



Landscape Ecology of the Sado River Estuary (Portugal). (dunes, fresh water and salt water marshes)

On the vestibular section, the Sado River drains into a lagoonal estuary, from Alcácer do Sal to Setúbal-Outão and Tróia; here, it reaches the sea through the outlet called Barra do Sado, between the high cliff of Serra da Arrábida and the tip of the spit of Tróia.

The channel of Barra do Sado is cut into the deltaic plain of the submarine delta of the Sado. The instability of the sediments in the channel is considerable, and increased by the dredging which is necessary to maintain the estuarine navigation (Setúbal-Setenave harbors), older than the Roman period.



In general, the vegetation in the area under study is influenced by a characteristic mediterranean climate with an atlantic influence and a lower thermomediterranean bioclimate, according to the classification of Rivas-Martinez (1996).

The flora is mostly mediterranean. However, various atlantic floral elements are to be found as a result of Quaternary climatic fluctuations. The originality of many of the floristic communities identified, resides in this superimposition of the atlantic and mediterranean species in the same territory.

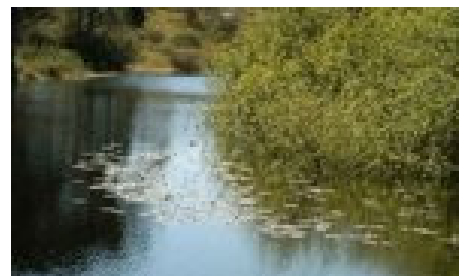


As a result of profound, ancient anthropic action, the floristic communities, corresponding to the various simple types, are poorly represented and the substitution stages, damaged to a greater or lesser degree, make up the dominant vegetation.

Objectives of the field trip:

1 - Geomorphological and ecological characteristics of the natural estuarine systems – the lagoon; the sandy-salty marginal beaches and wetlands, the oyster banks; the spit (marine beaches, dunes lagoon and its beaches).

2 – The economic systems organized around the estuary and depending upon it: urban (Setúbal), industrial (Setúbal), agricultural (rice fields all around the lagoon), touristic (Tróia). Impacts of these human activities on the geomorphology and the biological equilibrium of the margins of the estuary.



1st STOP (Castle of Alcácer do Sal)

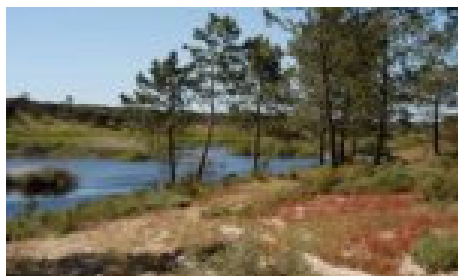


From the castle, one can see the landscape dominated by the terminal sector of the Sado River. Among the Portuguese rivers, the Sado River has the largest hydrographical basin with 7640 km² and a typically Mediterranean climate characterized by intense floods and long dry periods. The growth of vegetation associated to it is controlled by the hydrographical regimen. Thus, alder-groves are rare and willows (*Salix atrocinerea* and *Salix salvifolia*), ash-groves and blackberry thickets predominate in the riparian vegetation, mainly in the lower part of the Sado River. The riparian vegetation grows on the margins of the river as the alluvium soils are occupied mainly by rice fields.

In the valley slopes, the groves of cork-oaks and of holm-oaks are dominant. A psammophytic cork-oak grove (*Oleo-Quercetum suberis*) develops in shallower sands. A non psammophytic cork-oak grove (*Asparago aphyllly-Quercetum*

suberis) develops in detrital formations (gravel, sandstones and conglomerates) and an holm-oak grove *Myrto communis-Quercetum rotundifoliae* develops in schistous formations.

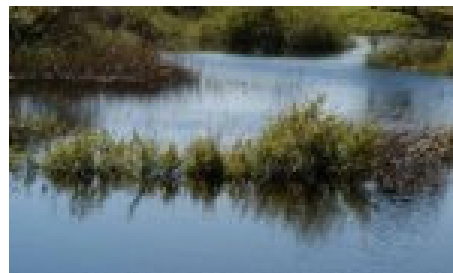
2nd STOP (Murta Dam lake)



Here, we can observe a flat bottom depression that corresponds to an interdunal corridor, with a water-table close to the surface without being subject to great fluctuations throughout the year. The Marateca formation forms the depression bottom oriented in the direction north-south and is limited to east and west by two sandy accumulations of psammytic regosols and podzols with allioz (*surraipa*)

The moist interdunale depression owes its origins to the rain-water that infiltrates in the dunes down to the low permeability level of

the Marateca Formation, where an extensive water table is formed and then cut by the interdune depression. Thus, no water streams down the dune surface and, instead, it flows straight to the underground water table that supplies the depression, even during summer.



In the Murta Dam lake, small floating islands, made of a large amount of organic matter, are the result of a small dam that covered the peat-bog with water, making it rise up to the surface due

to its low density. Thus, the peat-bogs *Sphagnum auriculatum*, the vegetation *litorelletea* and the hygrophilic rush with *Cirsium palustre* that can be observed in similar, but not very deep depressions along the Sado River, are sparsely represented in the Murta Dam lake. On the other side, it is possible to find important communities of emerging macrophytes, of floating macrophytes rooted in the soil, and mainly palustrian willow groves of the *Alnetea-glutinosae* class.

3rd STOP (Carrasqueira Fishing harbour of the Sado Estuary)

Carrasqueira is an ancient settlement of fishermen coming from the northern coast of Portugal (near Aveiro), during the last century. It is located on the dunes, constituting the ancient margin of the estuary. Before the reclamation of the ricefield, the village was close by the creek, and the houses were made of wood and reeds, and covered by a sea rush roof ("palheiros"). Some of them were palafittic and were the place of birth to some of the fishermen. But for most of their lives, a fair share of their time was spent on the boats.



The normal succession of the salt marsh communities can not be observed in Carrasqueira harbor, because of the marsh anthropogenic erosion, caused by the enlargement, deepening, and widening of the main channels and by trailing of the boats on the high marsh where they are repaired and parked. Also the high marsh is connected to dykes built to conquer the mud flats, transformed in rice fields. *Haliomiono portulacoidis-Sarcocornietum alpinii* dominates the marsh, with narrow fringes of *Spartinetum maritimae*, along the narrow tide channels, and marsh pools. *Cistancho phelypaeae-Arthrocnemetum fruticosae* are mixed with *Suaedetum verae*. Along the dykes, in very few places, small patches of the transition marsh of *Polygono equisetiformis-Juncetum maritimi*, can be seen, far from the harbor.

4th STOP (Tróia Peninsula– Botanic Reserve)



The sequence of plant communities can be observed from the shoreline towards the inland as a consequence of the changes of the biotope physical characteristics, such as the reduction of the undulation and the saline spray influence, reduction of the wind speed, increase of sand stabilization, greater paedogenetic development, etc. As a result, the coastal psammophytic communities grow in parallel strips along coastline, organizing a microgeosigmetum in which plant populations are not included in a serial logics but represent permanent steps of the vegetation.