



# Activity of bats in different altitudes at wind measurement masts and wind turbines

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## Introduction

As a result of bat call recording in wind turbine nacelles, we know a lot more about the activity of bats at these altitudes and their risk of collision.

In our study we investigated which species appear and how frequently they use different altitudes at wind turbines and wind measurement masts.



**Figure 1.** Ultrasonic detector „batcorder 2.0“ with “wind turbine extension” in a wind turbine nacelle. The microphone in the bottom left of the picture is orientated towards the bottom of the nacelle.

## Material and methods

Data were collected in different parts of Germany using ultrasonic detectors “batcorder 2.0/3.0/3.1” with “wind turbine extension” (ecoObs, Nuremberg, Germany) at wind turbine nacelles (fig. 1) in the years 2013 (n = 28) and 2014 (n = 34) at height levels of 73 m to 141 m. In two of these wind turbines, additional ultrasonic detectors were installed at lower levels at the outside of the tower: at turbine No. 1 at 6 m and at turbine No. 2 at 5 m and 55 m (fig. 2, 5, 6). In addition, recordings were taken at two wind measurement masts (fig. 3), where ultrasonic



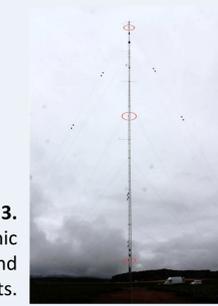
**Figure 2.** Installation of ultrasonic detector at wind turbine at 55 m.



**Figure 3.** Positions of ultrasonic detectors at wind measurement masts.

detectors were placed at mast No. 1 at 7.5 m, 60 m and 118 m and at mast No. 2 at 4 m, 60 m and 90 m (fig. 3, 7, 8).

In both study years, bat calls were recorded every night between 15<sup>th</sup> of March and 31<sup>st</sup> of October, from three hours before sunset until one hour after sunrise. The number of recorded calls was used as a measure for bat activity. Species were identified to the lowest possible taxonomic level, using the software “batident” (ecoObs, Nuremberg, Germany) and manual verification of the automatically identified results.

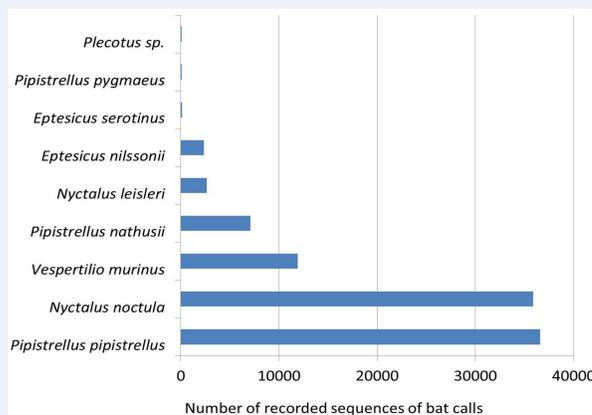


## Results I

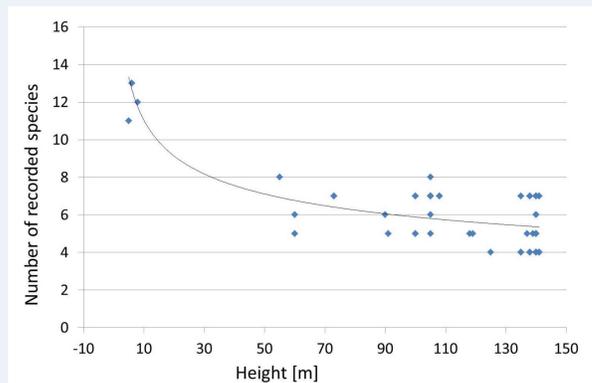
During two monitoring years, a total of **146.260 sequences of bat calls were registered at wind turbine nacelles**. At least 9 species of bats could be identified (fig. 4) while **the number of recorded species decreased with increasing height** (fig. 5).

With the exception of *Plecotus sp.*, which was recorded at the lowest nacelle (73 m), the remaining bat species are all classified as species with a high risk to collide with wind turbines, according to Brinkmann et al. (2011).

**Species from the genera *Myotis*, *Rhinolophus* and *Barbastella* were not registered at nacelles during our study.**



**Figure 4.** Number of recorded sequences of bat calls at wind turbine nacelles. Only bat calls that could be identified with certainty are shown.

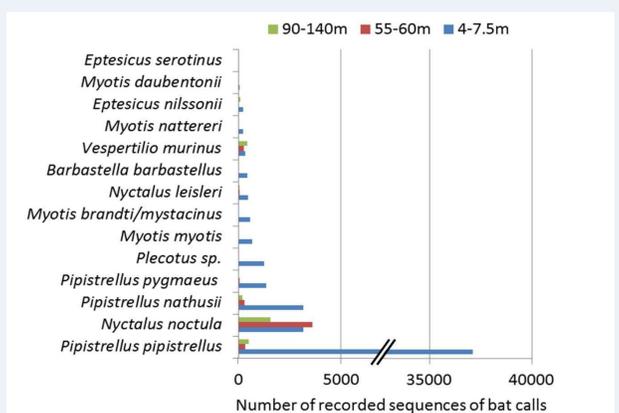


**Figure 5.** The number of bat species recorded at nacelles, wind turbine towers and wind measurement masts is showing the tendency of an exponential decline with increasing height.

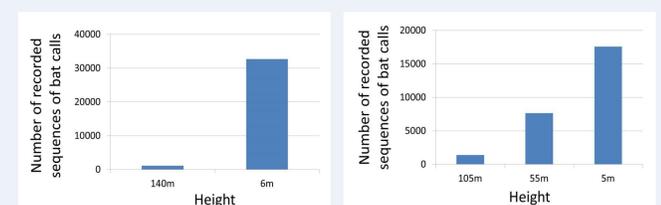
## Results II

Taking into account the data from two monitored turbines (fig. 7 and 8) as well as two wind measurement masts (fig. 9 and 10), the highest bat activity was always recorded at relatively low levels, between 4 m and 7.5 m of height. However, distinguishing at species level, **the highest flight activity of the two species *Nyctalus noctula* and *Pipistrellus nathusii* was not at ground level (4 m to 7.5 m), but was found to be at a medium height level between 55 m and 60 m** (fig. 6). **At the height of 4 m to 7.5 m we found the highest number of species, and the genera *Barbastella*, *Myotis*, and *Plecotus* were only detected at this height. Only four genera of bats were recorded at the higher levels from 90 m to 140 m: *Nyctalus*, *Eptesicus*, *Pipistrellus*, and *Vespertilio* (fig. 6).**

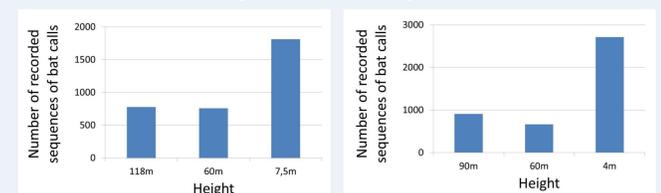
In wind turbine No. 2 (fig. 8) at a height of 55 m, the recorded activity is noticeably decreased in comparison to the bottom level, and recordings at the highest level were diminished even further. Interestingly, the recorded bat activity around the wind measurement masts did not decrease as much with increasing altitude as would be expected from the collected data at the turbine towers. While the activity was still a lot higher at the near-ground levels, the difference between medium levels of about 60 m on one hand, and



**Figure 6.** Activity of species at the wind measurement masts No. 1 and No. 2 and wind turbines No. 1 and No. 2 at different height.



**Figures 7. and 8.** Number of total calling sequences at wind turbine No. 1 (left) and No. 2 (right) at different heights.



**Figures 9. and 10.** Number of total calling sequences at wind measurement mast No. 1 (left) and No. 2 (right) at different heights.

the higher levels of 90 m up to 118 m on the other hand, was very small (fig. 9 and 10).

It is possible that bats behave differently around these very different structures of measurement masts versus turbine towers. Further studies with bigger sample sizes are required to address this question.

The Hessian Ministry “Hessisches Ministerium für Wirtschaft, Energie, Verkehr und Landesentwicklung” (2014) reports *Barbastella barbastellus* at a single wind turbine nacelle of 64 m. **However, in our study, *Barbastella barbastellus* was only recorded in very low height without risk of collision with rotor blades.**

## Conclusion

Our results clearly show that monitoring bats close to ground level does not give valuable information about bat activity in higher altitudes and vice versa. **The large activity differences between altitudes definitely demonstrate the necessity to conduct monitoring at the height of rotor blades in order to reliably estimate the risk of collision for bats.**

Based on our data, we expect bat fatalities will decrease with the development of higher wind turbines in the future.

## References

- Hessisches Ministerium für Wirtschaft, Energie, Verkehr und Landesentwicklung (2014): Konkretisierung der hessischen Schutzanforderungen für die Mopsfledermaus *Barbastella barbastellus* bei Windenergie-Planungen unter besonderer Berücksichtigung der hessischen Vorkommen der Art. pdf-document 65 S. (04/2014).  
Brinkmann, R., Behr, O., Korner-Nievergelt, F., Mages, J., Niermann, I. & Reich, M. (2011): Zusammenfassung der praxisrelevanten Ergebnisse und offenen Fragen. – In: Brinkmann, R. et al. (Hrsg.): Entwicklung von Methoden zur Untersuchung und Reduktion des Kollisionsrisikos von Fledermäusen an Onshore-Windenergieanlagen. Umwelt und Raum 4: 40–115, Cuvillier, Göttingen.

