

# Update on underwater noise and offshore wind farms.

Steve Parvin and Dr Jeremy Nedwell

Subacoustech Ltd

[Steve.parvin@subacoustech.com](mailto:Steve.parvin@subacoustech.com)

[www.subacoustech.com](http://www.subacoustech.com)



# Aim of study

- To evaluate the subsea noise from construction and operation of wind farms and to rate it in terms of its potential for environmental effect
- “Noise Audit” approach - may include noise during construction, operation and decommissioning

# Introduction






- Underwater sound measurement
- Species perceived sound level ( $\text{dB}_{\text{ht}}$ )
- Background noise
- Piling noise
- Operational noise

# The underwater environment

- Most underwater animals use sound to navigate, communicate and explore their environment (fish, marine mammals, crustaceans, ...)
- Man made underwater noise has great capacity to effect their environment
- How do we judge the significance of noise?

# Underwater Source Levels

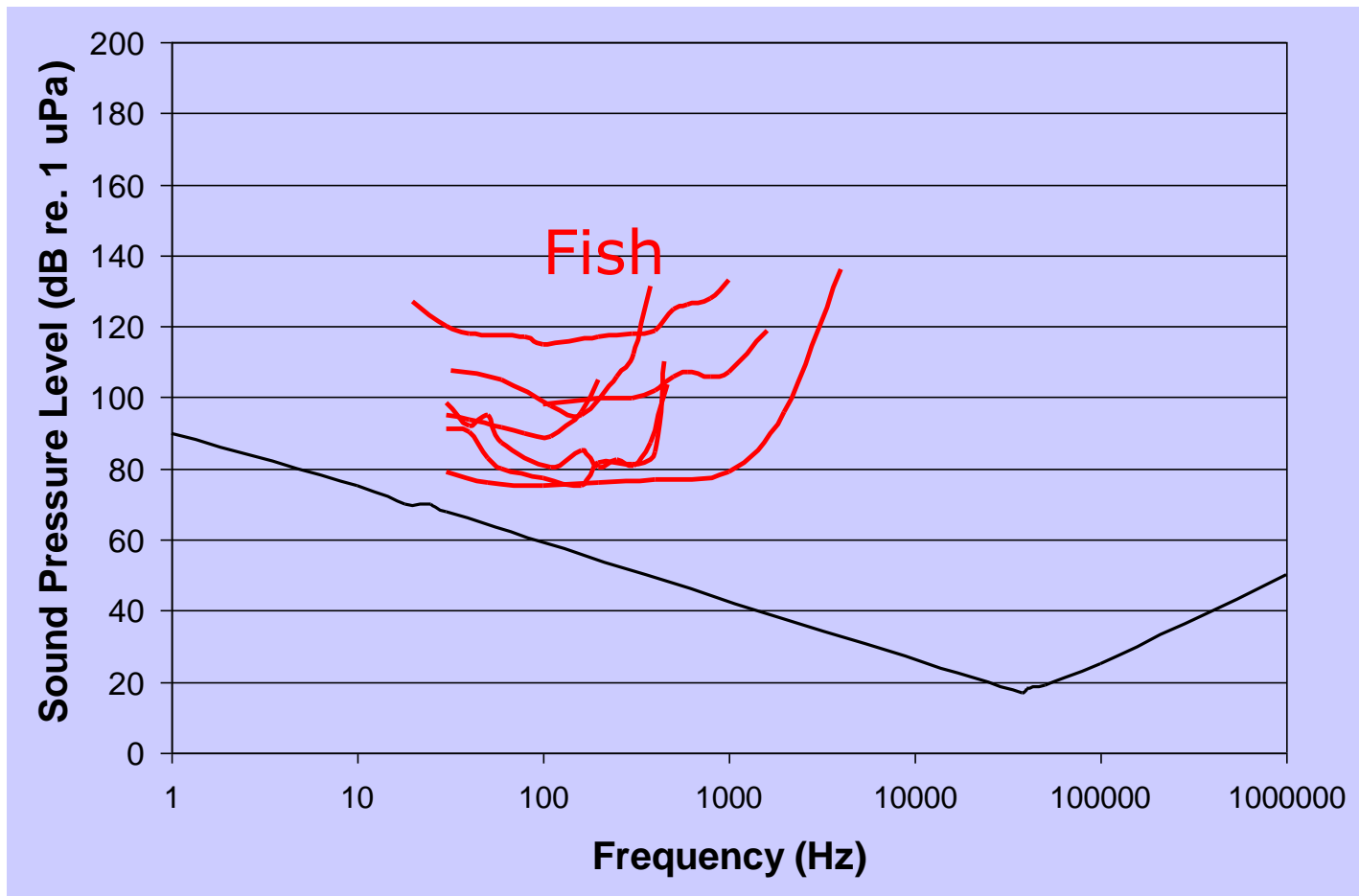
dB re 1 uPa @ 1 metre

Noise source	Source Level	Hear it!
Background noise	110-140	
Vessel	170-190	
Airgun array	190-240	
Piling	170-270	
Borehole blasting	220-260	

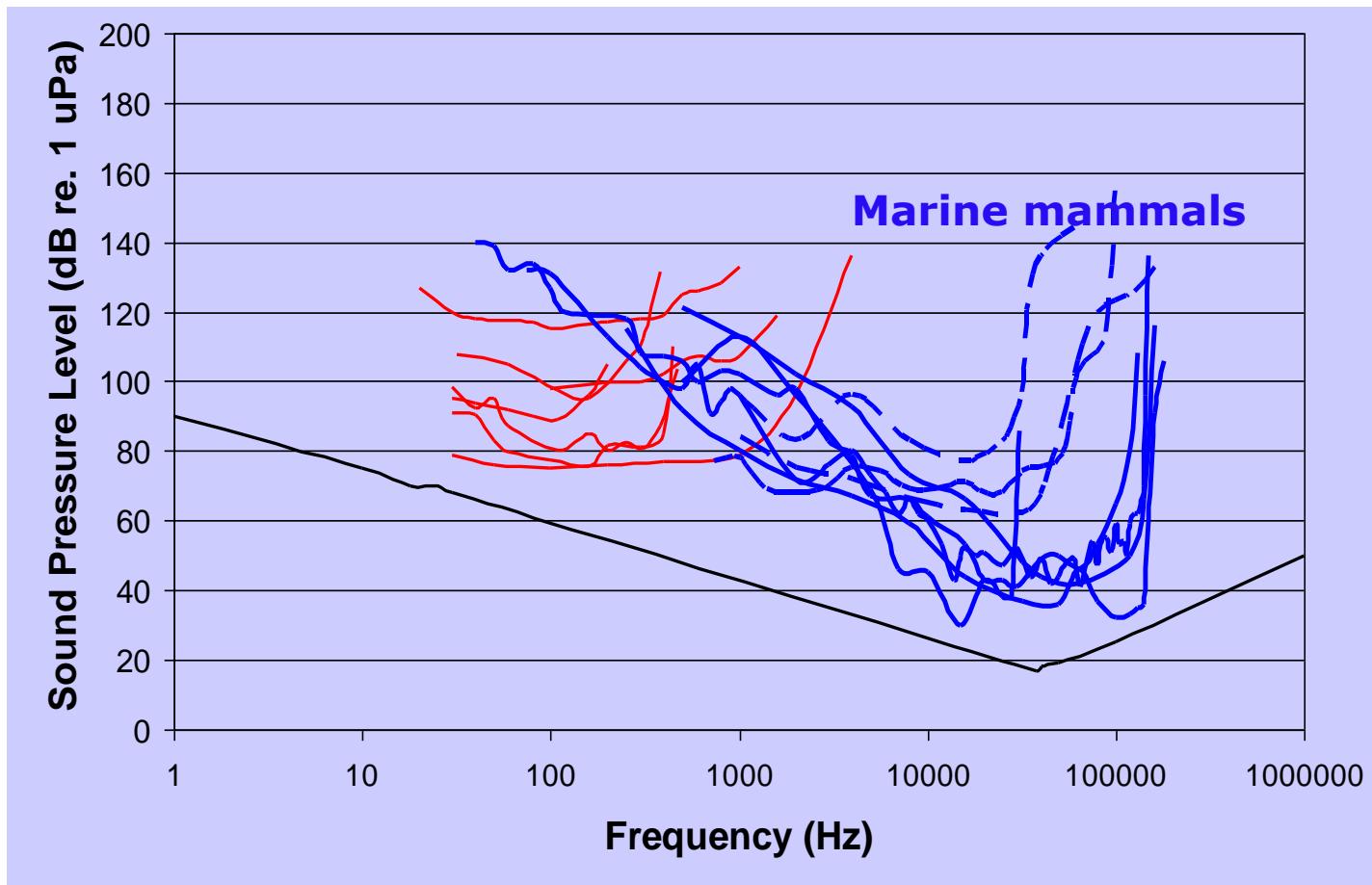
# Impact of Underwater sound

- Lethal: Peak levels greater than 240 dB re. 1 uPa (10's of metres)
- Injury: Peak levels greater than 220 dB re. 1 uPa (100's of metres).
- Behavioural response: Can extend to many 10's Kms.

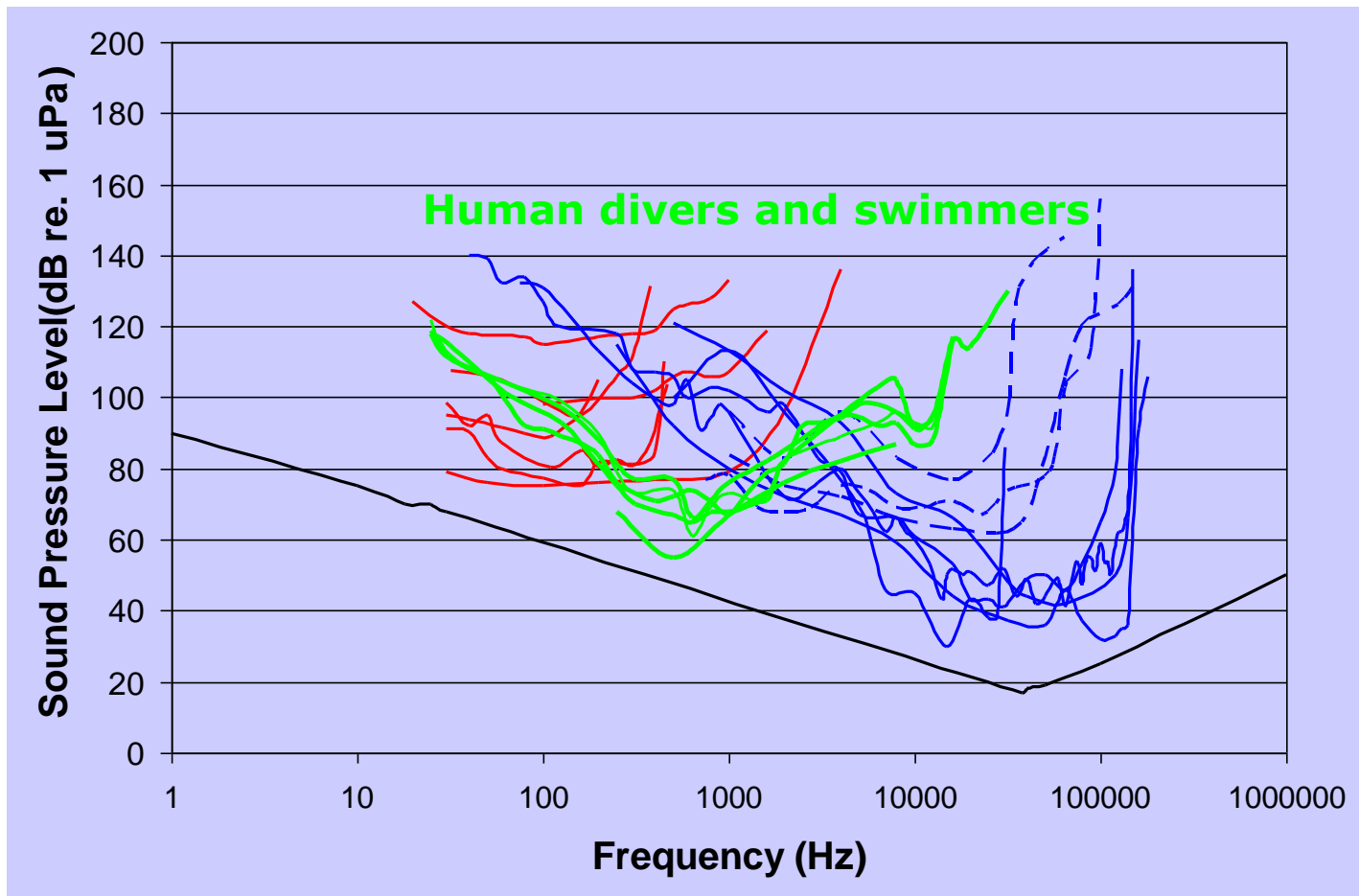
# Underwater hearing threshold



# Underwater hearing threshold

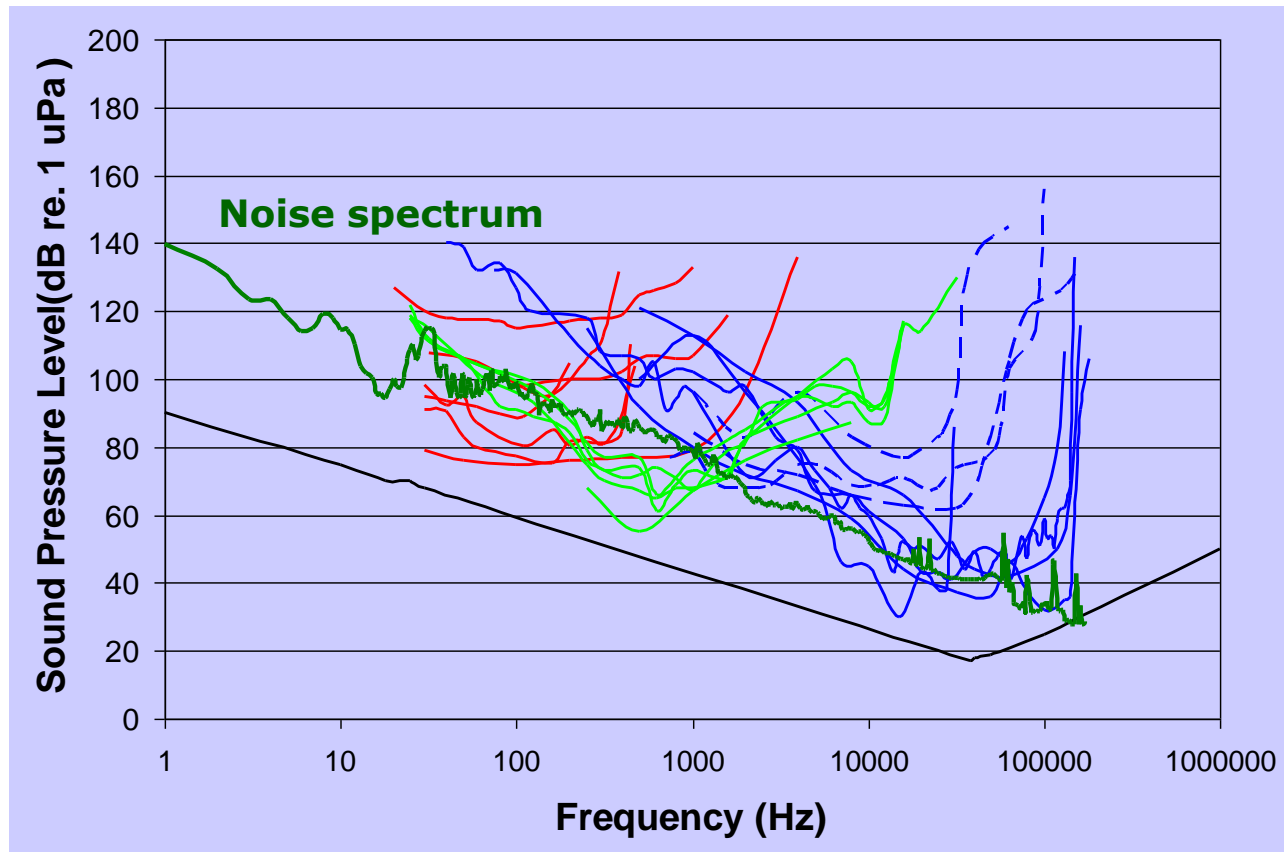


# Underwater hearing threshold

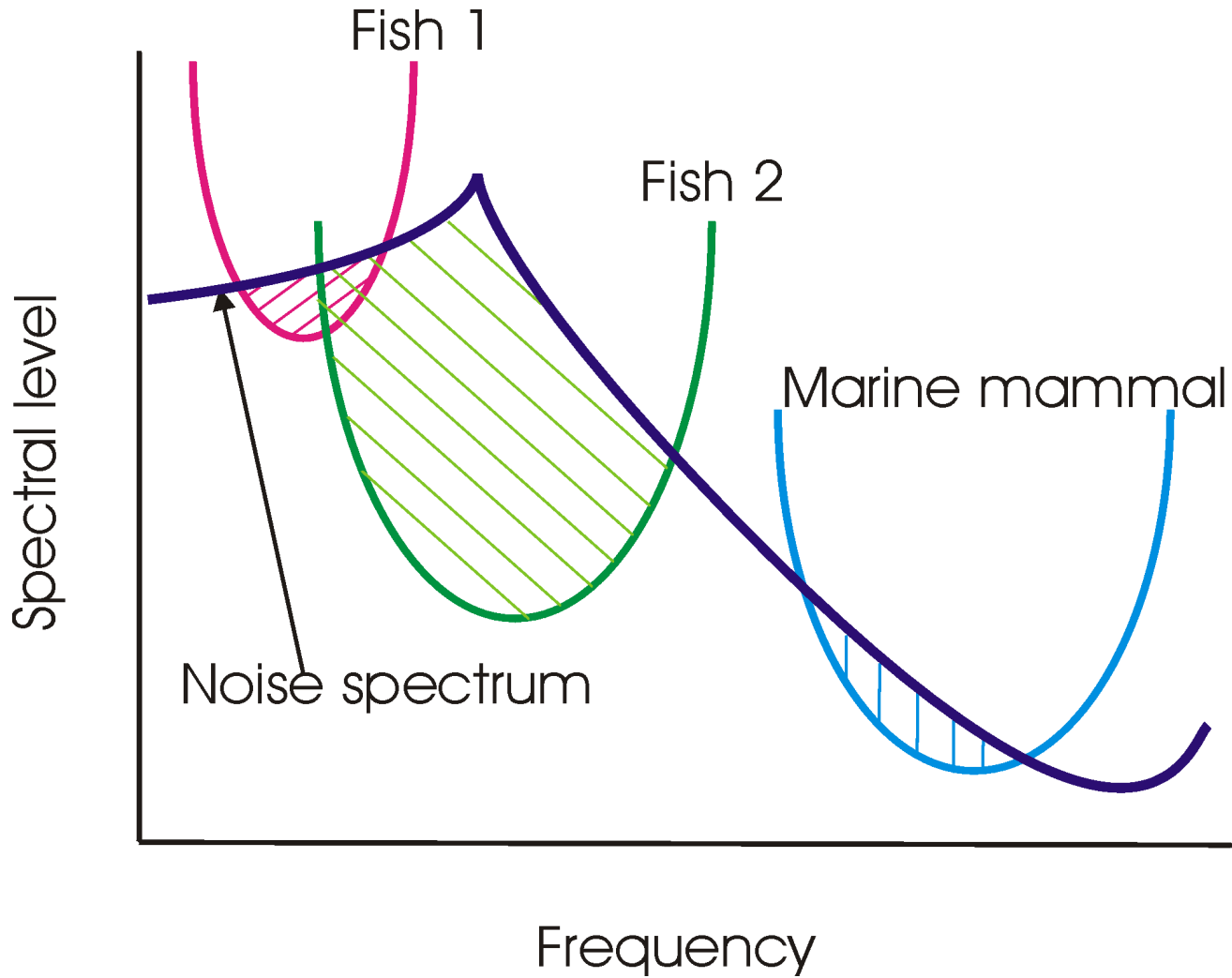


# Underwater hearing threshold

Perceived loudness  $\text{dB}_{\text{ht}}$



# Perceived 'loudness' $\text{dB}_{\text{ht}}$

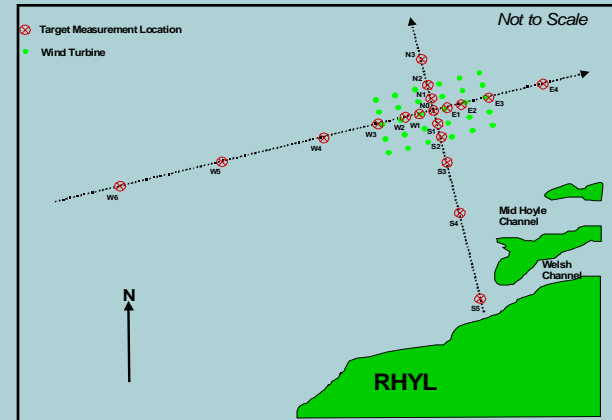


# Effects of noise

<b>Level</b>	<b>Comment</b>	<b>Effects</b>	<b>Human equivalent</b>
< 0 dB <sub>ht</sub>	Animal can't hear it	No reaction	Soundproof room
0-90 dB <sub>ht</sub>	Increasingly loud	Reactions primarily cognitive	e.g. office, workshop 50 - 70 dB <sub>ht</sub>
90-130 dB <sub>ht</sub>	Unbearably loud	Instinctive reaction (avoidance)	Roadhammer >100dB <sub>ht</sub>
> 130 dB <sub>ht</sub>	Deafening	Traumatic hearing damage	Gunfire near ear

# Underwater noise survey

- UW sound recording 1 Hz to 175 kHz.
- Dynamic range up to 100 dB.
- Overall sound level (Pk-Pk).
- Species perceived sound level ( $\text{dB}_{\text{ht}}$ )



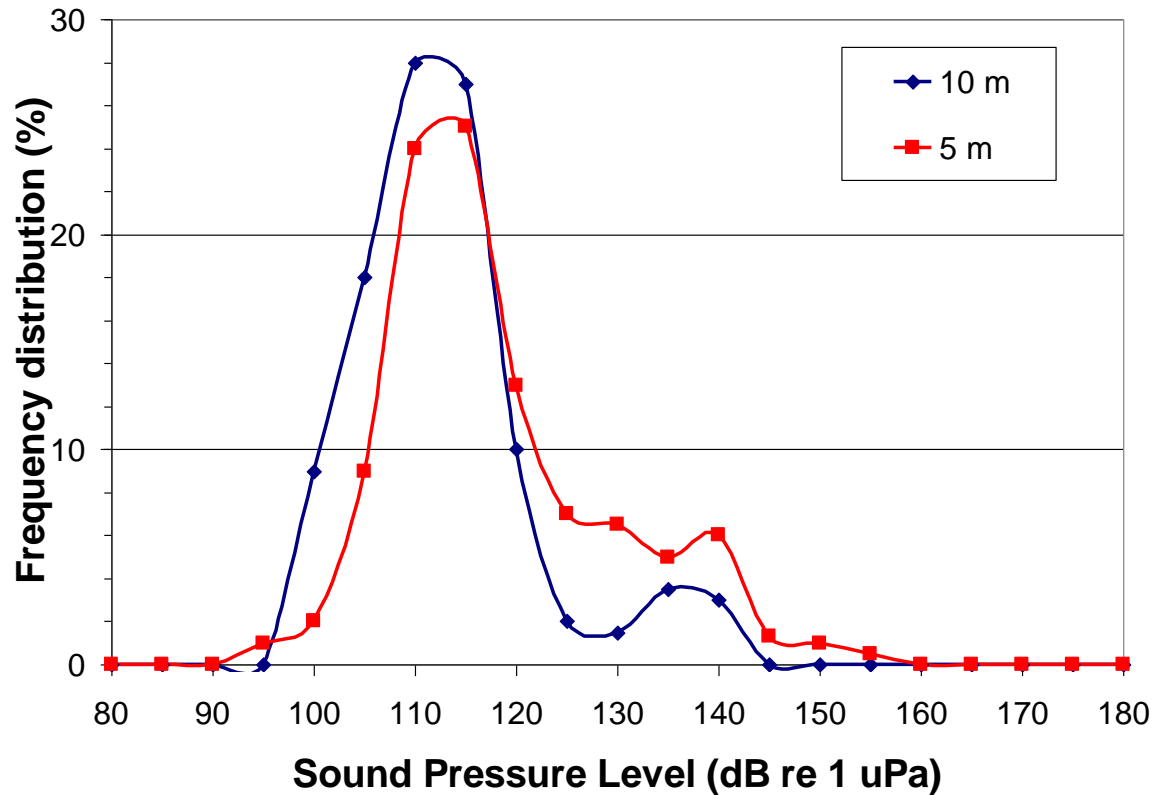
# Background noise

- Measure existing levels of noise prior to the wind farm development
- Determine statistical variation.



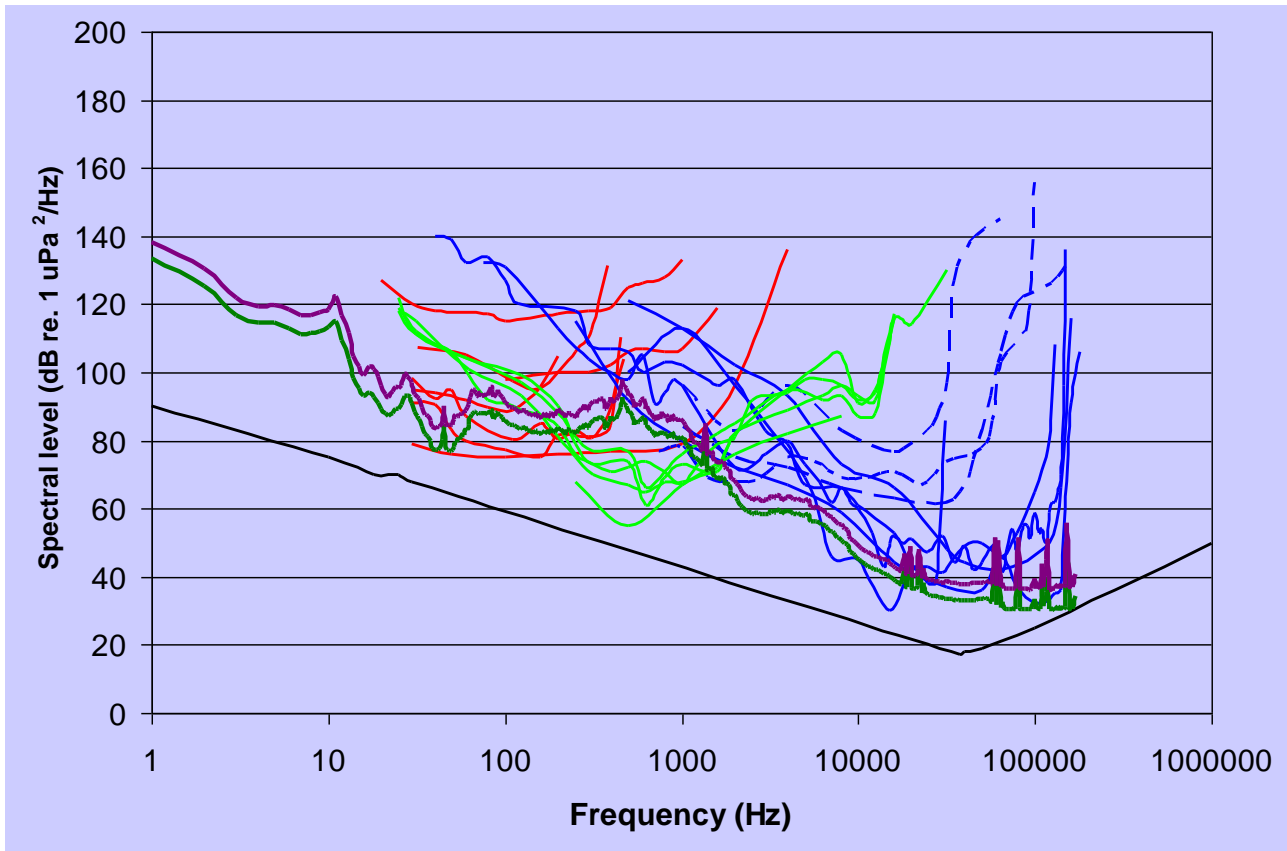
# Background Noise

Overall Sound Pressure Level  
North Hoyle



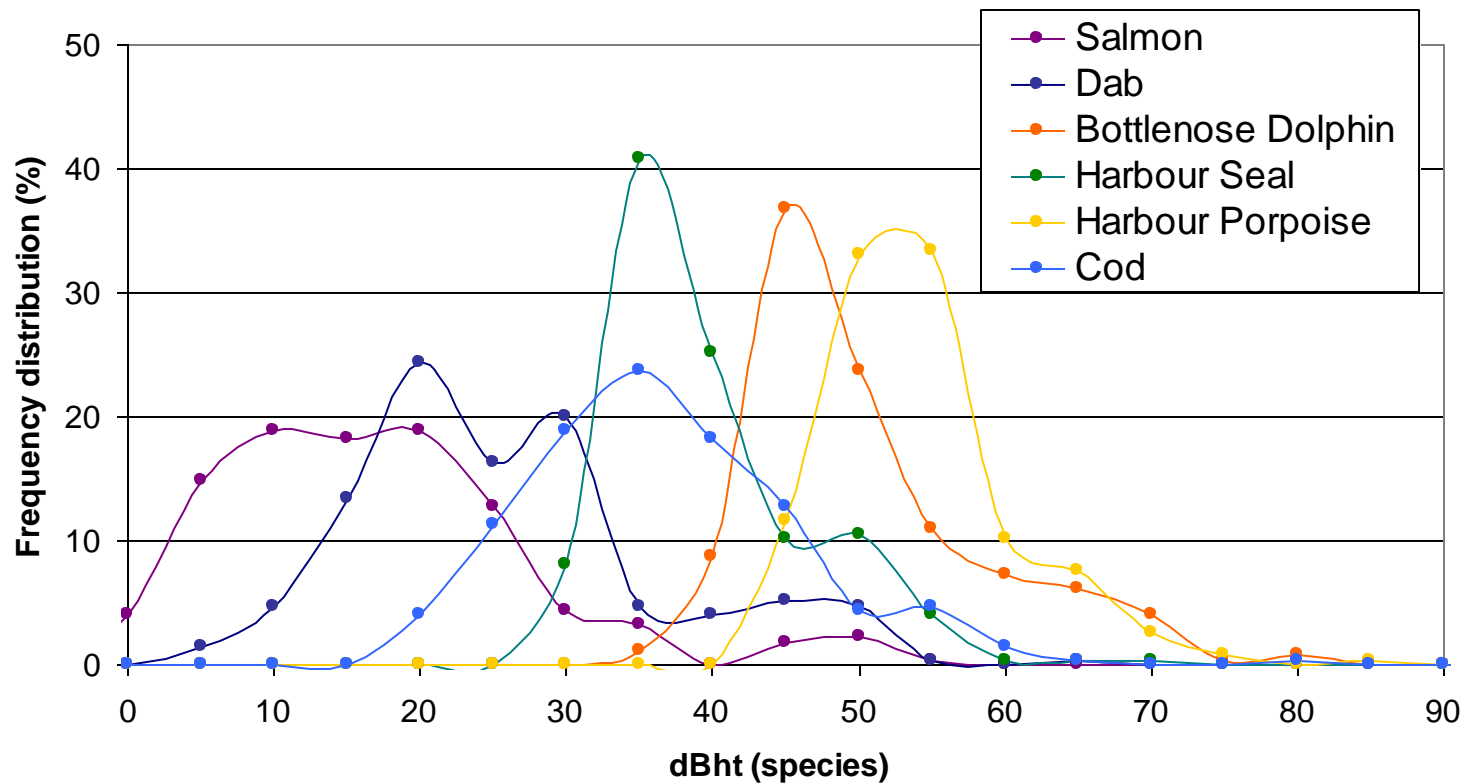
# Background Noise

Mean and 95% confidence interval



# Background noise

Species perceived sound level ( $\text{dB}_{\text{ht}}$ )



# Background Noise Summary

- Shallow coastal waters are a noisy environment when compared with deep waters.
- Greatest variation caused by shipping movements ( $< 1$  kHz).

# Piling Noise

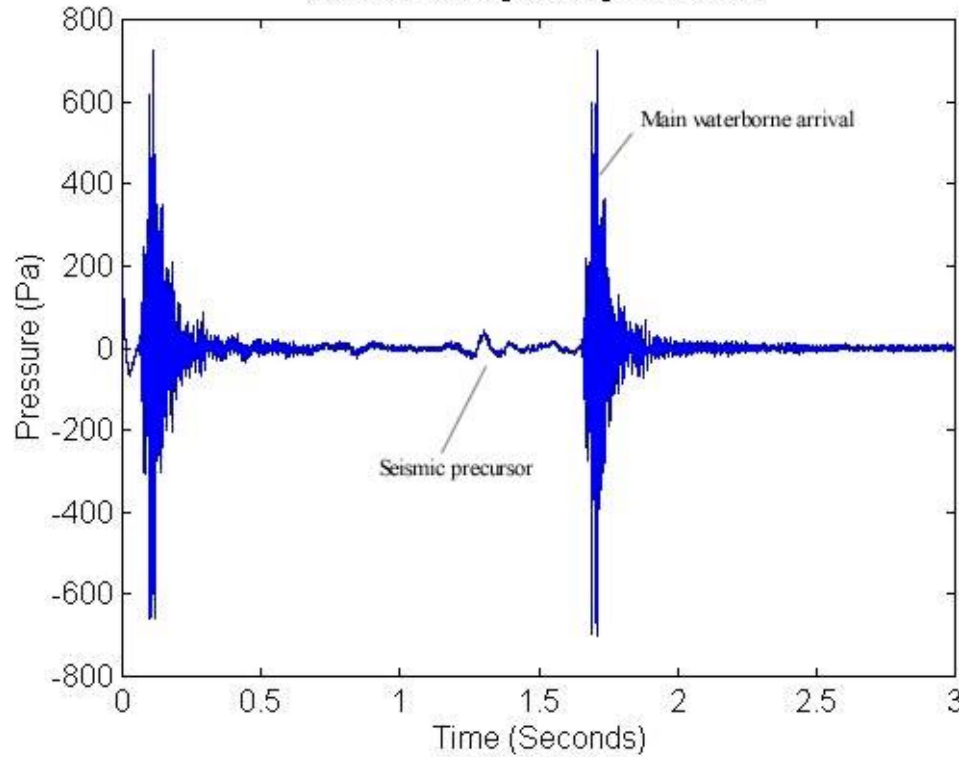
- Short duration impulse noise.
- Pile strike every 1 to 3 seconds for up to 6 hours.
- Piling operation takes many months



# Underwater piling noise

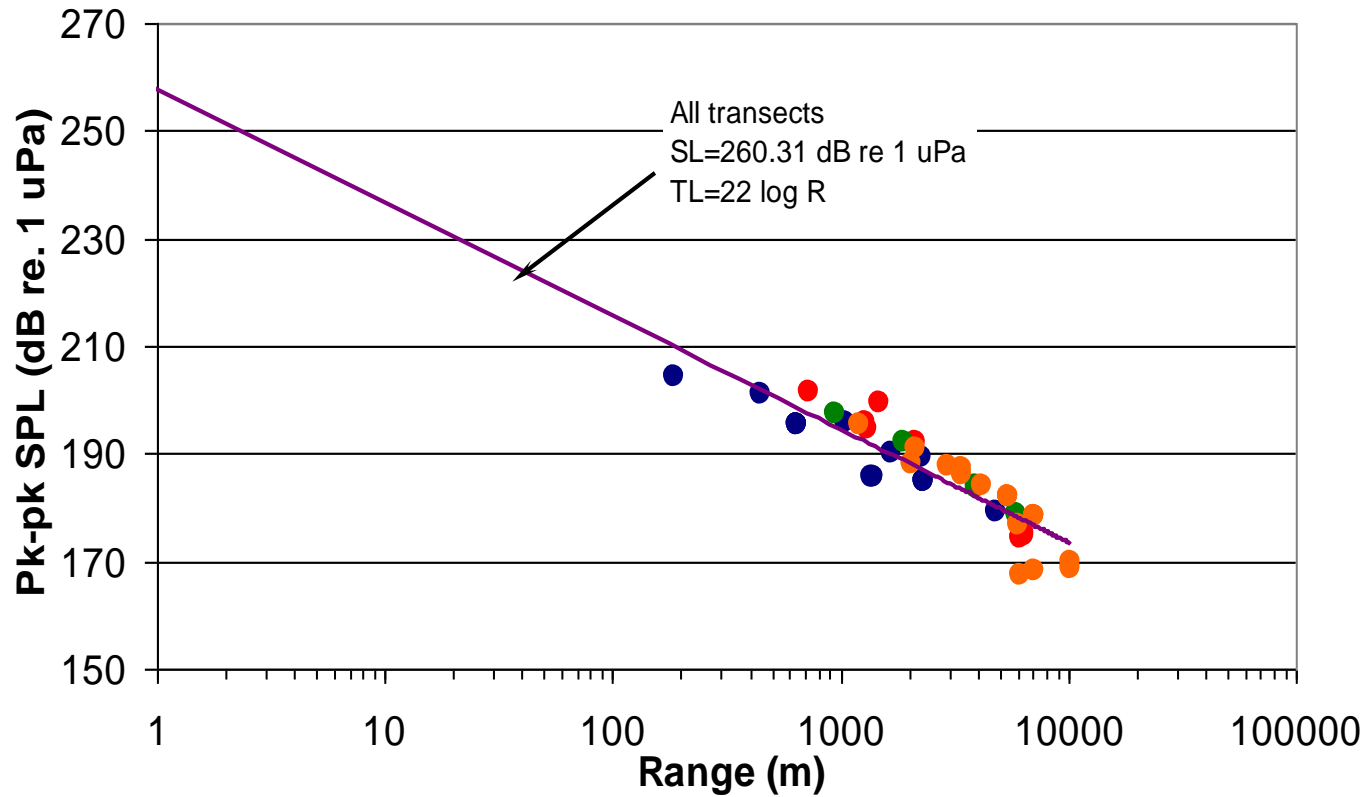
Hammering of a 4.3 m diameter pile, measured at a range of 3.9 km.

Pile hammering at range of 3905m



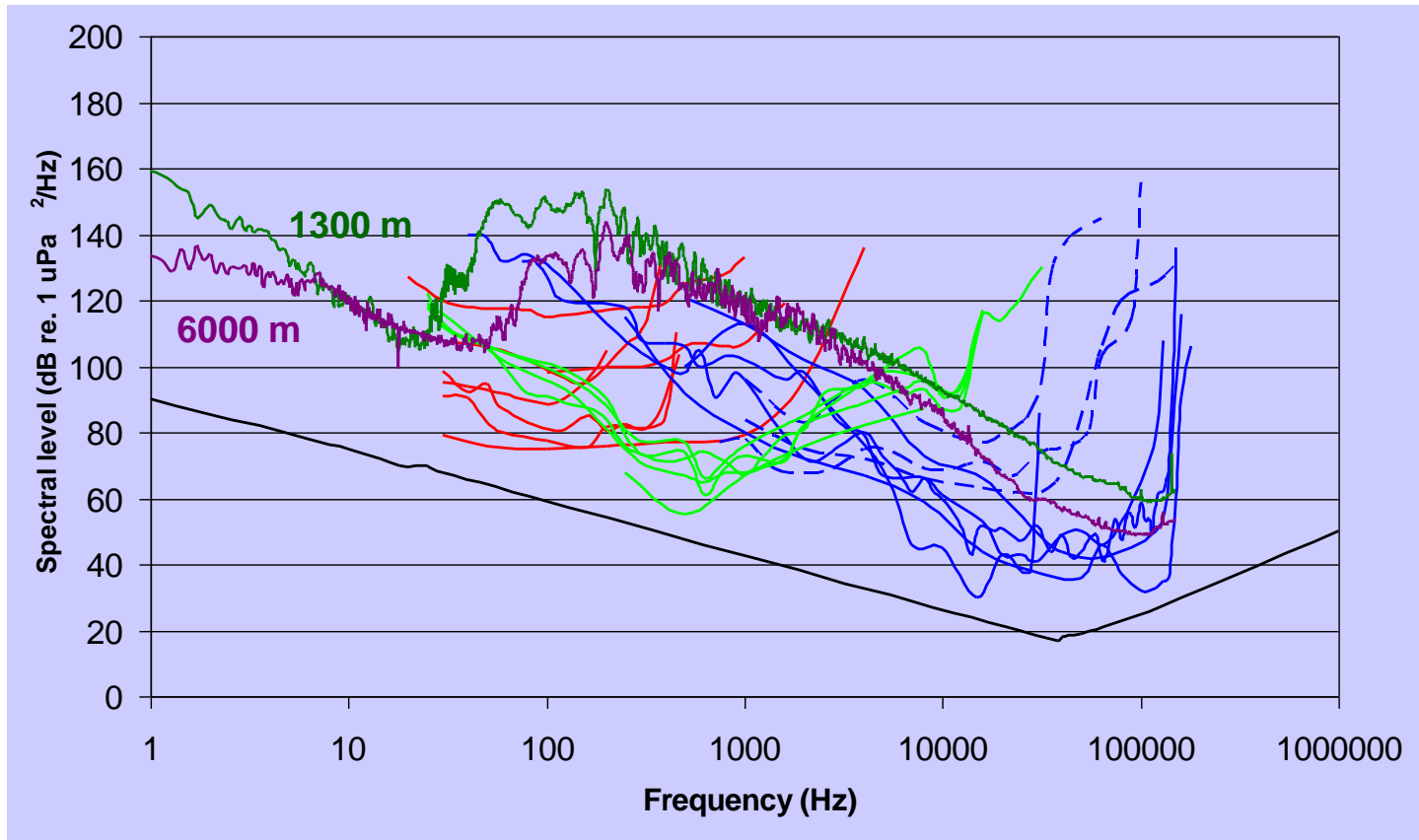
# Piling Noise

Peak Sound Levels, 4.3 m diameter pile.



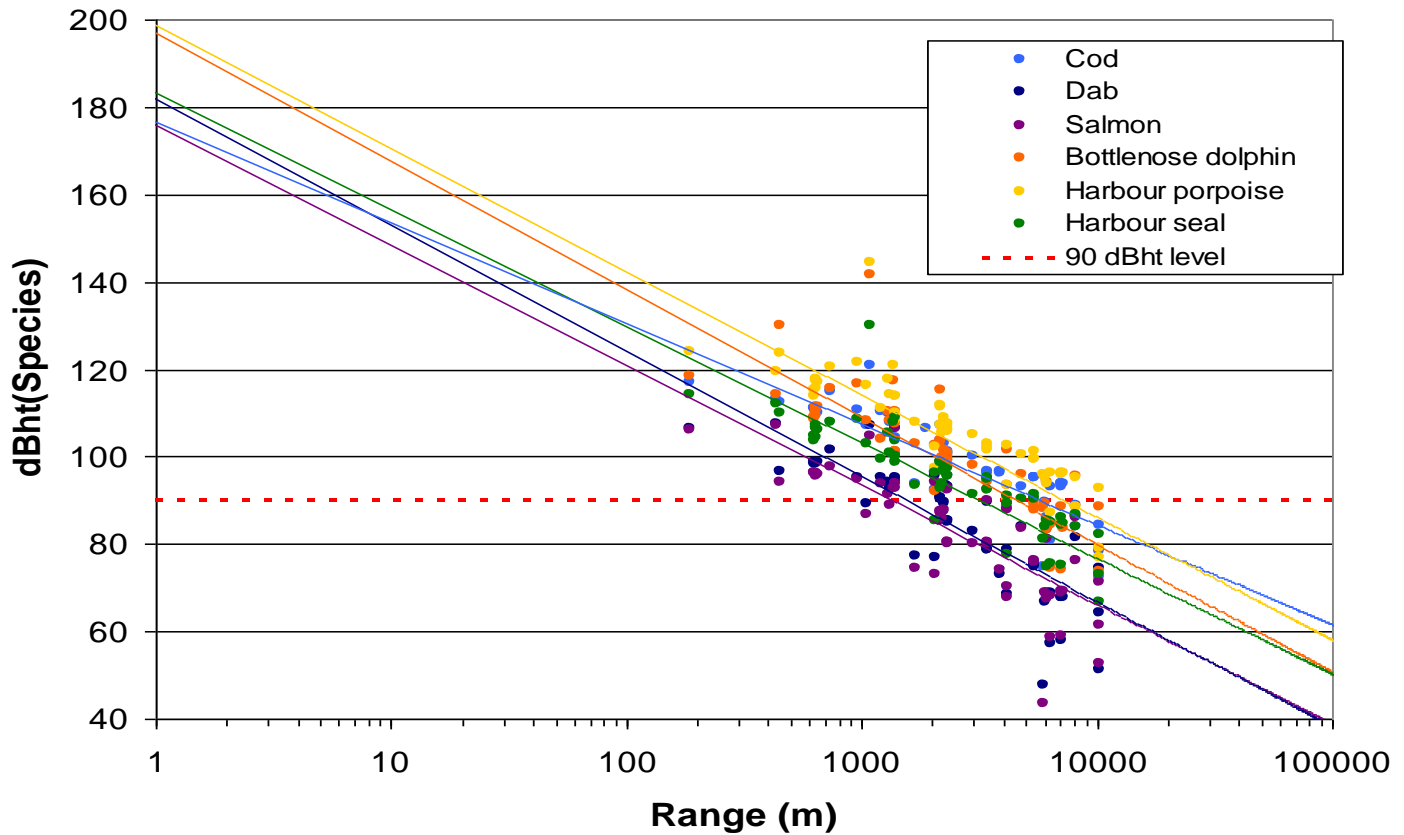
# Piling Noise

Spectral content at 1300 and 6000 m



# Piling Noise

Species perceived sound level ( $\text{dB}_{\text{ht}}$ )  
4.3 m diameter pile



# Further evidence

- **Piling:** World's largest offshore wind farm was built on Horns Reef in the Danish North Sea in 2002; observations from ship surveys showed a significant change in behaviour of harbour porpoise on days with pile driving at distances up to 15 km from the wind farm

(Tougaard, J, Carstensen, J, Skov, H, Teilmann, J, and Henriksen, O D (2003). Effects from pile driving operations on harbour porpoises at Horns Reef offshore windfarm, monitored by T-PODs and behavioural observations. Report by National Environmental Research Institute, Frederiksborgvej 399, DK-4000 Roskilde, Denmark)

# Piling Noise Summary

- Impact piling generates extremely high underwater sound levels, and should be regarded as capable of causing significant environmental effect.
- Development of mitigation measures ?

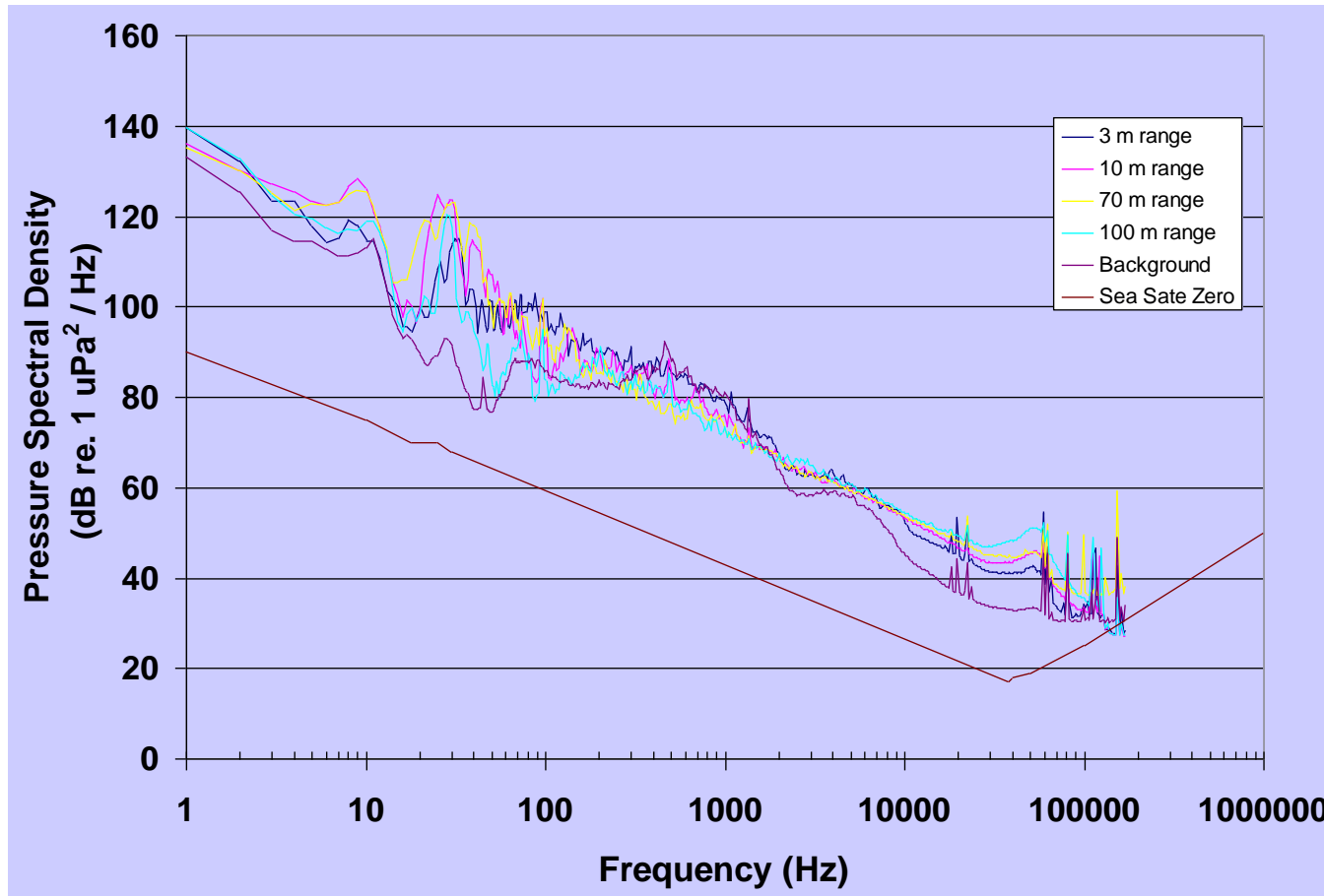
# Operational Noise

- Subsea noise measurement from operational wind farm.
- Broadband noise for many years.



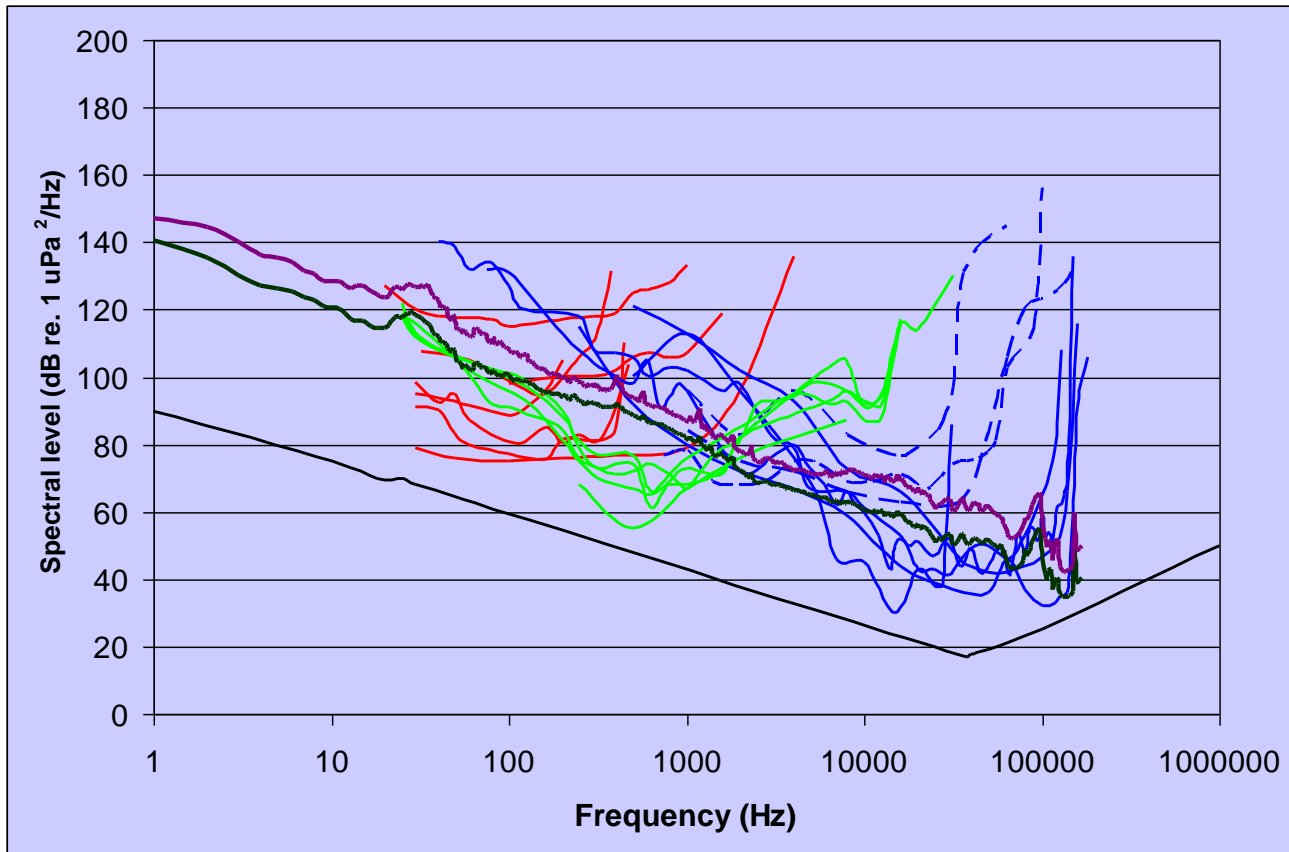
# Operational noise

## North Hoyle



# Operational Noise

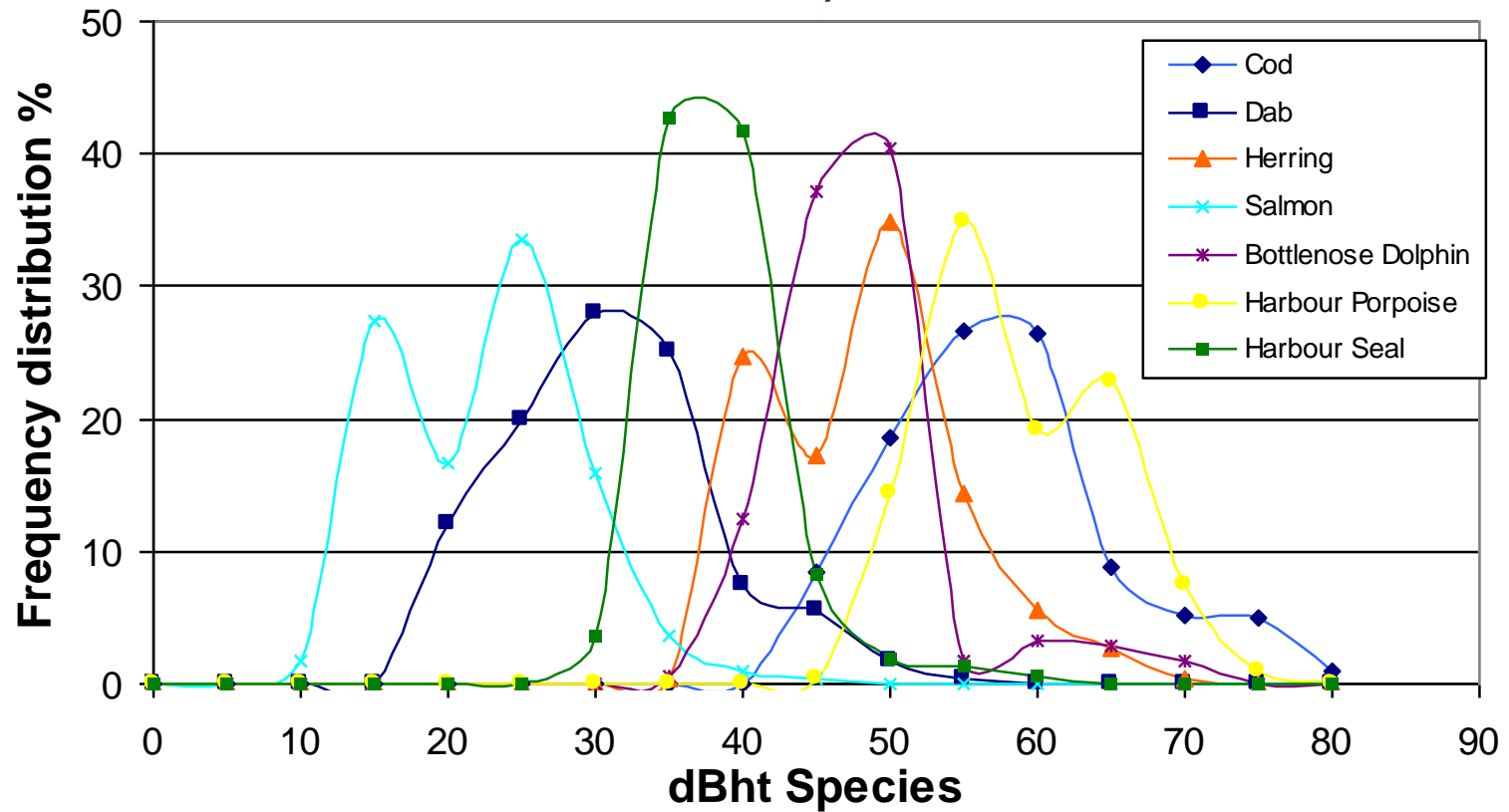
Mean and 95% confidence interval



# Operational Noise

## Species Perceived Sound Levels

North Hoyle



# Conclusions (so far ...)

- Shallow coastal waters are a noisy environment.
- Construction noise and particularly piling has the potential for significant environmental effect.
- Operational wind farm noise is marginally above shallow water noise and is therefore unlikely to adversely effect marine species.

# Programme

- Blyth – Operational noise.
- North Hoyle – Background, construction noise.
- Scroby Sands – Background and construction noise.

Report: JR Nedwell, J Langworthy and D Howell. *Assessment of sub-sea noise acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; Initial measurements of underwater noise during construction of offshore windfarms and comparison with background noise.* 544R0423, May 2003.

# Programme

- North Hoyle – Operational noise.
- Scroby Sands – Operational noise.
- 1 x Construction noise.
- 2 x Operational noise.

# Update on underwater noise and offshore wind farms.

Steve Parvin and Dr Jeremy Nedwell

Subacoustech Ltd

[Steve.parvin@subacoustech.com](mailto:Steve.parvin@subacoustech.com)

[www.subacoustech.com](http://www.subacoustech.com)

