The Catalan Breeding Bird Atlas 1999-2002

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Introduction

In 1984 the Atlas of Breeding Birds of Catalonia and Andorra was published (Muntaner et al, 1984). This pioneer work stood as a significant step forward in the knowledge of European Mediterranean avifauna and as one of the first extensive atlas published in southern Europe. In 1998 the Catalan Ornithological Institute (*Institut Català d'Ornitologia*, *ICO*) realised that there was a need to update the information provided by the first atlas and move forward in order to include information on species distribution changes occurred in Catalonia during the period between the two atlases. Bearing this in mind, the idea was proposed to the private foundation *Fundació Territori i Paisatge* and to the Catalan government's Ministry of the Environment. Needless to say, both institutions welcomed the proposition and from the very beginning funded the project, providing the necessary support for its success.

The present Catalan Breeding Bird Atlas includes information about the distribution of breeding birds in Catalonia during the period 1999-2002, presented in the same UTM 10×10 km grid used in the previous atlas. In this way, taking into account the sampling effort employed at each square in the two atlases, we could provide a robust evaluation of changes in species distribution during the last 20 years. Furthermore, the atlas contains maps of relative abundance at fine resolution for most species, information about habitat and landscape use and selection, as well as density estimates for several habitats obtained from the Catalan Common Bird Survey (SOCC). Finally, the book also reports for the first time exhaustive population estimates and conservation status at a regional level for all the breeding bird species.

Study area

Catalonia is an autonomous region situated in north-east Spain measuring nearly 32,000 km^2, roughly the size of Belgium. The country is located in the Mediterranean Basin, but in spite of its small size, it is remarkably heterogeneous, including a range of landscapes from alpine habitats to coastal marshes and from evergreen forests to steppes.

Sampling methods

A total of 385 10×10 UTM squares were surveyed during the atlas field work. The aim of this survey was to detect the maximum amount of evidence of breeding for all the species present. To do this, the observers were asked to try to find birds in all habitats, even minority ones, present within their square in order to avoid overlooking any species. Besides the generic sampling conducted in each UTM 10×10 square, observers surveyed a stratified subset of UTM 1×1 km squares within the former units. This approach is similar to the one used in the British, Swiss, Dutch and Flemish ornithological atlases (Gibbons et al. 1993, Schmid et al. 1998, SOVON Vogelonderzoek Nederland 2002, Vermeersch et al. 2004). Two 1-hour censuses were conducted for each one of the selected UTM 1x1 squares during which every square was entirely surveyed and every species detected was recorded. For nocturnal species, two additional 1-hour censuses were conducted at night. The number of individuals for a given species was not recorded. In total, 3,077 1×1 UTM squares corresponding to diurnal censuses and 1,204 to nocturnal ones were surveyed.

Study period

The field work was conducted during the period 1999-2002. As a general rule, the gathering of evidence of breeding was restricted to the period March-July inclusive but the surveying period for nocturnal raptors was brought backward to February in order to allow detection of territorial songs of species that call mainly in winter. In the UTM 1×1 squares, the first survey was conducted in March/April and the second in May/June to adapt to the periods of maximum activity of early and late breeders.

Changes in species' distribution

For a particular species, the quantification of changes in its distribution can be estimated by means of an analysis of the changes in occupied UTM 10×10 squares. However, this approach generates a problem: a temporal variation in sampling effort is often associated with a significant bias in the estimates of distribution changes. Unfortunately, the data collected for the first atlas

was not standardised in relation to the sampling effort applied to each UTM 10×10 square. Furthermore, despite the timed censuses conducted in the UTM 10×10 squares, a large portion of the data obtained for the new atlas comes from observations gathered in a non-standardised way.

The methodology used to solve the problems originating from changes in the sampling effort consisted of indirectly estimating the effective sampling time in every UTM 10×10 square for both atlases. These estimates were used as co variables in further analyses of changes in species' distribution between atlases. The analytical approach was based in the use of the timed censuses conducted in the sample of UTM 1×1 squares located within each of the UTM 10×10 squares. Species-time accumulation curves were drawn from these data and later used to estimate the effective surveying effort required for any particular value of species richness by reversing the process. The results of these trend analyses are shown in form of a table for each species together with the map that shows the distribution of the 1999-2002 period superimposed on the map from the 1975-1983 period (Figure 1).

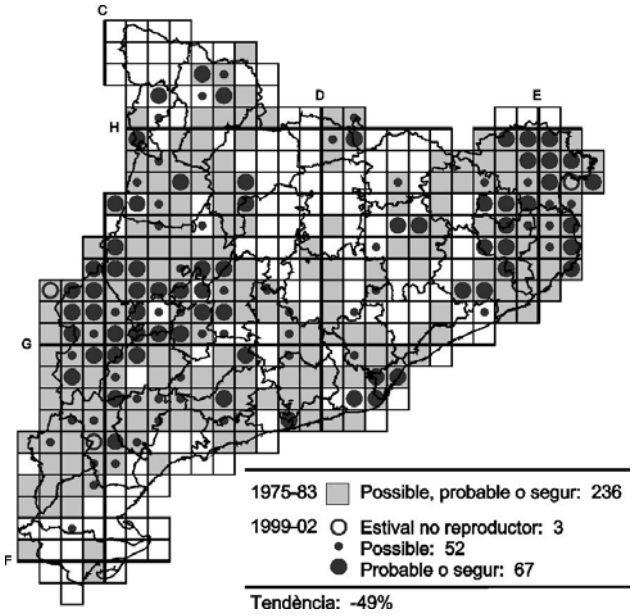

Fig. 1: Example of distribution map (Jackdaw) on a UTM 10×10 km grid. Circles present evidence of breeding in the period 1999-2002 in three categories: non-reproductive summer visitors (open circles), possible (small solid circles) and probable-confirmed (large solid circles). This distribution is superimposed on the map from the 1975-1983 period (solid squares). The trend (written in Catalan "tendència" *in the Figure) represents the changes in the number of 10×10 UTM squares occupied by the species, and is assessed by means of a statistical analysis that monitors the differences in sampling effort at each square between atlases.*

Abundance index maps

We also estimated the probability of occurrence of a species for all Catalan 1x1 UTM squares (roughly 32,000) by applying niche-based models to the data collected in the subset of 1×1 UTM squares that were surveyed. The models developed allowed us to estimate each species' response to a series of environmental variables and thereby obtain the predicted probability of occurrence for each species as a particular combination of environmental variables. The result of this procedure produced abundance index maps, which were finally produced for a total of 180 out of 232 breeding species (Figure. 2).

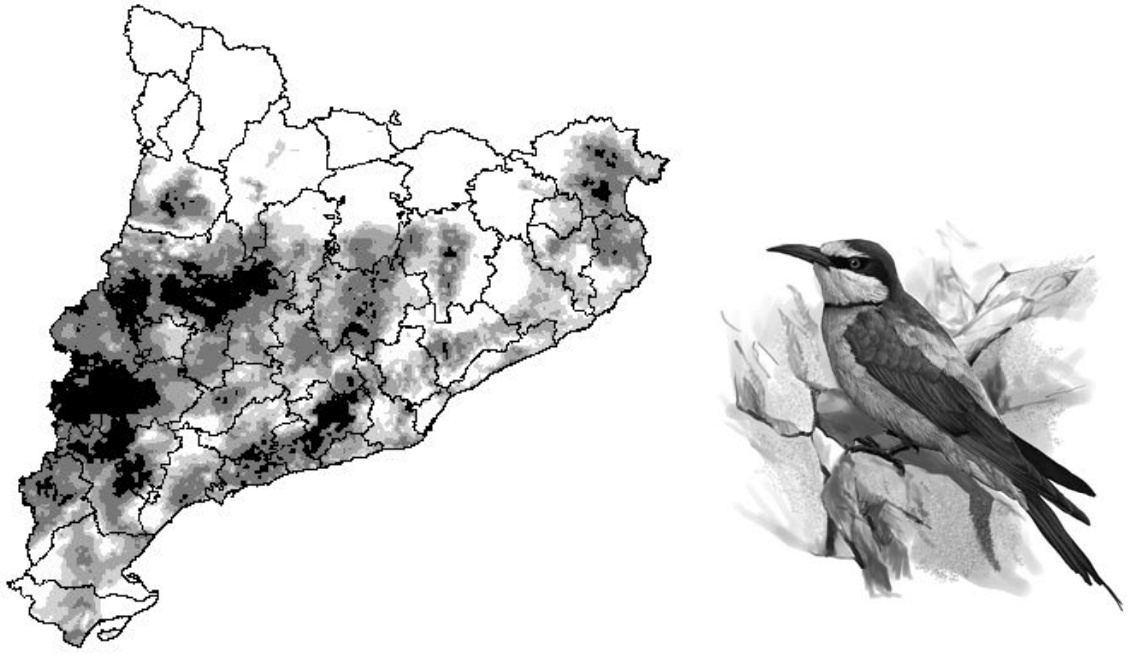

Fig. 2: Example of abundance index map (Bee-eater). This map shows the probability of detecting the species in each 1×1 km square during the breeding season with two 1-hour sampling periods (dark colour represents higher probabilities and light colour lower probabilities). This map has been generated by applying niche-based models to the data collected during 1×1 UTM square censuses.

In the modelling exercise used in the present atlas, we used a GLM with a logit link due to the binomial character of the presence/absence bird data employed (logistic regression, McCullagh & Nelder 1989). We used a cross-validation procedure to evaluate the accuracy of model predictions (Guisan & Zimmermann 2000). This procedure consisted of dividing the data (1× 1 UTM square surveys) into two different sets by randomly assigning 70% of occurrence values for each species to a calibration data-set and the remaining 30% of occurrences to an evaluation data-set. The calibration data-set was used to develop the niche-based model. The evaluation

consisted in measuring quantitatively to what degree predictions from the models fitted the independent observations that were not used for the development of the model.

Ecological requirements

The main objective of a bird atlas is to report on the distribution of birds in the area under study. Nevertheless, bird distribution is strongly linked to the occurrence of a series of environmental factors that are necessary for the completion of their life cycles. In the Catalan atlas, these ecological requirements, which vary in strictness from one species to another, are described in terms of ranges in altitude and habitat use and selection. In the texts for each species, various experts discuss some of the species' main ecological requirements; also included in this section is information regarding the selection of altitudinal ranges (Figure 3) and habitat composition, as well as densities from the Catalan Common Bird Survey (SOCC) in the principal habitat types.

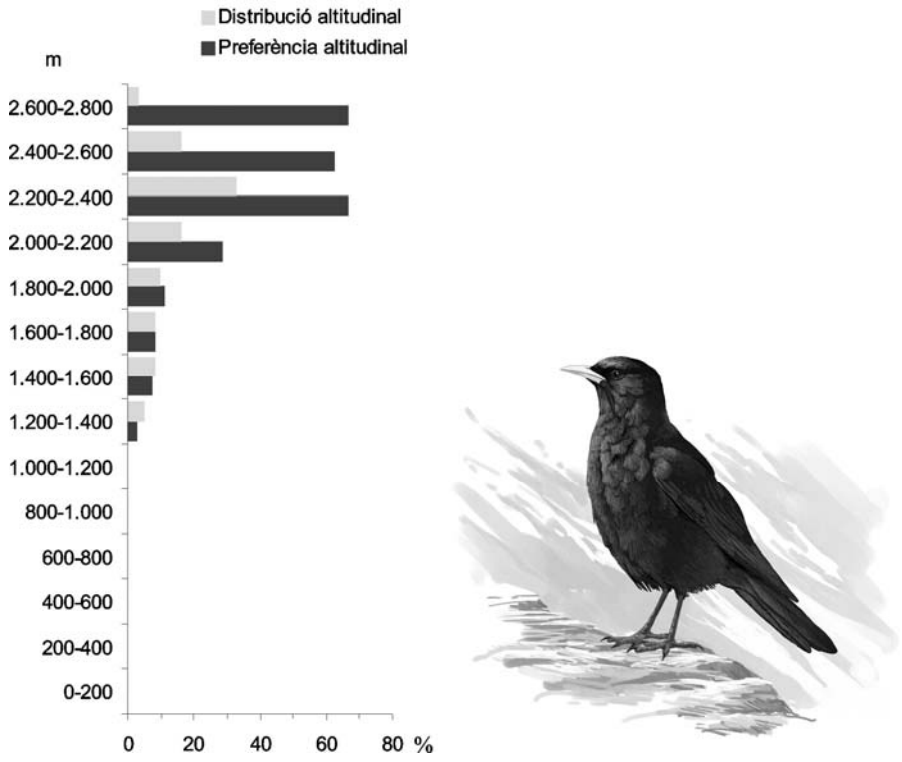

Fig. 3: Example of altitude graph (Alpine Chough). This shows the altitudinal ranges in which the species has been detected and which ranges are selected. Distribution bars (light grey) show the percentage of all observations of a species found in each altitudinal range; the sum of all the values for each range is 100%. Preference bars (dark grey), on the other hand, show the percentage of squares within an altitudinal range in which the species was found and indicate the selection for each altitudinal range.

Population estimates

One of the critical objectives of the present atlas was to generate reliable population estimates for the different bird species breeding in Catalonia. Generally, due to their scarcity, some species have been the target of greater conservation efforts and research institutes, governments and individuals have devoted a significant amount of time to estimate their populations. This atlas is a comprehensive attempt to integrate all information gathered by all these specific monitoring schemes. Nevertheless, specific procedures allowing direct evaluation of population size only exist for a few breeding species. Thus, two new methodologies had to be explored to address this issue which consisted in either, the use of qualitative field data estimation collected by atlas contributors at each UTM 10×10 km square or the combination of data from monitoring projects currently running in Catalonia such as the Catalan Common Bird Survey in Catalonia (SOCC) and the Catalan Ringing Constant Effort Site Network (SYLVIA).

This last methodology is exemplified by the Atlas-SOCC model, a procedure used to estimate the population of many common bird species from which both abundance index maps and density data from common bird surveys were available. The initial hypothesis behind this procedure is that the probability or frequency of occurrence of a species in a given area is related to its absolute abundance (see Gibbons *et al.* 1993, Robertson *et al.* 1995). Taking this into account, a statistical model for each species was built in order to relate the absolute abundance (pairs/km^2) of the SOCC transect (3 km) to the mean abundance index (from 0 to 1) of the 3 1×1 UTM squares in which this transect was located. We used this methodology to estimate the population of 65 species of common breeding birds in Catalonia (Figure 4).

Finally, in species for which the Atlas-SOCC model did not give reliable results and data from specific monitoring schemes were lacking, we used a methodology based on the qualitative estimates given by observers at each 10×10 UTM square (I: 1-9 pairs, II: 10-99 pairs, III: 100-999 pairs, IV: 1,000-9,999 pairs, V: >10,000 pairs). Then, the Catalan population was assessed following the methodology used in the EBCC atlas of European breeding birds (Hagemeijer & Blair, 1997), which is based on geometric means as the most reliable estimator of each square's population. This methodology tries to capture quantitatively contributors' impressions of bird numbers, since, although observers were not asked to count birds, they spent many hours covering the 10×10 square looking for birds.

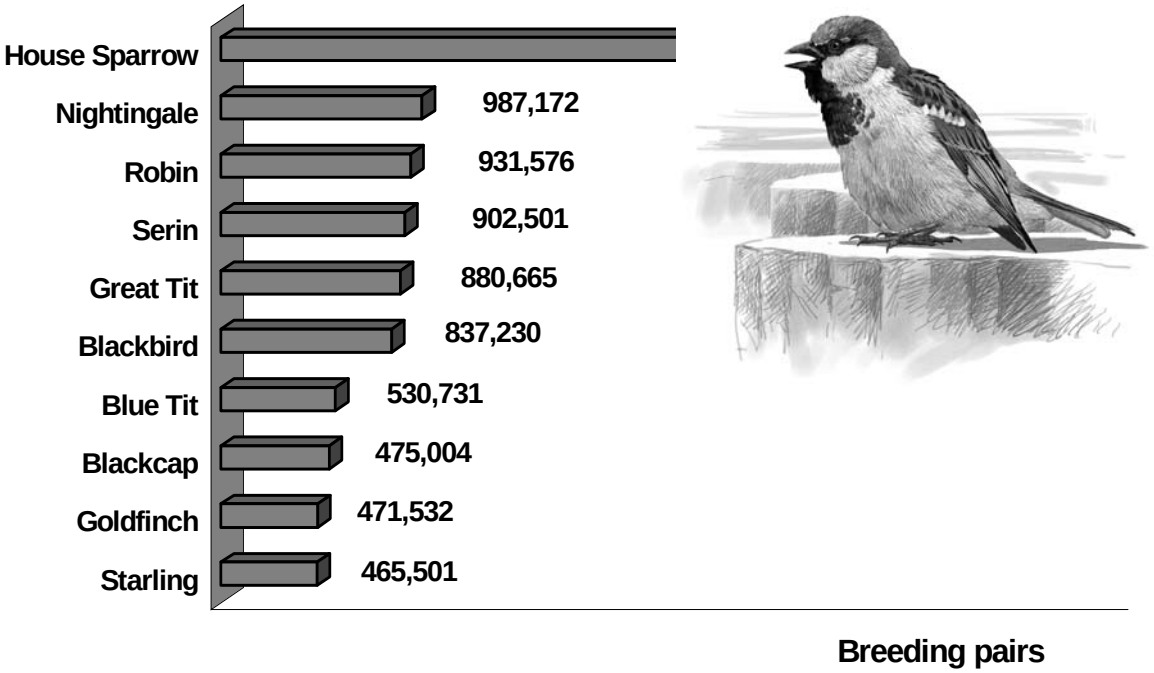

Fig. 4: Mean population estimates for the 10 most abundant breeding species in Catalonia. All these results come from the Atlas-SOCC model.

Species conservation status

Finally, the Catalan Breeding Bird Atlas 1999-2002 atlas provides a standardised and objective assessment of the conservation status of the bird species that breed in Catalonia. We decided to follow the IUCN (International Union for Conservation of Nature) criteria (UICN 2001) using regional corrections as proposed by Gärdenfors et al. (2001) to assess conservation status categories: Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR) and Extinct (EX).

One of the most obvious usefulness of this work of classification is the representation of conservation status in relation to habitat type (Figure 5). The results of this work show very clearly that steppe species stand, as a whole, as the most threatened group of birds in Catalonia.

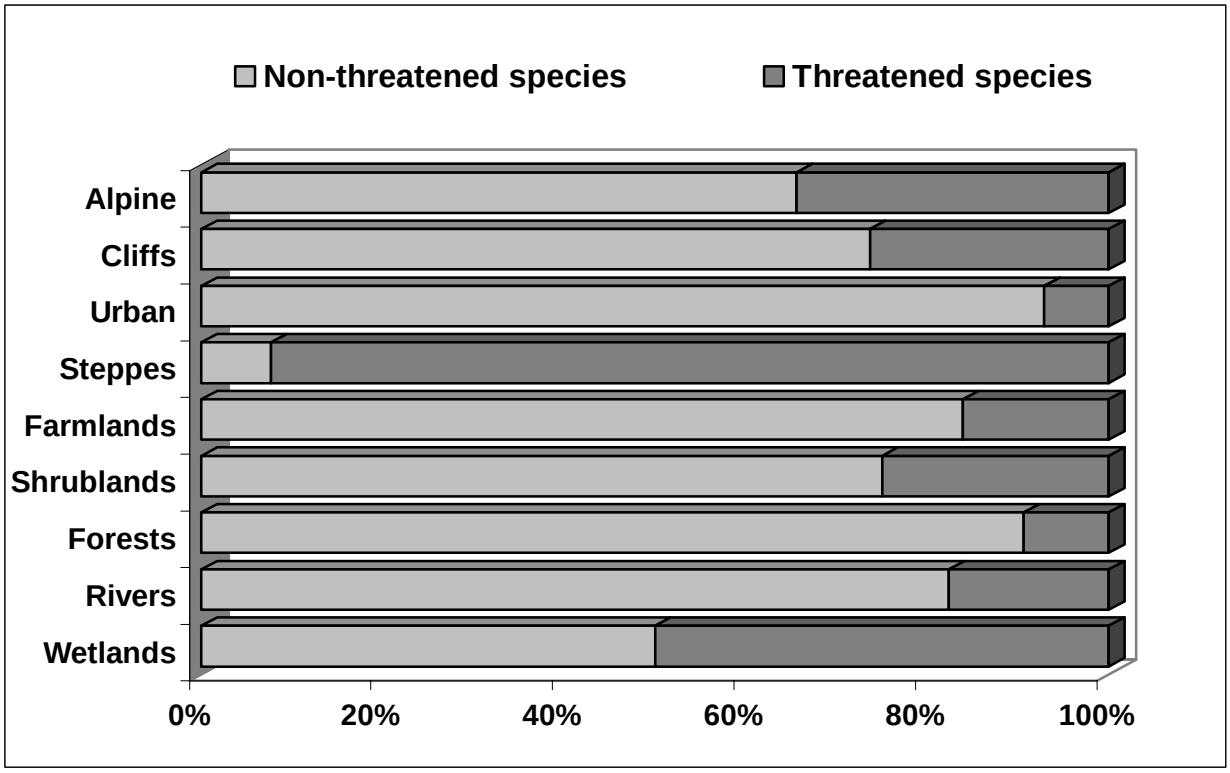

Fig. 5: Percentage of threatened (Vulnerable, Endangered and Critically endangered) and non-threatened species in the main habitat types. The species category was assigned following IUCN recommendations for the assessment of the conservation status at a regional scale. 90% of steppe species were classified as Vulnerable, Endangered or Critically endangered, a figure clearly higher than those obtained for the other habitat types.

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