Agriculture, Ecosystems and Environment 148 (2012) 83–88

Contents lists available at SciVerse ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Preventing biotic homogenization of farmland bird communities: The role of High Nature Value farmland

Aggeliki Doxa[a,*], Maria Luisa Paracchini[b], Philippe Pointereau[c], Vincent Devictor[d], Frédéric Jiguet[a]

[a] Centre de Recherches sur la Biologie des Populations d'Oiseaux, UMR 7204 MNHN-CNRS-UPMC, CP 51, Muséum National d'Histoire Naturelle, 55 rue Buffon, F-75005 Paris, France
[b] Joint Research Centre of the European Commission, Institute for Environment and Sustainability, TP 262, Via E. Fermi 2749, 21027 Ispra (VA), Italy
[c] SOLAGRO, 75, voie du TOEC, 31076 Toulouse Cedex 3, France
[d] Institut des Sciences de l'Evolution, UMR CNRS-UM2 5554, Université Montpellier 2, 34095 Montpellier Cedex 05, France

ARTICLE INFO

Article history:
Received 8 April 2011
Received in revised form
23 November 2011
Accepted 24 November 2011
Available online 30 December 2011

Keywords:
Agricultural intensification
Community Specialization Index
Farmland Bird Indicator
Farmland specialist species
Low-intensity agriculture
Past land use

ABSTRACT

High Nature Value (HNV) farmlands are expected to support high levels of biological diversity and may have a relevant role in driving biodiversity dynamics and particularly refraining biotic homogenization. The present study tests this hypothesis by examining whether spatial and temporal variations in contemporary composition and dynamics of bird communities are related to past changes in HNV farmland within a 30-year period. Analyses of three farmland types were made in areas of (1) highly intensified agriculture, (2) relatively recent agriculture intensification and (3) low-intensity agriculture identified as HNV farmlands. French farmland in its whole is currently subjected to biotic homogenization processes. However, no homogenization was observed in HNV farmland, potentially indicating that those areas were not affected – or at least not at the same pace as elsewhere – by biotic homogenization. Farmland species population trends remain high in recent non-HNV farmlands, indicating that some non-HNV areas may still contribute in refraining farmland biodiversity decline. Future conservation focus should be given in priority in HNV farmland, but also in areas of recent agriculture intensification, to buffer further negative effects on population and community dynamics.

1. Introduction

Species turnover due to human activities, with loser species being replaced by winners, has been widely documented (Ekroos et al., 2010; Julliard et al., 2004; Keith et al., 2009). Local extinction of specialists species leads to functional homogenization, as distinct functional traits are replaced by others shared by many species (Devictor et al., 2007; Rooney et al., 2007). Considerable attention has been given to sources of disturbance affecting the large-scale community functions and habitats stability to natural or human driven pressures, like agricultural intensification (Clavel et al., 2010; Clavero and Brotons, 2010; Devictor et al., 2008b). Yet, whether and how species react following an increasing spatial and temporal gradient of farming intensification on large spatial scale remains unclear. Biotic homogenization acting through population and community dynamics may not occur similarly in all types of agroecosystems.

Following the global changes in farming practices over half a century and associated strong impacts on biodiversity (Siriwardena et al., 1998; Sotherton and Self, 2000; Van Dyck et al., 2009), the role of low-intensity agriculture for the conservation of farmland biodiversity has been acknowledged (Baldi et al., 2005; Haas et al., 2001). In Europe, low-intensity farmlands favourable to biodiversity have been identified using agriculture production metrics, composing the so called High Nature Value (HNV) farmlands (Baldock et al., 1993; Beaufoy and Baldock, 1994; Henle et al., 2008) and conducting to the HNV indicator (Andersen et al., 2003; Paracchini et al., 2008). The importance of current HNV farmland in biodiversity conservation has been illustrated recently using a national case study of farmland specialist and threatened birds in France (Doxa et al., 2010). However, this role may be compromised in the future by further spatial restriction of HNV farmland following the ongoing intensification and abandonment of agricultural land. Yet, the evaluation of past spatial and temporal restrictions of HNV farmland and associated effects on biodiversity still needs to be performed.

In intensive and intensified agricultural areas, bird communities are expected to be composed of more generalist species, whereas more specialized bird communities are expected in HNV farmlands (Doxa et al., 2010). For population and community dynamics over time, we expect that if all types of farmlands are subject to biotic homogenization, negative population trends will be mostly observable within specialized communities. Our objective is to study whether and to what extent areas that have resisted to agriculture

* Corresponding author at: EPHE – CEFE – CNRS (UMR 5175), 1919 route de Mende, 34293 Montpellier Cedex 5, France. Tel.: +33 0 4 67 61 32 94.
E-mail addresses: doxa@mnhn.fr, aggeliki.doxa@cefe.cnrs.fr (A. Doxa).

0167-8809/$ – see front matter
doi:10.1016/j.agee.2011.11.020

intensification over the last decades can reverse biotic homogenization at the national scale. Moreover, we aim at investigating whether historical non-HNV farmlands differ from recent non-HNV farmlands, which might help in setting priorities in conservation actions among different categories, according to farmland past and current management.

2. Methods

Past and current HNV farmland distribution was estimated in 1970 and 2000 respectively for each municipality in France. Data used for current HNV distribution included the national Farm Structure Survey (FSS) data – carried out on 663.807 agricultural farms in 2000 –, the French National Forest Inventory (NFI), the Annual Agricultural Survey, the Grassland Survey, the Wetland Survey and data from the French Land Parcel Identification System. These databases provided detailed information about agricultural practices, e.g. crop diversity, nitrogen mineral fertilization of grasslands, crop yields, number of farms using common land and those having natural landscape elements (i.e. hedgerows, forest edges, traditional orchards, fishing ponds, wetlands; see Pointereau et al., 2007, 2010). Data used for past HNV distribution were available from the 1970 FSS, NFI, annual agricultural statistics, survey of traditional orchards and on data recorded in 1982 grassland survey. For missing data about past distribution of forest edge length, fishing ponds and wet grasslands temporal invariability was assumed and thus their actual distribution was considered.

The method was based on the calculation and combination of three components, identified on the basis of a thorough analysis of the characteristics of French agriculture considered to be favourable to biodiversity (Pointereau et al., 2010): (1) Crop diversity and share of permanent grassland. Information used to estimate this component was available from the FSS, gathering data for each farm in France. This information was brought to a larger scale by averaging the scores of all farms present in each municipality weighting by their utilized agricultural area. This indicator is a proxy for the rotation system and allows a first approach to the diversity of landscape. Longer rotations and presence of permanent grasslands are indicative of less intensive agriculture and allow a reduction in use of pesticides. (2) Extensive farming practices. As no specific data were available on extensive agricultural practices at the European scale, low intensity management was indirectly estimated with FSS data considering a number of farming conditions (e.g. low stocking density, non irrigated and non drained areas, presence of crops which can be considered as extensive – oats, alfalfa and other fodder legumes – follows, common lands and extensive permanent grasslands and absence of those considered as intensive – maize, sugar beet, industrial crops; temporary grasslands; see Pointereau et al., 2007). The level of intensity in agricultural practices was defined using two variables: the level of mineral nitrogen fertilization of grasslands and the yields of cereals. (3) Presence of natural landscape elements. The number of traditional trees (apple, pear, olive trees, etc.), the length of hedges, the length of wood edges, the number of farm ponds and the surface of wet grasslands were considered for this component. The same methodology was used for each of the three components i.e. precise information available at the local scale, was averaged at the municipality scale. The final HNV indicator was calculated for the agricultural area of each municipality by summing the scores of the three components. Components took values from zero to ten, the final HNV indicator thus varied from one to 30 (for methodological details see Appendix I in Doxa et al., 2010). The threshold separating HNV from non-HNV areas in both current and past HNV farmland was fixed at a HNV score of 14.78, as the minimum allowing to trace ecological differences between HNV and non-HNV farmlands (Pointereau et al., 2010; Doxa et al., 2010). Temporal changes in HNV scores were estimated for each municipality as the simple subtraction of the HNVscore_{2000}–HNVscore_{1970}. This new variable – denoted as DHNV – corresponds to the gradient of farming intensification, i.e. a positive value identifies areas where the HNV score increased over the period 1970–2000, containing actually a higher share of low-intensity farmland, whereas negative values indicate an intensification of agricultural production (see Fig. 1).

2.1. Population-scale analysis (FBI)

To test the response of species abundances to the temporal and spatial changes in HNV farmland (DHNV), the French Farmland Bird Index (FBI) was used based on monitoring data of the 20 farmland specialist species from 2001 to 2008 (Jiguet et al., 2007). Although bird metrics of the French indicator were available from 1989 onwards (Jiguet et al., 2011), we excluded the years 1989–2000, as a different protocol was used during this period with much less plots surveyed. Farmland specialist species were identified using their specialization to habitat through the Species Specialization Index (SSI), measured as the coefficient of variation of the species average abundance in 18 habitat classes and estimated using the French Breeding Bird Survey (BBS) data (Julliard et al., 2006).

Censuses of breeding birds were carried out on randomly selected plots each spring by skilled volunteer ornithologists (Jiguet et al., 2011). Each plot, covering a 2 km × 2 km area, was monitored twice in spring, before and after the eighth of May, with four to six weeks between the two surveying events. In each plot, the observer carried out 10 evenly distributed point counts, where every individual bird, heard or seen, was recorded during a 5 min survey. A total of 1747 plots were surveyed at least once between 2001 and 2008. Data retained for further calculation came from points located within farmland in a total of 1082 plots that had at least five points in farmland habitats. Of these plots, 285 were monitored during one year, 131 during two years, 117 during three years and 549 during four years or more. The number of plots monitored each year in each category i.e. HNV, non-HNV, in areas that lost the HNV status (HNV-lost) and those that gained the HNV status (HNV-gained) are presented in the Appendix (Table A1).

The FBI was calculated as the geometric mean of species abundance indices per year (Gregory et al., 2005). Yearly indices of abundance were obtained after exponential transformation of annual indices obtained with quasi-Poisson regression models using abundance as the dependent factor, first accounting for site effect and then testing for a year effect as a factor (Doxa et al., 2010). The FBI was calculated for four farmland categories i.e. (i) all sites (ii) those that remained HNV (HNV), (iii) those that became non-HNV (HNV-lost) and (iv) those that remained non-HNV (historic non-HNV). Municipalities which gained the HNV status between 1970 and 2000 were very few in France ($n = 288$ municipalities representing 0.8% of the total territory) and not enough bird data existed for this category to conduct a separate analysis. Finally, the temporal trends of the FBI per category were compared to test for significant differences among farmland types. To do so, linear mixed effects (LME) models were used, considering species yearly indices as the dependent variable, year as continuous predictor and species as random predictor. The percentage of increase (or decrease) of the trends was estimated as the average estimate of change per year, as resulted from the previous model, multiplied by the number of time intervals (i.e. number of years-1). The interaction between year and the HNV category was also considered to examine whether temporal linear trends in yearly indices differ among HNV categories.

2.2. Community Specialization Index (CSI)

The CSI was estimated by averaging the SSI of all species encountered in each BBS plot, weighted by the average species abundance.

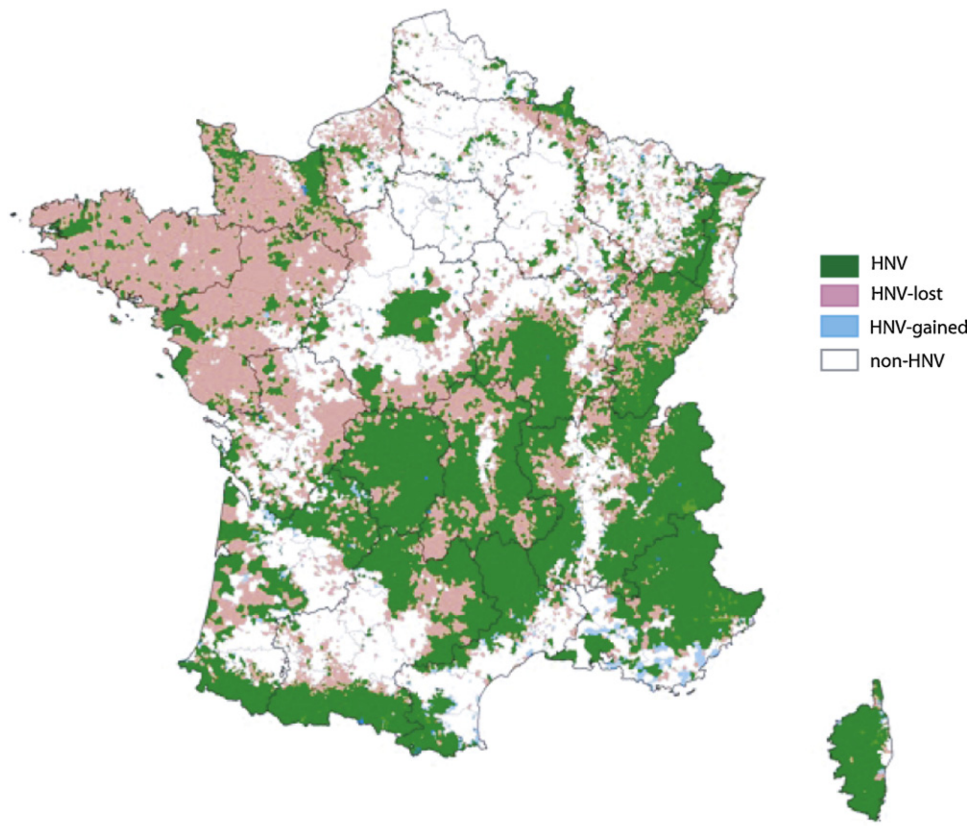

Fig. 1. Spatial changes in HNV farmlands between 1970 and 2000 in France.

The SSI of 144 species (Appendix A2) was used. As generalist habitat species were considered those that varied slightly in abundances across habitats, having a low SSI, whereas those that were more abundant in a certain type of habitats than elsewhere were considered as habitat specialists and had a high SSI value.

Given the location of each BBS site, a DHNV score was attributed to each bird community. This was possible by overlaying the DHNV scores per municipality with the spatial distribution of the BBS sites in a Geographical Information System (ArcGIS 9.3). The type of spatial autocorrelation was identified through semivariograms of available data, using the nlme package in R (Lindstrom and Bates, 1990). Linear models were then run using generalized least squares (GLS), considering a spherical spatial autocorrelation structure and by defining the range and nugget as resulted from the semivariogram analysis (Lin and Zhang, 1999). A spatial model was first tested, using the mean CSI per site as the dependent parameter and the DHNV as the explanatory factor. The temporal variation of the CSI was further analyzed using the CSI value per site and year over the period 2001–2008 as the dependent factor and as independent predictors, the year and the interaction between year and DHNV (as continuous parameters). For the graphical representation, raw data were grouped into 'bins' (Buckingham et al., 2006). Equal HNV score intervals were considered for each bin i.e. sites that had a HNV_{score} in [−10, −5]; [−5, 0]; [0,5]; etc., were grouped together. To explore potential non-linear responses, generalized additive models (GAMs) were used, with a smooth spline function and two degrees of freedom (see also Devictor et al., 2008a; Guisan et al., 2002). We conducted separate analyses for the previous four categories of farmlands (see Section 2.2).

3. Results

HNV farmlands covered a total area of 21.3 million hectares (Mha) in 1970, while this area was significantly reduced to 6.9 Mha in 2000 (see Fig. 1). Important losses of HNV areas occurred mainly in North-Western but also to a lesser extent in Central France. Farmland areas that acquired the HNV status from 1970 to 2000 were very few and located mainly in south-eastern France (blue coloured in Fig. 1; for interpretation of the references to color in text, the reader is referred to the web version of the article).

3.1. Population trends

At the population level, the FBI increased by +9.9% between 2001 and 2008 in areas that remained HNV and the trend was also positive in recent non-HNV areas (+4.5%; see Fig. 2). However, the indicator had a negative trend in intensively cultivated areas that

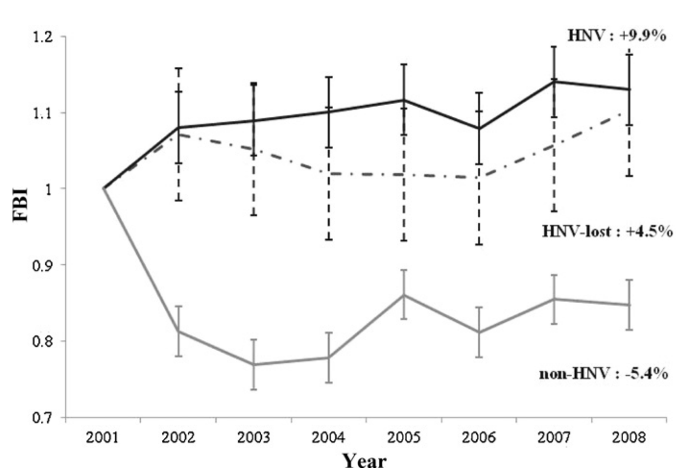

Fig. 2. The FBI estimated (i) for HNV farmlands, (ii) recent non-HNV farmlands (HNV-lost), (iii) for historically non-HNV farmlands. Standard errors are shown in bars.

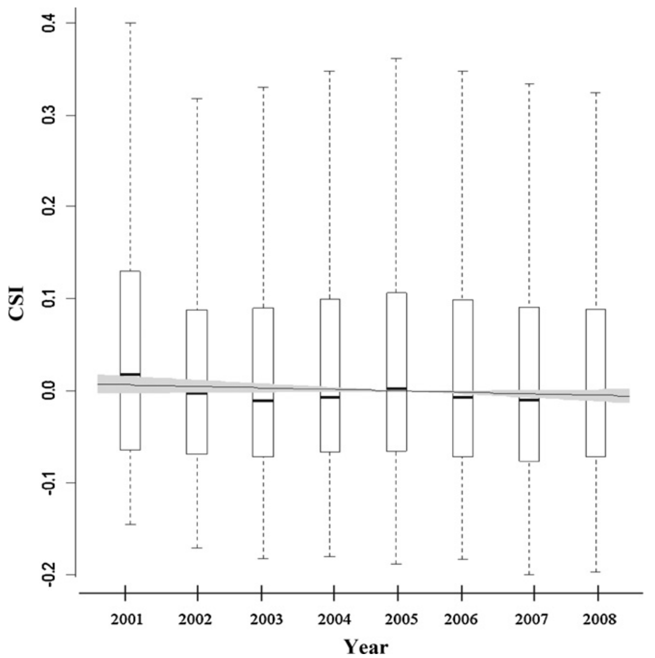

Fig. 3. CSI for the period 2001–2008. Raw data are shown in the boxplot. Trend and confidence intervals estimated from the generalized additive model are shown in black solid line and within grey lines, respectively.

were considered as non-HNV farmland both in 1970 and 2000 (historic non-HNV: −5.4%). Trends were significantly different between HNV and historic non-HNV farmlands ($t_{297} = 2.09$, $p = 0.04$). No differences were revealed in trends among other farmland types. A strong decline during the early 2000s in historic non-HNV farmlands was observed, which reflects the decline in farmland birds in France during the 1990s, stabilized further on.

3.2. Community structure

When considering all sites together, a significant positive linear trend between the CSI and the DHNV was observed ($t_{1072} = 5.01$, $p \ll 0.001$). Farmlands where the HNV score has increased (moving to the right part of the graph), hold more specialized bird communities. On the contrary, sites where the HNV score decreased (moving to the left part of the graph) hold bird communities dominated by habitat generalists (low CSI values). Moreover, testing for an overall temporal trend in the CSI, a negative trend was revealed ($t_{4081} = -2.92$, $p < 0.01$; Fig. 3), which indicates that bird communities were increasingly composed by habitat generalist species over the period 2001–2008. The interaction between year and DHNV was not significant ($t_{4081} = 0.52$, $p = 0.6$).

By considering separately each farmland category, a significant positive trend in community specialization was revealed along the DHNV gradient ($t_{501} = 7.65$, $p \ll 0.001$) for recent non-HNV farmlands (see Fig. 4a). The temporal trend of CSI was negative ($t_{1929} = -2.92$, $p < 0.01$), but the interaction between year and DHNV was significantly positive for this category ($t_{1929} = 5.00$, $p \ll 0.001$). Quite different results were obtained for the other two categories; for HNV farmlands, CSI continued to have a positive trend over increasing DHNV ($t_{402} = 2.26$, $p = 0.02$; see Fig. 4b), but interestingly the negative trend in CSI over time was not significant for this category ($t_{1511} = -1.66$, $p = 0.1$). Finally for historic non-HNV farmlands, no evidence was found of any significant trend neither along the DHNV gradient ($t_{163} = -0.38$, $p = 0.7$), nor over time ($t_{627} = 0.26$, $p = 0.8$). The interaction between year and DHNV was not significant for both categories (HNV: $t_{1511} = 0.05$, $p = 1$, historic non-HNV: $t_{627} = -0.33$, $p = 0.7$).

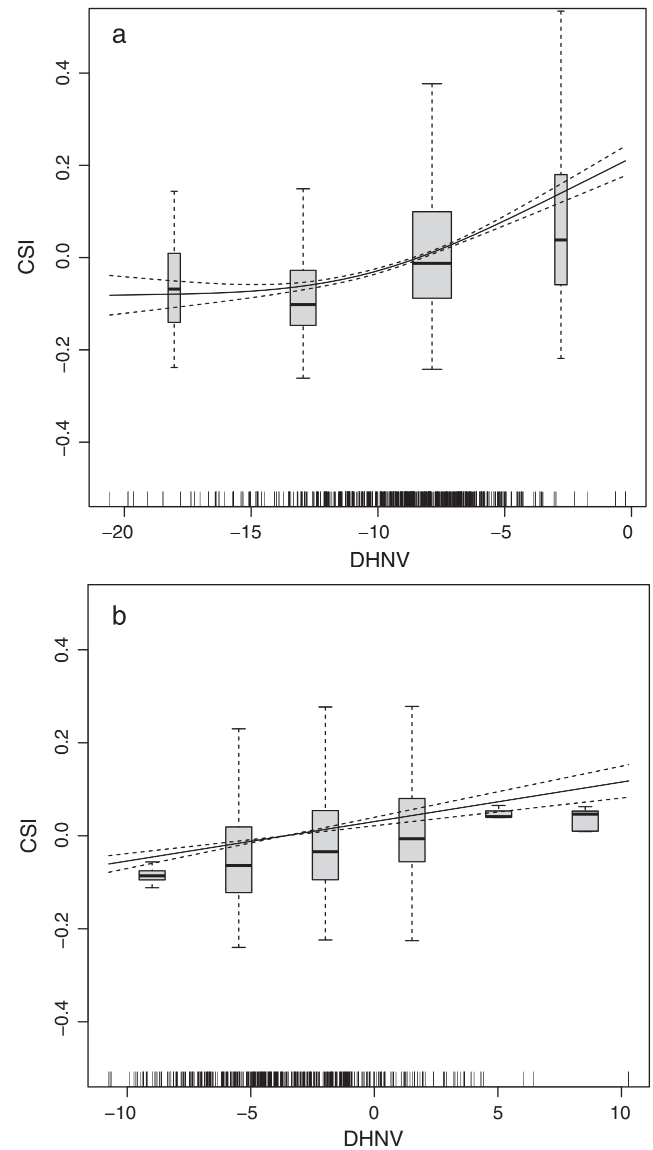

Fig. 4. CSI over DHNV for (a) recent non-HNV farmlands (HNV-lost; $n = 503$ sites), (b) HNV farmlands ($n = 404$ sites). Raw data are shown in the boxplots, trend estimate of the generalized additive model is shown in black solid line and confidence intervals are shown in dotted lines.

4. Discussion

Past and current HNV farmland had a net positive effect on the composition of bird communities, i.e. in farmlands of stable or increasing HNV score, bird communities were increasingly composed by farmland specialist species, as resulted from the analysis of CSI and FBI over space and time. A significant trend towards community homogenization was however revealed over time for the period 2001–2008 at the national level. Interestingly though, considering separate farmland categories, we revealed that not all farmland types were subjected to biotic homogenization, at least not in the same pace. Intensified agriculture practices applied for over 30 years in historical non-HNV farmlands coincided in areas where specialist species are most in decline. However in recent non-HNV farmlands some mitigated results were obtained as bird abundances were maintained there in higher levels than in historical non-HNV areas. At the community level, CSI results indicated species turnover over time with farmland specialists being replaced by habitat generalists, potentially indicating that landscape structure in recent non-HNV farmlands may be favourable to certain but not all farmland specialist species. The observed biotic homogenization was less marked within areas with relatively high HNV scores.

The influence of past land use on present biodiversity may vary according to species life-history traits. For instance, responses to landscape changes may be delayed by 25–100 years for long-lived birds (Ferraz et al., 2007). However, as most species considered in the present study are relatively short-lived passerines, such time-lagged effects, if present, should refer to more brief time periods. Metzger et al. (2009) suggested that delayed responses in population change to agriculture intensification arise when reaching a critical threshold set by of a number of interacting factors, rather than one single agent. The present study shows that past landscape structure in French farmlands influences present biodiversity in bird communities. Furthermore it shows that different levels of biodiversity are encountered within the different DHNV categories which could reflect various and continuous impacts of intensification. In terms of population trends, significant differences occur between HNV and historic non-HNV farmland, however no such difference is yet observed between HNV and recent non-HNV farmlands.

Farmlands with intermediate levels of Nature Value may still play an important role in biodiversity conservation in agricultural areas. For HNV farmland, a conservation effort should be targeted at preserving crop diversity, extensive farming practices and landscape elements, especially within the less favoured areas (LFA) in France (Doxa et al., 2010). In farmlands of relatively recent agricultural intensification, conservation measures should focus on the preservation of landscape elements that may potentially buffer the effects of intensification for some species. In heterogeneous landscapes, with a high variety of crops and management practices, birds can benefit from higher food availability (Danhardt et al., 2010). Landscape complexity can also buffer biodiversity from indirect or combined effects coming from different sources of disturbance.

Community-based metrics (e.g. Community Specialization Indices) integrating ecological differences between species (e.g. their specialization level) is useful for refining conservation targets (Norris, 2008). Using only species richness indices seem insufficient when studying anthropogenic habitat alteration. In fact some recent studies have shown that large shifts in relative species abundances may result in peaks of local species richness (Blair and Johnson, 2008; Catterall et al., 2010; Crooks et al., 2004), whereas others do not detect any observable changes in species richness over time (Doxa et al., 2010; Kerbiriou et al., 2009). In addition, species-rich communities may be mostly composed by generalists species than species-poorer communities (Clavero and Brotons, 2010).

Refraining biotic homogenization in agroecosystems and other types of habitats is a major world-wide conservation goal (Olden, 2006; Olden and Poff, 2003). The present study underlines the role of HNV farmland for halting in some cases biodiversity loss and biotic homogenization in bird communities and potentially in other taxa in French farmlands. Results are encouraging in the sense that biodiversity decline seems to be reversible – to some extent – if the types of farmland that mostly contribute in doing so are adequately managed. Habitat availability for farmland specialists should be further favoured. On this aspect, additional focus should be given to recent non-HNV farmlands that maintain relatively high HNV scores and which may still contribute in achieving conservation goals. Any further geographic and economic marginalization of HNV farming would probably result in a decrease of its actual positive role for conserving farmland biodiversity in France, and in other EU countries where agricultural changes are likely to severely affect bird populations (Butler et al., 2010). The identification of potential large-scale conservation areas, such as the HNV farmland network should therefore be seriously considered as part of an adaptive plan in reducing farmland biodiversity decline.

Acknowledgements

We would like to warmly thank the hundreds of volunteers that participated to the French Breeding Bird Survey. We also thank Jean-Michel Terres for comments on previous versions of this work. This study was funded by the Joint Research Centre of the European Commission, Institute for Environment and Sustainability.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.agee.2011.11.020.

References

Andersen, E., Baldock, D., Bennett, H., Beaufoy, G., Bignal, E., Brouwer, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D.I., Nieuwenhuizen, W., van Eupen, M., Hennekens, S., Zervas, G., 2003. Developing a high nature value farmland area indicator. In: Report for the European Environment Agency, Copenhagen.

Baldi, A., Batary, P., Erdos, S., 2005. Effects of grazing intensity on bird assemblages and populations of Hungarian grasslands. Agriculture Ecosystems and Environment 108, 251–263.

Baldock, D., Beaufoy, G., Bennett, G., Clark, J., 1993. Nature Conservation and New Directions in the Common Agricultural Policy. IEEP, London.

Beaufoy, G., Baldock, D.J.C., 1994. The Nature of Farming: Low Intensity Farming Systems in Nine European Countries. IEEP, London.

Blair, R.B., Johnson, E.M., 2008. Suburban habitats and their role for birds in the urban-rural habitat network: points of local invasion and extinction? Landscape Ecology 23, 1157–1169.

Buckingham, D.L., Peach, W.J., Fox, D.S., 2006. Effects of agricultural management on the use of lowland grassland by foraging birds. Agriculture, Ecosystems and Environment 112, 21–40.

Butler, S.J., Boccaccio, L., Gregory, R.D., Vorisek, P., Norris, K., 2010. Quantifying the impact of land-use change to European farmland bird populations. Agriculture Ecosystems and Environment 137, 348–357.

Catterall, C.P., Cousin, J.A., Piper, S., Johnson, G., 2010. Long-term dynamics of bird diversity in forest and suburb: decay, turnover or homogenization? Diversity and Distributions 16, 559–570.

Clavel, J., Julliard, R., Devictor, V., 2010. Worldwide decline of specialist species: toward a global functional homogenization? Frontiers in Ecology and the Environment.

Clavero, M., Brotons, L., 2010. Functional homogenization of bird communities along habitat gradients: accounting for niche multidimensionality. Global Ecology and Biogeography 19, 684–696.

Crooks, K.R., Suarez, A.V., Bolger, D.T., 2004. Avian assemblages along a gradient of urbanization in a highly fragmented landscape. Biological Conservation 115, 451–462.

Danhardt, J., Green, M., Lindstrom, A., Rundlof, M., Smith, H.G., 2010. Farmland as stopover habitat for migrating birds – effects of organic farming and landscape structure. Oikos 119, 1114–1125.

Devictor, V., Julliard, R., Clavel, J., Jiguet, F., Lee, A., Couvet, D., 2008b. Functional biotic homogenization of bird communities in disturbed landscapes. Global Ecology and Biogeography 17, 252–261.

Devictor, V., Julliard, R., Couvet, D., Lee, A., Jiguet, F., 2007. Functional homogenization effect of urbanization on bird communities. Conservation Biology 21, 741–751.

Devictor, V., Julliard, R., Jiguet, F., 2008a. Distribution of specialist and generalist species along spatial gradients of habitat disturbance and fragmentation. Oikos 117, 507–514.

Doxa, A., Bas, Y., Paracchini, M.L., Pointereau, P., Terres, J.-M., Jiguet, F., 2010. Low-intensity agriculture increases farmland bird abundances in France. Journal of Applied Ecology 47, 1348–1356.

Ekroos, J., Heliola, J., Kuussaari, M., 2010. Homogenization of lepidopteran communities in intensively cultivated agricultural landscapes. Journal of Applied Ecology 47, 459–467.

Ferraz, G., Nichols, J.D., Hines, J.E., Stouffer, P.C., Bierregaard, R.O., Lovejoy, T.E., 2007. A large-scale deforestation experiment: effects of patch area and isolation on Amazon birds. Science 315, 238–241.

Gregory, R.D., van Strien, A., Vorisek, P., Meyling, A.W.G., Noble, D.G., Foppen, R.P.B., Gibbons, D.W., 2005. Developing indicators for European birds. Philosophical Transactions of the Royal Society B – Biological Sciences 360, 269–288.

Guisan, A., Edwards, T.C., Hastie, T., 2002. Generalized linear and generalized additive models in studies of species distributions: setting the scene. Ecological Modelling 157, 89–100.

Haas, G., Wetterich, F., Kopke, U., 2001. Comparing intensive extensified and organic grassland farming in southern Germany by process life cycle assessment. Agriculture Ecosystems and Environment 83, 43–53.

Henle, K., Alard, D., Clitherow, J., Cobb, P., Firbank, L., Kull, T., McCracken, D., Moritz, R.F.A., Niemela, J., Rebane, M., Wascher, D., Watt, A., Young, J., 2008. Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe – a review. Agriculture Ecosystems and Environment 124, 60–71.

Jiguet, F., Gadot, A.S., Julliard, R., Newson, S.E., Couvet, D., 2007. Climate envelope, life history traits and the resilience of birds facing global change. Global Change Biology 13, 1672–1684.

Jiguet, F., Devictor, V., Julliard, R., Couvet, D., 2011. French citizens monitoring ordinary birds provide tools for conservation and ecological sciences. Acta Oecologica, doi:10.1016/j.actao.2011.05.003.

Julliard, R., Clavel, J., Devictor, V., Jiguet, F., Couvet, D., 2006. Spatial segregation of specialists and generalists in bird communities. Ecology Letters 9, 1237–1244.

Julliard, R., Jiguet, F., Couvet, D., 2004. Common birds facing global changes: what makes a species at risk? Global Change Biology 10, 148–154.

Keith, S.A., Newton, A.C., Morecroft, M.D., Bealey, C.E., Bullock, J.M., 2009. Taxonomic homogenization of woodland plant communities over 70 years. Proceedings of the Royal Society B – Biological Sciences 276, 3539–4354.

Kerbiriou, C., Le Viol, I., Jiguet, F., Devictor, V., 2009. More species, fewer specialists: 100 years of changes in community composition in an island biogeographical study. Diversity and Distributions 15, 641–648.

Lin, X., Zhang, D., 1999. Inference in generalized additive mixed models using smoothing splines. Journal of the Royal Statistical Society Series B 61, 381–400.

Lindstrom, M.J., Bates, D.M., 1990. Nonlinear mixed effects models for repeated measures data. Biometrics 46, 673–687.

Metzger, J.P., Martensen, A.C., Dixo, M., Bernacci, L.C., Ribeiro, M.C., Teixeira, A.M.G., Pardini, R., 2009. Time-lag in biological responses to landscape changes in a highly dynamic Atlantic forest region. Biological Conservation 142, 1166–1177.

Norris, K., 2008. Agriculture and biodiversity conservation: opportunity knocks. Conservation Letters 1, 2–11.

Olden, J.D., 2006. Biotic homogenization: a new research agenda for conservation biogeography. Journal of Biogeography 33, 2027–2039.

Olden, J.D., Poff, N.L., 2003. Toward a mechanistic understanding and prediction of biotic homogenization. American Naturalist 162, 442–460.

Paracchini, M.L., Petersen, J.-E., Hoogeveen, Y., Bamps, C., Burfield, I., van Swaay, C., 2008. High Nature Value Farmland in Europe. An Estimate of the Distribution Patterns on the Basis of Land Cover and Biodiversity Data. European Commission Joint Research Centre, Institute for Environment and Sustainability. Report EUR 23480 EN. Office for Official Publications of the European Communities, Luxembourg, 87 pp.

Pointereau, P., Doxa, A., Coulon, F., Jiguet, F., Paracchini, M.L., 2010. High Nature Value Farmland and Common Bird Indicators. Spatial and Temporal Modifications in Agricultural Practices and Bird Communities. Luxembourg: Office for Official Publications of the European Communities. JRC 24299 EN.

Pointereau, P., Paracchini, M.L., Terres, J.-M., Jiguet, F., Bas, Y., Biala, K., 2007. Identification of high nature value farmland in france through statistical information and farm practice surveys. Office for Official Publications of the European Communities, Luxembourg.

Rooney, T.P., Olden, J.D., Leach, M.K., Rogers, D.A., 2007. Biotic homogenization and conservation prioritization. Biological Conservation 134, 447–450.

Siriwardena, G.M., Baillie, S.R., Buckland, S.T., Fewster, R.M., Marchant, J.H., Wilson, J.D., 1998. Trends in the abundance of farmland birds: a quantitative comparison of smoothed Common Birds Census indices. Journal of Applied Ecology 35, 24–43.

Sotherton, N.W., Self, M.J., 2000. Changes in plant and arthropod biodiversity on lowland farmland: an overview. In: Aebischer, N.J., Evans, A.D., Grice, P.V., Vickery, J.A. (Eds.), Ecology and Conservation of Lowland Farmland Birds. British Ornithologists' Union, Tring, pp. 26–35.

Van Dyck, H., Van Strien, A.J., Maes, D., Van Swaay, C.A.M., 2009. Declines in common, widespread butterflies in a landscape under intense human use. Conservation Biology 23, 957–965.