How many trees to fall:
how and where we are loosing the Montado agro-silvo pastoral system?

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AGRO-SILVO PASTORAL SYSTEM MONTADO

IUFRO FOREST ENVIRONMENT DIV 8 CONFERENCE 2023
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ÉVORA, PORTUGAL

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Value and distinctive character

> 1M ha

Montado e floresta
- Sobreiro
- Azinheira
- Sobreiro com azinheira

fonte: COS_2018

Cork oak (national tree)

Multifunctional

Key-species are protected under the national legislation

Ecosystem services
(fire-friction landscapes, key-species in CC adaptation, biodiversity, carbon s., …)

High Nature Value farming system

Habitat 6310 of Natura 2000 (plus 9330 and 9340)

Regional Smart Specialization Strategy

Global value of the
cork oak systems: 441 x 10^6 €
holm oak systems: 52 x 10^6 €

Cork market: 9.97% of national exports in 2019; 1.25% of Gross Domestic Product in 2018 (DGAE)

High structural and compositional diversity

MONTADO

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High variability and complexity

Cork oaks

Holm oaks

Pyrenean oaks

VARIABILITY IN COMPOSITION AND STRUCTURE

BIOPHYSICAL CHARACTERISTICS

MANAGEMENT (LAND USE TYPE & INTENSITY)

BIOTIC/ABIOTIC DISTURBANCES

Disturbance factors

Droughts

Wildfires

Pests and diseases

Land use intensity
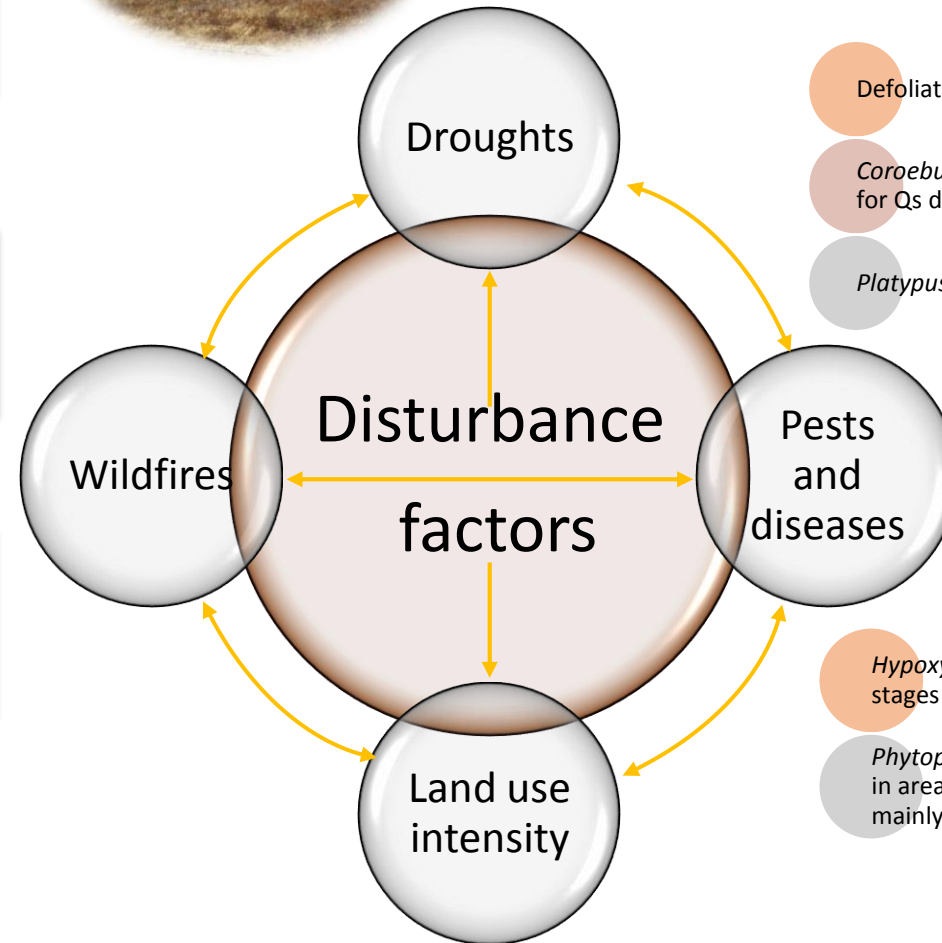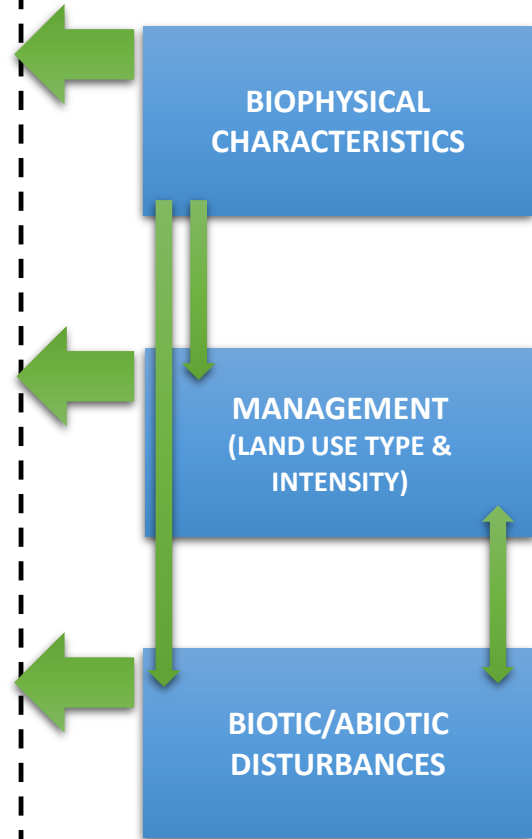
Defoliation insects (e.g., *Periclista andrei*)

Coroebus undatus (biophysical limiting facto for Qs development)

Platypus cylindrus (trees in stress)

Hypoxylon mediterraneum (trees in advanced stages of decline)

Phytophtora cinnamomi (contamination is favored in areas with limitations for cork oak development, mainly related to poor drainage)

Spatial and temporal dynamics

Is this a real trend in cork oak areas?

Are losses affecting only holm oak *montados*?
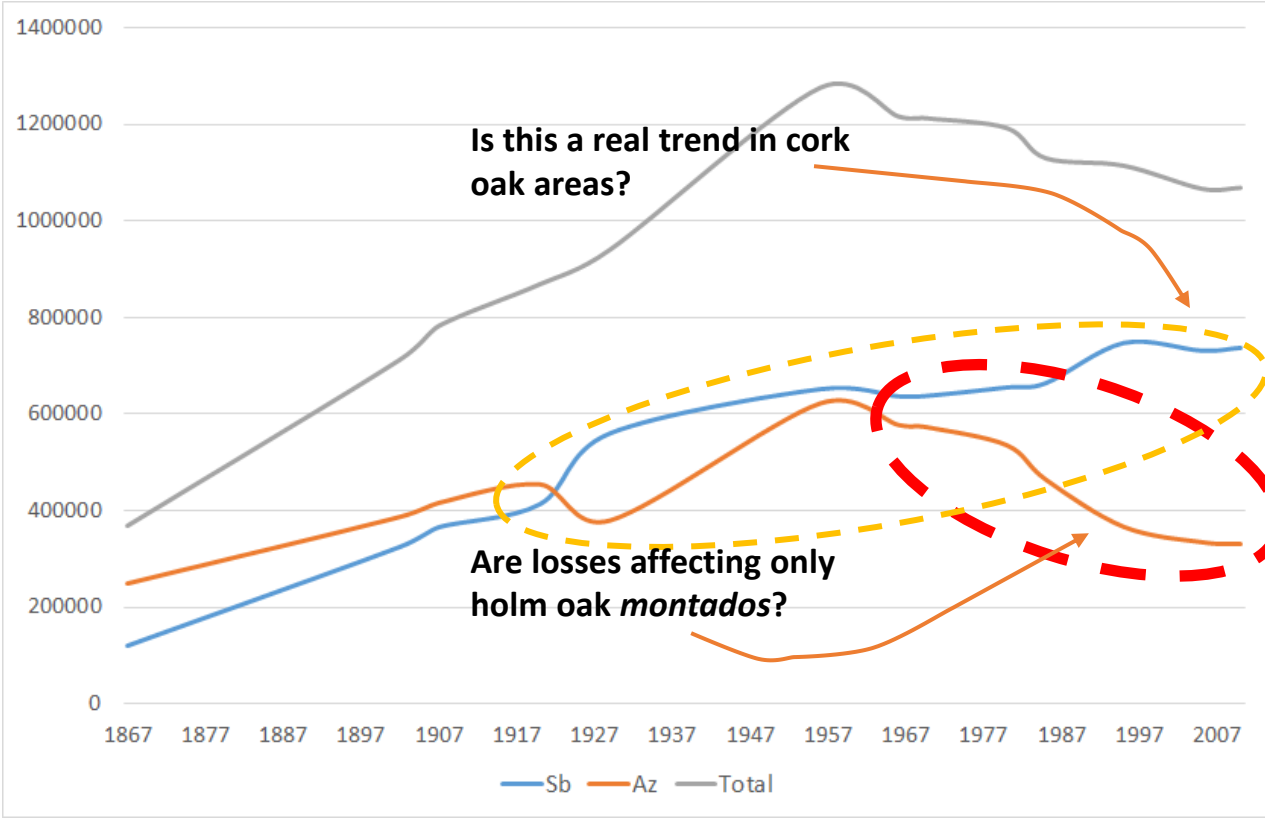
Balance between "gain" and "losses"

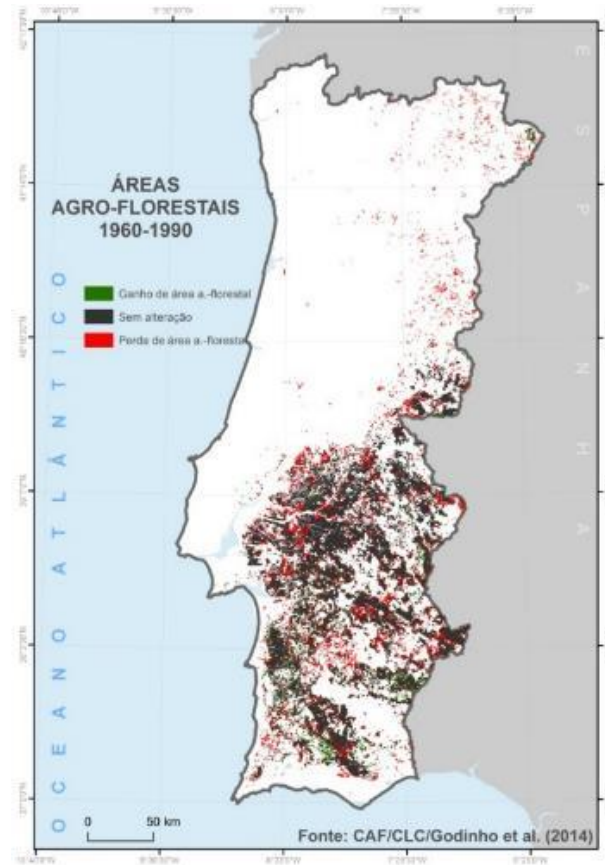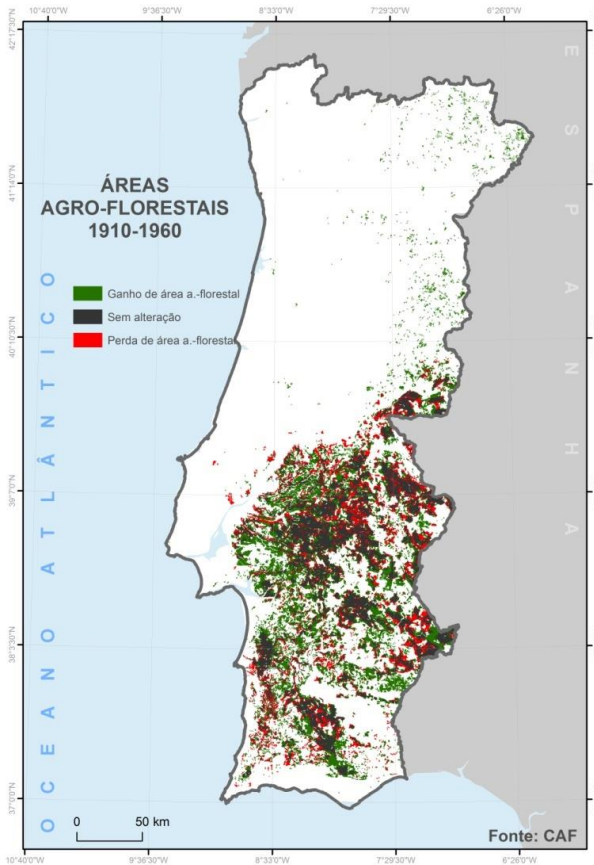Changes in highly anthropized landscapes require analysis considering "gains" and "losses" separately.

Political decision-makers "love large numbers" but…

…due to effects of generalization processes, these hide parts of reality.

But... the system is in "silent" decline

ÁREAS AGRO-FLORESTAIS 1910-1960
Ganho de área a.-florestal
Sem alteração
Perda de área a.-florestal
Fonte: CAF

ÁREAS AGRO-FLORESTAIS 1960-1990
Ganho de área a.-florestal
Sem alteração
Perda de área a.-florestal
Fonte: CAF/CLC/Godinho et al. (2014)

ÁREAS AGRO-FLORESTAIS 1990-2006
Ganho de área a.-florestal
Sem alteração
Perda de área a.-florestal
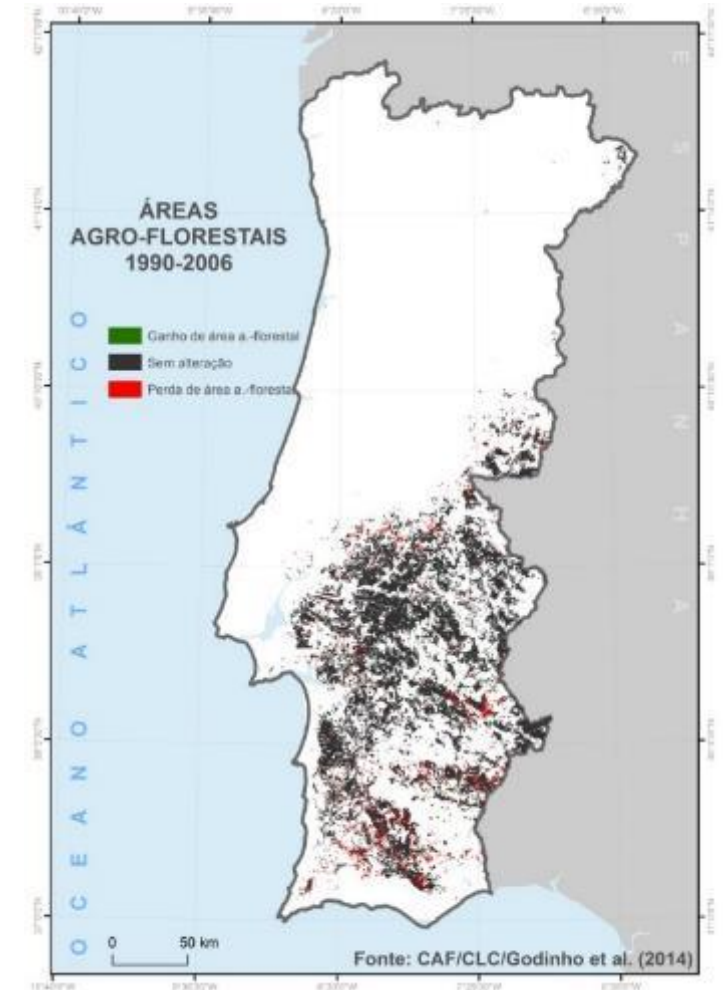Fonte: CAF/CLC/Godinho et al. (2014)

Decrease between 1990 and 2006:

~90.000 ha

(*5625 ha/year*)

Godinho et al. (2016)

Spatial and temporal dynamics – we need an update!

2010 ↓	1995 → Cork oak	Holm oak	Forests	Agriculture	Shrubland	Water bodies	Urban	Non-productive
Cork oak	660607	1925	6275	20730	47111	25	0	100
Holm oak	625	313425	725	4026	12328	50	0	0
Forests	5850	1950						
Agriculture	2501	3451						
Shrubland	74743	38059						
Water bodies	875	7502						
Urban	1225	275						
Non-productive areas	400	100						

Sb: 746826 → Sb: 736773

Az: 366687 → Az: 331179   - 45561 ha

6.º INVENTÁRIO FLORESTAL NACIONAL
IFN 6

Áreas dos usos do solo e das espécies florestais de Portugal continental

1995 | 2005 | 2010

GAINS are essentially the result of afforestation processes!

Area of afforestation and reforestation by species (ha)
PAF: Cork oak – 22 350.1 ha
PDF: Cork oak – 9 126.99 ha and Holm oak – 1 332.56 ha
Reg. 2080/92: Cork oak – 70901.62 ha and Holm oak – 25195.98 ha

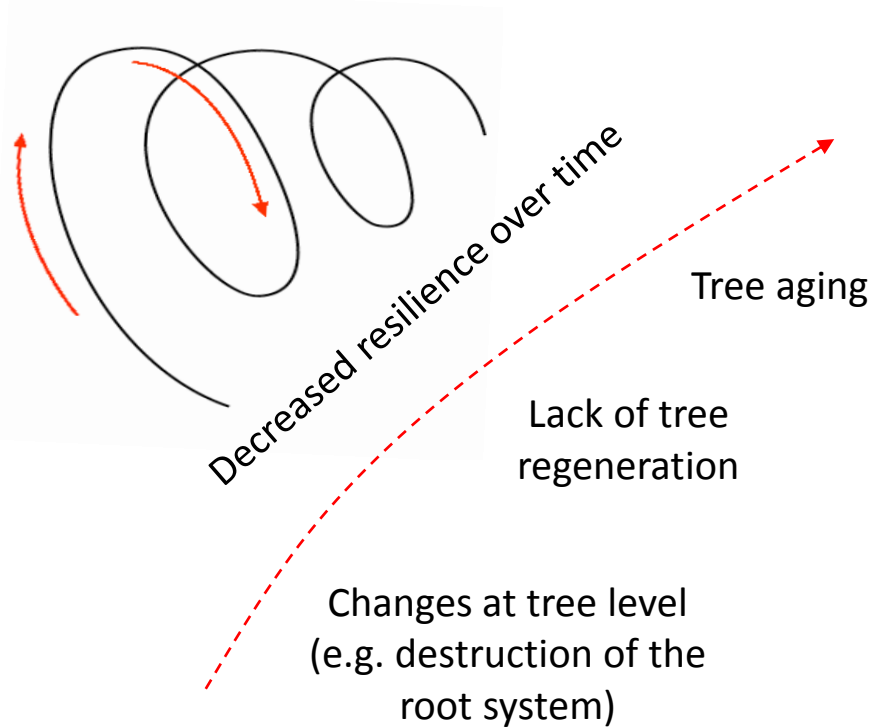**LOSSES** are approximately 137 000 ha, essentially transitions *montado-*shrubland

The system does not show stability or ability to regenerate without human intervention

Moreover, in an evaluation of afforestation programs in the Algarve region, it was determined that tree mortality is greater than 50% after the first year of planting (Louro, 1999).

Latest assessment: 987 592.45 ha

Tree decline factors: conceptual process from trees to patches

STATE TRANSITIONS: Type 3

Decreased resilience over time

Tree aging

Lack of tree regeneration

Changes at tree level (e.g. destruction of the root system)
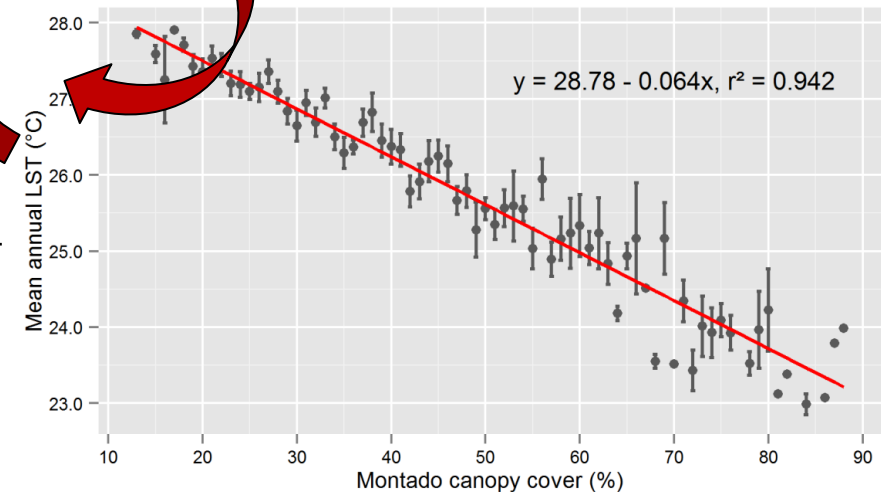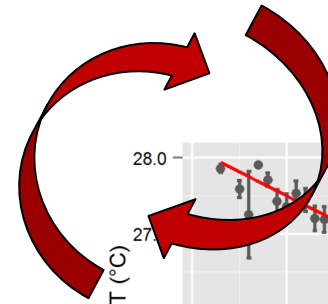
Critical point of transition

Progressive degradation of the system, even in the absence of disturbances, or decreased use intensity.

Increasing land surface temperature due to loss of canopy cover will affect soil fertility and increase the susceptibility of trees to biotic and abiotic agents.

y = 28.78 - 0.064x, r² = 0.942

Mean annual LST (°C)

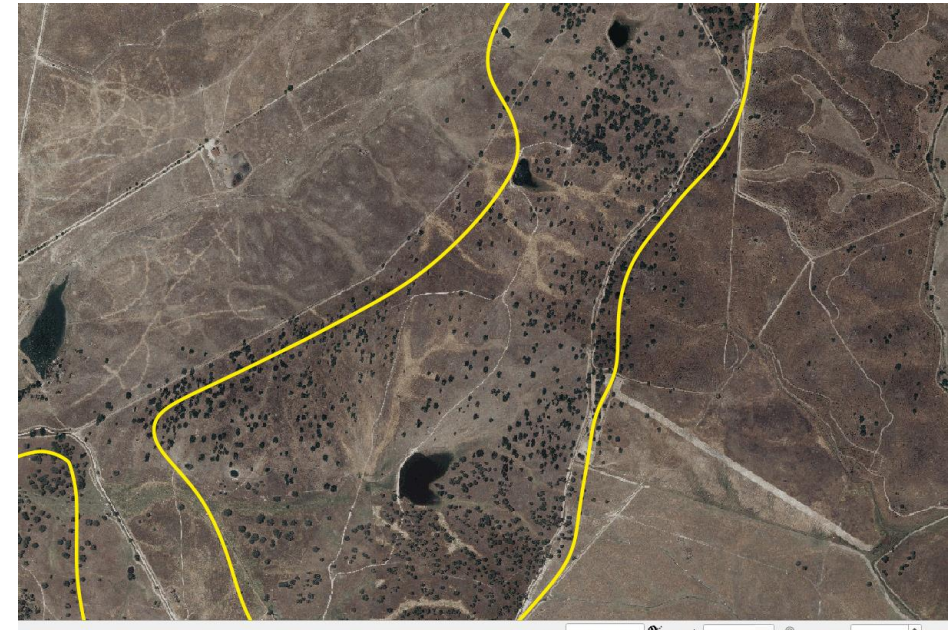Montado canopy cover (%)

Godinho et al. (2016)

Methods

Assessment of land use change /maintenance

Characterization of changes of land use

Decline of tree density – Mapping of tree mortality

Baseline map of the Montado areas
(aerial photos 2004 -2006)

Comparison with aerial photos 2018

Results

N total polygons 1547 (25 – 245 784 ha)

checked all polygons identified as **Montado**

Montado area changes

Decrease

Intensive cultures

Wildfires

Construction

Increase

Afforestation

Natural Regeneration

Montado decline factors: land use intensification

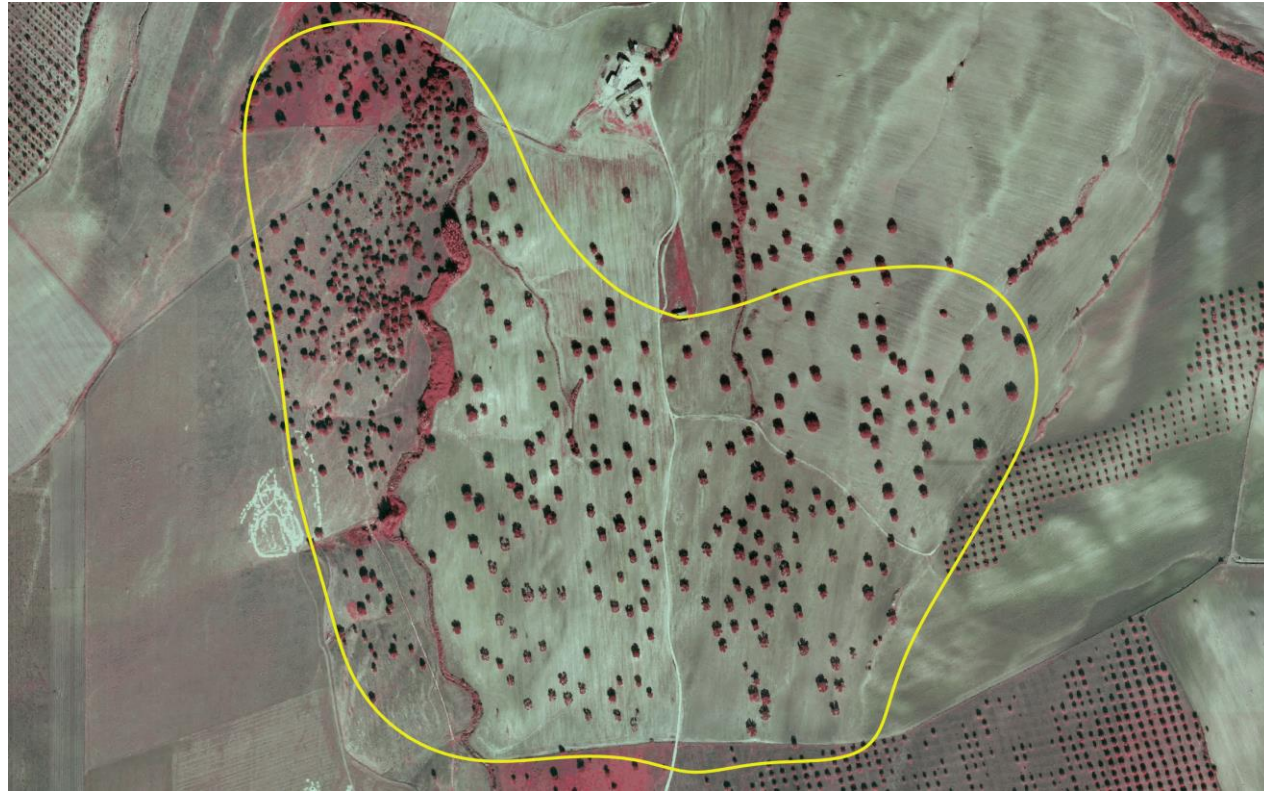Installation of intensive cultures (3.2% polygons)

2004-06

2018

59 ha

59 ha

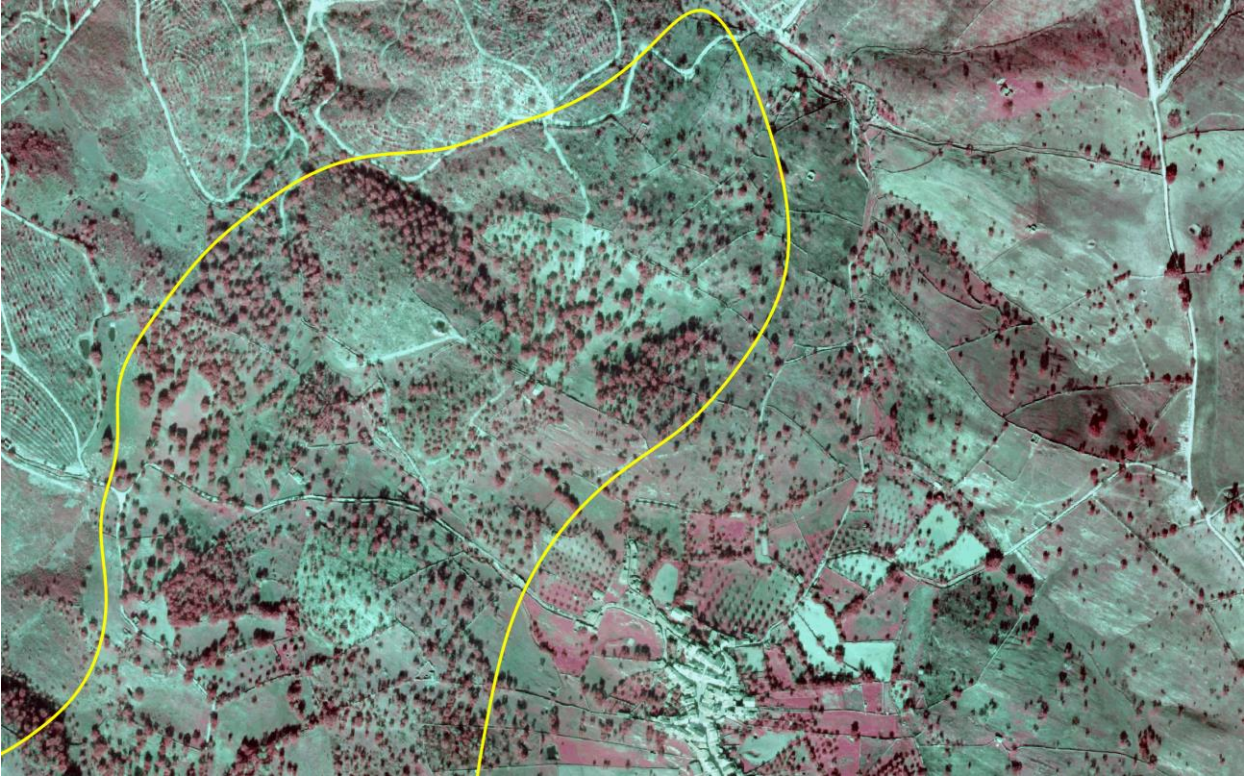# Montado decline factors: land use intensification
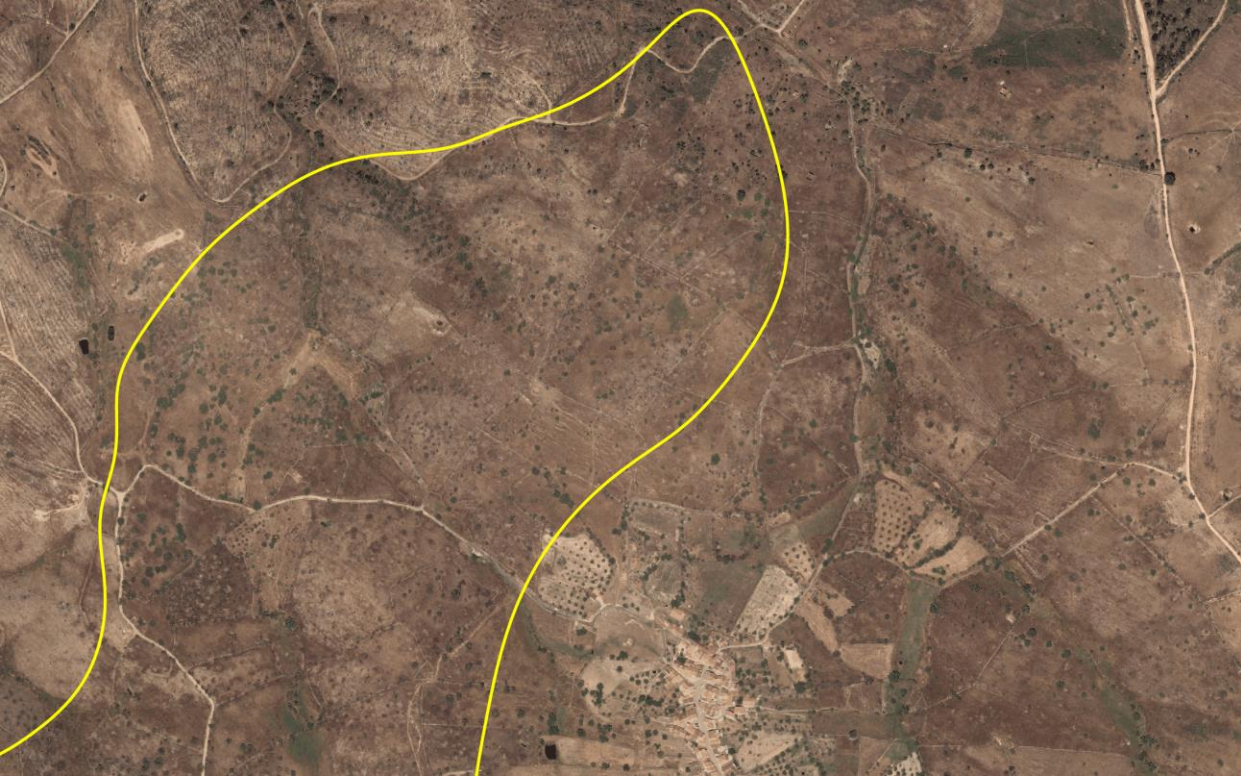

2004-06

2018

Installation of intensive cultures (3.2% areas)

Montado decline factors: wildfires

3.7% areas

2004-06

2018

Large Montado areas burned in 2003 -2005

Montado increase factors: afforestations

Afforestation (7.1%)

37 ha

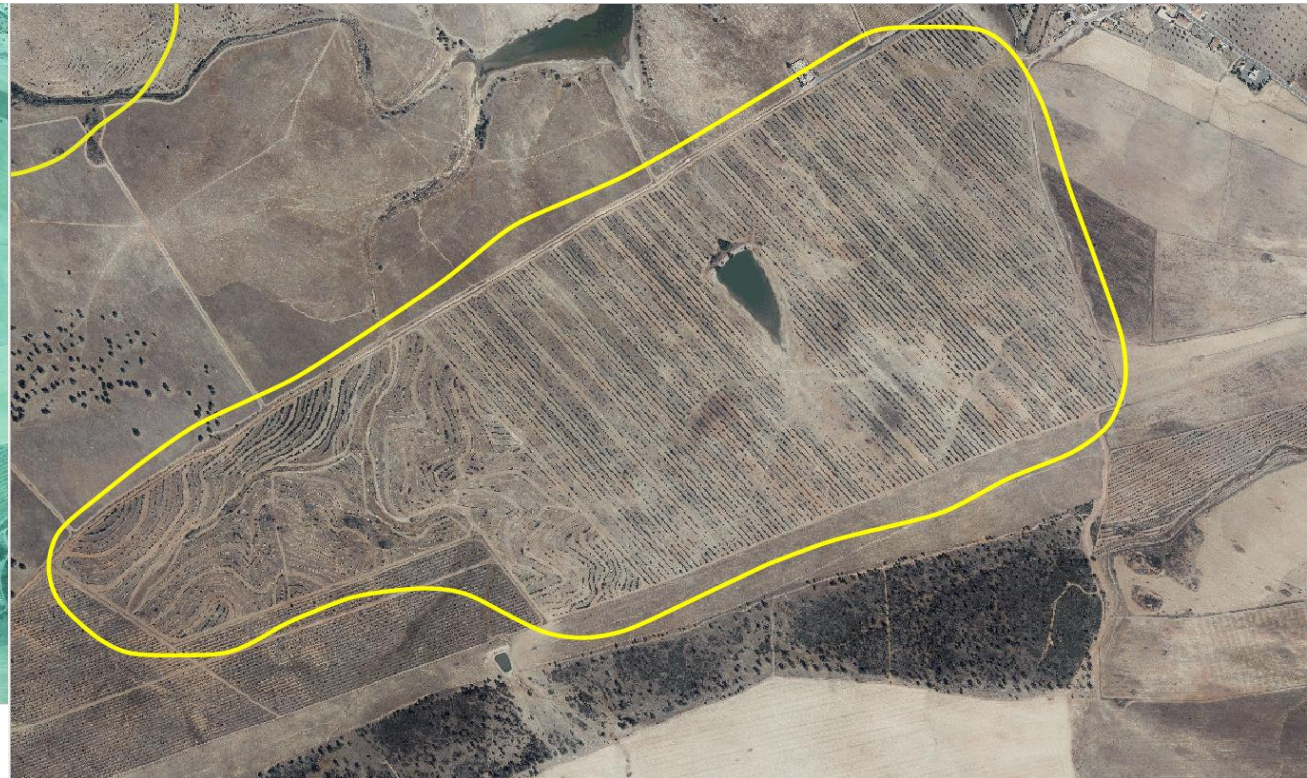# Montado increase factors: afforestations

But 12% of the afforestations had low tree growth or were burned

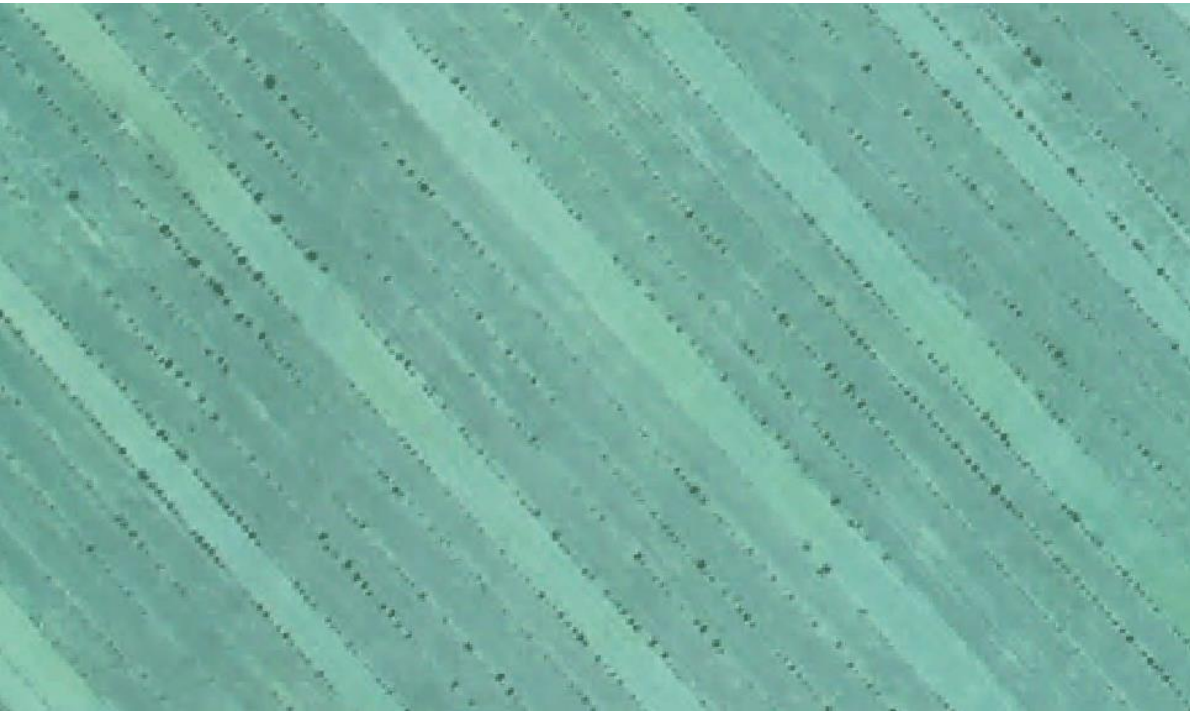2004-2006   2018

Montado increase factors: afforestations

Low tree growth

2004-2006   Trees 14 years after installation   2018

133 ha

Montado area (% polygons)

Decrease

Intensive cultures – 3.2%

Wildfires – 3.7%

Construction - 0,1%

Loss of trees / mortality ????

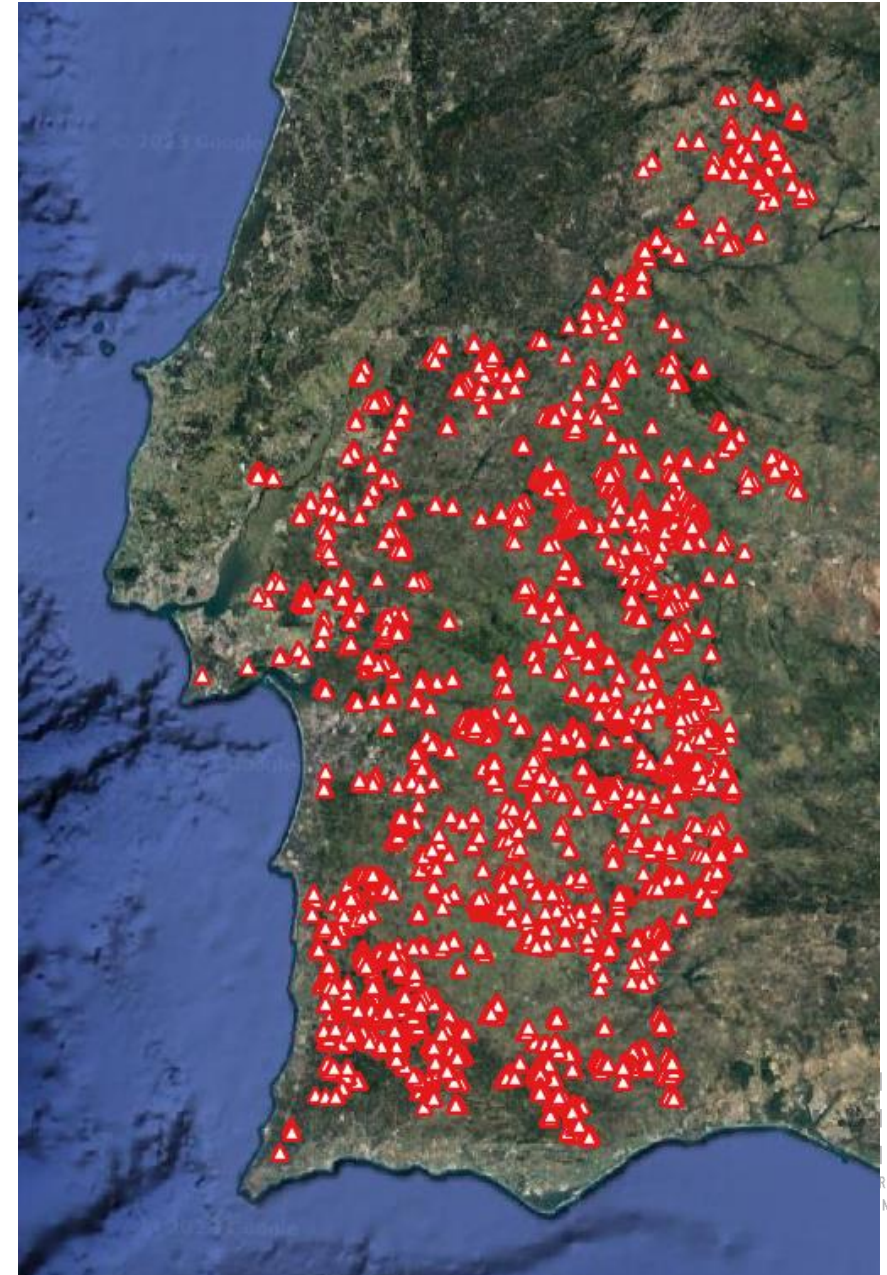**Increase**

Afforestation – 7.1%

But…low success areas

Regeneration – 0.1%

Tree mortality
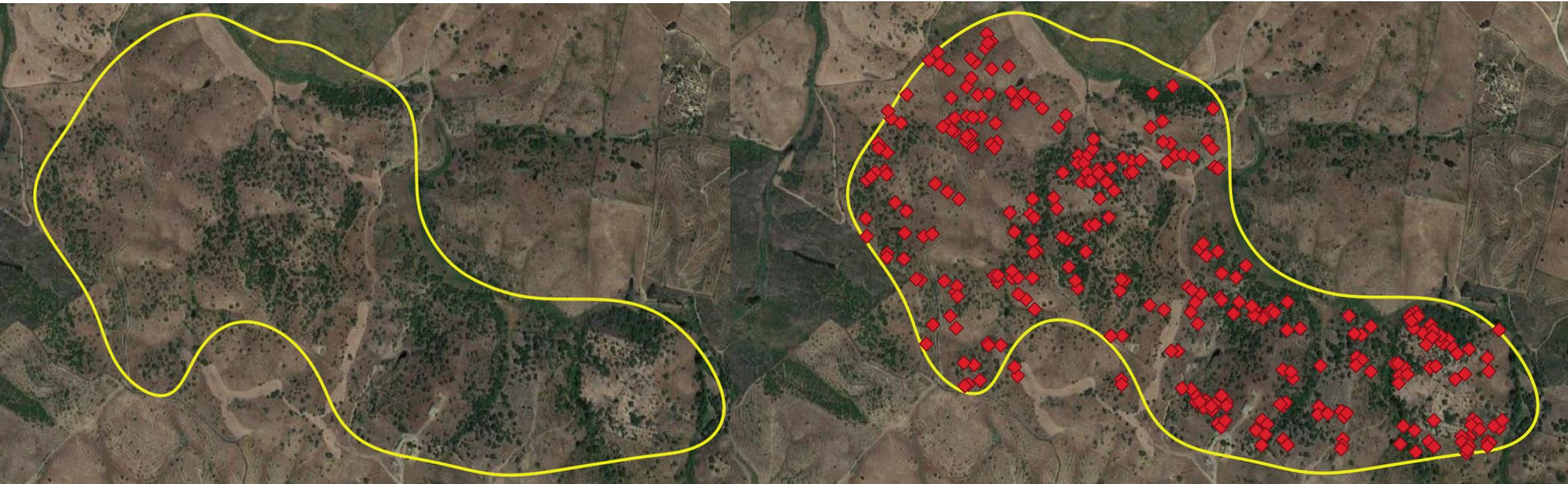
△ 18 895 dead standing trees

Tree mortality

Tree mortality occured – 57 % polygons

3% polygons > 1 dead tree /ha (max 4.88 dead trees /ha)
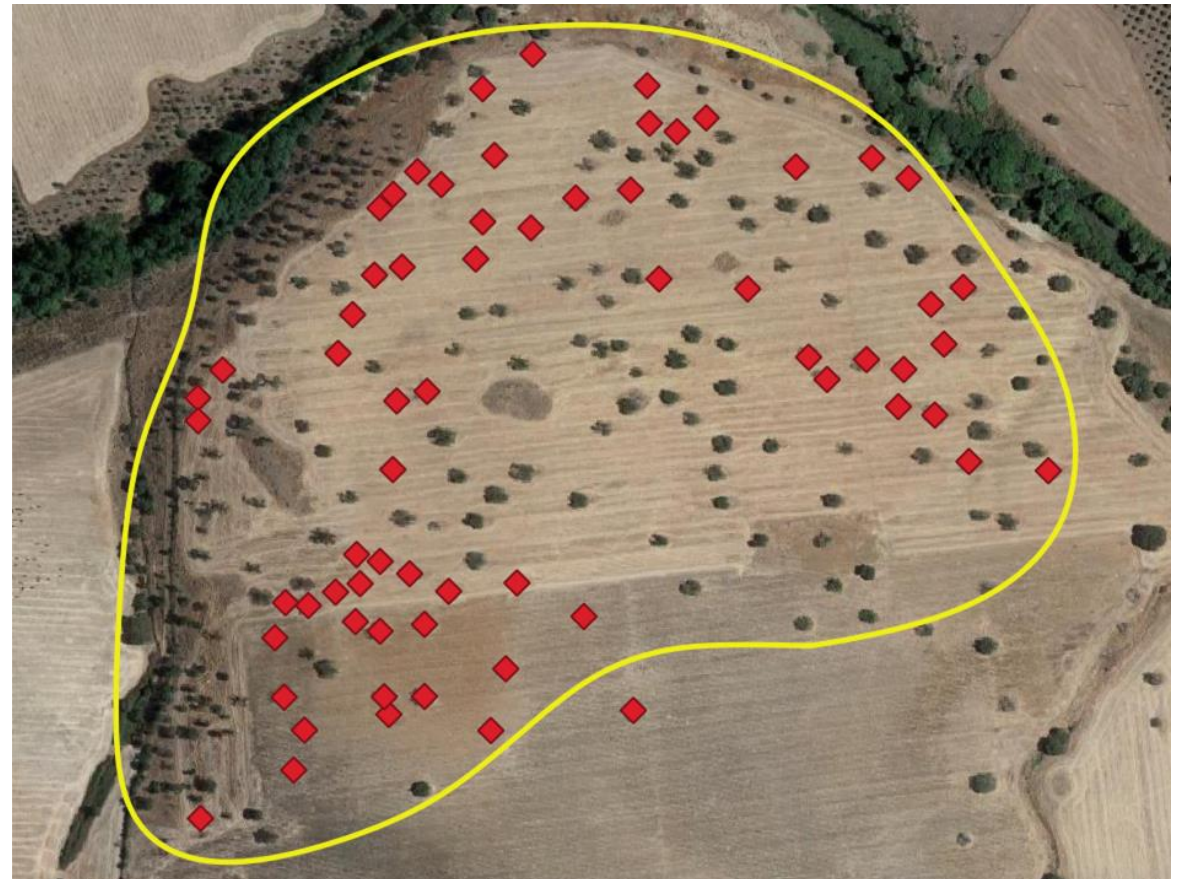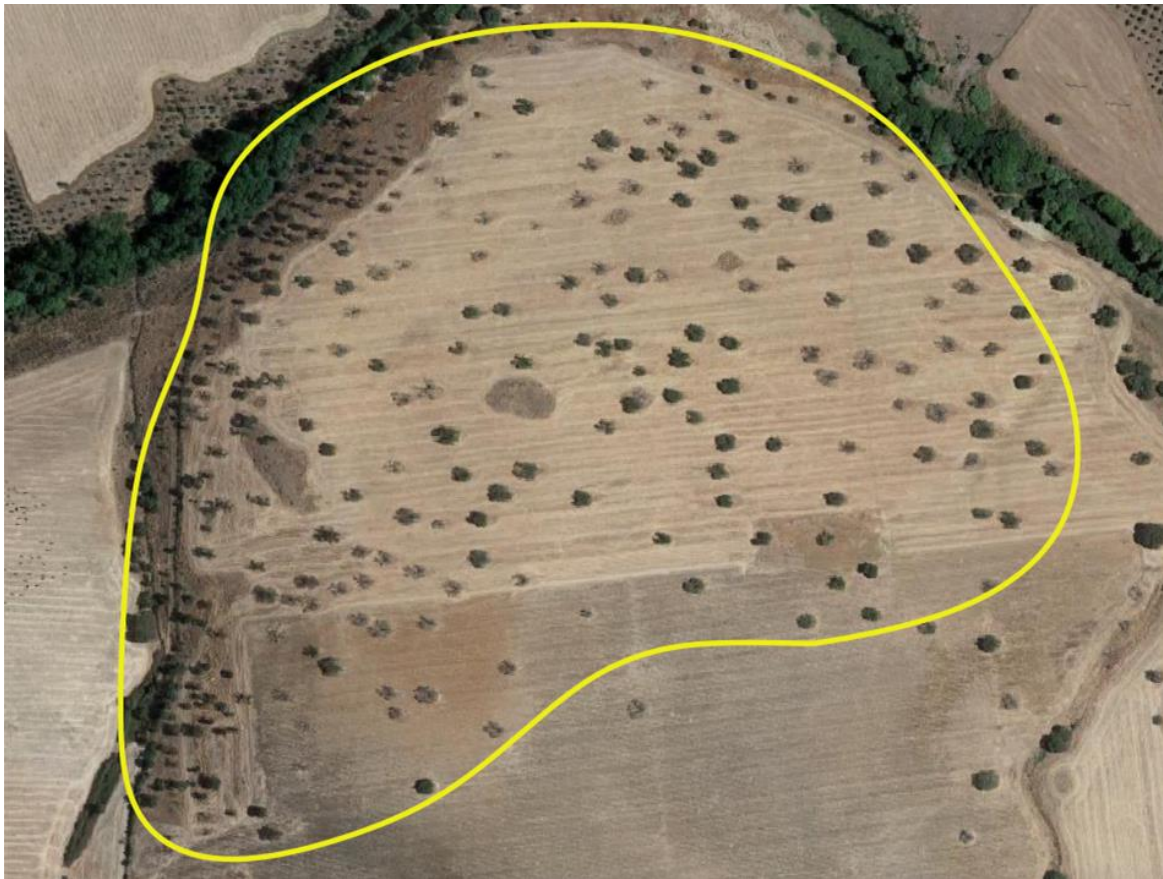
◆ Dead tree

63 ha

Tree mortality

Sparse Montado – loss of the low tree cover

◆ Dead tree

35 ha

Tree mortality

Sparse Montado – loss of tree cover – opening clearings (> 1ha)

– 8% opening clearings (> 1ha)

2018

Montado area (% polygons)

Decrease

Intensive cultures – 3.2%

Wildfires – 3.7%

Construction – 0.1%

Loss of trees /

Mortality > 1 dead tree/ha 3%

Increase

Afforestations – 7.1%

But...some areas with low success

Regeneration – 0.1%

-9.9%   +7.2%

Conclusions

Trend of Montado area - some areas experience a sharp decline but...

The process of tree decline and gradual loss of tree cover is more widespread and not assessed

Filling knowledge gaps on the decline

Why resilient trees do not equate resilient systems?

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Thank you!

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