

Effect on lagoon belts of groundwater development around the Doñana National Park coastal sand formations, southwestern Spain

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ABSTRACT

What is now known as Doñana is a 3000 km² coastal area in southwestern Spain near the Guadalquivir River estuary, which contains a large temporal clayey marsh (Ramsar site) and well-developed sandy areas, with a Pleistocene to recent sand dune cover. On the sandy sector, the areas of El Abalario and Los Cotos are well recharged by rainfall (600 mm/year in average, about 150 mm of recharge), and present day discharge takes place along the coast line, to a main permanent watercourse and along the ecotone separating the sandy formations from the marshes, as well as phreatophyte transpiration. Under natural conditions the water table intersected the land surface in many sites, especially in the low interdune areas, producing hundred of small permanent and temporal lagoons and shallow water courses from <1 ha to a few ha of surface area. These wetlands, and the similar ones generated along the ecotone, are of crucial ecological importance to the area. Along the coast, the stratified, fairly permeable fluviomarine sands form an erosional cliff with many small springs. Under natural flow conditions the hydrogeological conditions at the coast favours high enough water-table levels which maintain a non-penetrating marine water wedge. But the recent development of local groundwater to irrigate agricultural areas and to supply some large tourist resorts has produced a piezometric level drawdown, in deep gravely layers of the aquifer base, that translate in a decreasing although fluctuating trend of the water table. This affects wetlands and the associated vegetation, although no clear seawater intrusion has been yet observed. The area has been modelled and water balances are presented here to show how the groundwater system has been impacted. The system response is slow and the time to adapt to water balance changes is of several decades. The effect on the water table is from a few dm to some m, and continues to go down even if extraction is not increasing or even if it is decreasing in some areas. A water table drawdown of some dm may produce noticeable changes in the ecosystems. A dense network of boreholes helps in understanding the behaviour of such a 3-D system. In this case, a good knowledge of the hydrogeological conditions along the coast and their possible changes are very important to forecast the future patterns of wetlands-aquifer relationships.

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