ECOLOGICAL RESTORATION OF GUINCHO–CRISMINA
COASTAL SAND DUNE

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OBJECTIVES
The main purpose of this study is to analyze the response to the biophysical structures placement in sand dunes (embryonic and primary) in order to promote the sand deposition and the dune vegetation restoration.

INTRODUCTION
The dunes of Guincho-Crismina are a small portion of the dune complex Guincho-Oitoãs located in the Natural Park of Sinta-Cascais (Portugal). It is a system subjected to strong anthropogenic pressures that led to its degradation and that, by its natural values, requires restoration and protection measures. The habitat management actions aimed essentially to restore and manage the impacts on the dunes, through the removal of non-native species plus the establishment of biophysical structures in two different interventions (which reduce the wind velocity and promote the sand deposition) and the planting of characteristic dune species.

Promoted by the Municipality of Cascais in partnership with the Institute for Nature and Forest Conservation (ICNF), this project started to be implemented in October 2010. It was 50% co-financed by the FEDER under the POR Lisboa, in connection with Tourist Intervention Program (PTI). Operation code: LISB0-02-2507-FEDER-000209.

In this analysis was only taken into account the intervention in the Guincho beach dunes area (See map – Area I).

SITE CHARACTERIZATION
The potential natural vegetation was determined based on a simplified model of correspondences between ecology (sand dunes and beaches consolidated on Quaternary Period), sandy soils, bioclimatology (Termomediterranean stage) and the series of vegetation.

The sands of fixed dunes of Guincho and Crismina beaches are occupied by a psmorphilous vegetation series where the mature stage consists in a thicket of juniperus turbinata (Olymik quadriportiebre-Juniperetum turbinatae).

When the sands are less cohesive there emerges a community of Armeria wilwitschii with an annual prismsocloening membrane of Tubanervates guttatarum in the clearings.

On the primary dune there are communities of Ammophila arenaria ssp. arenincassae, Lotus creticus, Orychium maritimum, Eryngium maritimum and Pancratium maritimum (Lina-cretics Ammophiletum australis) and on the embryonic dune one can find formations of Elymus furcatus ssp. boro-antlanticus and Euphorbia paralias (Euphorbiaceae-Apochryphetum junceae).

MATERIAL AND METHODS
Actions carried out:
1. Eradication of invasive species – Carpobrotus edulis, plucked manually including the root system.
2. Biophysical structures placement – On the embryonic and primary dunes, where vegetation was absent, built with dry wicker (willow) with 1.80 m long (0.50 m buried), in parallel tracks with a spacing of 9-12 m between rows, perpendicular to the prevailing wind direction (N-NW), placed vertically and distributed homogeneously at a rate of 3 kg per linear meter.

3. Plantation of perennial herbaceous dune species (5.8 ha) – During the dormancy period (January), with 1.2m between plants. Embryonic dune and on the lower part of the primary dune: Elymus furcatus ssp. boro-antlanticus (8640 plants). Primary dune: Ammophila arenaria ssp. arenincassae (42000 plants), Lotus creticus (7182 plants) and Eryngium maritimum (702 plants). Intended to assist the natural process of establishment of other species as Pancratium maritimum, Orychium maritimum and Artemisia chrysantha.

Complementary actions:
4. Placement of fences and gates
5. Construction of walkways

The sand accumulation levels were monthly monitored through rulers distributed uniformly over the area of intervention and estimated for the total area by using Geographic Information System (GIS) spatial analysis (See diagram below).

RESULTS
After the 1st intervention (Nov 2010 till Dec 2011): the maximum incidence of sand deposition was observed in the dune ridge front reaching 197 cm high, the minimum reached -25 cm, which on average represents 16 cm of sand deposition.

After the 2nd intervention (Jan 2012 till Sep 2012): the maximum incidence of sand deposition reached 82 cm high in the dune ridge front, the minimum reached about -27 cm, which on average represents 3 cm of sand deposition.

In the highly mobile frontal dune, the planted vegetation was partly lost due to their lower development in comparison to the dune movement which buried the plants. The plants were not able to adapt to the sudden sand deposition. Loss of sand from the root area was also observed on the introduced dune depression plantation.

CONCLUSIONS
This type of biophysical structures built with dry wicker (willow) were chosen based on the bibliography, because it originates sand deposition similar to what naturally occurs in the dune system Guincho-Crismina. It proved to be an effective and reliable method to promote the recuperation of the dune ridge.

The plantation area was excessive. It should have been implemented in the first 25 m of the dune ridge front, where occurred a greater sand accumulation, gradually.

The high susceptibility of the rulers to vandalism despite the placement of fences and gates, questioned the sand measurement method due to its influence in the monitoring results. This obliges to seek for another measurement method.