

Expansió i densificació del bosc en un context de canvi global: el cas del pi negre (*Pinus uncinata*)

Aitor Ameztegui

Centre Tecnològic Forestal de Catalunya (CTFC)

Grup de Funcionament i Dinàmica del Bosc (FiDBosc)

Components of global change...

Atmospheric changes

- CO₂ (+1.5 ppm/year)
- N deposition (25kg/ha/y)
- Ozone (2.4% yearly)
- UV radiation

Invasive species

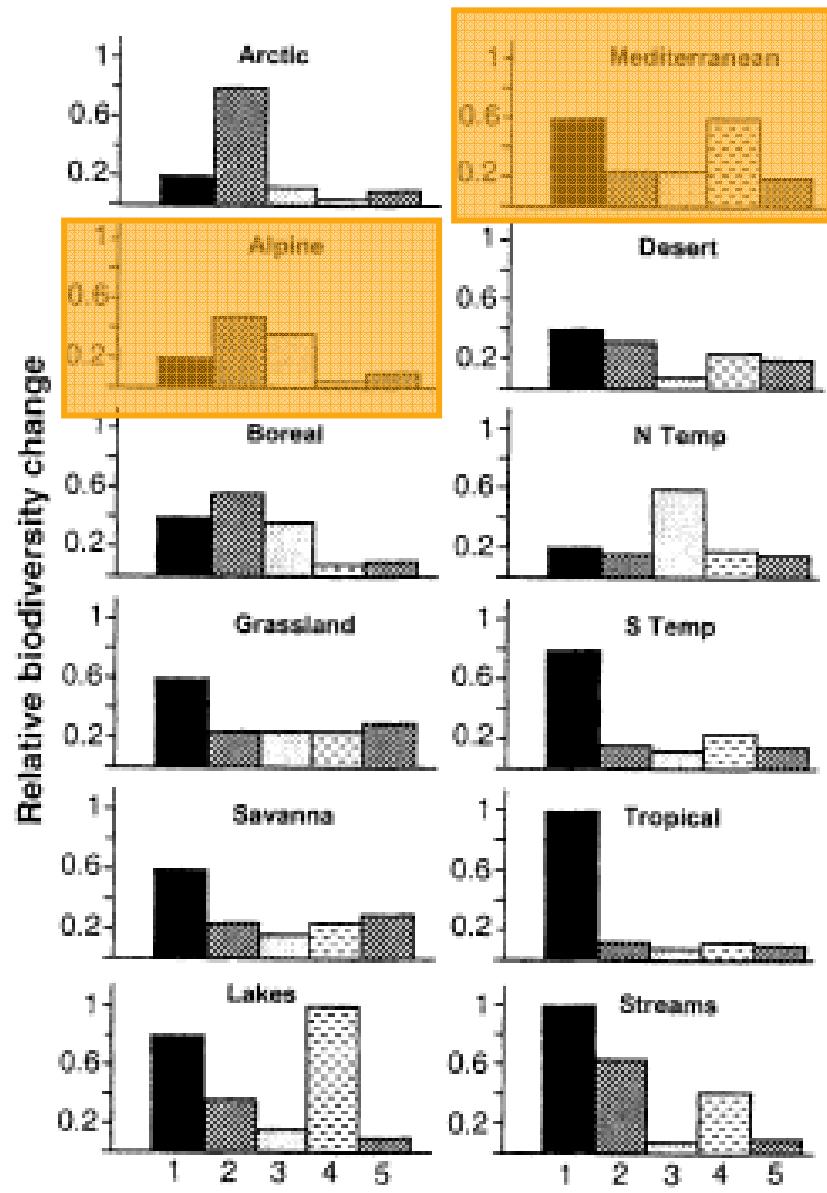
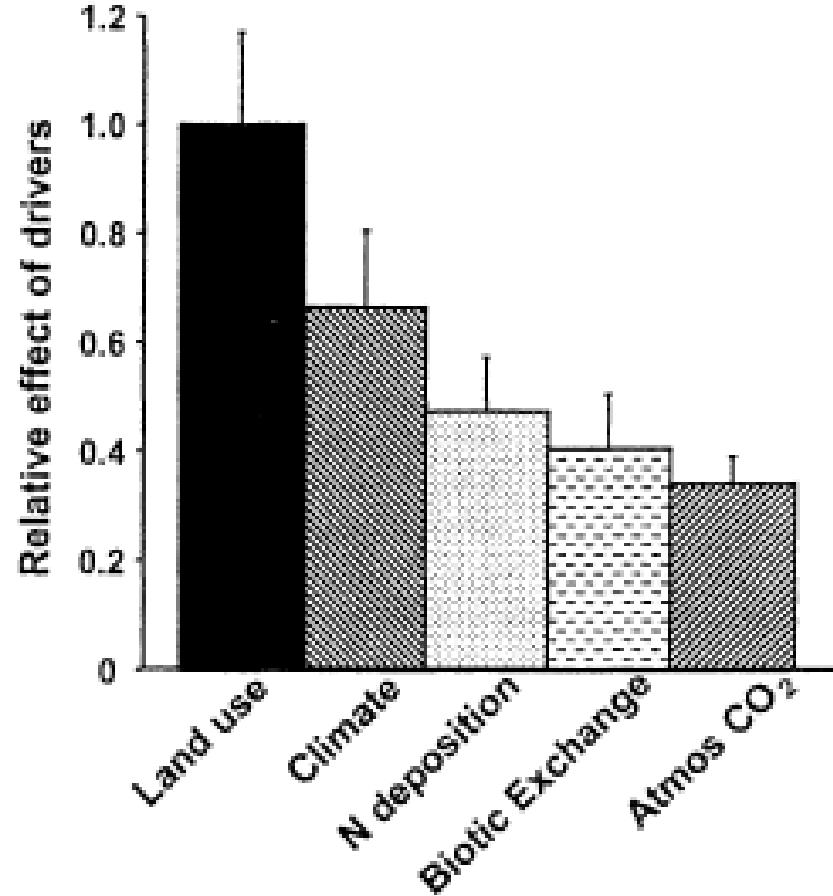
Land-use changes

- overexploitation
- agriculture abandonment

Climate change

- temperatures
- Precipitation
- disturbance regimes

...in Mediterranean mountains



Sala et al. (2000). Science

Recent global change in the Pyrenees

Climatic changes

Tmean: +0.83°C

Tmin: +2.11°C

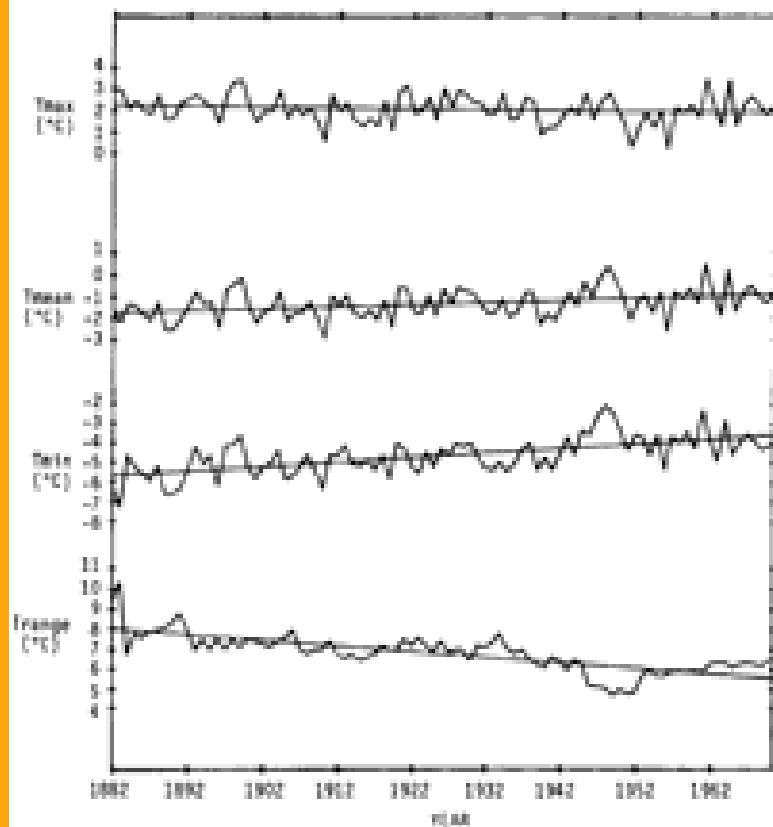
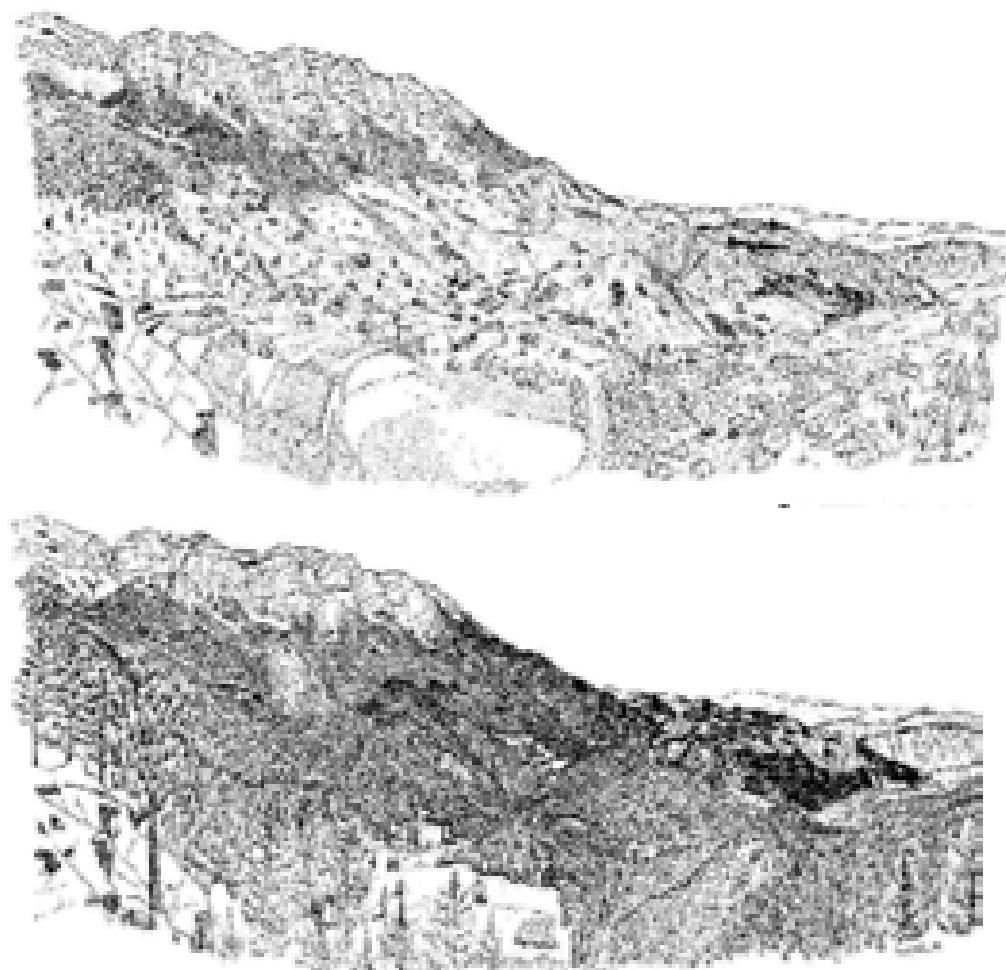


FIG. 5. Variation of annual temperatures at the Pic du Midi during the period 1882–1970: original wine and trend lines.

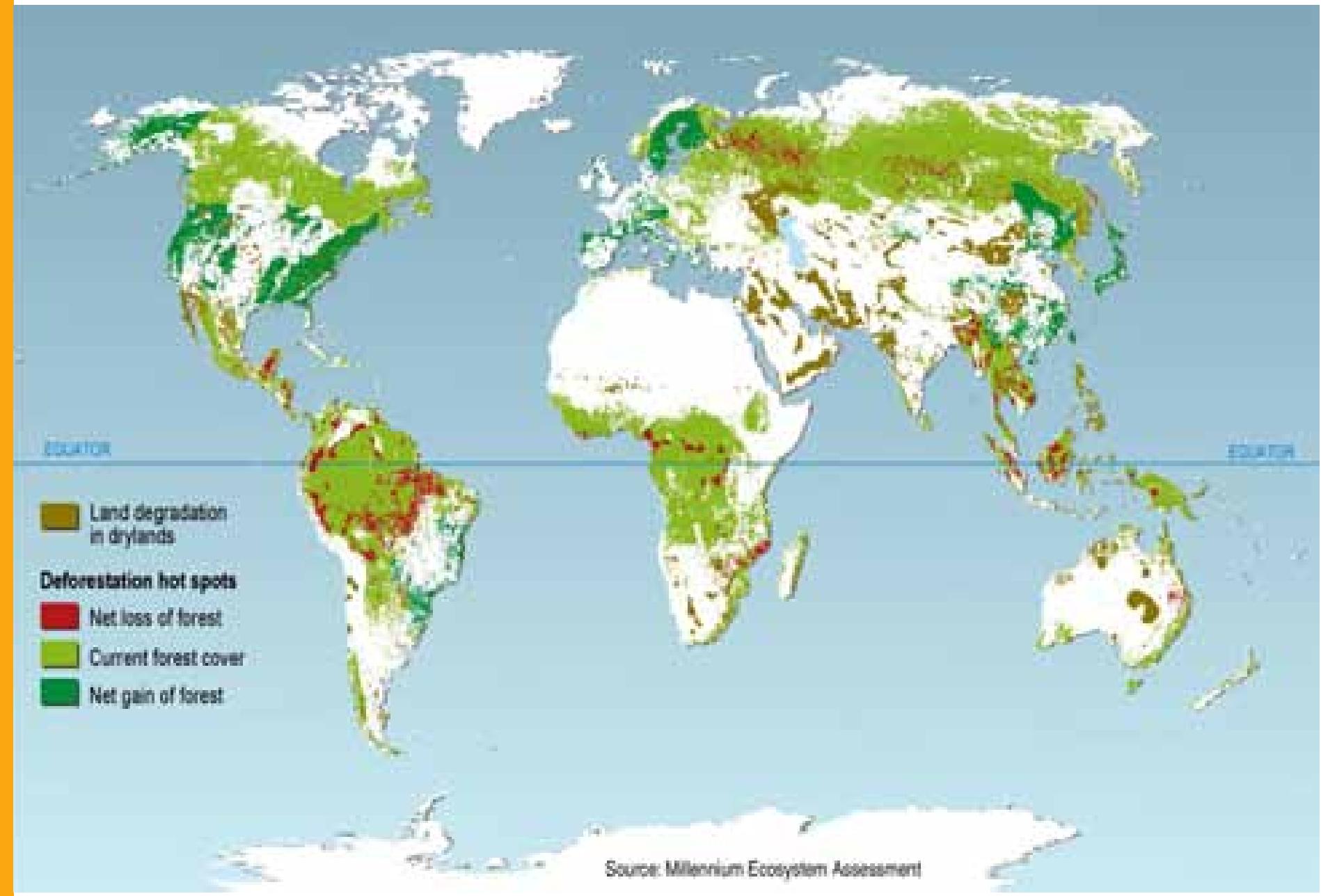
Bücher & Dessens (1991)

Demographic, economic and organizational changes

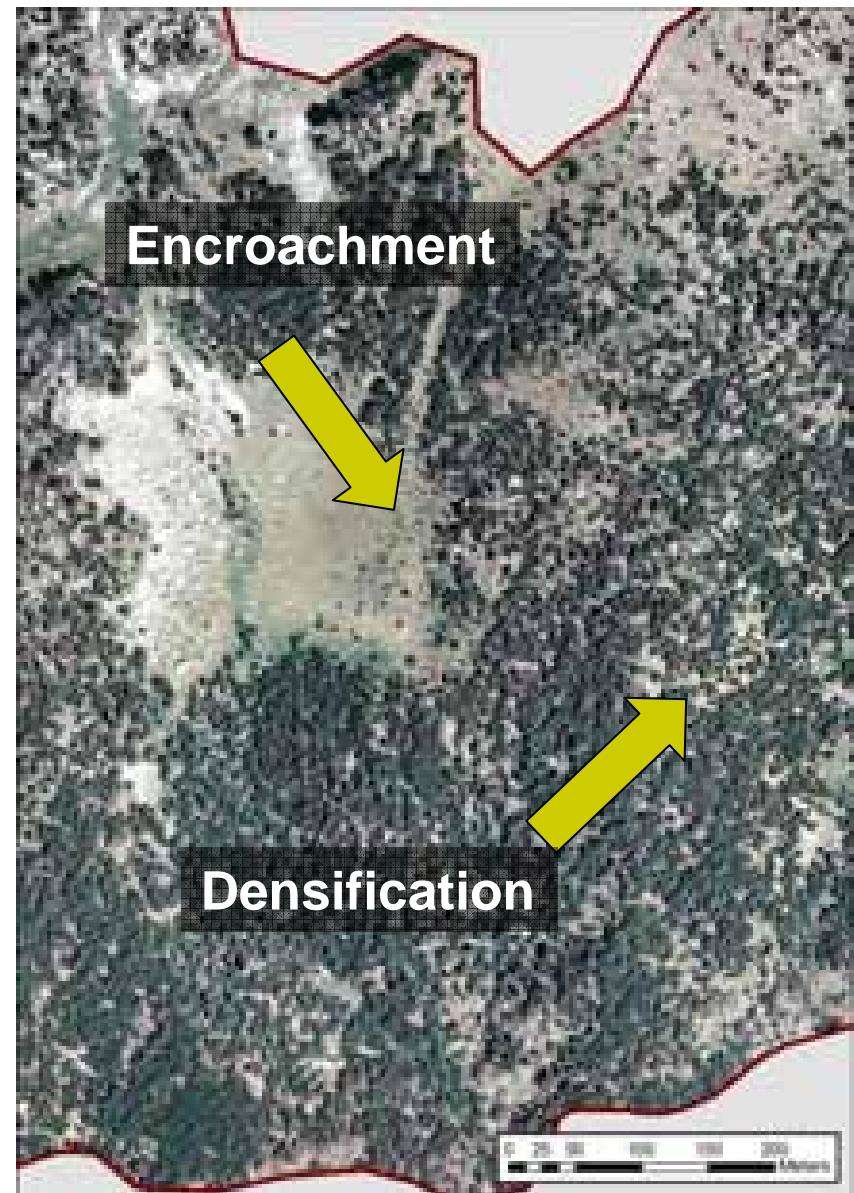
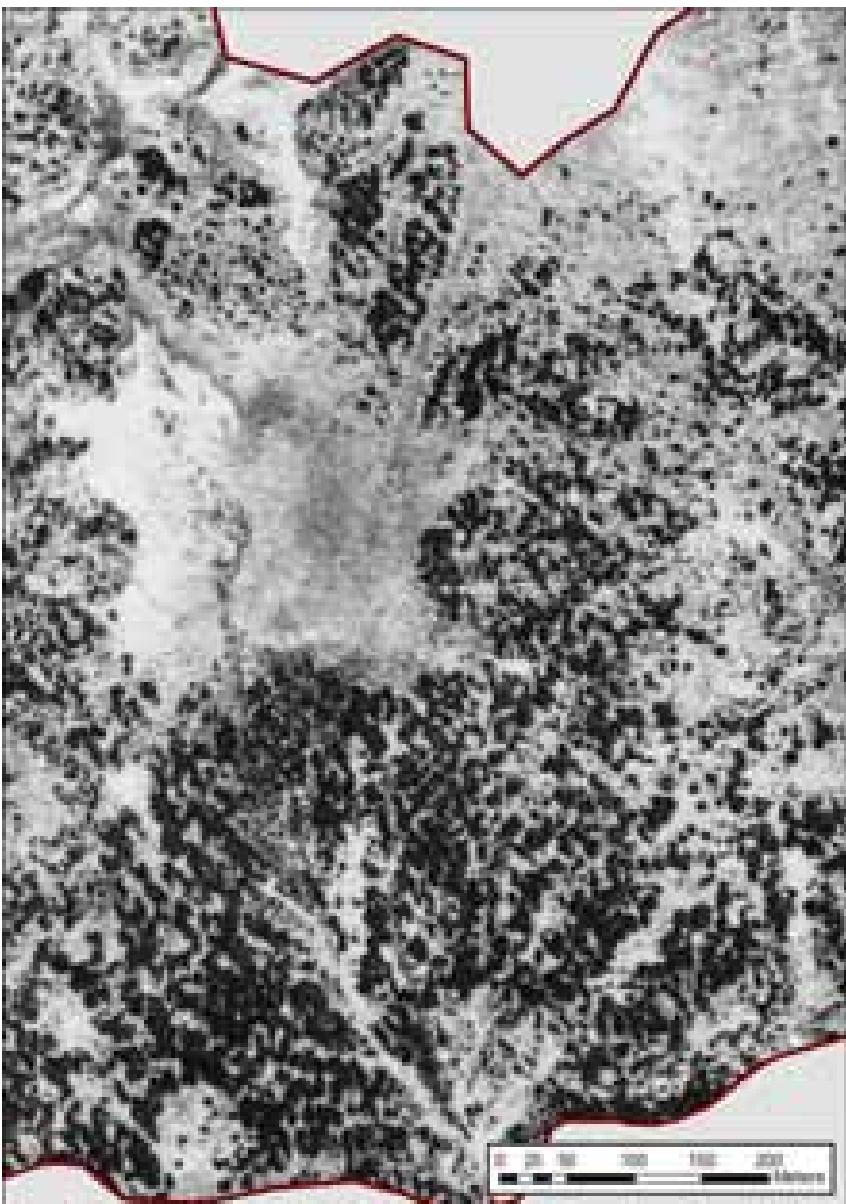


Molina (2002)

... leading to forest expansion



Components of forest expansion



Objectives

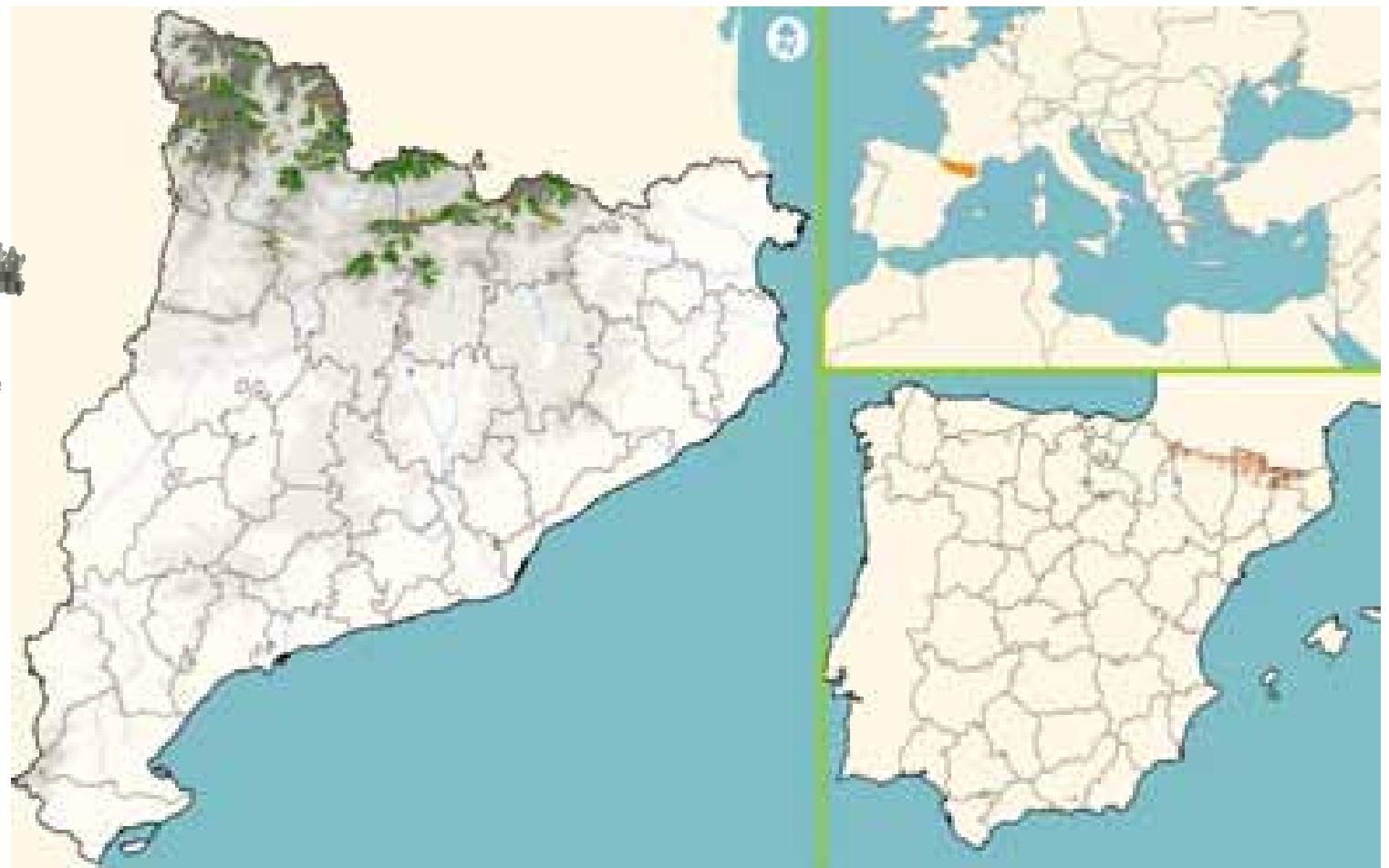
Which is the role of climatic and land-use changes in forest expansion?

- Assess the **spatial patterns** of the forest expansion at both local and regional scales
- Infer, from these spatial patterns, the main **driving factors**:
 - If **climate** is the main driver, the expansion will be more important **near the treeline**
 - If not, spatial patterns of expansion should **match patterns of land-use change**

Species: *Pinus uncinata*



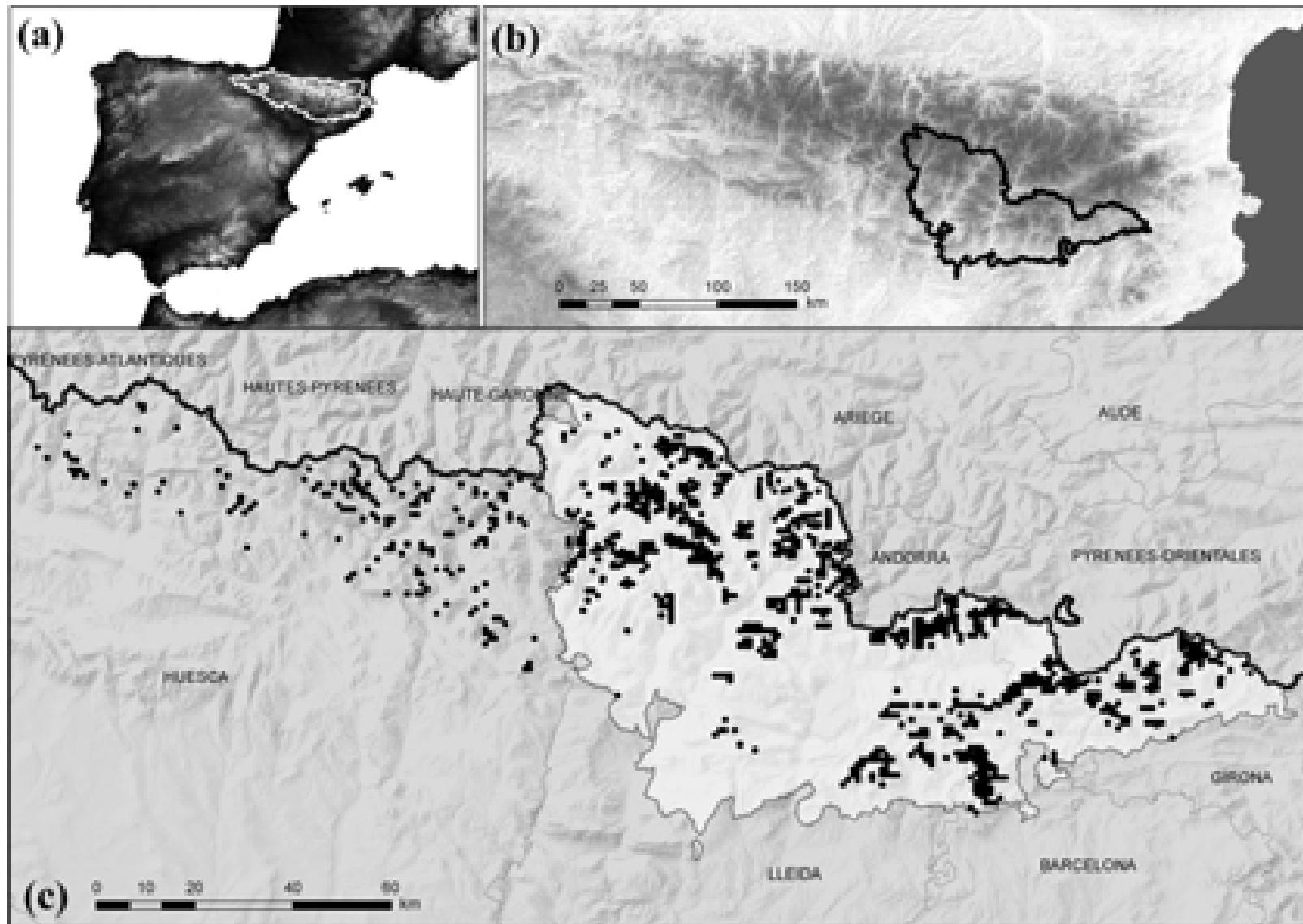
Subalpine belt (most of the Pyrenean treelines)



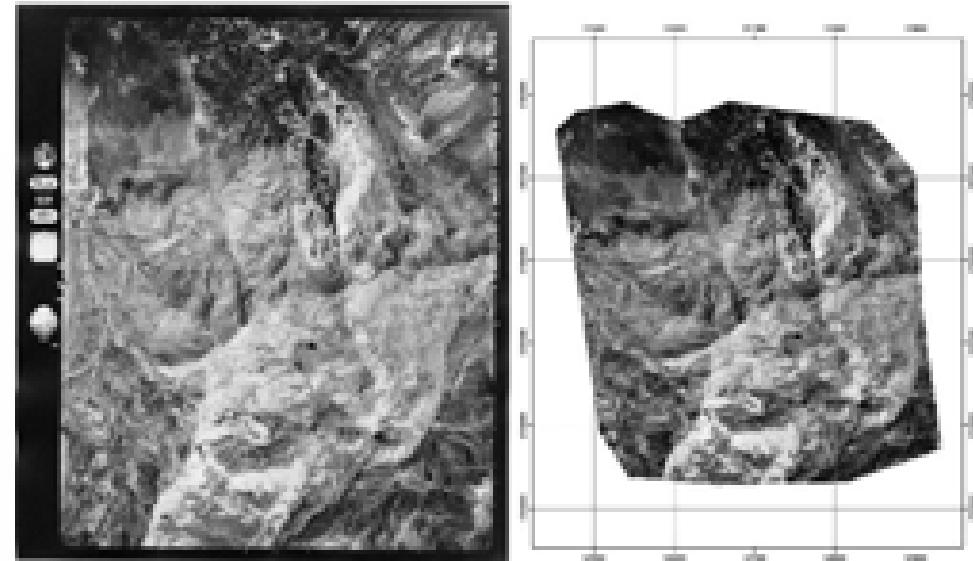
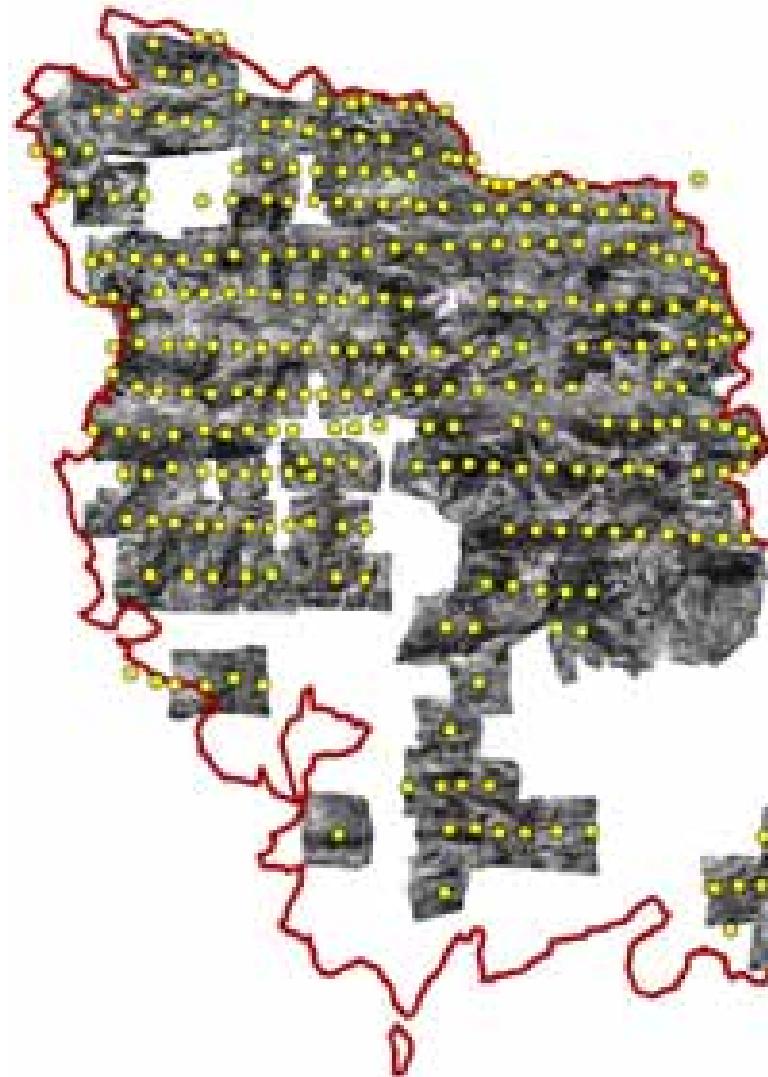
Vericat et al., 2010; Piqué et al., 2011

Methods: area of study

83 municipalities. 65.000 ha. (75% distribution Pyrenees)



Methodology



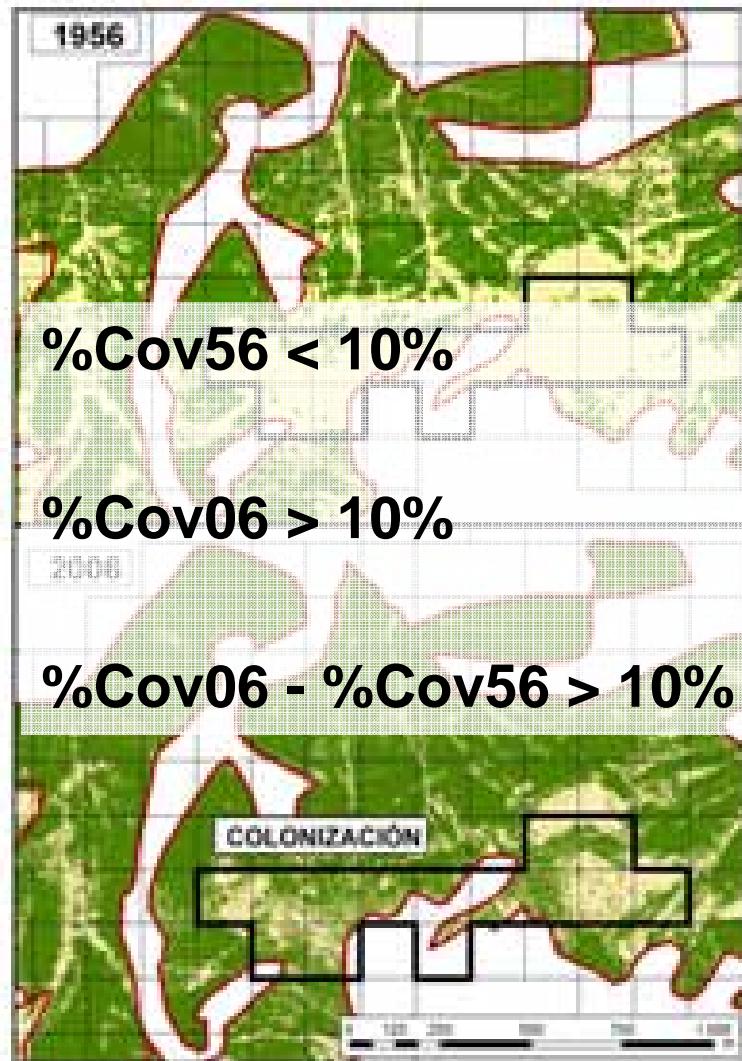
Methodology

- Map of Habitats of Catalonia
 - Grid (150x150 m)
 - Supervised classification
 - Assessment of %Cov56; %Cov06

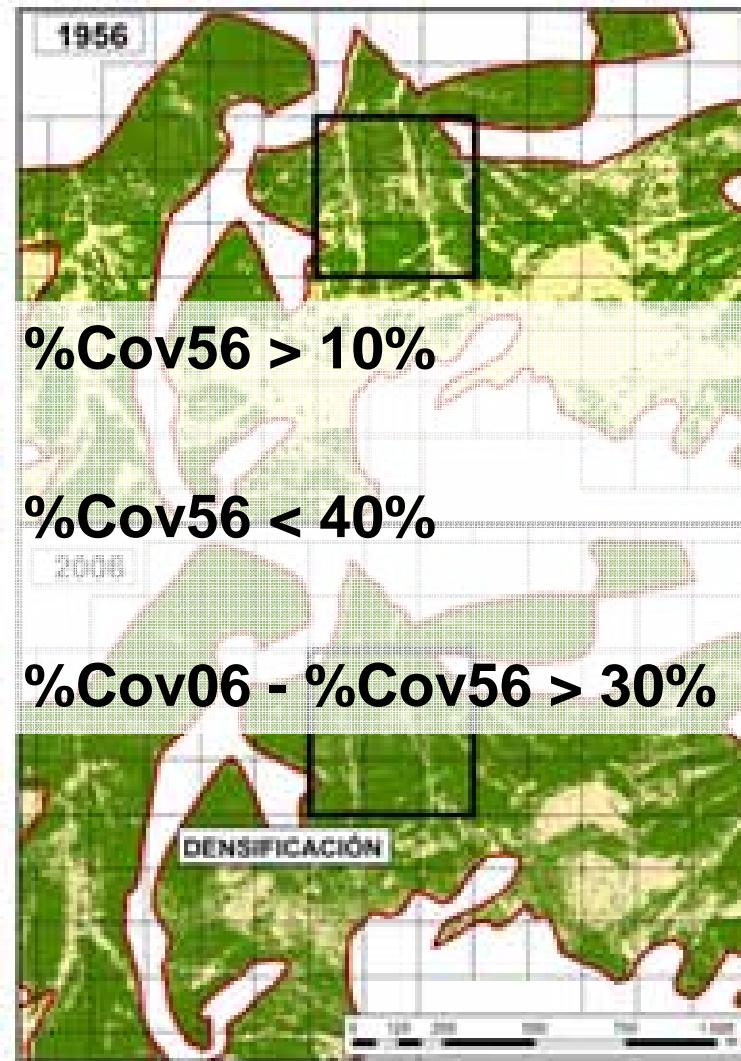
1956		96,21	77,87	95,38	47,8	17,29			98,28	87,7	98,73	10,89
		93,21	91,28	92,89	26,94	27,78	93,79	94,89	92,98	97,94	98,21	20,94
93,21	97,21	98,08	92,98	14,2	98,98	26,87	93,17	98,97	94,21	92,98	97,98	98,21
97,21	98,21	94,19	92,98	7,28	92,28	92,98	26,29	92,91	98,92	92,8	91,12	98,21
94,21	98,21	98,44	98,73	98,98	92,99	92,29	94,2	99,43	98,48	97,2	97,28	91,81
92,28	97,21	98,01	92,98	8,21	94,4	12,27	91,78	92,98	97,7	94,8	93,98	98,73
98,48	97,21	94,48	7,28	9	9	9,08	9	9,18	9,47	9,81	9,34	9,89
92,4	98,21	91,81	91,28	94,89	6,18	92,79		9,2	12,89	17,21	19	8,28
91,21	98,21	98,48	76,18	90,78	94,8	98,98	9,81			8,73	8,28	8,73
92,28	98,21	98,73	98,98	98,27	98,28	4,81						
2006		98,21	97,8	77,2	92,8	94,8			97,2	98,7	98,2	9
		95,21	98	92	94,2	92,8	91,2	98,2	92,2	98,2	98,2	98,2
92,28	98,21	98,2	92,2	92,2	97,2	92,2	92,2	92,2	92,2	92,2	92,2	92,2
94,2	98,21	98,2	47	92,2	72,2	72,2	92,2	72,2	92,2	72,2	92,2	92,2
97,2	98,21	98,2	92,2	92,2	78,2	78,2	92,2	78,2	92,2	78,2	92,2	92,2
92,2	98,21	98,2	92,2	92,2	79	79	92,2	92,2	92,2	92,2	92,2	92,2
94,2	98,21	98,2	94,2	94,2	97,2	92,2	92,2	92,2	92,2	92,2	94,2	92,2
92,2	98,21	47,2	78,2	72,2	92,2	92,2		92,2	92,2	92,2	92,2	92,2
97,2	98,21	92,2	92,2	92,2	92,2	92,2						

Methodology

Encroachment

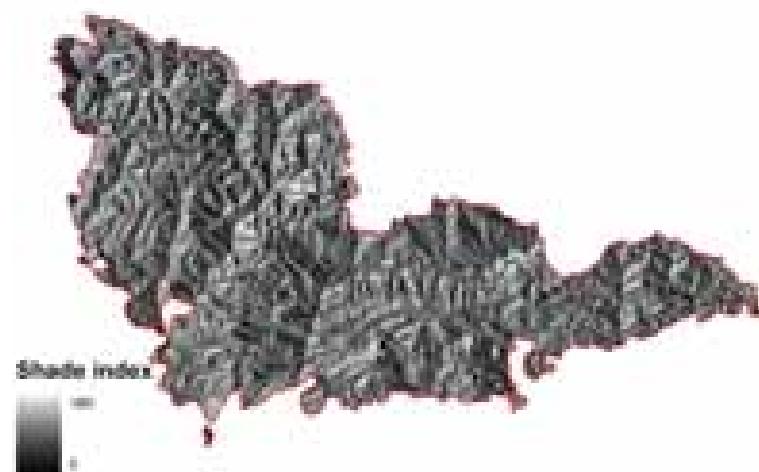
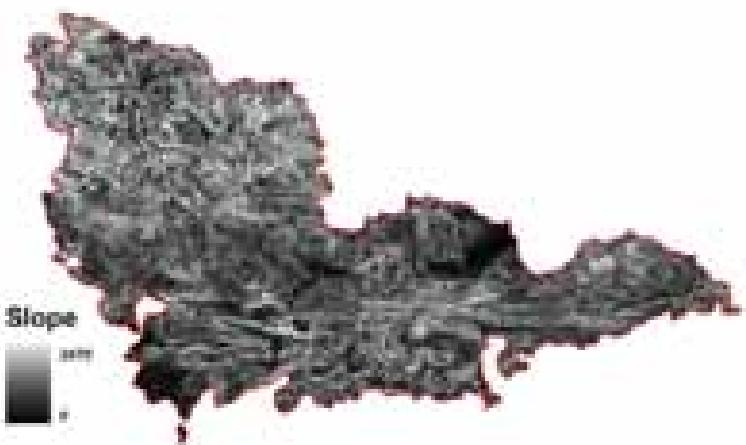
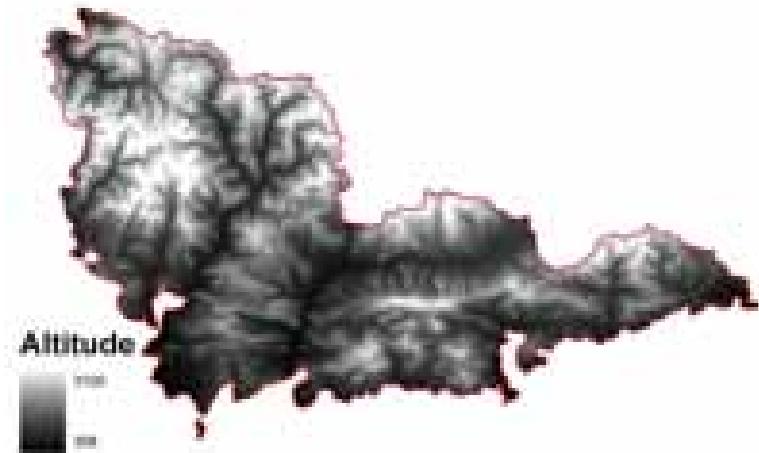


Densification



Methodology: explanatory variables

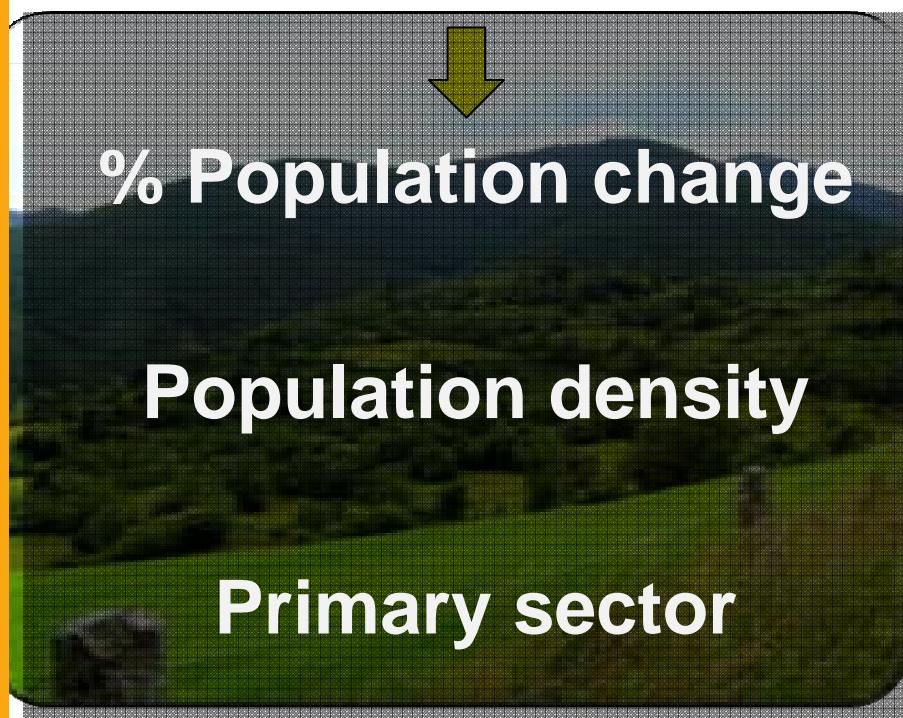
Topographic factors (local scale)



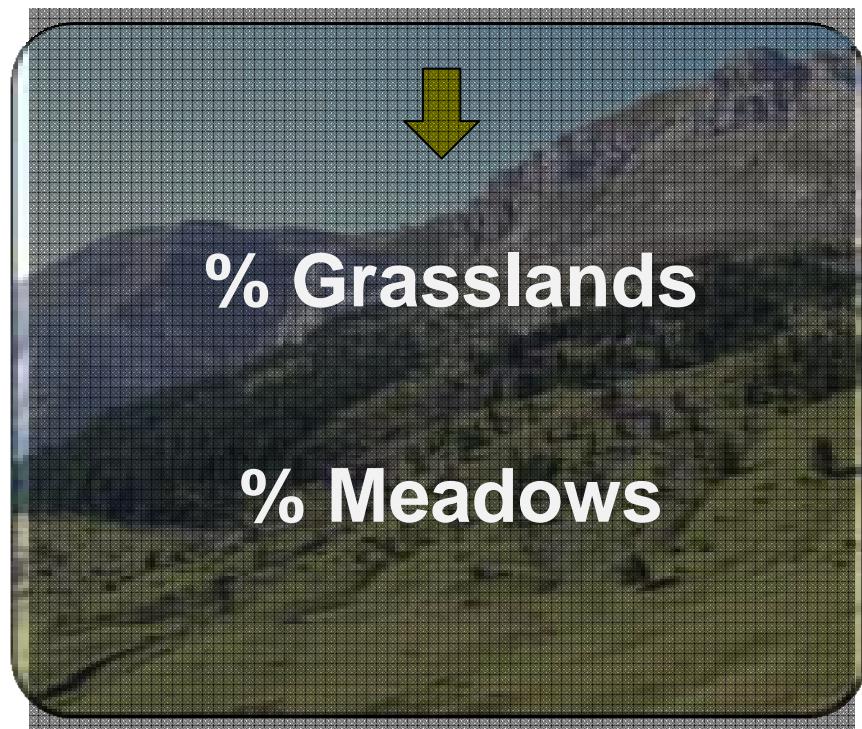
Methodology: explanatory variables

Socioeconomic factors (municipality scale)

Farmland abandonment

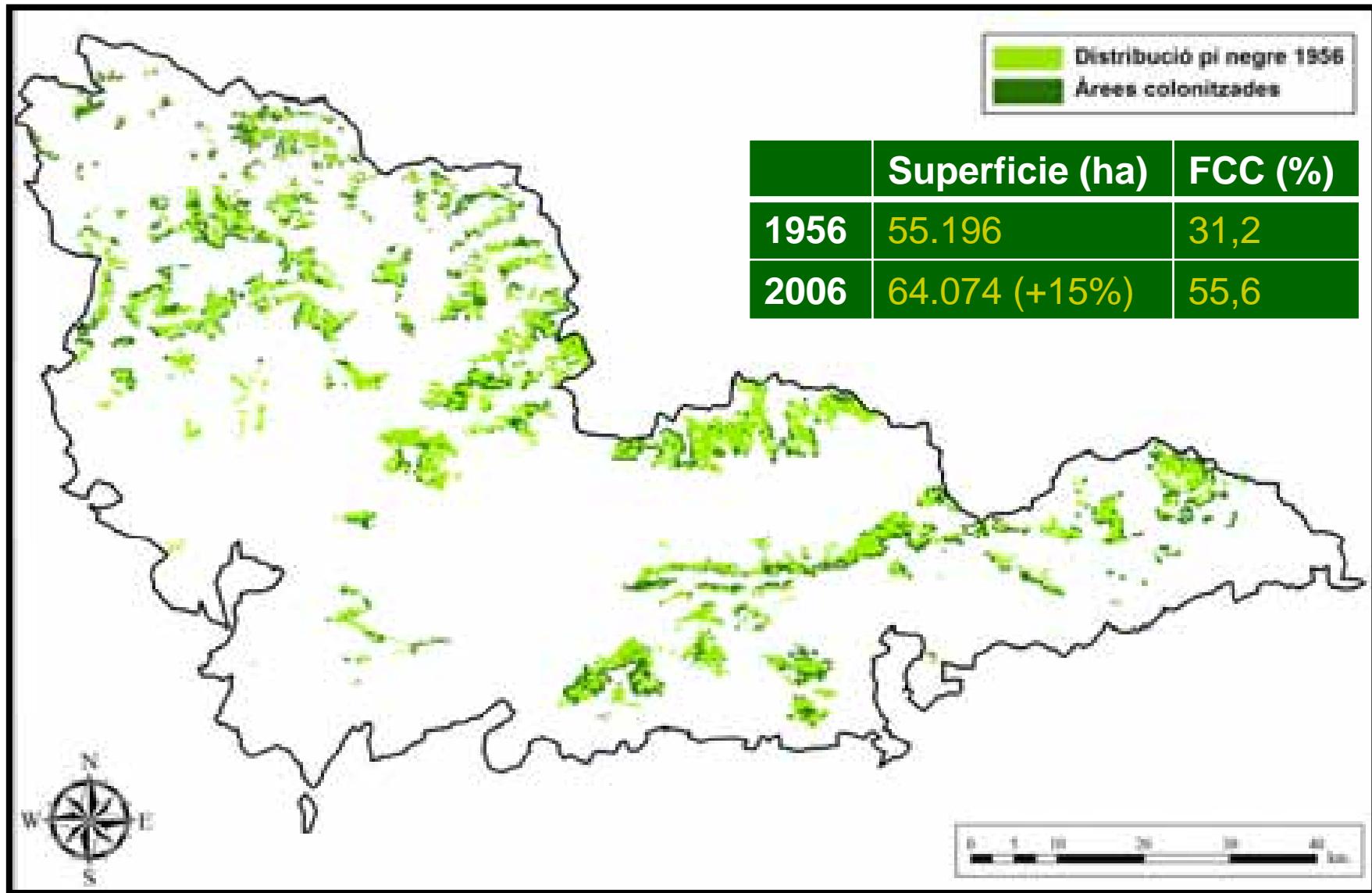


Livestock charge

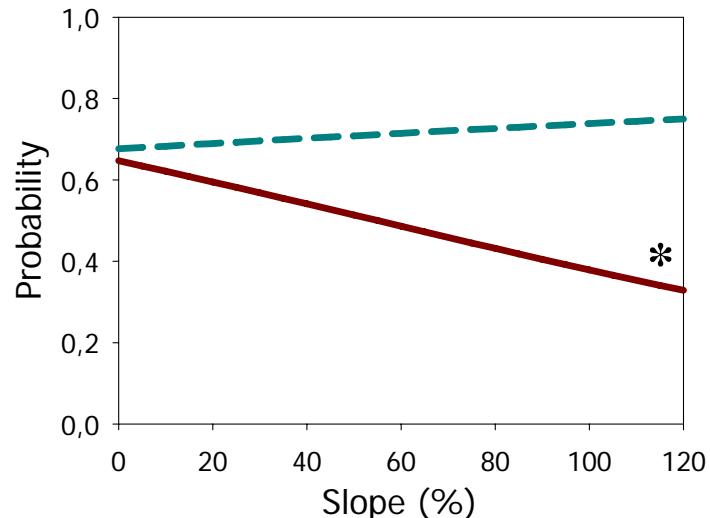
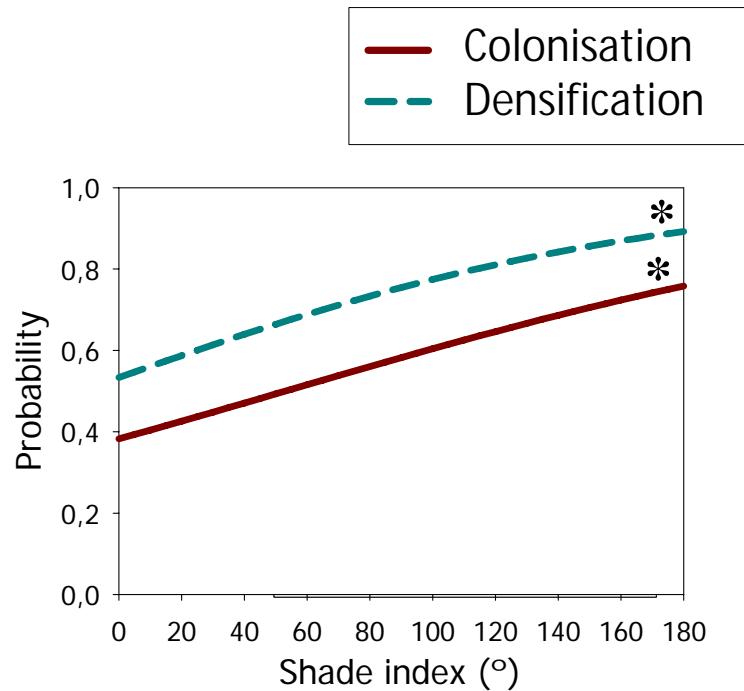
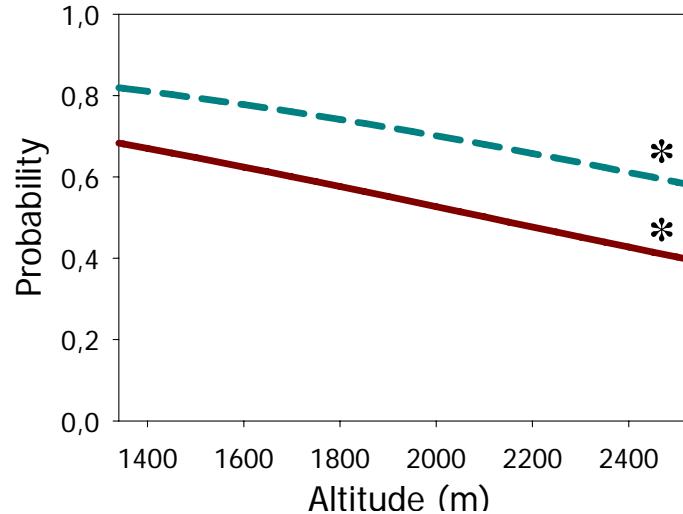


PROXIES

Results



Results: topography

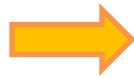


- Increasing encroachment and densification in low altitudes and northern aspect.

Interpretation

Higher encroachment rates in:

- North aspect
- Low elevation (<1600 m)
- Low slope

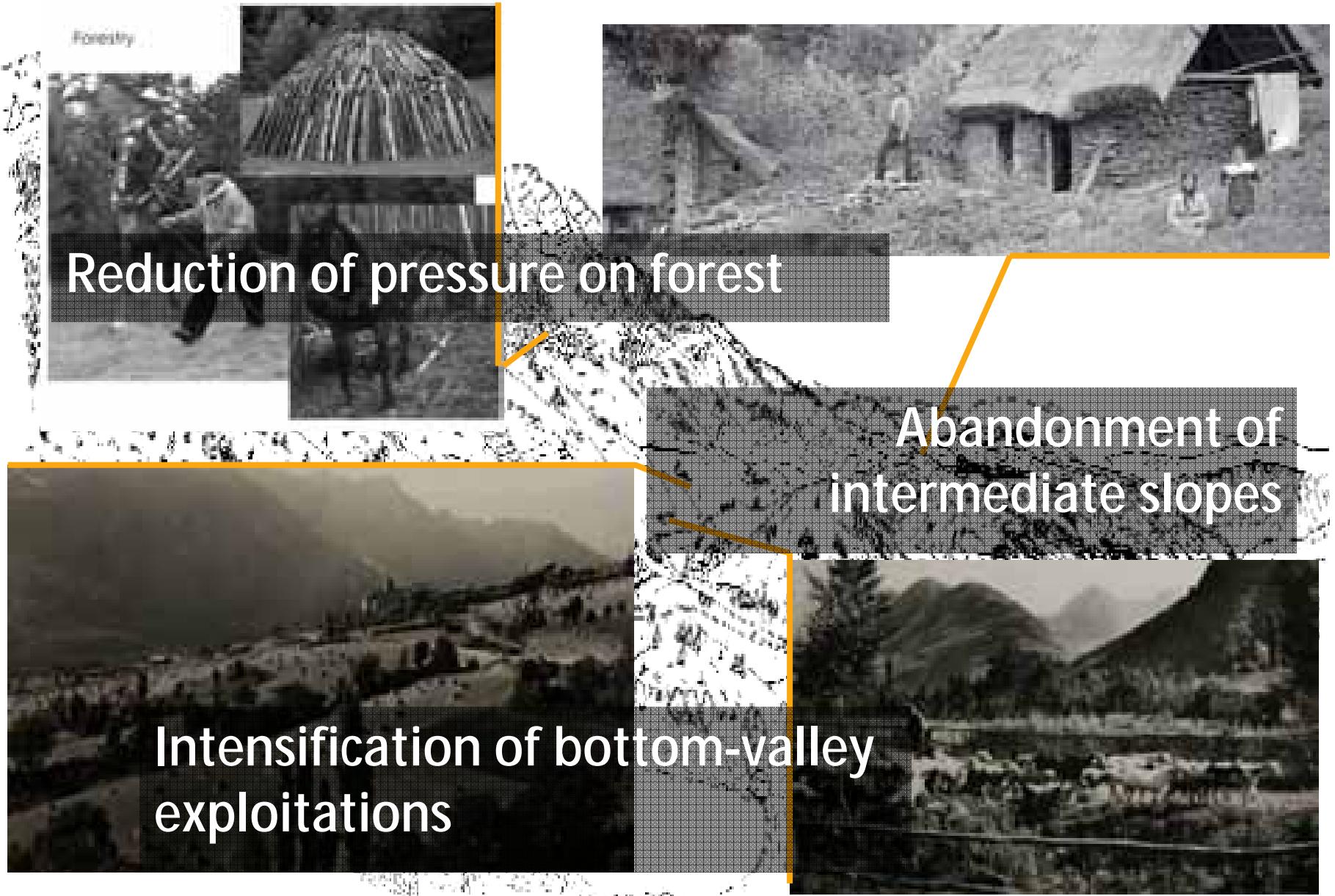


An effect of site conditions?
(neither thermal nor
hydrological limitations)

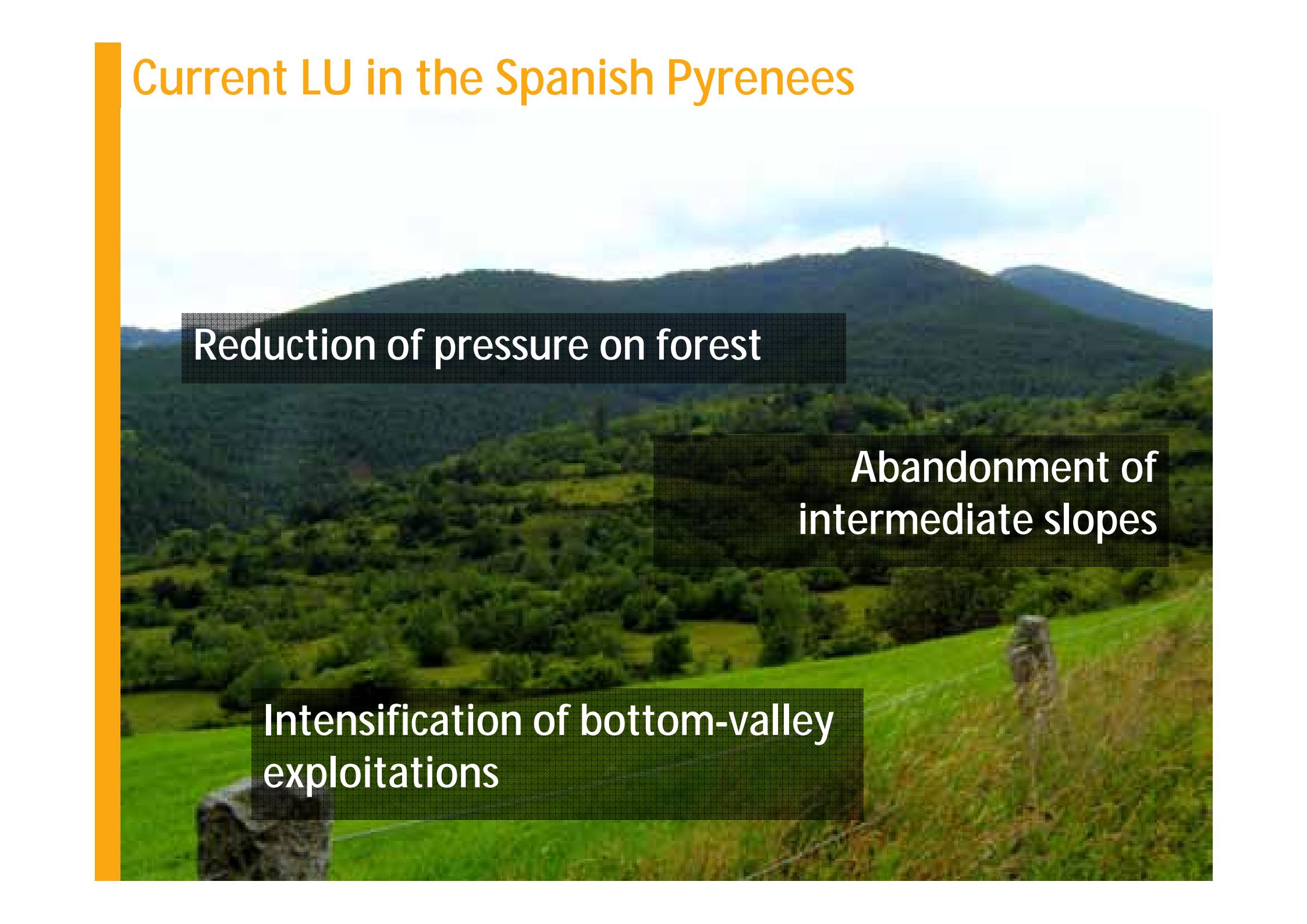
BUT

**Topography is not independent from
patterns of land-abandonment and livestock
grazing**

Traditional LU in the Spanish Pyrenees



Current LU in the Spanish Pyrenees

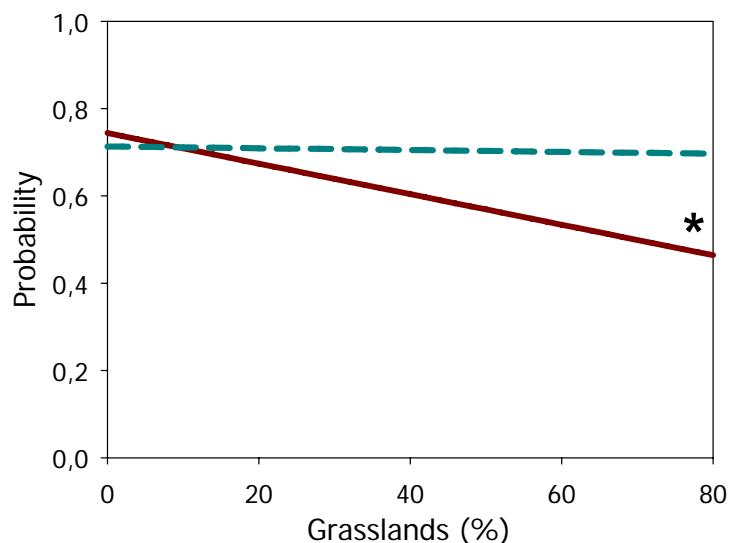
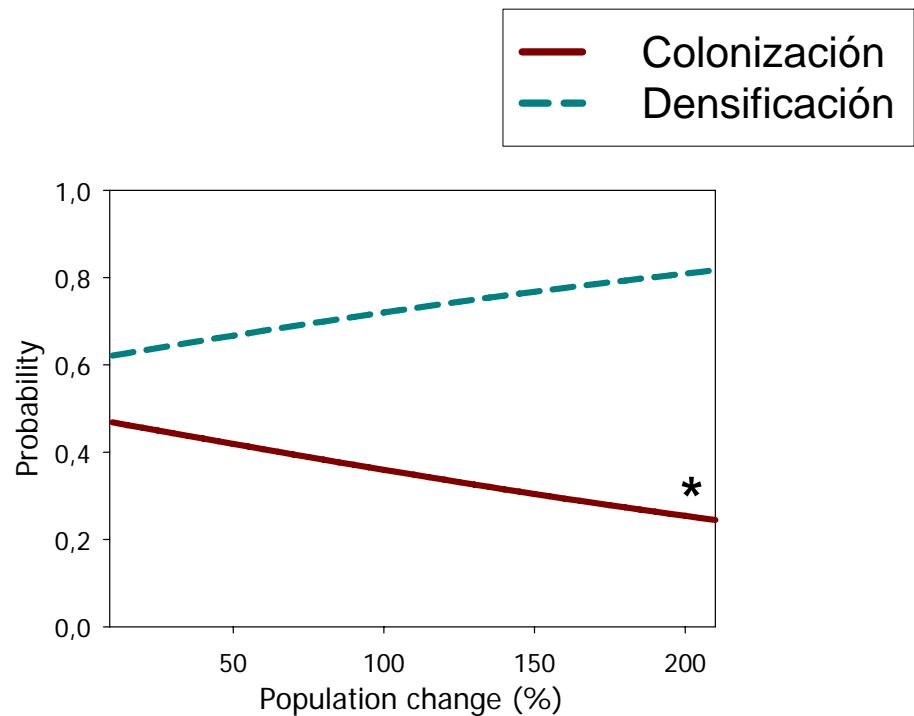
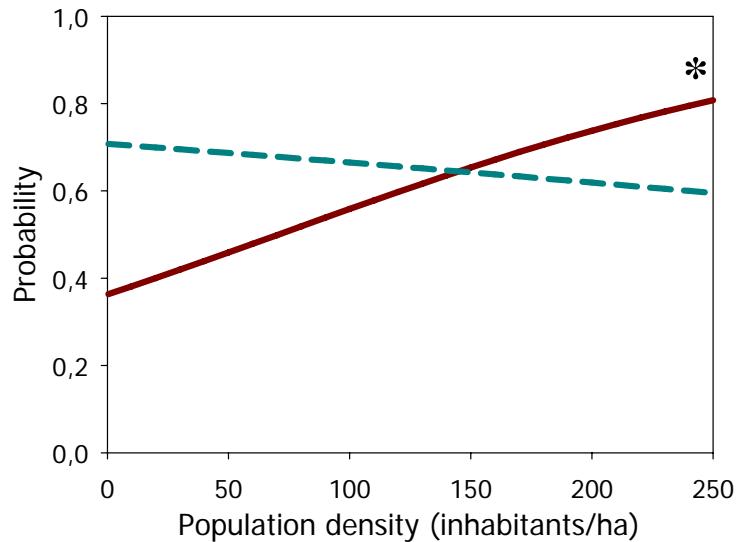
A scenic view of the Spanish Pyrenees mountains under a clear blue sky. The foreground shows a lush green valley with a small stream or path winding through it. The middle ground is filled with dense green forests covering the mountain slopes. In the background, several majestic peaks rise against the sky.

Reduction of pressure on forest

Abandonment of
intermediate slopes

Intensification of bottom-valley
exploitations

Results: socioeconomic



- Higher colonization in mun. with high density and high population losses
- Lower colonization in mun. with high % grasslands
- No effects on densification

“Take home” messages

- Important expansion of *Pinus uncinata*
- Spatial patterns match with those of disminution of anthropic activities (farmland and grazing)
- Doesn't mean a lack of influence of climate
- Stresses the importance of considering land-use changes



Thank you!



aitor.ameztegui@ctfc.cat
<http://fidbosc.ctfc.cat>