

Structure characterization of *Quercus pyrenaica* Willd open woodlands in the Spanish Central Mountain: implications for silvopastoral management

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Abstract

This chapter presents a preliminary characterization of *Quercus pyrenaica* Willd. open woodlands in Madrid province. From data from the second and third National Forest Inventory we compare main stand variables (N, Dg, Hm, Ho, G, V and Hart-Becking index) at the two inventories for open woodlands with low density ($N < 100$ trees/ha). A trend in recruitment of new trees from natural regeneration or growth of coppices under the main stand has been found, as well as a reduction in density of old dehesas of large trees.

Key words: dasometric characterization, grazing, recruitment

Introduction

Quercus pyrenaica Willd. (rebollo oak) open woodlands are extensive silvopastoral systems in many acid soil areas of Spain, of which the Spanish Central Mountain stands are a good example. The traditional management of these stands was aimed at producing diverse products: wood, pasture, timber..., mainly wood and charcoal, which resulted in coppice as the most used silvocultural treatment. Nowadays interest in these products has changed and the aim of rebollo oak open woodlands is mainly for maintaining landscape, recreation areas, ecological functions and some production functions, mainly livestock grazing. Changes in use and the difficulty of defining silvocultural managements to reach transformation of coppices have caused diverse ecological, silvocultural and socio-economic problems as regeneration is lacking, growth ceases, stumps decay, forest fires are a high risk, livestock causes damage, etc. (Serrada *et al.*, 1991; González del Tánago *et al.*, 2000). In order to build silvocultural rules for this species, the objective of this work is to characterize the structure of open woodlands of rebollo oak in Madrid estate and analyse the change over 10 years.

Materials and Methods

Data from the second and third National Forest Inventory (ICONA, 1990) from the Madrid estate have been characterized dendrometrically. To select second NFI plots and manage data of the forest inventory, BASIFOR software (Río *et al.*, 2002) was used. We selected the plots with at least one tree with dbh bigger than 7.5 cm (191 plots in Madrid) of *Quercus pyrenaica* and $N < 100$ trees/ha for dehesa stands (41 plots) (Serrada *et al.*, 1991). Plots were classified as pure (basal area (G) of *Q. pyrenaica* $> 90\%$, 29 plots), mixed dominated by rebollo oak ($90\% > G$ *Q. pyrenaica* $> 50\%$, four plots) and mixed not dominated by rebollo oak (G *Q. pyrenaica* $< 50\%$, six plots). A dendrometric characterization was done for the main variables for each stand type: number of stems (N); quadratic diameter (Dg); mean height (Hm); dominant height (Ho), calculated as the mean height of the 30 largest trees per hectare; basal area (G); volume (V) and Hart-Becking index (I_H). The same stand variables were calculated for the third NFI for the same selected plots that we studied at the second NFI and all dehesa-like plots ($N < 100$ trees/ha). To calculate volumes, equations from the NFI were used.

Results and Discussion

Rebollo oak woodlands on the Spanish Central Mountain are mainly pure stands of low height. Stands can be very diverse (Table 1); the most common structure is coppice or coppice with standards ($Dg = 25.5$ cm) with small diameters and variable density, but we can also find old and large trees in open woodlands ($D = 100$ cm, $G = 15$ m²/ha, $V = 63$ m³/ha). Sometimes, rebollo oak forms mixed stands with *Pinus sylvestris*, *Pinus pinea*, *Quercus ilex*, *Fraxinus* sp or *Populus nigra*, showing the wide ecological range of the species. Canopy cover is about 50% (51% for pure, 47% for mixed dominated by rebollo stands, and 53% in mixed but not dominated by rebollo stands).

Table 1. Mean, minimum and maximum values of mean dasometric variables for pure and mixed woodlands of *Quercus pyrenaica* in Central Mountain (second NFI) in Madrid estate. ^(a) Mean height of the largest 30 trees/ha. (1) Dominated by *Q. pyrenaica* stands. (2) Stands not dominated by *Q. pyrenaica*. In parentheses, number of plots. Variables defined in the text.

	N (trees/ha)	Dg (cm)	Hm (m)	Ho ^(a) (m)	G (m ² /ha)	V (m ³ /ha)	I _H (%)
Pure stands (29 p)	49.6 5.1-95.5	25.5 12.8-65.9	9 5.5-16	9 5.5-16	2.3 0.4-15.6	7.9 1.1-63.9	201.7 86.4-509
Mixed stands (1) (4 p)	81.3 36.9-99	21 14.3-29.1	8.1 5.8-12.3	9.5 6-13.3	3 1.3-6.6	11.3 2.9-21.6	163.4 94.7-260
Mixed stands (2) (6 p)	59.9 29.4-79.2	40.7 28.7-52.1	10.2 5-19.9	11 5-20	8.4 2.2-16.6	21.2 7.9-36	157.8 58.3-238

We found 64 plots in the third NFI of rebollo oak open woodlands (Table 2). 62.5% of them are plots that did not appear in the selection of the second NFI; half of these (23) are plots with small diameters, with no trees (D > 7.5 cm) at second NFI. The rest of these new open woodland plots are the result of density reduction in old stands (large diameters) due to natural mortality or silvicultural treatments (thinning, plant health treatments, etc.) that have been classified as dehesa-like stands at the third NFI but not at the second. From the plots considered as open woodlands at the second NFI, 38% have strong recruitment of trees with diameter under 7.5 cm, resulting in them actually having higher densities (N > 100 trees/ha).

The 69.2% of the open woodlands plots of 2nd NFI that remained classified as open woodlands at the 3rd NFI have clearly had a positive increasement in G, Dg, Ho and N, but on the other hand the 22.2% of open woodlands plots a N slightly decrease has been observed. In the open woodland plots of 2nd NFI that were not considered as dehesa-like stands at 3rd NFI we have observed an increment in G and N values and Dg clearly due to the small diameter tree recruitment.

Recruitment of small trees can be the result of processes of regeneration of the stands or growth of the coppices underneath the main stratum of larger trees due to changes in use. Changes in grazing management practices can cause severe damage to woody vegetation in overgrazed zones, and loss of herbaceous pastures and recovery of woody vegetation in lightly grazed zones (González del Tánago *et al.*, 2000).

Table 2. Mean, minimum and maximum values of mean dasometric variables for pure and mixed woodlands of *Quercus pyrenaica* in Central Mountain (third NFI) in Madrid estate. A: low density stands at inventories 2NFI and 3NFI; B: low density stands only at second NFI; C: low density stands only at third NFI. ^(a) Mean height of the largest 30 trees/ha. (1) Dominated by *Q. pyrenaica* stands. (2) Stands not dominated by *Q. pyrenaica*. In parentheses, number of plots. * Damaged or very old trees do not have volume equation at NFI. Variables defined in the text.

		N (trees/ha)	Dg (cm)	Hm (m)	Ho ^(a) (m)	G (m ² /ha)	V (m ³ /ha)	I _H (%)
Pure stands	A (16 p)	57	27.5	9	9.1	2.8	8.2	187.2
		8-95.5	14.5-64	6-11.7	6-12.5	0.5-6.4	1.3-19.9	109-381
	B (13 p)	492.5	17.0	9.4	10.8	8.5	28.2	70.6
		102-1539	9.4-28.4	6.3-15.2	6.8-18.7	3-30.5	9.6-107.1	33.7-141
	C (40 p)	47.9	29.0	10.1	10.2	2.7	8.8	196.6
		8-95.5	9.9-72.1	5-17.6	5-17.6	0.5-12.3	0*-70.7	64-448
Mixed stands (1)	A (3 p)	62.8	33.5	9.9	10	3.7	9.3	207.4
		8-95.5	17.2-50.5	7.7-11.9	7.7-12.3	1.6-7.2	2.4-18.6	98-381
	B (1 p)	456.4	13.4	10.4	13.8	6.4	26.7	48.6
Mixed stands (2)	A (5 p)	-	-	-	-	-	-	-
		18.7	33.3	11.2	11.2	1.2	4.4	268.7
		8-31.8	19.4-48	6-18	6-18	0.9-1.4	1.9-10.2	185-381
	B (1 p)	127.3	16.4	8.3	8.4	2.7	9.6	114.4
		-	-	-	-	-	-	-

Conclusions

In spite of the lack of management of coppices or woodlands of rebollo oak in recent decades, there is a clear growth in density of these stands and we do not have evidence of stand stagnation. In some cases of old and large tree woodlands (between the 25 and 30% of dehesa-like plots at the third NFI) there has been a reduction in density (N, G) due to different reasons into which it would be interesting to research. It is necessary to develop suitable management techniques for both types of stands to guarantee the persistence and stability of those forestry formations.

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