

The logo for IRSN, featuring the letters 'IRSN' in a bold, sans-serif font. The 'I' and 'R' are red, the 'S' is blue, and the 'N' is red. Below the letters, the full name of the institute is written in a smaller, blue, sans-serif font.

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

EMRAS II : Biota Working Group

Effects subgroup

DRC and SSD-type meta-analysis

Institute For Radioprotection & Nuclear Safety, France

We promised ...

- To produce a paper on the changes in protect SSD
– [Chronic gamma external exposure situations]

« An updated meta-analysis of chronic external irradiation effects on non-human species: refinement of previous ecological benchmarks for radioactive substances and remaining limitations »

Meta-analysis covers :

**data mining and data selection,
DRC and EDR10 derivation per data sets
selection of (species, endpoints) of relevance for
a SSD-type analysis
SSD**

**Tables & Figures have been prepared//Journal and
time-schedule for submission to be discussed**

Table 1. Overview of the references dedicated to chronic gamma (or X-rays) external irradiation in laboratory or controlled field for non human species populating the updated FREDERICA, including the work done under IAEA programmes (EMRAS II, Russian literature survey)

Study types	Number of references	Number of species
Laboratory Gamma irradiation	89	51
Laboratory X-ray irradiation	3	3
Controlled field Gamma irradiation	49	26
Total	141*	70**
references and species useful for PROTECT meta-analysis	31	20
references and species useful for this meta-analysis	60	30

*Among those references, the percentage of papers with grade A, B, C, D, E is 1%, 12%, 75%, 11%, 1% respectively.

**This total number of species is lower than the total number of species investigated per study type because some species were tested for several study types.

Table 2. List of species that were investigated in terms of responses to chronic gamma (or X-rays) external irradiation in laboratory or controlled field and for which corresponding data sets were rejected. The reason for rejection is given.

	Mutation Endpoint	No effect values	Bad score	Multiple species	Mixed irradiation	No control group	Only one dose rate	Only doses - no duration	Effect pattern not consistent with the	No effect data within 10-90% ymax can not be theoretically fixed	Bad fit for dose rate - response
Species excluded from the meta-analysis											
<i>Arabidopsis thaliana</i>	x										
<i>Aristichthys nobilis</i>			x								
<i>Armillaria mellea</i>						x					
<i>Astrangia danae</i>											x
<i>Balanus sp.</i>							x				
<i>Carex pensylvanica</i>						x					
<i>Cerasus sp</i>						x					
<i>Chironomus riparius</i>	x										
<i>Chlorella sp.</i>							x				
<i>Crassostrea virginica</i>					x						
<i>Crepidula forncata</i>								x			
<i>Drosophila melanogaster</i>								x			
<i>Euglena sp.</i>					x						
<i>Formica integra</i>								x			
<i>Fraxinus nigra</i>								x			
<i>Gaylussacia baccata, Vaccinium vacillans</i>					x						
<i>Habrobracon sp.</i>							x				
<i>Hymenacidon heliophila</i>											

<i>Species</i>	Wildlife Group	Ecosystem	EDR₁₀ in Protect (n Ref)	EDR₁₀ in this meta-anamysis (n Ref)	Lowest EDR₁₀ (μGy/h)	Maximumm EDR₁₀ (μGy/h)
Plants						
<i>Abies balsamea</i>	Plant	Terrestrial	1 (1)	4 (2)	<u>1643</u>	2573
<i>Fagopyrum esculentum</i>	Plant	Terrestrial	1 (1)	1 (1)	40153	40153
<i>Pinus rigida</i>	Plant	Terrestrial	1 (1)	2 (2)	710	997
<i>Pinus banksiana</i>	Plant	Terrestrial	–	1 (1)	6802	6802
<i>Triticum monococcum</i>	Plant	Terrestrial	14 (1)	23 (3)	<u>6009</u>	39860
<i>Solanum tuberosum</i>	Plant	Terrestrial	–	4 (1)	<u>514</u>	3079
<i>Hordeum sp.</i>	Plant	Terrestrial	–	3 (1)	70321	652607
<i>Pisum sp.</i>	Plant	Terrestrial	–	1 (1)	2703	2702
<i>Vitis vinifera</i>	Plant	Terrestrial	–	7 (1)	<u>603</u>	14122
Invertebrates						
<i>Eisenia fetida</i>	Annelid	Terrestrial	6 (1)	9 (1)	3369	13012
<i>Ophryotrocha diadema</i>	Annelid	Marine	5 (1)	21 (1)	36	12390
<i>Neanthes arenaceodentata</i>	Annelid	Marine	–	9 (1)	134	24412
<i>Daphnia magna</i>	Crustacean	Freshwater	2 (1)	3 (1)	16797	18760
<i>Daphnia pulex</i>	Crustacean	Freshwater	5 (2)	7 (2)	167045	730319
<i>Porcellio scaber</i>	Crustacean	Terrestrial	3 (1)	3 (1)	749	6274
<i>Callinectes sapidus</i>	Crustacean	Marine	–	5 (1)	158747	251844
<i>Dahlbominus sp.</i>	Insect	Terrestrial	–	1 (1)	3031	3031
<i>Mercenaria mercenaria</i>	Mollusc	Marine	2 (1)	8 (1)	14481	315462
<i>Physa heterostropha</i>	Mollusc	Marine	4 (1)	6 (1)	3851	177796
Vertebrates						
<i>Gallus gallus</i>	Bird	Terrestrial	3 (2)	26 (2)	13932	31875
<i>Larus ridibundus</i>	Bird	Terrestrial	1 (1)	1 (1)	3696	3695
<i>Oncorhynchus tshawytsch</i>	Fish	Freshwater	1 (1)	2 (1)	2046	3518
<i>Oryzias latipe</i>	Fish	Freshwater	6 (3)	9 (5)	2012	88732
<i>Pleuronectes platessa</i>	Fish	Marine	5 (1)	7 (3)	47	10982
<i>Poecilia reticulata</i>	Fish	Freshwater	2 (2)	3 (2)	105	2423
<i>Mus musculus</i>	Mammal	Terrestrial	25 (6)	59 (12)	25	2.9x10 ⁶
<i>Rattus norvegicus</i>	Mammal	Terrestrial	6 (2)	6 (2)	24	631
<i>Sus crofa</i>	Mammal	Terrestrial	7 (1)	9 (2)	3.6	2723
<i>Canis familiaris</i>	Mammal	Terrestrial	–	3 (2)	155	22911
<i>Capra hircus</i>	Mammal	Terrestrial	–	3 (2)	12	1968

Total 100 (31)

246 (60)

30

EMRAS II, Jan 2011, Vienna, EWG « Effects »

Including data from controlled field

0

44

4



Species (Group)	Effect description (as it appears in FREDERICA)	EDR ₁₀ (μGy/h)	SE (μGy/h)	Duration (days)	ED ₁₀ (Gy)	Reference (Score)
<i>Abies balsamea</i> (plant)	Number of buds	1643	760	4015	158	Dugle, 1986 (B)
<i>Fagopyrum esculentum</i> (plant)	Productivity in M3 generation expressed as Yield of seeds (g/sq.m)	40153	8253	45	43,1	Alexeyeva and Belonozhko, 1981 (
<i>Hordeum sp.</i> (plant)	Waxy-test in pollen grains (changed pollen grains)	70321	264072	25	42,2	Shershunova et al., 1990 (
<i>Pinus rigida</i> (plant)	Effect of long term irradiation on seed development	710	38,8	2091	35,6	Sparrow et al., 1965 (C)
<i>Pinus banksiana</i> (plant)	Cumulative stem growth (cm)	6802	1518,0	60	9,8	Amiro, 1986 (A)
<i>Pisum sp</i> (plant)	Mass of seeds per vessel, g	2703	468	76	4,93	Gudkov, 1990 (D)
<i>Solanum tuberosum</i> (plant)	Yield centres per hectare, Lorch cultivar,	514	522	85	1,05	Grechushnikov and Serebrenikov, 1966 (
<i>Triticum sp.</i> (plant)	Productive bush amount, % of the control value. N 13, K- 48993 T. sinskjae var. Sinskajae	6009	3722	41	5,91	Zolotova and Shcherbakov, 1987 (
<i>Vitis vinifera</i> (plant)	Length of ripe shoot, cm	603	1143	67	0,970	Archangelskaya, 1970 (
<i>Neanthes arenaceodentata</i> (annelid)	% live embryos in broods with >75% embryos	134	961	121	0,388	Harrison and Anderson, 1994 (B)
<i>Ophryotrocha diadema</i> (annelid)	The percentage of worms in generation 2 surviving to day 62.	35,8	35,0	62	0,0532	Knowles and Greenwood, 1994 (B)
<i>Eisenia foetida</i> (annelid)	Hatchlings per adult during the whole 13-week reproduction exposure period (F1/ Adult F0)	3369	1130	91	7,36	Hertel-Aas et al., 2007 (
<i>Callinectes sapidus</i> (crustacean)	Mean percentage increase in carapace width	158747	286317	70	267	Engel, 1967 (C)
<i>Daphnia magna</i> (crustacean)	Larval survival to starvation during 5 days, brood 1 (% survival when food lacks)	16797	53263	23	9,27	Gilbin et al., 2008 (
<i>Daphnia pulex</i> (crustacean)	Total dry weight (mg) of cadavers collected (n is given) as measure of net production	167045	40878	21	84,2	Marshall, 1966 (C)

<i>Daphnia magna</i> (crustacean)	Larval survival to starvation during 5 days, brood 1 (% survival when food lacks)	16797	53263	23	9,27	Gilbin et al., 2008 (C)
<i>Daphnia pulex</i> (crustacean)	Total dry weight (mg) of cadavers collected (n is given) as measure of net production	167045	40878	21	84,2	Marshall, 1966 (C)
<i>Porcellio scaber</i> (crustacean)	Mean weight of woodlice (g) per tank in each dose rate group	749	82559	96	1,72	Hingston et al., 2004 (C)
<i>Dahlbominus sp.</i> (insect)	Number of parasitised host cocoons from females	3031	618	4	0,32	Baldwin, 1968 (C)
<i>Mercenaria mercenaria</i> (mollusc)	Growth of juvenile clams (mean wet weights, g)	14481	33689	45	15,6	Baptist et al., 1976 (B)
<i>Physa heterostropha</i> (mollusc)	Number of capsules per snail	3851	5125	20	1,85	Cooley and Nelson, 1970 (C)
<i>Gallus domesticus</i> (bird)	Hatchability as a % of the control	13932	8191	20	6,69	Phillips and Coggle, 1988 (C)
<i>Larus ridibundus</i> (bird)	Number embryos reaching full term development as a % of the control	3696	3063	20	1,77	Phillips and Coggle, 1988 (C)
<i>Oncorhynchus tshawytscha</i> (fish)	% with undifferentiated sex	2046	1192	70	3,44	Bonham and Donaldson, 1972 (C)
<i>Oryzias latipes</i> (fish)	Germ cell survival %	2012	178	10	0,483	Egami and Hama-Furukawa, 1981 (C)
<i>Pleuronectes platessa</i> (fish)	Mean proportion of plaice testes occupied by different cell types	47,0	56,4	186	0,210	Knowles, 1999 (B)
<i>Poecilia reticulata</i> (fish)	Mean infertility onset in days	105	202	940	2,38	Woodhead, 1977 (C)
<i>Canis familiaris</i> (mammal)	Age (days) when death from a tumour arose.	155	45,0	4222	15,7	Carnes and Fritz, 1993 (C)
<i>Capra hircus</i> (mammal)	Total sperm production (% of control)	2,87	0,03	730	0,0503	Hupp, 1976 (C)
<i>Mus musculus</i> (mammal)s	Fertility span (interval between birth of the first and the last litter)	25,5	15,5	4	0,00245	Rönnbäck, 1983 (C)
<i>Rattus norvegicus</i> (mammal)	A1 Spermatogonia (% of control)	23,8	0,40	30	0,0171	Erickson and Martin, 1978 (B)
<i>Sus crofa</i> (mammal)	Body weight/testis weight	3,58	2,58	108	0,00929	Erickson, 1976 (C)

Percentage of Affected Fraction (%)

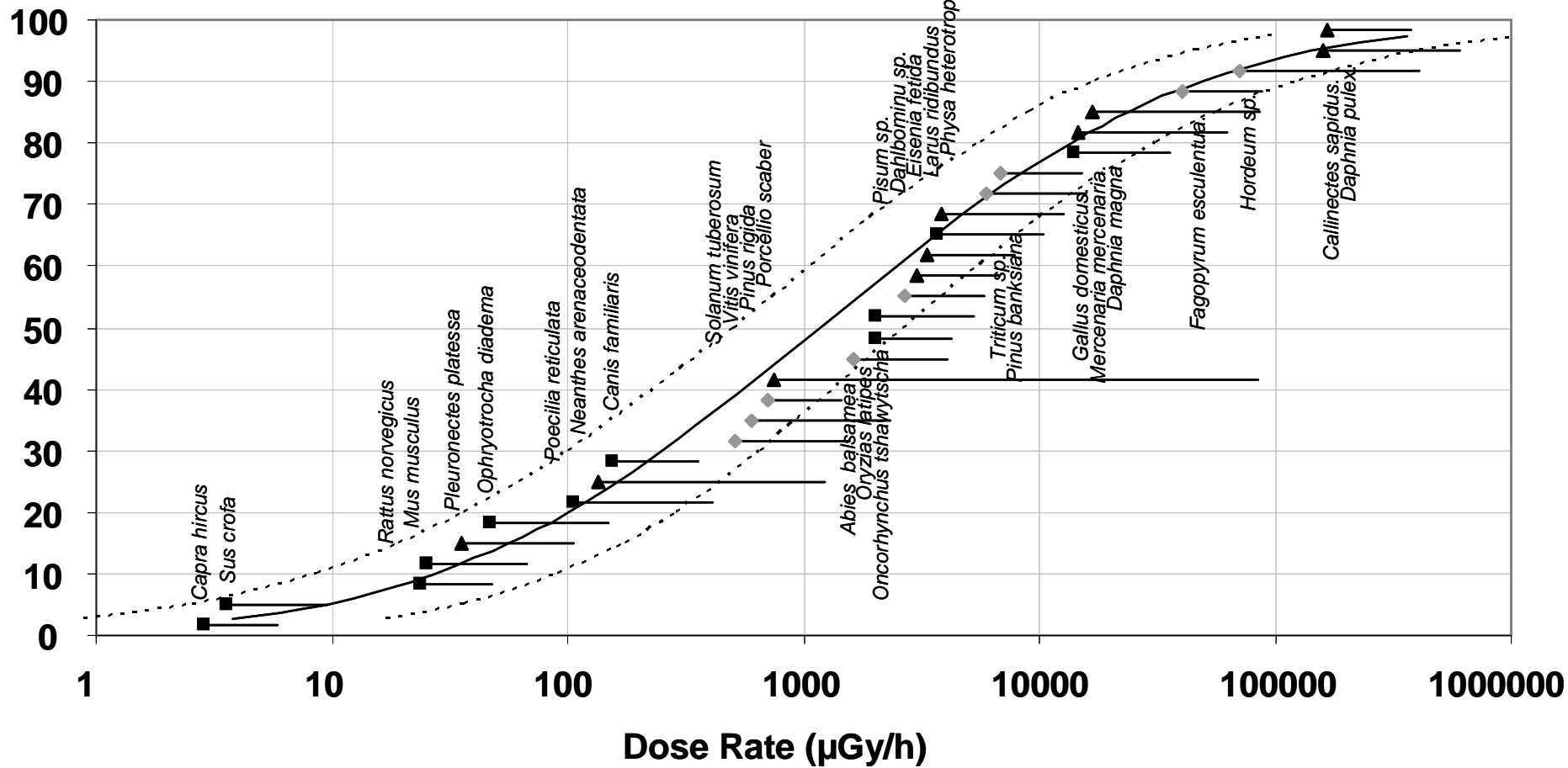


Table 6. Proposed organism group and generic ecosystems HDR₅ values (μGy h⁻¹) estimated using SSD.

	Number of species	Lowest EDR ₁₀	Most sensitive wildlife group (<i>species</i>)	SSD_HDR ₅ * (μGy/h)	r ²	Protect SSD_HDR ₅ ** (μGy/h)
plants	9	514	Plant (<i>Solanum tuberosum</i>)	192 (79-721)	0.924	n/a
invertebrates	10	35.8	Annelid (<i>Ophryotrocha diadema</i>)	43.0 (5.53-744)	0.960	505 (55-4447)
vertebrates	11	2.87	Mammal (<i>Capra hircus</i>)	1.4 (0.25-13)	0.951	2.1 (0.3-62)
Generic ecosystems	30	2.87	Mammal (<i>Capra hircus</i>)	9.55 (2.00 - 47.2)	0.976	17 (2-211)

*HDR₅ 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 HD₅ values (mGy) estimated using SSD.

Group	Number of species	Lowest ED ₁₀	Most sensitive wildlife group (<i>species</i>)	SSD_HD ₅ * (mGy)	r ²
Plants	9	970	Plant (<i>Vitis vinifera</i>)	630 (193-4009)	0.946
Invertebrates	10	53.2	Annelid (<i>Ophryotrocha diadema</i>)	50.1 (6.74-414)	0.985
Vertebrates	11	2.45	Mammal (<i>Mus musculus</i>)	2.56 (0.32-52.3)	0.956
Generic ecosystem	30	2.45	Mammal (<i>Mus musculus</i>)	18.4 (0.30-117)	0.973

*HD₅ estimated using SSD : best estimate and associated 95 % confidence limits (in parenthesis)

We also promised...(but...)

- **To produce the first paper on the variation of inter species sensitivity for acute gamma external exposure situations**

Materials ready during summer....

<p>2. Dose Response Curves and SSDs (JGL)</p> <p>2a. train group members for using database and developing dose-effects relationships</p> <p>2b. establish new dose-response curves</p> <p>2c. develop chronic SSDs at taxonomic level</p> <p>2d: develop and compare SSDs for acute vs chronic</p> <p>2e: publication</p> <p>6. Reports and Guidance Documents (TH)</p> <p>6b: guidance document on deriving screening levels</p>	<p>2a: July 2009</p> <p>2b: Jan 2010</p> <p>2c: July 2010</p> <p>2d: Dec 2010</p> <p>2e: July 2011</p> <p>6b: Feb 2011</p>	<p>Ended in Jan 10</p> <p>Ended in Jul 10</p> <p>On going <i>Draft paper in Jan 11 chronic</i> <i>Draft paper in Sep 11 acute</i></p> <p>?? Discussion in Jan 11 on TOC and work allocation among volunteers</p>
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