

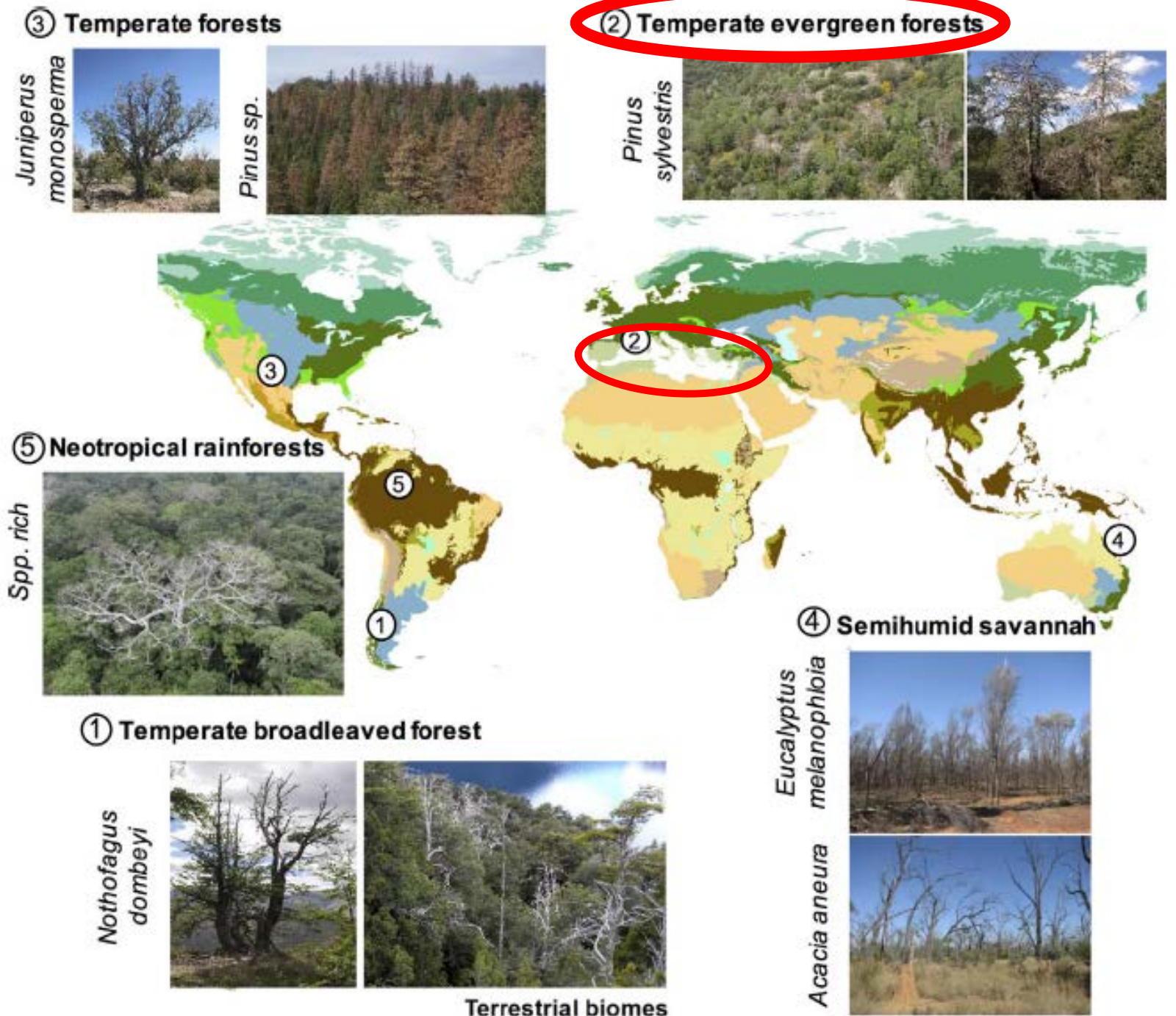
# Anthropogenic forest-use legacies underlie Mediterranean forest vulnerability to climate change

**Julen Astigarraga**

Miguel A. Zavala | Francisco Seijo | Albert Vilà-Cabrera |  
Paloma Ruiz-Benito



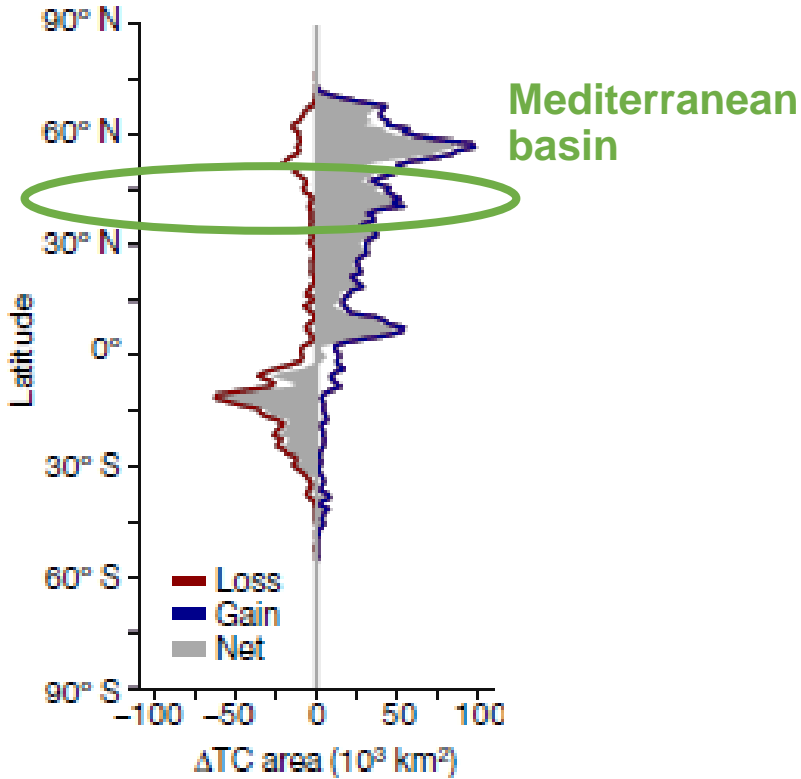
Worldwide **tree mortality** and **partial dieback** linked to **climate change** and **forest-use legacies**



# Drivers of changes in forest structure & dynamics

## Changes in land-use (1982-2016) Abandonment of traditional forest-use

Tree canopy cover change

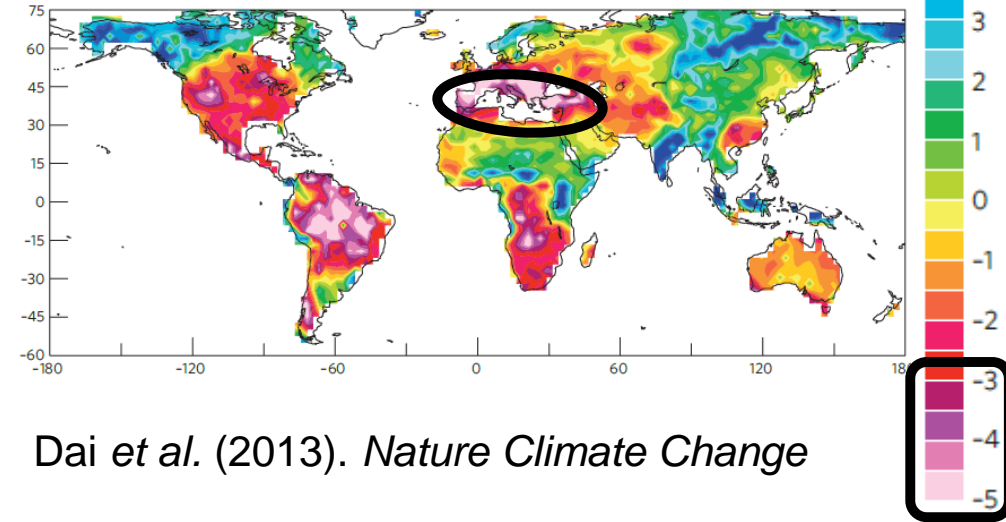


Song *et al.* (2018). *Nature*



Seijo *et al.* (2015). *Land Use Policy*

## More severe and widespread droughts in the next 30–90 years



Dai *et al.* (2013). *Nature Climate Change*

# Theoretical diagram of forest vulnerability to changing climate and forest-use

Anthropogenic past & present forest-use

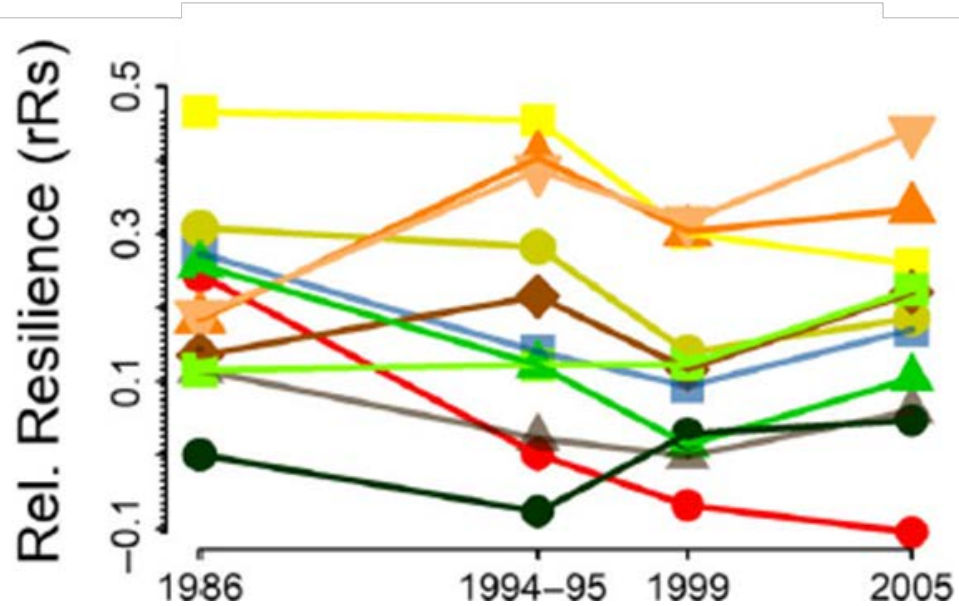


Drought

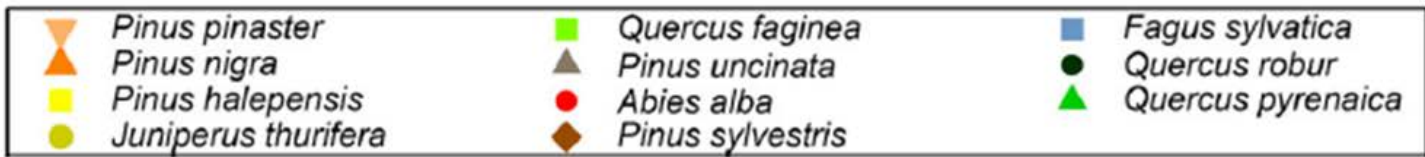


Forest vulnerability

Species specific



Tree resilience in response to extreme droughts based on ring-width indices



# Anthropogenic present forest-u

## Quantifying growth responses of trees to drought - a critique of the Lloret-indicators and recommendations for future studies

AUTHORS  
Julia Schwarz, Georgios Skiadarexis, Martin Kohler, Jörg Kunz, Florian Schnabel, Valentina Vitali, Jürgen Bauhus

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journal homepage: [www.elsevier.com/locate/foreco](http://www.elsevier.com/locate/foreco)



Photographs: J. Tijerín

## Changes in the ex Mediterranean for

### GLASSWORKS

#### FOREST PRODUCTS

- Firewood
- Charcoal
- Tannin
- Boxwood
- Cade oil
- Brushwood
- Green fodder
- Medicinals, aromatics
- Acorns
- Truffles, etc.

#### PASTURE ENCLOSURES

#### HUNTING

#### CEREAL CULTURE

#### VITICULTURE

## Interventions

- Coppicing & pollarding
- Thinning

ing  
tting

17 Potential of forest thinning to mitigate drought stress: A meta-analysis

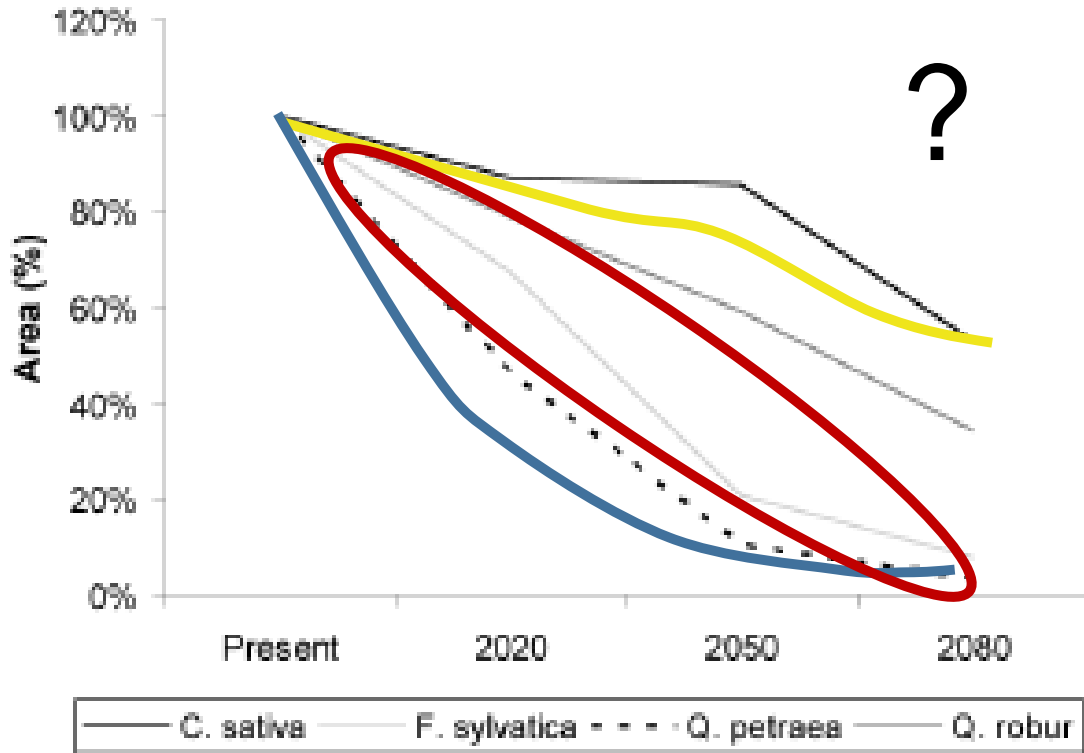
Blondel (2006). *Hu*. Julia A. Sohn<sup>\*.1</sup>, Somidh Saha<sup>1</sup>, Jürgen Bauhus

Chair of Silviculture, University of Freiburg, D-79085 Freiburg, Germany



# Climate change predictions – Species Distribution Models

(no biological processes included)



Benito-Garzón *et al.* (2008). *App Veg Sci*

Area occupied by the different species within forest types for different periods under the CSIRO-A2 climate scenarios



*Fagus sylvatica*  
forests location



## Covariables:

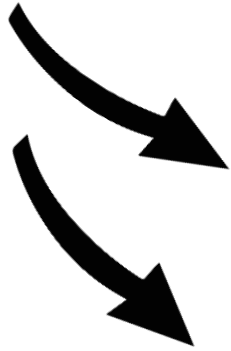
- “Intervention lag”
- Intervention intensity
- Functional group
- Tree age
- Drought severity & frequency



Photographs: J. Astigarraga

# Objective

What is the **relationship** between **forest vulnerability** and **extreme droughts** depending on **past & present forest-use**?



**Theoretical interest**



**Management interest  
(adaptation)**



# Materials & Methods

## Meta-analysis

### Keywords:

tree\* OR forest\*

AND \*thinn\* OR coppic\* OR pollard\* OR "prescribed burn\*" OR legac\*

AND drought\*

### Data source

- Scopus
- Peer-reviewed published data

### Search strategy

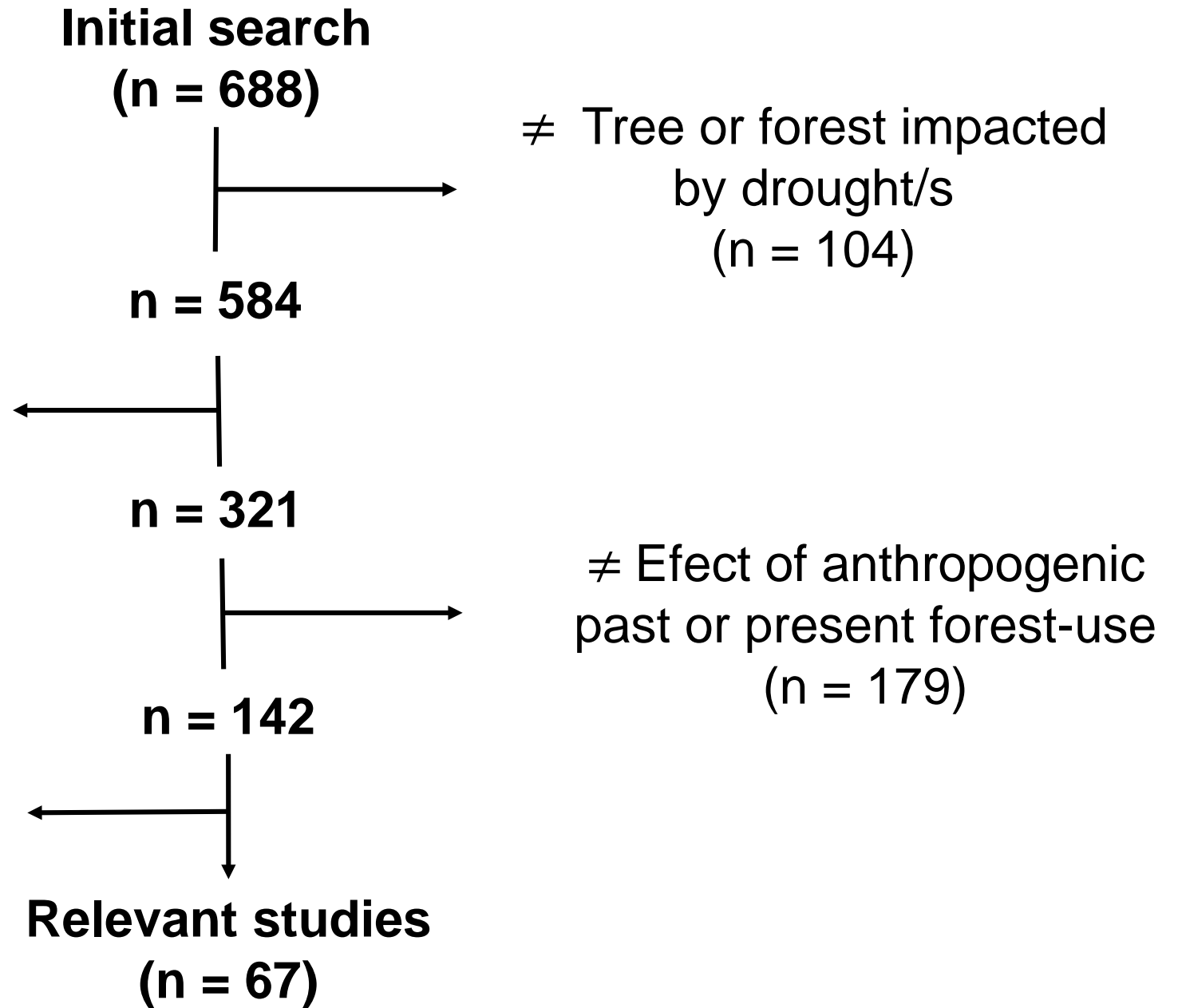
- Scope of search: Environmental Science, Earth and Planetary Sciences & Agricultural and Biological Sciences
- Document type: article, review, conference paper, book chapter & book
- Date: 2020-1967
- Language: English



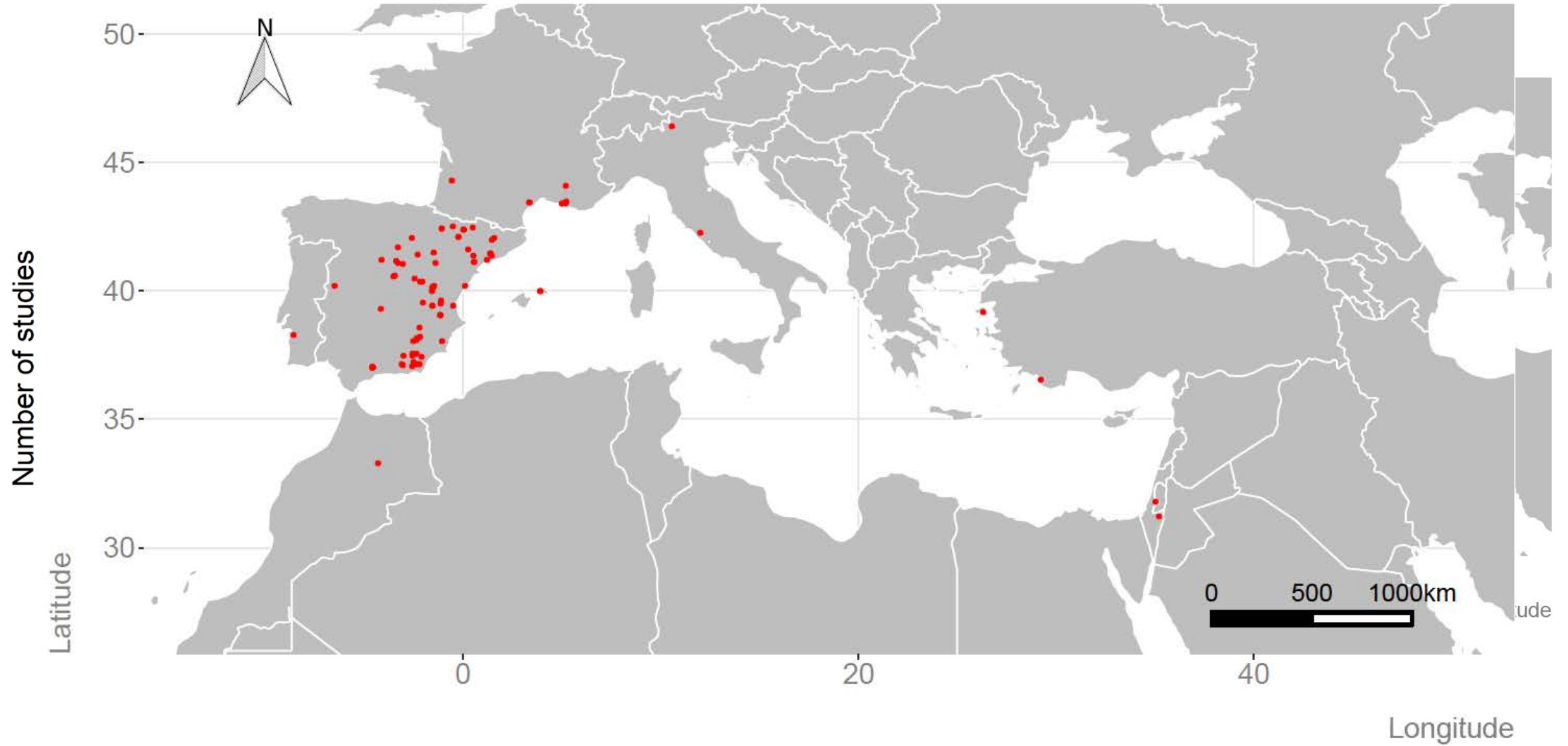
***Selection criteria & relevant studies***

Study area  $\neq$   
Mediterranean basin  
(n = 263)

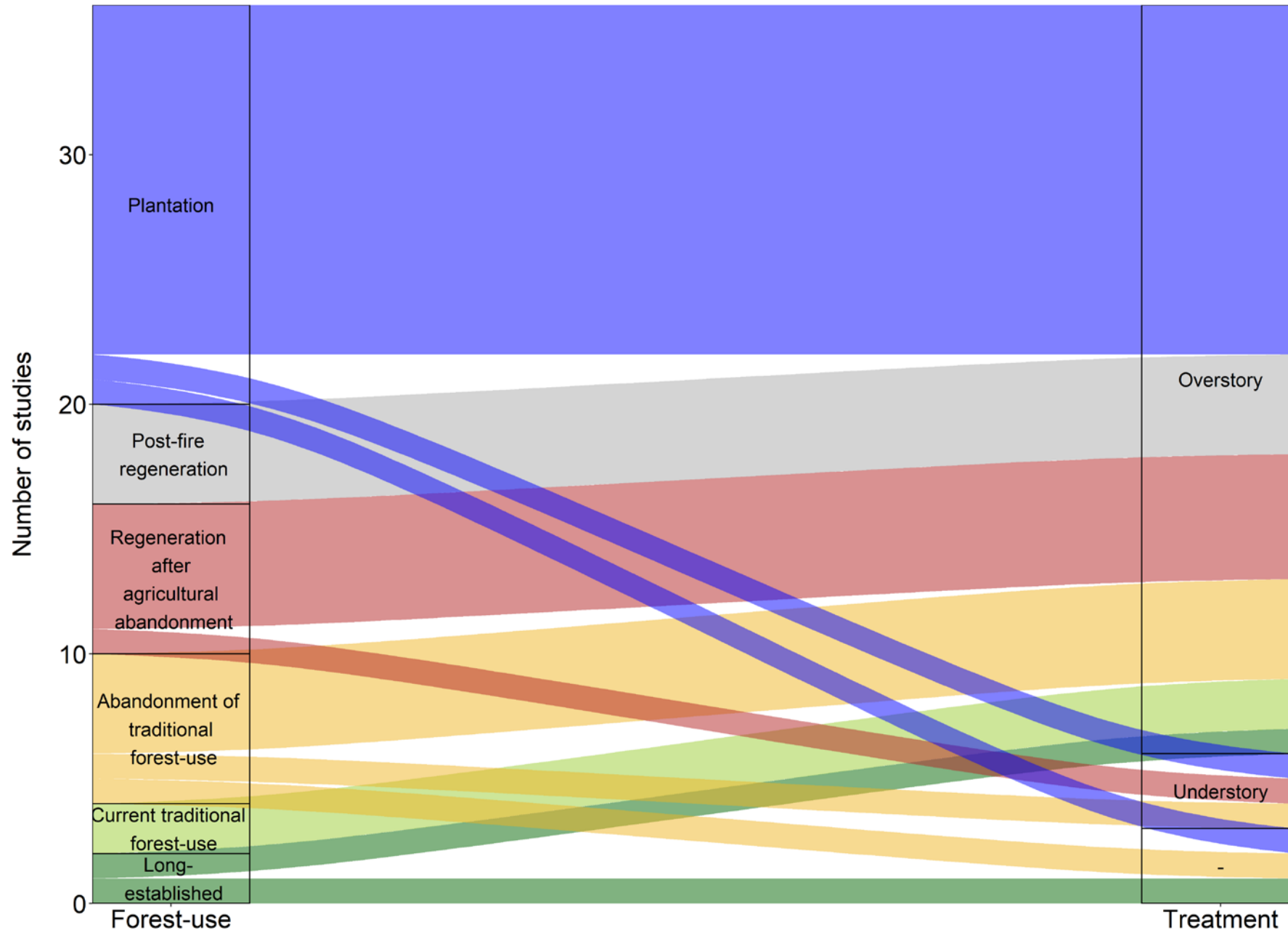
$\neq$  The paper has  
controls/comparators  
(n = 75)



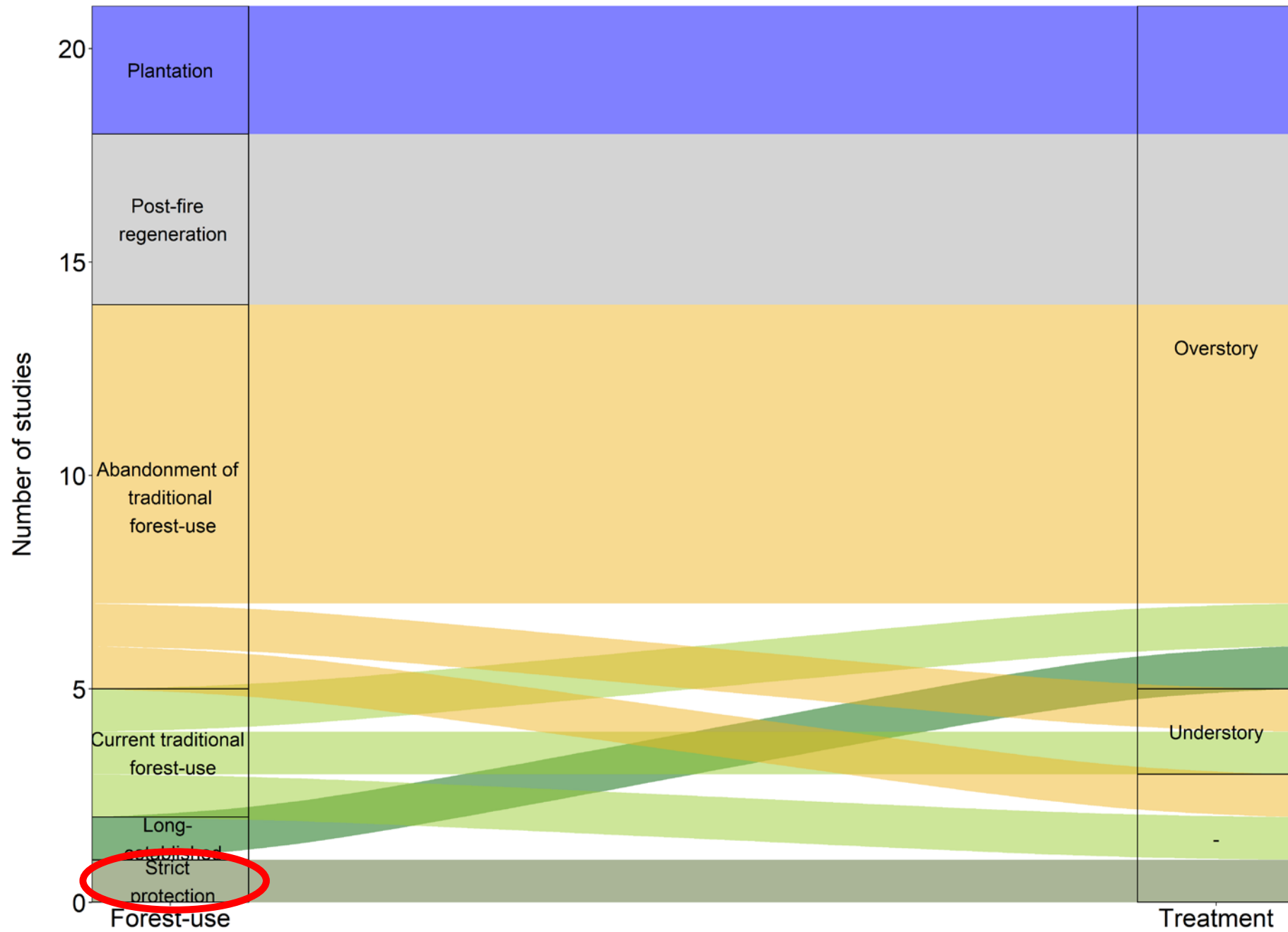
# *Preliminary results*



Case studies of *Pinus spp.* relating different forest-uses and recent management interventions (treatments)



Case studies of *Quercus* spp. relating different forest-uses and recent management interventions (treatments)



## ***Preliminary results***

**Abandonment of traditional forest-uses + Regeneration after agricultural abandonment + Afforestation policy**



**High competition**



**Extreme drought**

**Moderate over-understory treatment**



**Decrease tree vulnerability**

# ***Conclusions***

- The same species has many different forest-uses that could determine forest responses to extreme droughts.
- Since the second half of the 20<sup>th</sup> century, abandonment of traditional forest-uses and agriculture, and afforestation policies have led to increase tree competition and vulnerability under extreme drought events.
- In general, reducing tree competition could be beneficial to increase tree resilience to drought and ensure a long-term supply of ecosystem services in the Mediterranean basin.

# Acknowledgements

## Projects

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- Remedinal-4



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