Baltic Earth Workshop on Multiple drivers for Earth system changes in the Baltic Sea region

26-27 Nov 2018, Tallinn, Estonia

Impact of multiple drivers on fish stocks in the Baltic Sea

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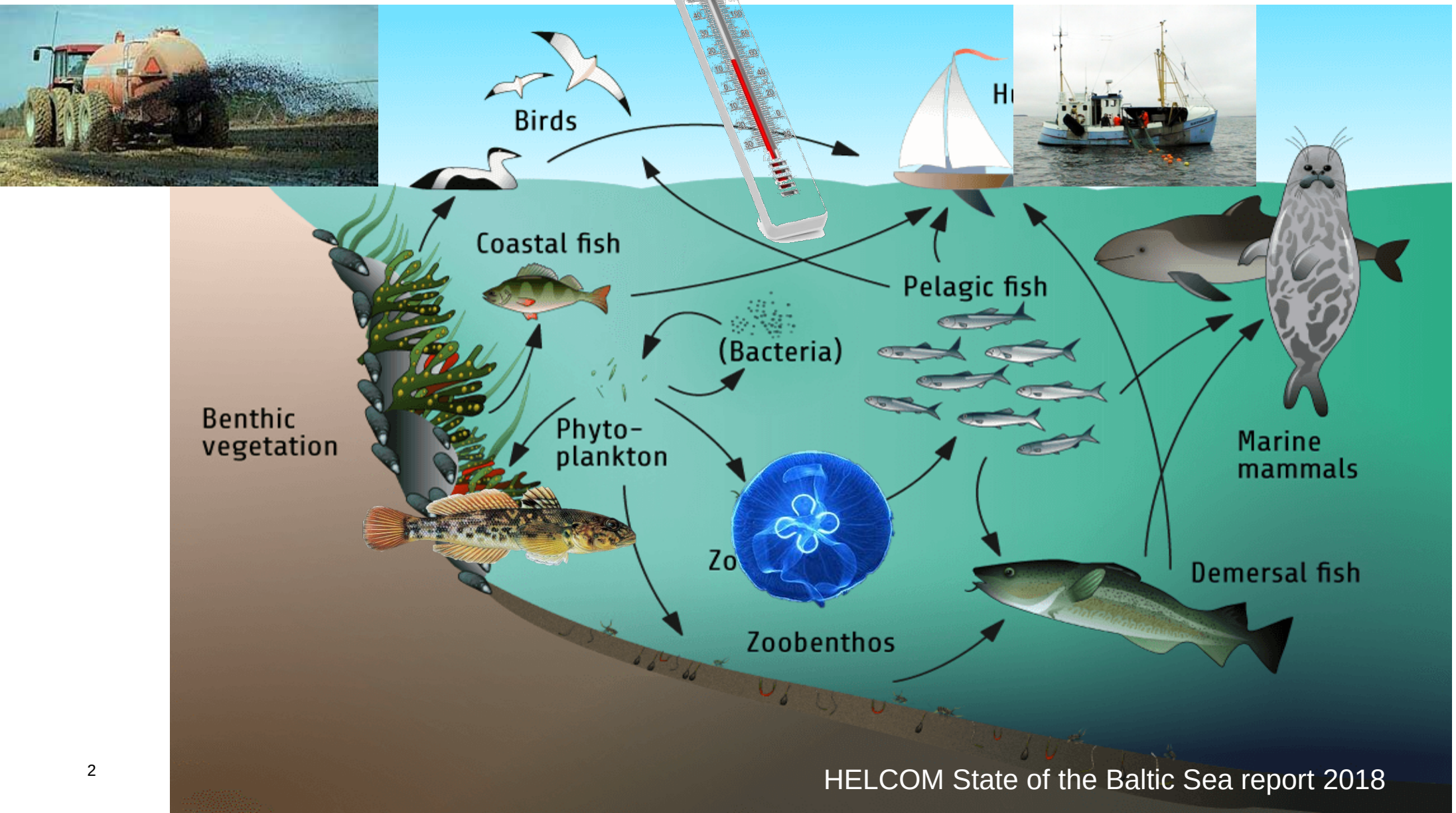
BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

Fish stocks are influenced by multiple drivers



HELCOM State of the Baltic Sea report 2018

Fisheries effects:

coordinated data collection and regular investigations

Data collection

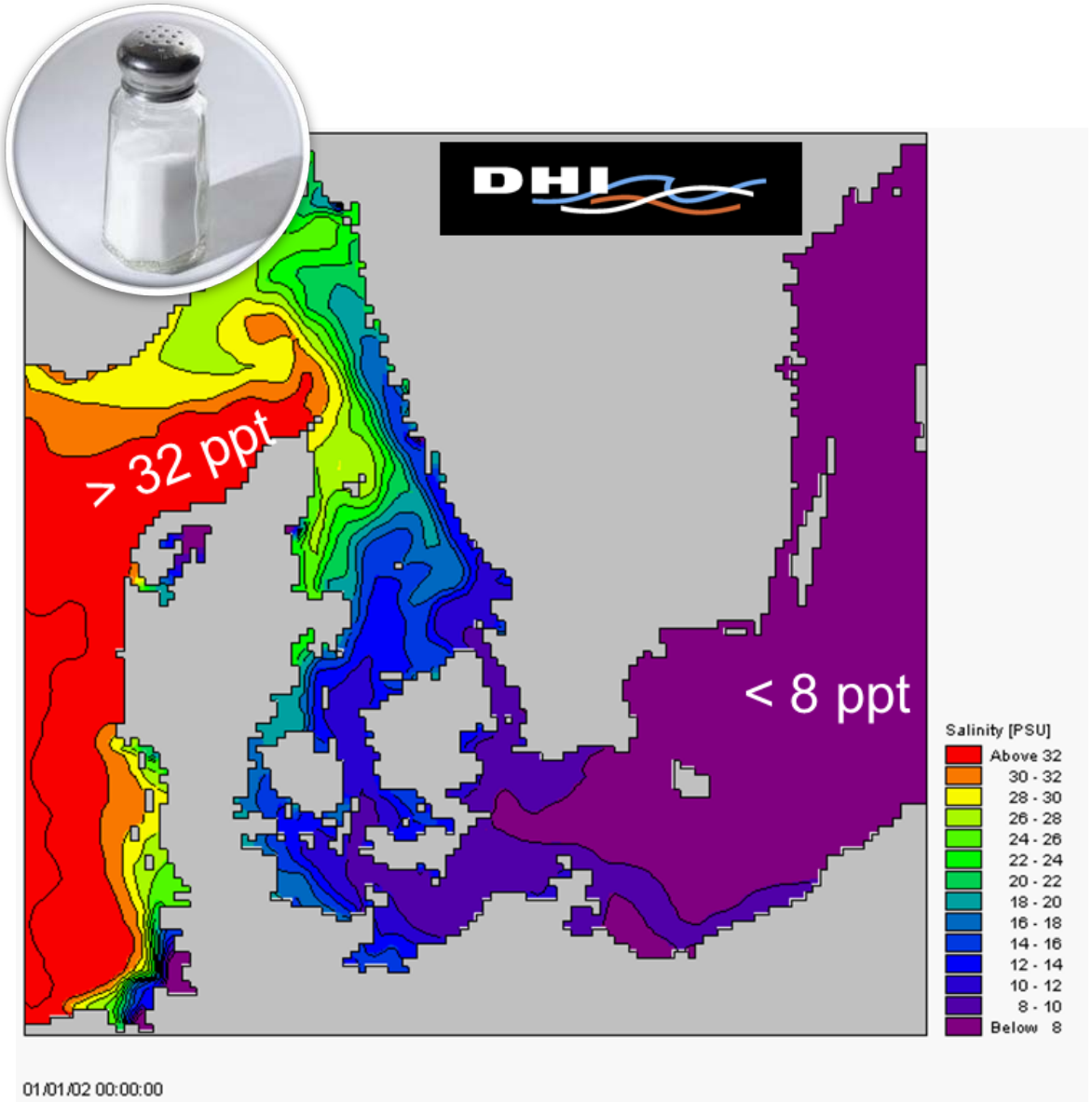
Fish stock assessments & management advice

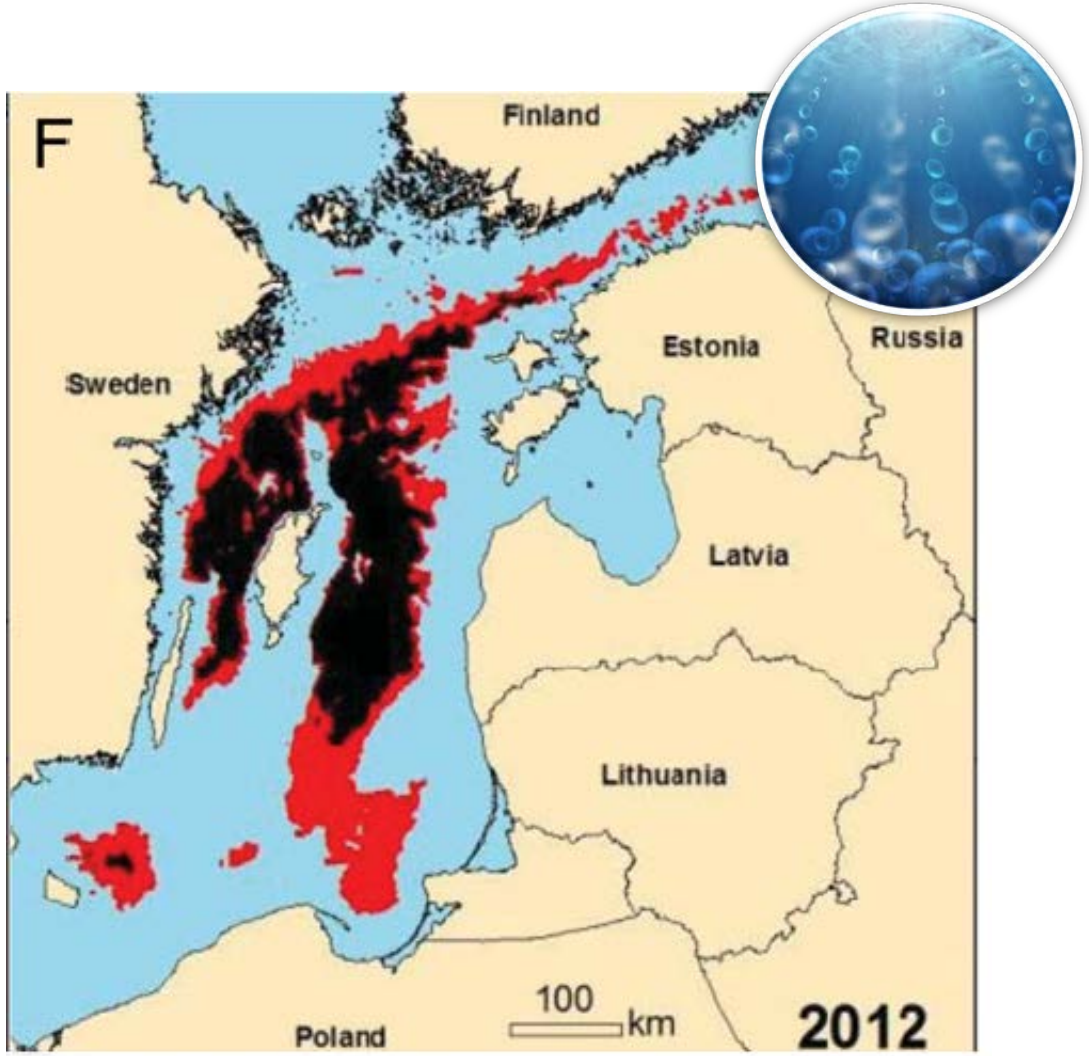
Fisheries regulations, quotas

Key question:

How much can be removed to achieve maximum sustainable long-term yields

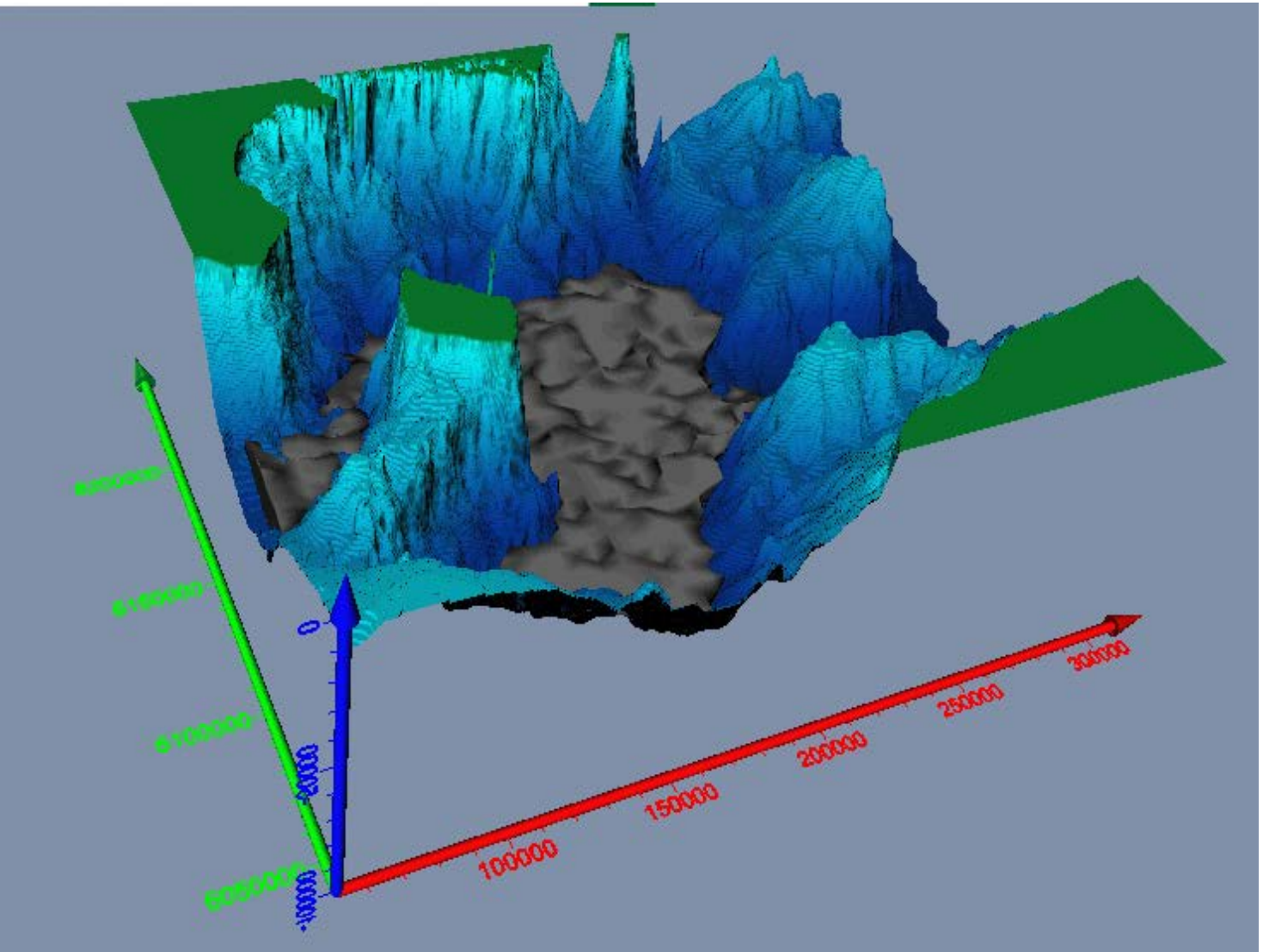
Climate impacts: Salinity & Oxygen

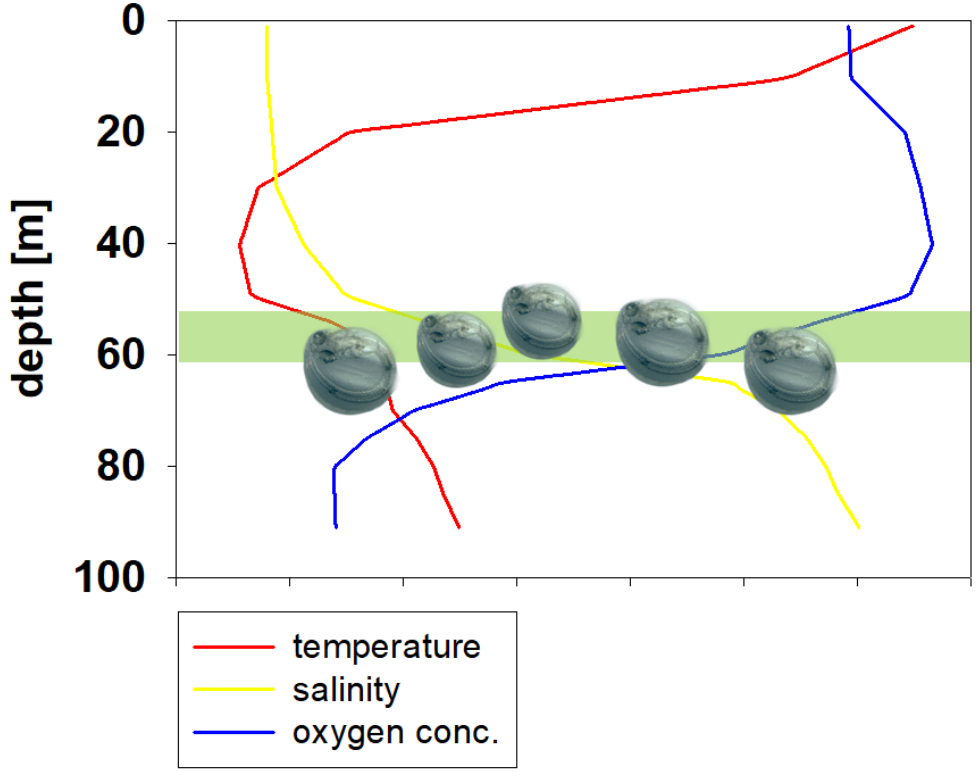




Carstensen et al 2014

Cod reproductive volume – water layer with certain S, O2 and T

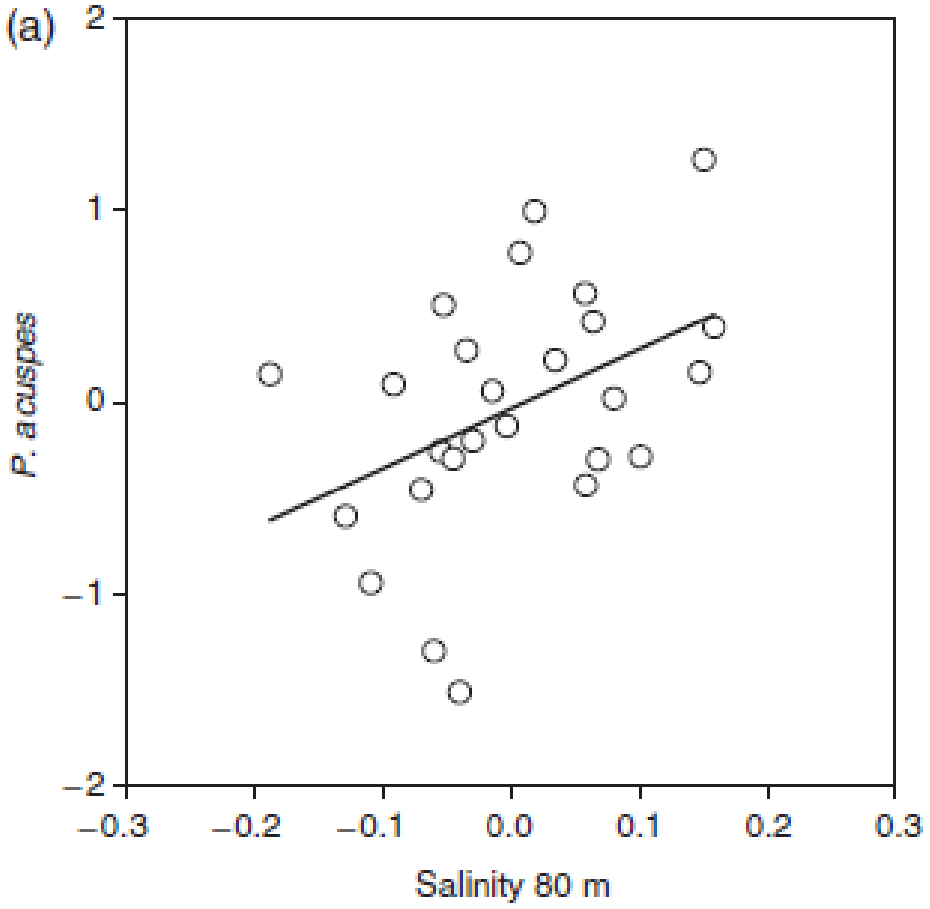


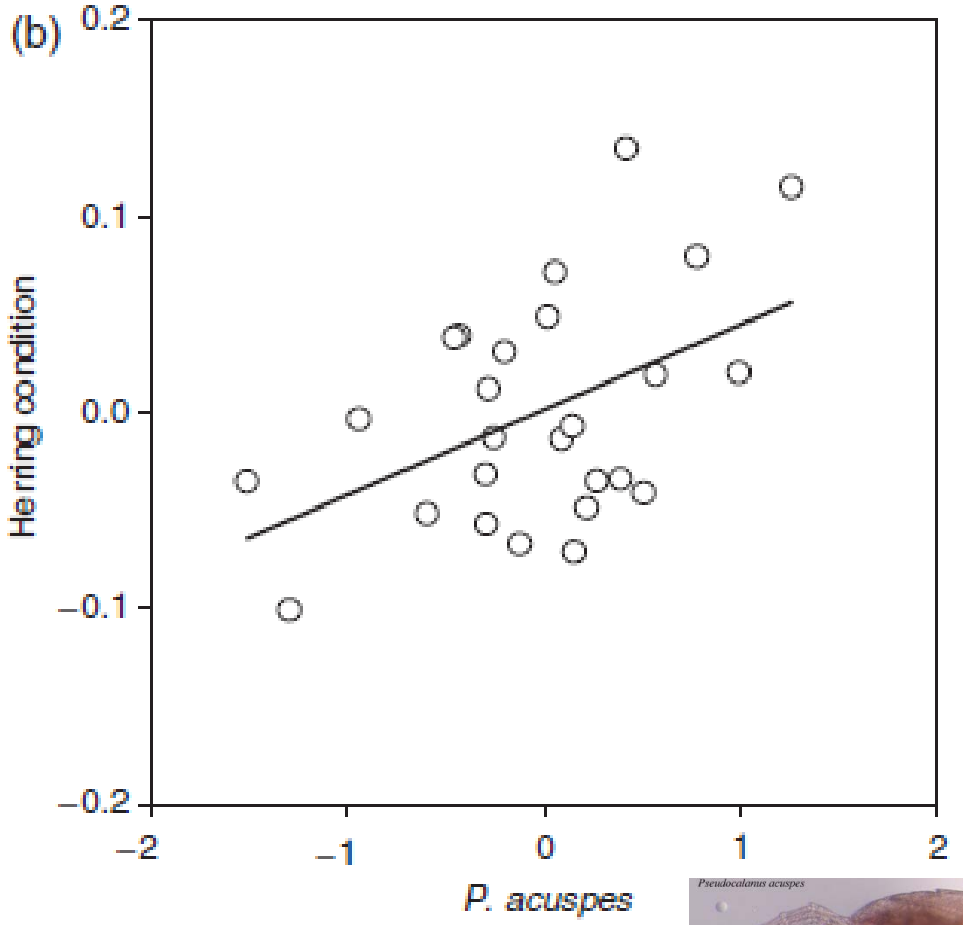


Reproduction volume:

- Salinity > 11 ‰
- Oxygen > 2 ml/l
- Temp > 2º C

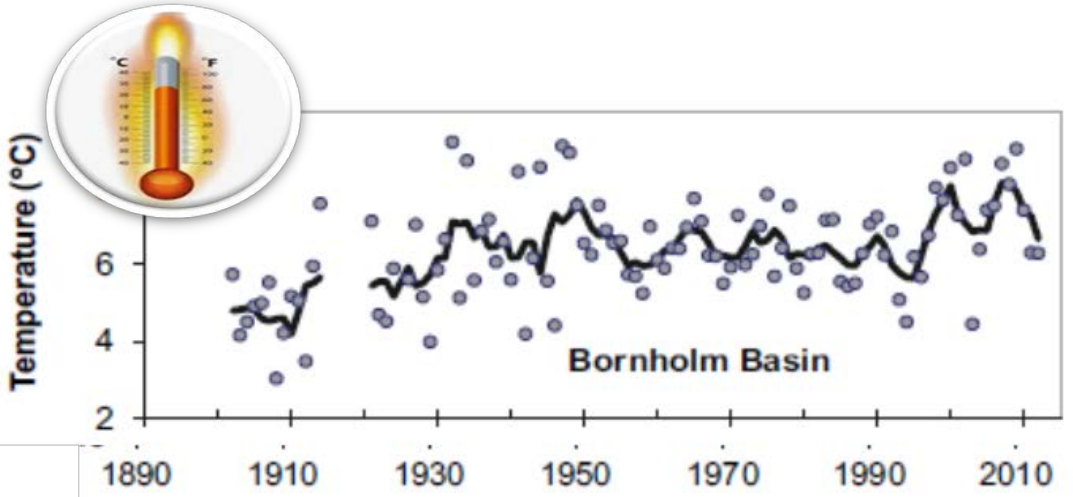
Low salinity reduces favourite prey availability

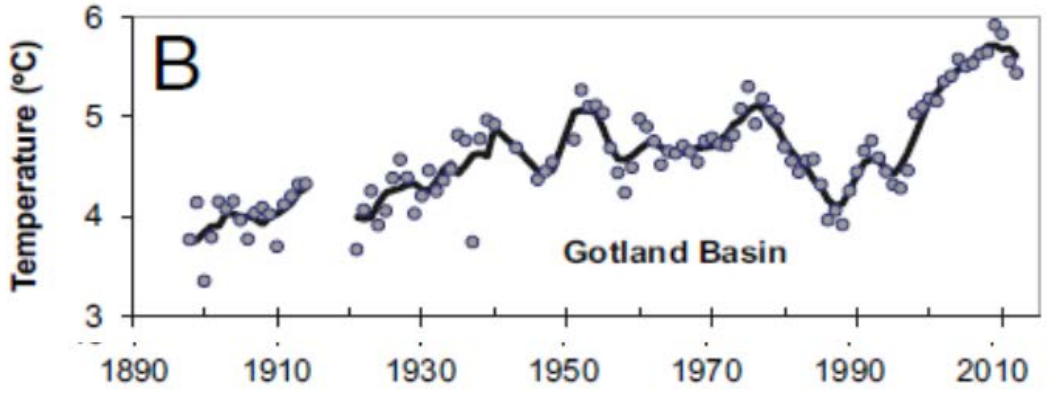




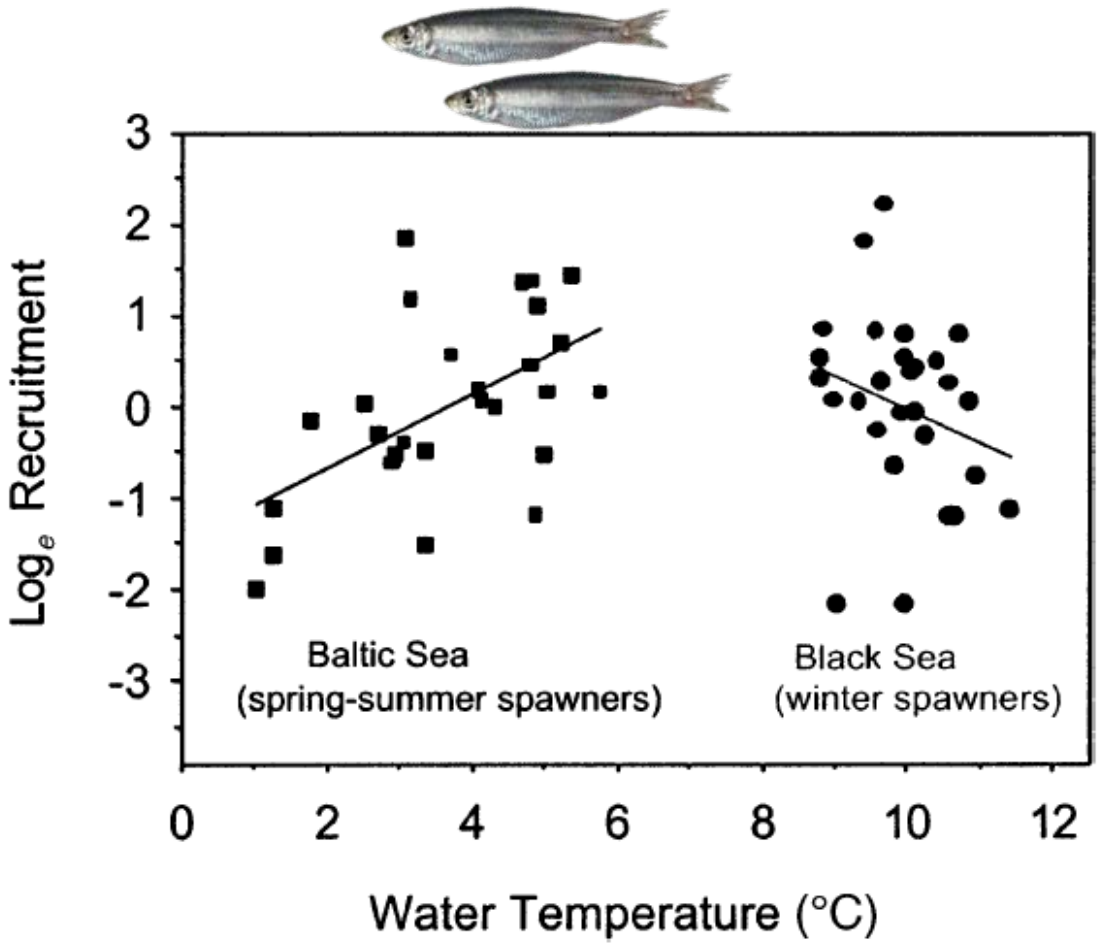
MacKenzie et al. 2007

Climate impacts: Temperature



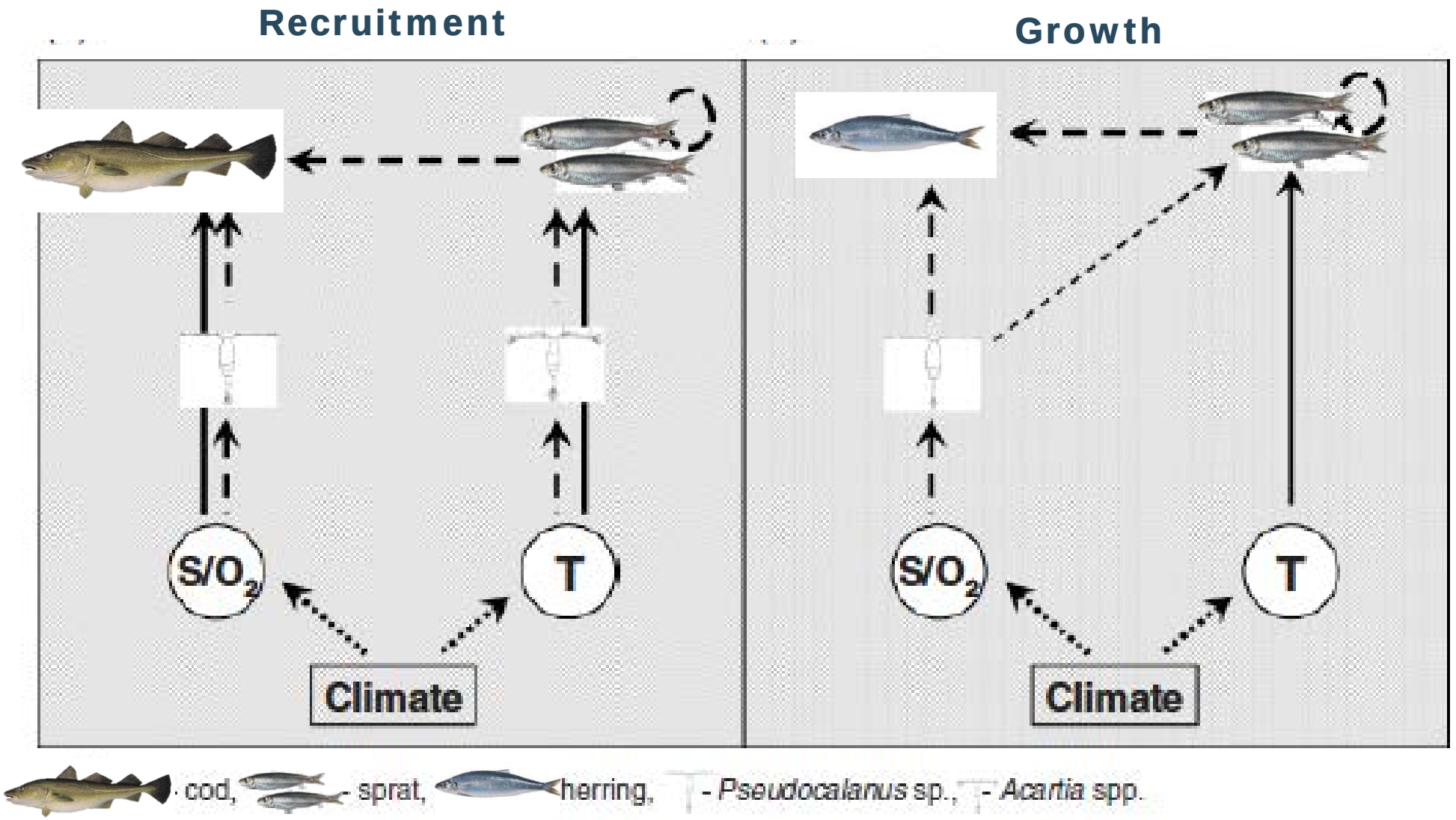


Swedish Meteorological and Hydrological Institute; Carstensen et al. 2014



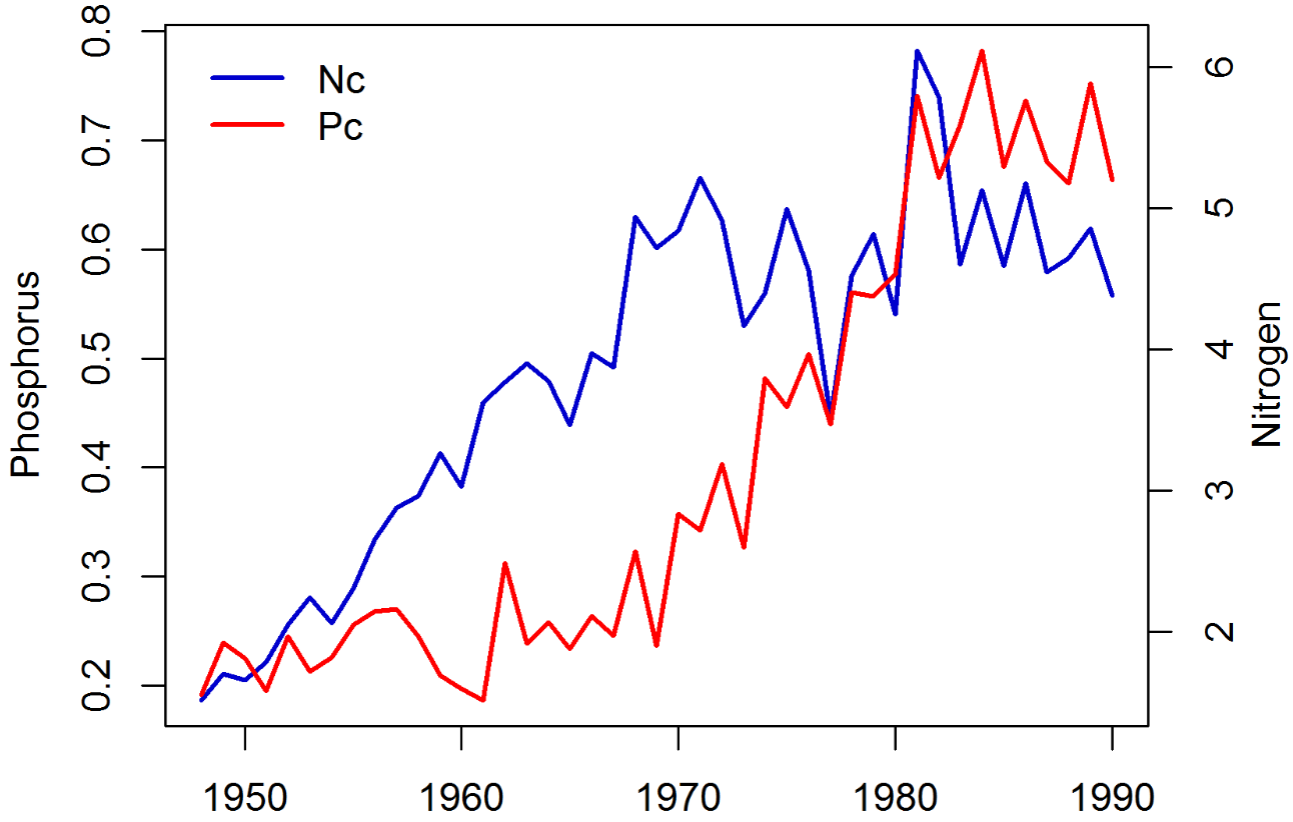
MacKenzie et al. 2007

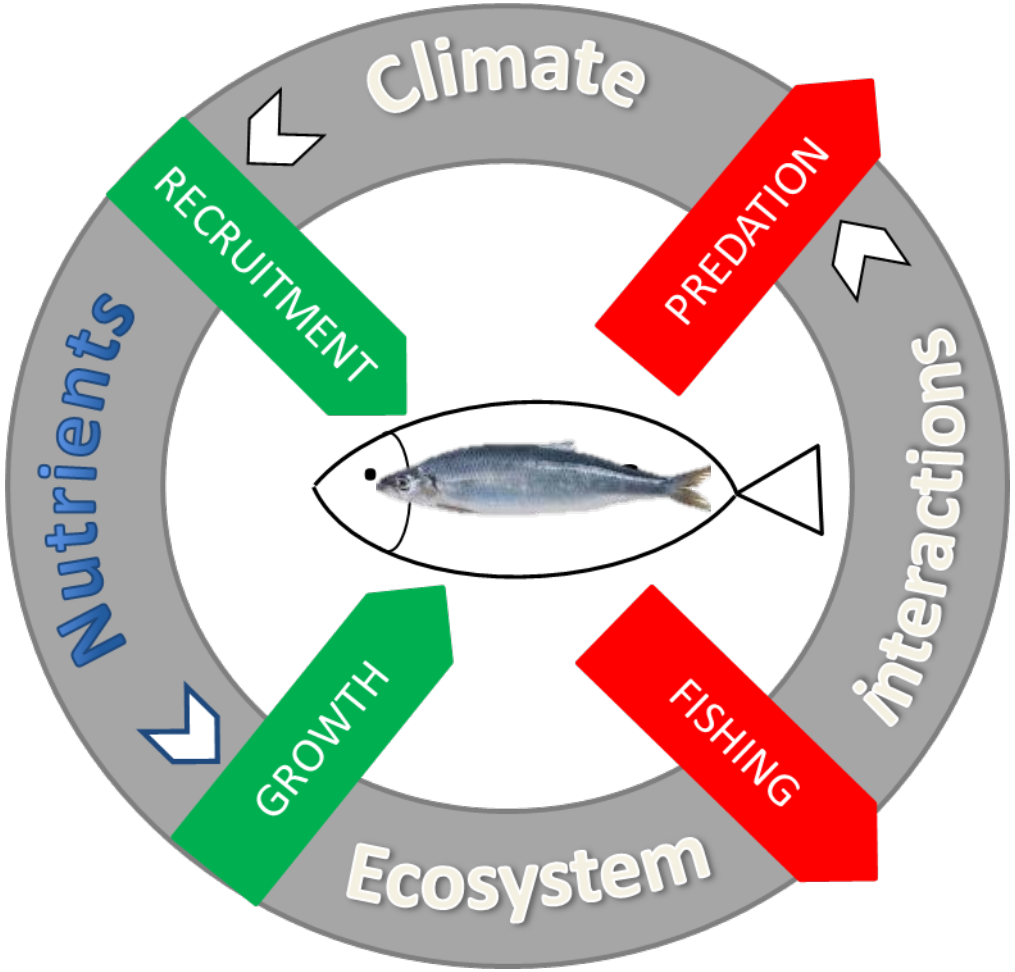
Climate has large and complex impacts on fish in the Baltic Sea



MacKenzie et al. 2007)

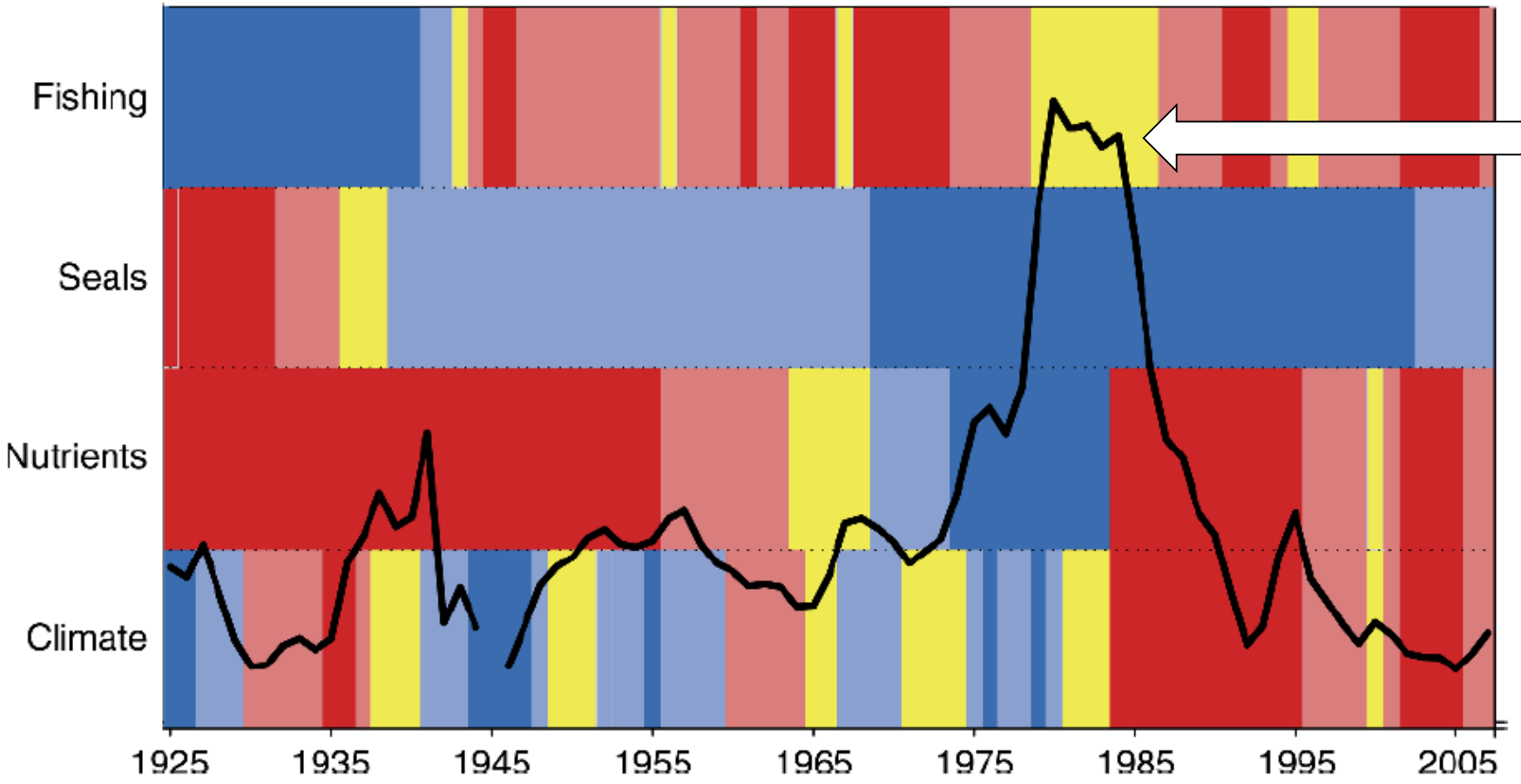
Historical impacts of nutrients increase on clupeids

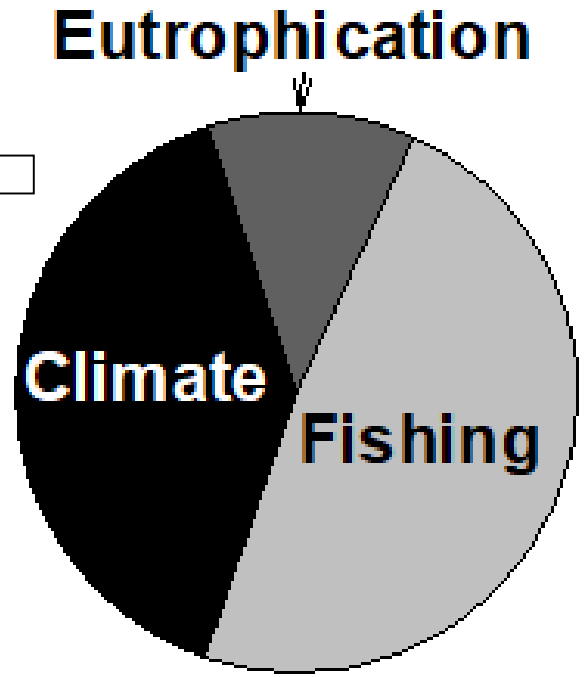




Eero et al. 2016

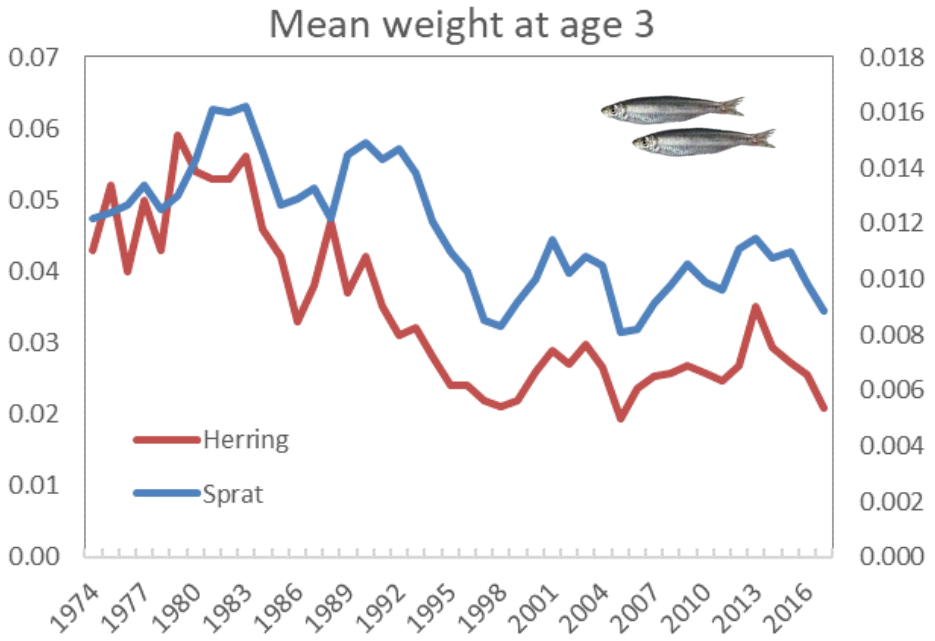
Historical impacts of nutrients increase on cod

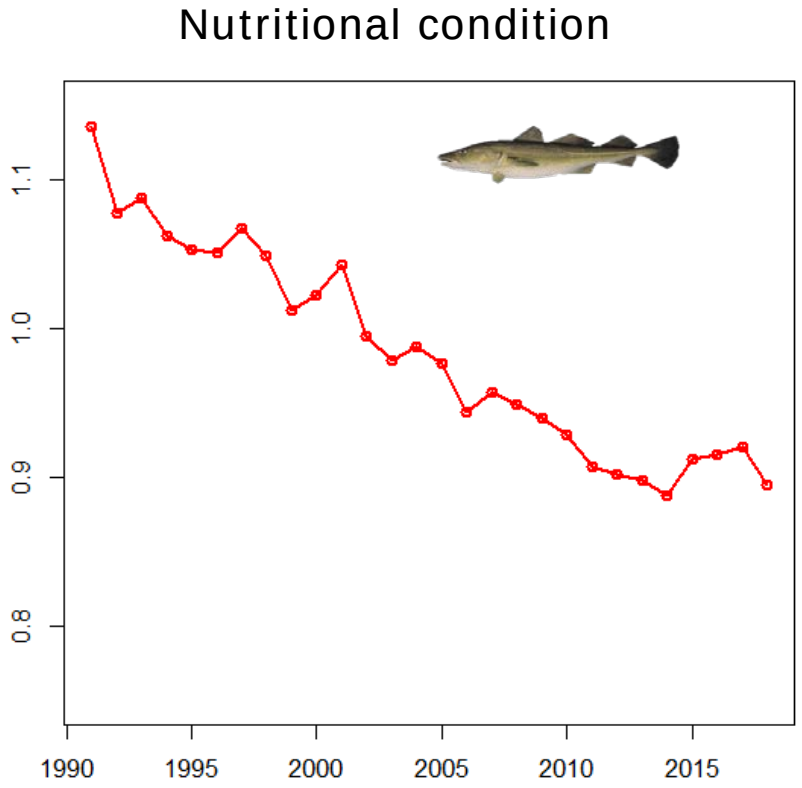




Eero et al. 2011

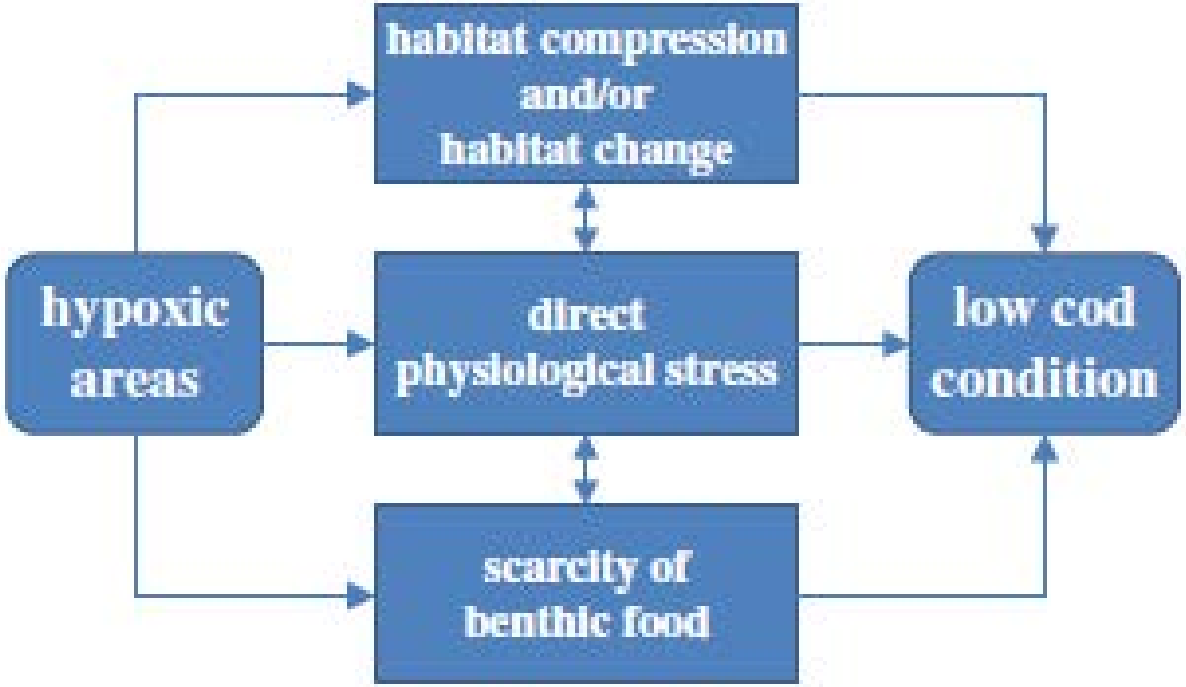
Baltic fish have become thinner





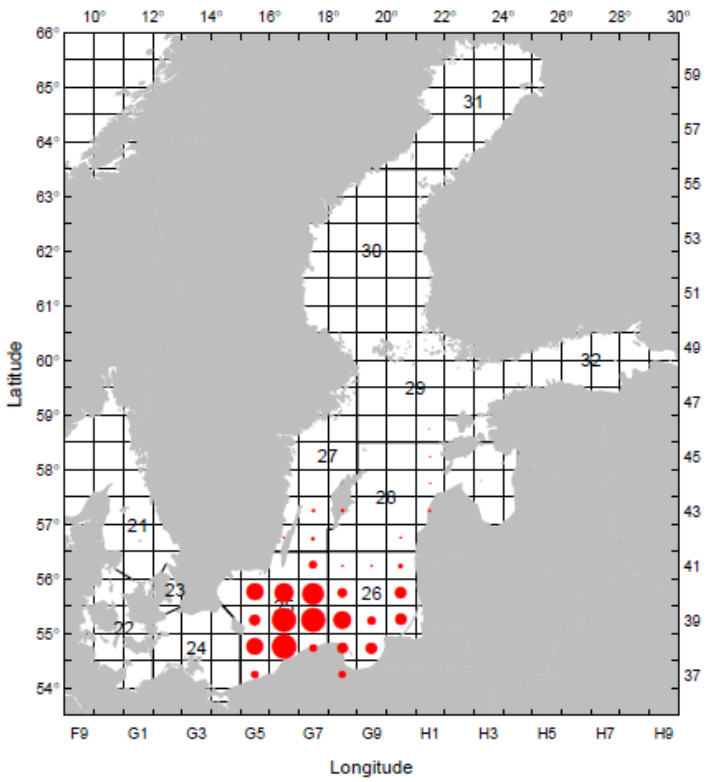
Eastern Baltic cod currently distressed by multiple factors

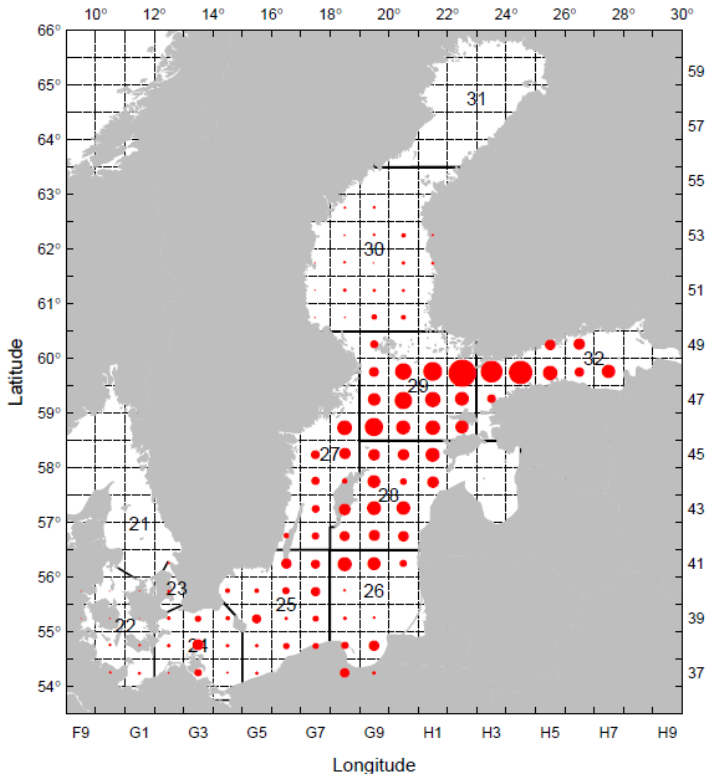
Hypoxia - negative impacts through several processes



Casini et al. 2016

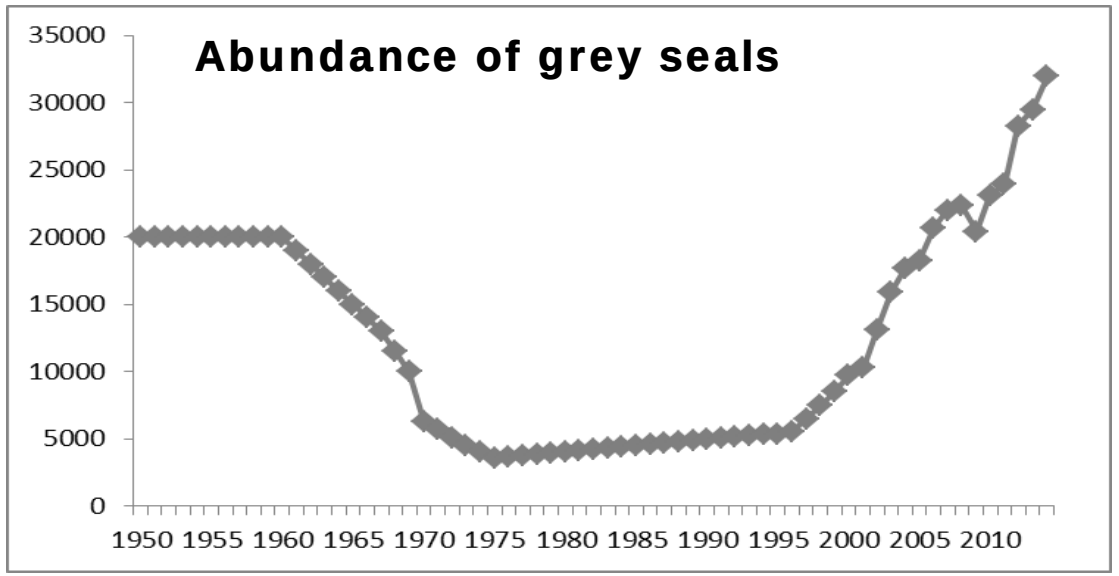
Spatial distribution of species affects prey availability





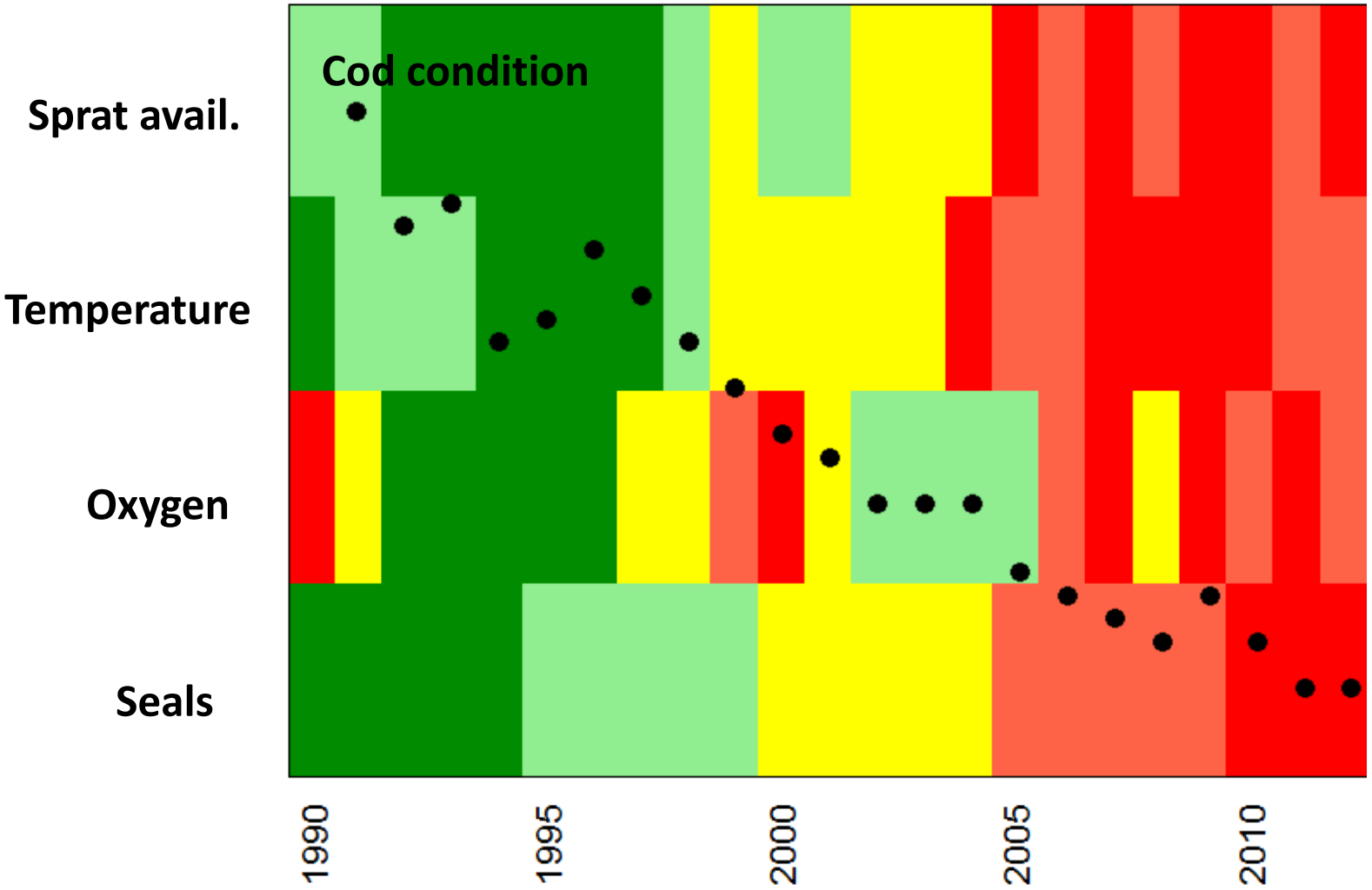
ICES Advice 2016, Book 8

Grey seals eat cod and give them parasites



HELCOM

Simultaneous changes in multiple drivers



Process knowledge needed to:

- Predict future, considering reproductive success of the fish & ecological interactions
- Define management targets in a changing world
- Evaluate the effect of management measures

Summary of knowledge:

What do we have:

- Long-term institutional knowledge
- Long time series
- Undigitized data & unprocessed samples
- Process knowledge on various species & life stages
- Progress in observation technology & molecular biology
- Advanced modelling tools

What is needed:

- Empirical analyses
- Controlled laboratory experiments
- Appropriately scaled field experiments
- Process modelling
- Integration into mechanistic and analytical model environments