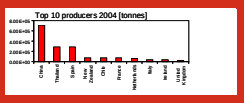
1. Mussel farming in the Adriatic Sea

In collaboration with:
IIASA – International Institute for Applied System Analysis, Laxenburg, AUSTRIA
MBI – Marine Biology Station, Piran, SLOVENIA
Dep. Environmental Sciences & Engineering, Univ. Nova de Lisboa, Portugal
Istituto Superiore per la Protezione e Ricerca Ambientale (ex ICRAM, sez. Chioggia)
Mare Scarl e Consorzio Mitilicoltori Emilia Romagna – Cattolica (RM)
Dipartimento di Scienze Ambientali, Università di Venezia

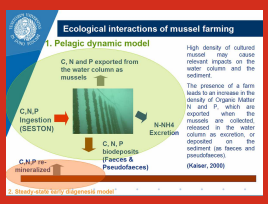
Funded by:
ECASA EU project
http://www.ecasa.org.uk
http://www.ecasatoolbox.org.uk/

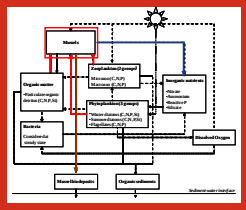
a. The context, the problem



• The Italian production of Mediterranean mussel *Mytilus galloprovincialis*, i.e. the principal mollusc species reared in Italy, was 6.3 x 10^7 kg on average between 2000 and 2005, which represents approximately the 12% of the total European production (FAO, 2007).
• In Italy the development of operational tools for the assessment of the ecological carrying capacity (i.e. density of bivalves at which harvest are maximized without causing unacceptable ecological impacts) is becoming an issue of primary importance, especially in those areas were the fast growth of mussel farming is calling for a rational and science-based distribution of the farms, e.g. the Gulf of Trieste and the North Western Adriatic coast.

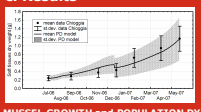
b. Methods. Integrated Reactive Transport numerical Models (RTMs)



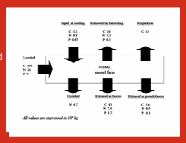


MODELS DEVELOPED
- Individual-Based Population Dynamic model (PD)
- Biogeochemical model (purposely designed for studying the environmental interactions of mussel aquaculture along the NW Adriatic coast)
- Steady-State Early Diagenesis Model

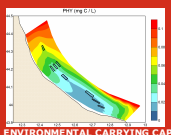
c. Results



MUSSEL GROWTH and POPULATION DYNAMICS:
Growth of a cohort in Chioggia, model prediction versus field



NUTRIENT RECYCLING:
C, N, P budgets for a typical Northern Adriatic mussel farm which produces 600 t a-1.



ENVIRONMENTAL CARRYING CAPACITY: food availability scenarios in a farmed region in function of farm size and density.

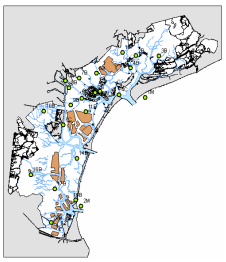
d. Potential applications of these models:
• Site-selection which takes into account the interactions with both benthic and pelagic systems
• Optimization of timing of the cycle (after an improvement of the population model)
• As a research tool, to understand the mussel farming - CNP fluxes interactions

2. Clam farming in the Venice lagoon

In collaboration with:
Dipartimento di Scienze Ambientali, Università di Venezia
OGS – Istituto Nazionale di Geofisica e Oceanografia Sperimentale, Trieste
Dip. Territorio e Sistemi Agro-Forestali, Università di Padova
Co.Ri.La. – Consorzio Ricerche Laguna

Funded by
SPICOSA

a. Backround and general objectives



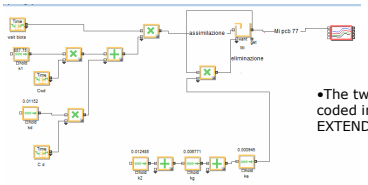
• Harvesting of Manila clam *Tapes philippinarum* is a major exploitative activity in the Venice lagoon;

• Different works focused on modelling the growth of the clam, with the aim of managing the rearing of this species;

• A comprehensive approach, which simulates the growth and the bioaccumulation of pollutants in the clam, as well as the socio-economic aspects of the clam industry is still lacking.

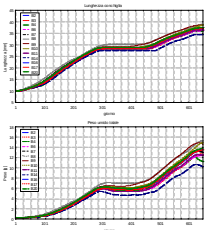
• The improvement of the preformances of an existing individual-based model of the clam, and the simulation of the bioaccumulation of pollutants in clam tissues are the main objectives of this research.

b. Methods. Individual based growth model and bioaccumulation model

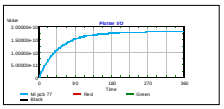


•The two models were coded in the user-friendly EXTEND software interface

c. Results



SCENARIOS of growth of *Tapes Philippinarum* under different food regimes in the Venice lagoon.



Concentration of pcb77 in the clam tissues during one year of cultivation.

d. Potential applications of these models:
• Optimization of the rearing cycle;
• Site-selection and carrying capacity issues
• Quality-check, based on the pollutants accumulated in clam tissues

3. Sea-bream farming in Italy

In collaboration with:
Istituto Superiore per la Protezione e Ricerca Ambientale (ex ICRAM, sez. Roma)

Funded by

The problem

Issue 1: Site-selection and optimization of husbandry practices

Numerical models of fish growth represent useful tools for simulating the potential biomass yield of a fish farm in response to varying environmental forcings (e.g. water temperature and feeding regime)

Issue 2: Preliminary EIA (Environmental Impact Assessment)

A key input data for the modelling the impact of finfish mariculture on the sediment is the quantification of the biomass of wasted food and fish faeces released by the fish cage, which in most applications is quantified by using growth data provided by the fish farmer.

A fish growth model can provide this information.

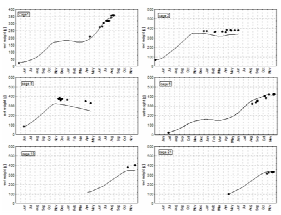
Methods. Individual based growth model and deposition model

Sites studied in Italy

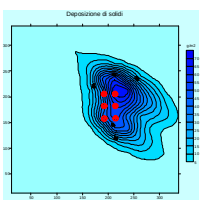
User-friendly interface developed for the seabream growth model

MODELS DEVELOPED
- An individual-based model for *Sparus aurata* was developed, taking into account the effects on the growth rate of water temperature, food availability and diet composition.
- The output from the individual based model represented an input for a deposition model, routinely used in the field of mariculture monitoring by different EU countries.

Results.



MODEL VALIDATION, fish weight predicted by the model were compared with field data collected *in situ*



FLUXES of SOLIDS deposited on the seabed underneath a fish farm located off-shore Bisceglie (BA)

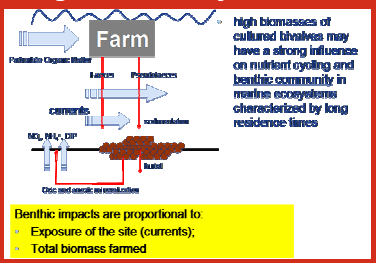
Potential applications of these models:
• the growth model can be used to estimate the potential biomass yield of a fish farm;
•The integration of growth and deposition models in a single system, with an approach similar to the one adopted in Norway with the MOM model, could provide an useful tool for site-selection and monitoring of finfish mariculture operations in Mediterranean environments.

4. Impacts of mariculture on sediment geochemistry

In collaboration with:
Geochemistry Dept. Utrecht University (The Netherlands)
Scottish Association for Marine Science (OBAN, Scotland, U.K.)
Dipartimento di Scienze Biologiche, Ambientali e Marine, Università di Trieste
ARPA – Friuli Venezia Giulia
Istituto Superiore per la Protezione e Ricerca Ambientale (ex ICRAM, sez. Chioggia)

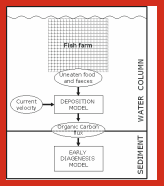
Funded by

Background and objectives

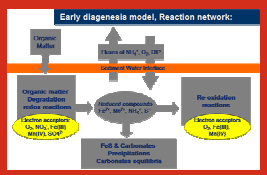


Main objectives of this work are:
1) evaluating the applicability of a Reactive-Transport Model of early diagenesis (EDM) in combination with the DEPOMOD;
2) testing DEPOMOD+EDM integrated model at sites which are exposed to high organic carbon fluxes from aquaculture activities, under transient conditions.

Methods.



DEPOSITION+EARLY DIAGENESIS MODEL:
Schematic representation of the integrated model.



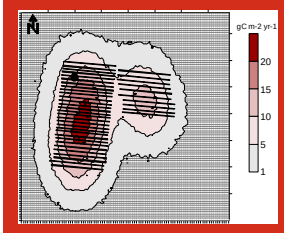
EARLY DIAGENESIS MODEL: primary and secondary redox reactions.

MODELS

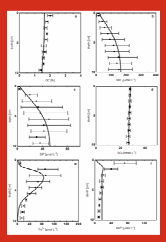
The benthic-pelagic exchange was simulated using two models:
- a 2D particle-tracking and resuspension model
- a 1D early diagenesis model;

The DEPOMOD-derived flux of OC from uneaten food and faeces released by the fish farm provides boundary condition for the EDM.

Results.



FLUXES of ORGANIC CARBON deposited on the sediment underneath a mussel farm in Chioggia.



Comparison between model prediction and field data underneath a salmon farm in a Scottish sealoch.

Potential applications of these models:
• results obtained indicate that the integrated model may represent an useful tool for:
- EIA and site-selection
- Optimization of the management practices.

• The future aim of this class of models might typically be to focus on the prediction of cost-effective indicators of organic enrichment.