PhytoMilk

Potential improvement of the salutary effect of organic dairy milk by forage species and by supplementation

Anne-Maj Gustavsson, SLU, Sweden

Anne-Maj.Gustavsson@njv.slu.se

Short about our project

Anne-Maj.Gustavsson@njv.slu.se

Recent research:
”There is a number of ingredients in milk that may be salutary (healthy)”

Bioactive components are for example:

- Fatty acids (omega-3, omega-6, CLA)
- Vitamins
  - Carotenoids (Vitamin A)
  - Tocopherols (Vitamin E)
- Phytoestrogens
- Endogenous hormones and growth factors (eg. estradiol, IGF-I and TGF-B)
- Low content of Selenium in organic Nordic milk – very little in the soil

Anne-Maj.Gustavsson@njv.slu.se

Organic milk

- Different from conventional milk :
  - Higher proportion of forages in the ration
  - Higher proportion of legumes and other herbs (not so much grass)
  - No mineral fertilizer
- Knowledge of the chemical and sensory characteristics are limited

▼Organic milk is more and differently affected by forage than conventional milk.

Anne-Maj.Gustavsson@njv.slu.se

We are going through the whole chain

- Forage and forage production
- Milk production
- Shelf stability
- Bioactive components

Anne-Maj.Gustavsson@njv.slu.se

We are studying the whole chain

- Forage crop and environmental conditions
- Different milk production systems
- Milk properties
  - Shelf stability
  - Biologic activity

Anne-Maj.Gustavsson@njv.slu.se

Experience with transnational research in this project

Anne-Maj.Gustavsson@njv.slu.se

Collaboration between 4 Nordic countries

- Dairy production is important in all Nordic countries
- Small countries
- Need to increase “the critical mass” for conducting high quality research
- Take advantage of the variation in sites and disciplines
- Use common research facilities as much as possible - one lab

Anne-Maj.Gustavsson@njv.slu.se

Collaboration between 4 Nordic countries

- The PhD students naturally get an international network of scientific groups to visit
- The PhD students have own scientific and social meetings

Anne-Maj.Gustavsson@njv.slu.se

We are scientists from many disciplines

- Crop Science
- Animal Science
- Chemistry

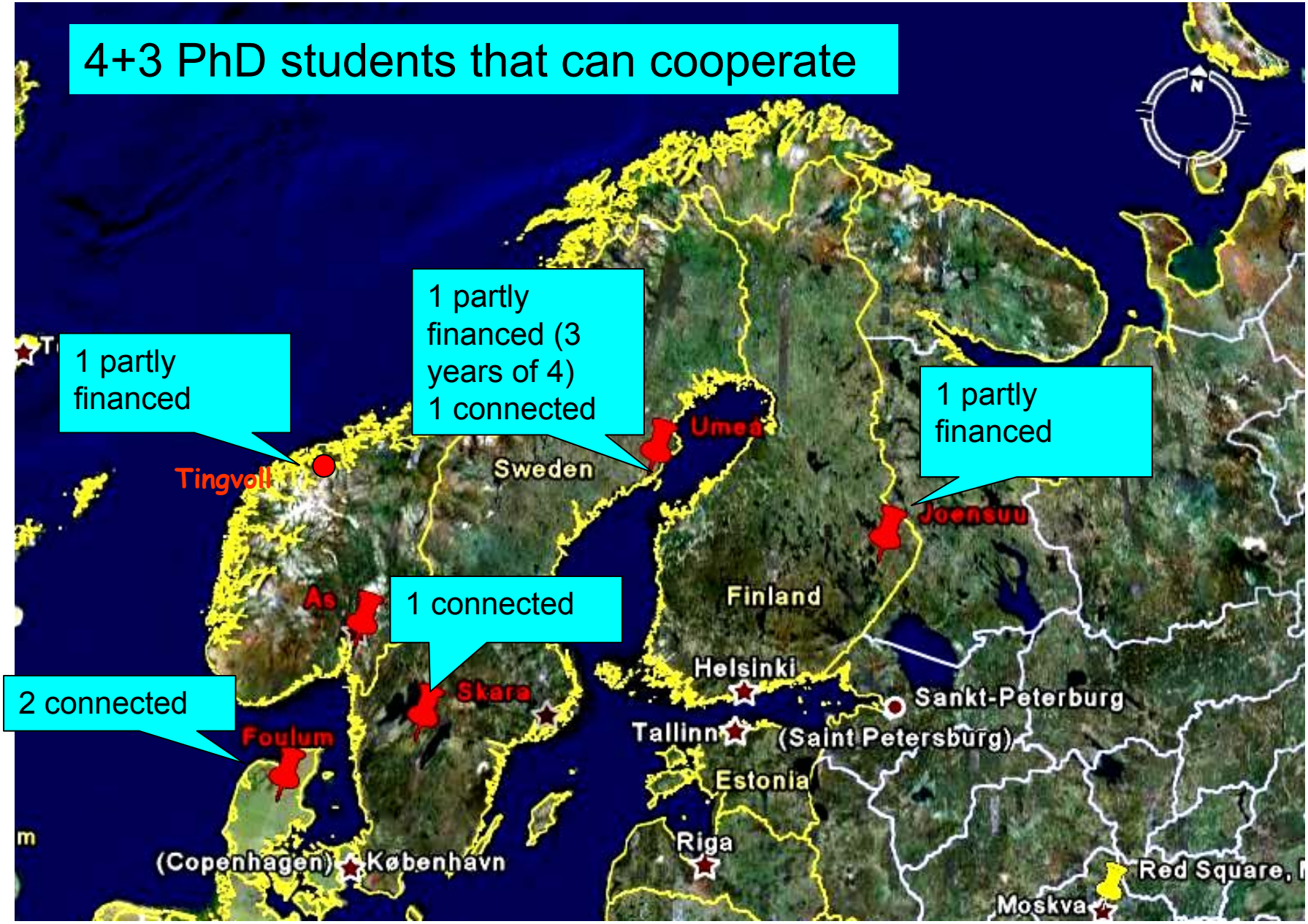
Its easy to be a project leader for this group. Everyone works for the common target.

Very good group for feedbacks on ideas.

Broader network of researchers with different skills to discuss plans and carrying out of experiments.

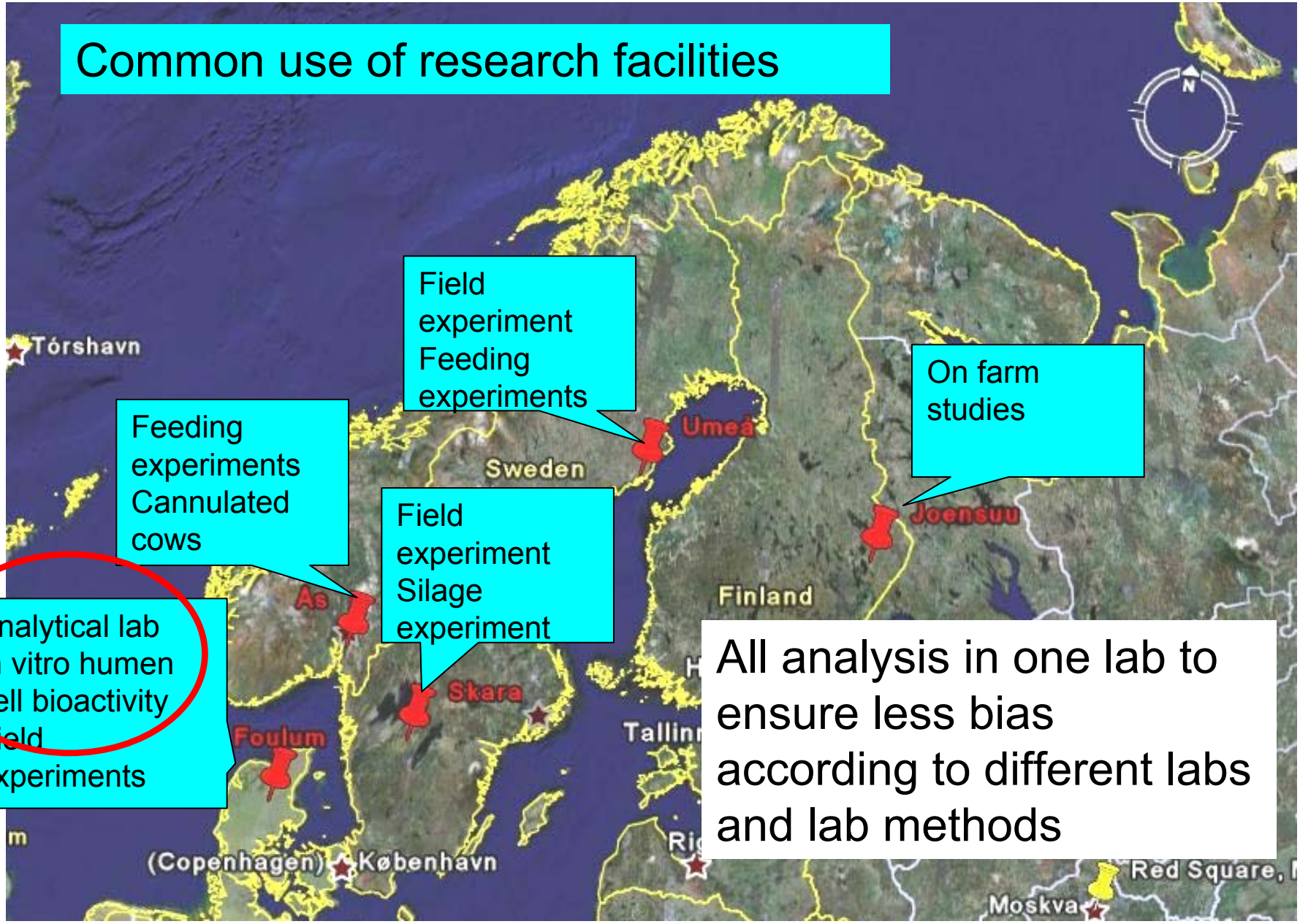
We really use the email system!

Anne-Maj.Gustavsson@njv.slu.se



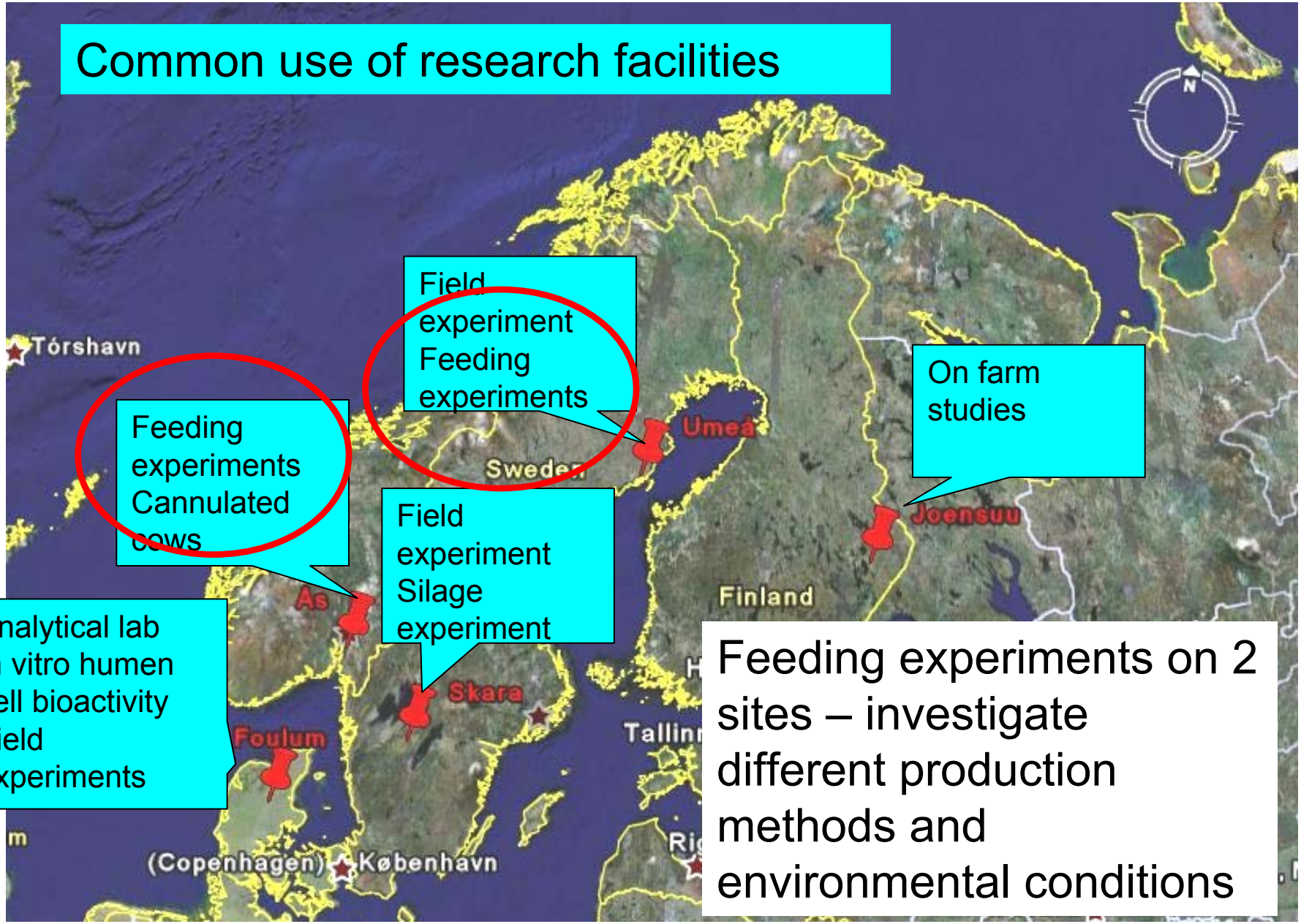
Anne-Maj.Gustavsson@njv.slu.se

Common use of research facilities



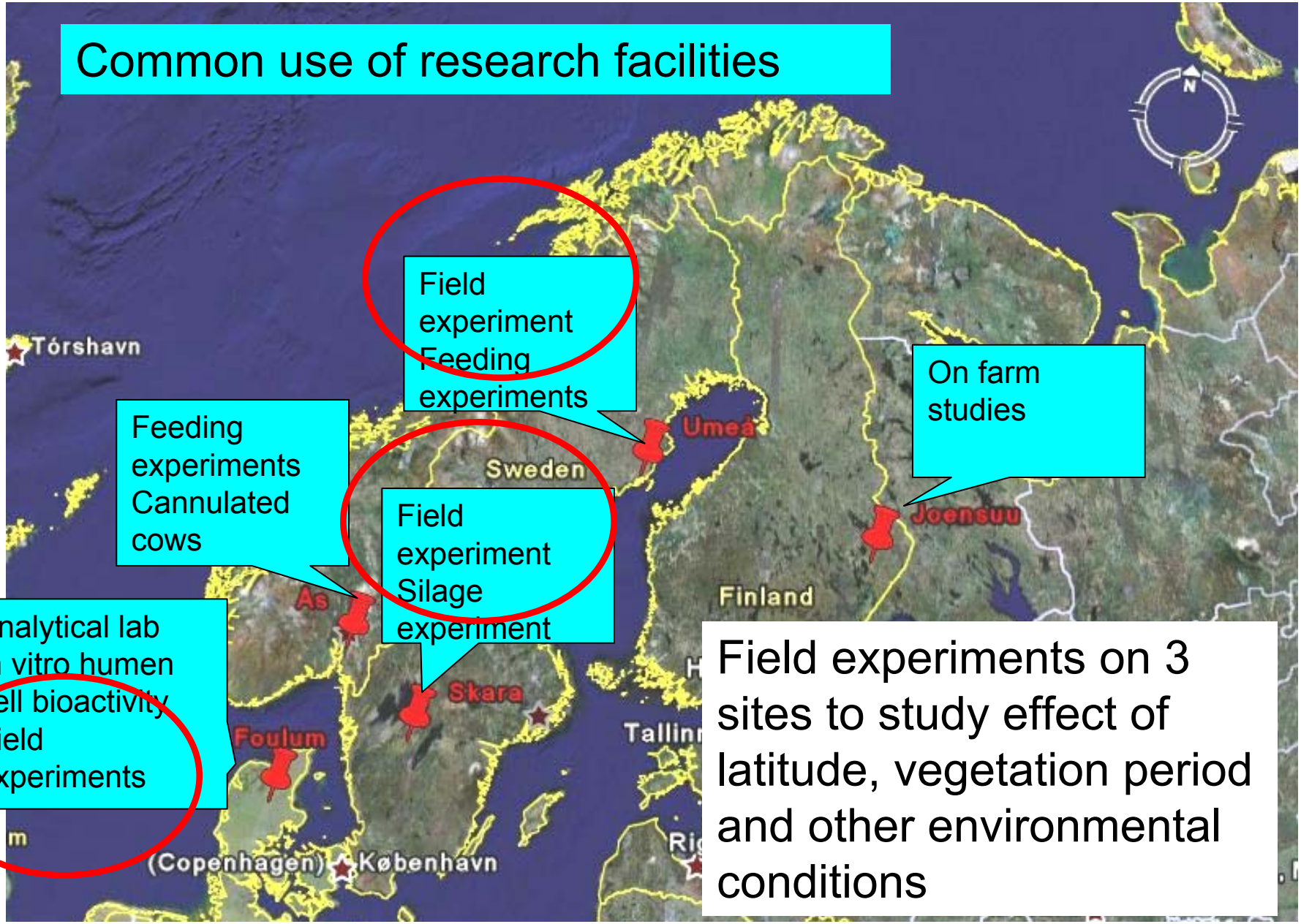
Anne-Maj.Gustavsson@njv.slu.se

Common use of research facilities



Anne-Maj.Gustavsson@njv.slu.se

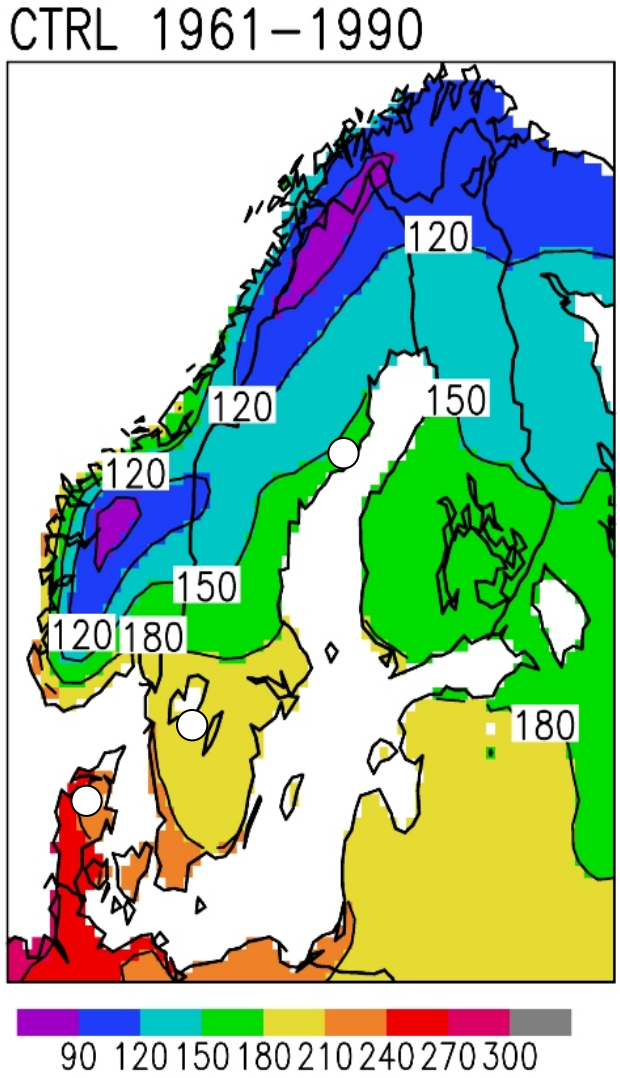
Common use of research facilities



Field experiments on 3 sites to study effect of latitude, vegetation period and other environmental conditions

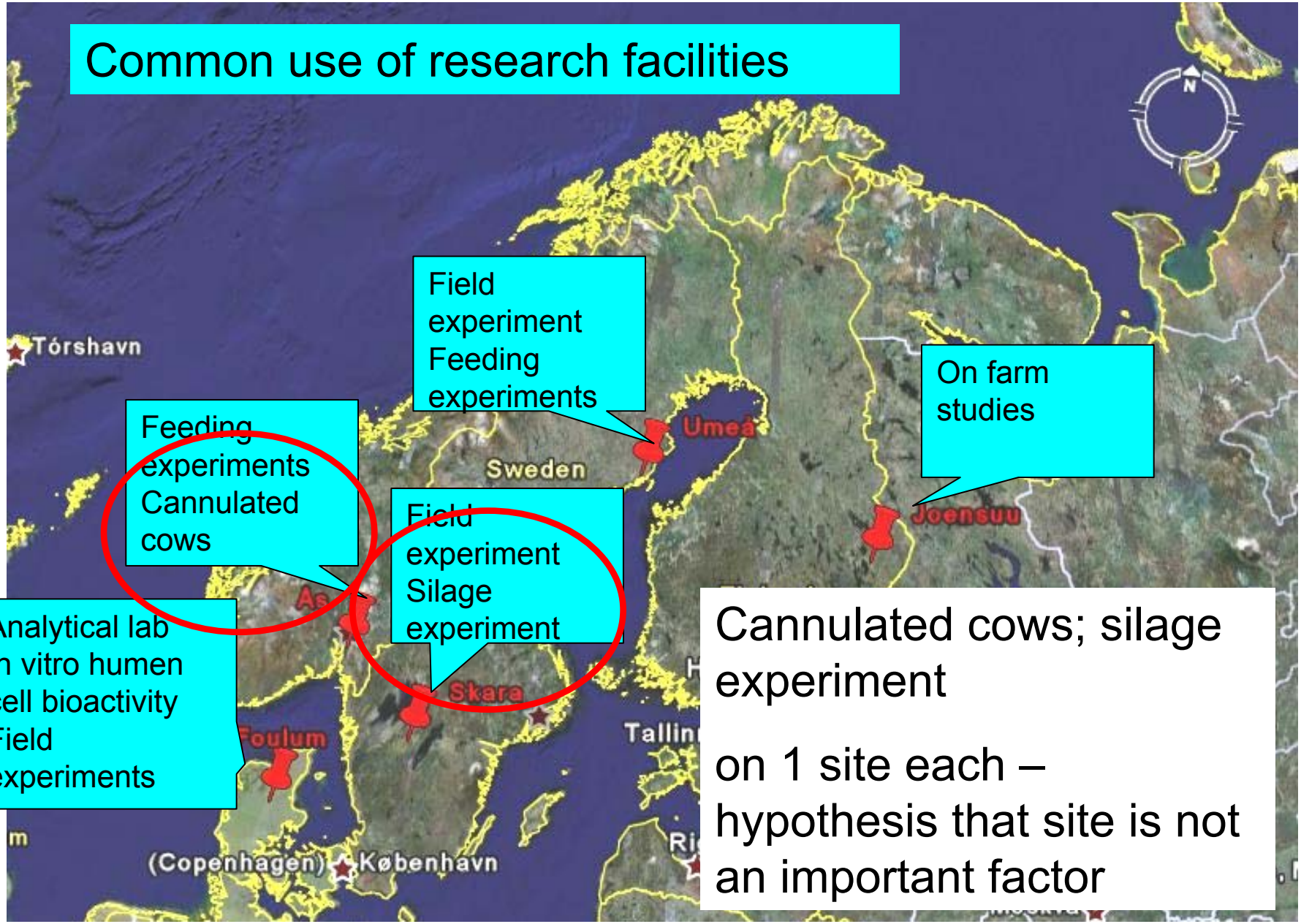
Anne-Maj.Gustavsson@njv.slu.se

Effects of latitude and harvest time



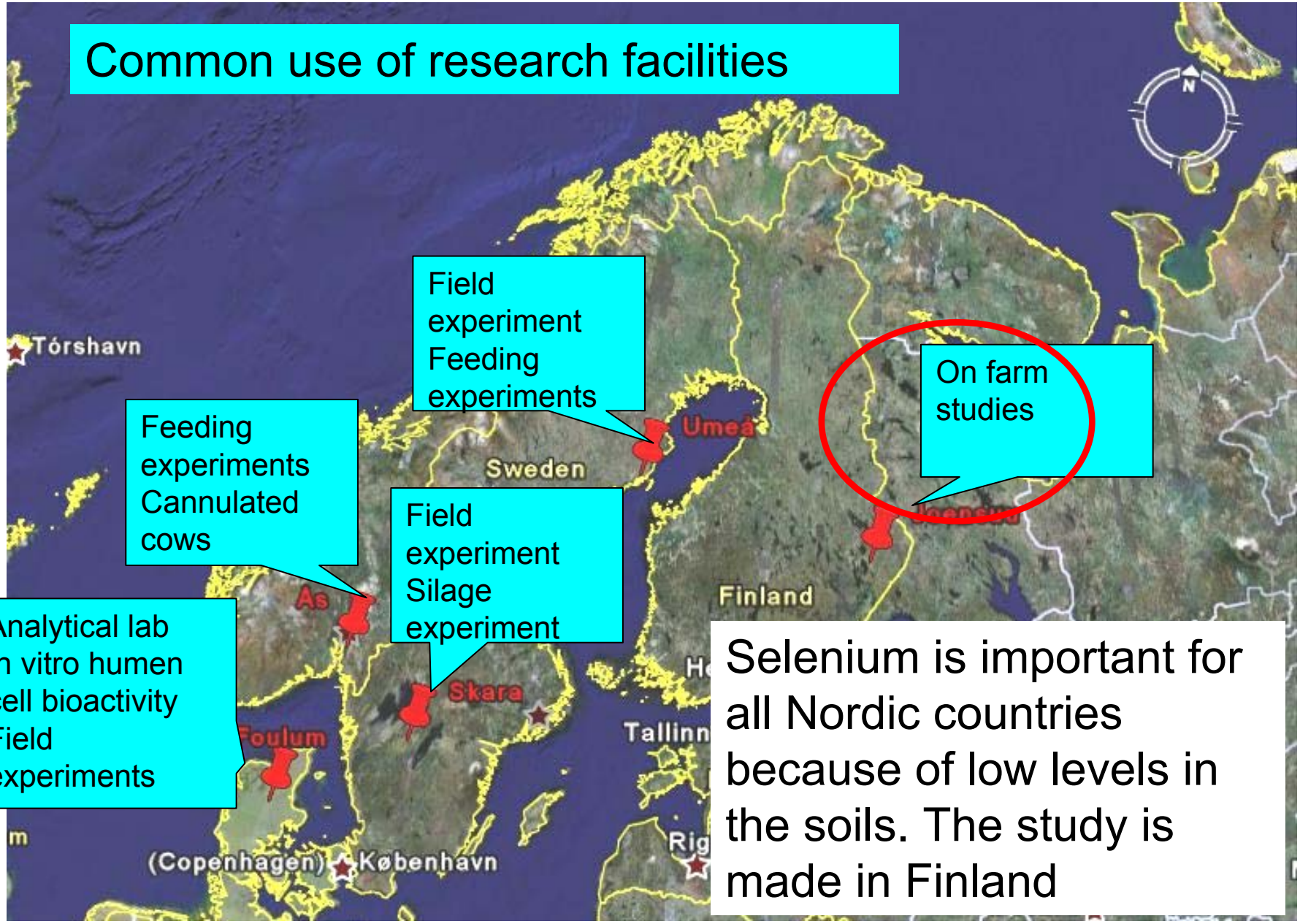
Anne-Maj.Gustavsson@njv.slu.se

Common use of research facilities



Anne-Maj.Gustavsson@njv.slu.se

Common use of research facilities



Anne-Maj.Gustavsson@njv.slu.se

We can explore the differences between the countries

Anne-Maj.Gustavsson@njv.slu.se

Different production systems – feeding experiment

Sweden:

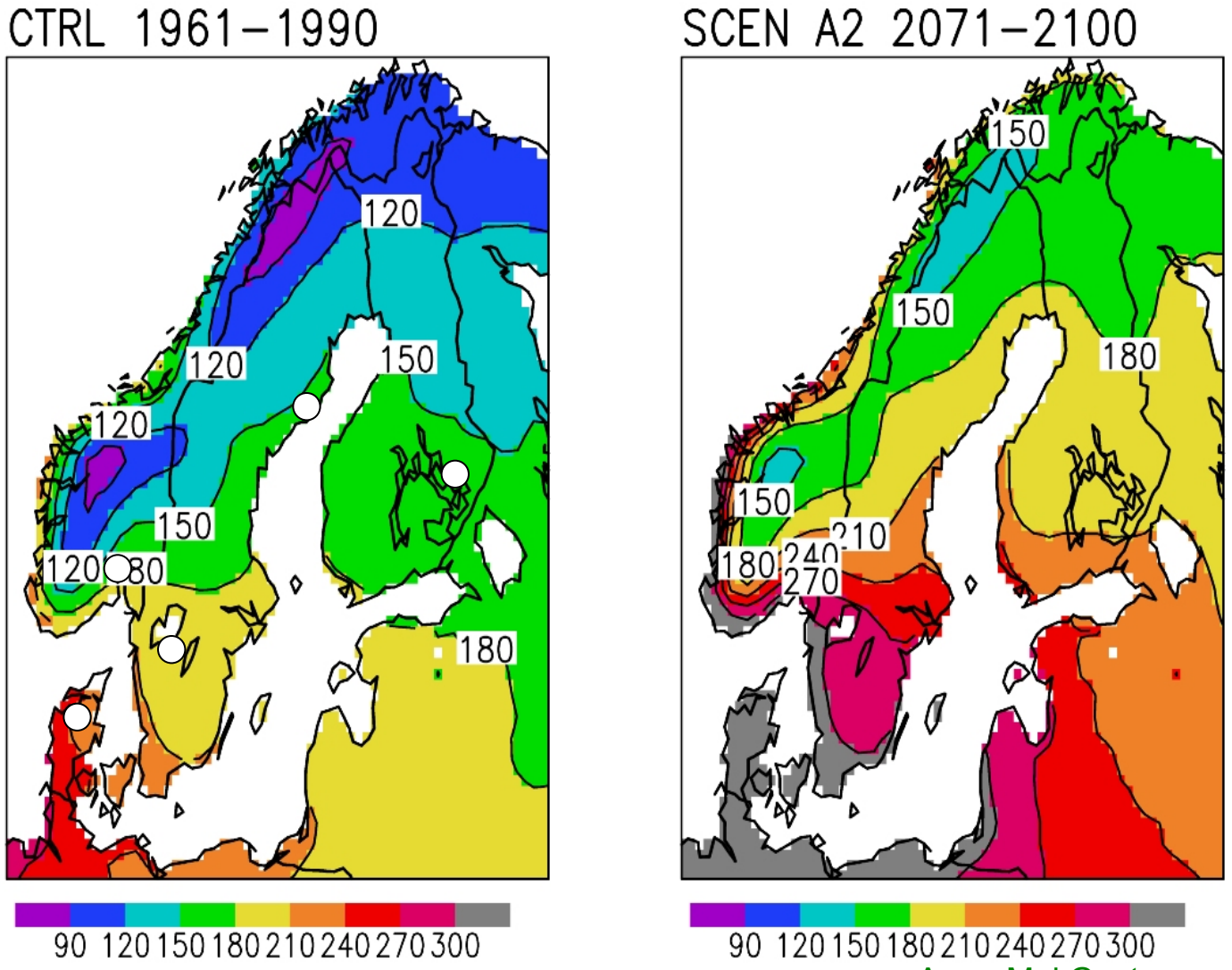
- More intensive production system
- Short term rotational leys

Norway

- Less intensive system
- Long-term leys with higher proportion of non red clover herbs are common

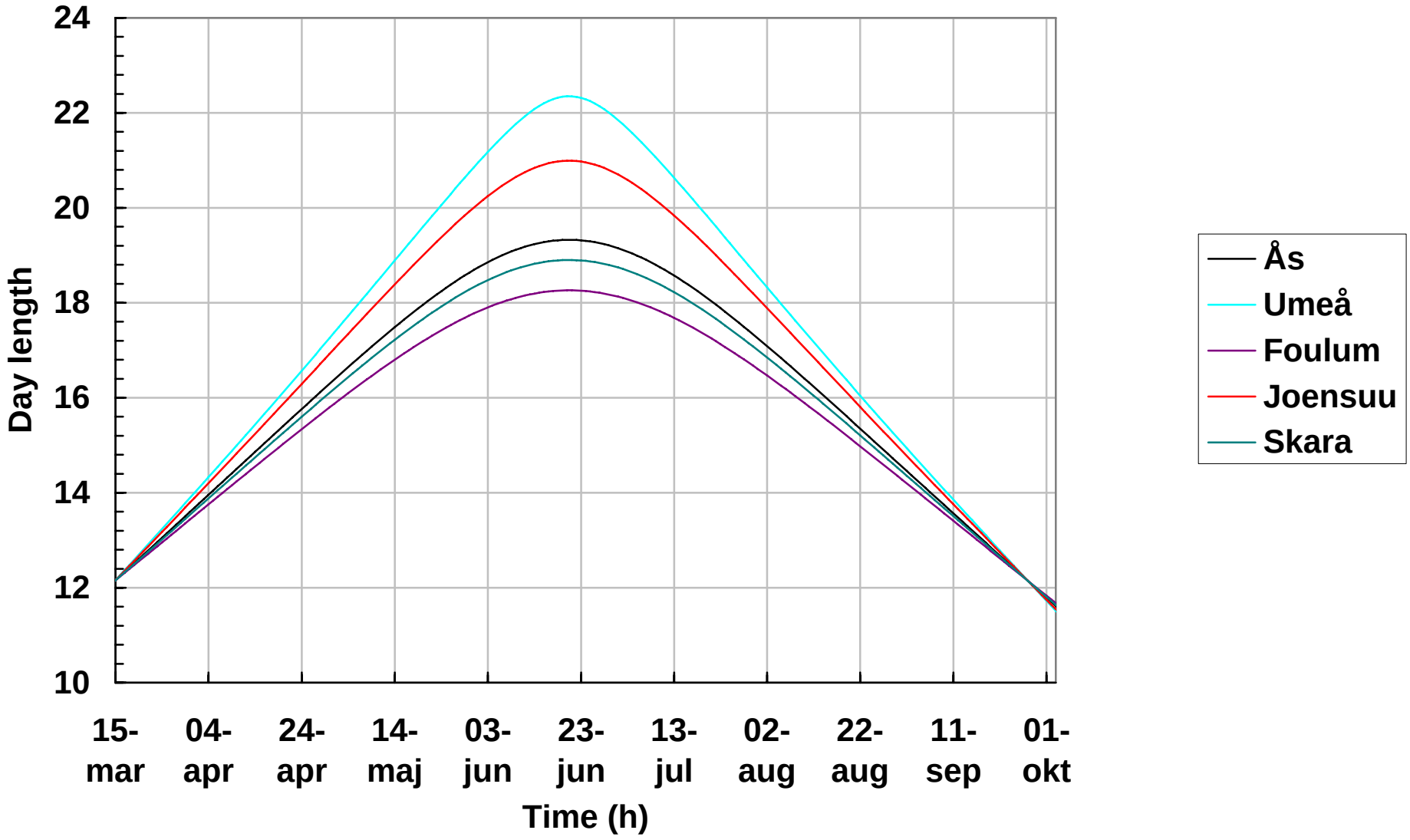
Anne-Maj.Gustavsson@njv.slu.se

Vegetation period



Anne-Maj.Gustavsson@njv.slu.se

Day length



Anne-Maj.Gustavsson@njv.slu.se

Basis for both farming management and dietary recommendations

Anne-Maj.Gustavsson@njv.slu.se

Objectives of the project - 6 hypothesis

Anne-Maj.Gustavsson@njv.slu.se

Objectives of the project - 6 hypothesis

High proportion of red clover yields milk with:

- higher proportion of n-3 fatty acids and CLA
- higher content of phytoestrogens
- lower oxidative stability

than milk produced on herbage from:

  - long-term grasslands with natural herbs (Norway)
  - grasslands with birds foot trefoil (*Lotus corniculatus*) and grass (Sweden)

Anne-Maj.Gustavsson@njv.slu.se

Preliminary results:
Pastures with high red clover proportion gave milk with:

- Higher proportion of C18:0 and C18:1-trans-11
- Lower proportion of C16:0
- Higher concentration of α-tocopherol
- Phytoestrogens are not yet analysed

Red clover did not:

- Give higher proportion of n-3-FA and CLA
- Reduce lipid oxidative stability of the milk

Silage feeding experiments

- The experiments have been conducted both in Sweden and in Norway
- All milk and forage samples are in Denmark for analysis
- Annika Höjer has been 6 weeks in Denmark helping with analysis (came home last week)
- Steffen Adler has also been in Denmark making analysis (mostly the grazing experiment)
- No results of the analysis yet

Biohydrogenation of fatty acids in the rumen

- The effect of non-clover herbs in grass silage on the fatty acids composition of milk fat is due to partly inhibition of rumen biohydrogenation

This experiment with cannulated cows is postponed and will be run from November 2009 to February 2010

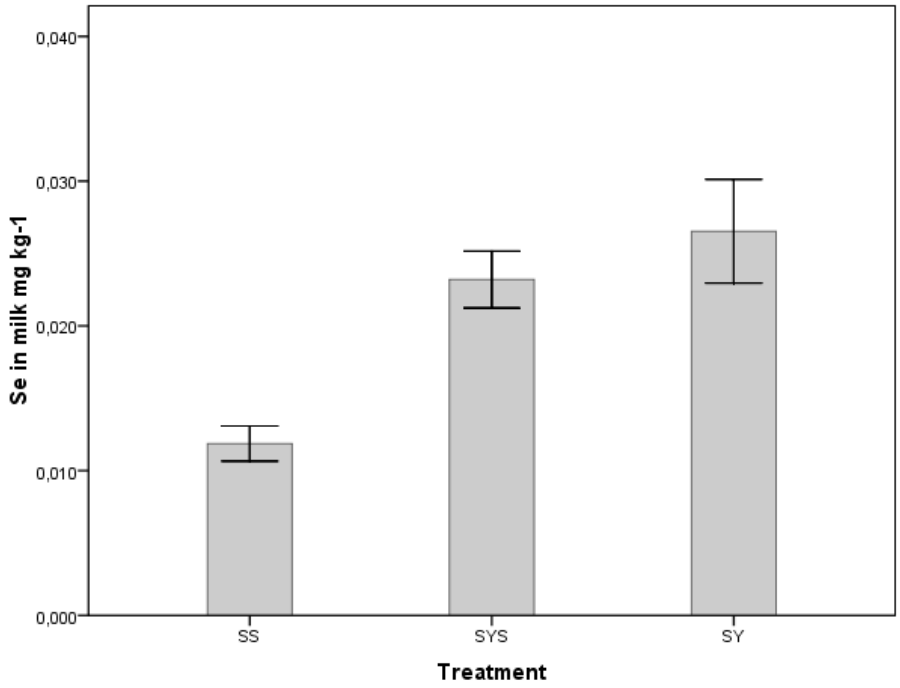
Anne-Maj.Gustavsson@njv.slu.se

Organic selenium

- Organic Se supplementation will:
  - increase milk Se concentration
  - decrease somatic cell number
  - improve milk oxidative stability

Anne-Maj.Gustavsson@njv.slu.se

Replacing mineral Se partly or totally with organic Se increased milk Se concentration in the milk



Mineral Se

50 % of each

Organic Se

Se experiment - preliminary results

- Replacing mineral Se partly or totally with organic Se, increased milk Se concentration in the milk
- Somatic cell number was not affected by Se form
- Milk stability could not be measured because the method did not work

Latitude and weather

- The fatty acid composition and phytoestrogen concentration of organically managed forage grass and legumes are affected by latitude and weather conditions

All experiments are conducted on all three sites for two years.

The chemical analysis on FA composition, vitamins and phytoestrogens will be done in autumn 2009.

Anne-Maj.Gustavsson@njv.slu.se

The ensiling process

- The choice of silage preservation methods will affect the fatty acid composition and carotene and tocopherol content of the silage

The experiment is conducted.

The chemical analysis on FA composition, vitamins and phytoestrogens will be analysed this spring and autumn.

Anne-Maj.Gustavsson@njv.slu.se

Biological activity of the milk

- There is biological activity of the collected dairy milk samples from the Nordic countries on normal and cancer cells

Milk samples from the grazing experiment, the two silage feeding experiment and the Se experiment are collected.

In vitro cell based models to assess the biological activity in specific human tissues will be used. Selected samples will be tested this spring.

Anne-Maj.Gustavsson@njv.slu.se

Deliveries - Common articles

- Compare long term and short term leys
- Compare short term red clover with birdsfoot trefoil
- Compare short term red clover, different production systems
- Biodehydrogenation
- Effect of storage time and preservation
- Effect of latitude and harvest time
- Biological activity in milk
- Effects of vitamins and Se on oxidation stability of organic milk
- Effects of Se supplementation on tank milk quality

Anne-Maj.Gustavsson@njv.slu.se

Selenium farm study

Deliveries - Common articles

- Compare long te
- Compare short te
- Compare short te systems
- Biodehydrogenat
- Effect of storage
- Effect of latitude
- Biological activity
- Effects of vitamin organic milk -
- Effects of Se supplementation on tank milk quality

Our first article, the manuscript has been submitted !

Anne-Maj.Gustavsson@njv.slu.se

Feeding experiment

veries - Common articles

- Compare long term and short term leys
- Compare short term red clover with birdsfoot trefoil
- Compare short term red clover, different production systems
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible] organic milk
- Effects of Se supplementation on tank milk quality

Two PhD students are working with the experiments.

Anne-Maj.Gustavsson@njv.slu.se

Cannulated cows

veries - Common articles

- Compare long term and short term leys
- Compare short term red clover with birdsfoot trefoil
- Compare short term red clover, different production systems
- Biodehydrogenation
- Effect of storage time and preservation
- Effect of latitude and harvest time
- Biological activity in milk
- Effects of vitamins and Se on oxidation stability of organic milk
- Effects of Se supplementation on tank milk quality

Anne-Maj.Gustavsson@njv.slu.se

Silage experiment

veries - Common articles

- Compare long term and short term leys
- Compare short term red clover with birdsfoot trefoil
- Compare short term red clover, different production systems
- Biodehydrogenation
- Effect of storage time and preservation
- Effect of latitude and harvest time
- Biological activity in milk
- Effects of vitamins and Se on oxidation stability of organic milk
- Effects of Se supplementation on tank milk quality

Anne-Maj.Gustavsson@njv.slu.se

Field experiment

Deliveries - Common articles

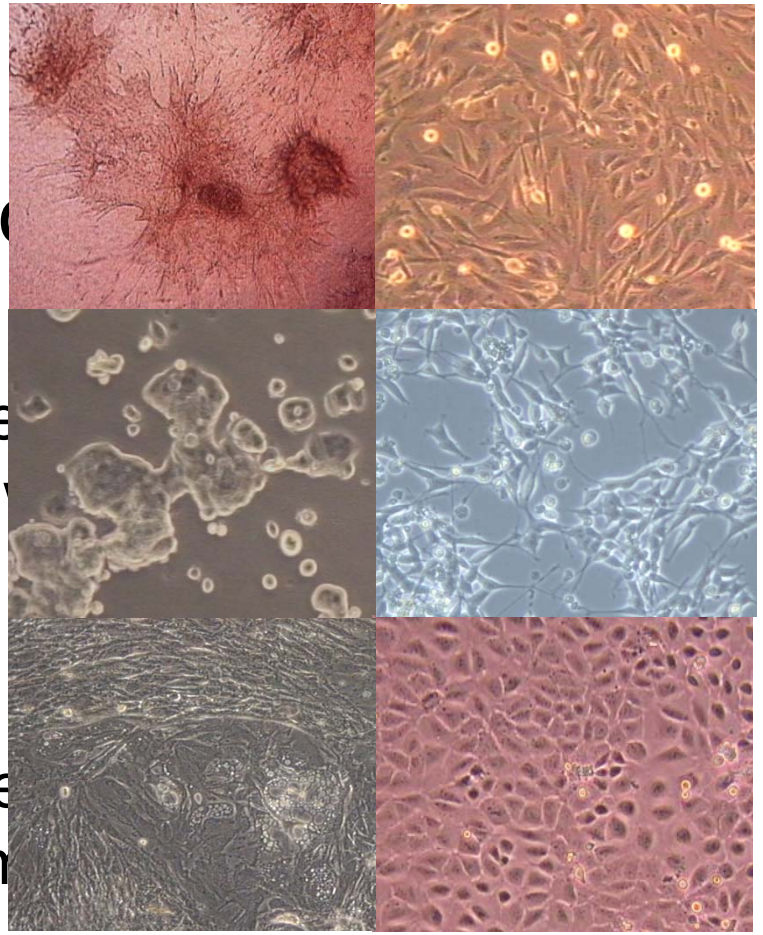
- Compare long term and short term leys
- Compare short term red clover with birdsfoot trefoil
- Compare short term red clover, different production systems
- Biodehydrogenation
- Effect of storage time and preservation
- Effect of latitude and harvest time
- Biological activity in milk
- Effects of vitamins and Se on oxidation stability of organic milk
- Effects of Se supplementation on tank milk quality

Anne-Maj.Gustavsson@njv.slu.se

In vitro cellbased human models

Normal and cancer cell lines

veries - Comm



- Compare long term and short te
- Compare short term red clover
- Compare short term red clover, systems
- Biodehydrogenation
- Effect of storage time and prese
- Effect of latitude and harvest tim
- Biological activity in milk
- Effects of vitamins and Se on oxidation stability of organic milk
- Effects of Se supplementation on tank milk quality

Anne-Maj.Gustavsson@njv.slu.se

New research ideas (1)

- Milk is a very interesting product - it contains a lot of interesting healthy substances -we need more knowledge about this
- Low cost feeding systems based on farm grown or near farm grown feeds are very important for our region
- Improve the use of the grassland for protein and energy feeding

Anne-Maj.Gustavsson@njv.slu.se

New research ideas (2)

- Vitamin D supplementation during long winters - should it improve the health
- Enzyme activity in forages during ensiling and rumen fermentation - we know very little about this (PPO*, lipases, proteases etc.)

*)The enzyme polyphenol oxidase (PPO) is important for prevention of lipolysis and proteolysis -we know very little about this

Anne-Maj.Gustavsson@njv.slu.se

Interesting for the further development of the organic sector

- Documented salutary effects of organic milk will increase the interest from the consumers
- The negative image of low Se organic milk can be changed with organic Se supplementation

Anne-Maj.Gustavsson@njv.slu.se