Reconciling Pollen Limitation Theories: Insights from Temperate Oak Masting

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Résumé

Due to climate change, forests face great challenges such as greater exposure to climatic hazards resulting in increasing dieback that makes forest regeneration a critical issue. Reproduction in many perennial species is characterized by a reproductive strategy called masting, characterized by very large fluctuations in seed production from year to year, synchronized between individuals within populations. Although masting has major consequences on forest regeneration as well as significant socio-economic impacts, the underlying mechanisms are still poorly understood. For instance, pollen limitation is recognized as a central masting process in many species, but several hypotheses on how pollination can limit reproduction are still debated. Depending on the hypotheses, very contrasting scenarios can be drawn with regard to the future of masting and forest regeneration in the context of climate change. We explored the relative contribution of the three main pollen limitation mechanisms proposed in the literature in ten oak populations using surveys of airborne pollen and fruiting rate as an indicator of pollen limitation. While considering each mechanism in isolation did not explain more than 30% of the variability in fruiting rate, considering their interaction allowed us to explain nearly 80%. Our results thus evidence that (i) none of the hypotheses widely accepted in the literature can alone explain pollen limitation, (ii) the combination of the two main hypotheses, phenological synchrony and pollen coupling, and the effect of weather conditions on the maturation and diffusion of pollen can largely explain variations in the fruiting rate in oaks. Our work highlights the need for a coherent theoretical framework for pollen limitation, as a basis for modeling the phenomenon and ultimately improving the accuracy of the predictions about the impact of climate change on oak-dominated ecosystems.

Mots-Clés: Pollen limitation, Masting, Pollen coupling, Phenological synchrony, Moran Effect, Pollen Phenology

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