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New insights on the psammophilic gradient applying a multidisciplinary biogeochemical based approach - a case study in the Mediterranean Region of the Portuguese coast

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From the point of view of plant life, the communities of recent coastal beaches and sand dunes (with ages inferior to 4000 years B. P.) are submitted to a stressful and harsh environment, generally characterized by incipient or inexistent pedogenetic evolution of the oligotrophic sands, weak water retention capacity and total absence of podzolization. In the biogeographical Mediterranean Region of the Portuguese coast, the climatic conditions are also severe. Major features are hot and long summers, short winters, low and concentrate precipitation patterns, weak incidence of aestival fogs, and increasing temperatures in the South.

The unique spatial position of interface between the sea and land, and consequent environmental extreme conditions, result in original, sensitive, and valuable habitats, distributed along a well marked littoral-inland psammophilic gradient. This vegetation shows a notorious succession of segregated communities, (geopermasigmetum), that follows a clear geomorphological zonation (embryonic, primary and semi-stabilized dunes). The thermophilic conditions, the sea salt influence, the wind, the mobility of the sand, the waves action and the oligotrophic conditions, determine the occurrence of specific and highly adapted plant associations, confined to that specific type of habitat, having few species in common with other terrestrial ecosystems. Specialized in relatively spatially isolated and low sized communities, they are endowed with important ecological services and high interest for conservation.

Investigation about how may these ecosystems respond to the climatic variability, namely global warming, must relay not only in the comprehension of plants' biological characteristics (has physiognomic types, phenological periods and dispersion strategies), but also in a solid knowledge of species interaction and grouping, together with their ecological requirements and limits. Since species distribution depends on environmental requirements and spatial interactions among plants, the relations between vegetation cover, soil and geomorphological factors are determinant in the variation and occurrence of clearly defined ecological gradients. The understanding of physical gradient drivers or predictors, like distance to the sea and profile length, sand grain size, pH, salinity, sands stability, or microclimates is important for the interpretation of communities' distribution patterns.

The study area was the continuous line of sand dunes between Tróia and Sines, bathed by the Atlantic Ocean. In randomly selected areas, the main plant associations were studied, and their floristic compositions, differential and characteristic species identified by the phytosociological method.

Since the full understanding of the mechanisms underlying the species distribution and communities' differentiation along the psammophilic gradient is still poor, new insights are needed. In order to establish relations with the floristic composition swifts and to quantify critical environmental conditions, it was used a more complex and a finer scale approach: the floristic composition and structure of the plant communities, given by the floristic inventories, was crossed with the data gathered in fixed plots of 2 x 2 m, marked with 5 m of distance, along transects made from the first vegetation strip, until the interior limit of the gray dune.

Each plot, according its vegetation and topographic position, was inserted in a correspondent phytosociological community, or in a transition area between communities; also samples of soil (sands) were collected, and several of its physic and chemical properties (e.g. sands granulometry, salinity, base exchanges, calcium, m. o.

contents) were analysed in laboratory.

A geo-ecological correlation analyses between the vegetation composition and structure, the distance to the sea, the topographic position, and the sands physic and chemical characteristics, was performed. A geo-spatial model was also created, to represent the distribution patterns of the studied plant communities along the environmental gradient.

Significant correlations were found, allowing bettering understanding the psammophilic gradient and the importance of a multidisciplinary approach, biogeochemical based, in such plant ecology studies.