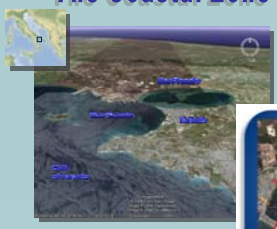
SSA 7.14 - Mar Piccolo in Taranto

The Coastal Zone

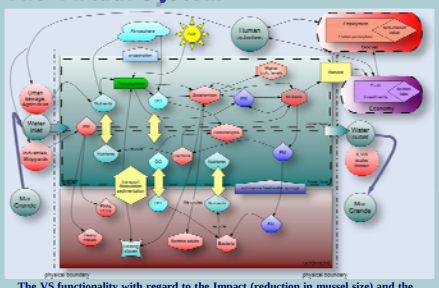


Mar Piccolo is a shallow, nearly enclosed estuary of 21 km2 consisting in two basins: Seno I and Seno II. The exchange with the larger semi-enclosed bay of Mar Grande occurs through a primary artificial navigation channel (12 m) and a small natural inlet. Mar Grande opens into the Gulf of Taranto and the Northern Ionian Sea.

The estuarine circulation in Mar Piccolo is driven by a positive water balance of ~23 mil. m3 yr-1. Tidal-mixing is low, of ~ 30-40 cm. Salinity is influenced by the input of freshwater deriving from small tributary rivers, runoff from the surrounding agricultural soils and from freshwater aquifers, which contribute an average quantity of freshwater of about 1,6 mil. m3 d-1 (Cerruti,1938).

Up until recently, the organic and nutrient loading was practically uncontrolled deriving from 14 sewage pipes, or the equivalent at about 18,272 m3 d-1 Starting from 2000 the number of sewage outfalls has been reduced to five, which have total discharge of about 3,000 m3 d-1 and the levels of nitrogen and phosphorus have been correspondingly reduced (Annichiarico et al., 2008). During this period, an additional policy change was enacted to allow mussel farms to occupy more area.

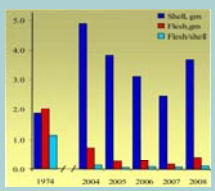
The Virtual System



The VS functionality with regard to the Impact (reduction in mussel size) and the causal set of environmental conditions driven by its waste discharges.

The Policy Issue

This issue of concern negotiated with the Participant Group was the observed decline in the Tarantine mussel production. This is illustrated best by the change in the shell/flesh ratio, which almost doubled after the enactment of the two cited policy changes. The final wording of the Policy Issue, puts this Impact in the broader framework of the value and use of the Mar Piccolo.



Impact

The significant decline in quantity and quality of mussel aquaculture.

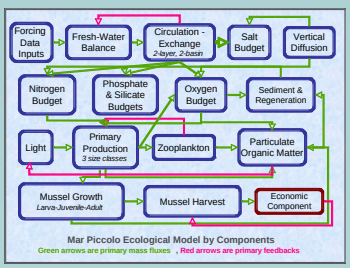
Policy Issue

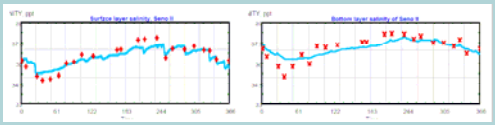
How to include mussel culture in a management plan for the sustainable use of the Mar Piccolo resources?

Scenarios

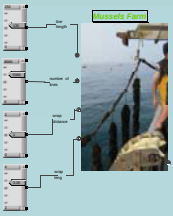
- **What are the environmental conditions that control or are causing the mussel decline?**
  - 1a. To what extent would optimal environmental conditions reduce the costs of mussel culture and increase socio-economic benefits?
  - 1b. What kind of indicators can we use to estimate the mussels growth based on different types of food?
  - 1c. What would be nutrients target ratio in order to optimize MP productivity?
  - 1d. To what degree are contaminant substances or organisms inhibiting or endangering the mussels growth?
- **What would be the costs and benefits derived by enacting the measures needed for sustainable mussel growth?**
  - 2a. Are there other uses preventing better environmental conditions for mussel culture?
  - 2b. What technological options or policy strategies are available to mitigate these damaging effects?
  - 2c. What are the socio-economic consequences of these options or strategies?
- **What are the effects on human and ecological health resulting from the exposure to pollutants and organic wastes?**
  - 3a. What are the implications to human health due to mussels uptake of hazardous substances or microorganisms?
  - 3b. What are the economic benefits of improved ecological health for Mar Piccolo?

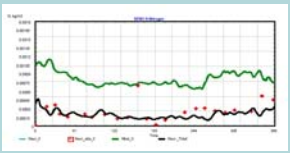
Extend Model & Calibration





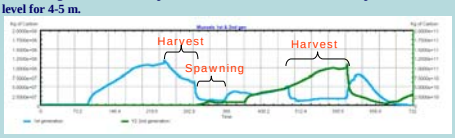
Salinity data observed The surface salinity (left panel) and bottom salinity (right panel) in Seno II, with observations from three centered stations, for the test year of 2003.





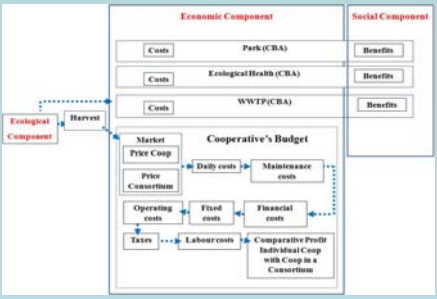
Nitrogen Calibration: In the right panel, the total N of the surface layer (black), the total for the bottom layer (right) using concentrations, and the observed surface data values (red crosses) - in kg m-3.

Mussels Farming and Harvest: In the left panel, the model block for dimensioning the volume of the mussel farms. The actual farming area was based on the sea surface areas licensed to farmers (data from Port Authorities). The farming volume is calculated considering that nets are disposed on lines and fixed as to be suspended under the sea level for 4-5 m.



The MP mussels life cycle simulation is based on 18 months, including harvest phase. The mussel biomass of two age classes (blu: 1st gen.; green:2nd gen.) of a 2003 -2004.

Socio-Economic Dimension, Simulated



The conceptual diagram reports a blow-up of the socio-economic component. A broader set of scenarios that provide options both for the mussel culture management and for urban planning.

Major Problems about Data

Socio-Economic Data

Scarce Information on:

- **Willingness to pay: At present we have not completed the analysis of questionnaires on willingness to pay and public perceptions**

Lacking Data on:

- **Market data: Official prices, Official harvest; Illegal production**
- **Financial budget of the mussel farms: Revenue**
- **Health costs (concerning exposure to mercury and PAHs due to mussel consumption)**

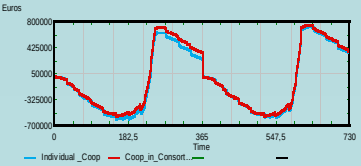
Ecological Data

Scarce Information on:

- **Geo-Chem-Bio-Physical Variables**
- **Ecosystem function and Carrying Capacity**
- **Freshwater fluxes from Streams, Land Drainage, and Aquifers**
- **Input Data on Waste Discharge (nutrients, particulate matter, synthetic chemicals)**

Lacking Data on:

- **Observational Sampling: e.g. Time Series, Depth Profiles, Spatial Coverage**
- **Process Observations: e.g. Primary Productivity, Sedimentation Rates, Mussel Filtration Rates and Assimilation**



Cost and Revenue of an individual Cooperative (blue) and Cooperative in Consortium (red).

- **In Taranto the mussel farms are mostly managed as Cooperatives (about 80%).**
- **The mean age of employees has increased progressively because of failure of generational turnover, characteristic of traditional family-run enterprises.**
- **The "illegal" employment consists of family members of the managers of each cooperative, who are utilised during the harvest. This is a cultural tradition typical of farming in southern Italy.**
- **Evidence exists that a Consortium of the Cooperatives would be a better way to manage the mussel farming.**
- **As a Consortium there will be advantages in terms of employment benefits and net revenue.**

Stakeholder Concerns

Major aim → **Decision-making information on policy options** → **Improvement of the quantity and quality of mussel culture**

To outline the approach:

- **How do different stakeholders perceive water quality?**
- **What are their demands with respect to water quality?**
- **Would a "good" water quality satisfy all stakeholders?**
- **Can a "good" water quality be reached in such impacted basin?**
- **If no what would be the alternatives?**
- **What are the sustainable policy options for reducing the reduction of the productivity and quality of the mussels?**
- **How can this be done to the best long-term interest of the end-users and preserve the bio-productivity of the Mar Piccolo?**
- **What trade-offs and options would minimize such policy decisions?**

New Unforeseen Outcomes

The benefits of the Spicosa SAF application of Mar Piccolo have been:

- **a model tool that allows us to understand the factors controlling on the mussels quality and on Mar Piccolo carrying capacity;**
- **a more integrated plan for Sustainable Development in the Taranto Region;**
- **forecast analyses, in cases of some "extreme-disturbance" events and for more complex policy scenarios;**
- **the rewarding experience of the participatory exposure and dialogue with city officials, regional environmental agencies, and stakeholders;**

On a larger scale, the SAF "exercise" taught us how to manage a new approach to integrated multidisciplinary research and the ability to create a much wider, more accurate tool with important benefits both on the Science and Policy in the framework of environmental sustainability.