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DECLINE OF RELICT CENTENNIAL CORK OAKS IN DOÑANA (SW SPAIN) AND POTENTIAL DELETERIOUS EFFECT OF TREE- NESTING COLONIAL WATERBIRDS

Cristina Ramo¹, Teodoro Marañón², Cristina Aponte², María T. Dominguez², Paolo de Vita³, Adela Moreno², Lorena Gomez-Aparicio^{2,4}, Pilar Burgos², Pierre Callier³, María E. Sánchez³ and Luis V. García²

¹ Estación Biológica de Doñana (CSIC). Avda. AméricoVespucio s/n, 41092 Sevilla, Spain

² Instituto de Recursos Naturales y Agrobiología de Sevilla (CSIC). P.O. Box 1052, 41080-Sevilla (Spain).

³ Dep. Agronomía, Patología Agroforestal, Universidad de Córdoba, Apdo. 3048, 14080 Córdoba, Spain

⁴ Present address: Centro de Investigación Forestal, INIA, Carretera de la Coruña km 7, 5, 28040-Madrid, Spain.

Centennial cork oaks (*Quercus suber* L.) are spread in the sandy soils of Doñana (S. W. Spain). They are remnants from the formerly extended oak forests that were overexploited during the XVII-XX centuries. After the protection of the area as Biological Reserve forty years ago, all silvicultural practices such as cutting, pruning and cork extraction ceased. At the same time, seven species of wading birds began to nest on the centennial oaks located in the marsh edge, forming a big colony. We hypothesize that colonial nesting birds are contributing to the observed rapid oak decline.

We analysed a cohort of centennial cork oaks along a gradient of nesting bird influence. In each tree we evaluated the bird isotopic signature ($\delta^{15}\text{N}$), crown defoliation status, a proxy for leaf water-use efficiency ($\delta^{13}\text{C}$), several key soil variables, and percent of leaf surface covered by faeces. $\delta^{15}\text{N}$ values were positively related to increased leaf water-use efficiency and crown defoliation values, suggesting that the heavily occupied trees were under higher water stress and in poorer health condition than the unoccupied ones.

On the other hand, the soil bird isotopic signature was highly correlated to increased soil salinity values which, in turn, were significantly related to increased leaf $\delta^{13}\text{C}$ values and to increased crown defoliation status. No relationship was found between declining symptoms and leaf covering by faeces.

We tested structural equations models (SEM) based on different hypothesized bird effects on tree health status. Indirect (soil mediated) effects of the nesting birds best explained the observed tree declining symptoms.

We concluded that the decline of the centennial oaks is related to the cumulative effect of the nesting wading birds. The morphological and isotopic drought stress-like symptoms observed in the declining trees are consistent with the huge increase in the levels of biogenic salts (as nitrates and phosphates) detected beneath the heavily occupied trees.

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For the Reserve managers there is a challenging trade-off between preserving the relict large scattered trees, which harbour a high genetic diversity and have a key ecological role in these savannah-like ecosystems, and maintaining the current nesting area for these protected but expanding wading birds.

Key words: $\delta^{15}\text{N}$, $\delta^{13}\text{C}$, heronry, indirect effects, soil salinity, oak decline, stable isotopes.