

## MANAGEMENT OF POSIDONIA OCEANICA LEAF LITTER IN CALABRIAN SANDY BEACHES (SOUTHERN ITALY).

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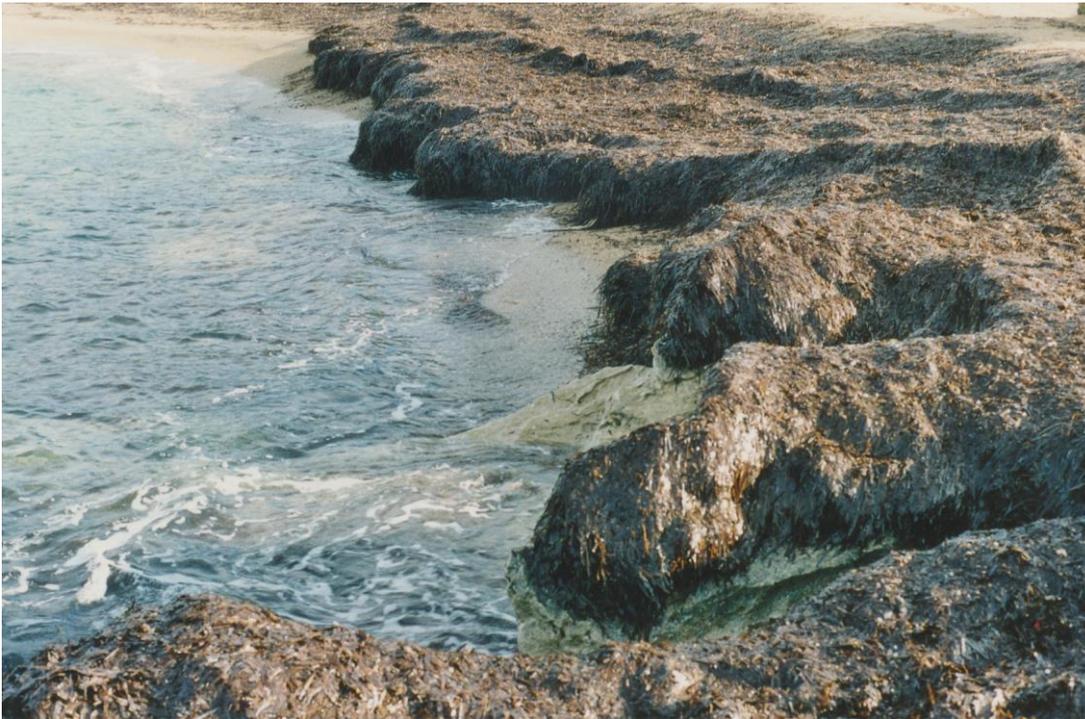
### Abstract

The wracks of *Posidonia oceanica* leaves on the sandy beaches of Calabrian region could be one of the most important defence against erosion processes. The management of *Posidonia oceanica* leaf litter in Italy has been realized through the mechanical removal and the transport in dumping areas of the beach-cast material. This solution, apparently simple and fast, produces a net loss of sediments from the sandy beaches and, therefore, a deficit in the sedimentary budget of coastline leading the coastal system to possible shore erosions. Instead, it could be better to keep these vegetable deposits on the place so to warrant a positive sedimentary budget and the tourist value of the regional beaches improving coastal tourism in the seaside resorts with bathing vocation.

Keywords: *Posidonia oceanica* · “Banquettes” · Calabria · Seaside tourism.

*Posidonia oceanica* (Linnaeus) Delile, endemic species of the Mediterranean Sea, forms extensive beds in the infralittoral bottom of the basin, according to favourable environmental conditions. Along Mediterranean coasts *Posidonia* beds provide a great variety of ecosystem services amongst which the power of entrapping marine plastics (Sanchez-Vidal et al., 2021) and the protection of sandy beaches against erosional process are ones of the most important (Boudouresque and Ruitton, 2016). Really, a long time ago, the meadows of *Posidonia oceanica* surrounded a large part of the Mediterranean coastline forming an almost continuous belt along the coasts of the basin. However, in these last decades, there is a widespread regression of these natural barriers along the Mediterranean coasts with a declining trend of the global area extent variable from 13% to 50% (Marbà et al., 2014). So, the meadows have been replaced, in the damaged areas, with deserts of dead “mattes” or have been colonized again by some algal species as *Caulerpa prolifera* (Forsskål) J.V. Lamouroux or *Cymodocea nodosa* (Ucria) Ascherson. This negative trend has been reported in many areas of the Italian coasts where the 72% of the prairies have been deteriorated, as shown by the “National Program of characterization and development of *Posidonia oceanica*” started up on 1989 and, actually, ongoing (Ministero dell’Ambiente e della Tutela del Territorio e del Mare, Si.Di.Mar., 2008). More generally, these critical conditions of the Mediterranean meadows have been also reported in other Mediterranean countries by scientific literature (Augier and Boudouresque, 1970; Astier, 1972; Meinesz and Laurent, 1978; Peres, 1984; Blanc and de Grissac, 1989; Meinesz et al., 1991; Ruiz et al., 2001; Boudouresque et al., 2012). The widespread deterioration of the coastal environments, in the Mediterranean basin, implies a global vision of the problem. The critical state of the Italian coasts has become in these last years a serious problem along our coastal boundary where the 42% is in erosion (Consiglio Nazionale delle Ricerche, 1999). These negative conditions are particularly severe in the Calabrian coastline where the 43% of the beaches are in erosion (Gruppo Nazionale per la Ricerca sull’Ambiente Costiero, 2006). The particular position of this region, surrounded by the Tyrrhenian and the Ionian seas, for a coastal boundary of 715.7 Km., as 9.7% of the national coastal perimeter, suggests the solution of some problems linked to the protection of its coastline, transition area between the terrestrial and the marine environments. So, the coastal defence must become the main appointment for the national and the regional authorities.

The balance of sandy beaches is made by three basic elements: the shore-face, the shoreline and the coastal dune amongst which take place sediment exchanges so to grant the littoral sedimentary equilibrium and the right working of coastal system. The loop of organic and inorganic materials between the underwater and the terrestrial shore begins at the end of the vegetative period when leaves senesce and detach off the rhizomes (Mateo and Romero, 1997). This leaf loss may reach values of 10-20 tons of vegetable fragments for hectare of meadow (Medina et al., 2001) of which 5% is exported outside, 70% remains in the meadow and 25% is washed by wave action on adjacent shorelines, forming deposits known as “banquettes” (Boudouresque and Meinesz, 1982; Mateo et al., 2003; Astier, 2008; Boudouresque, 2010; Boudouresque et al., 2012; Simeone and De Falco, 2013; Pergent et al., 2014; Boudouresque and Ruitton, 2016). Indeed, during their life, the plants pose a lot of leaves that are carried by hydrodynamic pressure onto the beach in clumps and are accumulated on sandy beaches where form very conspicuous wedge-shaped deposits up to 2 m. height (Fig. 1).



**Fig. 1** “Banquette” surveyed on a sandy beach of Calabrian coast.

The “banquettes” play, also, a leading role trapping high amounts of sediment inside the overlapping layers of the deposits (Medina et al., 2001). The leaf piles and their sediment store carry out an important functional and structural role by attenuating wave and stream energy and limiting coastal erosion (Cantasano, 2009). The wedge-shaped deposits of *Posidonia oceanica* leaf litter, that pile up on the sandy beaches of the Mediterranean basin, are a temporary sink of organic matter made up of detached leaves of the plants but include, also, inorganic materials as marine plastics, sands and water. The amount of sediments in the “banquettes” depends on their grain size. The quantity of sand trapped in the “banquettes” is very high in the beaches of coarse – grained while it decreases in those of medium and thin – grained. Anyway, the “banquettes” represent the “sand factory” of coastal system producing and exporting towards coastline great amount of sands (De Falco et al., 2017). In Italy, some regional and local trials have been realized to test the importance of “banquettes” against the erosion process actually ongoing on Italian sandy beaches. The results of Arena Project, carried out along the Sardinian coasts, prove that the removal of 100 m<sup>3</sup> of “banquettes” from beaches of coarse texture causes a loss of sediment of 11.2 tons like a loss of 11.2 Kg. from the beach (De Falco et al., 2006). These conditions produce a negative beach sediment budget and, consequently, possible shore erosions following storm events. Therefore, it is necessary to value the percent in weight and in volume of the organic and inorganic fractions contained in these deposits so to establish the physic role of “banquettes” in the coastal dynamics. The first results of this method, held by the Environmental Department of Livorno Province (Provincia di Livorno, 2006), prove that the sandy fraction of the deposits is very high, ranging from 37% (percent in volume) to 56% (percent in weight) and, consequently, these wedge – shaped deposits of *Posidonia oceanica* leaf litter can be considered basic for the hydrodynamic equilibrium of littorals. Really, for a long time until seventies, the presence of “banquettes” was accepted by coastal users (Boudouresque, 2010; Boudouresque et al., 2017). From then on, just at the beginning of seaside tourism, most of tourist operators, stakeholder and coastal municipalities regarded “banquettes” as a useless waste with negative impacts on coastal tourism. So, the dead leaves of *Posidonia oceanica*, with their large amounts of sand, were removed from sandy beaches, often using mechanical earth movers, and transported to landfills.

The cleaning operations of the beaches and the whole removal of these beach – cast litter produce a subtraction of sediments from the beaches and may lead to possible shore erosions. These conditions produce, also, the deterioration of coastline and the loss of dune vegetation. The desertification of sandy beaches gives raise, long-term, to substantial changes in beach morphology. From a biological point of view, the “banquettes” are an important and potential sink of biogenic elements for the sea-grass ecosystems (Mateo et al., 2003). These vegetable biomasses accumulate, indeed, a large amount of organic carbon valuable from 18 to 500 Kg. of dry wt m<sup>-1</sup> of shoreline (Duarte, 2004). The complete removal of the “banquettes” causes a nutrient depletion for the trophic chain of coastal ecosystem and, in particular, a permanent loss of C, N and P. The N and P losses are respectively 5,4% and 1,2% of the annual requirement of the plant (Romero et al., 1992; Mateo and Romero, 1997; Gacia et al., 2002). The removal operations, made by coastal municipalities, using heavy machinery such as bulldozers and excavators, are carried out to keep the tourist value of sandy beaches. The following loss of sediments from the shoreline impacts upon the littoral stability and may support erosive processes on the beaches exposed to high hydrodynamic pressure. So, Calabrian beaches, unprotected by

“banquettes” and exposed to a growing withdrawal trend, were steadily eroded and, afterwards, were made many human attempts to compensate this increasing erosion process by unsuccessful hard structures and/or costly sand replenishment. Therefore, it is hoped to avoid this kind of procedure or to carry out late actions of displacement in the months of May or June, at the beginning of steady anti-cyclonical conditions, to minimize the impacts of removal. So, it is necessary to avoid the mechanical handling of the deposits while it is right to work manually so to avoid the direct removal of sandy materials. The solution to the problem should be to leave these vegetable deposits to their natural process of maturation maintaining the “banquettes” on place or to stock them on the ground in the highly tourist areas and to move them inside the coastal dune or in retired belts close to the shoring events within the point of maximum wave expansion. It is necessary, in this instance, to proceed by hand so to avoid health risks. This kind of operations may contribute to the protection of the coastline against erosion processes and to the stability of substrates behind the fore-dunes allowing, at last, a real saving of financial resources. These suggestions have been ratified by a ministerial memorandum of issued by the Ministry of Environment dated 17 March 2006 (DPN/VD/2006/08123) concerning the management of beach-cast litter found in coastal areas. This provision states three alternative solutions: the removing and dumping of beach-cast litter, the moving of the deposits or the maintenance on spot of the “banquettes”. This last one is the ideal solution to the problem and in this event the coastal municipalities have to inform the public opinion and, particularly, the tourists through posters, placards and information boards (Fig. 2) explaining the ecological issues of the species so to improve the presence of *Posidonia oceanica* meadows in that areas as pattern of ecological shore like the “bio-beaches” of French coasts (Boudouresque et al., 2006).



**Fig. 2** Tourist advertising on *Posidonia oceanica*.

In this sense the joined presence of meadows and “banquettes” could become the main factor of wildness of the coastal area. The final result will be a tourist attending of the beaches and a favourable perception of “banquettes” by the public opinion that could support this kind of ecological approach so to improve the leisure enjoyment of sandy beaches.

The vegetable biomasses known as “banquettes” are an excellent indicator of the quality of marine coastal environment for the presence of extensive *Posidonia oceanica* meadows on the marine sea-beds. Therefore, the presence of these massive supra-littoral deposits of leaf litter along the coastal areas is a clear sign of a sea in good environmental health. The wedge-shaped deposits, placed on some stretches of the protected coastline, perform an important mechanical and biological role in the trophic and sedimentary budget of coastal system and cannot be considered a simple waste material but, instead, a natural resource for the sensitive balance of coastal ecosystems.

The actual technologies and the current management practices about “banquettes” must change from the simple beach wrack removal to their maintenance on spot to reduce wave energy providing a protection to the foreshore and reducing erosion processes. At last, it is necessary to revalue the ecological role of *Posidonia oceanica* “banquettes”, natural

elements of some Calabrian coasts that could become the “bio-beaches” of the coastal regional boundary so to improve tourism in the seaside resorts with bathing vocation.

## DECLARATIONS

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