INSTITUTO PIRENAICO DE ECOLOGÍA
IPE CSIC

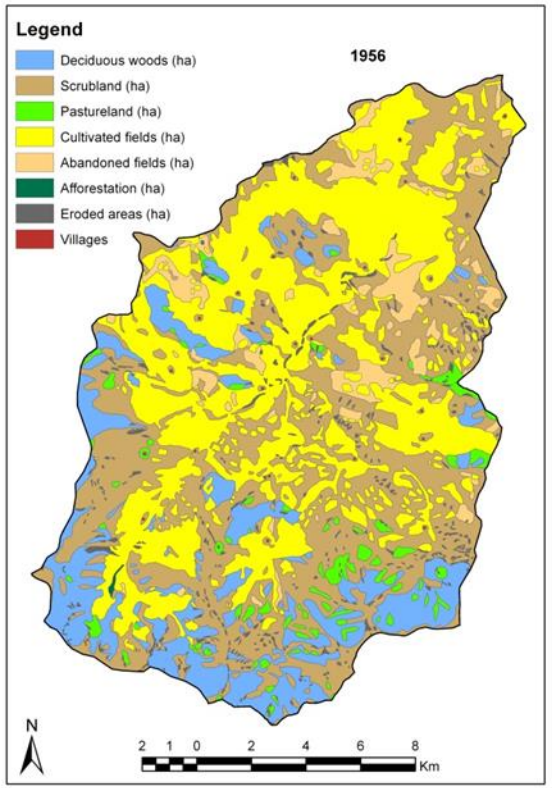
Mediterranean mid-mountain adaptation to Global Change: land management as strategy for enhancing soil carbon stock

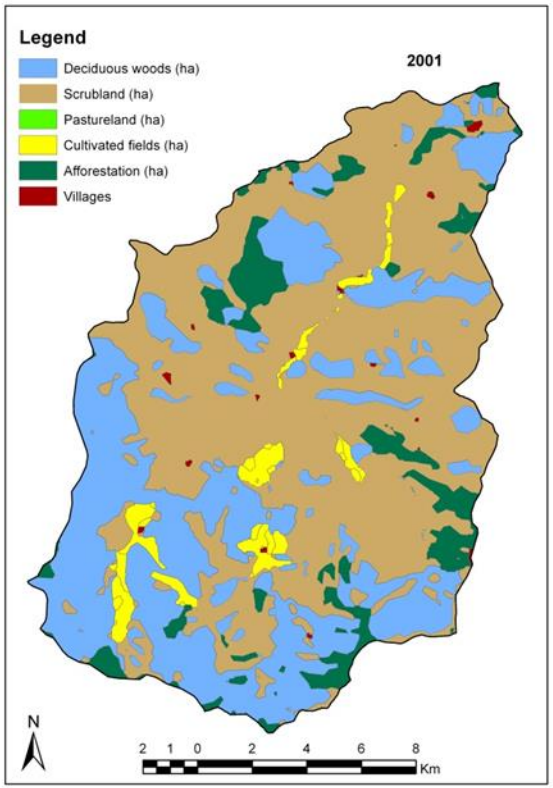
Melani Cortijos-López, Pedro Sánchez-Navarrete, Teodoro Lasanta, Estela Nadal-Romero

melani@ipe.csic.es

Mediterranean mid-mountains suffered throughout the 20th century depopulation and abandonment of traditional activities

The secondary sucession starts with the encroachment of the shrub





Land Use of the Leza Valley

ECOSYSTEM SERVICES

- Rewilding of landscape and recovery of forest ecosystem
- More CO_2 fixation
- Less soil erosion
- Aesthetic benefit for urban tourism
- …

ECOSYSTEM DISSERVICES

- Homogenization of landscape
- Diversity loss
- Increase of wildfires
- Decrease in water resources
- Reduction of agropastoral resources
- Change in soil properties, quality and soil organic carbon

MANMOUNT PROJECT

Objective: to apply an **interdisciplinary and multi-scale** approach to understanding the effects of **post-land abandonment management** practices (LMPs) (afforestation, forest thinning and shrub clearing) on **soil properties, soil quality, and SOC sequestration** (as indicators of land degradation), **soil hydrology and water resources** in a marginal Mediterranean mountain area at different spatial scales

Post-land abandonment management

Climate variability

Mediterranean marginal mountain areas

IMPLEMENTATION: multi-scale and interdisciplinary

WP1. Land degradation: Soil quality and SOC stocks

WP2. SOC Modelling

WP3. Water resources: Soil hydrology and hydrological response

WP4. Water resources: Hydrological connectivity and modelling and water supply

WP5. Guideline proposal

IMPACT

SCIENTIFIC

Interdisciplinary and multi-scale approach (testing and modelling): land degradation and water resources

ENVIRONMENTAL

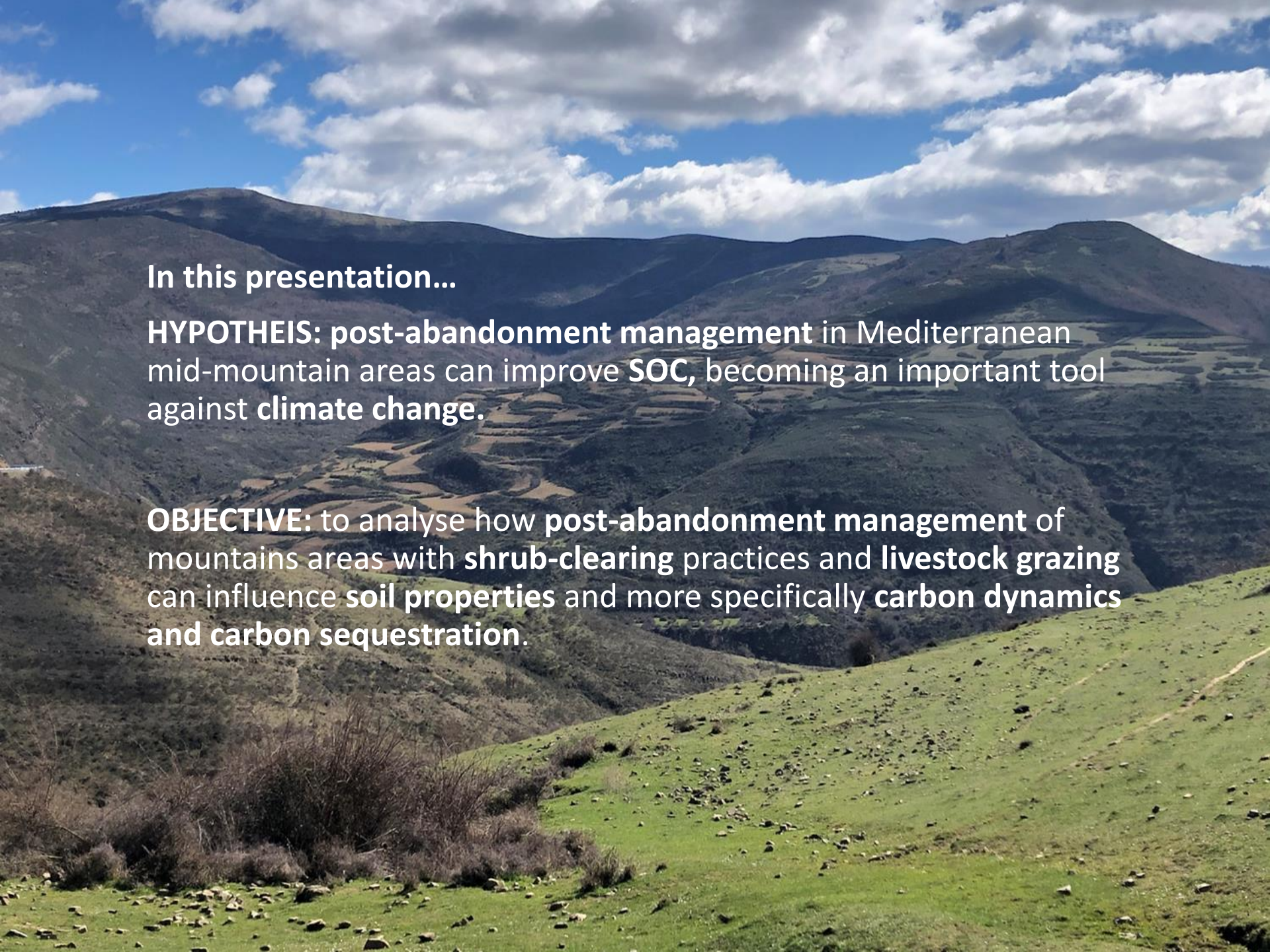
Land management of marginal mountain: land degradation (soil quality, carbon storage) and water supply

SOCIO-ECONOMIC

Land management of marginal mountain areas for enhancing ecosystem services

IPE CSIC · UNIVERSIDAD DE LA RIOJA · UNIVERSIDAD DE MURCIA · IBED · UNSW SYDNEY · DONALD BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

GOBIERNO DE ESPAÑA · MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES



In this presentation…

HYPOTHEIS: post-abandonment management in Mediterranean mid-mountain areas can improve **SOC,** becoming an important tool against **climate change.**

OBJECTIVE: to analyse how **post-abandonment management** of mountains areas with **shrub-clearing** practices and **livestock grazing** can influence **soil properties** and more specifically **carbon dynamics and carbon sequestration**.

STUDY AREA

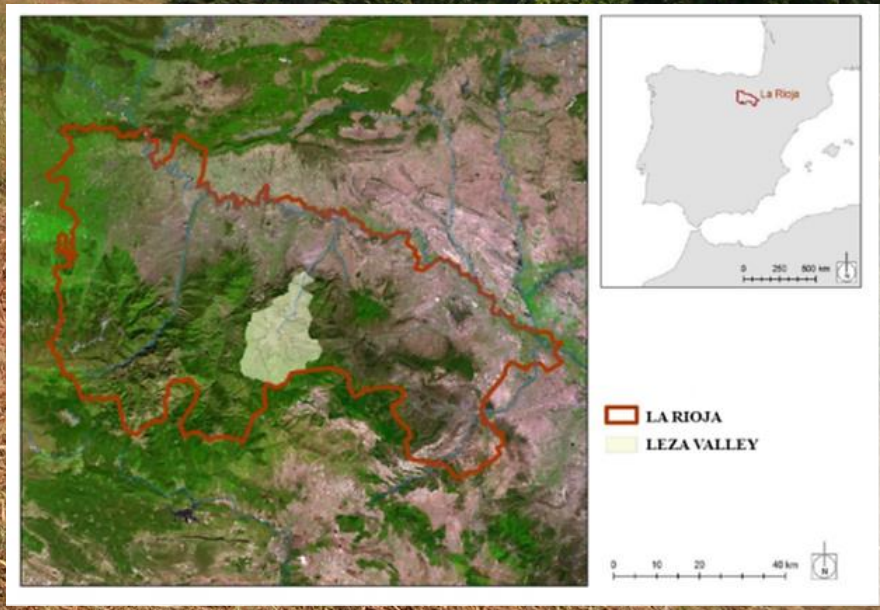
Shrub clearing plan of La Rioja Administration

Table II. Requirements of an action plan (elaborated from Lasanta *et al.*, 2009)

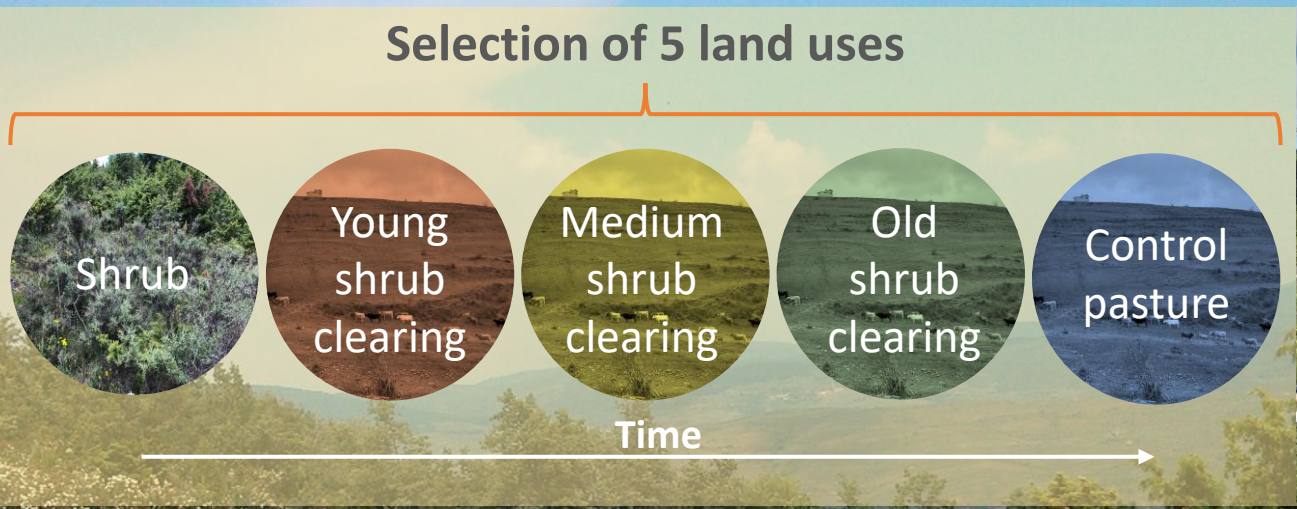
An action plan must fulfill the following requirements:
The maximum area to clear must be double the number of large animal (LA) units
Areas with more than 20% forest cannot be cleared
Sectors with slope > 30% cannot be cleared
Trees and scrubs taller than 1·5–2 m must not be removed
Areas at different altitude will be cleared to find the seasonal equilibrium of pasturelands
The patches originally cleared should be compact, avoiding the generation of narrow bands that could easily be invaded by scrubs
Clearing must be compatible with the conservation of natural habitats and plants or animals of special scientific interest or conservation concern
Each cleared area must not exceed 10 ha, leaving 2 ha of natural scrub or trees to minimize landscape impacts and protect wild fauna
Scrubs must not be removed under the following conditions: (a) ridge of farm edges; (b) less than 5 m from river banks, ravines and eroded lands; and (c) from the edges of small forests, with the purpose of protecting the integrity of these ecotones
Clearing must not be rectilinear to enhance landscape complexity
Clearing should adapt to the topography and must be integrated with undisturbed areas
To protect partridge (*Perdix perdix*) habitat, clearing at altitudes exceeding 1700 m (a) cannot exceed 5 ha and (b) should not take place during the months of May, June or July to avoid disturbance during the breeding period and destruction of nesting areas
Track and trail widening to provide machinery access for clearing is forbidden

***Positive effects of the plan*:**

- Control of wildfires
- Increase of pasture land
- Implementation of extensive livestock
- Improvement of landscape structure



METHODOLOGY

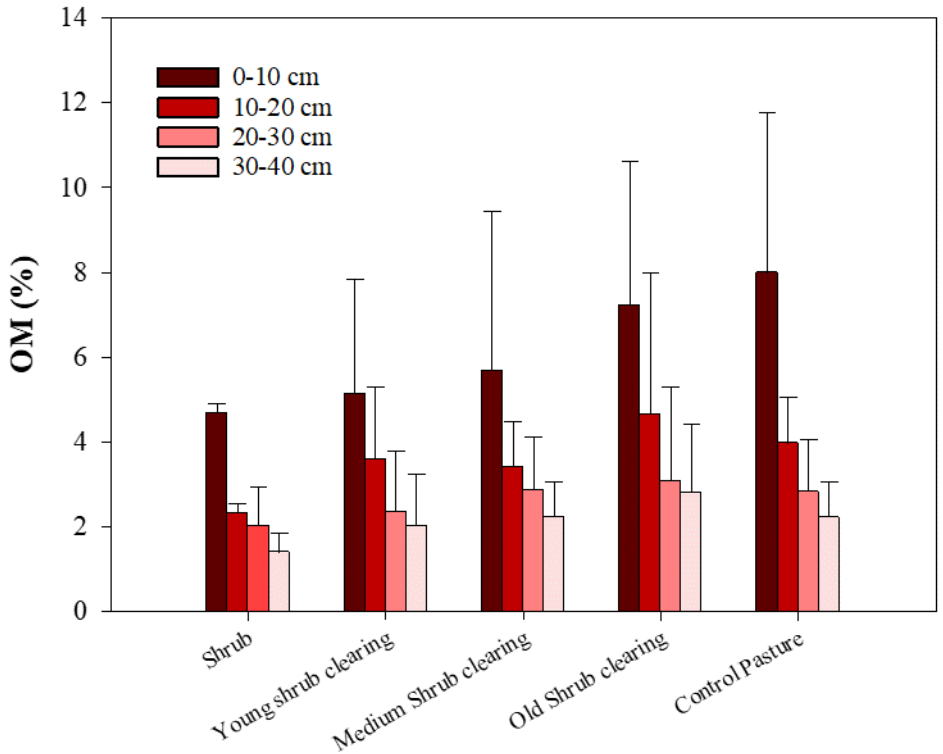


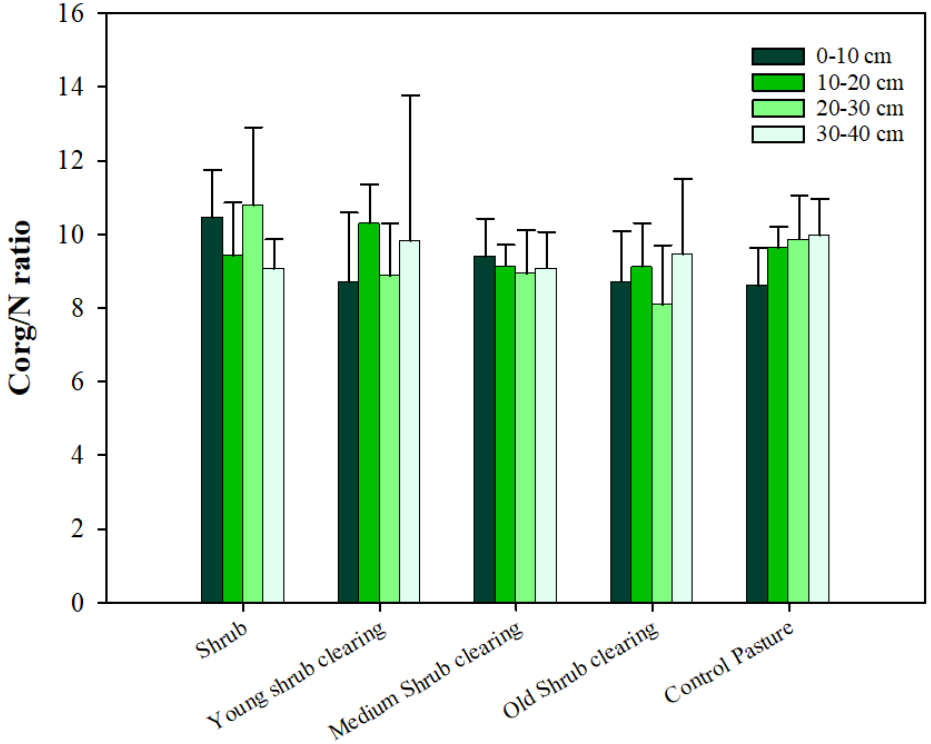
120 number of samples

Analysis in laboratory:

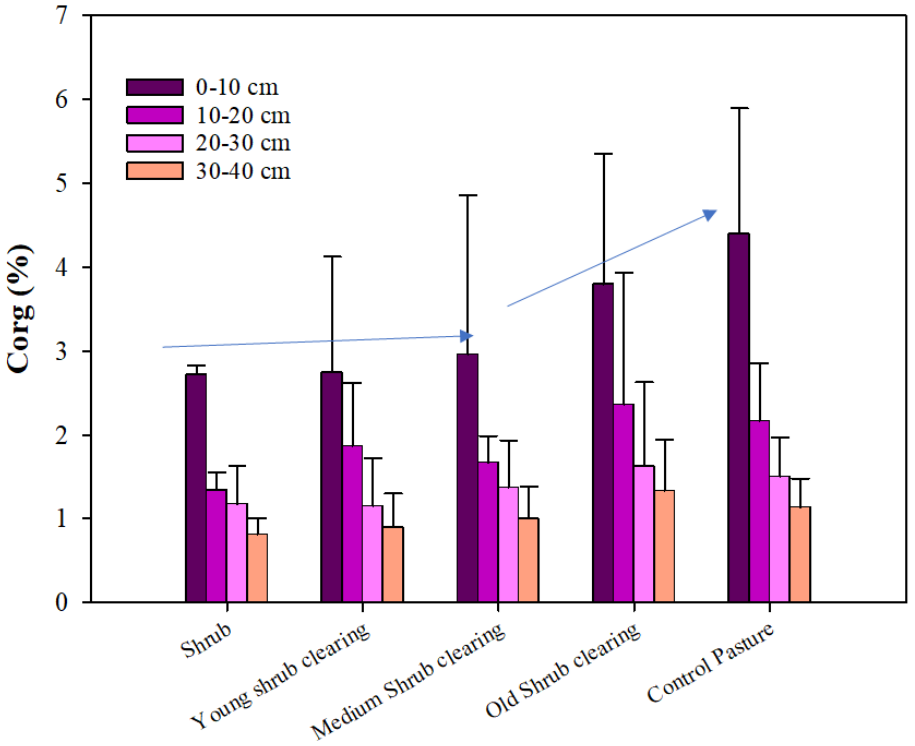
- C org concentration (%)
- N concentration (%)
- O.M. concentration (%)
- C org/N ratio
- Soil Organic Carbon (SOC) and Nitrogen Storage (Mg C ha^{-1})

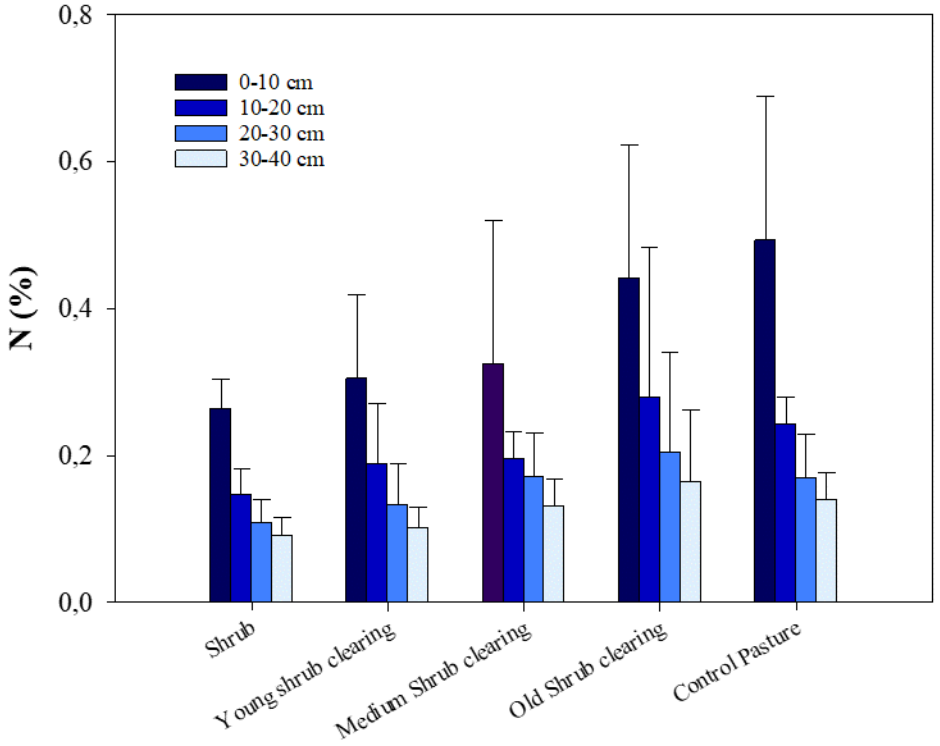
PRELIMINARY RESULTS



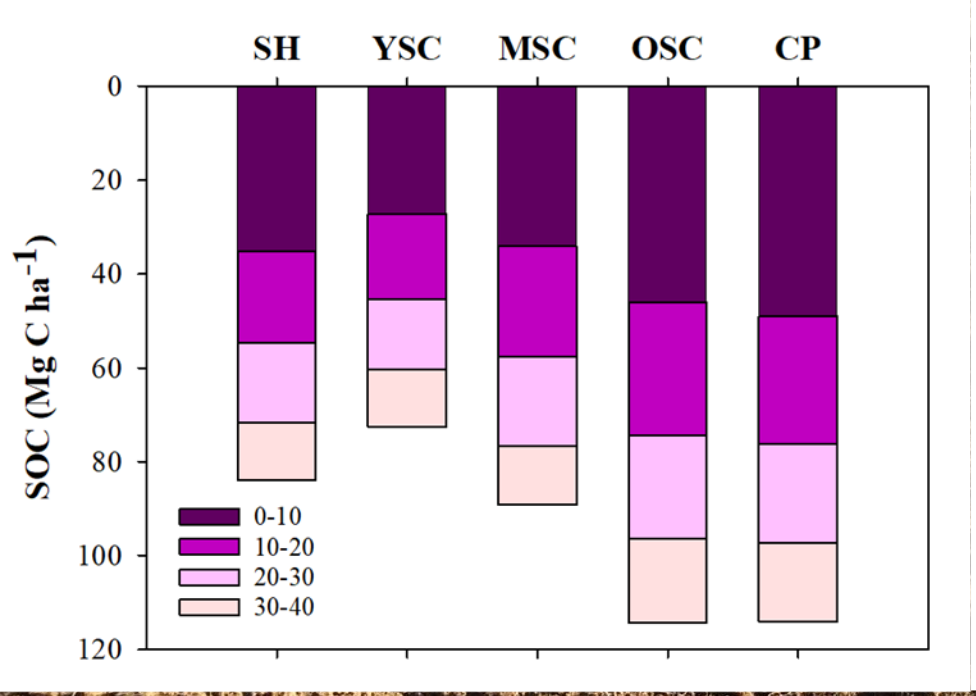


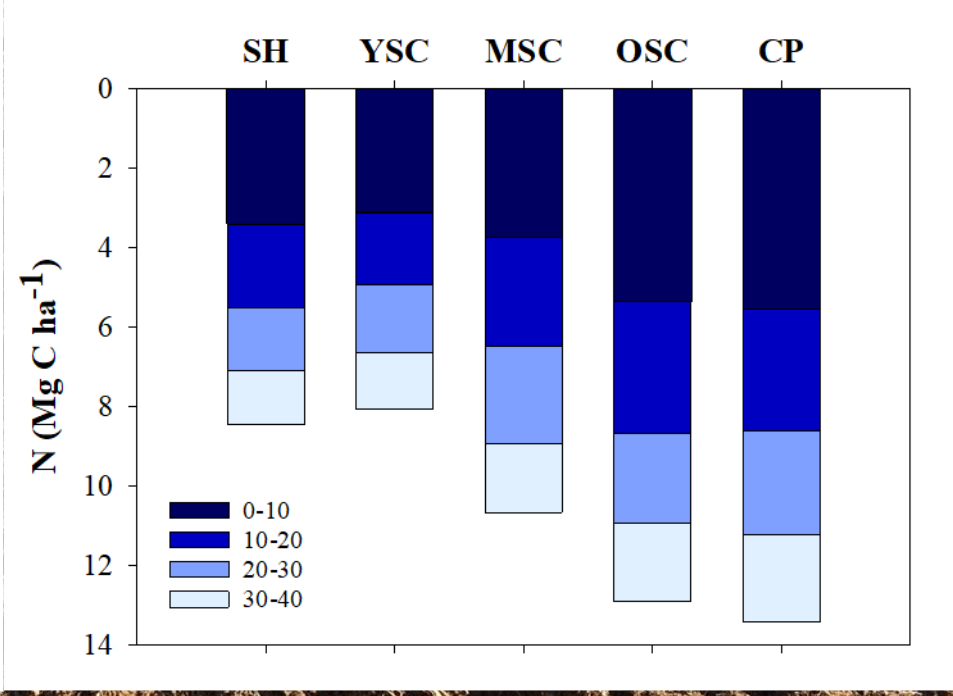
PRELIMINARY RESULTS





PRELIMINARY RESULTS

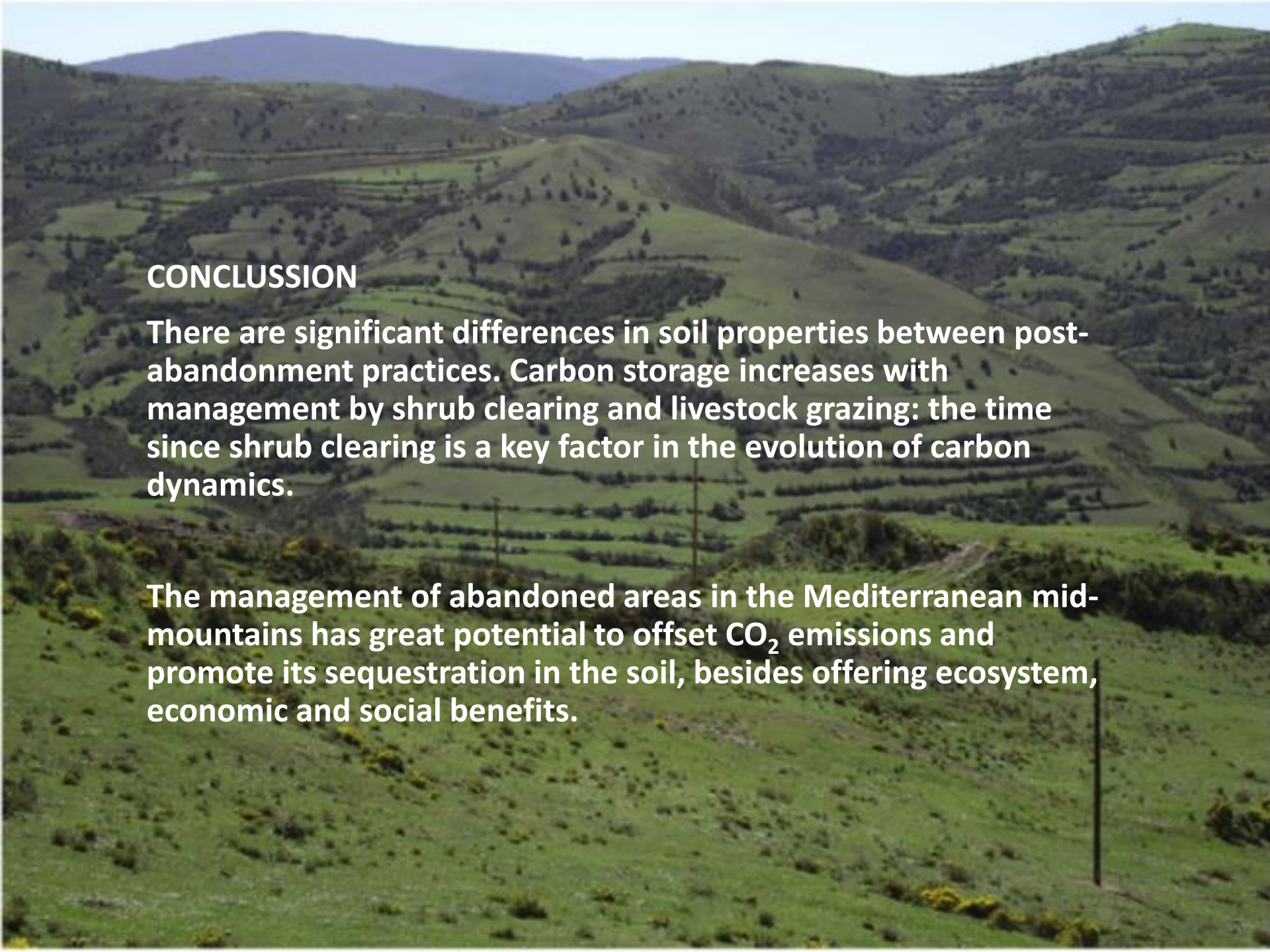




SH≠OSC and CP

FURTHER STUDIES:

- **Create a Soil Quality Index (SQI) to analyze the complete dataset**
- **SOC analysis (aggregate size fractions and density fractionation)**
- **Prediction of SOC evolution in future climate scenarios under different LMPs using SOC modelling**



CONCLUSSION

There are significant differences in soil properties between post-abandonment practices. Carbon storage increases with management by shrub clearing and livestock grazing: the time since shrub clearing is a key factor in the evolution of carbon dynamics.

The management of abandoned areas in the Mediterranean mid-mountains has great potential to offset CO_2 emissions and promote its sequestration in the soil, besides offering ecosystem, economic and social benefits.

MANMOUNT Project.

PPID2019-105983RB-I00/AEI/10.13039/501100011033

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES