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Counting mammals while counting birds: results and perspectives from Catalan Common Bird Survey

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Abstract. Bird monitoring schemes are prevalent throughout European countries. However, despite being less common and more complex to develop, mammal monitoring projects are increasingly more widespread. In recent decades, some bird monitoring schemes have incorporated observations of mammals to increase the amount of standardised large-scale monitoring data for this group. In 2008, the Catalan Common Bird Survey (SOCC) included mammals in their protocol. Standardised observations of mammals were obtained across 336 transects, and population trends for seven mammal species have been calculated. Our results indicate five increasing trends, one stable, and one uncertain. This study points towards the potential benefits of integrating observations of mammals in bird monitoring schemes.

Introduction

Bird monitoring schemes allow to determine relative measurements of abundance and population trends on a yearly basis (Voříšek et al. 2008). Birdwatchers that participate in these projects love identifying and counting birds, but most of them are also naturalists and, as such, are also attracted to other groups of species. This broader interest in life-history possibly contributed to enlarging the scope of some bird monitoring programmes to count mammals and not only birds as they were designed for initially. Since 1995, the British Trust for Ornithology has clearly illustrated this issue by obtaining mammal observations in 80–90% of its survey sites for three of its programs: the BTO/JNCC/RSPB Breeding Bird Survey (BBS), BTO/JNCC/RSPB Waterways Breeding Bird Survey (WBBS), and Garden BirdWatch (GBW) (Battersby & Greenwood 2004). In fact, the data collected by the BBS in the UK currently produces population trends for nine mammal species (Harris et al. 2021). Additionally, NOF BirdLife Norway, the Norwegian Institute for Nature Research (NINA) and the Norwegian Environment Agency have recently expanded their extensive monitoring of breeding birds in Norway to include the observation of mammals (NINA 2022). In this context, and as a direct demand from volunteers, the Catalan Common Bird Survey (SOCC, from their initials in the Catalan language) made a similar decision in 2008 and offered the possibility of counting mammals while conducting bird monitoring line transects.

For quite a long time, this interest did not go much further than the observers' motivation in collecting and storing these data, but this changed considerably in the framework of the development of indicators including not only birds but also other vertebrates. The best contemporary example would probably be the Living Planet Index, a composite indicator that shows the average rate of change in vertebrate population sizes at the global level (Collen et al. 2009), which has also attracted attention at the national level in several European countries (e.g. The Netherlands, van Strien et al. 2016). In Catalonia, the debate about producing such an indicator for animal species

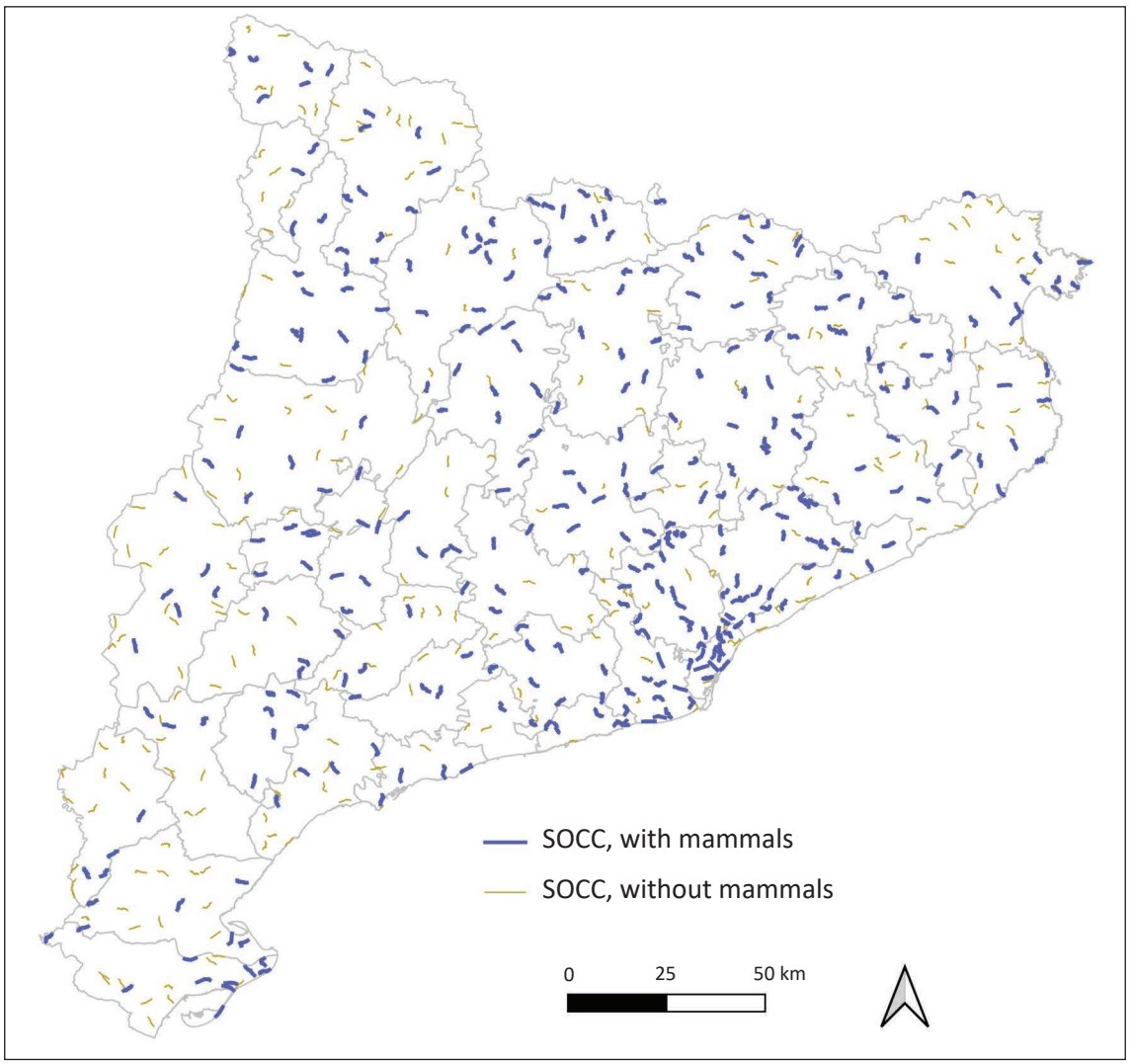

Figure 1. SOCC transects where observers have reported mammal data at least once within the period 2008–2021.

(including vertebrates and invertebrates, as in the Dutch case) unfolded progressively and the SOCC data on mammals was used in the first version of the Living Planet Index for Catalonia (LPI-Cat, ICO 2018). More recently, a science-policy-oriented approach on the situation of biodiversity ended in the constitution of the Observatory of Natural Heritage and Biodiversity and the publication of the State of Nature in Catalonia 2020 (Brotons et al. 2020), a report in which this indicator represented a true backbone.

In this context, what started as a bottom-up initiative by birdwatchers is now one of the pillars of mammal monitoring in Catalonia. In the forthcoming years, the plan is to combine these mammal data from the SOCC with data from other mammal monitoring initiatives for a better estimation of species population trends, and finally, a better estimate of the LPI-Cat.

Methods

Study area and field methodology

The SOCC (Catalan Common Bird Survey) is a region-wide monitoring scheme which aims to survey common bird species in Catalonia, NE Spain, in the long term. Catalonia has a surface of 31.990 km^2, ranging from 0 to about 3100 m.a.s.l. in elevation.

The SOCC started in 2002 and it is constituted by 3-km line transects well distributed over Catalonia with at least one transect in every UTM 10-km square (Fig. 1). The project has more than 600 transects covering all administrative counties as well as all main bird habitats. Each transect is divided into six sections of 500 m which is the real geographical data resolution collected. The bird surveys take place four times a year: two samplings in spring (between the 15th of April and the 15th of May; and the 16th of May and the

15th of June) and two more in winter (in December and January, respectively). All bird surveys should be done within the first four hours after sunrise, which means that the time frame used is optimised for bird detectability rather than for mammals. Two forms of participation are offered to volunteers. The simplest one just counts all individuals heard or observed within the transect, but the observer does not estimate the distance at which the individual stands. The advanced method collects data on the distance between the transect and the detected individual within three distance categories (0–25 m, 25–100 m, and more than 100 m). Regarding the topic of this study, since 2008, all mammals heard or seen within the surveyed area may also be annotated regardless of the method (simple or advanced) chosen, although all tracks (excrements, footprints, or other evidence of the previous passage) are excluded.

The mammal count is optional for volunteers. To properly identify who participated in the mammal count, they are urged to choose one of these three options: "I do not count mammals", "I count mammals, but I have not observed any", or "I count mammals and I have observed at least one". Surveys are mostly reported through the platform "Ornitho.cat", where the observers can enter the mammal species and number of individuals together with the birds: by noting down the section of the transect where the individual was observed, and within which distance category they observed it if they do the advanced form of the survey.

Species' annual indices and trends

To analyse trends in the mammal species, surveys where the observer had indicated they provided data for mammal species were selected

Table 1. Mammal species observed in SOCC surveys between 2008 and 2021, as well as the number observations.

Species (latin name)	Species (common name)	Observations in surveys
Oryctolagus cuniculus	Rabbit	2191
Capreolus capreolus	Roe Deer	1250
Sciurus vulgaris	Red Squirrel	917
Rupicapra pyrenaica	Chamois	808
Marmota marmota	Alpine Marmot	465
Vulpes vulpes	Red Fox	421
Sus scrofa	Wild Boar	260
Cervus elaphus	Red Deer	233
Lepus europaeus	European Hare	215
Capra pyrenaica	Iberian Ibex	192
Dama dama	European Fallow Deer	90
Mustela nivalis	Weasel	28
Myocastor coypus	Coypu	20
Martes foina	Beech Marten	16
Neogale vison	American Mink	16
Lutra lutra	Eurasian Otter	14
Meles meles	European Badger	14
Felis silvestris	European Wildcat	9
Rattus norvegicus	Brown Rat	8
Lepus granatensis	Granada Hare	7
Erinaceus europaeus	European Hedgehog	4
Martes martes	Pine Marten	3
Arvicola sapidus	Southwestern Water Vole	2
Genetta genetta	Common Genet	2
Mustela erminea	Stoat	2
Atelerix algirus	North African Hedgehog	1
Rattus rattus	Black Rat	1

(Figure 1). Using data from these surveys, annual population indices and trends (period 2008–2021) were estimated for those mammal species that 1) have enough data (i.e. appears at least in 10 transects according to similar study cases (Kyek et al. 2017)), 2) have total or partial diurnal behaviour as an assumption of sufficient detection probability during the bird survey, and 3) are large or medium-sized, to ensure the correct identification of the species in the conditions where transects were done.

To run the analysis, only years with the four counts in each transect carried on were used. Then, the maximum count obtained across the four surveys of a year is used for each transect. This protocol assumes that the population is closed all year around and the same mammal is not counted in different transects. Furthermore, trends are calculated using the rtrim package (Boogart et al. 2020) in R (R Core Team 2021), applying a weight to each transect to correct for the relative importance of each transect by taking into account information on the number of transects present on every county, 10-km square, and within a predefined biogeographic strata.

Results

Between 2008 and 2021, 27 species of wild mammals were reported in SOCC surveys (Table 1). Observers reported mammals at least once in 336 transects out of 460, which represent 73% of the total transects carried out during the studied period. Within these transects, mammals were detected on average in 63% (± 34.5% standard deviation) of the surveyed years. The most observed species were Rabbit *Oryctolagus cuniculus*, followed by Roe Deer *Capreolus capreolus* and Red Squirrel *Sciurus vulgaris*.

With the data collected, we calculated trends for seven species (Figure 2): five of them show increasing trends (Brown Hare *Lepus europaeus*, Rabbit, Alpine Marmot *Marmota marmota*, Roe Deer *Capreolus capreolus*, and Chamois *Rupicapra pyrenaica*), one species shows a stable trend (Red Squirrel), and one species had an uncertain trend (Red Fox *Vulpes vulpes*) (Table 2). Remarkably, the Roe Deer has the steepest increasing trend (slope ± SE: 1.156 ± 0.014), followed by the Alpine Marmot (1.092 ± 0.033) and the Rabbit (1.074 ± 0.011).

Discussion

Specific wild mammal monitoring programs based on diurnal line transects usually use signs of activity, such as animal tracks, because the probability of detecting many mammal species during daylight hours is too low to accurately estimate densities (Sutherland 2006). However, using indirect evidence has some limitations since they are difficult to validate, and a certain level of experience is needed to discriminate them (Barea-Azcón et al. 2007), reason why they are not included in the SOCC protocol.

Several medium and large mammals have adapted their behaviour to anthropogenic activity, for example, by becoming more nocturnal in areas with high human frequency (Lewis et al. 2021) or with reduced habitat availability (Gallo et al. 2022). However, some taxa have preserved a certain degree of diurnal activity and individuals can be regularly observed at dawn or just a few hours later, when SOCC surveys are carried out. Despite the field method is certainly not optimal for the study of mammals, part of its disadvantages are compensated, at least to some degree, by the possibility of gathering plenty of standardised data across the whole territory.

Here we presented data on seven mammal species being frequently spotted in our region during bird surveys that are performed within the first daylight hours. All of them are native and common in the study area and most of them have been included in similar analyses (Wright et al. 2014). The species showing the most positive trend is the Roe Deer, coinciding with the results obtained in other European regions (Massimino et al. 2018). The Roe Deer is favoured by the hunting reintroductions conducted in the 90s, as well as the absence of their predators (i.e., large carnivores: Grey Wolf *Canis lupus* and Eurasian Lynx *Lynx lynx*), and the increase of forested areas, where it finds food and refuge. These two latter factors might also explain the positive trend of the Brown Hare, whereas the population of the Rabbit usually fluctuates depending on the impact of viruses that are spread throughout populations (Ruiz-Olmo & Aguilar, 1995).

The relatively large size of the SOCC citizen science network distributed across Catalonia enables not only the possibility to obtain information about the species mentioned above, but also about other more discrete mammals. For instance, the Red Squirrel, despite being the most

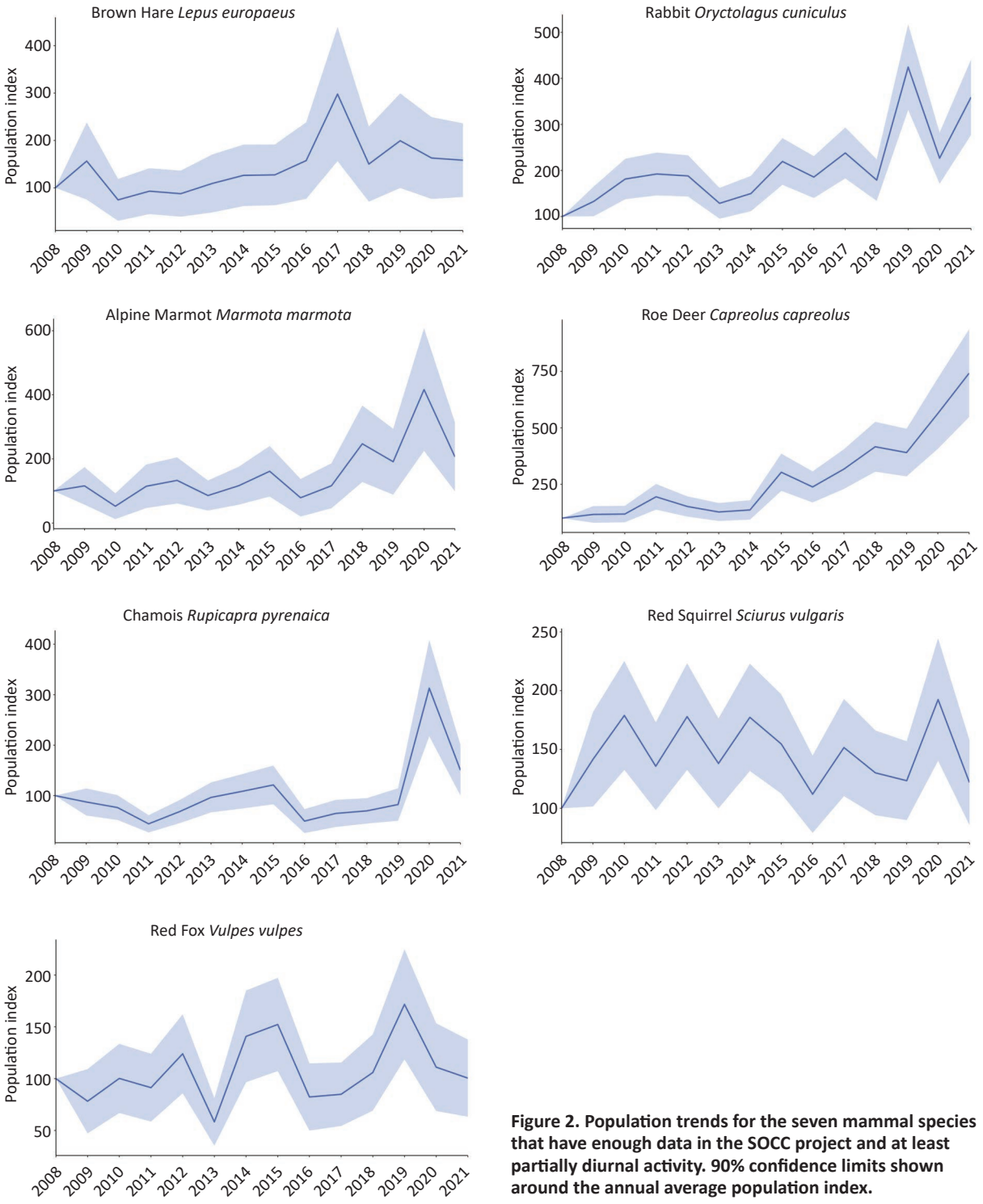

Figure 2. Population trends for the seven mammal species that have enough data in the SOCC project and at least partially diurnal activity. 90% confidence limits shown around the annual average population index.

diurnal mammal species, might be difficult to see due to their arboreal behaviour. However in some countries, its abundance is calculated with a similar methodology (Jokimäki et al. 2017). In Catalonia, the high number of individuals detected in the bird monitoring project represents, at the moment, the only available data to calculate its trend at the Catalan scale.

Furthermore, taxa that have restricted distributions in the region but high densities in the core area, such as the Alpine Marmot or the Chamois, are only possible to study by widespread monitoring programs (Ruiz-Olmo & Aguilar 1995) so can potentially profit from the distribution of the SOCC coverage. Another advantage of including mammal count data in bird surveys is simply the

Table 2. Trends of the populations of mammals in Catalonia in the period 2008–2021, calculated with the data of Catalan Common Bird Survey (SOCC).

Species		Sites	Slope (SE)	Slope classification
Lepus europaeus	Brown Hare	69	1.058 (0.027)	Moderate increase (p<0.05)
Oryctolagus cuniculus	Rabbit	132	1.074 (0.011)	Moderate increase (p<0.01)
Sciurus vulgaris	Red Squirrel	155	1.001 (0.013)	Stable
Marmota marmota	Alpine Marmot	13	1.092 (0.033)	Moderate increase (p<0.05)
Vulpes vulpes	Red Fox	126	1.020 (0.018)	Uncertain
Capreolus capreolus	Roe Deer	143	1.156 (0.014)	Strong increase (p<0.01)
Rupicapra pyrenaica	Chamois	34	1.047 (0.020)	Moderate increase (p<0.05)

efficiency in getting information about another group of fauna with hardly any extra effort, provided the volunteers have sufficient knowledge on the identification of these mammal species.

On the other hand, this lack of specificity might also be a drawback in terms of ensuring that enough observations are gathered to avoid potential biases caused by stochasticity. In fact, most of the large mammal species have extensive home ranges (Ferreras et al. 2016) and thus the technique employed might not be the best strategy to measure their relative abundance, even if some individuals are detected. Besides, as other studies have shown, bird surveys are done at a specific time of the day and year to ensure the detectability of the target species. Meanwhile, mammals may have different life strategies (daily activity, breeding seasons, hibernation periods, etc.) depending on the species and this might influence their detection probability at a specific time of the year (Massimino et al. 2018). Hence, our analysis focuses on the annual peak of species abundance observed across the four surveys within a year, probably encompassing both juveniles and adults. This approach not only provides a more robust estimate of true species abundance but also serves as a proxy for annual productivity.It is crucial to note that the study of mammals presents a unique challenge due to their diverse life cycles, requiring the use of multiple approaches to gain a comprehensive understanding of this heterogeneous group.

Given everything mentioned above, our data should be retained and used to support mammal monitoring projects, as it provides a reliable source of information for several species. In fact, some of this data has already been used to complete other monitoring initiatives. First, a portion of the information has filled in some species distribution gaps of an ongoing large mammal research project (Atlas of Mammals of Catalonia, Observatori del Patrimoni Natural i la Biodiversitat 2022a), whose main goal is to use citizen science to depict the most recent distribution of Catalan wild mammal species. Second, our results were used in the calculation of the Catalan Living Planet Index (LPI-Cat, Observatori del Patrimoni Natural i la Biodiversitat 2022b), which aims to have a major influence on decision-makers and general public attitudes. Moreover, population change indices obtained with SOCC data are similar to those calculated with nocturnal transects applied by field technicians belonging to the Catalan administrations of each of these target species (Generalitat de Catalunya, unpublished data), giving greater consistency and reliability to our data. In conclusion, it is probable that similar initiatives will emerge in the near future, and the information collected should be integrated with other sources to gain a more comprehensive understanding of the distribution and abundance of elusive animal groups.

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