



## Do vineyards in contrasting landscapes contribute to conserve plant species of dry calcareous grasslands?



Juri Nascimbene<sup>a,b,\*</sup>, Michela Zottini<sup>c</sup>, Diego Ivan<sup>c</sup>, Valentina Casagrande<sup>a</sup>, Lorenzo Marini<sup>a</sup>

<sup>a</sup> Department of Agronomy, Food, Natural Resources, Animals and the Environment (DAFNAE), University of Padova, viale dell'Università 16, 35020 Legnaro, Padova, Italy

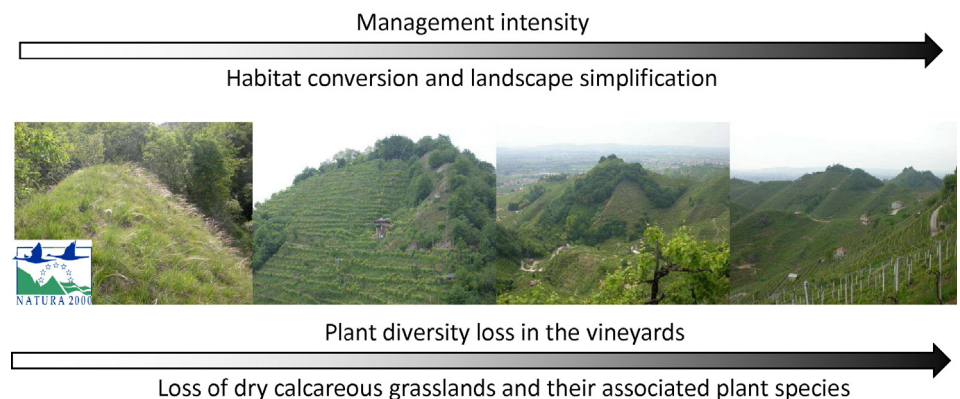
<sup>b</sup> Department of Life Sciences, University of Trieste, via Giorgieri 10, 34100 Trieste, Italy

<sup>c</sup> Department of Biology, University of Padova, via U. Bassi 58/B, I-35121 Padova, Italy

### HIGHLIGHTS

- The development of vineyards is a major driver of conversion of dry grasslands.
- We test the potential of vineyards in contrasting landscapes for plant conservation.
- Semi-natural habitats in the landscape positively affect plant diversity of vineyards.
- Vineyards provide moderate chance for the conservation of plant of dry grasslands.
- Remnants of dry grasslands are refugia for species of conservation concern.

### GRAPHICAL ABSTRACT



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### ABSTRACT

The increasing development of vineyards in Mediterranean areas worldwide is considered a major driver of conversion of several habitats of conservation concern, including calcareous dry grasslands that are targeted for biodiversity conservation by the European Union, according to Natura 2000 policies. Here, we aim at evaluating the potential of extensive vineyards located in contrasting landscapes (semi-natural vs crop-dominated) for providing suitable habitat conditions to plant species associated with dry grasslands. This study was carried out in one of the economically most important winemaking districts of Italy, characterized by a hilly landscape with steep slope vineyards. We compared plant communities of vineyards in contrasting landscapes with those of the remnants of dry grasslands. Our study demonstrates that landscape composition strongly affects local plant communities in vineyards, with a positive effect of semi-natural habitats bordering the cultivated areas. Our findings thus supply an additional tool for improving the effectiveness of viticultural landscapes for nature conservation. In particular, our results indicate that vineyards on steep slopes could provide moderate chance for the conservation of plant specialists inhabiting calcareous dry grasslands, depending on the landscape composition: vineyards embedded in semi-natural landscapes have more potential for conservation than those in crop-dominated landscapes. Our study also indicates that conservation efforts should aim at (a) decreasing the current management intensity that likely hampers the beneficial effects of semi-natural habitats in the surrounding

\* Corresponding author at: Department of Agronomy, Food, Natural Resources, Animals and the Environment (DAFNAE), University of Padova, viale dell'Università 16, 35020 Legnaro, Padova, Italy.

E-mail address: [junasc@libero.it](mailto:junasc@libero.it) (J. Nascimbene).

landscape on local plant assemblages, and (b) strictly conserving the remnants of dry grasslands that are irreplaceable refugia for habitat specialists and species of conservation concern.

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## 1. Introduction

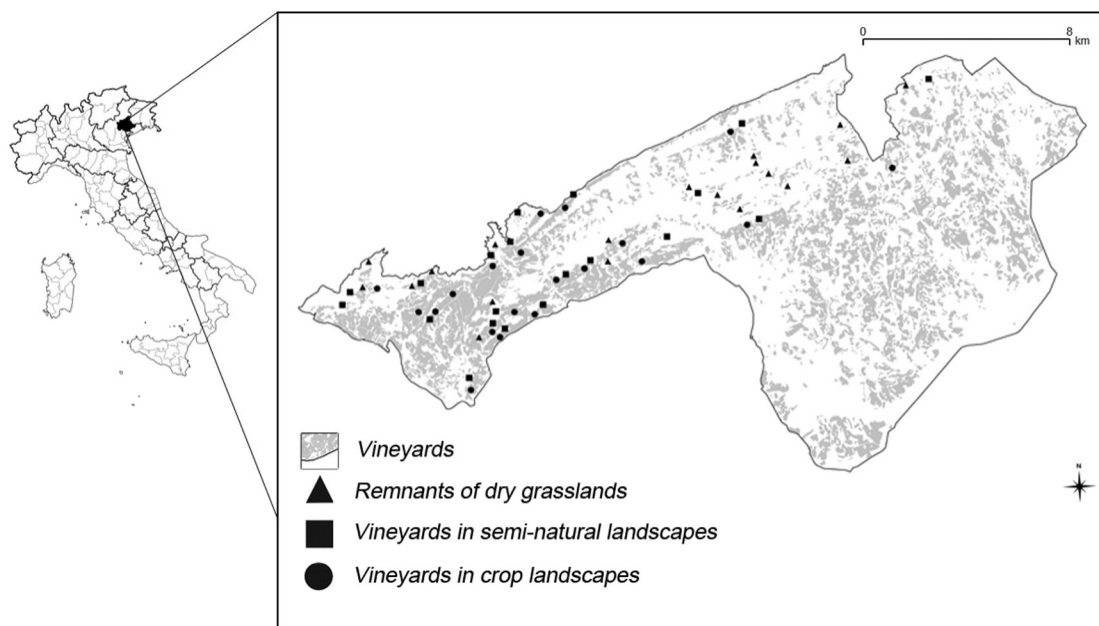
Biodiversity conservation is increasingly recognized as a crucial task for sustaining several ecosystem services that improve human well-being (Cardinale et al., 2012). Agriculture is among the main causes of biodiversity loss worldwide (Frishkoff et al., 2014; Karp et al., 2012; Pignatti, 1982) and there is increasing awareness that future biodiversity conservation will largely depend on the capability of cultivated areas to provide suitable habitats for species and communities of conservation concern (Baudron and Giller, 2014; Green et al., 2005; Phalan et al., 2011; Wright et al., 2012).

The increasing development of vineyards in Mediterranean areas worldwide is considered a major driver of conversion of several habitats of conservation concern (e.g. Richter, 1989; Rühl, 2004; Viers et al., 2013), including calcareous dry grasslands that are targeted for biodiversity conservation by the European Union, according to Natura 2000 policies (European Commission, 2007). Habitat conversion results in simplified landscapes where this semi-natural vegetation is restricted to small scattered patches. However, recent research also highlighted that coupling biodiversity conservation with wine production could be a winning strategy both for marketing purposes and for counteracting the negative effects of global change (Bellosi et al., 2013; Hannah et al., 2013; Trivellone et al., 2014; Viers et al., 2013). This view is also reflected by the inclusion of several viticultural landscapes world-wide in the UNESCO world heritage list (<http://whc.unesco.org/en/list/>).

Besides local management intensity, that is among the main drivers of local plant diversity in vineyards (Brugisser et al., 2010; Nascimbene et al., 2012, 2013; Poldini et al., 1998), the potential of vineyards to contribute to the conservation of dry grasslands is likely to be related to landscape composition (Weibull et al., 2003). In general, landscape composition influences local biodiversity of agro-ecosystems, with a positive effect of semi-natural habitats on various components of the

biota (e.g. Tschardt et al., 2005, 2012b). This rationale would predict that richer plant communities should be expected in vineyards bordered by semi-natural habitats than in vineyards embedded in a landscape dominated by cultivated areas. While this hypothesis has been already tested in vineyard regions for several faunistic groups (e.g. Brittain et al., 2010; Hilty and Merenlender, 2004; Laiolo, 2005; Schmitt et al., 2008), it is still awaiting experimental evidence for plant communities.

Here, we aim at evaluating the potential of extensive vineyards located in contrasting landscapes (semi-natural vs crop-dominated) for providing suitable habitat conditions to plant species associated with dry grasslands. This study was carried out in one of the economically most important winemaking districts of Italy, characterized by a hilly landscape with steep slope vineyards. In this region, dry grasslands are severely declining due to agriculture intensification, being replaced by vineyards even on the steepest slopes. We compared plant communities of vineyards in contrasting landscapes with those of the remnants of dry grasslands. Besides considering the full species pool, we contrasted among different a-priori selected groups of species indicative of different local conditions (e.g., dry grassland specialists vs ruderal species) and of conservation concern (e.g., red-listed species and orchids). The patterns of these selected groups of species is expected to better help to elucidate the potential of vineyards to provide surrogate habitat for the conservation of plant communities of dry grasslands. On the one hand, we hypothesise that vineyards in semi-natural landscapes could host species assemblages more similar to those of dry grasslands as compared with vineyards in crop-dominated landscapes, especially when specialist species are considered. On the other hand, the vineyards in contrasting landscapes are expected to host similar assemblages of ruderal species, reflecting comparable management intensity, independently of landscape composition.



**Fig. 1.** Map of the study area, corresponding with the Conegliano-Valdobbiadene DOCG. Dry grasslands, vineyards in crop and in semi-natural landscapes are marked with different labels. Grey areas indicate the vineyards.

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