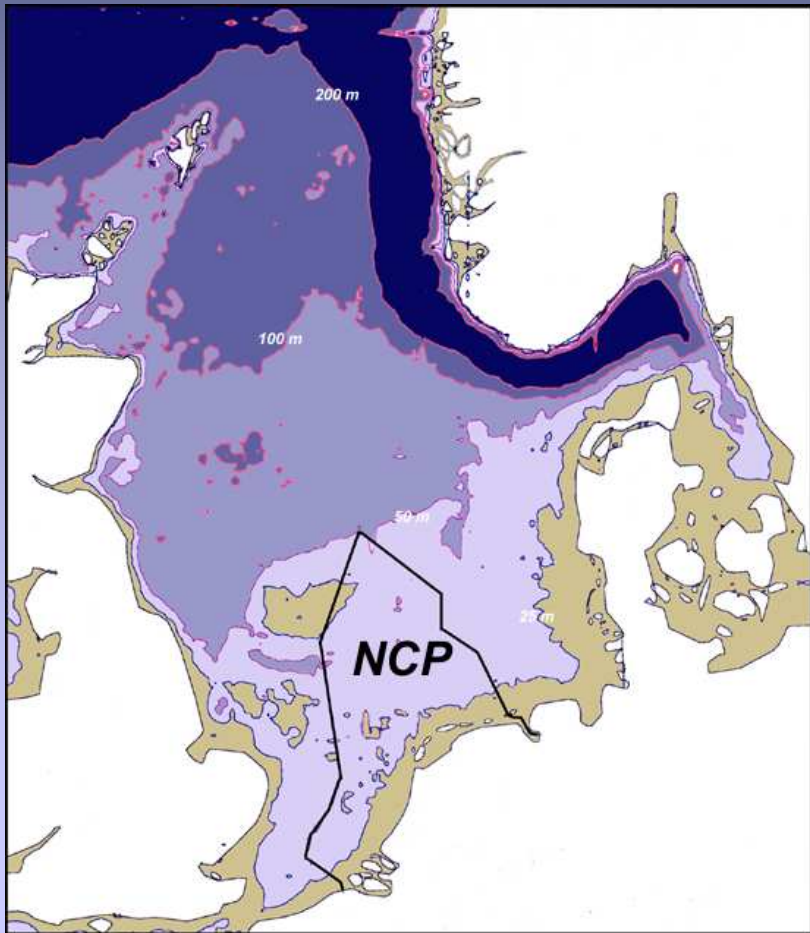


Causes of spatial and temporal trends in species richness and abundance ?



Niels Daan

Pensioner Wageningen IMARES

Climate change: a hot issue

Vol. 316, 268–276, 2004

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Published December 21

Long-term increases in prevalence of North Sea fishes having southern biogeographic affinities

D. J. Beare^a, F. Burns, A. Craig, E. G. Jones, K. Peach, M. Klenzie,
E. McKenzie, D. G. Reid

 THE ROYAL
SOCIETY

FirstCite®
e-publishing

Received 8 September 2003
Accepted 19 November 2003
Published online

Regional climatic warming drives long-term community changes of British marine fish

Martin J. Genner^{1,2}, David W. Sims¹, Victoria J. Wearmouth¹,
Emily J. Southall¹, Alan J. Southward¹, Peter A. Henderson³
and Stephen J. Hawkins^{1*,4}

Scienceexpress

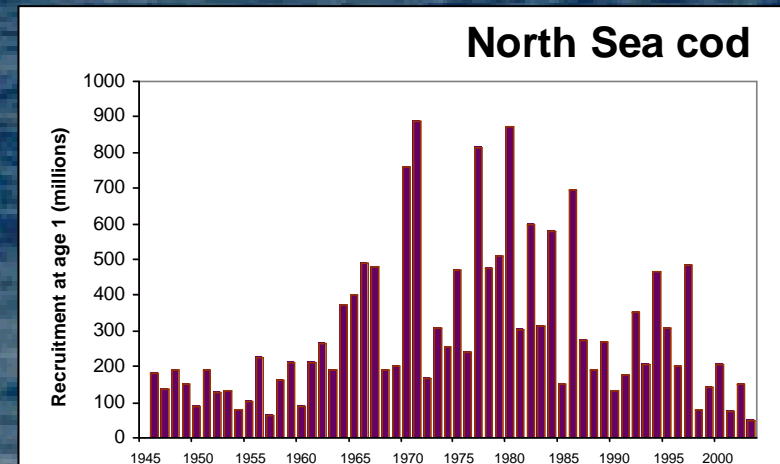
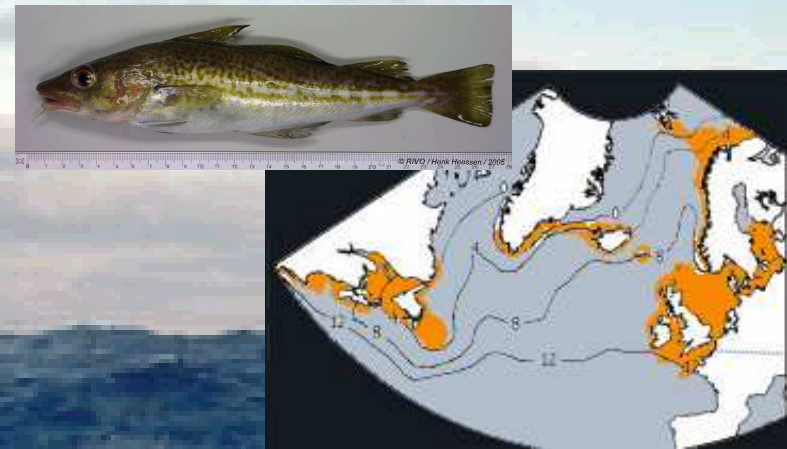
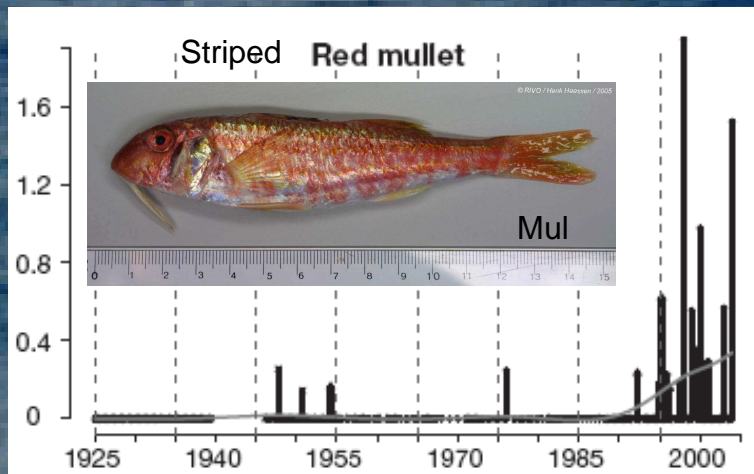
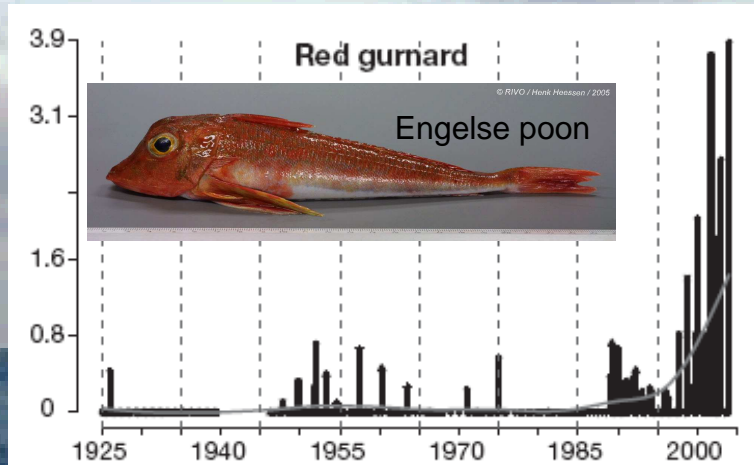
Report

Climate Change and Distribution Shifts in Marine Fishes

Allison L. Perry,^{1*} Paula J. Low,^{2†} Jim R. Ellis,² John D. Reynolds^{1*}

Recent success stories of southerly species ...

Beare et al. 2004



... as well as current failure of a northerly species

Axiomatic conclusion:

Effects of climate change!

But:

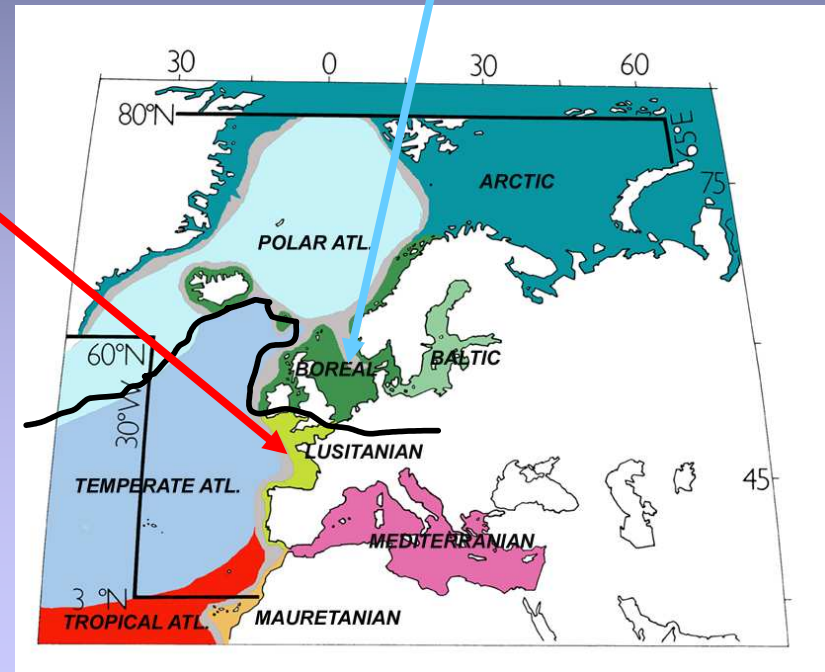
- **A priori selection of examples?**
- **Correlations do not imply a causal relationship**
- **How would the response mechanism work?**

Hypothesis

- If there are effects of climate change, **northerly** and **southerly** species should decrease and increase, respectively

Two parameters:

- (1) *Species richness*
- (2) *Species abundance*



Biogeographic regions (after Ekman, 1953)

NORTHERLY SPECIES

Artediellus atlanticus
Cyclopterus lumpus
Hippoglossoides platessoii
Hippoglossus hippoglossus
Liparis liparis
Lumpenus lampretaeformis
Raja radiata
Triglops murrayi
Anarhichas lupus
Glyptocephalus cynoglossus
Myoxocephalus scorpius
Pholis gunnellus
Agonus cataphractus
Belone belone
Brosme brosme
Ciliata septentrionalis
Clupea harengus
Echiodon drummondi
Entelurus aequoraeus
Gadus morhua
Limanda limanda
Liparis montagui
Melanogrammus aeglefinus
Micrenophrys lilljeborgi
Microstomus kitt
Molva molva
Osmerus eperlanus
Phrynorhombus norvegicus
Phrynorhombus regius

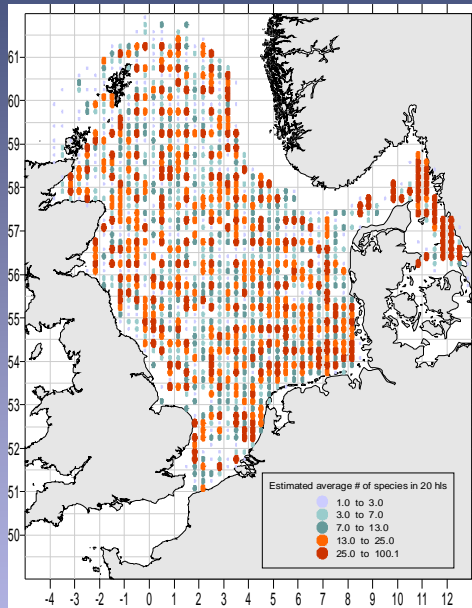
Pleuronectes platessa
Pollachius virens
Raja batis
Raniceps raninus
Rhinonemus cimbrius
Sebastes viviparus
Spinachia spinachia
Taurulus bubalis
Trisopterus esmarki
Zeugopterus punctatus
Zoarces viviparus
Ciliata mustela
Galeorhinus galeus
Lophius piscatorius
Platichthys flesus
Pollachius pollachius
Psetta maxima
Scomber scombrus
Squalus acanthias
Trisopterus minutus

SOUTHERLY SPECIES

Aphia minuta
Argentina sphyraena
Arnoglossus imperialis
Arnoglossus laterna
Aspitrigla cuculus
Atherina presbyter
Buglossidium luteum
Callionymus lyra
Callionymus maculatus
Callionymus reticulatus
Chelon labrosus
Crystallogobius linearis
Ctenolabrus rupestris
Dicentrarchus labrax
Diplecogaster bimaculata
Echiichthys vipera
Engraulis encrasicolus
Eutrigla gurnardus
Gaidropsurus vulgaris
Gobius niger
Labrus bergylta
Labrus mixtus
Lepidorhombus whiffiagoni
Lesueurigobius friesii
Merlangius merlangus
Microchirus variegatus
Mullus surmuletus
Mustelus spp.
Myxine glutinosa

Pomatochistus spp.
Raja clavata
Raja montagui
Raja naevus
Scophthalmus rhombus
Scyliorhinus canicula
Solea vulgaris
Sprattus sprattus
Symphodus melops
Trachinus draco
Trachurus trachurus
Trigla lucerna
Trisopterus luscus
Capros aper
Dasyatis pastinaca
Liza aurata
Lophius budegassa
Merluccius merluccius
Pagellus erythrinus
Phycis blennoides
Raja brachyura
Raja circularis
Raja undulata
Sardina pilchardus
Scyliorhinus stellaris
Solea lascaris
Spondylisoma cantharus
Trigloporus lastoviza
Zeus faber

IBTS – International Bottom Trawl Survey



Participation by 8 countries
Standardized since 1977
DATRAS data base ICES
300-400 hauls annually

**Species specific catchability:
Species identification often questionable
Spatial and temporal effort variable**

15000 hauls

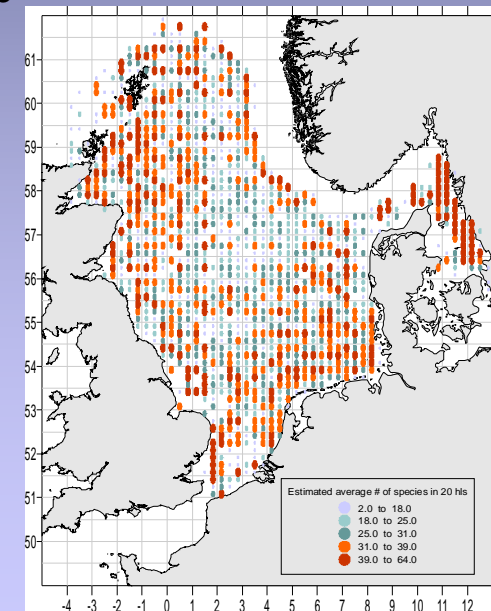
107 ‘species’:

49 Northerly, 58 southerly

Species recorded

Affected by # hauls:

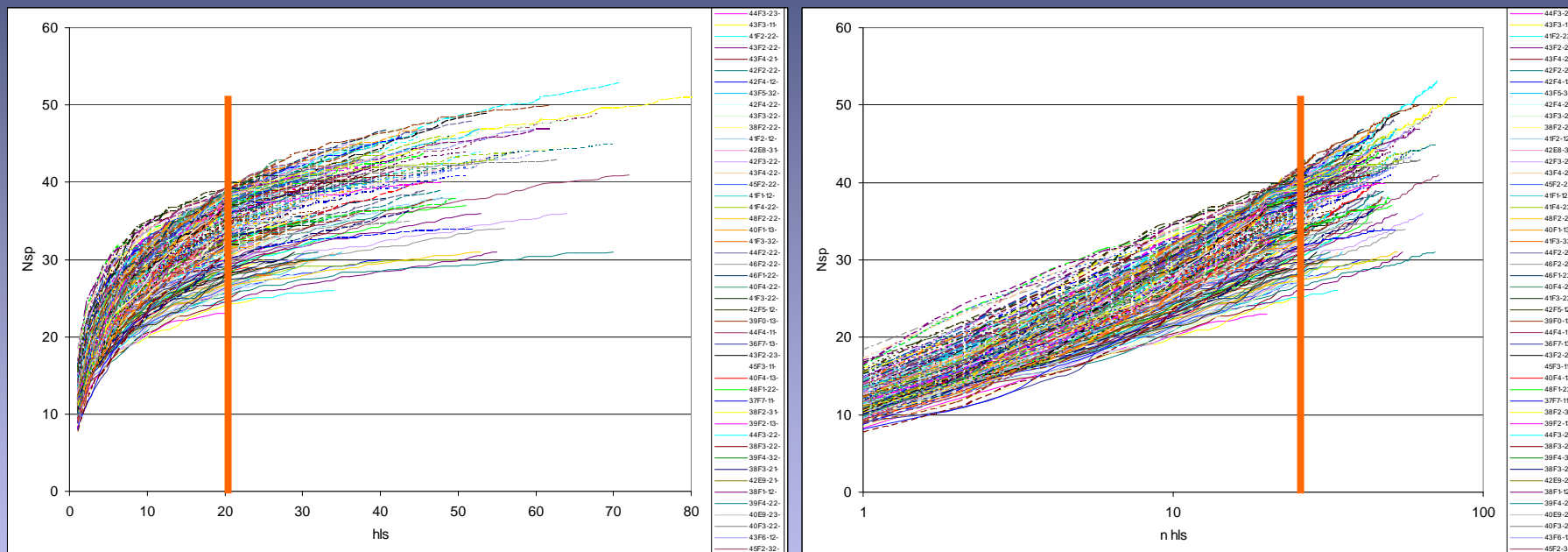
Correction necessary



SPECIES RICHNESS

Species recorded after 1 .. n hauls

(based upon 20 Monte Carlo simulations)

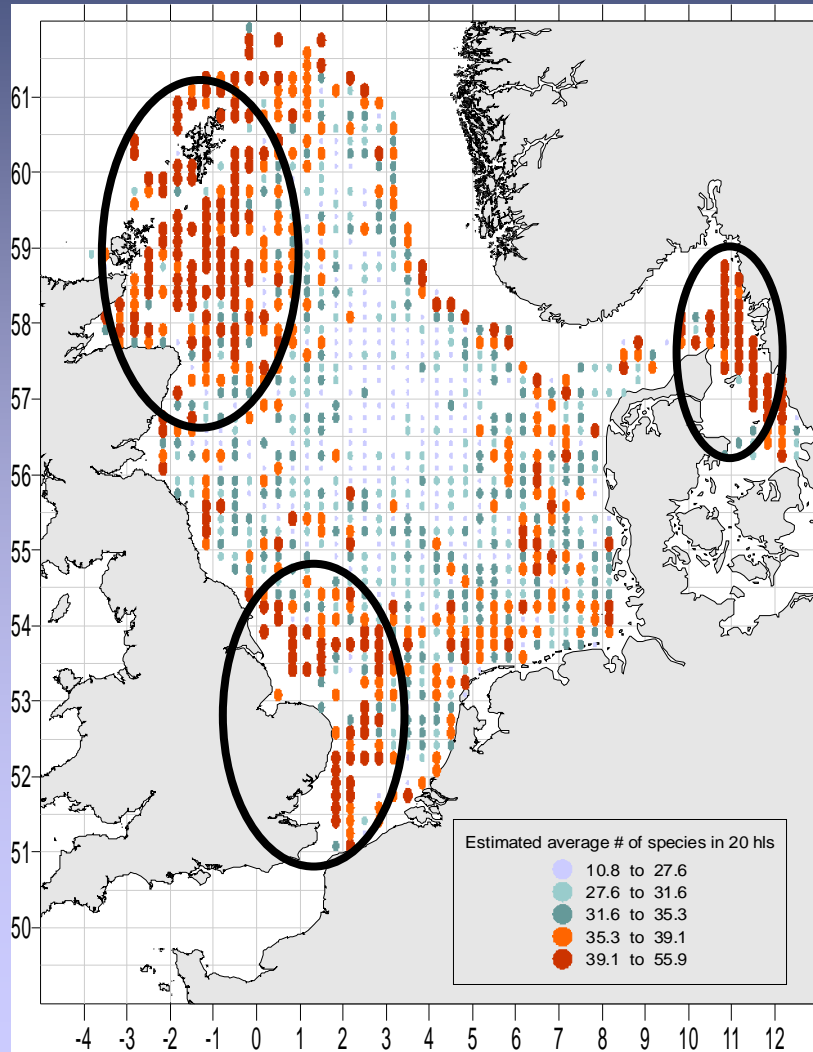


- Loglinear increase: no asymptote!
- Slopes and intercepts vary by location
- Relative index determined by arbitrary choice of n (20)

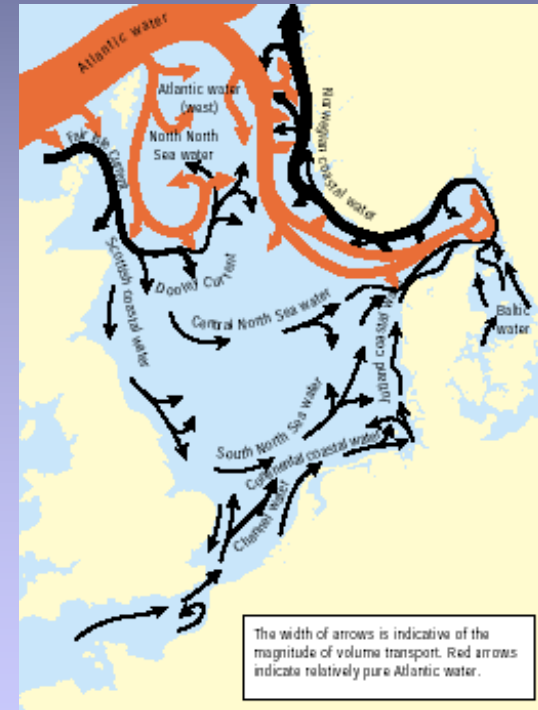
SPECIES RICHNESS

Spatial variation in diversity

(Average # species recorded after 20 hauls)

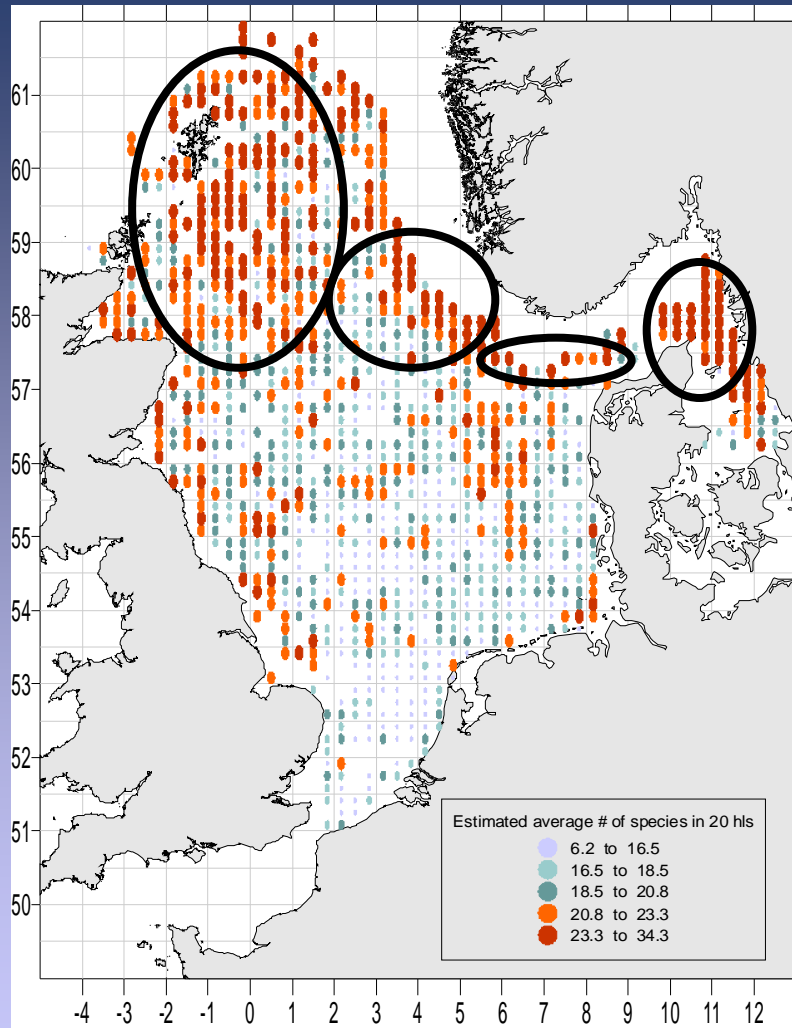


Diversity higher along borders
Central North Sea relatively poor

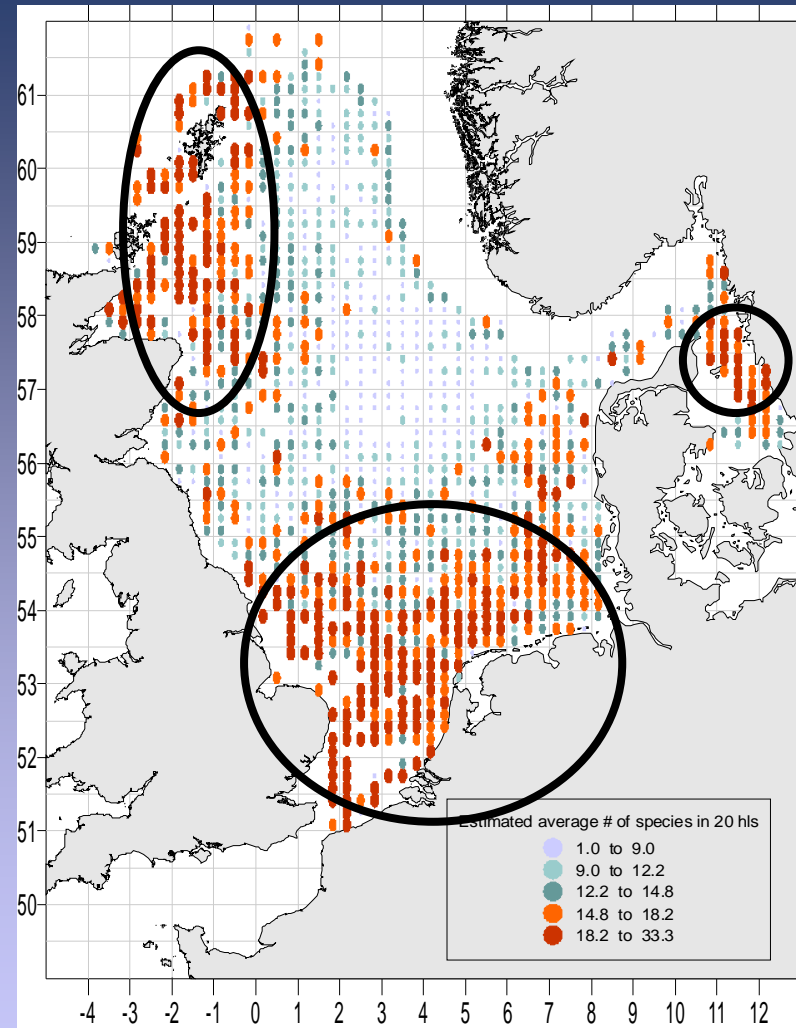


SPECIES RICHNESS

Species richness for the two groups separately



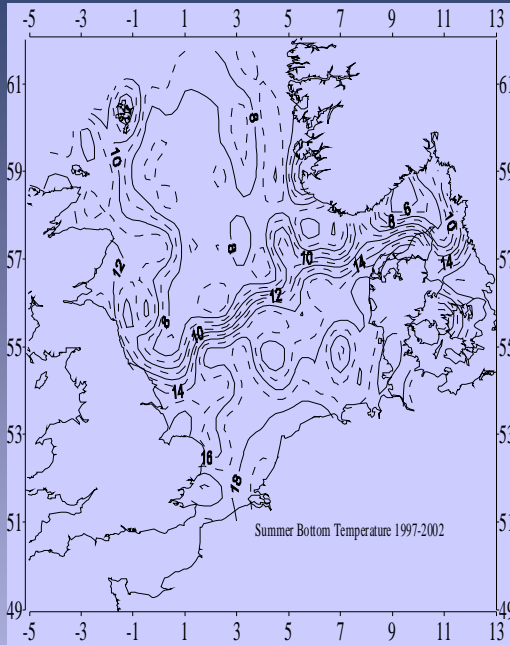
Northerly species



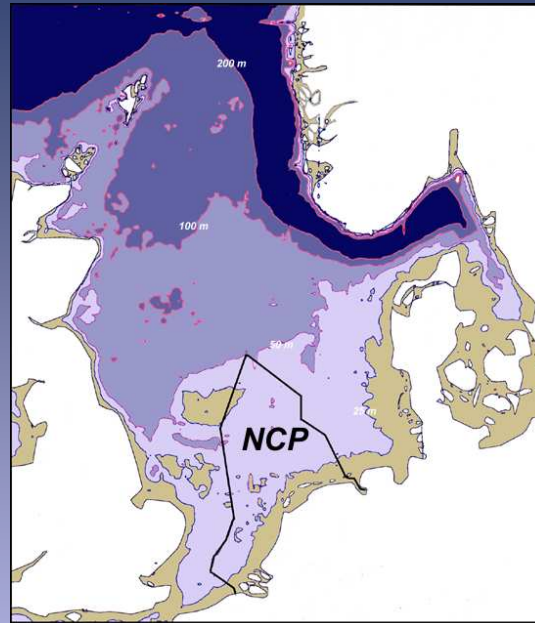
Southerly species

SPECIES RICHNESS

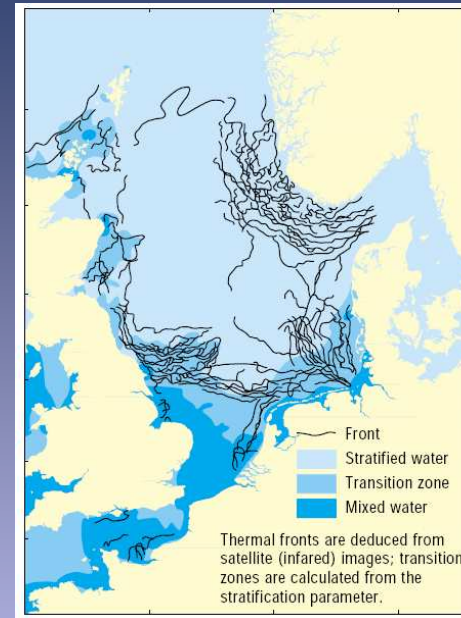
Relationship with environmental factors



Bottom T (ICES)

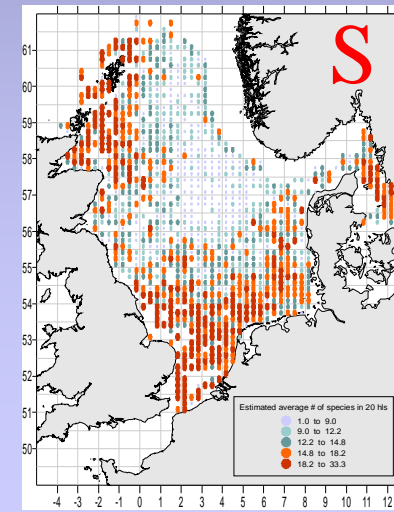
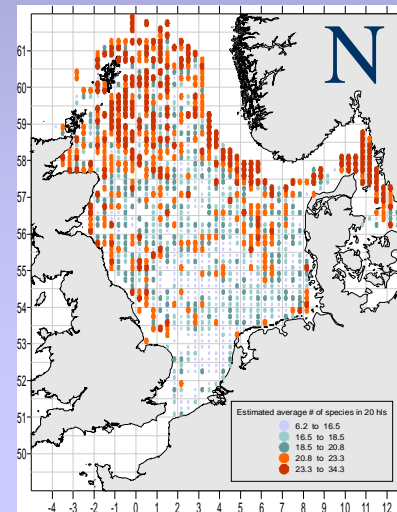


Depth



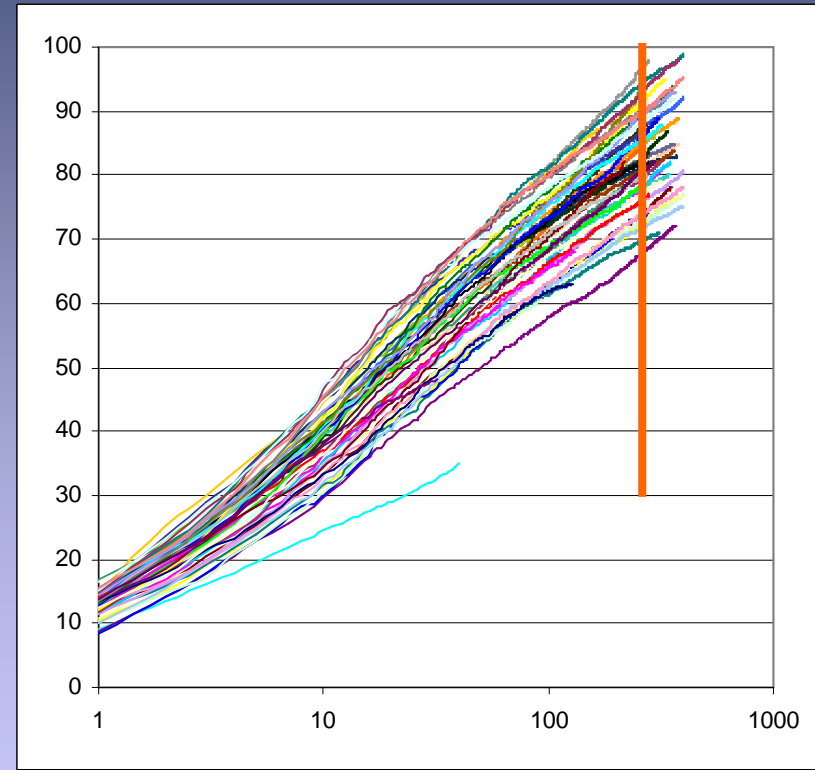
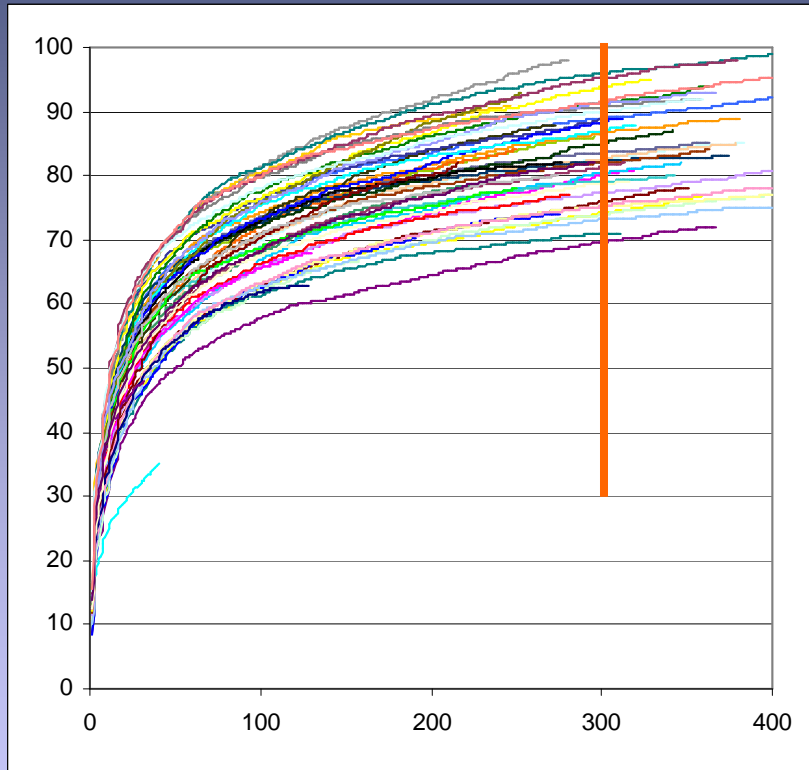
Fronts

SPECIES RICHNESS



Temporal trends?

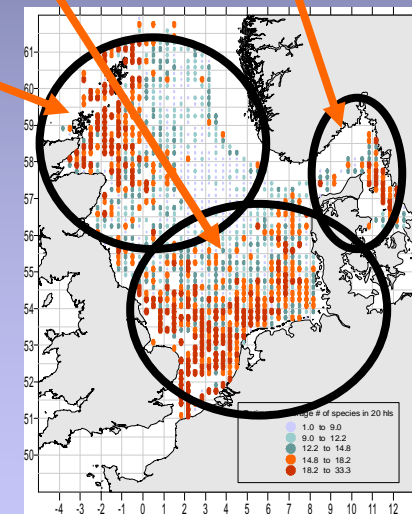
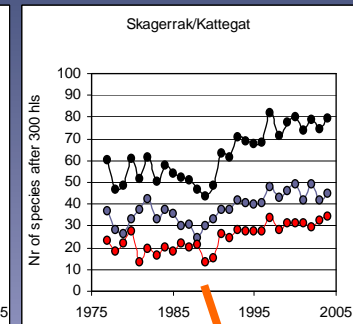
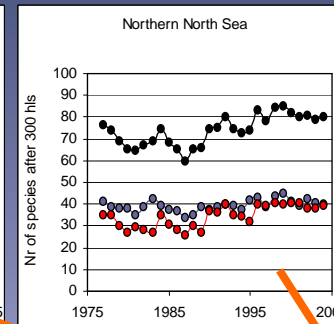
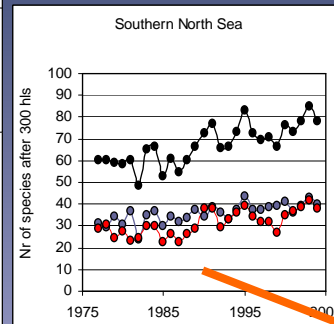
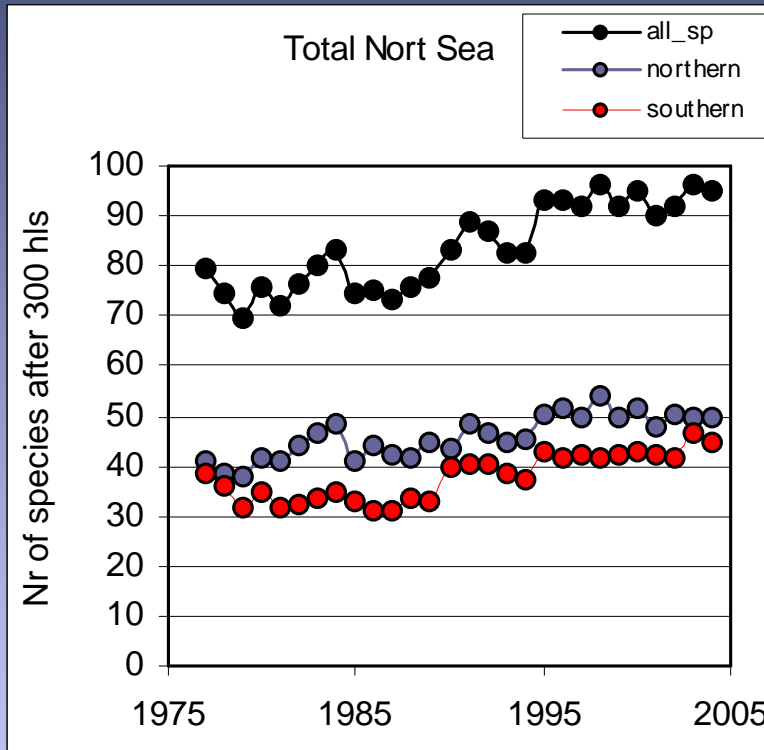
(Same trick: # species after 300 hauls)



SPECIES RICHNESS

Trends total North Sea and by area

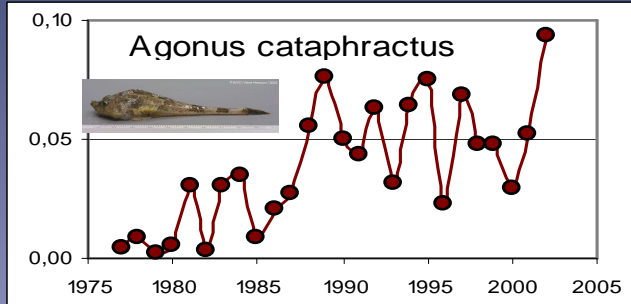
Smoothed in threes



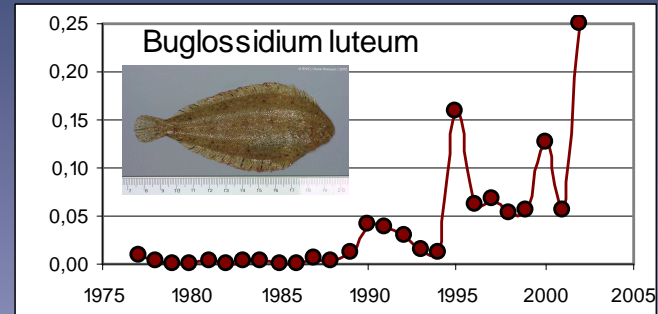
All trends significant!
N & S not significantly different!

SPECIES RICHNESS

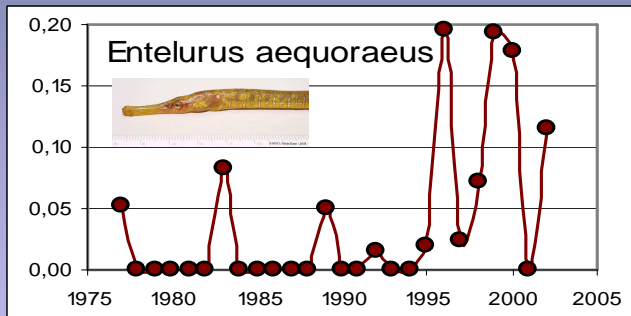
Standardized indices by species



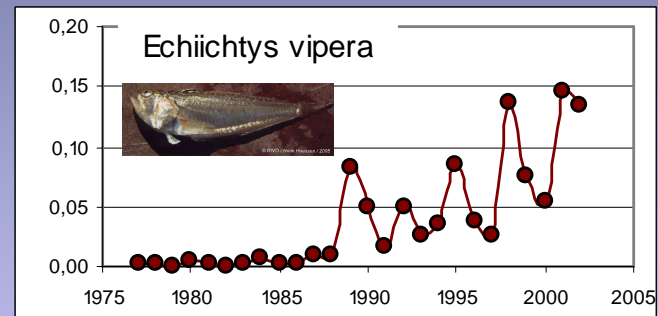
hooknose



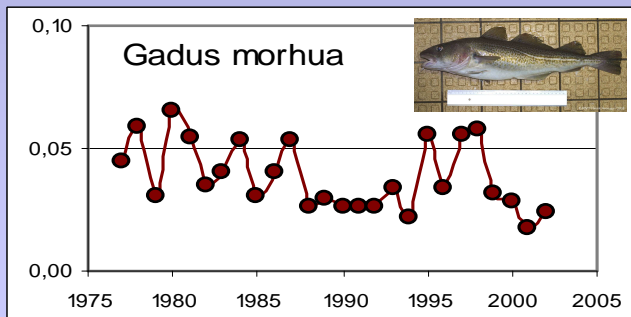
solenette



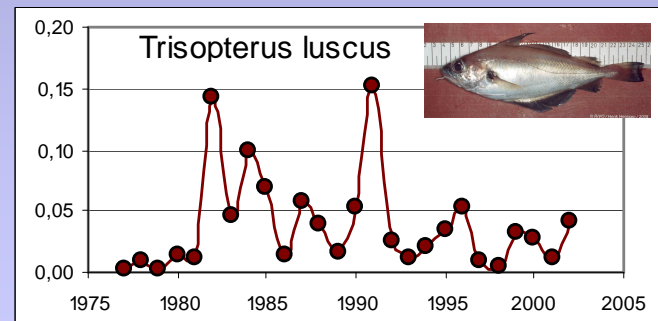
snake pipefish



little weever



cod



bib

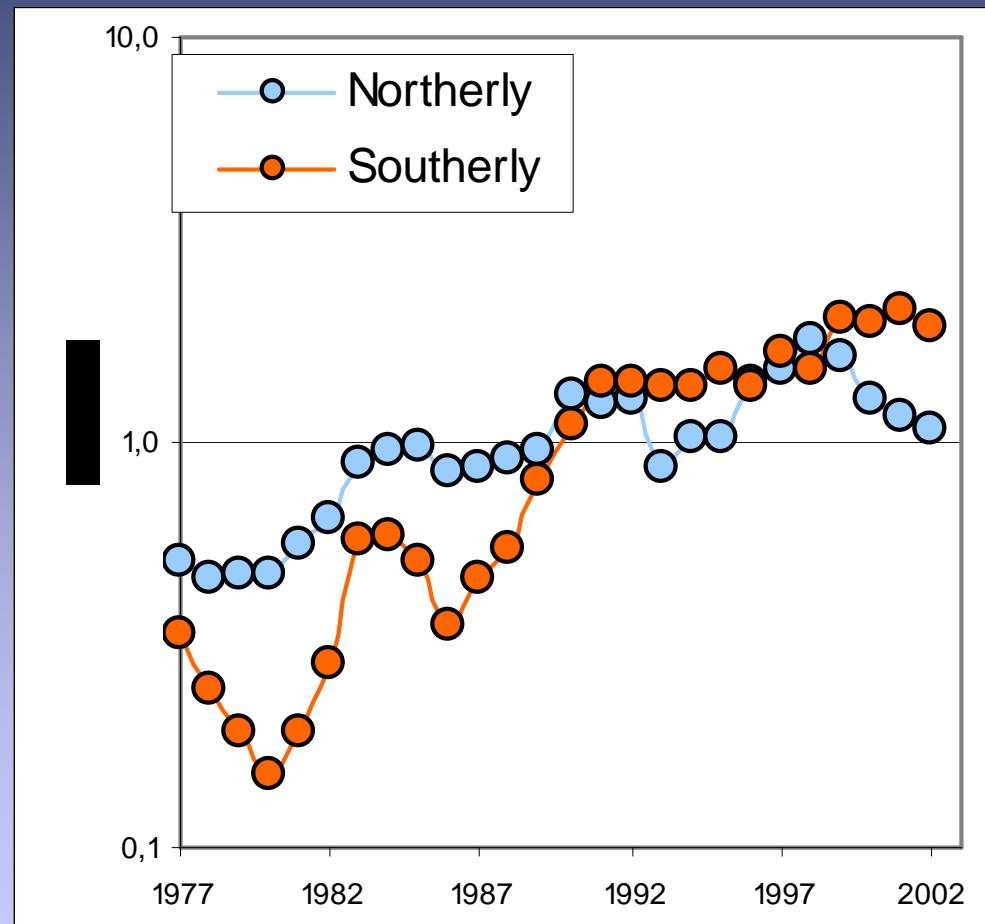
N

S

NUMERIC TRENDS

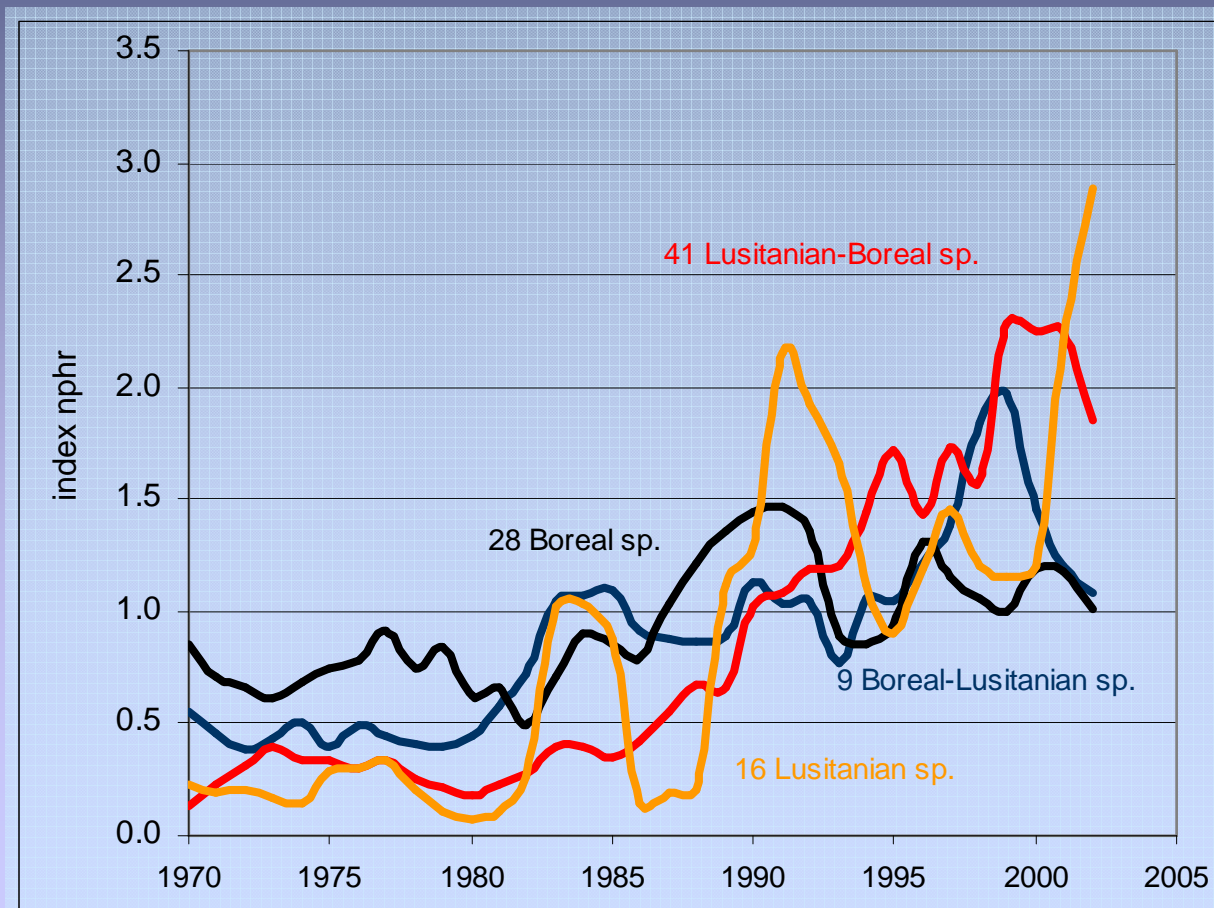
Mean trends in abundance

- More species increased than decreased, independent of origin
- Southerly species have increased steeper than northerly species



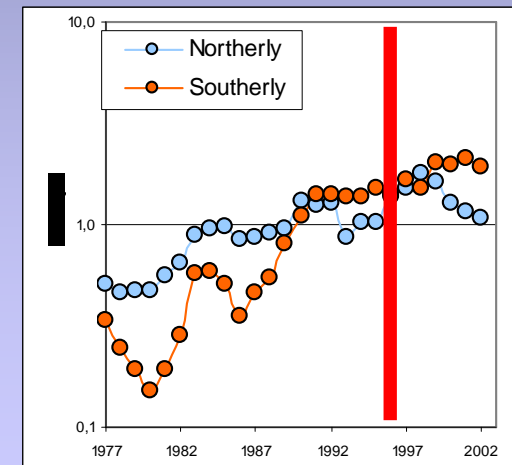
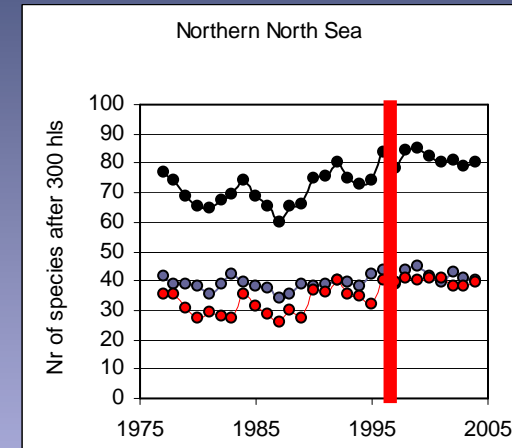
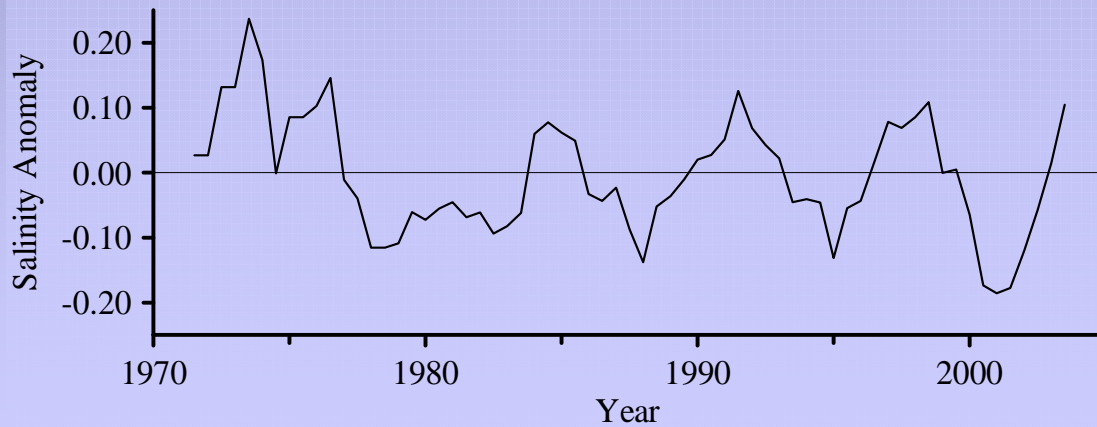
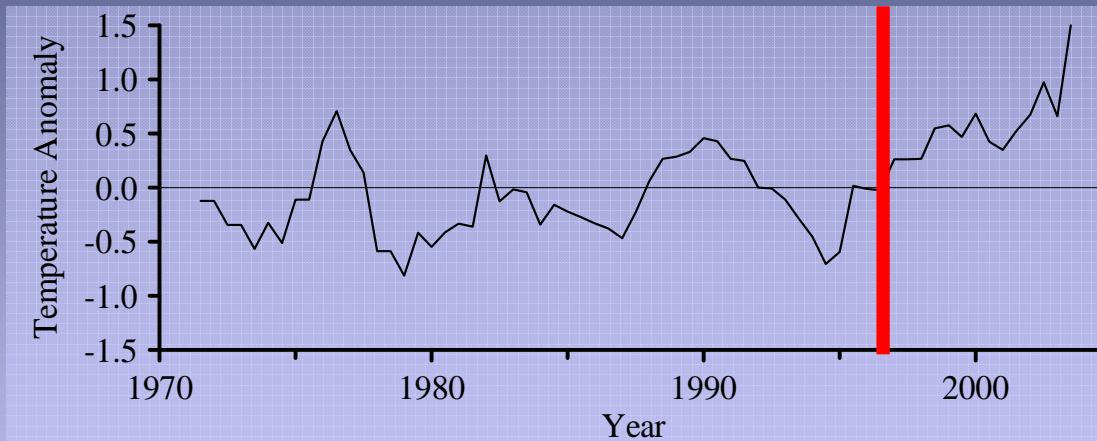
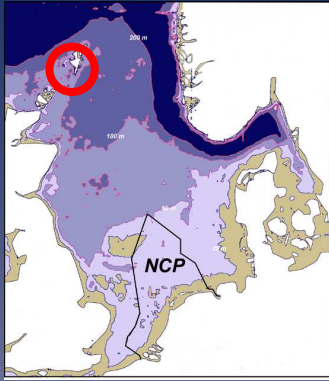
NUMERIC TRENDS

Average trend in standardised catch per hour of species of different biogeographic origin (corrected for differences in catch rates among species)



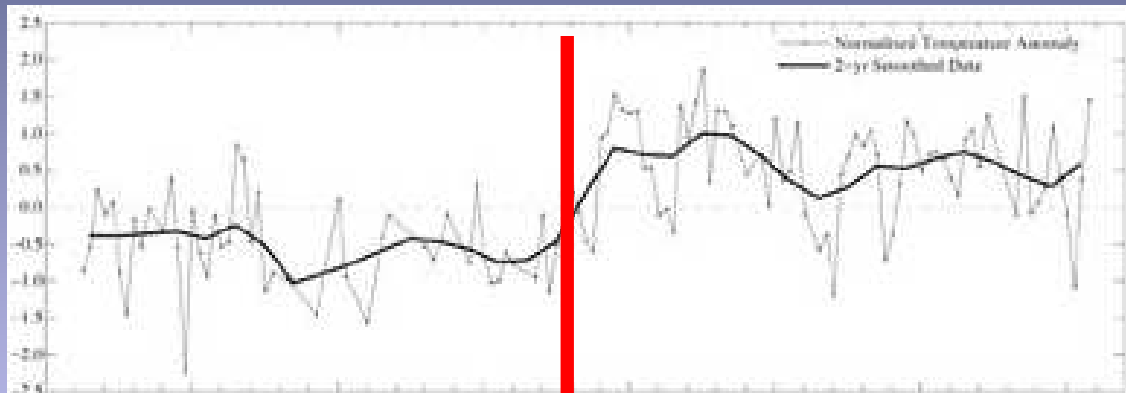
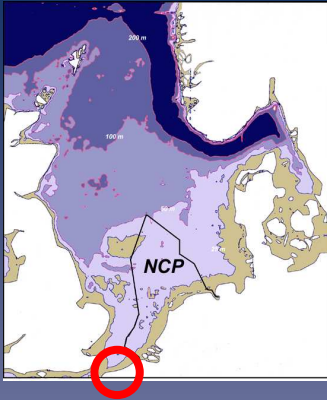
- More species of all origin have increased than declined
- Southerly species (LU+LB) have on average increased steeper than northerly species (BO+BL)

Anomalies in the Fair Isle Current

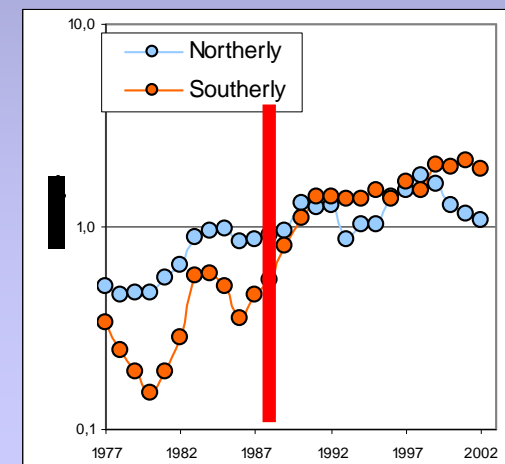
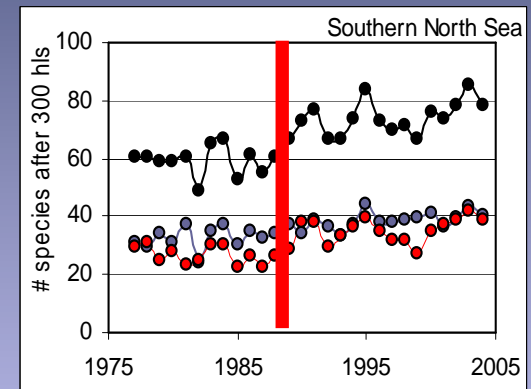
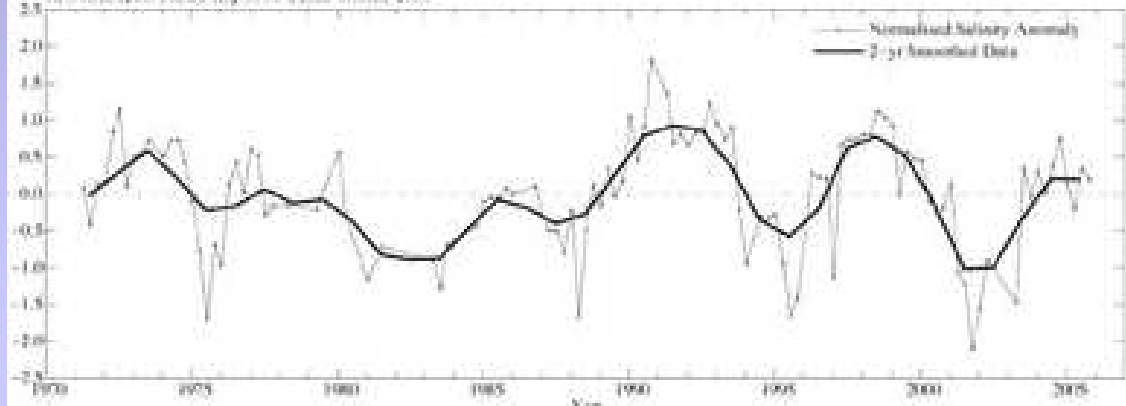


NUMERIC TRENDS

Anomalies in the southern North Sea

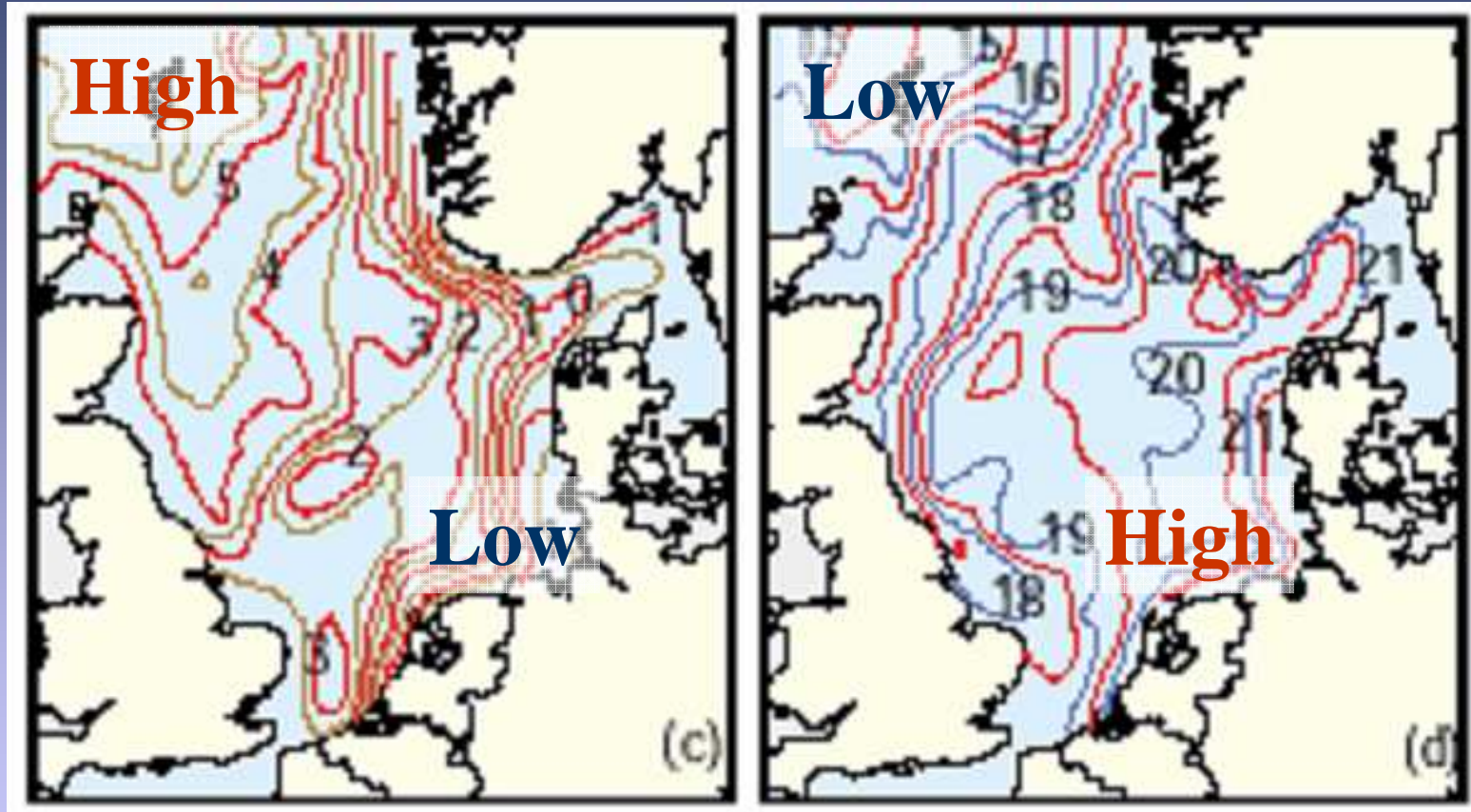


Data Provider: CEFS - Centre for Environmental Fisheries and Aquaculture Science - UK
Ref: ICES(2007) HCS Report on Ocean Climate 2006



Ferry at 52°N

Average surface temperature



winter

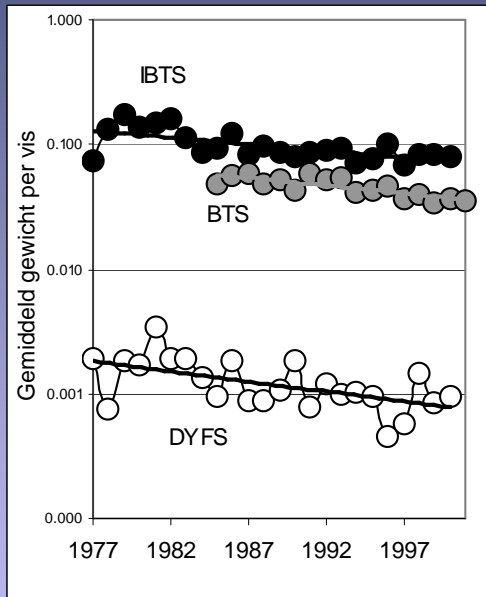
summer

SPECIES RICHNESS

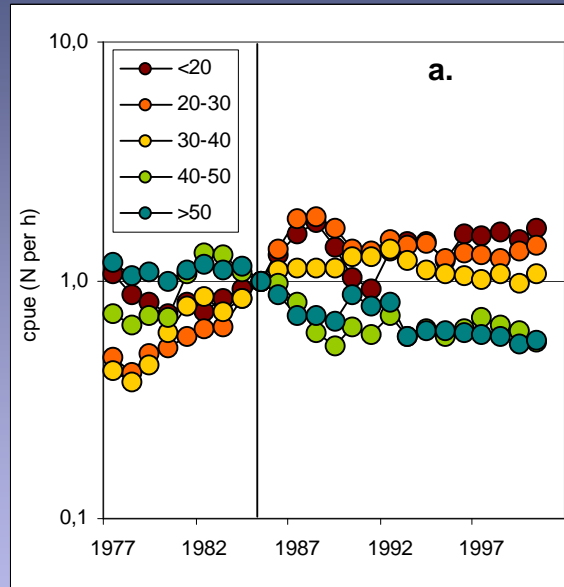
Size compositions

Daan et al., 2005 IJMS

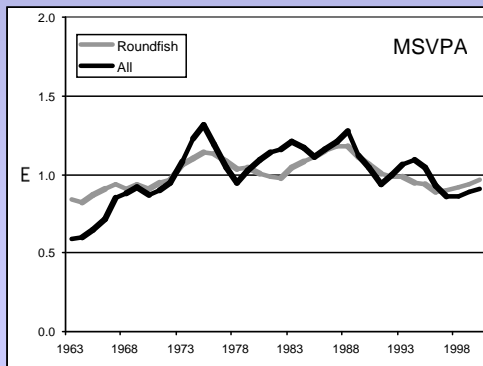
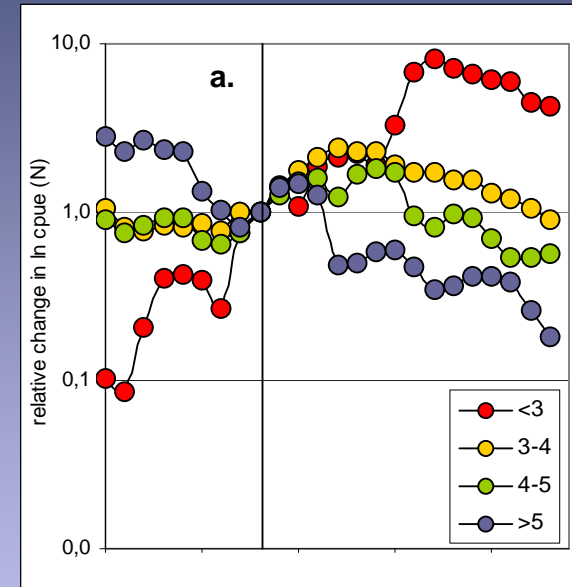
Mean weight



N by size class



N by ln(Lmax) class



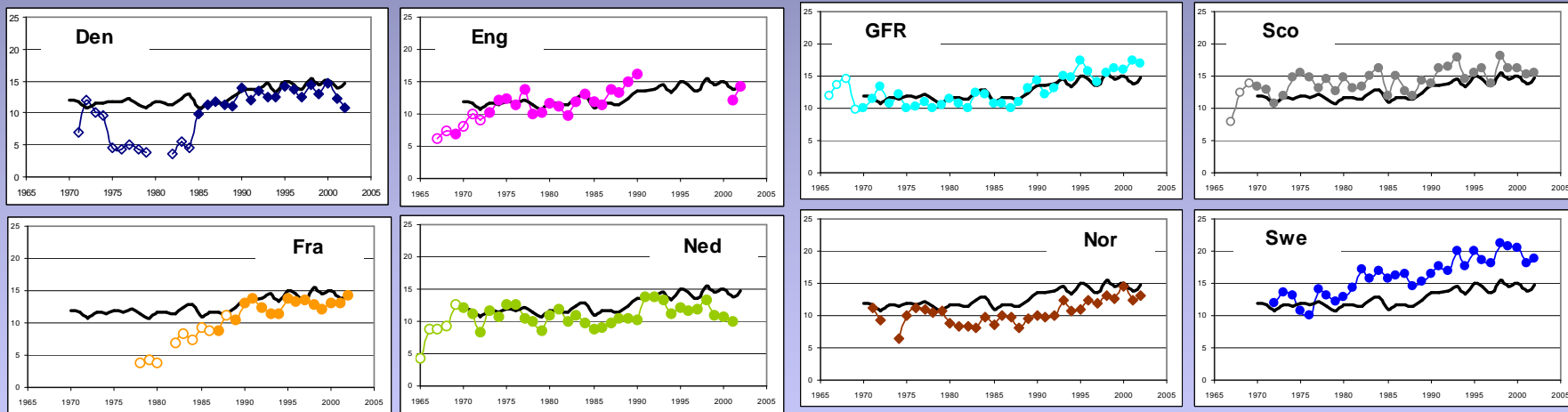
Exploitation rate

3: 20 cm
4: 55 cm
5: 148 cm

OTHER CHANGES IN FISH COMMUNITY

An Alternative Interpretation

These changes are all artefacts of improved sampling and better species identification !!!



Mean # species per haul by country compared with overall trend

Conclusions

- Species richness has increased despite overexploitation or climate change.
- Both southerly and northerly species have increased in abundance, both in terms of # species and numerically.
- Southerly species have increased steeper.
- **Climate change does not provide a satisfactory explanation, although it may have contributed.**
- **The mechanism still has to be elucidated: how would these species now that it has become warmer up north?**
- **Simultaneous changes in size composition better explained by overexploitation: better survival of juvenile fish and small species by released predation pressure (Daan et al., 2005).**
- **But the last word has not yet been said!**