



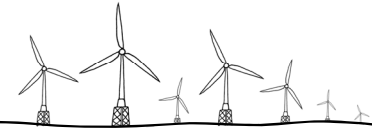
# Alternative approaches to mitigating the impacts of piling noise

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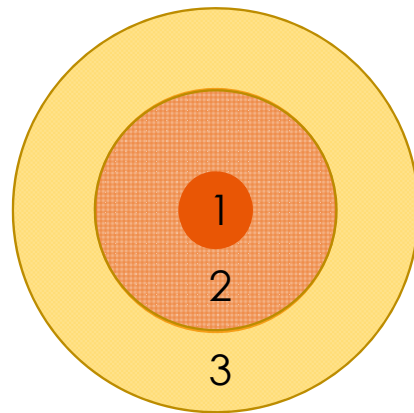
A. Farcas  
N.D. Merchant



# Assessing Impacts of Piling Noise



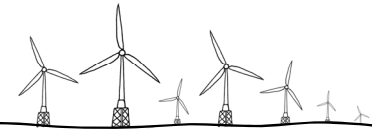
1. Death or injury (< 100 m) → HRA typically assumes no impact if developers follow JNCC guidance
2. Auditory damage from accumulated noise doses
3. Behavioural disturbance



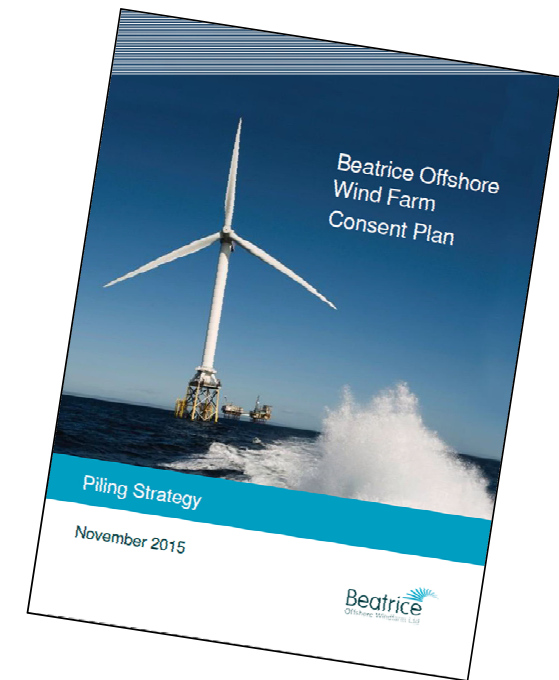
Population modelling  
to inform Habitats  
Regulations Assessment



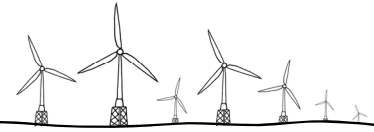
# BOWL Piling Strategy



1. Optimised hammer energies used to predict source levels (& impact ranges)
2. Alternative mitigation procedure:
  1. Acoustic Deterrent Device (ADD) used for 15 min
  2. Soft start at lowest hammer energy for 20 min
  3. Gradual ramp up to max energy permitted: 2500 kJ
3. Risk assessment should ADD mitigation fail



# Key Uncertainties

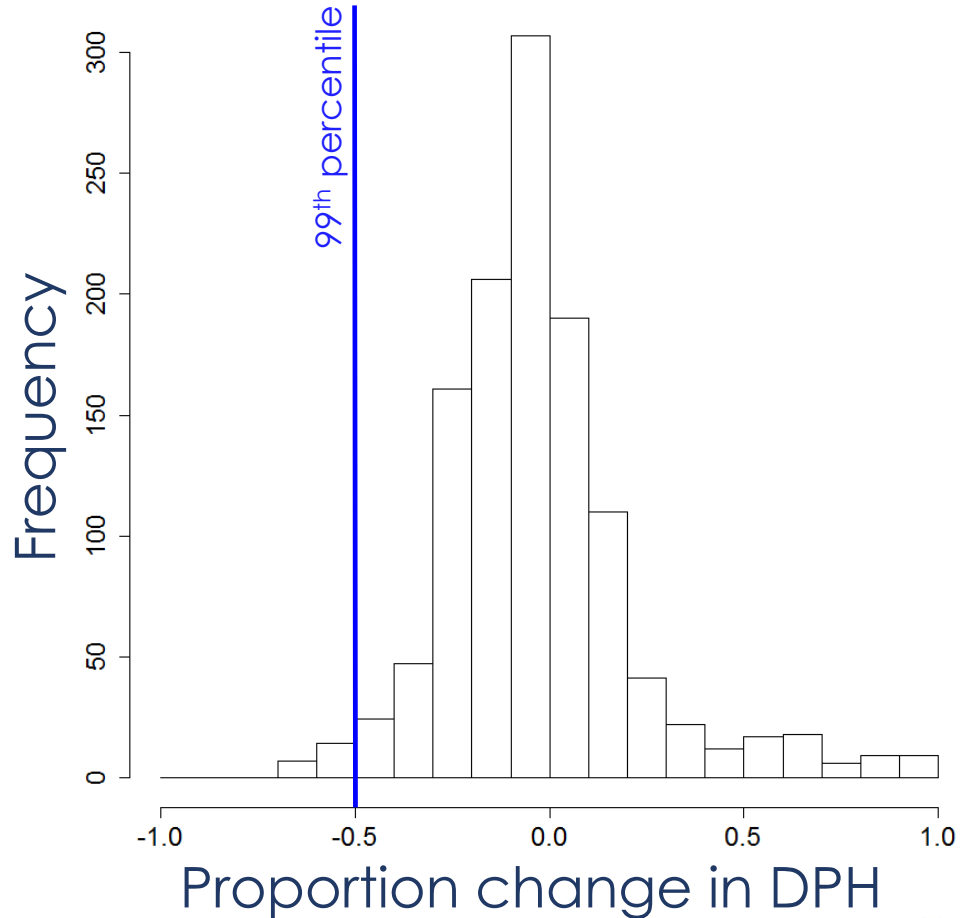
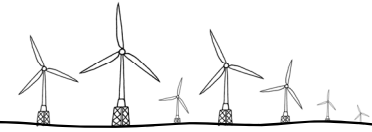


1. To what extent are porpoises displaced by ADDs ?
2. How soon do porpoises return after ADD use ?
3. Do responses to piling change through construction ?
4. How do noise levels vary with hammer energy ?

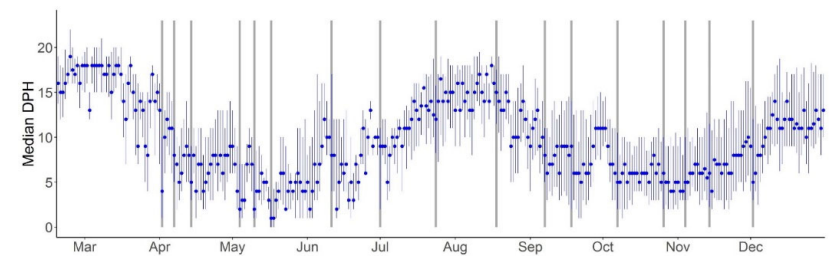




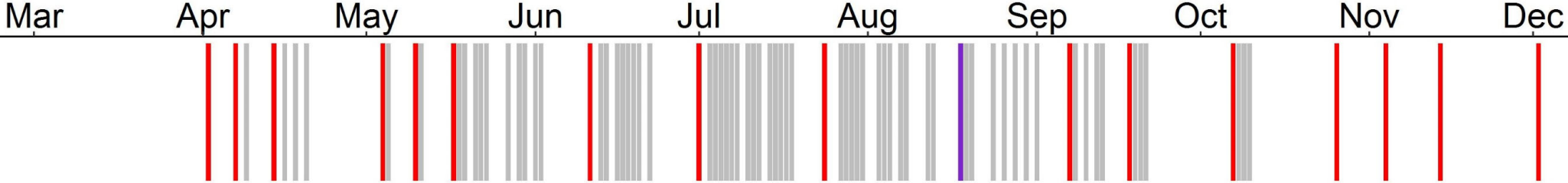
# What is a response?



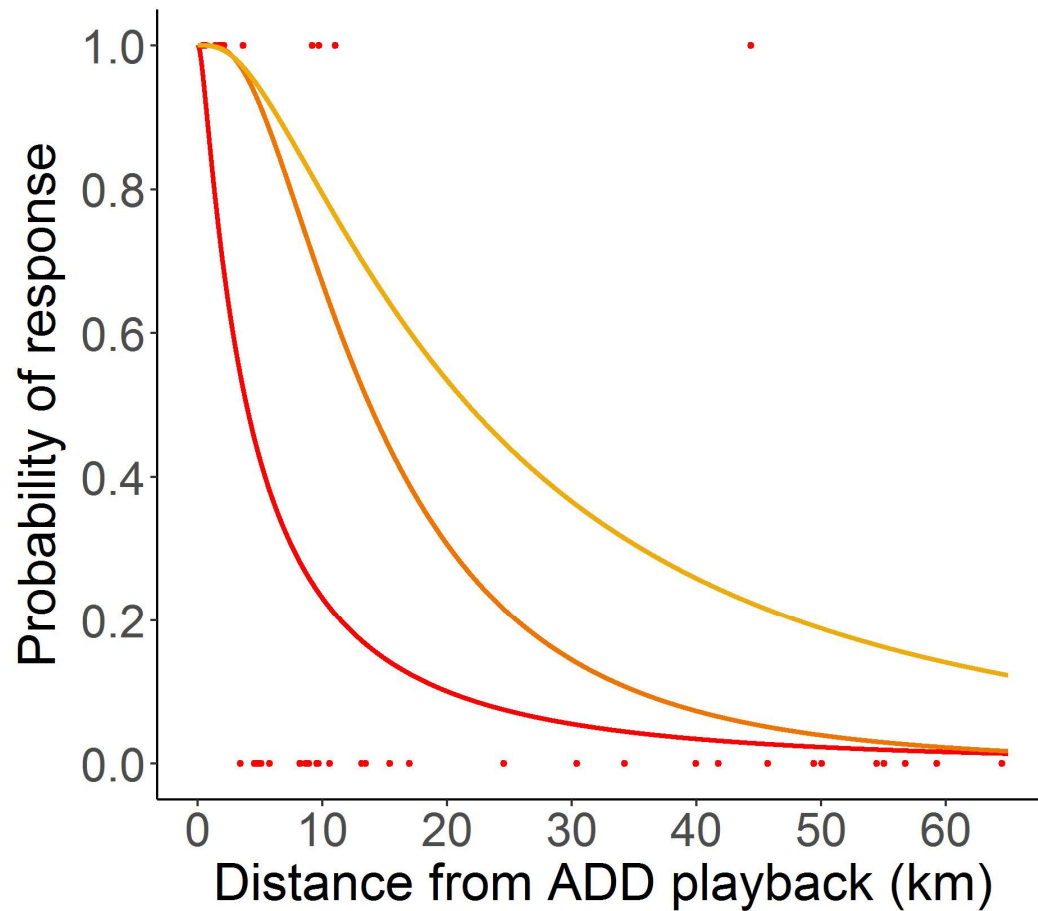
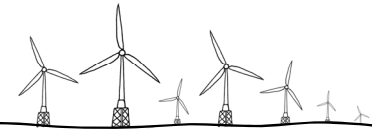
- Baseline distribution of proportion change
- 99% values  $> -0.5$
- Response defined as:  
Proportion change in DPH  $\leq -0.5$



# Responses to **piling** & piling without ADD



# 1. Porpoise responses to ADD playback



## 50% Response

Response Length      Distance (km)

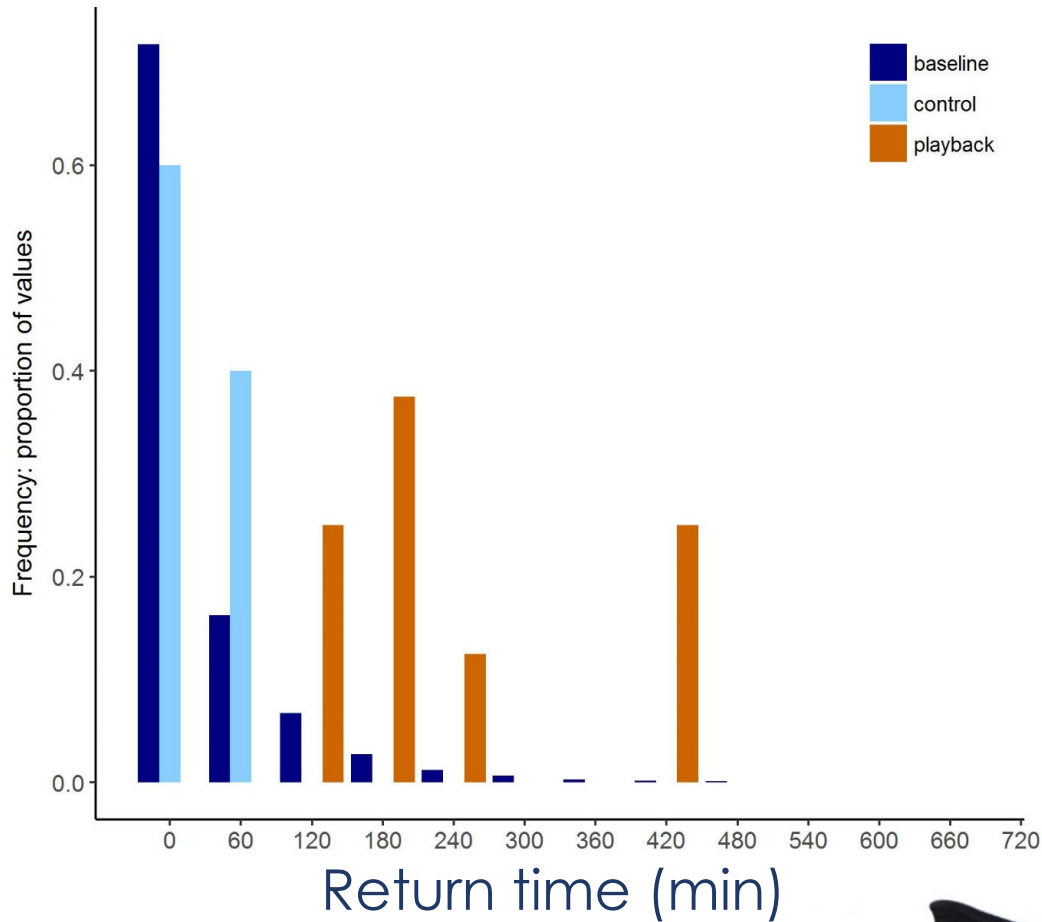
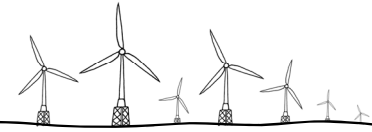
**3 h**                      **21.7**

**6 h**                      **13.8**

**12 h**                     **3.9**



## 2. How soon do porpoises return after ADD?



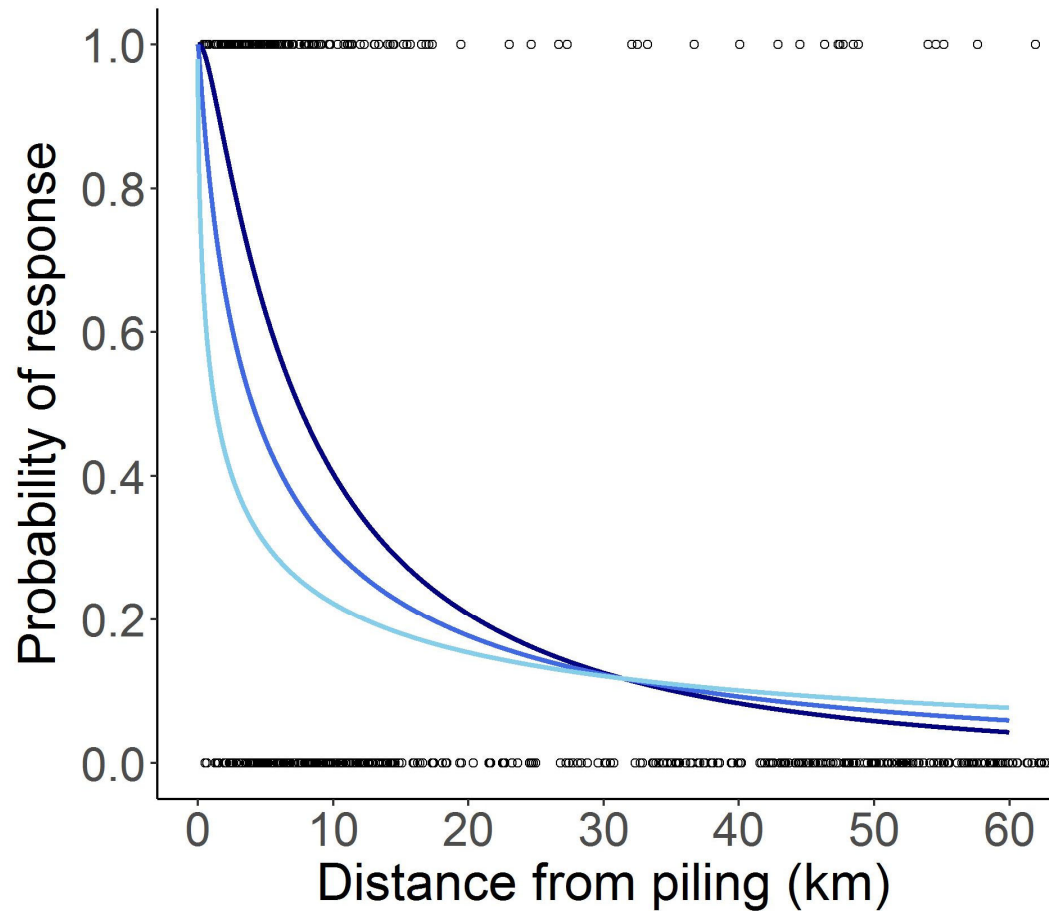
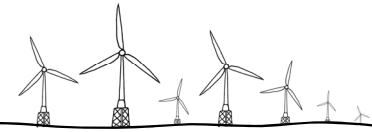
	CPODs within 1 km
Playback	8
Control	5

Minimum time to next detection = 133 min





### 3. Responses to piling (and ADD)



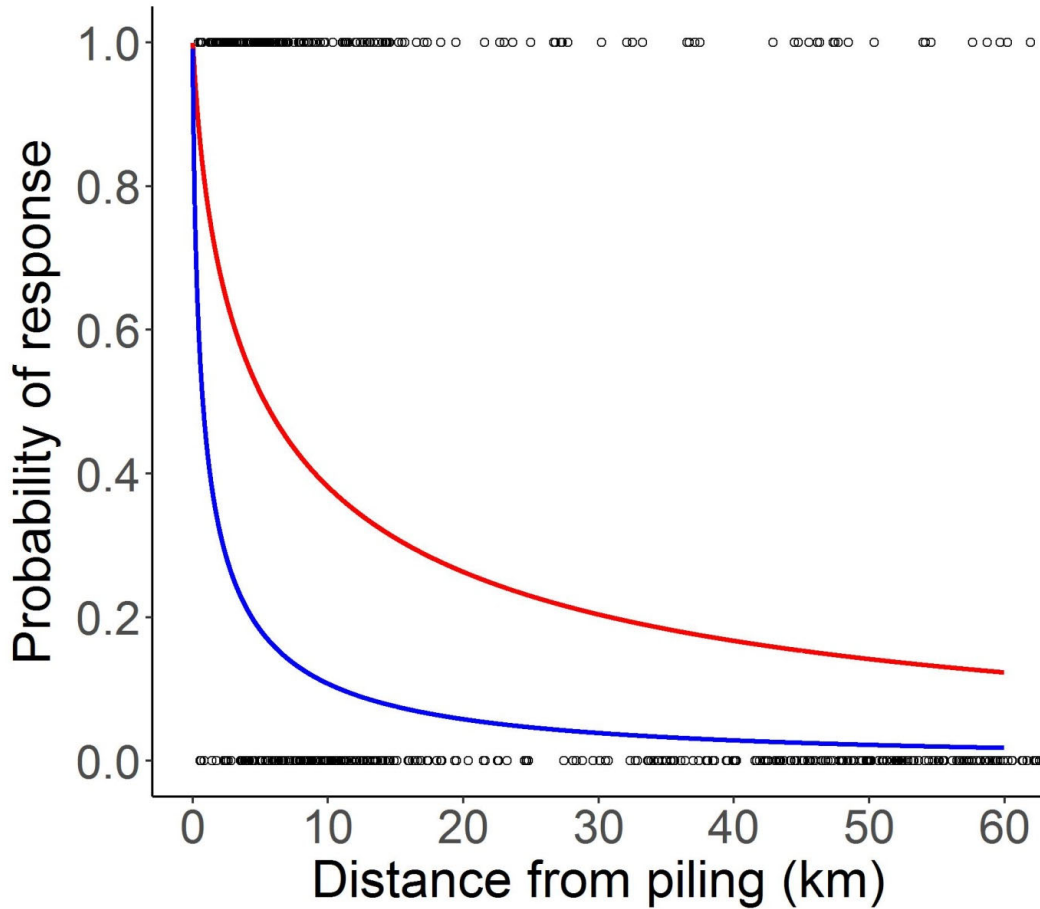
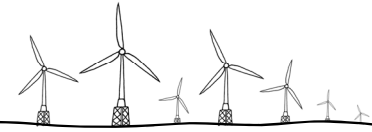
... decrease over time

**50% Response (24 h)**

Date	Turbine	Distance (km)
<b>2 Apr</b>	<b>1<sup>st</sup></b>	<b>7.4</b>
<b>24 Jul</b>	<b>47<sup>th</sup></b>	<b>4.0</b>
<b>2 Dec</b>	<b>86<sup>th</sup></b>	<b>1.3</b>



# ADD use increases response to piling



## 50% Response (12 h)

ADD used      Distance (km)

**Yes**                      **5.2**

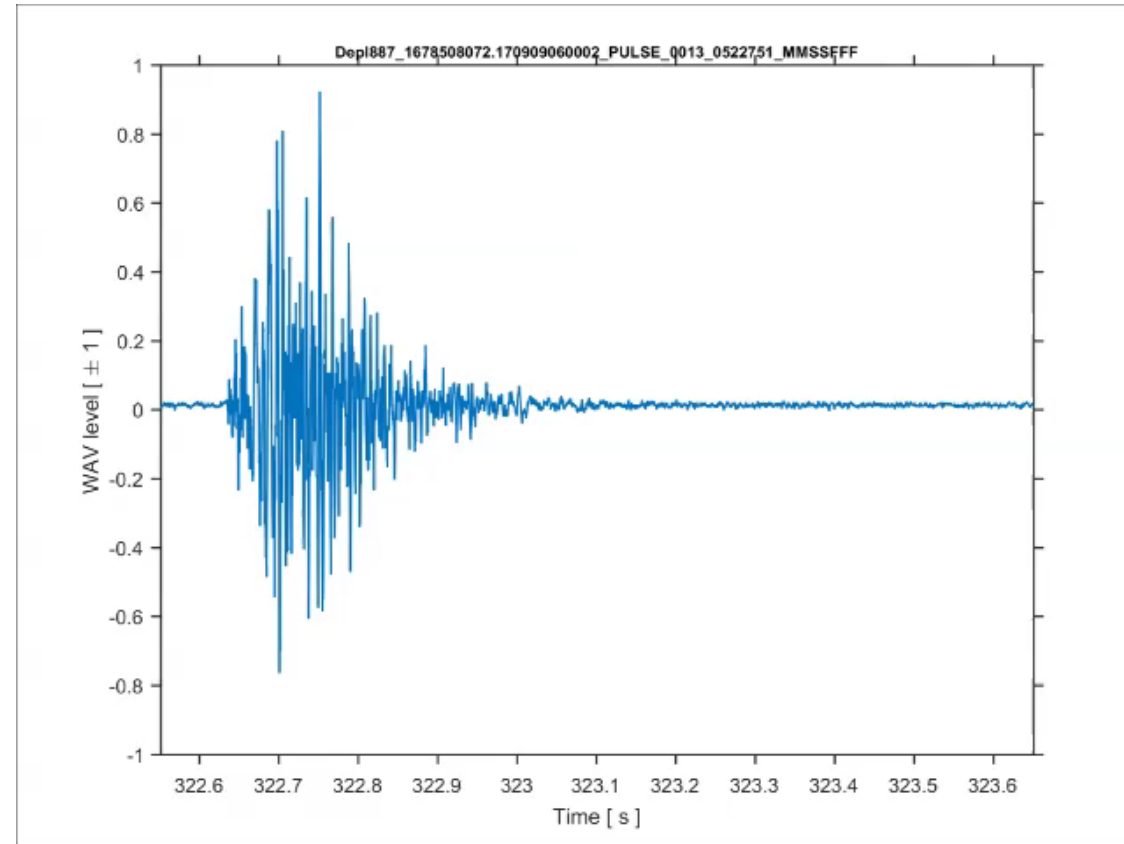
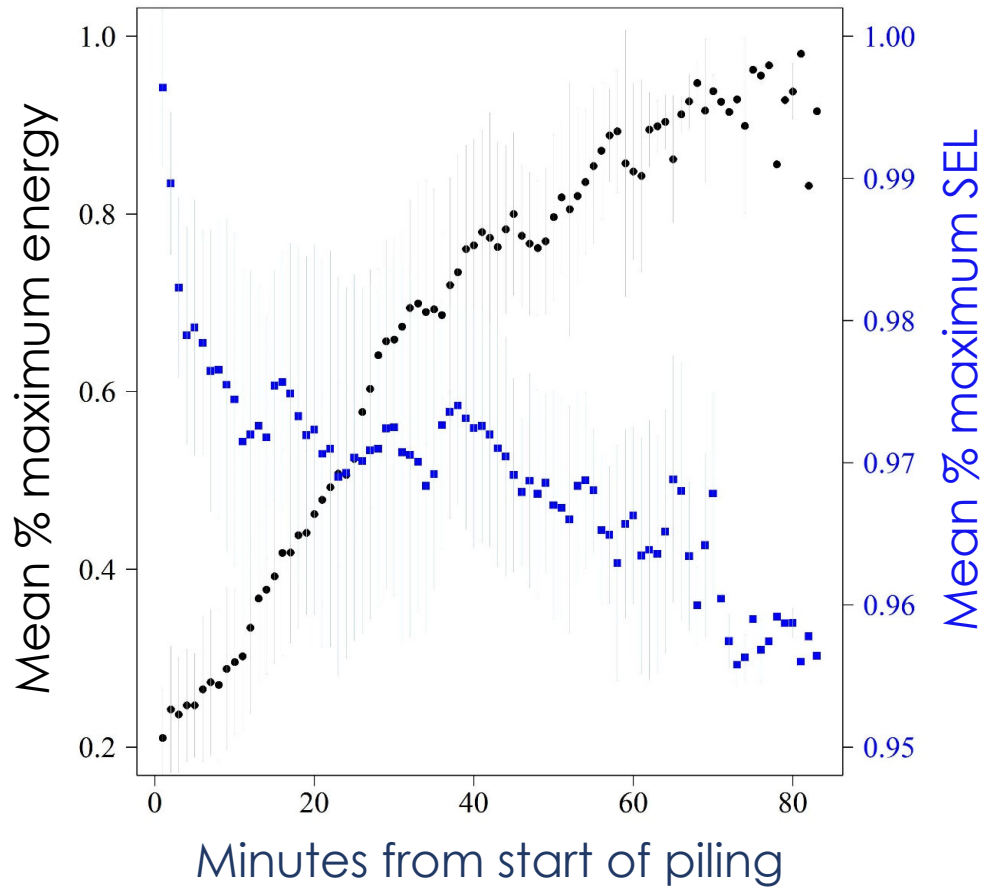
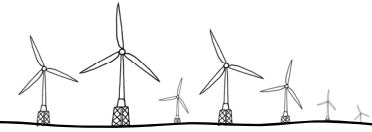
**No**                        **0.7**

No ADD: 61<sup>st</sup> turbine (18 Aug)

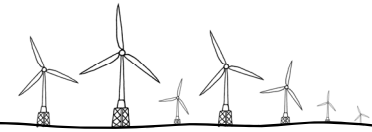
Yes ADD: 62<sup>nd</sup> turbine (19 Aug)



# 4. Noise levels & hammer energy?



# Key Results



Porpoises were **present on windfarm site throughout construction**

1. Response appears to be **increased by ADD** use
2. Porpoises return > 2 hours after ADD playback
3. Porpoise dose-response curve, but **decline** in response over time
4. Distance to piling & length of pile exposed influence noise levels more than hammer energy

