
ORBETELLO LAGOON - ITALY

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The Orbetello lagoon is located in southern Tuscany (Italian West Coast), between 42°25'28" and 42°28'57" lat. North and between 11°10'6" and 11°16'45" long. East, and covers a total area of 25.25 km² (Fig.1). This lagoon consists of two communicating basins known as Ponente (West) and Levante (East) measuring in area respectively 15.25 and 10.00 km² (values according to Travaglia & Lorenzini, 1985, modified as a result of recent filling operations), with an average depth of about 1 m.

The tidal range is small and varies between 0.1 and 0.45m. Precipitation is estimated 700 mm/y⁻¹ (Referred to catchment basin estimated 35 Km²). Orbetello lagoon receives freshwater input from Albegna river, which has 1m³s⁻¹ annual average flow-rate, with the highest flow-rates in autumn.

Over the past thirty years, the Orbetello Lagoon, as many other coastal environment in the world has developed a considerable seaweed (macroalgae) proliferation (see Lenzi, 1992 and Bombelli & Lenzi, 1996, for a detailed review) (Fig.2).

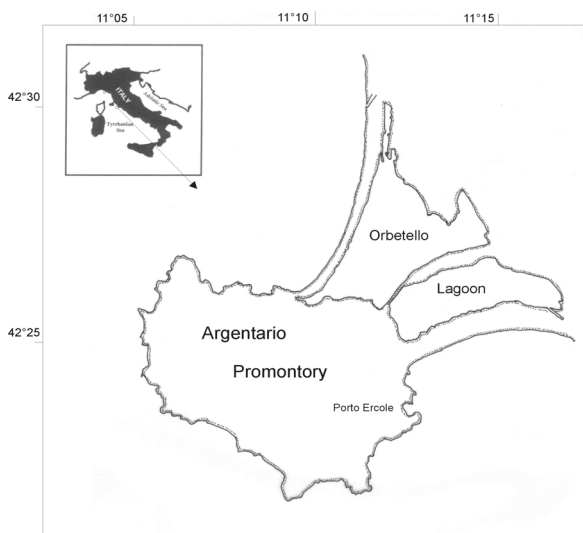


Figure 1 : Orbetello Lagoon map

This phenomenon depends mostly on intensive aquaculture and agricultural activities, as well as the discharge of treated/untreated urban wastewater, which increased strongly as a consequence of the

development of the tourist trade (Lenzi, 1992). The increase in eutrophication has gradually led to qualitative and quantitative changes in the vegetation

from seagrasses (phanerogams) to macroalgae. Various species of opportunistic macroalgae have thus alternated in the dominance of the submerged vegetation (Lenzi & Mattei, 1998). Macroalgal blooms began to appear in the mid 1960s and have been periodically accompanied by microalgal blooms.

The algal masses produced almost uninterruptedly throughout the year are moved by the winds and accumulate at high densities, sometimes exceeding 20 kg m⁻² (Lenzi, unpublished data). Decomposition of the seaweed biomass in summer, and the subsequent sulphate reduction processes cause a drastic decrease of dissolved oxygen and development of toxic reducing gases, and represents the main causes of aquatic fauna mortalities (Izzo & Hull, 1991). These harsh environmental conditions led to a reduction in the quantity and quality of the fish output from the lagoon from the 1980s (Lenzi, 1992) and the outflow of discoloured water to the adjacent beach areas caused a problem for tourism.

For these reasons a basin Authority (Orbetello Lagoon Environmental Reclamation Authority, OLERA) was set up to implement action strategies that could solve the environmental crisis. The OLERA acted in three main ways: removal of the macroalgal masses from the lagoon; increasing the inputs of clean sea water in the lagoon; reduction of nutrients of anthropic origin (Lenzi & Mattei, 1998).



Figure 2: View of Orbetello Lagoon (picture by Lenzi)

At the same time action was taken to increase water renewal, at the three sea-lagoon canals. The hydraulic model proposed by Bucci *et al.* (1989) was adopted as a basis for the environmental

management activity in the lagoon. This consisted essentially of pumping water from two sea-lagoon canals into the lagoon, and allowing it to exit through the third canal. After the establishment of OLERA, the pumping was boosted from 8000 l s⁻¹ to 20,000 l s⁻¹. The pumping is concentrated in the warmer months.



Figure 3: Phytotreatment pond

All domestic waste waters, previously discharged directly in the lagoon, are being collected and pumped to a treatment plant. The treatment plant effluent is discharged into a especially bounded shallow phytotreatment pond (marginal lagoon area) of about 12 hectares. After, the phytotreatment effluent water is discharged into the main lagoon. Using this system it was possible to decrease the nutrient concentrations of these discharges with benefits on the whole lagoon.

OLERA activities have thus far have resulted in a significant reduction in algal biomass production in the lagoon (Lenzi & Mattei, 1998; Lenzi *et al* 1998b). Since 1996, seagrasses return to develop itself in the lagoon, and during 2000 they cover 60% of the bottom surface.

LaguNet (<http://www.dsa.unipr.it/lagunet/>) is a scientific observational network studying the fluxes of nutrients and other contaminants from lagoon catchments to the near coastal environment. The objectives of LaguNet are to support and encourage co-operation of research groups studying lagoons, wetlands and saltmarsh systems situated along the Italian coast and to evaluate the application of the LOICZ (Land Ocean Interactions in Coastal Zones, a core project of IGBP) biogeochemical flux model and typology classification to such sites.

The methodology has been applied by LOICZ to approximately 170 coastal environments worldwide; it is based on a mass balance approach and provides important information on the flux of nutrients and ecosystem functions; the approach used is applicable to a majority of coastal ecosystems with data that are normally available from conventional monitoring campaigns. In this way it is possible to compare and to group aquatic systems having different characteristics based on properties related to biogeochemical cycles and to the ecosystem functions that result from these processes. On the basis of this experience and

considering the paucity of LOICZ sites in the Mediterranean and Southern Europe it was decided to apply this methodology to a series of Italian coastal environments where sufficient data are available (Fig.4).



Figure 4: LaguNet sites around the Italian peninsular

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