

# Diversity, and Health of the tundra

Terry Callaghan

*Royal Swedish Academy of Sciences,*

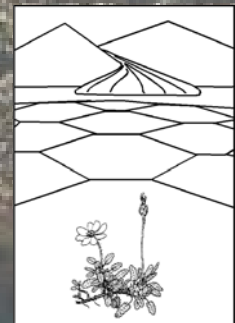
*Abisko Scientific Research Station*

*Sheffield Centre for Arctic Ecology, UK*

*University of Lund, Sweden*



CAFF



# Aims

To give an appreciation of what “biodiversity” means

To give examples of the importance of biodiversity

To explain why we should be worried about loss of biodiversity

To explain what we should do to reduce loss of biodiversity



# What is biodiversity?

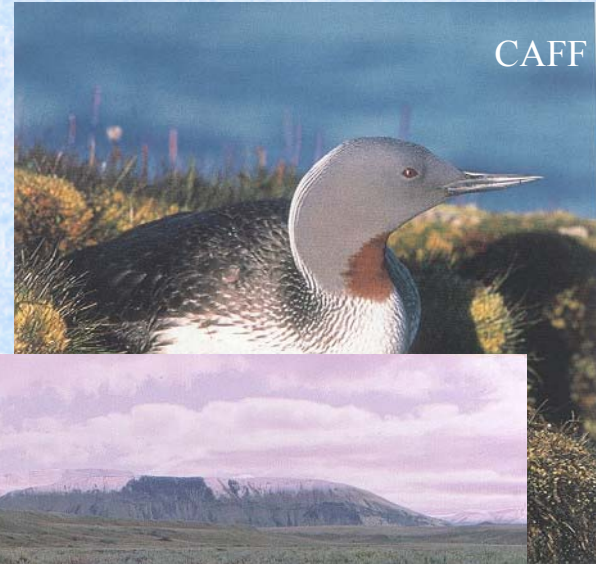
The abundance and variety of biological systems including:-

Genetic  
individuals

Species

Ecosystems  
and habitats

*Species richness and  
the abundance of species  
are important*



**Functional diversity** places the emphasis on roles of species such as producers, grazers, decomposers

# Roles and importance of Arctic biodiversity

Food - *cloudberries*

Fuel - *treeline timber*

Fibre - *shrub roots*

Fodder - *lichens*

“Pharmaceuticals” - *cyclosporin*

Tourism - *bird watching*

Function of ecosystems - *mosses such as bog moss*

Feedbacks to the climate system - *tundra versus taiga*

Future genetic recombinations and adaptation - *low temperature microbes*

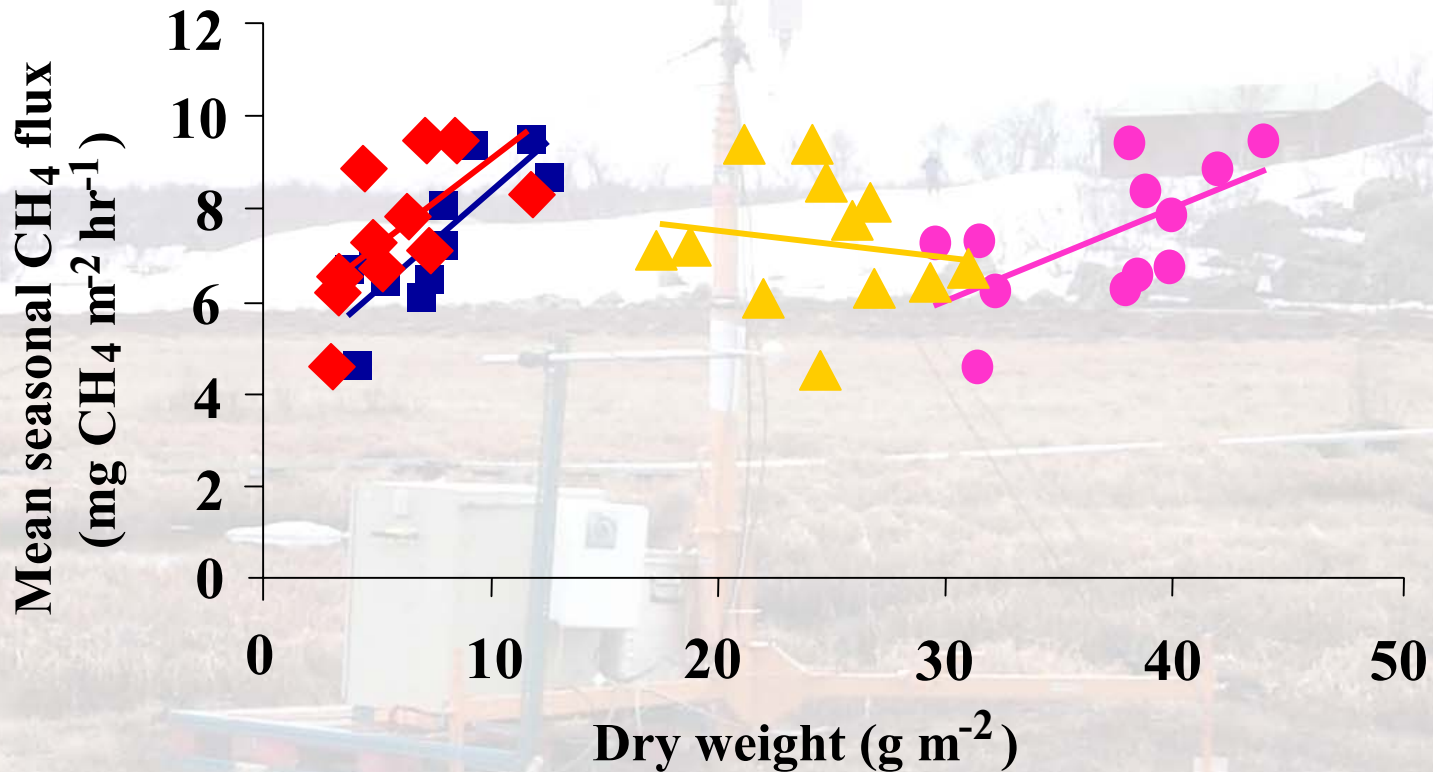


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Future surprises ????

# BIODIVERSITY AFFECTS GREENHOUSE GASSES

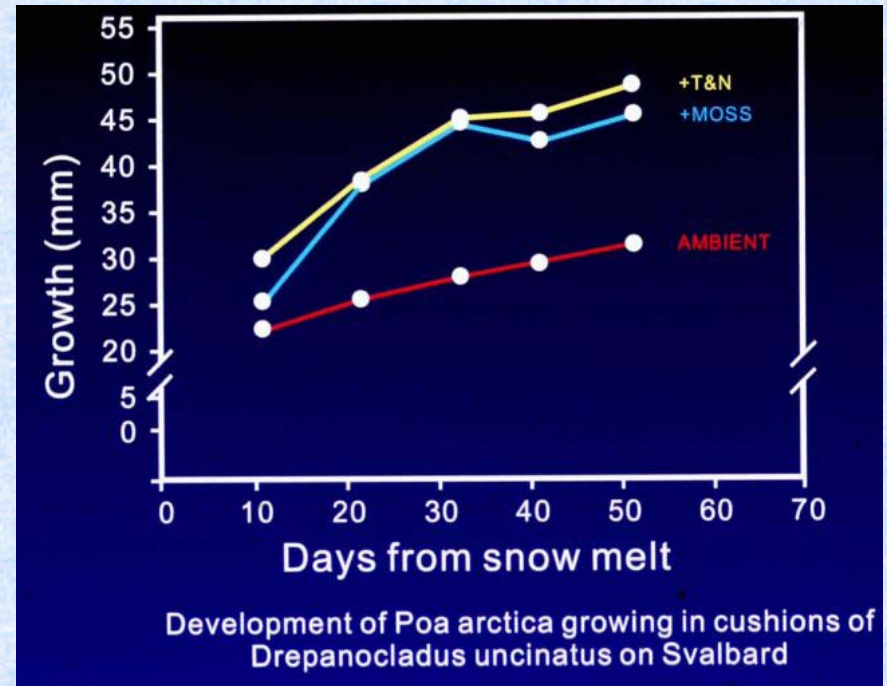
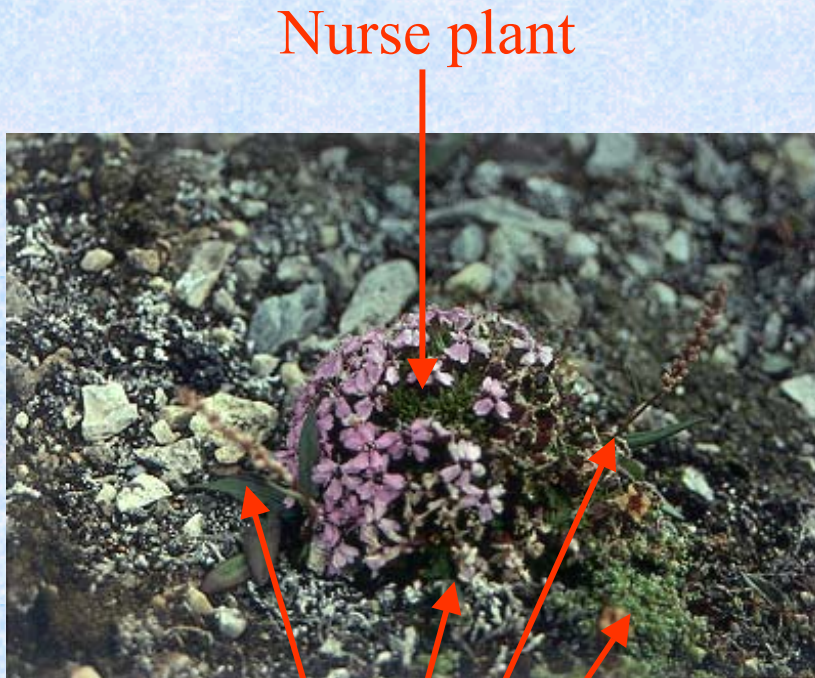
◆ *E. scheucheri*    ■ *C. subspathacea*    ▲ *D. psilosantha*    ● Total



Joabsson & Christensen. *Global Change Biology* 2001.

Some species have important effects on others,  
acting as “nurse plants”

They can help vegetation  
establishment after disturbance



But are very sensitive to  
invasion of competitors

# Biodiversity estimates for the Arctic are low when compared with world biota

modified from Matveyeva and Chernov in Nuttall and Callaghan (2000)

## Animals

Group	Number	% of world biota
Mammals	55	1.8
Birds	200	3.4
Insects	3000	0.3-0.4
Flies	1600-1800	1.0
Beetles	350	0.1
Springtails	400-500	2.0
Other groups	1600	---

## Plants

Flowering plants	1800	0.7-0.8
Mosses	780	5.7-7.0
Lichens	1300	5.0-6.5
Fungi	~5000	---

**Total estimate 6000-7000**

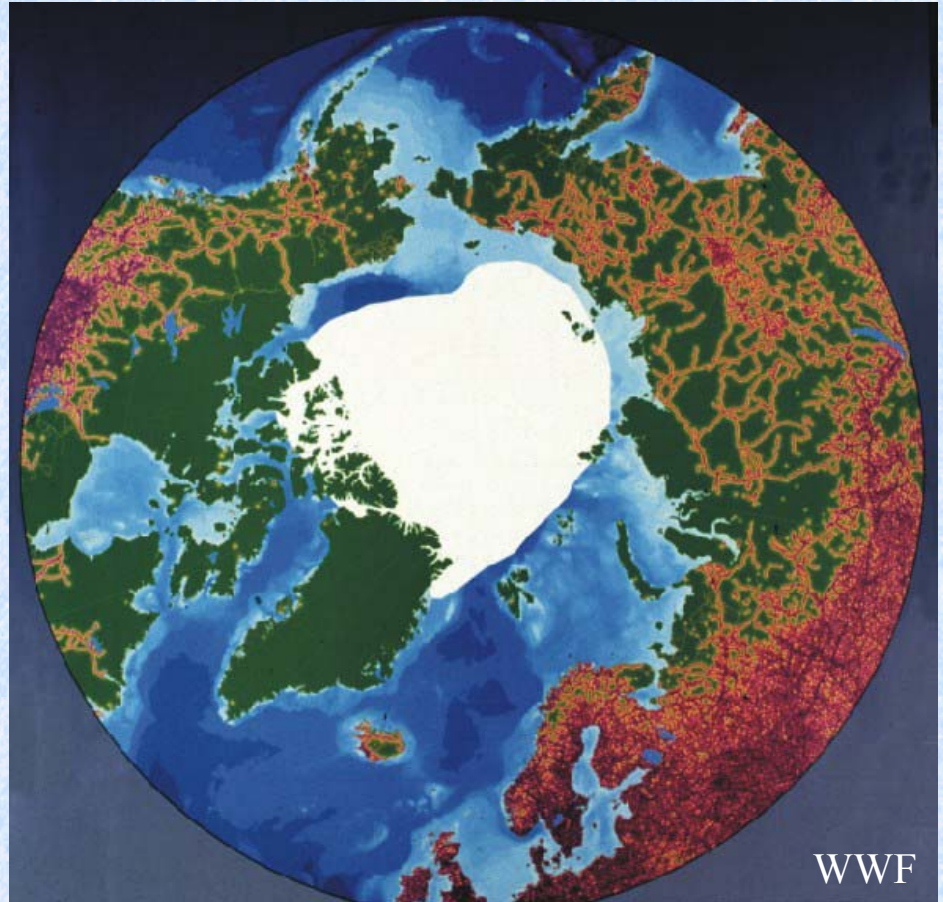




# Threats to Arctic biodiversity

## Human activities

*Fragmentation of habitat, extractive industries, hunting, fishing etc, over-exploitation of pastures, abandonment of agricultural land, tourism etc.*



# Threats to Arctic biodiversity

## Chemical contamination

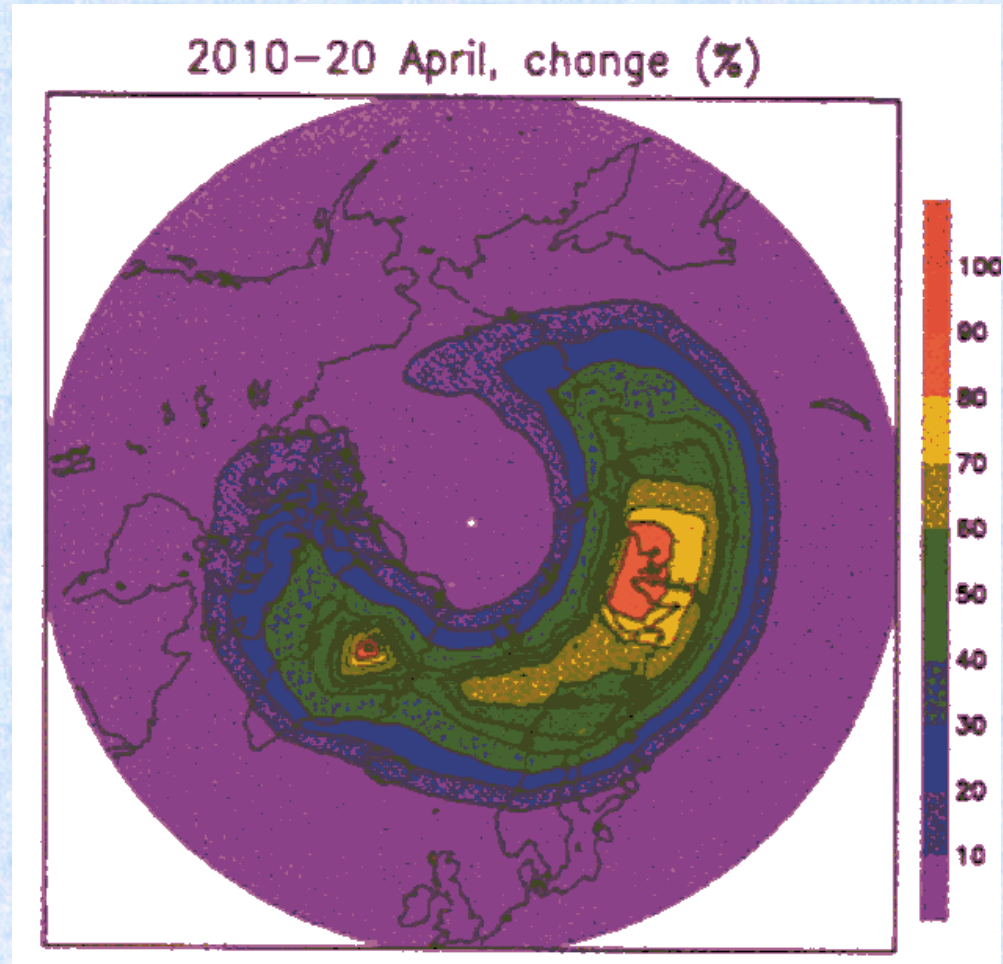
*AMAP has recorded contaminant levels in the Arctic but their impacts are often unknown. Atmospheric nitrogen deposition has a great potential to reduce the diversity of primitive plants, for example mosses in Iceland*



# Threats to Arctic biodiversity

## Ozone depletion

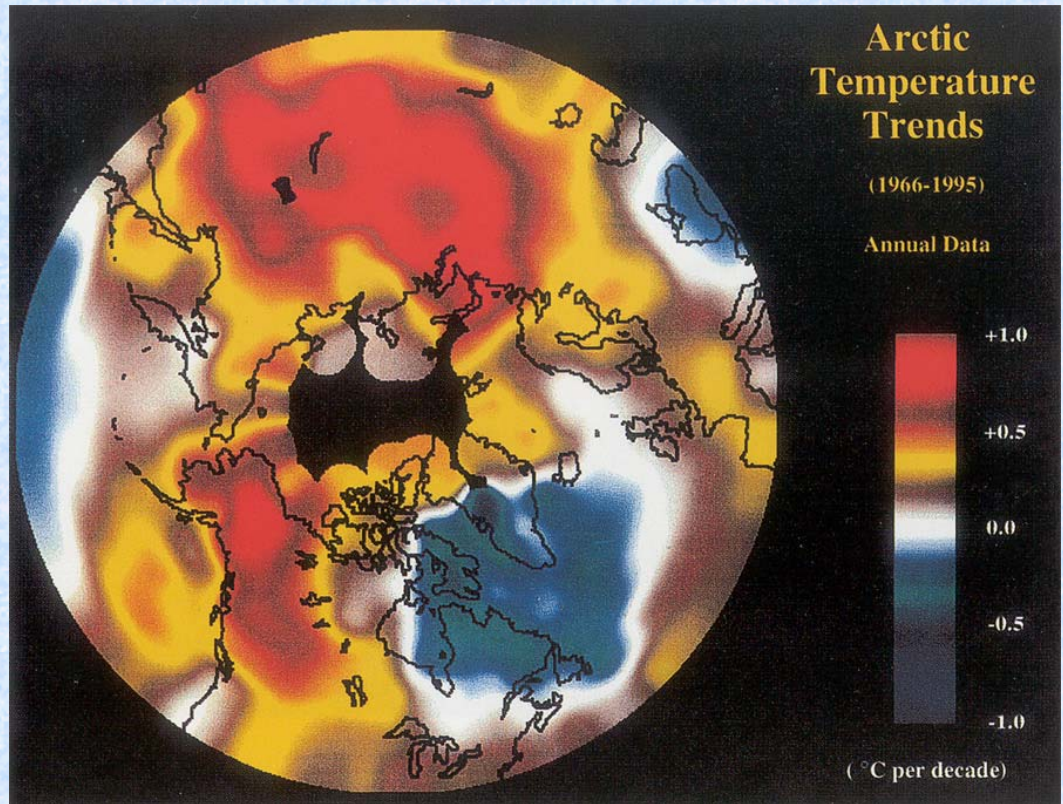
*Interactions between warming of the earth's surface and cooling of the stratosphere leads to continuing loss of ozone and increases in UV-B radiation.*



# Threats to Arctic biodiversity

## Climate change

*Amplification of global warming in the Arctic but local variability including cooling. Warming will be greatest in winter and in continental areas. Precip will change and disturbance(thermokarst, pests and fires) will increase*

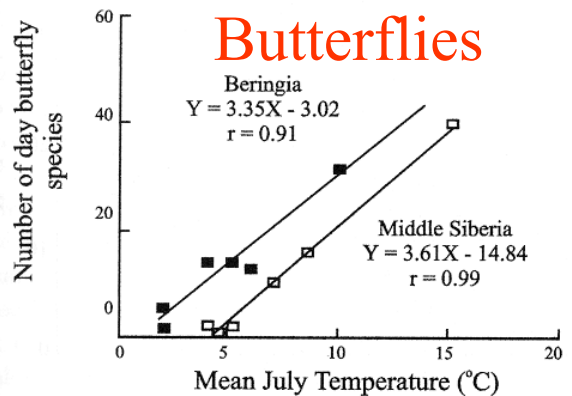
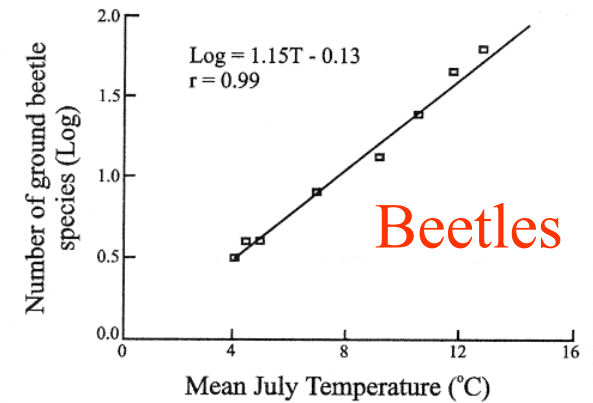
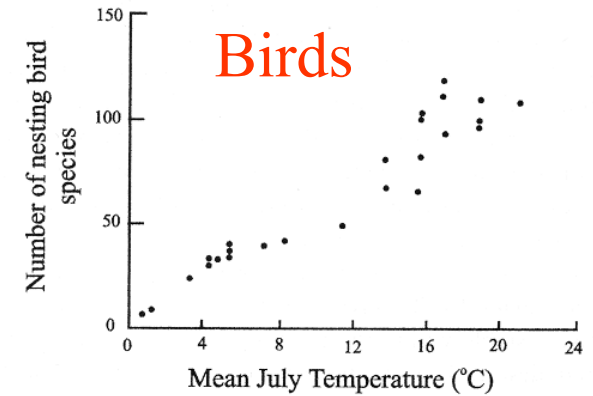


# Biodiversity is naturally low in the Arctic.....

....can we expect it to increase if the Arctic becomes warmer?

Species richness might increase, but the potential is less than earlier due to loss of biodiversity in the temperate regions and compression of the tundra:

some Arctic species might be lost



# Past climate warming = Extinction of many large animals and loss of habitat such as tundra steppes

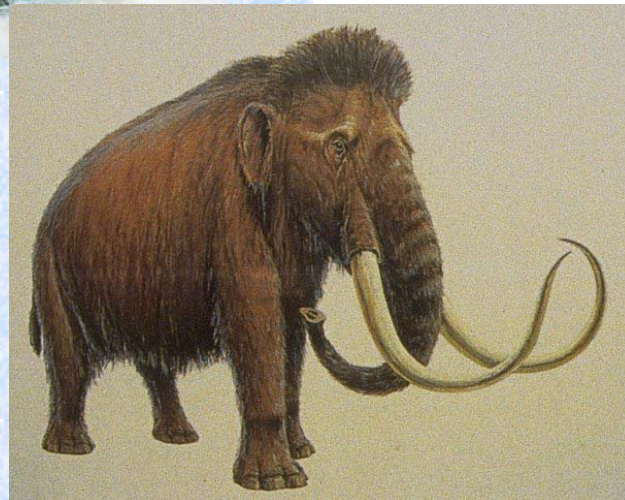


↑  
Woolly  
rhinoceros

← Giant elk



↑  
Sabre-toothed  
tiger



← Mammoth -  
extinct less  
than 6,000  
years ago!



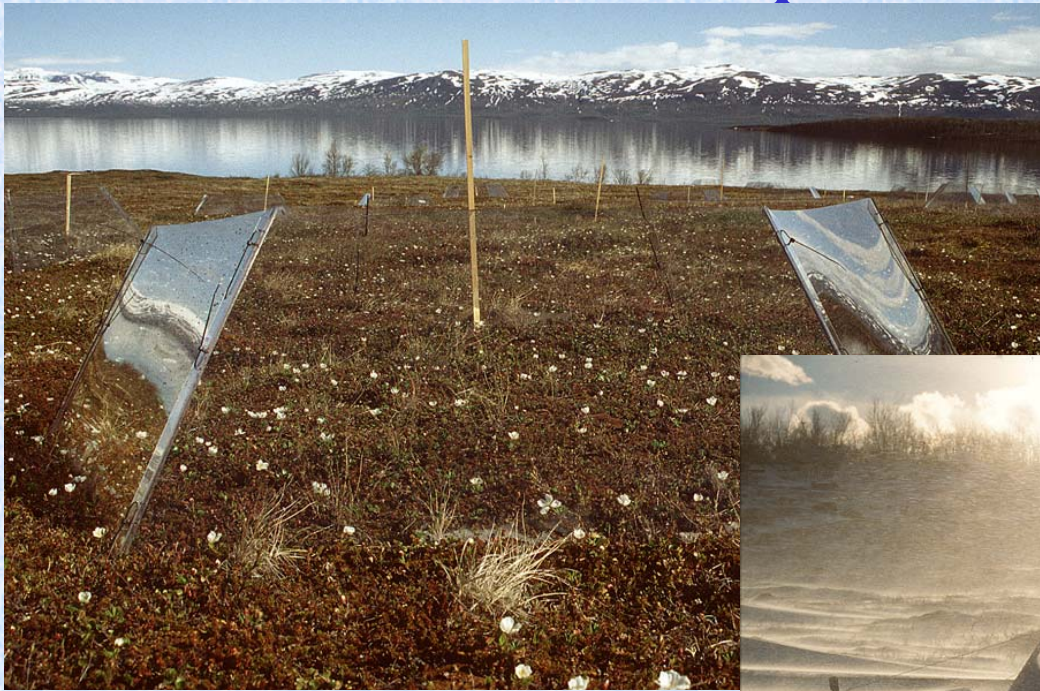
# What will become extinct in the Arctic during future warming?



Globally threatened species include 43 mammals, 16 birds, 12 fish and 73 plants



# Warmer summers and winters can enhance species performance

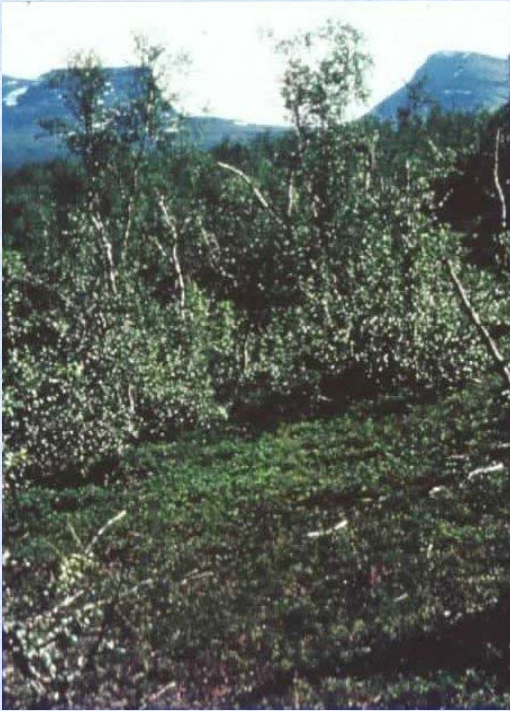


Increased cloudberry  
production in ITEX shelters

*Cornelissen et al.*



# Community structure and biodiversity will change firstly by changes in abundance of existing species



**Year 0**



**Year 2**



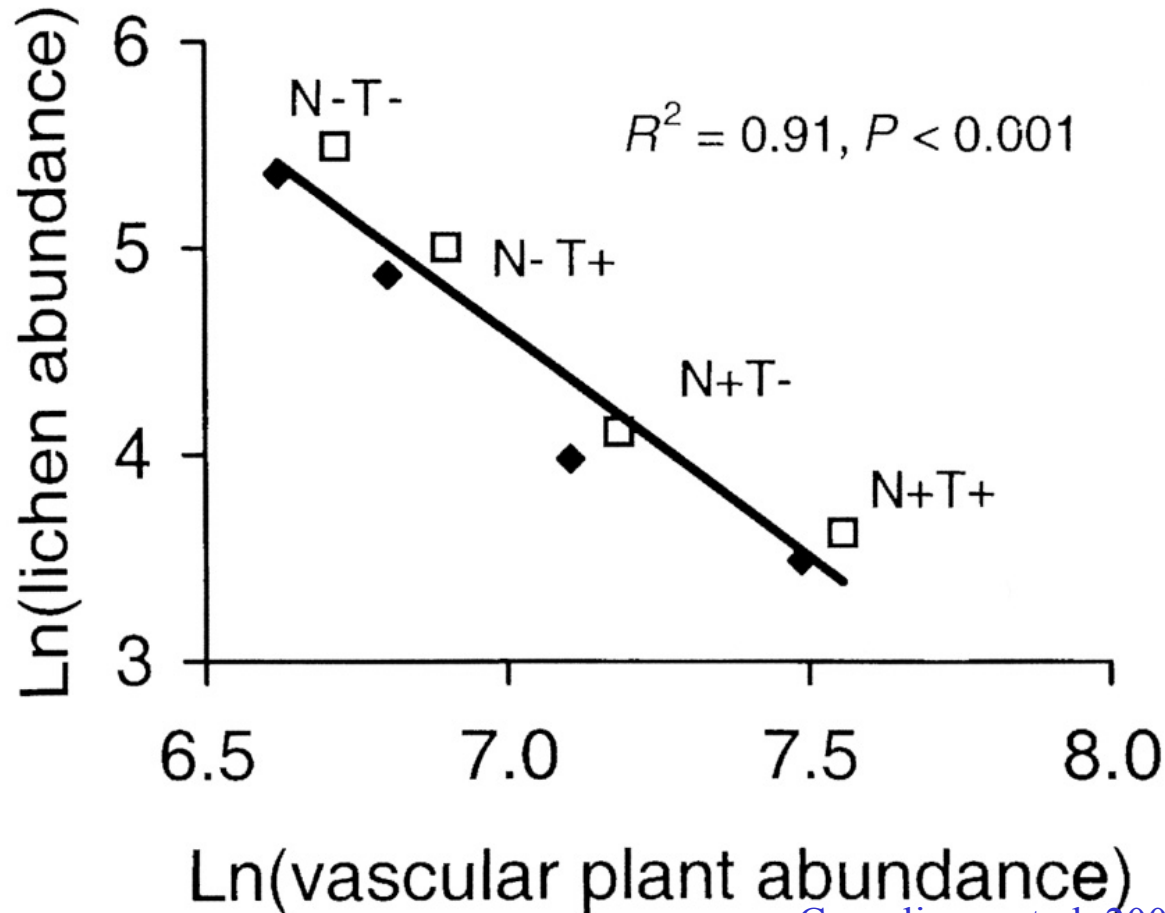
*(Press et al.)*

**Year 5**



*Species immigration is slower than species loss*

Slow but widespread changes within communities are easily over-looked because of focus on boundaries such as tree-lines



Cornelissen et al. 2002

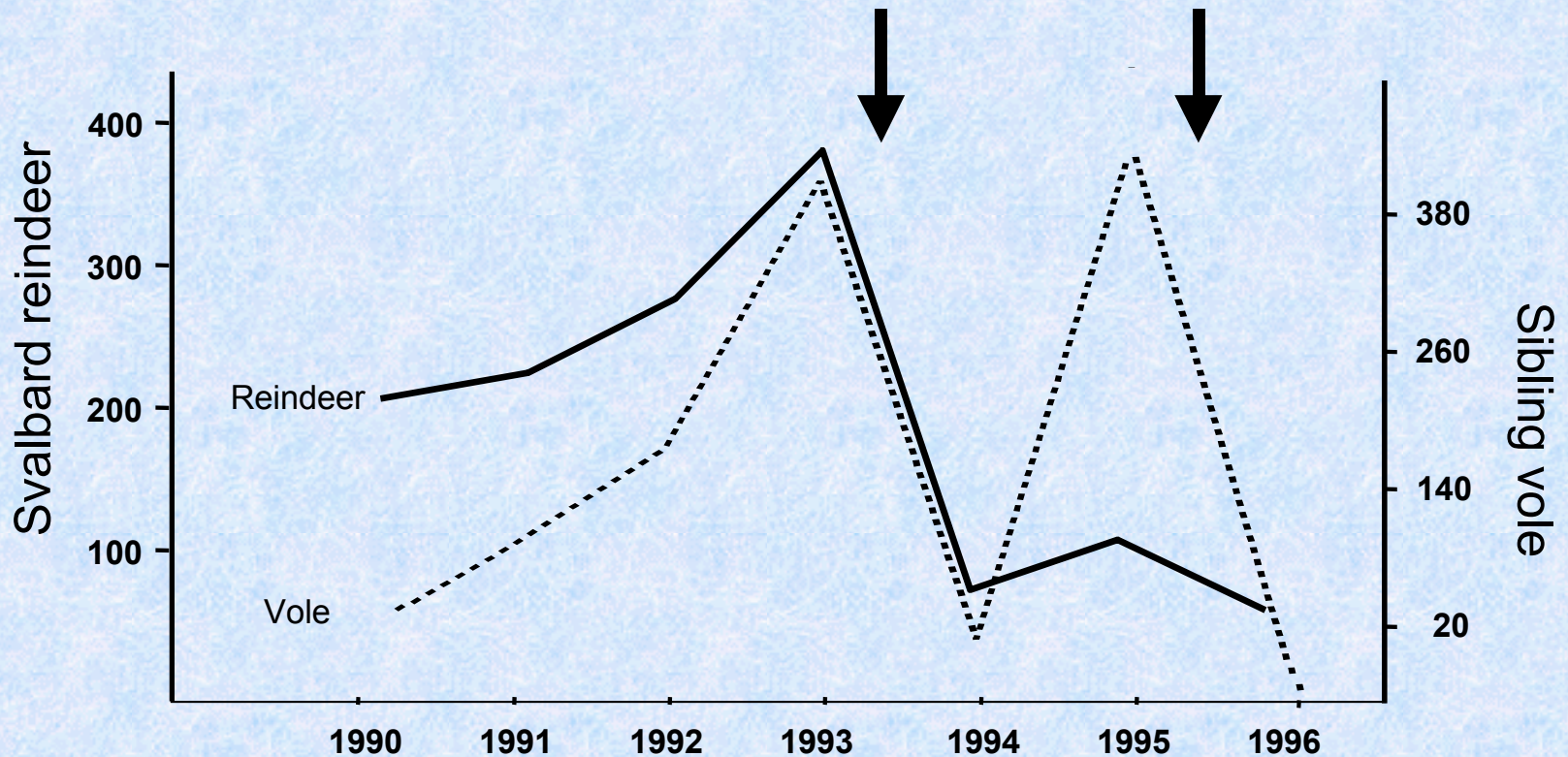


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Lichens are important as food for reindeer and they fix atmospheric nitrogen

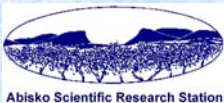
warmers winters and extreme events can reduce species performance and eventually biodiversity

Ice layer on the ground during winter



Population dynamics of reindeer and sibling voles on Svalbard

*Aanes et al. 1999, Yoccoz and Imms 1999*



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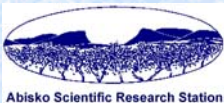
# We need to protect biodiversity by protecting habitats - and by being innovative

Farm land has been abandoned in Northern Norway, e.g. 1959-99

Loss of Farms	-32,000
Loss of Farmland	-34,000 ha
Loss of Cows	-42,000
Loss of Ewes	-205,000

Sheep and cows maintain diversity and prevent forest growth

Appropriate reindeer management can preserve diversity, inappropriate management can reduce it



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*Svein Eilertsson*

# Conclusions

Biodiversity is threatened in the Arctic by a variety of environmental change factors

We may lose red book and endemic species but also some widespread species

Although there will be some compensation from southern species moving into the Arctic, the potential for this is less than in former times.

Loss of Arctic species can potentially affect people and ecosystem function

We do not yet know what we have in the Arctic, so cannot guess the importance of what we can lose



# Recommendations (personal)

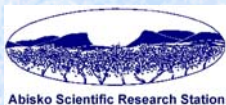
We need to seek political solutions to minimise harmful environmental changes

We need to develop and employ conventional and innovative methods to protect biodiversity and habitats

We need to document (using a “doomsday” approach) existing biodiversity and species dynamics

We need to monitor threatened species and “typical” Arctic species, ecosystems and habitats

We need to understand how Arctic species behave in a changing environment in order to predict threats to biodiversity, rather than waiting for critical situations to develop



**Thank You**