

# Low Frequency Noise and Health: A Wind Turbine Case (2007-2013)

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**eceo**

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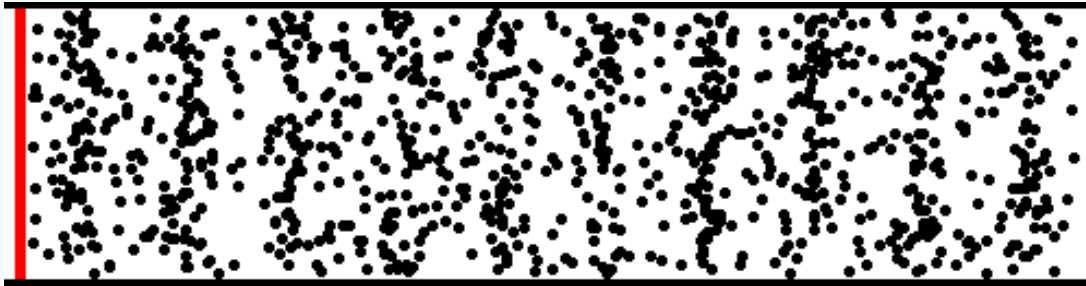


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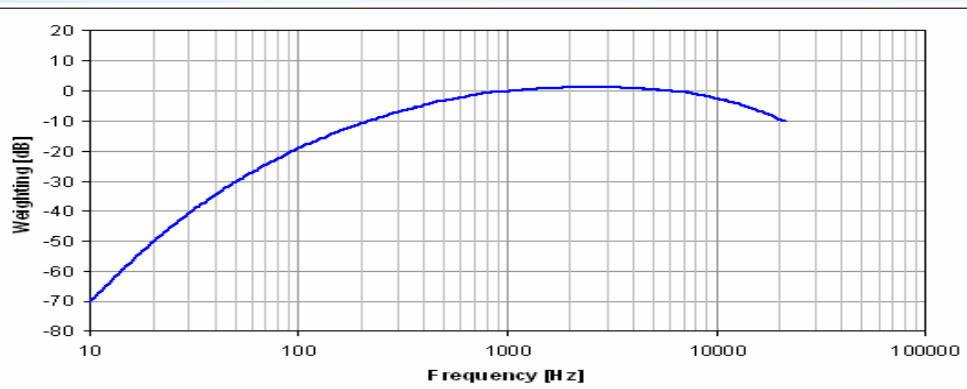
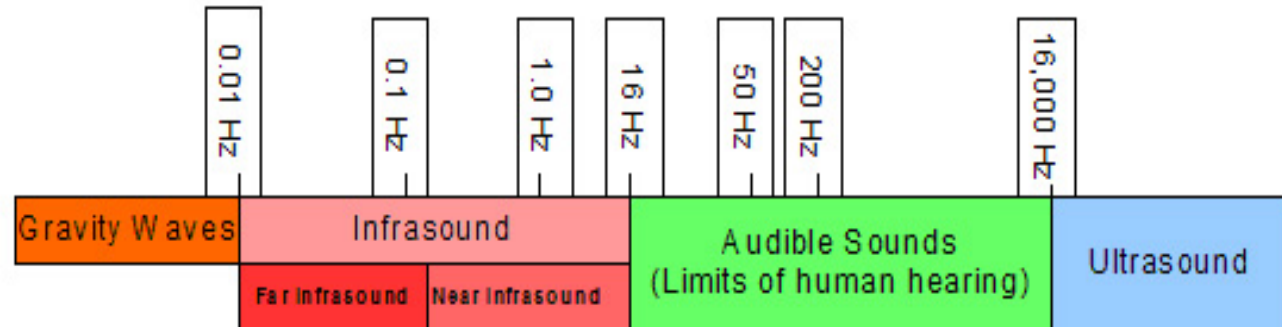
# Low Frequency Noise

## *Evaluation Problems*



Noise is a Pressure Wave:  
A time-varying force  
impacting upon a surface.

Rudimentary  
and outdated  
segmentation of the  
acoustical spectrum.



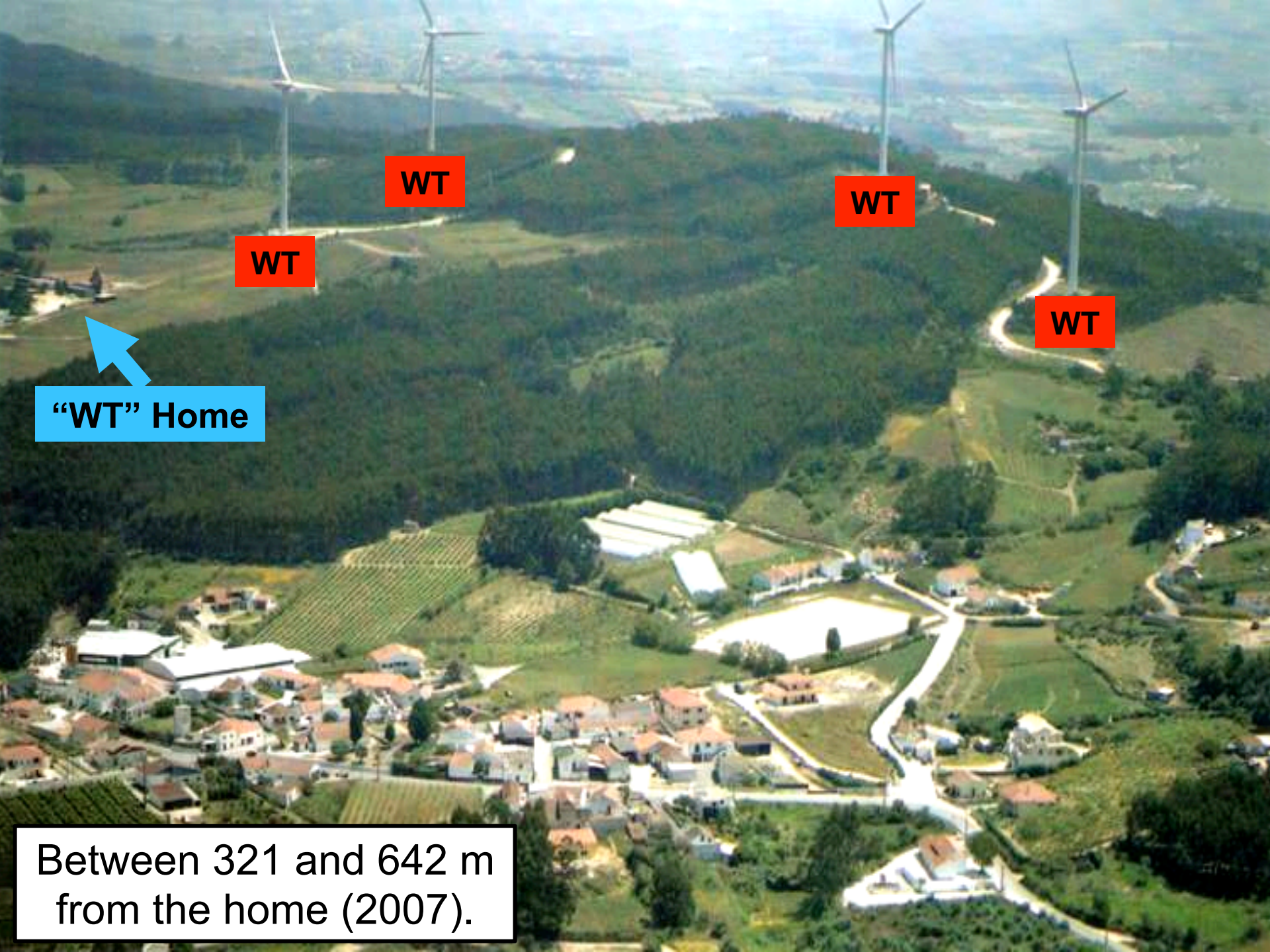
The dBA unit is inappropriate  
for measuring LFN

# Disclaimer

**We:**

- ***Do not harbour anti-technology sentiments;***
- ***Consider Wind Turbines as welcome additions to modern technological society;***
- ***Have scrutinized data under one, and only one, agenda - pure scientific inquiry;***
- ***Are not producing a report arguing against the implementation of Wind Turbines;***
- ***Are not contractually (or otherwise) linked to the firm that conducted the acoustical measurements; and***
- ***Have provided consulting activities to this family, of a purely academic and scientific nature, and hence pro bono.***





WT

WT

WT

WT

WT Home

Between 321 and 642 m from the home (2007).





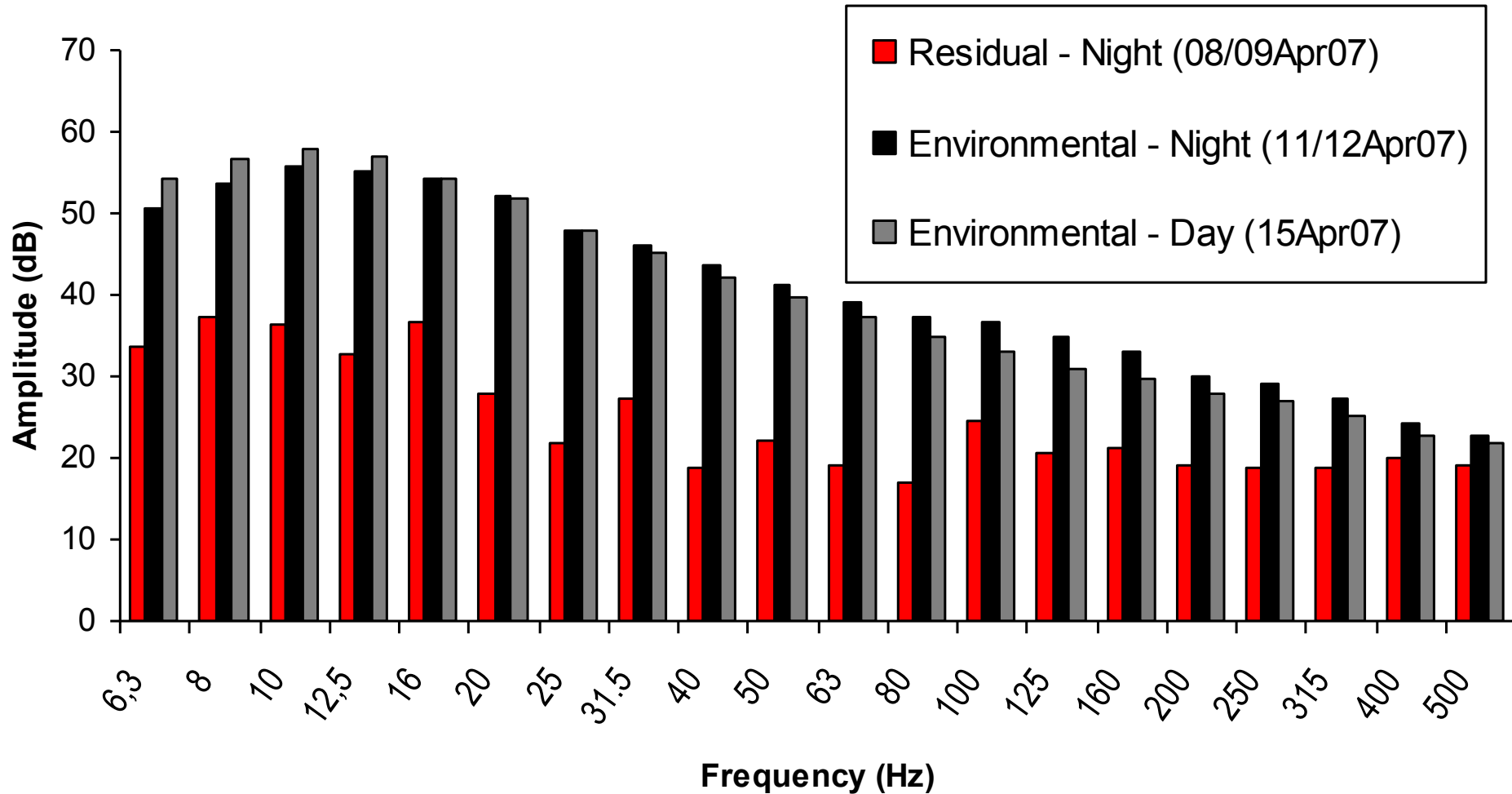
# Infrasound & Low Frequency Noise

## *Technical Details of Measurements*

- **dBLin**
- 1/3 octave bands
- **1-500 Hz** (herein reported: 6.3-500 Hz)
- 01dB Symphonie
- 1/2" microphone (GRAS, model 23606)
- **Continuous - Apr 5th-16th, 2007**
- 30-min periods
- **Wind Speed + Structural Vibrations**

# In Master Bedroom

## Wind Turbine Home With Same Wind Speed (5.4 Km/h)





# Trafaria Deep Water Grain Terminal

2004





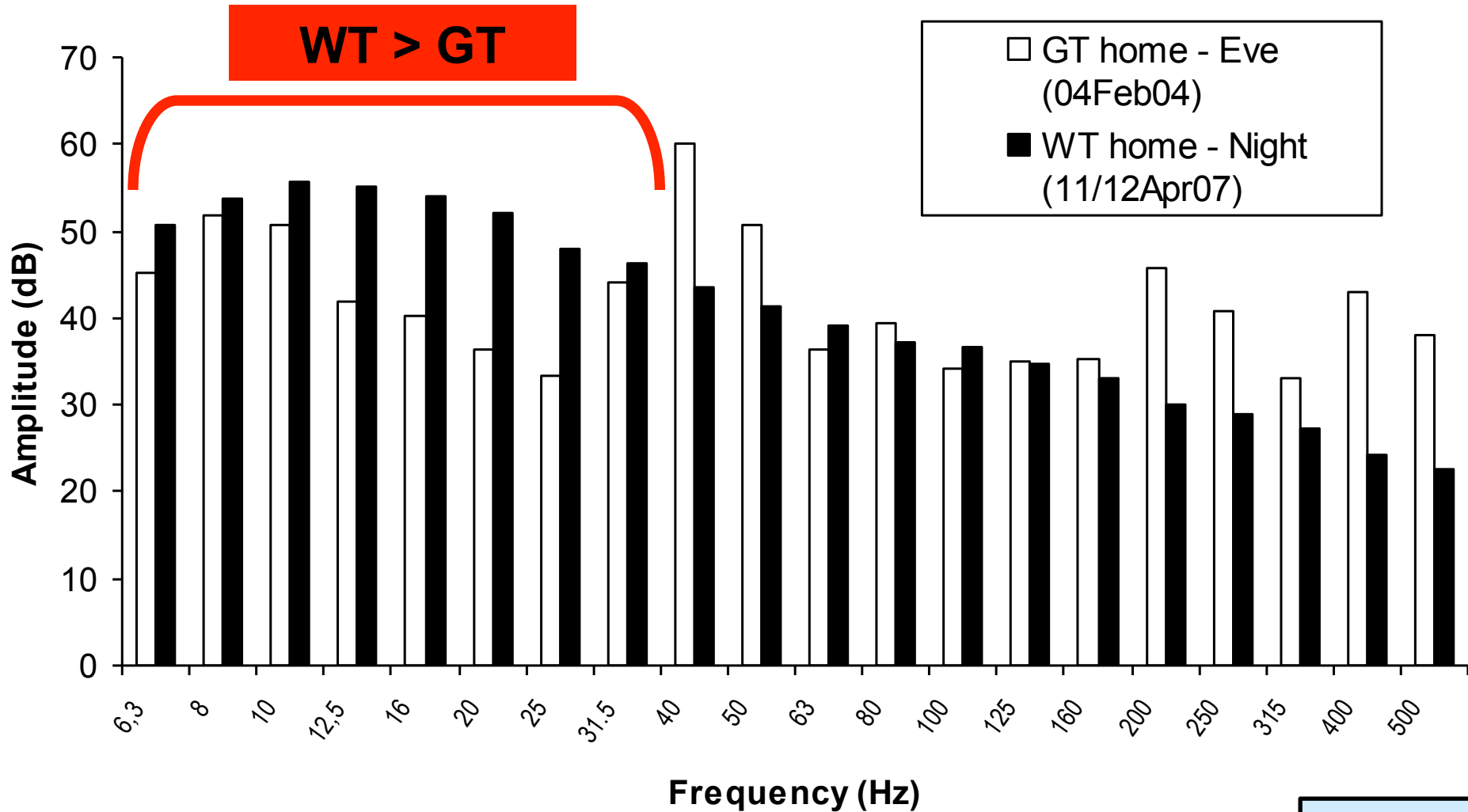
**View from Balcony of  
“Grain Terminal” Home**

**2004**



# In GT Child's Bedroom vs. WT Master Bedroom

## Grain Terminal Home vs. Wind Turbine Home





# Problems in the WT Home

- WT began operation in Nov 2006.
- Inability to obtain restful sleep; increased irritability.
- Dog, horse, and ant behaviour.
- Mar 2007: letter from school (12-yr-old):

*“...It seems that [the child] has lost interest, makes a lesser effort, as if he were permanently tired”.*

Our team was contacted in March 2007, and the following complementary diagnostic tests were recommended:

- Echocardiograms, P300, PCO<sub>2</sub> respiratory drive.

# Vibroacoustic Disease (VAD)

## *Clinical Stages*

### **Mild**

***1-4 years of LFN exposure***

Slight mood swings, indigestion & heartburn, repeated mouth & throat infections, bronchitis.

### **Moderate**

***4-10 years of LFN exposure***

Chest pain, back pain, fatigue, fungal & viral skin infections, allergies, blood in urine, inflammation of stomach lining.

### **Severe**

***> 10 years of LFN 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.

# VAD Clinical Signs in the WT home

## *Respiratory Drive*

### *P300-Event-Related Potentials in Child*

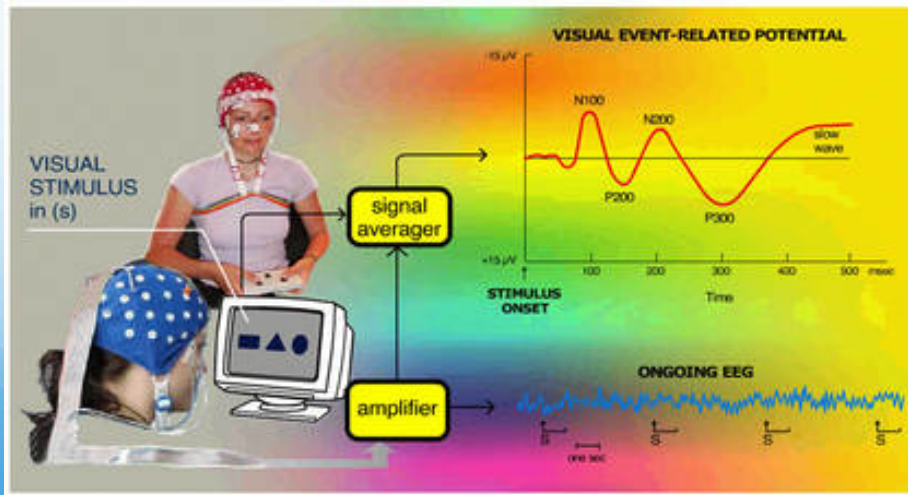
Jun 2007: **352 ms**  
Sep 2007-after 2 mo. holiday: **322 ms**  
(norm: **300 ms**)

39-year-old father: **46%**  
42-year-old mother: **53%**  
(norm: **>60%**)



### *Echocardiography Score for Pericardial Thickening:*

39-year-old father: 1  
42-year-old mother: 1  
12-year-old child: 1





# 2007 Legal Proceedings

## *Standing Court Order*

- WT No. 2, closest to home, at 322 m was ordered to be shut down.
- All other (3) WT were ordered to be shut down during the evening (8-11 pm) and night hours (11 pm – 7 am).
- Meanwhile, the installation of WT continued in the contiguous vicinity of the R family home.



# Situation in 2010

## *Lusitanian Horses*



- Mrs. R and the children have moved.
- The child has normal P300 values.
- Mr. R. must stay to care for thoroughbred Lusitanian horses.
- Mr. R's health is visibly deteriorating, with increased cognitive impairment and severe noise intolerance.
- Between 2000 and 2006, 13 healthy thoroughbred Lusitanian horses were born and raised on Mr. R's property.
- All 4 horses raised after 2007 developed asymmetric equine flexural limb deformities (EFLD).
- All 4 were studied + 1 control.

# Equine Flexural Limb Deformities (EFLD)



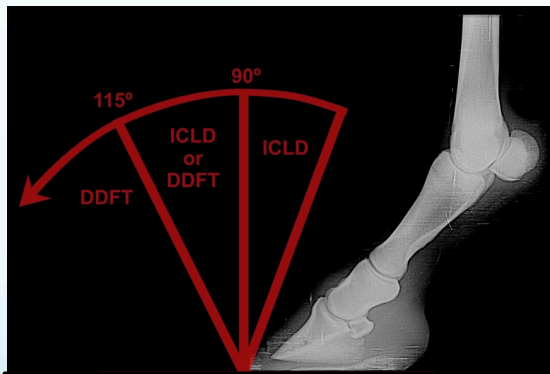
## Espartaco – Case 4

Born: 02May09 and raised on R's Farm;  
Father: Zircão;  
Mother: Vassoura.



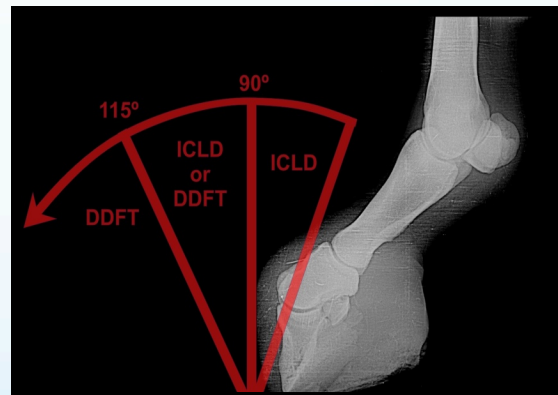
## Engenheiro – Case 5

Born: 17May09 and raised on R's Farm;  
Father: Zircão  
Mother: Zizi



### Normal right forelimb:

Hoof wall-to-floor angle is  $>115^\circ$

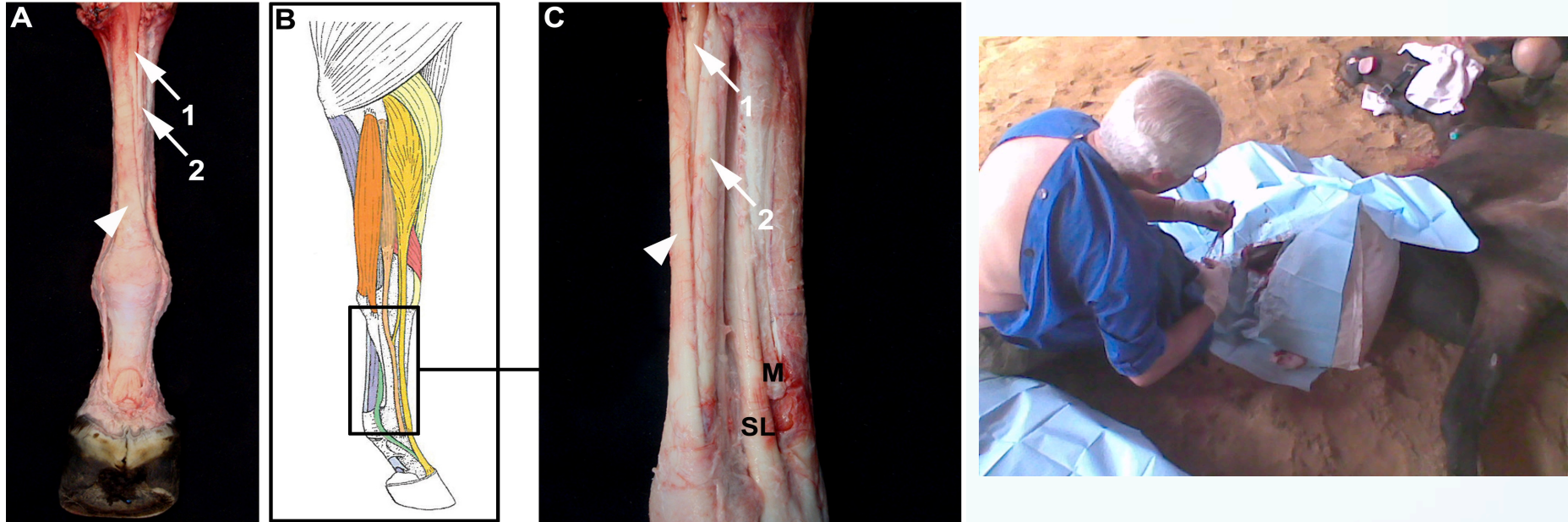


### EFLD left forelimb:

Hoof wall-to-floor angle is  $<115^\circ$



# Corrective Surgery: severing the accessory or check ligament.



**Case 1 (Canela; Born: 26Feb07), Case 4 & Case 5:**

Born and raised on Mr. R's farm.

**Case 2 (Desplante; Born: 20Apr08):**

Acquired at 15 days of age and raised on farm.

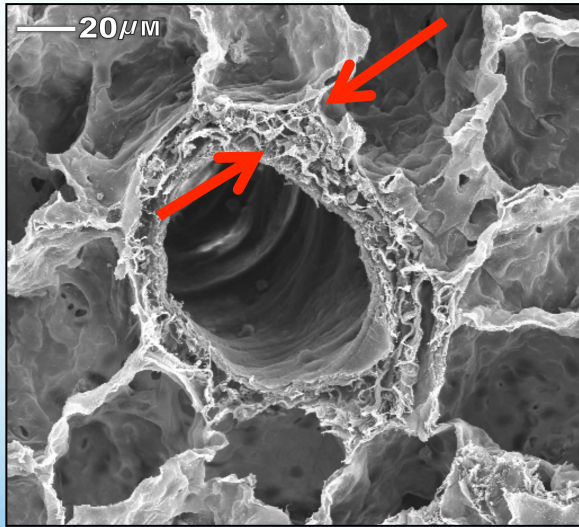
**Case 3 – Control - (Dondoca; Born: 04Apr08):**

Acquired at 14 months of age.

# Response of Biological Tissue to LFN

In all cases (1,2,4 & 5), **blood vessel walls were abnormally thickened due to the presence of collagen.** No such images were seen in Case 3. Cells normally associated with inflammatory processes were absent from all images.

***This unusual biological feature is the hallmark of LFN exposure.***



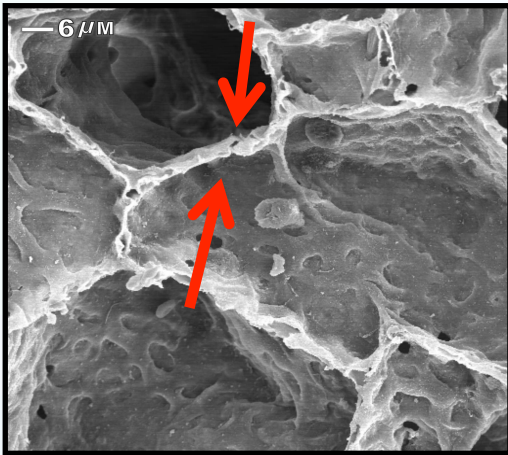
**Blood Vessel Wall Thickening  
in LFN-exposed Wistar rat.**

**Blood Vessel Wall Thickening  
in Vibroacoustic Disease Patient.**

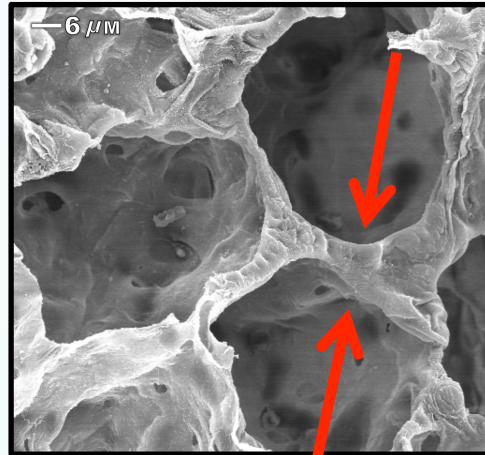


# Response of Biological Tissue to LFN

**Structural thickening due to abnormal growth of collagen in the absence of an inflammatory process.**



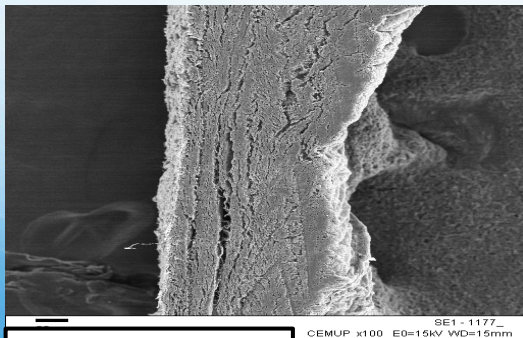
**Control**



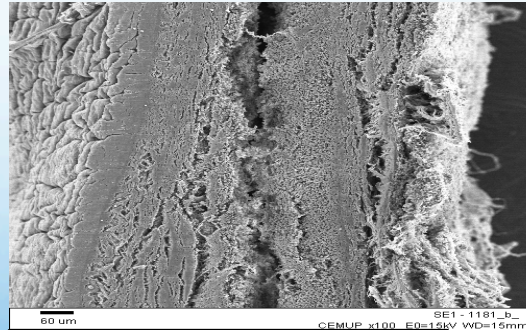
**LFN-Exposed**

**Thickening of Alveolar Walls**  
(LFN-exposed Wistar rat).

*Note: Scale of paired images is the same.*



**Control**



**VAD patient**

**Thickening of Pericardium**  
(VAD patient).



# Today – 2013

## *Supreme Court Order on R. Family's Case:*

- The remaining 3 WT must be removed.
- Monetary retribution to the R. Family was increased from the previous value stipulated by the lower court.

Meanwhile, Mr. R's health has visibly deteriorated further.

## *Master's Thesis – School of Veterinary Medicine, Technical University of Lisbon*

**“Acquired flexural deformity of the distal interphalangeic joint in foals” (2012), by Teresa Margarida Pereira Costa e Curto.**





**Thank you for your attention!**  
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