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Title of thesis : Environmental variability and energetic adaptability of *Pecten maximus* facing climate change.

Thesis project description

General framework

Ecological dynamics in coastal areas is highly variable, mainly because of *bottom-up* control of primary production (which is under the influence of climate and continental inputs). The great scallop *Pecten maximus* is a species whose biogeographical area extends from Moroco to Norway, and from the coastal embayments of Brittany and Ireland to the edge of the continental shelf. Reproduction and growth of *P. maximus* have been particularly described in coastal temperate areas (Buestel et Laurec, 1975; Wilson, 1987; Thouzeau et Lehay, 1988; Paulet et al., 1988; Hawkins et al., 2005; Magnesen et Christophersen, 2008). The links between those life history traits and environmental variability (quantity and quality of food, temperature) are known. As many other suspension feeding bivalves (Riera et Richard, 1996), *P. maximus* feed on many different food sources (Chauvaud et al., 2001) ; the great scallop is thus capable to develop a plastic trophic niche, variable in space as an adaptation to available trophic resources, and in time depending on its development stage, as it has been demonstrated for other bivalves (Rossi et al., 2004; Marín Leal et al., 2008). However, Lorrain et al. (2000) showed that the abundance of trophic resources may negatively affect the growth of *P. maximus*, and Strohmeier et al. (2007) demonstrated that the energetic balance of the great scallop may be positive even in oligotrophic environments near the northern limit of the repartition of the species.

Objective

The main objective of this project is to describe the variability of the energetic strategy (growth and reproduction) of *Pecten maximus* according to the variability of its environment (food resources, temperature, and seasonality). Three different stations of the biogeographical area of *P. maximus* will be studied : the Bay of Brest, a norwegian fjord and the Iroise Sea. Results should help in evaluating the impact of global warming on the evolution of populations and biogeographical area of great scallop.

Methods

Environmental parameters and populations will be monitored in coastal stations (Bay of Brest and Norwegian fjord). Results will be used to develop a dynamic bioenergetic model of individual growth of the great scallop. This model will then be used to reconstruct the trophic environment of the deep Iroise Sea individuals.

In situ monitoring

Coastal stations populations and environment will be first studied and compared (eutrophic temperate environment in the Bay of Brest *vs* oligotrophic cold environment in Norway). In both sites, trophic resources will be characterized using isotopic analysis and other tags (lipids, pigments, ...). Results of the monitoring and databases of ancient monitorings in the Bay of Brest and in Norway will be used to calibrate an individual bioenergetic model.

The Iroise Sea population, less accessible, will be sampled on an irregular basis. Shell archives stored in Lemar will be studied to calibrate and validate the bioenergetic growth model.

Experimental study of isotopic composition

Growth and isotopic composition will be monitored in a controlled environment experiment; *Pecten maximus* individuals will be submitted to different trophic regimes with a known isotopic composition (δ^{13}C and δ^{15}N). Incorporation and fragmentation in the different organs will be monitored (Lorrain et al., 2002; Paulet et al., 2006).

Bioenergetic modeling

The *Dynamic Energy Budget* (DEB) theory (Kooijman, 2000) will be used to develop the individual growth and reproduction model, taking into account the variability of the environment and food resources.

Collaborations

This thesis will take place under joint supervision of the university of Brest (France) and the university and IMR of Bergen (Norway), in the MENTOR framework. This work will be part of the AquaDEB European research group. The PhD student will have to collaborate with Ø. Strand et R. Rosland in Bergen, Marianne Alunno-Bruscia from Ifremer in Argenton laboratory, S. Lefebvre in university of Caen and Pr. Kooijman in Vrije Universiteit in Amsterdam.

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