Radioecology at the service of mitigating societal impacts of nuclear accidents

Astrid Liland

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Nuclear accidents affects…

- Health
- Food production
- Environment
- Livelihood
- Culture and traditions
- Family bonds

Syndicat Interprofessionnel de Défense du Camembert de Normandie

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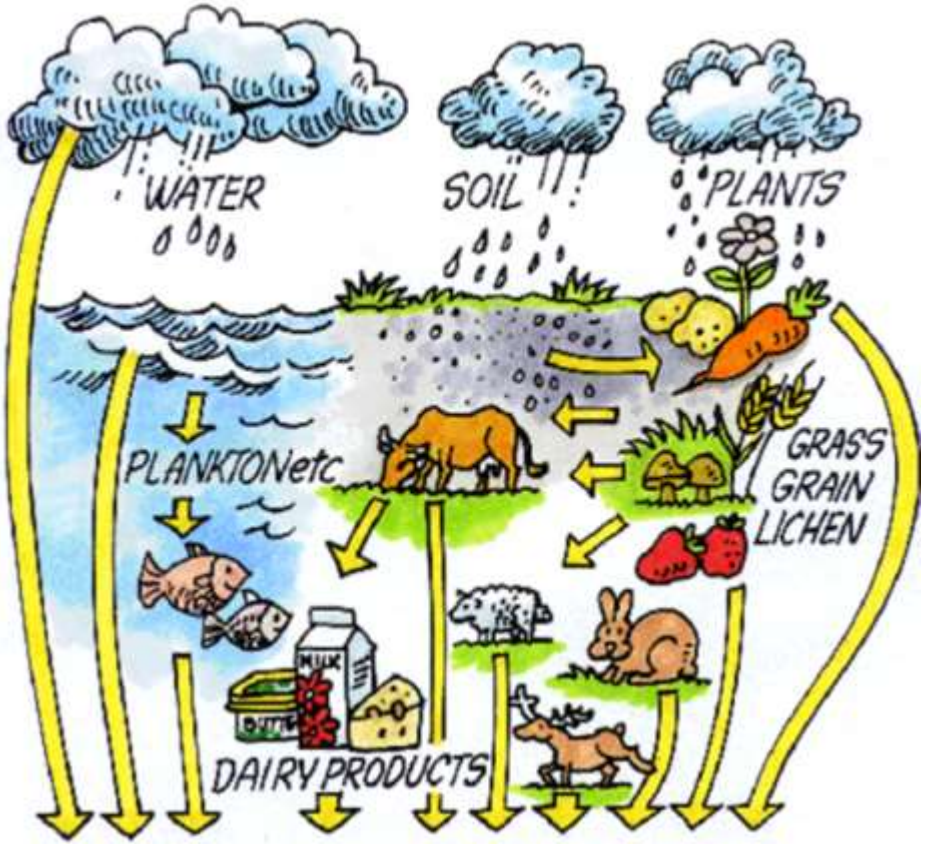
A societal challenge where radioecology can help

- Food
  - Is the food safe?
  - What should I feed my animals?
  - What can I grow in my field?
  - Can I use my kitchen garden?
  - Can we gather food from the forest?
  - Which fish are safer to eat?

We know about transfer



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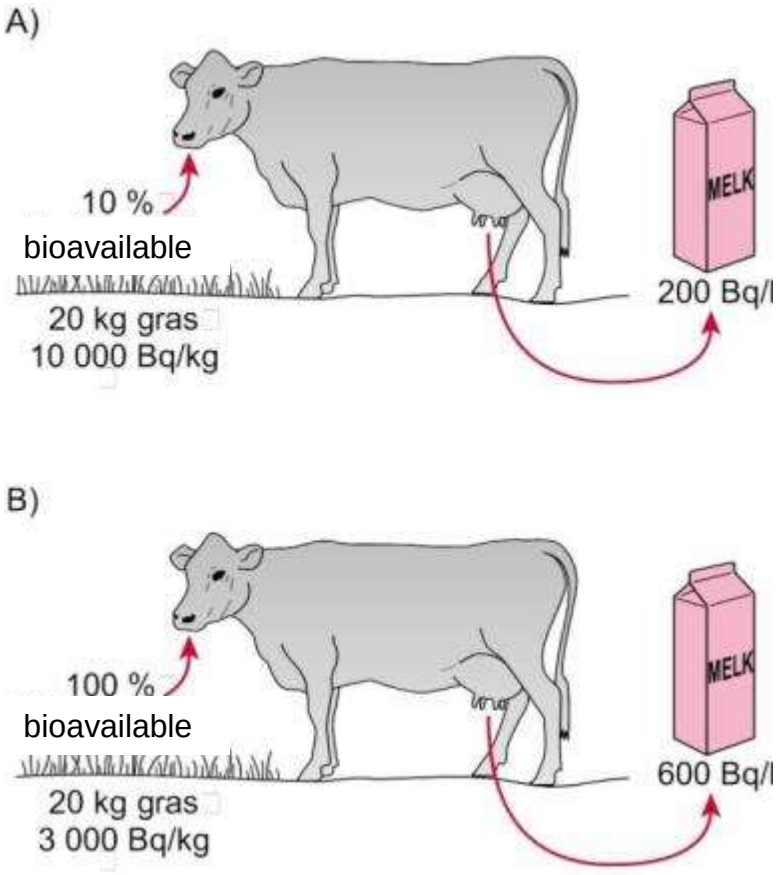
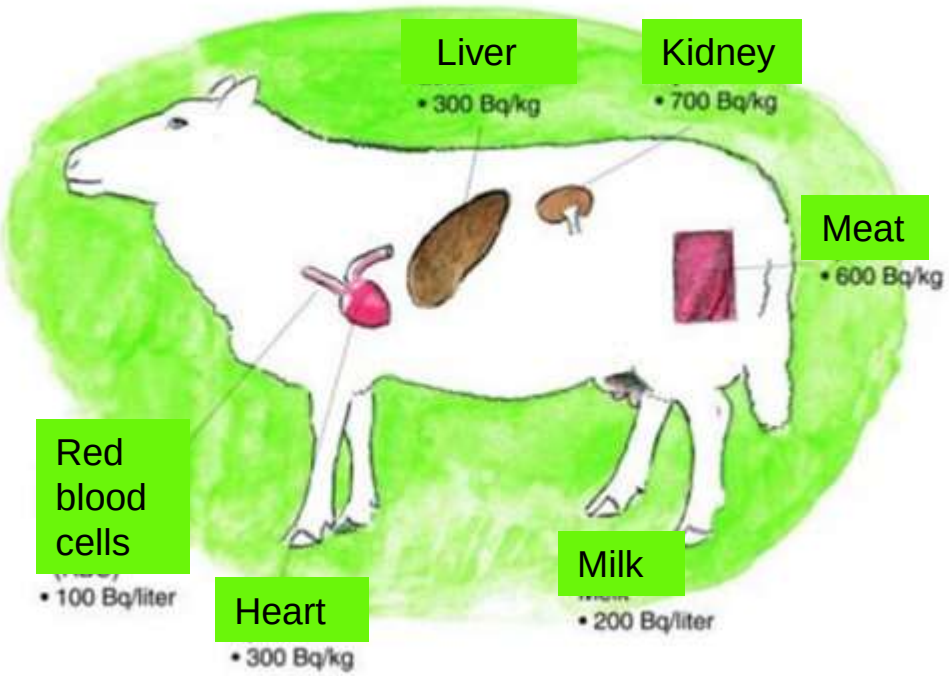
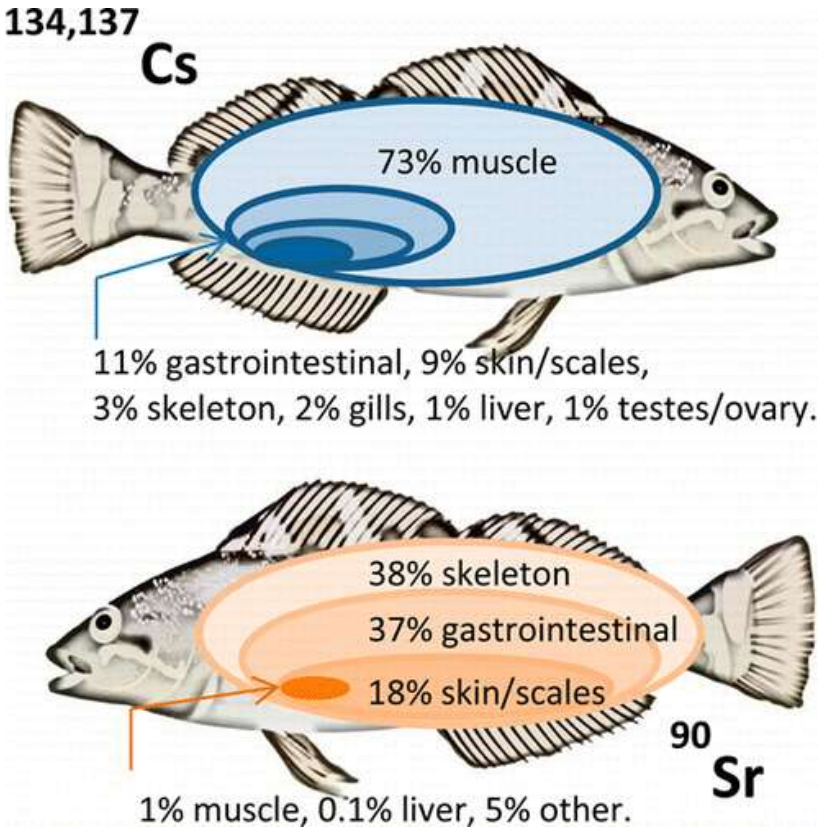
How much is bioavailable for gut uptake? How much go in the milk?



Internal distribution of radionuclides



Harbitz and Skuterud, 2000



Johanson et al, 2014

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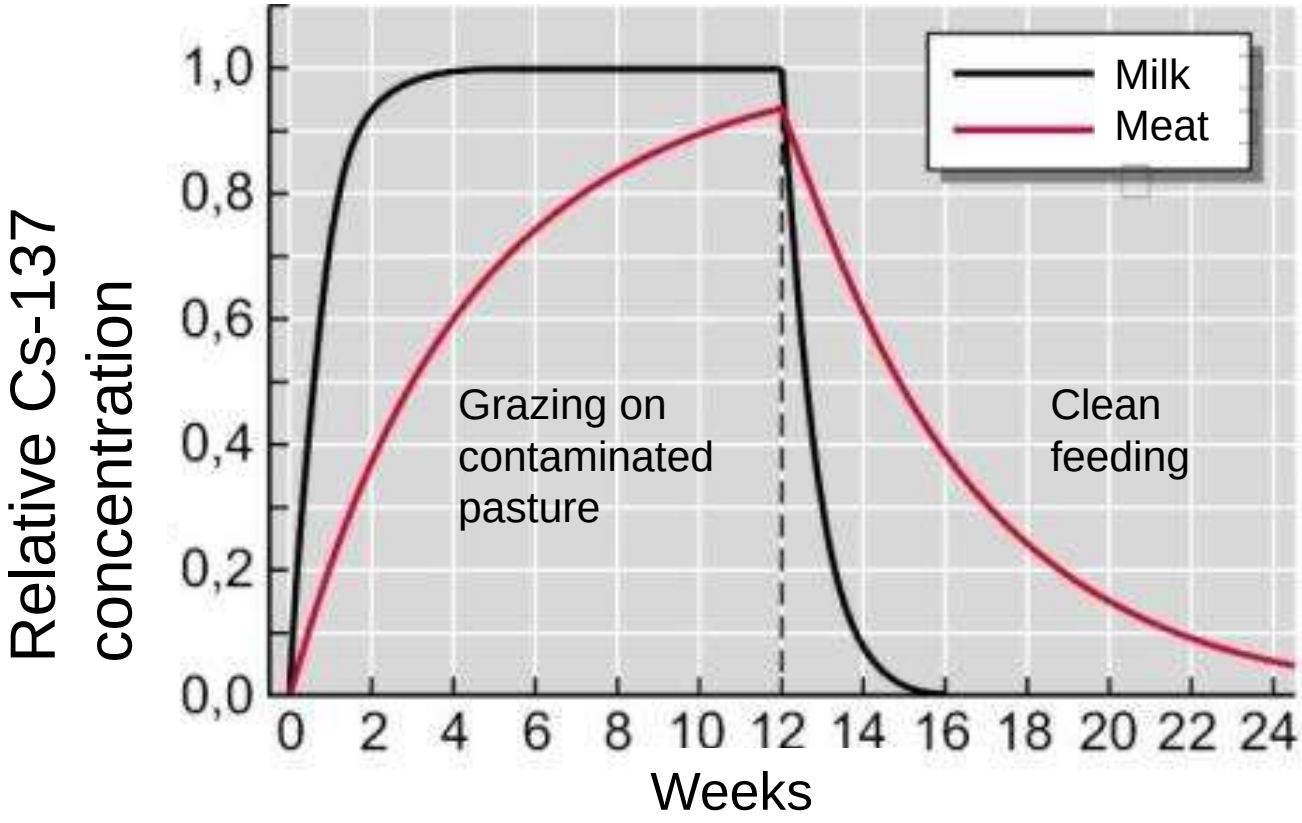
Uptake and depuration (biological half-live) in animals



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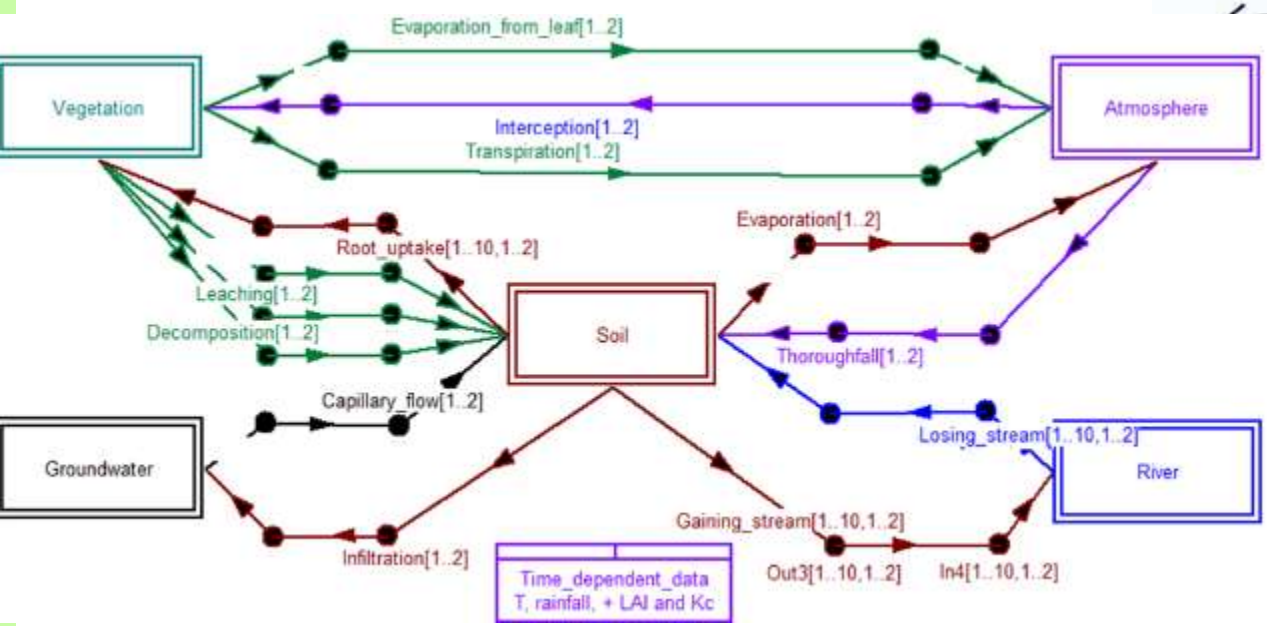
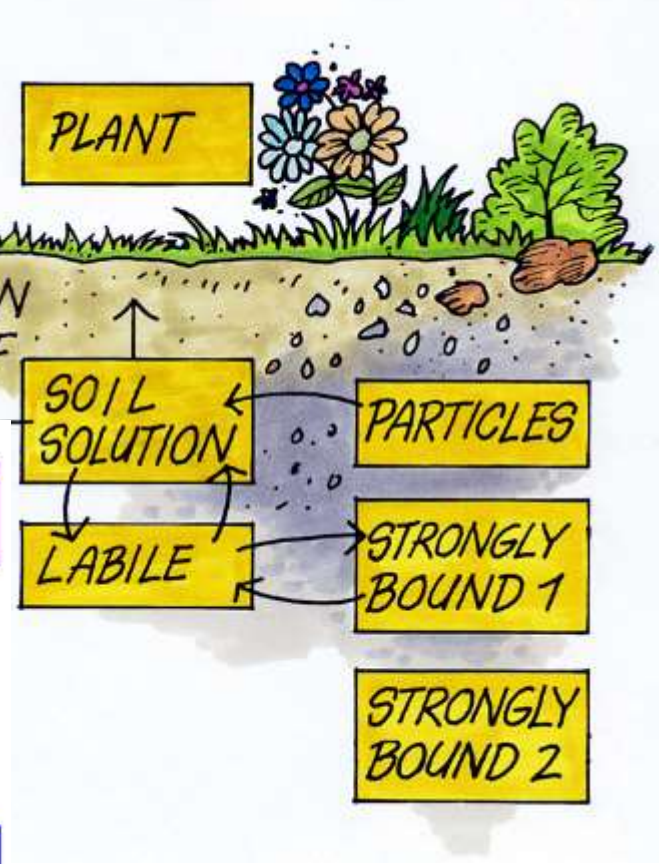
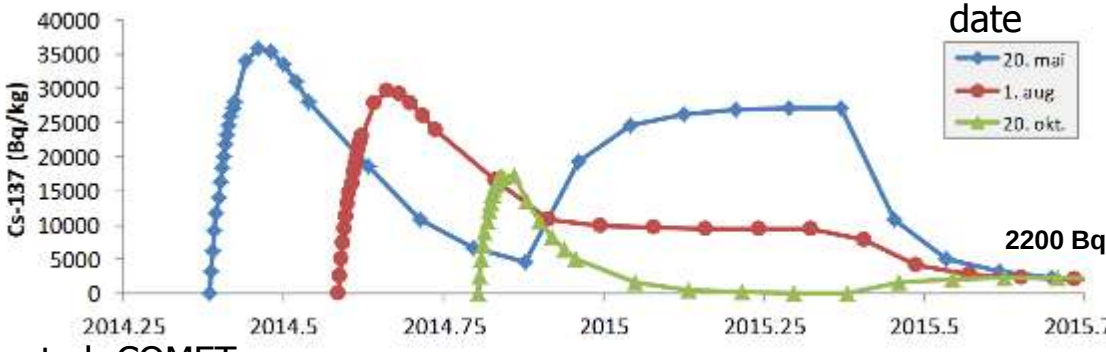
We can model



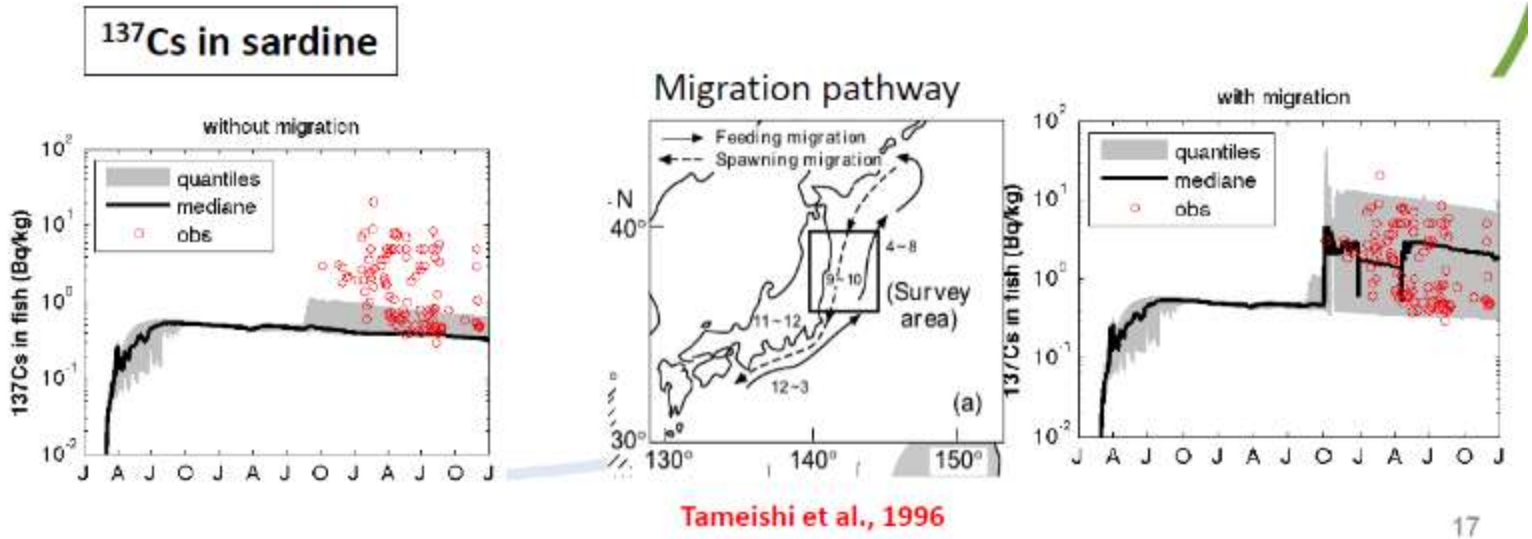


Forest modelling COMET, Vives-i-Batlle et al



Food chain modelling, ex. lamb meat, Thørring et al, COMET

Modelling with and without migration of species

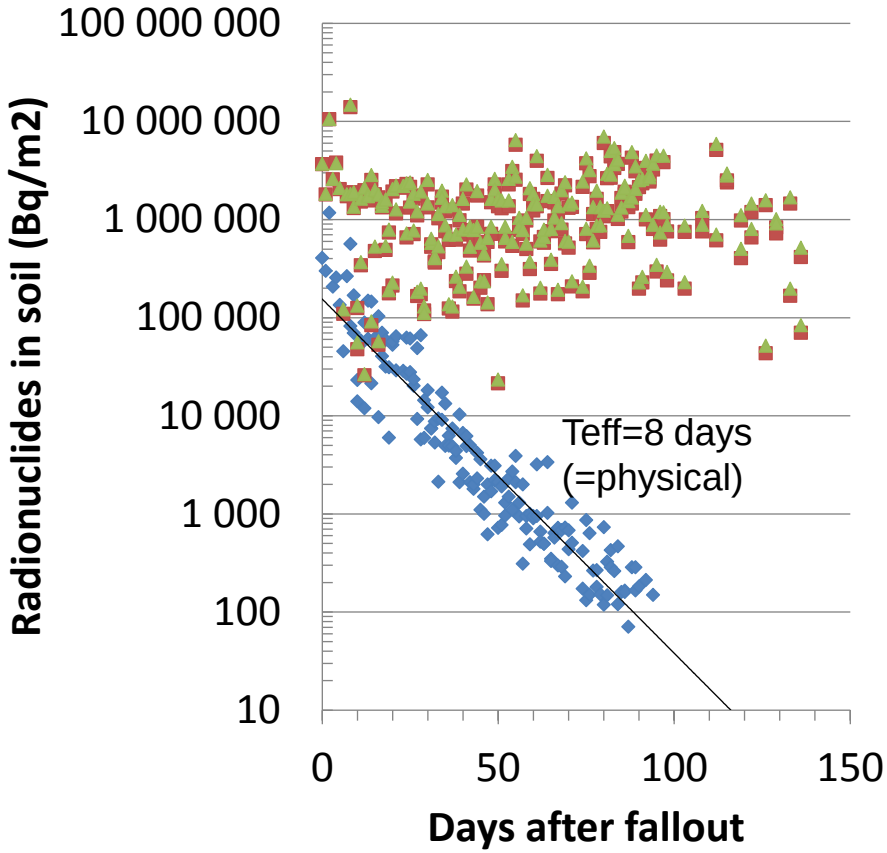


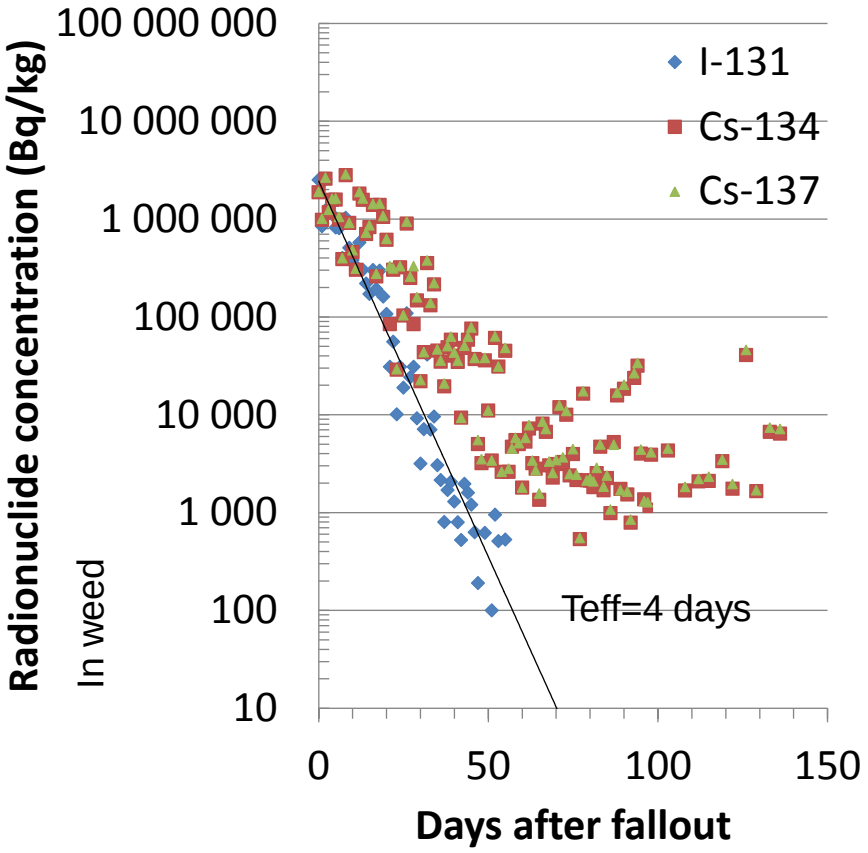
Tameishi et al., 1996

A societal challenge where radioecology can help

- How long will the contamination last?
- How can I reduce the uptake in agricultural products?
- How can I reduce my intake?
- What are the health consequences for me and my children in the long run?

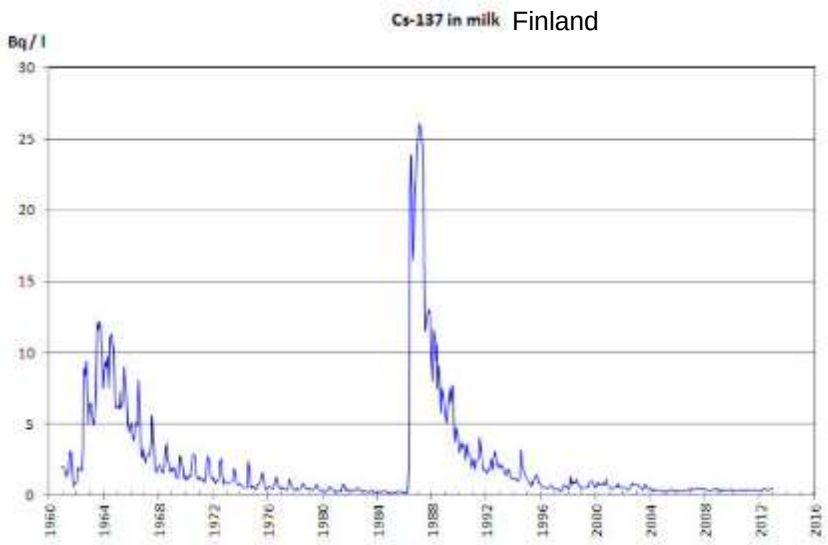
Physical vs effective ecological half-lives

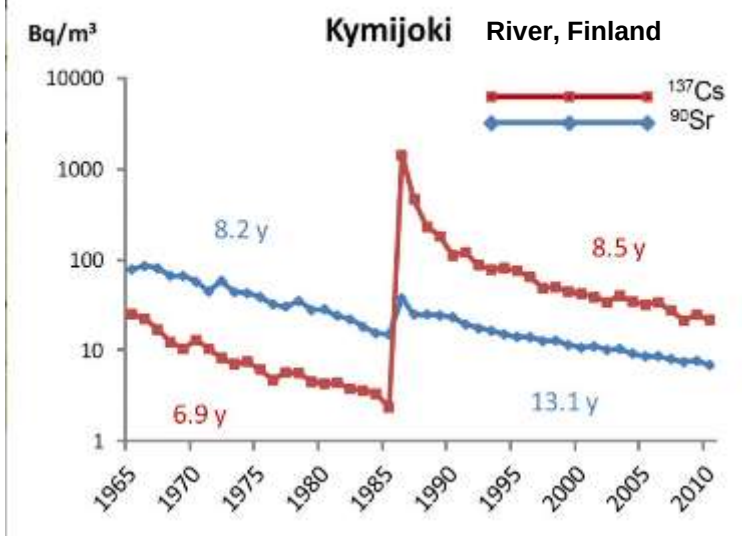




litate, Japan

Duration varies from months to decades





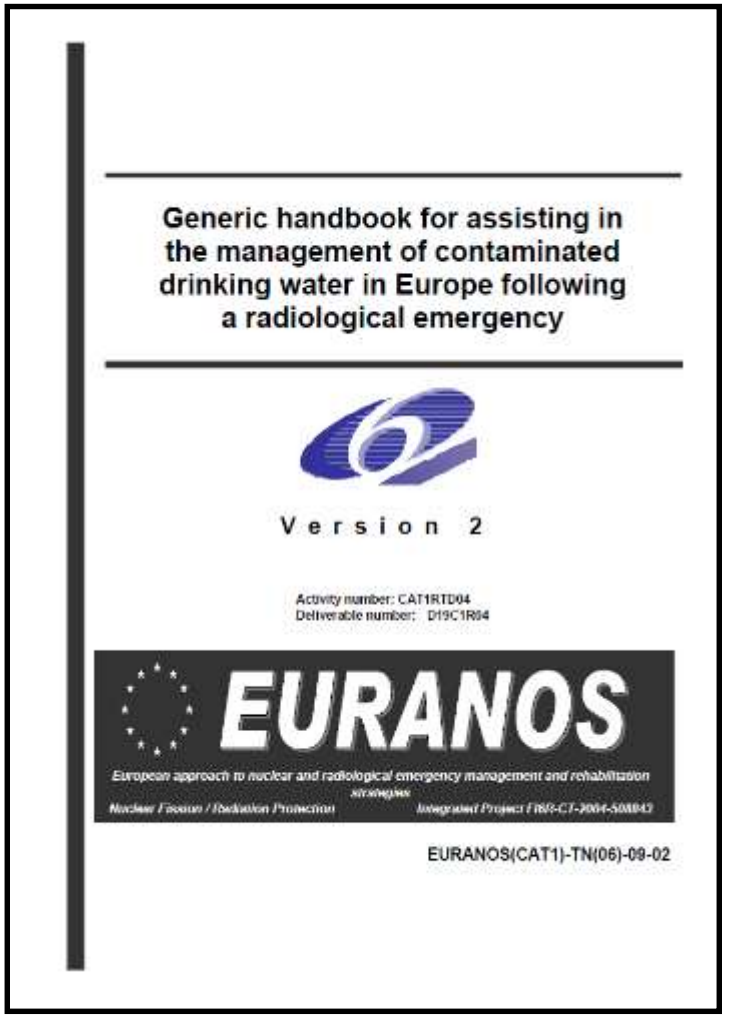
- Radionuclide
- Ecosystem
- Mitigating actions possible
- Soil properties, nutrient status, etc

Countermeasures

EURANOS handbooks for drinking water and **food:**

- 6 groups:
  - Countermeasures before fallout (6)
  - Generic countermasures (6)
  - Directed at soil/plants (11)
  - Directed at animals and animal products (15)
  - Societal countermeasures(8)
  - Waste disposal (12)

- Addresses efficiency, feasibility, cost, side-effects, waste implications,. incremental doses, ethical aspects



http://www.eu-neris.net/index.php/library/handbooks.html

Examples of countermeasures

Before fallout:

- Cover harvests
- Keep milking animals indoors

Generic:

- Dilution (water, milk, grain)
- Food restrictions or destruction

Soil/plants:

- Fertilising
- Ploughing to different depths, techniques
- Removal of top soil

Societal:

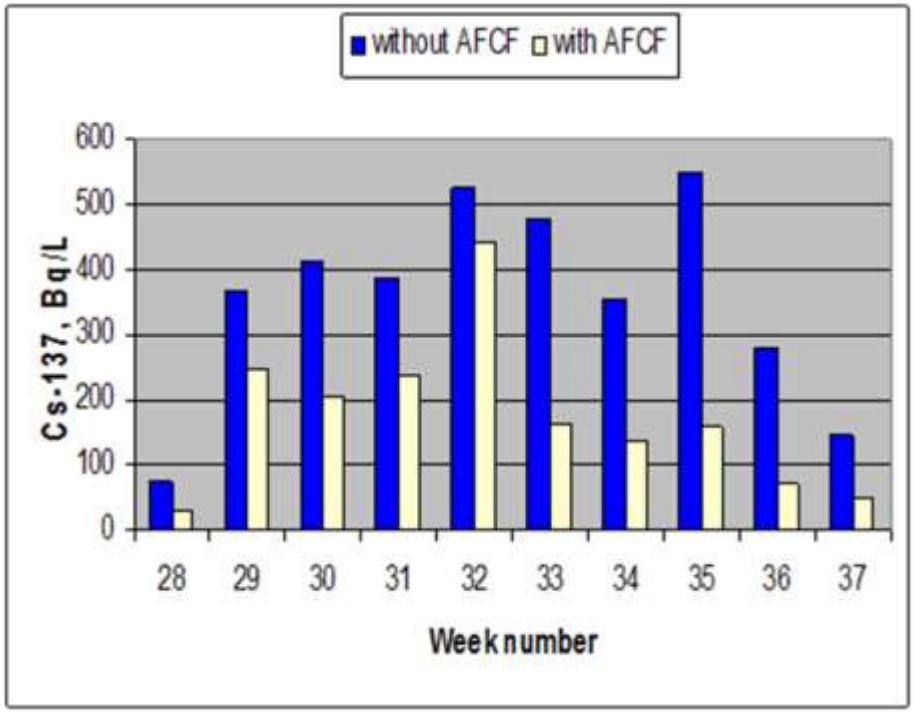
- Dietary advice
- Compensation schemes
- Increased food intervention limits
- Whole body counting

Examples of countermeasures

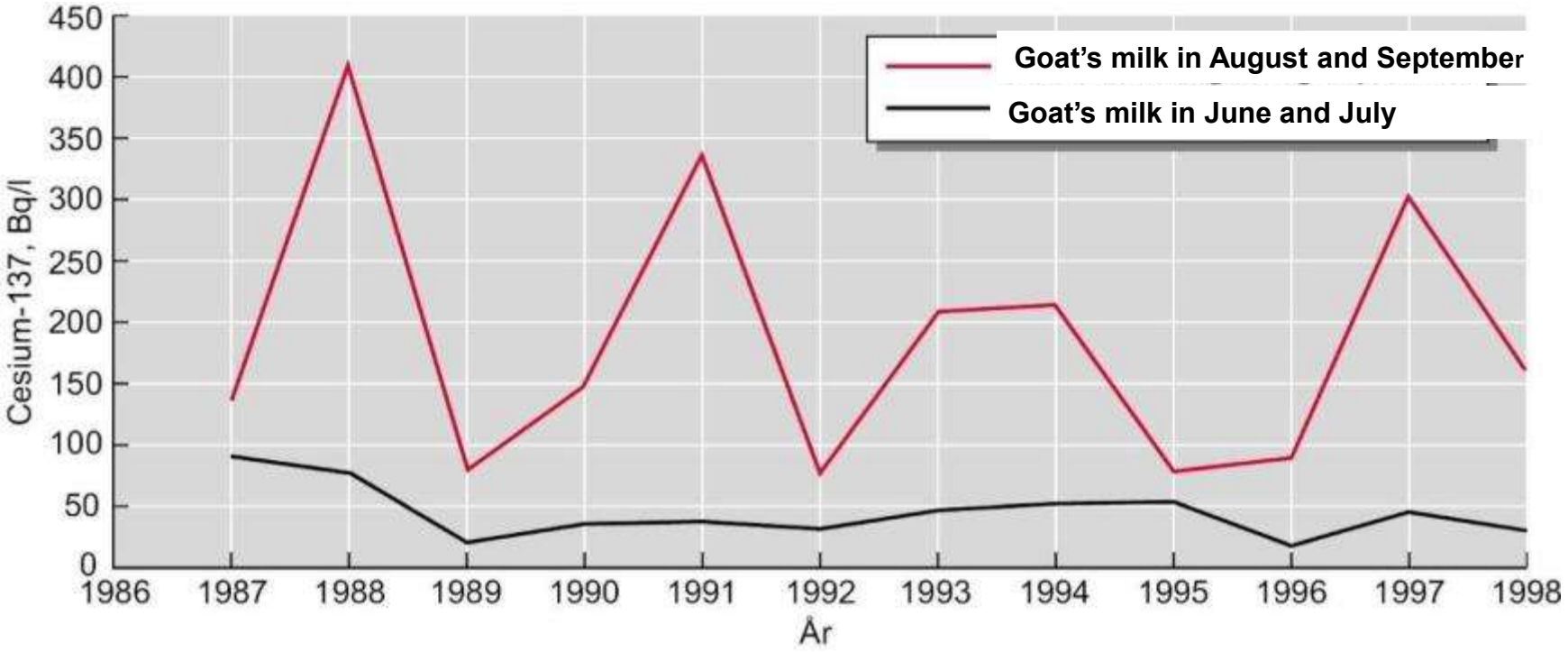
Animal produce:

- Cesium binders
- Measurements of live animals prior to slaughtering
- Clean feeding
- Change of slaugther time
- Processing of meat and milk

‘Prussian Blue’ – AFCF – distributed in pelleted feed to milking goats



Seasonal variations for grazing animals



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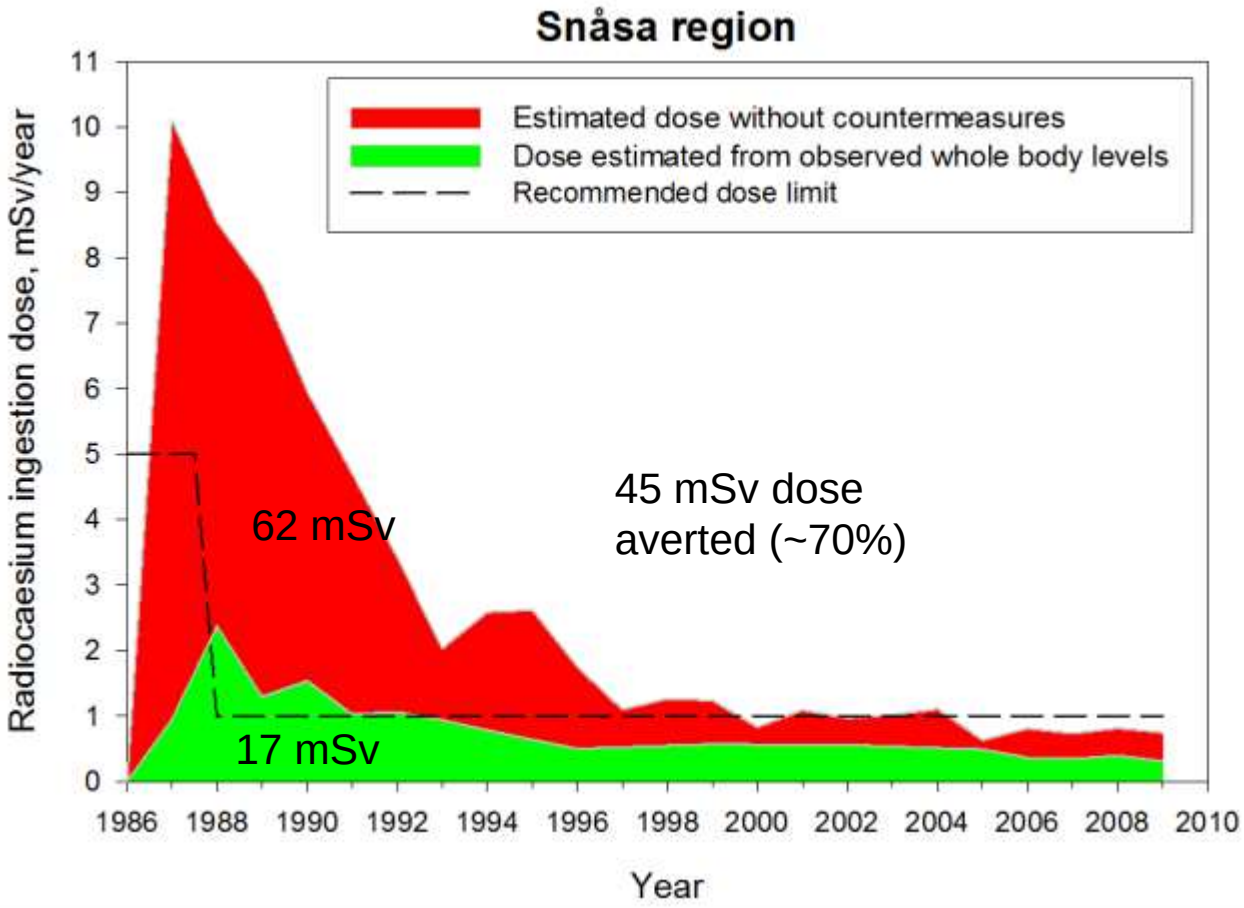
Long term exposure – increased cancer frequency?

Averted doses due to countermeasures

- Change in slaughter time
- Clean feeding
- Dietary vigilance



A societal challenge where radioecology can help

- Available countermeasures in inhabited areas?
- What about the radioactive waste?
- What is the consequence for our environment in the long run?
- Can the ecosystems be at risk?

EURANOS handbook for inhabited areas

2 MANAGEMENT OPTIONS

2.1 Shielding options
2.2 Removal options
2.3 Self-help management options
2.4 Implementing management options with people in-situ
2.5 Decision not to implement any management options
2.6 References

Radioactive waste

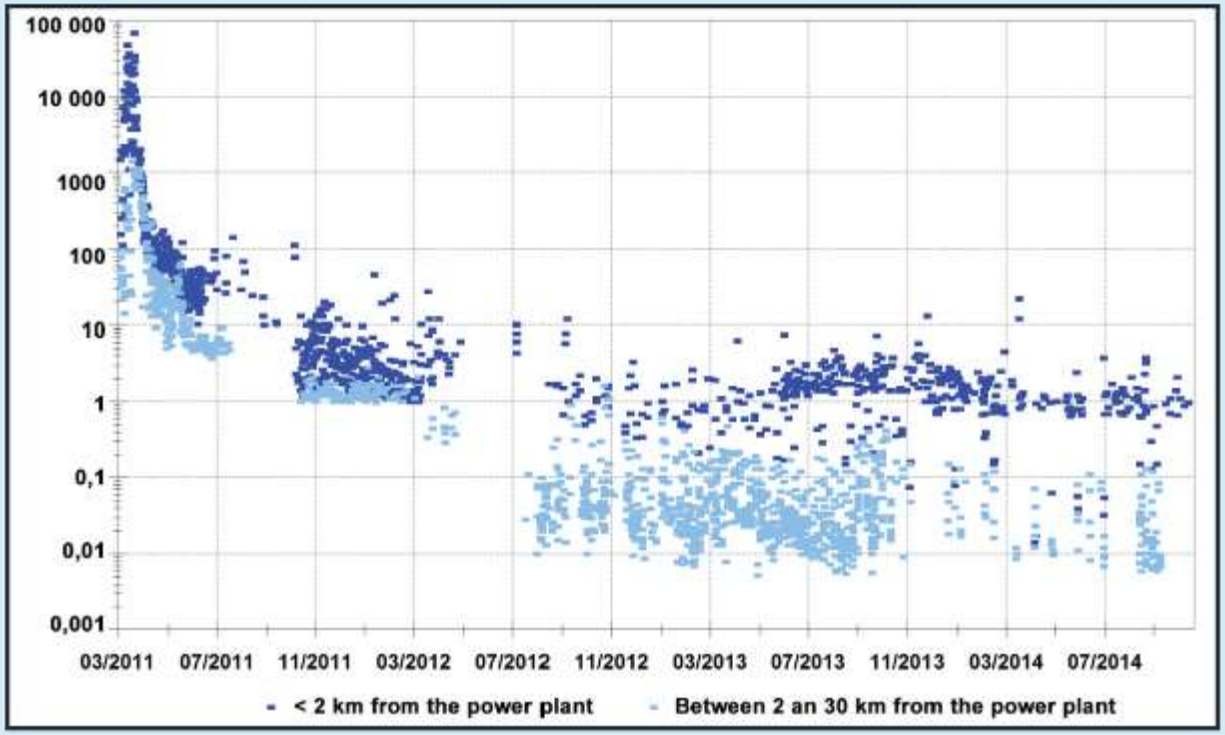
- Many waste disposal options available; many described in EURANOS handbooks
- Japan has chosen vegetation and top soil removal → large quantities of slightly contaminated waste to be handled


Astrid Liland

Temporary storage site in Tomioka, Fukushima Prefectu


Shimbun newspaper 26/02 201

Long term consequences for the environment



Radioactive caesium-137 (Bq/L) in seawater from 2011 to 2014. www.irsn.fr

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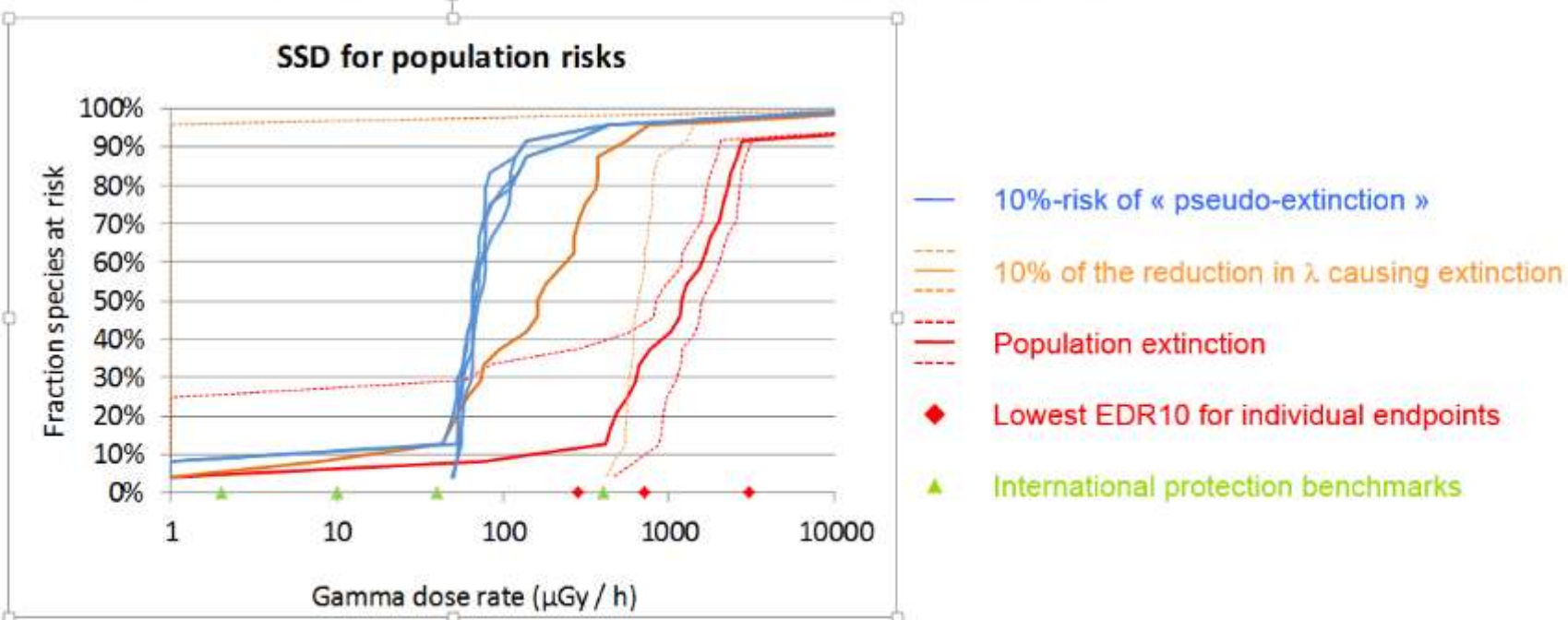
Dose effect relationships for wildlife

Many examples shown here in Aix; example below from poster by Alonzo et al.

Species sensitivity distributions (SSD) are built for population risks in 24 fish species (including 3 species modelled in this study and 21 European fish species for which Leslie matrices are described in realistic field conditions (Ibrahim et al., 2014):

- a majority of species are theoretically protected at the population level below 10 µGy / h;
- some species with population λ close to 1 appear at risk at any dose rate.



Access to understandable information

Welcome to the Radioecology Exchange
Protecting Humans and the Environment from Radiation

Home | Training & Education | Information Exchange | SRA | Fukushima Research | News & Careers | Virtual Laboratory | Work

The Radioecology Exchange | Information Exchange | Radioecology Data

Information Exchange

- Radioecology Data
- EURATOM Project Outputs
- European Platforms
- Links to other websites
- Interactive Links
- Newsletters from Platforms
- Publication catalogues
- International organisations
- STAR
- COMET

Data from the STAR NoE

STAR is committed to making all of the data we generate during the course of the science activities of available.

Other datasets held by STAR partners have been made available and information on these can be fou links below. Click on the arrow to view the individual datasets on a topic (to expand figures within the d information sheets, click-on them).

View data by topic

- Chernobyl
- Freshwaters
- Foodstuffs and crops
- Fukushima
- Fungi
- Marine
- Milk
- Natural radioactivity
- Nuclear weapons fallout
- Reindeer
- Wildlife

View data by country

- Data from Finland
- Data from France

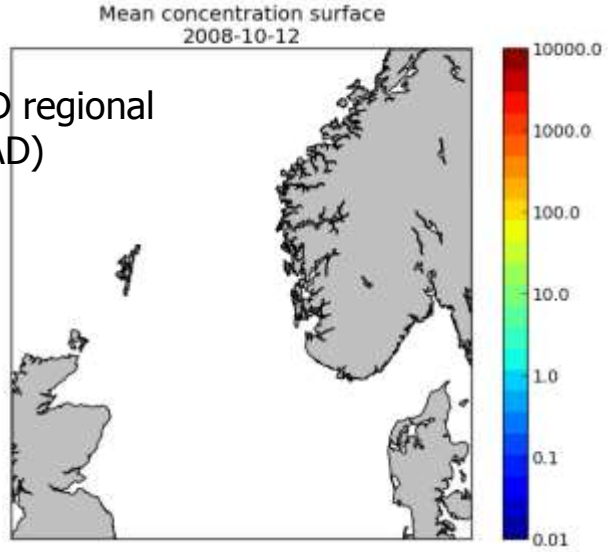
Unresolved issues related to nuclear fallout

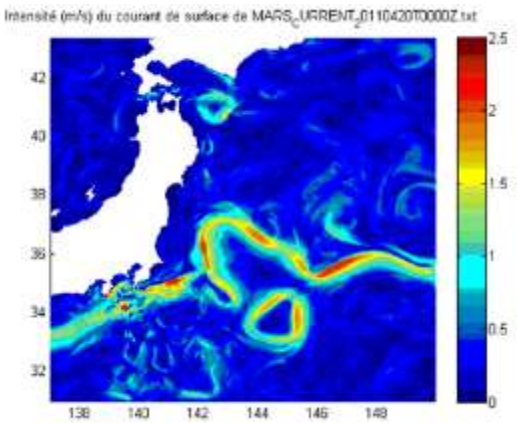
For instance:

- Total exposures from all exposure pathways
- Bias towards Northern ecosystems and foodstuffs
- Massive marine contamination still understudied
- Forest modelling under way
- Long term environmental effects still understudied, in particular in the field
- Extrapolation approaches still being developed

Persimmon fruit in Japan, Astrid Liland

Development of 3-D regional ocean model (CERAD)





STERNE model, COMET

To know or not to know, is that the question?

Information skewed towards last accident; the SRA ask us to look at radioecological research more strategically

To maintain, or re-build, public trust we should be specific about what we know and do not know

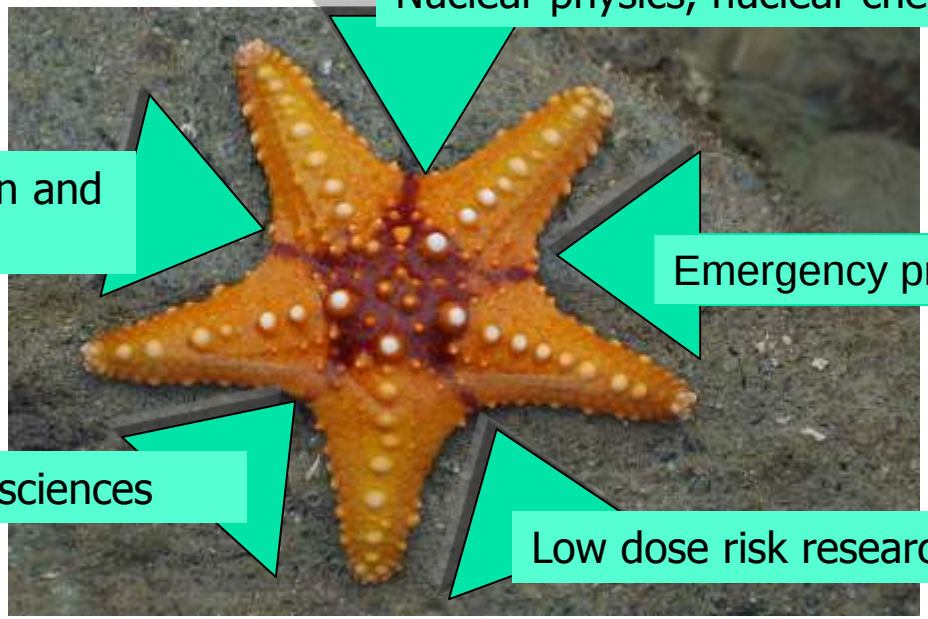
We will never know all about everything everywhere…

Every new accident will create new questions – but we have a solid knowledge base to build upon

Knowledge useful for planned, existing and emergency situations

Enough work remaining for all of us… to be ready to respond adequately to a serious nuclear accident

- Radioecology is an inherent part of this, along with other disciplines



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To be ready to respond adequately to the next nuclear accident, in 1, 5 or 50 years, we need a living research community in radioecology and related fields!

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