Maritime pine stand development after fire disturbance: a case study in centre inland of Portugal

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Introduction

Pure, naturally regenerated, maritime pine stands dominate the forest scenario of centre inland of Portugal, resulting in an high fire risk mostly due to the absence of management (vertical and horizontal continuity of fuel).

In this study, the working hypothesis was that natural regeneration in burned areas of maritime pine stands will be suppressed after more than one fire cycle shorter then 20 years, since seed production became viable only when stand age reaches 20 years old (Oliveira et al., 1990).

Materials and methods

In 2007 a forest inventory was conducted in the study area (Martins, 2007). Sampling intensity was assessed based on yield data variability from previous studies. A grid of 500 m was used to set a systematic sampling of 60 plots in the field (Fig. 1).

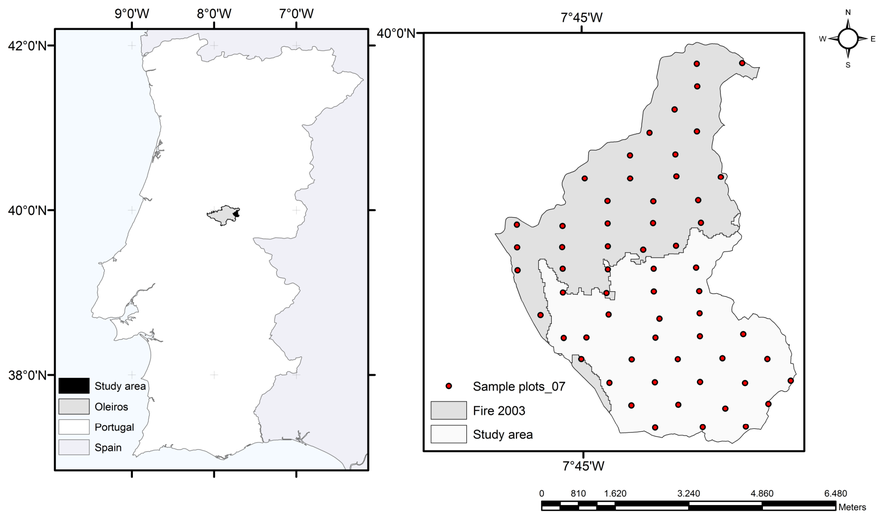


Figure 1. Geographical location of the study area and sample plots in 2007 inventory

Results

Forests and semi-natural areas dominate the study area land cover (90%) being 78% of these pure maritime pine stands (Fig. 2). Several changes occurred since the 90's land cover map production (COS'90) due to forest fires in 1991, 1992, 1995 and 2003 (Fig. 2).

Stand data was collected in 29 plot samples (Fig. 2 and Tab. 1). The remaining 31 plot samples were located in burned area: tall regeneration was found in 8 plots, short regeneration in 10 plots and bush land in 13 plots (Fig. 2 and Tab. 2). Comparative analysis of the understory was also made in the stand areas and in the burned areas with and without regeneration (Fig. 3).

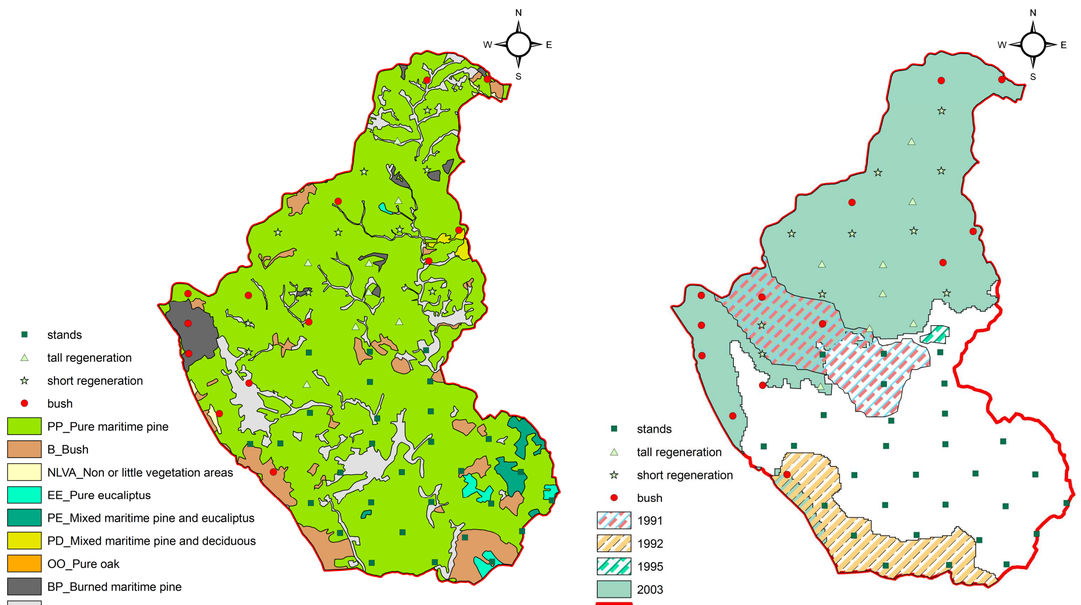
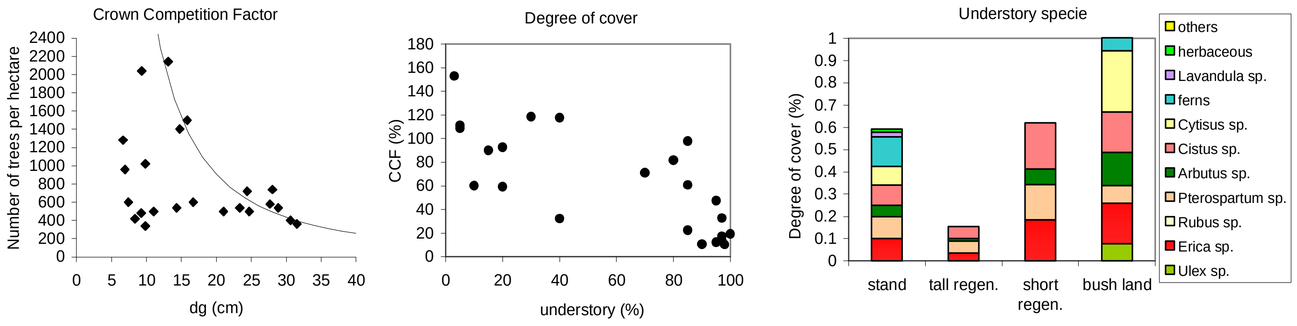


Figure 2. Land cover in 1990, burned areas in 1990, 1991, 1992, 1995 and 2003 and sample plots in stands and in burned areas (tall regeneration, short regeneration and bush land)



specie proportion in the stand areas and in the burned areas with regeneration (tall and short) and without regeneration (bush land).

Table 1. Data summary statistics - Sample plots in stands

Variable	Units	*n*	Minimum	Maximum	Mean	SD
N	arv.ha^{-1}	25	340	2800	970	731
G	m^{2}.ha^{-1}	25	2.3	45.7	18.0	12.8
dg	cm	25	6.6	31.6	16.4	8.5
$\bar{h}$	m	25	6.3	21.3	12.6	5.1
ddom	cm	25	7.5	25.6	15.1	5.2
hdom	m	25	8.8	40.3	22.9	10.8
CCF	%	25	10.3	153.0	65.5	42.3
c(*SDI*)	-	25	0.07	1.11	0.47	0.31
Fw	-	25	0.15	0.61	0.28	0.13
SDI	-	25	57.6	911.3	386.4	253.8
$\bar{t}$	years	25	7	40	21	11
SI_{35}	-	25	14	29	20	4
Sh_{25}	-	25	11	20	16	3
id	cm.year^{-1}	25	0.5	1.3	0.8	0.2
ih	m.year^{-1}	25	0.5	1.7	0.8	0.3
iV	m^{3}. ha^{-1}.year^{-1}	25	1.0	11.5	5.3	3.4
V	m^{3}.ha^{-1}	25	10.5	461.4	133.8	122.1
Nr	arv.ha^{-1}	9	20	960	347	332
Nrt	arv.ha^{-1}	8	20	960	338	354
Nrs	arv.ha^{-1}	1	420	420	420	
$\bar{tr}$	years	7	6	15	9	3
UDC	%	23	3	100	59	38

Table 2. Data summary statistics - sample plots in burned areas

sample plots with tall regeneration (*n*=8)						
Nrt	arv.ha^{-1}	8	1000	50000	32625	15519
$\bar{tr}$	years	8	3	4	4	0
UDC	%	6	10	30	18	8
sample plots with short regeneration (*n*=10)						
Nrs	arv.ha^{-1}	10	300	30000	8442	10860
$\bar{tr}$	years	10	2	4	3	1
UDC	%	8	10	90	62	32
sample plots with no regeneration (*n*=13)						
UDC	%	13	95	100	100	1

Table 3. Symbols

CCF - crown competition factor

ddom - quadratic mean dominant diameter, e.g. the 100 trees of largest dbh per hectare

dg - quadratic mean diameter at breast height (dbh)

Fw - Wilson´s factor

G - basal area per hectare

$\bar{h}$ - average height

hdom - average dominant height, e.g. the 100 trees of largest dbh per hectare

N - number of trees per hectare

Nr - natural regeneration number of trees per hectare

Nrt - number of trees of tall natural regeneration (e.g. over 1.30 m) per hectare

Nrs - number of trees of short natural regeneration (e.g. under 1.30 m) per hectare

SDI - stand density index

$\bar{t}$ - average age

$\bar{tr}$ - natural regeneration average age

UDC - understory degree of cover

V - stand total volume, over bark (m^{3}.ha^{-1})

The analysis of land cover during 1990-2007 showed a slightly reduction in pure maritime pine and an increase in mixed maritime pine and eucalyptus and bush land (Fig. 4). Even though burned area in 2003 was 49% of the study area, maritime pine stand reestablishment through natural regeneration was observed in 58% of the sample plots located in that area (Fig. 2).

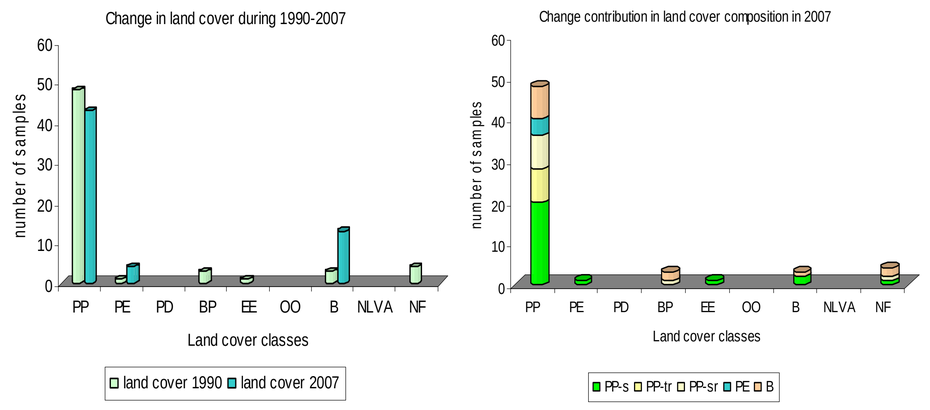


Figure 2. Change in land cover

Maritime pine regeneration was observed in situations were one or two fire cycles occurred. Bush land was also observed in situations were one or two fire cycles occurred but 46% of then in high elevation zones (montano level: 700-1000 m) therefore out of the optimal zone for maritime pine (Fig. 5).

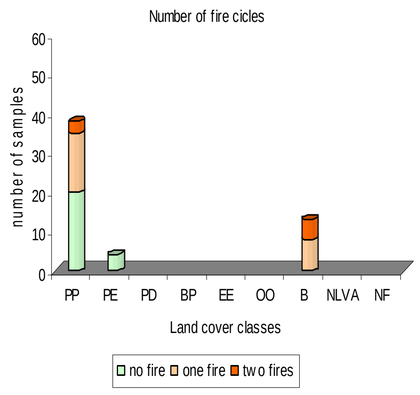


Figure 4. Fire cycles

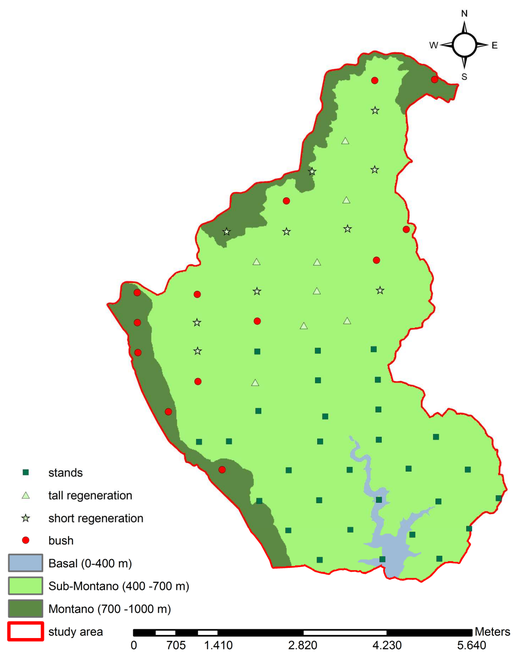


Figure 5. Elevation zones

Discussion

The findings of this study pointed out that stand reestablishment through natural regeneration still occurs when one or two fire cycles less then 20 years occurred showing that viable seed production is not a conditioning factor if stored seeds in the soil and/or mature stands horizontal continuity exists. Recent burned areas of mature maritime pine stands showed excellent levels of regeneration.

Continuous evenaged monospecific areas (existing maritime pine stands and recent afforestation of eucalyptus) will compromise study area regional and municipal goals, unless specie diversification and compartimentation (mainly with deciduous broadleaves) will be promoted.

References

Martins, R. 2007 Análise da Capacidade Produtiva da Floresta na Freguesia de Sarnadas de S. Simão, Concelho de Oleiros. issertation, Instituto Politécnico de Castelo Branco, Escola Superior Agrária, Castelo Branco..

liveira A., 1999. Boas práticas florestais para o pinheiro bravo. Manual. Centro Pinus, Porto, 31 p.