



“Resin resource monitoring & modelling in a context of climate change”

Inter-regional workshop INIA Madrid

January 21/22, 2019

Maritime pine decline in Northern Castile, droughts and implied pathogens

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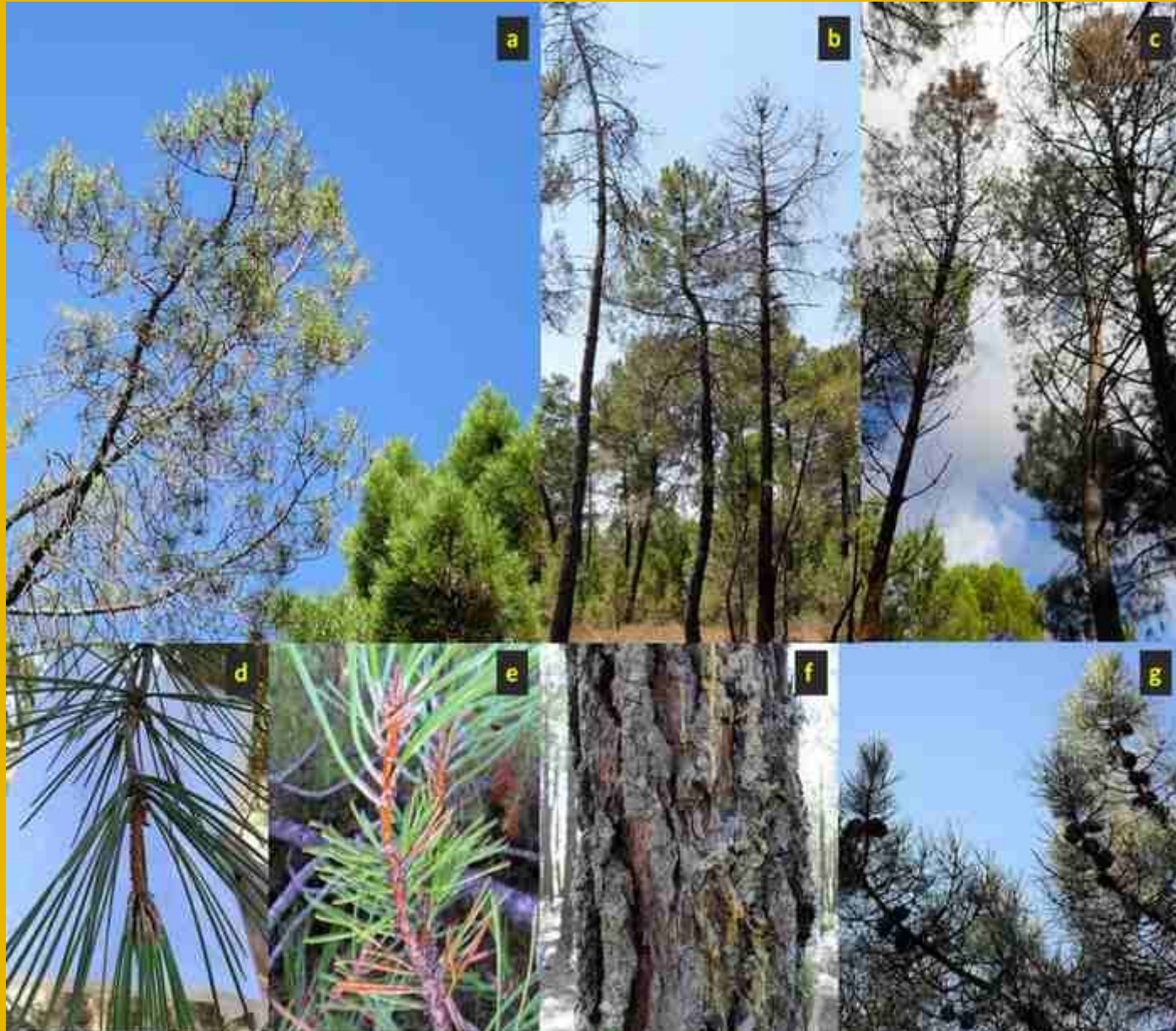




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RESEARCH ARTICLE

OPEN ACCESS

Ophiostomatoid fungi associated with declined *Pinus pinaster* stands in Spain

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Abstract

Aim of study: We studied the presence of fungi and distribution patterns in relation to the health status of declining *Pinus pinaster* trees.

Area of study: Trees in two declining stands in Central Spain were allotted to three declining classes.

Material and Methods: Trees in two declining stands in Central Spain were allotted to three declining classes (healthy, declining and recently dead) and 3 trees of each class were felled in each stand. Wood slides (phloem and xylem) were taken at six positions along the trees and samples collected from fungal identification.

Main results: A total of 21 fungal taxa were isolated and identified; eleven of these species belonged to the Ophiostomatoid group. *Ophiostoma minus* was the most frequently isolated fungus and was identified in 22% of the samples, mainly associated to dead and diseased trees.

Research highlights: Together these results suggest a putative association of *O. minor* with the decline in this area, and thus we suggest paying more attention to this fungus as a potential agent of decline in *P. pinaster* stands.

Key words: Ophiostomatoid fungi; forest pathology; blue-stain fungi; multivariate analyses.

Abbreviations: UTM: Universal Transverse Mercator coordinate system; MEA: Malt Extract Agar; DNA: Deoxyribonucleic acid; ITS: Internal Transcribed Spacer; BLAST: Basic Local Alignment Search Tool; CCA: Canonical Correspondence Analyses; PWN: Pine Wood Nematode.

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Introduction

Maritime pine (*Pinus pinaster* Aiton) is a western Mediterranean and north-African typical species that stretches down to the Atlantic coast. Most extensive forests are located in Spain, France and Portugal. In Spain, *P. pinaster* is an important source of natural goods; it covers naturally the largest surface (600.000 ha) (Del Río *et al.*, 2004) and is the pine species more intensively used in reforestation (800.000 ha) for wood and resin production, with 270.000 ha managed for resin tapping in the old sixties (40.000 ton per year, Serrada, 2004).

During the last years a general decline has appeared in

unusual crown transparency, and short, yellow-green needles, and death (Fig. 1). Blue-stain was always visible in the wood since the first stages of the disease, suggesting damages caused by ophiostomatoid or other fungi as *Diplodia pinea*. However, no damages caused by insects are usually found in these *P. pinaster* stands. The symptoms spread following a gradient of mortality indicating damages caused by a biotic agent. At the final stages of the disease, symptoms appear with extraordinary violence being visible a sudden and entire necrosis of the crown, and the dead of the tree in some weeks after the more evident symptoms appearance (Álvarez *et al.*, 2008b, 2009). The mortality rate was important reaching 60% of

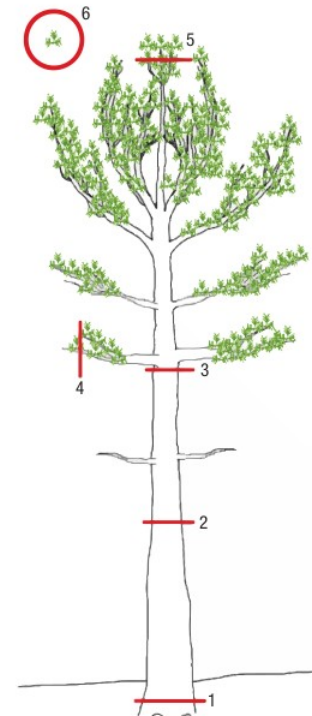


Figure 3. Different levels where samples were taken from *Pinus pinaster* trees, 1: collar, 2: middle of the trunk 3: fist alive branch, 4: branch cross section, 5: terminal guide, 6: needles.

***Ophiostoma minus*, *O. ips* and *C. fasciata* were the most frequently isolated fungi, mainly associated to dead and diseased trees.**



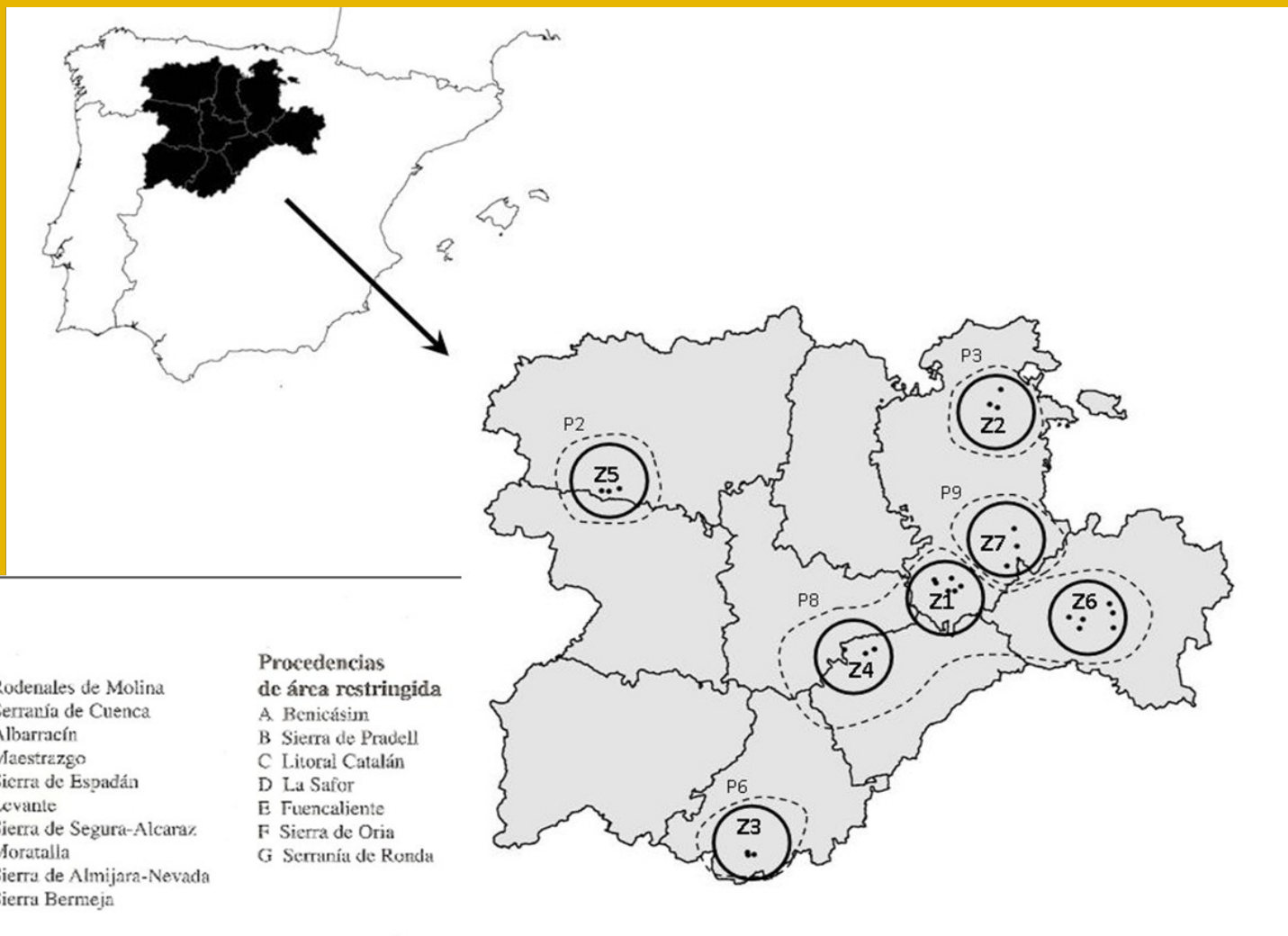


**Biotic, Abiotic and Management
Factors Involved in *Pinus pinaster*
Decline in the Iberian Peninsula**



Doctoral Thesis

Cristina Prieto Recio



Abiotic and management factors, predisposing and/or inciting *Pinus pinaster* to decline

1-The present study has pointed out that **competition and water deficit might trigger the mortality of *Pinus pinaster*** by acting as predisposing factors.

2-Results suggested that zones with a tradition of timber production, where the **stands have been historically managed**, have a **better health status** than zones with lower wood quality, where lower intensity of thinning triggered high levels of competition for the resources.

4-A **model was constructed to predict** the probability of a **particular health status for individual *Pinus pinaster*** trees (healthy, symptomatic or dead). The model developed includes variables related to the size of the tree (diameter at breast height), stand structure (average height of the stand) and climate (seasonal summer precipitation).

Biotic factors, predisposing and/or inciting *Pinus pinaster* to decline

4-*Heterobasidion annosum* is involved in the mortality and decline process of Maritime pine (*Pinus pinaster*). This pathogen was previously recorded on *Pinus sylvestris* in central Spain and on *Pinus nigra* in northeast Spain, but this is the first record of *Heterobasidion annosum* on *Pinus pinaster* in Spain.

5-Fifteen species of fungi were isolated from declined *P. pinaster* stands, displaying different degrees of virulence. Four out of seven species belonging to the group of Ophiostomatoid fungi identified were particularly relevant: *Ophiostoma minus*, *Ophiostoma ranaculosum*, *Ophiostoma ips* and *Ophiostoma piliferum*.

***Ophiostoma minus* was the most abundant species** on symptomatic and dead trees, indicating that it plays a crucial role in the decline of Maritime pine in the Iberian Peninsula. On the other hand, ***Heterobasidion annosum* was the most pathogenic species detected in this study.** This fungus could be the most important contributing factor of *Pinus pinaster* decline in the Iberian Peninsula.

Biotic factors, predisposing and/or inciting *Pinus pinaster* to decline

6-Pathogenicity tests performed on two-year-old seedlings of *Pinus pinaster* has confirmed the virulence of the isolates of *Heterobasidion annosum*. This study reports the first pathogenicity test with *Heterobasidion annosum* isolates and *Pinus pinaster*, and the results demonstrated the susceptibility of Mediterranean Maritime pine to *Heterobasidion annosum* in Spain. **Therefore, this pathogen seems to be an important contributor** to the decline of *Pinus pinaster* in Spain.

Concept of Decline

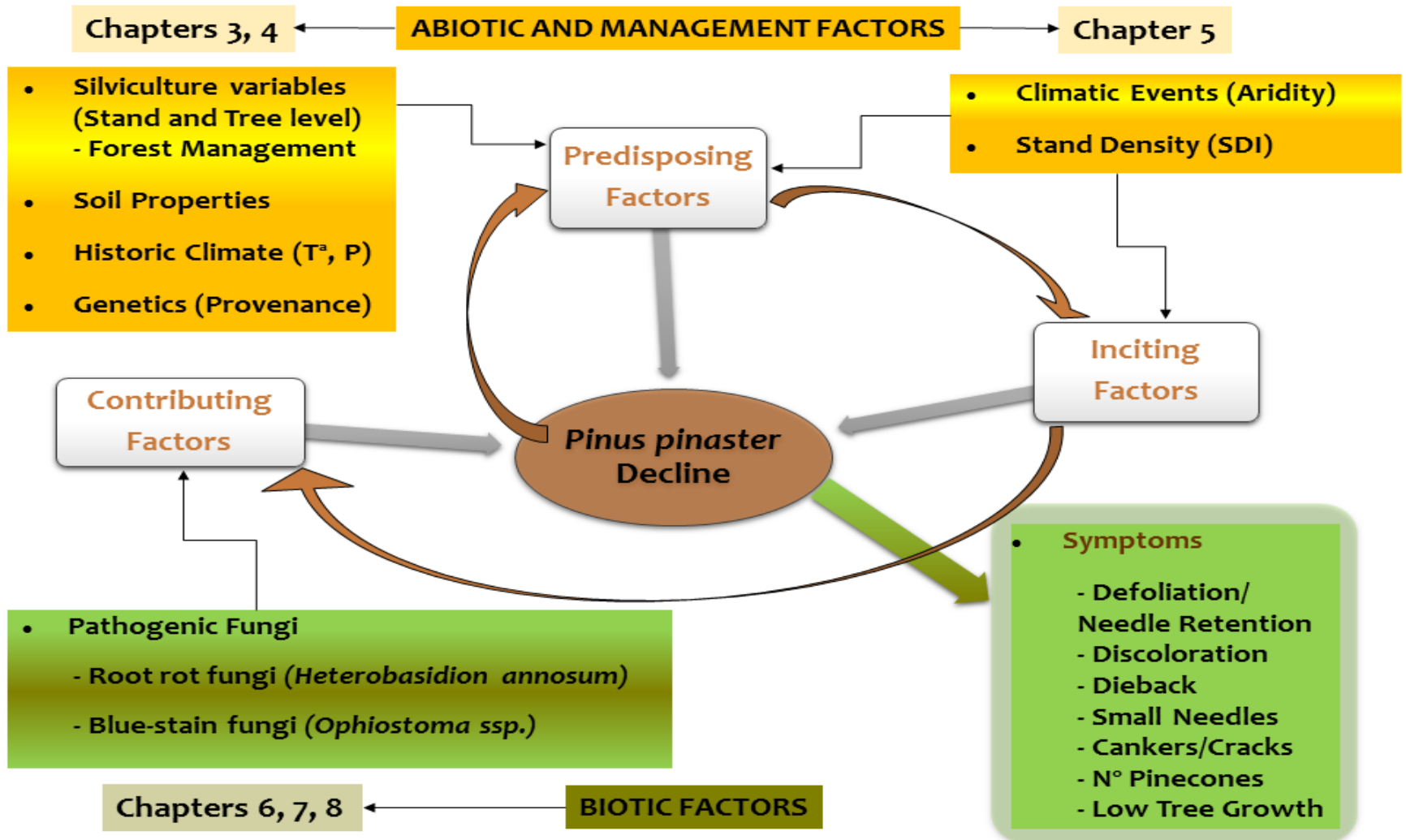
Complex disease: several factors affecting the forest and killing trees

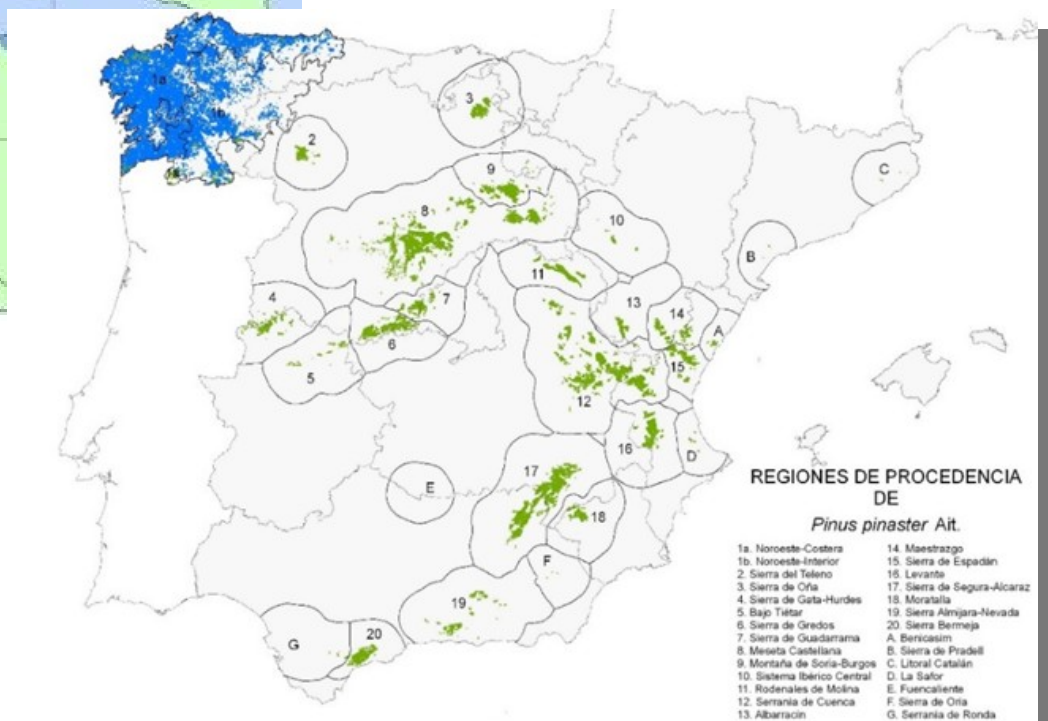
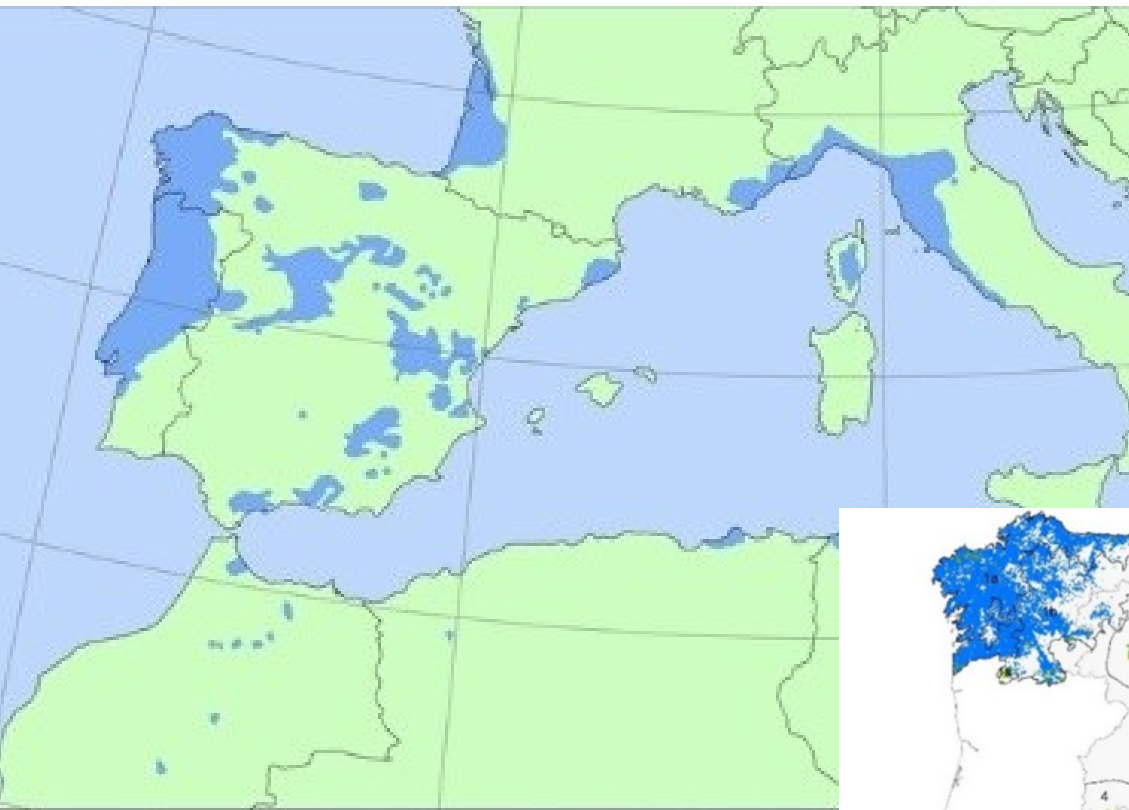
Manion Theory (1991)

1-Predisposing Factors

2-Inciting Factors

3-Contributing Factors







<https://vimeo.com/16208138>



Thanks so much!!!

Coordinator



Partners



Forestas

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