Could fishery management be used to mitigate the climate change effects on marine ecosystem function?

Susa Niiranen[1], Johanna Yletyinen[1], Maciej Tomczak[1], Olle Hjerne[2] and Thorsten Blenckner[1]

[1] Baltic Nest Institute, Stockholm Resilience Centre, Sweden

[2] Department of Systems Ecology, Stockholm University, Sweden

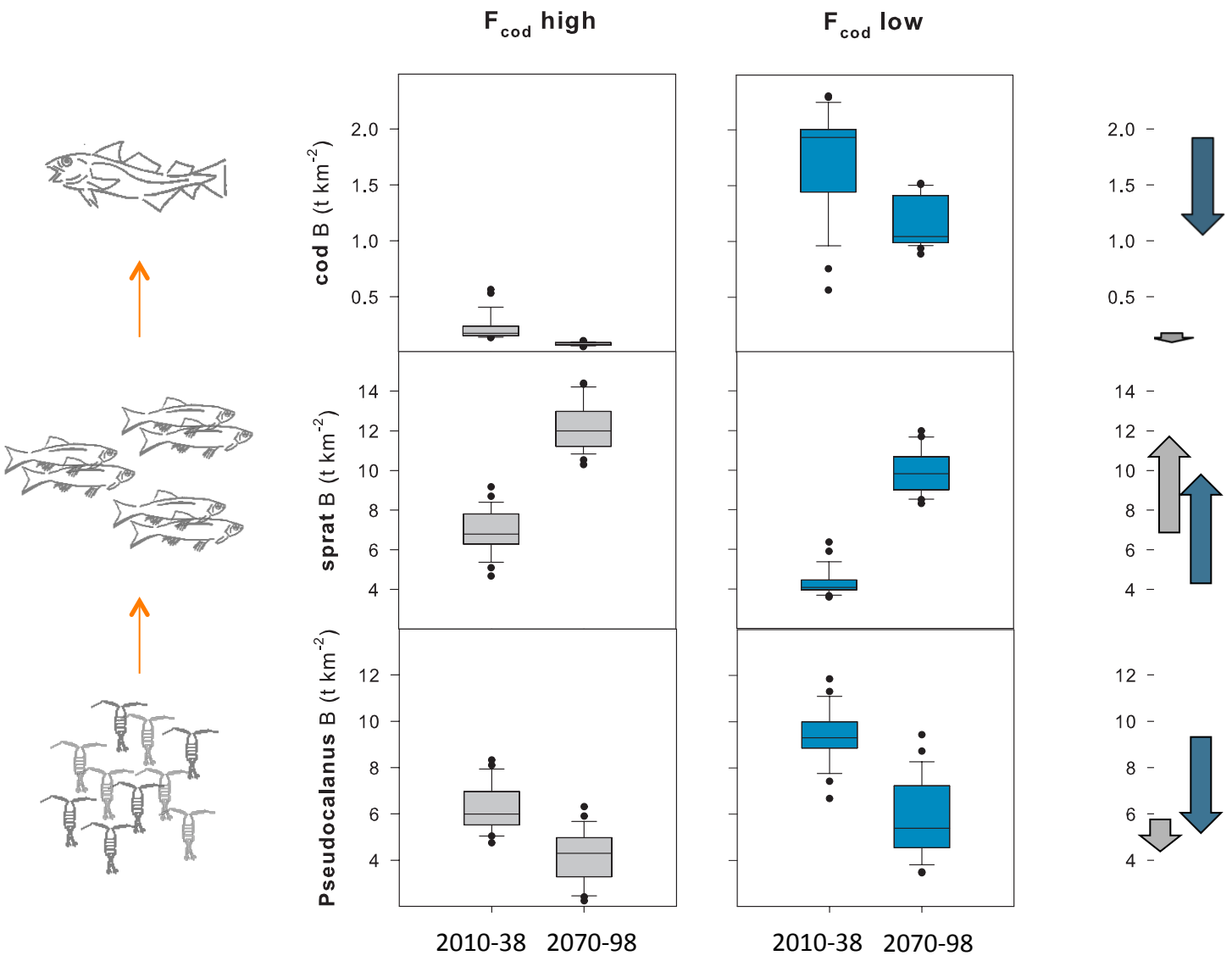
May 2012, Yeosu

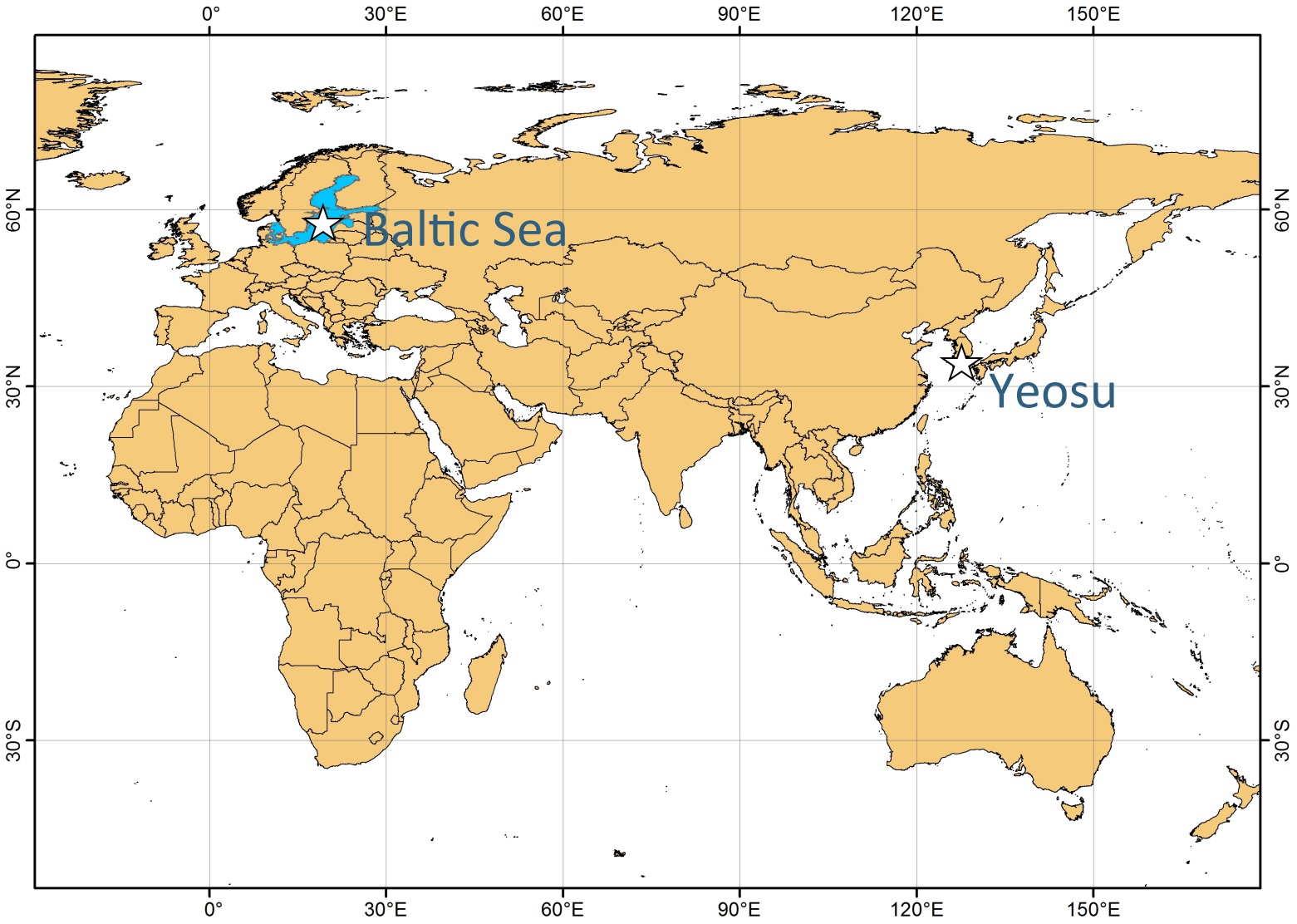
Stockholm Resilience Centre
Research for Governance of Social-Ecological Systems

Stockholm University

Baltic Nest Institute

The Baltic Sea case




0°
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°
30°S
Baltic Sea
Yeosu

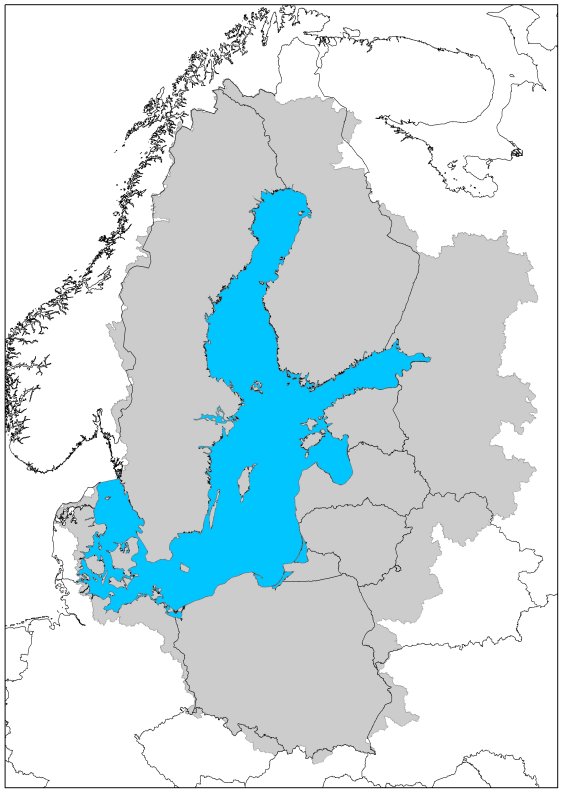
Baltic Sea and climate change

- In 1871-2004 the Baltic Sea surface T increased by 0.07-0.1 C / 10 yrs (global av. 0.05 C).
- Large changes projected in the Baltic by 2100

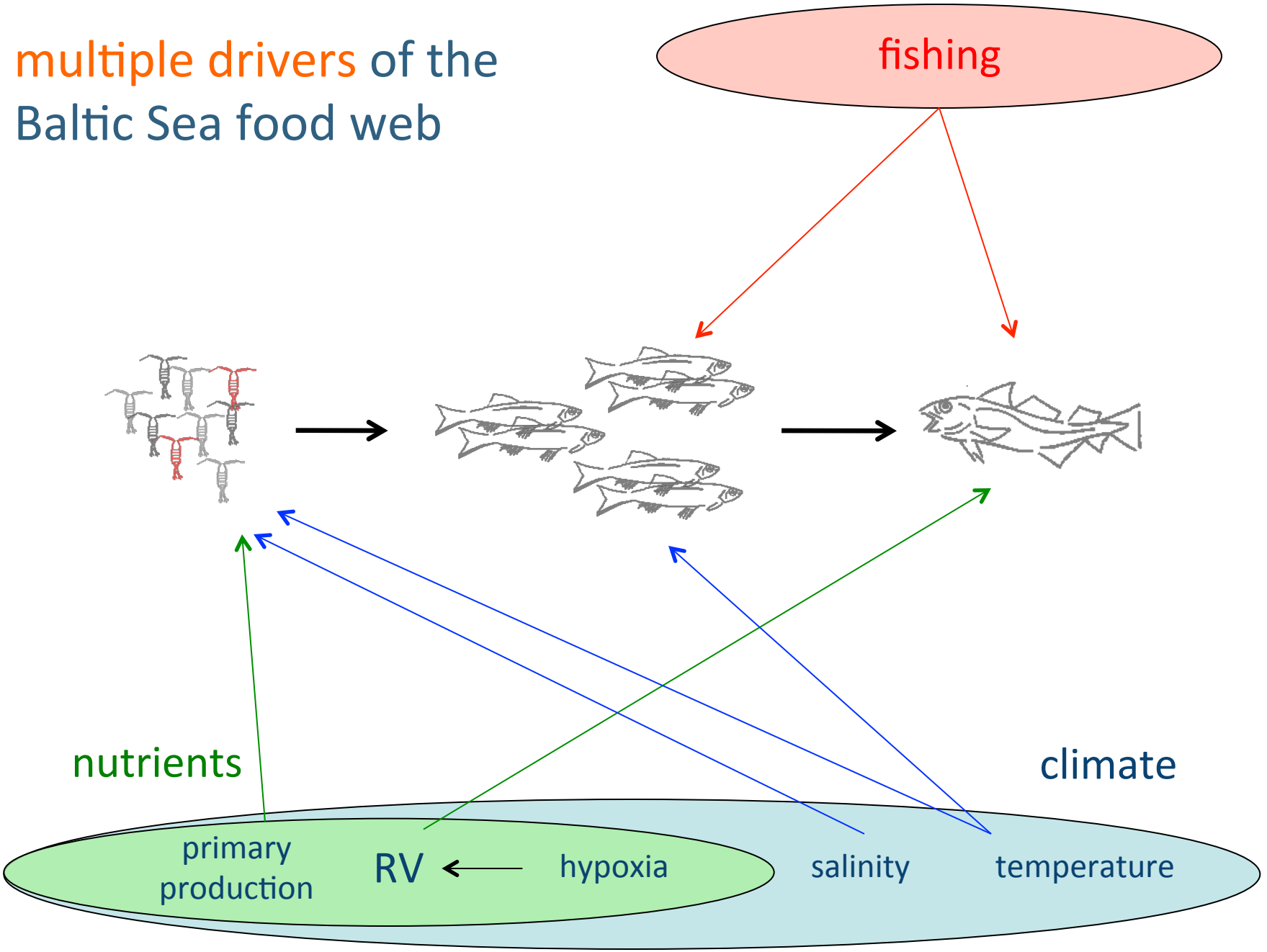
	trend	change
temperature	↑	+ 3-5 C
salinity	↓	- 8-50%
hypoxia	↑	

➢ Fast change → a good showcase

- Multiple drivers/stressors present
  - large catchment area → nutrient loads
  - intensive fishing
  - strong stratification → prone to hypoxia

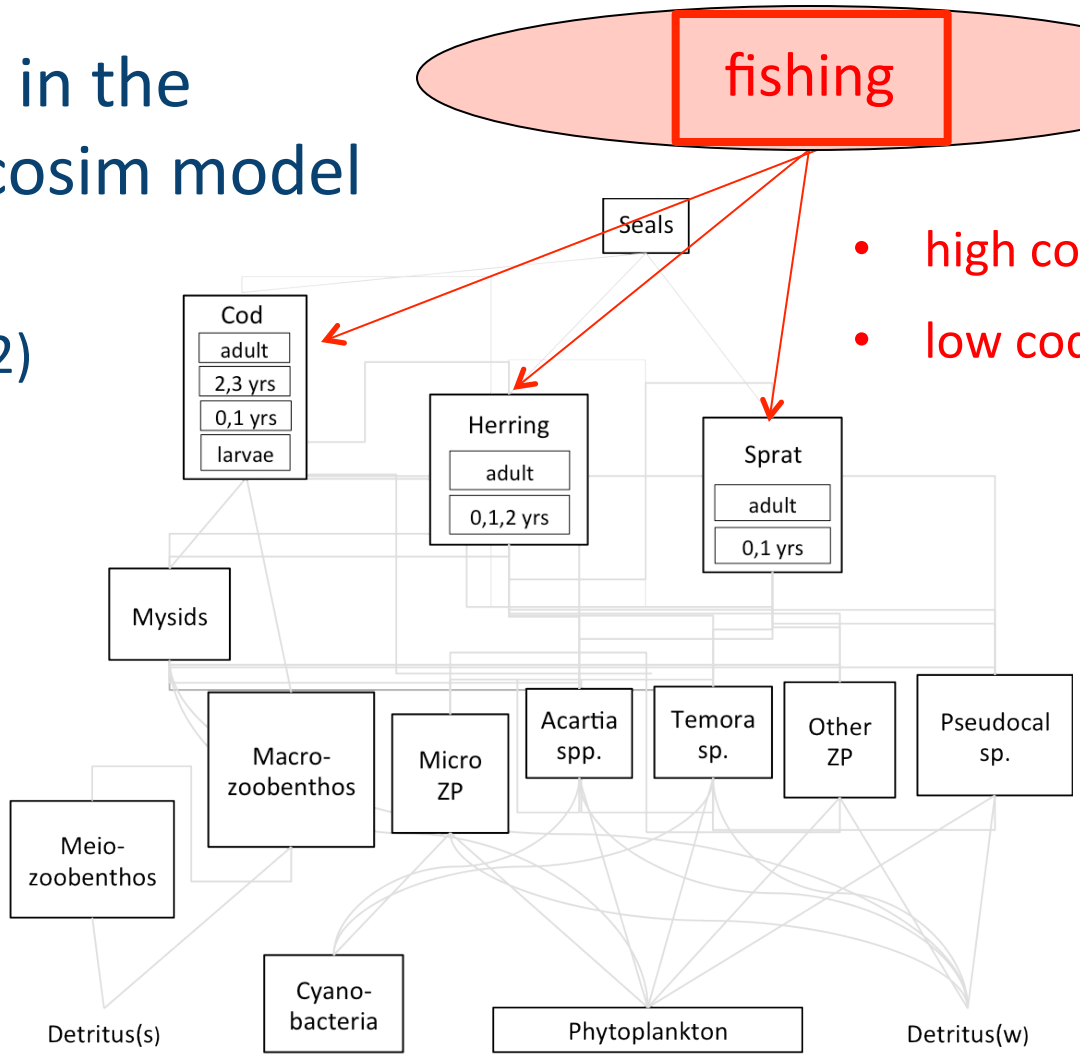


multiple drivers of the Baltic Sea food web



multiple drivers in the Ecopath with Ecosim model BaltProWeb

(Tomczak et al. 2012)



- high cod F (=1.1)
- low cod F (=0.3)

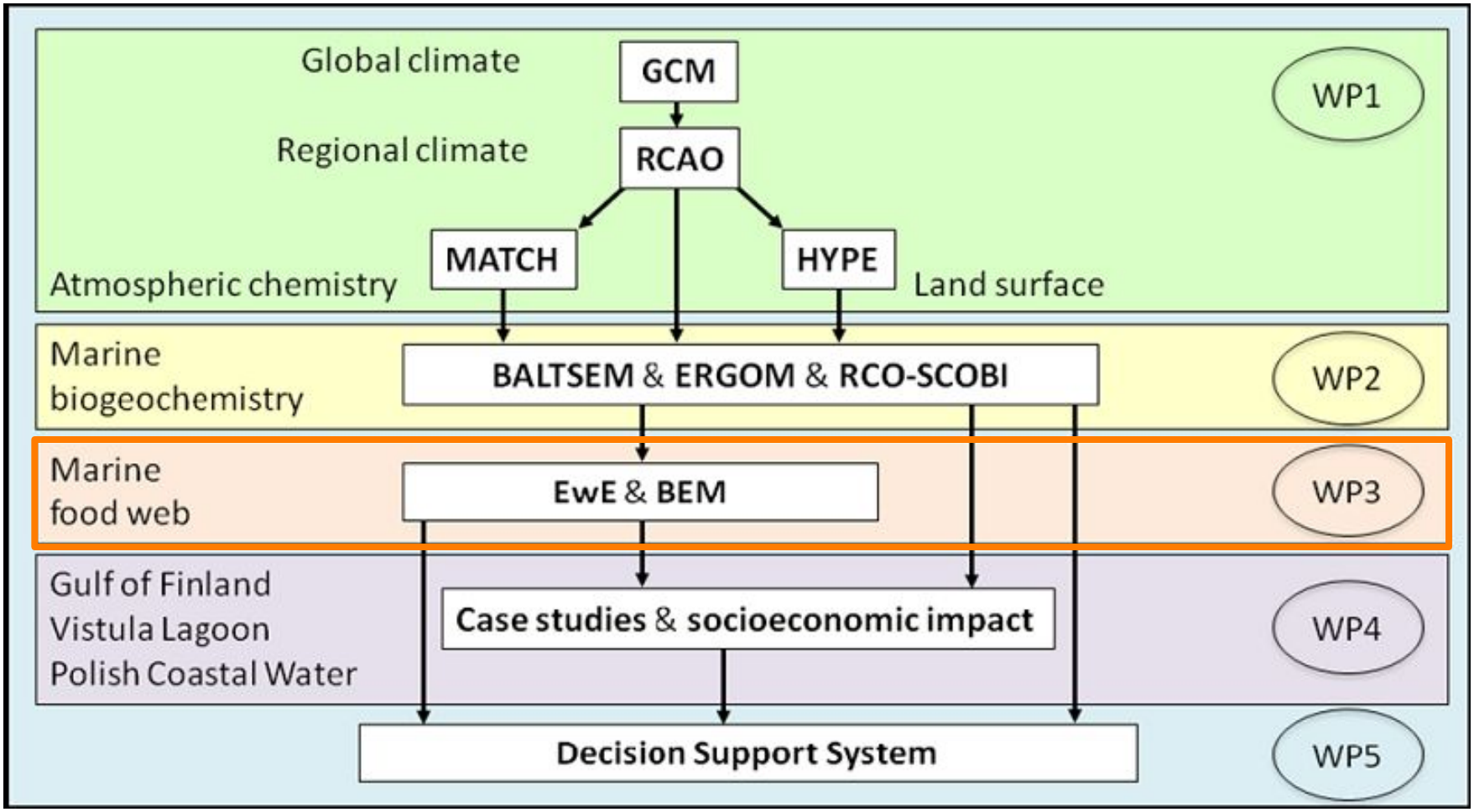
- high nutrients (=REF)
- reduced nutrients (=BSAP)

primary production → RV ← hypoxia

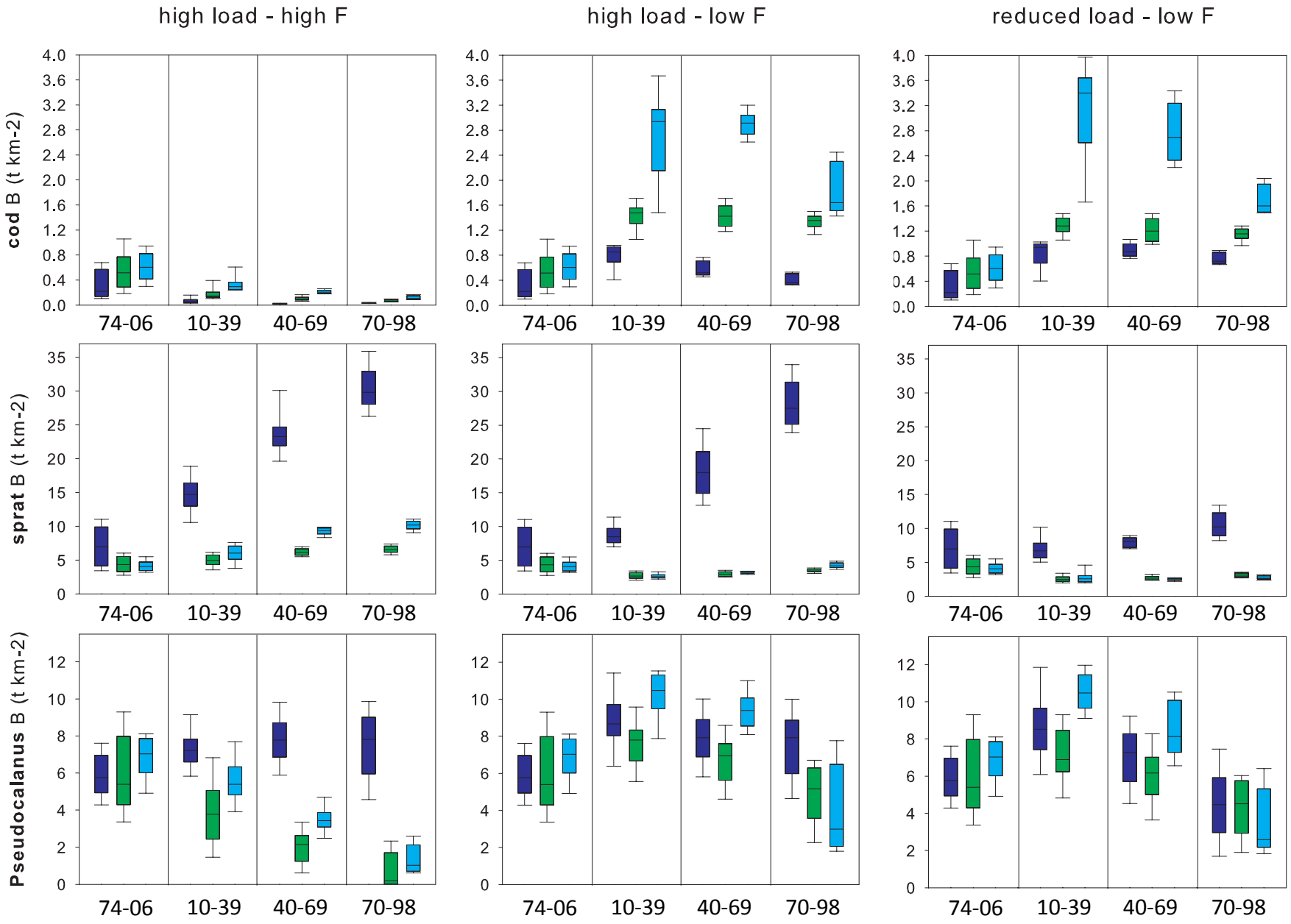
salinity

temperature

ECOSUPPORT-project: model hierarchy



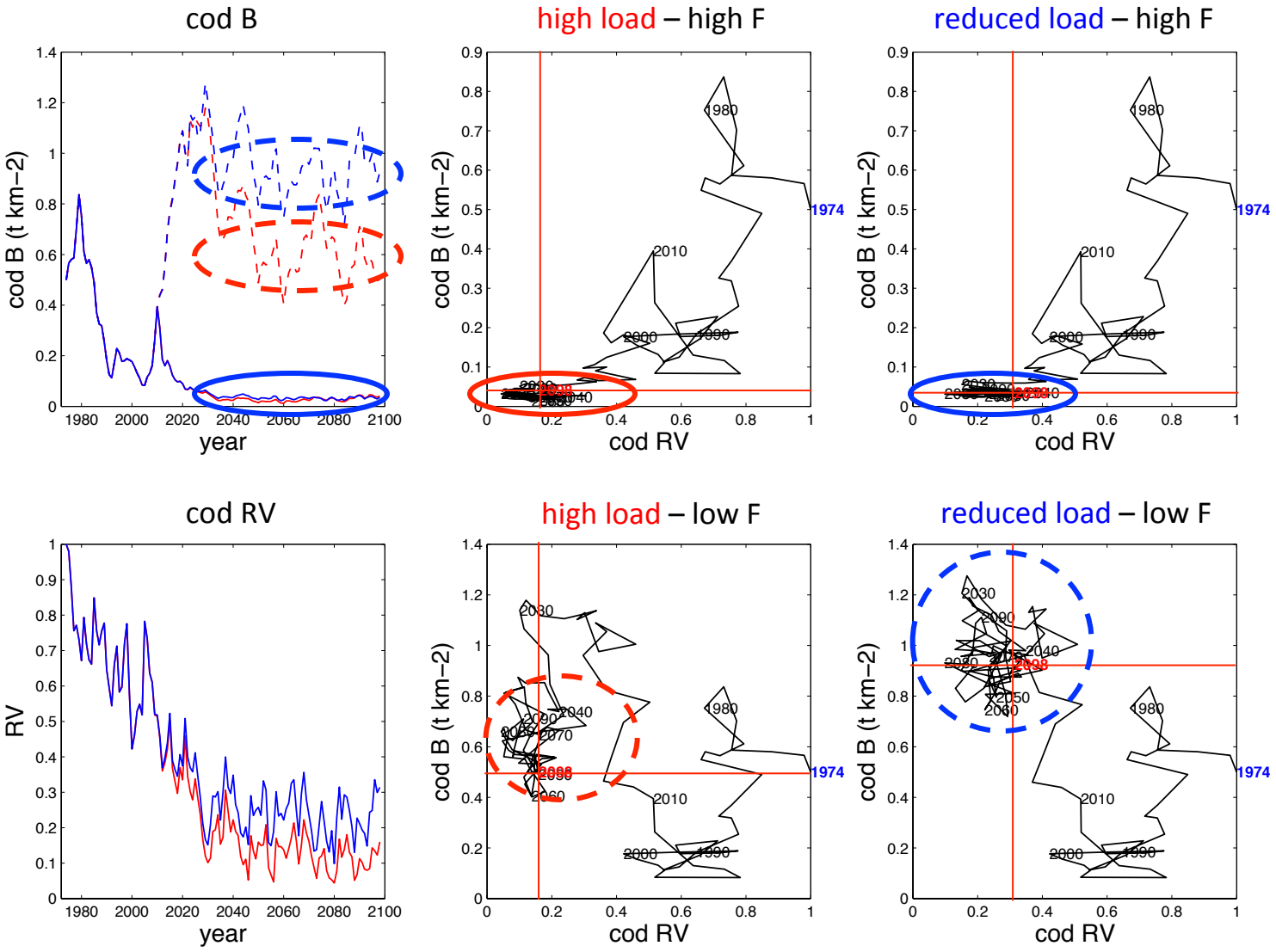
Results from three BGMs averaged over global emission scenarios A1B and A2 (Echam 5)



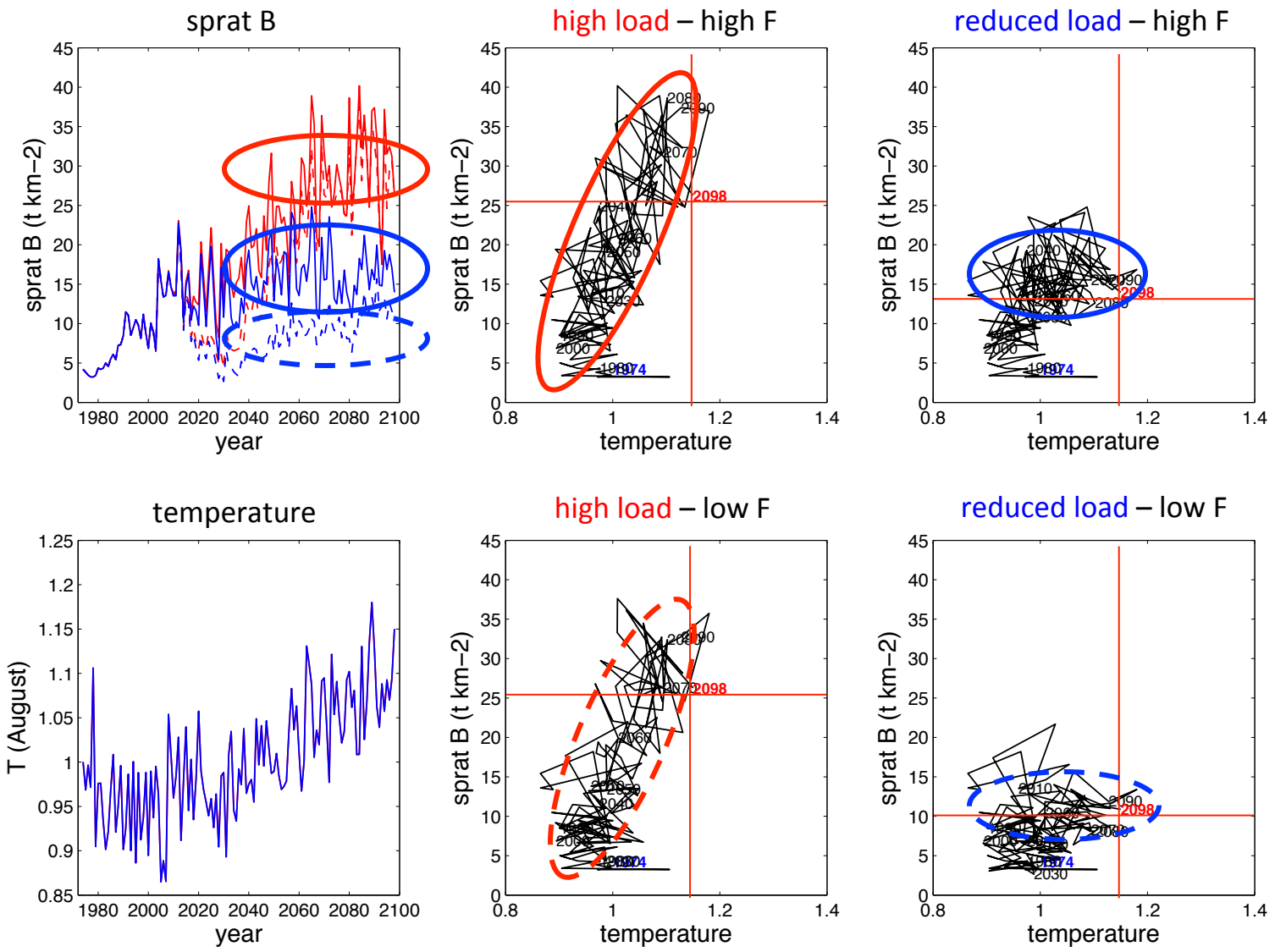
Population responses to changes in climate variables under different conditions

climate scenario A2

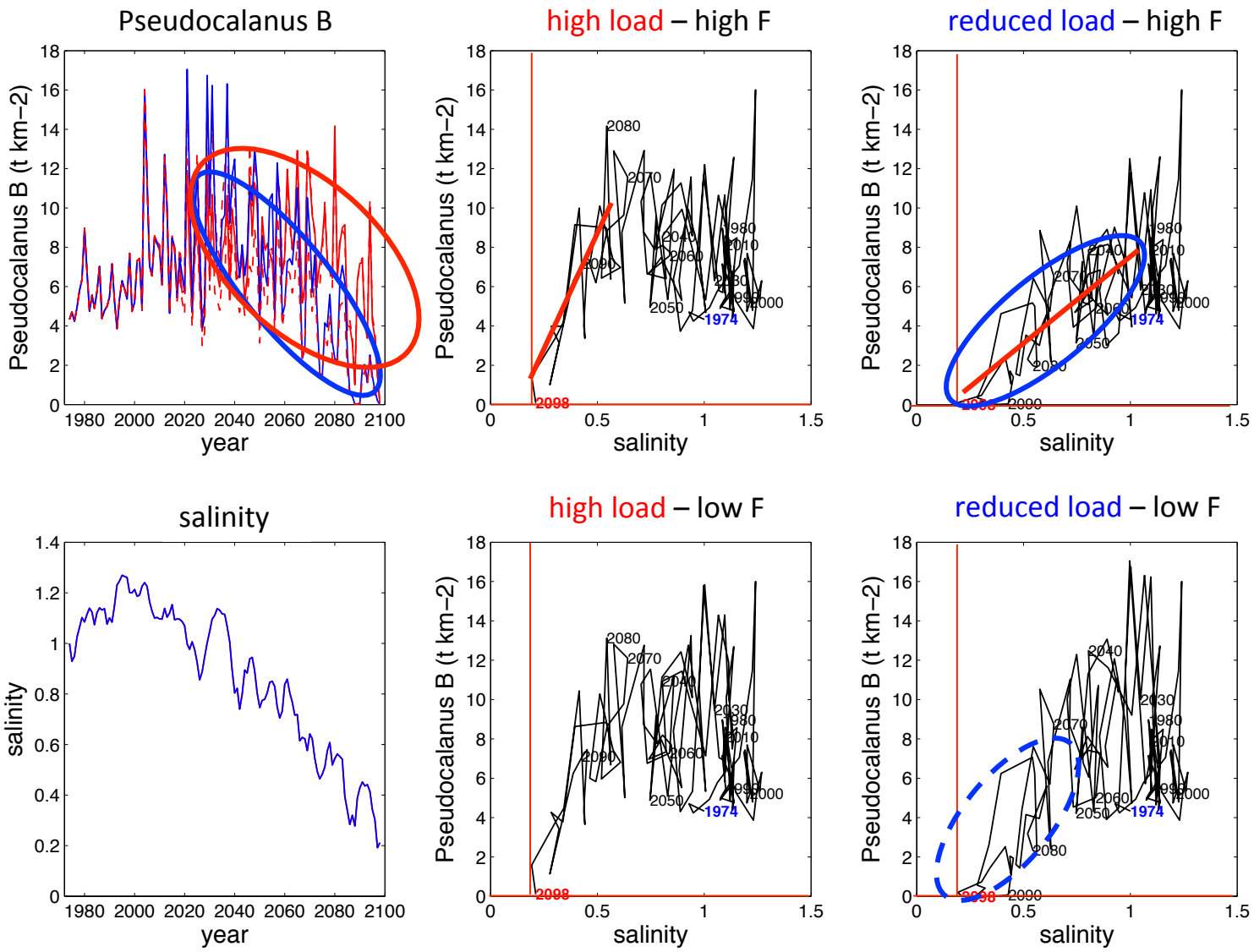
Cod biomass VS reproductive volume (RV)



Sprat biomass VS summer temperature



Pseudocalanus biomass VS salinity



To conclude

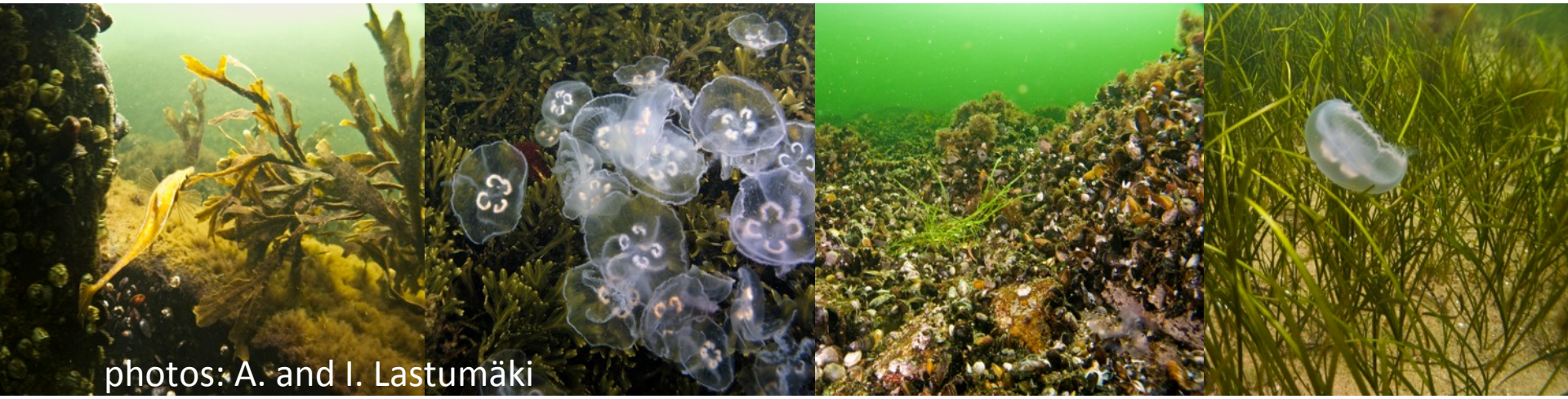
- The simulations show that the combination of drivers is likely to determine the future of the Baltic Sea ecosystem.
- Population level responses to changes in climate variables (incl. thresholds) were different as a response to
  - Fishery
  - Nutrient loads →primary productivity, hypoxia

→ Potential to mitigate the global climate change effects by regional actions

- Future challenges:
  - In these long term simulations no extreme events or evolution/ adaptation were taken into account
  - What is projected for the future has not been seen in the past → possibility for unseen dynamics

Acknowledgements

- The study has been carried out as part of the ECOSUPPORT project (www.baltex-research.eu/ecosupport)
- ICES travel funding enabled my participation in this symposium



e-mail: susa.niiranen@stockholmresilience.su.se