

ADAPTIVE MANAGEMENT OF MEDITERRANEAN *PINUS HALEPENSIS* FORESTS IN THE FACE OF CLIMATE CHANGE



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LIFE ADAPT-ALEPPO (LIFE20 CCA/ES/001809)

The geographical scope of the project covers the potential area of distribution of the habitat subtype in the Iberian Peninsula, including the Mediterranean slopes of the Catalan mountains and the Iberian System, the Ebro basin and the pre-Baetic mountain ranges. Demonstrative implementation actions have been carried out on 205 hectares spread across 42 plots.

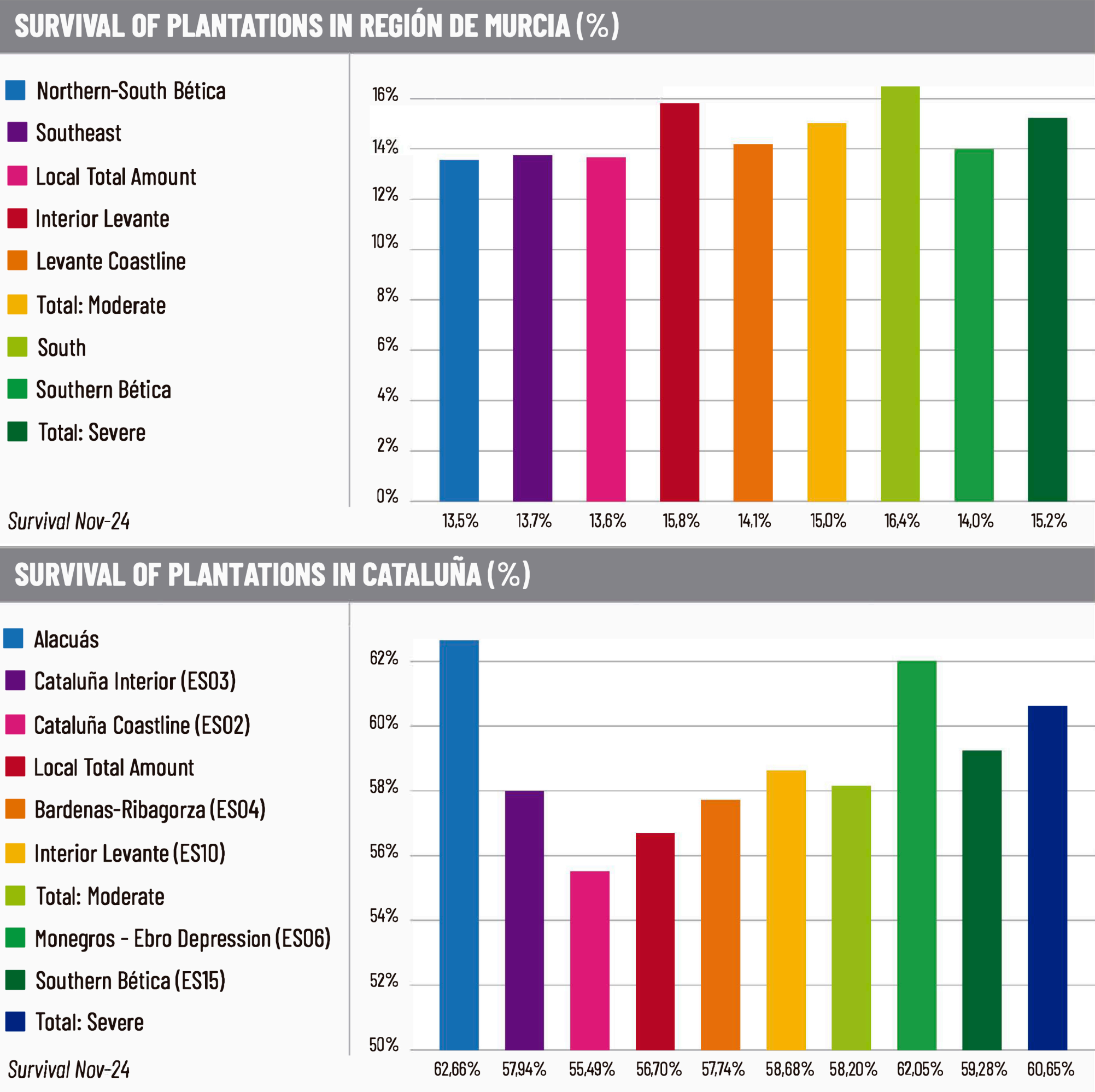


C2 - ASSISTED MIGRATION

OBJECTIVES
Implementation of assisted migration techniques to improve forest ecosystems' ability to adapt to climate aridification.

DESCRIPTION
Plantation of *Pinus halepensis* from different provenances, including populations from drier and warmer climates. A total of 12 plots have been planted across Zaragoza, Barcelona, Castellón, Valencia, and Murcia (59.80 ha), in degraded or aging forest systems, with low natural regeneration and canopy gaps.

RESULTS
The "Interior Levante" provenance has performed best overall, particularly in Murcia, Valencia, and Barcelona, showing good survival and growth across most sites. Populations with greater genetic divergence generally showed better results. Local provenances, overall, did not perform well.

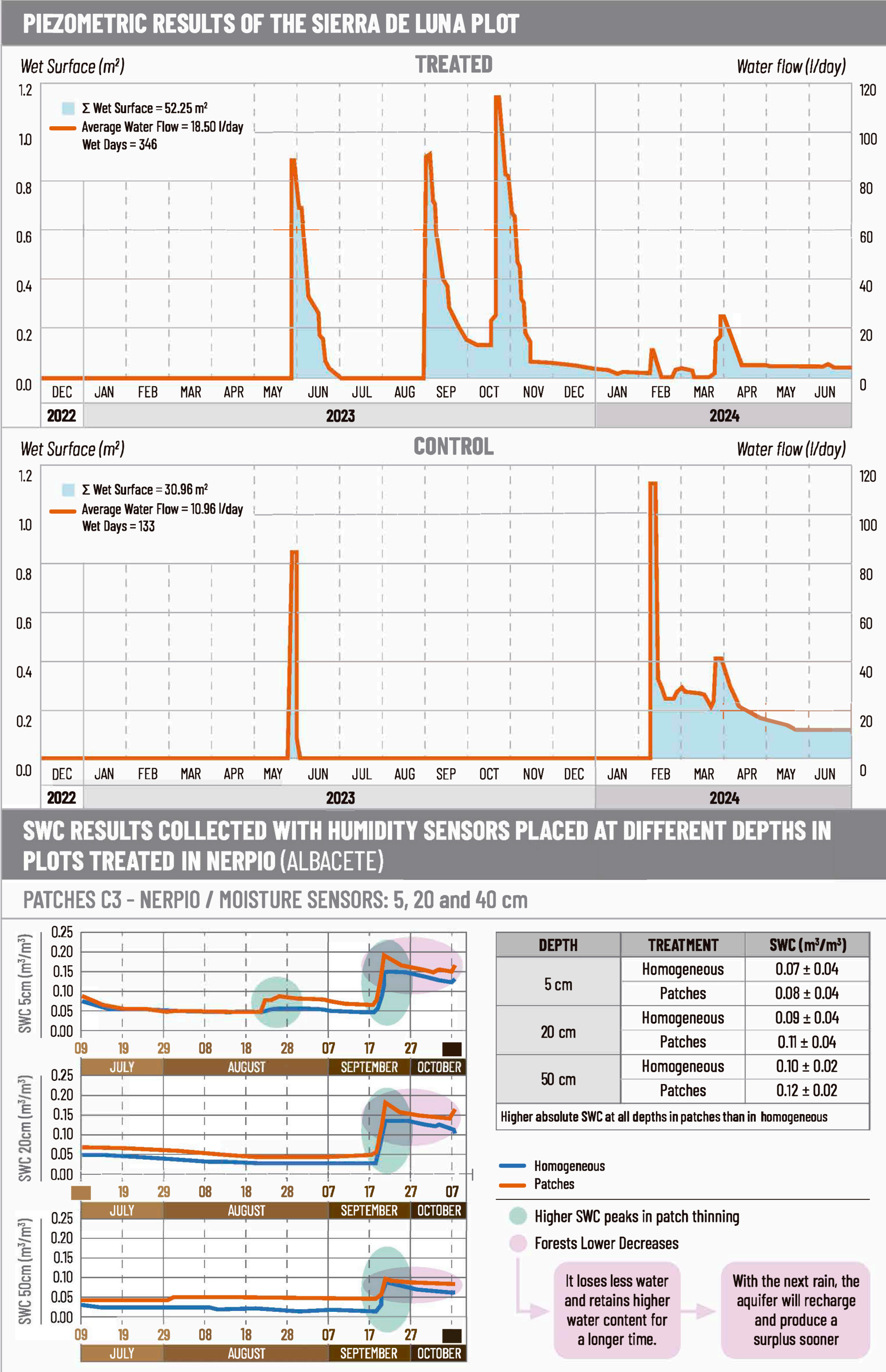


C3 - ECOHYDROLOGICAL-BASED SILVICULTURE

OBJECTIVES
Implementation of ecohydrological-based silvicultural treatments aimed at improving forest vitality and reducing water stress.

DESCRIPTION
Silvicultural treatments to enhance ecohydrological processes, such as reducing runoff and increasing water infiltration and retention in the soil. Implemented in forests within Mediterranean basins, where silvicultural treatments improve forest structure and homogeneity (44.35 ha).

RESULTS
Treated plots retained more water than control plots. Treatment analysis shows better hydrological functioning in more homogeneous treated plots, indicating improved water management over time.



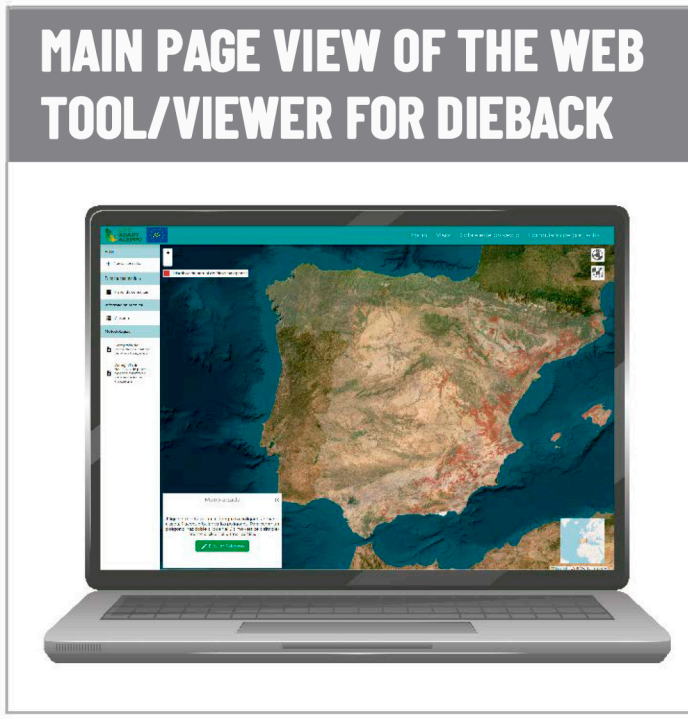
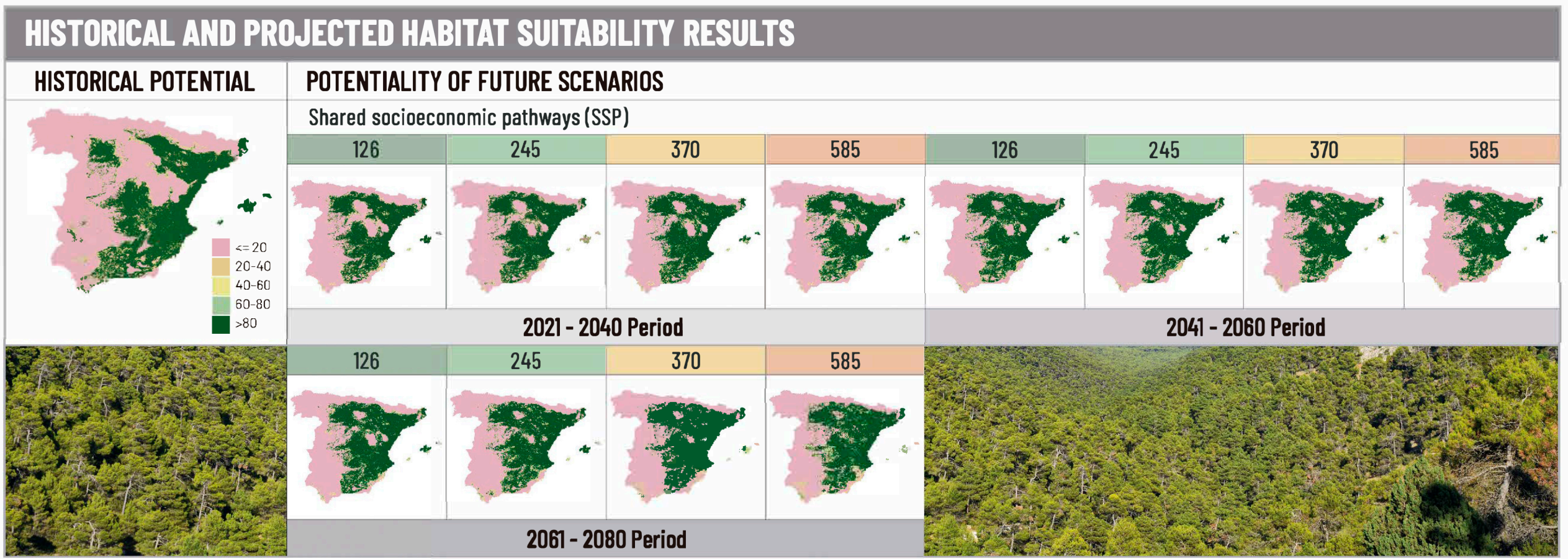
LIFE ADAPT-ALEPPO (LIFE20 CC4/ES/001809) - "Adaptive management of Mediterranean *Pinus halepensis* forests in the face of climate change", is a project carried out in Spain, part of the 2020 call for proposals of the LIFE Programme, as a Climate Action subprogram, within the vulnerability assessment and adaptation strategies sector. The main objective of this proposal is to develop new tools aimed at adapting Iberian Aleppo pine forests (subtype 42.841 of Habitat 9540 in Habitats Directive, Annex I) to climate change, as well as their demonstrative application through forest management actions. It focuses on the early detection of decay processes and on the improvement of the resilience of this ecosystem by increasing its vigour, its capacity to adapt to climatic aridification and the ability to recover its functions after natural disturbances.

C1 - CONTINUOUS MONITORING OF FOREST DECLINE

OBJECTIVES
Development of a habitat suitability map and implementation of a tool to detect decline processes using remote sensing.

DESCRIPTION
Monitoring the state of forests for the implementation of preventive and corrective measures aligned with forest management for climate change adaptation. It includes the creation of habitat suitability maps for Aleppo pine and tools for detection and characterization of decline processes using AI-based image analysis and temporal series of remote sensing images.

RESULTS
A web tool (visor) is available to provide results and maps obtained through habitat suitability mapping methodologies and forest decline detection models. Aleppo pine habitat suitability in the Iberian Peninsula and Balearic Islands: <https://lifeadaptaleppo.agrestaweb.org>.



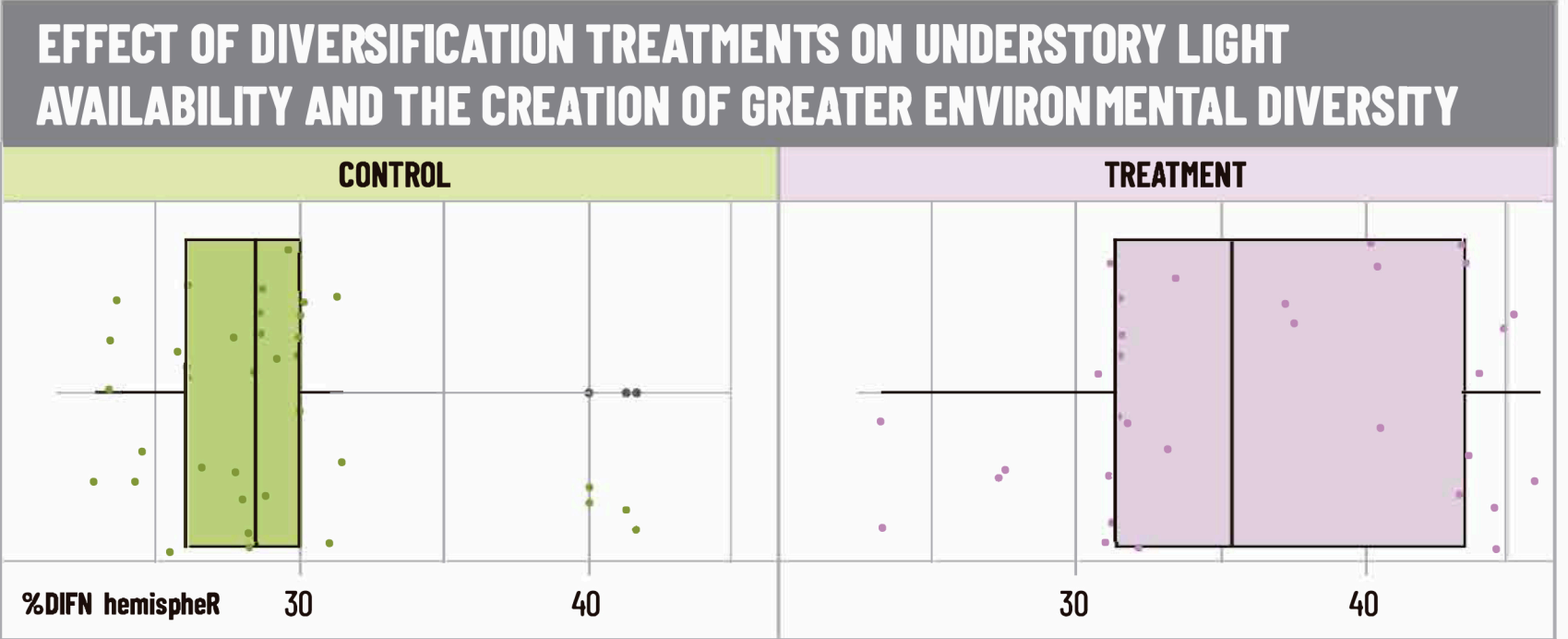
C4 - FLORISTIC AND STRUCTURAL DIVERSIFICATION

OBJECTIVES
Implementation of silvicultural treatments to improve structural and floristic heterogeneity and increase ecosystem resilience to disturbances.

DESCRIPTION
Various silvicultural treatments: selective thinning, thinning in strips, underbrush clearing, and controlled canopy opening. Implemented in 12 plots (58.66 ha) across the Mediterranean forest.

RESULTS
Persistence Index values increased in all treated plots, indicating improved forest resilience. Treatments enhanced ecosystem heterogeneity, improved light availability, increased native species incorporation, and improved plant vigor.

INCREASE IN PERSISTENCE INDEX (PI) VALUES AS A FUNCTION OF PLOT TYPE (CONTROL VS. TREATMENT) AND THE CONSIDERED DISTURBANCE				
TYPE OF PLOT	CONTROL		TREATMENT	
	PI Wooded Area	PI Shrubland	PI Wooded Area	PI Shrubland
General	0	+4.2%	+16.7%	+12.0%
Fires	0	+5.6%	+12.8%	+14.3%
Drought	0	+4.2%	+20.0%	+12.0%
Wind	0	13%	+60.0%	-33.1%

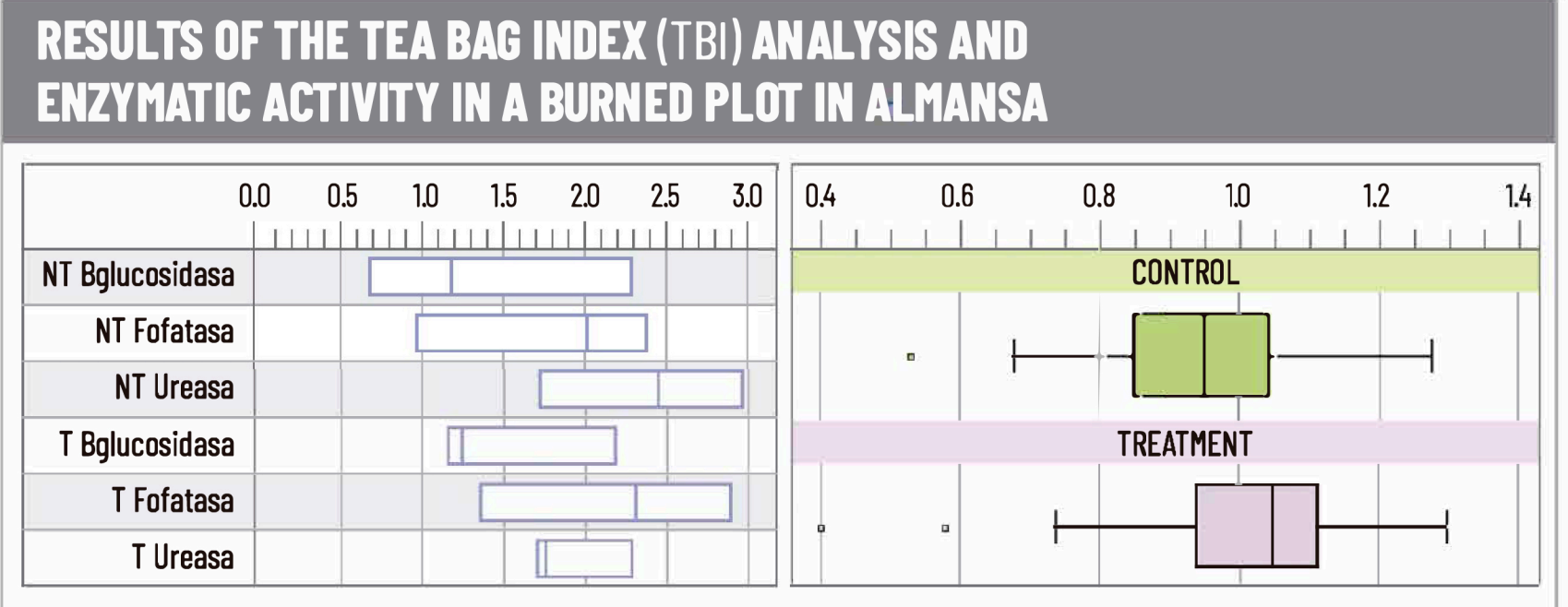
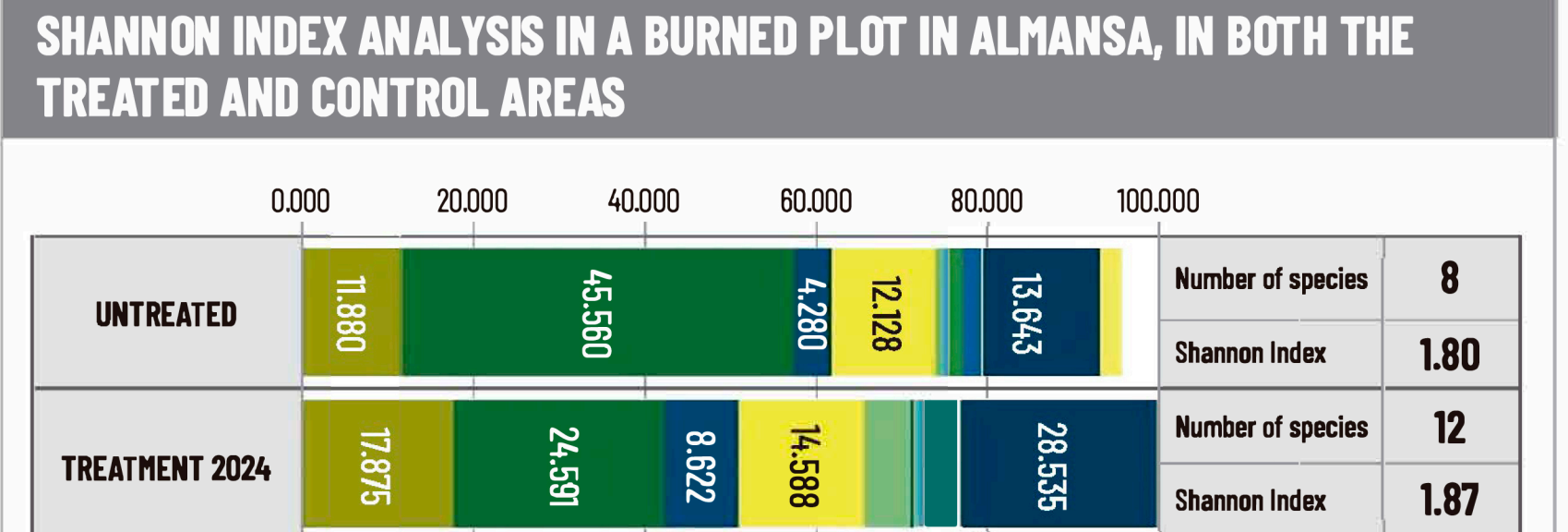


C5 - POST-FIRE REGENERATION

OBJECTIVES
Implementation of adaptive management techniques to improve the resilience and natural regeneration capacity of Aleppo pine stands after wildfire.

DESCRIPTION
Silvicultural treatments to reduce pine density and intraspecific competition (50000-100000 pine trees ha⁻¹) to promote natural regeneration and improve resilience. Implemented in 9 plots (41.67 ha) across Spain (Catalonia, Aragon, Valencia, Castilla-La Mancha).

RESULTS
Treatments enhanced species diversity and vegetation cover. Shannon Index values indicate increased floristic richness and improved soil microbial activity (e.g., higher β -glucosidase and phosphatase activity), showing essential roles in soil quality and nutrient cycling.



DURATION: 1 SEPTEMBER 2021 - 31 AUGUST 2025 (4 YEARS) | TOTAL BUDGET: €2,606,279 | EU FINANCIAL CONTRIBUTION: €1,433,268 (54.99%)

