# CABRAS LAGOON - ITALY

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Cabras lagoon is a shallow water body (mean depth 1.7 m) located on the west coast of Sardinia, western Mediterranean sea (39° 57' N, 08° 29' E; Fig. 1), and is one of the largest brackish water basins in the Mediterranean region with a surface of 22 km$^2$. Its watershed drains an area of 459 km$^2$, characterised by intense agricoltural and zootechnical uses, with a natural plant coverage nearly 20% of the area.

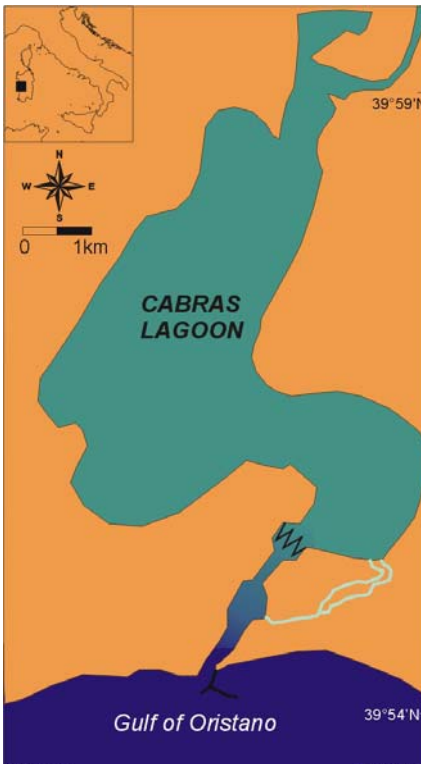


***Figure 1.*** *Map of Cabras Lagoon.*

The northern sector of the lagoon is connected to a small river which represents the major source of freshwater. River discharge, however, is rather limited due to a low rainfall regime in the region (ca. 10-100 mm form July-December, respectively) and an increasing water demand for land use, especially agriculture.
Although there is a trend towards increasing salinity caused by a progressive reduction of freshwater input, salinity may drop to <10 PSU following rainfall periods and raise up to >30 PSU, especially in summer.
In the southern sector of the basin (Fig. 1), a dam rising to the high-tide water level allows the flushing of excess water only in case of flood. Partial connection between the lagoon and the adjacent Gulf of Oristano mainly relies upon narrow creeks flowing into a large southernmost channel dredged in the late 70$^{ies}$, where additional artificial barriers have also been constructed in order to control the fish catch. The tidal amplitude is <40 cm. Due to these constrains, water mass exchange between the lagoon and the Gulf is very limited.
The lagoon has a high economic rating due to extensive fishery activities (e.g. *Liza ramada*, *Mugil cephalus*) involving about 300 people (Fig. 2).

***Figure 2.*** *Fishing activities in the Cabras Lagoon.*

However dystrophic events often cause massive fish mortality (the last one occurred in the summer 1999). In fact this brackish ecosystem is often subject to eutrophication phenomena which cause water quality deterioration with consequent decrease in its high productivity.
During the hydrological year 97/98 in order to plan interventions aimed at controlling these dystrophic events, nourishing loading (total phosphorus and nitrogen) from drainage basin was evaluated both by experimental and theoretical survey (Casula *et al.* 1999). Automatic samplers connected to flow loggers were installed in the main tributaries of the lagoon allowing to evaluate experimentally the total phosphorus and nitrogen loading obtaining values respectively of 16 and 240 ton /year. These values were then compared with those obtained by the indirect procedure showing a high agreement between the experimental and theoretical evaluation of phosphorus loading and an overvalue of the nitrogen indirect load respect to the direct one. This difference resulted anyway to be close to the error in general associated to the indirect approach. Moreover the theoretical assessment allowed to investigate primary sources of nutrient release pointing out the

important role of diffuse sources (intensively cultivated soils) in determining the high value of Nitrogen/Phosphorus ratio.
Environmental data analysis in the water column showed high oxygen inter-annual fluctuations, with undersaturation events especially during summer and extended climatic stasis. The lagoon is characterised by high load of nutrient coming from the watershed, but also released by the sediment. In particular high concentrations of DIN (annual mean of about 105 mg N $m^{-3}$, whose nitrogen ammonia represents more than 50%) and total phosphorus (312 mg P $m^{-3}$) were observed.
Phytoplanktonic component seems to be more prevalent than macroalgae. The structure of phytoplankton is characterised by an elevated cellular density (often more than 1 x $10^9$ cell $l^{-1}$) due to very small cells (less than 2 µm), which can be ascribed to Bacillariophyceae and Cyanophyceae classes. Most abundant species were *Chlorella* sp., *Cyclotella atomus*, *Cylindrotheca closterium*, *Minidiscus* sp. and *Navicula* sp. Mean annual concentration of chlorophyll *a* never was less than 40 mg $m^{-3}$ according to high phytoplankton density.
Data here gathered indicate an intense eutrophication as already observed by Sechi (1982), with consequent high probability of dystrophic events especially in summer.
Littoral vegetation is composed of *Salicornietum fruticosae, Scirpetum maritimi and Juncetum maritimi* associations.
The surface sediments of the lagoon are mainly silty-clayey (silt+clay mean content 89% of dry weight) with a high content of organic matter (10%) and total organic carbon (33 mg $g^{-1}$) (De Falco *et al.* 2003). Sediment characteristics show a marked increase of the muddy fraction and organic carbon content in the superficial layers. The results suggest that a major change in the sedimentary regime of the lagoon, associated with internal trapping and re-distribution of organic C-bounding finer particles, has been occurring in the last few decades. The cause would appear to be the construction of a dam at the lagoon mouth rising up to the high tide level in order to maintain a constant lagoonal water level (Fig. 3).
Consistently with these findings, poor and heterogeneous macrofaunal communities characterize the benthic environment of the Cabras lagoon (Magni *et al.* 2003). Few predominant *taxa* include small-size surface (e.g. *Polydora ciliata* and *Corophium sextonae*) and subsurface (e.g. Tubificidae nc) deposit feeders, and larger nereidid polychaetes (i.e. *Neanthes succinea* and *Hediste diversicolor*), most of them typically occurring in degraded environments. Filter feeders are almost exclusively represented by the reef-like builder polychaete *Ficopomatus enigmaticus* and the hard-shelled bivalve *Cerastoderma glaucum*. Simple associations include that between *F. enigmaticus* and *Corophium sextonae*, patchily distributed along the shores and positively correlated with sediment sorting ($\sigma$), an index of sediment selection due to hydrodynamic energy. By contrast, inner areas, characterized by a major accumulation of fine sediment particles (mean size up to 8.2 phi) and organic matter, are least populated. The results suggest the existence of an early stage of faunal succession which might be related to an excessive organic content of sediments and the tendency to dystrophic events.

***Figure 3.*** *Aerial view of the southern sector of the Cabras Lagoon with the dam closing the artificial channel build in the 70ties.*

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