Characterization and Management of *Posidonia oceanica* Banquettes as Nature-Based Solutions for Coastal Resilience

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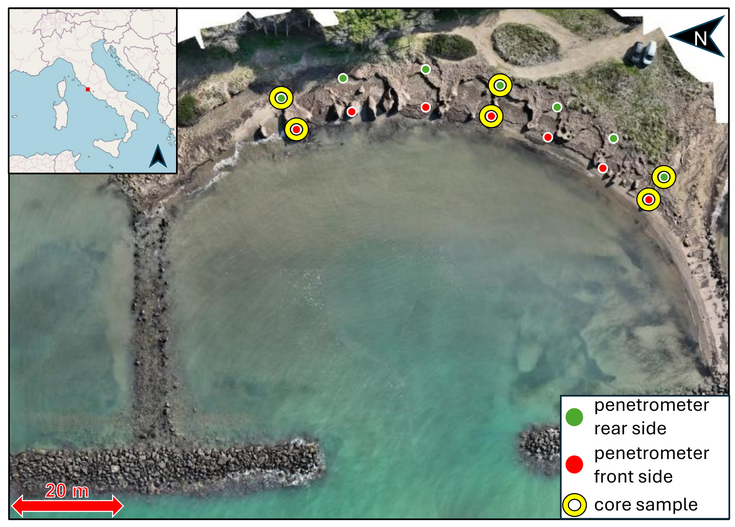
INTRODUCTION

The Interreg AMMIRARE Project aims to improve beach system resilience and enhance adaptive capacity to climate change through the adoption of nature-based solutions (NBS), recognizing *Posidonia oceanica* as key natural assets for coastal protection. *Posidonia oceanica* plays a crucial role both within underwater ecosystems and along shorelines, where the accumulation of detached leaves and rhizomes forms distinctive structures known as “banquettes”. These deposits significantly contribute to shoreline stabilization and mitigating erosion processes, by trapping and retaining sandy sediments, and sustaining a wide number of organisms, enhancing the biodiversity at the land–sea interface. Despite their ecological value, Italy currently lacks clear legislation to protect and manage banquettes, which are frequently removed to preserve the aesthetic appeal of recreational beaches.

Here, we report on the temporal evolution of a banquette located in northern Civitavecchia (Rome, Italy), monitored on a monthly basis through penetrometer measurements. These results, integrated by grain size and surface/volumetric analyses, will allow us to estimate the degree of compactness of the banquette, necessary information for establishing clear guidelines for their management.



MATERIALS AND METHODS

Field Activity

A light dynamic penetrometer was used for the measures of penetration resistance in different areas of the banquette, both in front and rear side of the deposit. The penetrometer was calibrated with an 8 kg weight and a falling height of 10 cm; the values of the penetration resistance was measured every 10 cm counting the number of fall of the weight. Value of resistance (MPa) was calculated on the base of the L’Herminier formula for dynamic penetrometer tests.

Core samples were collected along the banquette (sampler 20x20x20 cm, volume 0.008 m³) to analyse the content of trapped sediment.

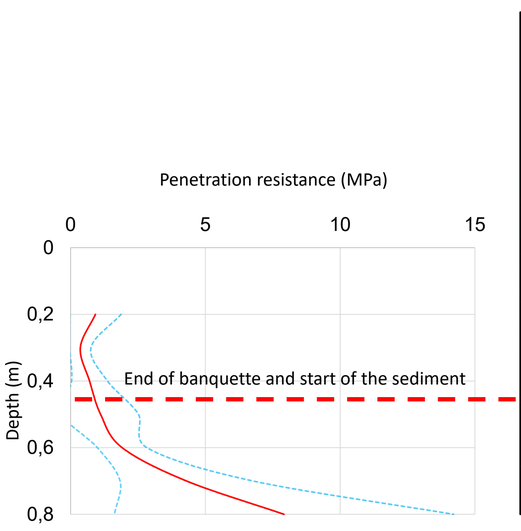
Lab Activity

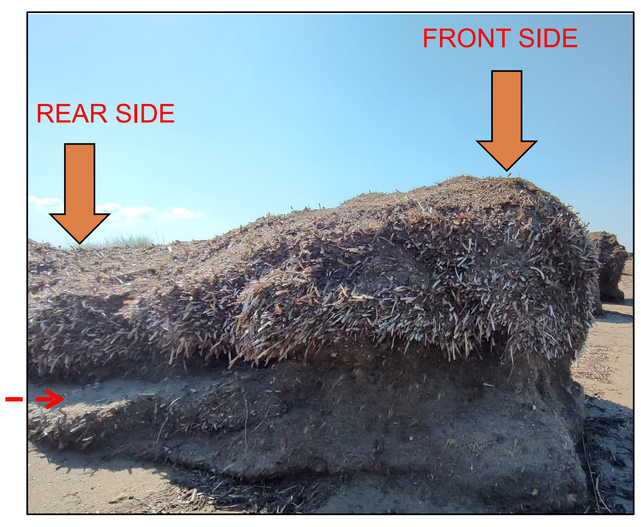
Sediments were manually separated from the Posidonia leaves, and the sandy fraction was retained. These sediments were weighed and then dried in an oven at 60 °C for 48 h. Once dry, they were weighed again to determine water content, and the different grain size fractions were separated by sieves. A portion of the samples was used to measure organic matter content (muffle furnace for 4 h at 450 °C).

RESULTS

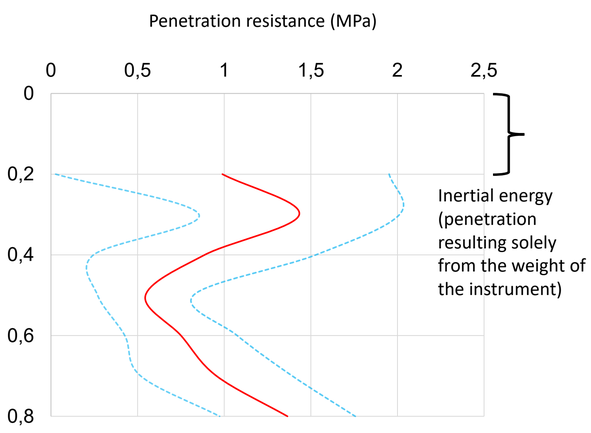
Penetrometer Analysis

Rear side





Front side



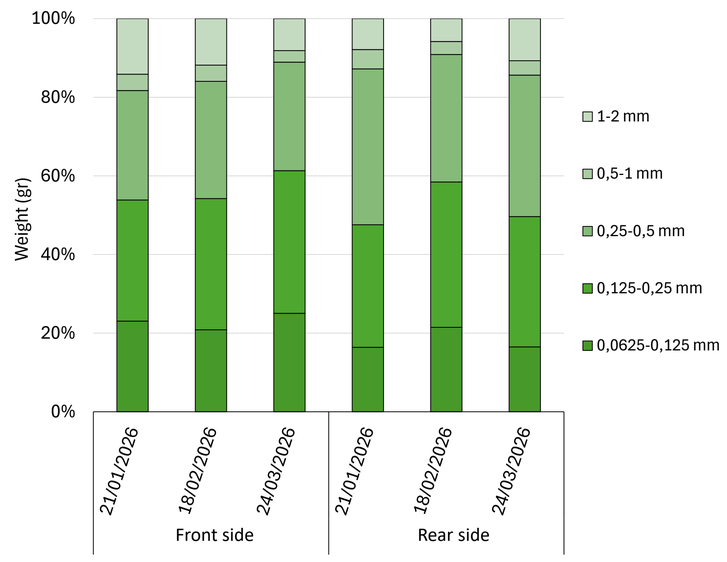
These graphs shows the energy required to penetrate the banquette in the front and rear side. As can be observed from both the graphs and the photo, these deposits are composed of layers of varying thickness and composition and, consequently, exhibit varying degrees of compactness.

The energy shown in the graphs appears to accurately reflect the extreme variable nature of these layers, increasing or decreasing as their composition changes. Usually, in its rear side the banquette is thinner and, at the lower level, the penetration energy increases significantly due to the greater resistance offered by the sediment.

Sediment Analysis

The average value of dry sediment content in the uppermost 20 cm was 405 grams in 0.008 m³ of banquette (approximately 51 kg in 1 m³).

percentage distribution of grain size fractions



The most abundant granulometric fraction were the fine (0.125-0.25 mm) and medium (0.25-0.5 mm) sand in all the sampling dates and in both the sampling site (front and rear side of the banquette).

CONCLUSION

This study presents the preliminary results of an ongoing investigation on the morphodynamic analysis of a *P. oceanica* banquette. What is clearly evident even at this initial stage is the high variability of these deposits; even when sampling was conducted on a monthly basis, the structure of the deposit changed from one sample to another. The high sediment content found in the core samples highlights the important ecological role these deposits play, significantly mitigating the coastal erosion process and acting as a NBS contributing to shoreline stabilization. The calibration and validation of penetrometer measurements will help to establish a simple method for assessing the compactness of the banquette. Classifying them into compactness classes will provide a valuable tool for the management and preservation of these deposits.

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