Biological Conservation 235 (2019) 77–78

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Addendum to "Estimating habitat loss due to wind turbine avoidance by bats: Implications for European siting guidance" [Biol. Conserv.] 226, 205–214☆

Wind turbine impact on bat activity is not driven by siting altitude

Kévin Barré[a,b,c,*], Isabelle Le Viol[a,b], Yves Bas[a,d], Romain Julliard[a], Christian Kerbiriou[a,b]

[a] Muséum national d'Histoire naturelle, Centre d'Ecologie et des Sciences de la Conservation, UMR 7204 MNHN-CNRS-UPMC, 61 rue Buffon, 75005 Paris, France
[b] Muséum national d'Histoire naturelle, Station de Biologie Marine, 1 place de la Croix, 29900 Concarneau, France
[c] Agrosolutions, 83 Avenue de la Grande Armée, 75782 Paris, France
[d] Centre d'Ecologie Fonctionnelle et Evolutive, UMR 5175, CNRS, 1919 route de Mende, 34293 Montpellier, France

1. Context of addendum

Results we published in Barré et al. (2018) have new implications on wind energy establishment providing knowledge about distances of negative impacts on bat activity, including species so far little considered in assessment studies because not known as sensible to collisions (Voigt and Kingston, 2015). We found strong negative impacts of wind turbine on bat activity of both aerial and gleaner communities, which occurred at least until 1000 m from wind turbines and generate huge losses of habitat use around farms. Such results potentially imply significant constraints for wind energy development. To build robust and effective recommendations, it is essential to ensure disturbance impacts are not confounded with other variables. In a meeting on 18/09/2018, France Energie Eolienne, a wind developer syndicate, raised a potential altitude bias we did not take into account in our previous analyses. With the aim to optimise energy performances, wind turbines are as much as possible established in windy situation, thus at local scale at the highest altitudes. Given that bat activity is widely recognized as strongly dependant of wind speed (Voigt et al., 2015), we conducted supplementary analyses about possible biases using two metrics: the absolute altitude and the relative altitude. The relative altitude was computed as the difference in meters between the altitude of a given site and the average altitude a 500 m radius using the raster R package. We tested for (i) possible relationship between the distance to wind turbine gradient used in our study with both altitude variables, and (ii) the impact of altitude variables on bat activity compared to the impact of distance to wind turbines primary published.

2. Supplementary statistical analyses

We first tested for relationship between both altitude variables and the distance to the nearest wind turbine in order to assess the potential dependence of our results to altitude using Pearson's correlation tests.

In case of significance, we then re-performed the same statistical procedure (i.e. multi-inference procedure averaging candidate models included in a delta AICc < 2; Barton (2015)) than primary analyses in Barré et al. (2018) by replacing distance to wind turbines variable with altitude variables in order to check if altitude variables could be an alternative to explain our bat activity patterns. We used same full models, containing same environmental covariates and same random effects as explained in Barré et al. (2018), to perform the dredge and model averaging procedures. These analyses were re-performed on species for which the effect of the distance to wind turbines on bat activity was significant or close to the significance.

3. Results

The 207 sampled sites in North-West of France exhibited low values and low variability of absolute altitude (mean = 116.8 m; Standard Deviation = 60.2 m) and relative altitude (mean = 0.4 m, SD = 3.5 m).

Altitude of sampled sites was not correlated to the distance to the nearest wind turbine (Pearson's correlation test; $r = -0.05$; p-value = 0.49). However, we found a significant negative relationship between relative altitude and the distance to the nearest wind turbine (Pearson's correlation test; $r = -0.26$; p-value < 0.001).

DOI of original article: https://doi.org/10.1016/j.biocon.2018.07.011

☆ This addendum is motivated by criticisms of the concerned paper by wind developers who raised a potential altitude bias, wind turbines being most often positioned higher than their surrounding environment. Despite altitude vary very little in the study area, we believed it was valuable to control for this potential confounding effect and thus to ensure the robustness of the conclusion drawn.

* Corresponding author at: Muséum national d'Histoire naturelle, Centre d'Ecologie et des Sciences de la Conservation, UMR 7204 MNHN-CNRS-UPMC, 61 rue Buffon, 75005 Paris, France.

E-mail addresses: kevin.barre@edu.mnhn.fr (K. Barré), ileviol@mnhn.fr (I. Le Viol), ybas@mnhn.fr (Y. Bas), julliard@mnhn.fr (R. Julliard), christian.kerbiriou@mnhn.fr (C. Kerbiriou).

https://doi.org/10.1016/j.biocon.2019.04.009

Table 1
Estimates and standard errors of the distance to the nearest wind turbine variable (linear and quadratic effects) found in Barré et al. (2018), and the relative altitude effects on bat activity.

Species	Distance to the nearest wind turbine effect on bat activity found in Barré et al. (2018)		Relative altitude
	Linear	Quadratic	
Barbastellus barbastella	0.237 ± 0.107*	/	0.033 ± 0.030
Eptesicus serotinus	0.132 ± 0.169	/	−0.064 ± 0.052
Myotis spp.	0.260 ± 0.091**	/	0.049 ± 0.027
Nyctalus leislerii	0.537 ± 0.208*	−0.413 ± 0.198*	−0.068 ± 0.050
Nyctalus noctula	0.308 ± 0.290	−0.575 ± 0.307#	−0.134 ± 0.078
Pipistrellus pipistrellus	0.413 ± 0.100***	/	0.034 ± 0.028
Plecotus spp.	0.309 ± 0.096**	/	−0.022 ± 0.032

*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.
# $p < 0.1$.

We did not find any significant effect of relative altitude on bat activity, and slopes highlighted very low effect sizes in comparison with distance to wind turbines variable (i.e. 7.3 times lower in average; Table 1).

4. Conclusion

Correlation detected between the relative altitude and the distance to wind turbines highlighted potential confounding effect in bat activity measures. However, models exhibited non-significant and very low effects of relative altitude on bat activity. These supplementary analyses ensure the robustness of already published results against potential environmental biases on bat activity related to altitude and thus wind speed or exposition to wind. This reveals that wind turbines impacts on bat activity occurs regardless of altitude in low relief regions as our study area, and appears to be constant regardless landscape composition as tested in Barré et al. (2018). Further studies are needed to assess impacts of wind energy on bat activity on steeper while limiting confounding effect from altitude.

References

Barré, K., Le Viol, I., Bas, Y., Julliard, R., Kerbiriou, C., 2018. Estimating habitat loss due to wind turbine avoidance by bats: implications for European siting guidance. Biol. Conserv. 226, 205–214. https://doi.org/10.1016/j.biocon.2018.07.011.

Barton, K., 2015. MuMIn: Multi-Model Inference [WWW Document]. URL. http://cran.r-project.org/package=MuMIn.

Voigt, C.C., Kingston, T., 2015. Impacts of wind energy development on bats: a global perspective. In: Bats in the Anthropocene: Conservation of Bats in a Changing World. Berlin, pp. 1–606. https://doi.org/10.1007/978-3-319-25220-9.

Voigt, C.C., Lehnert, L.S., Petersons, G., Adorf, F., Bach, L., 2015. Wildlife and renewable energy: German politics cross migratory bats. Eur. J. Wildl. Res. 61, 213–219. https://doi.org/10.1007/s10344-015-0903-y.