SOCIO-ECONOMIC IMPACTS OF BIODIVERSITY LOSS IN VENICE LAGOON AS RESULT OF CLIMATE CHANGE

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Abstract
Rapid global warming can affect an ecosystem's ability to adapt naturally. The potential impacts of climate changes on the clam fishery in the Venice lagoon have been analysed according to two different scenarios by 2030. Biological and socio-economic consequences of changes in population dynamics and species distribution have been evaluated. Both hypotheses of change of sea level rise and surface temperature have shown that the natural capital will be negatively affected and that the impact will not be homogeneous across the whole lagoon.
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With about 800 fishermen and a generated income of about 80 million euros, the Manila clam (*Tapes philippinarum*) fishery is one of the most profitable activities in the Venice lagoon [1].
Due to management issues, the activity, initially allowed on the whole basin, is now taking place in limited areas of the lagoon, assigned to fishermen from a local government body and called 'concessions'. While 'concessions' are employed for clam culture, other areas are specifically used as a source of seed.
The process of identification and assignment of the concession and areas for seed harvesting is articulated and involves numerous management organisms [2].
According to the last Plan for the management of fish resources [2] 3000 ha of surface of the Venice lagoon are designated to clam fishing. This area has been estimated to guarantee the sustainability of the fishery, but only 2000 ha of this surface area are productive.
There is the need to identify the areas that can guarantee the socio-economic stability of the activity. This process is becoming challenging since the adult organisms may grow in an area far from the area where they have been generated.
The knowledge of the possible distribution of clam biomass on the lagoon basin in terms of density and dispersion can support local government and management bodies involved in decisions dealing with the choice of the extension and position of 'concessions' within the basin as well as the assignment of these areas to the fishermen.
Rapid global warming can affect can affect an ecosystems ability to adapt naturally. The lagoon ecosystems are particularly sensitive to change of climatic conditions due to the shallowness and the low volume of water in relation to the surface area [3].
An integrated bio-economic model has been developed according to the valuation framework showed in the figure 1, in order to assess the socio-economic consequences of climate change impacts on biodiversity loss with respect to the Manila clam (*Tapes philippinarum*).
In particular, we analysed the dynamics of growth and settlement under two scenarios of climate change: i) increase of temperature (T08), ii) increase of temperature combined with a sea level rise of 10cm (T08L10).

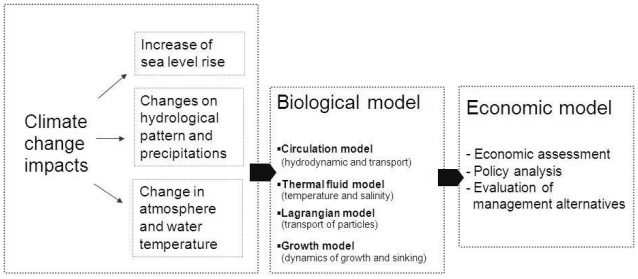

Fig. 1. Valuation framework

The impacts have been analysed through a 'biological model' that results from combining a lagrangian growth-settlement model with an hydrodynamic model (see fig. 1).
The value of each area has been determined by taking into account the outputs from the 'biological model' in terms of number of organisms per square meter that will reach the market size. Bivalves reach the market size, L_0, when their weight is equal to 12.5 g.
By taking into account the final number of organisms per square meter, N_0, their size, L_0 and a market price about 4 euros per kilogram, it is possible to estimate the revenue of the 'concessions'.
The revenue of each 'concession' in one year is equal to:

$$V_i\ (\Delta t, t_0, L_0, N_0) = \sum p \times Hi$$

Where i is the concession, p is the price per kilogram and H is the total biomass of a i 'concession'.
The net income is equal to the income that a 'concession' generates after subtracting costs and expenses from the total revenue.
Our results show that climate changes would negatively affect clam biomass in the Venice lagoon in both scenarios. The impact would not be homogeneous across the lagoon and taking into account different hypothesised sea level rise scenarios, we found that the actual sea level, combined with an increase in temperature, would have major implications. There are areas in which the settlement process would be particularly difficult and areas that would become more suitable for fisheries. By keeping the actual asset of areas in the lagoon, and maintaining the same level of income, equal to about 40.700 euros per year, the number of fishermen would have to decrease by about 200 in the T08L10 scenario and 300 in the T08. If we maintain the same number of people employed in this sector, it would no longer be possible to ensure the same level of income: the income would be reduced in scenario T08 by about 40% and in scenario T08L10 by about 30%. The loss of biodiversity will increase the current level of social tension. It becomes important to promote aquaculture, to protect the nursery areas and to experiment practice of culture with the support of tools as the bio-economic model we developed.

References
1 - Silvestri S., Pellizzato M., Boatto V., 2006. Fishing across the Centuries: What Prospects for the Venice Lagoon? FEEM–Working Paper n. 126.2006, serie SIEV – Sustainability Indicators and Environmental Valuation, Milano, Italy.
2 - Torricelli P., Boatto V., Franzoi P., Pellizzato M., Silvestri S. 2009. Piano per la gestione delle risorse alieutiche delle lagune della Provincia di Venezia. Provincia di Venezia, Arti Grafiche Zoppelli Dosson di Casier (TV), 203 pp.
3 - European Commission, 2005. Climate change and the European Water Dimension. A report to the European water Directors, 253 p.