

NEA Workshop on Preparedness for Post-Nuclear Accident Recovery

Radiological Protection
2022

Building a Framework for Post-Nuclear Accident Recovery Preparedness

National-Level Guidance

Managing the foodchain

*Norwegian post-Chernobyl experience and recent plans in light of
the war in Ukraine*

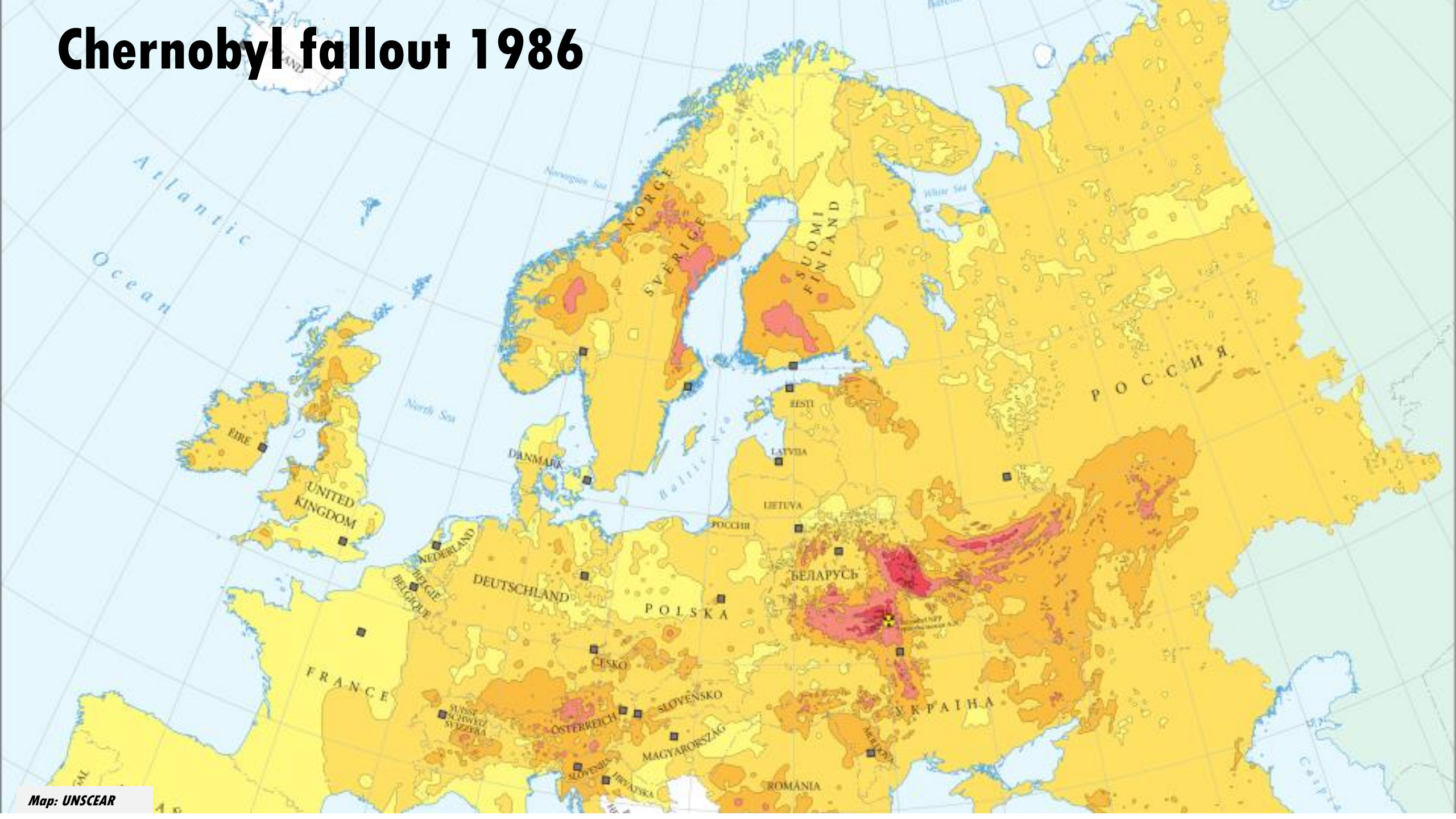
Astrid Liland

Director for emergency preparedness and response

DSA, Norway



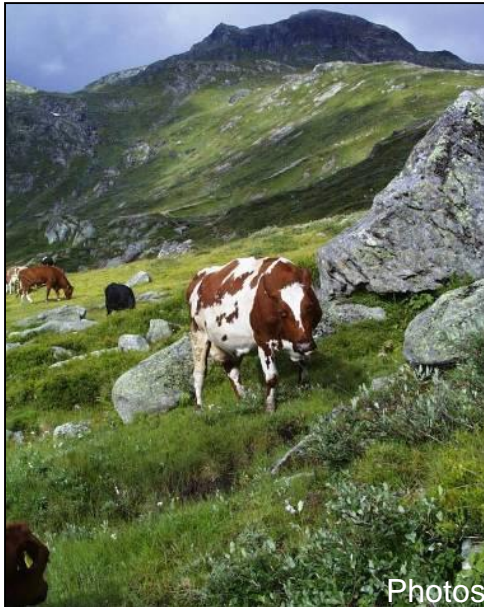
Chernobyl fallout 1986



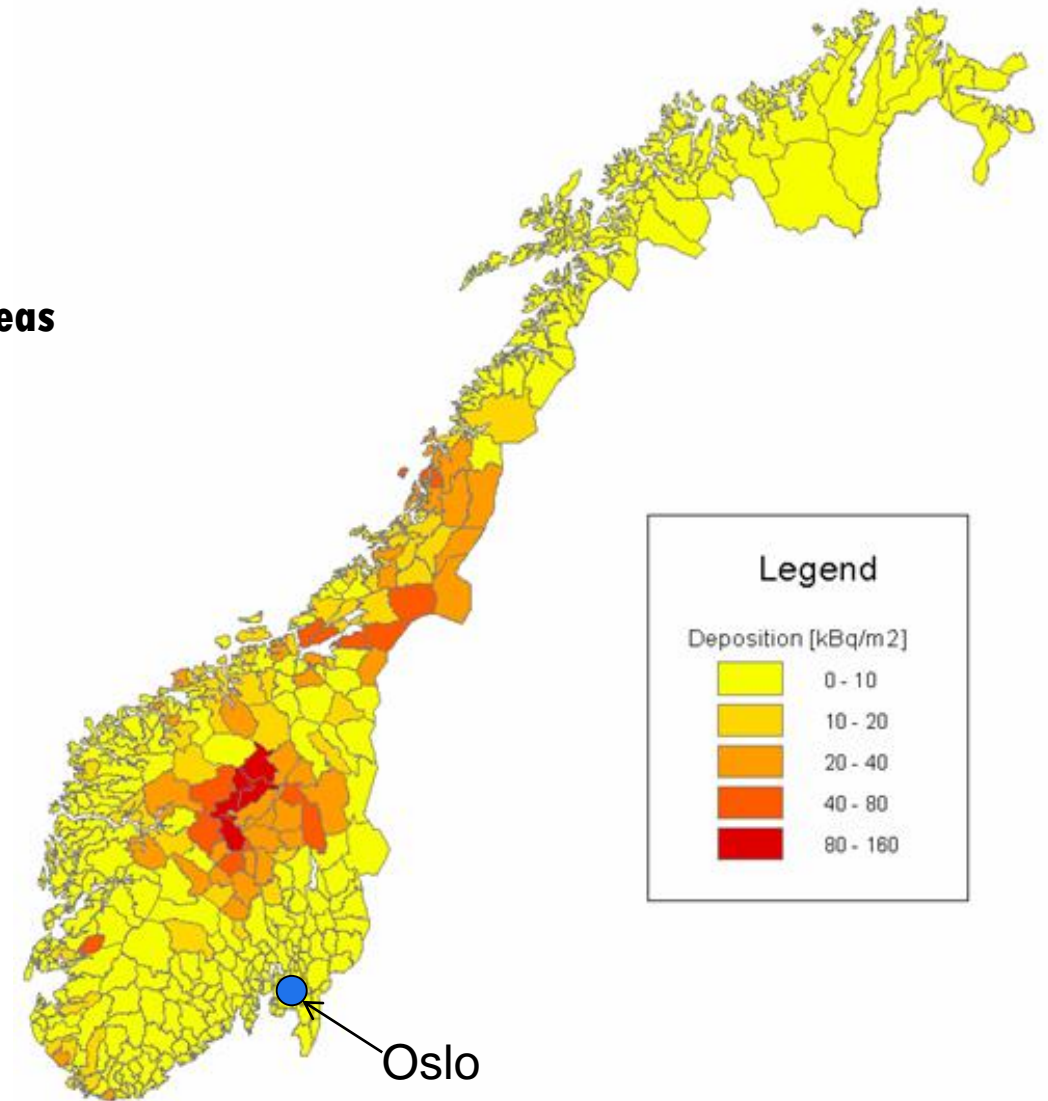
Map: UNSCEAR

Consequences in Norway

- **From denial to confusion to management**
- **Highly contaminated areas coincided with pasture areas**
→ **meat and milk very contaminated**
- **Wild foodstuffs highly contaminated**



Photos: Knut Hove



Some measured maximum values, total caesium

1986

- **Goat's milk: 2890 Bq/kg**
- **Cow's milk: 1160 Bq/kg**
- **Freshwater fish: 30 000 Bq/kg**
- **Lamb: 40 000 Bq/kg**
- **Reindeer: 150 000 Bq/kg**
- **Mushrooms: 1-2 MBq/kg**

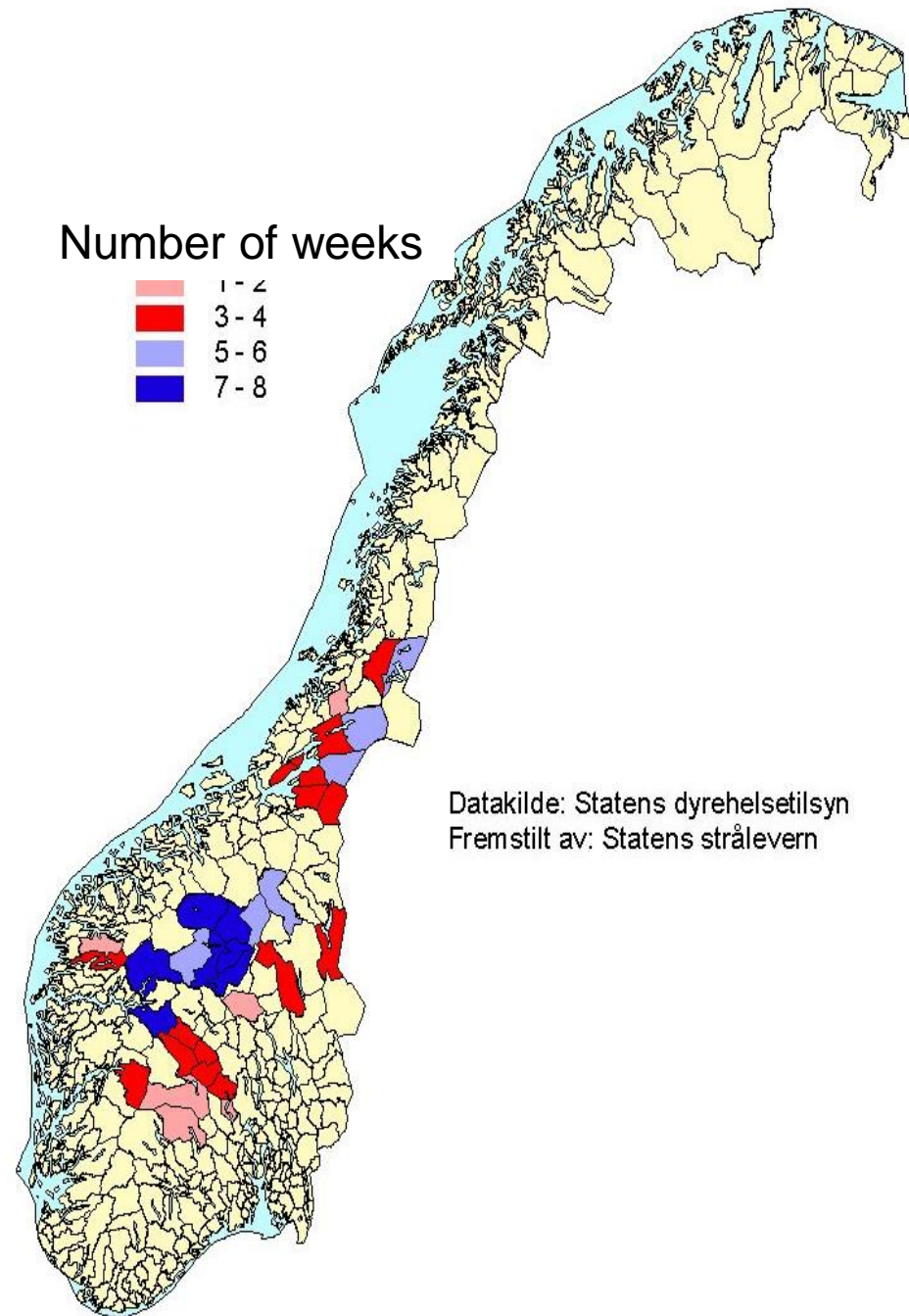
A range of countermeasures introduced

- **Monitoring of radiocaesium in animals before slaughter (“live monitoring”)**
- **Clean feeding of animals before slaughter**
- **Caesium binder (Prussian blue/AFCF) in feed, salt licks and rumen boli to prevent absorption of ingested radiocaesium in the animals (milk and meat)**
- **Extensive food monitoring programme**
- **Dietary advice and monitoring of internal contamination (whole body counting)**

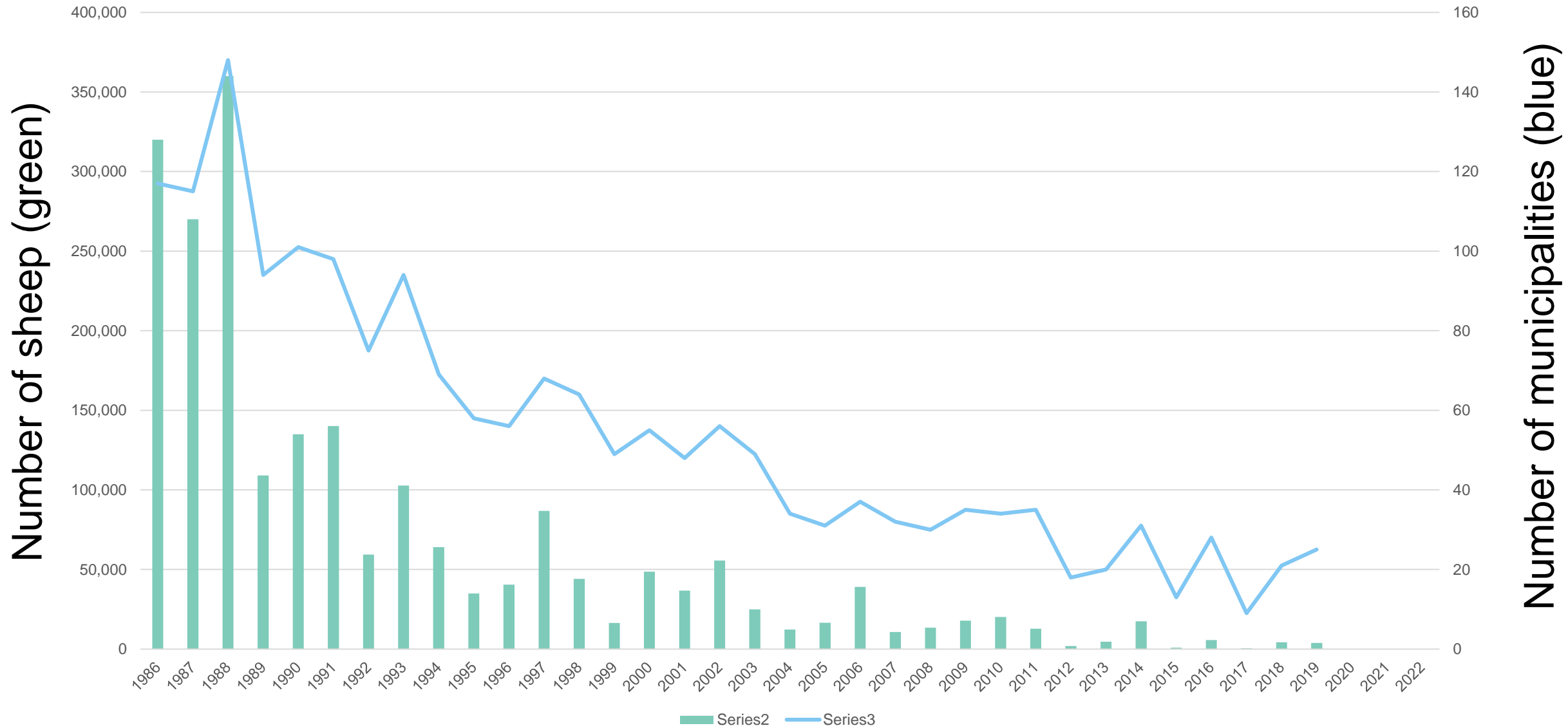


Zoning of animals

- Based on live monitoring data
- Number of weeks with imposed clean feeding depends on contamination levels
- Compensation paid to farmers from week 2 for extra work ~1 €/animal/day



Clean feeding of sheep in Norway, 1986-2022



Meat from semi-domesticated reindeer



- Free ranging animals, natural pastures only
- Difficult to implement countermeasures
- The Samis has a strong spiritual and cultural connection to the reindeer and the nature → their existence was threatened
- Low average consumption by Norwegians ~0.5 kg/y
- High consumption by Sami people > 50 kg/y

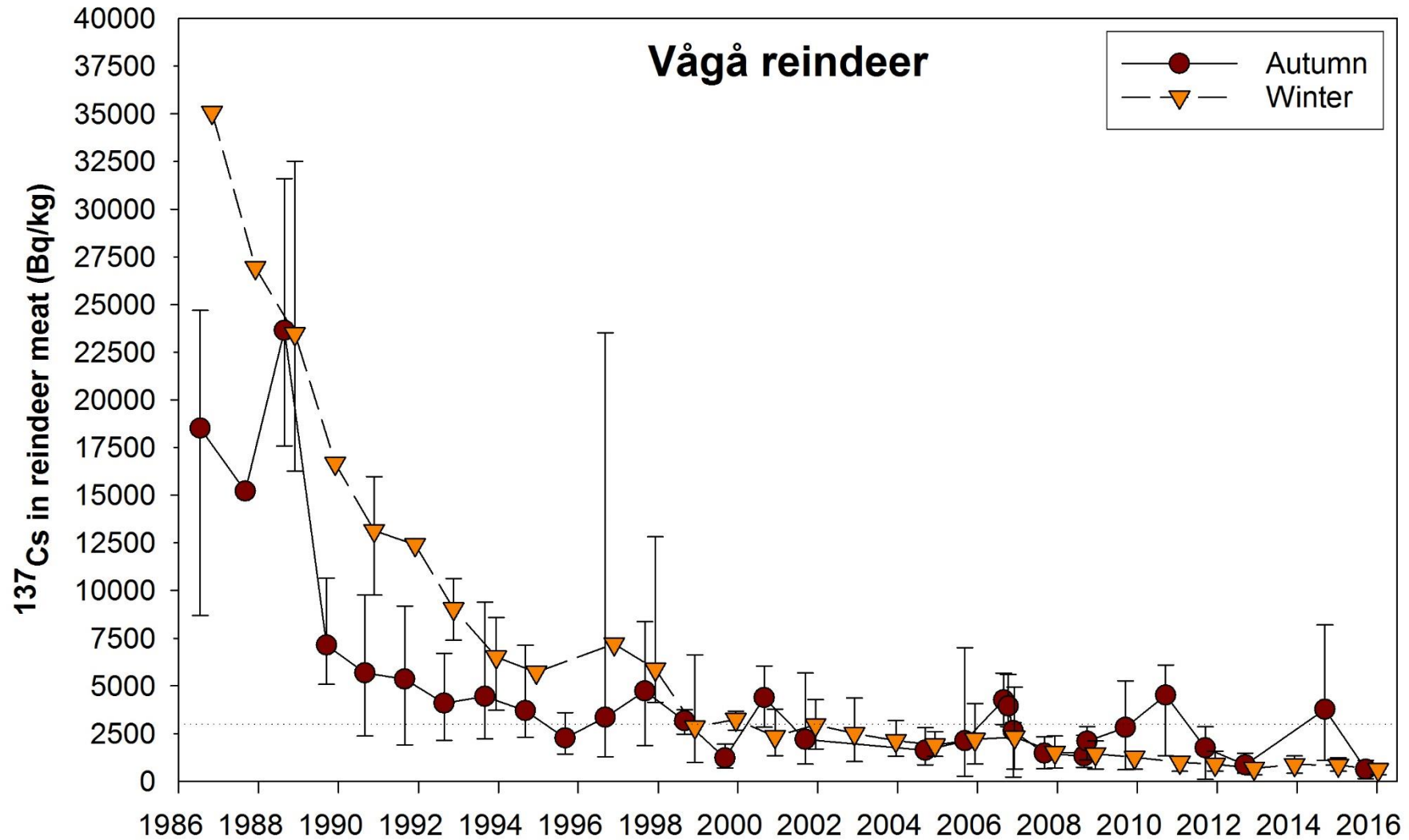
Raising the permissible level

- **A level of 600 Bq/kg for total caesium in reindeer meat would mean a complete liquidation of reindeer herding in Norway which would lead to the extinction of the Sami culture**
- **To save the Sami culture and reindeer herding as an industry the permissible level was raised to 6000 Bq/kg in November 1986**
- **Rationale:**
 - **The general public consume little reindeer meat (~0.5 kg/y)**
 - **The value of preserving the Sami culture outweighs the exposure to the general public**
- **The decision making process: meeting with Sami people in their district, consultations with the industry and the reindeer herders' associations, consideration by radiation protection and health experts**

Specific countermeasures for reindeer and Sami population

- **Elevated permitted levels for reindeer meat for sale**
- **Change of slaughter time (from winter to autumn)**
- **Dietary advice and compensation scheme (until 2007):**
 - **To buy less contaminated reindeer from other areas**
 - **To buy other types of meat**
 - **To clean feed the animals consumed by the household**

Seasonal variation → change slaughter time

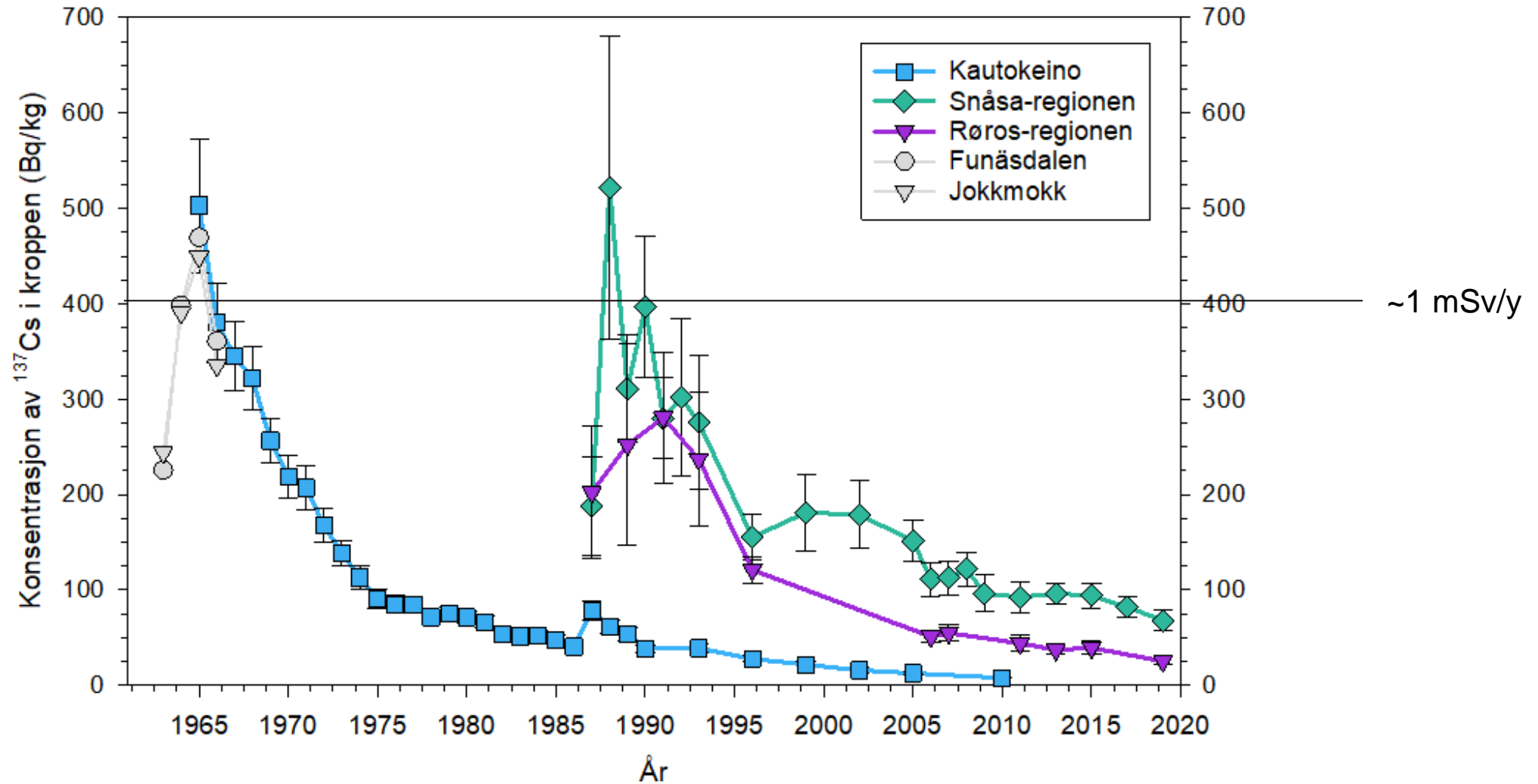


Dietary advice and WBC of Samis

- Advice to reduce levels to below 600 Bq/kg of Cs-134+137 for reindeer consumed in the Sami household
- Compensation payed to Sami huseholds to buy food from less contaminated areas or to clean feed their animals
- Invited to wholde body counting at regular intervals
 - Both measurement and dialogue

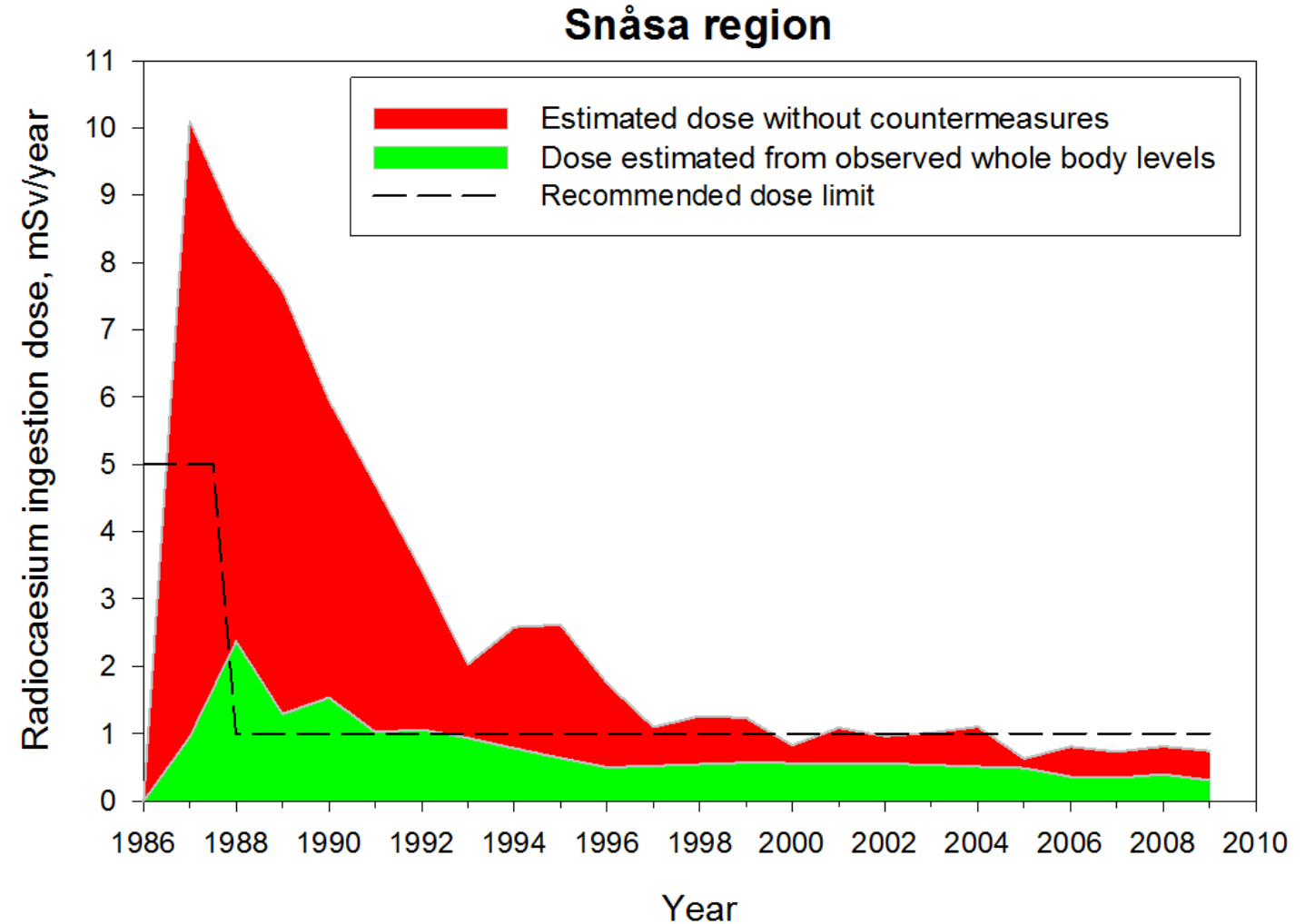


WBC results from ongoing programme



Averted doses due to countermeasures

- **Change in slaughter time**
- **Clean feeding**
- **Dietary vigilance**



Costs of countermeasures in Norway 1986- 2011

- **Total costs ~90 million € 1986-2011 (measurements, mangement, countermeasures, compensation, research)**

- **Sheep on clean feeding 1986-2010**
 - ~ **2,2 millions animals**
 - **Total costs: 28,5 million €**
 - **Value of the saved meat 350 million €**

- **~ 0.5 million € annually 2011-2019**
 - **0.35 million € for sheep, goats, cows, foodstuffs**
 - **0.15 million € for reindeer, reindeer herders, WBC**

Many options are available – let's plan to use them!

And communicate them.

What you can do to protect yourself if a nuclear incident affects us

The authorities will provide advice or instructions on how you can protect yourself:

- Stay indoors**
Close doors, windows and air ducts and shut off the ventilation. Heat pumps can be left on. The time you need to stay indoors will normally be short, and no more than 48 hours. Staying indoors will reduce the amount of radiation to which you could be exposed. Staying indoors will also protect you from breathing in any radioactive contamination and prevent direct radioactive contamination on your body.
- Only take iodine tablets on the advice of the authorities**
Buy iodine tablets from your pharmacy for storage at home. You should do this before a nuclear incident or accident, so you have them readily available. You should only take iodine tablets on the advice of the authorities, and this will only be necessary for children and adolescents under 18 years of age, adults aged 18 to 40 and pregnant and breast-feeding women. Iodine tablets give protection from the risk of thyroid cancer following a nuclear incident.
- Take a shower if you have been contaminated**
Wash yourself thoroughly with soap without scratching your skin. Use shampoo, but not conditioner which could keep the contamination in your hair. Wash your clothes in the normal way to rinse off any radioactive contamination. Wipe your shoes with a damp cloth and discard the cloth afterwards.
- Follow dietary advice**
The authorities may advise you to avoid food and drink that is not controlled by the authorities. This applies, for example, to fruit and vegetables from your own garden and the use of rainwater collected in tanks, as well as foods that you might gather yourself such as game meat, freshwater fish, mushrooms and berries. Food purchased in shops and tap water are safe.
- Respect official regulations on safety cordons, decontamination or evacuation**
Check the radio, TV or internet for up-to-date details of the official advice.


More information: dsa.no/en/preparedness


 DSA Norwegian Radiation and Nuclear Safety Authority

Tiltak for næringsmidler ved en atomhendelse Teknisk dokument
14.10.2022, nummer 24

Tiltak for næringsmidler ved en atomhendelse

Countermeasures in food production for nuclear incidents



 DSA

Direktoratet for strålevern og atomikkerhet

<https://dsa.no/publikasjoner>

References

- **Liland, A. & Skuterud, L. (2013). Lessons Learned from the Chernobyl Accident in Norway. In D. Oughton & S. O. Hansson (Eds.), *Social and Ethical Aspects of Radiation Risk Management*. Elsevier Science, 157-176. ISBN: 978-0-08-045015-5, ISSN: 1569-4860.**
- **Skuterud L, Thørring H. Averted doses to Norwegian Sámi reindeer herders after the Chernobyl accident. *Health Physic* 2012; 102(2): 208-216**
- **Liland, A., Lochard, J., Skuterud, L. How long is long term? reflections based on over 20 years of post-Chernobyl management in Norway. *Journal of Environmental Radioactivity* 100 (2009) 581-584. doi:10.1016/j.jenvrad.2009.04.006**
- **Gjelsvik R. Radioactivity in sheep meat, cow and goat milk, 1988-2004. StrålevernRapport 2005:10. Østerås: Norwegian Radiation Protection Authority, 2005. Language: Norwegian.**
- **Thørring H, Skuterud L, Komperød M. Radiation doses to reindeer herders in Central Norway after the Chernobyl accident. DSA report 2022:1. Østerås: Norwegian Radiation and Nuclear Safety Authority. Language: Norwegian.**

astrid.liland@dsa.no