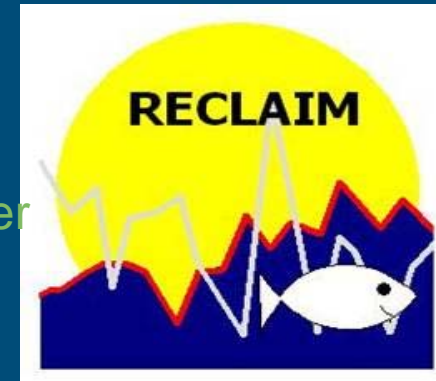


Climate impact on fish productivity: key mechanisms in North Sea plaice



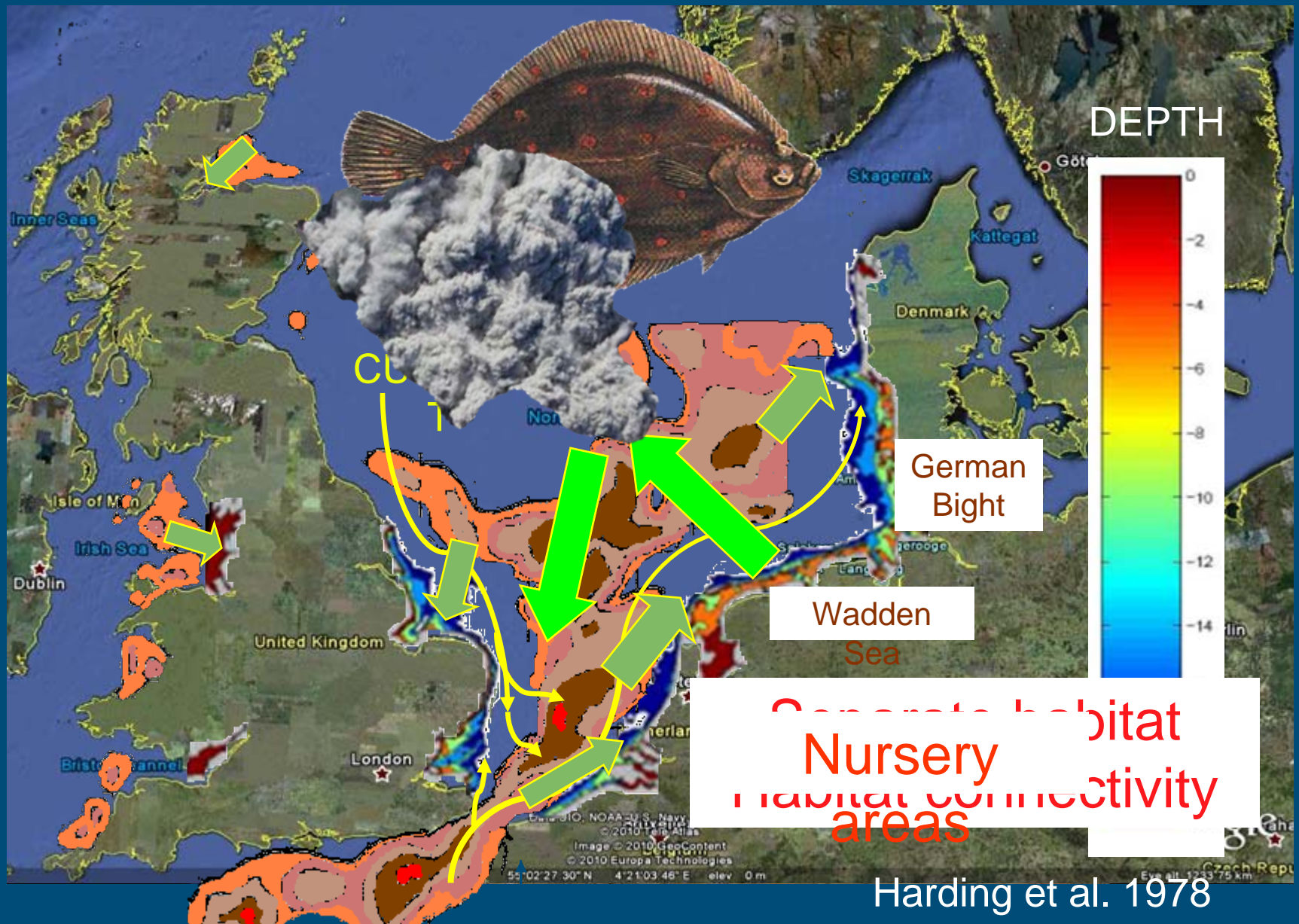
A.D. Rijnsdorp, R. van Hal, M. Hufnagl, R.D.M. Nash, A. Schroeder, L.R. Teal, I. Tulp, R. Witbaard, D. Beare, H.W. van der Veer



Objectives and approach

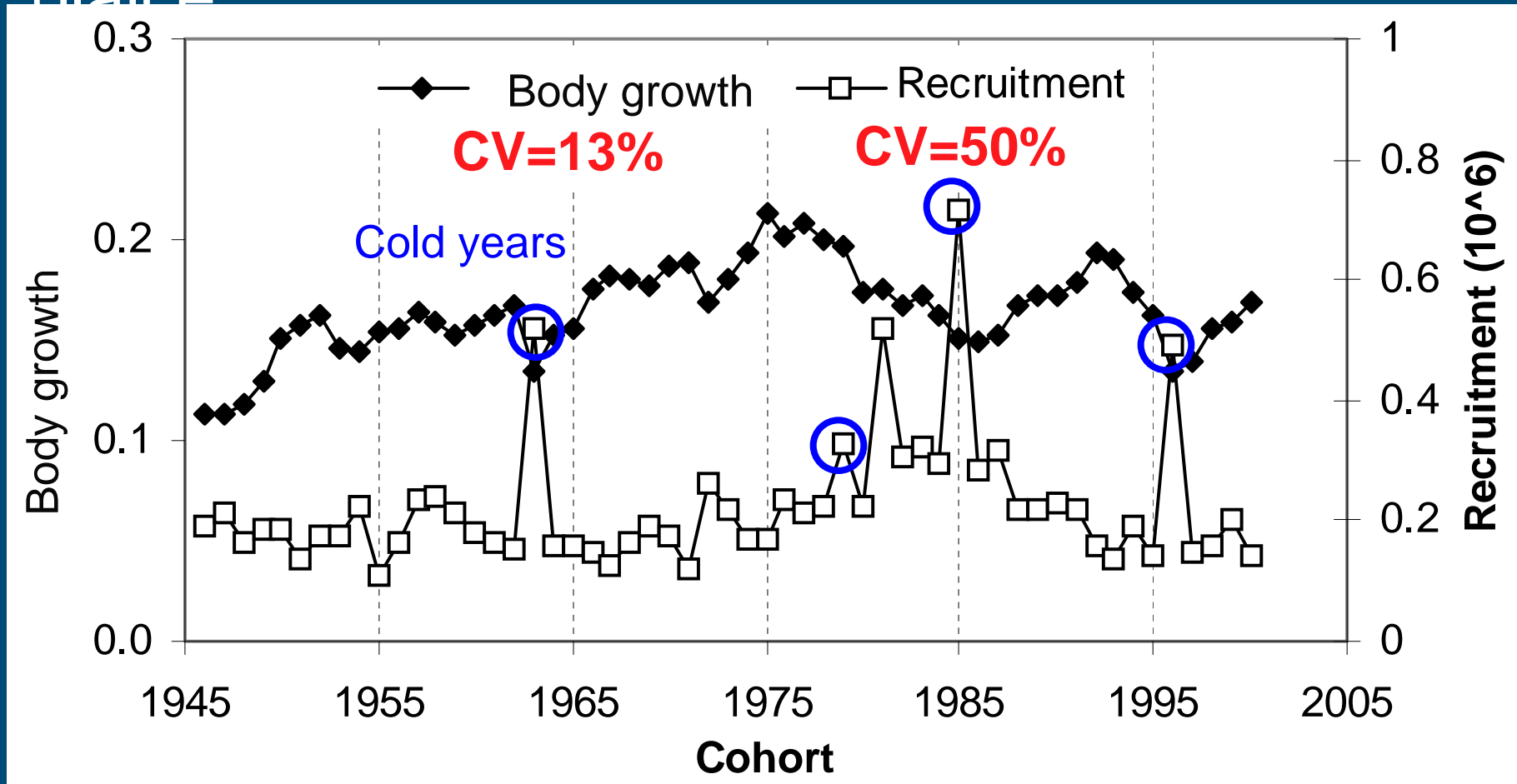
- Objectives
 - Study role of climate change and fishing on changes in productivity
- Approach
 - Bottom up approach focused on key mechanisms
 - Life cycle perspective
 - connectivity
 - Habitat availability
 - North Sea plaice as a research model
 - Focus on pelagic egg/larvae and demersal juveniles

The North Sea and plaice living in it

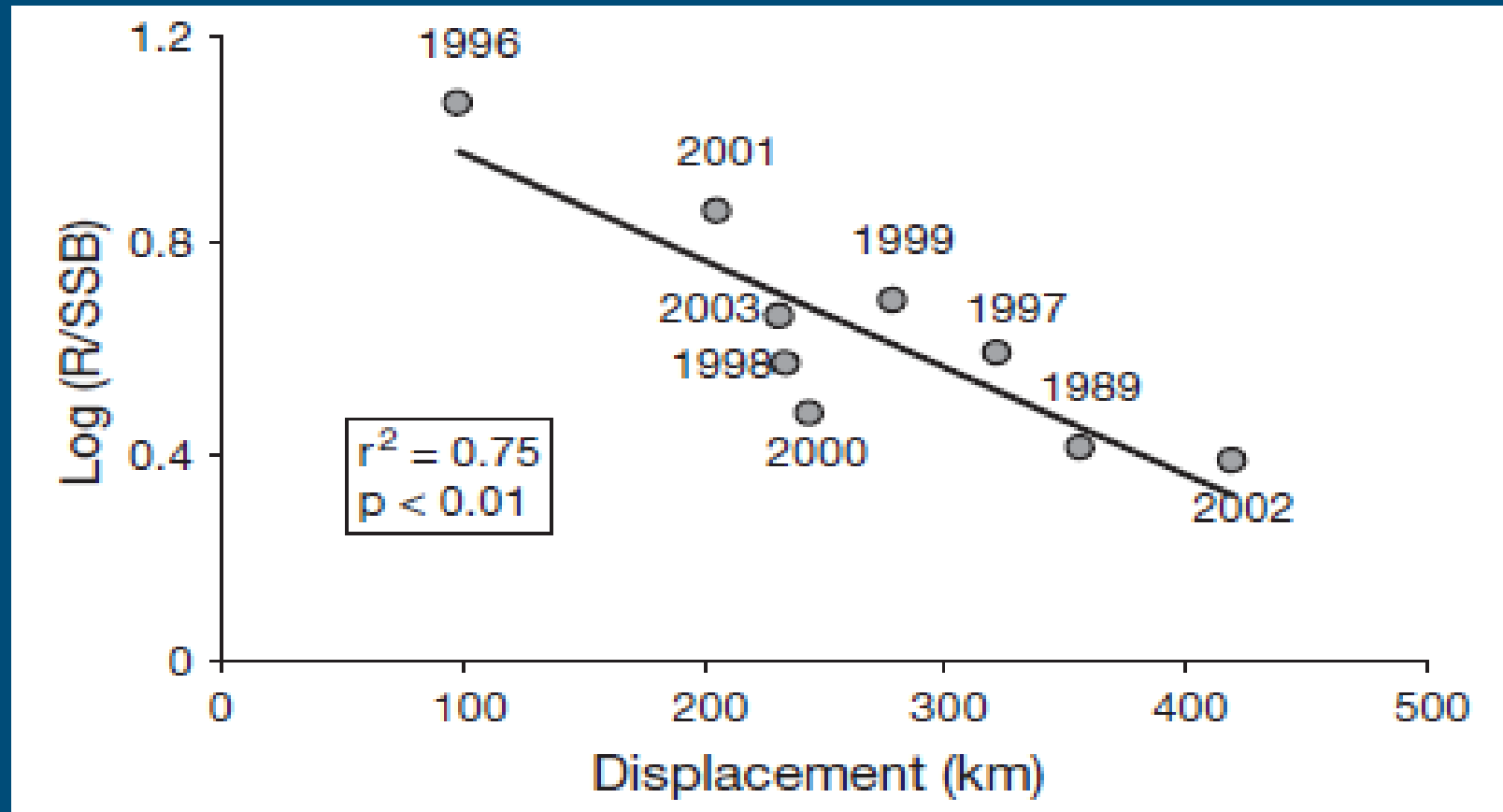


Changes in the productivity of North Sea plaice

plaice



Recruitment and connectivity

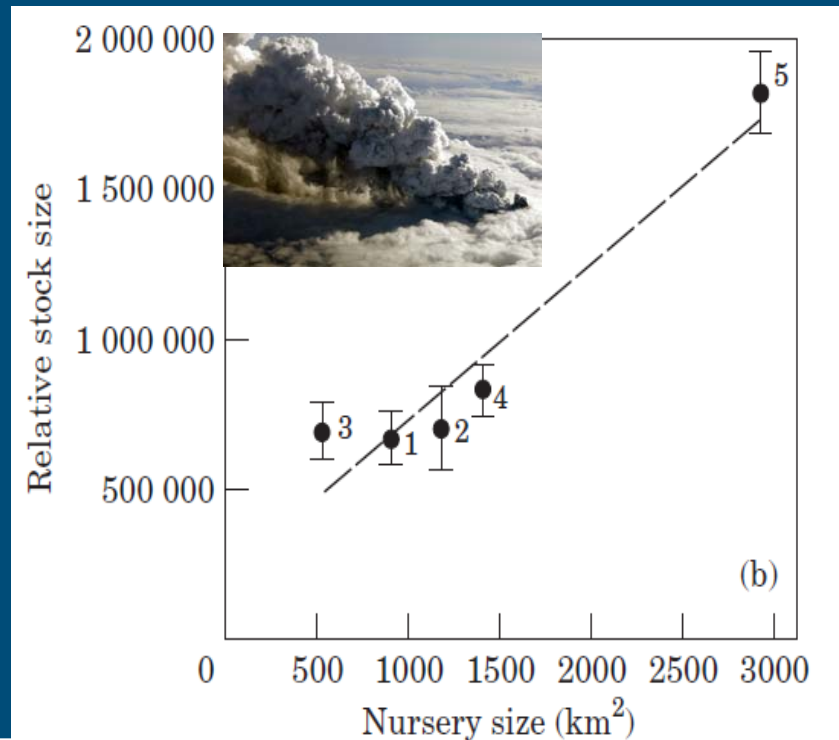
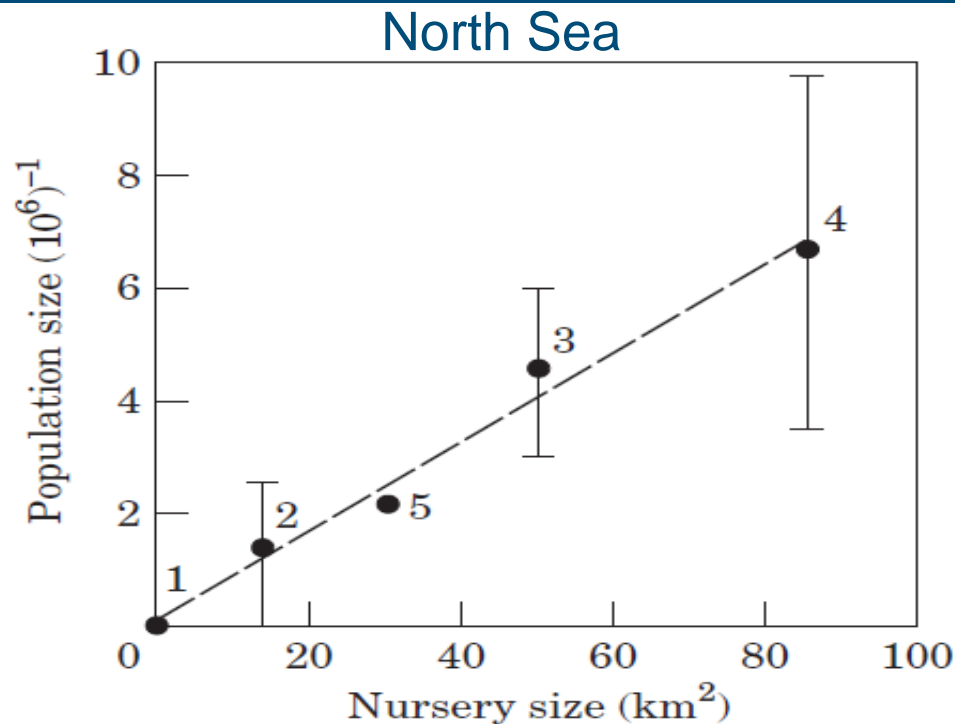


How will climate change affect long-shore residual currents?

Bolle et al 2009 MEPS 390: 195-211

Recruitment

- Variation in recruitment determined by egg / larval mortality
- Overall level of recruitment is determined by available nursery grounds

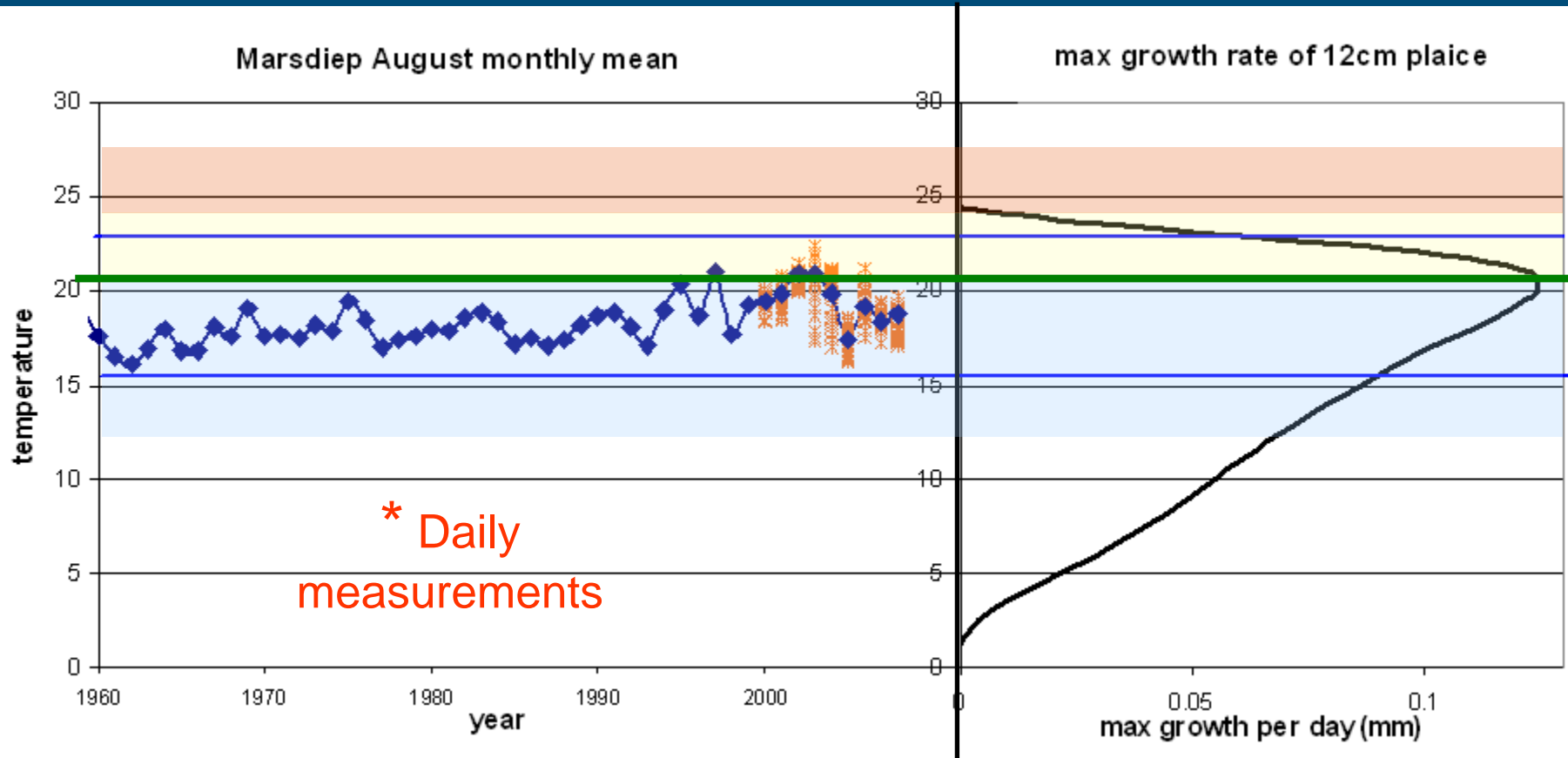


Larval supply to the nursery areas

- Low temperatures improve egg/larval survival but increase transport duration
- Recruitment is negatively affected mainly by transport distance
- Future strength of the current unknown
- Nursery size determines population size

Habitat quality of the nursery areas

Temperature tolerance of juvenile plaice



Van Aken, NIOZ website

Habitat quality nursery areas

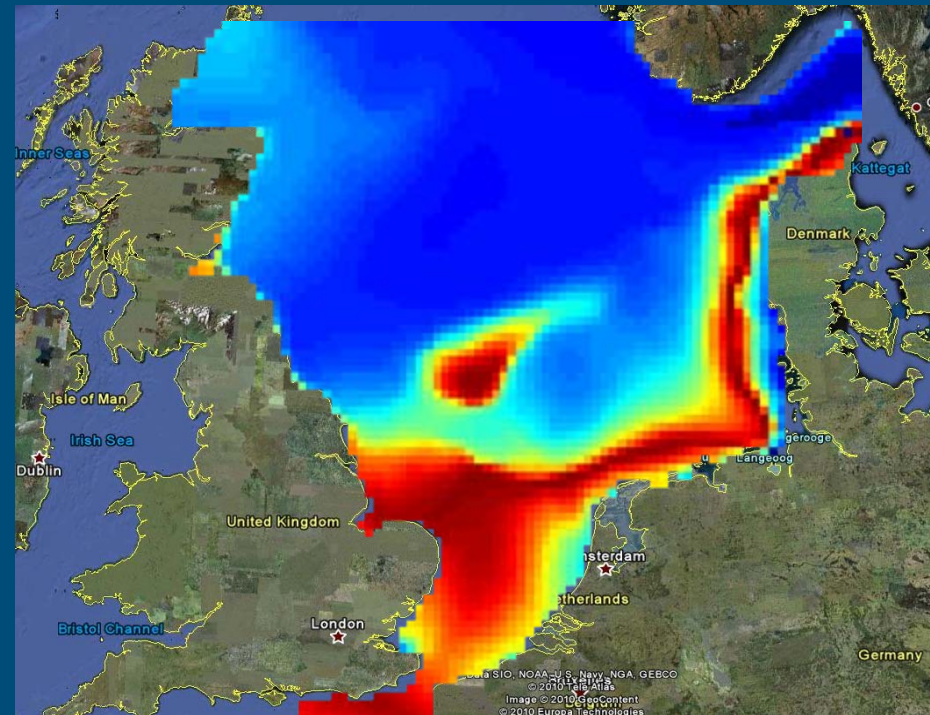
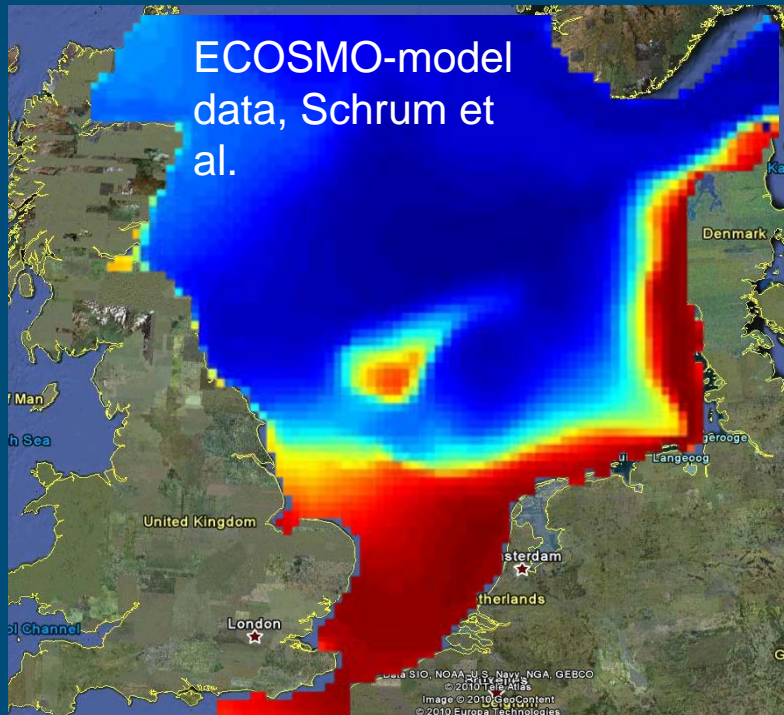
- Summer temperature may exceed upper tolerance limit
- Shifts in distribution to deeper (colder) waters
- Growth condition may be further limited in summer when temperatures are high and inter / intra-specific competition may be higher due to a decrease in nursery habitat availability

Temperature controlled growth of plaice determined by DEB

Growth rate in August/September of 1-group plaice (15+ cm)

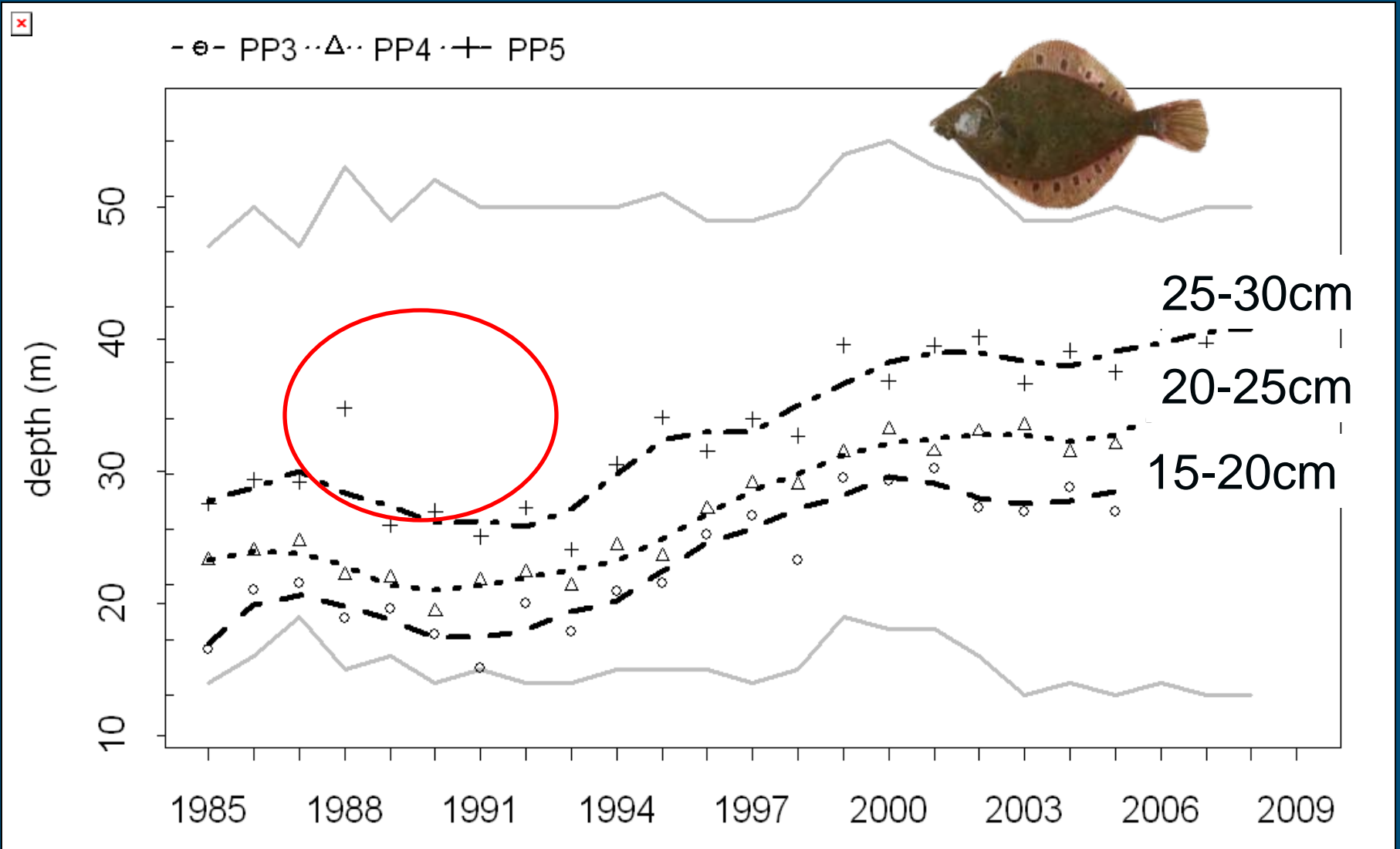
1963 cold

2003 warm



Next step is including food, to estimate a more realistic growth

Depth distribution of plaice

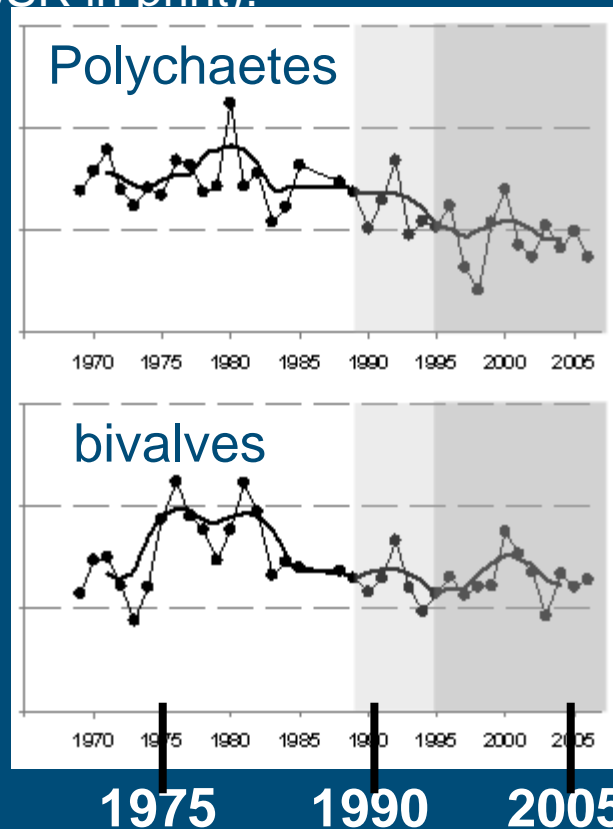


Competition

- Decrease in available food (Climate/De-eutrophication)
- Increase in small bodied Lusitanian flatfish species (Climate)

(van Hal et al. 2010 JSR in print).

German Bight
Plaice box
area



Schroeder et al (2010)

Conclusions

- Variations in productivity determined mainly by recruitment and for a smaller part by growth.
- Recruitment determined in pelagic phase (survival and transport success)
- Nursery grounds are critical habitat (bottleneck)
- Global warming will change nursery habitats and thus productivity
- Observed shift to deeper water is related to increase in temperature in conjunction with decrease in benthic food

Implications for fisheries and management

- The changes in distribution have implications for the management.
- The effectiveness of MPA's can change (Plaice box)
- Increase in discard mortality and thus a lower productivity of marketable plaice.

