



Diversity in the monotony? Habitat traits and management practices shape avian communities in intensive vineyards



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ABSTRACT

Spreading of viticulture may pose serious threats to biodiversity and adequate policies targeted at decreasing its impact are urgently required. Current knowledge of viticulture effects on biodiversity is scarce and studies on bird communities in vineyards are even scarcer.

We surveyed avian assemblages in Trentino vineyards (North-East Italy) in both breeding and wintering seasons to evaluate the effect of: i) landscape, ii) management and iii) topographic-climatic characteristics on birds and to derive implications for conservation. We calculated four community indexes (species richness, abundance, evenness and conservation index) and modelled their relative variation according to 18 environmental variables belonging to the three above-mentioned groups.

Landscape models performed better than the others, except for winter evenness, for which management models were the most supported ones. Generally, models considering the three groups together explained more variation than models from an individual group.

Landscape (and agricultural) heterogeneity, extent of marginal habitats, density of traditional elements (hedgerows, tree rows, isolated trees and rural buildings) all had positive effects, whereas vineyard cover had negative impact on the value of the four community indexes.

Organic management had no apparent effect on avian communities. We detected a seasonal difference in the effects of environmental characteristics on bird communities, which suggested that local conservation efforts could be tuned according to the seasonal importance of vineyards in different regions.

Key measures to promote biodiversity in vineyards include maintaining patches of residual habitats in the vineyard matrix and enhancing heterogeneity. Marginal features appeared particularly important in the homogeneous landscape of intensive vineyards to favour bird communities.

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1. Introduction

Millennia of agricultural expansion have resulted in a substantial amount of terrestrial species surviving on land dedicated to food production (Krebs et al., 1999). At the same time, agricultural intensification is one of the main causes of biodiversity loss (Green et al., 2005), and thus sustainable management of farmland habitats has become a key topic of modern conservation biology (Chapin et al., 2000). Considering the agricultural impacts on

biodiversity, arable crops in temperate regions are among the most studied systems (Balmford et al., 2012), whereas permanent crops (e.g. orchards, vineyards, timber plantations) had received much less attention. As a result, knowledge of factors affecting biodiversity in these cultivations remains limited. In addition, permanent crops have been excluded from any kind of biodiversity-friendly practices in the recent Common Agricultural Policy (CAP) 2013 reform. In particular, the 30% of direct payments delivered to farmers according to three 'greening measures' (the most relevant of which is devoting 5% of the farm to Ecological Focus Areas), applies to only half of EU farmland and all permanent crops had been excluded (Pe'er et al., 2014).

Such exclusion is particularly concerning, as available evidences suggested that permanent crops are no more suitable for biodiversity than other crops. Intensification in olive orchards, traditionally considered to host a high level of biodiversity

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(Loumou and Giourga, 2003), produced strongly detrimental effect on plant biodiversity (Allen et al., 2006), whereas in fruit orchards different management strategies strongly affected bird assemblages (Myczko et al., 2013). Therefore a better understanding of the effect of management practices on biodiversity in permanent crops is urgently needed to inform evidence-based conservation practices (*sensu* Arlettaz et al., 2013).

Vineyard is a typical Mediterranean permanent crop, which can locally reach extreme levels of intensification. Despite the high economic value and the potentially high impact that such crops can have on species and ecosystems, very little attention has been paid to investigate factors and management practices affecting vineyard biodiversity. In recent years, the environmental quality of wine production is increasingly perceived by consumers as a key determinant of the wine quality. As a consequence, landscape, in its cultural and ecological dual nature, and biodiversity are assuming a new (at least economic) value, and this could be a fundamental resource for research and conservation (Bisson et al., 2002; Viers et al., 2013).

Recent studies suggested that different taxonomic groups, occupying different trophic levels, may respond differently to disturbance intensity and types in vineyards (Bruggisser et al., 2010). A better understanding of management effects is therefore needed to implement well-focused conservation strategies.

Agricultural intensification caused major decreases in farmland bird populations in Europe (Donald et al., 2001). Despite the efficacy of birds as environmental indicators (Gregory et al., 2005),

there are a very few studies on bird communities in vineyards, often limited to highly specific topics. Duarte et al. (2014) reported that soil conservation practices based on mechanically managed herbaceous corridors favour bird communities in vineyards. Similarly, an endangered ground-nesting bird species, the wood-lark *Lullula arborea*, have been reported to be favoured by a mixture of ground vegetation and bare ground in vineyards (Arlettaz et al., 2012).

Sierro and Arlettaz (2003) suggested that vineyards have the potential for harbouring quite rich communities, but the availability of natural remnants and ground vegetation cover are key factors for several species. The same authors also advocated for further studies with a fine-scale approach, which should also consider management type and intensity.

In this work, we studied avian communities in Italian vineyards in both breeding and wintering season, aiming at understanding the effects of habitat characteristics and management practices on birds. In particular, we first tried to disentangle which environmental levels (i.e. group of variables: landscape, management, topography-climate) affect avian assemblages in vineyards; secondly, we investigated what are the specific effects of each environmental variables belonging to the above mentioned groups. The ultimate goal of this study was the definition of some potential measures for bird conservation at both the landscape and at the farm scale. Such measures could be used to inform agri-environmental schemes in the framework of national and regional regulation (e.g. Rural Development Programme).

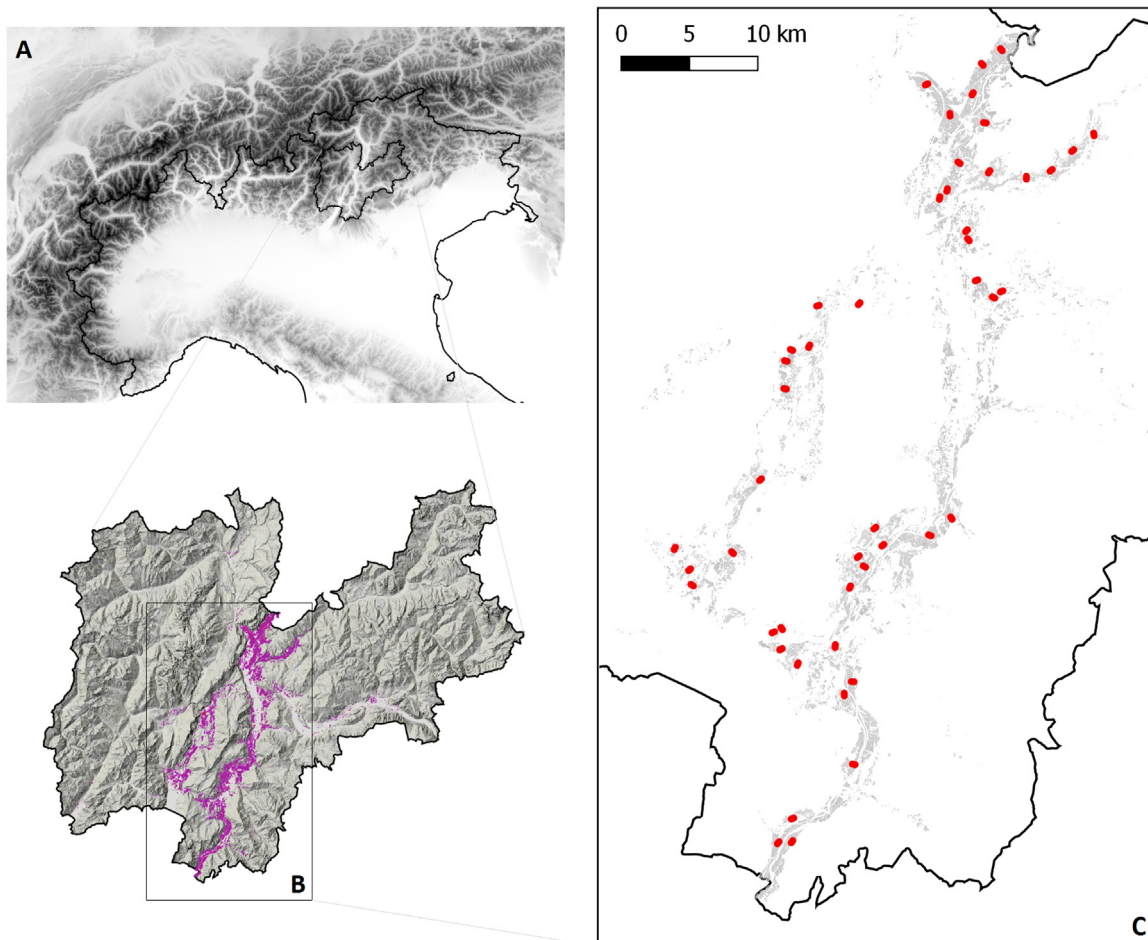


Fig. 1. Study area. (A) Position of Trento Province in Northern Italy. (B) Vineyard cover in Trento Province (in violet). (C) position of the 47 plots in Trento Province wine district. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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