



AWWI Webinar Audience Q&A Panelist Responses
Bat Impact Minimization Part 2, Deterrence

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Dr. Sharma - can you share more about the distance at which you are measuring sound power from the resonator?

- **Anupam Sharma, Iowa State University:** About 2 m from the source in some of the results shown.

In general - have those exploring blade mounted solutions quantified the AEP losses incurred by compromising the air foil? Do we expect those losses to be less than those we can gain by reducing cut in speed?

- **Sauro Liberatore- Mide Technologies Inc:** Much less, no doubt. We can show that the 10 watts even if multiplied by 5-10 will be as much as you lose.
- **Anupam Sharma, Iowa State University:** We have compared the lift and drag coefficients with and without some initial blade-mounted deterrent designs and found the difference to be small. However, we have not done an AEP calculation to see how it compares with curtailment.

Do these devices provide 360-degree coverage?

- **Anupam Sharma, Iowa State University:** Each deterrent is typically directional; the higher the frequency the more directional the sound. To get 360 deg coverage, you would need multiple deterrents facing in different directions.

The concept of blade mounted deterrents make sense, but has anyone worked with turbine manufacturers to determine if mounting anything on blades be allowed and warranted?

- **Anupam Sharma, Iowa State University:** Wind turbine OEMs are very interested in blade-mounted technology IF the aero performance impact is small/negligible.

Where we can find Brad Romano publication?

- **Paige Johnson, AWWI:** <https://wildlife.onlinelibrary.wiley.com/doi/10.1002/wsb.1025>

Are blade mounted deterrents being designed with an understanding of turbine manufacturer's constraints? What amount of vibration would they accept, for example. Would it affect the life span of the individual generator?

- **Anupam Sharma, Iowa State University:** To some extent, yes. But the blade-mounted deterrent technology is in its early stages and deeper integration with the OEMs is required.

Can deterrent devices be used in conjunction with smart curtailment devices? Are any of you aware of projects/research conducted to date that have employed both technologies? If so, were bat mortality rates further reduced by combining the two?

- **Sara Weaver, Bowman:** Yes, there have been some studies looking at this. WEST conducted a study at Pilot Hill and found combining deterrents with curtailment can have added fatality reduction benefits. However, it also varied by species.

How much are ambient conditions likely to impact transmission of ultrasound?

- **Sara Weaver, Bowman:** Temperature and humidity do affect the distance ultrasound can travel and it is not linear.

To expand on questions regarding blade mounted solutions: are we mature enough in the development process to define the installation and O&M requirements? are these solutions to be intended as retrofits or would they need to be introduced to the blade at the manufacturer? do we understand the cost of accessing the mechanical system(s) should we need to?

- **Sauro Liberatore, Mide Technologies Inc:** Retrofit is hard since I am not sure there will operators willing to attach any device on the blade. But we need to start somewhere to convince the industry that it is feasible. We are far from a final solution, so we have large room for design improvement. That's the way I see it.

There are modifications to blades that help reduce noise. Could a modification be added to turbine blades that generate ultrasound?

- **Anupam Sharma, Iowa State University:** There has been some thought given to this; one could create whistles/resonators that are built into the blade. But it requires a deep integration with blade design/manufacturing. I see that as a next step once the technology is demonstrated when mounted on blades.

For blade-mounted devices, presumably, a bat would experience the doppler effect (e.g. like sirens sounding differently as a firetruck drives by) as they fly in the RSZ...? If that is indeed the case, how far out from the blade might the "true" emitted frequency be experienced at a given RPM?

- **Anupam Sharma, Iowa State University:** The Doppler shift would be very small as we are dealing with very high frequencies.

Will debris clog these whistles up (i.e. dust)? How long will they last? Will they require maintenance or replacement frequently?

- **Anupam Sharma, Iowa State University:** This (and icing) is a concern and one idea is to blow out the whistles using pressurized air.

If operators are already applying/glueing serrations as noise mitigation, could these "blade mounted" deterrents be applied similarly?

- **Sauro Liberatore, Mide Technologies Inc:** That is a great point. You need to convince wind operator that can be done. That's why starting with a prototype is a huge step. NREL is the only one that can do this.

Will climatic conditions play a role on the effectiveness of these devices? For example, will they work differently between humid coastal regions, versus inland dryer regions?

- **Sara Weaver, Bowman:** Yes, humidity and temperature both affect ultrasound attenuation and site-specific conditions can contribute to the distance the sound will travel.

How consistent are individual bats of the same species in their response to a "random" sound?

- **Brad Romano, Invenergy:** In case we do not get to this discussion, my past experience as part of the GE deterrent research team is the response of bats within the same species was consistent. It is reasonable to expect some variability in individual responses.