Impactos, Vulnerabilidad y Adaptación de los **Bosques** y la Biodiversidad de España frente al cambio climático

CENEAM, Valsaín, Segovia (28-29 mayo 2013)

Understanding some of the causes of widespread forest decline: what we know, and what (I think) we need to know

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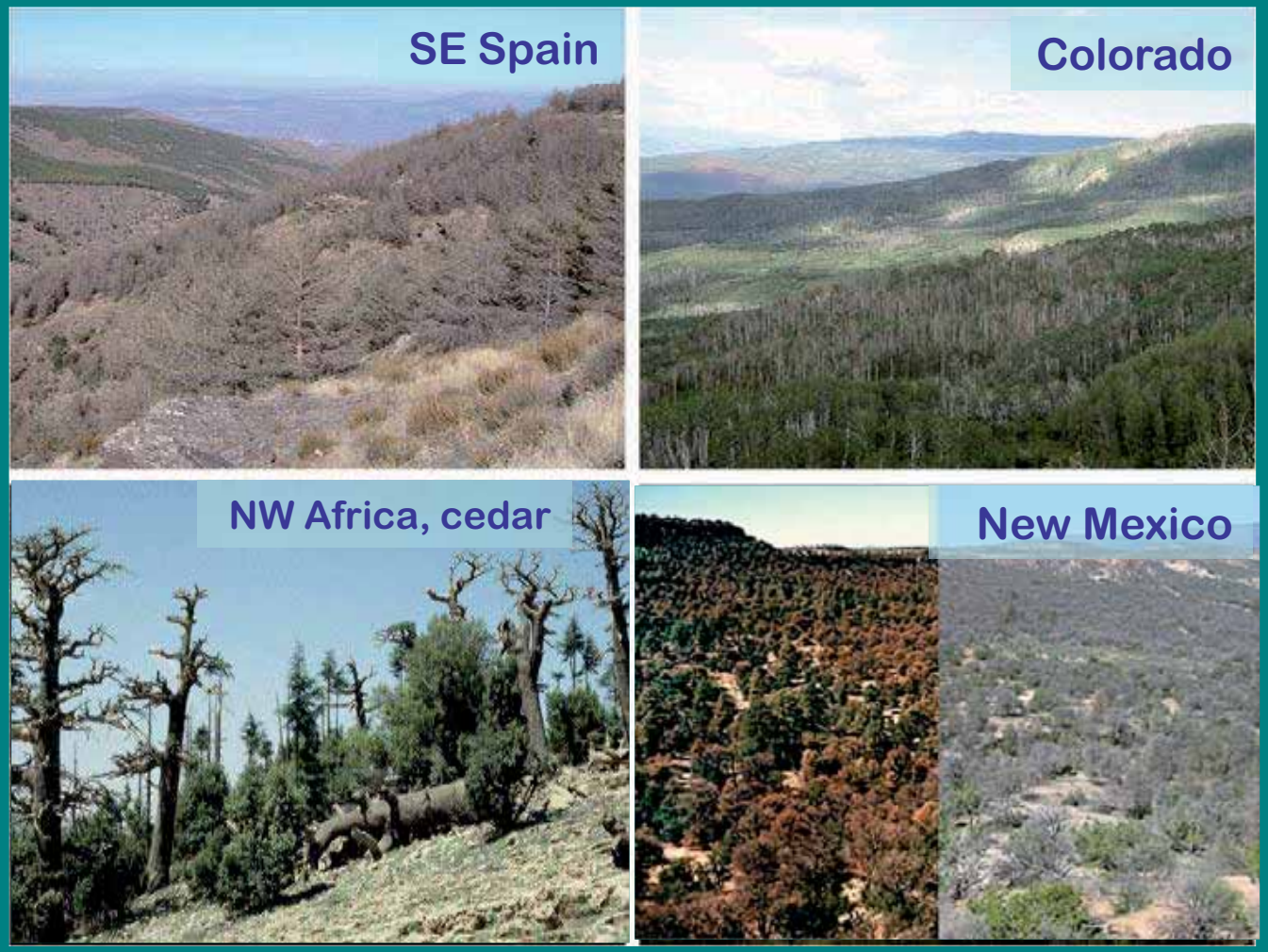
1. “No forest type or climate zone is invulnerable to anthropogenic climate change, even in environments not normally considered water-limited”.
2. “Our data are consistent with the possibility that climate change is contributing to an increase in reported mortality”.



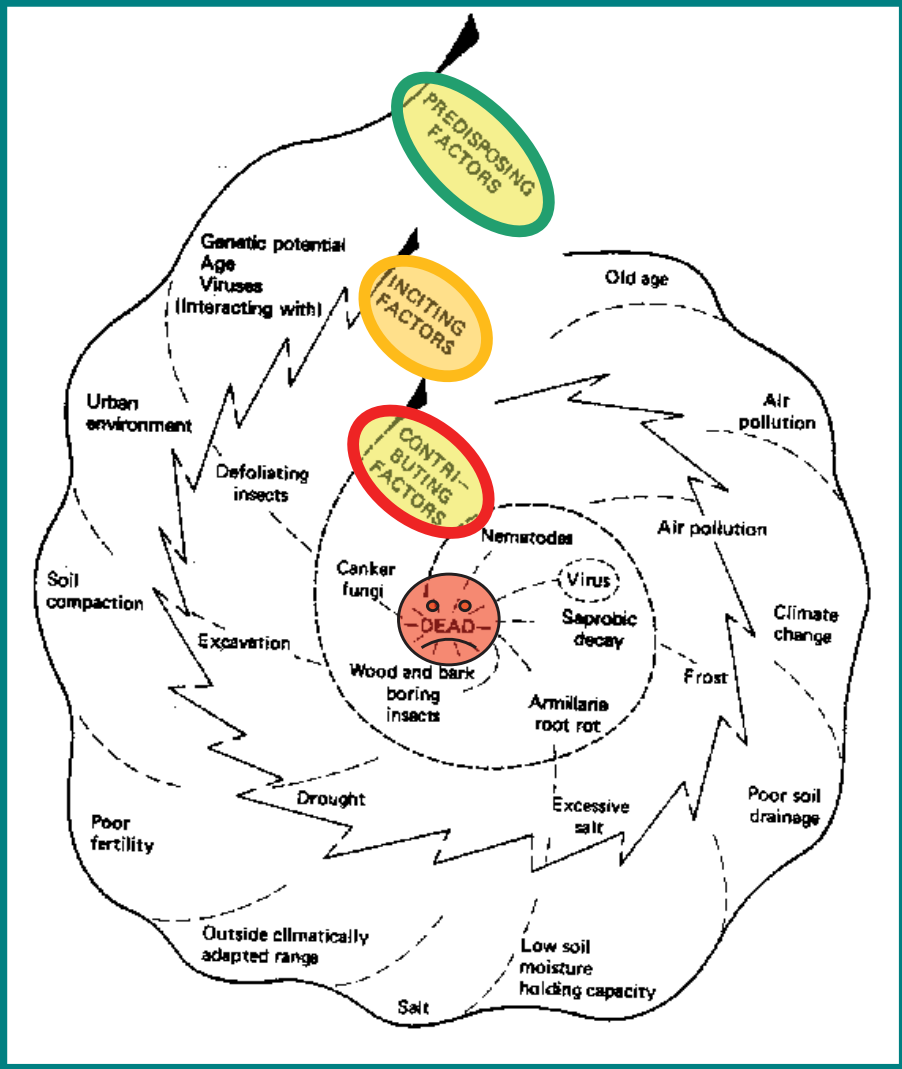
Climate-induced forest die-off

Sources: van Mantgem *et al.* (2009), Allen *et al.* (2010), Anderegg *et al.* (2012)

Manion (1991) conceptual model.

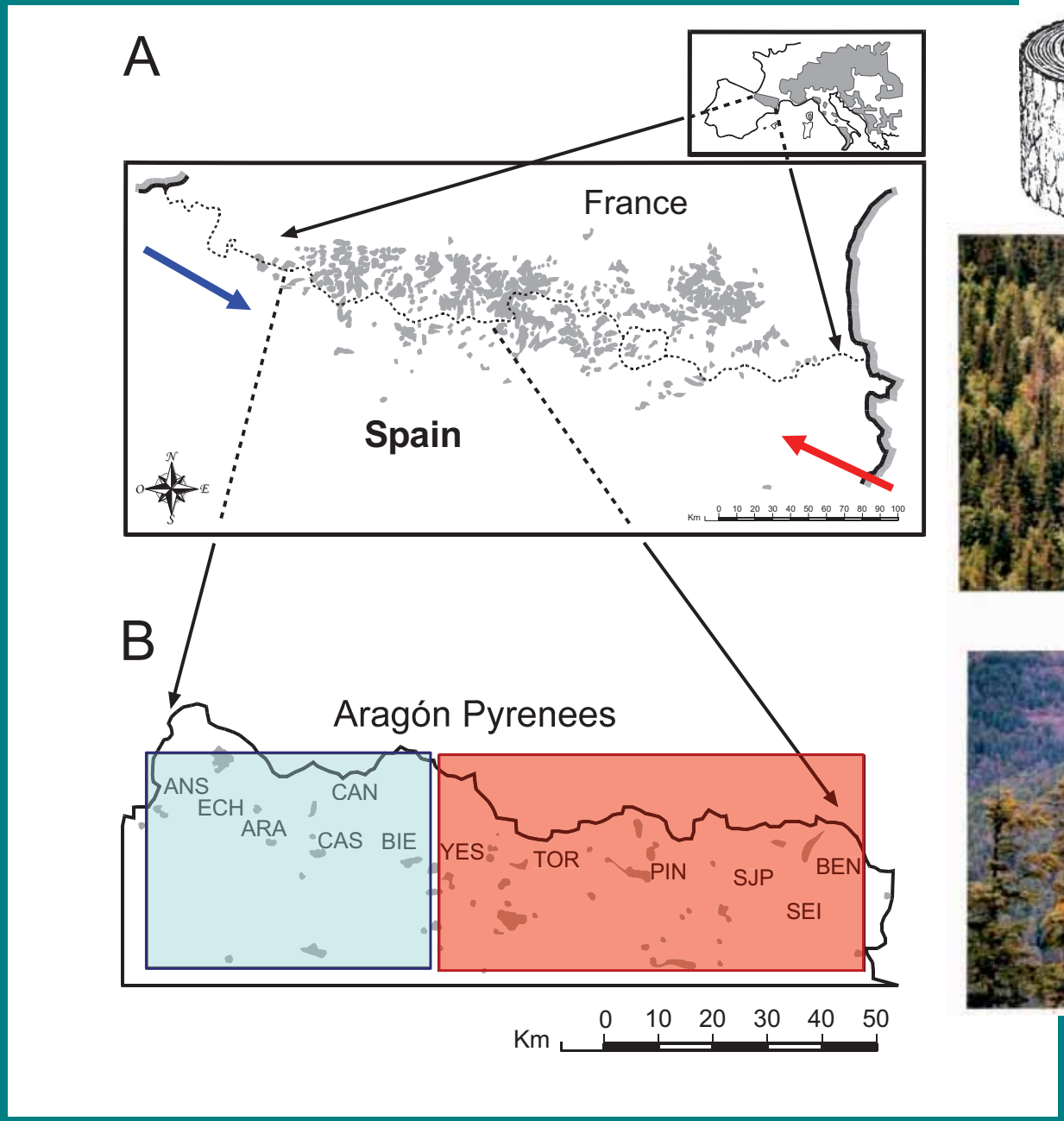
Decline is caused by interacting abiotic and biotic factors (decline disease spiral) classified in three groups:

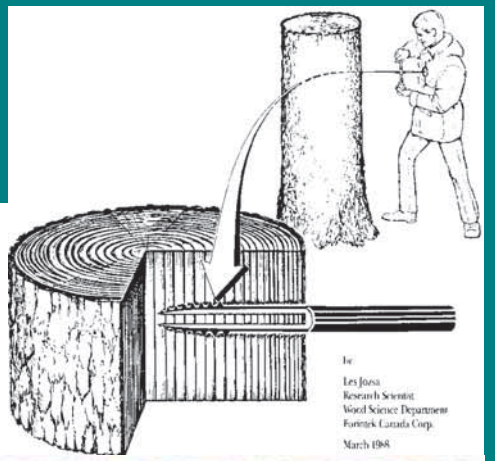
- PREDISPOSING factors: long-term drivers (climate, site, soil, age, genetic pool, historical use). Reduce tree vigor.
- INCITING factors: short-term stressors (reduce C storage, enhance branch mortality and casue defoliation) such as droughts, frosts, insects, mechanical damages.
- CONTRIBUTING factors: opportunistic (secondary) organisms which contribute to kill the already weakened tree (e.g., root fungi, scolitids, etc.).



Manion (1991, 2002)

STUDY CASE 1

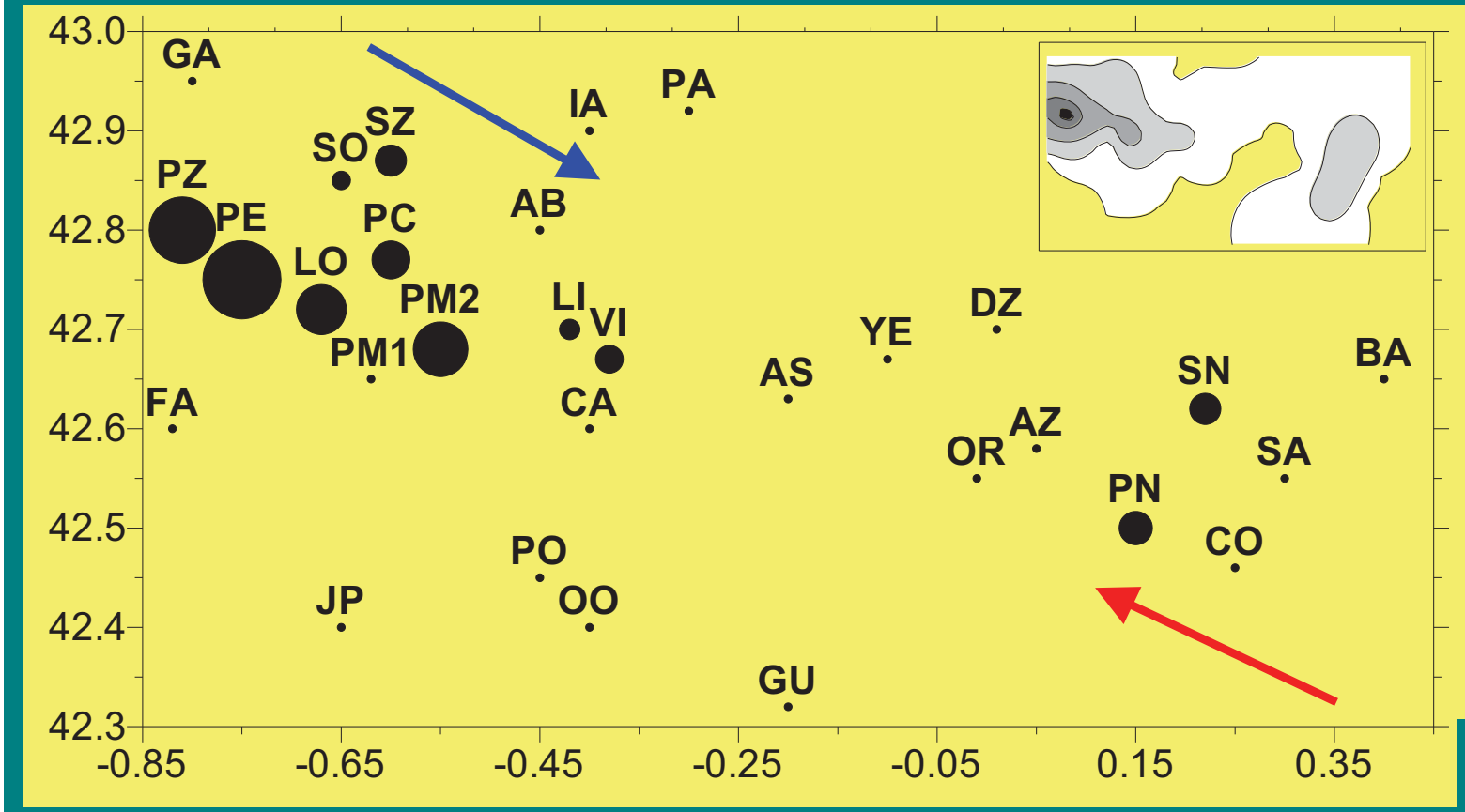


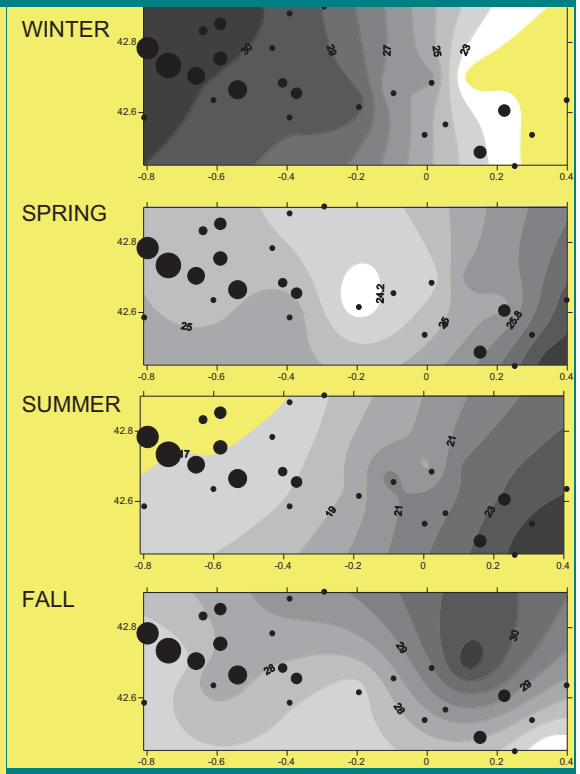


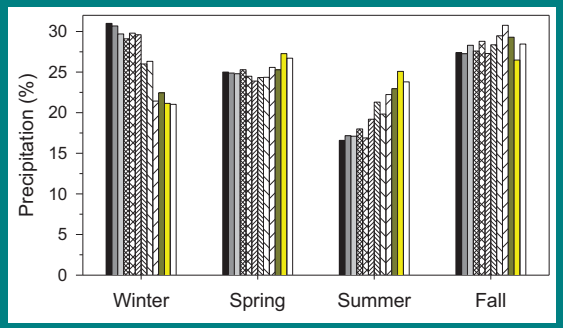
A.

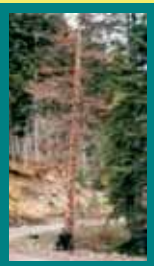
Camarero *et al*. (2011), Linares and Camarero (2012)

STUDY CASE 1: defoliation (W-E spatial pattern)



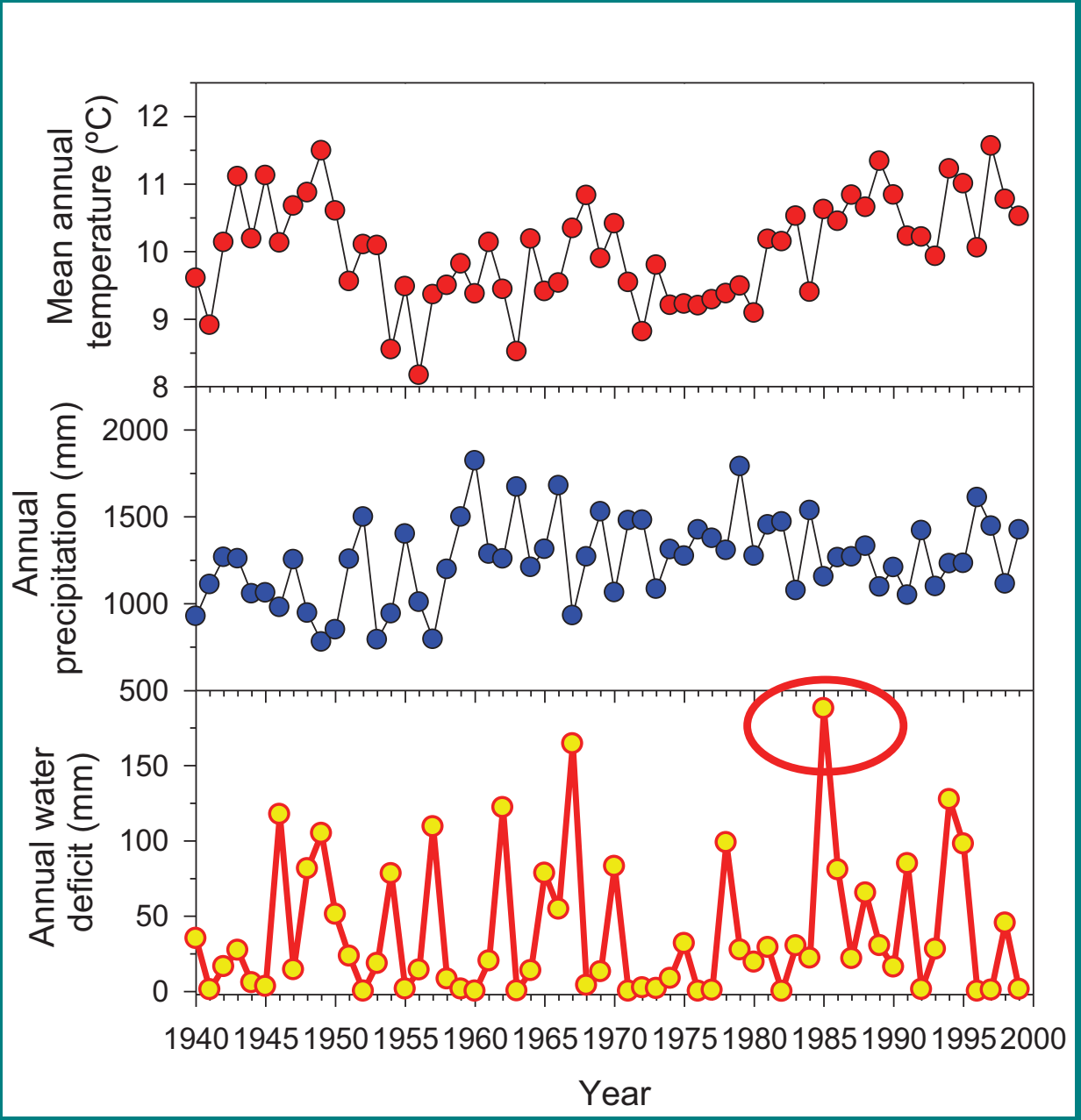






Camarero *et al*. (2011), Linares and Camarero (2011, 2012)

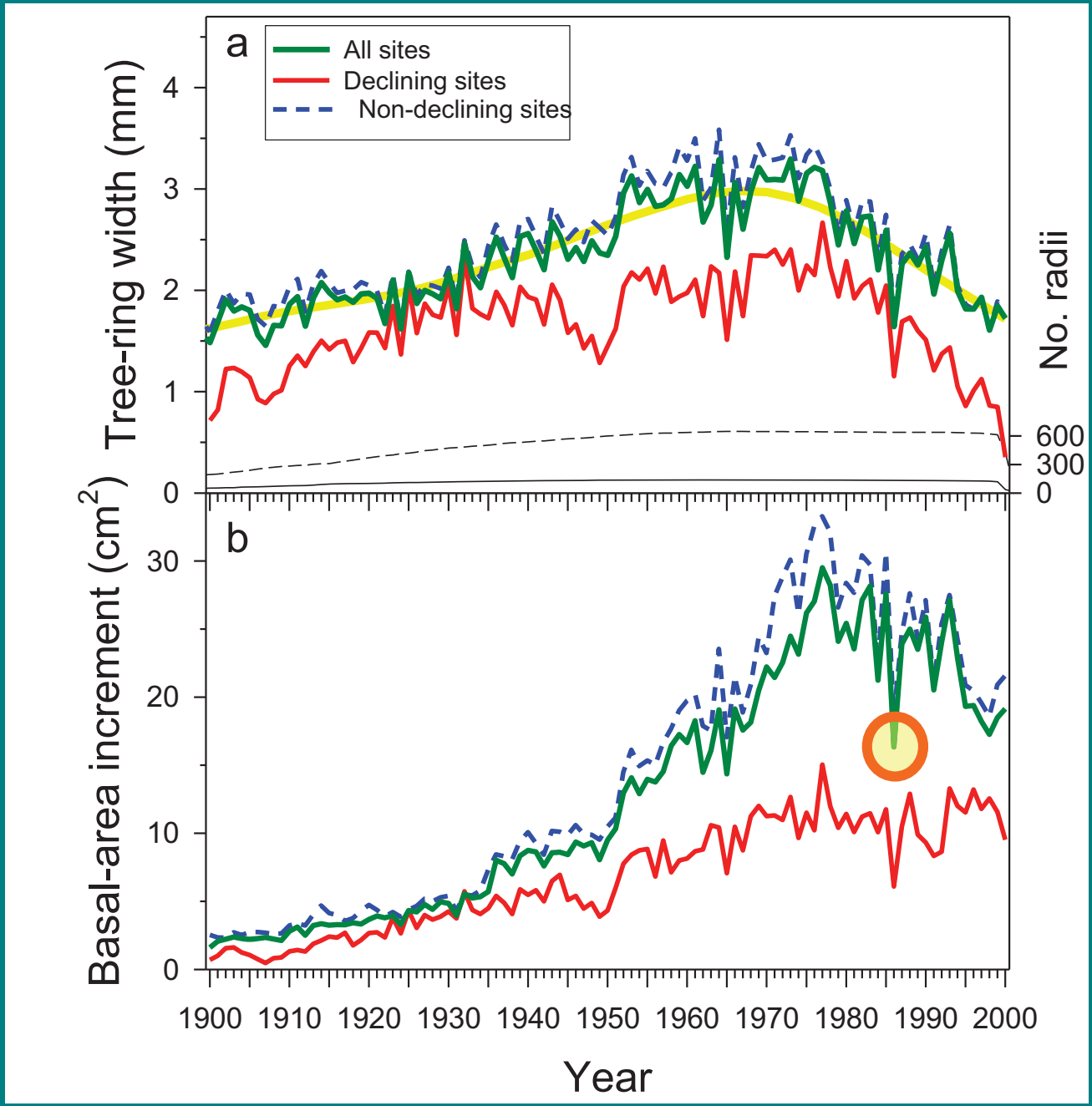
STUDY CASE 1: drought (mid 1980s)



1985

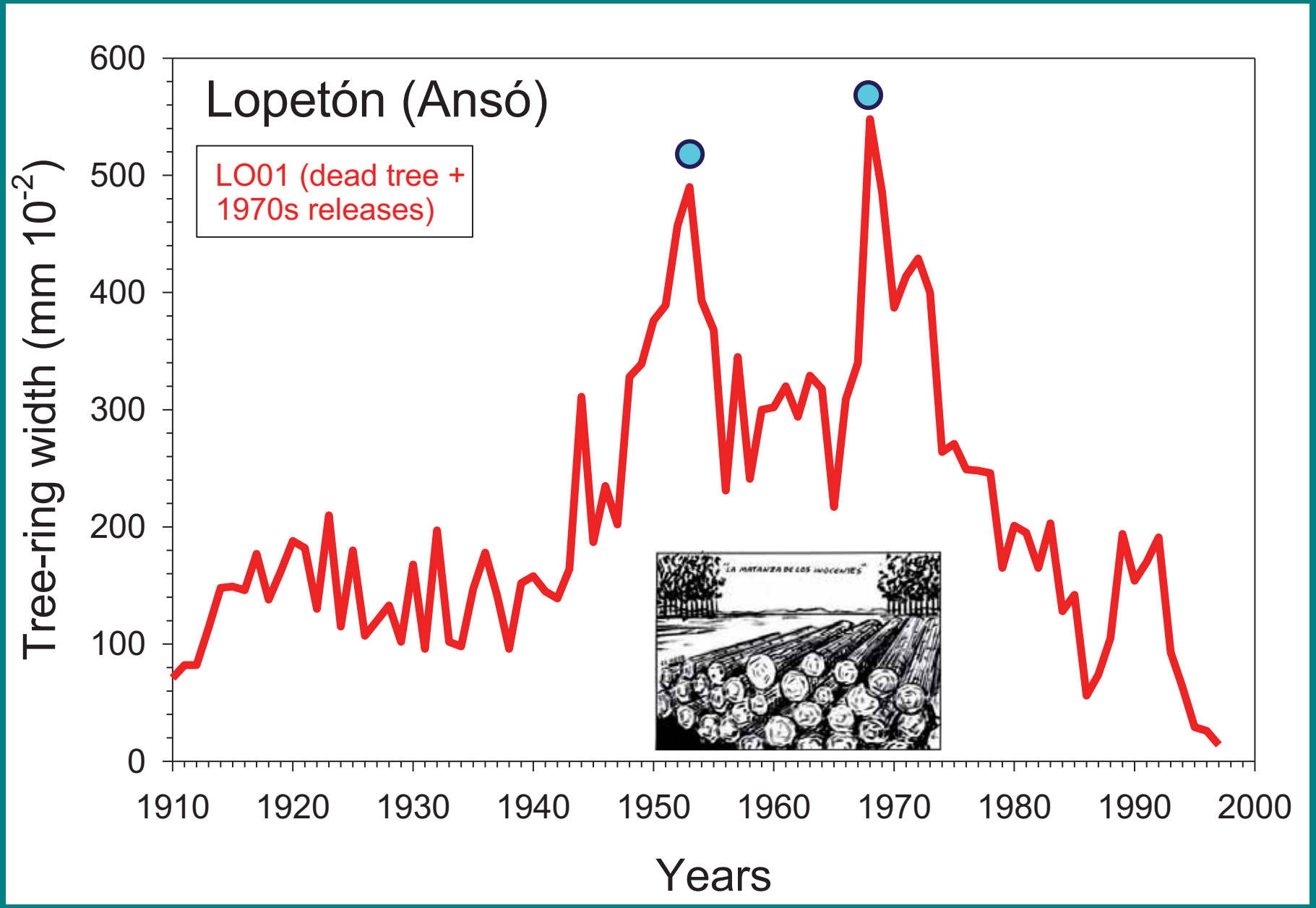
Camarero *et al*. (2011), Linares and Camarero (2011, 2012)

STUDY CASE 1: Growth patterns.



Camarero *et al*. (2011), Linares and Camarero (2011, 2012)

STUDY CASE 1: HISTORY as a predisposing factor: more dying trees in formerly more intensively logged stands.



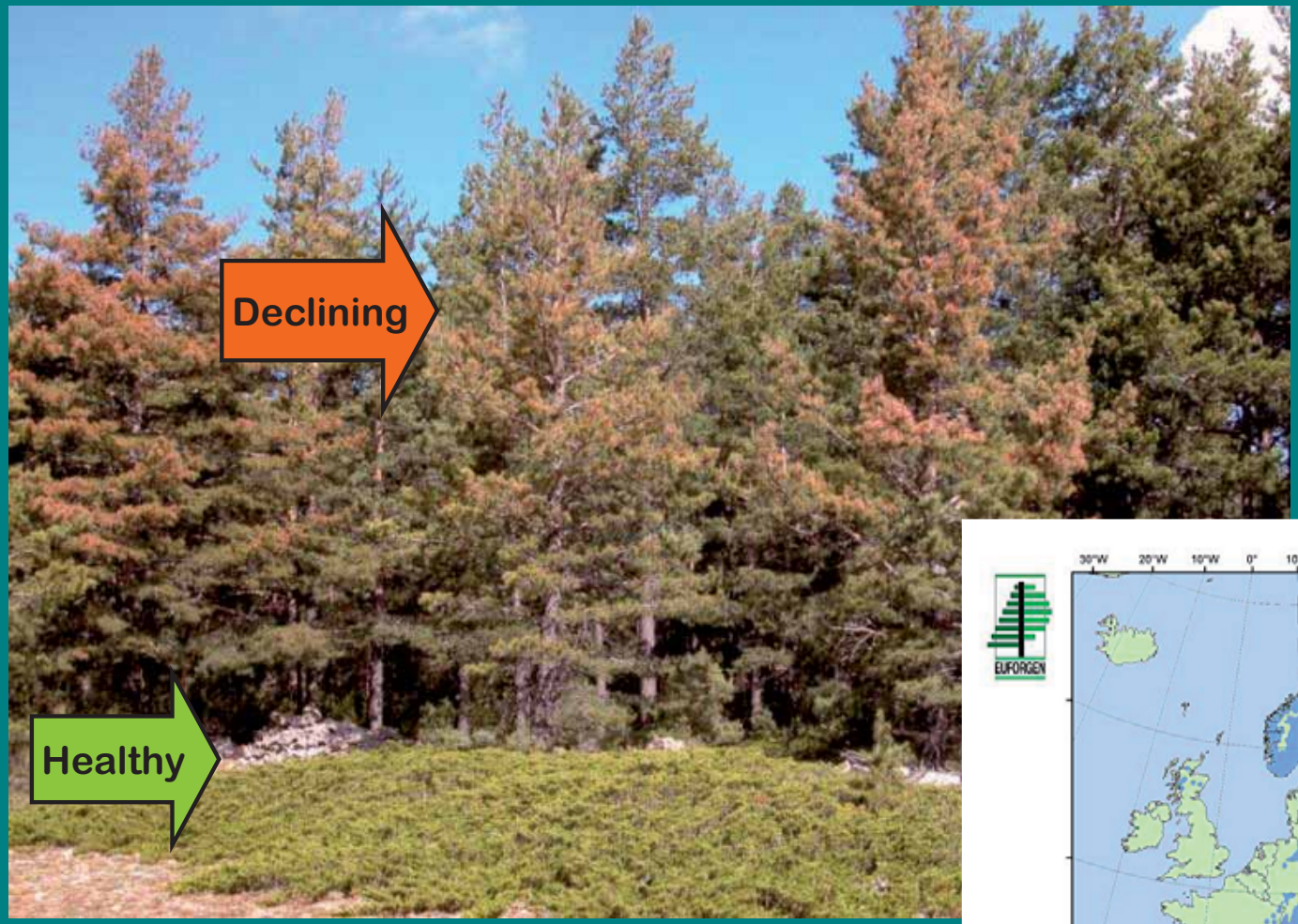
Camarero *et al*. (2011)

STUDY CASE 2: Scots pine (*Pinus sylvestris*) decline in the Iberian System (Gúdar Range, Teruel, E Spain).

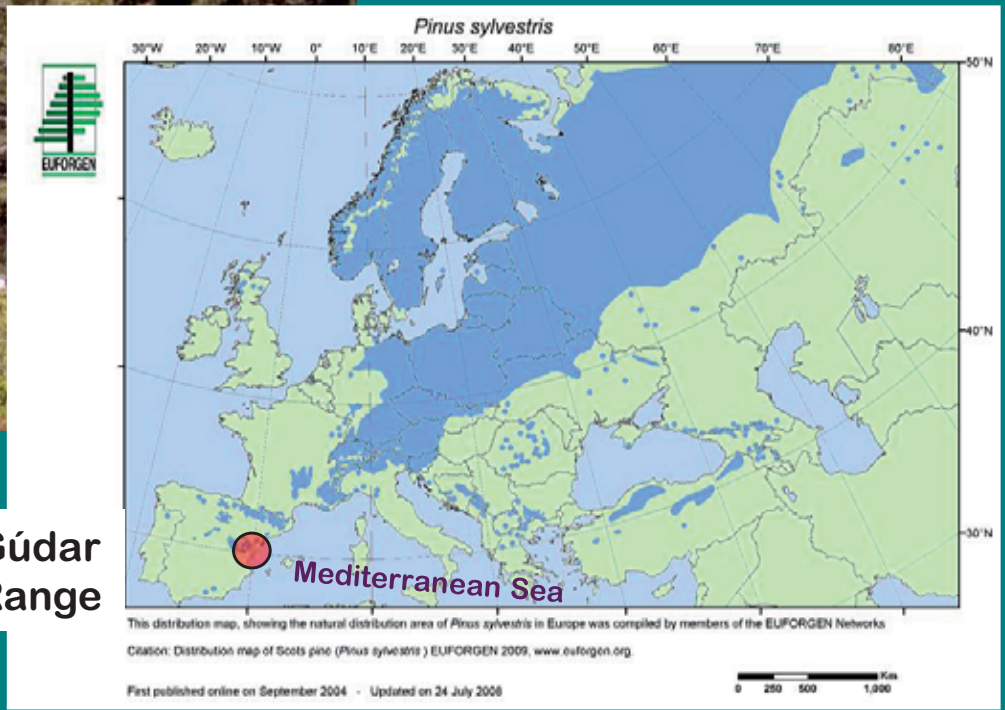
STUDY CASE 2: : Dieback (more defoliation & mortality) was more severe in S than in N-oriented slopes (and also within tree crowns in flat areas).

Ca. 50% trees died in S-oriented slopes.

STUDY CASE 2: Since 2002 ongoing dieback is observed in the study area. Healthy and Affected trees are located side-by-side and they are distributed randomly.

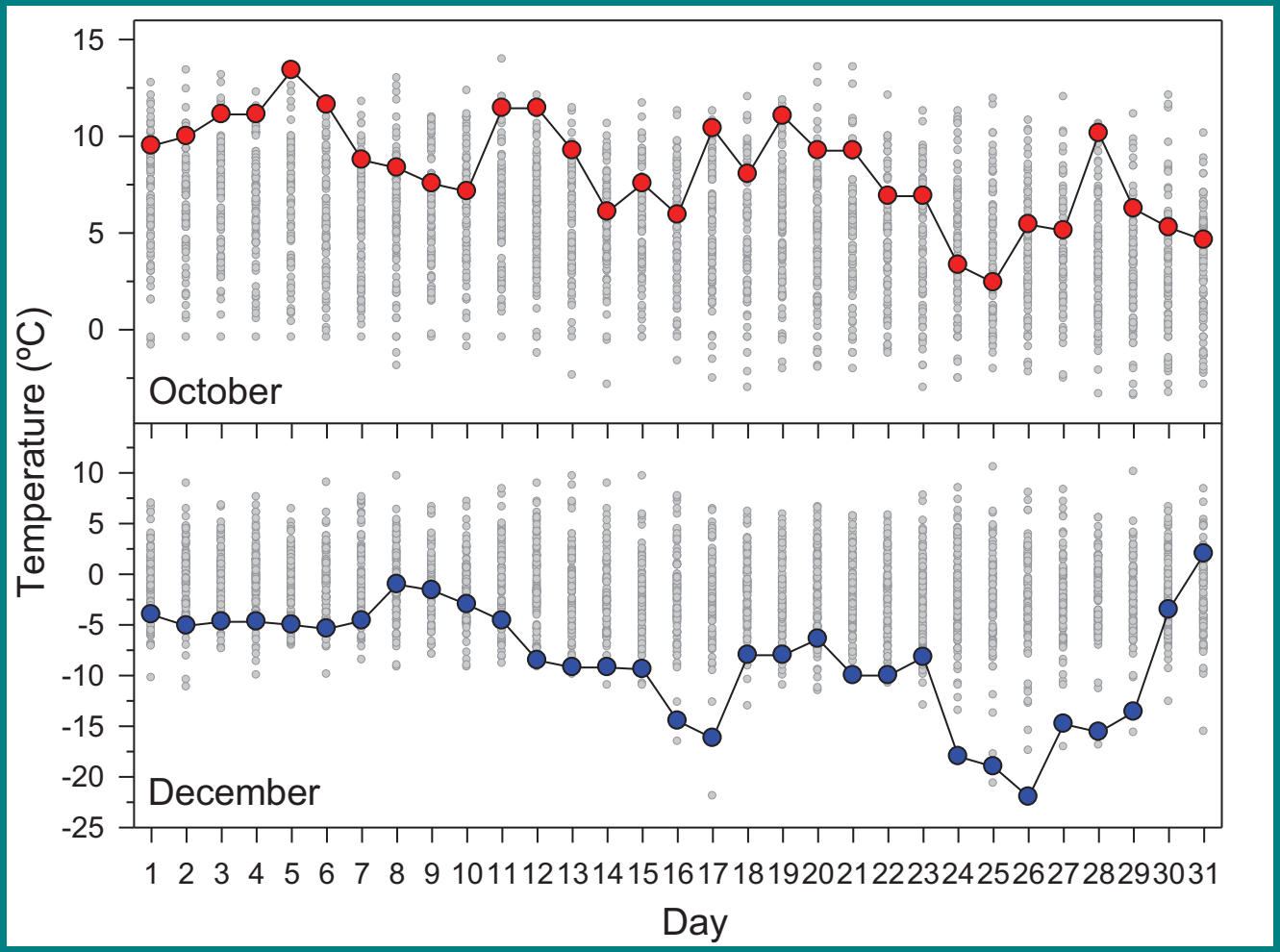


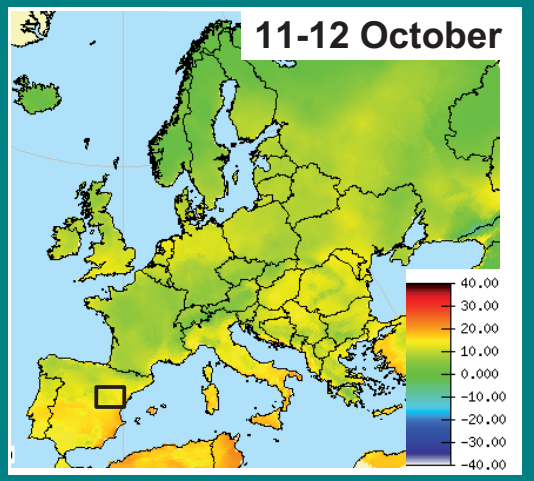
We are close to the rear edge or southernmost limit of the species distribution area.

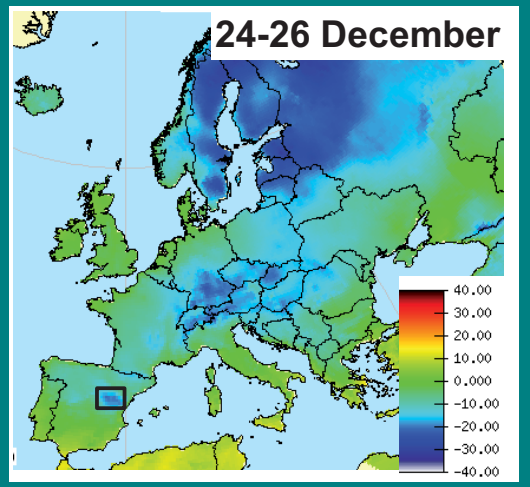


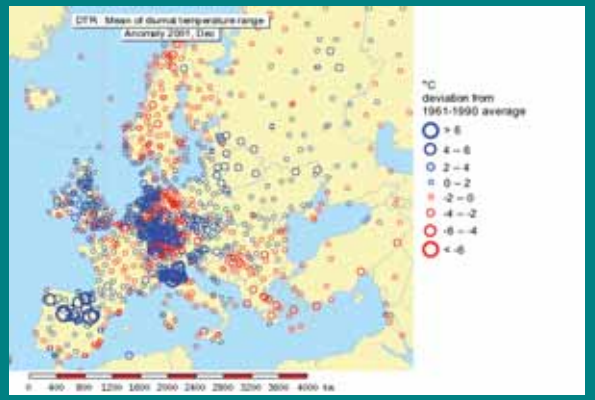
Gúdar Range

STUDY CASE 2: Triggering factor: anomalous autumn-winter in 2001.

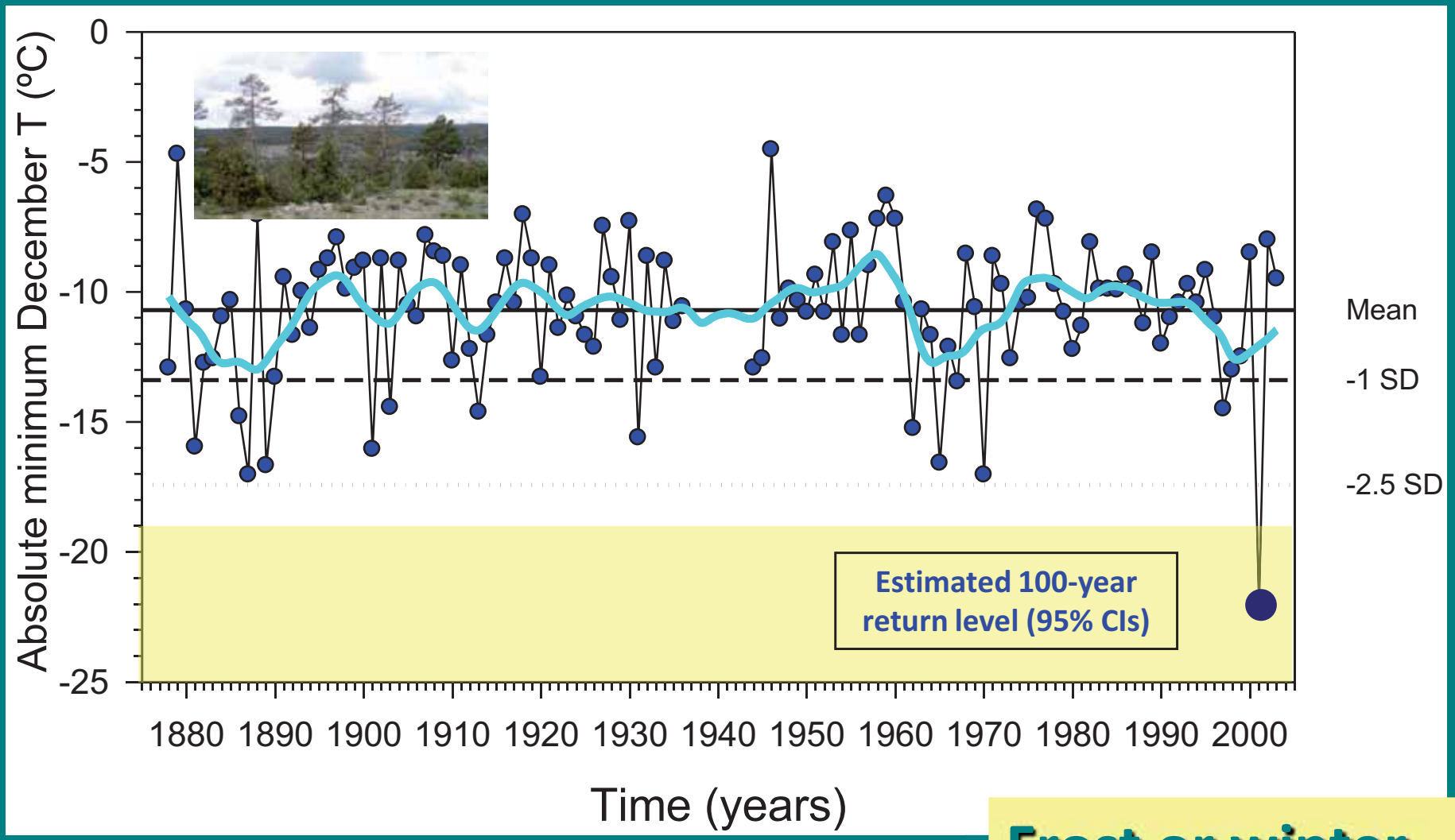






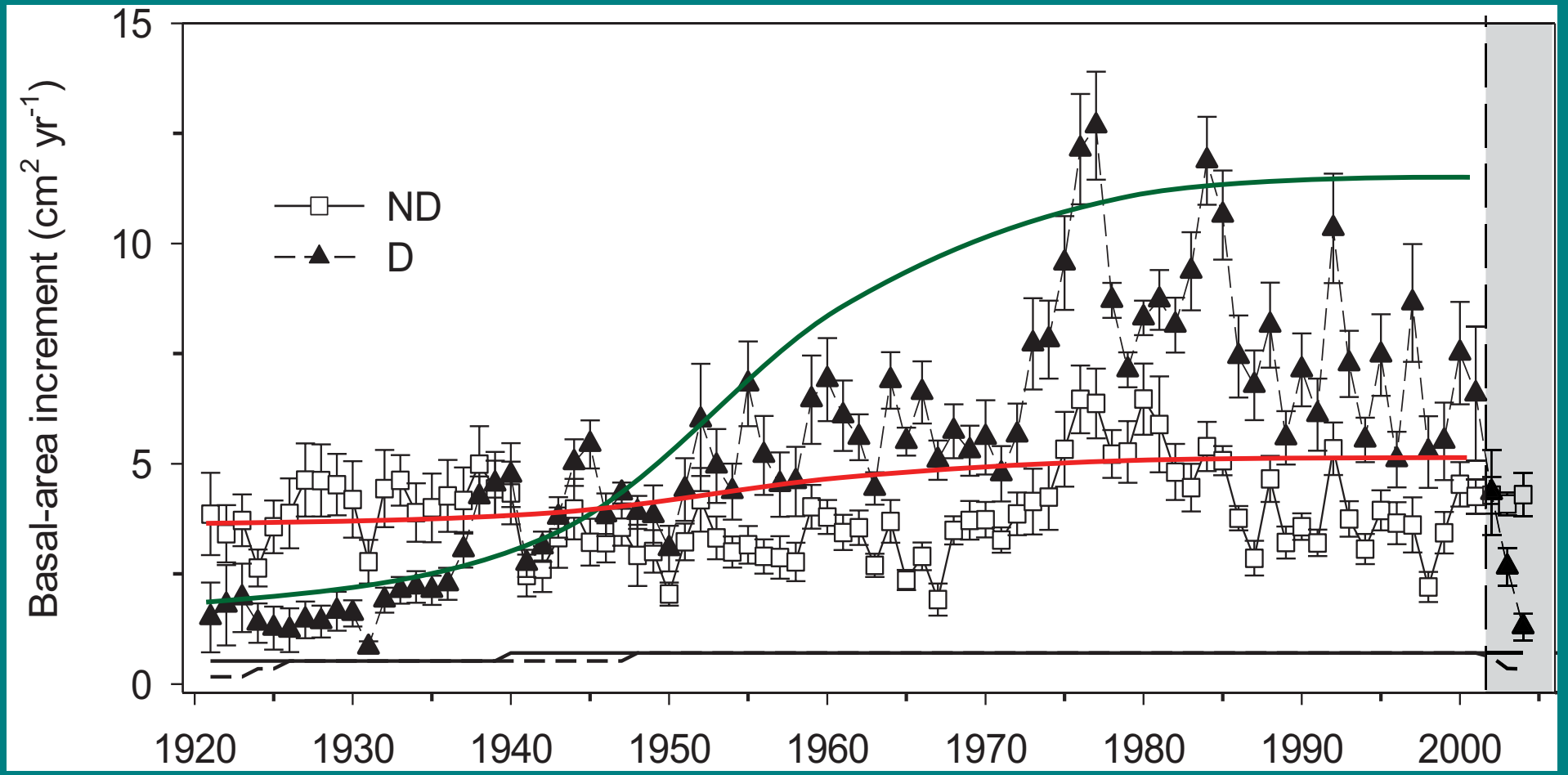


STUDY CASE 2: Triggering factor: anomalous autumn-winter in 2001.



Frost or winter drought

STUDY CASE 2: Pre-dieback differences: BAI.



During the mature phase and until the decline episode in 2002, declining trees (D) grew faster than healthy ones (ND) (same pattern when comparing S- vs- N-oriented slopes).

STUDY CASE 2: Some conclusions.

1) Healthy and declining trees show a **differential previous history** in growth and water relations (**higher sensitivity in declining trees**).
2) After the anomalous 2001 autumn-winter, **a critical threshold of plasticity for WUE was reached.**

Predisposing factors → Inciting factors

1. Null snow cover, shallow snowpack.
2. Shallow and rocky soils (rapid and superficial freezing).
3. Southern aspect (radiation, temperature change).
4. Low growth and cover in southern-oriented slopes?
5. Historical use of forests?

1. **SHARP and RAPID drop in temperatures (high DTR) and very low temperatures** causing repeated freeze-thaw events, xylem embolism, mortality of fine roots, damage on needles).
2. Phenological shifts (dehardening induced by very warm fall) ?

Winter drought-induced decline

(near the rear edge of distribution!)