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Adapting a Mediterranean marginal Oak forest to water scarcity

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Adaptive Forest Management (AFM) aims to adapt the forest to water availability by means of an artificial regulation of the forest structure and density. Areas under water scarcity situations, such as the Mediterranean region, might require AFM to optimize the hydrological cycle under normal and future global change conditions, especially on those forests growing in marginal habitats. However, forest treatments can also cause nutrient and soil loss as well as increase soil water evaporation. Therefore, AFM has to find a compromise that satisfies both forest and catchment needs.

The present study applies the AFM to a Mediterranean marginal oak forest with the aim to optimize the hydrological resources, but avoiding the possible negative impacts such as nutrient and soil loss or an excessive soil water evaporation. The forest is located in a typical Mediterranean area, within the public forest La Hunde, Valencia (E Spain). Two contiguous plots, control and treatment, of 1800 m^2 area respectively were selected. The orientation (NO), slope (30 %) and forest density (861 tree per ha) were the same for both plots. Treatment plot was thinned in May 2012, following the forest requirements. The initial forest density was then reduced from 861 to 414 tree per ha. Control plot was not thinned.

The thinning effects into the hydrological and biogeochemical cycles were characterized comparing control and thinned plots. In the same way, primary tree growth and nutrient resorption proficiency were also compared. The hydrological cycle was characterized by means of throughfall, stemflow, runoff, soil moisture and transpiration monitoring. The biogeochemical cycle was characterized through the analysis of N, P and C content in: rainfall, throughfall, stemflow, runoff and soil leaching. The primary growth was registered for the years 2012-2013. The nutrient resorption proficiency was analyzed comparing C, N, K and P contents and ratios of green leaves, old leaves and litter.

The results indicate an early effect of the thinning that optimize the hydrological cycle. There is a significant increase of sapflow, stemflow and soil moisture. On the contrary, no effect is registered neither in runoff nor throughfall. In the same way, the thinning does not produce a significant effect in the biogeochemical cycle, were water N, P and C content is not significantly different between both plots. The nutrient resorption proficiency and primary growth appears to be affected by the forest treatment. The thinned plot shows a faster growing combined with lower nutrient resorption proficiency.

Under these results, it can be stated that applying an adequate AFM it is possible to optimize the hydrological cycle without harming the forest nutrient cycling. In the same way, besides the satisfaction of the hydrological and nutrient needs of the ecosystem, AFM increases the water availability to refill rivers and/or aquifers, or to support other ecosystems.