World Congress Silvo-Pastoral Systems

Progress in analytical approaches integrating
Livestock and Biodiversity
to identify HNV Montados

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P.Simões, A.Belo, L.Catarino, P.Costa, E.Fonseca, S.Godinho,
C.Azeda, L.Gomes, J.Lopes Castro, R.Louro, M.Silvestre, M.Vaz

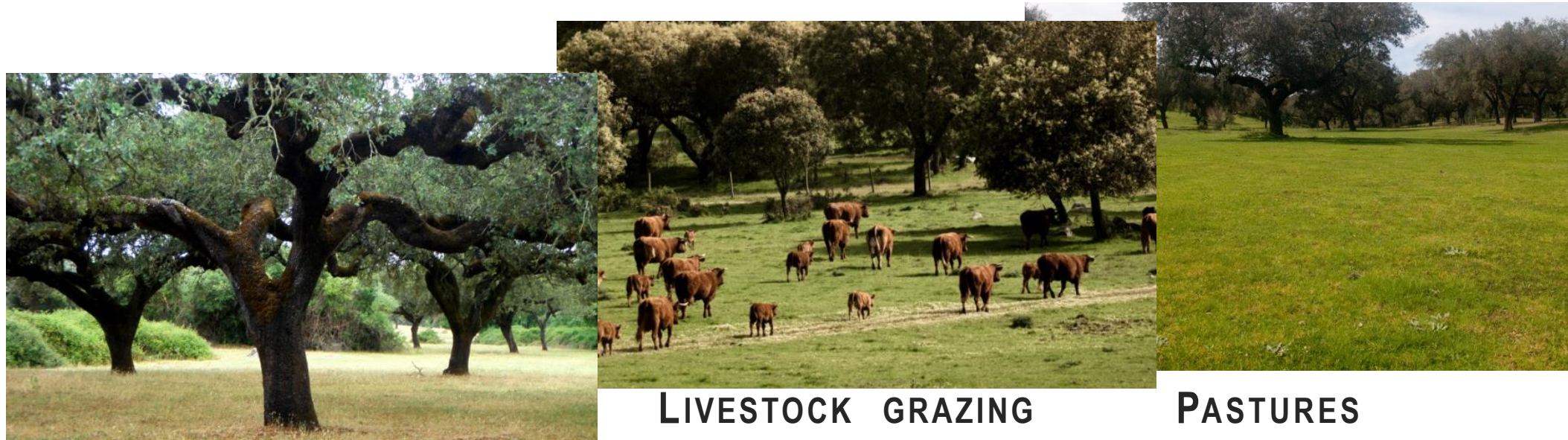**»» results of an interdisciplinary and integrated research design**

The Montado: challenges for management

A **complex** system depending on the **high variance**
of its main components, in different biophysical conditions

TREE COVER
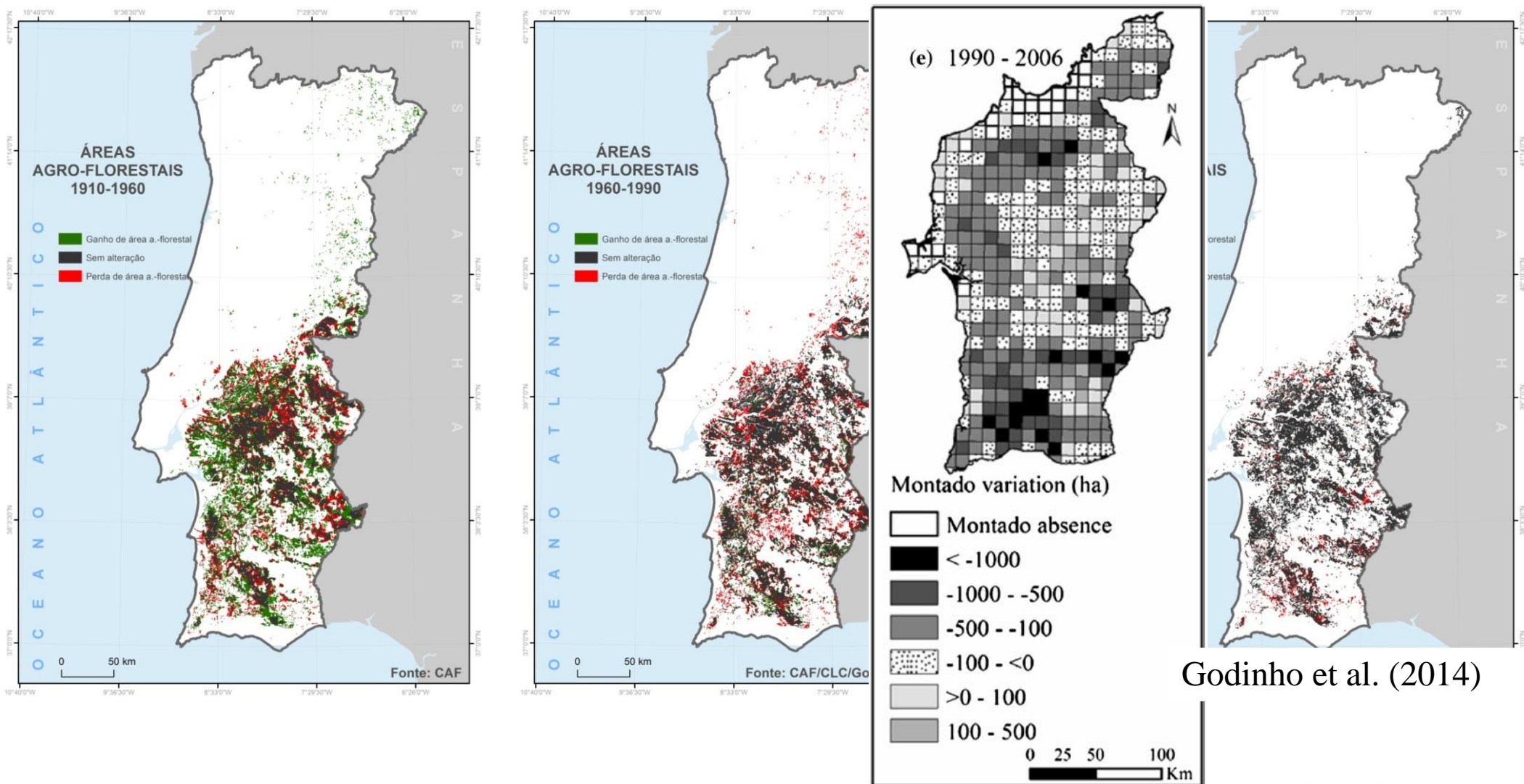
LIVESTOCK GRAZING

PASTURES

at the landscape level ➡ spatial and functional complexity
multiple uses and externalities

at the farm level ➡ articulating these different dimensions
securing production and income

As other silvo-pastoral systems,
Montados are over-mature and suffer recruitment failure
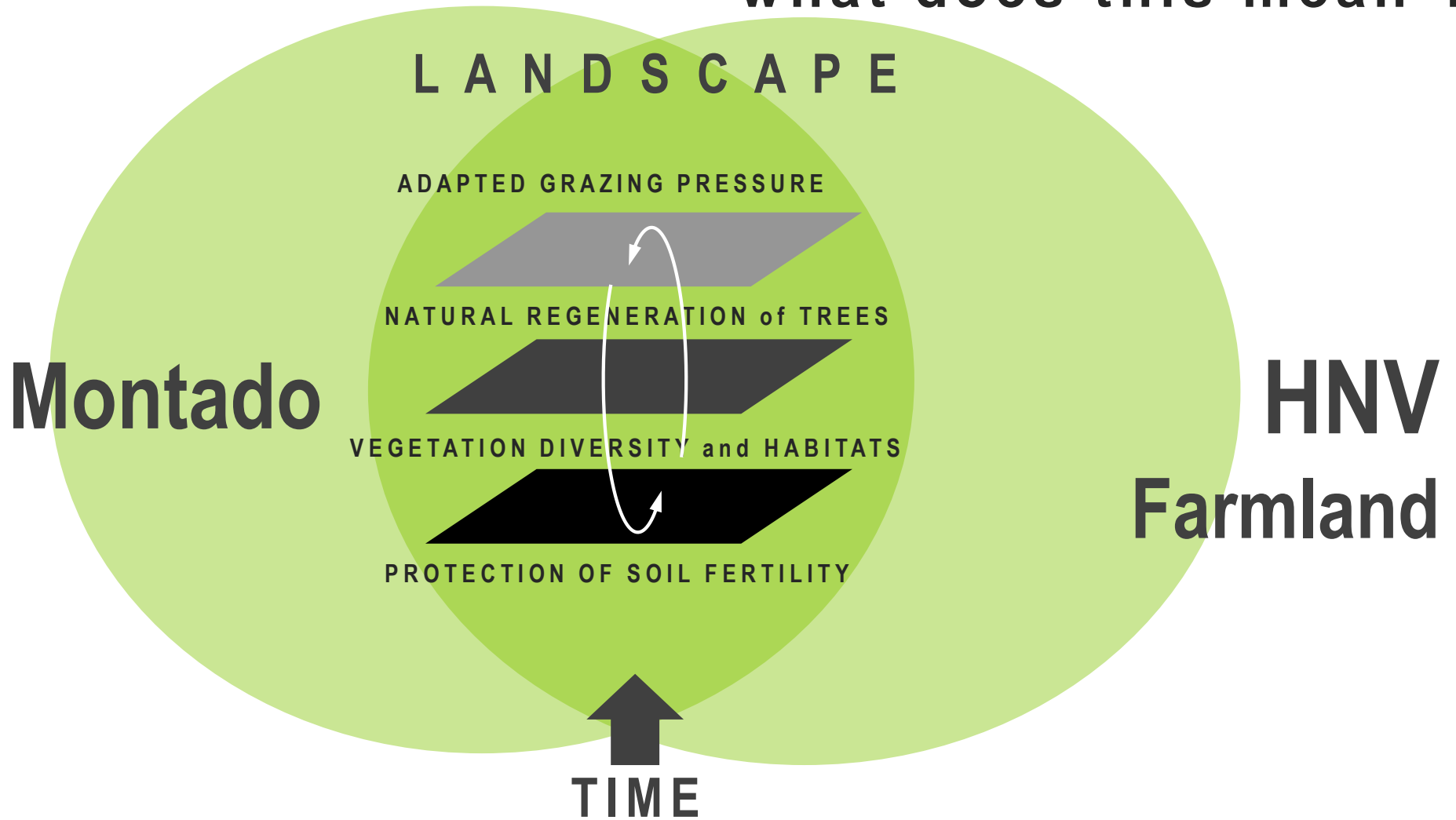## …showing a significant decline:

Godinho et al. (2014)

Between 1990 e 2014 and continuing....
»» 5625 ha/year have been lost
eventhough its multiple values are ackowledged

Sustainable Management of the Montado:
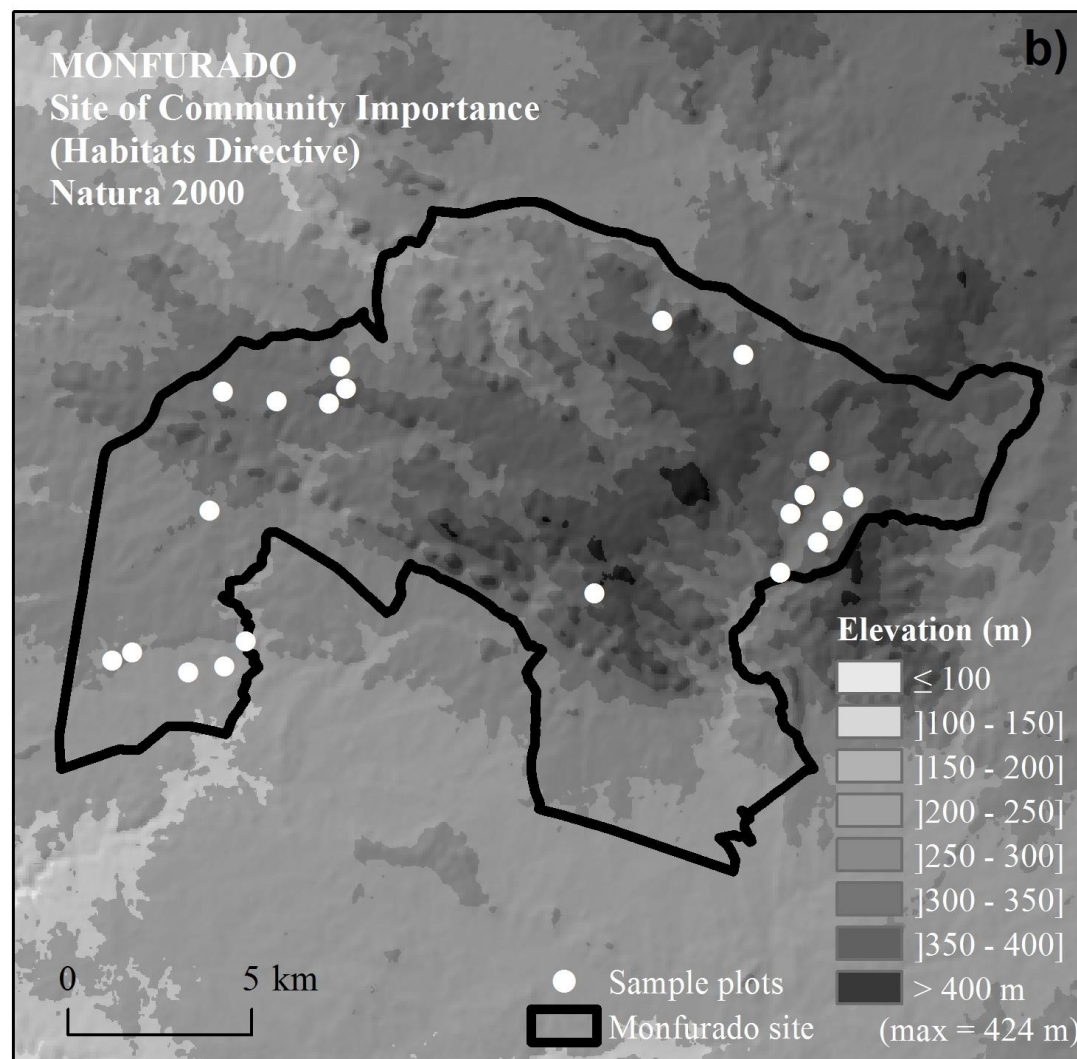## what does this mean ?

LANDSCAPE

ADAPTED GRAZING PRESSURE

NATURAL REGENERATION of TREES

Montado

VEGETATION DIVERSITY and HABITATS

HNV
Farmland

PROTECTION OF SOIL FERTILITY

TIME

HNV = High Nature Value

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Study area: Natura 2000 site of Monfurado

a)

b)

MONFURADO
Site of Community Importance
(Habitats Directive)
Natura 2000

Elevation (m)
≤ 100
]100 - 150]
]150 - 200]
]200 - 250]
]250 - 300]
]300 - 350]
]350 - 400]
> 400 m

○ Sample plots
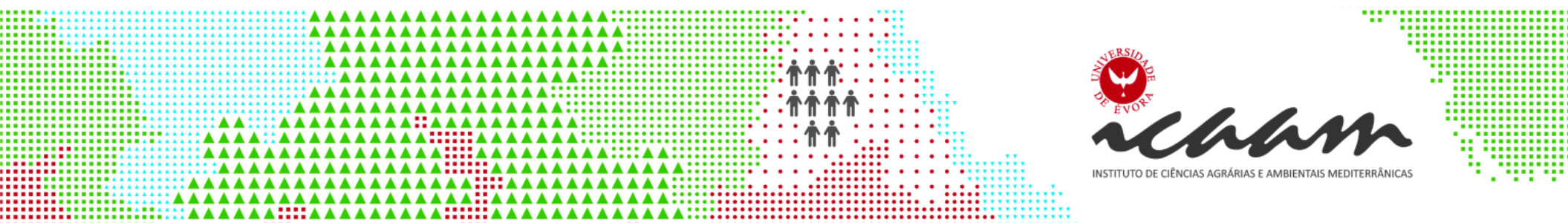▭ Monfurado site
(max = 424 m)

0   5 km

Farms with similar structural
characteristics

Survey :
Management » interviews to farmers

Biodiversity » field work by different
teams with different field protocols

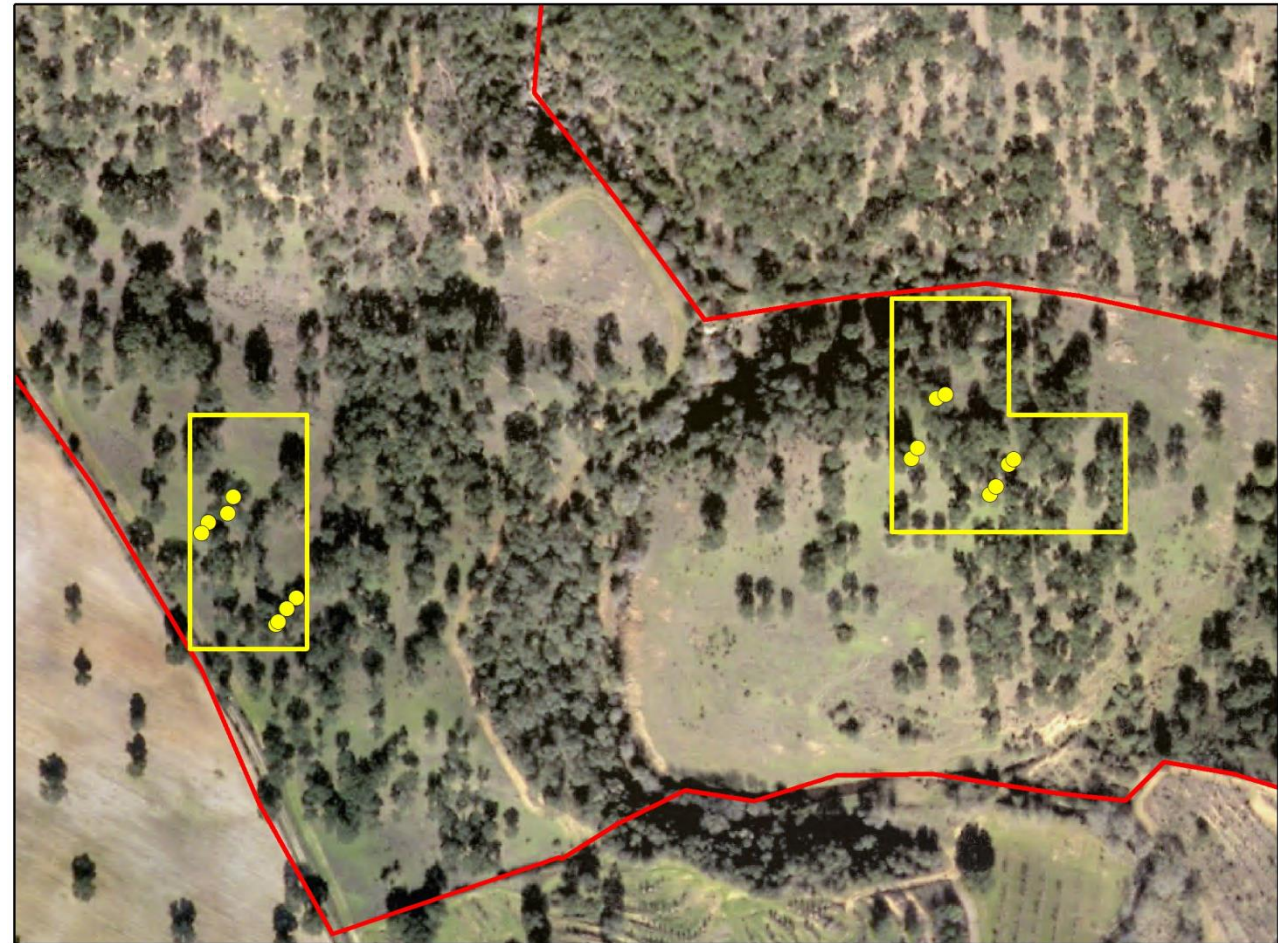Structural characteristics » existing data

Field surveys: a long and complex trajectory to achieve consistency and integration
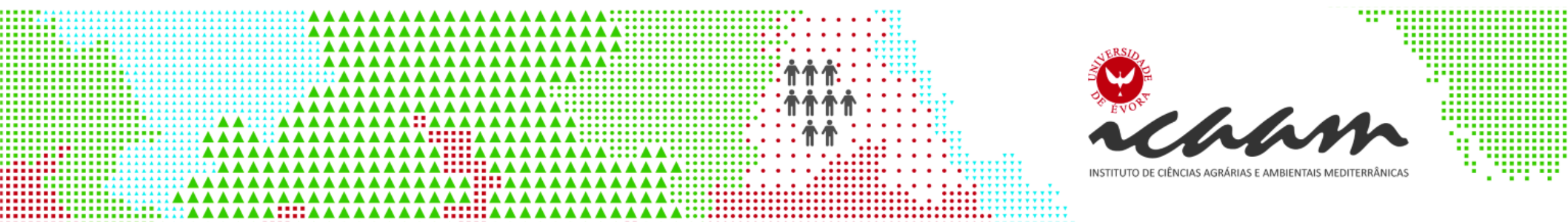
17 farms

30 paddocks

60 plots
previously classified in
two grazing intensity
classes (high and low)

□ SA intersectadas pelos transectos	□ Cercas
● Vértices dos transectos	

0   50 m

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Data: multiple types and series of data

Vegetation
a) Inventory of species presented in the two spatial scales (paddocks and plots);
Data collection made in two periods: Autumn and Spring;
Samplings made under and outside the tree canopy :
200 indicatores plus species distribution;

b) Nutritional value of the pastures (samples analyzed in the laboratory)
Data collection made in two periods: Autumn/Winter and Spring;
Biomass (KgMS/ha), Proteins (%MS) e Fibers (%MS)
14 indicators

d) Assessment of the stands structure (7 indicators), tree health (10 indicators) and other indicators (e.g. year of debarking)

→ e.g.

$$IC = 1 - \prod_{i=1}^{4}\left(1 - \frac{C_i}{100}\right)$$

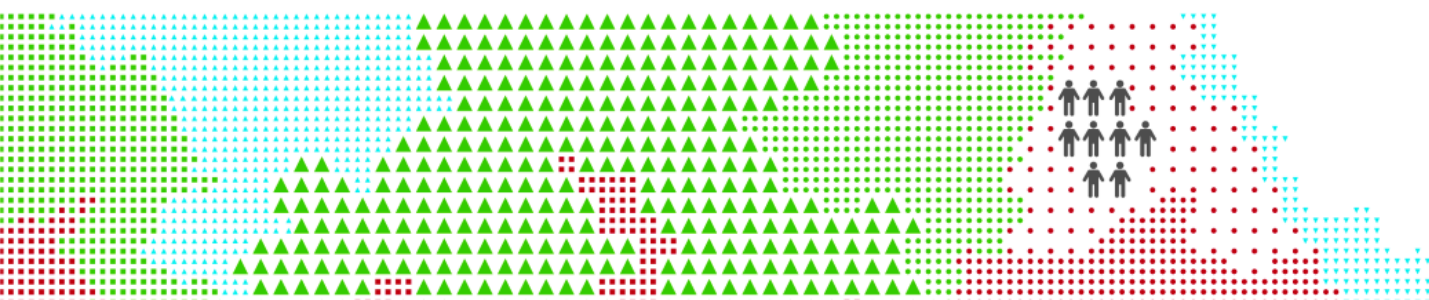$$IA = \frac{C_1 \times 18 + C_2 \times 5 + C_3 \times 1.25 + C_4 \times 0.25}{\sum_{i=1}^{4} C_i}$$

$$IDEA = \frac{\sum_{i=1}^{2} C_i - \sum_{i=3}^{4} C_i}{100}$$

Cover index   *Height index*   *Tree dominance index*

(% considering 4 height classes: <0.5; 0.5-2; 2-8; >8 m)

Data: multiple series and types of data

Macrofungi
e) Presence-absence of 145 species / Species richness

Birds
f) Sampled in Winter and Spring
Specific richness; Functional types; Diversity assessment
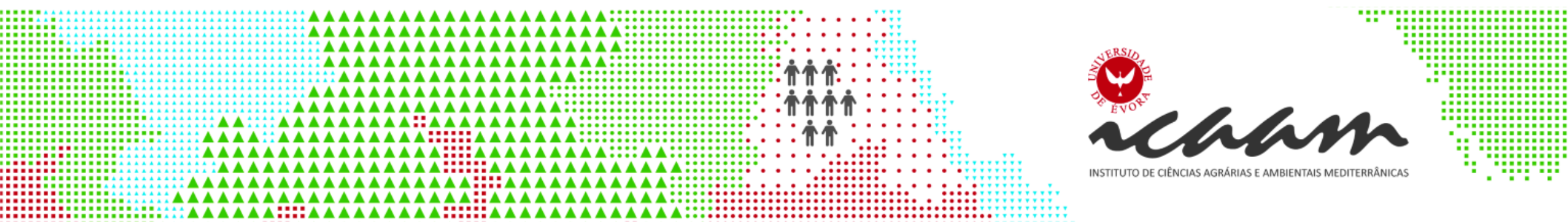
Reptiles
g) Abundances (6 lizards/slow worm/5 snakes)

Landscape/land cover
i) Indicators of landscape heterogeneity and fragmentation; proportion of land cover classes

Indicators derived from Digital Elevation Models
j) Slope angle, aspect, slope position, ruggedness, wetness idex (18 indicators)

Caracterization of the farms – and also of the plots

Categoric indicators…

    dominant specie:
        15 farms with cows
        1 with sheep
        1 with pigs

    grazing management:
        15 farms with rotational grazing

    type of pasture:
        10 improved pastures
        5 natural pastures
        2 mixed

Pure grazing systems:
Cows: 6
Sheep: 1
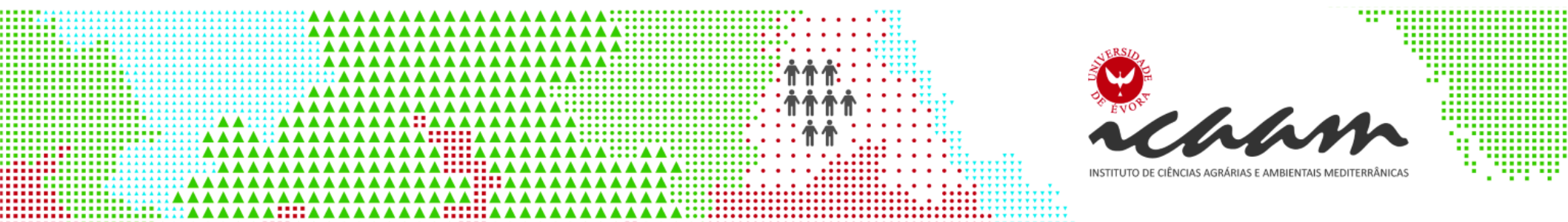Pigs: 1
   = 8

Mixed grazing systems
Cows+Sheep: 5
Cows+Sheep+Pigs: 1
Cows+Pigs: 2
Cows+Pigs+Horses: 1
   = 9

Mean value of livestock
density: 0.51 LU/ha/yr
(máx: 2.23)

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Factors affecting biodiversity in Montado

	Factor 1	Factor 2	Factor 3
Macrof.	0.019	-0.044	**-0.831**
Rep_Pvi	0.187	-0.081	0.673
Rep_Psa	0.028	**-0.778**	0.039
Birds_wint	**0.776**	0.080	0.263
Birds_spr	**0.869**	0.016	-0.091
Div_Veg	0.138	**0.742**	0.049
Expl.Var	1.414	1.170	1.224
Prp.Totl	0.236	0.195	0.204

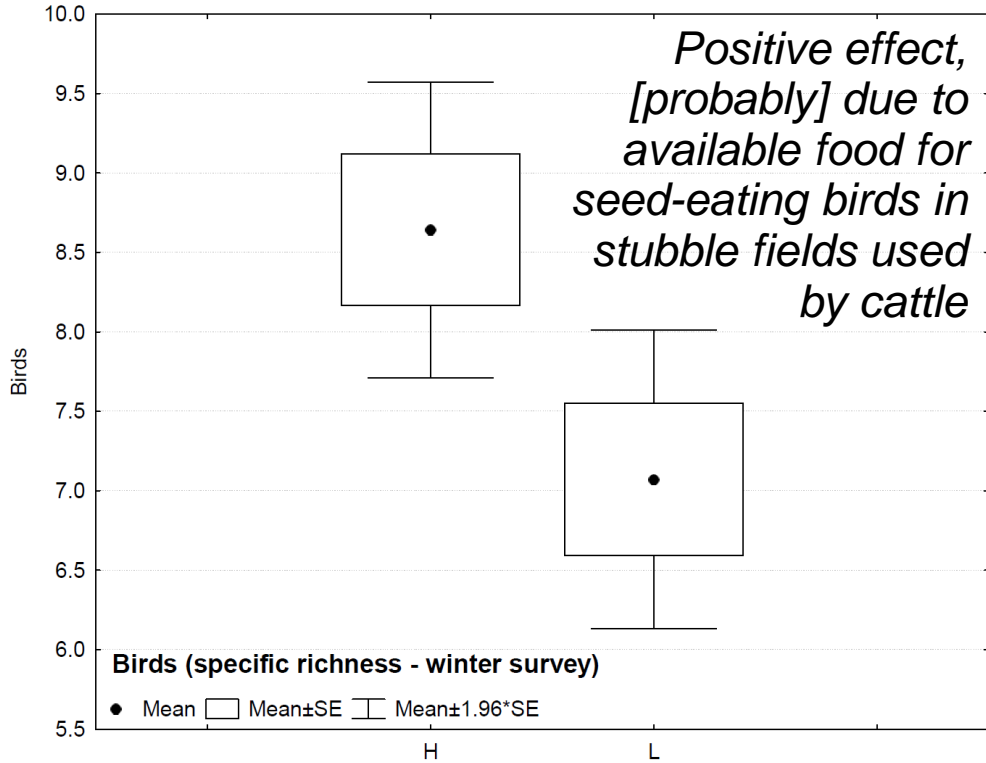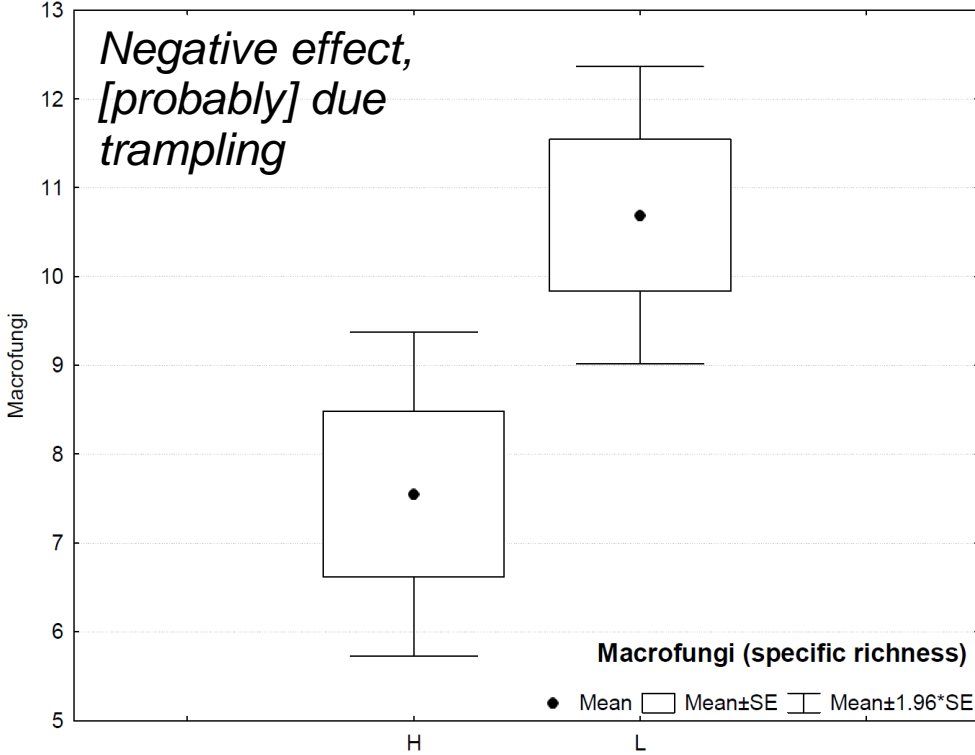**Biodiversity in montados is closely related with stand structure and heterogeneity**
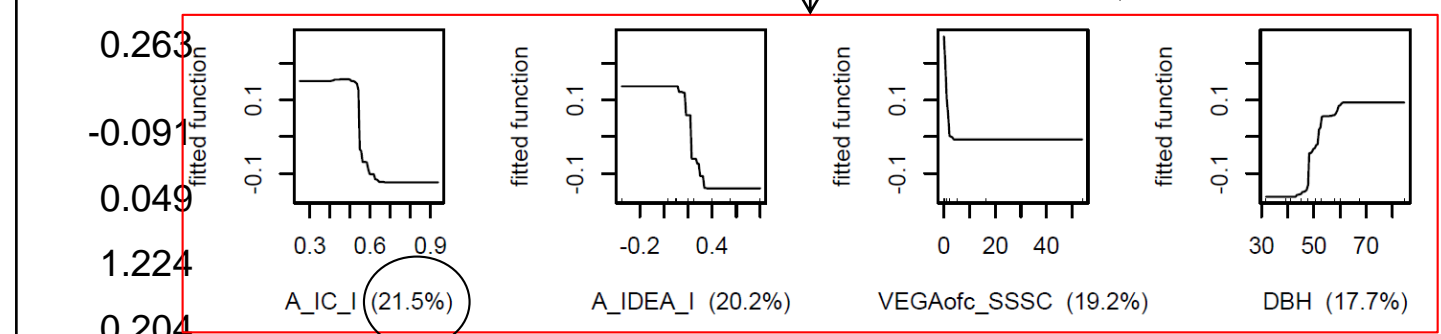
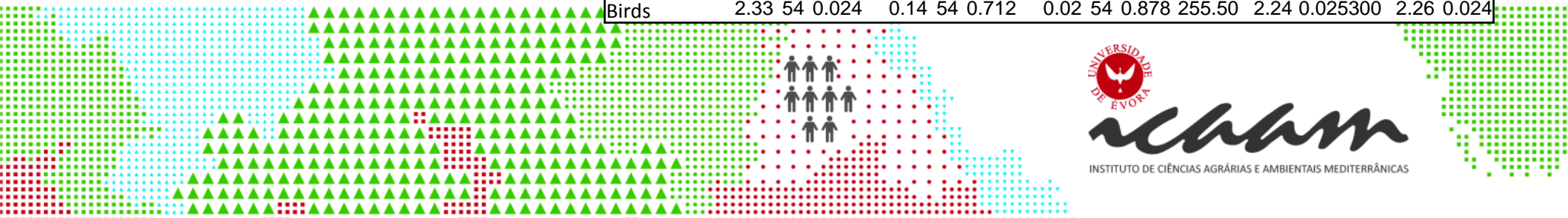**Higher relative influence:** cover index, shrub cover, higher and larger trees
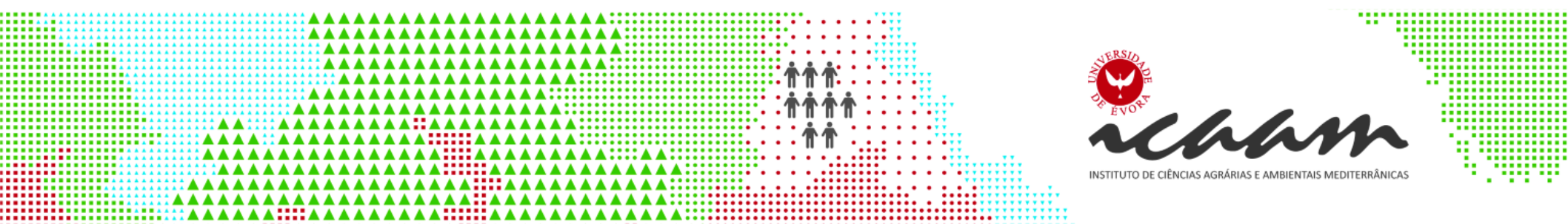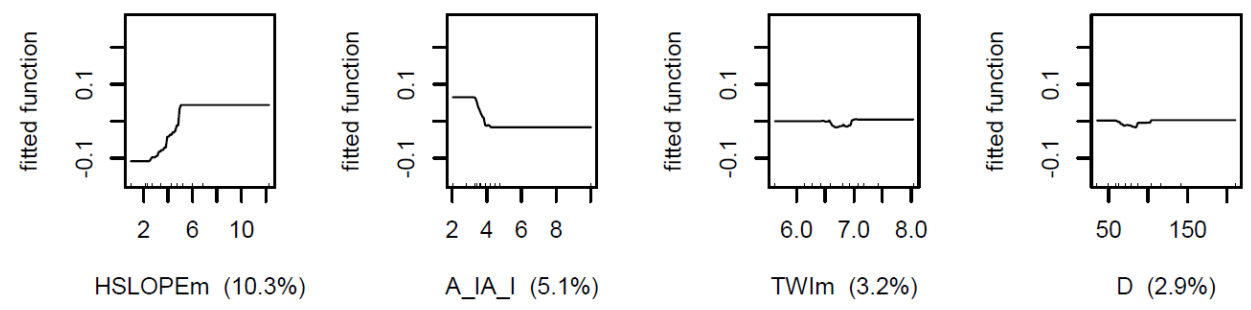
Effects of livestock management on biodiversity

…however there are evidences of direct effects of livestock grazing on biodiversity indicators (assessed through statistical tests)
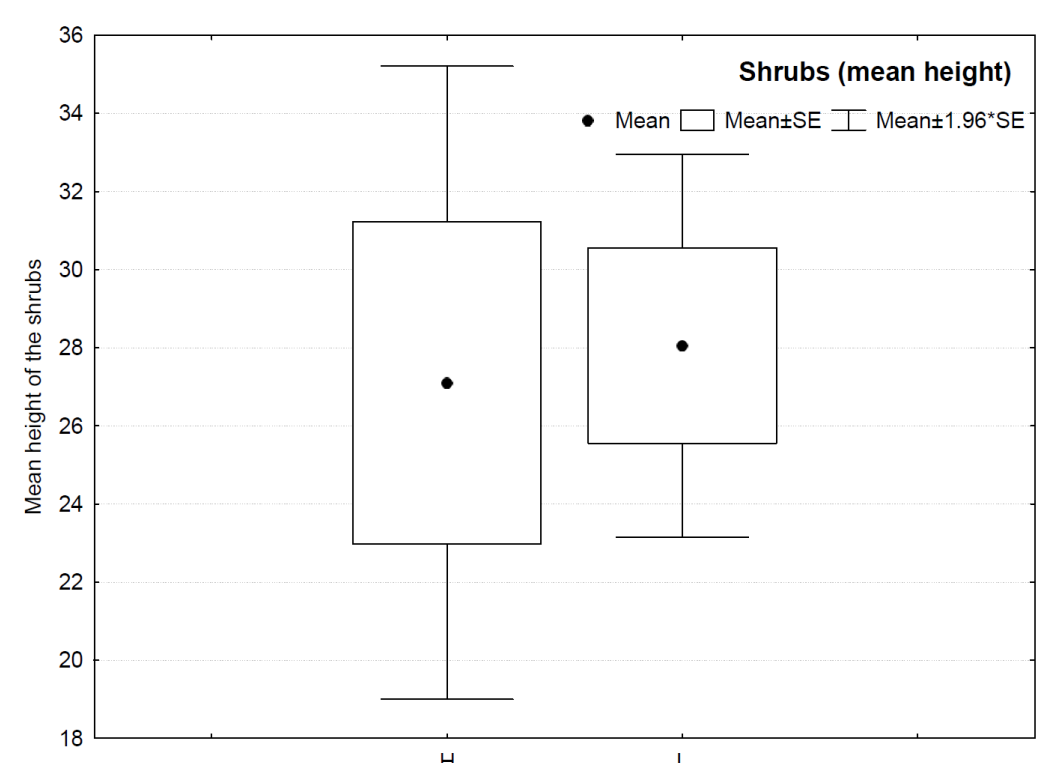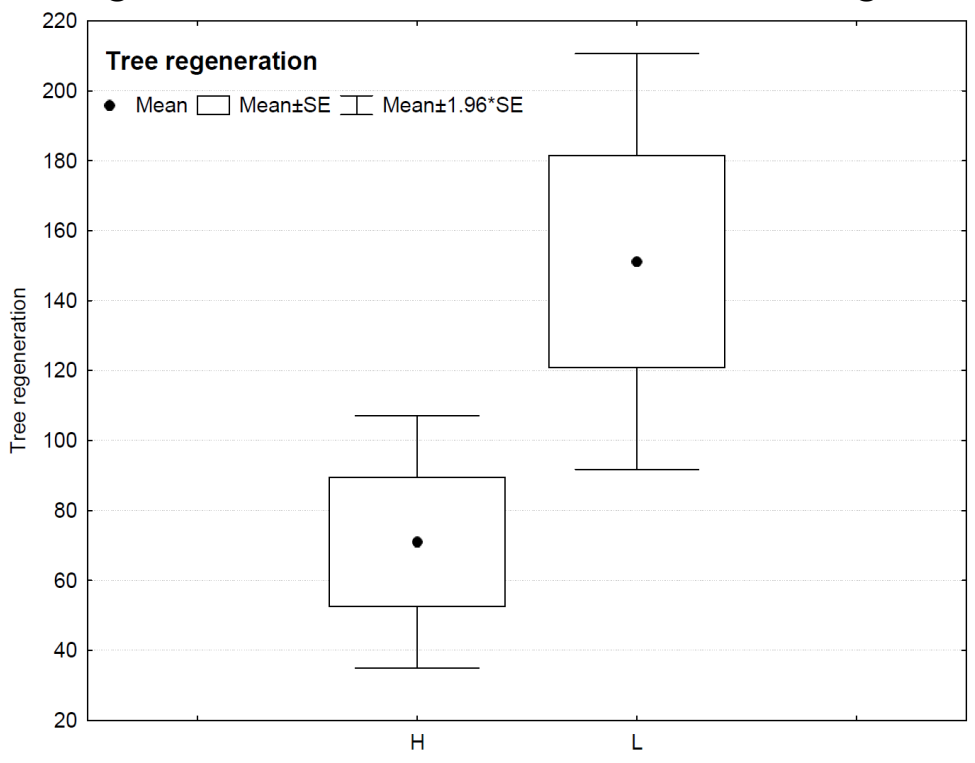

Negative effect, [probably] due trampling

Macrofungi (specific richness)

● Mean ☐ Mean±SE ⊥ Mean±1.96*SE

Positive effect, [probably] due to available food for seed-eating birds in stubble fields used by cattle

Birds (specific richness - winter survey)

● Mean ☐ Mean±SE ⊥ Mean±1.96*SE

Variables	t-test			Levene's test			Brown-Forsythe test			Wilcoxon-Mann-Whitney test				
	t-value	df	p	F(1,df)	df	p	F(1,df)	df	p	U	Z	p	Z-adj	p
Macrofungi	-2.48	56	0.016	0.20	56	0.655	0.19	56	0.661	259.50	-2.50	0.012289	-2.51	0.012
Birds	2.33	54	0.024	0.14	54	0.712	0.02	54	0.878	255.50	2.24	0.025300	2.26	0.024

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Effects of livestock management on biodiversity

…but also of indirect effects, promoting changes in the strucure and composition of vegetation communities and in tree regeneration
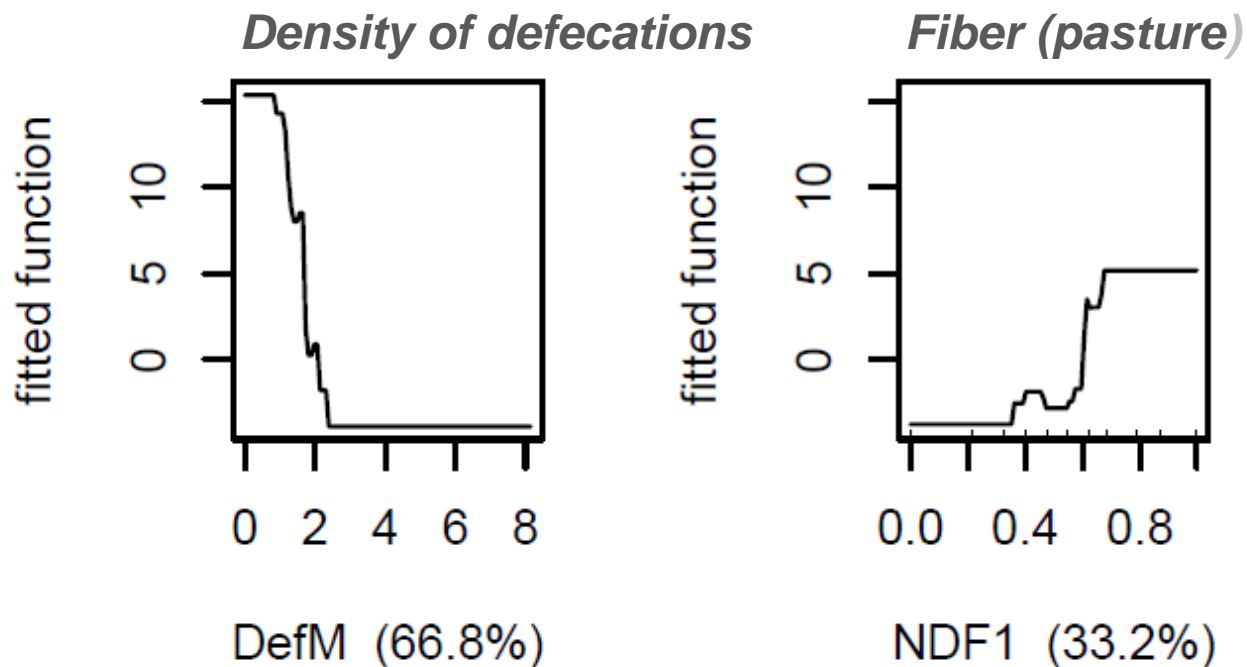

|	t-test			Levene's test			Brown-Forsythe test			Wilcoxon-Mann-Whitney test				
Variables	t-value	df	p	F(1,df)	df	p	F(1,df)	df	p	U	Z	p	Z-adj	p
Tree regeneration	-2.26	56	0.028	9.15	56	0.004	4.51	56	0.038	294.50	-1.96	0.050	-1.97	0.049
Shrubs (mean height)	-2.10	30	0.044	0.53	30	0.472	0.84	30	0.368	75.00	-1.94	0.053	-1.94	0.053
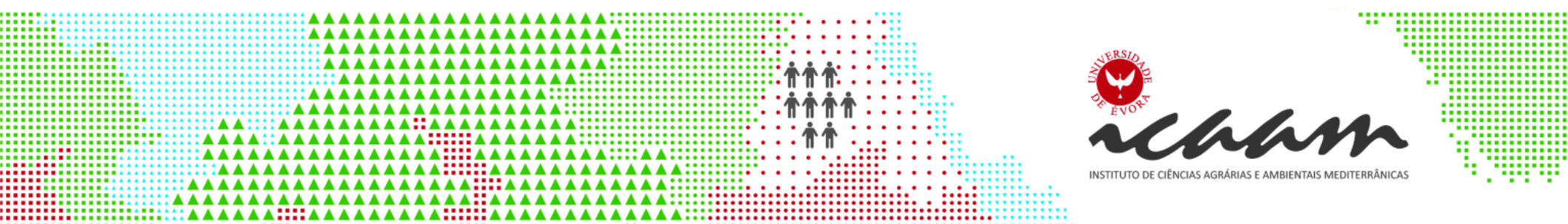
Tree regeneration

OAK'S REGENERATION (assessed through Boosted Regression Trees)

Tree regeneration is strongly affected by livestock density,

however improving quality of the pastures can reduce or minimize this negative effect.
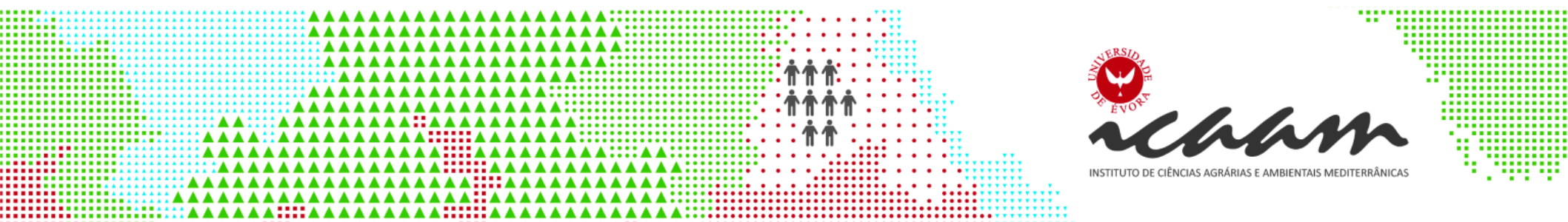
Achievements and way forward

Methodological combination : farm selection and sample design

Disciplinary integration:

get to know each other and each other's tools, aims, and goals

adapt procedures and boundaries

search for new nd unexploited bridges

Awareness raising within land owners and

closer colaboration research-practice

Few consistent data sets: some relevant results,

but mainly better defined and grounded questions

And a confirmation: not all Montados can be equally classified as HNV

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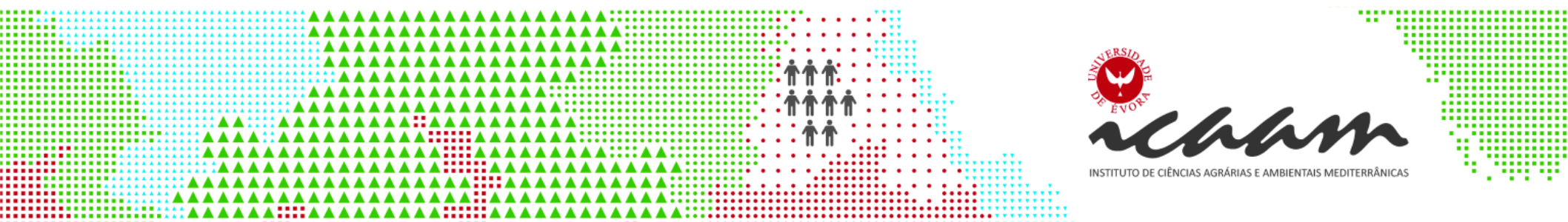
This work in in progress and will continue

All suggestions are welcome

Thank you!

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