



Effects of vineyard inter-row management intensity and landscape diversity on wild bee diversity, abundance and functional traits across Europe

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Agricultural intensification is a major driver for wild bee decline. Vineyards may be inhabited by many plant and animal species, especially when the inter-row space is vegetated with spontaneous vegetation or cover crops. Wild bees depend on floral resources and suitable nesting sites which may be found in vineyard inter-rows or in viticultural landscapes. Inter-row vegetation is managed by mulching, tillage and/or herbicide application and results in habitat degradation when applied intensively. Here, we hypothesize that lower vegetation management intensities, higher floral resource availability and landscape diversity affect wild bee diversity and abundance dependent on their functional traits.

We sampled wild bees semi-quantitatively in 63 vineyards under different vegetation management intensities across Europe (Austria, Spain, France, Romania) in 2016. A proxy for floral resource availability was based on visual flower cover estimations. Management intensity was assessed by vegetation cover (%) twice a year per vineyard. The Shannon Landscape Diversity Index was used as a measure for landscape diversity within a 750 m radius around each vineyard. Functional traits (nesting type, sociality, body size) were summarized by community weighted means and then assessed by multivariate analysis. The effects of management intensity, floral resource availability and landscape diversity on wild bee diversity, abundance and functional traits analysed by generalized linear models.

Wild bee communities were clustered by country and at the country level between 20 (Spain) and 64 (Austria) wild bee species were identified. Overall, increased floral resource availability was interlinked to extensive vegetation management and affected wild bee diversity and abundance in vineyards positively. Increased landscape diversity had a minor positive effect on wild bee diversity but compensated the negative effect of low floral resource availability for eusocial bee abundance. Most of the eusocial and solitary wild bees were ground nesting and thus benefitted from undisturbed soil conditions in extensively managed inter-rows.

We conclude that wild bee diversity and abundance in vineyards is efficiently promoted by increasing floral resources and reducing vegetation management frequency. High landscape diversity further complements low floral resources in vineyards for providing resilient pollination services in viticultural and agricultural landscapes.