



The importance of traditional orchards for breeding birds: The preliminary study on Central European example



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ABSTRACT

Orchards are parts of agriculture and apart from their economic role they may preserve biodiversity in highly transformed farmlands. An increasing intensity of orchards management is known to be threat for some species, especially pollinators and birds. On the other hand, the biodiversity of abandoned orchards was hardly investigated. Here, I present a survey of orchards in Poland to estimate how bird's diversities differ in response to the intensity of orchards management. In 2014, 66 orchards of three types – abandoned, extensively and intensively managed – were investigated. Bird species' richness and abundance were found to be highest in abandoned orchards but overall bird diversity and species composition in abandoned did not differ from these found in extensively managed orchards. In abandoned and extensively managed orchards, hollow-dwellers and insectivores (with some rare old-forest associated species) dominated, whereas in intensively managed orchards the most diverse were ground-dwellers. Among the several selected environmental features, the highest impact on bird diversity was related to the tree diversity, abundance of older trees, presence of multilayer understory and heterogeneous surrounding. The preliminary study point that traditional orchards could play a important role for wood-dwelling species in agriculture and because of that the removal or replacement of all traditional orchards by intensively managed orchards should be avoided and needs of orchard protection should be implemented into Agri-Environmental Schemes/High Nature Value farming systems and possibly also into habitat directive of EU. Unfortunately, the number of abandoned and extensively managed orchards is declining from agricultural landscapes, and traditional orchards are replaced by conventional fruit plantations.

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1. Introduction

The loss of biological diversity in Europe has been observed for various species, including those associated with traditional farmland landscapes (Donald et al., 2006). The decrease of species' richness and population numbers has been caused by the intensification of management in agriculture and horticulture (Benton et al., 2003; Verhulst et al., 2004; Kleijn et al., 2009; Santana et al., 2014). These phenomena were particularly studied with bird communities (Donald et al., 2006; Vorisek et al., 2008; Berg et al., 2015), as birds are known to be appropriate keystone species and indicators of changes in the environment (Mills et al., 1993; Gregory et al., 2008). Over the last few decades, the traditional mosaic of field margins, hedges, midfield woods, ponds and orchards surrounded by extensively managed meadows, pastures and

arable fields in agricultural landscapes of Europe have been transformed into large and intensively managed plantations of crops, vegetables or fruits. Many studies describe the impact of management intensification in farmlands on biodiversity, particularly bird diversity, but most of them concern mainly open lands (Blair, 1996; Chamberlain et al., 2000; Freemark and Kirk, 2001; Filippi-Codaccioni et al., 2008) or field margins (Arnold, 1983), and rarely concern complex landscapes including woodlands (but see: Skórka et al., 2006; Berg et al., 2015). Relatively less research focuses on orchards and studies are mostly conducted to investigate the impact of pesticide use on biodiversity (e.g., Genghini et al., 2006; Bouvier et al., 2011). Bird monitoring programmes show that woodland-related species have stable or slightly declining trends of populations' prevalence and abundance, contrary to open land species, although local and fragmented populations of woodland birds in agricultural landscapes are vulnerable (Vorisek et al., 2008). This concern mainly corresponds to species naturally associated with old trees in scattered deciduous woodlands (e.g., some

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woodpeckers [Michalczyk and Michalczyk, 2016]; saproxylic beetles [Dubois et al., 2009; Horák, 2014]; bees and wasps [Steffan-Dewenter, 2003]). For these species, old orchards (and also parks) could act as replacement environments (Bailey et al., 2010; Horák et al., 2013). A long tradition of orchard cultivation in Europe makes them a highly stable and predictable habitat for many organisms (Brown and Welker, 1992). The intensification of orchard management (transformation of multi-tree species and extensively managed orchards into monoculture plantations) combined with the loss of natural woods (due to increase area of fields or tree plantations), could have a serious impact on the biological occurrence of some species in agricultural landscapes. Some of these species are rare and threatened (e.g. Syrian woodpecker *Dendrocopos syriacus*, Hermit beetle *Osmoderma eremita*), e.g. included in Habitat or Bird Directives of European Union and/or Species of European Conservation Concern (Tucker and Heath, 1994; BirdLife International, 2015).

Some studies from Western and Southern Europe (Chamberlain et al., 1999, 2004; Daniels and Kirkpatrick, 2006; Genghini et al., 2006; Mühlner et al., 2010; Brambilla et al., 2015) investigate breeding bird communities' in farmlands (including gardens and orchards). On the contrary, only one similar study concerned Central Europe (Wiącek and Polak, 2008), but conservation of agriculture-related birds in this part of Europe faces different challenges than in Western Europe (Tryjanowski et al., 2011). Moreover, no studies include a verification of the significance of abandoned orchards (exception from USA – Patnode and White, 1992), which could greatly differ from managed orchards. Myczko et al. (2013) recently showed that abandoned and extensively managed orchards in Central Europe (using the Poland example) are crucial for wintering birds in the agricultural landscape. It could be expected that the significance of extensively managed and abandoned orchards for birds would be even greater during breeding season, as shown for bird communities of central and south-eastern European vineyards, grasslands, pastures and arable lands (e.g. Verhulst et al., 2004; Radović et al., 2013).

In the preliminary study presented, I investigate how bird diversity differs between abandoned, extensively and intensively managed orchards in Central Europe (on example of Poland). I hypothesised that the intensification of management of orchards negatively affects the diversity of birds. Moreover, I tested how orchard features and the landscape structure in surrounding influence on differences in bird communities diversity. Finally, this study offers an answer to the question of whether and how important the conservation of traditional orchards is for maintaining bird diversity (especially of woodland species) in Central European agricultural landscapes.

2. Material and methods

2.1. Orchards selection

The area of study chosen was the western part of the Carpathian Foothills in Poland. This area has a long horticultural history and is currently an important region for fruit cultivation in Poland (Kulikowski, 2007). The main trees cultivated in that area are: apples *Malus* spp., and less abundant pears *Pyrus* spp., plums and cherries *Prunus* spp. and allochthonous walnuts *Juglans regia*.

First, orchards were searched for in selected area (approx. 150 km² to the south of Krakow city within West Carpathian Foothills; 250–350 m a.s.l.) (supplementary file 1). Orchards in that area were identified using the orthophotomaps and topomaps available at <http://mapy.geoportal.gov.pl/imap>. Next, the majority of the identified orchards were verified in the field in Summer 2013. Only orchards that had at least 0.5 ha of wooded area were

considered. Finally, 22 abandoned orchards (hereinafter “A”) were confirmed in selected area. Those orchards that could be characterised by the presence of the following were considered abandoned: i) uneven-aged trees, with prevailing old trees, also dying and dead trees, with no signs of recent cutting of branches, and often including non-fruit species (like limes *Tilia* spp., oaks *Quercus* spp., willows *Salix* spp.); ii) dense bushes and dense herb and grass layer; and iii) usually abandoned buildings in the surrounding areas. As there were many more managed orchards, especially intensively managed plantations, I randomly selected 22 extensively (“E”) and 22 intensively (“I”) managed orchards (with an arbitrary assumption that any orchard could not be located closer than 250 m to any other selected orchard). Those orchards that could be characterised by the presence of the following were considered extensively managed: i) uneven-aged trees but without dead trees and with signs of recent cutting of branches, and sometimes including non-fruit species; ii) grass layer mowed since May (bushes and herbs missing); iii) usually inhabited buildings in surrounding areas. Those orchards that could be characterised by the presence of the following were considered intensively managed: i) even-aged trees belonging to single fruit tree species, without any dying or dead trees, with numerous signs of branch cutting; ii) low grass layer or bare ground (due to herbicide use) (bushes and herbs missing); and iii) usually inhabited buildings in surrounding. The locations of all orchards used in the study are shown in supplementary file 1 (based on google earth tool; <http://www.google.pl/intl/pl/earth/>).

2.2. Bird survey

Birds were counted twice in 2014 between the 10th and 20th of April and the 20th and 30th of May, to include both early and late breeders. I used the standard point count technique to perform this step (Bibby et al., 2000). As most of the orchards (single patches) were small (0.5–1 ha, only some intensively managed had 1–2 ha but usually then consisted of a network of adjacent plots) all birds were surveyed within a 40 m radius point count. Point counts were situated in the centre of orchards (only one study point in each orchard), therefore only birds noticed within the wooded area were considered. All birds flying above the orchards were excluded. Only species associated (as breeders) with environments present in orchards were considered, whereas birds only visiting orchards (like some building-dwellers, e.g., the House Sparrow (*Passer domesticus*) or swallows, and open area-dwellers, e.g., the Eurasian Skylark (*Alauda arvensis*)) were omitted. I also did not count any species with large territories (like diurnal raptors and storks) or that have nocturnal activity (like owls). Woodpeckers were included despite their relatively moderate home ranges (much larger than the area of examined orchards), as these species are associated with woodlands and are important tree hole excavators. Counts were made in the early morning hours (30 min–3 h after dawn), only in good weather conditions (rainless, excluding windy and foggy days). All birds were noted and counted in 10-min periods at each study point (orchard), and, for the most part, counts concerned singing males and birds showing mating or breeding behaviours. Nests were not searched for. To estimate the number of breeding bird abundance (for every species) in each orchard, the higher number of birds noted during one of the two counts was used. Only two counts per breeding season were executed in single year as such counting scheme is commonly used in ecological studies on birds, which focus on estimation of relative diversity of birds, not absolute inventory. Nevertheless, as such limited sampling could lead to some biased results of birds diversity caused by climatic, environmental, demographic or just random conditions, results of this study should be considered as preliminary.

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