

Quercus ilex open woodland widespread decline: Is it just a matter of climate-change or intensive use?



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An ecosystem in decline: Dehesa/montado

- ✧ Dehesas were originated by humans: thinning of closed forest
- ✧ They are socio-economically important in some rural areas
- ✧ Dehesa systems have been considered a sustainability ecosystem
- ✧ *Quercus ilex* and *Quercus suber*
- ✧ Tree growth decline is being observed
- ✧ Tree mortality has increased
- ✧ *Sudden oak death* (including *Phytophthora cinnamomi*)
- ✧ Lack of recruitment
- ✧ Overexploitation , i.e. excess of pruning, Livestock raising, ... = ecosystem degradation

➤ Challenges for future sustainability:

global change threats



Why is this happening?

- ✧ Different synergistic factors: climate and management (exploitation)
- ✧ The most accepted idea is that climate change is affecting
- ✧ In addition inadequate human intervention and overexploitation may affect synergistically (and negatively) with climate.



Objective

To infer the causes that produce dehesa decline among factors like climate, stand structure and human land-use.

We hypothesise that, in addition to climate, human related factors will be related to mortality rates and the health status of stands

Study area

- ✧ South West Spain, covering 100,000 km²
 - Mediterranean climate
 - Summer drought
 - Mean annual precipitation: 500 mm/year
 - Mean annual temperature: 15 °C
 - Acidic soils
- ✧ Main species studied: *Quercus ilex* L (evergreen species)
- ✧ III Spanish National Forest Inventory
- ✧ *Dehesa* plot: tree density < 500 trees/ha



Data and woodland traits studied

III Spanish National Forest Inventory (1997-2007): permanent inventory is composed by a grid where each plot is in a node, being the distance among plots 1 km

Data:

- Tree health status (1 - 6); vigorous tree to dead standing tree
- Tree mortality (number dead trees/plot)
- Early recruitment (number of recruits/plot)
- Established recruitment (number of saplings/plot)

A total of 2792 plots were then analysed



Factors affecting woodland decline: explanatory variables tested

- Climatic: Precipitation; period of drought; Temperature
- Topographic: Elevation; aspect; slope;
- Soil: Soil type, FAO classification
- Stand structure: Tree density; basal area; % forest canopy cover; tree plot diametric differentiation
- Demographic variables: Distance and population density to the nearest urban centre;

Data analysis

- **Preliminary check** (correlation, spatial distribution of variables)
- **Check explanatory variables: Generalized Linear Models [GLMs] fitting**
 - *Health status - GLM, Gamma distribution*
 - *Mortality - GLM, Zero-inflated-model*
 - *Early recruitment - GLM, Poisson distribution*
 - *Saplings - GLM, Poisson distribution*

Health status of oak woodlands

- Worse health status in southern Spain
- Tree health decreased
 - *precipitation decreased*
- Tree health increased
 - *not very hot summers*
 - *diameter differentiation*
 - *farer to urban centres*
 - *population density*

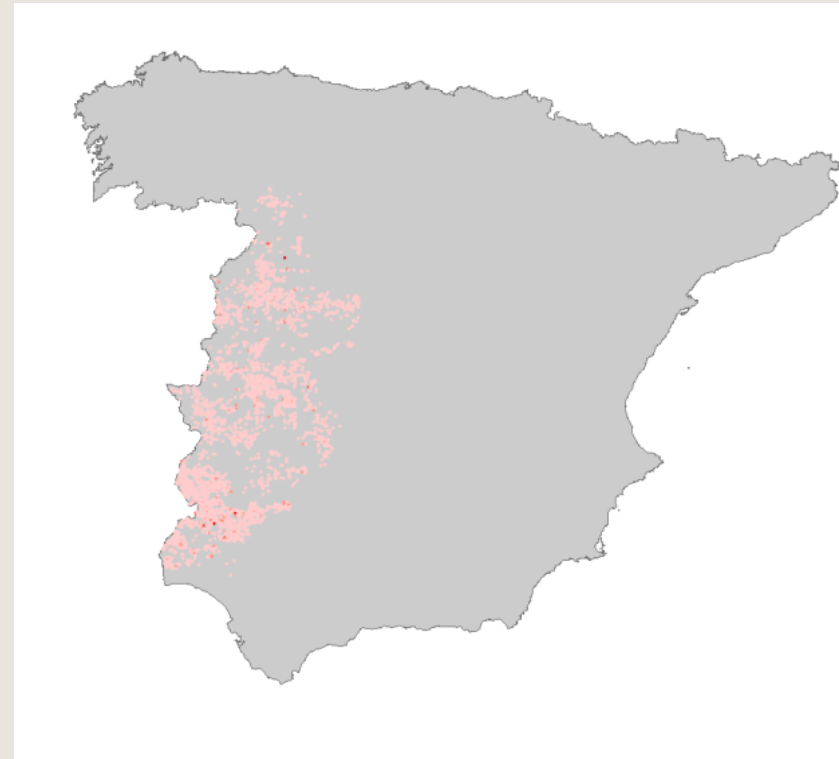


Legend:

Moves from light pink, good tree health
To dark red, very poor health

Factors affecting tree mortality

- Presence/absence of dead trees was explained by environmental variables
- Number of dead trees was explained by stand variables
- Dead trees increased:
 - *higher summer temperature*
 - *lower spring precipitation*
 - *larger drought periods*
 - *larger dbh sizes*
 - *bad tree health*

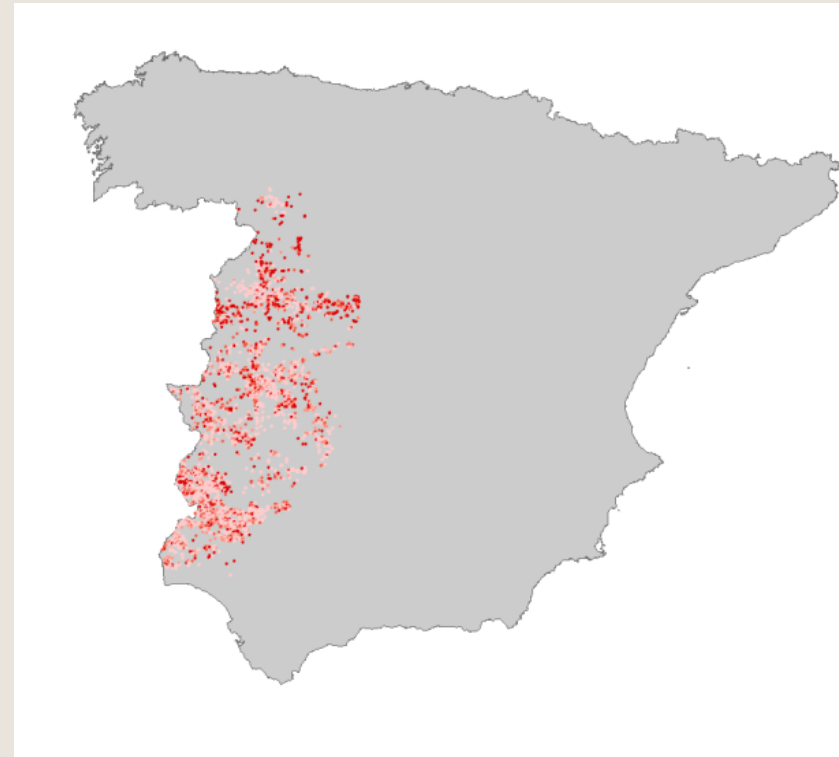


Legend:

Moves from light pink, low mortality
To dark red, high mortality

Early recruitment model

- The amount of recruits depends:
 - *lower mean annual temperature*
 - *Forest cover*
 - *distance to urban area*
 - *more shrubs were present*



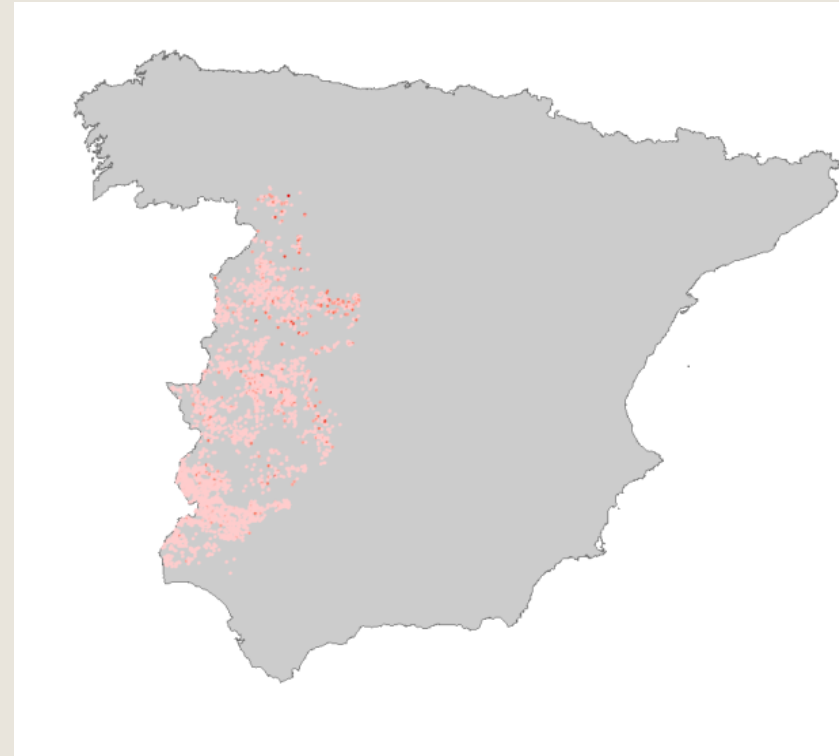
Legend:

Moves from light pink, lower number recruits

To dark red, high recruits density

Sapling occurrence as a function of environmental and human factors

- saplings appeared in northern
- presence of saplings was related :
 - *lower duration of the drought period*
 - *Slope*
 - *Forest cover*
 - *Distance to urban area*



Legend:

Moves from light pink, less sapling

To dark red, high sapling density

Discussion and conclusions

Dehesa decline = Climate + human land-use

✧ Dehesa decline could have been mitigated by a less intensive silvopascicultural pressure: compatible with actual socio-economic reality?

✧ Need of a better understanding of the impacts of management: soil erosion, lack of regeneration, ...



Thank you very much for
your attention



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