# Human impact, geomorphological and bio-environmental indicators for mapping and monitoring of a Mediterranean urban-beach with *Posidonia oceanica* (Gulf of Cagliari-Sardinia)

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This work describes the human conditioned evolution (medium term) and the short term dynamics (mainly sediment transport) in southern Sardinia beach (between Giorgino and Cala d'Orri, about 11km), composed of fine to coarse quartz sand, backed by dune ridges and lagoons. The study was founded by NEPTUNE Project, Tender6 (L n. 7/2007).

Geomorphological and bio-environmental indicators as: urbanization and coastal defence expansion, dune and beach changes, biotic indices (benthic foraminifera and Posidonia meadow) have been used.

Medium-term evolution, over a period of 60 years, was carried out by ortho-images (1954-2015) for reconstructing coastline changes at this temporal scale. The main modifications were the building of the canal harbor, the consequent loss of 2.5km of beach, and the construction of several coastal defense structures, which caused asymmetric accumulations (lee zones) and erosion areas.

Short-term variations have been periodically monitored (2014-2015) during 5 different field surveys (DGPS and Echo-sounder data) obtaining topo-bathymetric digital models. Sedimentary and hydrodynamic characteristics have been studied. Wave propagation, coastal currents and sediment transport, have been simulated through numerical models within Delft3D software. The results obtained allowed to visualize the response of the beach to wave stress, forced from SW, S, SE (Cagliari buoy and weather data).

The comparison between data collected, thematic maps and models allowed to identify the main controlling factors and distribution mechanisms of the sedimentary paths on the shoreface.

Those human modifications (e.g. building of the canal harbour and jetties, lagoon mouths stabilization, the consequent modified hydrodynamics and bottom trawling) have direct influence on the \textit{Posidonia oceanica} and on its upper limit. In 2002, the Italian Environment Office reported a wide area (between -4m and -20m) of degraded Posidonia and dead matte in front of the study beach. Reflecting the poor state of the Posidonia upper limit, during data collection it has been documented the presence of banquette, mainly composed of \textit{Caulerpa prolifera}, with which the Posidonia competes for the substrate. The roles of \textit{Posidonia oceanica} in coastal defence (sediment retainment, hydrodynamics attenuation), fish nursery and water oxygenation have been largely recognized.

The health of the Posidonia meadow is also linked to the biotic communities. In order to evaluate the ecosystem quality of the investigated area, living benthic foraminiferal assemblages (Rose Bengal stained) were analysed. Benthic foraminifera are useful as bioindicator proxies for characterization of specific environments in coastal systems, because foraminifera have short life cycles reacting quite quickly to both short and long-term changes in marine and transitional-marine environments on both global and local scale.

Results demonstrate, in medium-term scale, the human modification, and in short-term scale, the consequent human conditioning in sediment transport. The benthic foraminiferal biocoenosis and biotic indices decrease in the samples characterized by high environmental stress and are linked to the poor state of the Posidonia upper limit. The low abundance values and the dominance of indicative opportunistic species, such as \textit{Ammonia tepida}, \textit{Haynesina germanica} and bolivinids, are the result of these stressed conditions.