Integrating field data to parameterize a larval transport model of sole and improve knowledge on recruitment in the North Sea

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Introduction

Inter-annual recruitment variability of sole (Solea solea) is high in the North Sea. It has been shown, with a Lagrangian larval transport model, that hydrodynamics explains part of this variability in sole [1]. IBMs require a good knowledge of the biological processes governing larval dispersal. However, it is difficult to obtain observations of life history traits; their estimates may strongly influence larval connectivity / retention and successful migration as predicted by the model. Various assumptions about these traits can be tested by comparing simulation results with field data.

Objective

Assess the model performance: Comparing simulated test cases with data to establish the most likely parameterization set.

Sole Larval transport model (LTM)

The sole LTM results from the coupling between the 3D hydrodynamic model COHERENS and an Individual-Based Model (IBM) for sole larvae [1].

Larval parameterization.

Larval stage duration and mortality depend on the environmental conditions met by the larvae. An overall discrepancy criterion summarizes the local anomaly

\[ d = \sqrt{n \sum (N_i - \tilde{N}_i)^2} \]

where \( n \) is the number of nurseries. 2. g, global recruitment indicator, representing global recruitment discrepancy in IVb and IVc ICES division.

\[ g = \frac{\sum (N_i - \tilde{N}_i)}{\bar{N}_i} \]

where \( N_i \) and \( \bar{N}_i \) are the total recruitment observed and predicted by the model.

Methodology

4 larval durations: a, Temperature (°C) 3 mortality levels: Medium: c, b, with the instantaneous temperature and specific stage coefficient.

Results

The local anomaly shows that variability between test cases is bigger than inter-annual variability (Fig.4). In particular for Long and reference larval duration test case.

Conclusions & Perspectives

- Increasing of larval duration improves recruitment predicted by the model.
- Many biotic and abiotic parameters might influence dispersal patterns. Before building more complex models, it is necessary to better represent the biological processes influencing the dynamics of marine species.
- This study represents a first step towards the calibration and improvement of a larval dispersal model of sole in the North Sea and the development of a tool for fisheries management.

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PERSPECTIVES:

- Investigate the influence of spawning (zone, period and egg number) on the recruitment.
- Validate the model with other approaches (atolliths, genetic demography).

Reference:

http://www.mumm.ac.be/
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