Bird and bat mortality at Portuguese wind farms

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Introduction

Wind energy had a remarkable growth in Portugal over the last 10 years. As it happened in other countries, several pre- and post-construction monitoring studies have been performed in order to assess the impacts of turbines on flying vertebrates. However, few studies gathered data collected at different sites and analysed it in an integrated way.

As one of the first tasks of the R&D project, Wind & Biodiversity, this paper presents the results of the literature revision regarding bat and bird mortality at onshore wind farms. We were interested to know: 1) which species or assemblages present higher levels of mortality; and 2) when and where these events are more evident.

Methods

From March to July 2011 we performed an intensive literature research and revision of monitoring reports about bird and bat activity and mortality at onshore wind farms, published between 2003 and 2010.

The information contained in each one of the documents was gathered for each species found dead, including time of the year in which the fatality occurred. Alongside this information, we collected data about the activity of each group all over the year, including activity peaks. Since different wind farms had different sampling efforts (regarding the number of turbines searched and the number of searches performed per year), the collected mortality data were weighted. The following formula was used to reach the value of adjusted mortality:

Adjusted mortality = (observed mortality / No. of turbines searched / No. of searches performed)

Using this formula we were able to compare data from different monitoring reports and analyze in which wind farms and for which species higher mortality levels were observed.

In order to analyze the spatial distribution of observed mortality over the country, the mortality values were weighted by region, taking into account the total number of wind farms considered within each site. This information was then introduced on a GIS separately for the group of birds and bats. We also intended to establish a relation between mortality and activity peaks of flying vertebrates. To accomplish that, we analyzed the information contained in each monitoring report concerning the reference to higher activity levels or mortality peaks. Since sampling effort was not uniform across the twelve months of the year, the number of times a given month presented a peak of activity or mortality was weighted by the number of reports that surveyed that same month.

Results

A total of 85 monitoring reports concerning 62 Portuguese wind farms have been analysed. From these studies, 56 were used to collect data regarding bird mortality/activity and 45 to collect data regarding bat mortality/activity.

Regarding the sample of reports analyzed, a total of 414 carcasses were found at Portuguese wind farms, 200 of them were birds and 214 bats.

Which were the most affected species?

Concerning birds, the results showed that the most affected bird species was house martin (*Delichon urbica*) (0.091 fatalities/turbine/search and an absolute number of 40 carcasses detected), followed by skylark (*Alauda arvensis*) (0.057 fatalities/turbine/search and a total of 20 carcasses detected) and corn bunting (*Emberiza calandra*) (0.043 fatalities/turbine/search and 20 carcasses detected). Fifteen percent of the registered fatalities were birds of prey. Common Kestrel (*Falco tinnunculus*) is the most common raptor affected with 20 carcasses found and an adjusted mortality of 0.011 fatalities/turbine/search. The Montagu's Harrier (*Circus pygargus*) is the only bird species detected (0.003 fatalities/turbine/search; 7 carcasses detected) which presents an unfavorable a conservation status, classified as Endangered (EN) by Portuguese Vertebrates Red List (Cabral *et al.,* 2006).

Regarding bats, the 214 carcasses found corresponded to 14 different species or assemblages. The analysis showed that the most affected species was common pipistrelle (*Pipistrellus pipistrellus*), with 76 fatalities and a value for adjusted mortality of 0.104

carcasses/turbine/search, followed by Leisler's bat (*Nyctalus leisleri*), with 43 fatalities and an adjusted mortality of 0.078 carcasses/turbine/search. These results are consistent with those of other studies in Europe, which considered Nyctalus and Pipistrellus spp. 'high-risk' species (Rydell et al. 2010). The Leisler's bat (*Nyctalus leisleri*), is classified as Data Deficient (DD) by the Portuguese Vertebrates Red List (Cabral *et al.,* 2006), but the majority of the carcasses found belong to species classified as Least concern (LC) (Cabral *et al.,* 2006). However, one of the species found is classified as Vulnerable (VU), the bentwing bat (*Miniopterus schreibersii*), and other three species are classified as Data Defficient: Savi's pipistrelle (*Hypsugo savii*), european free-tailed bat (*Tadarida teniotis*) and giant noctule (*Nyctalus lasiopterus*).

When and where did they die?

The higher mortality values for birds (carcasses/turbine/search) were found in Faro region, in the south of Portugal, followed by Viseu region (Figure 1). These values, however, showed apparently no differences between the coastal and inland wind farms. For bats, the highest adjusted mortality values were registered in Viseu region, in central part of Portugal (Figure 1). Bat mortality appears to be similar in coastal and inland Portuguese wind farms, however, it is higher in the North, reflecting the location of the majority of the existing wind farms.

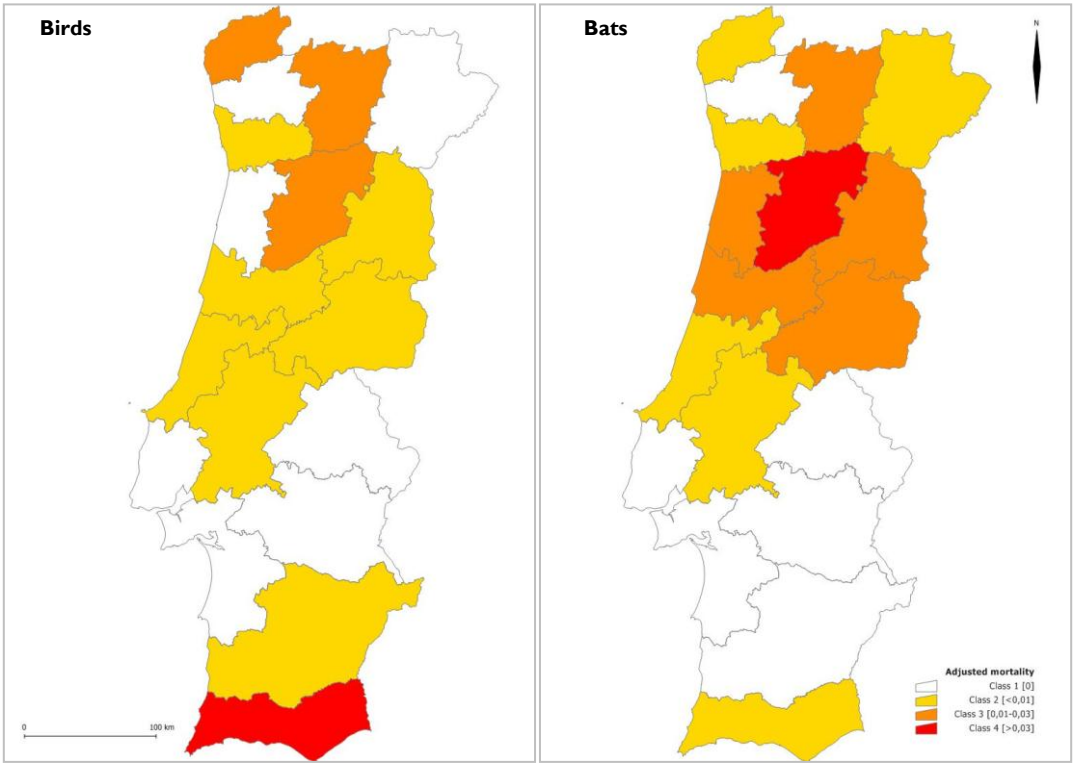

Figure 1 - Adjusted mortality of bird (in the right) and bat (in the left) for each region of Portugal.

Concerning the temporal analysis, the results put in evidence the existence of activity peaks for birds along the year. A higher activity period between September and October has been detected in several studies. This time of the year is coincident with the post-breeding migration period. After this period, during the winter, the activity reaches low levels and in spring rises again, until the summer. In the spring and summer the activity levels are quite similar. Despite the activity patterns observed, the mortality temporal analysis did not show any evident pattern, yet, the probability of occurrence of mortality peaks in the spring is higher than in any other time of the year.

For bats, the activity temporal analysis clearly evidenced two sharply defined peaks, one in May and one in August/September, although activity levels remain high from July to October. On the other hand, the number of fatalities was higher in May and in the late summer, between August and October. Thus, the results evidenced a relation between bats activity peaks and the number of carcasses detected around the turbines. These results are consistent with those published by the Portuguese Institute for Nature Conservation and Biodiversity (ICNB, 2010) and similar to the mortality temporal pattern reported in Northwestern Europe (Rydell et al. 2010)

Conclusion

A relation between bats activity and mortality peaks has been identified, with higher mortality when the activity level is bigger, during May and in late Summer. This relation has not been found for birds, in spite of the existence of activity peaks between September and October.

Although none of the species with higher fatalities rates are included in the Portuguese Red List, some of them have low resilience to additional mortality (e.g. raptors) and/or little is known about their population (e.g. *Nyctalus leisleri*). Thus, it is essential to incorporate the results of these types of reviews in future EIA and to focus monitoring studies on the most affected species to implement the appropriate mitigation/compensation plans.

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