What the Dynamic Energy Budget theory can tell us about filter feeders eco-physiology?

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Marine filter feeders and especially bivalves are extensively and world-wide studied due to their key-role in the functioning of coastal ecosystems regarding ecological, fishery or aquaculture issues. Bivalves' physiology, growth, reproduction and survival strongly rely on environmental factors, especially food abundance and temperature. In this context and since more than 30 years, many authors have focused on the effect of both factors on growth and reproduction performances of bivalves: from Bayne (1976) to Riisgard (2001), knowledge on bivalve ecophysiology has undoubtedly gained in details, especially about feeding and particles selection mechanisms. Meanwhile, other multidisciplinary approaches have tried to catch the diversity of bivalve ecophysiology through bioenergetics' models. Most of these models are based on the Scope For Growth (SFG) concept and are built on empirical allometric relationships. They constitute useful tools to describe the multifactorial effects of food and temperature on growth performances of bivalves. But this generation of models exhibits some major limitations: (1) they are not dynamic since SFG describes only a state in the energy budget; (2) each model has its own set of equation and consequently is strongly species-specific and even site-specific; (3) a great part of them are largely over-parameterised and rely on weak mechanistic explanation underlying the various equations and parameters.

With a hope for generality in quantifying the bioenergetic of living organisms, recent applications of Kooijman's DEB theory to bivalves help to overcome these limitations by providing a generic and mechanistic framework to model with one unique set of rules the effects of environment on bivalves life traits (growth, reproduction and survival). As an illustration, this presentation will show successful applications of the DEB theory to filter feeders bioenergetics, from controlled experiments to field conditions. Results of simulating growth and reproduction of the Pacific oyster (*Crassostrea gigas*) will be presented by using data from several French sites and for many years (*e.g.* Fig. 1). A particular attention will be paid also on what we learn from DEB theory about the oyster physiology in natural environment, especially concerning its food preferences or its spawning strategy. Application of the DEB oyster model to other filter-feeders will be also addressed to demonstrate how far the DEB theory is generic. Finally, potential DEB applications in operational scientific projects at Ifremer will be shown especially in the domain of climate-induced variability in marine resources.

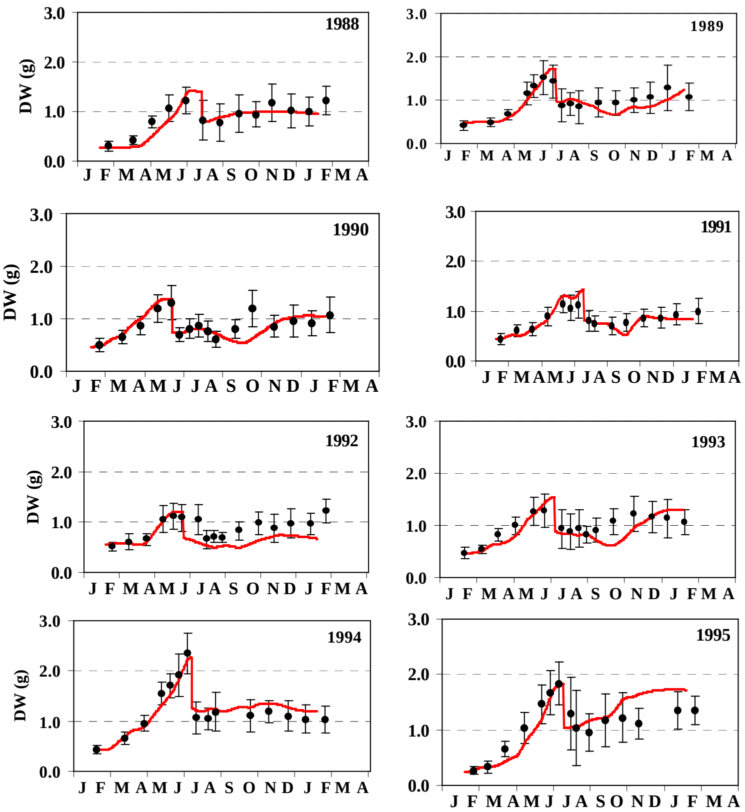

Figure 1 : Application of the DEB theory to model the growth and the reproduction of the Pacific oyster model in the Bay of Arcachon (France): more than eight years of data. Black dots are mean individual oyster flesh weight observation (in dry weight g +/- IC), red curves are simulation obtained each year from the model under real environmental forcing (sea temperature and phytoplankton concentration). The sharp decrease corresponds to the spawning event simulated by the model and also observed in data.