LIFE Maronesa

LIFE Climate Governance and Information

Extensive Livestock - a sustainable model that contributes to the mitigation of climate change

LIFE MARONESA

Coordination:

Aguiar Floresta

Partners:

ipb Instituto Politécnico de Bragança

Associação de Criadores do Maronês A.C.M.

CASAL DA BOUÇA

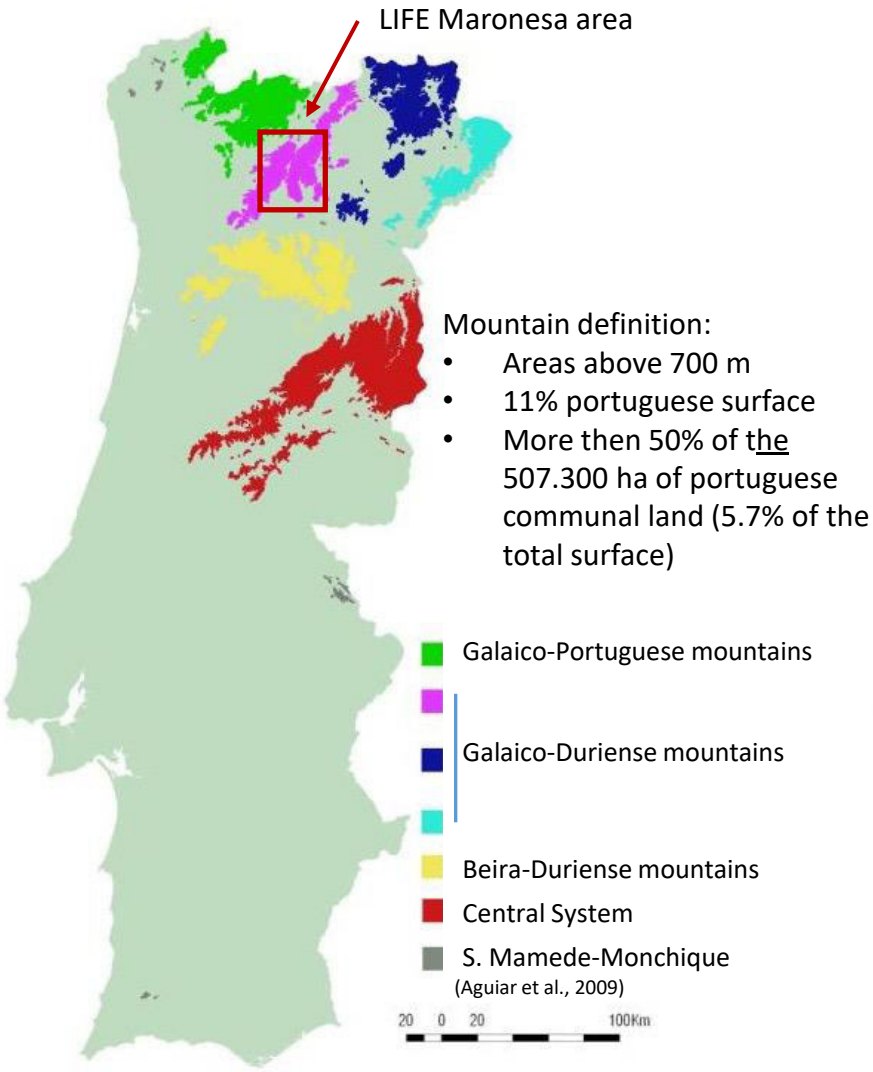
LIFE19 GIC/PT/001285

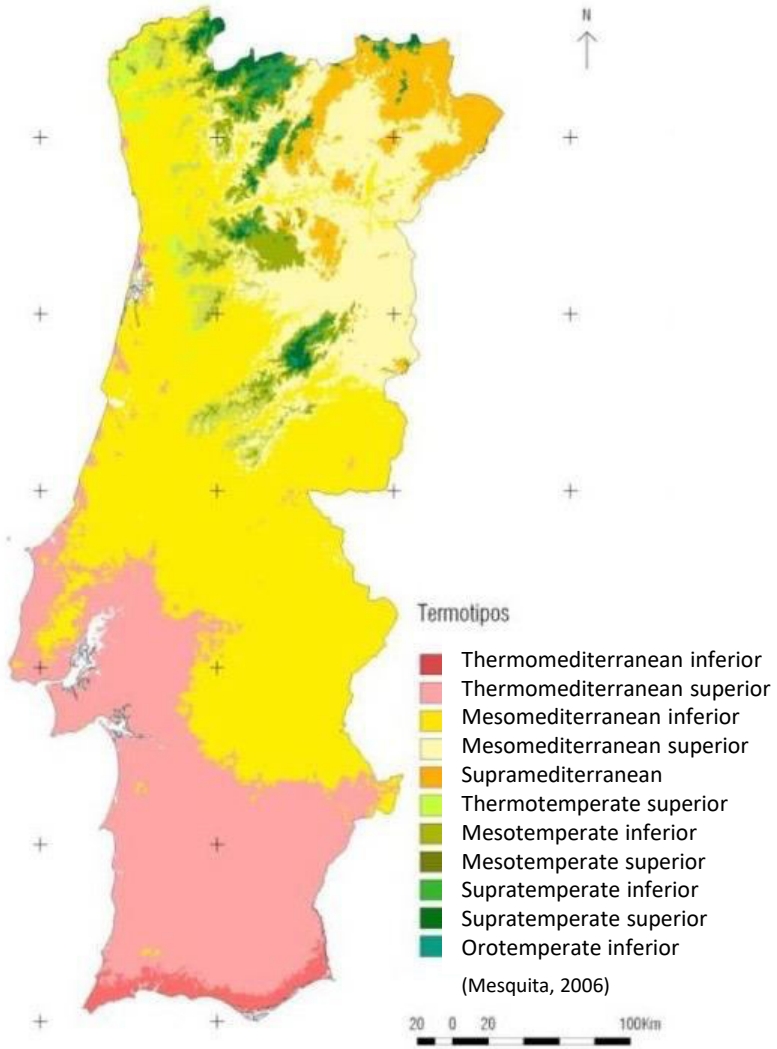
Mountains of northern Portugal

LIFE Maronesa

LIFE Climate Governance and Information

Main portuguese mountain massifs





- Geomorphology
  - "The Portuguese relief is broken down into more or less extensive plateau fragments, more or less elevated, more or less cut by valleys. Almost all topographic features are scarps that separate plateaus of different altitudes." (BIROT, 1950)
  - See figure
- Bioclimatology
  - See figure

Lithology and soil fertility

	%	pH		mg kg^{-1}		Cmol(+) kg $^{-1}$						mg kg^{-1}
Parameter	M.O	H_2O	KCl	P_2O_5	K_2O	Ca^{++}	Mg^{++}	K^+	Na^+	AT NaOH	Cation exchange capacity	B
Hay meadows (n=27)												
Mean	5,22	5,47	4,39	11,03	84,26	1,37	0,48	0,18	0,24	1,84	4,11	0,44
SD	1,21	0,12	0,05	1,77	17,28	0,31	0,08	0,04	0,09	0,49	0,74	0,27
Qualification	Very high	Acid		Very low	Medium	Very low	Very low	Low	Low		Very low	Medium
Rangelands (n=24)												
Mean	7,96	4,66	3,96	15,92	83,68	0,64	0,39	0,22	0,43	3,77	5,45	0,81
SD	4,76	0,16	0,13	5,88	33,75	0,22	0,11	0,11	0,22	1,29	1,65	0,25
Qualification	Very high	Acid		Very low	Medium	Very low	Very low	Low	Low		Low	Medium
T test												
Significancy	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	n.s.	<0,01	<0,01

- Lithology
  - Acid rocks: granits or schists
- Soils
  - Leptosoils or regosoils
  - Low chemical fertility (vd. table)

Grazing lands and local breeds

‘Maronesa’ cattle grazing in hay meadows (private land)

‘Maronesa’ cattle grazing in well managed rangelands (common land)

‘Bravia’ goat browsing in heavily burned rangelands (common land)

Grazing lands

Productivity and stocking rate (Souto and Outeiro common rangelands)

Rangelands cattle grazing days and stocking rate (Casal da Bouça farm)			
	nº	AU	Rangeland grazing days
Cows	117	0,8	195
Heifers	23	0,6	209
Bulls	5	1	184
Rangeland (ha)	410,2		
AU/ha	0,15	Conversion in cows/ha	0,12

Maronesa cow								
Mean adult female weight (LW) (kg)	Ingestion of rangeland forrage DM (% LW)	Ingestion of hay meadow forrage DM (% LW)	Rangeland grazing (days)	Shrubs in the rangeland grazing diet (%)	Hay meadow grazing (days)	Hay ingestion (days)	Shrub water content (%)	Hay water content (%)
425	2,20%	2,50%	195,00	40%	45	125,00	40%	15%
Annual DM ingestion (kg DM/cow.yr)	Mean DM diary ingestion (kg DM/cow.day)	Daily ingestion of shrubs DM during grazing (kg DM/cow.day)	Annual ingestion of shrub DM during rangeland grazing (kg DM/cow.yr)	Annual ingestion of grass DM during rangeland grazing (kg DM/cow.yr)	Annual ingestion of grass DM during hay meadow grazing (kg DM/cow.yr)	Annual ingestion of hay DM (kg DM/cow.yr)	Annual grass DM ingestion (hay + hay meadow and rangeland grass) (kg DM/cow.yr)	Annual ingestion of shrubs GM during rangeland grazing (kg GM/cow.yr)
3629,5	9,9	3,7	729,3	1094,0	478,1	1328,1	2900,2	1215,5

Bravia goat				
Mean adult female weight (LW) (kg)	Mean adult female metabolic weight (MW) (LW^0.75)	Ingestion (g DM/kg LW^0.75)	Daily DM ingestion (kg/day.goat)	
35	14,4	54	0,78	
Rangeland grazing period (months)	Shrubs in the rangeland diet (%)	Shrub water content (%)	Hay water content (%)	
11,5	60%	40%	15%	
Annual DM ingestion (kg DM/goat.yr)	Annual ingestion of shrub DM during rangeland browsing (kg DM/goat.yr)	Annual ingestion of grass DM during rangeland browsing (kg DM/goat.yr)	Annual ingestion of hay DM (kg DM/goat.yr)	Annual ingestion of grass DM (hay + rangeland grass) (kg DM/goat.yr)
283,6	163,1	108,7	11,8	120,5

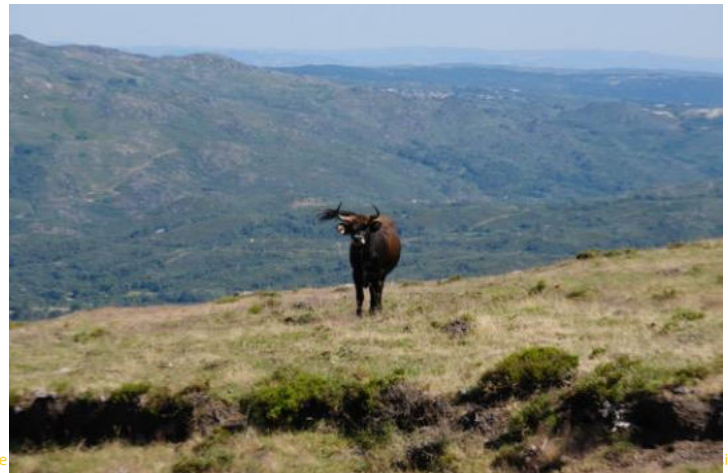
	Shrub DM /grass DM (annual ingestion)
Goat (12,8 goats=1cow)	1,4
Cow	0,3

Landscape of temperate mountains in the recent past

Rangelands

Serra do Marão, beginnings of the XX century

Mesomediterranean grassland of *Poa bulbosa* sustained by pastoral fire and goat grazing



Supratemperate grassland of *A. capillaris* sustained by pastoral fire and cattle and goat grazing

Landscape of temperate mountains in the recent past

Hay meadows

Hay meadows of *Holcus lanatus* with a potencial DM production above 10 t DM/ha

Actual drivers of change

↓ Agriculture abandonment

↑ Pinus plantations

↓ Cultivated area

↓ Grazing disturbance

↑ Wildfire intensity

↓ Nutrient cycling

↓ Managment knowledge and intensity of grazing lands

Rangelands

↓ Phytocoenosis diversity

↑ Shrub encroachment

↑ Annual/bienal grasslands

↓ Perennial grasslands

↓ Soil cover

↓ Soil organic carbon (SOC) stock

↓ Forage productivity

↓ Stocking rate

Hay meadows

↓ Area

↓ Soil fertility

↓ Phytocoenosis diversity (landscape scale)

↓ Species diversity

↓ Productivity

↓ Stocking rate

LIFE Maronesa

LIFE Climate Governance and Information

Rangelands

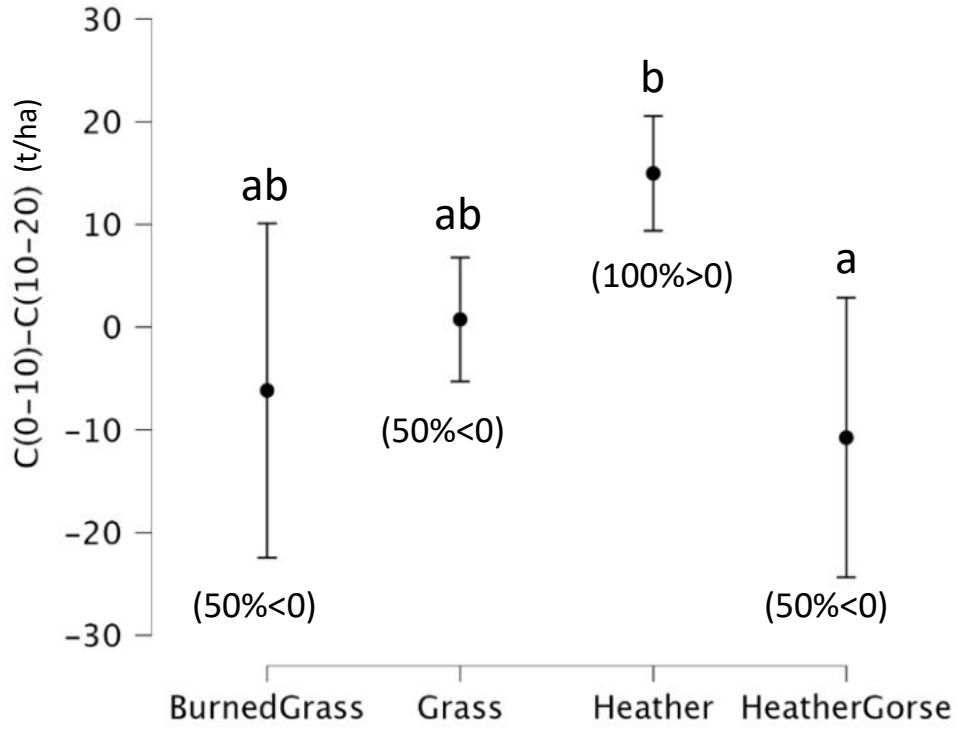
Main species: *Erica australis, E. arborea, E. umbelata, E. cinerea, Halimium alyssoides, Pterospartum tridentatum* subsp. *cantabricum, Ulex minor, Pseudarrhenatherum longifolium*

LIFE Maronesa

LIFE Climate Governance and Information

Rangelands

Shrub encroachment, wildfires and SOC



SOC (0-10 cm) – SOC (10-20 cm) (t C/ha) in four rangeland vegetation types (n=6 rep x 4 veg types) (ANOVA, Tukey test)

Soil collapse caused by the mineralization of soil organic matter following de wildfire of 2016

Rangelands

Competitive exclusion of grasses and forbs

Wildfires and flora turnover

Shrub encroachment and the competitive exclusion of grasses and forbs (noticeable with shrubs above 50-60 cm)

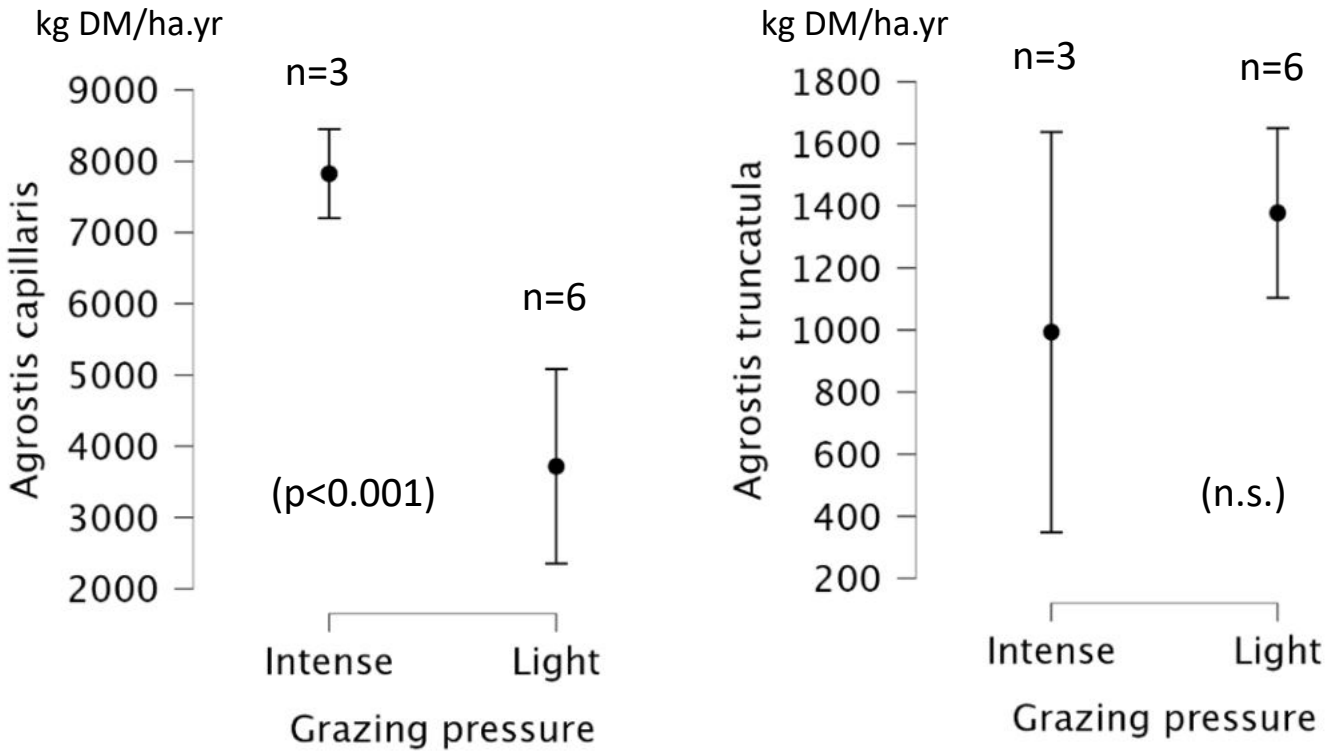
Summer high intensity wildfires

Agrostis capillaris

Agrostis truncatula subsp. *durieui*

Rangelands
Flora turnover and productivity

LIFE Maronesa rangeland monitoring plot in a wildfire damaged area



Productivity of grass **pure stands** with 8 yrs. of cattle grazing following the 2016 wildfire (ANOVA)

LIFE Maronesa

LIFE Climate Governance and Information

Hay meadows

Main species: *Holcus lanatus, Cynosurus cristatus, Arrhenatherum bulbosum, Agrostis capillaris, Trifolium dubium, T. pratense, T. repens, Hypochaeris radicata*

Hay meadows Abandonment

Land use transition matrix (1958-2017) (Montesinho mountain, northeastern Portugal)

	2017																						
Land use type	111	112	121	131	133	211	212	221	222	232	242	243	244	311	312	313	321	322	324	332	333	512	Total area (ha) (1958)
112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
131	0.0	0.0	0.0	18.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7
133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
211	0.5	1.9	1.4	0.0	0.0	44.9	0.0	0.0	41.2	11.3	14.9	3.6	4.1	43.2	43.7	9.8	18.5	523.8	55.6	0.0	0.0	0.0	818.2
212	0.7	0.3	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.8	10.9	0.0	0.0	1.7	0.0	0.0	0.4	1.0	0.0	0.0	0.0	0.0	19.2
221	0.4	1.5	0.0	0.0	0.0	0.2	0.0	0.9	0.0	0.0	4.8	0.5	0.0	2.3	1.4	0.0	0.0	7.7	0.0	0.0	0.0	0.0	19.6
222	1.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.9	0.1	1.4	0.0	0.0	10.1	0.2	2.3	0.0	2.3	0.1	0.0	0.0	0.0	18.8
232	1.1	0.0	0.0	0.0	0.0	6.2	0.0	0.0	1.5	91.5	4.0	1.6	12.8	27.4	4.3	3.7	40.8	65.1	2.8	0.0	6.2	0.9	269.7
242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
243	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
244	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	16.4	0.0	0.0	7.3	47.5	0.5	1.0	0.2	2.0	2.9	0.0	1.3	1.1	80.8
311	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	6.9	0.4	0.4	5.7	69.0	22.1	10.2	1.4	27.9	0.6	0.0	0.6	0.0	145.3
312	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.5	0.1	0.0	0.0	0.0	2.4	33.5	1.6	0.0	4.4	0.4	0.0	0.0	0.0	43.7
313	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.3	2.6	0.0	0.5	0.0	0.0	0.0	0.0	6.2
321	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.0	0.3	1.6	0.0	0.0	0.6	0.5	2.1	0.0	20.7	52.6	12.4	0.0	24.9	0.1	117.9
322	0.9	0.6	0.1	0.0	4.9	16.4	0.0	0.3	16.8	8.5	6.6	0.0	4.4	74.1	222.2	18.5	37.3	1477.0	313.0	0.0	224.9	25.3	2451.8
324	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	1.2	0.8	0.0	0.0	33.6	241.9	3.4	0.0	150.0	48.9	0.0	1.5	0.0	481.8
332	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	759.1	0.0	0.0	759.1
333	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
512	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total area (ha) (2017)	22.9	4.3	1.5	18.7	5.5	74.1	0.0	1.2	61.7	138.4	43.8	6.1	34.9	313.5	573.2	53.1	119.2	2314.3	436.6	759.1	259.4	27.4	5269.1

(Castro & Aguiar, 2019)

232 hay-meadows: 269.7 ha (1958)–> 138.4 ha (2017) [- 48,7%]

211 cereals: 818.2 ha (1958) -> 74.1 ha (2017) [-90,9%]; 523.8 ha converted to shrublands (322)

312 *Pinus pinaster* plantations: 43.7ha (1958) -> 573.2 ha (1958) [+ 1211%]

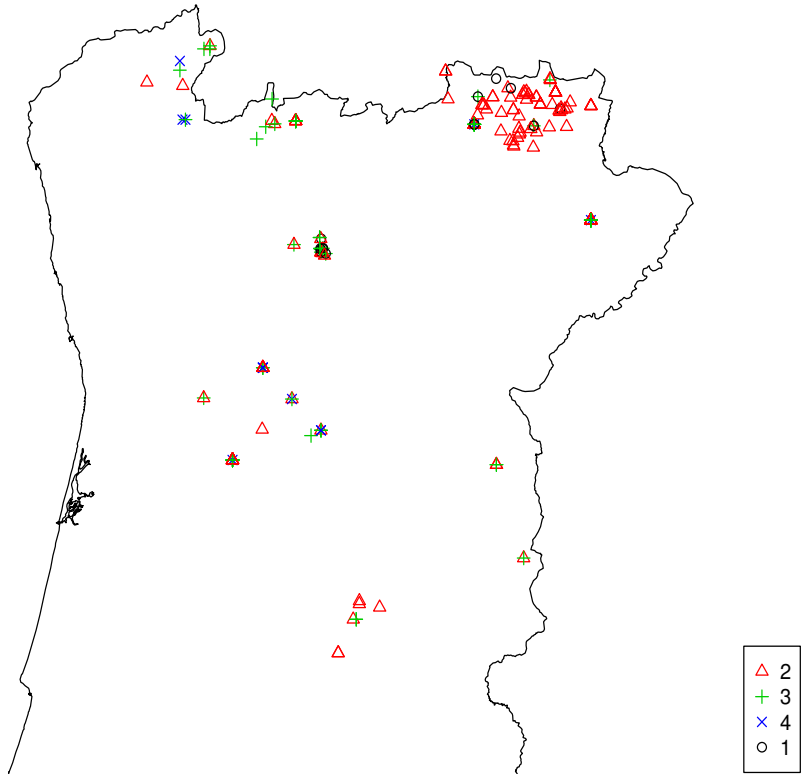
Hay meadows

Evaluation of the floristic quality (Aguiar & Monteiro-Henriques 2019)

- Criteria
  - **Level 4:** Presence of indicators of good state of conservation : ≥ 6
  - **Level 3:** Presence of indicators of good state of conservation : 3 - 5
  - **Level 2**: Presence of indicators of good state of conservation : 0 - 2
  - **Level 1**: Presence of indicators of good state of conservation : depends on the number of sanctions
- Sanctions
  - The degree of conservation goes down to 1 level until reaching level 1 if the cumulative coverage (%):
    - **Annual nitrophilous plants** > 33%
    - **Perennial nitrophilous plants** > 33%
    - **Annual and biannual oligotrophic plants** > 33%
    - **Clonal plants** > 15%
    - **Trees and bushes** > 10%

Hay meadows

Evaluation of the floristic quality (Aguiar & Monteiro-Henriques 2019)



Relévès distribution (degree of conservation)

Diachronic evolution of the degree of conservation

Levels	Historical relévès (< 2000)	Actual rélèves (≥ 2000)
4	7.8%	2.4%
3	41.7%	17.5%
2	47.0%	69.0%
1	3.5%	11.1%

Hay meadows

Causes of floristic impoverishment and reduced productivity

Trends

- > soil acidity
- < nutriente bioavailability (e.g. calcium, boron, phosphorous)
- < legumes
- < dicots with large flowers or inflorescences
- > clonal species; e.g., *Mentha suaveolens, Brachypodium rupestre*
- > acidophilous species; e.g., *Festuca rothmaleri, Danthonia decumbens, Nardus stricta*
- > low palability species; e.g. anual *Geranium*
- Structural simplification – colapse of the *Holcus lanatus* layer
- < crude protein and digestibility
- < productivity

LIFE Maronesa hay meadow experimental plots
Treatments: Ca 0, 1; N 0, 1, 2; herbivory 0, 1, 2

Hay meadows

Causes of floristic impoverishment and reduced productivity

Causes

- > nutrient export
  - > hay consumed ouside the system
  - < nutrient return by manure or chemical fertilization
- < autumn and late winter grazing
- < hedge management
- < cattle dung spread
- < traditional irrigation systems
- < manual control of clonal plants
- < reseeding
  - Earlier hay making dates
  - > hay making and transport eficiency

Mr. Augustinho Alves, one of our best hay meadows informants, with a three-slot yoke still used for taming cows

"When the goats disappeared, the hay meadows [production] ended", says the shepherdess Clementina Vale

LIFE Maronesa

LIFE Maronesa

LIFE Climate Governance and Information

Geographic area of intervention

The geographical area of intervention of the LIFE Maronesa project covers the following municipalities:

- Vila Pouca de Aguiar
- Ribeira de Pena
- Mondim de Basto
- Vila Real
- Vila Pouca de Aguiar - demonstration area

Remaining municipalities - replication areas of the extensive production model and by the following producers.

Hay meadows
Goals and procedures

LIFE Maronesa
LIFE Climate Governance and Information

Short term goals

- > area
  - < *Cytisus* sp.pl. cover (landscape scale)
- < fire risk
- > specific diversity
- > habitat heterogeneity
- > *Holcus lanatus* cover
- > legume cover and nitrogen fixation
- > productivity and hay quality (protein)
- > farmer's work efficiency

Procedures

- > restoration of hay meadows from thickets of *Cytisus* sp.pl
- > grazing pressure before the closure of the hay meadows
- Hay making after the beginning of *Holcus lanatus* spikelets disarticulation
- > seed dispersal through hay spread inside the hay meadows for direct cattle feed during winter
- > cattle using rural ground roads
- > water from rural ground roads directed towards hay meadows
- Aplication of a low dose of magnesium limestone (500 kg/ha)
- Aplication of 30-40 kg P_2O_5/ha

Hay meadows
Goals and procedures

LIFE Maronesa
LIFE Climate Governance and Information

Programing the application of magnesium limestone

Before

After

Hay meadows restauration using tractor shredder followed by (i) hay distribution for consumption *in situ* and (ii) vegetation cover stabilization with grazing

Rangelands
Goals and procedures

LIFE Maronesa
LIFE Climate Governance and Information

Short term goals

- < fire return interval
- < fire intensity
- > vegetation heterogeneity
- < *Agrostis trucatula* cover
- > perennial grasses cover (e.g. *Pseudarrhenatherum, Avenula, A. capillaris*)
- < *Cystisus* sp.pl. cover
- > forage productivity and quality
- > soil carbon sequestration
- > soil fertility
- > farmer's work efficiency

Procedures

- > grazing pressure
  - > rangeland grazing period (+ 15 days – 1 month)
  - > cattle overnight stay in the rangeland
- Hay spread in the rangeland for direct cattle feed
- > prescribed fire (preferably when shrubs > 60 cm)
- > fencing
- > canadian fences
- > manger distribution through the rangeland
- > GPS collars
- > Temple Grandin handling cattle systems
- Rotational mixed grazing (nearby future)

Rangelands
Goals and procedures: increased grazing pressure

Herbivory exclusion fences: mesic (above) and wet soils (below)

Undergrazed vegetation with increasing fire risk

Seed dispersal by cattle dung

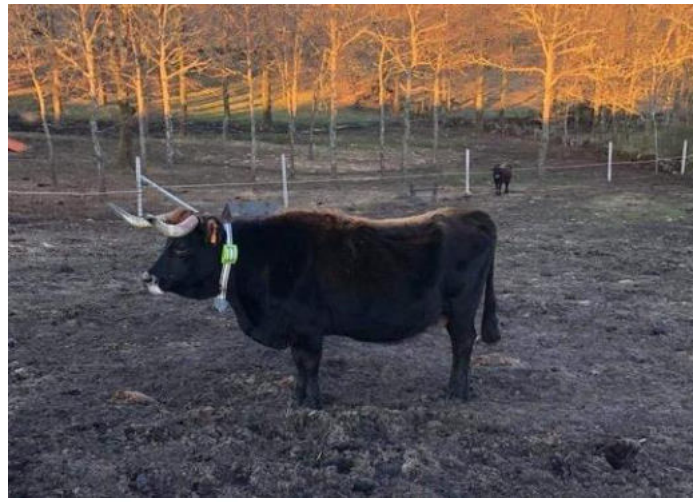
Carduus asturicus, an endemic thistle of NW Iberia dependent of cattle dung depositions

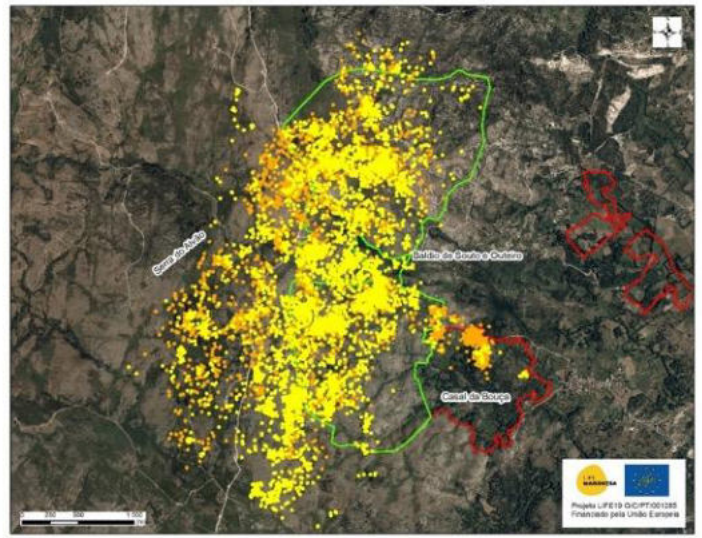
Rangelands

Goals and procedures: improved cattle management

Manger effect in the surrounding vegetation

Low-stress cattle handling system of Casal da Bouça farm (Vila Pouca de Aguiar)





1 year of monitoring data with GPS collars of the cattle herd of the Casal da Bouça farm

Rangelands

Goals and procedures: prescribed fire

Prescribed fire training for shepherds developed with the cooperation of the LIFE Maronesa Project.

Instead of heathers (*Erica australis* and *E. arborea*) and gorse (*Ulex minor*), brooms (*Cytisus* sp.pl.) are avoided by cattle. The brooms also have the disadvantage of practically only burning in the summer, increasing the risk of high intensity fires that damage de soil.

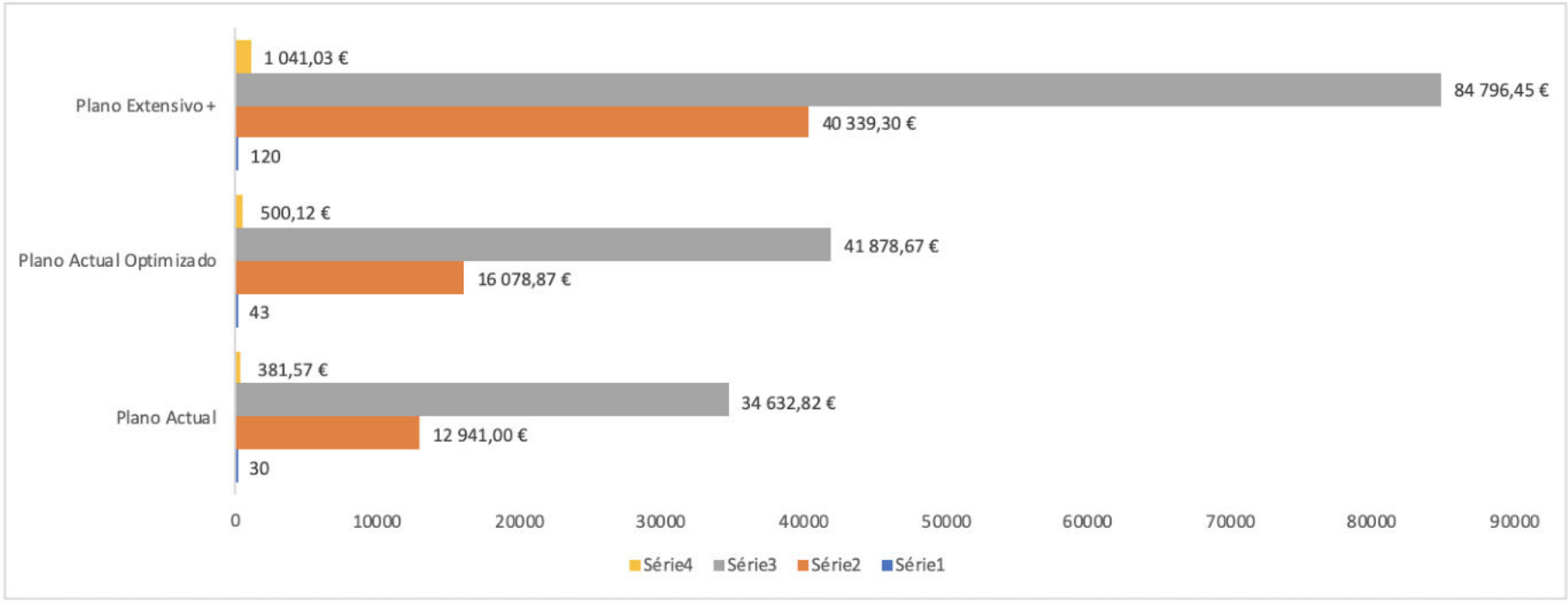
Agrostis capillaris

Prescribed fire preserves the rhizomes of this species

Recover of *Arrhenatherum bulbosum* after a winter prescribed fire in a *Cytisus* ticket

Income from cattle rearing in temperate mountains

	Evolução Exploração				
	Model	Cows & heifers	Expenses	Revenues (Inc. EU aids)	Monthly gross income
	Modelo	Efectivo Animal	Despesas	Receitas	Rendimento mensal pago ao Agricultor
Actual model	Plano Actual	30	12 941,00 €	34 632,82 €	381,57 €
Optimized actual model	Plano Actual Optimizado	43	16 078,87 €	41 878,67 €	500,12 €
Extensive model	Plano Extensivo +	120	40 339,30 €	84 796,45 €	1 041,03 €



Conversion of the Avelino Rego exploration to the extensive system:

- 7 months of mountain grazing
- 29% increase in hay meadow productivity
- Ca. 55% of EU aids

LIFE Maronesa
LIFE Climate Governance and Information

Obrigado pela atenção
(Thank you for your attention)

LIFE Maronesa

LIFE Climate Governance and Information

Project LIFE19 GIC/PT/001285

Main species: *Quercus pyrenaica, Genista falcata, Pteridium aquilinum, Poa nemoralis, Holcus mollis*

The extensive cattle production is a important tool in forest conservation in fire prone landscapes