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The impact of Natura 2000 on non-target species

Assessment using volunteer-based biodiversity monitoring

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Executive summary

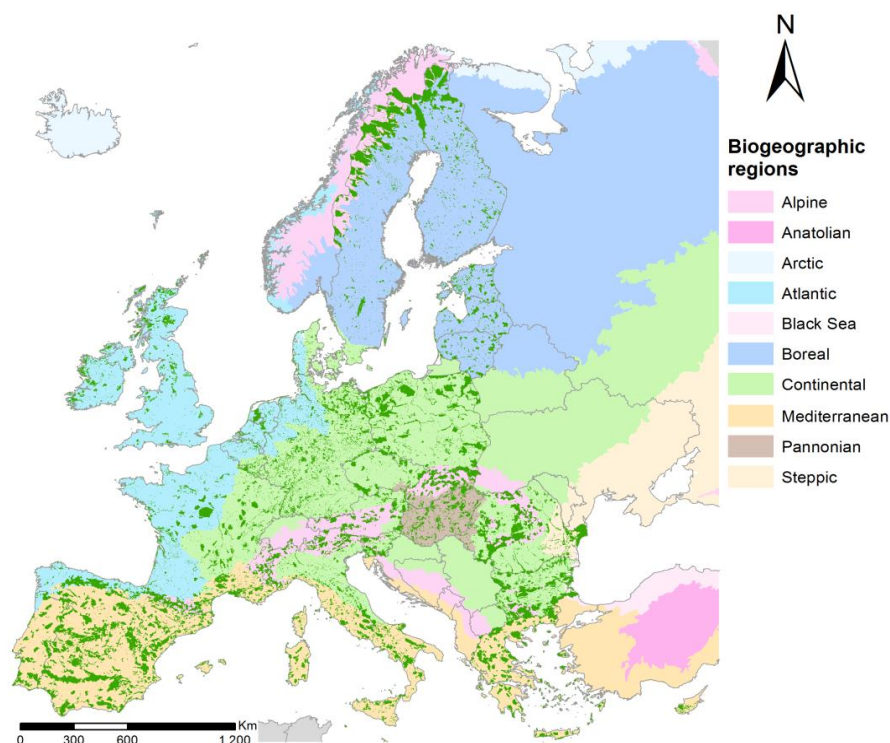
- Following a study in France in 2013 assessing the impact of the Natura 2000 network on common bird species populations, this survey aims at expanding the analysis at a European scale, making use of data on 166 common breeding bird species gathered through volunteer-based schemes in 13 EU countries and the EU Natura 2000 database describing the network at the end of 2012. In addition the analysis of the possible impact of the Natura 2000 was also tested on 103 butterfly species populations, making use of data provided through volunteer-based schemes in 6 countries/ regions. Results for butterflies should be considered as preliminary
- The spatial variations in abundance of bird and butterfly species were analysed in relation to the variations of the Natura 2000 coverage in the landscape around the survey sites. Half of the 166 bird species have a higher abundance when the coverage of Natura 2000 is larger in the landscape, meaning that the abundance of half of the bird species is likely to be higher within Natura 2000 than outside. More woodland specialist species are present among these species responding positively than among species responding negatively (*ie* species less abundant inside than outside) or among neutral species (*i.e.* species equally abundant inside and outside). A similar pattern exists for the 103 butterfly species, even though there is a higher number of neutral species. A similar analysis was performed per biogeographical region (Atlantic, Boreal, Continental and Mediterranean). For the bird species, patterns similar to the European one are found in the Atlantic and Continental region, whereas it was the case in the Continental and Mediterranean region for the butterfly species.
- The characteristics of bird species were analysed and it appears that the species more abundant within the Natura 2000 network are more likely to have a narrower ecological niche. Indeed, these species have a higher Species Specialization Index than the species with a lower abundance.
- When analysing the responses at the community level, it appears that the bird communities within Natura 2000 have longer trophic chains and are less biologically homogeneous than the communities outside. Indeed, both the Bird Trophic and Community Specialization Indexes are higher in sites with a high Natura 2000 coverage. Thus, bird communities appear to be more functional inside Natura 2000 than outside.
- Finally, the temporal trends of a subset of bird and butterfly populations were analysed. The species were grouped according to their habitat preferences (farmland/woodland for birds and grassland/woodland for butterflies). The main result is that the declining trend of farmland birds observed throughout Europe seems to be less sharp within the Natura 2000 network.

1 Introduction

With more than 27 000 sites covering 18% of the European Union land territory and over 251 500 km² in the marine area (European Commission, 2014a), the Natura network of protected areas represents by far the largest coordinated effort to preserve biodiversity at a continental scale (Map 1.1). The implementation of this network is underpinned by two policy instruments of the EU, *i.e.* the Bird Directive (79/409/EEC, amended 2009: 2009/147/EC) and the Habitats Directive (92/43/EEC, consolidated 2007). While the general aim of both Directives is to contribute to biodiversity conservation in general, the Natura 2000 network is targeted to the conservation of a selection of species and habitats which are considered of European interest due to their rarity, vulnerability or typical characteristic of the region. Member States of the European Union thus have to designate Special Protection Areas (SPAs) to ensure the conservation of 192 bird species listed in Annex I of the Birds Directive as well as of migratory species, and Special Areas of Conservation (SACs) to ensure the conservation of over 900 taxa from other taxonomic groups listed in Annex II of the Habitats Directive and 233 Habitat-types listed in Annex I of the Habitats Directive across nine biogeographic regions (Map 1.1). The combination of SPAs and SACs form the Natura 2000 network.

This designation phase is (almost) over now for the terrestrial part, meaning that all the areas in the network have been identified even though the management *per se* has barely started.

Map 1.1. Designated Natura 2000 (non-marine areas) and biogeographical regions in Europe (end 2012)



There is now scientific evidence that common species play a crucial role in ecosystem structure and functioning (Gaston, 2010). Declines in common species could have important evolutionary and ecological consequences as they may disrupt food web and other ecosystem structure and alter macro-ecological patterns or ecosystem functions (Gaston, 2011).

There is also evidence that common farmland birds (Le Viol *et al.*, 2012), as well as grassland butterflies (Van Swaay *et al.*, 2013) are declining throughout Europe whereas woodland birds seems to have stabilized their decline.

(http://www.ebcc.info/index.php?ID=568&result_set=Publish2014&one_indik=E_C_Fo).

A study done in France at national level (Pellissier *et al.*, 2013) showed that the abundance of the majority of common bird species tended to increase in Natura 2000 areas as compared to the wider countryside and that the communities seemed to be more functional in such areas (more specialized, with longer trophic chains). Based on these results it was felt interesting to expand the survey for the European level *i.e.* to assess whether other bird species than those targeted by Annex I of the Birds Directive (thereafter called common bird species) exhibited similar patterns as those found in this previous study. In addition, performing the same type of analysis with butterfly species was attempted.

Demonstrating a positive role of the Natura 2000 network on common bird species and on butterflies would thus suggest the importance of the network for maintaining ecosystem functioning and structure beyond the protection of rare and threatened species.

This study combines two different sources of data, *i.e.* data reported by EU Member States describing the designated Natura 2000 sites and data collected through voluntary based monitoring schemes on common species abundance (breeding birds and butterflies). Volunteer based surveys are now well established in Europe and are able to provide large scale biodiversity data. Such data are used by states to compute trends and indicators (Gregory *et al.*, 2005) and are considered reliable to assess protection networks (Devictor *et al.*, 2007; Jiguet *et al.*, 2012; Pellissier *et al.*, 2013).

Looking at two main categories of each taxonomic group (*i.e.* farmland/ woodland birds, grassland/ woodland for butterflies), the purpose of the study is mainly to assess:

- (i) whether the designation of Natura 2000 areas also favors common, non-target species at both population and community level
- (ii) whether the trends of the most habitat specialized species differ inside and outside the Natura 2000 network.

To do so, we first evaluated the response of each species and of species community indices to the Natura 2000 coverage in the landscape. Second, we assessed the temporal trends of a subset of species (the most specialized ones) in a subset of sites located inside or outside the network.

2 Data used

2.1 Biodiversity data

Both bird and butterfly data originate from volunteer based surveys.

Bird data were provided for 14 monitoring schemes located in 13 countries of the EU (Austria, Spain -which have two different survey schemes, one for Catalonia and for the rest of the Spain- France, Latvia, UK, Germany, Denmark, Sweden, Czech Republic, Netherlands, Poland, Italy and Finland). Abundance estimates were available for the 166 most common and widespread bird species detected by the monitoring schemes, that is, species occurring in at least 2% of the sites located inside their distribution area (BirdLife International & NatureServe, 2013). Various monitoring schemes exist across Europe, such as point count, line transect or territory mapping (see <http://www.ebcc.info/pecbm.html>). The centroid of the survey site is thus retained as the spatial

coordinates of the site. One count value was available for each species and for each of the 11635 sites surveyed, from 2000 to 2011 in this original dataset.

Butterfly data were provided for 6 schemes (France, Catalonia, UK, Finland, Germany and Netherlands) and for 102 species, in 3439 sites. The data we used are not raw abundances but abundance indexes, from 2001 to 2012. These indices are abundances corrected for the phenology of each species in the biogeographical region in which it occurs. This correction takes into account imperfect detection due to the particular nature of the phenological cycle of butterflies. Indeed, butterflies can exhibit several abundance peaks during the season, depending on both the species and the climatic conditions. Thus, if the sampling period occurs between these peaks, which may occur depending on the survey scheme, the null count could be misinterpreted as a real absence, whereas it is just an imperfect detection. Basically, GAM (Generalized Additive Model) were used to estimate the seasonal pattern for each species in site, with a limitation for the bioclimatic region, and this pattern was fitted for each year, in order to account for inter-annual pattern variations (Dennis *et al.*, 2013). To make sure that the seasonal patterns were correctly assessed, and thus that the abundance indices produced were reliable, we only kept the sites for which the sampling period covered at least 70% of the phenology. This leads to the removal of almost all points from the French BMS. After this selection, 3033 sites were kept in the dataset.

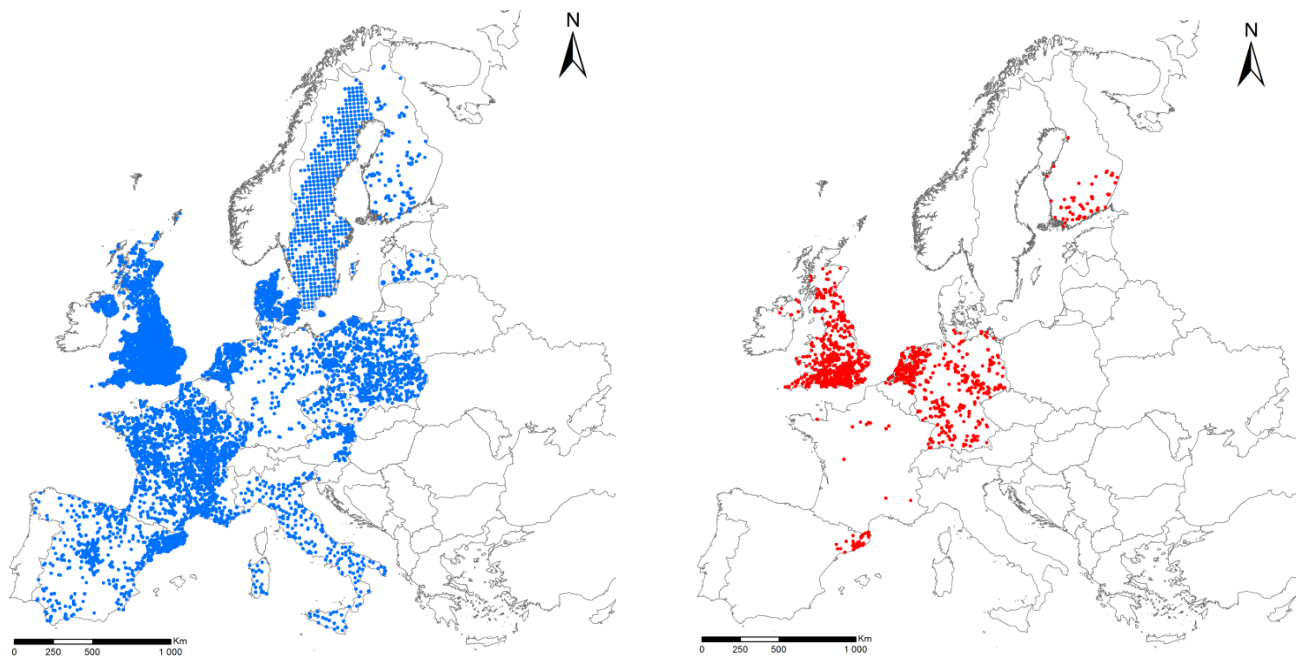
Both bird and butterfly species were classified into groups by their habitat preferences. For birds, the species groups were chosen according to the list defined by the European Bird Census Council and used to compute national and supranational farmland and forest bird indicators (<http://www.ebcc.info/wpimages/other/SpeciesClassification2014.xls>). For the butterflies, we used the list defined by Van Swaay *et al.*, (2006), who defines grassland and woodland specialists.

2.2 Spatial data

Two spatial datasets were used in this survey to define the spatial boundaries of the Natura 2000 network and to assess the main land cover around survey sites:

- The Natura 2000 network coverage was assessed with the Natura 2000 database provided by the European Environment Agency representing the status of the network by end 2012. The coverage of Natura 2000 was assessed in a 1000m radius around the centroid of each survey site. This radius was chosen after Pellissier *et al.* (2013) who described the landscape in 2x2km squares in France (but see Appendix 4 for a comparison with other radii)
- The land cover was assessed using the Corine Land Cover 2006 database, version 16. Land cover was reclassified into broader categories: farmland, woodland and urban areas. For butterflies, the farmland category was subdivided into cropland and grassland areas to match the existing specialization categories existing for such taxa. The main land cover of each site was defined as the land cover category covering the largest part of a 1000m radius around the centroid of each site, providing that this category covers at least 50% of the buffer. All the other sites (*i.e.* without a land cover category covering more than 50% of the buffer) were removed from the datasets. This leaves 10209 and 1787 sites from the bird and butterfly surveys (Map 2.1, Appendix 1 for a more detailed overview of the survey sites).

Map 2.1. Centroids of survey sites used in this study, after data selection from national Breeding Bird Surveys (BBS: blue dots) and from Butterfly Monitoring Schemes (BMS: red dots)



3 Approach used to assess the impact of the Natura 2000 network on non-target species

3.1 Variation in abundances

We tested whether areas belonging to the Natura 2000 network hosted a greater abundance of each of the bird and butterfly species (*i.e.* a ‘designation effect’). For the purpose we used generalized linear mixed models (GLMMs) with the abundance of each species as the dependent variable, the proportion of Natura 2000 coverage in each site as an independent quantitative variable and land cover type of the site as a covariate. These models assumed a negative-binomial response and a log link.

To account for potential variations in abundance due to different survey schemes we added the scheme as a random intercept. Survey year was added as a random effect, nested within the scheme to correct for potential temporal variation in the species populations. The same model structure was kept for the butterfly species, with one exception. Indeed, as the transect length is highly variable (mean = 1199 ± 1117 m), we accounted for this variability by scaling each butterfly species abundance by the transect length.

As ecosystems may be more or less sensitive depending on the biogeographic regions, we examined the interaction between the biogeographic region and the Natura 2000 coverage. The Alpine and Pannonian regions were excluded from the dataset because of the fairly low number of surveys occurring in these regions. These analyses per biogeographic regions were performed for the Atlantic, Boreal, Continental and Mediterranean biogeographic regions with a sub-set of the original datasets *i.e.* respectively for 119, 132, 143 and 132 bird species and 53, 17, 66 and 69 butterfly species.

To assess the ecological characteristics of the species, we tested the relationship between the response of bird species to Natura 2000 coverage and their habitat specialization measured by the Species

Specialization Index (SSI; Julliard *et al.*, 2006). The SSI is a measure of the species niche width. *i.e.* it measures how narrow is the habitat requirement of a given species. The SSI was first measured in France by Julliard *et al.* (2006), for each bird species, as the coefficient of variation of the abundance across 18 habitat categories. In the present analysis, we used the amended version of the French SSI, as measured by (Doxa *et al.*, 2012). The relationship was tested using a generalized additive model (GAM) with the estimate relationship between the Natura 2000 coverage and species abundance as the dependent variable and the SSI as an independent variable. To account for variation in the precision of the estimate of the species response to Natura 2000 among the different bird species, we weighted each estimate with the inverse of its variance. This analysis was only carried out for birds, as we do not have habitat specialization indices for butterflies.

3.2 Bird community indices

We computed, for each year and each site, two local community indices that are independent of species richness:

(1) The Community Specialization Index (CSI, Julliard, Clavel, Devictor, Jiguet, & Couvet, 2006), a measure of the average degree of habitat specialization of a local bird community, defined as the mean of the SSI of the censused species weighted by the abundances. The CSI allows for discrimination between generalist and specialized communities.

(2) The Bird Trophic Index (BTI), a measure of the average trophic level of a local bird community (Mouysset *et al.*, 2012; Pellissier *et al.*, 2013). To compute this index, we estimated the proportion of plant, invertebrate and vertebrate items in each bird species' diet as available from (BWPi, 2006). The species trophic index was defined as the exponential of the weighted mean of the diet item proportion values using weight values of 1, 2 and 3 for plant, invertebrate and vertebrate items, respectively.

The effects of Natura 2000 coverage on these indices were evaluated using generalized additive mixed models (GAMMs) with Natura 2000 coverage as an independent variable, broad habitat class as a covariate and year nested in the country as a random effect. The models were smoothed using a spline regression function with no limitation on the number of degrees of freedom. The goodness of fit of each model was evaluated using the Pearson correlation between raw and fitted data.

3.3 Temporal trends variations

The objective was to analyse differences in temporal trends for farmland and woodland specialists and for woodland and grassland butterflies. Potential differences in temporal trends for the species groups were assessed as follows:

First, we defined Natura 2000 sites as sites for which the center of more than 50% of the sites surface area was overlapping with Natura 2000 areas. In this analysis, we are interested in the dichotomy between protected and unprotected sites; therefore, we did not use a continuous metric, such as the one used in the previous analyses of the community indices. As the control group, we selected all sites outside the Natura 2000 network that were within 15 km of a Natura 2000 site.

Second, using TRIM software, we derived species yearly indices for each of the bird and butterfly specialist species for the sites inside and outside the Natura 2000 network. To account for the variability in transect length, the indices were weighted with the transect length for the butterflies. Moreover, we removed the butterfly data from the French and German schemes, as they only have data since 2005. Thus, trends were computed using respectively 2668 and 838 from bird and butterfly monitoring schemes.

Third, we tested differences in trends between areas within the Natura 2000 network and areas outside for each of the two species taxonomic groups by using GLMMs with the yearly indices for individual species as the explained variable, Natura 2000 status (inside vs. outside) as a categorical variable, the year as a continuous variable as well as the interaction between these two variables. If the interaction (*i.e.* Natura 2000 status x year) is found significant, then the difference in trend between the inside and the outside of the network will be considered significant. To account for variations between species, the species name was added as a random variable.

All statistical analyses were carried out using R 3.1.0 (R Core Team, 2014) with the nlme (Pinheiro *et al.*, 2014) and MASS (Venables & Ripley, 2002) packages for the GLMMs and the mgcv package (Wood, 2011) for the GAMs and GAMMs.

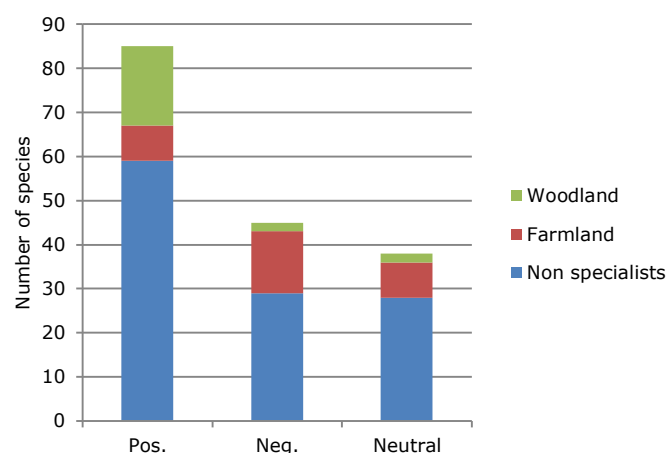
4 Natura 2000 and common species abundance

The purpose of the present analysis was to first define if the bird and butterfly species are more abundant when the proportion of Natura 2000 in the landscape increases. Second, we try to determine if the species with a higher abundance are more often habitat specialist than the species with a lower abundance.

4.1 Natura 2000 and abundance of bird species

A majority of bird species appears to be more abundant in sites with a high Natura 2000 coverage. Indeed, of the 166 most common bird species (*i.e.* present in at least 2% of the survey sites over the 2000-2012 period) about 50% show higher abundances when the Natura 2000 coverage is larger in the landscape, of which, 8 are farmland specialists and 18 are woodland specialists (representing 20 and 67% of the European farmland and woodland specialists' species respectively). 27% of the species have lower abundances with higher Natura 2000 coverage, of which 14 are farmland specialists and 2 are woodland specialists (36% and 7% of the farmland and woodland specialists). The 38 remaining species do not show a particular response to the Natura 2000 coverage (Figure 4.1).

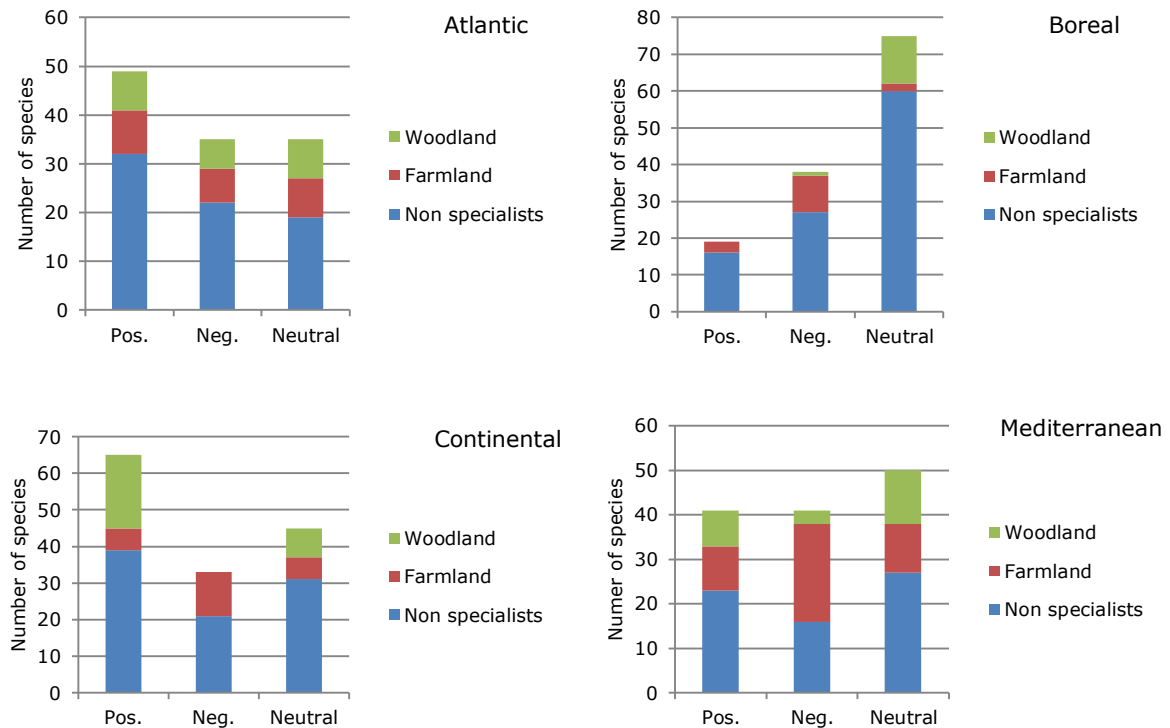
Figure 4.1. Number of bird species with a higher (Pos.) or lower (Neg.) abundance with the increasing in Natura 2000 coverage around the survey site



Note: Species without any particular response patterns are noted Neutral.

When the response patterns are analysed per biogeographic region, there are more bird species with higher abundance in areas with a high Natura 2000 coverage in the Atlantic and in the Continental regions but not in the Boreal and the Mediterranean bioregions. The European patterns regarding the preferred habitat are only found in the Continental region, with a high number of forest species responding positively. For the Atlantic region, the same number of farmland or forest specialist show positive, negative or neutral response. Interestingly, in Boreal, Continental and Mediterranean regions, the number of farmland specialists is higher among species responding negatively than among species responding positively (Figure 4.2).

Figure 4.2. Number of bird species with a higher (Pos.) or lower (Neg.) abundance with higher Natura 2000 coverage around the survey site per biogeographic region



Note: Species without any particular response patterns are noted Neutral.

It appears that the species more abundant in sites with a high Natura 2000 coverage are also the more specialized species. There is a significant positive relationship between species response to the Natura 2000 coverage and the Species Specialization Index at a European level ($F_{6.2,125}=6.11$, $P<0.001$, $\text{pseudo-R}^2=0.19$; Figure 4.3) Atlantic, Continental and Boreal biogeographic regions (Atlantic: $F_{1,103}=44.2$, $p<0.001$, $\text{pseudo-R}^2=0.23$, Continental: $F_{2.67, 121}=4.22$; $p=0.01$, $\text{pseudo-R}^2=0.07$; Boreal: $F_{2.29,78}=3.57$, $p=0.03$, Figure 4.4). In the Mediterranean region, the response to the Natura 2000 coverage is not related to the Species Specialization Index (Mediterranean: $F_{2.32,108}=2.24$, $p=0.08$, Figure 4.4)).

Figure 4.3. Variation of the responses of the bird species to the Natura 2000 coverage in relation to their habitat specialisation (Species Specialization Index)

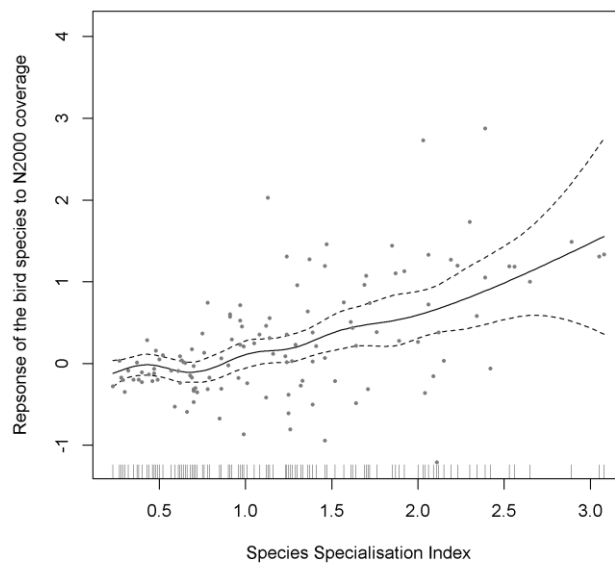
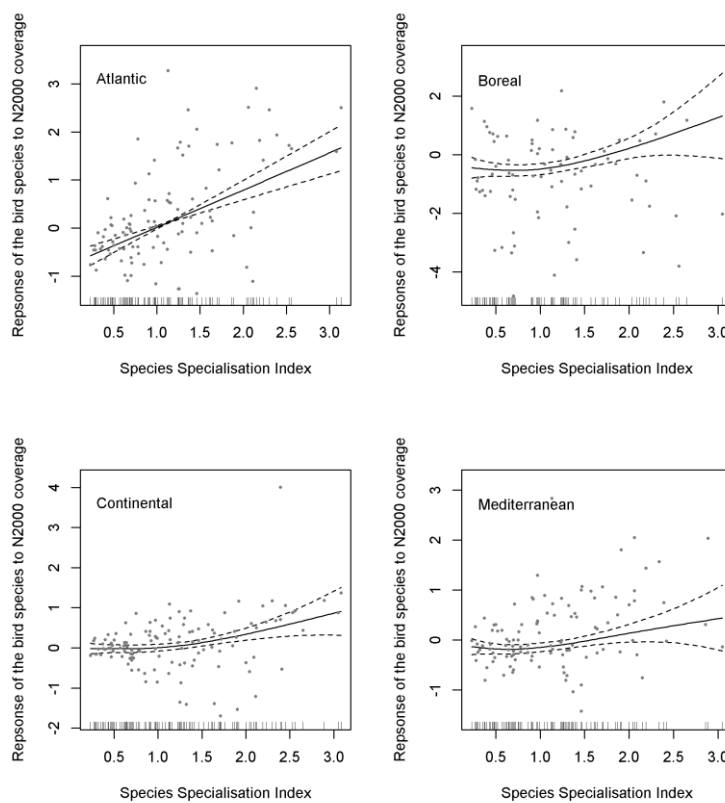


Figure 4.4. Variation of the responses of the bird species to the Natura 2000 coverage in relation to their habitat specialisation (Species Specialization Index) per biogeographic region



Box 4.1 How to read Fig. 4.3 and 4.4

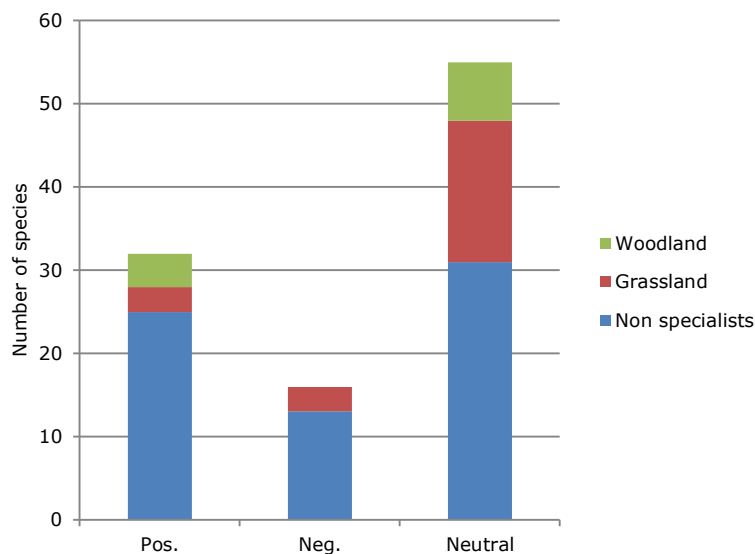
The two figures above (Figure 4.3 and 4.4) express the relationship between the species specialization index (SSI) of bird species and their response to the proportion of the Natura 2000 network in the landscape. The SSI is a measure of the width of the niche of the species, ranging from 0.23 to 3.47. The higher it is, the narrower the niche is, meaning that such species are limited to a low number of habitats and thus are considered habitat specialists.

The response to the Natura 2000 proportion is a measure of the variation in abundance of the species in relation to the density of Natura 2000 in the landscape. Thus, an increasing curve in Figure 4.3 and 4.4 indicates that the species which are more abundant in a landscape with a high coverage of Natura 2000 are more likely to be highly specialized species.

4.2 Natura 2000 and butterfly abundance

A higher number of butterfly species is more abundant in areas with a high Natura 2000 coverage. Of the 103 most common butterflies' species, 32 have higher abundances with a larger Natura 2000 coverage (3 grassland specialists and 4 woodland specialists). Sixteen species have lower abundances (including three grassland specialists). The 55 remaining species do not exhibit a particular response to the Natura 2000 coverage (Figure 4.5).

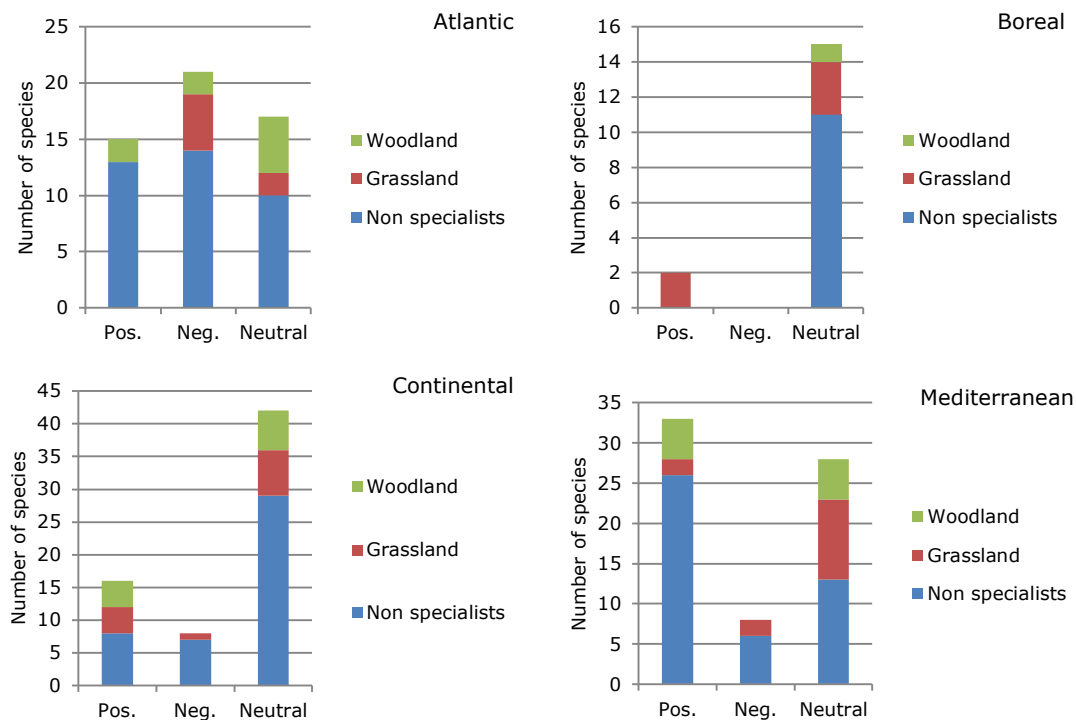
Figure 4.5. Number of butterfly species with a higher (Pos.) or lower (Neg.) abundance with a larger Natura 2000 coverage around the survey site



Note: Species without any particular response patterns are noted Neutral.

When analysing the response per biogeographic region, a higher number of butterfly species is more abundant in areas with a high Natura 2000 coverage in each region even though the pattern is really clear and similar to the European pattern for the Continental region and the Mediterranean regions. The Boreal region is characterized by the quasi-absence of responding species and the Atlantic region exhibit a reverse pattern, with a higher number of species responding negatively, such species being often grassland species (Figure 4.6).

Figure 4.6. Number of butterfly species with a higher (Pos.) or lower (Neg.) abundance with a larger Natura 2000 coverage around the survey site per biogeographic region



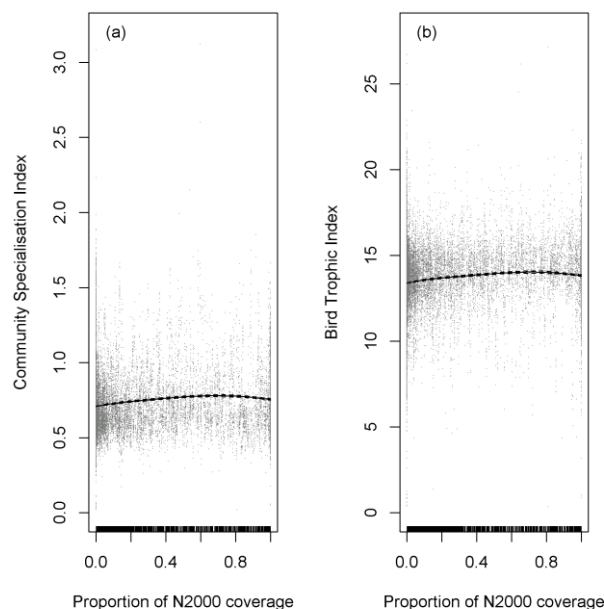
Note: Species without any particular response patterns are noted Neutral.

5 Natura 2000 and bird species communities

Here, we assessed if the bird communities are more likely to be more habitat specialized and with more predator species in landscapes with higher Natura 2000 coverage. It appears that the communities in sites with a high Natura 2000 coverage are more habitats specialized and have a higher trophic index. We find a globally positive relationship between the Community Specialization Index and the Natura 2000 coverage (Figure 5.1a, $F_{3,5, 58325}=218.9$, $P<0.001$, $r=0.11$). The response curve however exhibits a slight decrease between 80% and 100% of Natura 2000 coverage.

The Bird Trophic Index exhibits a similar response curve but with a less clear decrease around 80% of Natura 2000 coverage (Figure 5.1b, $F_{3,6, 56983}=184.7$, $P<0.001$, $r=0.20$).

Figure 5.1. Response of (a) the Community Specialization Index (higher values indicate a higher proportion of habitat specialists in the community) and (b) the Bird Trophic Index (higher values indicate more top-consumer birds in the community) to the proportion of Natura 2000 coverage



Note: Dashed lines represent the standard error of the response, tick marks represent the survey sites and grey dots represent the raw values.

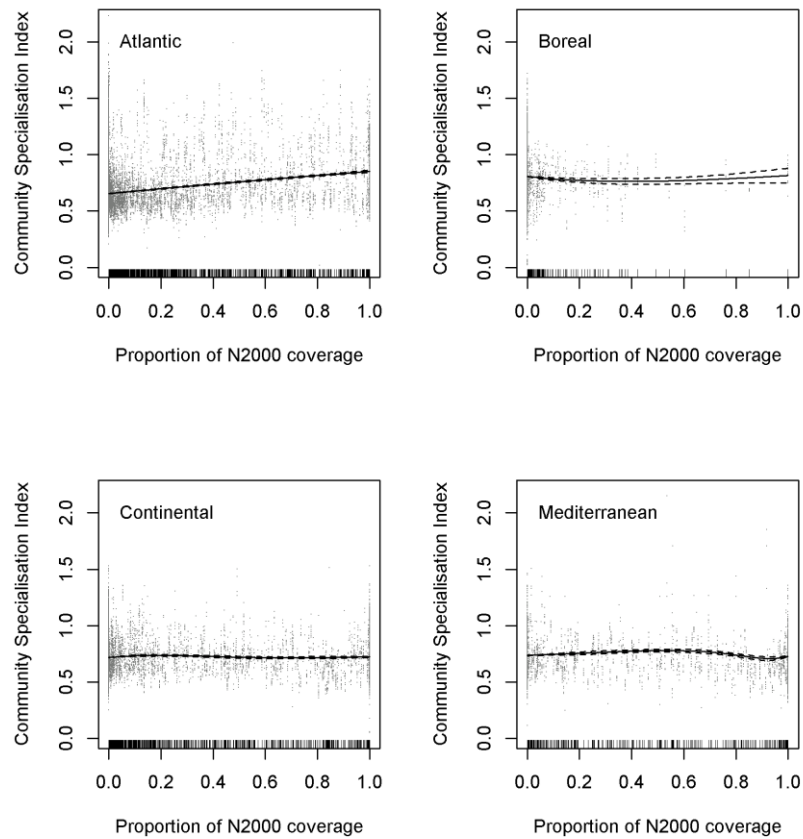
Box 5.1 How to read Fig. 5.1 and 5.2

In these figures (Figure 5.1 and 5.2), we linked the coverage of Natura 2000 in the landscape and community specialization and trophic indices (CSI and BTI). These two indices are weighted averages of Species Specialization and Species Trophic Indexes and thus range from 0.23 to 3.47 and from 0.27 to 27.11 respectively.

The CSI is a measure of the functional homogenization of a bird community. Indeed, the homogenization of biotic communities often results in the disappearance of specialist species, thus the higher the CSI, the less homogenized the communities. The BTI is a proxy of the food chain length of communities. Indeed, communities able to support long food chains often exhibit a high number of predator species, thus, a high value of BTI in a community is likely to indicate such a long food chain. Here, increasing response curves indicate that bird communities are less homogeneous and have longer food chain in areas with a high Natura 2000 coverage than in areas with a low Natura 2000 coverage.

A steep positive response of the CSI is shown in the Atlantic biogeographic region (Figure 5.2a; $F_{1,8,33678}=1084$, $P<0.001$, $r=0.25$), whereas an increase followed by a decrease for high Natura 2000 coverage value is shown in the Mediterranean area (Figure 5.2d; $F_{3,8,5548}=13.6$, $P<0.001$, $r=0.39$). The Boreal region exhibits a decrease in CSI value for low values of Natura 2000 coverage, followed by an increase (Figure 5.2b; $F_{2,1,5343}=6.77$, $P=0.001$, $r=0.25$). However, the amplitude of the variation is limited in the particular region. Small variations around the average are found in the Continental biogeographic region (Figure 5.2c; $F_{3,5,13756}=5.33$, $P<0.001$, $r=0.30$)

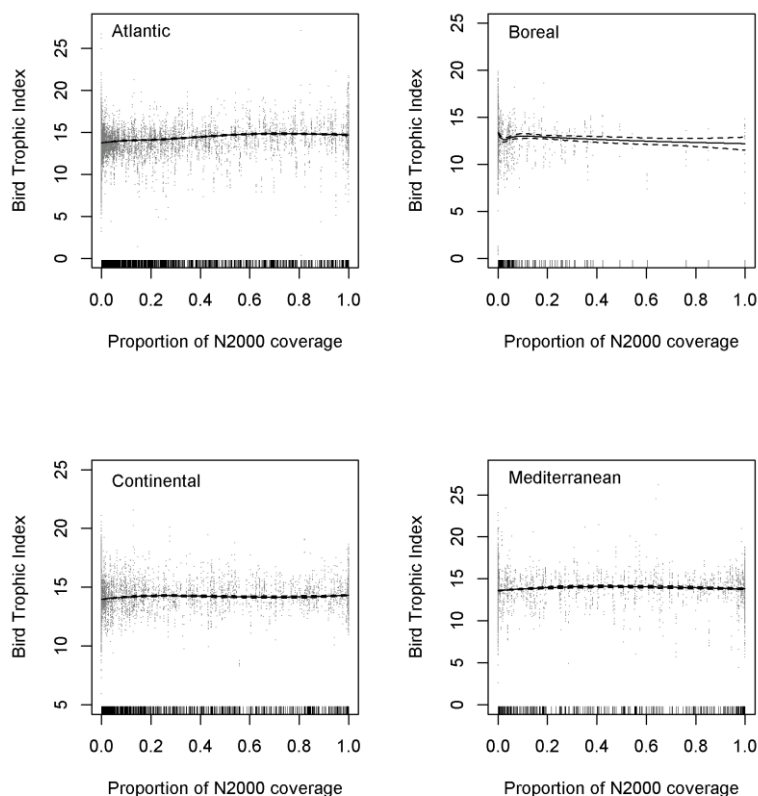
Figure 5.2. Response of the Community Specialization Index (higher values indicate a higher proportion of habitat specialists in the community) to the proportion of Natura 2000 coverage in the landscape in each biogeographic region



Note: Dashed lines represent the standard error of the response, tick marks represent the survey sites and grey dots represent the raw values.

Except in the Boreal region where the BTI tends to decrease ($F_{3.9,5343}=19.96$, $P<0.001$, $r=0.20$), the patterns of BTI in biogeographic regions are the same as for the CSI, with a steep increase in the trophic index in the Atlantic biogeographic region (Figure 5.3a; $F_{3.8,33678}=310.7$, $P<0.001$, $r=0.29$), a humped back response in the Mediterranean biogeographic region (Figure 5.3d; $F_{2.6,5546}=12.1$, $P<0.001$, $r=0.22$) and a very small increase in the Continental region (Figure 5.4c, $F_{3.5,13755}=39.06$, $P<0.001$, $r=0.28$)

Figure 5.3. Response of the Bird Trophic Index (higher values indicate more top-consumer birds in the community) to the proportion of Natura 2000 coverage in the landscape in each biogeographic region



Note: Dashed lines represent the standard error of the response, tick marks represent the survey sites and grey dots represent the raw values.

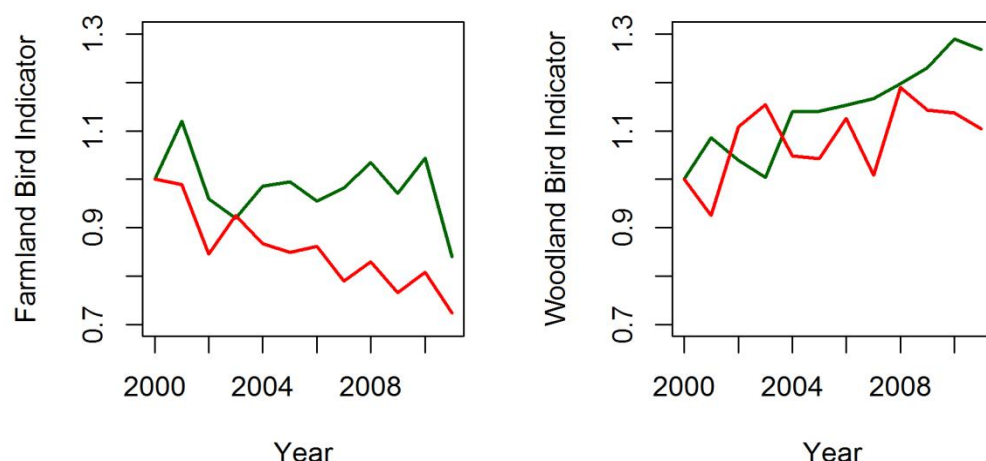
6 Natura 2000 and species temporal trends

6.1 Temporal trends for birds

For farmland birds, the population slightly decreases within the Natura 2000 network whereas the decrease is steeper outside the network. The interaction between the year and the Natura 2000 status trends are found statistically different ($F_{1,641}=4.09$, $P=0.044$; Figure 6.1), indicating that the trends inside and outside Natura 2000 are different for farmland bird species

For the forest specialists on the other hand, the trends are not different inside and outside the network ($F_{1,549}=3.09$, $P=0.079$), even though the trend tends to be more positive inside than outside the network.

Figure 6.1 European farmland and woodland bird indicator, within (green line) and outside (red line) the Natura 2000 network

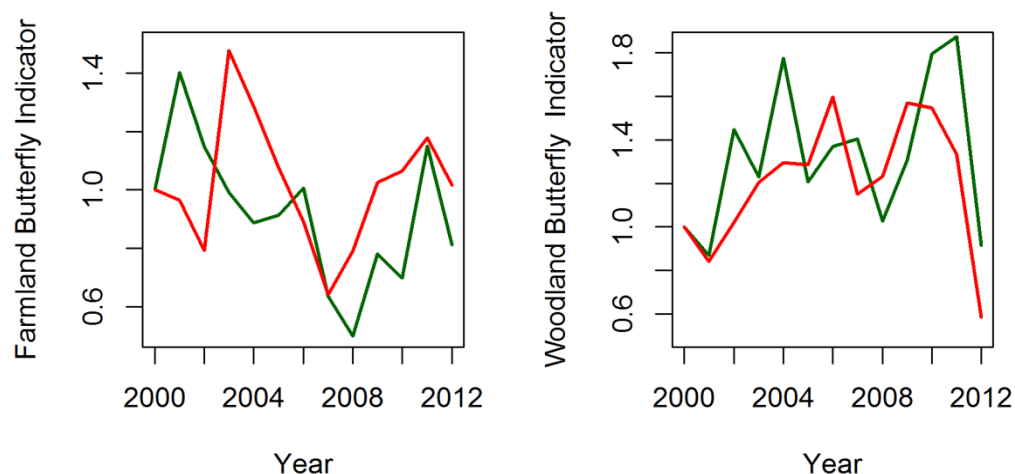


Note: The indices are computed as the geometric means of farmland and woodland birds European indices.

6.2 Natura 2000 and butterfly trends

The interaction between the survey year and the Natura 2000 status is not significant, either for generalist ($F_{1,433}=0.243$, $P=0.62$), woodland ($F_{1,134}=0.003$, $P=0.95$) or grassland butterfly species ($F_{1,188}=0.093$, $P=0.76$), meaning that there is no detectable differences between the temporal trends outside and the temporal trends inside Natura 2000 for butterfly species groups.

Figure 6.2 European farmland and woodland butterfly indicator, within (green line) and outside (red line) the Natura 2000 network



7 Discussion

7.1 *Species abundance in and outside the Natura 2000 network*

Our results partly confirm at the European scale the findings of Pellissier et al (2013). Indeed, it appears that the majority of the bird species responding to the coverage of Natura 2000 in the landscape do respond positively. In other terms, the abundance of a large number of bird species is higher inside than outside the Natura 2000 network, showing that the Natura 2000 areas designated upon the presence of targeted bird species listed in Annex I of the Birds Directive also harbor a substantial number and population of common bird species (only 16 species responding positively to Natura 2000 are actually Annex I species). When considering the whole network, the most abundant bird species are frequently woodland specialists – for instance the Great and Lesser spotted woodpeckers (*Dendrocops medius* and *Dendrocops minor*) or the Eurasian nuthatch (*Sitta europea*) -, also indicating the potential for Natura 2000 to mitigate the threats faced by specialist species (Julliard *et al.*, 2004; Le Viol *et al.*, 2012). There are far less farmland species among species more abundant. However, it should be noted that the proportion of forest cover is higher within the network than outside (Appendix 2), thus the observed difference in species specialist number might be induced by the fact that the landscape composition is different inside the network.

On the other hand, the results are far less clear for the butterfly species. Indeed, even though a larger number of species responds positively rather than negatively to the coverage of Natura 2000 in the landscape, the amplitude of the variation is pretty limited and the abundance of a large number of species is identical whatever the coverage of Natura 2000 around the site. It is noteworthy that, as for the birds, there is a larger number of woodland specialist species - such as the White Admiral (*Limnetis Camilla*) or the Scotch argus (*Erebia aethius*)- which are favored by Natura 2000 than of species which are disfavored. Nonetheless, it is important to keep in mind that the sampling design is far from complete for the butterfly monitoring scheme. Indeed, there is an underrepresentation of boreal and mediterranean biotopes, which might hamper any general conclusions. Thus, the results are merely preliminary results which should be updated as soon as possible.

7.2 *Species Community variations in Natura 2000 areas*

The species with a higher abundance are more likely to be habitat specialized species, with the Specialization Index increasing with the response to Natura 2000 coverage around the survey sites. At the community level, the Community Specialization Index increases along with the Natura 2000 coverage, indicating that the bird communities are significantly more specialized in Natura 2000 areas. Thus, our analyses confirm that the Natura 2000 network has the potential to be an efficient tool to help mitigate the decline of habitat specialist bird species. Moreover, the mean Trophic Index increases in Natura 2000 areas. As this increase indicates an increase in the abundance of predators, it potentially reflects an increase in either the abundance or the diversity of resources available, allowing these areas to support more top-predator species. However, as the amplitude of the increase in CSI and BTI is quite limited this result must be considered with caution.

The responses of species communities (abundance, but also community indices) found at a European scale show important variations in individual biogeographic regions.. The abundance patterns are identical in the Atlantic and Continental regions and fairly similar to the European pattern whereas the CSI and BTI patterns are compelling only in the Atlantic biogeographic region

Some of the reasons to explain these variable patterns rely only on technical issues. There are indeed far less survey points in the Mediterranean and Boreal regions than in the other two. Moreover, in the Boreal region, it appears that the number of survey sites including a part of a Natura 2000 area is quite limited (Appendix 2).

Regarding the preferred habitat of species, it appears that only in the Continental region and to a lesser extent in the Mediterranean region, the bird and butterfly woodland specialists are favored by Natura 2000. This discrepancy between the global result and the results per biogeographic region might be caused by the landscape composition variations in the various regions. Indeed, in the Continental region (as in the whole Europe), the coverage of forest tends to increase with the coverage of Natura 2000. This pattern is less clear in the Mediterranean region, but also in the Atlantic region, where the forest coverage is the lowest. On the contrary, in the Boreal region, the pattern does not exist either, but the coverage is very high (Appendix 2). Thus, this lack of variation in forest coverage (or at least different patterns) might explain the lack of forest specialist responding positively to Natura 2000.

Moreover, the SSI was computed using data from the French BBS only (Julliard *et al.*, 2006; Doxa *et al.*, 2012). As the French territory is mainly covered by the Atlantic and Continental regions (and marginally by the Mediterranean and Alpine region), these indices are potentially maladapted in the Mediterranean and Boreal regions. Thus, computing these indices adapted to a larger spatial scale might allow us to gain some insight in the response of the bird and butterfly species to Natura 2000.

Finally, it appears that the CSI is on average lower in the Atlantic bioregion than in the three others (resp. 0.65 ± 0.17 , 0.81 ± 0.16 , 0.72 ± 0.15 , 0.71 ± 0.15), which might explain the steeper response of this indice in this region. Indeed, if the Natura 2000 area harbors communities with CSI values around the values of the three other regions, if the base level is low, the effect is more likely to be detectable than otherwise.

The less compelling results in some biogeographic regions do not indicate that the Natura 2000 network will fail at preserving biodiversity in these regions. It merely means that a particular attention will have to be paid in the future in these regions. Indeed, these results are more a snapshot of the present state of biodiversity inside the network and the temporal evolution only will provide information on the efficiency of management measures. Moreover, the sampling effort should be higher in Natura 2000 areas in the Boreal region, in order to obtain a site distribution comparable to the other biogeographic regions.

7.3 Temporal trends in and outside Natura 2000

The temporal trends for farmland species appears to be better inside Natura 2000 than outside. Indeed, inside the Natura 2000 network, the decline of farmland species is less steep than outside. Thus, the declining trends of farmland species occurring in Europe (Le Viol *et al.*, 2012) seems to be slowed down within the Natura 2000 network. On the other hand, there is no difference for woodland species trends even though the trend inside Natura 2000 seems positive (not significantly however), but the trends at a European scale seems contradictory in the literature as Le Viol *et al.* (2012) reported a decline, whereas the latest update of the ECCB (http://www.ebcc.info/index.php?ID=568&result_set=Publish2014&one_indik=E_C_Fo) indicates a stable trend.

On the other hand, the results are not so compelling for the butterfly species, as no difference at all exists. Once again; these are preliminary results for the butterflies, as we only used data from 4 schemes. Thus, these analyses should be done again once enough data will be available.

These results might appear contradictory with the results above that indicate that, at a global scale, Natura 2000 favors forest species. However, one has to keep in mind those trends comparison do not give information about the population size. Farmland bird populations, which have been declining since the 1980's are more likely to be already low, thus, even small temporal variations in population sizes will be detectable.

Even though these results are encouraging, it is noteworthy that they do not reflect the effects of the management of Natura 2000 sites. Indeed, by 2011, only 7000 sites had a management plan whereas

14000 were planned (European Commission, 2014b), indicating that only half of the sites could indeed have started the management. What we are showing here, is the biodiversity state at the end of the designation phase.

Thus, any effective positive effect of the management *per se* is not likely to be caused by management measure. Indeed, even though most passerine birds communities may react quickly to environmental changes (Devictor *et al.*, 2012; Doxa *et al.*, 2012), it is admitted that there is often a temporal lag up to a decade (Male & Bean, 2005; Donald *et al.*, 2007) between the implementation of protection measures and a detectable biodiversity response.

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Reference checked: Vincent Pellissier 12th Sept. 2014 [date]

Appendix 1 Survey sites description

Table A1.1 Number of BBS sites surveyed per scheme and per year

	Sampling year											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Austria	139	139	139	139	139	139	139	139	139	139	139	0
Catalonia	0	0	239	239	239	239	239	239	239	239	239	0
Czech	98	98	98	98	98	98	98	98	98	98	98	98
Denmark	671	671	671	671	671	671	671	671	671	671	671	0
Finland	119	119	119	119	119	119	119	119	119	119	119	0
France	0	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Germany	0	0	0	0	0	166	166	166	166	166	166	0
Holland	690	690	690	690	690	690	690	690	690	690	690	0
Italy	237	237	237	237	237	237	237	237	237	237	237	0
Latvia	238	238	238	238	238	266	266	28	28	28	28	0
Poland	788	788	788	788	788	788	788	788	788	788	788	788
Other regions in Spain	373	373	373	373	373	373	373	373	373	373	373	0
Sweden	496	496	496	496	496	496	496	496	496	496	496	496
UK	4057	534	4057	4057	4057	4057	4057	4057	4057	4057	4057	0

Table A1.2 Number of BBS sites surveyed per biogeographic region and per year

	Sampling year											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Atlantic	4933	2296	5819	5819	5819	5873	5873	5873	5873	5873	5873	886
Boreal	831	831	831	831	831	859	859	621	621	621	621	474
Continental	1673	2444	2444	2444	2444	2556	2556	2556	2556	2556	2556	1679
Mediterranean	469	682	921	921	921	921	921	921	921	921	921	213

Table A1.3 Number of BMS sites surveyed per scheme and per year

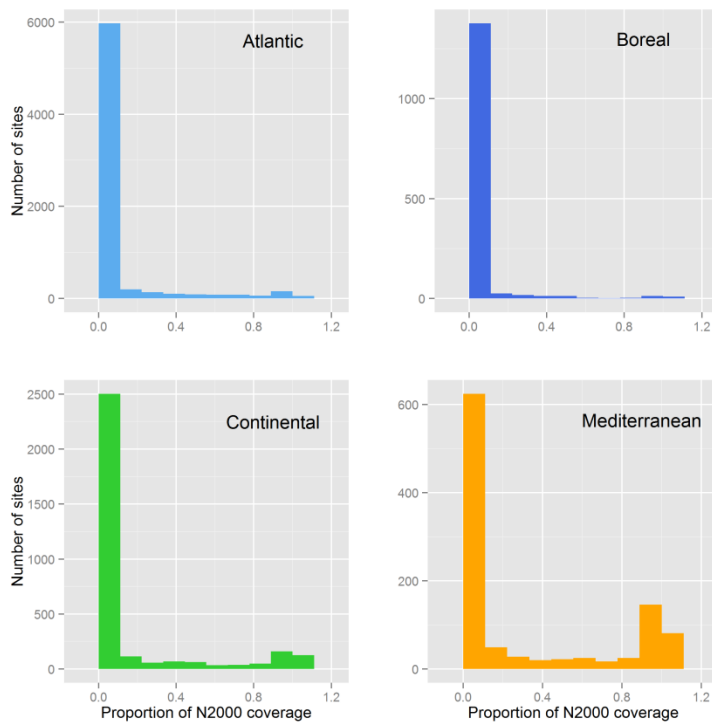
	Sampling year												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Finland	14	18	15	17	12	16	34	23	23	20	25	28	30
France	0	0	0	0	0	0	0	0	1	2	5	4	3
Germany	0	0	0	0	0	0	142	151	165	171	156	177	172
Netherlands	122	129	131	215	209	198	222	209	202	211	190	198	196
Spain	17	20	19	22	23	22	24	25	27	25	28	27	28
United Kingdom	262	239	302	370	351	368	416	457	479	534	529	565	523

Table A1.4 Number of BMS sites surveyed per biogeographic region and per year

	Sampling year												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Atlantic	384	368	433	585	560	566	647	678	701	762	742	789	746
Boreal	14	18	15	17	12	16	34	23	23	20	25	28	30
Continental	0	0	0	0	0	0	133	139	146	156	137	154	147
Mediterranean	17	20	19	22	23	22	24	25	27	25	29	28	29

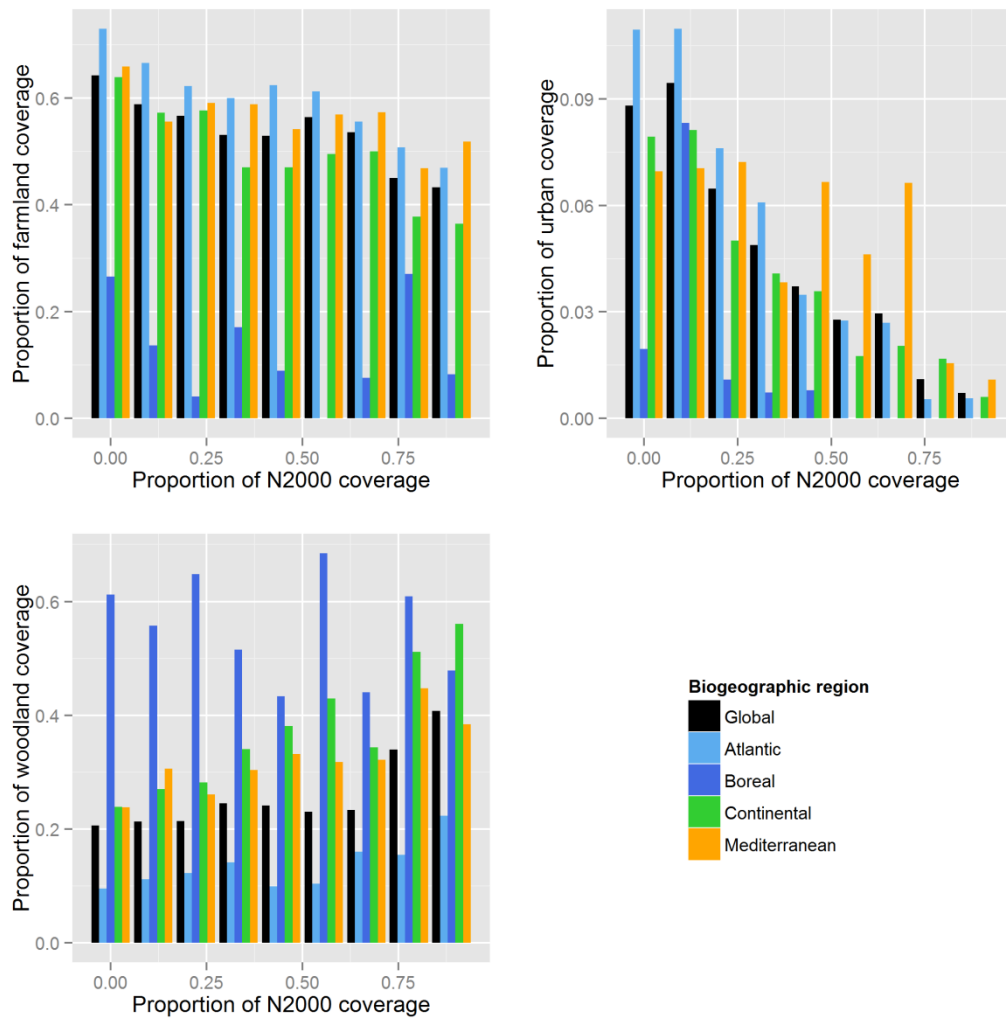
Appendix 2 Land cover and Natura 2000 coverage around BBS sites

Figure A2.1 Histogram of the proportion of the landscape around the sites covered by Natura 2000 per biogeographic region



The Atlantic and Continental biogeographic regions exhibited a pattern similar to the global one. A large number of sites had a low coverage of Natura 2000, few sites had a Natura 2000 coverage between 20 and 85% and this number slightly increased for coverage above 85%. In the Mediterranean region, a higher number of sites were partially or entirely covered by Natura 2000. In the contrary, a very small number of sites overlapped the Natura 2000 network in the Boreal region.

Figure A2.2 Proportion of Natura 2000 coverage vs proportion of farmland, woodland and urban coverage at European level and in each biogeographic region



Appendix 3 Specific responses to the N2000 coverage in the landscape

Table A3.1 Bird species response to the Natura 2000 coverage (mean estimate, S.E. within brackets) and associated P values. The N2000 columns indicates whether the species is included in the Annex 1 of the Bird Directive

Species	Coeff.	DF	P value	Abundance variation	N2000
<i>Accipiter gentilis</i>	-0.112 (0.167)	14397	0.504		
<i>Accipiter nisus</i>	-0.175 (0.068)	48260	0.01	Neg.	
<i>Acrocephalus arundinaceus</i>	1.488 (0.207)	11894	<0.001	Pos.	
<i>Acrocephalus palustris</i>	0.257 (0.075)	16346	0.001	Pos.	
<i>Acrocephalus schoenobaenus</i>	1.734 (0.174)	17018	<0.001	Pos.	
<i>Acrocephalus scirpaceus</i>	1.269 (0.118)	20254	<0.001	Pos.	
<i>Actitis hypoleucos</i>	1.001 (0.292)	9162	0.001	Pos.	
<i>Aegithalos caudatus</i>	-0.235 (0.061)	41056	<0.001	Neg.	
<i>Alauda arvensis</i>	0.12 (0.036)	52977	0.001	Pos.	
<i>Alcedo atthis</i>	1.103 (0.164)	11173	<0.001	Pos.	Annex 1
<i>Anas clypeata</i>	1.999 (0.362)	7881	<0.001	Pos.	
<i>Anas crecca</i>	1.007 (0.434)	12628	0.02	Pos.	
<i>Anas platyrhynchos</i>	0.749 (0.062)	22113	<0.001	Pos.	
<i>Anas strepera</i>	1.104 (0.38)	7987	0.004	Pos.	
<i>Anser anser</i>	1.452 (0.476)	5380	0.002	Pos.	
<i>Anthus campestris</i>	0.264 (0.154)	7969	0.086		Annex 1
<i>Anthus pratensis</i>	1.273 (0.081)	46514	<0.001	Pos.	
<i>Anthus trivialis</i>	0.601 (0.079)	35475	<0.001	Pos.	
<i>Ardea cinerea</i>	0.555 (0.118)	21647	<0.001	Pos.	
<i>Athene noctua</i>	-0.486 (0.153)	13483	0.001	Neg.	
<i>Aythya fuligula</i>	0.785 (0.31)	12315	0.011	Pos.	
<i>Branta canadensis</i>	0.194 (0.527)	3223	0.712		
<i>Bucephala clangula</i>	0.901 (0.34)	5324	0.008	Pos.	
<i>Buteo buteo</i>	-0.198 (0.029)	45667	<0.001	Neg.	
<i>Carduelis cannabina</i>	-0.031 (0.046)	49223	0.494		
<i>Carduelis carduelis</i>	-0.315 (0.032)	49541	<0.001	Neg.	
<i>Carduelis flammea</i>	0.5 (0.299)	33137	0.094		
<i>Carduelis spinus</i>	0.38 (0.172)	47223	0.027	Pos.	
<i>Carpodacus erythrinus</i>	1.142 (0.243)	8531	<0.001	Pos.	
<i>Certhia brachydactyla</i>	0.087 (0.044)	19640	0.048	Pos.	
<i>Certhia familiaris</i>	0.277 (0.075)	37435	<0.001	Pos.	
<i>Cettia cetti</i>	0.637 (0.105)	9613	<0.001	Pos.	
<i>Chloris chloris</i>	-0.591 (0.028)	52293	<0.001	Neg.	
<i>Ciconia ciconia</i>	1.308 (0.166)	14686	<0.001	Pos.	Annex 1
<i>Circus aeruginosus</i>	1.329 (0.095)	16614	<0.001	Pos.	Annex 1
<i>Circus cyaneus</i>	-0.381 (0.172)	11401	0.027	Neg.	Annex 1
<i>Circus pygargus</i>	0.962 (0.232)	10069	<0.001	Pos.	Annex 1
<i>Cisticola juncidis</i>	0.032 (0.108)	5537	0.769		
<i>Coccothraustes coccothraustes</i>	0.452 (0.099)	22256	<0.001	Pos.	
<i>Columba livia</i>	-0.362 (0.159)	12366	0.023	Neg.	
<i>Columba oenas</i>	0.231 (0.082)	43982	0.005	Pos.	
<i>Columba palumbus</i>	-0.348 (0.024)	52512	<0.001	Neg.	
<i>Corvus corax</i>	0.088 (0.073)	14721	0.233		
<i>Corvus corone</i>	-0.173 (0.03)	46552	<0.001	Neg.	
<i>Corvus frugilegus</i>	-0.675 (0.139)	36122	<0.001	Neg.	
<i>Corvus monedula</i>	-0.178 (0.063)	49447	0.005	Neg.	
<i>Coturnix coturnix</i>	-0.213 (0.069)	18007	0.002	Neg.	
<i>Crex crex</i>	0.556 (0.195)	9563	0.004	Pos.	Annex 1
<i>Cuculus canorus</i>	0.286 (0.028)	53022	<0.001	Pos.	
<i>Cyanistes caeruleus</i>	-0.199 (0.024)	51199	<0.001	Neg.	
<i>Cygnus cygnus</i>	1.218 (0.684)	2520	0.075		Annex 1
<i>Cygnus olor</i>	1.184 (0.149)	16464	<0.001	Pos.	
<i>Delichon urbica</i>	0.027 (0.086)	23202	0.754		
<i>Dendrocopos major</i>	0.017 (0.028)	49363	0.543		
<i>Dendrocopos medius</i>	1.129 (0.16)	9272	<0.001	Pos.	Annex 1
<i>Dendrocopos minor</i>	0.574 (0.115)	34042	<0.001	Pos.	
<i>Dryocopus martius</i>	0.354 (0.055)	17608	<0.001	Pos.	Annex 1
<i>Egretta garzetta</i>	2.875 (0.382)	4043	<0.001	Pos.	Annex 1

<i>Emberiza calandra</i>	-0.942 (0.346)	5953	0.006	Neg.	
<i>Emberiza cia</i>	1.46 (0.142)	7755	<0.001	Pos.	
<i>Emberiza cirius</i>	-0.53 (0.052)	11757	<0.001	Neg.	
<i>Emberiza citrinella</i>	-0.301 (0.037)	48064	<0.001	Neg.	
<i>Emberiza hortulana</i>	-0.273 (0.131)	9991	0.037	Neg.	Annex 1
<i>Emberiza schoeniclus</i>	1.053 (0.158)	22783	<0.001	Pos.	
<i>Erithacus rubecula</i>	0.158 (0.036)	24011	<0.001	Pos.	
<i>Falco subbuteo</i>	0.368 (0.171)	13379	0.032	Pos.	
<i>Falco tinnunculus</i>	-0.148 (0.04)	49531	<0.001	Neg.	
<i>Ficedula hypoleuca</i>	0.956 (0.119)	23738	<0.001	Pos.	
<i>Fringilla coelebs</i>	0.034 (0.017)	51721	0.05		
<i>Fringilla montifringilla</i>	-0.403 (0.525)	13805	0.442		
<i>Fulica atra</i>	1.189 (0.126)	19698	<0.001	Pos.	
<i>Galerida cristata</i>	-0.313 (0.127)	14923	0.014	Neg.	
<i>Gallinago gallinago</i>	1.835 (0.166)	43554	<0.001	Pos.	
<i>Gallinula chloropus</i>	0.506 (0.093)	14354	<0.001	Pos.	
<i>Garrulus glandarius</i>	-0.136 (0.031)	49334	<0.001	Neg.	
<i>Gavia arctica</i>	-0.037 (0.472)	2814	0.937		Annex 1
<i>Grus grus grus</i>	1.047 (0.147)	6675	<0.001	Pos.	Annex 1
<i>Haematopus ostralegus</i>	1.724 (0.211)	4157	<0.001	Pos.	
<i>Hippolais icterina</i>	0.155 (0.072)	15280	0.032	Pos.	
<i>Hippolais polyglotta</i>	-0.336 (0.054)	12215	<0.001	Neg.	
<i>Hirundo rustica</i>	-0.354 (0.034)	52739	<0.001	Neg.	
<i>Jynx torquilla</i>	0.527 (0.081)	17548	<0.001	Pos.	
<i>Lanius collurio</i>	0.311 (0.061)	20849	<0.001	Pos.	Annex 1
<i>Lanius excubitor</i>	0.013 (0.232)	16457	0.955		
<i>Lanius senator</i>	0.017 (0.145)	6151	0.908		
<i>Larus argentatus</i>	0.039 (0.2)	9794	0.847		
<i>Larus ridibundus</i>	2.027 (0.243)	20273	<0.001	Pos.	
<i>Limosa limosa limosa</i>	4.016 (0.327)	15153	<0.001	Pos.	
<i>Locustella fluviatilis</i>	0.618 (0.191)	5691	0.001	Pos.	
<i>Locustella naevia</i>	1.311 (0.107)	33579	<0.001	Pos.	
<i>Lophophanes cristatus</i>	0.437 (0.069)	21554	<0.001	Pos.	
<i>Loxia curvirostra</i>	0.384 (0.178)	9221	0.031	Pos.	
<i>Loxia pytyopsittacus</i>	0.451 (1.04)	2756	0.665		
<i>Lullula arborea</i>	-0.024 (0.053)	18695	0.654		Annex 1
<i>Luscinia luscinia</i>	0.368 (0.092)	8043	<0.001	Pos.	
<i>Luscinia megarhynchos</i>	-0.123 (0.046)	16330	0.007	Neg.	
<i>Melanocorypha calandra</i>	-0.88 (0.191)	2347	<0.001	Neg.	Annex 1
<i>Merops apiaster</i>	-0.308 (0.121)	5274	0.011	Neg.	
<i>Milvus migrans</i>	0.368 (0.118)	14851	0.002	Pos.	Annex 1
<i>Milvus milvus</i>	-0.014 (0.16)	16081	0.932		Annex 1
<i>Motacilla alba</i>	-0.171 (0.031)	48879	<0.001	Neg.	
<i>Motacilla cinerea</i>	0.217 (0.113)	11955	0.055		
<i>Motacilla flava</i>	-0.157 (0.086)	36619	0.068		
<i>Muscicapa striata</i>	0.231 (0.072)	48729	0.001	Pos.	
<i>Numenius arquata</i>	1.513 (0.269)	14323	<0.001	Pos.	
<i>Oenanthe oenanthe</i>	1.073 (0.119)	27623	<0.001	Pos.	
<i>Oriolus oriolus</i>	-0.066 (0.036)	20390	0.067		
<i>Parus major</i>	-0.201 (0.019)	51607	<0.001	Neg.	
<i>Passer domesticus</i>	-0.808 (0.04)	51461	<0.001	Neg.	
<i>Passer montanus</i>	-0.611 (0.09)	45886	<0.001	Neg.	
<i>Perdix perdix</i>	-1.21 (0.118)	39009	<0.001	Neg.	
<i>Periparus ater</i>	0.38 (0.056)	48851	<0.001	Pos.	
<i>Pernis apivorus</i>	0.427 (0.199)	14748	0.032	Pos.	Annex 1
<i>Petronia petronia</i>	-0.063 (0.165)	3752	0.703		
<i>Phalacrocorax carbo</i>	0.327 (0.359)	9348	0.363		
<i>Phoenicurus ochruros</i>	-0.417 (0.049)	18959	<0.001	Neg.	
<i>Phoenicurus phoenicurus</i>	0.715 (0.075)	35936	<0.001	Pos.	
<i>Phylloscopus ((collybita)) collybita (et al)</i>	-0.215 (0.027)	44809	<0.001	Neg.	
<i>Phylloscopus bonelli</i>	0.064 (0.093)	11288	0.487		
<i>Phylloscopus sibilatrix</i>	0.738 (0.119)	35088	<0.001	Pos.	
<i>Phylloscopus trochilus</i>	0.46 (0.039)	45650	<0.001	Pos.	
<i>Pica pica</i>	-0.474 (0.031)	51657	<0.001	Neg.	
<i>Picus ((viridis)) viridis</i>	-0.197 (0.041)	42743	<0.001	Neg.	
<i>Picus canus</i>	0.958 (0.199)	6357	<0.001	Pos.	Annex 1
<i>Podiceps cristatus</i>	1.333 (0.169)	15445	<0.001	Pos.	
<i>Poecile montanus</i>	0.025 (0.119)	38099	0.83		
<i>Poecile palustris</i>	0.209 (0.079)	37660	0.009	Pos.	
<i>Prunella modularis</i>	0.048 (0.061)	22481	0.433		
<i>Pyrrhula pyrrhula</i>	0.247 (0.057)	48040	<0.001	Pos.	
<i>Regulus ignicapilla</i>	0.355 (0.075)	21412	<0.001	Pos.	
<i>Regulus regulus</i>	0.068 (0.058)	48712	0.24		

<i>Riparia riparia</i>	1.439 (0.331)	13314	<0.001	Pos.	
<i>Saxicola rubetra</i>	1.195 (0.122)	48432	<0.001	Pos.	
<i>Saxicola rubicola</i>	0.745 (0.087)	33751	<0.001	Pos.	
<i>Scolopax rusticola</i>	1.298 (0.258)	13504	<0.001	Pos.	
<i>Serinus serinus</i>	-0.316 (0.049)	19410	<0.001	Neg.	
<i>Sitta europaea</i>	0.296 (0.048)	40611	<0.001	Pos.	
<i>Sterna hirundo</i>	2.728 (0.303)	6633	<0.001	Pos.	Annex 1
<i>Streptopelia decaocto</i>	-0.867 (0.056)	20917	<0.001	Neg.	
<i>Streptopelia turtur</i>	-0.229 (0.064)	36715	<0.001	Neg.	
<i>Strix aluco</i>	0.211 (0.176)	14061	0.229		
<i>Sturnus unicolor</i>	-0.185 (0.157)	3588	0.238		
<i>Sturnus vulgaris</i>	-0.087 (0.048)	52868	0.071		
<i>Sylvia atricapilla</i>	-0.087 (0.027)	27408	0.001	Neg.	
<i>Sylvia borin</i>	0.174 (0.049)	50315	<0.001	Pos.	
<i>Sylvia cantillans</i>	-0.211 (0.102)	5011	0.04	Neg.	
<i>Sylvia communis</i>	0.009 (0.033)	48516	0.795		
<i>Sylvia curruca</i>	-0.241 (0.06)	18241	<0.001	Neg.	
<i>Sylvia melanocephala</i>	0.133 (0.086)	5995	0.121		
<i>Sylvia undata</i>	0.721 (0.145)	4762	<0.001	Pos.	Annex 1
<i>Tachybaptus ruficollis</i>	0.582 (0.234)	11220	0.013	Pos.	
<i>Tadorna tadorna</i>	2.25 (0.234)	4683	<0.001	Pos.	
<i>Tetrao tetrix</i>	0.202 (0.308)	4102	0.511		Annex 1
<i>Tetrao urogallus</i>	0.368 (0.32)	3249	0.25		Annex 1
<i>Tetrastes bonasia</i>	-0.138 (0.401)	4213	0.731		Annex 1
<i>Tringa glareola</i>	1.175 (0.446)	2822	0.008	Pos.	Annex 1
<i>Tringa nebularia</i>	0.717 (0.394)	2099	0.069		
<i>Tringa ochropus</i>	1.115 (0.234)	7923	<0.001	Pos.	
<i>Tringa totanus</i>	2.521 (0.257)	21073	<0.001	Pos.	
<i>Troglodytes troglodytes</i>	0.011 (0.023)	48000	0.643		
<i>Turdus merula</i>	-0.278 (0.017)	48553	<0.001	Neg.	
<i>Turdus philomelos</i>	-0.108 (0.03)	47059	<0.001	Neg.	
<i>Turdus pilaris</i>	-0.503 (0.197)	18765	0.011	Neg.	
<i>Turdus viscivorus</i>	0.102 (0.041)	46027	0.012	Pos.	
<i>Upupa epops</i>	-0.09 (0.063)	16380	0.154		
<i>Vanellus vanellus</i>	1.197 (0.083)	47898	<0.001	Pos.	

Table A3.2 Bird species response to the Natura 2000 coverage (mean estimate, S.E. within brackets) and associated P values per biogeographic region

Species	Atlantic			Boreal			Continental			Mediterranean			
	Coeff.	DF	P value	Coeff.	DF	P value	Coeff.	DF	P value	Coeff.	DF	P value	N2000
<i>Accipiter gentilis</i>				0.547 (0.723)	3311	0.450	-0.297 (0.17)	8677	0.081				
<i>Accipiter nisus</i>	-0.529 (0.109)	33394	0.000				-0.081 (0.108)	12652	0.452	0.308 (0.167)	3821	0.066	
<i>Acrocephalus arundinaceus</i>							1.183 (0.204)	7847	0.000	2.033 (0.247)	2363	0.000	
<i>Acrocephalus palustris</i>	0.666 (0.15)	4337	0.000	1.526 (0.515)	3170	0.003	0.101 (0.081)	10938	0.211				
<i>Acrocephalus schoenobaenus</i>	2.463 (0.267)	5886	0.000	0.705 (0.762)	4136	0.355	1.17 (0.218)	9213	0.000				
<i>Acrocephalus scirpaceus</i>	1.823 (0.205)	6743	0.000	-0.896 (0.882)	2129	0.310	1.052 (0.153)	11331	0.000	1.437 (0.223)	2542	0.000	
<i>Actitis hypoleucos</i>				1.17 (0.378)	4027	0.002	0.439 (0.694)	3064	0.527				
<i>Aegithalos caudatus</i>	-0.428 (0.078)	28433	0.000	0.642 (0.62)	3136	0.300	-0.085 (0.17)	9604	0.616	-0.333 (0.099)	3865	0.001	
<i>Alauda arvensis</i>	0.527 (0.052)	33648	0.000	-4.107 (0.737)	5431	0.000	-0.363 (0.041)	13643	0.000	0.494 (0.116)	5500	0.000	
<i>Alcedo atthis</i>	1.774 (0.214)	6448	0.000				0.41 (0.242)	4822	0.091	0.502 (0.451)	1168	0.266	Annex 1
<i>Alectoris rufa</i>							0 (0)	0	0.000	0 (0)	0	0.000	
<i>Alopochen aegyptiaca</i>	0 (0)	0	0.000										
<i>Anas clypeata</i>	2.235 (0.199)	5622	0.000										
<i>Anas crecca</i>													
<i>Anas penelope</i>													
<i>Anas platyrhynchos</i>	0.835 (0.093)	7089	0.000	-1.063 (0.649)	3335	0.102	0.586 (0.068)	13026	0.000	0.977 (0.296)	1467	0.001	
<i>Anas querquedula</i>	1.045 (0.325)	3089	0.001										
<i>Anas strepera</i>	1.341 (0.158)	4640	0.000										
<i>Anser anser</i>	2.119 (0.704)	2482	0.003	-7.452 (1.987)	898	0.000	1.085 (0.251)	2458	0.000				
<i>Anthus campestris</i>							-0.365 (0.284)	4848	0.198	0.708 (0.16)	2919	0.000	Annex 1
<i>Anthus pratensis</i>	1.709 (0.103)	33240	0.000	0.594 (0.473)	5446	0.209	0.924 (0.127)	11876	0.000	-1.034 (0.498)	837	0.038	
<i>Anthus trivialis</i>	1.128 (0.155)	25101	0.000	0.375 (0.394)	690	0.342	0.412 (0.058)	12123	0.000	0.845 (0.224)	1215	0.000	
<i>Apus apus</i>	0.096 (0.23)	7178	0.676	-1.773 (0.479)	3893	0.000	-0.378 (0.1)	13164	0.000	-0.208 (0.071)	3983	0.003	
<i>Apus melba</i>										2.168 (0.541)	693	0.000	
<i>Apus pallidus</i>										-0.796 (0.977)	248	0.416	
<i>Aquila chrysaetos</i>													Annex 1
<i>Ardea cinerea</i>	0.541 (0.345)	7073	0.117	0.17 (1.4)	1155	0.903	0.746 (0.082)	12861	0.000	-0.188 (0.204)	3125	0.355	
<i>Ardea purpurea</i>										1.105 (0.539)	1022	0.041	Annex 1
<i>Asio flammeus</i>				-3.143 (4.567)	946	0.491							Annex 1
<i>Athene noctua</i>	-0.471 (0.309)	6327	0.128				-1.394 (0.491)	4538	0.005	-0.261 (0.135)	3942	0.053	
<i>Aythya fuligula</i>	0.675 (0.287)	6331	0.019										
<i>Bombycilla garrulus</i>				-0.989 (2.066)	690	0.632							
<i>Botaurus stellaris</i>				-18.299 (15.458)	591	0.237							Annex 1
<i>Branta canadensis</i>				-1.041 (0.644)	2813	0.106							
<i>Bubulcus ibis</i>										1.805 (0.311)	537	0.000	
<i>Bucephala clangula</i>				0.855 (0.414)	3226	0.039							
<i>Burhinus oedicnemus</i>							-1.53 (0.773)	1158	0.048	-0.238 (0.183)	2143	0.193	Annex 1
<i>Buteo buteo</i>	-0.284 (0.048)	28440	0.000	-3.262 (0.756)	4394	0.000	-0.077 (0.035)	13616	0.030	-0.354 (0.083)	3983	0.000	
<i>Buteo lagopus</i>				-0.154 (1.06)	3107	0.884							
<i>Calandrella brachydactyla</i>										-0.116 (0.213)	2340	0.586	Annex 1
<i>Carduelis cannabina</i>	0.263 (0.067)	33322	0.000	-6.112 (2.62)	3286	0.020	-0.246 (0.076)	13636	0.001	-0.224 (0.078)	3983	0.004	
<i>Carduelis carduelis</i>	-0.607 (0.054)	32775	0.000	-4.817 (2.733)	2394	0.078	-0.303 (0.052)	13628	0.000	-0.292 (0.069)	5552	0.000	
<i>Carduelis flammea</i>	0.469 (0.329)	27258	0.154	0.883 (0.552)	4027	0.109							

Carduelis spinus	0.331 (0.325)	32967	0.309	0.482 (0.157)	4012	0.002	0.502 (0.26)	11086	0.054				
Carpodacus erythrinus				0.893 (0.45)	4735	0.048	0.943 (0.303)	4872	0.002				
Certhia brachydactyla	0.187 (0.081)	6432	0.022				0.133 (0.074)	10280	0.073	0.015 (0.07)	4979	0.828	
Certhia familiaris	-0.151 (0.138)	26473	0.273	0.504 (0.288)	3848	0.081	0.273 (0.093)	10737	0.003				
Cettia cetti	2.457 (0.213)	3869	0.000				0.395 (0.369)	1334	0.285	-0.098 (0.103)	5027	0.338	
Charadrius dubius							-0.527 (0.546)	3281	0.335				
Chloris chloris	-1.088 (0.048)	33502	0.000	-1.418 (0.34)	4795	0.000	-0.405 (0.045)	13643	0.000	-0.531 (0.053)	5516	0.000	
Ciconia ciconia				-2.021 (1.507)	1417	0.180	0.877 (0.167)	8185	0.000	-0.134 (0.169)	2495	0.428	Annex 1
Cinclus cinclus							0.037 (0.33)	3566	0.911				
Circaetus gallicus										0.894 (0.236)	937	0.000	Annex 1
Circus aeruginosus	2.516 (0.231)	5295	0.000				0.613 (0.098)	10227	0.000	0.985 (0.2)	2255	0.000	Annex 1
Circus cyaneus	-0.114 (0.209)	6498	0.585				-1.35 (0.333)	4572	0.000				Annex 1
Circus pygargus							-0.47 (0.364)	3741	0.196				Annex 1
Cisticola juncidis	2.908 (0.236)	1312	0.000							-0.756 (0.114)	4215	0.000	
Clamator glandarius													
Coccothraustes coccothraustes	0.572 (0.229)	6370	0.013	-2.143 (2.28)	1369	0.347	0.258 (0.074)	13598	0.001				
Columba livia	-0.808 (0.311)	3602	0.009				-0.588 (0.259)	5177	0.023	-0.003 (0.126)	2804	0.981	
Columba oenas	-0.071 (0.09)	31730	0.428	0.865 (0.614)	3123	0.159	0.583 (0.154)	10576	0.000	-0.802 (0.434)	3098	0.064	
Columba palumbus	-0.875 (0.038)	33559	0.000	-0.788 (0.178)	5077	0.000	-0.151 (0.031)	13591	0.000	-0.243 (0.061)	5479	0.000	
Coracias garrulus										0.514 (0.316)	562	0.104	Annex 1
Corvus corax				-0.33 (0.307)	4027	0.283	0.131 (0.117)	6400	0.263	-0.04 (0.119)	5071	0.739	
Corvus corone	-0.366 (0.042)	32807	0.000	-1.171 (0.254)	4027	0.000	0.237 (0.065)	10897	0.000	-0.409 (0.067)	3642	0.000	
Corvus frugilegus	-0.755 (0.171)	31907	0.000				-0.636 (0.181)	7441	0.000				
Corvus monedula	-0.399 (0.08)	32905	0.000	-6.316 (1.138)	4292	0.000	-0.549 (0.135)	13397	0.000	0.325 (0.13)	3915	0.013	
Coturnix coturnix	0.102 (0.176)	6112	0.565				-0.049 (0.089)	10311	0.580	-0.344 (0.093)	3719	0.000	
Crex crex				3.438 (0.542)	2356	0.000	0.16 (0.159)	6716	0.312				Annex 1
Cuculus canorus	0.613 (0.054)	33640	0.000	0.755 (0.135)	5446	0.000	0.336 (0.031)	13639	0.000	-0.176 (0.056)	5552	0.002	
Cyanistes caeruleus	-0.427 (0.035)	33468	0.000	-1.215 (0.292)	3691	0.000	-0.174 (0.041)	13528	0.000	-0.116 (0.055)	5548	0.035	
Cyanopica cyanus										0.505 (0.16)	1009	0.002	
Cygnus cygnus				1.104 (0.772)	1711	0.153							Annex 1
Cygnus olor	1.652 (0.2)	5685	0.000	-3.796 (3.67)	2045	0.301	0.927 (0.192)	10530	0.000				
Delichon urbica	1.785 (0.229)	7393	0.000	-5.685 (1.92)	690	0.003	-0.007 (0.082)	12032	0.932	-0.65 (0.102)	5552	0.000	
Dendrocopos major	-0.14 (0.047)	31759	0.003	-0.18 (0.162)	3998	0.267	0.137 (0.034)	13641	0.000	-0.193 (0.081)	4862	0.018	
Dendrocopos medius							1.168 (0.156)	8364	0.000				Annex 1
Dendrocopos minor	0.592 (0.209)	23578	0.005	0.496 (0.914)	3335	0.587	0.64 (0.113)	9472	0.000	-0.319 (0.378)	1347	0.399	
Dryocopus martius	0.392 (0.188)	3969	0.037	-0.906 (0.266)	4027	0.001	0.277 (0.058)	11266	0.000	0.832 (0.477)	600	0.081	Annex 1
Egretta garzetta							4.004 (0.693)	1451	0.000	0.747 (0.651)	903	0.251	Annex 1
Emberiza calandra	-1.356 (0.704)	4357	0.054				-0.124 (0.311)	1970	0.690	-1.42 (0.327)	187	0.000	
Emberiza cia										1.069 (0.139)	5090	0.000	
Emberiza cirius	-0.675 (0.11)	3971	0.000				-0.215 (0.118)	3639	0.069	-0.702 (0.069)	5087	0.000	
Emberiza citrinella	-0.725 (0.059)	31836	0.000	-3.11 (0.265)	5435	0.000	-0.15 (0.039)	13643	0.000	0.72 (0.27)	2123	0.008	
Emberiza hortulana				-2.991 (1.401)	2511	0.033	-1.411 (0.179)	5647	0.000	0.689 (0.212)	2542	0.001	Annex 1
Emberiza rustica				0.465 (0.568)	2942	0.413							
Emberiza schoeniclus	1.938 (0.157)	7022	0.000	1.797 (0.316)	5446	0.000	0.704 (0.121)	11843	0.000				
Erethacus rubecula	0.054 (0.083)	7399	0.518	0.451 (0.4)	650	0.260	0.058 (0.041)	12958	0.159	0.303 (0.071)	5552	0.000	
Falco columbarius				6.095 (1.336)	2273	0.000							Annex 1
Falco subbuteo	0.213 (0.22)	6522	0.333	1.213 (0.8)	2910	0.130	-0.118 (0.323)	4638	0.715				
Falco tinnunculus	0.095 (0.056)	33626	0.090	-3.341 (1.843)	3335	0.070	-0.259 (0.07)	13639	0.000	-0.325 (0.061)	3983	0.000	
Ficedula albicollis							1.328 (0.254)	5529	0.000				Annex 1

<i>Ficedula hypoleuca</i>	1.516 (0.246)	11955	0.000	-0.086 (0.179)	4027	0.633	0.746 (0.125)	9332	0.000	-0.713 (0.618)	1140	0.248
<i>Fringilla coelebs</i>	-0.453 (0.028)	33644	0.000	-0.156 (0.094)	3983	0.097	0.178 (0.022)	13640	0.000	0.266 (0.056)	5552	0.000
<i>Fringilla montifringilla</i>				1.65 (0.449)	3340	0.000						
<i>Fulica atra</i>	1.722 (0.185)	6907	0.000	-2.08 (2.497)	1840	0.405	0.876 (0.179)	12050	0.000	-14.101 (0.004)	1414	0.000
<i>Galerida cristata</i>							-1.697 (0.357)	6723	0.000	-0.185 (0.087)	4960	0.033
<i>Galerida theklae</i>										-0.349 (0.155)	1507	0.025 Annex 1
<i>Gallinago gallinago</i>	2.379 (0.272)	33036	0.000	2.319 (0.231)	4027	0.000	1 (0.346)	10450	0.004			
<i>Gallinula chloropus</i>	0.363 (0.124)	7109	0.003				0.018 (0.146)	7258	0.903	0.841 (0.392)	1543	0.032
<i>Garrulus glandarius</i>	-0.455 (0.058)	31701	0.000	-1.251 (0.29)	3791	0.000	-0.011 (0.042)	13643	0.789	-0.086 (0.062)	5100	0.164
<i>Gavia arctica</i>				-0.019 (0.44)	3165	0.966						Annex 1
<i>Gavia stellata</i>				0.241 (0.658)	1745	0.714						Annex 1
<i>Grus grus grus</i>				0.559 (0.3)	3610	0.063	0.993 (0.158)	4111	0.000			Annex 1
<i>Gyps rueppellii</i>							0 (0)	0	0.000			
<i>Haematopus ostralegus</i>	1.908 (0.19)	3491	0.000									
<i>Hippolais icterina</i>	-0.225 (0.162)	3898	0.165	-0.586 (0.617)	2895	0.342	0.166 (0.072)	10489	0.021			
<i>Hippolais polyglotta</i>	-0.065 (0.087)	3994	0.459				-0.053 (0.092)	4160	0.566	-0.595 (0.087)	5040	0.000
<i>Hirundo daurica</i>										1.104 (0.17)	1173	0.000
<i>Hirundo rupestris</i>										-0.18 (0.224)	2272	0.420
<i>Hirundo rustica</i>	-0.384 (0.06)	33618	0.000	-1.518 (0.367)	5226	0.000	-0.247 (0.04)	13643	0.000	-0.398 (0.064)	5476	0.000
<i>Jynx torquilla</i>				-1.951 (0.67)	4027	0.004	0.693 (0.099)	9841	0.000	0.378 (0.16)	2997	0.018
<i>Lagopus ((lagopus)) lagopus</i>				0.025 (0.701)	1856	0.972						
<i>Lanius ((excubitor)) meridionalis</i>										1.258 (0.312)	931	0.000
<i>Lanius collurio</i>	0.723 (0.222)	4033	0.001	0.859 (0.389)	4213	0.027	0.208 (0.058)	13643	0.000	0.724 (0.144)	1475	0.000 Annex 1
<i>Lanius excubitor</i>				-0.371 (1.422)	2998	0.794	0.084 (0.205)	9193	0.682			
<i>Lanius minor</i>										0.962 (0.396)	1302	0.015 Annex 1
<i>Lanius senator</i>										-0.007 (0.101)	3561	0.946
<i>Larus argentatus</i>	-0.976 (0.39)	6127	0.012	-11.57 (3.633)	1890	0.001	0.626 (0.174)	2837	0.000			
<i>Larus canus</i>				-1.513 (0.46)	3345	0.001	-0.333 (0.242)	4014	0.169			
<i>Larus fuscus</i>				0 (0)	0	0.000						
<i>Larus marinus</i>												
<i>Larus michahellis michahellis</i>										1.503 (0.4)	937	0.000
<i>Larus ridibundus</i>	3.274 (0.386)	7124	0.000	-1.094 (1.012)	3145	0.280	1.092 (0.281)	11230	0.000	2.831 (0.568)	1340	0.000
<i>Limosa limosa limosa</i>	3.913 (0.243)	6700	0.000									
<i>Locustella fluviatilis</i>				8.901 (0.685)	1417	0.000	0.525 (0.183)	5244	0.004			
<i>Locustella naevia</i>	1.667 (0.177)	25370	0.000	2.181 (0.444)	2603	0.000	0.904 (0.117)	9230	0.000			
<i>Lophophanes cristatus</i>	0.225 (0.207)	5774	0.278	-0.334 (0.268)	3630	0.212	0.447 (0.105)	10877	0.000	0.254 (0.111)	3653	0.022
<i>Loxia curvirostra</i>				-0.14 (0.48)	3323	0.770	0.878 (0.265)	4288	0.001	0.343 (0.286)	1448	0.231
<i>Loxia pytyopsittacus</i>				0.432 (0.942)	3168	0.647						
<i>Lullula arborea</i>	0.144 (0.155)	4572	0.353	0.146 (0.727)	1351	0.841	0.313 (0.072)	9651	0.000	-0.408 (0.068)	5141	0.000 Annex 1
<i>Luscinia luscinia</i>				2.849 (0.709)	1969	0.000	0.37 (0.091)	6879	0.000			
<i>Luscinia megarhynchos</i>	0.071 (0.13)	5348	0.582				-0.227 (0.073)	7117	0.002	-0.259 (0.055)	5439	0.000
<i>Luscinia svecica</i>	2.503 (0.273)	1486	0.000									Annex 1
<i>Melanocorypha calandra</i>										-0.879 (0.192)	2513	0.000 Annex 1
<i>Mergus merganser</i>				-0.418 (1.084)	3235	0.700						
<i>Mergus serrator</i>												
<i>Merops apiaster</i>							-0.841 (0.579)	702	0.147	-0.25 (0.097)	4548	0.010
<i>Milvus migrans</i>	0.938 (0.223)	3142	0.000				0.857 (0.181)	9487	0.000	-0.001 (0.165)	3983	0.996 Annex 1
<i>Milvus milvus</i>							0.569 (0.229)	9427	0.013	-0.955 (0.235)	2990	0.000 Annex 1
<i>Monticola solitarius</i>										3.331 (0.377)	1256	0.000

Motacilla alba	0.077 (0.046)	33585	0.090	-0.684 (0.688)	2109	0.320	-0.141 (0.044)	12329	0.002	-0.644 (0.076)	5552	0.000
Motacilla cinerea	0.154 (0.248)	4389	0.536				0.366 (0.174)	4724	0.035	0.226 (0.175)	3983	0.199
Motacilla flava	0.009 (0.152)	23831	0.954	-0.703 (0.425)	4027	0.098	-0.234 (0.109)	10335	0.032	-0.293 (0.219)	2307	0.182
Muscicapa striata	0.135 (0.121)	33301	0.267	0.03 (0.231)	4027	0.895	0.287 (0.091)	13233	0.002	0.357 (0.196)	3187	0.068
Nucifraga caryocatactes				-3.338 (3.71)	1306	0.368						
Numenius arquata				-0.665 (0.601)	3951	0.268	1.726 (0.371)	4638	0.000			
Numenius phaeopus												
Nycticorax nycticorax							1.058 (0.876)	3062	0.227			Annex 1
Oenanthe oenanthe	1.743 (0.235)	19514	0.000	-5.086 (3.578)	690	0.156	-0.084 (0.176)	7368	0.633	1.067 (0.166)	2798	0.000
Oriolus oriolus	0.22 (0.102)	5387	0.031	0.706 (1.072)	1676	0.510	0.115 (0.041)	10493	0.005	-0.431 (0.062)	4990	0.000
Otus scops										0.493 (0.476)	875	0.301
Pandion haliaetus												Annex 1
Parus major	-0.457 (0.032)	33552	0.000	-0.896 (0.154)	3948	0.000	-0.157 (0.025)	13640	0.000	-0.079 (0.041)	5552	0.052
Passer domesticus	-1.258 (0.062)	33482	0.000	-5.632 (1.616)	3924	0.000	-0.871 (0.057)	13643	0.000	-0.535 (0.051)	5483	0.000
Passer hispaniolensis										-566.179 (570.546)	59	0.325
Passer montanus	-1.261 (0.196)	29648	0.000	-7.168 (1.825)	3556	0.000	-0.422 (0.091)	13579	0.000	-0.293 (0.141)	3813	0.037
Perdix perdix	-1.106 (0.159)	30507	0.000				-1.214 (0.182)	12239	0.000			
Periparus ater	0.225 (0.089)	31272	0.011	-0.658 (0.321)	3393	0.040	0.408 (0.084)	13452	0.000	0.531 (0.144)	5507	0.000
Perisoreus infaustus				0.575 (0.504)	1782	0.254						
Pernis apivorus				1.082 (0.745)	3188	0.146	0.392 (0.278)	5138	0.159	0.223 (0.529)	1658	0.674
Petronia petronia										-0.019 (0.163)	3083	0.906
Phalacrocorax carbo	0.448 (0.589)	5420	0.446	-7.416 (16.065)	101	0.645	0.526 (0.496)	3764	0.289	-1.994 (0.569)	1042	0.000
Phasianus colchicus	0 (0)	0	0.000	0 (0)	0	0.000	0 (0)	0	0.000	0 (0)	0	0.000
Philomachus pugnax				-10.314 (6.412)	1308	0.108						Annex 1
Phoenicurus ochrurus	-0.442 (0.105)	6804	0.000				-0.639 (0.054)	10417	0.000	-0.111 (0.122)	3983	0.363
Phoenicurus phoenicurus	1.414 (0.127)	23377	0.000	1.179 (0.768)	690	0.125	-0.022 (0.075)	13160	0.769	1.297 (0.209)	2427	0.000
Phylloscopus ((collybita)) collybita (et al)	-0.533 (0.042)	32710	0.000	-0.664 (0.297)	2295	0.026	-0.011 (0.029)	13277	0.702	0.197 (0.122)	1127	0.107
Phylloscopus bonelli	0.371 (0.235)	2730	0.115				0.413 (0.234)	4077	0.077	-0.098 (0.114)	5348	0.389
Phylloscopus sibilatrix	1.212 (0.286)	22084	0.000	0.128 (0.311)	3275	0.681	0.223 (0.119)	13152	0.062			
Phylloscopus trochilus	0.576 (0.061)	32403	0.000	-0.53 (0.095)	4027	0.000	0.432 (0.041)	13106	0.000	-0.256 (0.274)	937	0.349
Pica pica	-0.984 (0.048)	32760	0.000	-2.656 (0.435)	5446	0.000	-0.555 (0.053)	13485	0.000	0 (0.071)	5108	0.996
Picoides tridactylus												Annex 1
Picus ((viridis)) viridis	-0.179 (0.057)	29852	0.002	-1.392 (0.586)	2103	0.018	-0.016 (0.072)	13394	0.827	-0.804 (0.097)	1829	0.000
Picus canus				-1.768 (2.295)	775	0.441	1.166 (0.186)	4498	0.000			Annex 1
Pinicola enucleator				1.589 (1.159)	1958	0.170						
Pluvialis apricaria				0.993 (0.851)	2615	0.243						Annex 1
Podiceps cristatus	1.593 (0.272)	6697	0.000				1.372 (0.214)	7362	0.000			
Poecile cinctus												
Poecile montanus	-0.495 (0.269)	26764	0.065	0.789 (0.197)	4027	0.000	0.149 (0.112)	10900	0.182			
Poecile palustris	0.05 (0.144)	26032	0.730	0.206 (0.528)	1769	0.697	0.243 (0.078)	13243	0.002	0.143 (0.358)	608	0.690
Prunella modularis	-0.359 (0.073)	7399	0.000	-0.396 (0.555)	690	0.475	0.197 (0.067)	12958	0.003	0.308 (0.271)	3983	0.255
Pyrrhonorax pyrrhonorax										0.31 (0.224)	1800	0.165
Pyrrhula pyrrhula	-0.718 (0.085)	32078	0.000	-0.318 (0.287)	3991	0.269	0.548 (0.1)	13623	0.000	0.894 (0.36)	3247	0.013
Regulus ignicapilla	-0.304 (0.234)	7255	0.194				0.362 (0.107)	10853	0.001	0.537 (0.095)	5552	0.000
Regulus regulus	-0.092 (0.085)	33362	0.277	-0.558 (0.192)	3933	0.004	0.19 (0.084)	13640	0.024	-0.9 (0.326)	2786	0.006
Riparia riparia				-0.311 (1.63)	3335	0.849	0.051 (0.423)	5303	0.904	0.854 (0.73)	1502	0.242
Saxicola rubetra	2.056 (0.271)	33158	0.000	-1.162 (0.251)	5446	0.000	0.475 (0.105)	13315	0.000	1.001 (0.325)	1570	0.002
Saxicola rubicola	1.853 (0.179)	24425	0.000				-0.071 (0.083)	6814	0.389	-0.134 (0.067)	5552	0.045
Scolopax rusticola				-1.086 (0.602)	3855	0.071						

Serinus serinus	-0.385 (0.126)	4993	0.002																
Sitta europaea	0.006 (0.082)	26836	0.939	-0.727 (0.426)	2307	0.088	0.177 (0.058)	13326	0.002	0.818 (0.152)	2354	0.000							
Sterna hirundo				-1.547 (1.125)	2741	0.169													Annex 1
Sterna paradisaea																			Annex 1
Streptopelia decaocto	-1.156 (0.103)	7160	0.000				-0.85 (0.064)	12865	0.000	-0.54 (0.111)	1741	0.000							
Streptopelia turtur	-0.025 (0.138)	24121	0.856				-0.032 (0.073)	10710	0.660	-0.552 (0.066)	5458	0.000							
Strix aluco	0.606 (0.224)	5685	0.007	-3.583 (5.953)	1917	0.547	-0.309 (0.255)	7133	0.224	0.463 (0.451)	937	0.305							
Sturnus unicolor										-0.233 (0.161)	3540	0.149							
Sturnus vulgaris	-0.42 (0.066)	33615	0.000	-3.167 (0.51)	5435	0.000	-0.001 (0.058)	13638	0.988	0.198 (0.171)	5421	0.247							
Surnia ulula				0.824 (1.38)	1541	0.550													Annex 1
Sylvia atricapilla	-0.097 (0.058)	7395	0.098	-1.263 (0.242)	4345	0.000	-0.031 (0.027)	13165	0.244	-0.192 (0.072)	5552	0.008							
Sylvia borin	-0.011 (0.075)	32432	0.879	-1.196 (0.191)	5406	0.000	0.343 (0.061)	13640	0.000	-0.123 (0.186)	3983	0.510							
Sylvia cantillans										-0.202 (0.099)	4920	0.041							
Sylvia communis	0.007 (0.048)	33052	0.887	-0.628 (0.311)	4035	0.043	0.039 (0.039)	13604	0.314	-0.03 (0.161)	2791	0.851							
Sylvia conspicillata										2.046 (0.589)	934	0.001							
Sylvia curruca	-0.171 (0.198)	4865	0.390	-0.748 (0.22)	3499	0.001	-0.209 (0.06)	12180	0.001										
Sylvia hortensis										0.469 (0.153)	2420	0.002							
Sylvia melanocephala										0.17 (0.077)	5307	0.028							
Sylvia nisoria							0.702 (0.181)	5735	0.000										Annex 1
Sylvia undata										0.784 (0.142)	3076	0.000							Annex 1
Tachybaptus ruficollis							0.684 (0.319)	4914	0.032	1.57 (0.812)	1633	0.053							
Tadorna tadorna	2.737 (0.24)	3864	0.000							0.223 (0.457)	292	0.626							
Tetrao tetrix				0.071 (0.31)	4012	0.820													Annex 1
Tetrao urogallus				0.32 (0.296)	3292	0.280													Annex 1
Tetrastes bonasia				0.021 (0.406)	3809	0.959													Annex 1
Tetrax tetrax																			Annex 1
Tringa erythropus				-9.554 (4.478)	367	0.034													
Tringa glareola				1.012 (0.414)	3145	0.015													Annex 1
Tringa nebularia				-0.047 (0.349)	1863	0.892													
Tringa ochropus				0.049 (0.203)	3801	0.809													
Tringa totanus	3.261 (0.208)	7113	0.000				1.691 (0.573)	11738	0.003										
Troglodytes troglodytes	-0.375 (0.029)	33640	0.000	1.137 (0.785)	623	0.148	0.1 (0.041)	13433	0.014	0.436 (0.076)	4926	0.000							
Turdus iliacus				-0.995 (0.421)	690	0.018													
Turdus merula	-0.76 (0.028)	33591	0.000	1.58 (0.63)	616	0.012	-0.19 (0.024)	13433	0.000	-0.011 (0.044)	5552	0.806							
Turdus philomelos	-0.636 (0.036)	33597	0.000	0.95 (0.349)	690	0.007	0.206 (0.037)	13430	0.000										
Turdus pilaris				-2.539 (0.992)	2109	0.011	-0.444 (0.138)	10892	0.001										
Turdus viscivorus	-0.147 (0.055)	33235	0.007	0.622 (0.764)	661	0.416	0.36 (0.083)	12952	0.000	0.179 (0.124)	3711	0.149							
Upupa epops	-0.091 (0.137)	3229	0.509				0.058 (0.117)	9529	0.621	-0.109 (0.061)	5340	0.077							
Vanellus vanellus	1.417 (0.1)	33314	0.000	-1.751 (0.615)	5420	0.004	0.648 (0.142)	13168	0.000										

Table A3.3 Butterfly species response to the Natura 2000 coverage (mean estimate, S.E. within brackets), associated P values and habitat specialization

Species	Coeff.	DF	P value	Abundance variation	Habitat specialisation
<i>Aglais io</i>	-0.964 (0.169)	3956	<0.001	Neg.	
<i>Aglais urticae</i>	-2.365 (0.261)	3878	<0.001	Neg.	
<i>Anthocharis cardamines</i>	-0.21 (0.166)	4033	0.206		
<i>Anthocharis euphenoides</i>	0.68 (0.519)	124	0.192		
<i>Apatura ilia</i>	1.913 (2.218)	223	0.389		Woodland
<i>Aphantopus hyperantus</i>	-0.273 (0.148)	4322	0.065		
<i>Aporia crataegi</i>	2.547 (0.569)	1064	<0.001	Pos.	
<i>Araschnia levana</i>	-0.856 (0.205)	1354	<0.001	Neg.	
<i>Argynnis adippe</i>	3.794 (0.586)	1232	<0.001	Pos.	
<i>Argynnis aglaja</i>	2.345 (0.556)	3582	<0.001	Pos.	
<i>Argynnis niobe</i>	5.148 (1.025)	360	<0.001	Pos.	
<i>Argynnis paphia</i>	0.696 (0.321)	3024	0.030	Pos.	Woodland
<i>Aricia eumedon</i>	-1.248 (2.144)	132	0.562		
<i>Boloria dia</i>	3.263 (0.817)	359	<0.001	Pos.	
<i>Boloria euphrosyne</i>	2.363 (0.534)	1840	<0.001	Pos.	
<i>Boloria selene</i>	1.381 (0.444)	3495	0.002	Pos.	
<i>Brenthis ino</i>	-1.637 (1.359)	386	0.229		Grassland
<i>Brintesia circe</i>	-0.879 (0.255)	154	<0.001	Neg.	
<i>Callophrys rubi</i>	0.828 (0.3)	3932	0.006	Pos.	
<i>Carcharodus alceae</i>	1.088 (0.606)	468	0.073		
<i>Carterocephalus palaemon</i>	1.716 (0.624)	421	0.006	Pos.	
<i>Celastrina argiolus</i>	-0.622 (0.204)	4072	0.002	Neg.	
<i>Charaxes jasius</i>	0.014 (0.314)	119	0.966		
<i>Coenonympha arcania</i>	1.171 (0.469)	591	0.013	Pos.	
<i>Coenonympha dorus</i>	-3.362 (0.564)	134	<0.001	Neg.	Grassland
<i>Coenonympha glycerion</i>	1.67 (1.277)	323	0.192		Grassland
<i>Coenonympha pamphilus</i>	1.039 (0.187)	4007	<0.001	Pos.	
<i>Coenonympha tullia</i>	4.37 (0.884)	136	<0.001	Pos.	
<i>Colias alfacariensis</i>	-0.976 (0.536)	145	0.071		Grassland
<i>Colias crocea</i>	0.899 (0.162)	200	<0.001	Pos.	
<i>Colias hyale</i>	0.034 (0.699)	283	0.962		
<i>Cupido minimus</i>	-0.497 (1.005)	2092	0.621		Grassland
<i>Cyaniris semiargus</i>	-0.305 (0.745)	534	0.683		Grassland
<i>Erebia aethiops</i>	2.356 (0.471)	263	<0.001	Pos.	Woodland
<i>Erebia ligea</i>	-0.634 (1.266)	121	0.617		Woodland
<i>Erebia medusa</i>	2.079 (0.835)	195	0.014	Pos.	
<i>Erynnis tages</i>	-0.323 (0.399)	3260	0.420		Grassland
<i>Euchloe crameri</i>	0.978 (0.392)	135	0.014	Pos.	
<i>Euphydryas aurinia</i>	-2.865 (0.902)	1049	0.002	Neg.	Grassland
<i>Favonius quercus</i>	-0.101 (0.494)	4447	0.838		Woodland
<i>Glaucopsyche alexis</i>	-0.485 (0.565)	139	0.392		Grassland
<i>Glaucopsyche melanops</i>	-0.617 (0.61)	115	0.313		
<i>Gonepteryx cleopatra</i>	0.669 (0.245)	174	0.007	Pos.	
<i>Gonepteryx rhamni</i>	-0.045 (0.149)	3859	0.763		
<i>Hamearis lucina</i>	-1.777 (1.07)	1982	0.097		
<i>Hesperia comma</i>	-0.384 (0.533)	2966	0.471		

<i>Heteropterus morpheus</i>	-8.665 (9.37)	117	0.357		
<i>Hipparchia fidia</i>	-1.141 (0.41)	121	0.006	Neg.	
<i>Hipparchia semele</i>	6.211 (0.542)	3351	<0.001	Pos.	
<i>Hipparchia statilinus</i>	0.901 (0.475)	131	0.060		
<i>Iphiclides podalirius</i>	-0.229 (0.208)	151	0.273		
<i>Issoria lathonia</i>	3.935 (0.314)	1285	<0.001	Pos.	
<i>Lampides boeticus</i>	0.801 (0.424)	162	0.061		
<i>Lasiommata maera</i>	-1.578 (1.673)	273	0.346		
<i>Lasiommata megera</i>	0.027 (0.243)	4204	0.911		
<i>Leptotes pirithous</i>	0.427 (0.242)	155	0.080		
<i>Libythea celtis</i>	1.04 (0.369)	137	0.006	Pos.	
<i>Limenitis camilla</i>	2.582 (0.353)	3391	<0.001	Pos.	Woodland
<i>Limenitis reducta</i>	0.456 (0.255)	138	0.076		Woodland
<i>Lycaena hippothoe</i>	2.389 (0.77)	121	0.002	Pos.	Grassland
<i>Lycaena phlaeas</i>	0.77 (0.17)	3950	<0.001	Pos.	
<i>Lycaena tityrus</i>	0.951 (0.574)	601	0.098		
<i>Maniola jurtina</i>	0.315 (0.108)	4490	0.003	Pos.	
<i>Melanargia galathea</i>	-1.066 (0.284)	3128	<0.001	Neg.	Grassland
<i>Melanargia lachesis</i>	0.698 (0.315)	160	0.028	Pos.	
<i>Melanargia occitanica</i>	-2.812 (0.745)	131	<0.001	Neg.	
<i>Melitaea cinxia</i>	1.396 (0.49)	730	0.004	Pos.	Grassland
<i>Melitaea deione</i>	1.519 (0.529)	127	0.005	Pos.	Grassland
<i>Melitaea didyma</i>	-0.04 (0.416)	143	0.924		Grassland
<i>Melitaea phoebe</i>	0.257 (0.364)	154	0.482		Grassland
<i>Nymphalis polychloros</i>	0.669 (1.003)	484	0.505		
<i>Ochlodes sylvanus</i>	0.549 (0.147)	4717	<0.001	Pos.	
<i>Papilio machaon</i>	-0.668 (0.414)	1521	0.107		
<i>Pararge aegeria</i>	-0.149 (0.107)	3973	0.164		Woodland
<i>Phengaris nausithous</i>	0.957 (0.985)	250	0.332		Grassland
<i>Pieris brassicae</i>	-1.965 (0.161)	4270	<0.001	Neg.	
<i>Pieris napi</i>	-0.772 (0.133)	4152	<0.001	Neg.	
<i>Pieris rapae</i>	-1.648 (0.17)	4077	<0.001	Neg.	
<i>Plebejus argus</i>	0.719 (0.819)	3377	0.380		
<i>Plebejus optilete</i>	-0.638 (0.983)	141	0.517		
<i>Polygonia c.album</i>	-0.522 (0.202)	3664	0.010	Neg.	
<i>Polyommatus amandus</i>	0.656 (1.08)	400	0.544		Grassland
<i>Polyommatus bellargus</i>	-0.626 (0.844)	1792	0.458		Grassland
<i>Polyommatus coridon</i>	-0.565 (0.785)	2445	0.472		Grassland
<i>Polyommatus escheri</i>	-0.341 (0.686)	149	0.621		Grassland
<i>Polyommatus hispanus</i>	-0.75 (0.559)	124	0.182		
<i>Polyommatus icarus</i>	0.07 (0.125)	4331	0.574		
<i>Polyommatus thersites</i>	-0.238 (0.818)	140	0.772		Grassland
<i>Pyronia bathseba</i>	-1.164 (0.412)	133	0.005	Neg.	
<i>Pyronia cecilia</i>	-0.395 (0.327)	164	0.229		
<i>Pyronia tithonus</i>	0.009 (0.15)	4351	0.953		
<i>Satyrrium esculi</i>	1.878 (0.32)	148	<0.001	Pos.	
<i>Satyrrium ilicis</i>	2.446 (0.592)	1233	<0.001	Pos.	Woodland
<i>Satyrrium pruni</i>	-2.748 (2.126)	404	0.197		Woodland
<i>Satyrrium w.album</i>	-1.681 (2.313)	3106	0.467		Woodland
<i>Spialia sertorius</i>	0.367 (0.599)	145	0.540		Grassland
<i>Thecla betulae</i>	1.732 (0.516)	1456	<0.001	Pos.	
<i>Thymelicus acteon</i>	0.161 (0.899)	516	0.858		Grassland

<i>Thymelicus lineola</i>	-0.354 (0.457)	4269	0.439	
<i>Thymelicus sylvestris</i>	-0.446 (0.237)	4636	0.060	
<i>Vanessa atalanta</i>	-0.254 (0.22)	1220	0.250	
<i>Vanessa cardui</i>	-1.495 (0.181)	4353	<0.001	Neg.
<i>Zerynthia rumina</i>	0.811 (0.754)	117	0.284	

Table A3.4 Butterfly species response to the Natura 2000 coverage (mean estimate, S.E. within brackets) and associated P values per biogeographic region

Species	Atlantic			Boreal			Continental			Mediterranean		
	Coeff.	DF	P value	Coeff.	DF	P value	Coeff.	DF	P value	Coeff.	DF	P value
<i>Aglais io</i>	-1.124 (0.194)	3479	<0.001				-1.216 (0.516)	304	0.019	2.175 (0.422)	165	<0.001
<i>Aglais urticae</i>	-2.393 (0.286)	3556	<0.001				-2.068 (0.578)	315	<0.001			
<i>Anthocharis cardamines</i>	-0.561 (0.205)	3508	0.006				0.565 (0.302)	370	0.063	0.856 (0.29)	147	0.004
<i>Anthocharis euphenoides</i>										0.68 (0.519)	124	0.192
<i>Apatura ilia</i>							1.913 (2.218)	223	0.389			
<i>Apatura iris</i>	1.751 (1.287)	1083	0.174				5.479 (0.745)	243	<0.001			
<i>Aphantopus hyperantus</i>	-0.313 (0.167)	3665	0.062	-0.777 (0.728)	132	0.288	0.019 (0.298)	517	0.950			
<i>Aporia crataegi</i>							3.453 (1.46)	322	0.019	0.894 (0.502)	164	0.077
<i>Araschnia levana</i>	-1.201 (0.224)	954	<0.001				0.406 (0.474)	393	0.392			
<i>Arethusana arethusa</i>												
<i>Argynnis adippe</i>	3.766 (1.077)	759	0.001	0.62 (1.456)	106	0.671	4.151 (0.798)	365	<0.001			
<i>Argynnis aglaja</i>	1.945 (0.702)	3064	0.006	0.428 (0.797)	114	0.592	4.921 (0.697)	402	<0.001			
<i>Argynnis niobe</i>	5.148 (1.025)	360	<0.001									
<i>Argynnis pandora</i>												
<i>Argynnis paphia</i>	-0.054 (0.467)	2434	0.908				1.734 (0.511)	428	<0.001	1.917 (0.251)	154	<0.001
<i>Aricia eumedon</i>				-1.248 (2.144)	132	0.562						
<i>Boloria dia</i>							4.031 (1.302)	221	0.002	2.052 (0.447)	137	<0.001
<i>Boloria euphrosyne</i>	2.499 (0.579)	1691	<0.001				0.36 (1.357)	147	0.791			
<i>Boloria selene</i>	1.655 (0.478)	3156	0.001	-0.904 (0.651)	110	0.168	-3.639 (1.741)	221	0.038			
<i>Brenthis daphne</i>												
<i>Brenthis ino</i>				0.627 (0.791)	119	0.430	-4.255 (2.444)	266	0.083			
<i>Brintesia circe</i>										-0.879 (0.255)	154	<0.001
<i>Cacyreus marshalli</i>												
<i>Callophrys avis</i>												
<i>Callophrys rubi</i>	0.793 (0.337)	3437	0.019				0.905 (1.702)	351	0.595	0.479 (0.297)	136	0.109
<i>Carcharodus alceae</i>							1.57 (1.015)	294	0.123	0.379 (0.335)	173	0.259
<i>Carcharodus lavatherae</i>												
<i>Carterocephalus palaemon</i>	5.683 (0.818)	85	<0.001				1.123 (0.74)	330	0.130			
<i>Carterocephalus silvicolus</i>												
<i>Celastrina argiolus</i>	-1.731 (0.291)	3496	<0.001				1.346 (0.451)	375	0.003	0.906 (0.21)	193	<0.001
<i>Charaxes jasius</i>										0.014 (0.314)	119	0.966
<i>Coenonympha arcania</i>							1.842 (0.718)	444	0.011	0.248 (0.456)	146	0.588
<i>Coenonympha dorus</i>										-3.362 (0.564)	134	<0.001
<i>Coenonympha glycerion</i>				4.648 (1.136)	132	<0.001	-1.102 (2.387)	190	0.645			
<i>Coenonympha pamphilus</i>	1.103 (0.216)	3445	<0.001				-0.228 (0.358)	375	0.526	1.78 (0.454)	179	0.000
<i>Coenonympha tullia</i>	1.027 (1.858)	136	0.581									
<i>Colias alfacariensis</i>										-0.976 (0.536)	145	0.071
<i>Colias crocea</i>										0.899 (0.162)	200	<0.001
<i>Colias hyale</i>							0.034 (0.699)	283	0.962			
<i>Colias palaeno</i>												
<i>Cupido alcetas</i>												
<i>Cupido argiades</i>												
<i>Cupido minimus</i>	-3.97 (1.645)	1872	0.016				3.42 (1.315)	216	0.010			
<i>Cupido osiris</i>												
<i>Cyaniris semiargus</i>				-0.533 (0.951)	115	0.576	-0.124 (0.796)	418	0.876			
<i>Erebia aethiops</i>	-5.37 (2.52)	113	0.035				2.397 (0.567)	149	<0.001			
<i>Erebia ligea</i>				-0.634 (1.266)	121	0.617						

<i>Erebia medusa</i>						2.079 (0.835)	195	0.014			
<i>Erebia meolans</i>											
<i>Erebia neoridas</i>											
<i>Erynnis tages</i>	-1.062 (0.501)	2753	0.034			1.911 (0.788)	346	0.016	-1.222 (0.826)	153	0.141
<i>Euchloe crameri</i>									0.978 (0.392)	135	0.014
<i>Euphydryas aurinia</i>	-3.934 (1.53)	899	0.010						-2.649 (0.406)	149	<0.001
<i>Euphydryas maturna</i>											
<i>Favonius quercus</i>	-0.813 (0.616)	3910	0.187			1.548 (1.967)	376	0.432	3.272 (0.508)	152	<0.001
<i>Glaucopteryx alexis</i>									-0.485 (0.565)	139	0.392
<i>Glaucopteryx melanops</i>									-0.617 (0.61)	115	0.313
<i>Gonepteryx cleopatra</i>									0.669 (0.245)	174	0.007
<i>Gonepteryx rhamni</i>	-0.359 (0.176)	3386	0.041			0.688 (0.377)	313	0.069	1.673 (0.23)	152	<0.001
<i>Hamearis lucina</i>	-2.82 (1.595)	1811	0.077			1.048 (1.064)	170	0.326			
<i>Hesperia comma</i>	-0.232 (0.596)	2443	0.698			-1.644 (2.751)	389	0.551	0.169 (0.637)	126	0.791
<i>Heteropterus morpheus</i>						-8.665 (9.37)	117	0.357			
<i>Hipparchia fagi</i>											
<i>Hipparchia fidia</i>									-1.141 (0.41)	121	0.006
<i>Hipparchia hermione</i>											
<i>Hipparchia semele</i>	7.764 (0.489)	3052	<0.001						1.716 (0.596)	150	0.005
<i>Hipparchia statilinus</i>									0.546 (0.563)	129	0.334
<i>Hyponephele lycaon</i>											
<i>Iphiclides podalirius</i>									-0.229 (0.208)	151	0.273
<i>Issoria lathonia</i>	5.235 (0.414)	806	<0.001			-1 (0.776)	320	0.199	2.213 (0.301)	151	<0.001
<i>Laeosapis roboris</i>											
<i>Lampides boeticus</i>									0.595 (0.342)	160	0.084
<i>Lasiommata maera</i>				-0.018 (0.659)	123	0.978					
<i>Lasiommata megera</i>	0.292 (0.291)	3674	0.315			-2.034 (1.094)	334	0.064	-0.396 (0.193)	188	0.042
<i>Lasiommata petropolitana</i>											
<i>Leptotes pirithous</i>									0.427 (0.242)	155	0.080
<i>Libythea celtis</i>									1.04 (0.369)	137	0.006
<i>Limnitis camilla</i>	1.375 (0.505)	2810	0.006			4.201 (0.753)	462	<0.001	3.733 (0.698)	111	<0.001
<i>Limnitis populi</i>											
<i>Limnitis reducta</i>									0.456 (0.255)	138	0.076
<i>Lycaena alciphron</i>											
<i>Lycaena dispar</i>											
<i>Lycaena hippothoe</i>				2.389 (0.77)	121	0.002					
<i>Lycaena phlaeas</i>	0.776 (0.189)	3471	<0.001			0.018 (0.753)	298	0.981	1.015 (0.297)	173	<0.001
<i>Lycaena tityrus</i>	1.717 (0.617)	224	0.006			-1.58 (1.018)	370	0.122			
<i>Lycaena virgaureae</i>				-0.632 (1.022)	112	0.537			-16.504 (6.706)	331	0.014
<i>Maniola jurtina</i>	0.185 (0.121)	3839	0.128			0.513 (0.333)	444	0.124	1.014 (0.274)	199	<0.001
<i>Melanargia galathea</i>	-3.188 (0.415)	2635	<0.001			0.552 (0.408)	486	0.177			
<i>Melanargia lachesis</i>									0.698 (0.315)	160	0.028
<i>Melanargia occitanica</i>									-2.812 (0.745)	131	<0.001
<i>Melitaea cinxia</i>	2.117 (1.11)	252	0.057			3.351 (1.159)	325	0.004	0.74 (0.417)	146	0.078
<i>Melitaea deione</i>									1.519 (0.529)	127	0.005
<i>Melitaea diamina</i>											
<i>Melitaea didyma</i>									-0.04 (0.416)	143	0.924
<i>Melitaea parthenoides</i>											
<i>Melitaea phoebe</i>									0.257 (0.364)	154	0.482
<i>Melitaea trivia</i>											
<i>Minois dryas</i>											
<i>Nymphalis antiopa</i>						-1.838 (1.995)	287	0.358	2.084 (0.512)	142	<0.001

<i>Nymphalis polychloros</i>							0.466 (1.182)	359	0.694	0.427 (0.479)	123	0.375
<i>Ochlodes sylvanus</i>	0.556 (0.166)	3929	<0.001	-0.181 (0.581)	117	0.756	0.339 (0.44)	488	0.441	1.423 (0.404)	174	<0.001
<i>Papilio machaon</i>	-5.812 (3.413)	937	0.089				-1.229 (1.038)	387	0.237	0.691 (0.29)	189	0.018
<i>Pararge aegeria</i>	-0.254 (0.12)	3445	0.034				-0.63 (0.58)	326	0.278	0.677 (0.149)	194	<0.001
<i>Phengaris alcon</i>												
<i>Phengaris arion</i>												
<i>Phengaris nausithous</i>							0.957 (0.985)	250	0.332			
<i>Pieris brassicae</i>	-2.61 (0.211)	3728	<0.001				-1.165 (0.496)	357	0.019	0.503 (0.214)	177	0.020
<i>Pieris manni</i>												
<i>Pieris napi</i>	-1.156 (0.152)	3625	<0.001				0.02 (0.386)	331	0.960	1.625 (0.362)	188	<0.001
<i>Pieris rapae</i>	-1.971 (0.205)	3552	<0.001				-1.136 (0.384)	322	0.003	0.369 (0.203)	196	0.070
<i>Plebejus argus</i>	1.207 (1.001)	2612	0.228	1.561 (1.881)	121	0.408	-4.401 (3.919)	480	0.262	-1.818 (0.913)	155	0.048
<i>Plebejus argyrognomon</i>												
<i>Plebejus optilete</i>				-0.638 (0.983)	141	0.517						
<i>Polygona c.album</i>	-1.217 (0.252)	3164	<0.001				0.914 (0.674)	328	0.176	1.426 (0.311)	165	<0.001
<i>Polyommatus amandus</i>				1.023 (0.548)	123	0.064						
<i>Polyommatus bellargus</i>	-1.213 (1.236)	1491	0.327				-2.801 (1.375)	140	0.044	1.411 (0.417)	159	<0.001
<i>Polyommatus coridon</i>	-9.302 (1.269)	2126	<0.001				3.537 (1.337)	318	0.009			
<i>Polyommatus escheri</i>										-0.341 (0.686)	149	0.621
<i>Polyommatus hispanus</i>										-0.75 (0.559)	124	0.182
<i>Polyommatus icarus</i>	-0.062 (0.142)	3782	0.661				0.235 (0.436)	350	0.589	0.914 (0.197)	191	<0.001
<i>Polyommatus thersites</i>										-0.238 (0.818)	140	0.772
<i>Pseudophilotes panoptes</i>												
<i>Pyrgus armoricanus</i>												
<i>Pyronia bathseba</i>										-1.164 (0.412)	133	0.005
<i>Pyronia cecilia</i>										-0.395 (0.327)	164	0.229
<i>Pyronia tithonus</i>	-0.425 (0.166)	4005	0.011				3.259 (1.191)	180	0.007	1.722 (0.423)	158	<0.001
<i>Satyrrium acaciae</i>												
<i>Satyrrium esculi</i>										1.597 (0.315)	146	<0.001
<i>Satyrrium ilicis</i>	2.416 (0.646)	1090	<0.001									
<i>Satyrrium pruni</i>							-2.628 (2.229)	201	0.240			
<i>Satyrrium spini</i>												
<i>Satyrrium w.album</i>	-11.079 (8.348)	2871	0.185				-1.149 (2.776)	233	0.679			
<i>Satyrus actaea</i>												
<i>Spialia sertorius</i>										0.12 (0.548)	144	0.828
<i>Thecla betulae</i>							1.85 (1.023)	337	0.071			
<i>Thymelicus acteon</i>							2.24 (1.896)	313	0.238	0.087 (0.304)	202	0.775
<i>Thymelicus lineola</i>	-0.33 (0.558)	3651	0.555	0.156 (0.568)	125	0.783	-0.84 (0.54)	485	0.121			
<i>Thymelicus sylvestris</i>	-0.977 (0.304)	3957	0.001				0.432 (0.549)	510	0.431	4.314 (0.704)	161	<0.001
<i>Tomares ballus</i>												
<i>Vanessa atalanta</i>	-1.447 (0.334)	1030	<0.001							1.191 (0.193)	189	<0.001
<i>Vanessa cardui</i>	-1.825 (0.218)	3769	<0.001				-1.866 (0.61)	387	0.002	0.891 (0.196)	189	<0.001
<i>Zerynthia rumina</i>										0.567 (0.75)	116	0.451

Appendix 4 Results with various landscape description

In this appendix, we run the models presented in the main text of this report, using 500m and 2000m radius, instead of 1000m to measure the Natura 2000 coverage in the landscape. Only the global analyses are presented here.

Figure A4.1 Number of bird species with a higher (Pos.) or lower (Neg.) abundance with the increasing in Natura 2000 coverage in a 500m radius around the survey site

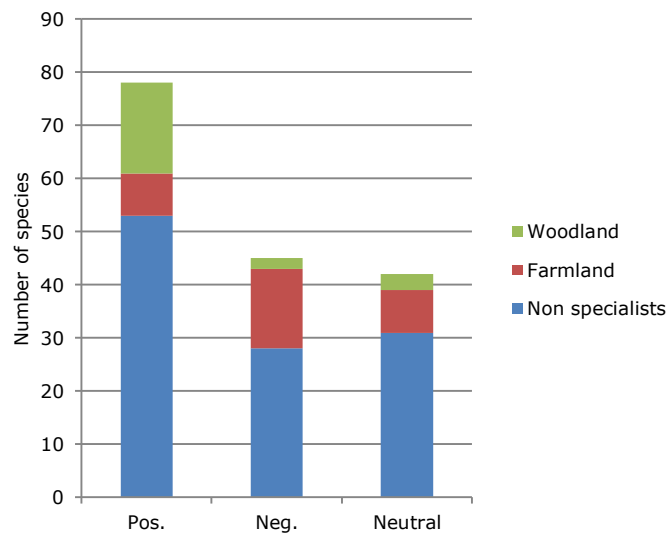


Figure A4.2 Variation of the responses of the bird species to the Natura 2000 coverage in a 500m radius with the habitat Species Specialization Index

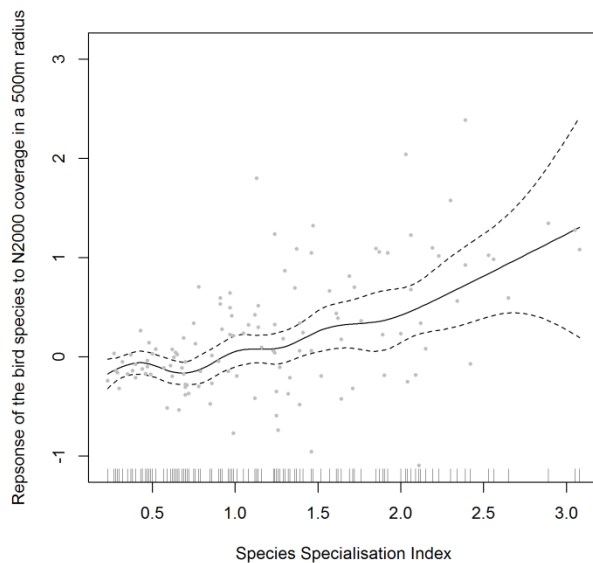


Figure A4.3 Response of (a) the Community Specialization Index (higher values indicate a higher proportion of habitat specialists in the community) and (b) the Bird Trophic Index (higher values indicate more top-consumer birds in the community) to the proportion of Natura 2000 coverage in a 500m radius

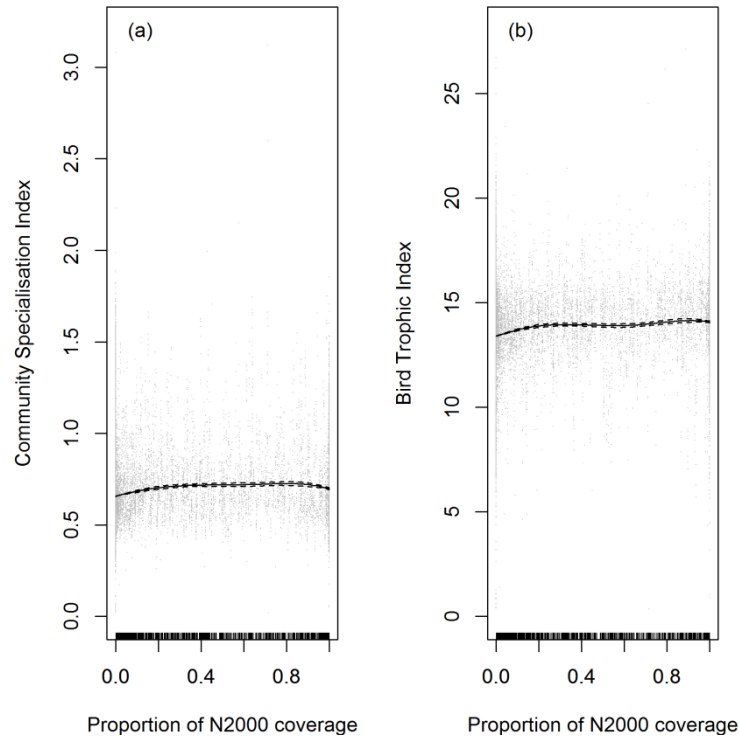


Figure A4.4 Number of bird species with a higher (Pos.) or lower (Neg.) abundance with the increasing in Natura 2000 coverage in a 2000m radius around the survey site

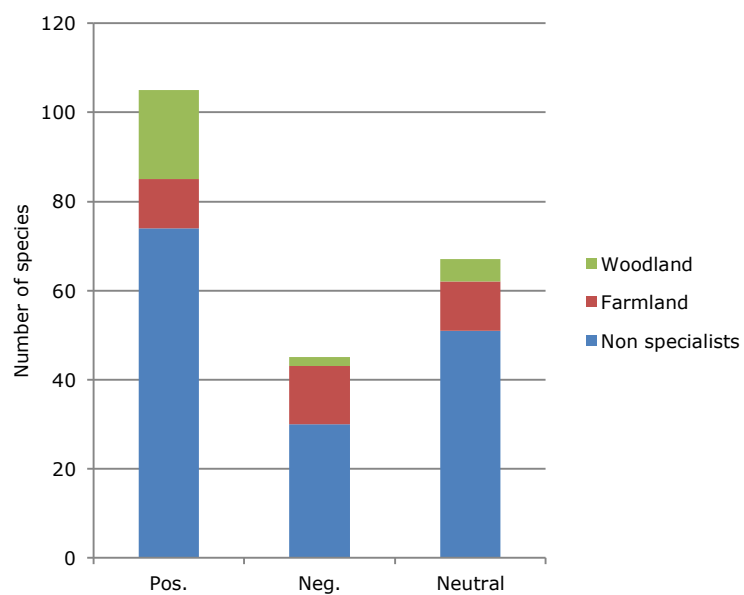


Figure A4.5 Variation of the responses of the bird species to the Natura 2000 coverage in a 2000m radius with the habitat Species Specialization Index

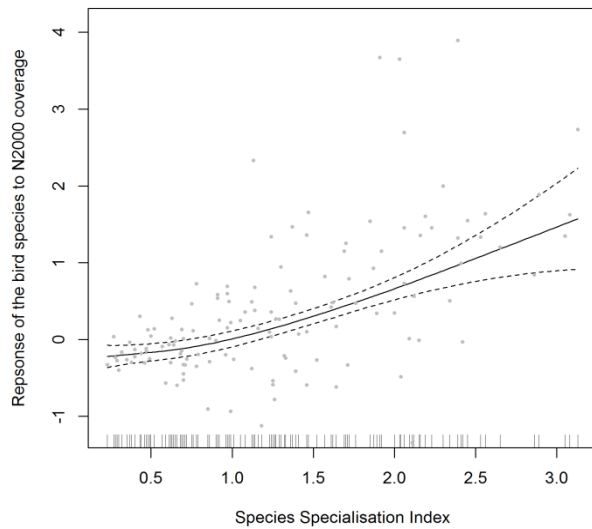


Figure A4.6 Response of (a) the Community Specialization Index (higher values indicate a higher proportion of habitat specialists in the community) and (b) the Bird Trophic Index (higher values indicate more top-consumer birds in the community) to the proportion of Natura 2000 coverage in a 2000m radius

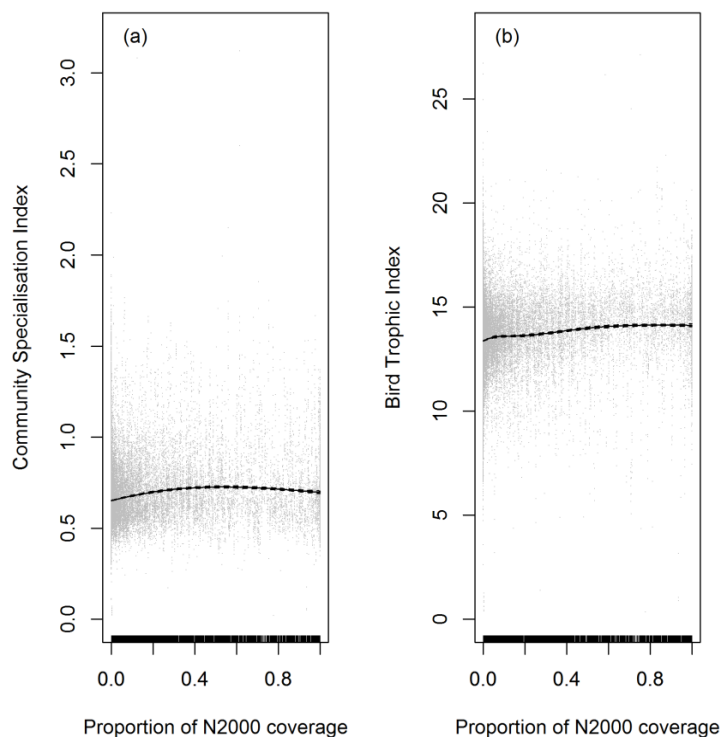


Figure A4.7 Number of butterfly species with a higher (Pos.) or lower (Neg.) abundance with the increasing in Natura 2000 coverage in a 500m radius around the survey site

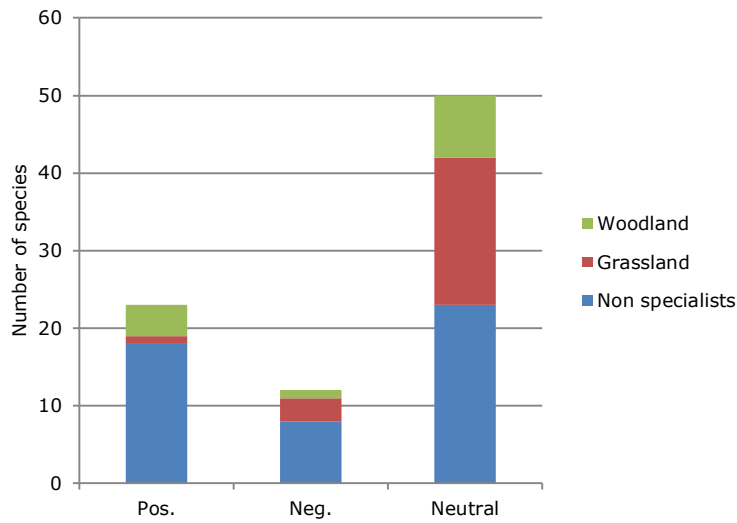


Figure A4.8 Number of butterfly species with a higher (Pos.) or lower (Neg.) abundance with the increasing in Natura 2000 coverage in a 2000m radius around the survey site

