Physiological Signatures of Salinity-Induced Osmotic Stress in Reforested Stahlia monosperma: Implications for Species Conservation

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Coastal wetland restoration is increasingly challenged by climate-driven salinity shifts that impose physiological constraints on vulnerable plant populations. This study evaluated how natural variation in soil water availability and groundwater salinity influences osmotic stress responses in reforested populations of Stahlia monosperma, a threatened coastal tree species. Monthly field sampling was conducted from September to December 2025 across four populations within the Ciénaga Las Cucharillas Natural Reserve in Cataño, Puerto Rico. Environmental measurements included soil water content and groundwater Na? concentration, while physiological responses were assessed through foliar water content, foliar Na? and Cl? concentrations, and stomatal behavior. Reduced precipitation coincided with declines in soil water content and increases in groundwater Na? concentration. Despite these shifts, foliar hydration remained stable, indicating short-term physiological regulation. In contrast, populations experiencing higher salinity exhibited greater foliar ion accumulation and increased stomatal closure, reflecting osmotic and ionic stress. Population-level differences were evident, with one population maintaining lower ion stress and higher hydration, suggesting more favorable site conditions. Foliar ion concentrations did not scale uniformly with groundwater salinity, indicating partial regulation of ion uptake influenced by local environmental factors. These results highlight that physiological responses, rather than environmental measurements alone, shape conservation efforts for Stahlia monosperma. Incorporating organism-specific stress indicators into restoration strategies may enhance long-term ecosystem stability as climate-driven salinity variability intensifies.

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