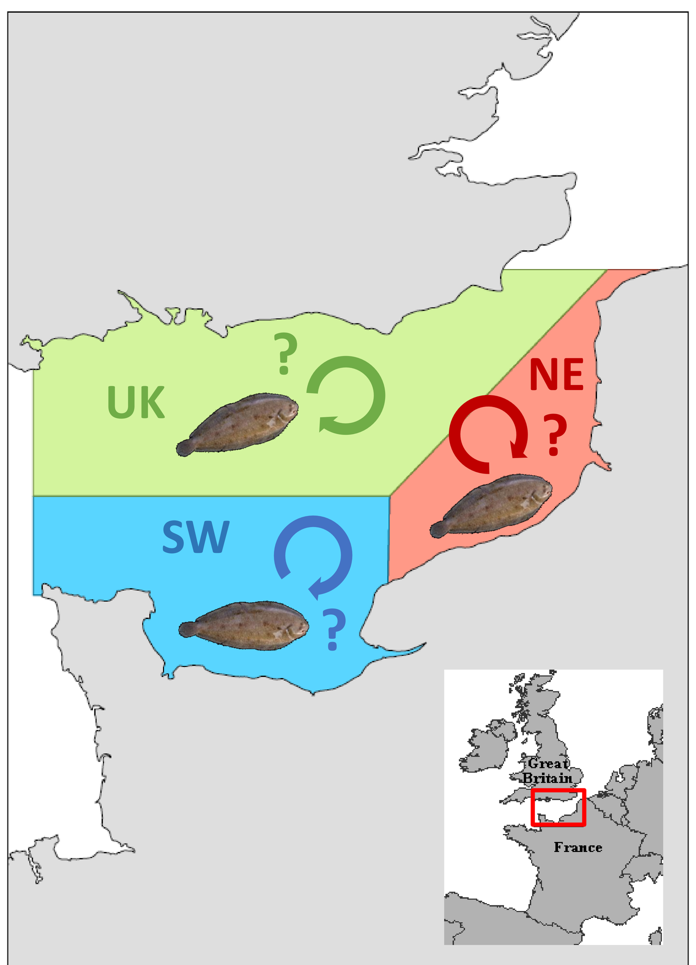
Spatio–temporal patterns in growth and density reveals structuration in a flatfish stock: The common Sole in the Eastern English Channel

Randon M.[1], Réveillac E. [1], Rivot E. [1], Du Pontavice H. [1] and Le Pape O. [1]

[1] Agrocampus Ouest, UMR Ecologie et Santé des Ecosystèmes, 65 Rue de Saint-Brieuc, 35042 Rennes Cedex, France

e-mail: marine.randon@agrocampus-ouest.fr

10th International Flatfish Symposium — Flatfish ecology - from genomics to ecosystems



INTRODUCTION

Context

- Eastern English Channel (EEC) stock of Sole → **alarming decline** through the last decade[1]
- Currently considered as a single and homogeneous population[2]
- **BUT**, potential **stock spatial structuration** in 3 subareas (**UK**, **N**orth**E**ast, **S**outh**W**est)[1,2] with **low connectivity** induced by early life stages[3,4,5]

Poster 1

Needs

- Understand the potential **stock structuration** and **connectivity** throughout the life cycle

Question

What could be learnt about the stock structuration using long-term growth and density patterns analyses ?

MATERIAL & METHODS

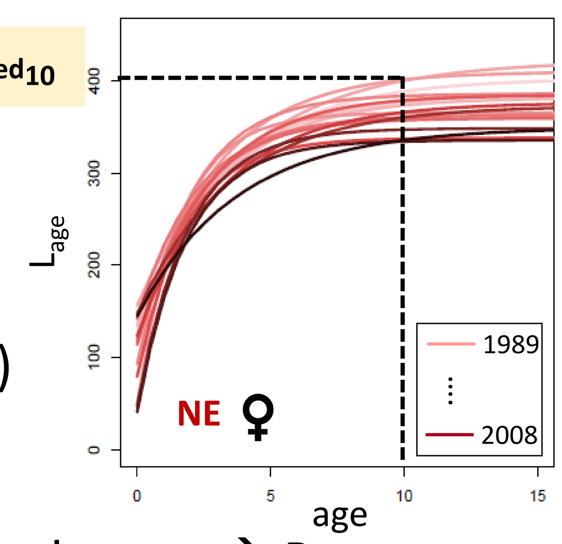
DATA: Number, sex and length-at-age data sets from the Beam Trawl Survey (1990 – 2015)

GROWTH

- Von Bertalanffy Growth Function:

$$L_{age} = L_\infty - (L_\infty - L_1) \times \exp(-K \times (age-1))$$

- Nonlinear Least Squares
- Sex + Subarea + Cohort effects on $\Theta = (L_\infty, L_1, K)$
- $Lpred_{10}$ = proxy of growth
- Synchrony of growth trends ($Lpred_{10}$) between subareas → Pearson correlation of residuals of linear regressions residuals



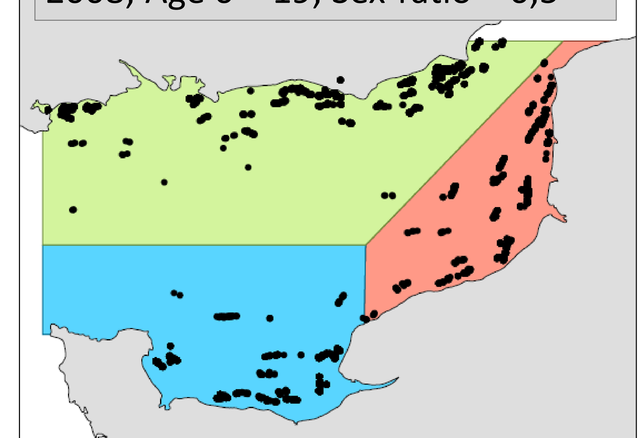
DENSITY

$$D_{age,cohort} = \frac{N_{age\ cohort}}{Surface_{age,cohort}}$$

$$A_{age,cohort} = \frac{D_{age,cohort} - mean(D_{age})}{sd(D_{age,cohort})}$$

- Synchrony between anomalies at age → Pearson correlation

GROWTH
N = 11313 soles (5650 UK + 3053 NE + 2610 SW); 17 Cohorts 1989 – 2008; Age 0 – 19; Sex-ratio = 0,5



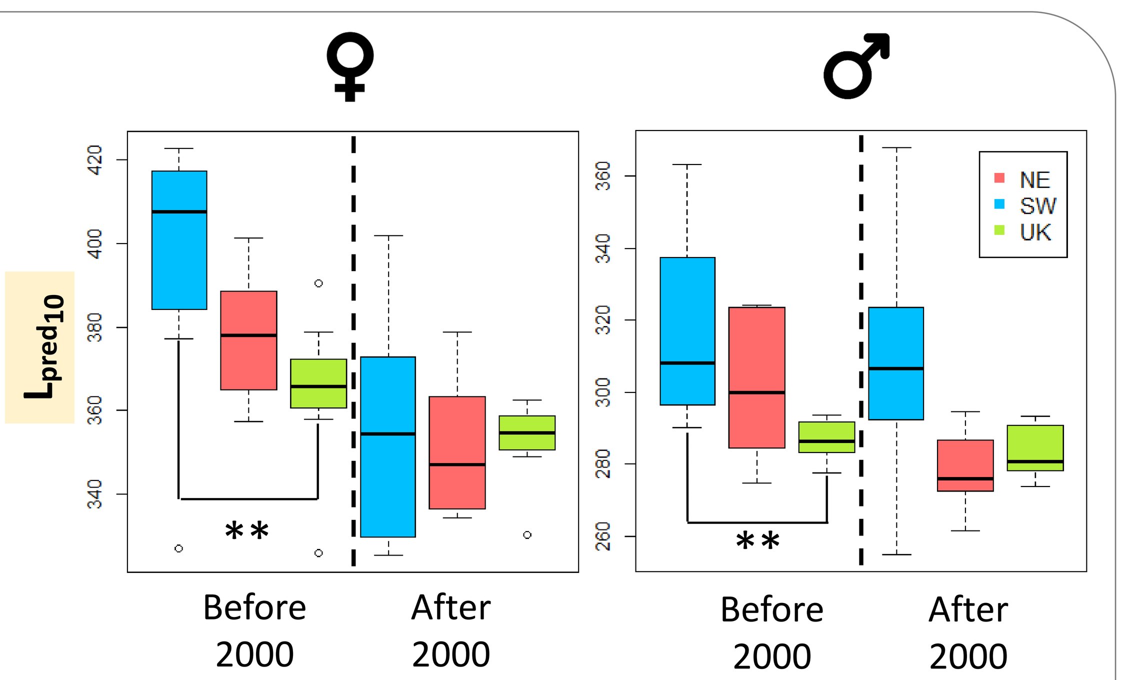
DENSITY
N = 11390 soles (5713 UK + 3097 NE + 2580 SW); 19 Cohorts 1989 - 2010; Age 1 - 5; Sex-ratio = 0,5

RESULTS

GROWTH

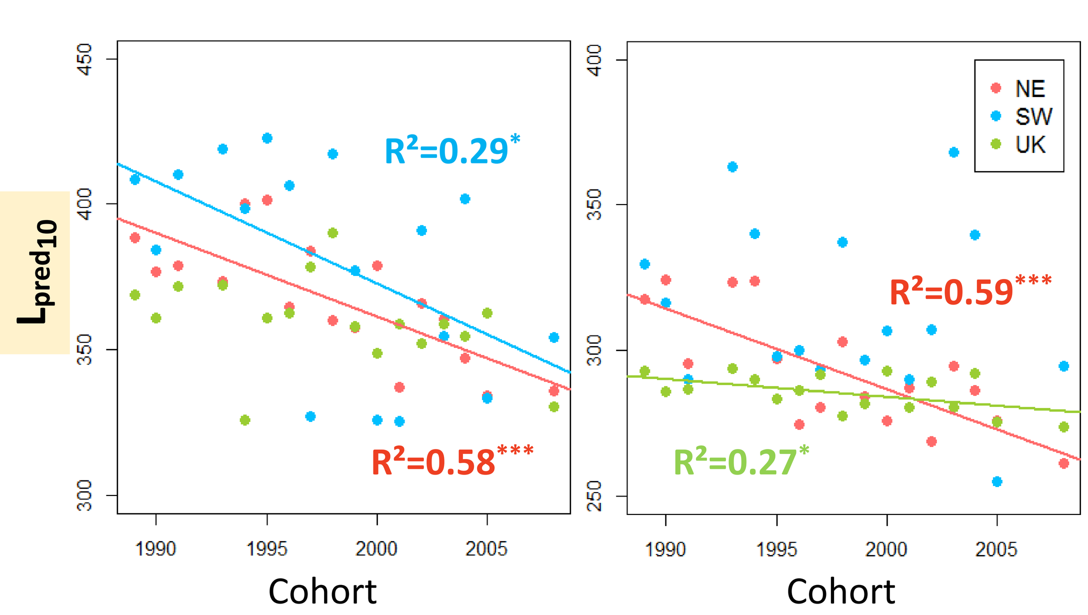
1. Spatial differences

- ANOVA($Lpred_{10}$ ~ Subarea)
- **Before 2000**
  → Fish from the **SW** significantly higher than fish from the **UK**
- **After 2000**
  → No differences



2. Decreasing trends

- Lm($Lpred_{10}$ ~ Cohort)
- Significant decrease in $Lpred_{10}$ in **NE** for both sex, in **SW** for females and in **UK** for males



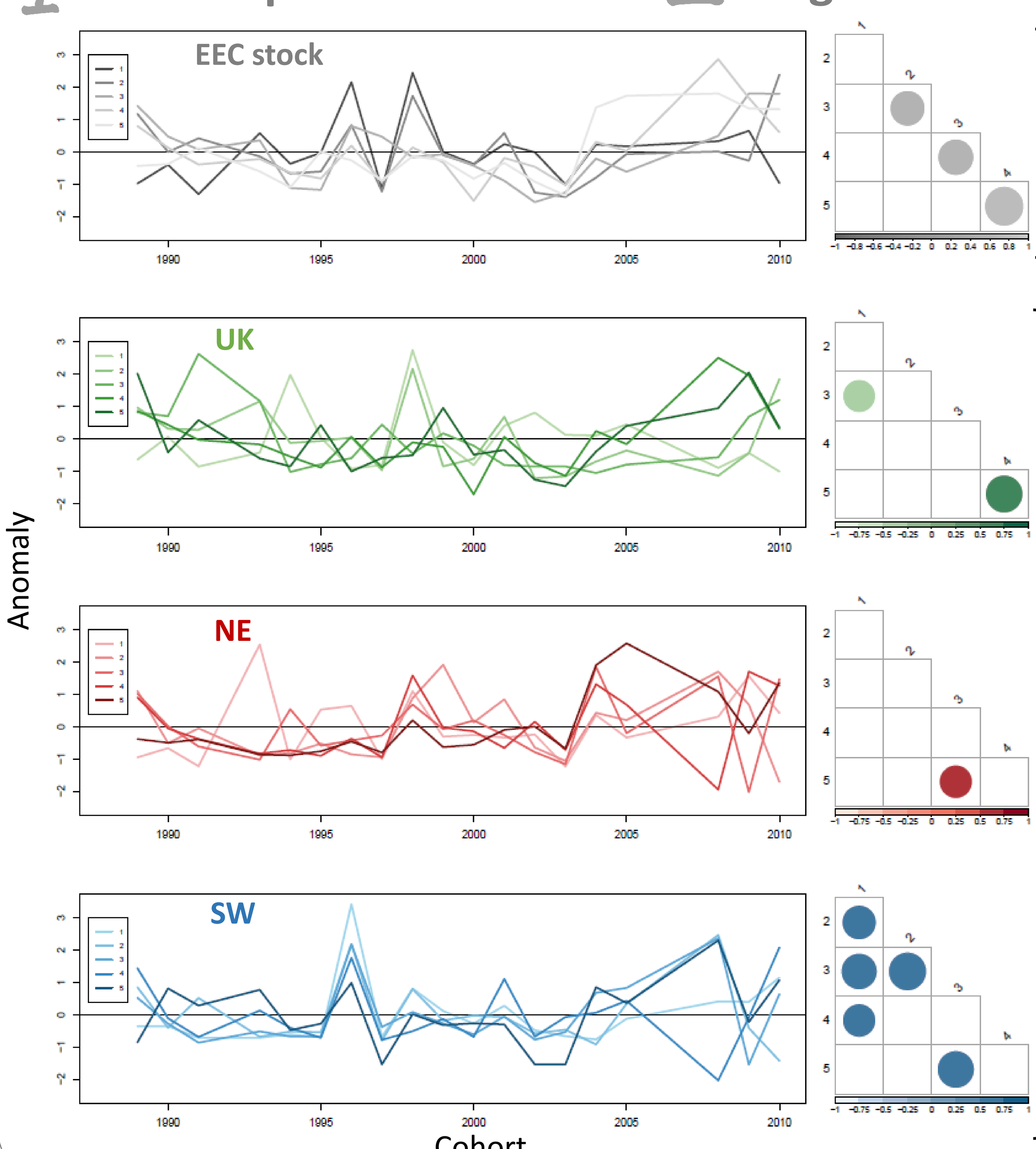
3. Asynchrony between subareas

Asynchrony of Interannual growth variations was found between subareas for both sex

DENSITY

1. No temporal trends

2. Higher level of synchrony in SW

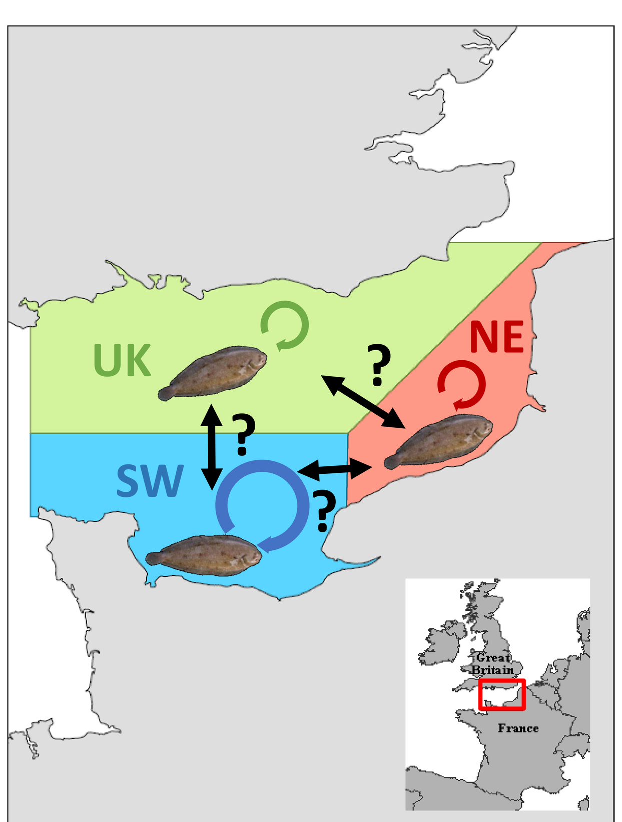


1 single stock → 3 correlations → "Moderate" cohort follow-up

3 subareas → 1 positive correlation in **UK** and **NE** → No cohort follow-up

But → 5 positive correlations in **SW** → "Strong" cohort follow-up

Cohort follow-up is better in SW, considering 3 subareas, than 1 single stock



CONCLUSIONS

- Global decrease of length in the EEC, especially in **NE** over the last 25 years → Fisheries Induced Evolution and/or environmental drivers?
- Spatial growth structuration of the EEC stock (especially between **SW** and **UK**)
- Considering densities at age in 3 subareas, strong cohort follow-up was found in **SW** → low exchange with the other subareas?

PERSPECTIVES

Researches at the individual scale are needed to deeply understand the level of connectivity between the 3 subareas

REFERENCES

[1]: **Archambault, B., Le Pape, O., Baulier, L., Vermard, Y., Véron, M., & Rivot, E. (2016)**. Adult-mediated connectivity affects inferences on population dynamics and stock assessment of nursery-dependent fish populations. *Fisheries Research*, *181*, 198-213.

[2]: **Rochette, S., Le Pape, O., Vigneau, J., & Rivot, E. (2013)**. A hierarchical Bayesian model for embedding larval drift and habitat models in integrated life cycles for exploited fish. *Ecological Applications*, *23*(7), 1659-1676

[3]: **Rochette, S., Huret, M., Rivot, E., & Le Pape, O. (2012)**. Coupling hydrodynamic and individual-based models to simulate long-term larval supply to coastal nursery areas. *Fisheries Oceanography*, *21*(4), 229-242.

[4]: **Le Pape, O., & Cognez, N. (2016)**. The range of juvenile movements of estuarine and coastal nursery dependent flatfishes: estimation from a meta-analytical approach. *Journal of Sea Research*, *107*, 43-55.

[5]: **Véron, M., Archambault, B., Rochette, S., Hunter, E., Lehuta, S., Randon, M., Savina-Rolland, M., Vermard, Y., Réveillac, E., Rivot, E., & Le Pape, O. (2017).** Integrating mark-recapture data within a Bayesian life-cycle model to evaluate the spatial structure of a population and its consequences on population dynamics: Application to the Sole population in the Eastern Channel. Flatfish Symposim, Saint-Malo. Poster 1.

PARTNERS/FUNDERS

This study is supported by the SMAC project conducted by Ifremer, and funded by FFP, DPMA and Regions
https://wwz.ifremer.fr/smac/Le-Projet-Smac