

# **FRESHREST** (Freshwater landscapes – management and restoration with climate change)

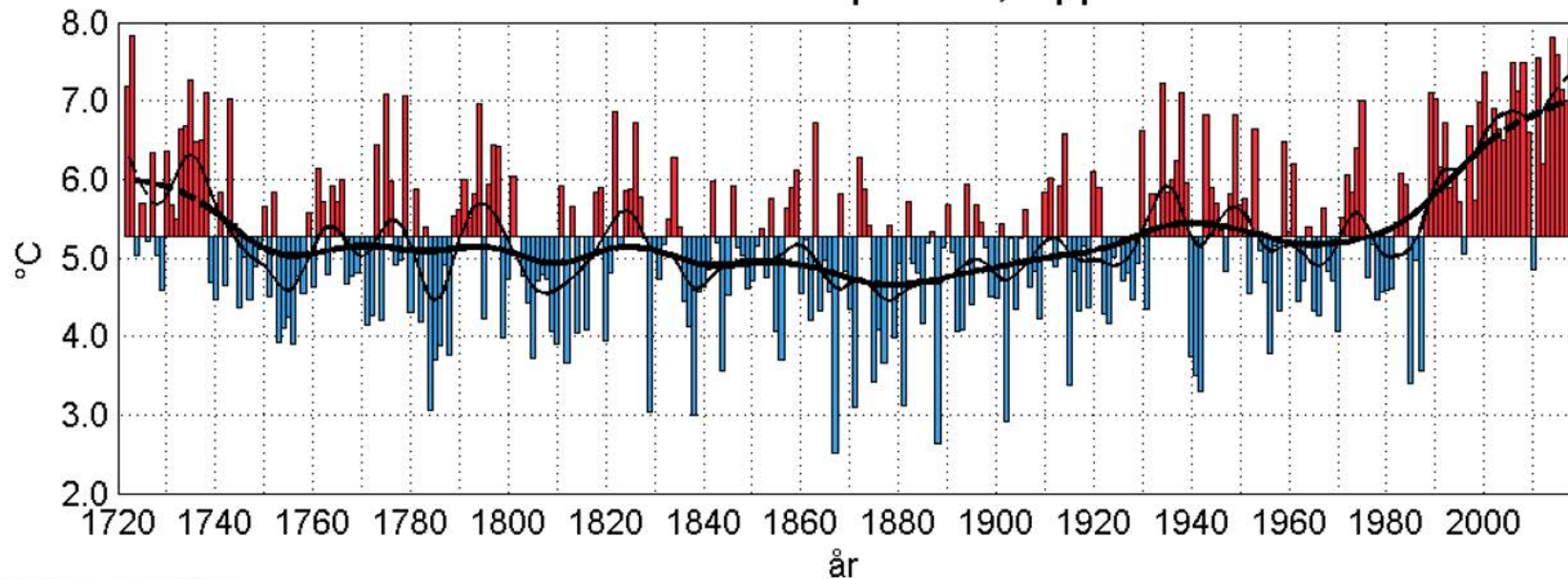
## Klimatförändringar i sjöar och vattendrag: Förvaltning och restaurering

**Douglas Jones**, Erik Degerman, Serena Donadi, Kerstin Holmgren,  
Erik Petersson, Eddie von Wachenfeldt, Leonard Sandin

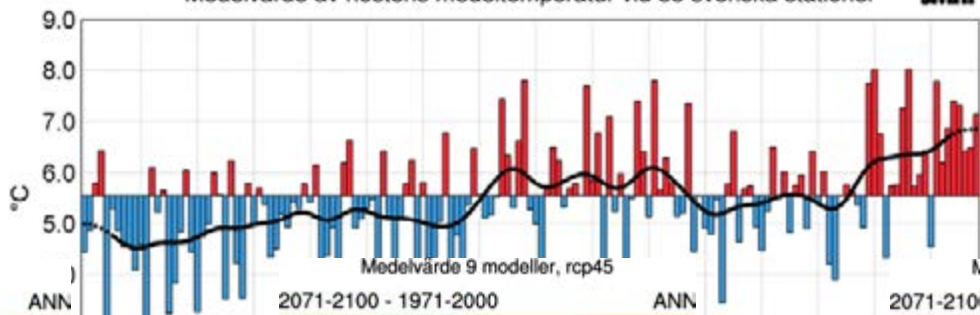
# FRESHREST (Freshwater landscapes – management and restoration with climate change)

- Bakgrund och teori
- Effekt av klimatförändring på sötvattensorganismer i Sverige
- Exempel och planer inom FRESHREST

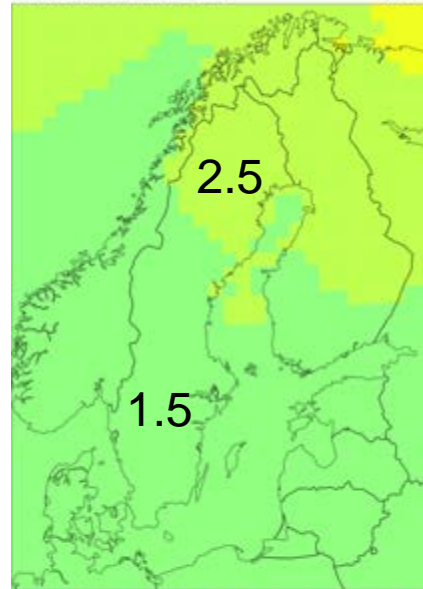
# Rekonstruerad årsmedeltemperatur, Uppsala 1722-2018



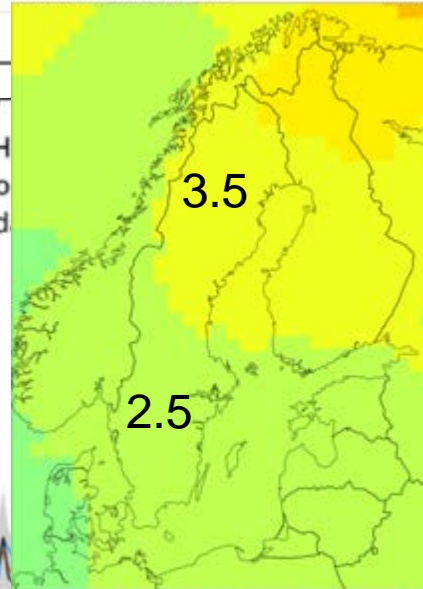
Medelvärde av höstens medeltemperatur vid 35 svenska stationer



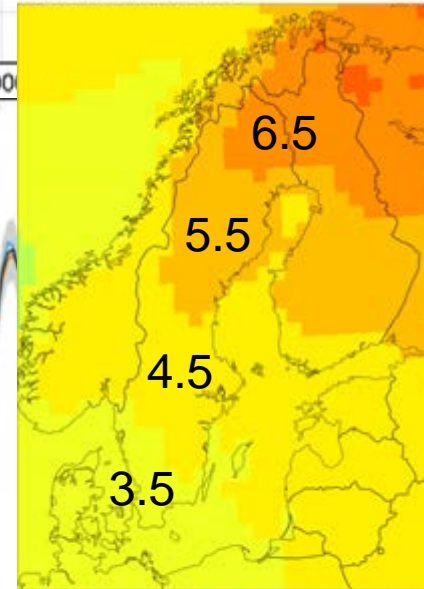
Medelvärde 3 modeller, rcp26  
2071-2100 - 1971-2000



Medelvärde 9 modeller, rcp45  
2071-2100 - 1971-2000

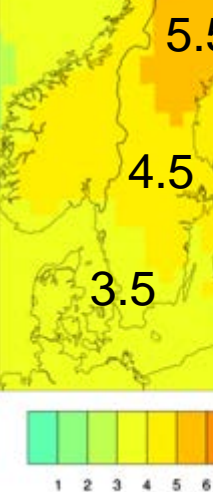
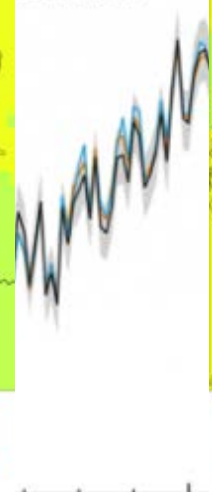
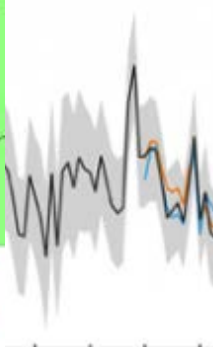


Medelvärde 9 modeller, rcp85  
2071-2100 - 1971-2000



- Met Office Hadley
- NOAA National Centers for Environmental Prediction
- NASA Goddard Institute for Space Studies

Research Unit  
formation



1 2 3 4 5 6 7 8 9 10 11

tas (°C)

1 2 3 4 5 6 7 8 9 10 11

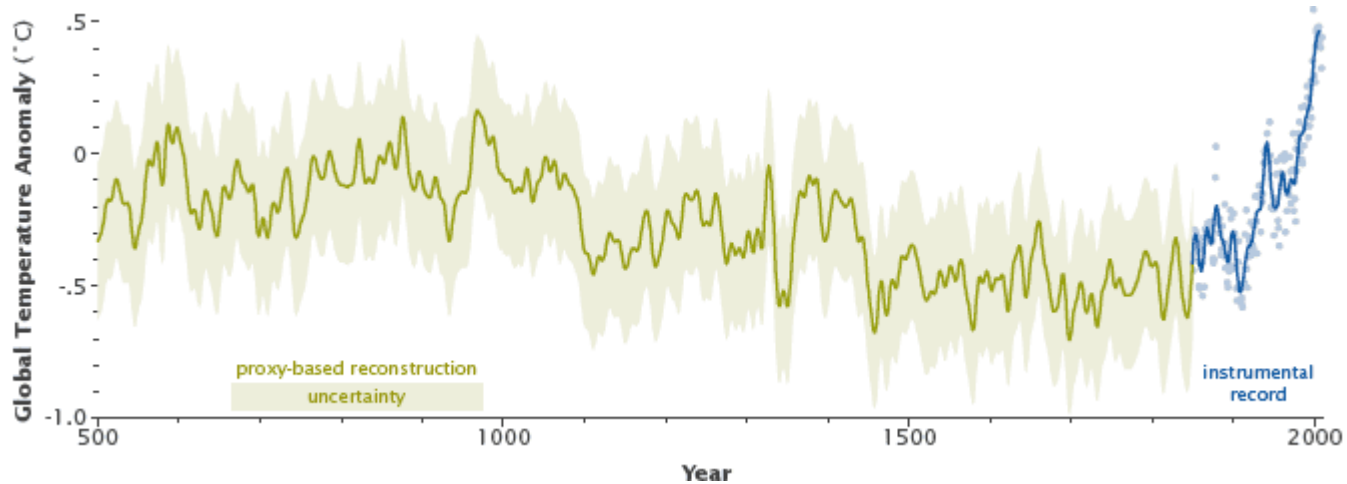
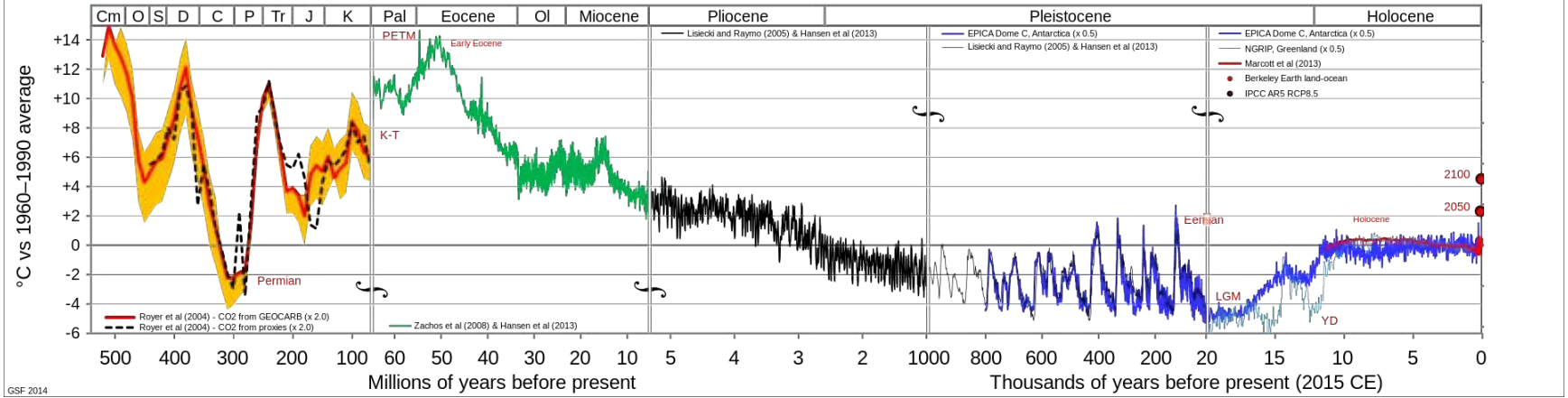
tas (°C)

1 2 3 4 5 6 7 8 9 10 11

tas (°C)

2001

# Temperature of Planet Earth



# SLU Effekter på organismer

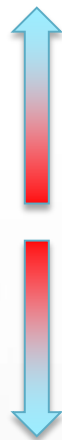
*~ move, adapt or die*

- Flytta
- Tolerera
- Anpassning
- Dö



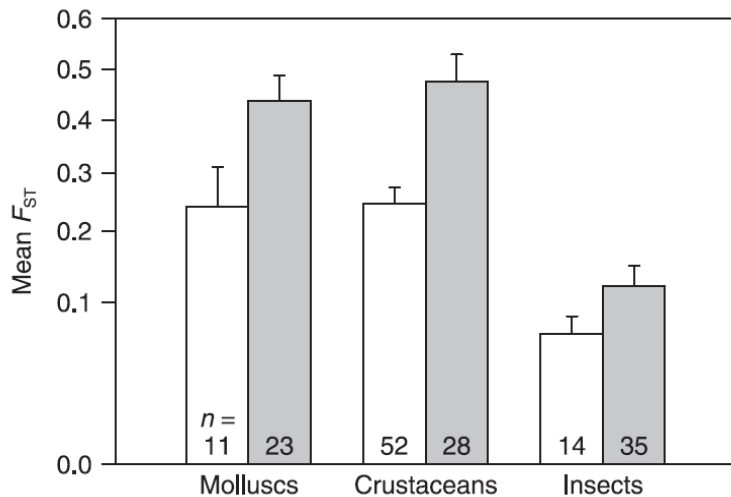
- Förändringar i utbredning (flytta)
- Anpassning (genetisk)
- Tolerans (fysiologisk anpassning)
- Dö

~1,7km / år

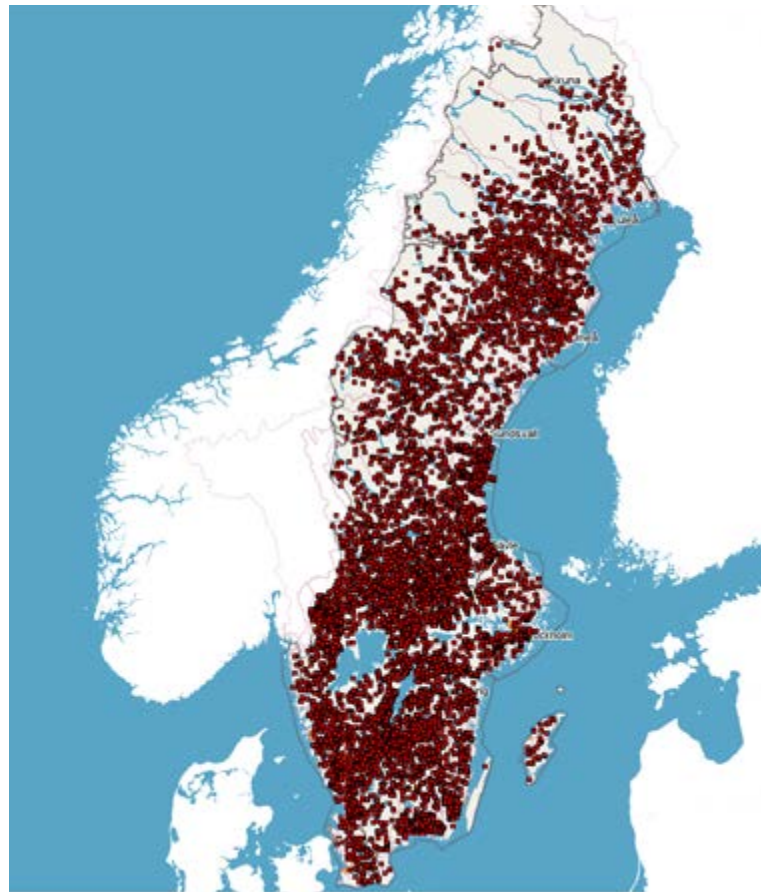


# Climate tracking

- **Vatten**, land eller luft
- Sjöar vs vattendrag



Marten et al. 2006





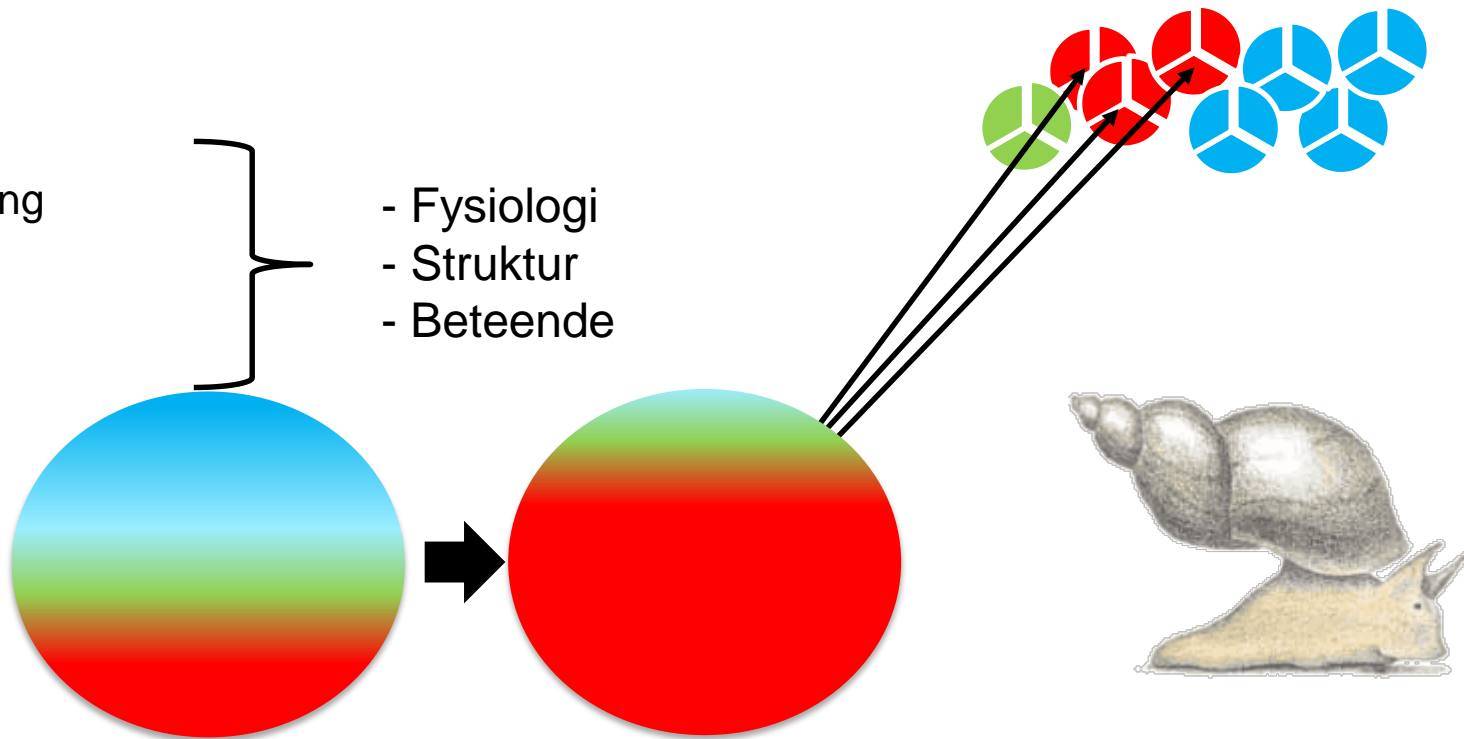
# Effekter på organismer

- Flytta

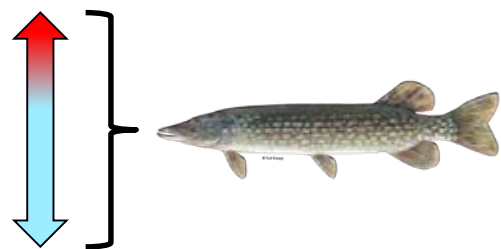
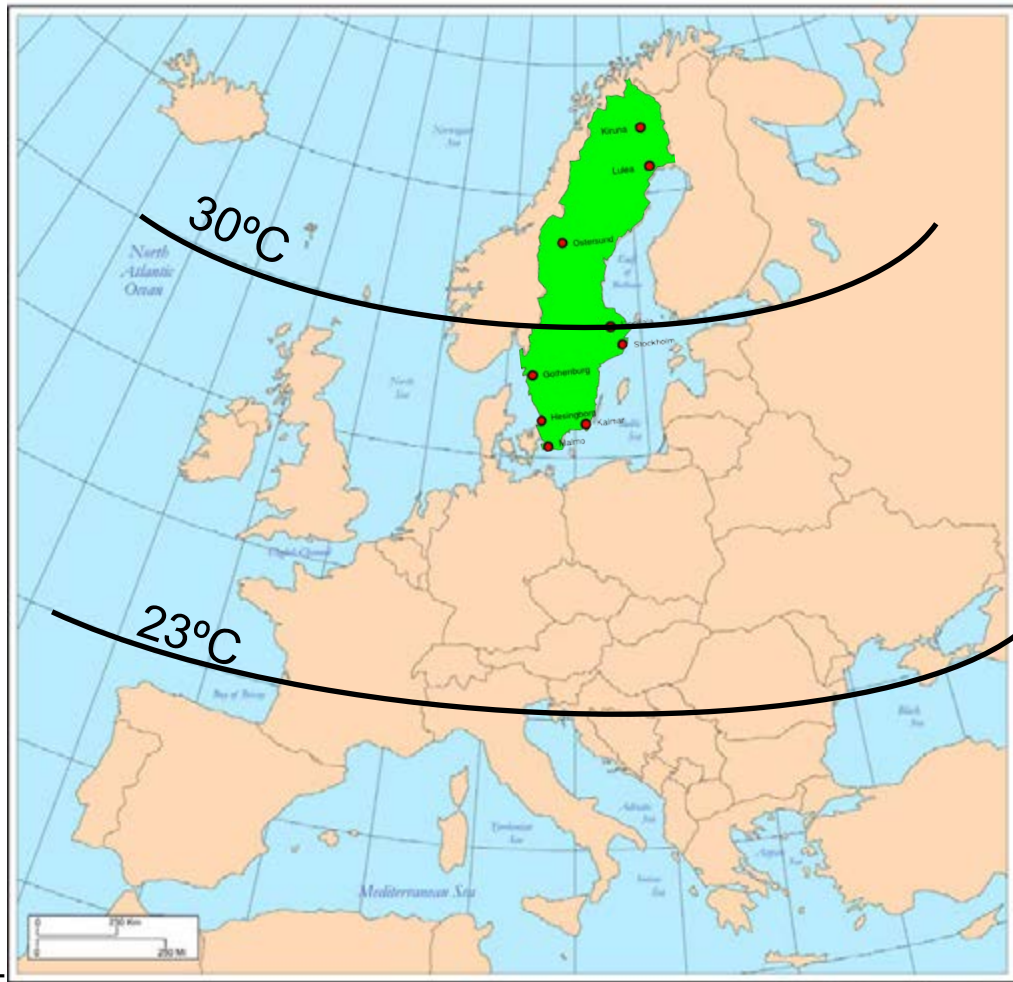
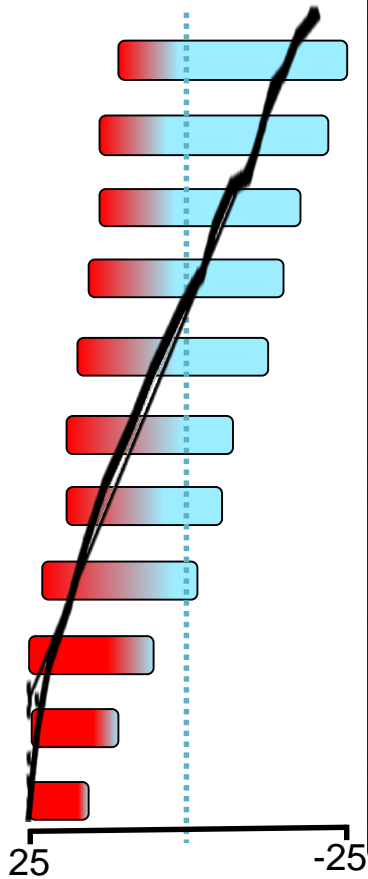
- Anpassning

- Tolerera

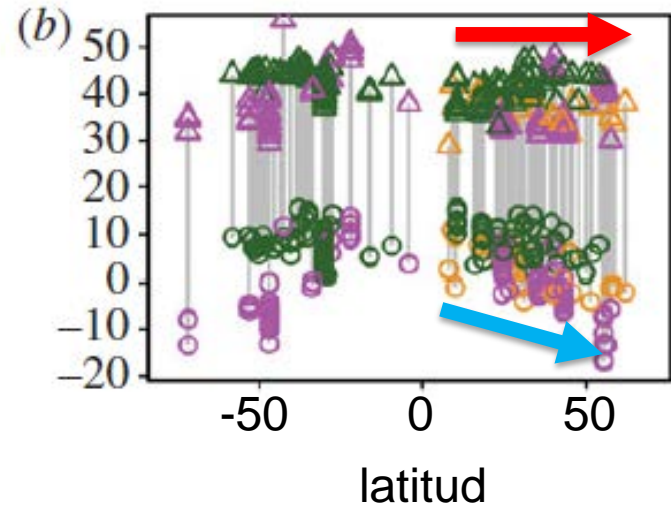
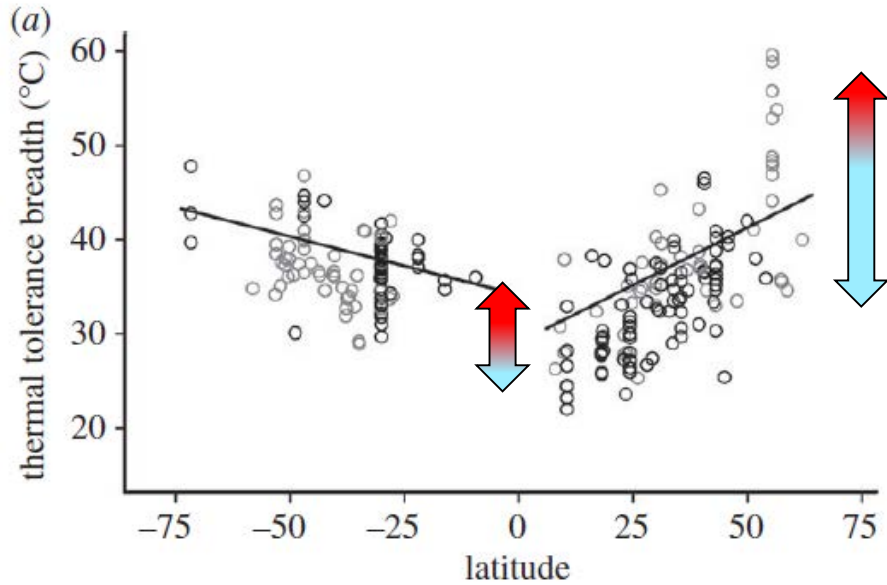
- Dö



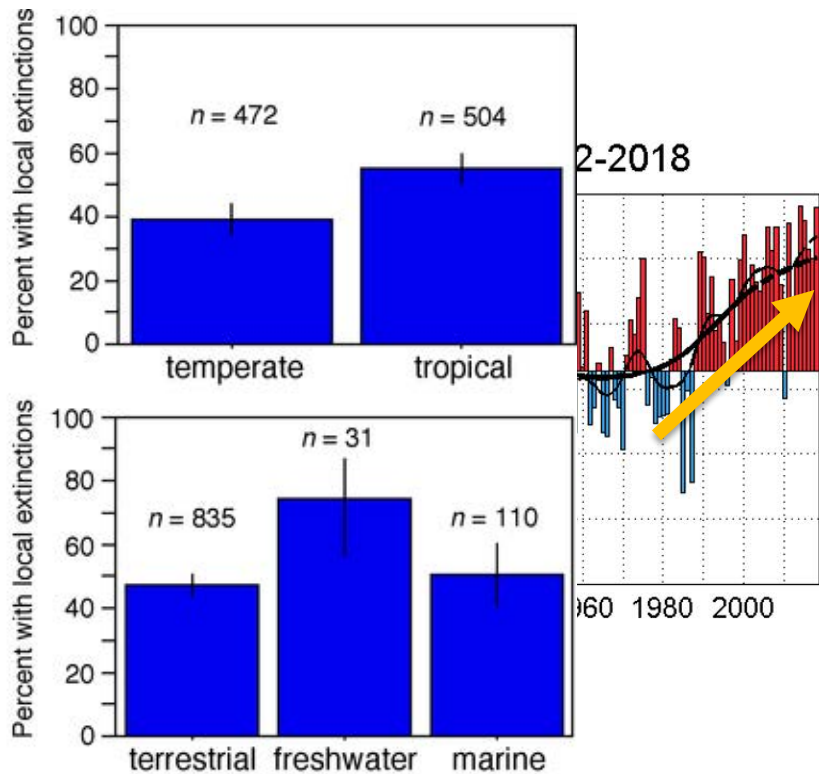
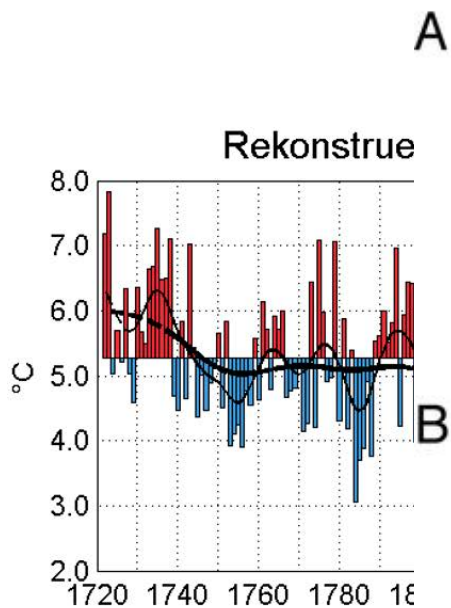
Sunday et al. 2010



# Temperaturtolerans ökar med latitud

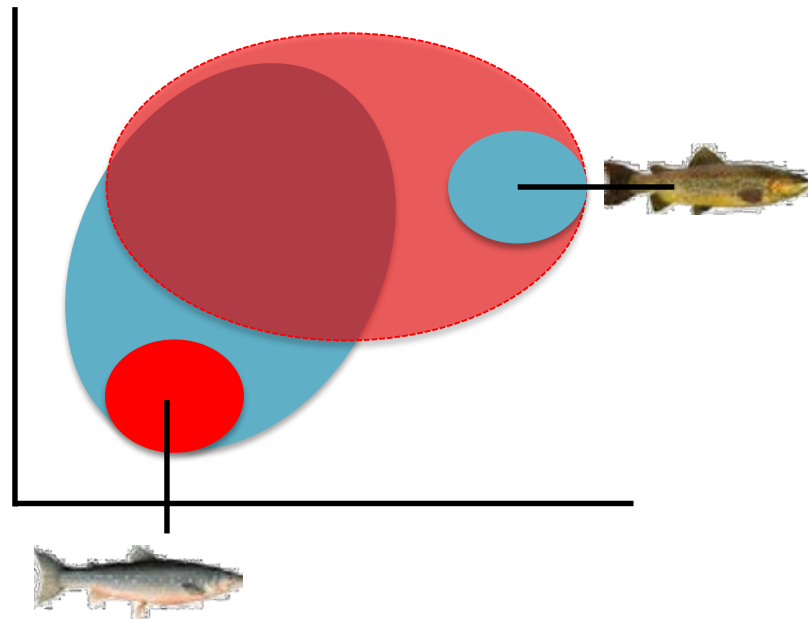
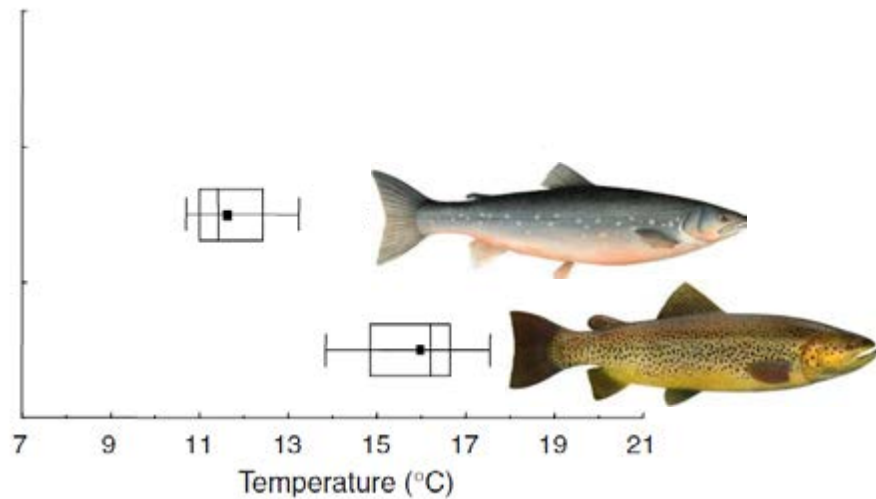


- Anpassning
- Flytta
- Tolererans
- Dö

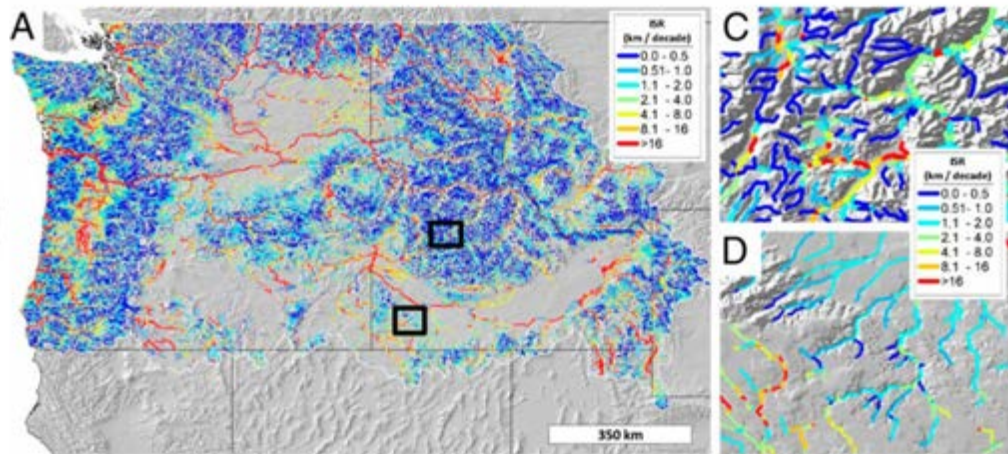
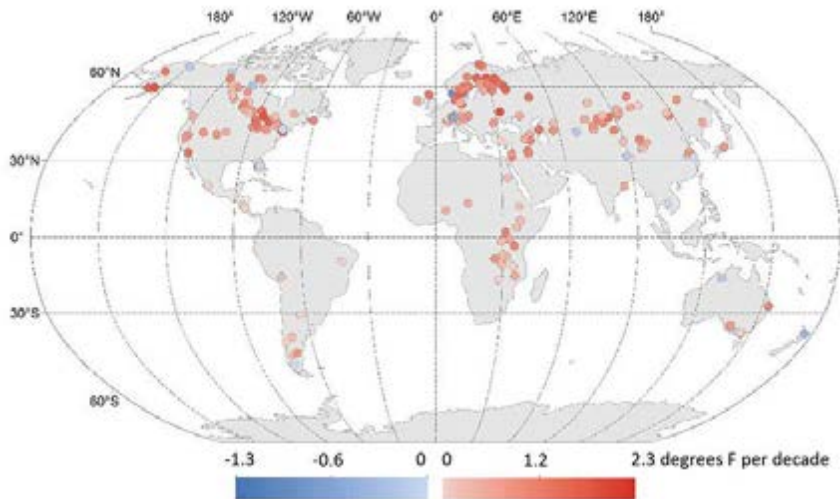


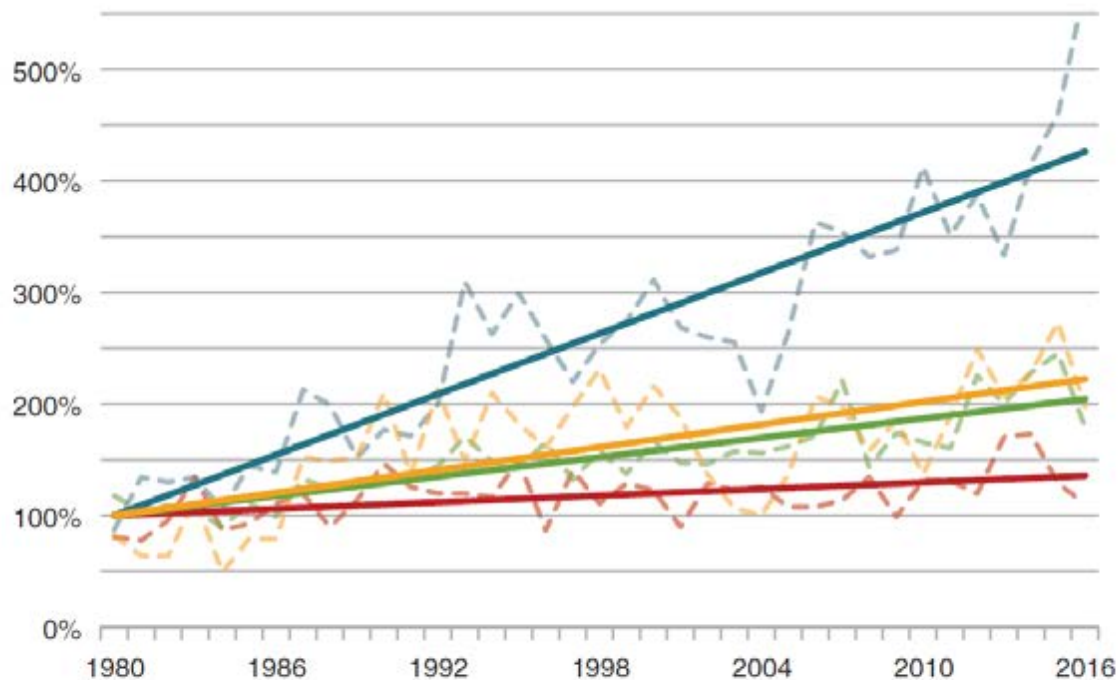
# Svårigheter för förvaltning

# Konkurrens



# Globalt mönster, regionala skillnader





- Geophysical events (earthquake, tsunami, volcanic eruption)
- Meteorological events (storm)
- Hydrological events (flood, mass movement)
- Climatological events (extreme temperature, drought, forest fire)

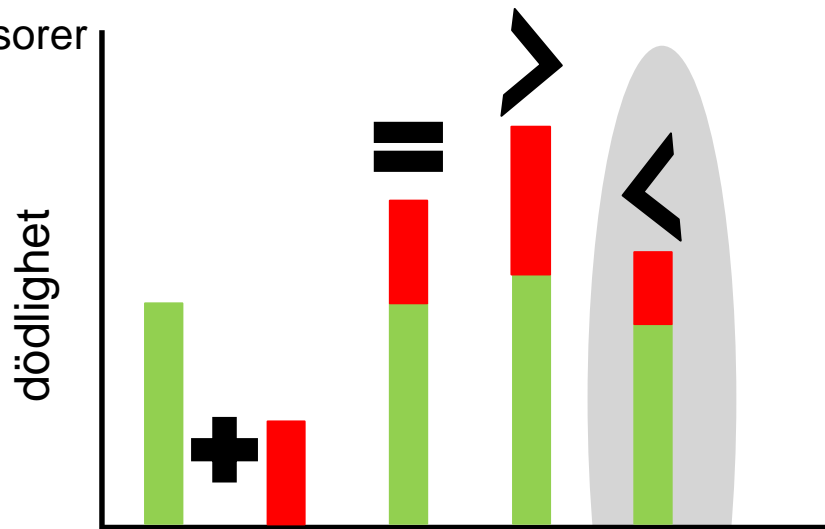


# Multipla stressorer

- Sötvatten särskilt känsligt för multipla stressorer
- Additiv
- Synergistisk
- Antagonistisk

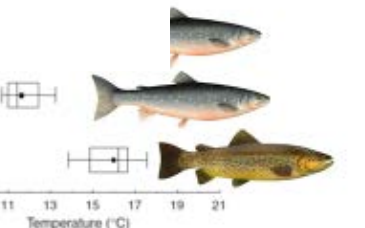
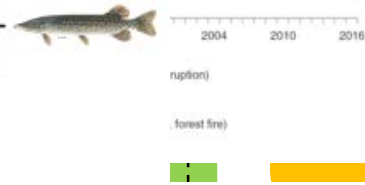
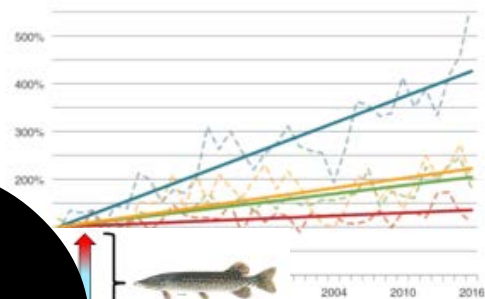
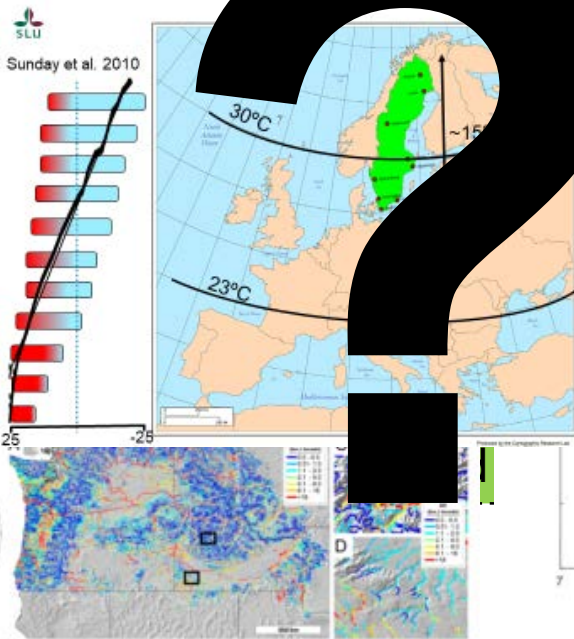
Vattenreglering

Klimatförändring



# Multipla stressorer

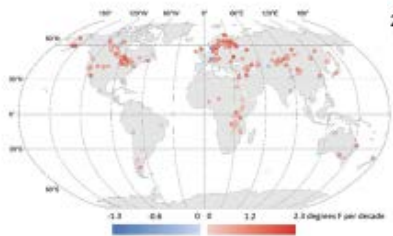
- Sötvatten känslig mot multipla stressorer
- Additiva
- Synergistisk
- Antagonistisk



börd

mus  
nifiering

# Globalt mönster skillnader



- Minska andra stressorer
  - Stor utrymme för förbättring
  - Acceptera förändring
- 
- Effektiv förvaltning = bra kunskap
  - Fokusera förvaltning, hitta intressanta mönster
  - Vecka fråga om prioritering

# FRESHREST

## WP1

- Typologi
- Position
- Markanvändning
- Klimat

Sjöar

- Altitud
- Yta
- Berggrund
- Medel djup



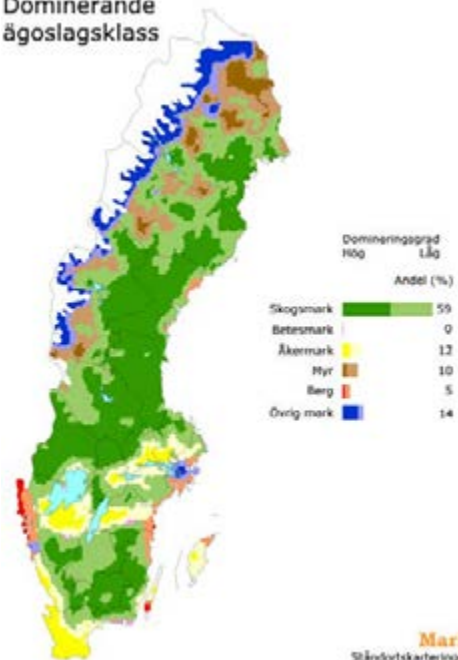
Rinnande vatten

- Altitud
- Avrinningsområde
- Berggrund



# Lager av information

Dominerande ägoslagsklass



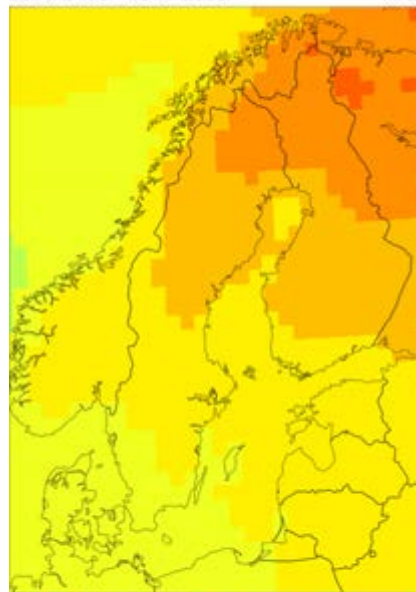
MarkInfo  
Ståndortskarteringen 83-87  
Karta: Åke Nilsson



Medelvärde 9 modeller, rcp85

2071-2100 - 1971-2000

ANN

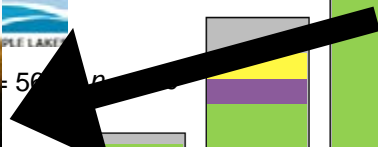
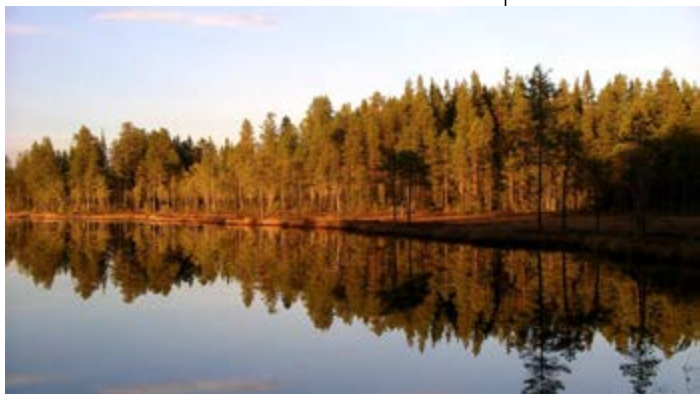
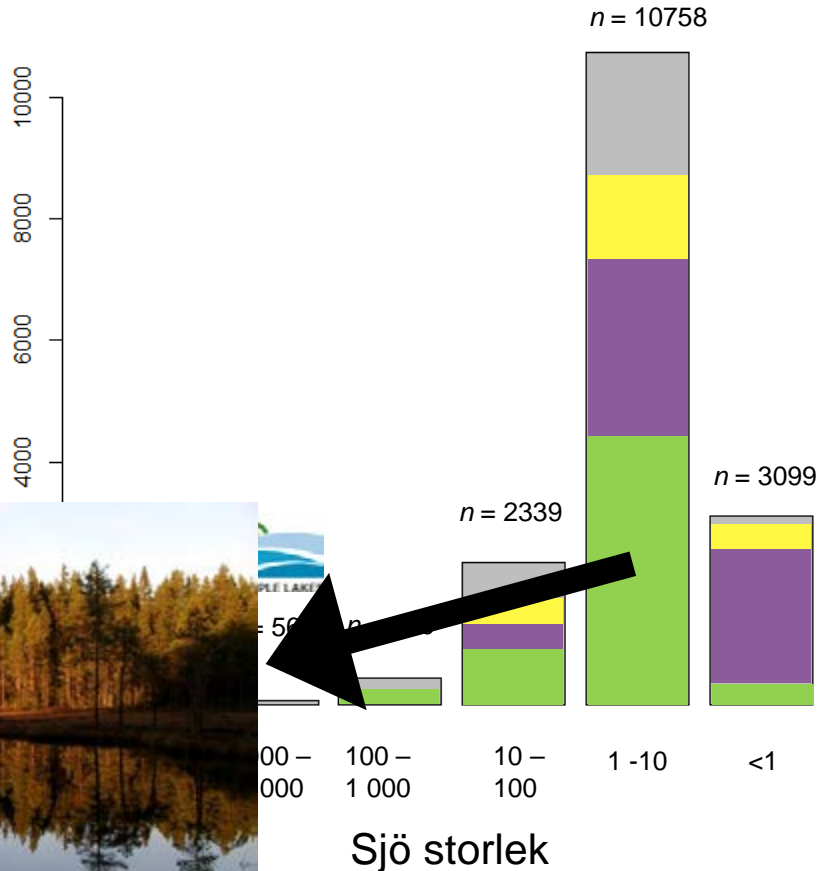


tas (°C)





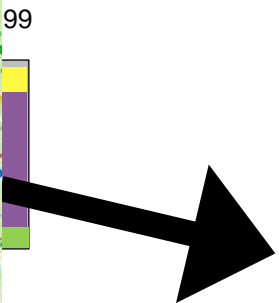
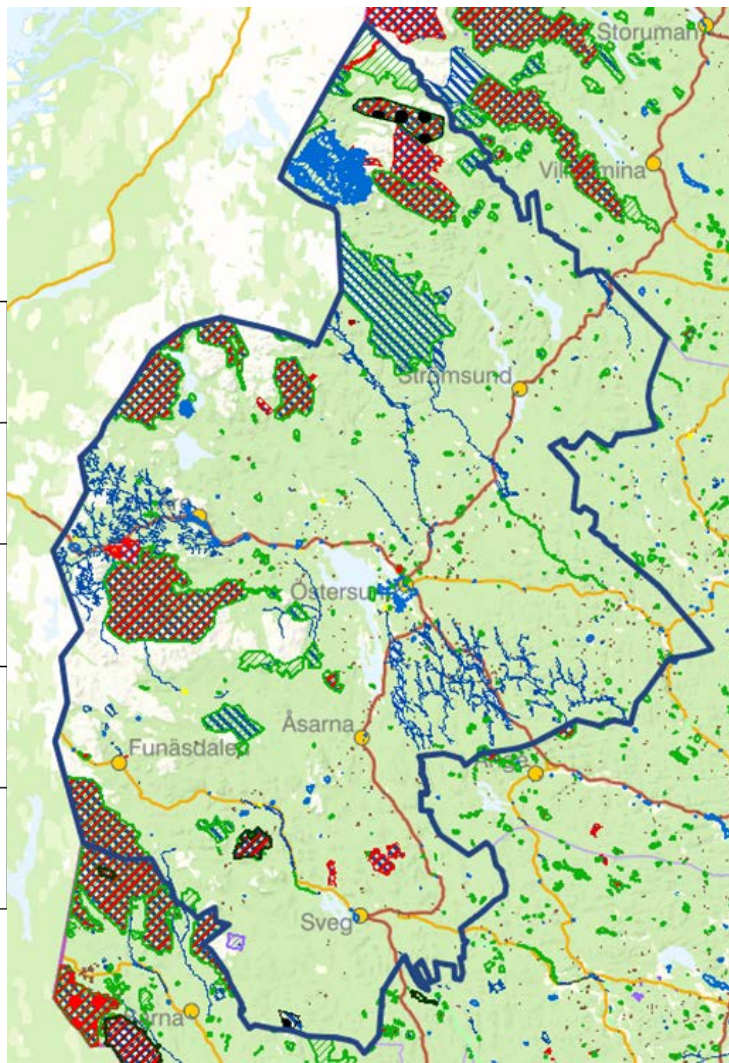
Antal sjö



- skog
- fjäll
- våtmark

Antal sjö

10000  
8000  
6000  
4000  
2000  
0



# Att göra inom FRESHREST

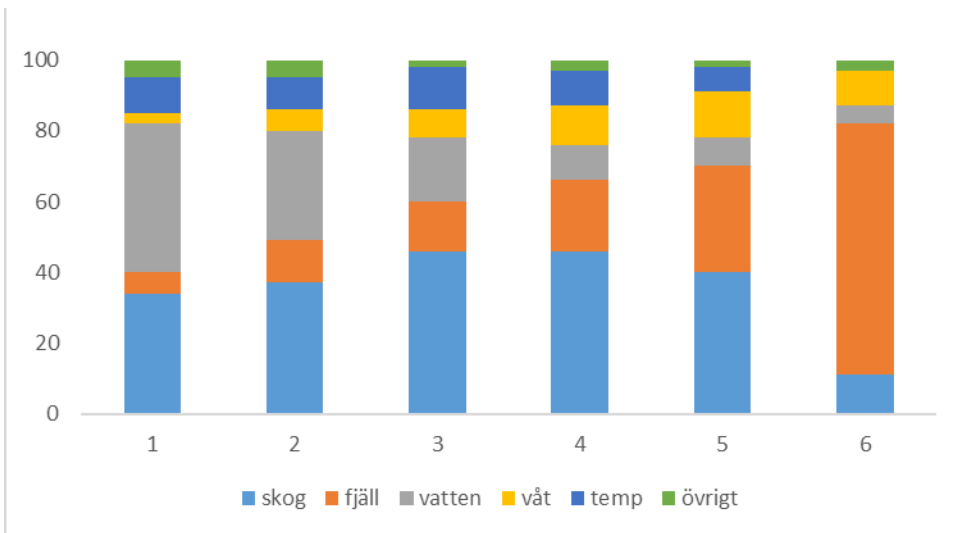
- Utvecklar GIS analys
- Kolla på multipla stressorer
- Restaureringsåtgärder

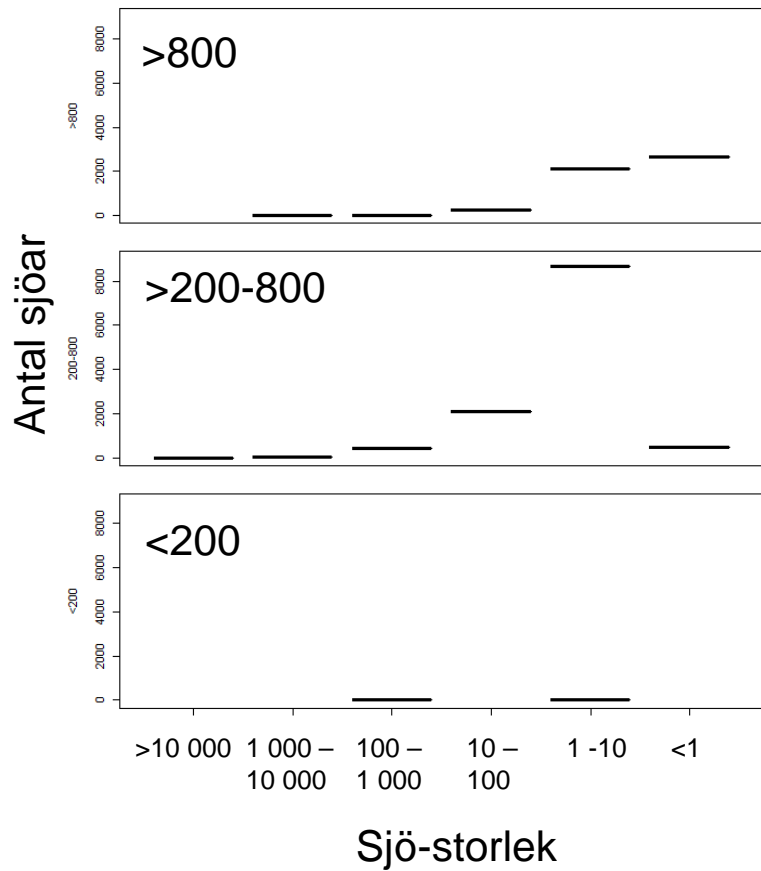


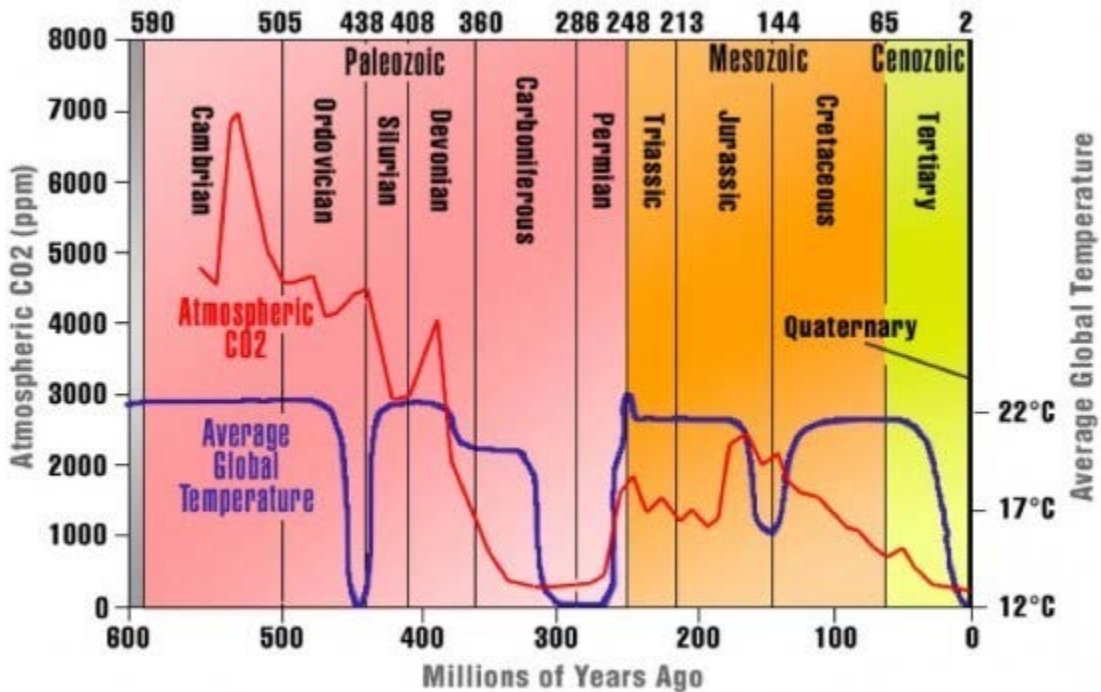
# FRESHREST (Freshwater landscapes – management and restoration with climate change)

# TACK!

[douglas.jones@slu.se](mailto:douglas.jones@slu.se)

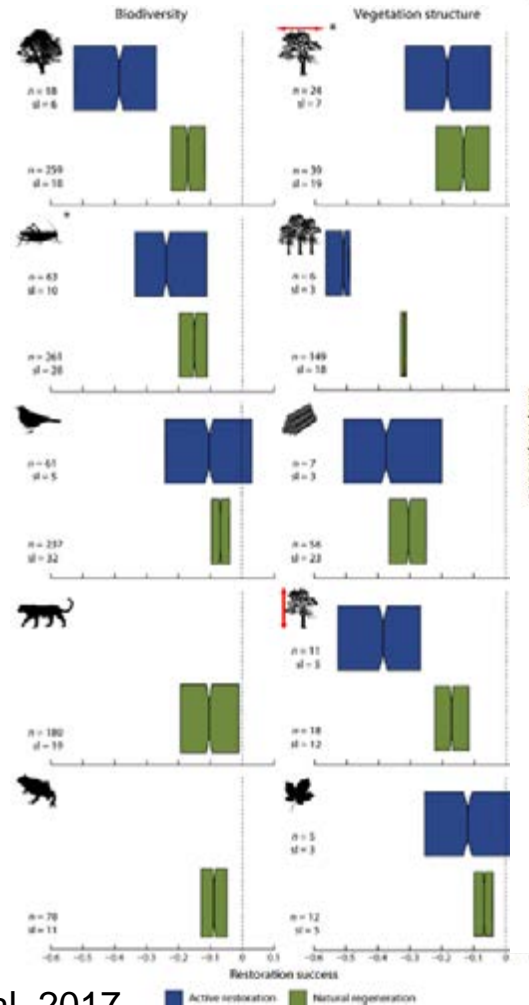






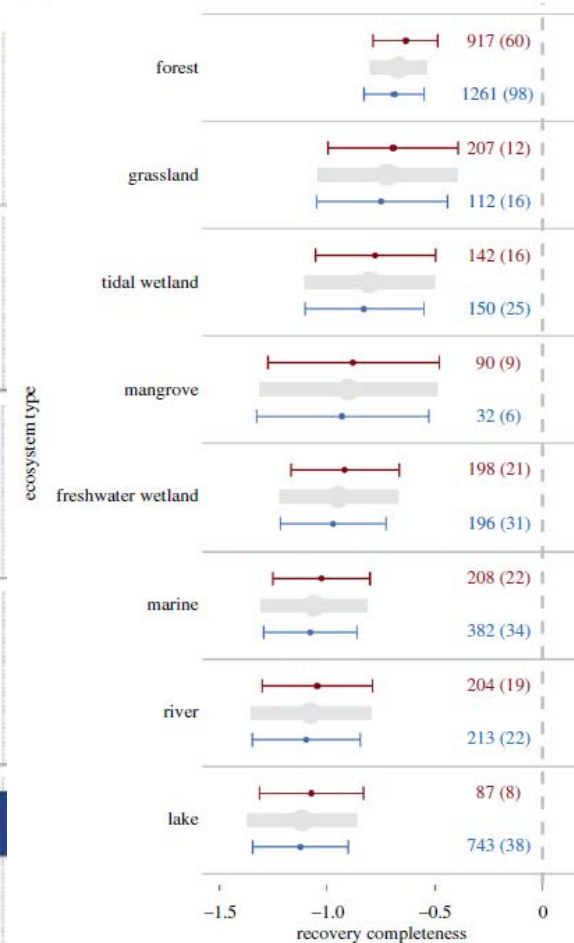
# Restaurering

- Vad vill man?
- Tidsperspektiv
- Vad fungerar?
- "Passiv" vs aktiv restaurering
- Kostnadseffektivitet?



Crouzeilles et al. 2017

(b)



Jones et al. 2018

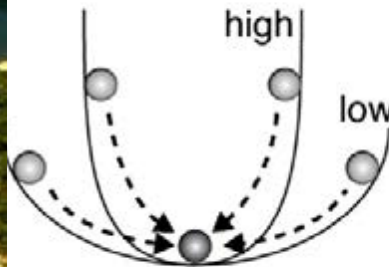
# Lite ekologisk teori...

- Spänstighet, resistans
- Bevis...
- "Safe operating space"
- Forntida / ursprungligt ekosystem  
degraderade ekosystem

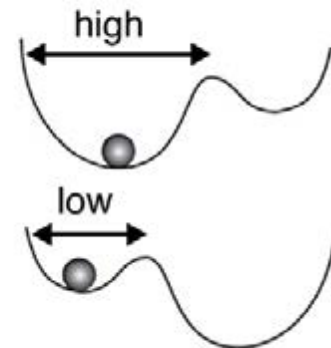


Storleken och nuvarande tillstånd  
avgörande för hur påverkan  
eller vattendrag blir framtida

(a) Engineering resilience



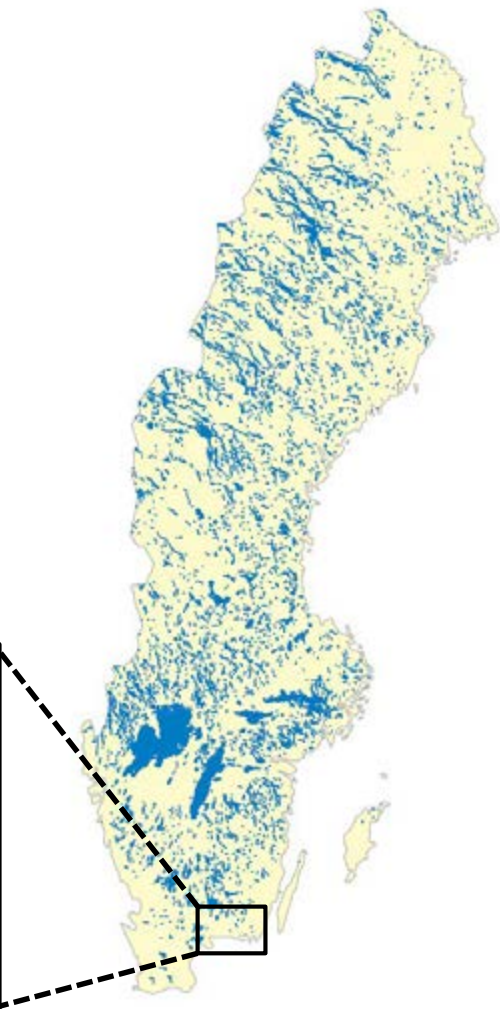
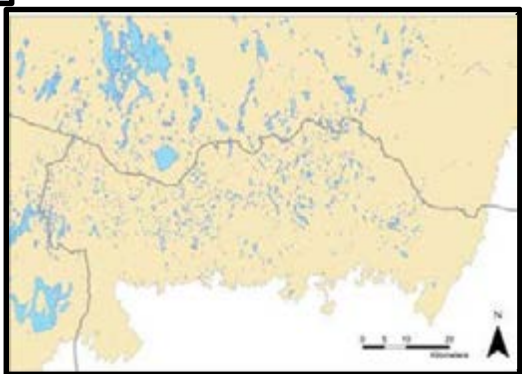
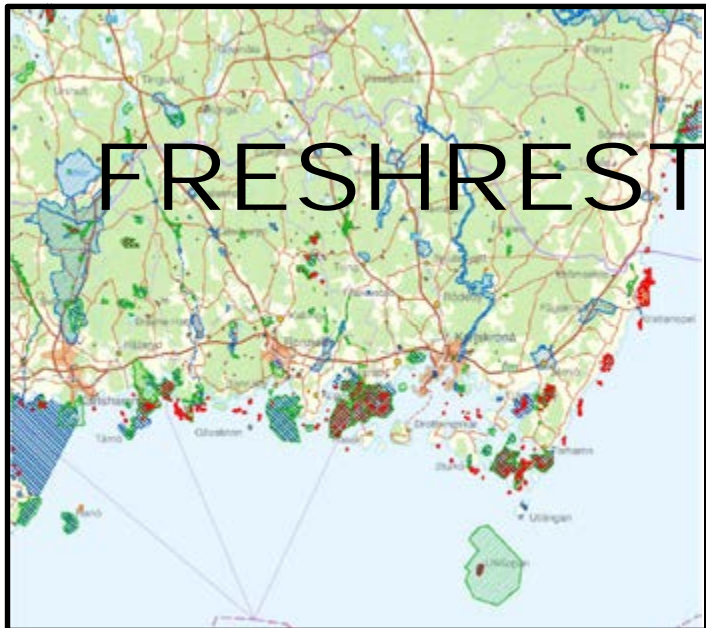
(b) Ecological resilience

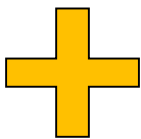


Current Opinion in Environmental Sustainability

Sterk et al. 2017

# FRESHREST





Warming



Rainfall

Droughts

Growth season

Growth rate

Warm water sp.

Cyanobacteria

Diversity

Resource mismatch

Parasites

Non-natives

Body size

Ice snow glaciers

Cold water sp.

Spring flooding

Food web niche

Flooding

Humus brown water

Primary production

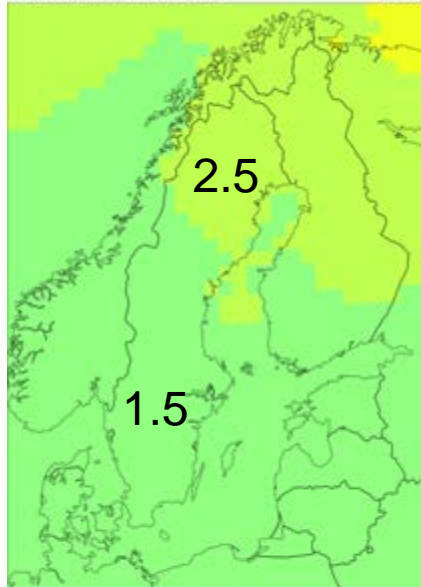
Dissolved organic carbon



# Relevans för djur och växter i sötvatten

# Klimatscenarier från SMHI

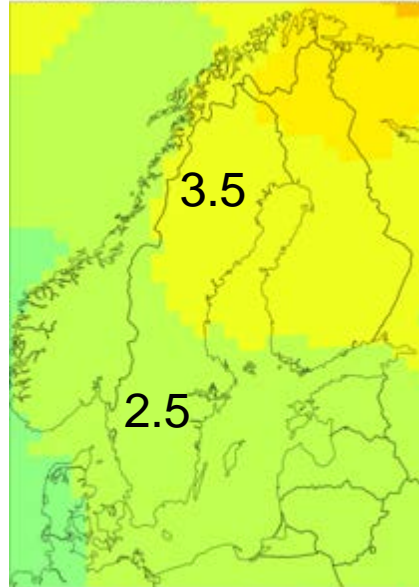
Medelvärde 3 modeller, rcp26  
2071-2100 - 1971-2000 ANN



1 2 3 4 5 6 7 8 9 10 11

tas (°C)

Medelvärde 9 modeller, rcp45  
2071-2100 - 1971-2000 ANN



1 2 3 4 5 6 7 8 9 10 11

tas (°C)

6.5  
5.5  
4.5  
3.5