Industrial contaminants in local food items from the Finnish – Norwegian - Russian border area

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Food and health security in the Norwegian, Finnish and Russian border region: linking local industries, communities and socio-economic impacts

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Murmansk County Birth registry

The Northwest Public Health Researcher Center

Institute of the Industrial Ecology Problems of the North

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Study area


Barents Sea
Kirkenes
NORWAY
Pechenga
Nikel
Zapoljarnyy
FINLAND
RUSSIA
Lake Inari
Arctic Circle
70 °N
60 °N
0
50
100
km
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Background

- The industrial facilities at Zapolyarny and Nikel in Russia are located approximately 30 km apart, approximately 15 and 5 km from the Norwegian border, respectively.
- Emissions of SO_2 and metals (mainly Ni and Cu) since around 1930.
- Documented that emissions affect air quality, terrestrial and aquatic environment in the border region.

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Concern among citizens:

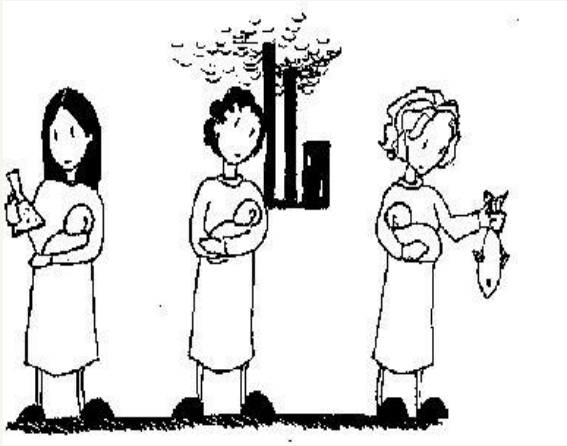
Is it safe to consume local food?

From Sør-Varanger Avis

Objective

- The objective of the project was to assess industrial impact on food safety and human health in the populated Norwegian, Finnish, and Russian border region.

- <u>Questions to be answered:</u>
  - Is the local food contaminated?
  - If so - in what regions is this the case?
  - To what extent do people actually eat this food?
  - Who are they?
  - Are people concerned about this, and has this influenced their use of local food?
  - Does knowledge about the industrial activities affect social and physical aspects, using the outdoors.



Risk perception

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Samples: Norway, Finland, Russia

- Berries
  - Cloudberries (*Rubus chamaemorus*)
  - Blueberries (*Vaccinium myrtillus*)
  - Crowberries (*Empetrum nigrum*)
  - Lingonberries (*Vaccinium vitis-idaea*)
- Mushrooms
  - Orange Oak Bolete (*Leccinum aurantiacum*)
  - Gypsy mushroom (*Cortinarius caperatus*)
- Fish
  - Perch (*Perca fluviatilis*)
  - Pike (*Esox lucius*)
  - Whitefish (*Coregonus* sp.)
  - Brown trout (*Salmo trutta*)
  - Arctic charr (*Salvelinus alpinus*)
- Reindeer (*Rangifer tarandus*)
- Moose (*Alces alces*)

- Sampled by scientists in the field
- Purchased from inhabitants
  - Representative of food items

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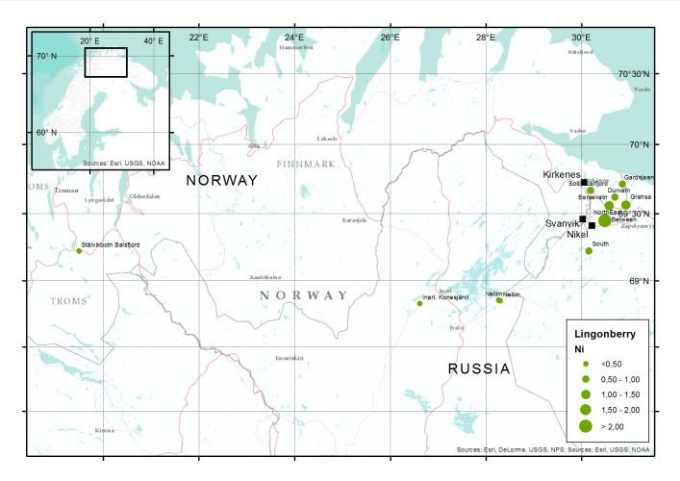
Analyses

- All samples analysed for selected metals
  - Cu, Ni, Co, As, Cd, Pb, Hg.
- Freshwater fish and reindeer analysed for:
  - Cu, Ni, Co, As, Cd, Pb, Hg.
  - PCBs, HCB, dioxins/furans (selected samples only).
- National, accredited laboratories

Results berries and mushrooms

- In general, low to moderate metal concentrations, but some exceptions.
- Geographical differences in concentrations of Ni, Cu and Co in mushrooms and berries, with the area northeast of the Nikel refinery showing the highest concentrations.

Average concentration per area (mg/kg ww)



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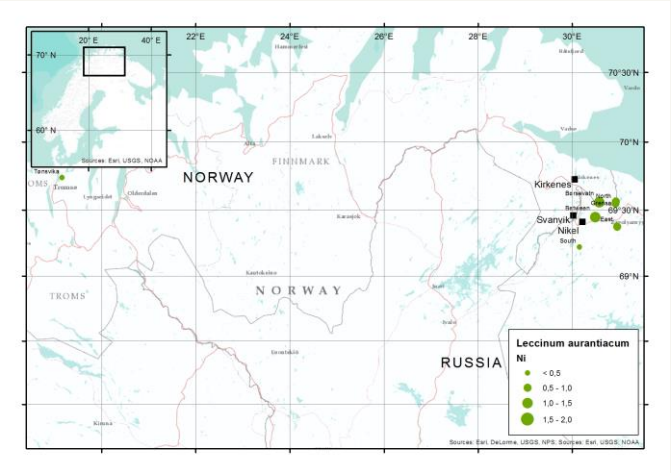
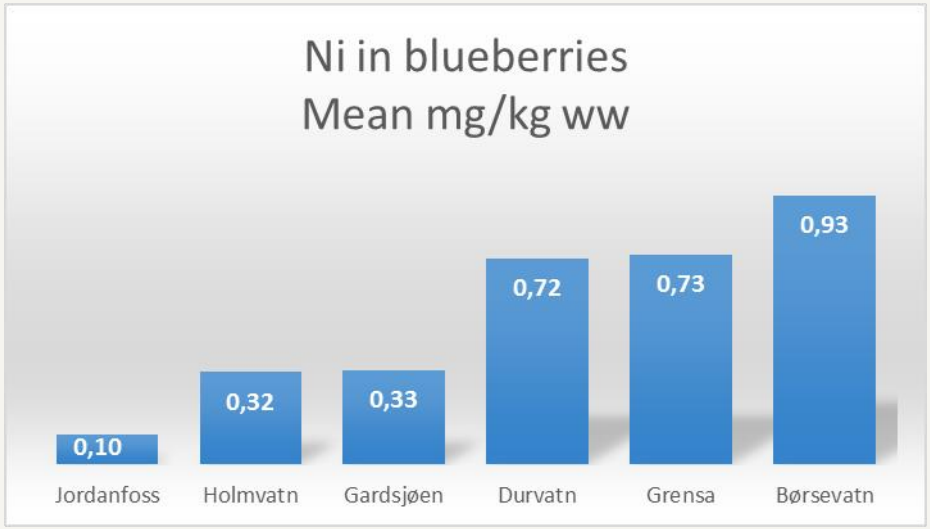
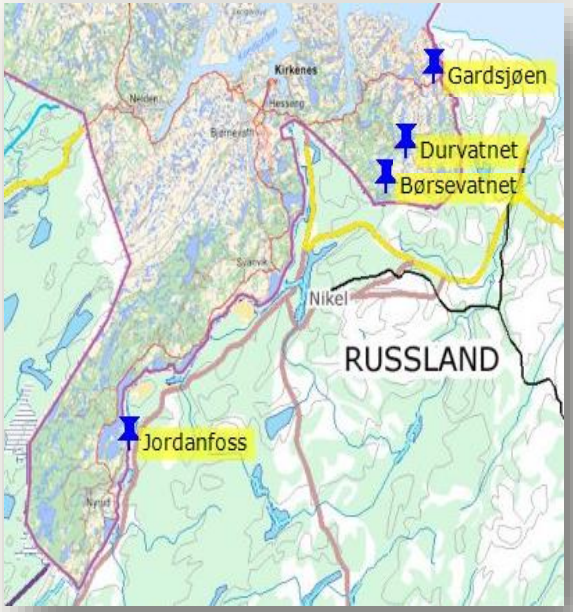
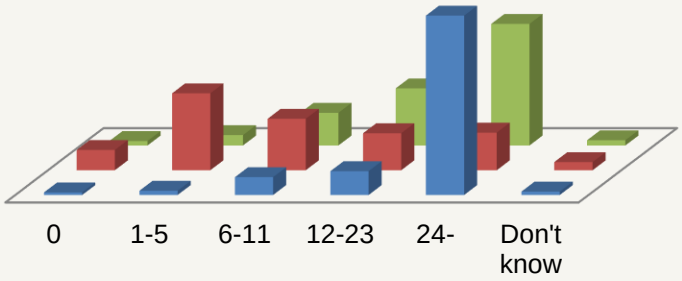






Intake frequency (days/year)



Sør-Varanger

Inari

Pechenga

Human risk?

- European Food Safety Authority (EFSA) limit - tolerable daily intake (TDI) of 2.8 µg Ni/kg body weight.

Russian Maximum Permissible Concentrations (MPC) of Metals in food products, mg/kg ww

Food product	Pb	As	Cd	Hg	Cu	Zn	Ni	Cr	Fe
Mammals meat	0.5	0.1	0.05	0.03	5.0	70.0	0.5	0.2	50.0
Birds meat	0.5	0.1	0.05	0.03	5.0	70.0	0.5	0.2	50.0
Fish muscles	1.0	-	0.2	-	10.0	40.0	0.5	0.3	30.0
freshwater Fish muscles	-	1.0	-	0.3; 0.6	-	-	-	-	-
marine Fish muscles	-	5.0	-	0.5	-	-	-	-	-
Vegetables	0.5	0.2	0.03	0.02	5.0	10.0	0.5	0.2	50.0
Potatoes	-	-	-	-	-	-	-	-	-
Carrot	-	-	-	-	-	-	-	-	-
Mushrooms	0.5	0.5	0.1	0.05	10.0	20.0	0.5	0.2	50.0
Berries	0.4	0.2	0.03	0.02	5.0	10.0	0.5	0.1	50.0

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- Highest measured Ni-concentration in berries:
  - 2.2 mg/kg ww (crowberries, close to border, Russian side)
  - 1.6 mg/kg ww (cloudberries, Pasvik, Norwegian side)
- A person weighing 70 kg can eat 89 g of crowberries or 123 g cloudberries per day (if no other sources).

Compared to Russian MPCs

		Ni	Cu	As	Cd	Pb	Hg
Berries	Norway	Exceed in 67 % of samples	NO	NO	NO	NO	NO
	Russia	Exceed in 90 % of samples	NO	NO	NO	NO	NO
	Finland	NO	NO	NO	NO	NO	NO
Mushrooms	Norway	Exceed in 86 % of samples	Exceed in 38 % of samples	NO	Exceed in 86 % of samples	NO	NO
	Russia	Exceed in 75 % of samples	NO	NO	Exceed in 100 % of samples	NO	NO
	Finland	NO	NO	NO	NO	NO	NO
Fish	Norway	NO	NO	NO	NO	NO	Exceed in 2 samples
	Russia	NO	NO	NO	NO	NO	Exceed in 1 sample
	Finland	NO	NO	NO	NO	NO	NO
Reindeer	Norway	NO	NO	NO	NO	NO	NO
	Russia	NO	NO	NO	NO	NO	NO
	Finland	NO	NO	NO	NO	NO	NO
Moose	Norway	NO	NO	NO	NO	Exceed in 1 sample	NO
	Russia	NO	NO	NO	NO	NO	NO
	Finland	NO	NO	NO	NO	Exceed in 1 sample	NO

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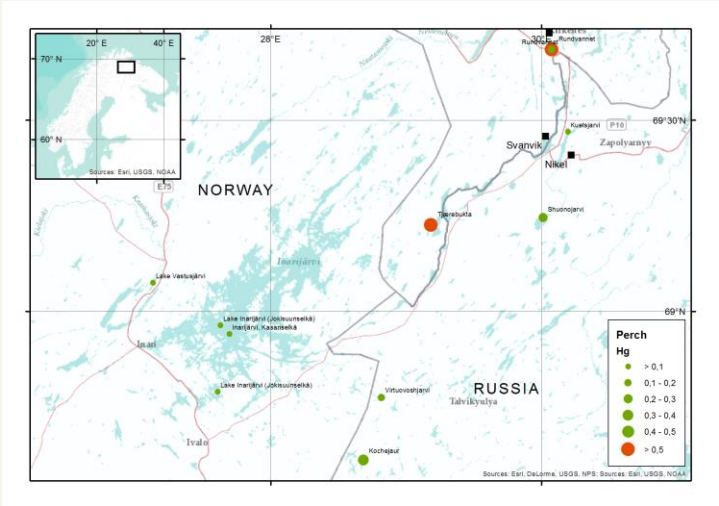
Results fish

- In general low to moderate metal levels.
- However, elevated levels of metals were measured in lakes located in both northeastern and southwestern directions from Nikel.
- Perch from two Norwegian lakes and pike from one Russian lake had Hg-levels exceeding level recommended for human consumption (0.5 mg/kg ww).
- Low levels of PCB, HCB and dioxins/furans.

Average concentration (mg/kg ww)



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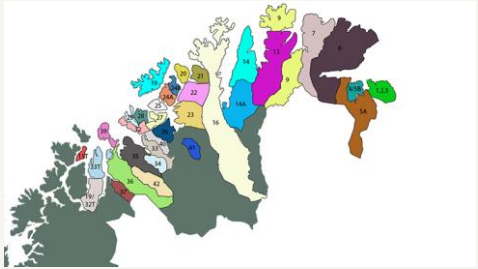
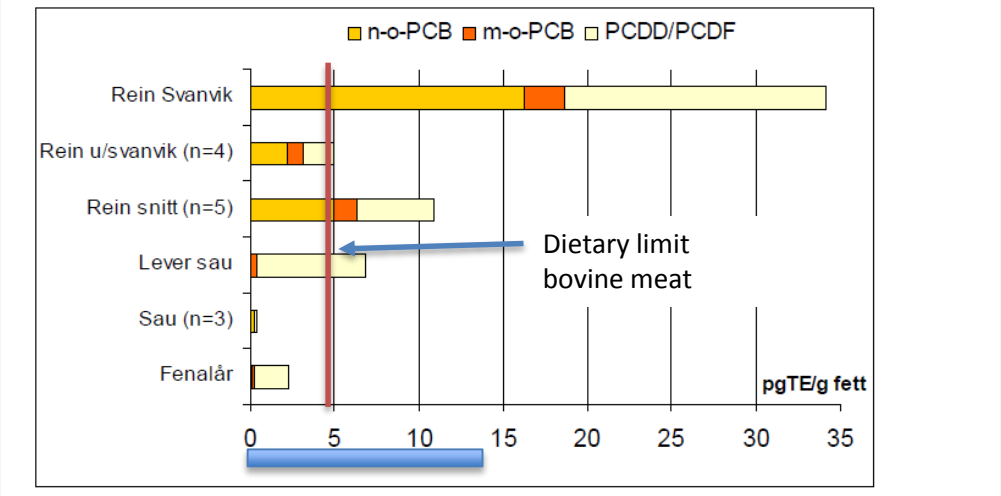
Results reindeer and moose

- Low levels of metals in reindeer (n = 16) and moose (n = 11) samples. No geographical trends.
- Low levels of PCBs and HCB in reindeer samples (n = 3).
- Elevated dioxin/furan levels in reindeer meat:
  - 9.9 to 13.6 pgTE/g lw

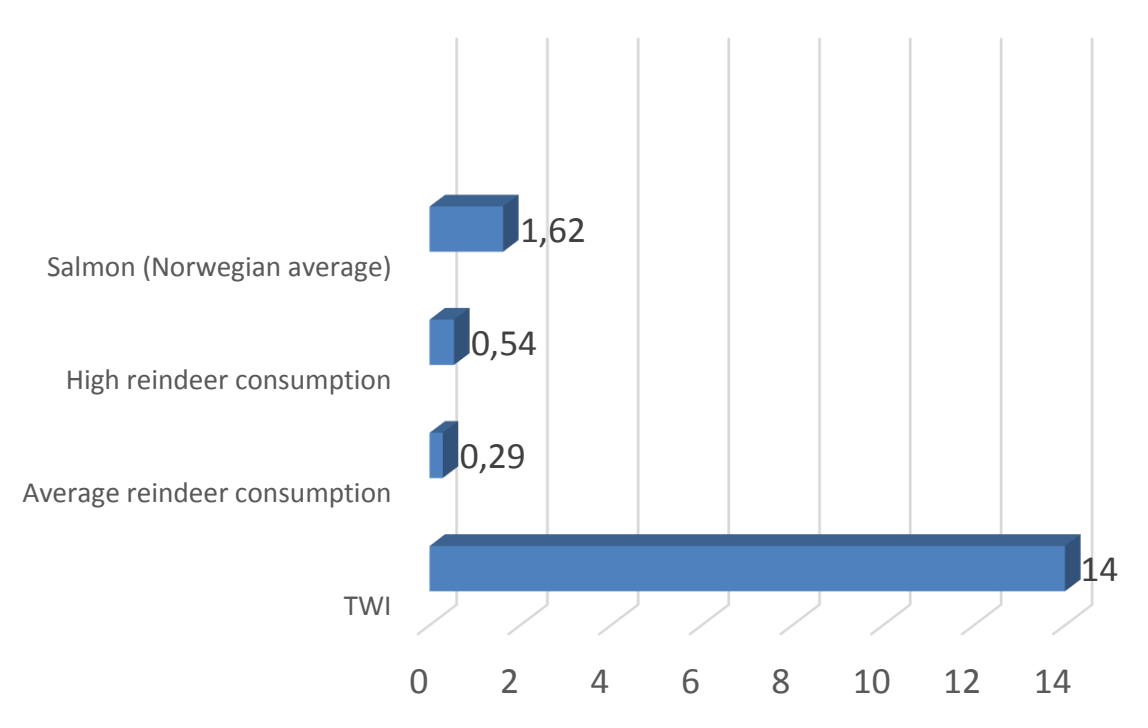
Source??





Reindeer from Pasvik 2014

High levels does not always mean high exposure



Preliminary conclusions

- Geographical differences in concentrations of Ni, Cu and Co in mushrooms and berries, with the area northeast of the Nikel refinery showing elevated concentration.
  - *Probably* low risk related to human consumption. A more comprehensive risk analyses will be performed.
- Elevated levels of other metals (Cd, Pb, Hg) in some samples, but no geographic trends.
- Low levels of most metals, PCBs, HCB and dioxins/furans in freshwater fish.

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Preliminary conclusions

- Low levels of metals in reindeer and moose.
- Low levels of PCBs and HCB in reindeer.
- Elevated levels of dioxins/furans (TE/g lipidweight) in reindeer meat from Norway.
  - Probably low risk related to human consumption.
  - May be a risk for families that consume high amounts of reindeer meat.




Thank you for your attention!