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Short communication

Lack of evidence for short-term structural changes in bird assemblages breeding in Mediterranean mosaics moderately perforated by a wind farm

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HIGHLIGHTS

- Wind farm turbines induce a habitat perforation in oak mosaics.
- About 10 % in habitat perforation is not enough to change structure in bird assemblages.
- A lack of changes is also evident at guild (edge vs. forest species) and species level.
- Further research is necessary to search a higher threshold in habitat perforation inducing a change in assemblage structure.

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ABSTRACT

We studied a set of common breeding birds living in a heterogeneous oak wood mosaic of Apennines (central Italy) where a wind farm occurred. Aim to assess differences in composition and structure between a treatment area (with wind farm turbines) and a control area (without wind farm turbines). We did not observe differences at assemblage (uni-and bi-variate metrics of diversity: mean species richness, Shannon–Wiener diversity index, evenness, Whittaker β_w index and diversity/dominance diagrams), guild and species level (relative frequencies). The limited habitat perforation and dissection induced by wind farm turbines and service roads (10% in area) and the consequent changes in spatial heterogeneity and level of anthropogenic disturbance (induced by a higher motor-car and people frequentation) did not seem to affect the breeding bird communities in oak mosaics, as supported also by the diversity/dominance analysis. However, our preliminary conclusions are limited only to the indirect impact on common breeding bird species and are not related on to possible direct impacts deriving from wind farm facilities and related infrastructures (e.g., direct impact for collision). Moreover, further research is necessary to detect possible higher thresholds in habitat perforation that may induce changes in breeding bird assemblages.

1. Introduction

Anthropogenic and natural spatial heterogeneity constitutes a driving force that explains patterns of species richness and abundance in animal communities occurring in patchy landscapes (Fahrig et al., 2011). Among birds, the role of fine-grained

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small-scale (i.e. patch-scale) habitat disturbances on avian assemblages have been widely investigated, mainly in temperate boreal forests (e.g. Derleth et al., 1989; Forsman et al., 2010).

In mountainous and hilly areas of Mediterranean basin, historical and recent anthropogenic disturbances contributed to structuralize complex landscape patterns (Forman, 1995; Blondel and Aronson, 1999; Zamora et al., 2007 and Battisti and Fanelli, 2011). These landscapes are frequently characterized by low level of anthropization and shows a natural and human-induced patchiness (e.g. Farina, 1997 and Brotons et al., 2005). Moreover, these hilly mosaics are often located in favourable conditions concerning dominant regional and local winds, therefore many ridges and exposed sides were selected as sites to locate wind farm facilities (Williams et al., 2001; Noguera et al., 2010).

Wind farm facilities are infrastructures that may structurally and functionally affect a large set of local abiotic and biotic components at multiple spatial and temporal scales (e.g.: Winkelman, 1992, 1995; Martì and Barrios, 1995; Richardson, 2000; Langston and Pullan, 2003; Zieliński et al., 2009 and Gove et al., 2013). The impact (direct, indirect or potential) on the biotic components has been analysed for birds and bats in particular, showing a strong context- and species-specific response (Jain et al., 2010; Huso, 2011; Johnson and Erickson, 2010; Ferrer et al., 2011 and Langston and Pullan, 2003). Particularly, wind farm-related infrastructures (windmills, roads, electric lines, etc.) and related disturbances (people frequentation, motor-car transit, etc.) may also indirectly impact the population density, as they change the level both of landscape heterogeneity, so consequently disrupting the structure at assemblage and species level (Langston and Pullan, 2003).

At least for Mediterranean ecosystems, research focusing on the indirect impact at bird assemblage level are still rare (e.g. Battisti et al., 2014a, b).

Here, we report a study carried out on common breeding bird assemblages living in a poorly studied heterogeneous landscape mosaic of Apennines (Abruzzo, central Italy) where a cluster of windmills is located. Particularly, the aim of this study is to quantify the differences at bird assemblage and species level between two oak mosaics with different wind farm-induced heterogeneity, assessing the differences between a treatment area (with a wind farm) and a control area (a comparable mosaic where wind farm infrastructures are absent). Our prediction is that as wind farm infrastructures created small but well distributed open areas inside the oak mosaics, thus increasing the internal patchy heterogeneity and small-scale disturbances, we should have sampled a change in some uni- and bi-variate metrics at level of structural assemblage, guilds and species of common breeding birds.

2. Materials and methods

2.1. Study area

The study has been carried out in a natural and human-induced heterogeneous landscape near San Giovanni Lipioni (Chieti) in the Southern Abruzzo (monti Frentani, central Apennines, Italy) on a surface of about 600 ha near the river Trigno at an altitude ranging from 400 to 740 m a.s.l. (geographic coordinates: 41° 84′73″ N, 14° 56′27″ E). In this area oak patchy mosaics (MOS) are present, characterized by termophilous woods of deciduous oaks (*Quercion pubescentis-petraea*, with *Quercus pubescens* dominant and secondarily *Quercus cerris, Acer* sp., *Carpinus* sp., *Castanea sativa*) on arid calcareous and muddy soils (EU habitat type 91H0: "Pannonian woods with *Quercus pubescens*", largely diffused in central–Southern Apennines: Petrella et al., 2005). Two plant associations occur in this context: *Rosa sempervirens-Quercetum pubescentis* and *Cytiso sessilifolii-Quercetum pubescentis* (Pirone, 1995). In the surrounding, open habitats characterized by large extension of crop and uncultivated lands (wheat and secondarily vegetable crops, vineyards and olive groves) with rare shrubs, hedge and trees (mainly *Prunus* sp., *Rosa* sp., *Crataeugus* sp.) are also present. Locally a patchy mesophilous and hygrophilous vegetation also occur with *Populus* sp., *Salix* sp., *Ulmus* sp., *Acer campestris*, *Fraxinus ornus* (Pirone, 1995).

Inside the MOS habitat type, five wind turbines (coded from WTG 1 to WTG 5; Eolica Lucana—Iberdrola) have been located (Caccavone ridge, Vernone hill) between 636 and 703 m a.s.l. so perforating an 300 hectares-wide area. At landscape level, the building of windmills and their related infrastructures regarded an area of about 30 ha (6 ha of transformed area for each wind turbine), corresponding to about 10% of the MOSs where the wind farm facilities have been located. Wind turbines were placed in 2012 and started their full-time activity in winter 2013.

2.2. Protocol

To study the structure of breeding bird assemblages, in MOS we carried out an intensive surveys sessions in 2013 from 4 May to 15 June carrying out a standardized quantitative point count method (hereafter, PCM; Koskimies and Väisänen, 1991; Bibby et al., 2000 and Sutherland, 2006). The point count method has been widely used to characterize bird assemblages in terms of species richness, diversity and composition at landscape level (Sutherland, 2006). Moreover, this method provided the analysis of fine-grained bird–habitat relationships (Morrison, 2002).

In each randomly selected point count ($n = 54$), we sampled any territorial sighting or singing individual of any bird species inside a standardized distance from the observer (100 m as fixed radium of detection; see Bibby et al., 2000). Time of sampling in each point count was 5 min. When highly replicated at landscape level, this timing can provide a good description of the breeding bird assemblages (Sutherland, 2006). However, some rarer species of the breeding assemblage under study, including some diurnal raptors, woodpeckers, and rare and less detectable passerines, could be underestimated