

OYSTER (*C. GIGAS*) RECRUITMENT IN MEDITERANEAN LAGOONS ; NEW APPROACHES FOR STUDYING LARVAL CONNECTIVITY USING MARS3D MODELING TOOLS

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Introduction

The Thau lagoon, located at the South of France, provides 10% of the French pacific oyster *Crassostrea gigas* production (Robert et al., 2013). Despite this intensive shellfish production, the larval recruitment of this species within the Thau lagoon is still misunderstood and spat collection remains highly variable; as a consequence, shellfish farmers rely mostly on hatchery's spat. In 2012, the PRONAMED II project was launched, aiming to improve our understanding of the *C. gigas* reproductive cycle within Mediterranean lagoons and to explore the feasibility for oyster-spat collecting. In addition to an extensive sampling work encompassing both spatial and temporal features of larval recruitment, we tried to understand the contribution of larval dispersal on recruitment patterns. For this purpose, we developed new approaches using the MARS 3D hydrodynamical model. While most models keep looking at the location of larvae after a simulation duration specified by the user, we propose here a new approach considering the pelagic larval duration and focusing on the duration of the larval competency for settlement. A new index was set up to take into account the binary possibility for the larvae to settle or not during its final pelagic stage, the settlement probability increasing with the amount of larvae passing through a model mesh.

Material and Methods

We used the Thau lagoon as our reference ecosystem. *C. gigas* broodstock was represented by shellfish farmer concessions, since no wild oyster beds exist within the lagoon. For larval release, farming structures were divided in 13 sectors of same volume. The lagoon was divided in 13 sectors of similar surface to define destination areas (Fig. 1A), the extent of each sector being obtained by clustering the longitudes and latitudes from the model grid (Thomas et al., 2014). Environmental variables (temperature, salinity, wind forcing, rain, tidal amplitude) were extensively followed since 2008 in order to impose realistic forcing to our model. We used the MARS 3D hydrodynamical model developed at IFREMER (Lazure & Dumas, 2008) in order to simulate the larval dispersal. Very little is known concerning *C. gigas* larval vertical migratio; thus, for practical reasons, oyster larvae were considered as dissolved matter in the model. Pelagic larval duration was calibrated using extensive larvae samplings during the 2012 and 2013 summers. Potential connectivity was calculated as a function of quantities, following:

$$P_{sd}(t) = \frac{Q_{sd}(t)}{Q_s}$$

Q_{sd} being the number of larvae found in the destination location d at time t and coming from the spawning site s , and Q_s being the total number of larvae released in the spawning site s .

In addition to this classical approach, we used a new index, integrating the amount of substances passing through a mesh of the model during the last days of the pelagic larval duration.

Results

Preliminary results showed that the hot spots figuring within the distribution of *C. gigas* larvae within the Thau lagoon are concentrated in both eastern and southern parts of the lagoon (Fig. 1B). This distribution was the mean pattern obtained for every simulation. Connectivity matrix showed that every farming structure areas were better connected to the eastern part of the lagoon (Fig. 1C).

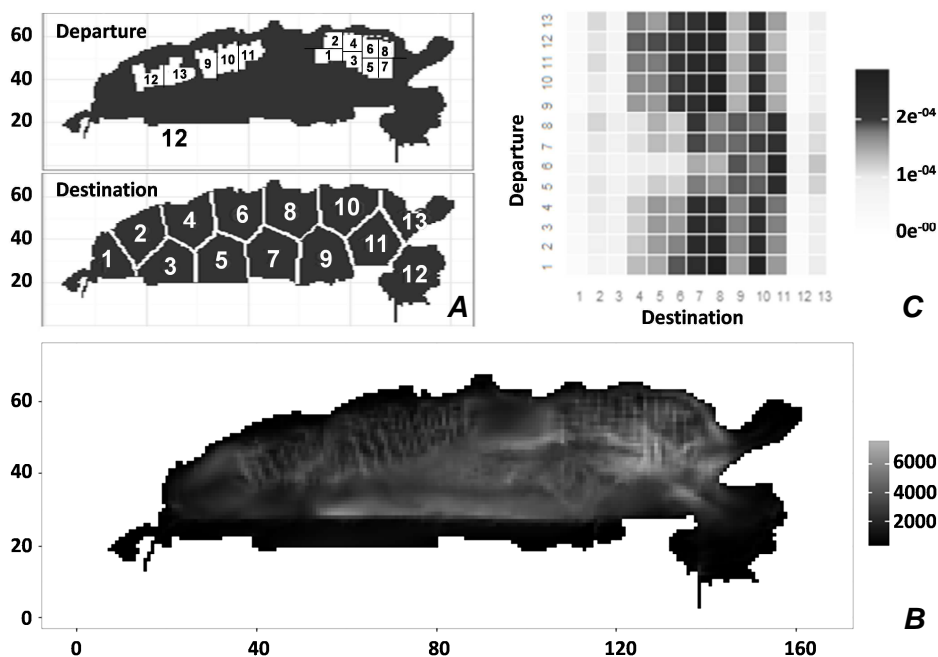


Fig. 1: Departure and destination sectors within the Thau lagoon (A); new index (P_{index}) representing the cumulative sum of substances passing through a model mesh during the late stage of the larval pelagic duration (B); connectivity matrix between departure and destination areas (C).

Discussion and Conclusion

Instead of the classic snapshot of larval dispersal at the end of the pelagic larval duration, our approach provides new insights in dispersal modeling of mollusk communities. The complementarities between both environmental and modeling approaches allowed us to highlight the relative importance of exogenous factors for larval dispersal, metamorphosis and settlement. However, some improvements are still needed and especially regarding to the farming structure influence on water currents, as well as vertical migration of larvae in the water column. Our modeling strategy, combined to the field study, will serve the design of a decision tool intended for helping shellfish farming management.

References

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