than field studies

Updated FREDERICA Database

EMRAS-II Programme (2009-2011)

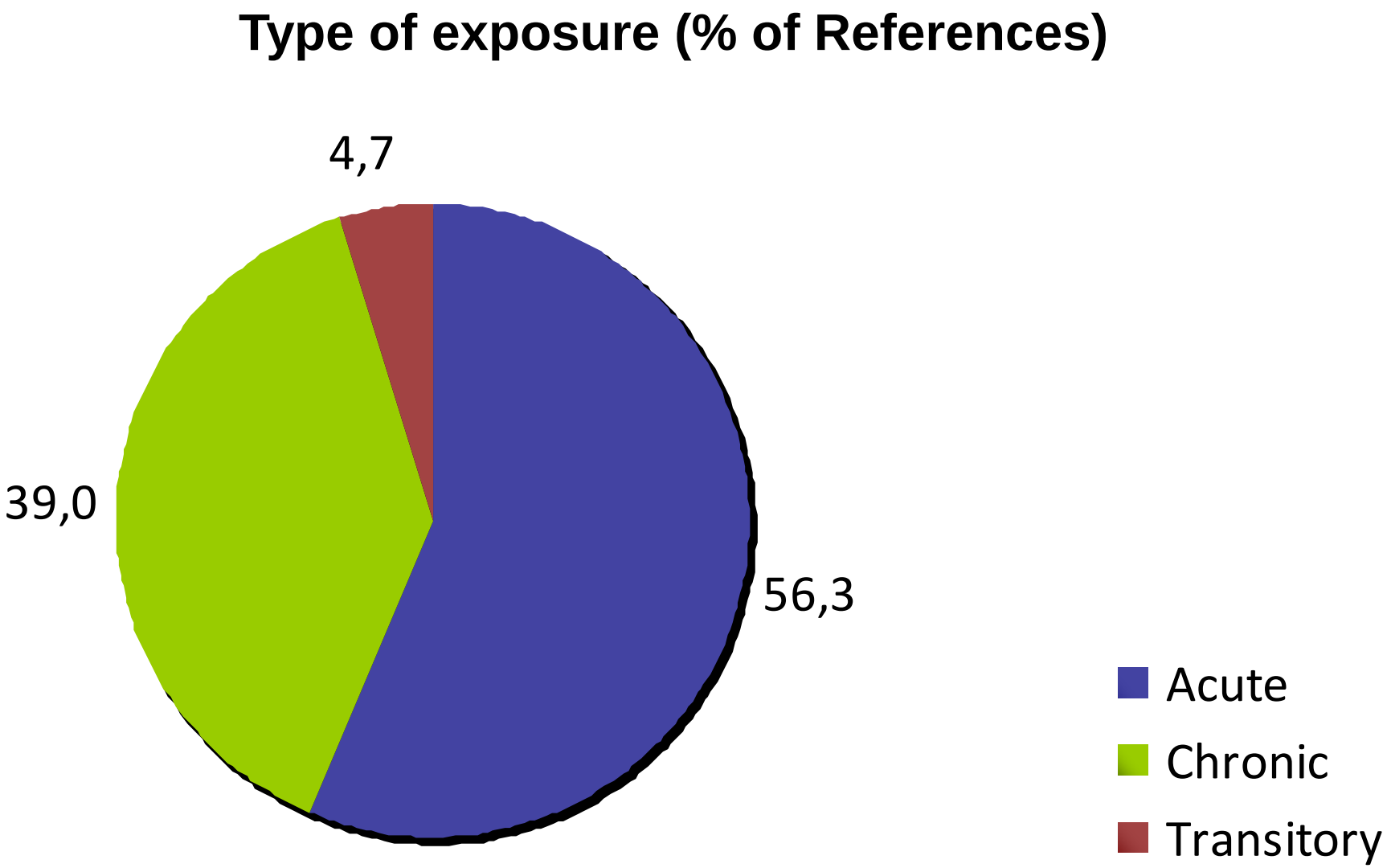
156 English papers included during EMRAS-II

- **Type of exposure**: Acute (67%); Chronic (33%)
- **Type of STUDY**: Field (11%); Controlled field (6%); Laboratory (83%)

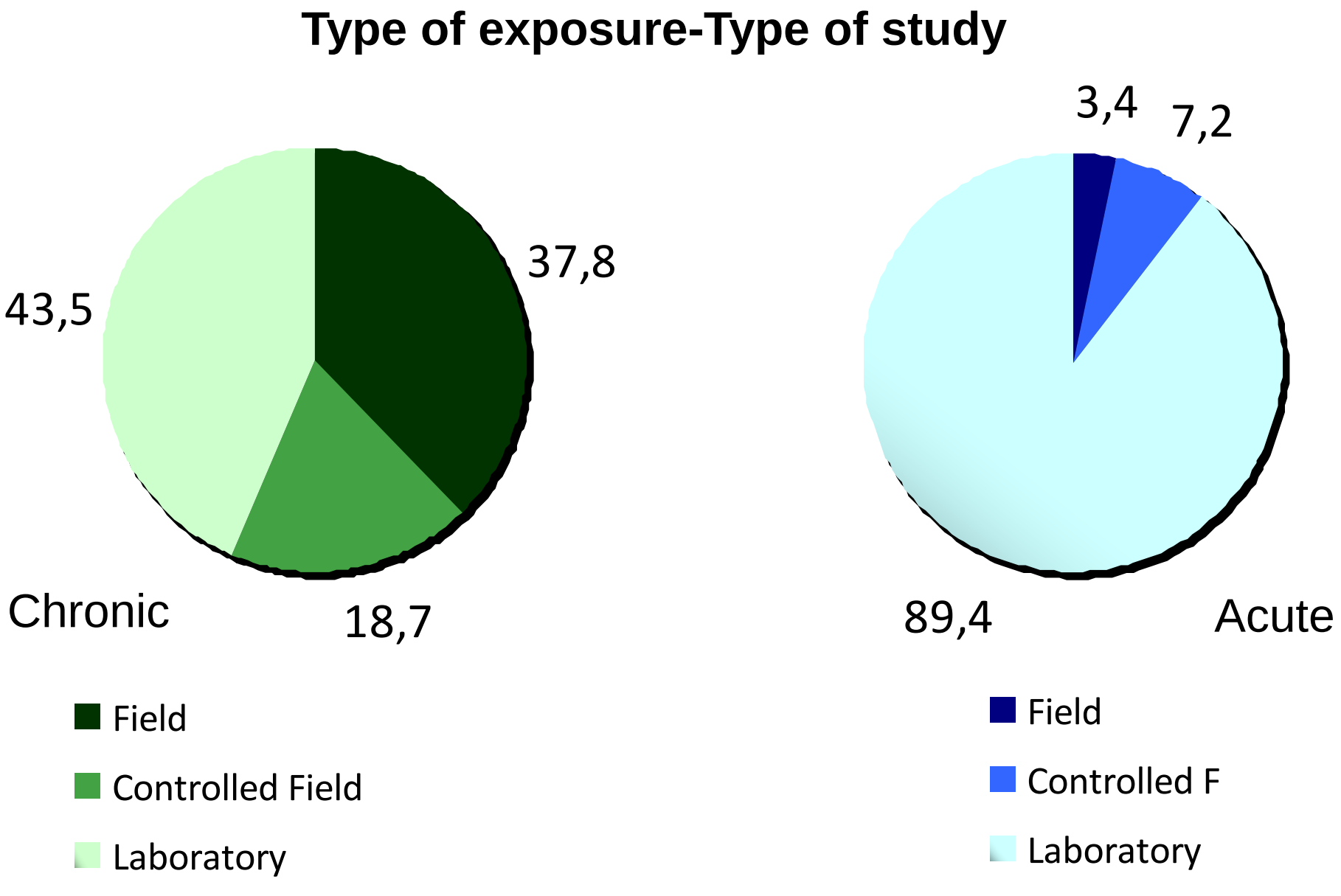
66 Russian papers

- **Chronic exposure**; **Field studies**: Chernobyl; Mayak; Komi Republic; Semipalatinsk; Taiga (Underground nuclear explosion); Vrangel Island.

Updated FREDERICA Database

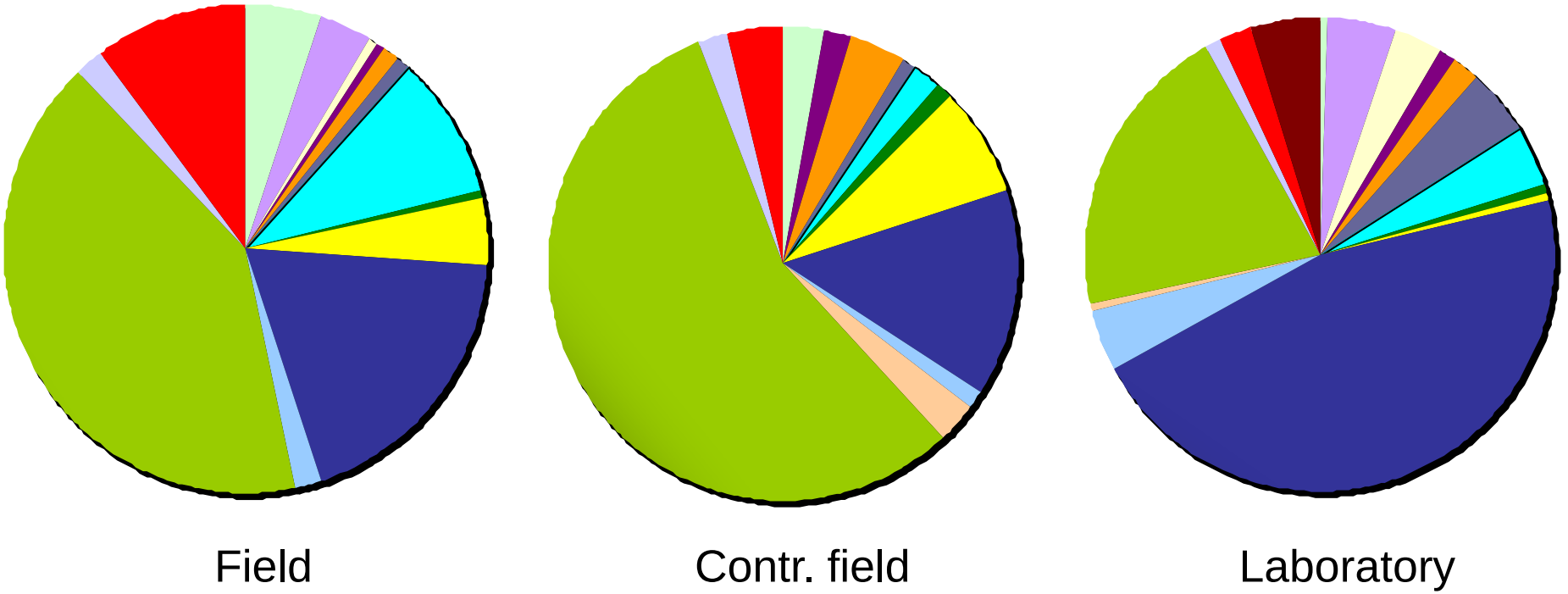


Updated FREDERICA Database

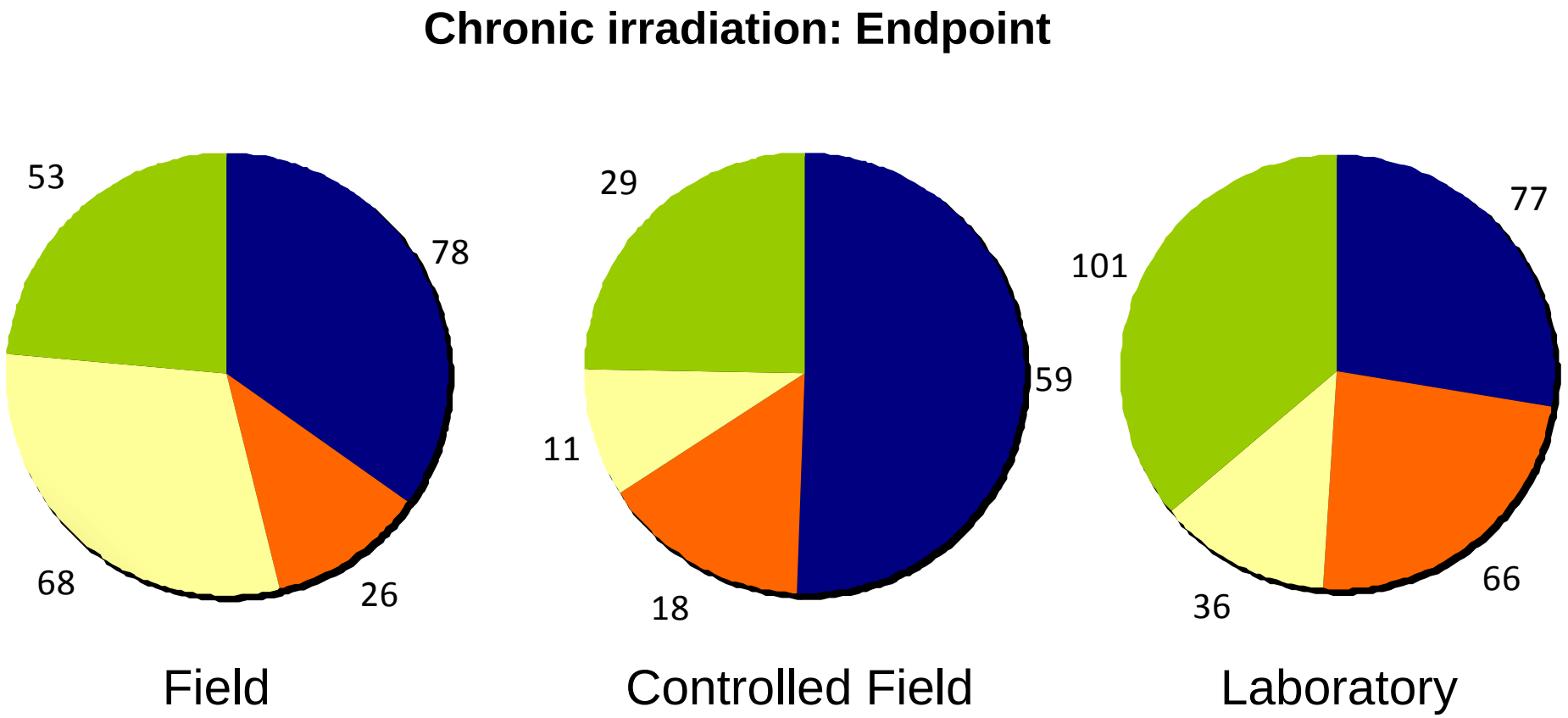


Updated FREDERICA Database

Chronic irradiation: Wildlife groups



Updated FREDERICA Database



Effects after chronic irradiation

	Morbidity	Mortality	Mutation	Reproduction
Amphibians				
Aquatic invertebrates				
Aquatic plants				
Bacteria				
Birds				
Crustaceans				
Fish				
Fungi				
Insects				
Mammals				
Molluscs				
Moss/lichen				
Plants				
Reptiles				
Soil fauna				
Zooplankton				

Effects after chronic irradiation

Data on radiation effects for chronic irradiation (< 1 mGy/h)

	Morbidity	Mortality	Mutations	Reproduction
Amphibians				
Aquatic invertebrates				
Aquatic plants				
Bacteria				
Birds				
Crustaceans				
Fish				
Fungi				
Insects				
Mammals				
Molluscs				
Moss/lichen				
Plants				
Reptiles				
Soil fauna				
Zooplankton				

Effects after chronic irradiation

Chronic exposures: Look-up tables ERICA Tool

Dose-rate range (µGy/h)	Endpoint	Effect	Species	Dose rate (µGy/h)	Cumulative dose (Gy)	Radiation type	FREDERICA ID
0-50	RC	No statistical effect on percentage of successful hatching and abnormal larvae	Plaice	0,53	0,00023	Beta	33
	RC	Severe effect on ovary development (supression) (no value given)	Bleak	3,08	0,03	Alpha	1112
	RC	Moderate increase in numbers of sex cells with anomalies (25%) in comparison to the control (0.25%)	Silver carp	16,66	4	Mixed	1082
50-100		Effects reported within this dose rate range also occurr at lower dose rate bands					
100-200	RC	No statistical effect on the number of egg deaths	Pike	112,5	1,2	Mixed	1105
	RC	Severe increase in the number of abnormal forelarvae from exposed female pikes (30-fold)	Pike	112,5	1,2	Mixed	1105
	RC	Minor increase in the number of dead forelarvae (1.4-1.7-fold)	Rainbow trout	179	0,55	Gamma	1088
200-400	RC	Severe increase in stimulation of embryonic development in irradiated fish eggs and earlier hatching of fore-larvae (3.7-fold)	Pike	208,33	0,04	Mixed	1086
	RC	Severe increase in the number of embryos with abnormalities (10-fold)	Pike	270,83	2,7	Mixed	1085
	RC	Moderate decrease in fertility (by almost 2-fold)	Roach	291,66	4,4	Mixed	1077
400-600		See lower dose rate bands - no additional data available					
600-1000							

Effects after chronic irradiation

Dose-rate range (µGy/h)	Endpoint	Effect	Species	Dose rate (µGy/h)	Cumulative dose (Gy)	Radiation type	FREDERICA ID
600-1000							
1000-5000	RC	Severe effect on reproduction (100%) - i.e.complete suppression of reproduction. Males were sterile and the larvae produced from irradiated females crossed with control males died within 160 days	Aquarium Fish (Tilapia mossambica)	1250	8	Beta	1101
	RC	Major increase in the percentage of abnormal larvae (2.6-fold)	Brown trout	1300	1,81	Beta	193
	RC	No statistically significant effect on germ cell survival	Medaka	4750	1,14	Gamma	97
5000-10000	RC	No statistically significant effect on germ cell survival	Medaka	9920	2,38	Beta	97
> 10000	RC	No statistically significant effect on survival of irradiated embryos	Pike	12500	2,6	Beta	1124
	RC	Severe increase in the number of eggs that die before hatching (4.8-fold).	Rainbow trout	13750	17	Gamma	1088
	RC	Severe decrease on the number of fertilised eggs laid by fish irradiated when young (100%)	Medaka	58750,47	104,69	Gamma	204
	RC	Germ cells destroyed (no value given)	Medaka	58750,47	104,69	Gamma	204

…, particular focus on field data

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Journal of Environmental Radioactivity 68 (2003) 65–87

JOURNAL OF ENVIRONMENTAL RADIOACTIVITY

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EPIC database on the effects of chronic radiation in fish: Russian/FSU data

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Received 21 October 2002; received in revised form 7 January 2003; accepted 13 January 2003

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Journal of Environmental Radioactivity 88 (2006) 11–48

JOURNAL OF ENVIRONMENTAL RADIOACTIVITY

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Radiation effects in wild terrestrial vertebrates – the EPIC collection

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Received 9 July 2005; received in revised form 30 December 2005; accepted 30 December 2005
Available online 23 February 2006

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Environment International 34 (2008) 880–897

ENVIRONMENT INTERNATIONAL

www.elsevier.com/locate/envint

Review article

Effects of non-human species irradiation after the Chernobyl NPP accident

S.A. Geras'kin [a,*], S.V. Fesenko [a,b], R.M. Alexakhin [a]

[a] *Russian Institute of Agricultural Radiology and Agroecology, Obninsk, Russia*
[b] *International Atomic Energy Agency, Agency's Laboratories, Seibersdorf A-2444, Austria*

Received 23 July 2007; accepted 14 December 2007
Available online 30 January 2008

"To date, provides the most comprehensive evaluation of observations of the effects of the Chernobyl accident on non-human biota"

UNSCEAR 2008; Annex E

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Available online at www.sciencedirect.com
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Effects of non-human species irradiation after the Chernobyl NPP accident

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[a] *Russian Institute of Agricultural Radiology and Agroecology, Obninsk, Russia*
[b] *International Atomic Energy Agency, Agency's Laboratories, Seibersdorf A-2444, Austria*

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Available online 30 January 2008

250 references evaluated

Only **79 papers** were considered too be have adequate information on environmental contamination and doses to biota

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Species effect	Estimated maximum dose (dose rate) at which effect was not observed
SOIL FAUNA Drastic decrease in the population density and species composition of forest litter mesofauna	1 Gy
AMPHIBIANS (Brown frog) Increased yield of chromosomal aberrations and damage severity in aberrant cells	0.01 mGy/d
HYDROBIONTS Silver carp. Higher occurrence of reproduction system alterations, reduced viability of pogeny	1 Gy/a
SMALL MAMMALS Inhibition of reproductive capacity (reduction of testis mass and irreversible or temporary sterility) Pathological changes in haemopoietic system, liver, adrenals and thyroid A dose-dependent increase in the frequency of chromosomal aberrations in bone marrow cells and embryonic losses in back vole, high frequency of polyploidy cells and genome mutations	1 Gy/a 0.5 Gy 5 µGy/d
CATTLE Destruction of thyroid, chronic radiation disease	20 Gy to thyroid

Geras kin et al 2008 (Environ. Intern. 34: 880-897)

Radiobiological evidences for effects of chronic low doses on wildlife

We have learn a lot…..

-Dosimetry

- Experimental design

-Endpoints

Thanks for your attention!!