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# First records of dead bats (*Chiroptera*) from wind farms in Croatia

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With 1 Figure

## Introduction

Many studies have shown that wind farms can have negative impact on bats. Records of dead bats under wind turbines were discovered in different countries, in some cases reaching very high numbers (ex. AHLÉN 2003, JOHNSON et al. 2003, KERNS & KERLINGER 2004, ARNETT 2005), however, it is not well understood, why bats collide with wind turbines (AHLÉN 2003).

In Croatia, two wind farms were built near the Adriatic coast, one in 2004 and the other in 2006. Recently, few sporadic checks of areas under the wind turbines revealed bat casualities at both locations. Record of one finding was reported in Slovenian bat magazine (JAŇCAR 2006). Here we summarize all records of dead bats, found under wind turbines in Croatia.

## Description of the sites and methods

In the second half of 2004, the wind farm in the area of Ravne on the Pag Island (Southern Kvarner) started operating. It is situated at approximately 200 m a.s.l., in the middle part of the island, near the town Pag. There are seven wind turbines, with pillars of 49 m height and the rotor's diameter of 52 m (www.adriawindpower.net). Area under wind turbines 2-6 was checked in April and May 2007, while the area under wind turbines 1-6 was checked in July 2007, in the morning hours. In all cases bat carcasses were found and collected for later identification. Carcasses have already been or will be handed to the Croatian Natural History Museum in Zagreb.

The second wind farm in the country, Trtar Krtolin near the town Šibenik (Northern Dalmatia), started working in the second part of the year 2006. It is situated at the plateau at about 400 m a.s.l. There are 14 wind turbines, with pillars of about 50 m height an the rotor's diameter of 48 m (www.enersyst.info). On the visit in November 2006, bat carcass was photographed, which enabled later identification (JAŇCAR 2006).

## Results

On four surveys carcasses of two bat species, Kuhl's pipistrelle, *Pipistrellus kuhlii* (Kuhl, 1817), and Savi's pipistrelle, *Hypsugo savii* (Bonaparte, 1837), were discovered. Details of records are given in Tab. 1, with additional descriptions of locations and bats.

In the case of the lactating Savi's pipistrelle female in Ravne wind farm (Fig. 1), open wounds were visible at the back side of the head and neck. The other carcass of Savi's pipistrelle from this location had visible injuries on the mouth, which could appear after the fall. Some bats had holes on wind membranes.

Figure 1. Savi's pipistrelle (*Hypsugo savii*) female, as found under the wind turbine 1 at Ravne wind farm on the Pag Island (Croatia) in July 2007. Stones on the ground under the wind turbines make the search for small bat carcasses very difficult. Photo: Ana Jančar

Table 1. Findings of dead bats under wind farms Ravne (Pag) and Trtar Krtolin (Šibenik) near Adriatic coast in Croatia*

| Wind farm | Location | Date | Species | Details |
|---|---|---|---|---|
| Trtar Krtolin Šibenik | 15 m from VT-10 | 1.11.2006 | *Hypsugo savii* | fresh carcass |
| Ravne, Pag Island | 20 m from VT-6 | 28.4.2007 | *Pipistrellus kuhlii* | ♀, ad, FA = 34,4 mm lactated; fresh carcass |
| | 5 m from VT-5 | 28.4.2007 | *Pipistrellus kuhlii* | ♀, ad, FA = 34,7 mm; lactated |
| | VT-2 | 1.5.2007 | *Pipistrellus kuhlii* | FA = 33,6 mm; partly mummified |
| | VT-3 | 1.5.2007 | *Pipistrellus kuhlii* | ♂, ad, FA = 33,5 mm; fresh carcass |
| | 32 m from VT-1 | 29.7.2007 | *Hypsugo savii* | ♀, ad, FA = 34,9 mm; lactating; fresh carcass, injury visible |
| | 25 m from VT-5 | 29.7.2007 | *Hypsugo savii* | ♂, juv, FA = 31,8 mm; fresh carcass |

* Abbreviations: VT – wind turbine, ♀ - female, ♂ - male, ad – adult, juv – juvenile, FA – forearm length

## Discussion

At only four non-systematic investigations of the areas under wind turbines in Croatia seven bat carcasses belonging to Kuhl's or Savi's pipistrelles, were found. The heterogeneous grounds under the wind turbines, covered with stones and often also with shrubs, make the search for carcasses very difficult. Additionally, in here reported checks, not all areas under all wind turbines were investigated. It would be possible, that dead bats would be discovered also under other wind turbines.

These findings confirm the negative impact of wind turbines on bats in Croatia. The two wind farms lie within the distribution ranges of both Kuhl's and Savi's pipistrelles (DIETZ et al. 2007). However, the question what is the actual effect of these wind turbines on bat populations, cannot be answered without regular checks within a systematic study and a long term monitoring scheme.

In Croatia, more wind farms are planned to be built (LIVAJIČ 2007). Activities for first wind power plants are in place also in other countries of Western Balkans, like Slovenia (PERŠOLJA 2005) and Bosna and Herzegovina (FENA 2007). Here described findings present the first proof in the region, that bats can be affected by the wind turbines. They therefore additionally support the fact, that impact assessments should seriously consider the potential negative impact of wind farms on bat populations before they are built. A more detailed study from the two wind farms would not be important only for impact assessments of other wind farms within the country, but would also be important for other countries in the region.

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## Summary

Records of dead bats from both wind farms in Croatia are reported. In November 2006, one Savi's pipistrelle (*Hypsugo savii*) was found at the wind farm Trtar Krtolin near Šibenik. In 2007, six bat carcasses of two species were collected at the wind farm Ravne on the Pag Island: in April and May, four Kuhl's pipistrelles (*Pipistrellus kuhlii*) and in July two Savi's pipistrelles. The extent of negative impact on bat populations by the two wind farms cannot be ascertained on the basis of these few investigations, so a systematic study is necessary.

## Zusammenfassung

### Erste Funde toter Fledermäuse (*Chiroptera*) von Windparks in Kroatien

Es wird über Funde von toten Fledermäusen in den beiden einzigen Windparks von Kroatien berichtet. Im November 2006 wurde eine Alpenfledermaus (*Hypsugo savii*) im Windpark Trtar Krtolin in der Nähe von Šibenik gefunden. Im Jahr 2007 wurden im Windpark Ravne auf der Insel Pag von zwei Fledermausarten insgesamt 6 Schlagopfer gesammelt: im April und Mai 4 Weißrandfledermäuse (*Pipistrellus kuhlii*) und im Juli 2 Alpenfledermäuse. Das Ausmaß des negativen Einflusses auf die Fledermauspopulationen kann auf der Basis der Ergebnisse von nur zwei Windparks nicht beurteilt werden. Deshalb ist eine systematische Studie notwendig.

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