Inf.EUROBATS.AC24.5.

24th Meeting of the Advisory Committee

Skopje, North Macedonia, 1 – 3 April 2019

Information on Bats and Infrasound

Compiled by Primož Presetnik

Wind turbines are known to harm bats both by direct killings and habitat destruction (e.g. Rodrigues et al. 2015). Direct killings occur when bats come into contact with turbine blades or through barotrauma to bat internal organs. Different bat species have different collision risks levels because of constraints within their ecological morphology. In means that higher flying species (*Nyctalus* spp., *Pipistrellus* spp.), which are usually also aerial hawkers, typically tend to have a higher risk for collisions.

However, a growing body of evidence has been substantiating the negative biological effects on organisms caused by exposure to infrasound and low frequency noise (ILFN) (< 100 Hz). Therefore, low-flying bat species (*Rhinolophus* spp., *Myotis* spp.) could, potentially, also be threatened by wind turbines. Longer living bat species (e.g. *R. ferrumequinum* or *M. myotis*) would be predominantly affected and their populations would be particularly harmed since they are a highly gregarious species and form relatively few maternity or hibernaculum colonies.

Here I present some references to studies on the biological effects of long-term exposure to ILFN in mammals (including humans).

In 1999, vibroacoustic disease (VAD) was defined as whole body, systemic pathology, characterized by the abnormal proliferation of extra-cellular matrices due to excessive exposure to ILFN (Castelo Branco 1999). This pathology was initially defined within occupational environments. The clinical stages presented below refer to the time required for 50% of the study population to develop the corresponding sign or symptom (Castelo Branco 1999):

- Mild (1-4 years of ILFN exposure):	Slight mood swings, indigestion & heartburn, repeated mouth & throat infections, bronchitis.
- Moderate (4-10 years of ILFN	Chest pain, back pain, fatigue, fungal & viral skin infections, allergies, blood in urine, inflammation of

exposure):	stomach lining.
- Severe (> 10 years of ILFN exposure):	Psychiatric disturbances, headaches, hemorrhages of nasal & digestive mucosa, duodenal ulcers, spastic colitis, varicose veins & hemorrhoids, decreased vision, severe joint pain, severe muscular pain, neurological disturbances.

Some of the morphological changes observed in ILFN-exposed human populations and laboratory animals were documented in a 2007 review paper (Alves-Pereira et al. 2007), and included:

- Abnormal thickening of cardiovascular structures (pericardium and blood vessel walls),

- Pulmonary fibrosis (alveolar wall thickening, trachea brush cell degradation),

- Deterioration of cochlear cilia (cilia fused together and with upper tectorial membrane).

Limb deformation and reproductive problems have also been documented in ILFN-exposed laboratory rats exposed (Castelo Branco et al. 2003), in horses living in the vicinity of a wind power station composed of 4 wind turbines (Castelo Branco et al. 2010), and in poultry living in a ILFN-contaminated home due to coal mining activities and a coal-powered electrical plant (Rapley et al. 2017).

However there are some voices of concern about real effect of ILFN and wind turbines (Chapman & St George 2013), but I think precautionary principle should also apply in this possible threat to bat conservation.

To conclude: bats may be at high risk for developing ILFN-induced disease and, therefore, I recommend that the Advisory Committee of EUROBATS take ILFN as a possible serious risk to bats, promote awareness of this threat within expert communities, encourage scientific research on the subject and take this hazard into the account during the possible renewal of “Guidelines for consideration of bats in wind farm projects”.

References:

Alves-Pereira M., Castelo Branco NAA., 2007. Vibroacoustic disease: Biological effects of infrasound and low frequency noise explained by mechanotransduction cellular signaling. Progress Biophysics & Molecular Biology, 93: 256-279.

[https://www.researchgate.net/publication/6780005_Vibroacoustic_disease_Biological_effects_of_infrasound_and_low-frequency_noise_explained_by_mechanotransduction_cellular_signalling]

Chapman S., A. St George, 2013. How the factoid of wind turbines causing 'vibroacoustic disease' came to be 'irrefutably demonstrated'. Australian and New Zealand journal of public health, 37 (3): 244-247. [https://onlinelibrary.wiley.com/doi/epdf/10.1111/1753-6405.12066]

Castelo Branco NAA., 1999. The clinical stages of vibroacoustic disease. Aviation, Space and Environmental Medicine, 70(Suppl): A32-A39.

Castelo Branco NAA, Monteiro E., Costa e Silva A., Reis Ferreira J., Alves-Pereira M., 2003. Respiratory epithelia in Wistar rats born in low frequency noise plus varying amount of additional exposure. Revista Portuguesa Pneumologia, IX (6): 481-492. [In English]

[https://www.researchgate.net/publication/8517732_Respiratory_epithelia_in_Wistar_rats_after_48_hours_of_continuous_exposure_to_low_frequency_noise]

Castelo Branco NAA, Costa e Curto T., Mendes Jorge L., Cavaco Faísca J., Amaral Dias L., Oliveira P., Martins dos Santos J., Alves-Pereira M., 2010. Family with wind turbines in close proximity to home: follow-up of the case presented in 2007. Proceedings of the 14th International Meeting on Low Frequency Noise, Vibration and Its Control, Aalborg, Denmark, 9-11 June: 31-40.

[https://www.researchgate.net/publication/290444702_Family_with_wind_turbines_in_close_proximity_to_home_follow-up_of_the_case_presented_in_2007]

Rapley BI, Bakker HHC, Alves-Pereira M, Summers SR., 2017, Case Report: Cross-sensitisation to infrasound and low frequency noise. Proceedings of the International Conference on the Biological Effects of Noise (ICBEN), 18-22 June, Zurich, Switzerland (Paper No. 3872).

[http://www.icben.org/2017/ICBEN%202017%20Papers/SubjectArea10_Bakker_1001_3872.pdf]

Rodrigues L., L. Bach, M.-J. Duborg-Savaga, B. Karapandža. D., Kovač, T. Kervyn, J. Dekker, A. Kepel, P. Bach, J. Collins, C. Harbusch. K. Park, B. Micevski & J. Minderman., 2015. Guidelines for consideration of bats in wind farm projects. Revision 2014. EUROBATS Publication series No. 6. (English version). UNEP/EUROBATS Secretariat, Bonn, Germany. 133 pp.