Assessment of the impact of oilseed rape cultivation on farmland birds in France.

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Introduction

The impact of biofuel on environment is strongly discussed in France and Europe. The debate focussed up to now on energy and climate change, but biodiversity is becoming a major concern. The measurement of biodiversity is difficult since no taxa could reflect alone the whole biodiversity. However, the birds seem good candidates to build biodiversity indicators, because globally near the top of the food web. For example, the Farmland Bird Indicator based on abundances is one of the structural indicators for environment at the European Union level. In order to assess the impact of oilseed rape (OSR) cultivation on biodiversity in France, we carried out a diagnosis to see how land-use in agricultural landscapes could influence different farmland bird indicators.

Material and methods

We used existing national databases to analyse the relation between land use on "small agricultural regions" -SAR- (statistical units homogeneous towards farming systems) and indicators provided by the STOC (Suivi Temporel des Oiseaux Communs) bird survey scheme (Julliard & Jiguet, 2002). This program gathers data coming from volunteer ornithologists. Plots sizing 2 X 2 km are randomly selected around the localities proposed by observers. Each plot is followed over years by one observer. Counts of seen or heard birds are carried out twice a spring on 10 points by plot (figure 1).
The network included 902 plots in 2004, the year we studied. We selected 415 plots among them, including at least five points declared as agricultural area by observers. We calculated four indicators.
- Farmland birds abundance. We took a list of 18 farmland specialist species into account, corresponding to that used for the national farmland bird indicator less two species known to generate high variability at the local level (rook, *Corvus frugilegus* and ring necked pheasant, *Phasianus colchicus*). We divided this list in two sub-groups: specialists of open fields, and specialists of grassland according to the expertise of naturalists from CRBPO (Centre de Baguage des Populations d'Oiseaux).
- Specific Richness. This indicator is the total number of species by plot.

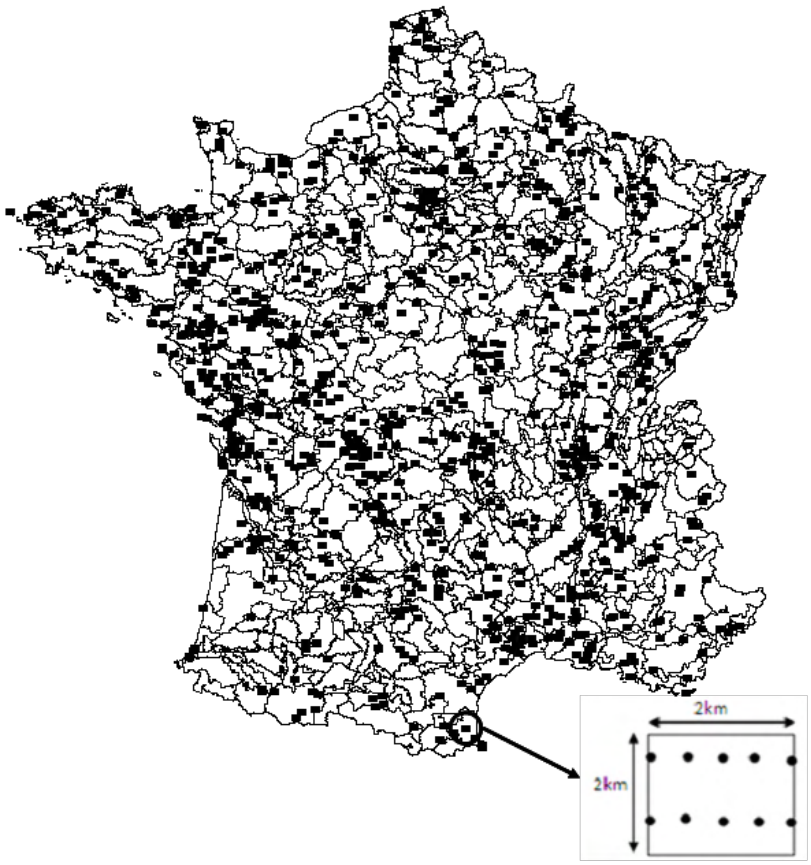

Figure 1: the STOC network in 2004. 902 plots and 10 points by plot. The limits inside the map are those of small agricultural regions.

- Community specialization index (CSI). The Species Specialization Indicator (SSI) is equal to the coefficient of variation of relative abundances among 18 habitats (Julliard et al., 2006). It is used to make a distinction between specialized species observed in a specific habitat with high SSI value (e.g. SSI of skylark, *Alauda arvensis* = 1.16), and more generalist observed in a wide range of habitats with low SSI. The average SSI value by point is the mean relative abundance for all observed species weighted by their SSI. The CSI for a plot is a mean value for the 10 points.

- Community trophic index (CTI) reflecting the diversity of birds' diets. The percentages of plants, invertebrates and vertebrates in the diet of each species are known from the literature. The trophic index of the species (TTI) is the sum of the three percentages weighted by 1 for plants, 2 for invertebrates, and 3 for vertebrates. Thus, a species at the top of the food web will have a higher index rather than an herbivorous (e.g. TTI of buzzard, *Buteo buteo* = 2.9 vs. TTI of skylark, *Alauda arvensis* = 1.3). The CTI by point corresponds to the average abundances of each species weighted by their TTI. The CSI by spot is a mean value for the 10 points. This experimental indicator is at the present time under test.

Land use was described according to Corin Land Cover data, and statistical data from ONIGC (Office National Interprofessionnel des Grandes Cultures). SAR gather “communes”, a low administrative level at which these statistical data are not easily available. We worked with data concerning the “cantons”, a higher administrative level, and chose the following rule for upscalling: a SAR was described according to data from “cantons” strictly included in these SAR, i.e. without part belonging to another SAR. The study covered 182 SAR of the French metropolitan territory where oilseed rape was grown, each of them described with the following variables: percentage of OSR, cereals, agronomic set-aside, grassland and semi-natural areas in the total SAR area.

Relations between farmland bird indicators and land use were analyzed thanks to multiple linear regressions (log-linear model for abundance, and linear model for CSI, CTI and specific richness). The variables were selected by minimization of Akaike Information Criterion.

Results and discussion

The table 1 gives the correlations between explanatory variables. These correlations should be interpreted cautiously due to possible non-linear relations. The table 2 gives for each multiple regression models, the estimation of coefficients and the variability explained by models.

Table 1: correlation matrix between explanatory variables

	OSR	Cereals	Set-aside	Grass	Semi-natural areas
OSR	1				
Cereals	0,61	1			
Set-aside	0,55	0,74	1		
Grass	-0,27	-0,41	-0,44	1	
Semi-natural area	-0,33	-0,73	-0,62	0,72	1

Table 2: estimations of coefficients of multiple regression models linking farmland bird indicators and land use expressed as percentage of the total regional area. X means the variable was not selected.

Indicator	Model	%OSR	%Cereals	%Grass	%Set-aside	%Semi-natural	Coefficient of determination
Farmland birds abundance μ=40,1	Log-linear	0,047	0,021	X	- 0,076	0,002	13,9%
Open-field specialists abundance μ=16,7	Log-linear	0,058	0,038	- 0,008	- 0,075	0,004	28,0%
Grassland specialists abundance μ=23,3	Log-linear	0,035	0,006	0,006	- 0,061	X	4,0%
CTI μ=1,6	Linear	- 0,004	- 0,002	X	X	X	16,3%
CSI μ=0,66	Linear	0,010	X	- 0,004	- 0,022	X	13,8%
Specific richness μ=49,0	Linear	X	- 0,184	0,107	2,55	X	3,5%

Percentages of OSR areas were positively linked with farmland birds abundances and CSI, whereas negatively linked with CTI. But these links were almost identical for cereals. This suggests the impact of field crops habitat, favourable to a specialised bird fauna, without the possibility to determine a specific effect of OSR by itself. Although set-aside was positively linked with cereals and OSR, it was negatively linked with all indicators, except species richness. It is not possible to determine the mechanisms behind these statistical links: is the agronomic set-aside not favorable to birds (permanent cover with limited food resources), which seems contradict common opinion? Or is there confusion with other factors not taken into account in our analysis? This example highlights the limitation of this global approach to analyze in depth cause and effect.

The table 2 shows the variability of biodiversity indicators was weakly explained by the selected variables. For example, total farmland birds abundances in SAR with 7-8% of OSR were between 11 and 162 (RSD = 69%). These results show OSR area in a region is not a major explicative factor, and does not threaten bird biodiversity by itself. In consequence, the diagnosis should take other factors into account in order to identify operational strategies to improve biodiversity. Further works are

planned to add new variables in this analysis. This exploratory study is complementary to more analytical and accurate field studies.

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