INSTITUTE OF MARINE RESEARCH

Effects of climate variability and change on fish populations

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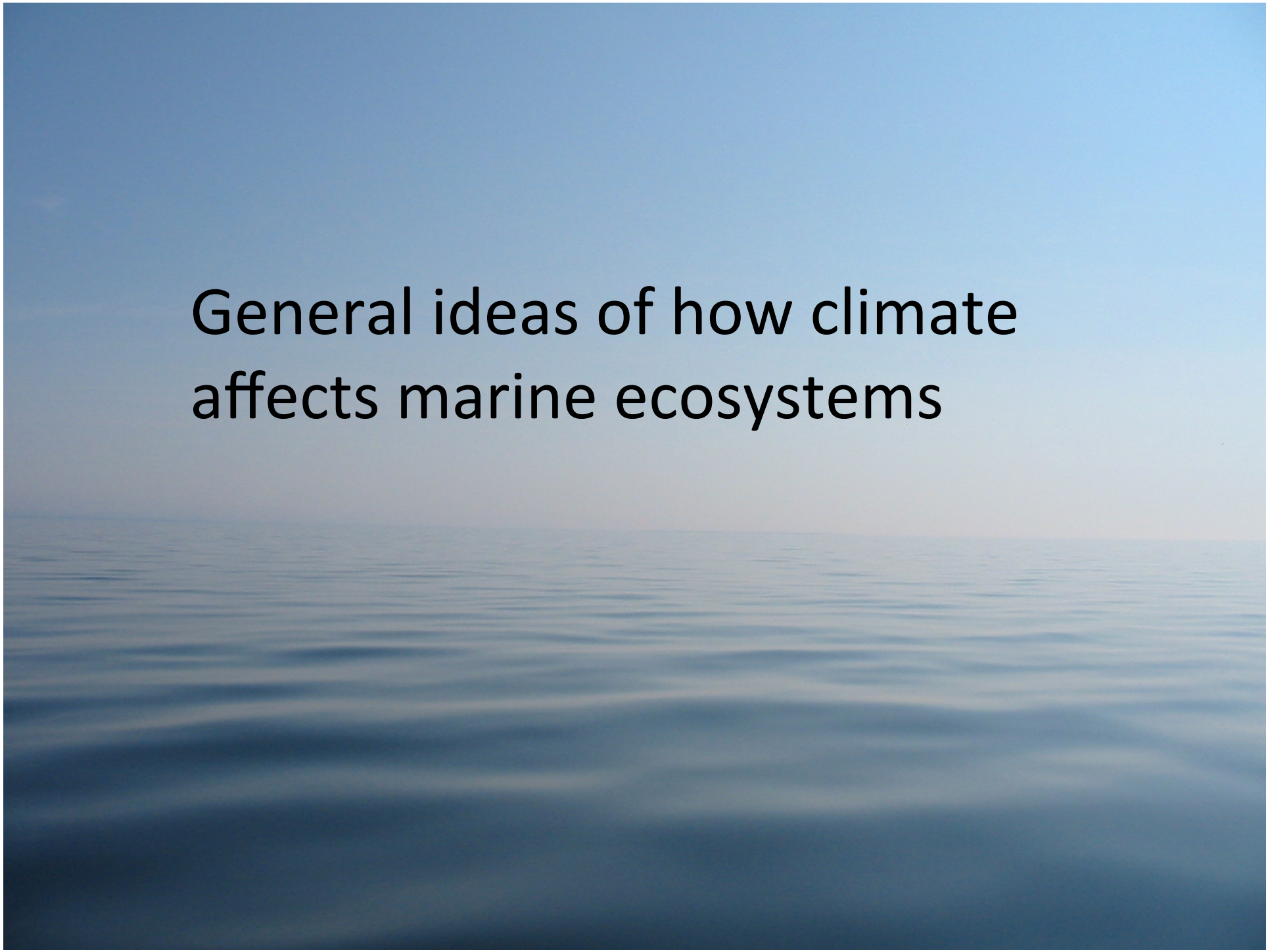
MULTI-LEVEL GOVERNANCE IN MARITIME SPATIAL PLANNING THROUGHOUT THE BALTIC SEA REGION

PartiSEApate

Workshop on Climate Change Adaptations and Maritime Spatial Planning in the Baltic Sea
Skanør, Sweden May 14th 2013

CEES
Centre for Ecological and Evolutionary Synthesis

Norwegian Centre of Excellence


General ideas of how climate affects marine ecosystems

How Does Climate Affect Fish?

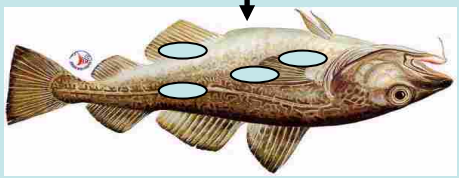
Predators

Recruitment
Distribution and migration

Physiological Effects

- Metabolic processes
- Growth

Prey



Disease

Modified from slide by Ken Drinkwater, IMR

Direct
response
to climate

Through physiology,
(metabolic and reproductive processes)

Indirect
response
to climate

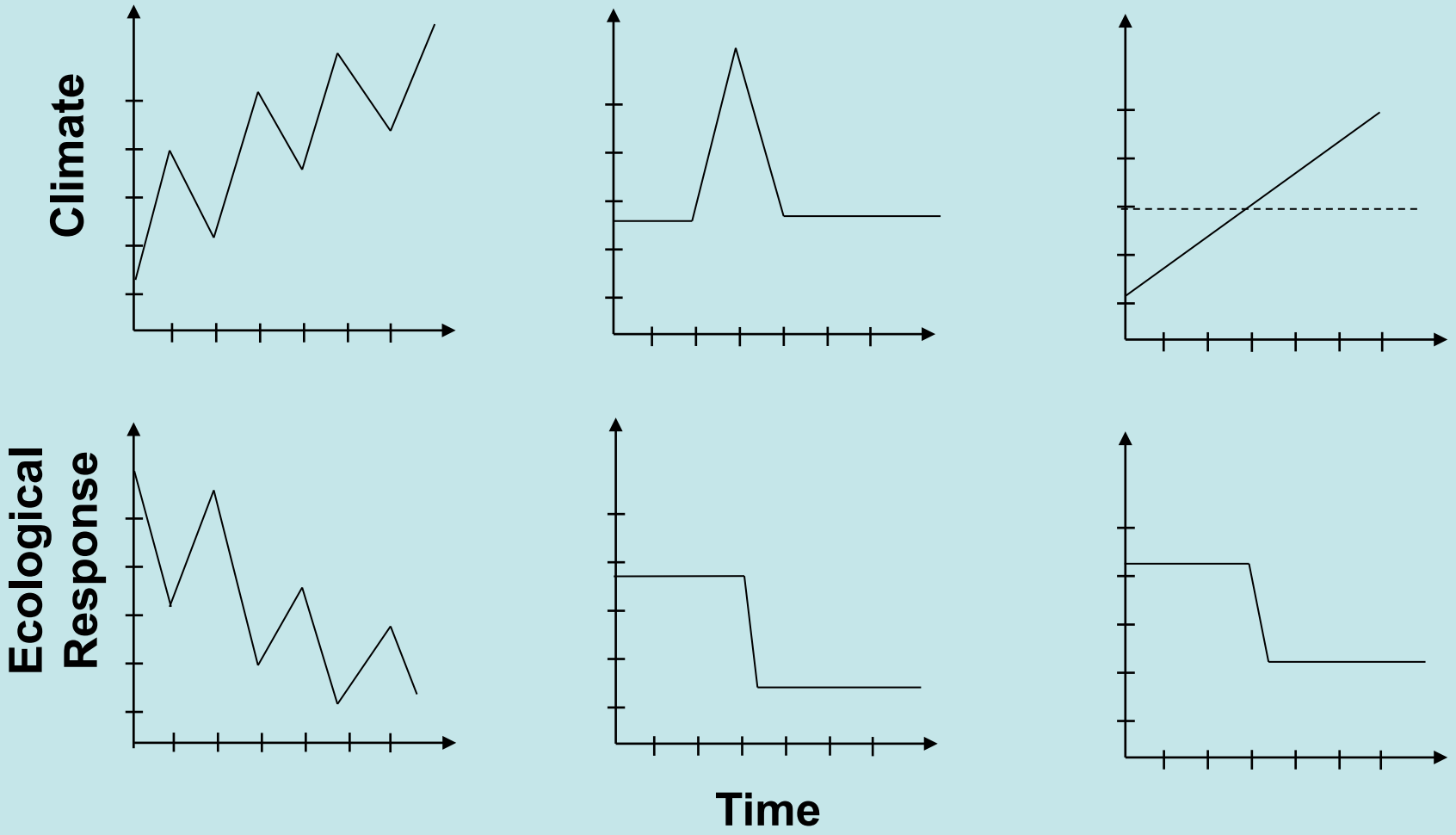
Through biotic environment
(predators, prey, species interactions, and disease)
and abiotic environment
(habitat type and structure).

Ecological response to climate signal

Linear ecological response to climate signal

Single climate event causes shift in ecological state

Linear climate signal causes shift in ecological state when climate threshold passed.

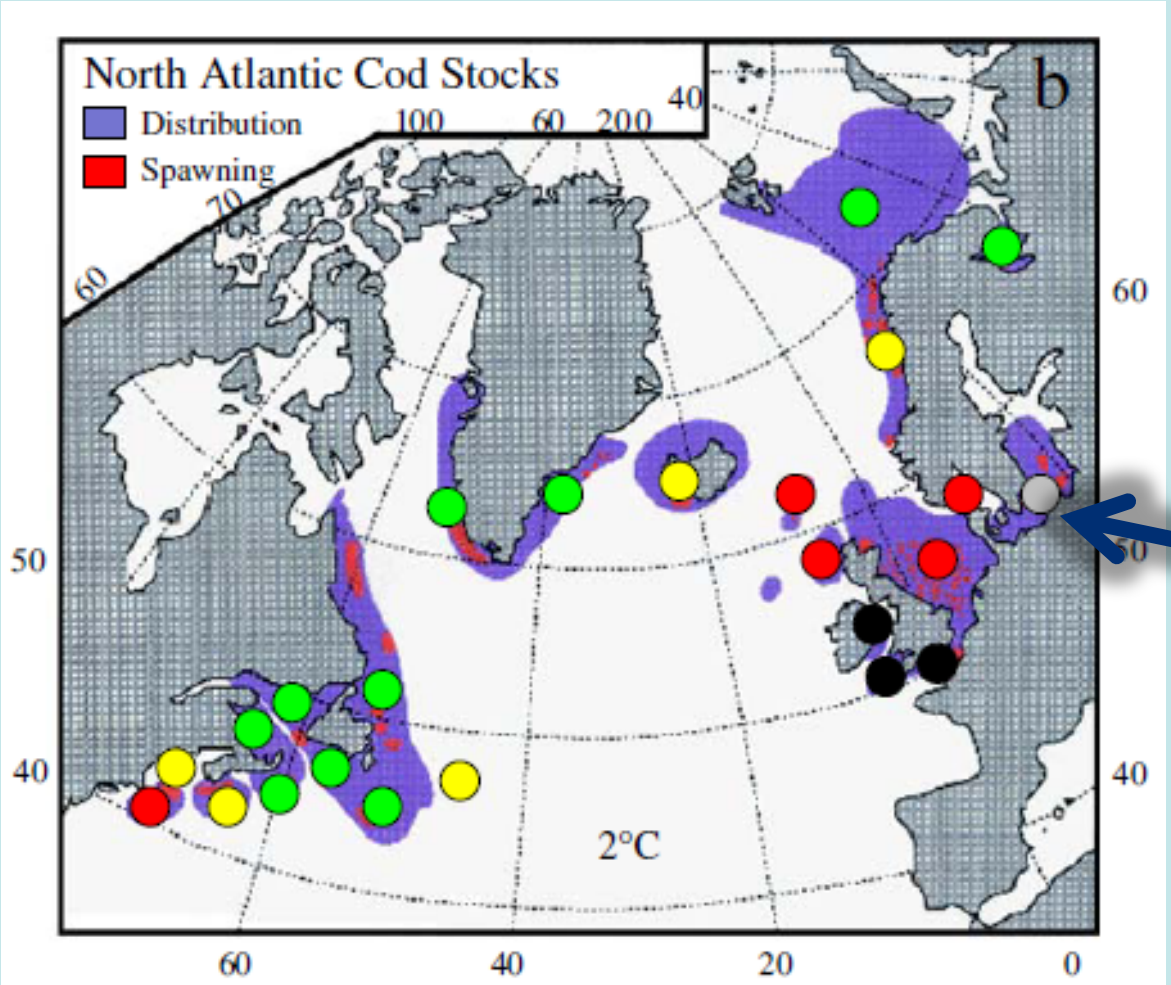


Ottersen et al. 2004 Climatic fluctuations and marine ecosystems... Oxford Univ Press


Climate and main Baltic fish stocks

Expected response of cod to climate change (2° increase)

based upon the observed responses of cod to temperature variability



Increase
No change
Decrease
Collapse
?

Baltic cod
is different!

Drinkwater, K. F. 2005. The response of Atlantic cod (Gadus morhua) to future climate change. ICES J Mar Sci

Response of cod, and other fish, to climate change is extra hard to project for the Baltic

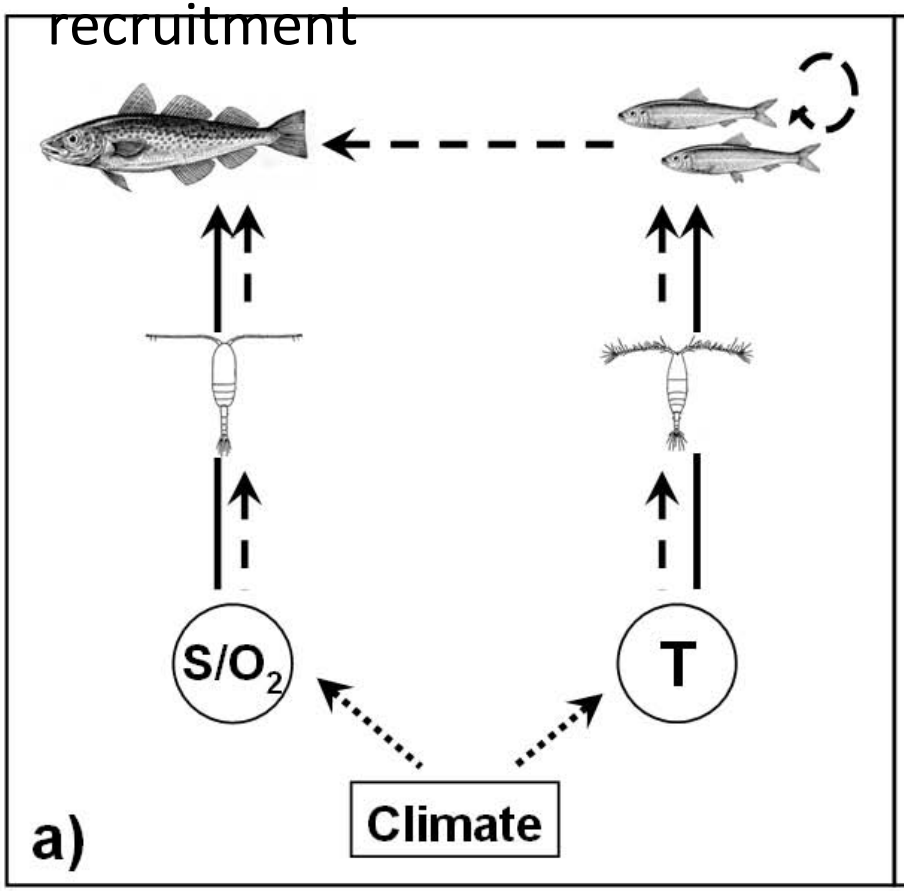
Because:

- The Baltic is brackish, an estuarine ecosystem with large horizontal and vertical salinity gradients
- Biodiversity sensitive to changes in salinity
- Expected climate changes will likely cause the Baltic to become warmer and fresher
- Temperature and salinity (and oxygen) important

MacKenzie et al. GCB 2007

Climate effects on recruitment

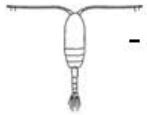
Climate effects on growth




- Cod


- Sprat


- Herring


- *Pseudocalanus* sp.


- *Acartia* spp.

Baltic open ocean ecosystem changes over the recent decades

Changes in fish and zooplankton communities

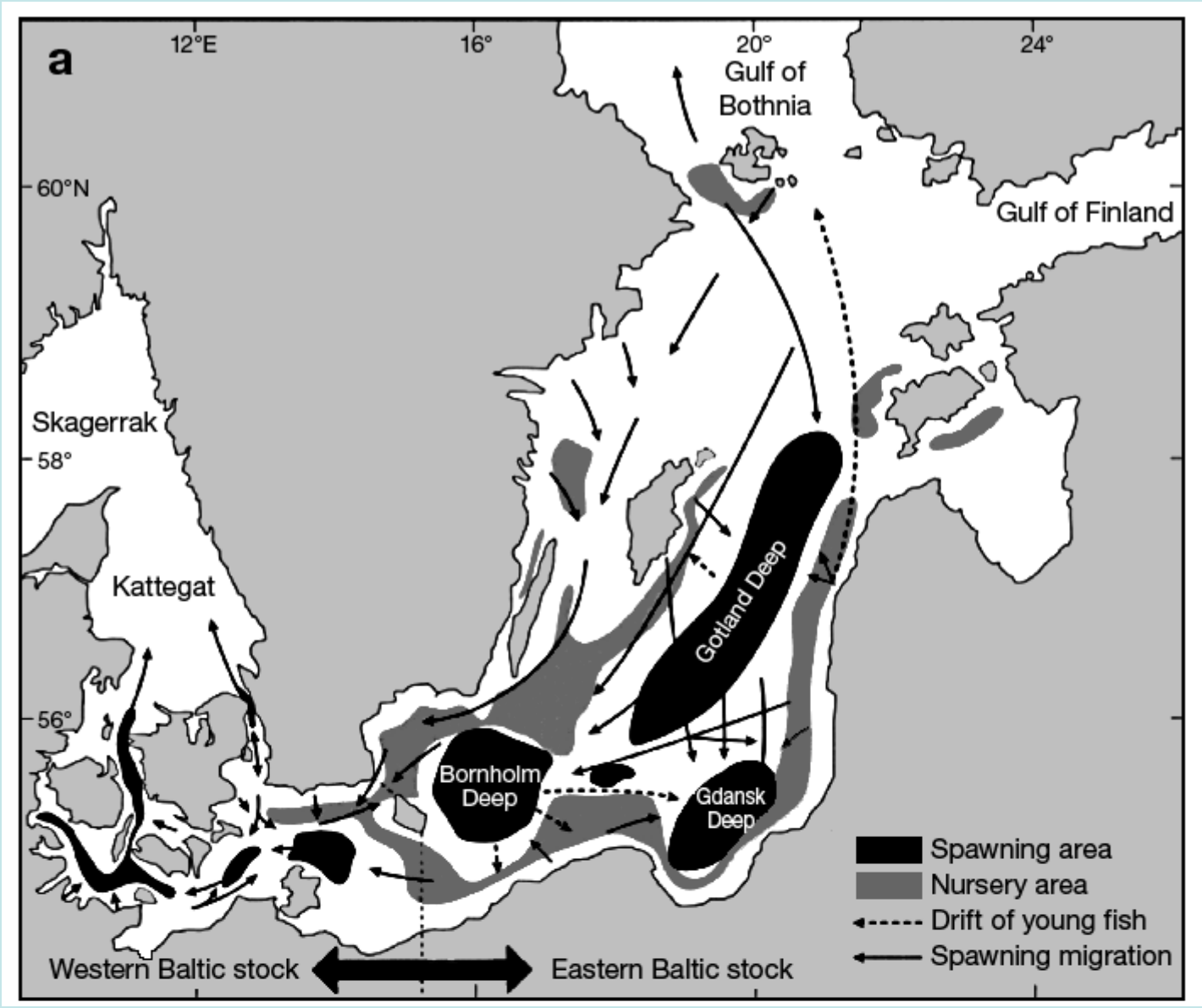
- More sprat and warm water zooplankton
- Less cod and herring
- Large sprat population eats many cod eggs
- ”Regime shift”?

May be other reason for changes in the Baltic ecosystem:

Change in population structure of Eastern Baltic cod because of climate and/or fishing

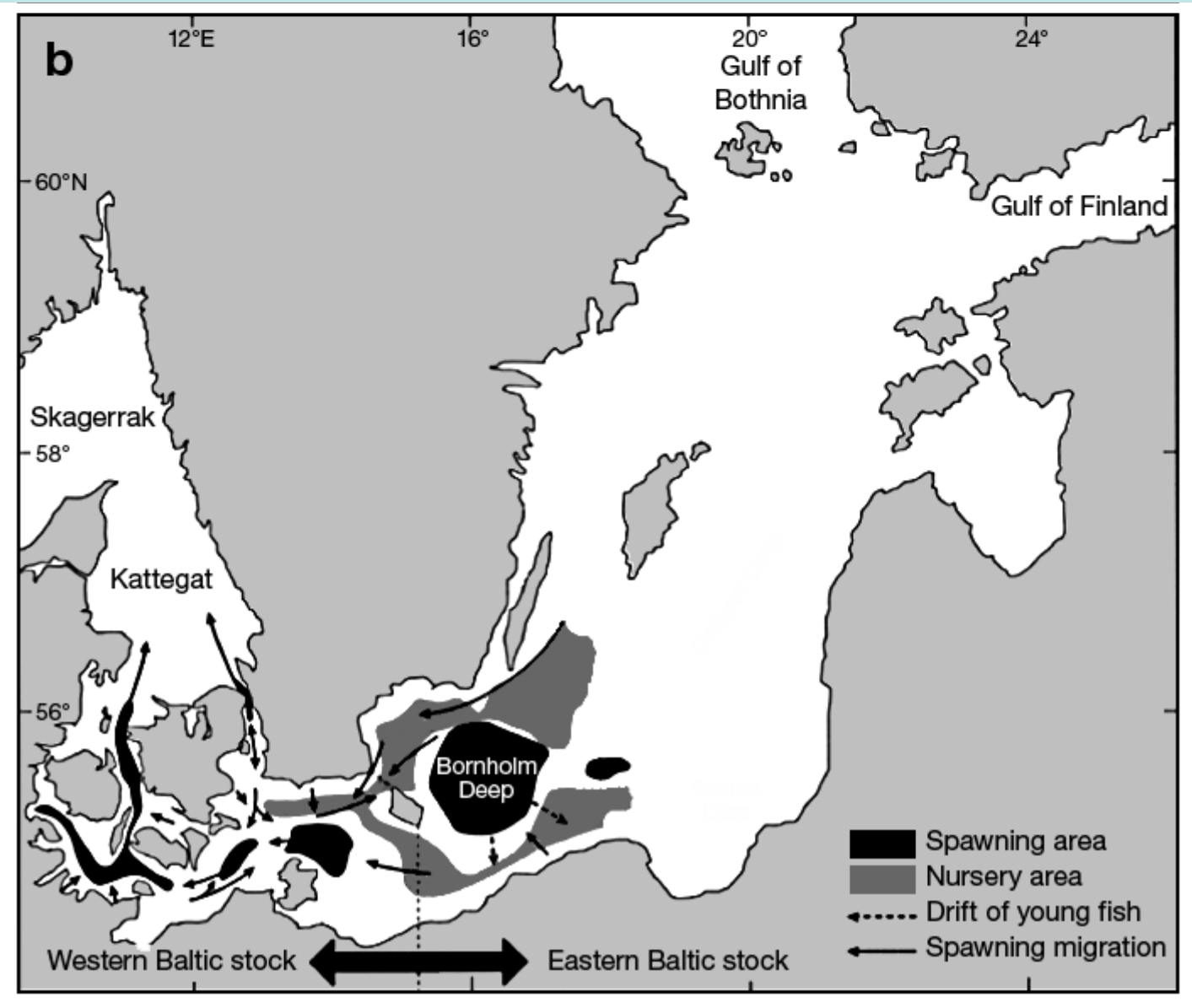
Möllmann et al. 2008; Cardinale and Svedäng 2011

Cod spawning grounds - historical



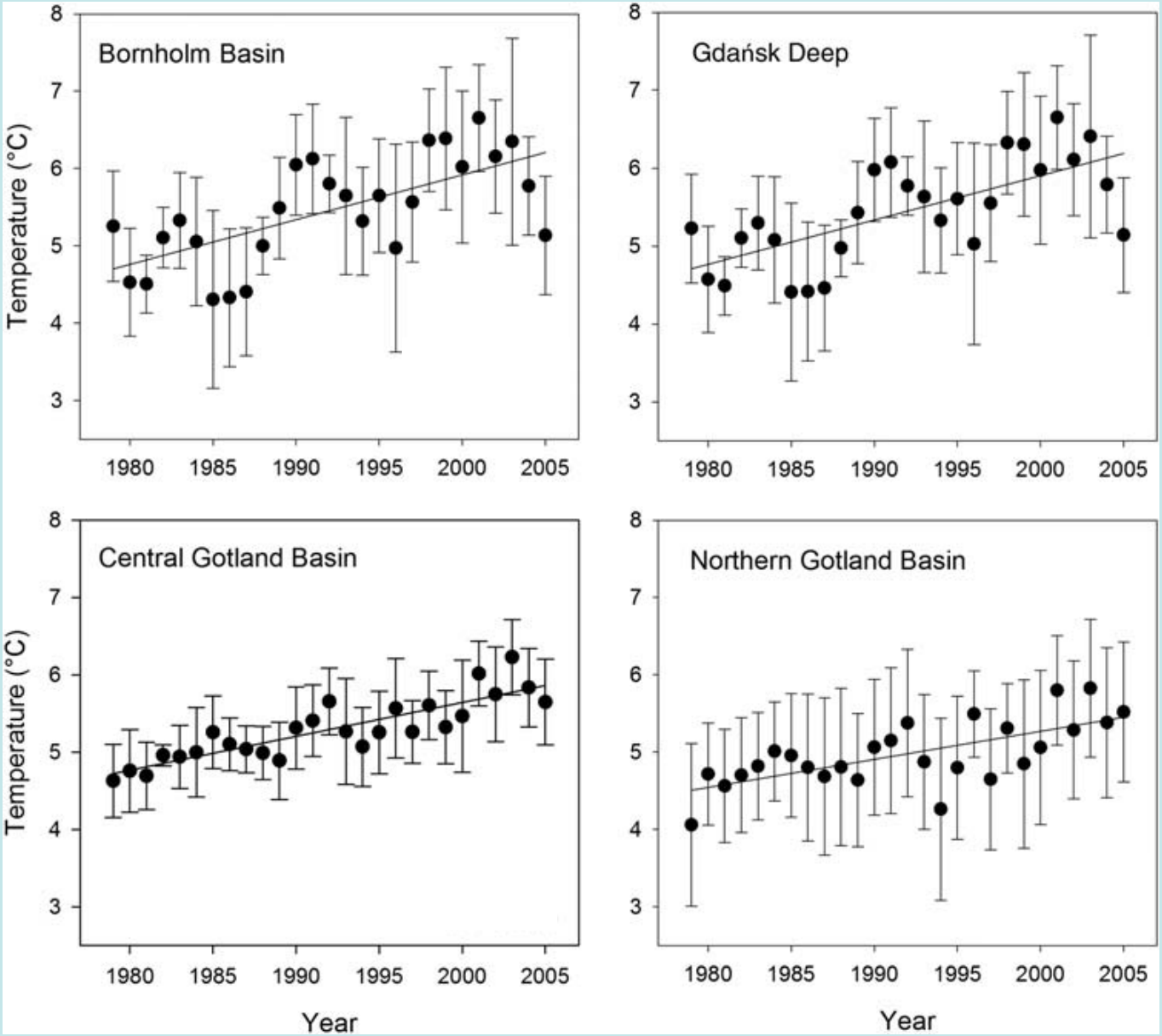
Cardinale and Svedäng 2011

Cod spawning grounds - present



Cardinale and Svedäng 2011

Temperature increase in **sprat** spawning grounds



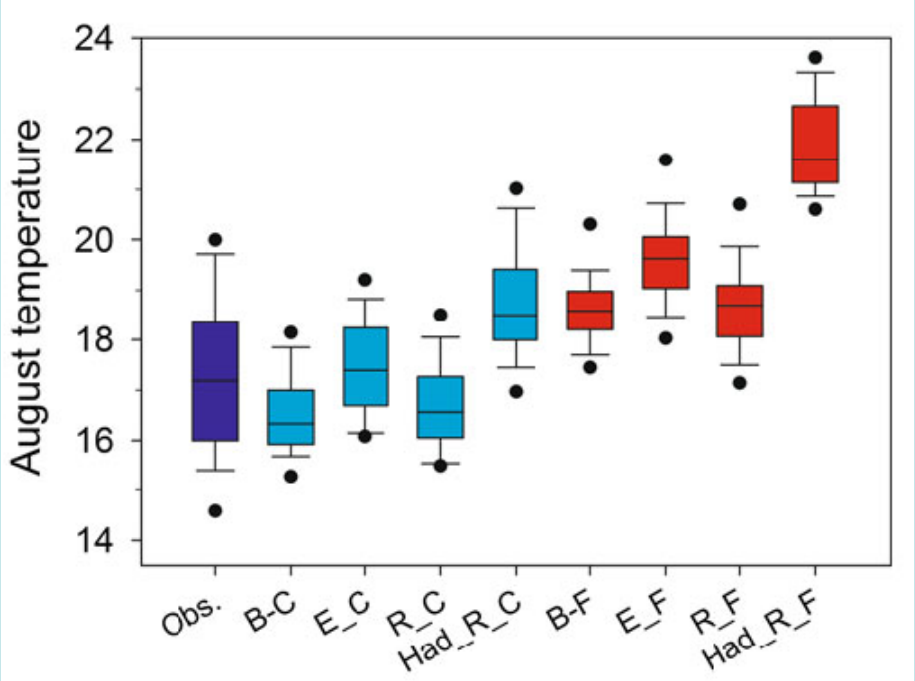
Voss et al. 2011

Projections of sprat spawner biomass

assuming temperature-driven spawner-recruit relationship

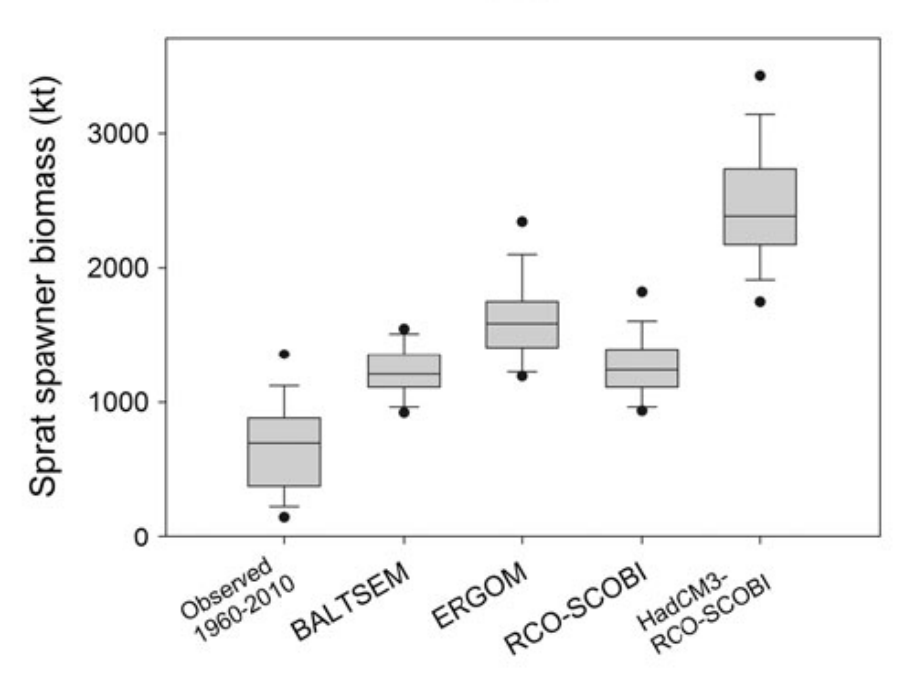
Historical obs. and projected future (2070-2099) values

Temperatures



Data source (climate model)

Spawner biomass



Data source (temperature)

MacKenzie et al. Ambio 2012

Climate change may strongly affect Baltic fish and fisheries, what can we do about it?

Pan-Baltic issue

pan-Baltic or at least multi-national action

Stocks should be robust and resilient

regulate fisheries accordingly

Preserve spawning habitat

reduce nutrient loads


Thanks for your attention!
Geir Ottersen
Image: Glynn Gorick for
'Cod and Climate' (ICES)
CEES
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Evolutionary Synthesis
IMR