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POST CONSTRUCTION MONITORING OF WIND FARMS: FIRST RECORDS OF DIRECT IMPACT ON BATS IN ITALY

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Long-term post-construction monitoring of the impact of wind farms on fauna started in 2008 in Abruzzo (central Italy). This study provides the first evidence of bat fatalities at wind turbines in Italy. Six carcasses of Hypsugo savii and one carcass of Pipistrellus pipistrellus were recorded in 2009 during 36 field sessions, involving 4 re-searchers at two wind farms, for a total of 46 (21 and 25) wind turbines.

Key words: wind farms, monitoring, impact, bats, Italy

Riassunto - ***Monitoraggi* post-operam *di impianti eolici: prima segnalazione di impatto diretto su pipistrelli in Italia***. La possibilità di attuare a partire dal 2008 un monitoraggio post-operam della fauna di interesse conservazionistico presso impianti eolici in Abruzzo ha permesso di evidenziare i primi casi certi di fatalità di pipistrelli in Italia. Durante 36 sessioni di campo del 2009, da parte di 4 operatori, presso due impianti eolici industriali, composti il primo di 21 ed il secondo di 25 turbine, sono state rilevate 6 carcasse di *Hypsugo savii* e una di *Pipistrellus pipistrellus*.

Parole chiave: monitoraggio post-operam, impianti eolici, impatto, pipistrelli, Italia

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INTRODUCTION

The uncontrolled increase of greenhouse gases and the increasingly tangible negative effects of global warming are resulting in an ever-stronger demand for more sources of renewable energy (Solomon et al. 2007). In little more than 20 years, industrial wind farms have increased exponentially, both in Europe and worldwide. Hazards and drawbacks of wind energy development for the environment and especially for wildlife are under discussion. However, it is clear that birds and bats are the most threatened groups due to collisions and close-contact injuries.

Since the end of the 90's several studies on flying wildlife, from Europe and North America, have shown some occurrence of bat mortality at wind farms, because of the direct impact with the spinning wind turbine blades (Lekuona 2001; Erickson et al. 2003; Arnett

2005); in some cases the number of bats involved per year has been higher than that of birds, overall. Bat mortality data at wind farms are updated every year both by EUROBATS Intersessional Working Group (AAVV 2010) and by Dürr and Bach (2004) and Dürr (2007).

The majority of kills involved potential tree bat species (i.e. species that roost within the foliage or in tree cavities) and the impact peak was found in late summer and autumn (Kerns et al. 2004). Collision and mortality peaks coincide with their migration and mating periods, but European studies showed a significant impact also on non-migratory species, such as *Pipistrellus* spp. (Rodrigues et al. 2008). A recent comprehensive world-wide analysis on the different types of mortalities within industrial wind farms (Cryan and Barclay 2009) confirmed that the most affected species are those linked to trees and which often migrate across latitudes. However, the reason why individuals of those and other non-migratory species end up crashing against the turbines is still unclear. Determining the causes of bat fatalities at turbines is important in order to develop practical solutions to this serious problem for bat conservation. Here we present the preliminary results of post-construction bat fatality searches that are part of a long-term monitoring (2009-2012) strategy at wind farms in Abruzzo (Central Italy).

MATERIALS AND METHODS

The study area is located near the Fucino Valley and the Sirente-Velino Natural Regional Park, along the southern slopes of the Sirente Massif, with an altitudinal range of 900-1150 m a.s.l. (WGS 84, F33 coordinates: top left - X 381.985, Y 4.663.406; bottom right – X 397.520, Y 4.653.612). The post-construction monitoring considered the wind farm of Cerchio-Collarmele (WF1) that began operation in March 2009 and consists of 21 2.0 MW turbines (Vestas V80) and 3 meteorological towers. Rotor diameter of each turbine is 80 m and spans over an area of 5072 m^2 and the tubular steel towers are 78 m high. Therefore, each turbine reaches a maximum height, at the tip of the blades, of 117 m from ground level. Non periodical surveys were also carried within the nearby Cocullo Wind Farm (WF2), 15 km away. WF2 was built in 2005 and consists of 38 Gamesa 850 kW turbines. This site is located along a mountain ridge between 1200 m and 1600 m a.s.l.

At both sites, the natural vegetation where wind farms are located consists of high hill - low mountain scrubland and hemicryptophytic pasture patches characterised by *Brachypodium rupestre*. In the sites with cattle present there are nitrophilous phyto-coenoses and sparse bushes (e.g. *Rosa canina, Prunus spinosa, Rubus ulmifolius, Crataegus monogyna*).

The surrounding areas of 46 turbines (21 at WF1 and 25 at WF2) were searched for bat carcasses every three days from March 15th to October 31st 2009, with 32 field sessions in WF1 and 4 field sessions in WF2. Permanent square plots, 120 m per side and centred on the turbine were set up. The searcher walking at a rate of approximately 45-60 m/min along each transect of 120 m, searching both sides up to 3 m for bat carcasses (Johnson et al., 2000, 2003). Subsequently, both transect width and search speed were based on visibility within the various habitat types and vegetation stages. On average, approximately 30 to 60 minutes were spent searching each turbine, depending on the habitat type. For each carcass found, recorded data included species, sex and age class (when discernable), date and time of collection, location

(WGS 84 F33 coordinates), habitat type, condition, and any further comment which may help estimating time and cause of death.

RESULTS AND DISCUSSION

During field sessions seven bat carcasses were found: 1 *Pipistrellus pipistrellus* and 6 *Hypsugo savii*. Dead bats were all found from 3 August to 16 September (Tab. 1); 3 carcasses were found beneath one of the WF1 turbines and 4 carcasses beneath four of the WF2 turbines. Three of the collected bat carcasses were fresh and intact: necropsy showed abundant haemorrhages within both the abdominal and the thoracic cavities, referable to the syndrome described as "baro-trauma" (Baerwald et al. 2008). Three other carcasses were scavenged by wasps and ants and one had been dismembered. The distances from turbines where the dead bats were found ranged from 0.7 m to 14.4 m and the average was 14.2 m. All of the bats were found during fair weather conditions.

In this early phase of post-construction monitoring at our study sites in Italy, we are not yet able to accurately estimate fatality rates and thus make comparisons with other European studies, especially in cases where carcasses of different species are encountered. However, we have documented for the first time the fatality of both *Pipistrellus pipistrellus* and *Hypsugo savii* at wind turbines in Italy.

Both of these species have been found dead beneath turbines in other European countries, also mostly during late summer and fall. *P. pipistrellus* and *H. savii* are not known to migrate in Italy and presumably non-migratory populations also show susceptibility to turbines as in other parts of Europe (e.g., Germany; Dürr and Bach 2004).

Monitoring at our study sites will con-

Table 1 - Bat carcasses found in 2009 during post-construction monitoring of Abruzzo' wind farms WF1 "Cerchio-Collarmele" and WF2 "Cocullo"; M: male; F: female; n.d.: not determined.

Species	Wind Farms	Date	Carcass condition	Distance from turbine (m)	Sex	Forearm length (mm)	Weight (g)
P. pipistrellus	WF2 Cocullo	03.09.09	partially scavenged by wasps / dried	1.40	n.d.	27.34	1.1
H. savii	cluster 1 WF1	03.08.09	intact / fresh	6.50	M	33.44	4.9
H. savii	WF2 Cocullo	09.08.09	partially scavenged by ants / dried	14.40	M	33.04	1.8
H. savii	cluster 1 WF1	27.08.09	intact / fresh	2.40	F	34.22	5.5
H. savii	cluster 1 WF1	11.08.09	intact / fresh	8.00	n.d.	n.d.	1.0
H. savii	WF2 Cocullo	03.09.09	rests of carcass scavenged by ants	11.00	n.d.	n.d.	1.2
H. savii	WF2 Cocullo	16.09.09	disjointed	8.20	n.d.	n.d.	0.8

tinue for two more years and final results, corrected for searcher efficiency, scavenger removal, and search-interval bias (Huso 2010) could provide a significant contribution to the understanding of the situation with bats and wind energy in Italy. The owners of WF1 have already been involved with this problem and we have proposed a mitigation activity to reduce bat mortality, as realized in some wind farms in Canada (Baerwald et al., 2009), Pensylvania (Arnett et al. 2009) and Germany, by changing the cut-speed (the minimum wind speed when the rotors start spinning) from a "normal" limit (3.5 - 4.0 m/sec) to 5.5 m/sec.

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