XIV International Symposium on Oceanography of the Bay of Biscay
11-13 June 2014, Bordeaux, France

Influence of phytoplankton diversity and community structure on oyster reproduction (Arcachon Bay, France)

A. Gonzales (1), I. Bernard (2), D. Maurer (3), I. Auby (3), S. Gasmi (1), S. Pouvreau (4), V. David (1)

(1) Université de Bordeaux, UMR EPOC, Station Marine d'Arcachon, 33120 Arcachon, France; (2) Euréka Modelisation, 13 Cité des Gardiens de Phare, 22740 Lézardrieux, France; (3) Institut Français de Recherche pour l'Exploitation de la Mer, Arcachon 33120, France; (4) Institut Français de Recherche pour l'Exploitation de la Mer, Argenton en Landunvez 29840, France

Introduction

Arcachon Bay is one of the most important spat-supplying area for the French oyster production. During the last 16 years, the local economic activity of spat production has been threatened recurrently by a high interannual variability of seed harvesting. This threatened spat production was attributed to reproductive problems highlighted by both a delay in oyster spawning and a decrease of small larvae abundances since 1995.

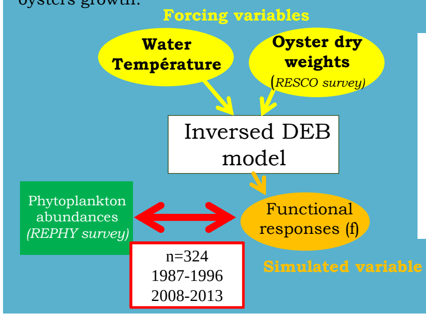
Recent works showed that these two reproduction indices seem closely related to climate change that might controls the phytoplankton communities of the Bay. Food availability in term of quantity and quality appears thus as a serious track to understand the reproductive problems of oyster in the Arcachon Bay.

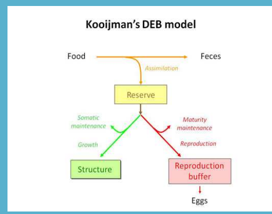
The aim of this work was thus **to understand how phytoplankton might control the growth and reproductive effort of oysters** in Arcachon Bay through microphytoplankton diversity and composition.

Material & Methods

The functional response (**f**) was used as an index of the feeding needs of oysters in order to obtain the observed growth. They were simulated thanks to an inversed DEB model from water temperature and dry weight of oysters available locally from 1987 to 1996 and from 2008 to 2013 as forcing variables (RESCO survey).

The temporal fluctuations of f were then analyzed and related to phytoplankton diversity (total abundances, taxonomic richness, Pielou evenness and Shannon diversity). Functional response model were finally established based on the abundances of several taxa in order to understand which species are better for oysters growth.



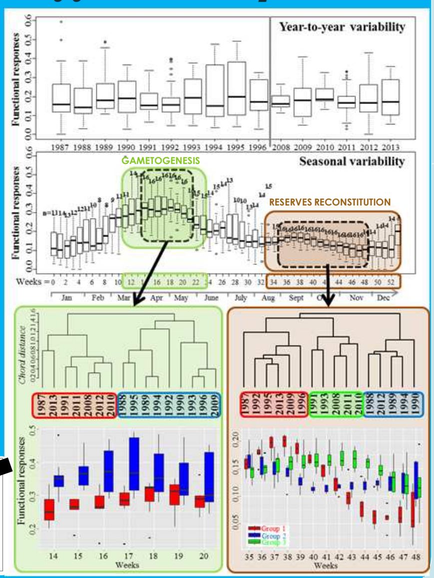


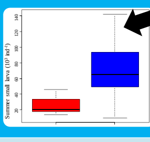
DEB model version performed from Pouvreau et al. (2006)

Results & Discussion

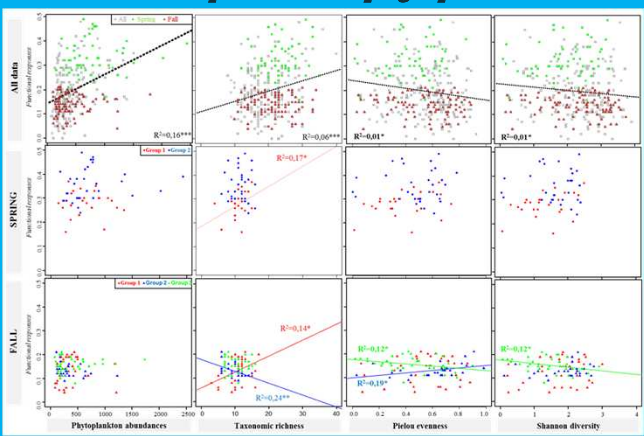
I. Temporal fluctuations of functional responses

- **Significant seasonal fluctuations** were highlighted *(Kruskal-Wallis test, p<0.001)* whereas **no significant year-to-year variations** were detected *(p>0,05)* on the whole f data.
- Two seasons presented significantly different f-values *(Steel Dwass post Hoc, p<0,05)*, with the **highest f-values during the spring** (i.e. the oyster "gametogenesis") and the **lowest during the fall** (i.e. the "reserves reconstitution")
- Two groups of years with similar seasonal profiles of f were put in evidence during the spring *versus* three groups during the fall *(CAH)*. The **first spring group** with the **lowest f-values** mainly **gathered together recent years**. These years were characterized by the **lowest mean of small larvae' densities** during summer, suggesting that lower f during the gametogenesis would imply either a lower reproduction effort or a lower gametes / larvae quality.





II. Functional responses and phytoplankton diversity

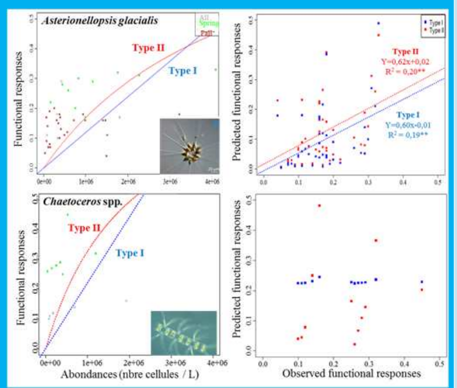


- Significant **higher f-values** were obtained **during the spring than during the fall** for similar range of phytoplankton abundances, richness and evenness.
- The functional response of oyster increases significantly and linearly with richness, total densities and dominance of some phytoplankton taxa. However, these trends were characterized by a very high dispersion and were absent or sometimes contradicted at specific seasonal scale, suggesting the **complexity of the global phytoplankton diversity-f relationships.**

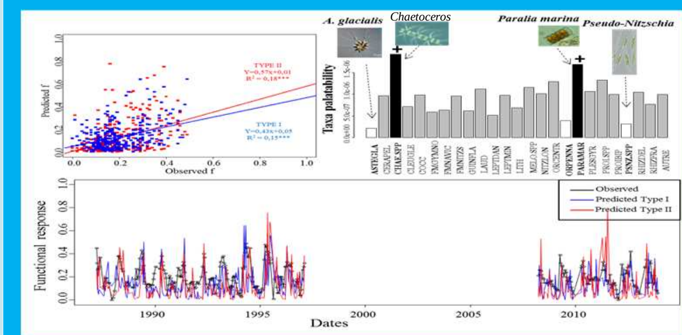
III. Modelling the functional responses

• Uni-specific functional response (when one species is dominant)

- For the dates characterized by a large dominance of one species, higher f-values were observed during the spring than during the fall for a same range of abundances
- For ***Asterionellopsis glacialis***, Type I and Type II models of functional responses simulated significantly the modelled f-values contrary to ***Chaetoceros spp***. The 2 models were equivalent even if dispersion was very high for both of them.



• Multi-specific functional response (all consumed species)



- Both Type I and Type II multispecific models simulated significantly the observed f-values. The **Type II model** provided however the best fit with observed data despite a high dispersion.
- *Chaetoceros* spp. and *Paralia sulcata* contribute highly to the f construction contrary to *Asterionellopsis glacialis* and *Pseudo-Nitszchia* spp. These results confirmed previous experimental approaches that have demonstrated the good and bad quality status of *Chaetoceros* and *Asterionellopsis glacialis*, respectively.

Conclusions

The **phytoplankton taxonomic composition might be more important than the diversity in explaining the functional response of oysters**. Type II multi-specific model on phytoplankton taxa significantly traduces the temporal fluctuations of f and thus the feeding response of oysters. However, f fluctuates at the seasonal scale for a same range of phytoplankton abundance or composition. Such seasonal fluctuations might be explained by differences in nutritive quality over season for a same phytoplankton taxa or by oysters' physiological features that are not included in DEB model.

Bibliography

Pouvreau et al. 2006. Journal of Sea Research 56:156-167

Acknowledgement

This study has been carried out with financial support from the French National Research Agency (ANR) in the frame of the Investments for the future Programme, within the Cluster of Excellence COTE (ANR-10-LABX-45)

Corresponding author: v.david@epoc.u-bordeaux1.fr