

European free-tailed bat fatalities at wind farms in southern Spain

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Abstract

European free-tailed bat fatalities at wind farms in southern Spain. Wind is increasingly used as a renewable energy all around the world. Although wind turbines help reduce greenhouse gas emissions, the costs to wildlife cannot be overlooked. To date, monitoring programs and research have mainly focused on the impact of wind farms on birds but negative effects on bats have also reported. Here we compile information related to European free-tailed bat deaths at wind farms in southern Spain. In a world where the demand for renewable energy is rising we highlight the need to better understand and prevent bat fatalities.

Key words: Bat collision, Monitoring program, *Tadarida teniotis*, Wind farm

Resumen

Mortalidad del murciélago rabudo en los parques eólicos del sur de España. El viento se está utilizando cada vez más como fuente de energía renovable en todo el mundo. Aunque las turbinas eólicas ayudan a reducir la emisión de gases de efecto invernadero, no se pueden pasar por alto los costos que conllevan para la fauna salvaje. Hasta la fecha, los programas de seguimiento e investigación se han centrado principalmente en el impacto de los parques eólicos en las aves, aunque se ha constatado que también afectan a los murciélagos. En este trabajo se compila información sobre la mortalidad del murciélago rabudo en los parques eólicos del sur de España y destacamos la necesidad de conocer mejor y evitar la mortalidad de murciélagos en un mundo donde la demanda de energías renovables no para de aumentar.

Palabras clave: Colisión de murciélagos, Programa de seguimiento, *Tadarida teniotis*, Parque eólico

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Introduction

Human activities cause environmental modifications such as fragmentation, destruction and degradation of habitats, exposing many animal populations to novel perturbations and consequent declines worldwide (Scheffer et al., 2001). Reducing greenhouse gases emission to prevent anthropogenic climate change has enhanced the innovation, development and application of renewable energy sources, but unfortunately, renewable energies, and in particular wind power, may come at some risk for wildlife. Wind turbines, for example, can cause large numbers of fatalities among flying animals (Ferrer et al., 2012; Zimmerling and Francis, 2016). Most research to date has focused on the impact of wind farms on birds, especially those of conservation concern and particularly raptors or other large species, but information related to bats is increasing and giving rise to serious concerns (e.g. Lintott et al., 2016). Here we compile the information available regarding fatalities of the European free-tailed bat *Tadarida teniotis* at wind farms in southern Spain. We report new distributional data for the species, discuss its probable underestimated distribution area, and point out some important aspects that should be taken into account to facilitate compatibility between the development of renewable energies and bat conservation.

Material and methods

The European free-tailed bat is the only representative of the family Molossidae in Europe. It is mostly a Palearctic species whose range extends into the Indomalayan region (Benda and Piraccini, 2016). It is well known in the Mediterranean basin, in Portugal, Spain, Morocco and Algeria, and eastwards to the Middle East, Saudi Arabia, Iran, Iraq, Azerbaijan, Turkmenistan, Afghanistan, India, and possibly Yunnan (China). It is widely-dispersed throughout Spain, including the Canary and Balearic archipelagos, but little information is available at the population level (Balmorí, 2007). A brief glance at the most recently available distribution map, in the *Atlas of Terrestrial Spanish Mammals and Red Book* (Palomo et al., 2007), shows that existing information is limited (fig. 1). Furthermore, the distribution data are biased towards some areas that seem to be surveyed systematically, such as the Canary Islands, Extremadura and Navarra, while information seems to be partial in areas such as Andalusia.

The study was performed from 2006 and 2016. We focused our research on southern Spain, particularly the provinces of Cadiz and Malaga (fig. 1). Most information comes from the Andalusia Environmental Agency, which provided all the data on bat fatalities recorded for Cadiz at 56 wind farms containing a total of 801 wind turbines. The information from Malaga is derived from two wind farms, one with 13 wind turbines and the other with four turbines. Monitoring at the former was performed regularly over two years but irregularly at the latter. In Cadiz, the Environ-

mental Agency requires all wind farms to develop a surveillance program to document all accidents caused to flying animals. This program operates on a daily basis from dawn to dusk (between eight and 14 daylight hours in winter and summer, respectively) and is carried out by trained observers who work in a coordinated manner. In Malaga, searches for animal carcasses were made on a weekly basis at one of the studied wind farms, as required by the same Environmental Agency, and six times a year at the second wind farm.

Results

During the study period, a total of 15 European free-tailed bats were found dead at 11 wind farms, all having collided with wind turbines. At two wind farms, one in Cadiz and other in Malaga, three fatalities were found (each site indicated by a star in fig. 1). All records collected for this study are new distributional data for the species, considering the specific information provided in the *Atlas of Terrestrial Spanish Mammals and Red Book* (Balmorí, 2007) (represented by grey squares in fig. 1). The new records correspond to the following 10 x 10 UTM squares: UF38, TF92 y TF93 in Malaga province, and TE69, TF60, TF53, TF44, TF40, TF35, QA64 and QA55 in Cadiz province.

Fatalities were not found every year. Pooling all data, we found that mortality was highest in 2012 and 2014 (fig. 2). During the study period, mortality peaked in October, although cases were reported during other months, including January (fig. 2).

Discussion

The European free-tailed bat is a relatively unknown species, and aspects such as population size and movements in the Iberian Peninsula are open questions. The fact that all fatalities in this study correspond to new distribution records for the species is a clear indicator of the lack of knowledge related to this bat.

In Spain, only some wind farms are required to develop surveillance programs and these focus mainly on bird mortality (De Lucas et al., 2012). The effects of wind power on bats seem to take second place for the environmental authorities, even though consequences can be serious, as demonstrated in other regions of the world (e.g. Lehnert et al., 2014). The absence of a standardised method to monitor bat fatalities and the current limitations of the existing monitoring protocols (such as the lack of training of observers in bat identification) suggest that the impact of wind farms on the European free-tailed bat is likely greater than that reflected in our figures.

The fatalities reported here occurred practically throughout the year with a clear peak in October. Although Arlettaz et al. (2000) demonstrated that the European free-tailed bat can be considered a hibernating species in the Swiss Alps —the highest

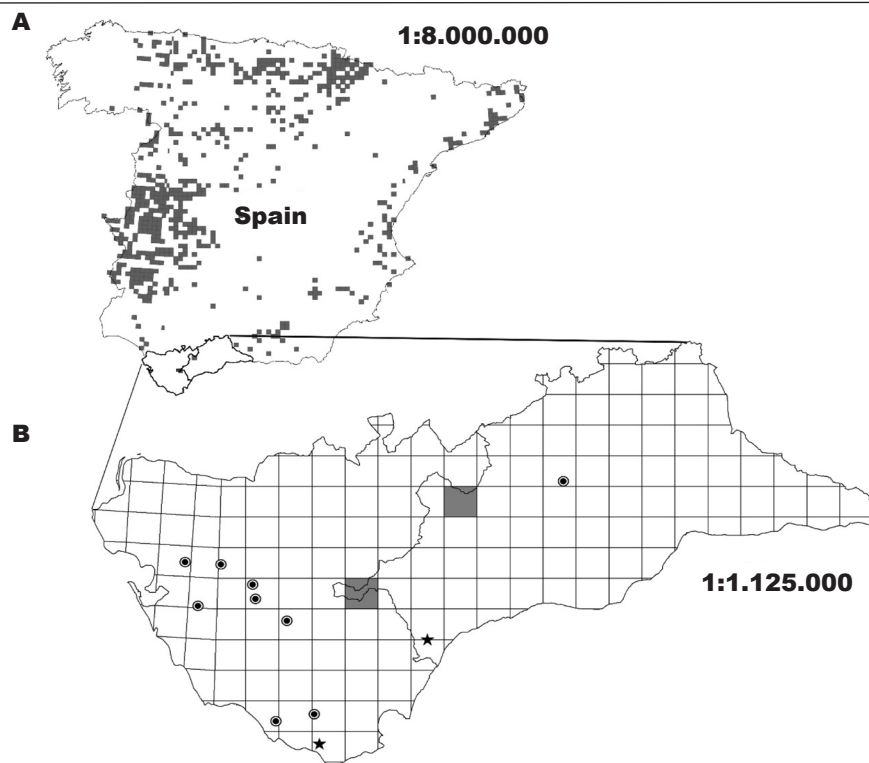


Fig. 1. A, species distribution for the UTM 10 x 10 km squares in Spain (dark squares indicate presences). The study area is indicated in solid lines (provinces of Cadiz and Malaga); B, study area and locations where fatalities were found (black dots); stars indicate the two wind farms that each had three fatalities. UTM 10 x 10 km squares are shown; those in grey are squares where the species was previously reported according to the *Atlas of Terrestrial Spanish Mammals and Red Book*.

Fig. 1. A, distribución de la especie en las cuadrículas UTM 10 x 10 km en España (la presencia se indica con cuadrículas oscuras). La zona del estudio se indica con líneas continuas de color negro (provincias de Cádiz y Málaga); B, zona del estudio y localización de los ejemplares fallecidos encontrados (puntos negros); las estrellas indican la ubicación de los dos parques eólicos en los que se produjeron tres fallecimientos. Se muestran las cuadrículas UTM 10 x 10 km; en gris se indican las cuadrículas donde ya se tenía constancia de la presencia del murciélago rabudo según el Atlas y Libro Rojo de los Mamíferos Terrestres de España.

northern limit for this species—it can be active all year round in the south of the Iberian Peninsula (Marques et al., 2004). This peak in October could be related to flocking and courtship behaviour during autumn, but the proximity of the study area to the African continent, 14 km. at the shortest distance, could also play a role. The species is found on both sides of the Strait of Gibraltar and its capacity for movement is well known, with single bouts of activity averaging more than 6 hours per night (Marques et al., 2004).

Being a fast flying species with low manoeuvrability compared to others bat species, the effects of turbines could have far reaching consequences. As with other flying animals (Schuster et al., 2015), it is likely that the consequences of wind farms are not the only factor responsible for the death of the

bats. However, disturbance, habitat loss, and barrier effects may also play a role. In the absence of population estimates for the European free-tailed bat in most of its distribution range, greater concern among environmental authorities is called for. Deaths of other species of the same family, particularly those in tropical regions, are commonly reported, such as for the Egyptian free-tailed Bat *Tadarida aegyptiaca* in South Africa (Doty and Martin, 2013), and the Brazilian free-tailed Bat *Tadarida brasiliensis* in South America (Barros et al., 2015). The impact on this latter species is severe; 245 of the 336 bat fatalities reported from Brazil corresponded to Brazilian free-tailed bats.

Our results may be biased. Nevertheless, as information about the impact of wind farms on bats in southern Spain is limited, in light of the high number

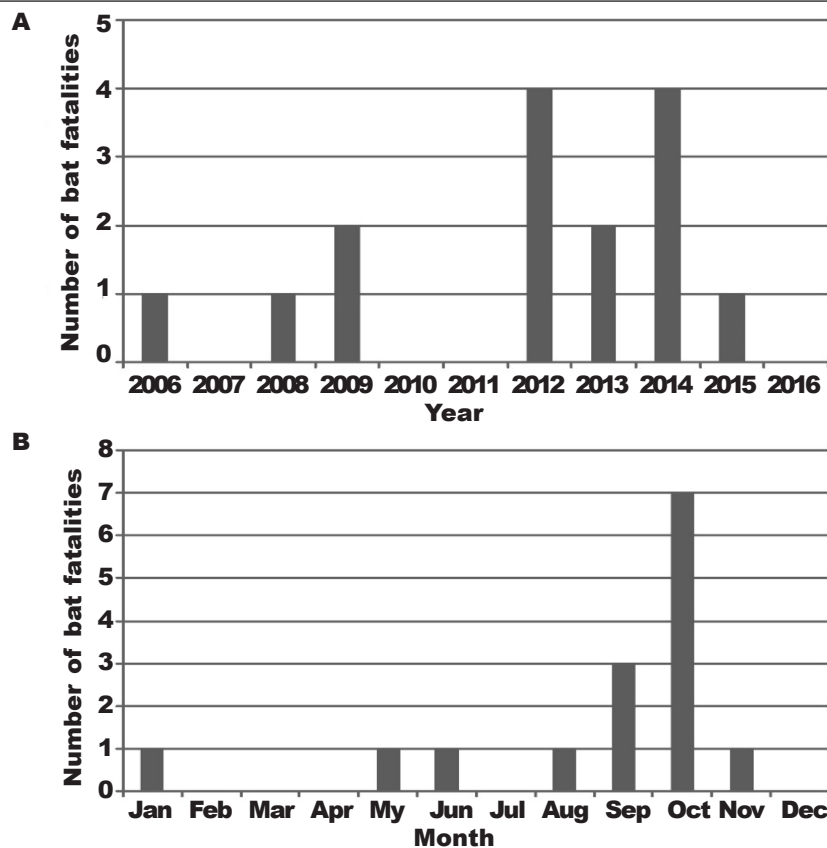


Fig. 2. A, distribution of European free-tailed bats found dead in wind farms per year; B, monthly distribution of dead European free-tailed bats, grouping data from 2006 to 2016.

Fig. 2. A, distribución anual de los ejemplares de murciélago rabudo fallecidos en parques eólicos; B, distribución mensual de ejemplares de murciélago rabudo fallecidos; agrupando la información del período 2006–2016.

of wind power facilities established over the last two decades, greater knowledge and understanding of bat fatalities is necessary (see Rodrigues et al., 2015). This is especially important if we consider that the demand for this type of renewable energy has been increasing rapidly and will likely continue to do so.

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