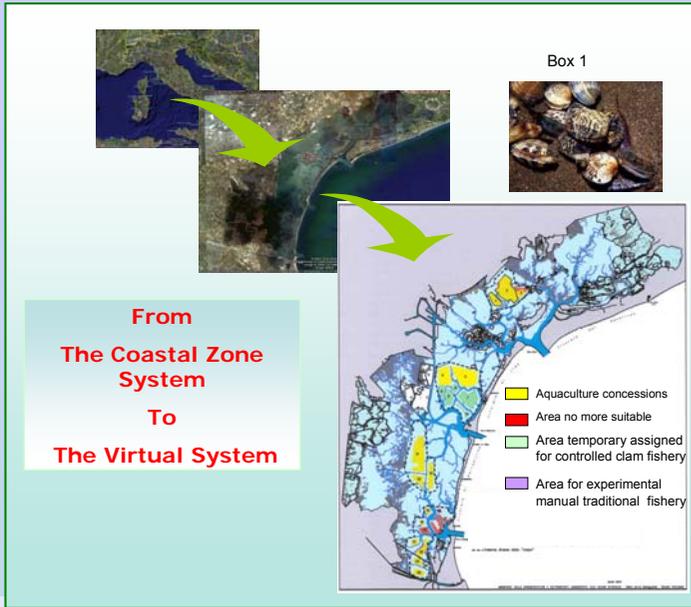


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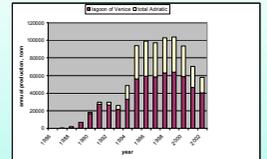


The Policy Issue

Sustainable management of the clam *Tapes philippinarum* in the Lagoon of Venice

History

- 1983: *Tapes philippinarum* introduction
- 1983-1990 clam colonisation
- From1990: fishermen started to fish in open access regime/ social tensions/poor quality (fished also in prohibited area)
- 1999: catches decline
- 2001: allocation of aquaculture concessions
- 2005: extension of aquaculture concessions
- Negative impacts: sediment resuspension, benthic habitat alteration
- Economic Relevance: 60% of national production
- Number of fishermen: around 1000;
- estimated gross annual production: 180 Million Euro

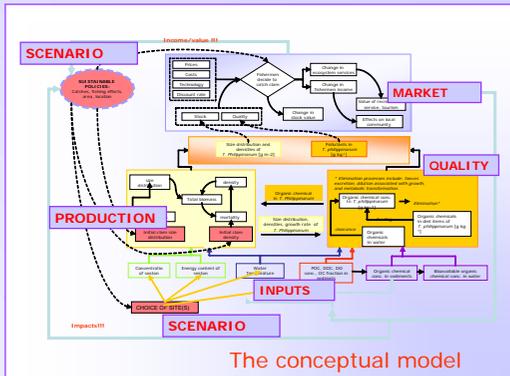


Objective of SSA 15

Our goal is to preserve the clam fishery activity, under aquaculture scenarios, since this economic activity is important for the welfare of the small islands communities, whose existence helps to preserve the lagoon social environment towards the tourism mono-culture.

Formulation step: From the conceptual model to EXTEND

With this aim we are developing the integrated model with EXTEND that simulates the PRODUCTION, QUALITY, and MARKET in order to evaluate the annual revenue under different scenario. SCENARIO will allow us to simulate the clam production varying the ENVIRONMENTAL QUALITY and the SOCIAL DIMENSION: this means, on one side, varying the location inside the lagoon or varying the trophic conditions in response to different anthropogenic inputs. On the social side it means varying the number of people or varying their distribution inside the lagoon.

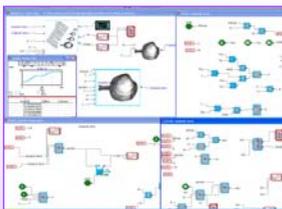


EQUATIONS

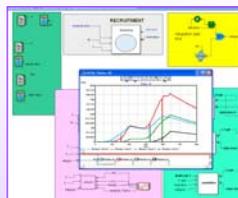
PROCESS	EQUATION	PARAMETER
CLAM GROWTH	$\frac{dw}{dt} = A - C = \min(\beta^* F, G_1 \max(gw^m) - R_2 f_r^{-1})$; growth w : dry weight	G_1 max 0.01456 (gW/265d day) Max specific growth rate R_2 max 0.0102 (day ⁻¹) Max specific mortality rate β^* 0.00265 (gW/m ³) Allometric coefficient of β β 0.21 Allometric exponent of the specific filtration rate β 0.0234 Allometric coefficient of the w - w relation w 2.1 (kg) Maximum filtration rate ϵ 4085 (gW _{cl} g Chl _a) Ratio among average energetic content of phytoplankton and of <i>T. philippinarum</i> T_{opt} 12 (°C) Max tolerance temperature for the growth T_{opt} 20.2 (°C) Max tolerance temperature for the respiration T_{opt} 22.7 (°C) Optimal temperature for the filtration rate β 0.12 (°C ⁻¹) Temperature coefficient for the filtration rate β 0.12 (°C ⁻¹) Temperature coefficient for the growth β 0.17 (°C ⁻¹) Temperature coefficient for the respiration
POPULATION DYNAMIC	$\frac{dN_i}{dt} = d - \delta N_i$	N_i : number of individuals in population d : death rate
BIOACCUMULATION	$C_i = [k_1 \cdot C_{env} + k_2 \cdot C_{di}] / [k_1 + k_2 + k_{ex} + k_{d}]$	C_i : [kg kg ⁻¹] concentrations of the chemical in <i>Tapes philippinarum</i> C_{env} : [kg L ⁻¹] concentrations of a chemical in the water; C_{di} : [kg kg ⁻¹] concentrations of a chemical in the diet
ECONOMY	$E = \Delta N \cdot p$; Fishing effort function $C = w \cdot L + L \cdot C + r \cdot R$; Cost function $MC = p \cdot L + p \cdot R + M \cdot N$; Nursery costs $\pi = R - C - MC$; Fisherman profit function	k_1 : [L kg ⁻¹ d ⁻¹] uptake rates through respiration; k_2 : [kg kg ⁻¹ d ⁻¹] uptake rates through diet; k_{ex} , k_{d} , and k_{d} : [d ⁻¹] represent the respiration, excretion, growth dilution and bioaccumulation rates, respectively. ρ : (kg/h) fishing effort w , L , R (Φ) = salary cost, a capital cost, r : other inputs p : price of juveniles (€/kg) d : (ind/sgm), density Δ : (sqm), initial surface M : the unitary cost for surveillance and M surveillance time.

Extend Implementation

Individual growth model



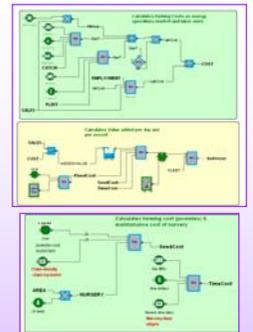
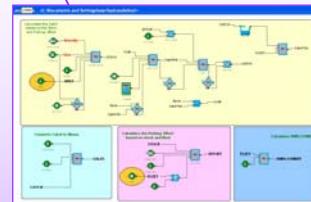
Population dynamic model



INTEGRATION, First Results:

evolution of Catch, Sales, Cost and Added Value.
Varying the schedule of seeding, from january to december

Economic model



Quality model

Forcings: pcb 77 in water (3.38 10⁻¹² g/l)
pcb 77 in sediment (2.70 10⁻¹⁰ g/l)

Aquaculture: biomass curves varying seeding time



Aquaculture model



Aquaculture: growth curves varying seeding time

