SCIENCESPRINGDAY

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Department of Environmental Sciences and Engineering

Co-use of wind farms for aquaculture: Simulation Analysis for northern and southern Europe, and assessment of overall potential

IMAR – Institute of Marine Research

Lurdes Brandão

Holds a Master of Science degree in Environmental Engineering by the Faculty of Sciences and Technology from the New University of Lisbon and a Specialization in Environmental Quality by the School of Technology and Industrial Management from the Portuguese Catholic University.

Objectives

Evaluate the co-use of marine space for aquaculture and offshore wind farms areas as an optimisation strategy for marine space occupation and determine the culture practice and evaluate the potential production of shellfish aquaculture in co-use.

Introduction

Because of the increasing world population a growing competition for resources is occurring, leading to a lack of food, space and energy & pressure on coastal environment. As a result, moving for offshore aquaculture and energy could be a solution. Conflicts in marine space occur as a result of on-going and future activities leading to the necessity of marine spatial planning. Co-use of certain activities such as offshore wind energy, fishing and aquaculture, shipping and marine protected areas may be an option to ease demands on space, energy and food.

Methodology

Approach: The "Planet, People, Profit" approach was used to analyse two contrasting systems, in Northern Europe and Southern Europe, for scenarios of shellfish monoculture within wind farms.
Select contrasting sites: Two contrasting systems, with different physical conditions, water quality and cultivated species (Fig. 1): A: Denmark (DK), North Sea – Horns Rev I) – Case study 1; B: Portugal (PT), Atlantic Ocean –WindFloat - Case study 2.
Data acquisition for water quality: Denmark: data were extracted from the validated BScmod hydrostatic 3D circulation model5. Portugal: data were collected from the International Council for the Exploration of the Sea (ICES) (http://www.ices.dk).
Tested species: Mediterranean Mussel - *Mytilus galloprovincialis* (PT); Blue Mussel - *Mytilus edulis* (DK); Pacific oyster - *Crassotera gigas* (DK and PT).
Model: A dynamic model (FARM - Farm Aquaculture Resource Management) was used to simulate shellfish growth (Fig. 2) in order to examine production, environmental impacts and economic viability. Tested for a one farm scenario of 1 to 4 ha.

Expected Results and Conclusions

The different bivalve culture of mussels and oysters scenarios tested at both case studies gave promising results for a one farm scenario of 1 to 4 ha. From a "People" and "Profit" perspective, the optimal production was between 500 – 3500 t y^{-1} (Fig. 3) for 1 to 14 M€ y^{-1} profit, for Pacific oyster. From a "Planet" perspective, ecosystem service was provided by bivalves from the nutrient removal up to 10 500 PEQ per year (Fig. 4). A scaling exercise to case study 1 (DK) would provide 210 000 PEQ per year in a 80 turbines park, although this is assuming no food competition between the farms, and applying a large scale ecological modelling would address this issue.

Offshore conditions pose challenges for aquaculture production, due to strong waves and currents limiting access to sites and conditioning the culture structures to fit and resist within the turbine areas. For these reasons, bivalves were appropriate species for the two case studies as opposed to finfish, as they are not fed aquaculture. Other challenges in co-use of marine space for aquaculture, and potentially infrastructures and services, such as appropriate site selection in relation to distance to port, appropriate mooring technologies, permitting costs, safety, and insurance, need also to be addressed.

Funding: The authors acknowledge financial support from the EU COEXIST Project. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement no 245178. This publication reflects the views only of the author, and the European Union cannot be held responsible for any use which may be made of the information contained therein.

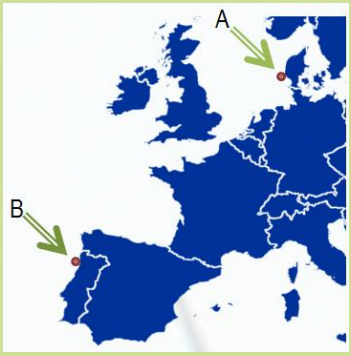

Figure 1. Location of both case studies

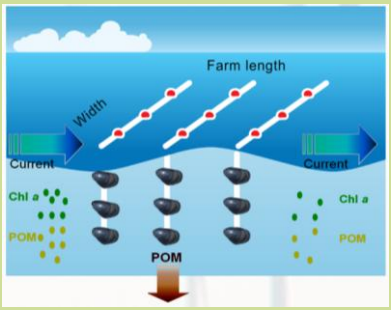

Figure 2. FARM: conceptual diagram

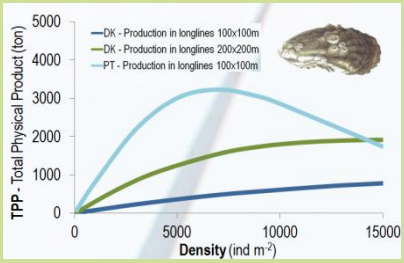

Figure 3. Oyster production at different densities in Denmark and Portugal

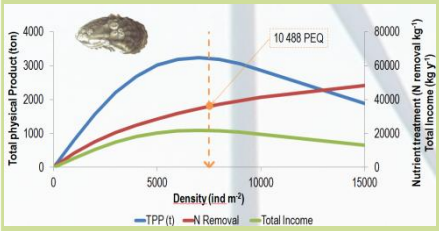

Figure 4. Mass balance analysis for Pacific oyster in longline area 200x200m