REVERTING HOMOGENOUS FOREST LANDSCAPES INTO MIXED OAK FORESTS IN SOUTHWESTERN EUROPE

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PURPOSE AND SCOPE

Transformation of homogenous pinewood landscapes into mixed oak forests through silvicultural interventions can contribute to increased resilience and adaptation to changing social and environmental conditions. The goal of this study was to implement an adaptation of the irregular shelterwood system in a Mediterranean-type climate in southwestern Europe. The success of the method was evaluated through the control of pine natural regeneration and the performance of artificial regeneration of oaks in gaps.

METHODS AND APPROACH

Las Llanas experimental site is located in Cabañeros National Park (39.40ºN, -4.45ºW). Transformation treatments consisted of creating small gaps (8 m in diameter) and medium gaps (16 m in diameter) followed by plantation of holm oak (*Quercus ilex*), cork oak (*Q. suber*), and quejigo oak (*Q. faginea*) in all possible combinations and three replicates. Another three gaps per treatment remained unplanted to follow natural regeneration, which also occurred in three 16 m by 16 m control plots. Nine plots with nine individuals per species were also underplanted in the control area. Pine and oak seedling density 4 years after harvest were modelled using a Poisson generalized linear mixed model. Predictors included treatment, abiotic and biotic features (global site factor, position in the gap, moss, stones, and herbaceous cover), and gap as a random effect was included in the intercept. Plantation survival after 2 years was analyzed with a general linear model approach by species and treatment.

FINDINGS AND APPLICATIONS

After 4 years, treatment and position in the gap were found to be significant predictors of pine abundance, whereas moss cover and treatment were significant predictors for oak. For both genus, medium-sized gaps had a positive impact. Pine regeneration was lower in the northern part of the gap. Harvest residues had a globally negative impact on pine regeneration, but a positive

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impact in the southern part of the gap. Oak regeneration was favoured by the presence of moss cover (table 1).

Table 1—Significant predictors of pine and oak seedlings density (plants/m^2) in the gap experiment 4 years after harvest

Variable	Pine regeneration		Oak regeneration	
	Estimate	*Standard error*	*Estimate*	*Standard error*
Intercept	NS	NS	-1.8686	0.6300
Medium gaps	0.53365	0.17083	2.0448	0.7729
Harvest residues	-0.69544	0.33158	NS	NS
North position	-0.45753	0.23261	NS	NS
Harvest residues x South position	1.39623	0.47982	NS	NS
Moss cover	NS	NS	6.8913	3.2537

NS = nonsignificant.

Mortality of all planted oak species was higher in control plots than in gaps. Holm oak had a significantly higher survival rate 2 years after planting in medium-sized gaps, whereas cork oak and quejigo oak treatments did not differ.

In the Northern Hemisphere, regeneration is higher in the northern part of gaps due to higher solar radiation (Raymond et al. 2011), however under semiarid conditions, like in the Mediterranean, high soil temperature and low moisture are expected in the northern part of the gap (Bagnato et al. 2021) and regeneration could benefit from protection of edge trees in the southern part of the gap. This protection increases if harvest residues are left in place. Moss cover is a possible indicator of more humid spots within the gap where successful oak regeneration occurs. However, low regeneration indicates that planting oaks in gap openings seems to be a feasible option to transform pine reforestations into mixed oak forests, though underplanting is not recommended due to high oak mortality.

LITERATURE CITED

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