Modelling growth and reproduction of Crassostrea gigas in different contrasted ecosystems by use of Dynamic Energy Budgets (DEB):

generic validation of the oyster-DEB model

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Introduction
Oyster (Crassostrea gigas) farming is the main aquaculture activity in France and the first shellfish production in Europe with an annual production of ~130 000 tons. The growth performances of C. gigas exhibit an important variability among culture sites along the French Atlantic coast. Many studies have been carried out to understand the effects of environmental factors on oyster growth and physiology, by using bioenergetics growth models. Most of these models, however, are site-specific (e.g. Barillé et al. 1997) and cannot be successfully applied to other culture sites without re-estimating parameters or re-formulating some processes. In that context, our study aims to develop a generic growth model, i.e. a model than can be applied in various contrasted environments with a constant set of parameters.

Material & methods
We use the DEB model designed for the Pacific oyster C. gigas (Pouvreau et al., 2006; Bourlès et al., 2009) based on the DEB theory (Kooijman, 2000). The resulting oyster-DEB model is built on 10 main DEB parameters with some extra parameters to consider specific bioenergetics of C. gigas. Only one DEB parameter, i.e. the half-saturation coefficient $X_{W}$ which depends on food quality and quantity (e.g. inorganic matter, phytoplankton composition) and therefore on ecosystems, is calibrated for each site in order to evaluate the generality and/or the limits of the model.

In collaboration with Ifremer coastal laboratories, we test the oyster-DEB model to simulate C. gigas growth on different cohorts (spat and adults) in major shellfish culture sites in France and for different years: 1) Arcachon (1993-1994); 2) Marennes-Oléron (2007); 3) Quiberon (1999, 2000, 2001); 4) Rade de Brest (2008); 5) Baie du Mont-Saint-Michel (2003); 6) Baie des Veyes (2002). These different ecosystems offer a wide range of values for the two model forcing $X_{T}$ and $X_{P}$. Forcing and validation data have been provided by REMORA and REPHY networks (http://www.ifremer.fr/envlit/) from Ifremer. The members of the European Research Group AquaDEB (http://www.ifremer.fr/aquadeb/) are gratefully acknowledged for the stimulating discussions and useful comments.

Results & discussion

Forcing variables:

- Temperature and Phytoplankton enumerations

Application of the oyster-DEB model

- Observed (dots) vs Simulated (red line) growth

Conclusion

With one single set of parameters (except for $X_{W}$), this is the first bioenergetic growth model for C. gigas which is robust enough and generic to simulate accurately the oyster growth in different ecosystems.

References


Acknowledgments

Y. Bourlès was supported by funding of Région Poitou-Charentes and Ifremer during his PhD project. Forcing and validation data have been provided by REMORA and REPHY networks (http://www.ifremer.fr/envlit/) from Ifremer. The members of the European Research Group AquaDEB (http://www.ifremer.fr/aquadeb/) are gratefully acknowledged for the stimulating discussions and useful comments.