**Demographic, ecological, and life-history traits associated with
bird population response to landscape fragmentation in Europe**

José Javier Cuervo¹ and Anders Pape Møller²

¹ Department of Evolutionary Ecology, Museo Nacional de Ciencias Naturales (MNCN-CSIC), Calle José Gutiérrez Abascal 2, E-28006 Madrid, Spain

² Ecologie Systématique Evolution, Université Paris-Sud, CNRS, AgroParisTech, Université Paris-Saclay, F-91405 Orsay Cedex, France

Corresponding author: José Javier Cuervo

Email: jjcuervo@mncn.csic.es

Tel.: +34 914111328

ORCID ID José Javier Cuervo: 0000-0001-7943-7835

ORCID ID Anders Pape Møller: 0000-0003-3739-4675

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Abstract

Context: Human land-use transformation has fragmented natural landscapes around the world, with fragmentation currently being considered a global threat to biodiversity conservation.

Landscape fragmentation, however, does not affect all species similarly, suggesting that some species characteristics may render species more sensitive to fragmentation than others.

Objectives: The aim of this study was to test whether demographic, ecological, and life-history traits are associated with vulnerability to landscape fragmentation in European breeding bird species.

Methods: Effective mesh size per area unit was used as an index of landscape fragmentation. Vulnerability to fragmentation for every bird species was estimated as population response to fragmentation per se (controlling for habitat loss due to fragmenting elements), with more vulnerable species showing a negative relationship between population density and fragmentation among countries, and less vulnerable species showing no (or even a positive) relationship. Comparative analyses controlled for similarity among species due to common phylogenetic descent.

Results: Response to fragmentation was more often positive than negative, and it was positively related to population size, migration distance, and body mass, and negatively related to age at first reproduction. The relationship between response to fragmentation and population size did not allow us to assess whether being less abundant was the cause or the consequence of being vulnerable to fragmentation. Response to fragmentation was not significantly related to other demographic, ecological, and life-history characteristics.

Conclusions: These results suggest that small-sized resident bird species with delayed maturity are particularly vulnerable to landscape fragmentation. Future conservation efforts should target these species.

48 **Keywords:** body size, European breeding birds, fragmentation vulnerability, generation time,
49 landscape fragmentation, migration
50

Introduction

Landscape fragmentation is the process by which habitat loss at the landscape scale results in the division of large, continuous tracts of natural habitat into smaller, spatially distinct fragments immersed within a dissimilar matrix (Collinge 2009; Didham 2010; Jaeger et al. 2011). This process implies a loss of original habitat, an increase in the number of habitat patches, a reduction in mean patch size, and an increase in patch isolation (Tscharntke et al. 2002; Fahrig 2003; Ewers and Didham 2006; Didham et al. 2012). Landscapes have been profoundly fragmented across the world owing to the expansion and intensification of human land use (Wade et al. 2003; Haddad et al. 2015; Wilson et al. 2016). While there is consensus on the large negative effects of habitat loss on biodiversity, there is currently no agreement on the effects of fragmentation per se. Some reviews suggest that fragmentation per se has weak effects on biodiversity (Fahrig 2003), and these effects, when present, are more likely to be positive than negative (Fahrig 2017). In contrast, other studies show evidence for large negative effects arising from a reduction in the size of habitat patches and from an increase in both patch isolation and the amount of habitat edge (Didham 2010; Haddad et al. 2015). These discrepancies possibly stem from multiple and complex effects of fragmentation on ecosystems, with indirect and interaction effects being major drivers of ecological change, sometimes operating across long periods of time (Didham et al. 2012; Ibáñez et al. 2014).

Landscape fragmentation and other human-induced environmental changes do not affect all species similarly. While many are negatively affected (losers), there is also a number of species that benefit from these changes (winners) (McKinney and Lockwood 1999). Interestingly, losers and winners are not randomly distributed among taxa or among functional ecological groups, which suggests that there are traits which render some species particularly sensitive to fragmentation and thus more prone to extinction. Identifying these

traits and understanding the differential vulnerability to fragmentation among species may have implications for ecological and evolutionary theory, and also for development of effective conservation (Laurance 1991; Kotiaho et al. 2005). A large number of species traits have been proposed to be associated with sensitivity to habitat fragmentation (reviews in Tschardt et al. 2002; Henle et al. 2004; Ewers and Didham 2006). In general, they are the same traits that have been postulated to predispose species to population decline and extinction (reviews in McKinney 1997; Purvis et al. 2000; Fisher and Owens 2004; O'Grady et al. 2004; Zavaleta et al. 2009), but there are exceptions depending on the type of extrinsic threat that is causing population decline of a species (Owens and Bennett 2000). It should also be considered that the relationship between particular species traits and the response to fragmentation can be complex, because different traits may interact and reinforce each other (Davies et al. 2004; Wang et al. 2015).

The species characteristics that have been suggested to be associated with vulnerability to habitat fragmentation constitute three categories: demographic, ecological, and life-history traits. Among demographic traits we focus on population size (abundance), population trend, and heterogeneity of distribution. Population size (or population density) is one of the best predictors of sensitivity to fragmentation (e.g., Bolger et al. 1991; Foufopoulos and Ives 1999; Davies et al. 2000; Gonzalez and Chaneton 2002; Feeley et al. 2007; Wang et al. 2009), with less abundant species more likely declining in numbers and going extinct as a consequence of habitat fragmentation. On the other hand, species with more heterogeneous spatial distributions are predicted to be more susceptible to habitat fragmentation, because these species share characteristics generally associated with inability to cope with environmental change (Møller et al. 2010).

In relation to ecological traits, the main predictors of fragmentation sensitivity seem to be dispersal capacity and ecological plasticity, although migration may also play a role.

Theoretical models predict that species characterized by poor dispersal capacity will be more negatively affected by habitat fragmentation (Liao et al. 2013), a prediction confirmed by empirical studies (Ekroos et al. 2010; Öckinger et al. 2010; Bensch et al. 2013; Ben-Chimol and Peres 2015). However, different patterns have also been observed in some cases, possibly because of interactions with other traits such as home range, sociality, or population density (Thomas 2000; Van Houtan et al. 2007). More consistent results have been found on ecological plasticity, with specialist species showing higher vulnerability to fragmentation than generalist ones (e.g., Davies et al. 2004; Feeley et al. 2007; Devictor et al. 2008; Wang et al. 2015; Khimoun et al. 2016; Keinath et al. 2017). Regarding migration, sedentary species have been found to be more vulnerable to landscape changes than dispersive or migratory ones (Newbold et al. 2013; Pavlacky et al. 2015). However, migration behaviour can be both beneficial (e.g., avoiding harsh winter conditions) and detrimental (e.g., migration itself can be risky), and can interact with other species traits or with characteristics of the environment.

Life-history traits associated with low reproductive potential (low fecundity, long generation time) generally render species more vulnerable to habitat loss and fragmentation (Vance et al. 2003; Öckinger et al. 2010; Newbold et al. 2013; Pavlacky et al. 2015).

Longevity, in contrast, has been suggested to decrease vulnerability to habitat fragmentation (Karr 1990) and other environmental changes (Morris et al. 2008). However, the role of longevity in fragmentation sensitivity is unclear (e.g., Henle et al. 2004), possibly because high longevity is also associated with low reproductive potential (Roff 1992), which, in turn, makes species more vulnerable to fragmentation. Large body size is simultaneously associated with traits making species more (e.g., low abundance and low reproductive potential) and less (e.g., high dispersal capacity) susceptible to habitat fragmentation, so the net effect is probably context dependent and difficult to predict. Although most empirical studies have found that larger species are more vulnerable to fragmentation (e.g., Feeley et al.

2007; Urquiza-Haas et al. 2009; Kormann et al. 2015; Pavlacky et al. 2015), in some cases smaller species were more vulnerable (Cosson et al. 1999; Boyle and Sigel 2015).

The aim of this study was to test the hypothesis that demographic, ecological, and life-history traits are associated with vulnerability to landscape fragmentation. Specifically, we predicted that vulnerable species would be characterized by small population size, negative population trend, high heterogeneity of spatial distribution, poor dispersal capacity, low ecological plasticity, non-migratory habits, low fecundity, long generation time, short longevity, and large body size. While some predictions seem to be robust according to the literature (e.g., regarding ecological plasticity), others are less clear because different studies have found contrasting results (e.g., regarding body size; see references above). Vulnerability to landscape fragmentation was estimated in terms of population response to fragmentation, with more vulnerable species having high and low population density in little and heavily fragmented areas, respectively, while less vulnerable species show no or even a positive relationship between population density and fragmentation. The hypothesis was tested in European breeding bird species because birds are one of the best studied classes of animals, particularly in Europe (so a large amount of information is available), and because Europe is the continent most affected by human-caused fragmentation (Wade et al. 2003). In addition, continent-wide programmes, such as the Pan-European Common Bird Monitoring Scheme, and international collaboration (e.g., Jaeger et al. 2011) provide the opportunity to estimate both bird population sizes and landscape fragmentation with standardized methodologies, thus making information from different European countries comparable.

Materials and methods

Landscape fragmentation index and response to fragmentation

An estimate of effective mesh density (i.e., the effective number of landscape patches per area unit) for each country was used as our index of landscape fragmentation. This estimate, obtained from Annex 1 in Jaeger et al. (2011), represented the number of times that the effective mesh size (calculated for the year 2009) fitted into an area of 1000 km². Effective mesh size is based on the probability that two points chosen randomly in a region are not separated by any barriers, and it is calculated by multiplying this probability by the area of the region (Jaeger 2000; Jaeger et al. 2008). Both effective mesh size and density depend on which kind of landscape elements are considered to be barriers. Jaeger et al. (2011) defined a set of fragmenting elements, called fragmentation geometry, that included anthropogenic barriers (motorways and major roads, connecting roads, railway lines, and built-up areas) and natural barriers (lakes and major rivers) of non-mountainous land areas. This fragmentation geometry gave rise to an estimate of effective mesh density, i.e., a fragmentation index, representing anthropogenic and natural fragmentation of non-mountainous land areas.

We estimated response to fragmentation for each bird species as the partial correlation coefficient from a multiple regression across countries, with population size as the response variable, fragmentation index as the predictor, and country area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers as confounding variables. Inclusion of confounding variables in the regression analyses meant that estimates of response to fragmentation were controlled for these variables. Large positive values imply a strong and positive response to fragmentation: the more fragmented the landscape, the more abundant the species. In contrast, large negative values imply a strong and negative response to fragmentation: the more fragmented the landscape, the less abundant the species. Values around zero imply weak or no effect of landscape fragmentation on

abundance. Population sizes of bird species in European countries were obtained from BirdLife International (2004), and area of countries was the area for which bird population sizes had been estimated. Latitude and longitude for each country were estimated, respectively, as the latitude of the mid-point between the northernmost and the southernmost mainland points, and the longitude of the mid-point between the easternmost and the westernmost mainland points of every country. Percentage of agricultural land in each country was obtained from the Central Intelligence Agency (2016) World Factbook. Percentage of country area covered by barriers (i.e., by artificial areas and water bodies) was calculated from land cover information for the years 2006 and 2012 (the average of the two years) provided by the European Environment Agency (2017). Artificial areas included transport networks and infrastructures, urban fabric (housing, services, and recreation), industrial and commercial units, and mineral extraction sites. Water bodies included lakes, reservoirs, and water courses.

Controlling for the percentage of country area covered by barriers was important to control for habitat loss caused by the presence of barriers and to estimate response to fragmentation per se. Habitat loss is inherent to landscape fragmentation, because fragmentation is impossible without habitat loss (Didham et al. 2012), and this intrinsic dependence gives rise to a strong association between the two parameters (Fahrig 2003). As a result, if we studied vulnerability to landscape fragmentation without controlling for habitat loss due to fragmenting elements (barriers), it would be impossible to distinguish between the effect of fragmentation per se and the effect of habitat loss. As we were interested in the effect of fragmentation on biodiversity independent of amount of habitat, habitat loss due to fragmenting elements was controlled when estimating population response to fragmentation. Therefore, in the present study, we explicitly focused on the possible association between certain species-specific characteristics and vulnerability to landscape fragmentation per se.

It should be noted that habitat is, by definition, a species-specific concept, so habitat loss and fragmentation are also species-specific (Haila 2002). Ideally, fragmenting elements should have been defined for each species, because what represents a barrier for one species may not be a barrier for others. Similarly, population size of every species should have been estimated for each habitat type within each country, because some habitats are not suitable for some species. However, all this information is unavailable for most European bird species, so a species-centred approach (Betts et al. 2014) was not possible. We tried to compensate for the lack of species-specific detail by including in the study a large number of species and by covering a wide geographic area.

For further information on landscape fragmentation index and calculation of bird population response to landscape fragmentation, see Online Appendix S1. Fragmentation index, country area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers for each country are reported in Online Table S1. Population size for each bird species and country is reported in Online Table S2.

Demographic, ecological, and life-history characteristics of bird species

Population size (number of breeding pairs) of bird species in the Western Palearctic west of the Ural Mountains was obtained from Hagemeyer and Blair (1997). Population trend for every bird species in Europe during the period 1990-2000 was estimated using an assessment by BirdLife International (2004) on a seven-category scale: large increase (3), moderate increase (2), small increase (1), stable (0), small decline (-1), moderate decline (-2), and large decline (-3). Heterogeneity of distribution was estimated as the coefficient of variation in population density among European countries (for more details, see Møller et al. 2010).

Migration distance was estimated as breeding latitude minus wintering latitude, considering latitudes in the Southern Hemisphere as negative values. Breeding latitude was determined as the mean of the northernmost and southernmost latitudes of the breeding distribution to the nearest tenth of a degree. Similarly, wintering latitude was determined as the mean of the northernmost and southernmost latitudes of the wintering distribution. Breeding and wintering ranges were obtained from maps in Cramp and Perrins (1977-1994). Maximum dispersal distance was estimated as the minimum distance from the mainland to an island with a permanent breeding population, using information from distribution maps in Cramp and Perrins (1977-1994). This estimate of dispersal distance was preferred to others (e.g., natal dispersal; Paradis et al. 1998) because it was available for a much larger number of species. Ecological plasticity was estimated as the number of different habitats in which a species has been known to breed. Number of habitats was obtained from the habitat preferences listed by Cramp and Perrins (1977-1994) for each species, considering only habitats that appeared in their glossary (for more details, see Belliure et al. 2000; Møller and Garamszegi 2012). Body mass and life-history traits (fecundity, longevity, and generation time) for each bird species were obtained from Cramp and Perrins (1977-1994). Mean body mass was calculated as the mean of male and female body mass. Longevity was estimated as annual adult survival rate. Annual fecundity was calculated by multiplying clutch size (mean number of eggs) by maximum number of clutches per season. In the case of generation time, estimated as age at first reproduction, information was also obtained from Glutz von Blotzheim and Bauer (1985-1997). More information on bird species traits can be found in Online Appendix S1 and raw data are reported in Online Table S3.

Comparative methods

Possible relationships between population response to landscape fragmentation and species-specific parameters were tested with phylogenetic generalized least square regression models (Martins and Hansen 1997; Pagel 1997, 1999) implemented in the R statistical environment (R Core Team 2014). To account for phylogenetic relationships among species in our analyses, we downloaded 1000 phylogenetic trees from <http://birdtree.org/> (Jetz et al. 2012) using the option “Ericson All Species”. Then, a majority rules consensus tree (Online Appendix S2) was estimated in the Mesquite environment (Maddison and Maddison 2015) and included in the models as a design matrix. The optimum degree of phylogenetic dependence was identified for each model, and the corresponding lambda parameter (λ) included in subsequent analyses. We performed weighted analyses using the number of countries from which response to fragmentation had been estimated minus seven as a weight (weight range = 1-19). Specifically, a matrix of 1/weight was added as an error term, and this term was multiplied by different values until the value providing the highest maximum likelihood was found. This method has been used and described in detail in previous studies (e.g., Garamszegi and Møller 2007).

Number of species with information for each parameter ranged from 137 in the case of heterogeneity of distribution to 261 species in the case of population size (Online Table S4). However, number of species with information for all ten parameters was only 73. To avoid a drastic reduction in sample size (and thus statistical power), we decided not to include all factors simultaneously in the same model, but to perform a forward stepwise selection of variables (see Online Table S4 for details). The final model included parameters related to response to fragmentation with $P < 0.10$ because a threshold of 0.05 is considered too stringent and can fail to identify potentially important variables (Bendel and Afifi 1977). Although stepwise variable selection has been criticized on various grounds, e.g., because the

final model is sometimes not the best model (Whittingham et al. 2006), we assume this was not a problem in our case, since backward stepwise procedure selected exactly the same variables (Online Table S5). Akaike's (1974) information criterion was not used to select the best model because it implied a reduction in sample size to only 73 species. More information on statistical analysis can be found in Online Appendix S1.

Results

We expected most bird species to have a negative response to landscape fragmentation, but the response was significantly more often positive than negative (sign test; $z = 4.33$, $n = 261$, $P < 0.001$; Fig. 1). Most responses to fragmentation were close to zero or slightly positive, with relatively few species showing very large (either positive or negative) values (Fig. 1).

Demographic, ecological, and life-history characteristics that entered the final model were population size, migration distance, body mass, and age at first reproduction (Table 1 and Online Tables S4 and S5). All these parameters were significantly related to bird population response to landscape fragmentation, with a positive relationship for population size, migration distance, and body mass, and a negative relationship for age at first reproduction (Table 1, Fig. 2). The relationship between response to fragmentation and age at first reproduction was just marginally significant (Table 1). All other species-specific characteristics (population trend, heterogeneity of distribution, dispersal distance, number of habitats, annual fecundity, and adult survival) were not significantly related to our estimate of response to fragmentation, and, hence, they were not included in the final model (Online Tables S4 and S5).

Discussion

Contrary to the general belief that landscape fragmentation per se (independent of amount of habitat) has detrimental effects on biodiversity (e.g., Haila 2002), we found that population response to fragmentation in European bird species was more often positive than negative. This result agrees with previous studies suggesting that significant ecological responses to fragmentation are mostly positive (Fahrig 2017). Population response to fragmentation, however, varied greatly among species, and some (e.g., *Prunella collaris*, *Tetrao urogallus*, *Tichodroma muraria* or *Oenanthe oenanthe*, just to cite a few) responded strongly and negatively to fragmentation, i.e., they were particularly vulnerable to the breaking apart of habitat. At least for these species, fragmentation might be an important issue to take into account should conservation measures be needed.

The relationships between population response to landscape fragmentation and the species parameters studied here suggest that European birds responded more negatively to fragmentation (i.e., showed lower population densities in more fragmented countries) in scarce, small, resident species with delayed maturation (Table 1). In the case of population size, the positive relationship might imply higher vulnerability to fragmentation in less abundant species, a conclusion reached in numerous studies (see Introduction). Another possible, non-mutually exclusive interpretation of the result is that species particularly vulnerable to fragmentation for reasons other than small population size experienced more pronounced decreases in abundance in highly fragmented countries. In that case, small population size would be a consequence and not the cause of vulnerability to fragmentation. In this study, population sizes of bird species in Europe were estimated in the 1990s (Hagemeijer and Blair 1997), while population sizes for every European country, the base for

calculating response to fragmentation, were estimated between 1990 and 2002 (BirdLife International 2004), that is, simultaneously or slightly later. Consequently, there was little time for new fragmentation between the two sets of avian censuses, and limited opportunities for population size causing different population trends depending on the level of landscape fragmentation in every country. Although some effects of population size on the response to fragmentation cannot be ruled out, the small population size in some bird species in the 1990s was probably the consequence of humans transforming, and thus fragmenting, the European landscape intensively for many decades (or even centuries) before the data were collected. The timing of bird censuses in this study was not appropriate for testing the possible effect of population size on vulnerability to landscape fragmentation.

Regarding migratory habits, our study suggests that sedentary bird species are more vulnerable to landscape fragmentation than migratory ones, as in tropical forest birds (Newbold et al. 2013; Pavlacky et al. 2015). It should be noted that resident bird species stay all year round in Europe, so they are affected by habitat fragmentation in Europe both during breeding and non-breeding, while migratory species are affected by fragmentation in Europe only during reproduction. During the last third of the 20th century, long-distance migrants declined in Europe to a larger extent than short-distance migrants or residents, and different processes have been suggested to drive this differential decline (Sanderson et al. 2006). Our results clearly suggest that landscape fragmentation in Europe is not responsible for the more negative trends of long-distance migrants, so other explanations should be invoked. When all existing birds are considered, migratory species are overall less likely to be threatened with extinction than sedentary species (Şekercioğlu 2007). The higher vulnerability to habitat fragmentation shown by sedentary species in this study might help explain this pattern.

The mechanism behind the higher vulnerability of sedentary species to fragmentation is unknown, but we can speculate that roads (or any parameter associated with road density)

had a more negative effect for sedentary than migratory bird species. Roads and traffic generally have a negative effect on animal abundance (review in Fahrig and Rytwinski 2009), mainly because they reduce the amount of habitat, increase mortality due to collision with vehicles, limit access to resources, and subdivide populations into smaller units (Jaeger et al. 2005). In general, all these effects might be more detrimental for sedentary species because they spend all year in Europe. However, it is also possible that detrimental effects of roads are more intense in winter, when resources (e.g., food) are scarce and reduce body condition, survival, and abundance of birds, at least at middle and high latitudes (Doherty and Grubb 2002; Carrascal et al. 2012; Morosinotto et al. 2017). For example, birds might need a larger home range during winter (e.g., Morganti et al. 2017), but less suitable habitat would be available in high road-density areas. Similarly, certain areas of high-quality habitat might be crucial for winter survival, thus attracting birds during this time of the year (e.g., Smith et al. 2014), but they might also be areas with high road density, with the consequent increase in traffic-related mortality. This could happen for example if valley bottoms concentrate most roads, but also a high proportion of birds in winter.

Our study suggests that small bird species are more vulnerable to landscape fragmentation than large ones, a result consistent with previous research on vertebrates in tropical forests (Cosson et al. 1999; Boyle and Sigel 2015). As explained in the Introduction, the relationship between body size and response to fragmentation was difficult to predict, because body size is simultaneously associated with traits making species more or less susceptible to fragmentation, so the net effect is probably context dependent. The simplest explanation for our result would be that body size is generally positively associated with dispersal distance (Jenkins et al. 2007) and survival (McCarthy et al. 2008; Collingham et al. 2014), two traits that presumably make species less vulnerable to fragmentation (see Introduction). However, dispersal distance and adult survival were not significantly related to

response to fragmentation in this study, thus suggesting that the relationship between body size and response to fragmentation was not mediated by these traits. In addition, large bird species are less sensitive to low winter temperatures or temporal food scarcity (Peters 1983), environmental conditions that might be associated with habitat fragmentation (e.g., fragmented habitats might have less refuge or food). Body size is related to almost every demographic, ecological, physiological or life-history trait of a species (Peters 1983), so it is difficult to disentangle the precise mechanisms behind the relationship between body size and response to fragmentation. Finally, bird abundance decreased dramatically in Europe during the last decades of the 20th century, but this reduction in abundance mostly affected small species, while large ones remained relatively stable or even increased in population size (Inger et al. 2015). According to our results, landscape fragmentation in Europe during the late 20th century (or any process associated with fragmentation) might be one of the factors responsible for the more negative population trends of small bird species.

Among life-history traits, only age at first reproduction (a proxy for generation time) was significantly related to response to fragmentation, with a more negative response in delayed breeders, as expected. Although the relationship was marginally significant, and thus should be interpreted with caution, this result is consistent with a previous study showing that tropical forest bird species with longer generation time are more negatively affected by human land use (Newbold et al. 2013). The most straightforward explanation for our result would be that long generation time implies low reproductive potential and probably less capacity to recover from perturbations and population crashes. However, other life-history traits generally considered prime indicators of reproductive potential (e.g., annual fecundity) were not significantly related to response to fragmentation, and thus other mechanisms have to be invoked. The relationship between response to fragmentation and generation time was not mediated by body size (larger bird species generally show longer generation time; Sæther

1987), because body mass was controlled in the analysis (Table 1). It has previously been shown that bird species with longer generation time suffer a higher extinction risk when the main source of extinction is human persecution or introduced predators (Owens and Bennett 2000). In our case, landscape fragmentation might entail an increase in predation-related mortality, thus having a more negative effect in species with longer generation time. For example, roads might enhance access of pets (cats, dogs) or hunters to natural habitats, and traffic itself can cause mortality due to collisions with vehicles (Fahrig and Rytwinski 2009). In addition, more fragmented landscapes usually contain more edge for a given amount of habitat, often resulting in increased predation by natural predators (Chalfoun et al. 2002).

According to theoretical models (e.g., Fahrig 1998; With and King 1999), populations under certain conditions are expected to show thresholds in their response to landscape fragmentation. These thresholds might reflect a non-linear relationship between the degree of fragmentation and population size (e.g., an accelerated rate of population decline after a critical fragmentation level is passed) or could result from an increasing effect of fragmentation on population size below some level of habitat amount. However, empirical research on birds has found mixed support for the existence of landscape-scale thresholds, as some studies detected them (e.g., Betts et al. 2007), but others did not (e.g., Villard et al. 1999). If we assume that thresholds were relevant in our study, species showing high vulnerability to fragmentation might be species whose thresholds have been reached. Thus, as landscape fragmentation increases (or suitable habitat is lost) a disproportionately greater proportion of species would be considered vulnerable to fragmentation. For the many bird species in this study showing a positive response to fragmentation, a threshold could be the level of fragmentation above which (or the level of habitat amount below which) the response to fragmentation becomes negative.

Some species characteristics were predicted to be associated with vulnerability to habitat fragmentation, but this study does not support such associations. This happened for example for dispersal capacity or heterogeneity of spatial distribution, although probably the most striking case is ecological plasticity. Previous studies (many of them on birds) have consistently found higher sensitivity to habitat fragmentation in specialist than in generalist species (see Introduction). However, most of these studies, particularly those on birds (e.g., Feeley et al. 2007; Devictor et al. 2008; Wang et al. 2015), did not investigate the effects of fragmentation per se, but the effects of habitat patch size or isolation, which are inherently confounded with effects of amount of habitat (Fahrig 2003, 2017). Moreover, both ecological plasticity and vulnerability to fragmentation have been estimated in different ways in this and previous studies, which might affect the results. Finally, the temporal framework of this study might also have played a role, because it is known that time lag is very important for understanding the impact of fragmentation on animal populations (Bennett and Saunders 2010). While some species characteristics might only be related to vulnerability to fragmentation when long-term effects are studied, it is possible that other characteristics appear to be related in the short term.

To summarize, this study suggests that small-sized resident bird species with delayed maturation are particularly vulnerable to landscape fragmentation in Europe, considering fragmentation as the breaking apart of habitat independent of amount of habitat. Vulnerability to fragmentation was also related to small population size, but it is unclear if being less abundant is the cause or the consequence of vulnerability to fragmentation. Other species characteristics such as dispersal distance, habitat specialization, annual fecundity or adult survival were not significantly related to susceptibility to fragmentation. These results could be useful for understanding and predicting, and maybe also mitigating, the effects of landscape fragmentation on biodiversity.

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Electronic Supplementary Material

Appendix S1 Additional information on Materials and methods

Appendix S2 Consensus phylogenetic tree in Phylip format used to test for relationships between bird population response to landscape fragmentation and a number of demographic, ecological, and life-history characteristics of bird species

Table S1 Fragmentation index, area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers for the countries included in the study

Table S2 Population size for each bird species within each country

Table S3 Demographic, ecological, and life-history characteristics of the bird species included in the study

Table S4 Forward stepwise procedure used to determine the final model (set of species-specific characteristics) that best predicted the estimates of bird population response to landscape fragmentation

Table S5 Backward stepwise procedure used to determine the final model (set of species-specific characteristics) that best predicted the estimates of bird population response to landscape fragmentation

Table 1 Phylogenetic generalized least square regression model on factors related to bird population response to anthropogenic and natural fragmentation of non-mountainous land areas. The final model only included parameters related to response to fragmentation with $P < 0.10$ after a forward stepwise procedure. A backward stepwise procedure provided the same final model. Phylogenetic relations among species and number of countries used to estimate response to fragmentation in each species were controlled in the analyses (see Comparative methods for details). Both the dependent variable and its residuals were approximately normally distributed (Kolmogorov-Smirnov test for normality; $P > 0.05$ in the two tests), thus justifying the use of a linear model approach. The model had the statistics: $F = 6.35$, $\text{adj-}r^2 = 0.088$, $n = 224$, $P < 0.001$, $\lambda = 0.000$

Factors	Estimate (SE)	t	P
Population size	0.079 (0.029)	2.75	0.0065
Migration distance	0.032 (0.008)	4.14	< 0.001
Body mass	0.095 (0.041)	2.31	0.022
Age at first reproduction	-0.064 (0.032)	-1.99	0.047

Figure legends

Figure 1 Frequency distribution of response to landscape fragmentation (anthropogenic and natural fragmentation of non-mountainous land areas) in 261 European bird species. Mean (SD) = 0.094 (0.396), median = 0.177, skewness = -0.444

Figure 2 Relationships between relative estimates of bird population response to anthropogenic and natural fragmentation of non-mountainous land areas and (a) relative population size, (b) relative migration distance, (c) relative body mass, and (d) relative age at first reproduction in European bird species. Relative estimates of response to fragmentation were estimated as the residuals from a model with response to fragmentation as the response variable and (a) migration distance, body mass, and age at first reproduction, (b) population size, body mass, and age at first reproduction, (c) population size, migration distance, and age at first reproduction, and (d) population size, migration distance, and body mass as predictors. Relative population size was estimated as the residuals from a model with population size as the response variable and migration distance, body mass, and age at first reproduction as predictors. Relative migration distance was estimated as the residuals from a model with migration distance as the response variable and population size, body mass, and age at first reproduction as predictors. Relative body mass was estimated as the residuals from a model with body mass as the response variable and population size, migration distance, and age at first reproduction as predictors. Relative age at first reproduction was estimated as the residuals from a model with age at first reproduction as the response variable and population size, migration distance, and body mass as predictors. All variables except age at first reproduction and response to fragmentation were transformed before the analyses (Appendix S1). Lines are best-fit regressions (a: $y = -0.018 + 0.073 x$; b: $y = -0.002 + 0.032 x$; c: $y =$

746 $0.022 + 0.078 x$; d: $y = 0.017 - 0.051 x$). All models and regressions took into account the
747 number of countries used to estimate response to fragmentation (bubble size indicates this
748 number; range = 8-26) and similarities among species due to common phylogenetic descent
749 (see Comparative methods for details)

Figure 1

Figure 2

(a)

(b)

(c)

(d)

Electronic Supplementary Material

Demographic, ecological, and life-history traits associated with bird population response to landscape fragmentation in Europe

José Javier Cuervo and Anders Pape Møller

Corresponding author: José Javier Cuervo, Department of Evolutionary Ecology, Museo
Nacional de Ciencias Naturales (MNCN-CSIC), Calle José Gutiérrez Abascal 2, E-28006
Madrid, Spain. Email: jjcuervo@mncn.csic.es

Appendix S1 Additional information on Materials and methods

Landscape fragmentation index and response to fragmentation

Although effective mesh density was available for 29 European countries (Jaeger et al. 2011), Liechtenstein and Malta were excluded because of their small area (160 and 316 km², respectively). We proceeded in a different way with Luxembourg, also a relatively small country (2586 km²), which was combined with Belgium. Fragmentation index for the virtual country “Belgium and Luxembourg” was the average of the two countries weighted by country area. Exclusion of two countries and combination of two others implied a reduction in the number of countries to 26 for subsequent analyses. Fragmentation index had to be log₁₀(x)-transformed before further analysis to approach a normal distribution (Kolmogorov-Smirnov test for normality; $P > 0.20$).

Multiple regressions to estimate response to fragmentation only included countries in which the species breeds, i.e., when a species was not present in a country, we did not consider population size to be zero, but we simply excluded that country. Response to fragmentation could only be estimated for species that bred in at least eight countries according to our approach. Multiple regressions could not be performed with smaller sample size because there were six independent variables in the models (the fragmentation index and the five confounding variables: country area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers (artificial areas and water bodies)).

Population size of bird species in the 26 European countries was the number of breeding pairs in most cases, but number of breeding individuals for *Otis tarda* (a lek-breeding species). These estimates were derived in a consistent way from national bird census programmes in all countries, in different years depending on species and country, but always

between 1990 and 2002. The arithmetic mean of the maximum and minimum estimates for each country was used. For the country “Belgium and Luxemburg”, population sizes were calculated by adding the estimates from both countries. A total of 412 bird species breed in at least one of the 26 countries, but response to fragmentation was estimated for 261 species only, because this is the number of species that breed in at least eight countries. Response to fragmentation was not calculated for *Phasianus colchicus* because this species is introduced to Europe (Cramp and Perrins 1977-1994). However, it was calculated for alpine species (e.g., *Prunella collaris*, *Pyrrhocorax graculus*, or *Tichodroma muraria*), despite the landscape fragmentation index being estimated only for non-mountainous areas (Jaeger et al. 2011). It should be noted that in central and southern Europe, mostly areas above 2500 m were considered as mountainous and excluded from fragmentation index calculation (Jaeger et al. 2011). Although some alpine species can indeed breed above that height, the bulk of their populations breed at lower altitudes (Cramp and Perrins 1977-1994), thus justifying the inclusion of these species in the study. Some closely related taxa have been considered as different species in recent years, but we have combined them as a single species for the calculation of population size in each country. Specifically, we considered *Anthus petrosus* as being part of *Anthus spinoletta*, *Larus cachinnans* as part of *Larus argentatus*, and *Phylloscopus ibericus* as part of *Phylloscopus collybita* (Cramp and Perrins 1977-1994). Population size estimates were always $\log_{10}(x)$ -transformed before analyses to approach a normal distribution.

Country area was the area for the entire country, including water bodies, but excluding some islands (Jan Mayen and Svalbard (Norway), Faroe Islands (Denmark), Isle of Man, Jersey, and Guernsey (United Kingdom), Madeira and Azores (Portugal), and Canary Islands (Spain)) and all non-European regions (e.g., Caribbean Netherlands or French overseas regions). When estimating latitude and longitude for each country, most islands were not

considered because they generally add a lot of distance in terms of latitudinal degrees, but very small area in relation to the entire country. The exceptions were Italy (the southernmost point was located at Sicily), Estonia (the westernmost point was located at Saaremaa), and Denmark (the southernmost point was located at Falster, the northernmost point at the North Jutlandic Island, and the westernmost point at Zealand). For the country “Belgium and Luxemburg”, total country area and country area covered by barriers were calculated by adding the estimates from both countries, the northernmost latitude and westernmost longitude were those of Belgium, the southernmost latitude and easternmost longitude were those of Luxemburg, and percentage of agricultural land was the average of the two countries weighted by country area. Country area and percentage of country area covered by barriers had to be $\log_{10}(x)$ -transformed before multiple regressions to approach a normal distribution, but latitude, longitude, and percentage of agricultural land followed an approximately normal distribution without transformation (Kolmogorov-Smirnov test for normality; $P > 0.20$ in the five tests).

A possible problem with our estimates of response to fragmentation was the temporal mismatch between the data sources for different parameters. Specifically, the mismatch between the two key variables used to calculate response to fragmentation was particularly noteworthy: while the landscape fragmentation index referred to 2009 (Jaeger et al. 2011), population size for each bird species in each country referred to 1990-2002 (BirdLife International 2004). Unfortunately, a smaller temporal mismatch was not possible because data sources closer in time were unavailable. In any case, our results would not be affected by this mismatch if landscape fragmentation in 2009 and in previous decades were strongly positively correlated across countries. This assumption seems to be plausible according to information from two European countries (Switzerland and Germany) in which the ranking of

different regions based on the degree of landscape fragmentation remained practically constant during the last decades (Jaeger et al. 2007a, b).

In an attempt to elucidate whether the response to landscape fragmentation was similar in all bird species, we performed a General Linear Model with population size as the response variable, fragmentation index as the predictor, and bird species as a factor, while also including in the model the five confounding variables (country area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers) and the interaction species x fragmentation. Only species that breed in at least eight countries were included in this analysis. The interaction species x fragmentation was highly significant ($F = 2.79$, d.f. = 260,4645, $P < 0.001$), thus implying that populations of different bird species indeed responded differently to landscape fragmentation. If response to fragmentation differs markedly among species, we can speculate that certain demographic, ecological, or life-history characteristics of the species will be related to their response to fragmentation.

Demographic, ecological, and life-history characteristics of bird species

The demographic parameters presumably related to population response to landscape fragmentation were population size, population trend, and heterogeneity of distribution. Population size was derived in a consistent way from national bird census programmes in all countries (Hagemeijer and Blair 1997). The arithmetic mean of the maximum and minimum estimates was used. The qualitative estimates of population trend used in this study have already been used in previous studies (e.g., Møller et al. 2008). Population density for each country (necessary to estimate heterogeneity of distribution) was estimated as the geometric mean from minimum and maximum population size estimates divided by area of countries in square kilometres. The geometric population size mean was calculated with the equation

$\exp((\log_{10}[\text{minimum value} + 1] + \log_{10}[\text{maximum value} + 1])/2 - 1)$ because of the exponential nature of the data. Maximum and minimum estimates of population size (number of breeding pairs) for each country were obtained from Tucker and Heath (1994). Information for countries not present in this source was obtained from Hagemeyer and Blair (1997), either directly or using values reported for the group “other countries” and assigning the breeding pairs proportionally to the different countries according to their area.

Regarding the ecological characteristics of bird species, the method used in this study to calculate migration distance has already been used previously (e.g., Møller et al. 2008). When estimating maximum dispersal distance, if another island was located between the mainland and the island with a permanent breeding population, inter-island distance or the minimum distance from the mainland to the intermediate island (the longest one) was considered (for more details, see Møller and Mousseau 2007). The estimate of maximum dispersal distance was a minimum estimate because birds travelling to islands may not have taken the shortest route. The number of different habitats in which a species is known to breed was obtained from Cramp and Perrins (1977-1994), the most comprehensive source of information on European bird habitats. Using the number of habitats to estimate ecological plasticity has some drawbacks, because it heavily depends on the filter used to distinguish between different habitat types: a fine filter will result in a larger number of habitats than a coarse filter. However, Cramp and Perrins (1977-1994) used a consistent and standardized method (i.e., a comparable filter) to define all habitat types, so we assume that at least the ranking of species based on number of habitats was robust to the number of habitat types considered. Interestingly, previous studies (e.g., García-Longoria et al. 2014) have shown that this estimate of ecological plasticity provides biologically meaningful information. We preferred not to use alternative estimates of ecological plasticity based on homogeneity in population density among habitats (e.g., Julliard et al. 2006) because they would partially

have overlapped with heterogeneity of distribution, which was estimated as the coefficient of variation in population density among countries (see above and main text). If multiple estimates of body mass or life-history traits were provided in Cramp and Perrins (1977-1994), information from the UK was used because those estimates were generally based on the largest sample sizes. However, in species where there was a range of values reported for age at first reproduction, we used the minimum value reported following Møller (2006).

Another species characteristic presumably related to population response to landscape fragmentation is genetic variability. Fragmented populations are expected to increase genetic drift and reduce gene flow, thus giving rise to inbreeding depression and fixation of deleterious mutations (Frankham et al. 2010). In turn, these genetic changes will cause a loss of adaptive potential, with the consequent implications for population persistence (Frankham et al. 2010). However, genetic variability has not been analysed because we only have information on estimates of genetic variability (e.g., band-sharing coefficient, number of alleles, proportion of polymorphic loci, or inbreeding coefficient) for a small number of European breeding bird species (Cuervo and Møller 2017). The possible association between genetic variability and vulnerability to landscape fragmentation is not the subject of the present study.

Population size in the Western Palearctic, heterogeneity of distribution, maximum dispersal distance, and mean body mass were $\log_{10}(x)$ -transformed, migration distance and annual adult survival rate were $\sqrt{x}$ -transformed, and annual fecundity was $(x)^{0.2}$ -transformed before further analysis to approach a normal distribution. In all cases, we chose the transformation that was more successful in approaching the frequency distribution of that variable to a normal distribution. Population trend, number of breeding habitats, and age at first reproduction were untransformed in subsequent analyses.

Comparative methods

Phylogenetic generalized least square regression models apply a maximum likelihood modelling approach to estimate the phylogenetically corrected partial correlation between the variables of interest (Freckleton et al. 2002). We used function `pglm3.3` developed by R. P. Freckleton (University of Sheffield, UK), and libraries “MASS”, “mvtnorm”, and “ape”. The phylogenetic tree included the 261 species of interest (see Appendix S2). Our estimates of response to fragmentation were derived from a different number of countries for each bird species (range = 8-26), and this implies that different species did not provide equally precise information on this parameter. Equal treatment of every species in the analyses would be inappropriate (Garamszegi and Møller 2010), so we performed weighted analyses.

Some of the ten demographic, ecological, and life-history traits included in this study were significantly related across bird species when controlling for phylogenetic relations, and, therefore, we checked whether collinearity might be an issue in our analyses. The strongest association between pairs of variables corresponded to body mass and age at first reproduction ($r^2 = 0.340$, $t = 11.03$, $n = 238$, $P < 0.001$), with all other relationships between pairs of variables showing smaller r^2 values. Although relationships among traits were not particularly strong, we calculated variance inflation factor (VIF) for each species-specific parameter as $VIF = 1 / (1 - r^2)$, where r^2 was the coefficient of determination from a model with the target parameter as the dependent variable and the other nine traits as predictors, while controlling for common descent. For these analyses, only 73 species were included, because that was the number of species with information for all ten parameters. VIF was 2.35 or less for the ten variables, so we assumed that collinearity was not a problem in our analyses (O'Brien 2007). VIF for predictors in the final model (population size, migration distance,

body mass, and age at first reproduction, $n = 224$ species; see Table 1 in the main document) was even smaller (1.69 or less).

Previous studies suggest that stepwise procedures for model selection lead to inflated type I error rates, because they constitute a form of multiple testing without error-level adjustment (Mundry and Nunn 2009). The reason to perform a stepwise model selection in this study was to increase sample size, because the number of species with available information differed greatly among traits. Thus, the number of species included in the analyses increased from 73 when all ten predictors were considered simultaneously to 224 in the final model with only four predictors (see main text and Table 1). Larger sample size implied an increase in statistical power and, consequently, a reduction in type II error rate. Regardless of the net effect of our model selection procedure on error rates (e.g., the reduction in type II error might be more pronounced than the increase in type I error), we could have decreased type I error by adjusting the significance level according to the number of variables tested in the study (e.g., Rice 1989). However, we decided not to perform this adjustment for a number of reasons. First, multiple testing correction leads to inflated type II error rates which are deemed overly conservative by some authors (Moran 2003, Nakagawa 2004). Second, low statistical power can increase type I error rates (Sprouse and Almeida 2017), so by increasing sample size we might have decreased not only type II error, but also type I error, so it is uncertain if model selection in our case actually increased type I error rates. Third, we chose $P < 0.10$ as the threshold for variable selection, but some studies suggest that $P < 0.15$ might be more appropriate (Bendel and Afifi 1977), so our approach might already be conservative. And fourth, and probably most important, the ten species-specific traits tested in this study were chosen based on extensive previous evidence of their association with vulnerability to landscape fragmentation in different taxa (see Introduction in main text), thus minimizing the probability of finding a statistically significant result by chance alone.

Statistical analyses controlling for phylogenetic relations among species were performed in R statistical environment as described above, but all other analyses were carried out with the Statistica programme (StatSoft 2007). All statistical tests were two-tailed and the significance level was set to 0.05.

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Appendix S2 Consensus phylogenetic tree in Phylip format used to test for relationships between bird population response to landscape fragmentation and a number of demographic, ecological, and life-history characteristics of bird species

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Table S1 Fragmentation index, area, latitude, longitude, percentage of agricultural land, and percentage of country area covered by barriers for the countries included in the study

Country	Fragmentation index	Country area (km ²)	Latitude	Longitude	% agricultural land	% country area covered by barriers
Austria	6.20	83871	47.69653	13.34583	38.4	6.4333
Belgium	105.11	30528	50.50115	4.47731	44.1	21.5633
Bulgaria	4.05	110879	42.72529	25.48356	46.9	5.7184
Czechia	22.64	78865	49.80361	15.47542	54.8	7.2200
Denmark	15.89	43094	56.15569	10.37875	63.4	9.8058
Estonia	9.23	45227	58.59223	25.01722	22.2	6.9004
Finland	0.69	338424	64.94944	26.06681	7.5	10.8220
France	29.55	551695	46.71111	1.71750	52.7	6.3159
Germany	42.63	357114	51.09083	10.45403	48.0	10.8569
Greece	3.24	131990	39.06712	23.32183	63.4	3.9822
Hungary	9.36	93028	47.16125	19.50569	58.9	8.0115
Ireland	5.87	70273	53.41533	-8.23875	66.1	4.5688
Italy	8.95	301336	41.86938	12.57381	47.1	6.3168
Latvia	8.86	64559	56.88005	24.60613	29.2	3.9924
Lithuania	13.22	65300	55.17348	23.89494	44.8	5.7966
Luxembourg	135.17	2586	49.81536	6.13339	50.7	9.6502
Netherlands	61.12	41528	52.10778	5.29292	55.1	21.7212
Norway	0.40	323802	64.55597	18.01458	2.7	5.1190
Poland	17.35	312679	51.91889	19.13444	48.2	7.3466
Portugal	9.21	89015	39.55711	-7.84538	39.7	5.3991
Romania	0.60	238391	45.94426	24.99106	60.7	7.0184
Slovakia	4.76	49037	48.67374	19.69625	40.1	6.5670
Slovenia	9.92	20273	46.14914	14.98608	22.8	3.3625
Spain	5.52	498466	39.89528	-2.98847	54.1	3.1769
Sweden	0.60	450295	62.19833	17.63181	7.5	9.8381
Switzerland	13.06	41284	46.81315	8.22412	38.7	10.1431
United Kingdom	3.77	242495	54.31540	-3.20728	71.0	9.6207

Table S2 Population size for each bird species within each country

Species	Austria	Belgium	Bulgaria	Czechia	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia
<i>Accipiter gentilis</i>	1800	648	1000	2150	600	850	5000	5600	13250	1100	2150	1	650	2500
<i>Accipiter nissus</i>	7000	3800	2000	4000	3500	2200	13500	34600	17700	2000	1500	6250	3000	2500
<i>Acrocephalus arundinaceus</i>	1750	3.5	30000	1800	9.5	6000	65	5500	5750	75000	90000	-	30000	15000
<i>Acrocephalus melanopogon</i>	12500	-	2.5	-	-	-	-	4000	-	125	800	-	800	-
<i>Acrocephalus palustris</i>	30000	14000	5000	120000	35000	75000	5000	50000	600000	1100	97500	-	20000	95000
<i>Acrocephalus schoenobaenus</i>	10000	2500	300	60000	3500	95000	300000	75000	9000	750	247500	60000	65	140000
<i>Acrocephalus scirpaceus</i>	30000	5250	1850	75000	55000	30000	25000	120000	185000	75000	117500	76	45000	30000
<i>Actitis hypoleucos</i>	250	7.5	175	300	0.5	7500	200000	900	295	75	165	1750	750	4250
<i>Aegithalos caudatus</i>	37500	26000	50000	75000	10000	10000	30000	1250000	240000	35000	142500	60000	300000	30000
<i>Aegolius funereus</i>	1650	75	750	1750	2	350	13500	3000	2250	55	1	-	2500	1000
<i>Alauda arvensis</i>	180000	40500	1650000	1200000	1200000	250000	350000	1900000	2150000	3500	815000	375000	750000	1450000
<i>Alca torda</i>	-	-	-	-	700	5.5	7250	26.5	11	-	-	17400	-	-
<i>Alcedo atthis</i>	400	1200	1000	800	325	350	17.5	20000	5750	200	1250	1750	7500	1050
<i>Anas acuta</i>	3	10.5	2.5	-	75	75	20000	3.5	19.5	-	40	2	-	10
<i>Anas clypeata</i>	230	950	18.5	95	900	2750	11000	1000	2700	-	550	60	175	300
<i>Anas crecca</i>	95	600	8.5	80	250	2750	200000	350	4750	-	10	625	35	3500
<i>Anas platyrhynchos</i>	15000	30000	2750	35000	35000	27500	200000	45000	340000	550	125000	15000	15000	35000
<i>Anas querquedula</i>	135	200	165	90	400	2250	2500	385	1550	5	1350	2	425	3000
<i>Anas strepera</i>	250	1150	60	2150	400	950	225	950	3850	15	150	65	75	200
<i>Anser anser</i>	600	1250	10	635	8000	1100	3000	73.5	14000	30	1250	625	175	55
<i>Anthus campestris</i>	50	-	750	45	11	55	1.5	23000	1295	12500	26500	-	27500	225
<i>Anthus petrosus</i>	-	-	-	-	150	6.5	1850	15000	0.5	-	-	15000	-	-
<i>Anthus pratensis</i>	1800	9400	-	52500	37500	75000	950000	625000	92000	-	-	750000	-	75000
<i>Anthus spinoletta</i>	90000	-	16000	130	-	-	-	15000	4100	350	-	-	50000	-
<i>Anthus trivialis</i>	52500	8950	14000	750000	30000	625000	1500000	625000	690000	600	182500	-	60000	700000
<i>Apus apus</i>	37500	37500	11250	90000	50000	50000	45000	1900000	345000	60000	4000	15000	850000	70000
<i>Aquila chrysaetos</i>	310	-	160	-	1	40	325	425	47.5	125	4	-	508.5	7.5
<i>Aquila pomarina</i>	-	-	160	-	-	540	-	-	138.5	78.5	45	-	-	4000
<i>Ardea cinerea</i>	1400	3400	1200	2100	6500	1350	300	30000	25750	700	3000	6250	10500	1300
<i>Ardea purpurea</i>	250	-	145	3	-	-	-	2100	27.5	127.5	1200	-	1900	-
<i>Ardeola ralloides</i>	-	-	475	-	-	-	-	125	-	550	355	-	600	-
<i>Asio flammeus</i>	8.5	1	-	5	9.5	100	6000	150	85	5	125	2	-	5
<i>Asio otus</i>	3500	5000	4000	6000	2500	1400	6000	20000	32500	3500	9250	1750	7500	3000

<i>Athene noctua</i>	85	13250	6500	300	150	-	-	40000	5950	10000	2000	-	40000	20
<i>Aythya ferina</i>	250	784.5	130	13000	500	1500	17500	2750	6000	10	7500	25	350	1750
<i>Aythya fuligula</i>	850	2250	1.5	18000	1500	6000	100000	650	13500	-	50	1750	45	1000
<i>Aythya nyroca</i>	100	175	-	-	-	-	-	-	1.5	190	775	-	85	2.5
<i>Bonasa bonasia</i>	12500	150	1250	1350	-	20000	400000	7000	1550	150	75	-	5500	11000
<i>Botaurus stellaris</i>	115	16	45	35	250	125	250	293.5	490	12.5	850	-	60	400
<i>Branta leucopsis</i>	-	171.5	-	-	125	115	400	-	32	-	-	-	-	-
<i>Bubo bubo</i>	500	27.5	220	700	22	160	2500	1100	720	350	20	-	275	40
<i>Bucephala clangula</i>	7.5	-	-	80	69.5	1250	225000	0.5	2385	-	0.5	-	-	450
<i>Burhinus oedicnemus</i>	12	-	190	-	-	-	-	7000	-	400	200	-	1000	-
<i>Buteo buteo</i>	10000	6600	1850	11500	6000	5500	6000	144000	88500	4000	15000	169	6000	19000
<i>Calandrella brachydactyla</i>	2250	-	-	-	-	-	-	4500	-	25000	35	-	22500	-
<i>Calidris alpina</i>	-	-	-	-	350	450	450	-	39	-	-	150	-	3
<i>Caprimulgus europaeus</i>	400	445.5	5000	550	550	4000	4000	100000	3750	20000	4750	17.5	14000	19000
<i>Carduelis cannabina</i>	18000	45000	70000	90000	225000	30000	25000	3000000	605000	75000	117500	175000	250000	17500
<i>Carduelis carduelis</i>	37500	6250	400000	300000	40000	25000	15000	3000000	450000	300000	800000	60000	1500000	32500
<i>Carduelis chloris</i>	165000	60000	400000	750000	600000	35000	350000	3750000	2250000	125000	515000	175000	600000	15000
<i>Carduelis flammea</i>	22500	150	-	9000	15000	-	350000	7500	12000	-	-	60000	35000	-
<i>Carduelis spinus</i>	85000	630	3000	135000	1100	175000	1350000	1500	62500	1250	250	60000	9500	150000
<i>Carpodacus erythrinus</i>	235	1	2	1650	150	65000	300000	10	885	-	-	2	-	35000
<i>Casmerodius albus</i>	650	-	12	-	-	-	-	17.5	-	20	2400	-	41	3.5
<i>Certhia brachydactyla</i>	13500	60000	137500	112500	2250	-	-	1800000	505000	65000	36500	-	300000	-
<i>Certhia familiaris</i>	225000	6250	137500	450000	20000	60000	200000	150000	310000	3500	9000	60000	65000	135000
<i>Cettia cetti</i>	-	75.5	200	-	-	-	-	150000	-	125000	0.5	-	300000	-
<i>Charadrius alexandrinus</i>	31	82.5	80	-	107.5	-	-	1350	390	1500	22.5	-	1700	-
<i>Charadrius dubius</i>	425	435	950	1100	425	600	4500	6750	5550	4000	1950	-	3500	1750
<i>Charadrius hiaticula</i>	-	20	-	-	2200	3000	9500	115	1350	-	-	1750	-	70
<i>Chlidonias hybrida</i>	-	-	320	-	-	-	-	2350	4	325	2700	-	440.5	5.5
<i>Chlidonias leucopterus</i>	-	-	2.5	-	-	5	-	-	12.5	-	1025	-	12.5	175
<i>Chlidonias niger</i>	-	-	10	15	59	2500	30	184.5	930	100	700	-	175	2500
<i>Ciconia ciconia</i>	390	45.5	4200	942.5	2	3500	-	650.5	4350	2250	5200	-	55	10000
<i>Ciconia nigra</i>	250	36	200	350	1	100	-	13	360	40	245	-	5	600
<i>Cinclus cinclus</i>	7500	1150	5000	1500	5	5	300	20000	10300	1250	15	6250	6000	5
<i>Circaetus gallicus</i>	-	-	140	-	-	6.5	-	2650	-	400	40	-	375	12.5
<i>Circus aeruginosus</i>	350	188.5	115	1500	650	475	425	1900	6950	65	5950	-	195	1250
<i>Circus cyaneus</i>	-	0.5	1	40	3.5	175	2500	9500	62	-	-	116.5	0.5	12.5
<i>Circus pygargus</i>	20	9	130	100	40.5	150	6	4450	258.5	20	150	-	320	150
<i>Cisticola juncidis</i>	-	18	-	-	-	-	-	90000	-	15000	-	-	200000	-
<i>Coccothraustes coccothraustes</i>	37500	10100	100000	210000	22500	7500	600	150000	255000	12500	113500	-	10000	6500
<i>Columba livia</i>	125000	-	600	750000	-	125000	30000	1400	265000	20000	450000	1750	5000	150000
<i>Columba oenas</i>	3500	15000	85	5500	900	750	3000	50000	45000	1250	9250	6250	200	350
<i>Columba palumbus</i>	30000	175000	25000	225000	300000	60000	175000	1250000	2300000	6500	93500	750000	35000	50000
<i>Coracias garrulus</i>	8.5	-	2000	-	-	75	-	570	-	250	550	-	400	37.5

<i>Corvus corax</i>	3000	30	750	1000	600	5000	6000	4500	10350	7500	2550	6250	4000	4000
<i>Corvus corone</i>	60000	60000	85000	18000	225000	75000	195000	2000000	450000	75000	67500	175000	315000	40000
<i>Corvus frugilegus</i>	900	17500	6500	3500	45000	7500	1100	500000	59000	1250	32500	375000	-	8000
<i>Corvus monedula</i>	4100	60000	162500	15000	150000	35000	105000	375000	80000	150000	7500	175000	75000	30000
<i>Coturnix coturnix</i>	10000	4050	11500	7500	400	30	55	300000	22000	3500	82000	10	12500	260
<i>Crex crex</i>	275	32.5	6400	1600	150	20000	5000	575	2550	-	850	148	325	32000
<i>Cuculus canorus</i>	30000	7000	35000	52500	30000	25000	65000	500000	87000	7500	60000	6250	75000	30000
<i>Cygnus olor</i>	425	405	21	470	4750	2250	7000	1300	10550	65	235	6250	400	700
<i>Delichon urbicum</i>	75000	39500	2400000	900000	75000	200000	100000	1000000	1110000	125000	150000	60000	750000	205000
<i>Dendrocopos leucotos</i>	1150	-	1450	200	-	525	40	325	325	1250	325	-	400	2250
<i>Dendrocopos major</i>	90000	32500	120000	300000	55000	35000	225000	1000000	640000	1500	300000	-	75000	80000
<i>Dendrocopos medius</i>	3600	2266	11500	5250	-	5.5	-	62500	12850	20000	11500	-	500	1750
<i>Dendrocopos minor</i>	3350	2750	15000	4500	44	3500	5500	100000	24000	750	23500	-	4000	12500
<i>Dendrocopos syriacus</i>	3000	-	30000	1200	-	-	-	-	-	15000	25000	-	-	-
<i>Dryocopus martius</i>	6250	1900	2500	6000	250	3000	15000	20000	36000	1500	7000	-	2500	7000
<i>Egretta garzetta</i>	4	17	1700	2.5	-	-	-	12000	1	1650	800	33.5	15500	-
<i>Emberiza cia</i>	750	-	4500	-	-	-	-	60000	325	15000	480	-	56000	-
<i>Emberiza cirrus</i>	7.5	-	75000	-	-	-	-	1250000	120	125000	5	-	550000	-
<i>Emberiza citrinella</i>	90000	26500	65000	3000000	500000	150000	900000	1000000	1900000	3500	742500	60000	35000	120000
<i>Emberiza hortulana</i>	20	-	37500	150	-	3000	40000	25000	6300	35000	12.5	-	10000	1250
<i>Emberiza schoeniclus</i>	9500	4650	300	60000	50000	65000	300000	240000	280000	400	61500	175000	75000	60000
<i>Erethacus rubecula</i>	1050000	175000	2500000	900000	250000	375000	2250000	9000000	3250000	75000	327500	1750000	2000000	850000
<i>Eudromias morinellus</i>	5	-	-	0.5	-	-	1250	6	-	6	-	-	3	-
<i>Falco cherrug</i>	17.5	-	4	9	-	-	-	-	1	-	140	-	-	-
<i>Falco columbarius</i>	-	-	-	-	-	15	2500	-	-	-	-	120	-	20
<i>Falco peregrinus</i>	225	25	105	16	1	-	135	1250	630	350	4	334.5	889	-
<i>Falco subbuteo</i>	1000	792	900	250	6	750	2500	8050	3150	500	1400	-	750	700
<i>Falco tinnunculus</i>	7500	4900	3750	11000	2500	375	2500	86500	54750	7500	4250	6250	10000	150
<i>Falco vespertinus</i>	3	-	100	-	-	5	-	3	0.5	-	1150	-	70	-
<i>Ficedula albicollis</i>	13500	-	5	45000	-	-	-	8000	3350	-	55000	-	3000	5
<i>Ficedula hypoleuca</i>	425	2050	-	18000	15000	350000	475000	50000	235000	-	45	5.5	-	350000
<i>Ficedula parva</i>	2250	-	4500	1800	-	35000	1500	-	3250	7.5	400	-	-	65000
<i>Fringilla coelebs</i>	2400000	175000	4000000	6000000	1750000	2000000	6000000	9500000	9000000	2000000	1085000	1750000	1500000	2900000
<i>Fringilla montifringilla</i>	-	-	-	-	1.5	275	1750000	-	2	-	-	-	-	55
<i>Fulica atra</i>	2750	6750	1850	30000	17500	4000	11500	100000	100500	3500	100000	6250	10000	9000
<i>Galerida cristata</i>	425	64.5	70000	900	9.5	35	-	25000	10300	75000	265000	-	300000	5
<i>Gallinago gallinago</i>	100	74	6	650	2750	25000	100000	325	8000	-	925	6250	-	6500
<i>Gallinula chloropus</i>	1950	15000	5500	6000	12500	1500	125	250000	41500	7500	9000	60000	100000	1250
<i>Garrulus glandarius</i>	30000	35000	250000	255000	40000	30000	175000	1250000	530000	35000	69500	6250	300000	30000
<i>Glareola pratincola</i>	-	-	40	-	-	-	-	41	-	750	55	-	116.5	-
<i>Glaucidium passerinum</i>	2750	-	60	1100	-	350	10500	300	2300	-	-	-	750	1750
<i>Grus grus</i>	-	-	-	11	22	1750	17500	2	3050	-	-	-	-	1750
<i>Haematopus ostralegus</i>	-	1800	37.5	-	12250	3500	4500	1100	33500	45	-	6250	129.5	65

<i>Haliaeetus albicilla</i>	4	-	8.5	24.5	7	75	250	-	323.5	6	80	-	-	35
<i>Hieraaetus pennatus</i>	1.5	-	90	-	-	-	-	515	0.5	75	2	-	-	-
<i>Himantopus himantopus</i>	17.5	11.5	235	1	-	-	-	1750	1.5	2000	290	-	2850	-
<i>Hippolais icterina</i>	15000	5250	225	75000	30000	35000	12500	37500	300000	-	7500	-	-	80000
<i>Hippolais polyglotta</i>	-	1500	-	-	-	-	-	500000	585	-	-	-	100000	-
<i>Hirundo daurica</i>	-	-	15000	-	-	-	-	76	-	30000	-	-	35	-
<i>Hirundo rupestris</i>	2250	-	6500	-	-	-	-	11250	40	12500	-	-	7500	-
<i>Hirundo rustica</i>	130000	50000	1900000	480000	225000	200000	155000	2000000	1275000	125000	270000	175000	750000	296000
<i>Ixobrychus minutus</i>	225	26.5	1200	70	-	-	-	275	105	1250	5000	-	1800	12.5
<i>Jynx torquilla</i>	3500	18	7500	3750	37.5	6000	10000	13500	16500	150	64500	-	75000	3500
<i>Lagopus muta</i>	12000	-	-	-	-	-	2000	6500	450	-	-	-	6500	-
<i>Lanius collurio</i>	30000	1850	650000	45000	2250	15000	45000	240000	140000	20000	605000	-	85000	30000
<i>Lanius excubitor</i>	41.5	126	-	1500	25	450	6500	5150	2150	-	3.5	-	-	125
<i>Lanius minor</i>	1	-	10000	-	-	-	-	45.5	-	2500	3250	-	1750	-
<i>Lanius senator</i>	-	-	7500	-	-	-	-	20000	15	20000	-	-	15000	-
<i>Larus argentatus</i>	-	1550	-	-	57500	42500	35000	75500	42500	-	-	5500	-	900
<i>Larus cachinnans</i>	17.5	2	6000	2.5	-	-	-	42500	84	4000	6	-	45000	-
<i>Larus canus</i>	3	71.5	-	2.5	27500	15000	70000	18.5	22000	-	1.5	1060	-	550
<i>Larus fuscus</i>	-	2800	-	-	5000	100	6000	22765	26000	-	-	2900	-	-
<i>Larus marinus</i>	-	-	-	-	2500	4000	3500	3850	23	-	-	2200	-	2.5
<i>Larus melanocephalus</i>	30	1450	12.5	35	3	0.5	-	2264	113	1175	170	2	1980	-
<i>Larus minutus</i>	-	-	-	-	1	1500	15000	-	2	-	-	-	-	1350
<i>Larus ridibundus</i>	7000	18500	70	75000	117500	65000	75000	30800	151500	-	11000	3900	750	32000
<i>Limosa limosa</i>	130	1200	-	15	712.5	750	50	165	6650	-	950	1	11	90
<i>Locustella fluviatilis</i>	6000	-	5	15000	17	7000	750	-	6750	-	57500	-	-	75000
<i>Locustella luscinioides</i>	2050	33.5	400	600	16.5	225	1.5	6000	5400	1250	21500	-	2000	600
<i>Locustella naevia</i>	1850	2650	1	25500	1000	10000	3000	45000	87500	-	19500	6250	-	55000
<i>Loxia curvirostra</i>	105000	6250	4500	65000	2000	25500	225000	45000	63500	7500	300	1750	45000	8000
<i>Loxia pytyopsittacus</i>	-	-	-	-	0.5	3500	55000	-	1	-	-	-	-	700
<i>Lullula arborea</i>	800	750	60000	750	300	2000	900	125000	35000	12500	52500	-	75000	4000
<i>Luscinia luscinia</i>	-	-	2.5	2.5	30000	60000	17500	-	22800	-	5	-	-	100000
<i>Luscinia megarhynchos</i>	3000	1925	500000	12000	-	-	-	900000	105000	150000	252500	-	750000	-
<i>Luscinia svecica</i>	300	3600	-	500	22	65	150000	25000	3950	-	650	-	-	125
<i>Mergus merganser</i>	175	-	-	2	33	1750	25000	190	565	20	-	25	3	125
<i>Mergus serrator</i>	-	-	-	-	2500	750	35000	5	375	-	-	1750	-	15
<i>Merops apiaster</i>	225	8.5	22500	38	5	-	-	8000	155	2500	30000	-	7500	1.5
<i>Miliaria calandra</i>	5250	3000	1650000	6000	50000	2.5	-	375000	22500	350000	195000	-	400000	5
<i>Milvus migrans</i>	75	23	110	50	-	3	12.5	24400	3400	12.5	105	-	950	20
<i>Milvus milvus</i>	7.5	66	-	85	19.5	-	-	3400	12250	-	7	-	350	1.5
<i>Monticola saxatilis</i>	90	-	1850	-	-	-	-	15000	-	15000	25	-	7500	-
<i>Monticola solitarius</i>	-	-	350	-	-	-	-	7500	-	20000	-	-	15000	-
<i>Montifringilla nivalis</i>	3500	-	-	-	-	-	-	7500	300	250	-	-	4500	-
<i>Motacilla alba</i>	75000	35000	200000	150000	125000	125000	750000	1000000	835000	7500	212500	175000	105000	225000

<i>Motacilla cinerea</i>	37500	6700	25000	30000	475	2.5	20	80000	35000	7500	245	15000	35000	5.5
<i>Motacilla flava</i>	550	15000	750000	1200	7500	15000	325000	150000	94000	15000	187500	2	30000	17500
<i>Muscicapa striata</i>	35000	9750	17500	45000	20000	150000	1500000	600000	320000	15000	90000	60000	200000	300000
<i>Netta rufina</i>	200	1	-	225	0.5	-	-	750	480	2.5	35	-	50	2.5
<i>Nucifraga caryocatactes</i>	30000	350	20000	3750	4	7500	2000	6250	12500	75	-	-	20000	12500
<i>Numenius arquata</i>	110	600	-	2	470	2000	42500	1650	3600	-	40	6250	1	175
<i>Nycticorax nycticorax</i>	55	13.5	2150	490	-	-	-	5000	35	1000	3000	-	13000	-
<i>Oenanthe oenanthe</i>	6750	29.5	40000	300	1500	15000	175000	30000	10000	65000	42500	6250	150000	20000
<i>Oriolus oriolus</i>	9000	2700	200000	12000	16	11000	3000	375000	65000	25000	215000	-	35000	20000
<i>Otis tarda</i>	107	-	5	5.5	-	-	-	-	84	-	1150	-	-	-
<i>Otus scops</i>	50	-	7500	0.5	-	-	-	7500	-	12500	550	-	7500	-
<i>Pandion haliaetus</i>	-	-	2	-	2	42.5	1225	42.5	365	-	-	-	-	125
<i>Panurus biarmicus</i>	4500	31.5	140	120	6000	1000	600	6000	2050	3500	7500	-	7000	800
<i>Parus ater</i>	1200000	60000	450000	675000	150000	12500	40000	600000	1700000	300000	12000	175000	2000000	80000
<i>Parus caeruleus</i>	300000	60000	550000	1200000	225000	75000	525000	6000000	3100000	750000	220000	750000	750000	120000
<i>Parus cristatus</i>	225000	15000	11250	120000	25000	35000	300000	600000	325000	3500	4250	-	30000	335000
<i>Parus major</i>	600000	175000	1650000	4500000	850000	200000	950000	6000000	5550000	1500000	1200000	375000	1500000	450000
<i>Parus montanus</i>	110000	15000	60000	60000	200	75000	650000	450000	265000	600	400	-	40000	215000
<i>Parus palustris</i>	75000	15000	150000	90000	15000	55000	-	625000	445000	6000	81500	-	65000	150000
<i>Passer domesticus</i>	525000	375000	6000000	4200000	750000	150000	300000	6000000	7000000	600000	2325000	750000	75000	1375000
<i>Passer hispaniolensis</i>	20	-	600000	-	-	-	-	-	-	350000	-	-	400000	-
<i>Passer montanus</i>	120000	22500	450000	600000	500000	75000	30000	540000	1500000	20000	2400000	1750	750000	225000
<i>Perdix perdix</i>	9000	8300	7500	18000	12500	5500	4000	500000	73500	3250	23500	11	3000	2750
<i>Pernis apivorus</i>	1950	583	225	1000	650	1000	3500	12800	4500	1500	575	-	800	2500
<i>Phalacrocorax aristotelis</i>	-	-	215	-	-	-	-	6350	-	1100	-	3400	1900	-
<i>Phalacrocorax carbo</i>	16.5	990	2400	180	38500	9500	1000	3350	16800	4300	2400	4550	880	450
<i>Philomachus pugnax</i>	-	-	-	-	150	350	15000	2.5	116.5	-	-	-	-	125
<i>Phoenicurus ochruros</i>	150000	26500	100000	300000	875	450	60	1000000	800000	20000	220000	-	300000	1400
<i>Phoenicurus phoenicurus</i>	9000	4950	3500	6000	50000	45000	800000	200000	139500	3500	12500	7.5	45000	80000
<i>Phylloscopus bonelli</i>	50000	-	12500	-	-	-	-	250000	31000	20000	-	-	75000	-
<i>Phylloscopus collybita</i>	800000	175000	650000	1200000	250000	350000	125000	9000000	3200000	35000	620000	60000	550000	550000
<i>Phylloscopus ibericus</i>	-	-	-	-	-	-	-	20000	-	-	-	-	-	-
<i>Phylloscopus sibilatrix</i>	70000	10150	17500	120000	10000	750000	150000	250000	460000	1250	97000	15	30000	1150000
<i>Phylloscopus trochiloides</i>	-	-	-	7.5	0.5	3000	6500	-	6	-	-	-	-	1250
<i>Phylloscopus trochilus</i>	30000	60000	2.5	750000	500000	1400000	9000000	4500000	2250000	55	84500	750000	-	550000
<i>Pica pica</i>	12000	60000	550000	75000	250000	45000	175000	1500000	340000	30000	76500	60000	350000	15000
<i>Picoides tridactylus</i>	3400	-	140	400	-	850	17500	75	875	75	-	-	115	2000
<i>Picus canus</i>	2550	20	2250	4000	-	1500	2000	10000	15250	125	2500	-	1100	2500
<i>Picus viridis</i>	10500	10900	20000	13500	875	250	-	400000	29000	7500	16000	-	60000	55
<i>Platalea leucorodia</i>	58.5	4	80	4	5	-	-	94.5	42	175	1025	-	78.5	-
<i>Pluvialis apricaria</i>	-	-	-	-	4.5	4000	60000	-	22	-	-	300	-	400
<i>Podiceps auritus</i>	-	-	-	-	1	350	3000	-	2	-	-	-	-	35
<i>Podiceps cristatus</i>	1100	1650	550	3750	4000	2500	30000	8000	21000	1150	8000	1750	3250	6500

<i>Podiceps grisegena</i>	-	-	50	3	1500	250	7000	0.5	2050		115	-	-	1750
<i>Podiceps nigricollis</i>	40	223.5	20	600	250	5	-	1350	1750	10	800	25	-	37.5
<i>Porzana parva</i>	17000	-	200	22.5	-	35	5.5	6.5	75	30	4000	-	40	125
<i>Porzana porzana</i>	55	77	100	60	105.5	3000	1000	625	785	5	550	4.5	125	750
<i>Porzana pusilla</i>	-	2	75	-	-	-	-	1.5	-	5	25	-	-	-
<i>Prunella collaris</i>	12000	-	4750	17.5	-	-	-	15000	950	3500	-	-	15000	-
<i>Prunella modularis</i>	300000	375000	40000	375000	100000	75000	400000	4250000	1650000	3000	1350	750000	150000	225000
<i>Pyrrhocorax graculus</i>	12000	-	2250	-	-	-	-	30000	3000	6000	-	-	7500	-
<i>Pyrrhocorax pyrrhocorax</i>	-	-	-	-	-	-	-	1500	-	1450	-	641.5	1750	-
<i>Pyrrhula pyrrhula</i>	200000	10100	20000	255000	37500	55000	400000	600000	325000	1250	175	60000	45000	185000
<i>Rallus aquaticus</i>	5250	975	1000	1000	3500	650	450	21500	11100	2000	15000	1750	4500	1000
<i>Recurvirostra avosetta</i>	144.5	670	370	3	4350	125	-	2500	6300	400	600	-	1900	-
<i>Regulus ignicapilla</i>	300000	60000	100000	105000	32.5	-	-	500000	675000	60000	450	-	450000	5
<i>Regulus regulus</i>	900000	60000	225000	300000	100000	200000	1100000	625000	970000	3000	3000	175000	300000	600000
<i>Remiz pendulinus</i>	1250	16.5	600	3750	37.5	200	1.5	200	6600	17500	8750	-	25000	550
<i>Riparia riparia</i>	10000	10200	50000	22500	30000	35000	75000	100000	158000	15000	102500	175000	8500	65000
<i>Rissa tridactyla</i>	-	-	-	-	465	-	-	5300	7300	-	-	33000	-	-
<i>Saxicola rubetra</i>	5250	246.5	3250	22500	7500	100000	350000	30000	63500	750	137500	1750	15000	400000
<i>Saxicola torquatus</i>	6750	3800	5500	3750	28	-	2.5	1000000	4200	75000	452500	15000	250000	-
<i>Scolopax rusticola</i>	3000	2200	10	3000	2750	35000	125000	20000	18000	5	35	6250	115	25000
<i>Serinus serinus</i>	67500	2200	100000	675000	6	75	1.5	1200000	310000	20000	202500	-	750000	175
<i>Sitta europaea</i>	300000	34000	550000	900000	25000	35000	10	1200000	1000000	30000	187500	-	125000	70000
<i>Somateria mollissima</i>	-	-	-	-	25000	17500	150000	10	1450	-	-	625	1	-
<i>Sterna albifrons</i>	-	224	105	-	460	400	50	1600	750	1500	7.5	206	4250	175
<i>Sterna hirundo</i>	250	2550	360	500	1000	5250	60000	4750	9250	1250	950	2500	5000	2000
<i>Sterna nilotica</i>	-	-	8.5	-	1.5	-	-	319.5	60	75	-	-	382	-
<i>Sterna paradisaea</i>	-	-	-	-	8500	7500	75000	0.5	6400	-	-	2700	-	37.5
<i>Sterna sandvicensis</i>	-	1550	325	-	4250	700	-	6800	10100	40	-	1800	611	-
<i>Streptopelia decaocto</i>	30000	85000	300000	270000	35000	600	125	1000000	355000	30000	190000	60000	400000	350
<i>Streptopelia turtur</i>	11500	7700	60000	90000	50	6000	17.5	300000	68000	20000	190000	-	300000	1250
<i>Strix aluco</i>	12500	7500	6000	14000	3500	1350	2000	130000	60500	15000	6500	-	30000	17500
<i>Strix uralensis</i>	3	-	37.5	7.5	-	1950	3250	-	5	-	125	-	3	2000
<i>Sturnus vulgaris</i>	150000	60000	4000000	1350000	500000	35000	45000	3750000	3000000	15000	850000	375000	2000000	150000
<i>Sylvia atricapilla</i>	1050000	175000	1400000	1200000	375000	200000	40000	6250000	2750000	12500	920000	15000	3500000	425000
<i>Sylvia borin</i>	15000	60000	100	300000	175000	300000	1000000	2000000	1100000	550	29000	365	30000	600000
<i>Sylvia communis</i>	30000	60000	137500	150000	375000	150000	325000	1200000	375000	75000	265000	60000	125000	400000
<i>Sylvia curruca</i>	52500	6250	20000	90000	150000	55000	250000	50000	375000	12500	88000	1.5	25000	60000
<i>Sylvia nisoria</i>	1550	-	7000	4500	-	15000	1000	-	11500	550	48500	-	1500	3500
<i>Tachybaptus ruficollis</i>	1600	1300	700	3000	2500	10	20	6000	7900	1750	9500	1750	3500	550
<i>Tachymarpis melba</i>	250	-	4750	-	-	-	-	6000	80	3000	-	-	7500	-
<i>Tadorna tadorna</i>	35	2450	30	3	2500	850	300	3000	5850	70	1	625	114	55
<i>Tetrao tetrix</i>	12500	22.5	-	900	-	10000	450000	9000	1350	-	-	-	9000	7500
<i>Tetrao urogallus</i>	6000	-	650	87.5	-	1600	250000	2150	810	269	-	-	2250	2000

<i>Tichodroma muraria</i>	1050	-	325	-	-	-	-	12000	150	200	-	-	4000	-
<i>Tringa glareola</i>	-	-	-	-	100	2500	250000	-	-	-	-	-	-	900
<i>Tringa nebularia</i>	-	-	-	-	-	175	35000	-	0.5	-	-	0.5	-	2.5
<i>Tringa ochropus</i>	1.5	-	17.5	55	15.5	12500	85000	-	850	-	-	-	-	20000
<i>Tringa totanus</i>	155	434.5	12.5	32.5	13500	5500	7000	1400	10850	600	700	625	1000	500
<i>Troglodytes troglodytes</i>	525000	375000	300000	225000	400000	110000	115000	3250000	1850000	75000	40000	1750000	1750000	250000
<i>Turdus iliacus</i>	-	-	-	2.5	-	150000	2000000	-	-	-	-	-	-	80000
<i>Turdus merula</i>	525000	750000	3000000	3000000	2250000	200000	375000	3600000	12000000	1400000	1275000	1750000	3500000	175000
<i>Turdus philomelos</i>	375000	60000	500000	600000	250000	300000	750000	3300000	1850000	2000	340000	375000	300000	225000
<i>Turdus pilaris</i>	45000	15250	1	120000	3500	150000	1500000	15000	475000	55	65	-	7500	95000
<i>Turdus torquatus</i>	75000	12.5	22500	1050	-	-	150	7000	13500	75	-	150	15000	-
<i>Turdus viscivorus</i>	100000	60000	100000	60000	25000	7500	80000	300000	425000	35000	14500	60000	75000	45000
<i>Tyto alba</i>	30	2100	325	275	104	-	-	40000	14000	4500	1250	625	9000	-
<i>Upupa epops</i>	500	-	6000	105	-	12.5	-	40000	385	12500	13500	-	35000	200
<i>Uria aalge</i>	-	-	-	-	2500	-	30	248	2600	-	-	88000	-	-
<i>Vanellus vanellus</i>	4500	20500	800	8500	37500	22500	65000	18500	85500	75	121500	6250	1800	13500

Table S2 (continuation)

Species	Lithuania	Luxembourg	Netherlands	Norway	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	Switzerland	United Kingdom
<i>Accipiter gentilis</i>	650	55	1900	1700	7500	125	6000	1700	550	5000	3750	1500	296.5
<i>Accipiter nissus</i>	3000	250	4500	4500	6250	900	1300	1750	1250	8000	17500	3500	40100
<i>Acrocephalus arundinaceus</i>	60000	2	275	-	35000	5500	202500	1500	300	15000	450	225	-
<i>Acrocephalus melanopogon</i>	-	-	-	-	-	-	32000	15	-	1750	-	-	-
<i>Acrocephalus palustris</i>	125000	900	90000	650	500000	-	550000	45000	7500	-	17500	4500	16
<i>Acrocephalus schoenobaenus</i>	350000	-	22500	45000	90000	-	975000	13000	750	-	125000	-	321000
<i>Acrocephalus scirpaceus</i>	40000	250	200000	2000	120000	5500	1050000	15000	200	60000	550000	8000	91400
<i>Actitis hypoleucos</i>	1750	-	7.5	150000	1500	1125	19000	1000	375	6250	87500	90	12000
<i>Aegithalos caudatus</i>	15000	3500	35000	10000	55000	275000	825000	90000	17500	1175000	30000	12500	273000
<i>Aegolius funereus</i>	400	-	0.5	11000	1500	-	8000	500	350	150	12500	1250	-
<i>Alauda arvensis</i>	1300000	7500	60000	250000	5500000	5500	655000	300000	10000	4000000	750000	45000	1785000
<i>Alca torda</i>	-	-	-	30000	-	-	-	-	-	-	10000	-	126000

<i>Alcedo atthis</i>	850	65	185	2.5	4250	6000	13500	1000	250	5300	210	325	6400
<i>Anas acuta</i>	12.5	-	25	1250	15	-	2.5	5	-	25	850	-	26
<i>Anas clypeata</i>	225	-	8500	200	1650	2.5	300	25	5	150	1250	-	1250
<i>Anas crecca</i>	2500	-	2250	40000	1500	-	11	25	5	24.5	65000	2.5	2200
<i>Anas platyrhynchos</i>	85000	1250	425000	55000	300000	6500	160000	16000	15000	82750	212500	15000	110950
<i>Anas querquedula</i>	2500	-	1750	12.5	2750	2.5	4000	150	25	150	325	1	68.5
<i>Anas strepera</i>	125	-	6500	5.5	2100	200	4250	65	4	3200	600	6.5	790
<i>Anser anser</i>	125	-	8500	11000	3400	-	1150	47.5	-	-	17500	9	15700
<i>Anthus campestris</i>	500	-	27.5	-	22500	5500	185000	110	40	520000	25	1	-
<i>Anthus petrosus</i>	-	-	-	125000	-	-	-	-	-	-	4000	-	35700
<i>Anthus pratensis</i>	250000	300	75000	3000000	225000	-	-	375	-	75	750000	500	1680000
<i>Anthus spinoletta</i>	-	-	-	-	2450	2.5	175000	900	2250	60000	-	175000	-
<i>Anthus trivialis</i>	400000	5500	40000	1500000	650000	75	725000	300000	25000	350000	5000000	60000	74400
<i>Apus apus</i>	75000	2750	45000	55000	200000	60000	11000	45000	2250	750000	300000	62500	60000
<i>Aquila chrysaetos</i>	-	-	-	950	37.5	47	107.5	92.5	30	1300	580	305	422
<i>Aquila pomarina</i>	1050	-	-	-	1800	-	2650	850	3	-	-	-	-
<i>Ardea cinerea</i>	4500	60	11375	7500	9500	650	4000	500	550	5500	5750	1350	14800
<i>Ardea purpurea</i>	-	-	407.5	-	1.5	425	925	40	-	2000	-	-	-
<i>Ardeola ralloides</i>	-	-	-	-	-	5	6000	2.5	-	975	-	-	-
<i>Asio flammeus</i>	125	-	40	5500	60	-	250	25	-	360	2850	-	2250
<i>Asio otus</i>	5000	450	5500	5500	16500	550	95000	3250	2000	6250	6000	2750	3100
<i>Athene noctua</i>	7.5	60	6000	-	1500	100000	50000	900	175	60000	-	65	8700
<i>Aythya ferina</i>	3500	-	1900	5	25000	35	17500	750	25	6250	1350	6.5	375
<i>Aythya fuligula</i>	5000	3.5	16000	8500	20000	2.5	90	375	45	25	35000	150	10850
<i>Aythya nyroca</i>	20	-	1.5	-	35	1	6000	12.5	5	5.5	-	0.5	-
<i>Bonasa bonasia</i>	7500	80	-	24000	40000	-	11500	4000	1500	-	100000	8250	-
<i>Botaurus stellaris</i>	900	-	225	-	4450	1.5	1750	75	1	25	380	-	21
<i>Branta leucopsis</i>	-	-	925	75	-	-	-	-	-	-	5000	-	-
<i>Bubo bubo</i>	15	14	1.5	1500	260	350	875	350	40	6250	750	120	-
<i>Bucephala clangula</i>	1750	-	17.5	15000	1350	-	1.5	-	-	-	87500	-	200
<i>Burhinus oedicnemus</i>	-	-	-	-	-	3000	600	2.5	-	35000	-	-	220.5
<i>Buteo buteo</i>	4750	950	9000	1500	65000	2250	31000	6000	3000	15500	30000	22500	37550
<i>Calandrella brachydactyla</i>	-	-	-	-	-	11000	11000	5	-	2400000	-	-	-
<i>Calidris alpina</i>	27.5	-	-	35000	15	-	-	-	-	-	40000	-	25900
<i>Caprimulgus europaeus</i>	5000	3	1050	270	5000	5500	13500	1500	1250	97000	2000	60	3400
<i>Carduelis cannabina</i>	225000	16000	45000	12500	450000	550000	940000	50000	7500	2500000	125000	45000	556000
<i>Carduelis carduelis</i>	75000	7000	17500	3000	600000	1500000	925500	125000	55000	1850000	7500	35000	313000
<i>Carduelis chloris</i>	300000	17500	75000	750000	550000	1100000	880000	115000	65000	2330000	450000	115000	734000
<i>Carduelis flammea</i>	-	-	250	1050000	150	-	-	450	750	-	625000	12500	26900
<i>Carduelis spinus</i>	200000	5.5	850	550000	15000	-	44500	30000	2500	800	750000	7500	369000
<i>Carpodacus erythrinus</i>	85000	-	12.5	1250	20000	-	970	750	12.5	-	16500	15	3.5
<i>Casmerodius albus</i>	-	-	6	-	22.5	-	1000	40	-	25	-	-	-
<i>Certhia brachydactyla</i>	-	6500	100000	-	100000	275000	5500	2000	75000	2150000	-	45000	475

<i>Certhia familiaris</i>	85000	2500	87.5	60000	250000	-	1115000	125000	75000	35000	575000	70000	214000
<i>Cettia cetti</i>	-	-	0.5	-	-	55000	30	-	120	60000	-	1.5	534
<i>Charadrius alexandrinus</i>	-	-	295	-	0.5	3250	550	0.5	27.5	5450	1	-	-
<i>Charadrius dubius</i>	4000	25	925	250	3500	3000	4000	2500	500	2900	1450	110	947.5
<i>Charadrius hiaticula</i>	40	-	450	12500	375	-	-	-	-	-	15000	-	8600
<i>Chlidonias hybrida</i>	12.5	-	0.5	-	750	100	10000	125	-	6250	-	-	-
<i>Chlidonias leucopterus</i>	55	-	-	-	2275	-	60	-	-	-	-	-	-
<i>Chlidonias niger</i>	3000	-	1125	-	4500	-	1850	95	-	45	195	-	-
<i>Ciconia ciconia</i>	12750	-	363	-	45000	5000	4500	1175	200	16600	3	174.5	-
<i>Ciconia nigra</i>	700	5.5	-	-	1150	90.5	205	500	30	625	1.5	-	-
<i>Cinclus cinclus</i>	-	175	-	12500	1250	1500	74500	2500	2000	6250	27500	4000	13400
<i>Circaetus gallicus</i>	-	-	-	-	12.5	425	260	22.5	12.5	2500	-	-	-
<i>Circus aeruginosus</i>	3000	-	1375	2.5	7250	113	2100	450	-	625	1450	-	151
<i>Circus cyaneus</i>	2.5	-	95	27.5	20	20	-	-	-	625	850	-	570
<i>Circus pygargus</i>	250	-	37	-	1900	750	6	55	-	6250	65	-	6
<i>Cisticola juncidis</i>	-	-	17	-	-	275000	-	-	55	60000	-	-	-
<i>Coccothraustes coccothraustes</i>	50000	3500	9000	3000	300000	5500	850000	165000	15000	6250	10000	6000	4750
<i>Columba livia</i>	600000	7500	125000	22500	175000	550	500000	-	150	2140000	40000	30000	175000
<i>Columba oenas</i>	500	325	60000	3000	15000	300	8000	4500	250	22500	7000	2000	309000
<i>Columba palumbus</i>	100000	9500	450000	300000	500000	55000	14000	90000	7500	175000	650000	55000	2865000
<i>Coracias garrulus</i>	125	-	-	-	125	200	5550	25	4	1750	-	-	-
<i>Corvus corax</i>	5500	-	95	35000	15000	650	29500	3000	1250	75000	15000	2000	12900
<i>Corvus corone</i>	60000	3500	85000	450000	100000	27500	280000	11500	30	420000	370000	115000	1202000
<i>Corvus frugilegus</i>	90000	3750	62000	750	175000	-	385000	13500	-	2100	37500	1300	1275000
<i>Corvus monedula</i>	55000	2750	200000	11750	200000	5500	325000	4000	2500	478300	275000	1150	555000
<i>Coturnix coturnix</i>	1500	17.5	4250	175	125000	27500	190000	4000	1500	377500	25	1750	227.5
<i>Crex crex</i>	27500	2.5	470	30	37500	-	52000	1550	550	-	175	30	589
<i>Cuculus canorus</i>	20000	70	7000	2000	175000	55000	600000	10500	7500	60000	50000	25000	14800
<i>Cygnus olor</i>	1250	40	6000	600	6750	-	875	250	60	-	6000	525	24750
<i>Delichon urbicum</i>	300000	4500	92500	55000	475000	550000	170000	750000	75000	1650000	150000	75000	404000
<i>Dendrocopos leucotos</i>	1050	-	-	1750	500	-	20000	2000	25	86.5	5	7.5	-
<i>Dendrocopos major</i>	50000	4000	60000	10000	600000	55000	400000	45000	15000	166500	175000	45000	40700
<i>Dendrocopos medius</i>	2250	250	12.5	-	15000	-	22000	3250	800	1125	-	275	-
<i>Dendrocopos minor</i>	8500	350	5000	2500	30000	3000	7000	3000	750	3507.5	4500	2750	2150
<i>Dendrocopos syriacus</i>	-	-	-	-	550	-	28000	2000	7.5	-	-	-	-
<i>Dryocopus martius</i>	4500	125	1350	3000	52500	-	50000	2000	2000	1200	25000	4000	-
<i>Egretta garzetta</i>	-	-	12.5	-	1	1250	4500	15	-	15000	-	-	72.5
<i>Emberiza cia</i>	-	-	-	-	-	275000	13250	200	7500	1410000	-	6000	-
<i>Emberiza cirius</i>	-	-	-	-	-	55000	10000	-	1250	650000	-	1000	459.5
<i>Emberiza citrinella</i>	675000	13500	25000	325000	3000000	550	825000	1150000	40000	155000	1000000	65000	792000
<i>Emberiza hortulana</i>	500	-	2.5	152.5	225000	1500	190000	2.5	250	212500	4500	125	-
<i>Emberiza schoeniclus</i>	115000	900	85000	750000	350000	550	662500	30000	150	319	600000	4000	201500
<i>Erithacus rubecula</i>	1150000	17500	400000	1000000	1250000	275000	2262000	750000	850000	2100000	3750000	525000	5895000

<i>Eudromias morinellus</i>	-	-	-	10000	0.5	-	-	-	-	2.5	6500	-	630
<i>Falco cherrug</i>	-	-	-	-	1	-	7.5	25	-	-	-	-	-
<i>Falco columbarius</i>	7.5	-	-	4500	-	-	-	-	-	-	4950	-	1300
<i>Falco peregrinus</i>	5.5	11.5	6	425	6.5	75	11.5	12.5	70	2550	92.5	200	1400
<i>Falco subbuteo</i>	550	22.5	875	72.5	4000	300	3600	700	150	2650	2000	500	2200
<i>Falco tinnunculus</i>	250	600	6250	3000	7500	2000	12000	5000	1750	27500	3000	4000	36800
<i>Falco vespertinus</i>	-	-	-	-	-	-	1450	60	-	-	-	-	-
<i>Ficedula albicollis</i>	-	-	-	-	6250	-	586000	110000	3000	-	5150	22.5	-
<i>Ficedula hypoleuca</i>	200000	2250	16000	600000	200000	-	300	150	-	240000	1500000	15000	31650
<i>Ficedula parva</i>	20000	-	-	5	30000	-	436000	7500	125	-	750	-	-
<i>Fringilla coelebs</i>	3000000	60000	650000	1250000	7500000	1500000	4375000	4000000	1250000	4500000	11250000	1050000	5974000
<i>Fringilla montifringilla</i>	2.5	-	32.5	1500000	-	-	-	-	5	-	1250000	-	-
<i>Fulica atra</i>	25000	50	155000	1250	175000	1100	100000	6000	400	18260	35000	5750	25700
<i>Galerida cristata</i>	5	-	70	-	8500	55000	266000	4500	900	700000	0.5	-	-
<i>Gallinago gallinago</i>	15000	-	1350	110000	22500	11	250	175	27.5	62.5	125000	1.5	60800
<i>Gallinula chloropus</i>	3500	500	47500	1250	15000	27500	65000	1750	750	105000	3000	1750	270000
<i>Garrulus glandarius</i>	80000	3500	50000	55000	300000	55000	520000	22500	15000	820000	300000	60000	160000
<i>Glareola pratincola</i>	-	-	-	-	-	625	625	-	-	4650	-	-	-
<i>Glaucidium passerinum</i>	100	-	-	7500	325	-	3250	1250	250	-	14000	400	-
<i>Grus grus</i>	1050	-	0.5	2000	11000	-	1	-	-	-	17500	-	3
<i>Haematopus ostralegus</i>	30	-	105000	40000	25	-	100	-	-	52	15000	-	112750
<i>Haliaeetus albicilla</i>	45	-	-	2050	485	-	30.5	2.5	2	-	270	-	16
<i>Hieraaetus pennatus</i>	-	-	-	-	3	650	100	0.5	-	3000	-	-	-
<i>Himantopus himantopus</i>	-	-	16.5	-	2.5	3500	500	2.5	18.5	14750	-	-	-
<i>Hippolais icterina</i>	75000	3	21000	175000	300000	-	67500	15000	-	-	70000	350	-
<i>Hippolais polyglotta</i>	-	35	1	-	-	275000	-	-	1500	1100000	-	400	-
<i>Hirundo daurica</i>	-	-	-	-	-	55000	200	-	2	60000	-	-	-
<i>Hirundo rupestris</i>	-	-	-	-	-	27500	750	-	750	60000	-	4500	-
<i>Hirundo rustica</i>	225000	7000	150000	45000	2250000	1250000	900000	300000	150000	750000	225000	75000	726000
<i>Ixobrychus minutus</i>	5.5	3	20	-	700	325	9250	300	45	2100	-	100	-
<i>Jynx torquilla</i>	7000	75	57.5	3000	14000	3000	32000	3250	2500	15000	7500	2500	1.5
<i>Lagopus muta</i>	-	-	-	350000	-	-	-	-	400	590	60000	13500	10000
<i>Lanius collurio</i>	40000	1750	180	3000	300000	850	1990000	97500	25000	370000	30000	22500	2.5
<i>Lanius excubitor</i>	125	65	2.5	600	15000	30000	15500	750	-	225000	5500	-	-
<i>Lanius minor</i>	5.5	-	-	-	7.5	-	610500	700	15	25	-	-	-
<i>Lanius senator</i>	-	-	-	-	7.5	55000	60	-	-	625000	-	6.5	-
<i>Larus argentatus</i>	15	-	64500	200000	1950	-	-	-	-	-	75000	-	144000
<i>Larus cachinnans</i>	-	-	24	-	190	25000	4250	7.5	70	175000	-	450	2
<i>Larus canus</i>	135	-	6050	90000	3250	-	-	1.5	-	-	150000	3.5	48700
<i>Larus fuscus</i>	-	-	65250	35000	1.5	7.5	-	-	-	490	3500	-	114000
<i>Larus marinus</i>	-	-	13	75000	-	-	-	-	-	-	12500	-	17500
<i>Larus melanocephalus</i>	-	-	633	-	40	-	185	35	-	2.5	-	1	110
<i>Larus minutus</i>	300	-	6.5	47.5	10	-	-	-	-	-	450	-	-

<i>Larus ridibundus</i>	45000	-	134500	40000	115000	2.5	15000	13000	225	6250	100000	950	138000
<i>Limosa limosa</i>	375	-	47500	70	5500	-	70	22.5	-	4	175	-	44
<i>Locustella fluviatilis</i>	40000	-	-	-	65000	-	29000	12500	2000	-	50	-	-
<i>Locustella luscinioides</i>	8000	-	1900	-	20000	275	420000	1500	150	1750	7.5	275	2
<i>Locustella naevia</i>	55000	425	5000	65	150000	-	4000	400	225	7500	4500	225	12300
<i>Loxia curvirostra</i>	16500	25	1800	300000	6250	50	402500	37500	7500	165000	300000	45000	10500
<i>Loxia pytyopsittacus</i>	-	-	5	55000	-	-	-	-	-	-	30000	-	25
<i>Lullula arborea</i>	17500	27.5	5500	205	65000	275000	76000	2250	3500	930000	7500	375	1500
<i>Luscinia luscinia</i>	55000	-	1	650	300000	-	103000	1250	-	-	35000	-	-
<i>Luscinia megarhynchos</i>	-	400	7000	-	125000	550000	278000	15000	3000	1075000	-	2250	7500
<i>Luscinia svecica</i>	150	-	10000	750000	1550	2.5	2500	22.5	-	10900	195000	4	-
<i>Mergus merganser</i>	850	-	-	3000	950	-	1	-	8	-	15000	475	3250
<i>Mergus serrator</i>	5.5	-	40	20000	15	-	-	-	-	-	16000	0.5	2400
<i>Merops apiaster</i>	-	-	-	-	35	15000	17500	1000	35	175000	-	10	-
<i>Miliaria calandra</i>	20	30	75	-	275000	550000	1070000	6000	3000	2870000	4	500	10350
<i>Milvus migrans</i>	65	40	0.5	-	350	1200	140	50	2	6250	1	1350	-
<i>Milvus milvus</i>	5.5	40	0.5	-	675	75	2.5	17.5	-	2300	825	1000	431
<i>Monticola saxatilis</i>	-	-	-	-	5	275	1350	22.5	200	6250	-	1000	-
<i>Monticola solitarius</i>	-	-	-	-	-	5500	-	-	25	15000	-	22.5	-
<i>Montifringilla nivalis</i>	-	-	-	-	-	-	-	-	200	5250	-	6000	-
<i>Motacilla alba</i>	450000	9000	105000	300000	225000	55000	1700000	75000	7500	175000	750000	125000	312000
<i>Motacilla cinerea</i>	-	350	270	1050	3000	27500	362500	15000	4500	60000	1250	9500	42300
<i>Motacilla flava</i>	25000	60	45000	300000	600000	27500	1000000	3250	350	60000	125000	175	19000
<i>Muscicapa striata</i>	300000	700	25000	300000	200000	2750	400000	107500	17500	665000	850000	45000	63700
<i>Netta rufina</i>	-	-	145	-	17.5	70	550	20	-	6250	-	75	-
<i>Nucifraga caryocatactes</i>	7500	-	-	550	3500	-	300000	6000	2500	-	10000	25000	-
<i>Numenius arquata</i>	350	-	6900	7500	675	-	50	16.5	10	3	15000	2.5	112250
<i>Nycticorax nycticorax</i>	-	-	-	-	513	75	7250	250	4	3300	-	-	-
<i>Oenanthe oenanthe</i>	7500	7.5	700	750000	35000	2750	284000	7500	400	343500	300000	25000	52500
<i>Oriolus oriolus</i>	20000	125	4500	2.5	115000	55000	785000	11000	6000	175000	75	1500	14.5
<i>Otis tarda</i>	-	-	-	-	-	1000	2.5	12	-	23000	-	-	-
<i>Otus scops</i>	-	-	-	-	-	4000	32500	60	1050	32500	-	7.5	-
<i>Pandion haliaetus</i>	35	-	-	175	72.5	-	-	-	-	17	3750	-	127
<i>Panurus biarmicus</i>	450	-	1600	-	2150	-	105000	275	-	875	5500	35	355
<i>Parus ater</i>	75000	11000	35000	300000	300000	275000	1710000	375000	400000	3430000	450000	650000	653000
<i>Parus caeruleus</i>	90000	25000	300000	150000	750000	1500000	970000	1050000	75000	2265000	1000000	200000	3535000
<i>Parus cristatus</i>	300000	2750	25000	125000	150000	275000	525000	37500	75000	1180000	325000	140000	2400
<i>Parus major</i>	750000	45000	550000	750000	2000000	1500000	2225000	2250000	550000	2265000	2250000	425000	2074000
<i>Parus montanus</i>	70000	5500	25000	500000	250000	-	975000	105000	15000	-	750000	50000	8500
<i>Parus palustris</i>	50000	5500	13500	50000	150000	-	895000	120000	75000	89000	112500	60000	52800
<i>Passer domesticus</i>	250000	37500	750000	450000	3750000	5500000	2300000	1500000	650000	9653500	350000	450000	2887500
<i>Passer hispaniolensis</i>	-	-	-	-	-	55000	189500	-	-	60000	-	17500	-
<i>Passer montanus</i>	400000	10500	100000	100000	750000	275000	2113500	450000	150000	3300000	500000	85000	68000

<i>Perdix perdix</i>	15000	50	11000	-	450000	-	150000	5500	1000	4000	7500	1.5	72500
<i>Pernis apivorus</i>	350	125	575	1000	3000	125	2300	1100	700	1100	5900	500	51
<i>Phalacrocorax aristotelis</i>	-	-	-	16000	-	125	-	-	-	4390	-	-	28900
<i>Phalacrocorax carbo</i>	2750	-	18950	22500	12500	-	19000	150	-	25	25500	3.5	9100
<i>Philomachus pugnax</i>	150	-	120	15000	27.5	-	-	-	-	-	45000	-	3.5
<i>Phoenicurus ochrurus</i>	20000	9000	32000	30	325000	110000	325000	150000	150000	650000	750	375000	50
<i>Phoenicurus phoenicurus</i>	37500	450	26500	275000	115000	5500	175000	12500	3000	15000	200000	12500	101000
<i>Phylloscopus bonelli</i>	-	-	1.5	-	-	55000	17.5	-	400	1900000	-	22500	-
<i>Phylloscopus collybita</i>	600000	27500	575000	300000	1250000	55	1290000	800000	500000	50000	250000	250000	807000
<i>Phylloscopus ibericus</i>	-	-	-	-	-	55000	-	-	-	370000	-	-	-
<i>Phylloscopus sibilatrix</i>	750000	4000	2750	5500	850000	-	360000	150000	4000	2	225000	12500	9750
<i>Phylloscopus trochiloides</i>	2000	-	-	-	15	-	-	55	-	-	70	-	-
<i>Phylloscopus trochilus</i>	500000	10000	500000	6000000	1500000	-	72500	500000	250	150	13000000	6000	2125000
<i>Pica pica</i>	20000	9000	50000	450000	350000	27500	702000	45000	10000	710000	450000	30000	650000
<i>Picoides tridactylus</i>	175	-	-	4500	500	-	17500	1000	250	-	5500	1250	-
<i>Picus canus</i>	600	40	-	3000	2500	-	52500	1750	1500	-	800	1500	-
<i>Picus viridis</i>	400	325	5000	4500	6000	27500	97500	1600	1500	80550	30000	7500	24200
<i>Platalea leucorodia</i>	-	-	1135	-	-	150	1300	17.5	-	1750	-	-	4
<i>Pluvialis apricaria</i>	45	-	-	75000	-	-	-	-	-	-	70000	-	48900
<i>Podiceps auritus</i>	5.5	-	1	1250	-	-	-	-	-	-	1050	-	45
<i>Podiceps cristatus</i>	17500	17.5	14500	325	20000	400	25000	750	150	2850	20000	5000	6100
<i>Podiceps grisegena</i>	175	-	7.5	-	3500	-	750	12.5	4.5	-	750	-	2
<i>Podiceps nigricollis</i>	175	-	400	-	4500	-	3000	175	1.5	525	105	6	42
<i>Porzana parva</i>	325	-	-	-	1500	-	6500	110	15	-	-	5	-
<i>Porzana porzana</i>	1250	-	225	65	3000	-	11500	130	35	27	125	15	73
<i>Porzana pusilla</i>	-	-	-	-	-	2.5	15	-	-	25	-	2.5	-
<i>Prunella collaris</i>	-	-	-	-	375	-	17750	350	1500	18500	-	17500	-
<i>Prunella modularis</i>	225000	12500	225000	1000000	225000	27500	777500	400000	25000	700000	1750000	165000	2163000
<i>Pyrhacorax graculus</i>	-	-	-	-	-	-	-	-	1000	10500	-	12500	-
<i>Pyrhacorax pyrrhacorax</i>	-	225	-	-	-	-	-	-	-	15000	-	50	475
<i>Pyrhula pyrrhula</i>	200000	3500	8000	300000	75000	1100	550000	95000	15000	144000	375000	65000	166000
<i>Rallus aquaticus</i>	2250	35	2850	120	15000	1250	8500	450	150	40100	5000	1250	1050
<i>Recurvirostra avosetta</i>	12.5	-	8000	1	2	425	400	10	1	5750	1000	-	743
<i>Regulus ignicapilla</i>	-	11000	6000	-	80000	55000	750000	45000	150000	1455000	-	200000	38.5
<i>Regulus regulus</i>	500000	13500	45000	750000	450000	-	2045000	300000	250000	375000	3000000	240000	842000
<i>Remiz pendulinus</i>	1250	3	175	-	15000	2.5	105000	7500	150	13500	75	2.5	-
<i>Riparia riparia</i>	100000	150	25250	75000	225000	55000	67500	15000	500	60000	125000	6000	138650
<i>Rissa tridactyla</i>	-	-	1.5	450000	-	-	-	-	-	50	27.5	-	380000
<i>Saxicola rubetra</i>	85000	30	600	175000	500000	55	798500	15000	4000	17500	300000	12500	16550
<i>Saxicola torquatus</i>	-	450	6750	2.5	30000	137500	202000	30000	17500	375000	-	500	34350
<i>Scolopax rusticola</i>	15000	90	2500	40000	60000	-	7500	1900	150	2450	625000	1380	9550
<i>Serinus serinus</i>	3000	2250	425	-	200000	3000000	447500	75000	35000	5350000	8	30000	-
<i>Sitta europaea</i>	40000	17500	18000	30000	350000	55000	570000	850000	150000	875000	225000	95000	144000

<i>Somateria mollissima</i>	-	-	9000	125000	0.5	-	-	-	-	-	315000	2	31600
<i>Sterna albifrons</i>	175	-	487.5	1	900	716.5	650	2.5	2.5	5750	450	-	1900
<i>Sterna hirundo</i>	2500	-	18750	7000	4250	2.5	6500	200	150	6250	22500	400	12000
<i>Sterna nilotica</i>	-	-	-	-	-	47.5	31	-	-	3250	-	-	-
<i>Sterna paradisaea</i>	-	-	2100	35000	-	-	-	-	-	-	22500	-	53400
<i>Sterna sandvicensis</i>	-	-	14500	-	12	-	50	-	-	3000	325	-	12500
<i>Streptopelia decaocto</i>	15000	250	75000	1750	300000	27500	600000	60000	50000	60000	2500	17500	298000
<i>Streptopelia turtur</i>	3500	1900	11000	-	55000	55000	20000	22500	2500	895000	0.5	1750	44000
<i>Strix aluco</i>	3000	450	5000	4250	70000	25000	65000	2750	3000	60000	15000	5500	19400
<i>Strix uralensis</i>	22.5	-	-	6.5	575	-	16000	850	550	-	2350	-	-
<i>Sturnus vulgaris</i>	275000	35000	700000	350000	2250000	-	1032000	600000	90000	800000	1125000	185000	804000
<i>Sylvia atricapilla</i>	350000	16500	295000	450000	1600000	275000	775000	900000	750000	1175000	700000	250000	932000
<i>Sylvia borin</i>	400000	2500	135000	450000	400000	550	950000	300000	2500	550000	2000000	125000	190000
<i>Sylvia communis</i>	450000	2500	140000	175000	1500000	13750	650000	90000	9000	525000	750000	1500	945000
<i>Sylvia curruca</i>	75000	1500	16500	55000	400000	-	980000	60000	4000	-	275000	17500	64000
<i>Sylvia nisoria</i>	3500	-	-	15	35000	-	32500	4500	800	-	300	5.5	-
<i>Tachybaptus ruficollis</i>	1500	67.5	2150	30	8750	3000	9500	2000	800	6600	350	700	8400
<i>Tachymarptis melba</i>	-	-	-	-	-	550	900	-	300	6250	-	1250	-
<i>Tadorna tadorna</i>	40	-	6500	3500	130	1	140	-	-	137.5	7000	-	8300
<i>Tetrao tetrix</i>	2500	-	19	150000	850	-	70	250	1500	-	175000	8750	6550
<i>Tetrao urogallus</i>	350	-	-	75000	310	-	4850	600	575	1950	97000	475	536
<i>Tichodroma muraria</i>	-	-	-	-	17.5	-	1350	40	250	10500	-	750	-
<i>Tringa glareola</i>	125	-	-	30000	2.5	-	-	-	-	-	75000	-	6
<i>Tringa nebularia</i>	-	-	-	22500	-	-	-	-	-	-	20000	-	1110
<i>Tringa ochropus</i>	6000	-	-	15000	7500	-	7.5	-	-	-	6500	-	-
<i>Tringa totanus</i>	700	-	22500	60000	2250	30	1000	52.5	10	750	15000	-	37900
<i>Troglodytes troglodytes</i>	175000	12500	550000	300000	700000	550000	1050000	150000	60000	3050000	300000	300000	8512000
<i>Turdus iliacus</i>	35000	-	-	1250000	750	-	-	2.5	-	-	1125000	-	12
<i>Turdus merula</i>	300000	55000	1050000	550000	1500000	1100000	1335000	600000	450000	4100000	1750000	500000	4935000
<i>Turdus philomelos</i>	1500000	6500	140000	1250000	650000	550	1785000	450000	150000	175000	2250000	225000	1144000
<i>Turdus pilaris</i>	100000	2500	175	2000000	300000	-	71000	15000	2000	-	750000	80000	2.5
<i>Turdus torquatus</i>	-	-	-	55000	2000	-	96000	4000	4000	6500	6500	50000	6900
<i>Turdus viscivorus</i>	15000	2500	15000	30000	75000	55000	35000	60000	22500	560000	137500	100000	222500
<i>Tyto alba</i>	50	250	1575	-	1500	4000	1000	500	65	70450	1.5	1250	4000
<i>Upupa epops</i>	250	-	-	-	12500	55000	33000	800	800	603500	2.5	125	-
<i>Uria aalge</i>	-	-	-	8000	-	6	-	-	-	25	11500	-	952000
<i>Vanellus vanellus</i>	19000	25	250000	60000	125000	12.5	50000	3750	2500	1750	75000	325	155500

Table S3 Demographic, ecological, and life-history characteristics of the bird species included in the study

Species	Migration distance (degrees latitude)	Heterogeneity of distribution	Population size (x 1000)	Adult survival (%)	Clutch size	Number of clutches	Dispersal distance (km)	Population trend	Mass (g)	Age at first reproduction (years)	Number of habitats
<i>Accipiter gentilis</i>	-	-	185.00	70.00	3.64	1	-	2	1139.50	2	5
<i>Accipiter nisus</i>	12.790	-	395.00	43.00	4.90	1	-	1	204.00	1	8
<i>Acrocephalus arundinaceus</i>	38.690	2.37963	2200.00	65.00	4.80	2	110	-1	30.35	1	4
<i>Acrocephalus melanopogon</i>	4.105	2.16279	225.00	-	4.90	1	60	0	10.75	1	3
<i>Acrocephalus palustris</i>	66.835	1.38325	5000.00	49.25	4.30	1	40	0	12.00	1	14
<i>Acrocephalus schoenobaenus</i>	62.100	1.35800	5900.00	31.00	4.98	2	40	0	11.90	1	7
<i>Acrocephalus scirpaceus</i>	44.600	2.36266	3850.00	56.00	3.89	1	60	0	11.80	1	10
<i>Actitis hypoleucos</i>	44.390	-	1160.00	75.00	4.00	1	-	-2	47.75	1	9
<i>Aegithalos caudatus</i>	0	1.13704	8500.00	-	9.40	1	60	0	8.80	1	11
<i>Aegolius funereus</i>	0	-	230.00	-	5.35	1	-	0	143.00	1	6
<i>Alauda arvensis</i>	13.015	1.11190	60000.00	66.50	3.69	4	310	-1	36.40	1	10
<i>Alca torda</i>	7.690	-	600.00	89.00	1.00	1	-	-	722.00	5	8
<i>Alcedo atthis</i>	0	-	119.50	23.80	6.70	4	-	-	32.43	1	6

<i>Anas acuta</i>	26.725	-	340.00	52.00	8.30	1	-	-2	917.00	1	-
<i>Anas clypeata</i>	24.065	-	190.00	56.00	9.20	1	-	-	608.75	1	6
<i>Anas crecca</i>	20.840	-	1060.00	46.00	9.50	1	400	-	286.50	1	16
<i>Anas platyrhynchos</i>	8.125	-	4200.00	52.00	9.60	1	2730	-1	1119.00	1	8
<i>Anas querquedula</i>	36.815	-	490.00	-	8.50	1	-	-	361.00	1	-
<i>Anas strepera</i>	17.275	-	78.00	-	9.96	1	-	-	792.50	1	-
<i>Anser anser</i>	12.280	-	155.00	77.00	5.90	1	400	3	3464.50	3	9
<i>Anthus campestris</i>	16.620	2.52676	1450.00	-	-	2	80	-	28.80	1	7
<i>Anthus pratensis</i>	15.645	1.48565	11500.00	65.00	4.64	3	390	-1	19.25	1	15
<i>Anthus spinoletta</i>	21.270	1.70579	1520.00	-	5.45	2	310	-1	21.45	1	16
<i>Anthus trivialis</i>	47.070	1.19544	34500.00	42.85	4.53	3	60	-1	23.40	1	9
<i>Apus apus</i>	59.385	0.91556	11950.00	84.50	2.40	1	68	-1	39.65	2	6
<i>Aquila chrysaetos</i>	0	-	9.70	91.00	1.91	1	-	0	4383.00	5	4
<i>Aquila pomarina</i>	-	-	16.50	-	1.78	1	-	-2	1630.00	-	-
<i>Ardea cinerea</i>	1.500	-	250.00	69.00	3.95	2	380	2	1433.00	2	9
<i>Ardea purpurea</i>	-	-	35.50	-	4.50	1	380	-2	873.75	2	-
<i>Ardeola ralloides</i>	-	-	22.50	-	5.00	1	-	-2	288.00	-	-
<i>Asio flammeus</i>	48.690	-	119.00	-	6.00	2	-	-	295.00	1	-
<i>Asio otus</i>	3.180	0.91556	595.00	69.00	4.15	2	1360	-	255.50	1	18
<i>Athene noctua</i>	0	1.08946	930.00	64.80	3.60	2	68	-2	168.00	1	11
<i>Aythya ferina</i>	17.665	-	325.00	-	9.50	1	-	-2	869.00	1	7
<i>Aythya fuligula</i>	17.080	-	805.00	54.00	10.90	1	-	-2	656.50	1	5
<i>Aythya nyroca</i>	-	-	15.00	-	9.00	1	-	-3	570.00	-	-

<i>Bonasa bonasia</i>	0	-	2800.00	-	9.38	1	-	1	369.50	1	-
<i>Botaurus stellaris</i>	2.700	-	44.00	-	4.76	1	-	0	1231.00	2	8
<i>Branta leucopsis</i>	20.250	2.42069	47.50	-	4.50	1	-	3	1630.50	2	-
<i>Bubo bubo</i>	0	-	28.50	-	2.59	1	-	0	2686.00	2	10
<i>Bucephala clangula</i>	9.655	-	540.00	63.00	9.50	1	-	1	840.30	2	-
<i>Burhinus oediconemus</i>		-	62.00	-	1.90	1	-	-3	462.00	-	6
<i>Buteo buteo</i>	29.565	-	955.00	80.90	2.53	1	-	1	806.50	2	5
<i>Calandrella brachydactyla</i>	17.470	3.22864	10650.00	-	3.51	2	80	-2	22.25	1	7
<i>Calidris alpina</i>	30.520	-	435.00	75.00	3.77	1	-	-	43.05	2	-
<i>Caprimulgus europaeus</i>	55.710	-	735.00	-	2.00	2	-	-1	85.00	1	15
<i>Carduelis cannabina</i>	4.110	0.86737	19000.00	34.00	4.40	3	110	-2	18.95	1	11
<i>Carduelis carduelis</i>	1.160	0.80871	20500.00	35.00	4.77	3	1360	1	15.60	1	11
<i>Carduelis chloris</i>	1.340	0.78124	23000.00	43.00	4.83	2	1360	0	27.65	1	9
<i>Carduelis flammea</i>	9.460	1.35097	13900.00	42.50	5.00	2	390	-	13.05	1	14
<i>Carduelis spinus</i>	6.830	1.25614	14000.00	39.00	4.36	2	40	-	13.80	1	3
<i>Carpodacus erythrinus</i>	24.220	2.13671	4550.00	76.00	5.13	1	40	0	23.40	1	11
<i>Casmerodius albus</i>	-	-	17.50	74.00	4.00	1	-	3	995.00	2	-
<i>Certhia brachydactyla</i>	0	1.47324	6200.00	-	5.90	2	60	1	9.15	1	5
<i>Certhia familiaris</i>	0	0.89050	8350.00	44.00	5.43	2	60	0	9.15	1	4
<i>Cettia cetti</i>	2.105	1.96428	1100.00	-	4.55	2	60	1	14.10	1	14
<i>Charadrius alexandrinus</i>	-	1.32258	28.50	60.00	3.00	2	300	-2	47.65	1	-
<i>Charadrius dubius</i>	-	-	175.00	45.00	3.87	2	-	-1	38.75	2	7
<i>Charadrius hiaticula</i>	2.565	1.25262	170.00	58.00	3.79	3	390	-1	63.25	1	7

<i>Chlidonias hybrida</i>	-	-	64.50	-	2.74	1	-	-	88.00	-	-
<i>Chlidonias leucopterus</i>	52.550	-	142.00	-	2.80	1	-	-	59.80	-	-
<i>Chlidonias niger</i>	57.080	-	126.50	-	2.83	1	10	-	72.50	2	-
<i>Ciconia ciconia</i>	41.865	-	200.00	79.00	4.00	1	10	2	3448.00	3	14
<i>Ciconia nigra</i>	11.740	-	9.90	-	3.20	1	-	0	3000.00	-	-
<i>Cinclus cinclus</i>	0	1.10498	250.00	57.50	4.42	2	60	0	61.90	1	5
<i>Circaetus gallicus</i>	-	-	10.70	-	1.00	1	-	-1	1699.50	3	-
<i>Circus aeruginosus</i>	6.420	-	116.50	74.00	4.66	1	-	2	584.50	2	7
<i>Circus cyaneus</i>	52.545	-	45.50	72.40	4.46	1	-	-1	436.50	2	-
<i>Circus pygargus</i>	-	-	50.00	-	4.20	1	-	2	315.50	2	7
<i>Cisticola juncidis</i>	0	3.10324	665.00	-	5.70	3	110	0	8.50	1	6
<i>Coccothraustes coccothraustes</i>	5.070	1.45849	3300.00	-	4.60	1	40	0	54.70	1	13
<i>Columba livia</i>	0	-	12150.00	66.50	1.93	5	1360	-	261.00	1	4
<i>Columba oenas</i>	3.445	-	625.00	55.00	2.30	4	50	2	314.50	1	6
<i>Columba palumbus</i>	2.035	-	13000.00	64.00	1.84	3	-	1	494.50	1	10
<i>Coracias garrulus</i>	55.745	-	81.50	-	3.80	1	-	-3	147.00	1	10
<i>Corvus corax</i>	0	0.84762	710.00	-	4.50	1	390	1	1200.55	4	9
<i>Corvus corone</i>	5.715	0.81402	12000.00	73.60	4.10	1	60	0	544.50	3	9
<i>Corvus frugilegus</i>	2.315	1.86185	14000.00	62.00	4.45	1	50	-	453.50	2	7
<i>Corvus monedula</i>	0.285	1.65637	10100.00	65.00	4.40	1	60	0	249.00	2	2
<i>Coturnix coturnix</i>	9.250	1.77802	3750.00	-	10.20	2	1360	-	98.75	1	3
<i>Crex crex</i>	67.915	-	1650.00	-	8.90	2	-	-	146.50	1	3
<i>Cuculus canorus</i>	49.380	0.60334	6400.00	-	9.20	1	68	-1	120.50	1	16

<i>Cygnus olor</i>	1.080	-	103.00	81.00	6.00	1	-	3	10750.00	3	14
<i>Delichon urbicum</i>	44.250	0.70023	16950.00	43.00	4.10	2	130	-2	19.55	1	4
<i>Dendrocopos leucotos</i>	0	-	365.00	-	4.00	1	-	0	107.00	1	-
<i>Dendrocopos major</i>	0	0.76591	15000.00	-	5.50	1	75	0	89.65	1	5
<i>Dendrocopos medius</i>	0	1.25503	225.00	-	5.64	1	0	0	59.00	1	-
<i>Dendrocopos minor</i>	0	-	775.00	-	5.00	1	-	-	25.50	1	-
<i>Dendrocopos syriacus</i>	0	-	815.00	-	5.10	1	-	-1	76.75	1	-
<i>Dryocopus martius</i>	0	-	1070.00	-	4.80	1	-	0	273.00	1	4
<i>Egretta garzetta</i>	7.530	-	81.00	-	4.80	1	-	1	532.50	1	6
<i>Emberiza cia</i>	0	3.22360	2700.00	-	3.78	3	40	0	23.25	1	10
<i>Emberiza cirrus</i>	0.480	1.56446	3600.00	-	3.53	3	40	2	23.75	1	9
<i>Emberiza citrinella</i>	4.720	1.22809	24500.00	53.00	4.49	3	40	-1	26.75	1	10
<i>Emberiza hortulana</i>	36.475	1.30111	10600.00	-	4.52	1	40	-1	20.60	1	10
<i>Emberiza schoeniclus</i>	10.520	0.79075	6800.00	51.70	4.76	2	40	-1	18.80	1	15
<i>Erithacus rubecula</i>	5.000	0.63316	63000.00	38.00	5.00	3	1360	1	16.35	1	3
<i>Eudromias morinellus</i>	-	2.18801	26.50	-	2.92	1	50	-1	108.50	-	-
<i>Falco cherrug</i>	-	-	0.45	-	4.00	1	-	-3	987.50	-	-
<i>Falco columbarius</i>	16.545	1.54198	40.00	-	3.96	1	390	-	187.00	1	-
<i>Falco peregrinus</i>	15.105	-	18.50	75.00	3.40	1	380	-2	889.25	2	-
<i>Falco subbuteo</i>	41.735	-	95.50	-	2.93	1	-	0	211.00	1	-
<i>Falco tinnunculus</i>	5.595	-	415.00	65.00	4.72	1	-	-2	174.50	1	11
<i>Falco vespertinus</i>	-	-	32.50	-	3.48	1	-	-3	155.25	-	-
<i>Ficedula albicollis</i>	61.280	2.24109	1900.00	45.00	5.80	1	60	1	13.40	1	4

<i>Ficedula hypoleuca</i>	42.995	1.38868	16000.00	49.90	7.45	1	40	-2	14.35	1	10
<i>Ficedula parva</i>	31.650	2.31897	3900.00	-	5.70	1	40	0	11.70	1	3
<i>Fringilla coelebs</i>	5.535	0.40446	185000.00	64.00	4.30	2	1360	0	24.20	1	10
<i>Fringilla montifringilla</i>	13.750	2.08748	17500.00	-	5.80	2	10	0	22.65	1	3
<i>Fulica atra</i>	3.320	-	1800.00	76.50	7.46	2	1500	-	732.50	1	12
<i>Galerida cristata</i>	0	1.52568	5600.00	-	3.90	3	60	0	44.65	1	10
<i>Gallinago gallinago</i>	7.050	-	1415.00	48.10	3.89	1	-	-2	106.50	1	15
<i>Gallinula chloropus</i>	2.125	1.44627	1300.00	-	6.58	3	1000	0	348.50	1	8
<i>Garrulus glandarius</i>	0	1.45058	9500.00	59.00	4.80	1	60	0	161.70	1	7
<i>Glareola pratincola</i>	-	-	14.00	-	3.00	1	-	-2	77.10	-	-
<i>Glaucidium passerinum</i>	0	-	78.50	-	5.20	1	-	0	65.50	1	-
<i>Grus grus</i>	39.095	-	92.00	-	2.00	1	-	3	4541.50	5	15
<i>Haematopus ostralegus</i>	21.385	1.44627	375.00	84.10	2.78	1	400	-2	531.00	3	2
<i>Haliaeetus albicilla</i>	-	-	5.80	70.00	2.10	1	-	3	4793.00	5	-
<i>Hieraaetus pennatus</i>	-	-	6.65	-	2.00	1	-	0	842.00	-	-
<i>Himantopus himantopus</i>	-	-	50.50	-	4.00	1	-	-	178.75	-	-
<i>Hippolais icterina</i>	71.335	1.73994	5300.00	34.80	5.04	1	60	-1	13.30	1	10
<i>Hippolais polyglotta</i>	30.625	2.61408	2000.00	-	4.33	2	60	-	11.45	1	5
<i>Hirundo daurica</i>	5.000	2.23290	265.00	-	4.13	3	80	0	22.25	1	2
<i>Hirundo rupestris</i>	0.945	2.36736	245.00	-	3.20	2	80	0	20.55	1	5
<i>Hirundo rustica</i>	42.340	0.71864	26000.00	37.00	4.40	3	130	-1	19.10	1	4
<i>Ixobrychus minutus</i>	-	-	90.00	-	5.50	1	-	0	147.50	2	5
<i>Jynx torquilla</i>	35.195	-	940.00	-	8.20	3	-	-2	37.35	1	5

<i>Lagopus muta</i>	0	-	915.00	-	6.60	1	-	-	426.50	1	2
<i>Lanius collurio</i>	64.725	1.38780	9650.00	50.00	4.44	1	60	-1	30.70	1	16
<i>Lanius excubitor</i>	4.865	2.89031	325.00	-	6.20	1	110	-2	66.90	1	9
<i>Lanius minor</i>	62.590	2.79673	1060.00	-	6.17	1	10	-2	46.55	1	11
<i>Lanius senator</i>	28.445	2.90765	840.00	-	5.38	1	60	-2	36.00	1	8
<i>Larus argentatus</i>	22.135	-	1525.00	93.50	3.00	1	1360	3	895.00	4	13
<i>Larus canus</i>	13.760	1.48279	1045.00	74.00	3.00	1	-	-	386.50	3	9
<i>Larus fuscus</i>	34.345	-	325.00	-	2.71	1	400	3	817.50	4	2
<i>Larus marinus</i>	7.275	-	145.00	-	2.90	1	-	3	1599.50	5	7
<i>Larus melanocephalus</i>	-	-	220.00	-	3.00	1	-	0	-	3	-
<i>Larus minutus</i>	9.760	-	41.00	-	2.71	1	-	2	98.50	-	-
<i>Larus ridibundus</i>	23.500	-	1850.00	76.00	2.54	1	-	-2	280.50	2	15
<i>Limosa limosa</i>	50.595	-	119.50	63.10	3.86	1	-	-3	331.50	2	9
<i>Locustella fluviatilis</i>	63.420	1.97693	3250.00	-	5.00	1	40	0	18.80	1	10
<i>Locustella luscinioides</i>	29.940	2.81959	665.00	-	5.00	2	40	0	16.60	1	8
<i>Locustella naevia</i>	29.745	1.57225	1520.00	-	5.45	3	40	-	12.70	1	11
<i>Loxia curvirostra</i>	0	0.98983	9400.00	-	3.70	3	110	-	40.60	1	5
<i>Loxia pytyopsittacus</i>	0	1.73107	680.00	-	3.70	2	40	-	54.40	1	1
<i>Lullula arborea</i>	3.795	2.60944	2300.00	-	3.97	2	60	0	30.05	1	11
<i>Luscinia luscinia</i>	63.100	1.72902	5300.00	-	4.80	1	60	0	25.00	1	5
<i>Luscinia megarhynchos</i>	32.195	1.21489	8100.00	48.50	4.75	2	60	0	20.15	1	9
<i>Luscinia svecica</i>	25.500	2.02385	6150.00	66.00	6.19	2	10	0	18.25	1	7
<i>Mergus merganser</i>	4.890	-	60.50	60.00	9.50	1	-	-1	1641.50	2	5

<i>Mergus serrator</i>	11.055	-	96.50	-	9.20	1	-	-1	1090.50	2	8
<i>Merops apiaster</i>	19.860	1.73586	740.00	-	6.00	1	68	2	55.10	1	12
<i>Miliaria calandra</i>	6.405	1.82974	14950.00	48.00	3.97	3	110	-2	47.65	1	8
<i>Milvus migrans</i>	15.790	-	82.00	-	2.50	1	-	-3	828.50	3	4
<i>Milvus milvus</i>	-	-	22.00	82.20	2.00	1	-	-2	1015.50	3	-
<i>Monticola saxatilis</i>	38.375	2.42298	210.00	-	4.50	2	80	-1	51.25	1	8
<i>Monticola solitarius</i>	9.305	1.82703	190.00	-	4.54	2	130	0	51.25	1	9
<i>Montifringilla nivalis</i>	0	2.04762	1060.00	-	3.90	2	60	0	32.45	1	5
<i>Motacilla alba</i>	18.125	0.81772	19500.00	52.00	5.10	3	390	0	20.75	1	11
<i>Motacilla cinerea</i>	24.675	1.45038	1170.00	-	4.90	3	1360	0	17.35	1	10
<i>Motacilla flava</i>	40.985	1.17877	10950.00	34.25	5.20	2	60	-1	17.45	1	17
<i>Muscicapa striata</i>	64.400	1.31829	18000.00	72.00	4.25	2	40	-1	15.50	1	13
<i>Netta rufina</i>	11.845	-	43.00	-	9.00	1	-	2	1156.50	1	-
<i>Nucifraga caryocatactes</i>	0	1.21995	630.00	-	3.50	1	130	0	193.00	1	2
<i>Numenius arquata</i>	44.670	-	290.00	73.60	3.78	1	-	-2	725.00	2	11
<i>Nycticorax nycticorax</i>	9.085	-	75.00	75.45	4.00	1	-	0	636.00	2	-
<i>Oenanthe oenanthe</i>	38.175	1.65515	8800.00	55.00	5.50	2	390	-2	23.95	1	7
<i>Oriolus oriolus</i>	44.765	1.23513	5250.00	-	3.80	1	60	-1	68.50	1	8
<i>Otis tarda</i>	-	-	33.50	-	2.50	1	-	0	7895.50	-	-
<i>Otus scops</i>	-	-	325.00	-	4.50	1	80	-	90.50	1	11
<i>Pandion haliaetus</i>	13.420	-	9.30	81.50	2.63	1	-	2	1527.50	3	7
<i>Panurus biarmicus</i>	-	2.64748	360.00	43.00	5.86	3	40	0	15.30	1	3
<i>Parus ater</i>	0	0.74414	20500.00	33.80	8.50	2	130	0	9.25	1	5

<i>Parus caeruleus</i>	0	1.21499	32000.00	41.60	11.76	2	110	0	11.75	1	9
<i>Parus cristatus</i>	0	1.19447	9050.00	53.70	6.50	2	40	-2	11.15	1	3
<i>Parus major</i>	0	0.95905	68500.00	48.60	10.92	2	130	0	18.50	1	8
<i>Parus montanus</i>	0	1.12923	33000.00	60.00	8.05	1	40	-1	11.65	1	11
<i>Parus palustris</i>	0	0.97597	4500.00	-	8.02	2	40	-2	11.90	1	7
<i>Passer domesticus</i>	0	0.66175	96500.00	55.00	4.00	4	60	-2	30.35	1	6
<i>Passer hispaniolensis</i>	2.370	1.90612	4500.00	46.00	4.30	2	240	0	26.60	1	8
<i>Passer montanus</i>	3.620	0.71310	37000.00	41.50	4.92	3	130	-2	21.70	1	4
<i>Perdix perdix</i>	0	-	2350.00	44.00	14.60	1	-	-3	382.00	1	5
<i>Pernis apivorus</i>	60.745	-	135.00	-	2.00	1	-	0	626.00	3	-
<i>Phalacrocorax aristotelis</i>	-	2.35644	92.00	84.00	3.07	1	-	0	1790.00	3	2
<i>Phalacrocorax carbo</i>	2.635	-	340.00	89.50	3.50	1	-	3	2254.00	3	9
<i>Philomachus pugnax</i>	52.205	-	355.00	52.40	3.72	1	-	-2	140.50	2	-
<i>Phoenicurus ochruros</i>	15.830	1.32356	6400.00	55.30	4.90	3	40	1	16.00	1	3
<i>Phoenicurus phoenicurus</i>	33.930	0.65445	11400.00	38.00	6.04	2	40	0	15.90	1	7
<i>Phylloscopus bonelli</i>	26.855	2.59834	2450.00	-	5.30	2	60	-2	7.75	1	4
<i>Phylloscopus collybita</i>	22.550	0.67949	45445.00	36.70	5.50	2	110	0	7.70	1	9
<i>Phylloscopus sibilatrix</i>	52.745	2.34648	18000.00	38.60	5.90	2	40	-2	9.10	1	6
<i>Phylloscopus trochiloides</i>	26.790	3.00982	13500.00	-	4.70	1	60	0	7.05	1	9
<i>Phylloscopus trochilus</i>	68.085	1.16365	78000.00	32.70	6.20	2	40	-1	9.35	1	13
<i>Pica pica</i>	0	1.02863	13250.00	69.00	5.90	1	130	-2	228.00	2	9
<i>Picoides tridactylus</i>	0	-	725.00	-	3.40	1	-	-	65.65	-	-
<i>Picus canus</i>	0	-	250.00	-	8.00	1	120	0	136.50	1	6

<i>Picus viridis</i>	0	-	945.00	-	6.10	1	100	0	193.50	1	10
<i>Platalea leucorodia</i>	7.045	-	11.95	-	3.50	1	-	0	1261.50	3	6
<i>Pluvialis apricaria</i>	17.970	-	600.00	61.00	3.85	1	-	-	175.50	2	-
<i>Podiceps auritus</i>	10.440	-	8.65	-	4.50	1	-	-2	394.00	-	-
<i>Podiceps cristatus</i>	4.405	-	375.00	-	3.50	2	-	-2	875.00	2	8
<i>Podiceps grisegena</i>	7.870	-	44.00	80.50	4.50	2	-	-1	829.75	-	-
<i>Podiceps nigricollis</i>	-	-	74.50	-	3.20	2	-	-1	294.50	-	-
<i>Porzana parva</i>	-	-	100.50	-	6.75	2	-	-1	54.10	-	-
<i>Porzana porzana</i>	47.000	-	190.00	-	10.30	2	-	-	80.80	-	4
<i>Porzana pusilla</i>	-	-	1.98	-	7.40	2	-	-	44.00	-	-
<i>Prunella collaris</i>	0	1.72271	140.00	50.80	3.50	2	130	0	42.25	1	2
<i>Prunella modularis</i>	9.230	1.11184	19000.00	49.00	5.10	3	40	0	18.95	1	18
<i>Pyrrhocorax graculus</i>	0	1.55393	220.00	-	4.20	1	60	0	230.35	1	2
<i>Pyrrhocorax pyrrhocorax</i>	0	1.81405	76.50	74.00	4.70	1	110	-2	330.00	1	6
<i>Pyrrhula pyrrhula</i>	0	0.39797	10650.00	44.50	4.67	3	40	0	31.05	1	10
<i>Rallus aquaticus</i>	2.690	-	250.00	-	8.50	2	-	-1	115.50	1	3
<i>Recurvirostra avosetta</i>	3.030	-	47.50	71.80	3.90	1	50	0	282.00	2	11
<i>Regulus ignicapilla</i>	1.610	1.45922	5000.00	-	8.80	2	80	0	5.25	1	7
<i>Regulus regulus</i>	0	0.67158	27000.00	22.00	10.36	2	1360	0	5.80	1	4
<i>Remiz pendulinus</i>	10.315	1.15286	315.00	-	4.40	2	40	0	9.15	1	8
<i>Riparia riparia</i>	42.725	0.74595	7450.00	35.00	4.78	2	80	-	13.15	1	7
<i>Rissa tridactyla</i>	6.975	-	2550.00	83.50	2.01	1	-	-2	407.00	4	2
<i>Saxicola rubetra</i>	34.835	1.38489	7700.00	46.00	5.66	2	60	-1	16.60	1	10

<i>Saxicola torquatus</i>	3.975	1.19723	3300.00	31.90	5.06	4	400	2	14.90	1	9
<i>Scolopax rusticola</i>	14.320	-	4200.00	61.00	3.84	1	-	-2	309.50	1	8
<i>Serinus serinus</i>	4.905	1.78724	14150.00	60.30	4.00	2	110	0	11.95	1	6
<i>Sitta europaea</i>	0	0.89808	13250.00	43.00	7.10	1	130	0	23.90	1	8
<i>Somateria mollissima</i>	3.345	-	1020.00	94.00	4.60	1	-	1	2066.50	2	3
<i>Sterna albifrons</i>	11.895	-	45.00	-	2.05	1	-	-2	57.50	2	4
<i>Sterna hirundo</i>	52.750	-	420.00	92.00	2.65	1	-	0	125.00	4	-
<i>Sterna nilotica</i>	40.250	-	17.00	77.20	2.35	1	-	-2	232.90	4	-
<i>Sterna paradisaea</i>	114.170	-	700.00	87.50	2.66	1	-	-	109.50	4	15
<i>Sterna sandvicensis</i>	49.255	-	106.00	78.00	1.43	1	-	-1	249.00	3	-
<i>Streptopelia decaocto</i>	0	-	7850.00	61.00	1.97	6	275	2	201.50	1	4
<i>Streptopelia turtur</i>	25.895	-	5350.00	50.00	1.90	3	75	-2	136.50	1	11
<i>Strix aluco</i>	0	-	740.00	52.40	2.70	1	120	0	491.00	1	7
<i>Strix uralensis</i>	0	-	96.50	90.00	2.80	1	23	0	730.00	1	-
<i>Sturnus vulgaris</i>	2.630	0.86001	39500.00	47.00	5.40	2	1360	-2	80.50	1	8
<i>Sylvia atricapilla</i>	19.635	0.71120	37000.00	46.00	4.65	2	1360	1	18.85	1	7
<i>Sylvia borin</i>	63.250	0.81249	24000.00	45.70	4.03	2	40	0	19.05	1	9
<i>Sylvia communis</i>	53.050	0.67781	19500.00	26.10	4.63	2	40	1	14.50	1	12
<i>Sylvia curruca</i>	27.785	0.79491	6300.00	45.80	4.78	2	40	0	12.40	1	15
<i>Sylvia nisoria</i>	44.775	2.32415	730.00	39.00	5.02	1	60	-	24.35	1	11
<i>Tachybaptus ruficollis</i>	-	-	134.50	-	5.00	3	-	0	190.00	1	8
<i>Tachymarptis melba</i>	11.520	-	235.00	79.10	2.70	1	-	1	92.00	2	2
<i>Tadorna tadorna</i>	9.350	-	53.50	80.00	9.00	1	-	0	1152.00	2	7

<i>Tetrao tetrix</i>	0	1.52890	2850.00	50.00	7.91	1	38	-1	1107.00	1	10
<i>Tetrao urogallus</i>	0	-	880.00	56.50	8.43	1	-	0	3112.50	3	6
<i>Tichodroma muraria</i>	1.085	2.05948	69.00	-	4.50	1	0	0	16.60	1	3
<i>Tringa glareola</i>	62.890	-	775.00	53.60	4.00	1	-	0	67.50	1	-
<i>Tringa nebularia</i>	49.155	-	117.50	-	3.91	1	-	0	173.50	1	14
<i>Tringa ochropus</i>	36.415	-	565.00	-	4.00	1	-	-	84.80	1	-
<i>Tringa totanus</i>	35.280	-	445.00	71.30	3.95	1	-	-2	112.00	1	11
<i>Troglodytes troglodytes</i>	1.340	1.75629	31500.00	37.00	5.70	2	390	1	8.90	1	14
<i>Turdus iliacus</i>	10.765	1.83365	18500.00	42.50	5.50	2	390	0	62.85	1	5
<i>Turdus merula</i>	3.980	0.95471	61000.00	56.00	3.87	4	1360	1	95.85	1	11
<i>Turdus philomelos</i>	14.650	0.63432	28000.00	46.00	4.70	4	40	0	70.50	1	7
<i>Turdus pilaris</i>	10.770	1.20081	19000.00	35.00	5.20	2	40	0	92.10	1	6
<i>Turdus torquatus</i>	14.130	1.45795	490.00	-	4.10	2	40	0	117.00	1	14
<i>Turdus viscivorus</i>	4.360	0.66718	5200.00	52.00	3.92	3	40	0	117.80	1	7
<i>Tyto alba</i>	0	1.46435	165.00	57.10	5.70	3	428	-2	332.50	1	6
<i>Upupa epops</i>	9.585	2.66310	1295.00	-	7.00	2	428	-2	67.05	1	12
<i>Uria aalge</i>	1.070	3.26290	2350.00	87.90	1.00	1	-	-	861.50	5	2
<i>Vanellus vanellus</i>	12.080	-	2250.00	67.80	3.85	1	-	-3	218.50	2	8

Table S4 Forward stepwise procedure used to determine the final model that best predicted bird population response to anthropogenic and natural fragmentation of non-mountainous land areas. First, all ten species-specific parameters were analysed one by one as predictors, with the estimate of response to fragmentation as the dependent variable (first column). When at least one of the parameters was related to response to fragmentation with $P < 0.10$, all tests were repeated (second column), but also including in the models the factor showing the smallest P -value in the first set of analyses (population size in this case). If at least one additional parameter showed $P < 0.10$ in the second set of analyses, then all tests were repeated again (third column) including in the models the parameter previously selected (population size) and the additional factor showing the lowest P -value in the second set of analyses (migration distance in this case). If at least one additional parameter showed $P < 0.10$ in the third set of analyses, then all tests were repeated again (fourth column) including in the models all parameters previously selected (population size and migration distance) and the additional factor showing the lowest P -value in the third set of analyses (body mass in this case). The procedure was repeated as many times as necessary and ended when inclusion of an additional parameter in the models did not result in new factors showing $P < 0.10$. The final model included all parameters (shown in bold) that had been selected in the different sets of analyses. All analyses were phylogenetic generalized least square regression models controlling for phylogenetic relations among species and for number of countries used to estimate response to fragmentation in each species (see main text for details). Heterogeneity distr. = Heterogeneity of distribution; Age at first repr. = Age at first reproduction. # $P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

	Factors analysed one by one		Also including population size		Also including migration distance		Also including body mass		Also including age at first repr.	
Factor	<i>n</i>	<i>t</i>	<i>n</i>	<i>t</i>	<i>n</i>	<i>t</i>	<i>n</i>	<i>t</i>	<i>n</i>	<i>t</i>
Population size	261	4.68***	-	-	-	-	-	-	-	-
Population trend	222	-0.06	222	-0.02	196	-0.22	196	-0.48	192	-0.18
Heterogeneity distr.	137	-1.07	137	0.62	133	-0.06	133	-0.08	133	-0.05
Migration distance	231	3.83***	231	3.90***	-	-	-	-	-	-
Dispersal distance	154	-0.71	154	-1.06	149	-0.24	149	-0.58	149	-0.71
Number of habitats	205	1.09	205	1.14	196	0.07	196	-0.12	195	-0.31
Body mass	260	-0.84	260	0.42	231	1.70#	-	-	-	-
Annual fecundity	259	1.40	259	0.28	230	0.81	230	1.33	223	0.13
Adult survival	145	-1.11	145	-0.46	137	-0.42	137	-1.41	136	-0.40
Age at first repr.	239	-1.40	239	-0.64	224	-0.98	224	-1.99*	-	-

Table S5 Backward stepwise procedure used to determine the final model that best predicted bird population response to anthropogenic and natural fragmentation of non-mountainous land areas. The table shows *P*-values from phylogenetic generalized least square regression models controlling for phylogenetic relations among species and for number of countries used to estimate response to fragmentation in each species (see main text for details). First, all ten species-specific parameters were included in the model as predictors, with the estimate of response to fragmentation as the dependent variable (first column). Then, the parameter with the largest *P*-value (population trend in this case) was excluded from the model and the test was repeated again (second column). The procedure was repeated as many times as necessary and ended when all parameters in the model showed $P < 0.10$. The largest *P*-value in each model (indicating the variable to be excluded) is shown in bold. Backward and forward stepwise procedures provided the same final model (see Table S1). Heterogeneity distr. = Heterogeneity of distribution; Age at first repr. = Age at first reproduction

Factor	Including all factors	Excluding population trend	Also excluding number of habitats	Also excluding dispersal distance	Also excluding heterogeneity distr.	Also excluding annual fecundity	Also excluding adult survival
Population size	0.066	0.078	0.074	0.124	0.051	0.046	0.006
Population trend	0.993	-	-	-	-	-	-
Heterogeneity distr.	0.603	0.551	0.545	0.678	-	-	-
Migration distance	0.048	0.024	0.020	0.016	0.001	0.001	0.000
Dispersal distance	0.643	0.698	0.701	-	-	-	-
Number of habitats	0.906	0.892	-	-	-	-	-
Body mass	0.763	0.494	0.481	0.647	0.008	0.008	0.022
Annual fecundity	0.406	0.503	0.491	0.572	0.948	-	-
Adult survival	0.416	0.313	0.302	0.369	0.733	0.689	-
Age at first repr.	0.050	0.042	0.031	0.170	0.011	0.008	0.047