Why Does Egg Mortality Increase Near a New Wind Industry?

HENNING THEORELL, MD. SPEC. INTERNAL MEDICINE, *HENNING.THEORELL@HOTMAIL.COM*

MARIA VEMDAL, M. SC.. INDUSTRIAL ENGINEERING, *MVEMDAL@GMAIL.COM*

Published in "Svensk Veterinärtidning" No 5 June 2024 Vol. 75

https://www.svenskveterinartidning.se/wp-content/uploads/2024/06/SVT2405.pdf
(please answer "yes" to initial question to access the publication)

Introduction

In Sweden, 2 million eggs are produced annually, with many hobby chicken owners supplementing established suppliers. The Facebook group "Vi som har höns" (We Who Have Chickens) has 42,000 members, and "Höns och fjäderfä" (Chickens and Poultry) has 92,000 members. Associations like the Swedish Land Chicken Association and other breeding societies are committed to preserving and raising chicken breeds, reflecting the significant interest in poultry farming and its importance for food production and cultural heritage in Sweden.

In addition to domestic chickens, Sweden has a rich fauna of forest birds such as capercaillie, black grouse, ptarmigan, hazel grouse, pheasant, and guinea fowl.

At a permaculture farm in Småland, egg mortality has markedly increased since a new wind industry began operating only 1000 meters from the farm center. This is concerning given the massive rollout of wind power planned in southern Sweden. The farmers referenced in this article have tried to investigate the phenomenon to the best of their ability, but controlled studies and measurements are needed to better understand the causes.

This article summarizes the studies already conducted in relevant research areas but primarily aims to highlight the importance of more controlled studies as soon as possible before the risks materialize and both wild and domestic poultry's egg mortality becomes catastrophically high.

Background

A significant change within the wind power industry is the marked increase in the size of wind turbines (both height and rotor diameter) since 2018. Despite this increase, guidelines for audible noise from wind turbines have not been updated accordingly. Moreover, there are still no limits for low-frequency noise and infrasound, which is a serious deficiency. This is despite a thorough modeling study conducted in 2014.

In the environmental impact assessments (EIM) carried out before applying for permits for environmentally hazardous activities (wind turbines), no consideration is given to the effects of ground geology or ground vibrations on people or local fauna. Only the distance from wind turbines to lekking sites for forest birds is considered, i.e., the collision risk.

Interestingly, there is no clear guidance on the vibrations that large-scale wind power can generate. This is despite it being well-documented that vibrations can affect cells at the chromosomal level. This raises questions about whether wind farms can have a similar impact on wildlife and humans nearby. An illustrative example of this is the restrictions for female helicopter pilots who are prohibited from flying during pregnancy due to the risks of vibrations affecting the fetus. This shows the serious need for guidelines and regulations that consider the potential health risks associated with vibrations from wind industries.

For animal husbandry, there are no guidelines at all, and with the aggressive rollout of large-scale wind power in southern Sweden, there could be extensive and irreversible damage to animal husbandry and, in the long term, food production.

Case Study

The Schwere family in Ljungbyholm maintains a hobby flock with five different breeds. The normal hatch rate from 2009 to 2020 has been at least 95% successful hatches after 21 days of incubation.

In 2021, a new wind power industry with 12 turbines of 4.5 MW each began operating about 1000 meters from the farm center. During the years 2021-2023, the hens stopped incubating after 16 days, leaving all the eggs dead. Even the few hens that went into the forest returned alone instead of returning with chicks as in previous years.

The family's adult son lives 3 kilometers from the new wind industry and also keeps free-range chickens, mostly of the Blomme breed. From 2009 to 2023, the hatching success rate has been at least 90%. In 2022, the son moved three of these hens and a rooster to his parents' chicken yard, 950 meters from the nearest wind turbine. These hens also stopped incubating after 16 days, leaving dead eggs.

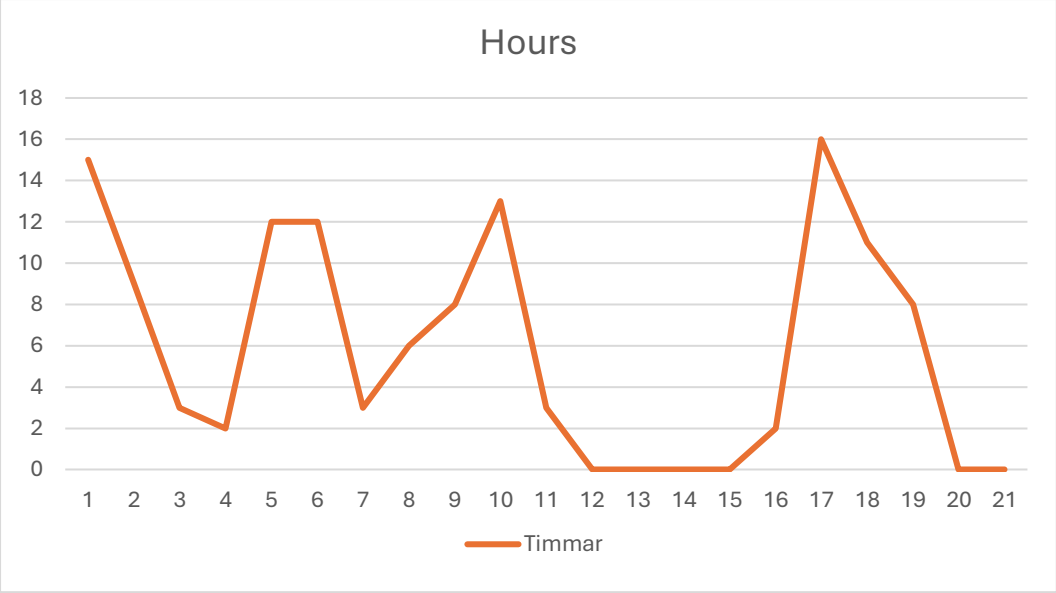
Table 1. Egg Mortality in the Coop During the Period May 1-21, 2023

Using a Willab incubator, mostly with the Skåne Blomme breed:

Location	Distance (meters)	Total	Dead	Alive	Mortality %
Chicken house 1	950	49	49	0	100
Closet house 1	1006	22	17 +1	4	83
Coop behind house 1	1025	10	6	4	60
Closet house 2	3160	40	2	38	5

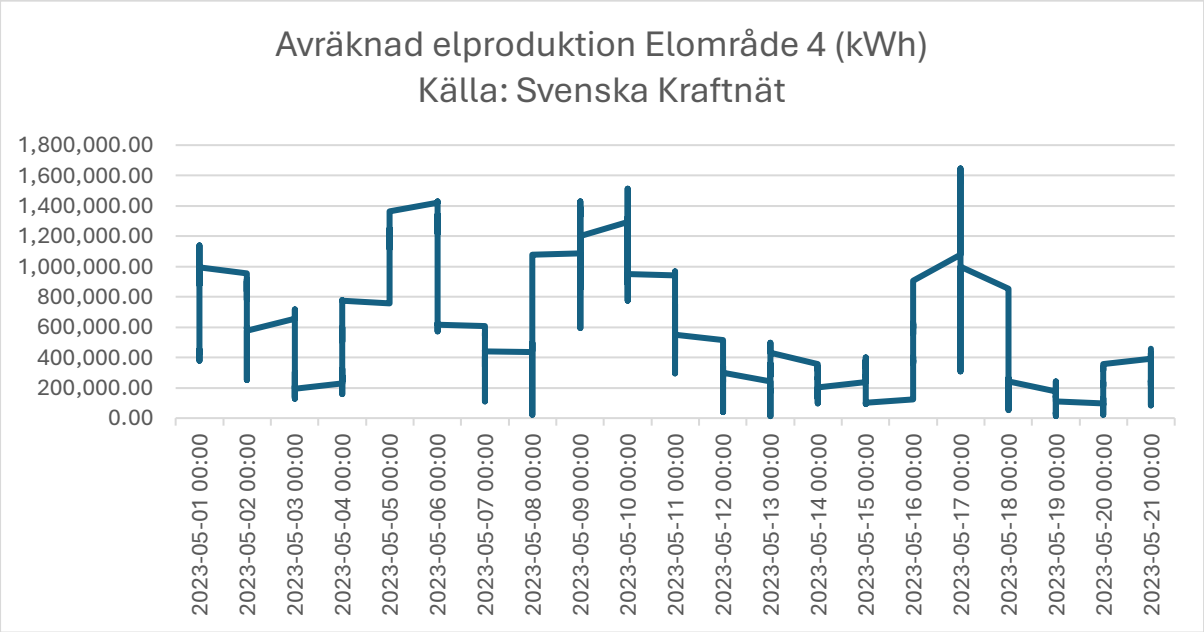
Note: +1 indicates hatched malformed and died.

Table 2. SMHI Weather Data with Wind Speeds During the Period May 1-21, 2023



| Hours with wind speed >5 m/s distributed over calendar days in May 2023. Note the peak recordings on the days 1-2, 5-6, 10, and 17-19, which coincide with critical developmental stages for chicken eggs.

Table 3. Svenska Kraftnät's Electricity Production at the Nearest Measuring Station During the Relevant Period



The tables indicate a significant correlation between wind speeds and peak loads, which likely generates the most tower and foundation vibrations in the ground.

Egg Mortality

Egg mortality in free-range chickens is a complex phenomenon influenced by multiple factors. It is known that hens that do not incubate properly may leave their eggs unattended, which can lead to increased egg mortality, and increased stress levels can reduce hens' inclination to incubate the eggs. Stress levels are naturally affected by disturbances or threats in the environment.

Insufficient nutrition or an unbalanced diet can affect both egg production and egg quality, increasing the risk of egg mortality. In the case of the current observation, this factor has been constant as the same individuals were only moved, and the feeding remained the same.

The age of the hens naturally affects reproduction. Older hens may experience reduced fertility and egg quality compared to younger individuals. Inbreeding is another factor that can have negative consequences as it can lead to genetic defects and reduced survival of the chicks.

Infectious diseases pose a significant risk to hens' reproduction. Bacterial infections such as E. coli and salmonella, as well as viral diseases like avian influenza and Marek's/herpesvirus, can cause egg mortality and malformations in chicks. Parasites such as roundworms, coccidia, and chicken mites can also negatively affect hens' reproductive health.

Therefore, it is important to conduct controlled trials with regular veterinary checks and appropriate preventive measures both before and during the course of a study.

The question is how much environmental factors such as noise and vibrations affect egg mortality in chickens. A review of the studies conducted in the area indicates an impact, but studies investigating the effects of ground vibrations combined with low-frequency noise on hens' reproductive health are lacking.

Previous Research

Research has shown that vibrations during days 5-8 of the development of chicken eggs can inhibit oxygen uptake in the allantois membrane[i]. Laboratory experiments conducted in the USA in 1990 and 1994 have shown that vertical vibrations on chicken eggs increase mortality and malformations, especially at frequencies between 20-30 Hz and acceleration amplitudes of 0.25-1.5G[ii iii iv]. The same frequencies and amplitudes increase mortality by up to 48% in guinea fowl eggs[v].

It has been clarified that it is not low-frequency sound itself that affects but a combination with whole-body vibrations with an acceleration amplitude of 1.16G and at 12 Hz (corresponding to the resonant frequency of a standing human) that is required to increase sister chromatid exchange in both human and mouse lymphocytes[vi vii].

At a seismological measurement station in Askome in Halland, near wind turbines, acceleration amplitudes with weak peaks of 0.0033 nm/s² in the range of 0.3-10 Hz and from 12-39 Hz[viii] have been recorded, strongly correlating with the performance of the wind turbines.

In Ontario, rapid minute-long acceleration peaks at frequencies of 10-20 Hz were recorded at a distance of 600 meters from a facility with 4 wind turbines of 2-3MW[ix].

Airborne noise emissions with cylindrical propagation at frequencies from 20-100 Hz decrease by 3 dB per doubling of distance, and air absorption decreases by 0.02-0.05 dB per km, i.e., negligible difference between the farms' exposure[x].

Together with reports showing that whole-body vibration in addition to airborne noise is required for chromosome impact, this may indicate that ground vibration frequencies and

amplitudes from tower foundations generated at a distance of 1000 meters are harmful to eggs but not harmful when the distance increases to 3000 meters[xi].

It has been scientifically proven that noise and vibrations from wind turbines cause stress in various animals, evidenced by elevated cortisol levels in the serum and hair follicles of geese and badgers when they are close to wind turbines[xii] [xiii]. It remains unclear whether this stress can be attributed to auditory perception affecting neural pathways leading to stress centers in the amygdala and hypothalamus/pituitary gland, or if it can be ascribed to ground vibrations. Reports indicate that badgers abandon their dens, moose and reindeer flee from wind industries during operation and return when the wind is still, and birds vacate areas with wind power installations, both domestically and internationally.

A 2008 report on increasing egg mortality and malformations following the commissioning of a wind industry in Wisconsin[xiv] suggests potential links between airborne wind turbine noise and/or ground vibrations from tower bases. This is further supported by WG Ackers' compilation of international observations during 2016-2019, highlighting the impact of wind farms on human and animal health[xv].

Vibrations disrupt laminar capillary blood flow in all tissues, leading to turbulent flow and damage to the endothelium's nitric oxide (NO) release. This results in hypoxia and the release of tissue-damaging free radicals. Mechanoreceptors connecting cells have been shown to initiate pericapillary fibrous tissue deposition and revascularization. These pressure and vibration-sensitive cation channels in cell membranes, Piezo 1 and Piezo 2, were first identified by Coste, Papapoutian, and colleagues in 2010 in neuroblastoma cells. This newly discovered receptor group, which includes position, pain, temperature, and itch receptors, earned Patapoutian and Julius the Nobel Prize in Medicine in 2021. Activation triggers perivascular collagen and elastin synthesis, providing small vessel protection[xvi].

These vascular changes, along with electron microscopy-detectable tissue damage related to exposure time and intensity of IS/LFN exposure and whole-body vibration, have been documented in various organs in mammals and humans[xvii] [xviii].
However, the vascular beds of birds are not as well documented.

An Israeli company has successfully altered the sex ratio of chickens from 50/50 to 5 roosters and 95 hens using mRNA promoters and low-frequency sound during days 4-6 in the incubator[xix].
The impact of low-frequency sound on chromosomes is undeniable. Studies have shown that male Z chromosomes tend to accumulate more mutations compared to female W chromosomes[xx].

The question remains: what happens to both wild and domestic birds when exposed to both noise and vibrations in their habitat? There are no studies on eggs in wild bird nests to assess whether bird populations are decreasing due to chromosomal disturbances or if birds are choosing to flee. Is bird fertility affected by stress on hormone-regulated nerve centers, or are the eggs harmed by detrimental vibrations?

Conclusion

Science data and observations indicate the need for further research to understand how ground vibrations combined with low-frequency noise can affect the reproductive health of hens.

At the time of writing, industries with much larger wind turbines than those currently operational are being established. The turbines planned for installation in the coming years are of the size 6-10 MW each, which will likely generate even stronger ground vibrations.

It is important not to downplay the potential harm of wind power emissions to the biology of all living organisms, and thus interdisciplinary research collaboration is needed between acousticians, geotechnicians, medical doctors, veterinarians, ornithologists, infectious disease specialists, pathologists, and chromosome researchers.

---

[i] Ljud från vindkraftverk, modellvalidering-mätning Slutrapport Energimyndigheten projekt 32437-1. Conny Larsson 2014-12-30

[ii] Lizurek, Piotr. 1973. The effect of low frequency mechanical vibration on oxygen uptake by the chick embryo during embryogenesis. Acta physiology of Poland. XXIV:4

[iii] Effect of Vibration Frequency and Acceleration Magnitude of Chicken Embryos on Viability and Development Phase I By Linda C. Taggart Nabih M. Alem Helen M. Frear Biodynamics Research Division EDr T i C, November 1990 USAARL, Fort Rucker, Alabama 36362-5292

[iv] Effect of Vibration Frequency and Amplitude on Developing Chicken Embryos By Samuel G. Shannon Al W. Moran Linda C. Shackelford and Kevin T. Mason ELECTED DEC J 2 1994; Aircrew Protection Division 19941205 086 October 1994USAARL Fort Rucker Alabama 36362-0577

[v] Sabo, Vladimir, Boda, Koloman, and Peter, Vladimir. 1982. Effect of vibration on the hatchability and mortality of embryoes of Japanese quails. Polnohospodarstvo 28,6

[vi] Sister chromatid exchange analysis in workers exposed to noise and vibration M.J. Silva, A. Carothers, N. Castelo Branco, A. Dias, M.G. Boavida a Mutation Research 369 (1996) 113-121

[vii] Low frequency noise and whole-body vibration cause increased levels of sister chromatid exchange in splenocytes of exposed mice. M J Silva 1, A Dias, A Barreta, P J Nogueira, N A A Castelo-Branco, M G Boavida. Teratog Mutagen 2002;22(3):195-203

[viii] Lund, B., Schmidt, P., Shomali, Z.H., Roth, M. (2021) The Modern Swedish National Seismic Network: Two Decades of Intraplate Microseismic Observation, Seismol. Res. Lett., 92, 1747-1758,

[ix] The Industrial Wind Turbine Seismic Source M. WEST, P. GEOPH., B.SC., GDM WINDSOR, ONTARIO. CSEG RECORDER JUNE 2019

[x] Luftabsorption ref.: SNV Rapport 6241 (2010) (dB/km)

[xi] Seismic radiation from wind turbines: Observations and analytical modeling of frequency-dependent amplitude decays. Fabian Limberger, Michael Lindenfeld, Hagen Deckert, and Georg Rümpker. Institute of Geosciences, Goethe-University Frankfurt, Germany. Institute for Geothermal Resource Management, Germany. Solid Earth, 12, 1851–1864, 2021. https://doi.org/10.5194/se-12-1851-2021

[xii] Preliminary studies on the reaction of growing geese (Anser anser f. domestica) to the proximity of wind turbines. J. Mikołajczak, S. Borowski, J. Marć-Pieńkowska, G. Odrowąż-Sypniewska, Z. Bernacki, J. Siódmiak, P.

Szterk. Polish Journal of Veterinary Sciences Vol. 16, No. 4 (2013), 679–686

[xiii] WIND TURBINES CAUSE CHRONIC STRESS IN BADGERS (MELES MELES) IN GREAT BRITAIN. Roseanna C. N. Agnew, Valerie J. Smith, and Robert C. Fowkes. Royal Veterinary College, Zoological Society of London, Scottish Oceans Institute, University of St. Andrews. Journal of Wildlife Diseases, 52(3), 2016, pp. 000–000, Wildlife Disease Ass. 2016

[xiv] The BPRC Research Nerd in Fond du Lac County, Home in a wind farm with a 1000 foot setback: Fond du Lac County WI, Life in a wind farm, We Energies, property values, wind farm birds Posted on Wednesday, October 28th , 2009 at 09:09PM

[xv] Some Of The Case Studies That Have Convinced Me That Industrial Wind Turbines Make People Sick, Which Supports My Belief That We Can Prove In A Court Of Law That These Wind Turbines Are Causing Annoyance and Illnesses. By: William G. Acker Acker & Associates Prepared: December 27th 2015 through Feb. 18th 2019

[xvi] Coste B, Mathur J, Schmidt M, Earley TJ, Ranade S, Petrus MJ, Dubin AE, Patapoutian A. Piezo1 and Piezo2 are essential components of distinct mechanically activated cation channels. Science 2010:330: 55-6

[xvii] Mariana Alves-Pereira. Bruce Rapley. Huub Bakke. Rachel Summer. Infrasound and Low frequency Noise; A Public Health Nightmare. Universida de Lusofonia. Massey University. New Zealand. ICBEN Glasgow. Scotland. Sept 22. 2017

[xviii] Impairment of the Endothelium and Disorder of Microcirculation in Humans and Animals Exposed to Infrasound due to Irregular Mechano-Transduction Ursula Maria Bellut-Staeck Independent Scientist, Berlin, Germany. J. of Biosciences and Medicines > Vol.11 No.6, June 2023 DOI: 10.4236/jbm.2023.116003

[xix] We aren't playing God": An Israeli development can change the sex of chicken embryos. Israeli Startup SOOS Technology CEO Yael Alter. Interview by Ida ben Tovim in GEEKTIME Aug 28th 2022

[xx] Emergence of male-biased genes on the chicken Z-chromosome: Sex-chromosome contrasts between male and female heterogametic systems.Hans Ellegren[1] Genome Res. 2011 Dec; 21(12): 2082–2086.
doi: 10.1101/gr.119065.110