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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Experimental Investigation of Aerodynamic Characteristics of Bat Carcasses after Collision with a Wind Turbine" *by* Shivendra Prakash and Corey D. Markfort

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First I have to apologise for the tardy review process on this paper. Many referees have been contacted without luck. Therefore will I, acting as an associate editor make a review myself.

This paper studies an area which is quite underrepresented in Wind Energy Science namely how to investigate bat killings by wind turbines. The specific research question investigated is how large a search area around the turbine is necessary to collect all the bat carcasses. This in turn depends on the aerodynamics of the carcasses and more specifically the terminal fall speed. The research is new and important but some

aspects have to be improved before it can be published. The paper is quite clear and well illustrated. Maybe some illustrations (Figs 9,10 , 12, 13) could be condensed or some parts left out.

Major issues 1. The so-called peak-locking error should be avoided. It is good but not sufficient to determine the top and bottom pixels for each frame of the bat carcass "shadow", but it is only the beginning of a more thorough analysis. It is well known from particle tracking studies that a much better resolution can be obtained (I guess that is also mentioned in the Westerweel reference). Already more than 20 years ago Mann, Ott and Andersen (1999) (Mann, J., Ott, S., & Andersen, J. S. (1999). Experimental study of relative, turbulent diffusion. Denmark. Forskningscenter Risoe. Risoe-R, No. 1036(EN) (page 22), see also Ott and Mann (2000), https://doi.org/10.1017/S0022112000001658) showed that precision down to 1/10 to 1/50 of a pixel is obtainable for images of dots that fill up a few pixels by a few pixels, very similar to the image in fig 6. The procedure is quite simple. First the background image (= no bats) should be subtracted from the image and then the already found top and bottom pixel values should be used to select a small area around the bat. Then the center of gravity of the pixel grey values should be calculated. It might not be that the precision will be as good as in the case of spherical particles but it should be much better still. 2. It is fine to calculate the drag coefficient Cd, but what is really important is the terminal fall velocity, wt. I think the emphasis should be on that because in the definition of Cd the projected area of the bat is entering. When this study is going to be used in practise people might be more interested in wt by species. There is quite some uncertainty related to the projected area. In table 1 there are some dimensions, but how exactly are those used to get the projected area? Are the wings of the bat flush with the body or do they sometimes flap out, greatly changing this area? These complications might be suppressed by focussing on the more practical wt.

Minor issues

1. The references in the start of the introduction are a bit outdated. See the recent re-

ports from either the International Renewable Energy Agency (IRENA) or WindEurope. You could also include other, newer references to wildlife issues related to wind energy, e.g. Kuik et al (2016) Wind Energy Science vol1 , pp 1.39 or H J Lindeboom et al (2011) Environmental Research Letters vol 6, 035101, or something else, just ass long as it is newer. 2. p 1 l 28. Could the wind turbine related bat fatality estimate 600.000 be related to the number of fatales caused other things, or maybe to the number of bats born every year. It might be difficult for the common reader of WES who has not much background knowledge in biology to relate to this number. Is it a lot or is it negligible? 3. also l 28: When you write a reference as a part of a sentence like Hayes 2013, "2013" has to be in parenthesis, see general WES guidlines on our web page. 4. p 2. It could be worthwhile to mention Sark and Sørensen (2015) Characterisation of blade throw from a 2.3 MW horizontal axis wind turbine upon failure, 53rd AIAA Aerospace Science meeting. There blade fragments can end up 100 to 500 m from the turbine. 5. p 3 l 71, Please mention the definition of coefficient of restitution e more clearly. 6. p 3 l 78, A "d" should be appended to "enable". 7. p 5 top lines. Use italics for the subscripts of the variables explained inline as they appear in the displayed equation (1). 8. p 5 eq 4, Minus inside cosh argument can be removed since cosh is symmetric. 9. p 7 table 1. It is unclear whether the numbers include wings or if they are only concerning the body. 10. p 8 text: Is it assumed in the analysis that the bat is falling on the y2 vertical line? Were the experiment conducted in no wind conditions? 11. p 11, l 210, How much was the lateral translation of the Evening bat? 12. p 11 sec 2.5: At the entrance of the bat into the frame of the camera, one could measure the position z and the vertical velocity w. The vertical velocity at that point could serve as the initial condition for (2) where wt is the only unknown. By adjusting wt the best fit to the subsequent measurements of w(t) could be obtained. I think I'm trying to simplify your procedure. 13. sec 2.5: it would be nice to avoid the complication of using Delta t_c. Maybe the procedure outlined in Major Issues point 1 would eventually make Delta t_c redundant. 14. p 19 l 358: Is the assumption of uniform distribution over the rotor right? 15. Section 5: It is not sufficiently well described how the histograms in figure 14 are obtained. What

is the assumption about the initial velocity of the bat relative to the blade speed at impact? The horizontal mean wind speed is an important parameters for the dispersion of the bats. What is assumed about that? How is it distributed? I think a more detail description is necessary. 16. Summary and Conclusion: It is not clear whether you use position or velocity data to do the fit. It is good to try to summarise the uncertainties, but the uncertainty on the fall distance should also be discussed.

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