Increasing forest diversity and recovery in southwest Europe: Transformation of monospecific pine plantations into mixed-oak Mediterranean forests

BRAVO-OVIEDO, A[1,*], DIAZ, M[1], MAESTRE-VILLANUEVA, J[1,2], ACUÑA-MÍGUEZ, B[1], BRAVO, F[3,4] ,DEL RIO, M[5], CONCEPCION, E[1*]

*Presenting autor, [1]Department of Biogeography and Global Change, MNCN-CSIC, [2]Universidad Autónoma de Madrid, [3]Instituto Universitario de Investigación en Gestión Forestal Sostenible (iuFOR) ETSIIAA,-UVA, [4]Gestión Forestal Sostenible, Universidad de Valladolid, Unidad Asociada al CSIC, [5]ICIFOR-INIA, CSIC

Background

Environmental stressors and human pressure decimated the forest cover that were substituted for monospecific pine reforestations to quickly recover tree cover and control soil erosion, but the lack of a silvicultural program has resulted in dense and less resilient forests. In order to revert this situation COMFOR-SUDOE and IMFLEX projects aimed to promote complex forests (mixed and irregular) as a resilient strategy in response to climate change and declining biodiversity and to guide forest managers to integrative forest management by including biodiversity objectives. Here, we present two research actions to fulfil these objectives: (i) a diversification experiment of a 50-year pine plantation into a Mediterranean mixed oak forest and (ii) the effect of transformation on the abundance of soil bacteria and fungi, as well as bird communities as indicators of forest ecosystem transformation success.

How it worked and results

The experimental site is in Cabañeros National Park (Ciudad Real, Spain). The transformation method opened small (D_{gap}=0.5Ho) and medium-size gaps (D_{gap}=Ho) followed by a plantation of three oak species (*Quercus ilex* L., *Q. faginea* Lam., *Q. suber* L.) with tube shelters in all possible combinations, including unplanted gaps for natural regeneration monitoring. Eight gaps per treatment were fenced. After three years, **small gaps kept survival rate of planted oak rate high and prevented pine regeneration** (Fig. 1). Unfenced gaps did not show increased oaks mortality but height growth was stopped because of browsing. In fenced gaps the height growth overtopped 1.3 m but pine seedlings, herbaceous and shrub encroachment add competition to oaks. **Physical barriers** like stones cover and harvest residues **reduced the natural regeneration abundance** of pines and oaks, whereas distinct **surrogate abiotic factors increased regeneration**: GSF (light indicator) for pines and moss cover (soil humidity indicator) for oaks (Fig. 2). In the harvested area the number of bird species that used and reproduced in the territory (forest specialists) decreased although the number of generalist species kept higher (Fig. 3). In general **harvest reduced the bird abundance but not the species richness**. The observed number of bacteria and fungi genera increased with treatment intensity and were similar to the genera richness in an adjacent mixed oak forest.

Plantation Survival

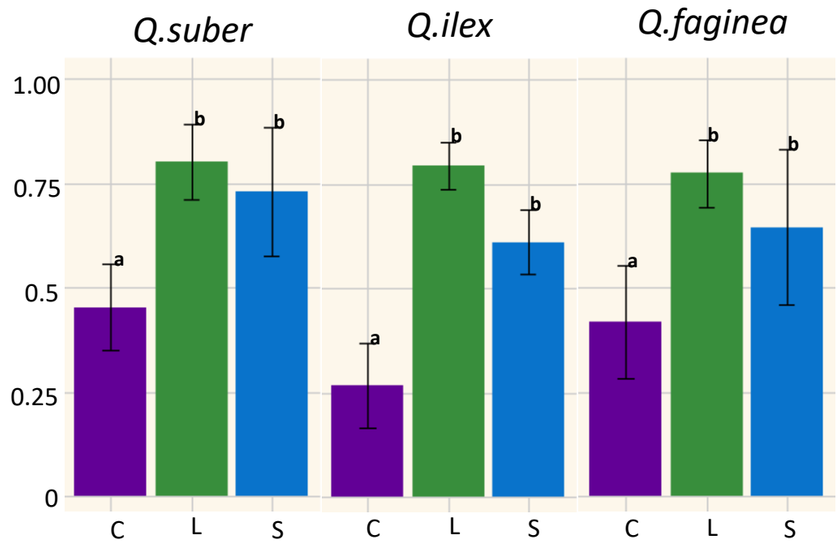

Figure 1. Plantation survival by species, C: control, L: large gaps, S: small gaps
Villanueva-Maestre et al (2024)

Regeneration ~ Characterization parameters

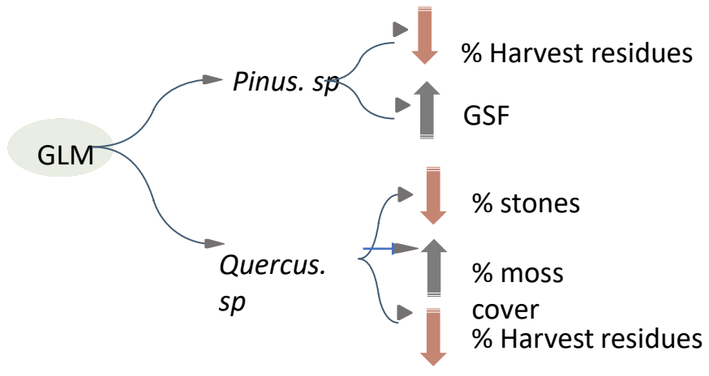

Figure 2. Main factors affecting the regeneration of pine and oaks
Villanueva-Maestre (2023)

Bird communities

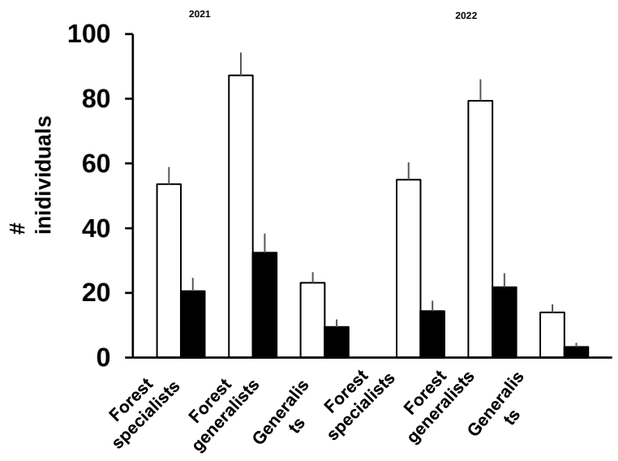

Figure 3. Number of bird individuals and strategies in control (white bars) and harvested areas (black bars)
Bravo-Oviedo et al. (2023)

Conclusions

Our results contribute to guide practitioners dealing with fully species substitution of monospecific *P. pinaster* reforestations and their transformation into complex forests. The use of indicator species contribute to evaluate the ecological sustainability of the silvicultural method applied.

References

Bravo-Oviedo A. et al (2023) Libro blanco para una estrategia de especialización inteligente en el SUDOE. Informe final del Proyecto COMFOR-SUDOE

Villanueva-Maestre, J (2023) Dinámica espacial de la regeneración natural en un pinar de repobalción sometido a distintos tratamientos selvícolas. Trabajo Fin de Grado (Biología). URJC

Villanueva-Maestre, J et al. (2024) Spatial dynamics of natural regeneration in a reforested pine forest subjected to different silvicultural treatments. XVIII Young Foresters Researcher Meeting, Palencia

Acknowledgments: IMFLEX Grant PID2021-126275OB-C21 funded by MCIN/AEI/10.13039/501100011033 and by "ERDF A way of making Europe" financed by Spanish Ministry for Science, Innovation and Universities and by SOE4/P1/E1012 COMFOR-SUDOE Gestión integrada e inteligente de bosques complejos y plantaciones mixtas del SUDOE funded by INTERREG-SUDOE program (ERDF). Many thanks to former and current Cabañeros National Park directors as well as forest rangers and park staff.