

The McPherson Study The Infrasound Smoking Gun

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Note - All my references are lumped into their own section below.

Abstract

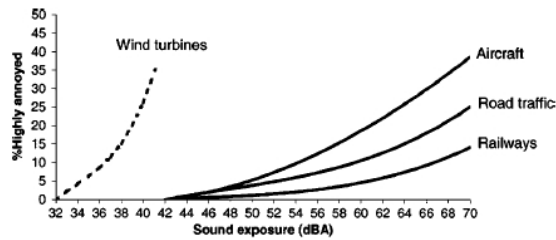
McPherson is the first (and so far only) study to specifically look for the presence of excessive infrasound due to nearby wind turbines in a home that was identified by the owners as having a problem. Two professional acousticians, Robert Rand and Steven Ambrose lived in the home for 3 days during which they took detailed measurements of the infrasound and noted its effects upon themselves. They discovered that the infrasound often crossed the threshold of detection by the ear's low-frequency detection mechanisms, and did so in a manner that could be very disturbing to individuals, causing potentially significant health problems. This study calls into question all the existing but unsupported claims by the wind energy industry and its supportive governments that infrasound is not a health issue.

Background

Modern wind turbines are large industrial machines that produce a variety of noises. As these turbines are placed closer to residences the number of complaints, from around the world, have been rapidly increasing. The complaints generally fall into two categories, audible and infrasound.

Audible noise may not seem so loud when casually passing by a turbine on a nice day. But a constant 24-hour exposure to this noise can cause annoyance – and by annoyance I mean something severe enough to lead to, among other stressors, increased blood pressure and all the resultant health issues that flow from that. In addition, the noise is more audible at night when it can lead to sleep disturbance, and all the health problems that follow that.

The wind energy industry admits there is audible noise and it can be disturbing to *some* neighbors. Since it isn't disturbing to all the neighbors, the fault must therefore lie with the complaining neighbors themselves. Perhaps they are jealous, or there's a nocebo effect, or they just didn't like the turbines to begin with, or they are unusually sensitive. The fact is that wind turbine noise is very much more disturbing than just about any other noise we encounter in our modern world, as shown by this widely-distributed chart from Pedersen:



The McPherson Study and this critique have nothing to add to the discussion about audible noise.

Infrasound is noise whose frequency is too low to be easily audible, generally below 20hz. Modern wind turbines produce a large amount of it, and as they continue to grow larger they produce more of it, even relative to the total amount of noise they produce. Low frequency noise has the potential to cause a number of health issues. Tyrrell Burt's list is from 1996, which referred to infrasound in buildings: "*symptoms resulting from exposure to infrasound can include fatigue, headache, nausea, concentration difficulties, disorientation, seasickness, digestive disorders, cough, vision problems and dizziness, that is, symptoms typical of the sick building syndrome.*" The quite similar list from Nina Pierpont's 2009 Wind Turbine Syndrome is: "*sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and episodes associated with sensations of internal pulsation or quivering*".

The wind energy industry steadfastly denies that their product can produce enough infrasound to cause any health problems. They typically cite acousticians - the names Leventhall, Howe and Jakobsen appear frequently— saying things like Leventhall's: "*Infrasound from wind turbines is below the audible threshold and of no consequence.*" Although these assertions sound reassuringly absolute there are two major problems with all of them. First is the idea that what you can't hear can't harm you. This is of course rubbish, akin to saying xrays can't harm you because you can't see them. Second is that none of these acousticians have ever gone into a home that is reported to be having problems and actually measured the infrasound levels.

The McPherson Study was the first time anyone went into a problematical home and actually measured the infrasound. What they found there puts an end to all the irresponsible speculation by these convenient professionals, some of whom are profiting thereby.

Part One – the Ear

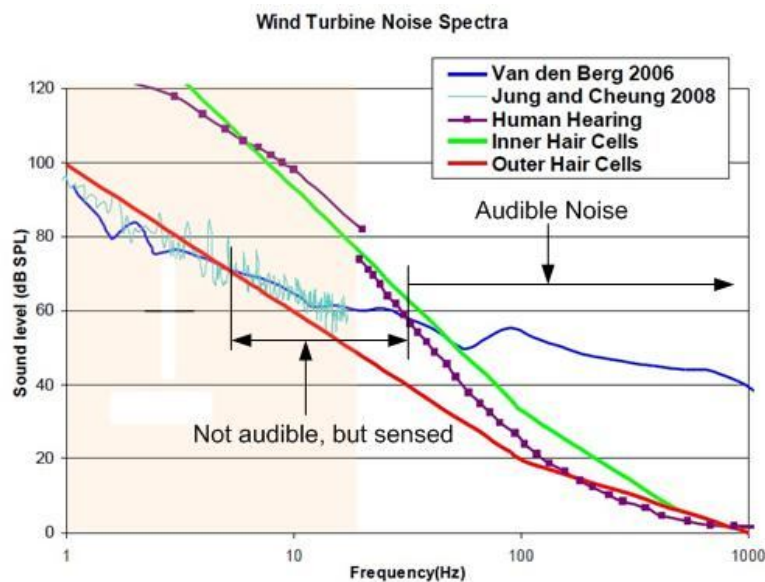
Before we discuss the McPherson Study itself, it is important to set the stage by very briefly discussing the ear and its capabilities. For the purposes of this discussion it is important to know that there are two types of hair cells in the ear that translate physical vibrations (i.e. noise) to the electrical signals that are sent to the brain.

Inner hair cells (IHC) and their nerve impulses have been well studied and are generally accepted to provide for the sounds that we are conscious of – in other words, audible.

Outer hair cells (OHC) are more mysterious. They have a different set of nerve connections to the brain and until recently it wasn't clear that they sent any signals at all, and it is still not clear exactly what all their functions are. In real science, there's always more to learn.

Alec Salt has been studying the ear for some 30 years at Washington University in St. Louis and he became interested in the topic of wind turbine infrasound when he came across Wind Turbine Syndrome. Given the symptoms he realized infrasound as detected by the ear could be the culprit. From his research he knew that the OHC were sensitive to lower frequencies than the IHC, and did send signals to the brain. And while his research wasn't aimed at determining what the brain did with these signals, he knew it was irresponsible to blindly assert that inaudibility equaled no effects.

The essence of his argument is that wind turbines are documented to produce enough infrasound in neighbors' homes to go above the OHC thresholds, and thus send signals to the brain that could lead to the documented symptoms associated with infrasound. The chart below presents this pictorially (from Salt's SWV Picton presentation, slide #14).



I'm sure the wind energy industry would love to characterize Dr. Salt as some sort of non-mainstream non-scientist, sliming him like they did Dr. Pierpont, but so far they haven't. Probably a good idea. Salt is well-published, an expert in his field, which currently concentrates on the effects of drugs on the ear. I first came across him in mid-2010, when *Responses of the ear to low frequency sounds, infrasound and wind turbines* was published in PubMed, peer reviewed and even sponsored by the NIH. I thought Salt's work was of great value and posted about it at my windfarmrealities.org web site.

So how does the wind energy industry discuss his work? Not being able to dismiss it out-of-hand, they try to minimize it by saying things like (from Howe (2011), *Low Frequency Noise and Infrasound – Wind Turbine Generators*):

Salt acknowledges that “the fact that some inner ear components (such as the [outer hair cells]) may respond to infrasound at the frequencies and levels generated by wind turbines does not necessarily mean that they will be perceived or disturb function in any way”, but hypothesizes that there is a “possibility that wind turbine noise could be influencing function or causing unfamiliar sensations”. Salt also indicates that there are medical conditions where individuals may become hypersensitive to infrasound. Salt calls for more research.

Notice the attempts to minimize the effects and blame the victims? Even when Pedersen’s curves show that a third or more of the neighbors are highly annoyed by the noise? Where I strongly disagree with Howe and others like him is that even with the acknowledged unknowns, they never suggest that maybe, just maybe, they should slow the installation of wind turbines close to homes down a little. Bad for business, you see. At least Howe, in this case, finally started fudging on the infrasound issue. In the paper containing the above quote, he had four recommendations. Three of them involved more research, and one of the three specifically mentioned doing indoor testing. Well, McPherson is exactly what Howe requested, published two days before he did so!

Part Two – the Study

Falmouth, MA is located on the southern extension of Cape Cod, the part that ends at Woods Hole. Several years ago the town fathers decided to install a wind turbine (now grown to three) in an area that was close to a number of homes. Almost immediately the neighbors started complaining. Concerned about the welfare of his neighbors, one Bruce McPherson ponied up enough money to hire two professional acousticians, Rob Rand and Steven Ambrose, to do a thorough acoustical study of several of the homes that were affected.

The actual report is well written, and deserves to be read by everyone. To sum it up, both of Rand and Ambrose started feeling uncharacteristically unwell shortly after arriving at the home as they set up their equipment. Totally separate from Salt, I also posted on this at windfarmrealities.org. They recorded the noises for several days and then spent several months analyzing their results and doing additional research. I will present a brief summary – the full report really does deserve a reading.

We start with the overall noise measurements taken indoors, as shown in their figure 8b:

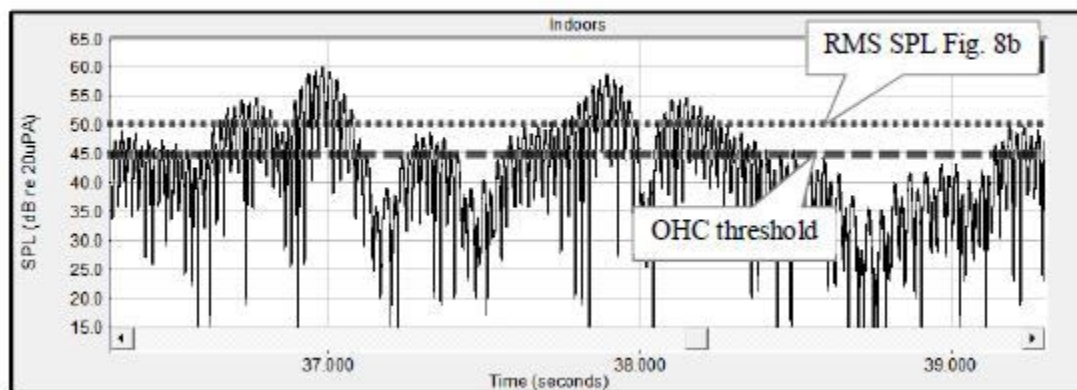
8b – Indoors (RMS)



The IHC and OHC thresholds are shown same as above with the average (RMS) unweighted dB level. Note that there wasn't much audible noise (from above the IHC threshold, remember?) from the turbine indoors, and yet the neighbors generally complain that they are more disturbed indoors than out. The tone that is of the most interest was at 22.9Hz, which was confirmed as characteristic of the nearby turbine. It was on average just above the OHC threshold. It doesn't seem possible that this slightly-sensed tone, averaging 50 dB with a threshold of 45 dB could cause very significant problems.

Rand and Ambrose then studied the 22.9Hz tone in more detail, filtering out the other noises. Here's what they found, per their figure 9:

Figure 9 – 22.9 Hz tone and its OHC threshold



Note the time scale – that entire picture covers just 3 seconds! As Rand says:

Figure 9 reveals a remarkable range of modulation in the 22.9 Hz tone, which peaks in this example time record as high as 60 dB SPL, 10 dB higher than the 50 dB SPL mean established by the FFT averaging. Nulls between peaks drop down several tens of decibels below the OHC threshold. The figure suggests that the inner ear OHC circuitry is receiving individual low-frequency pressure events 43 milliseconds apart at the 22.9 Hz driving frequency.

Imagine your brain getting continually pounded by the coming and going of the signals the OHC would be generating. The end result was that the acousticians themselves became nauseated etc and recovered as the measured levels of noise went up and down with the change of wind speeds during the several days they were in the home. As Rand states with a great deal of New England reserve:

The research is more than just suggestive. Our experiencing of the adverse health effects reported by others confirms that industrial wind turbines can produce real discomfort and adverse health impacts.

Discussion

The “smoking gun” portion of this report’s title is some indication of how important I think this study is, especially when combined with Salt’s pre-existing work. Salt established the physiology that explains fairly precisely how infrasound could cause the reported symptoms. It is difficult to dismiss his work. Rand and Ambrose then examine a situation where those symptoms have been reported by a large number of people in circumstances that lend credibility to the reports. They then find that the conditions that Salt hypothesized do in fact exist. It is difficult to dismiss their work. At this point anyone with any sense of precaution would have warning flags popping up all over. To add icing to the cake, the researchers themselves suffer the same symptoms in concert with their measurements crossing the threshold that was previously established by Salt. In the real world it isn’t often that the evidence is this clear-cut.

In spite of the overwhelming nature of this evidence there are still some loose ends. In science, there always are. The 22.9Hz tone may be characteristic of this particular turbine (a Vestas V82), or it may be due to location, the turbine type, the wind, this home etc. It may be common or not, it may be 22.9 or some other value. Establishing the entire truth will take many more studies, studies that cost a fair amount of money. But what is clear that for this home in this situation, the complaints of the owners are real and are beyond any reasonable doubt due to the noise generated by the turbine.

Another loose end is how the incoming signals from the OHC trigger the symptoms. Given the complexity of the brain this may never be wholly understood. But so what? We may not totally understand how, for example, bipolar disorder occurs but nobody doubts that it does, and treats it as best as they can.

The wind energy industry is always scolding the opponents for not being scientific. That is nonsense. The industry is simply accusing opponents of what they themselves are guilty of, an old trick worthy of scoundrels. The industry trots out about half a dozen “studies” that purport to show that there are no infrasound issues, but not one of them went into a troubled home and measured anything. The same pattern holds for the industry’s oft-quoted health studies, where not one of them interviewed any victims, nor their doctors, let alone ran a health study. And what happens when a real study comes along, like Nissenbaum, Pierpont, Salt or McPherson? They belittle it, usually along with the author. They’ve apparently read *Doubt Is Their Product*, by David Michaels.

It has been two weeks since McPherson has been released and so far neither CanWEA nor AWEA have responded. Perhaps the Ontario re-release of Howe two days after McPherson was meant to be an answer, but given the speed of governments that seems unlikely (even though nobody can figure out any other motive). So I can only guess how they'll respond, if they ever do. They'll have trouble attacking either Salt's work (peer-reviewed, NIH support) or the measurements of Rand and Ambrose (vetted by the Acoustical Society of America). So that leaves attacking the symptoms reported by them as anecdotal and thus automatically discardable, or attacking their obviously anti-turbine bias, or blaming the victims (or in this case, blaming the victim's home), or saying it needs yet more proof.

It seems that some homes suffer and some victims suffer, but it isn't yet clear what (if any) combination has to exist. The industry has already taken to blaming the victim for any health problems they might be having (i.e. attitude, nocebo, sensitive, jealous etc.) so maybe in this case they'll try to blame the homes – too big, too small, not constructed properly, whatever. The homes in the neighborhood where the measurements were taken were built in the 1980's and are rather small, less than 1,000 sq ft, and were presumably built to modern standards. There is nothing noteworthy about these particular homes. I've long thought that there might well be some characteristics to a particular home that would make it prone to having noise problems. To date it is impossible to determine what those characteristics might be. Should the neighboring homeowners be forced to take the entire risk that this new industrial development will render their home unlivable? Aside from an industry-government oligarchy, in what sort of political system is this acceptable? In what sort of ethical, moral or even religious system is this acceptable?

As for saying you need more proof, one has to wonder exactly what it is going to take to convince the governments there's a problem. Thousands of reports, too consistent and widespread to be part of a conspiracy; too tied to wind turbines to be the result of something else? Check. A plausible physiological mechanism? Check. Measurements that show the mechanism is satisfied? Check. First-hand disinterested professional observation that agrees with the measurements? Check. Or perhaps this is a case of one's salary depending on not understanding something.

References

Robert Rand et al.

(1) Rand has his own web site, <http://randacoustics.com/> . It contains a variety of wind-turbine-related materials, including the McPherson Study.

(2) The McPherson Study, available at Rand's web site at:
<http://randacoustics.com/wind-turbine-sound/wind-turbines-published-articles/the-bruce-mcpherson-ilfn-study/> .

(3) The McPherson Study, a backup copy, from my web site at:
<http://windfarmrealities.org/wfr-docs/rand-mcpherson-study.pdf> .

(4) My posting about Rand and his illness in what eventually became the McPherson Study: <http://windfarmrealities.org/?p=962> .

(5) Rand's writings led me to post about community noise levels set way back in the 1970's: <http://windfarmrealities.org/?p=927> .

Articles on McPherson.

(1) The article that seems to have gotten replicated many places was originally at Cape Cod Online, at:

<http://www.capecodonline.com/apps/pbcs.dll/article?AID=/20111226/NEWS/112260313>

Be sure to read the comment by Sue Hobart, the owner of the home.

(2) I have a backup copy of the Cape Cod Online article at:

<http://windfarmrealities.org/wfr-docs/cconline-mcpherson-111226.pdf>

I included the comment by Sue Hobart as part of this backup.

Alec Salt et al.

(1) The abstract to his article on PubMed, as sponsored by the NIH, entitled *Responses of the ear to low frequency sounds, infrasound and wind turbines*:

<http://www.ncbi.nlm.nih.gov/pubmed/20561575>

(2) The direct link to his article on PubMed:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2923251/pdf/nihms214369.pdf>

(3) I have a backup copy of the PubMed article at:

<http://windfarmrealities.org/wfr-docs/salt-nih-infrasound-wind-turbines.pdf>

(4) The NIH had a press release about Salt's article, at:

http://www.nidcd.nih.gov/news/releases/10/Pages/07_28_10.aspx

(5) I have a backup copy of the press release at:

<http://windfarmrealities.org/wfr-docs/nihcd-salt-conventional.pdf> .

(6) Dr. Salt presented at the Society for Wind Vigilance's (SWV) Picton conference, one of many fine presentations, listed on their site at:

<http://www.windvigilance.com/international-symposium/proceedings-first-international-symposium> .

I was privileged to have attended and posted about it at:

<http://windfarmrealities.org/?p=699> . His presentation can be found on my web site as

well as at the SWV's. I also posted on his work when I first came across it, at:

<http://windfarmrealities.org/?p=400> .

Brian Howe et al.

(1) The paper I referenced was re-released by the government of Ontario with a press release: http://www.ene.gov.on.ca/environment/en/resources/STDPROD_092087 .

(2) The paper itself is at:

http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_092086.pdf

(3) I have a backup copy at:

<http://windfarmrealities.org/wfr-docs/hgc-lfn-infrasound-report.pdf> .

(4) John Harrison wrote a critique of the latest Howe report, at:

<http://windfarmrealities.org/wfr-docs/harrison-response-hgc.pdf> .

Jorgen Jakobsen.

(1) I have a copy of the paper everyone quotes from at:

<http://windfarmrealities.org/wfr-docs/jakobsen-low-freq-noise.pdf>

If you read that paper, you'll find it was just another literature review.

Geoff Leventhall

(1) I have a copy of the paper everyone quotes from at:
<http://windfarmrealities.org/wfr-docs/leventhall-canacoustics.pdf>
If you read that paper, you'll find the main topic wasn't infrasound per se, rather it was about the confusion regarding infrasound.

CanWEA/AWEA Health Study

(1) This is an example of what the industry calls a health "study". Note they never talked to one victim, nor any attending doctor.
<http://windfarmrealities.org/wfr-docs/canwea-health-dec-2009.pdf>

Eja Pedersen

(1) The chart is from Pedersen & Waye (2004), *Perception and annoyance due to wind turbine noise – a dose-response relationship*, available at:
<http://windfarmrealities.org/wfr-docs/pedersen-dose-response-2004.pdf> .

(2) The industry has taken her generally competent work and stretched it beyond its original scope. An example is how Ontario has misused it, as detailed at:
<http://windfarmrealities.org/?p=1201> .

Tyrrell Burt

(1) The complete study would cost money. In lieu of that the abstract is at:
<http://ibe.sagepub.com/content/5/1/44> . Burt was an early infrasound investigator.

(2) Other writings of his give an idea of the earlier one cited above:
http://www.accessengineeringlibrary.com/mghpdf/0071450076_ar019.pdf

Paul Fuchs

(1) Here is a summary of Fuchs' work on signals from the OHC to the brain:
http://www.sciencecodex.com/now_hear_this

(2) Here is the Johns Hopkins press release on his work:
http://www.hopkinsmedicine.org/Press_releases/2009/10_22a_09.html

Nina Pierpont

(1) Pierpont has her own web site, <http://www.windturbinesyndrome.com> . It is full of useful and interesting information relating to Wind Turbine Syndrome.

(2) On that site, at <http://www.windturbinesyndrome.com/articles.html> there's a series of interviews of, among others, Ambrose and Rand about their experiences.

Update History

Update #1, 12/28/2011 – I forgot to include my Pedersen references. Now fixed.

Update #2, 12/28/2011 – I also forgot to include any Pierpont references. Now fixed.