A review of marine bird diving behaviour: assessing underwater collision risk with tidal turbines

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Outline

1. Background to the review
2. Literature review:
   - The scope
   - Methods
3. Results
   - Data rich, moderate and poor species
4. Conclusions and implications

Assessing impacts on marine birds

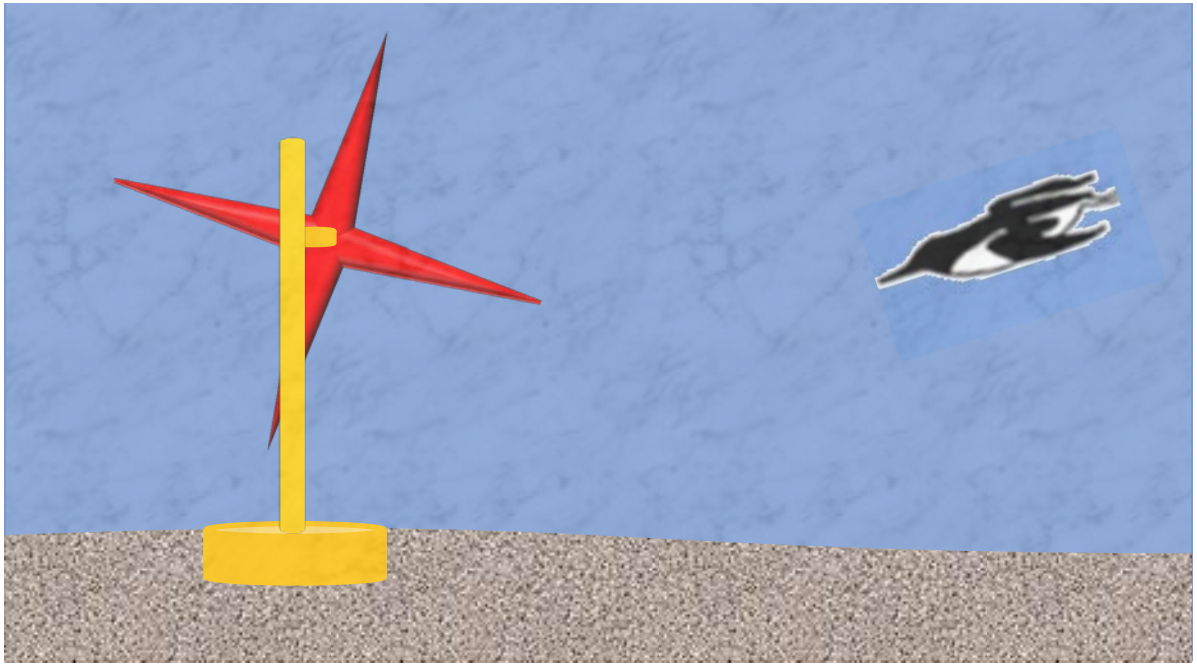
- Tidal turbines have the potential to impact diving birds through collision.
- European legislation requires assessment of impacts:
    - Environmental Impact Assessment (EIA)
    - Habitats Regulations Appraisal (HRA)
- Collision Risk Modelling has been developed for quantifying collision risk with windfarms…

…. can we use the same approach underwater?

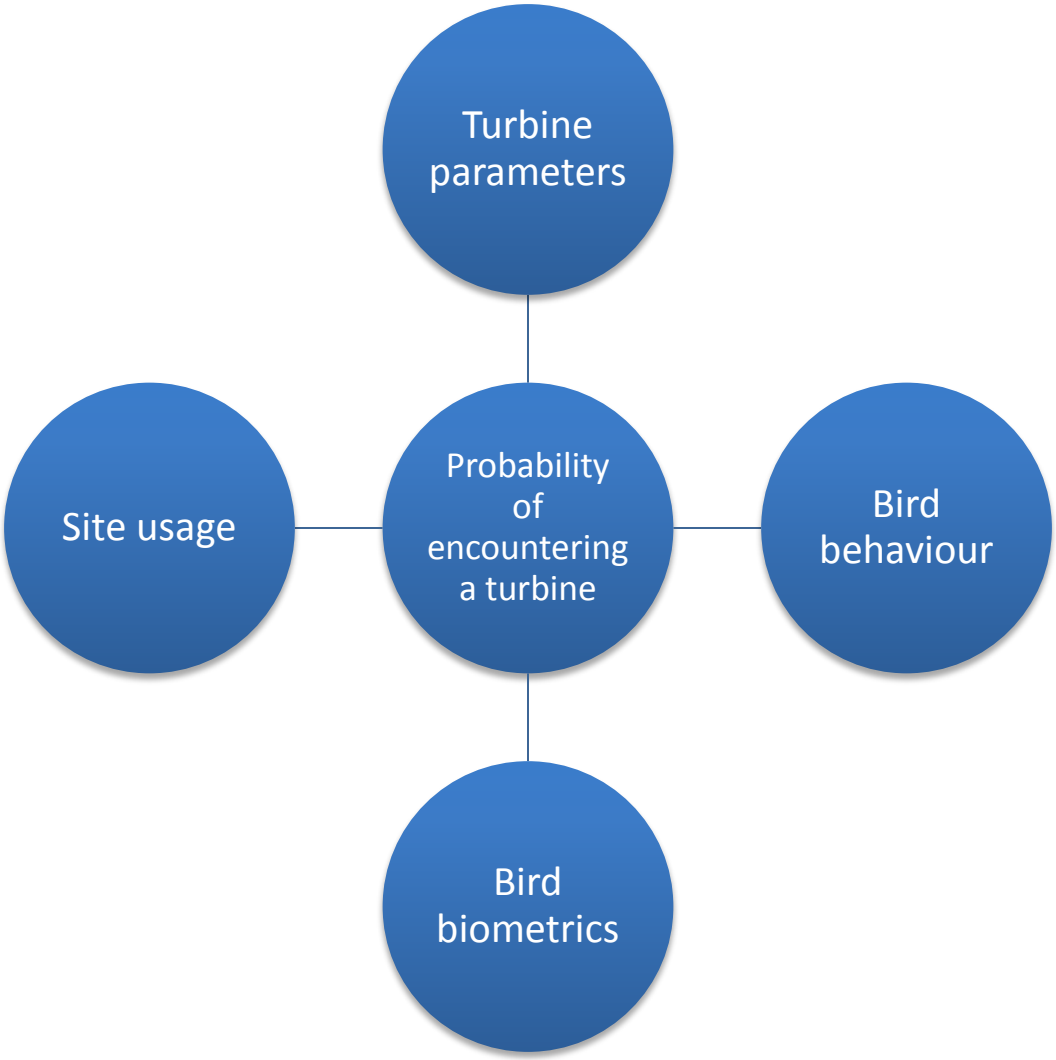
Collision Risk Modelling

Three main models are currently being used for birds:

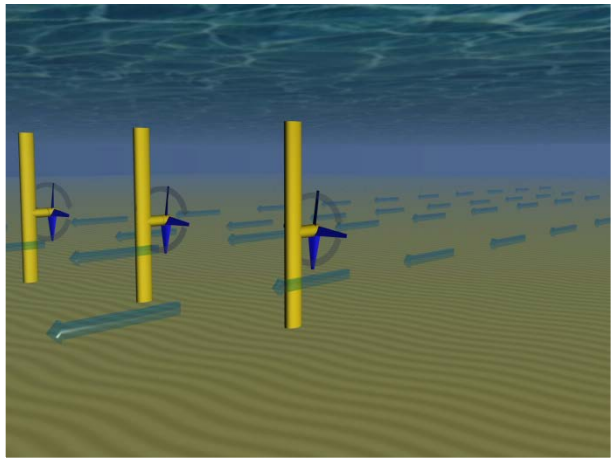
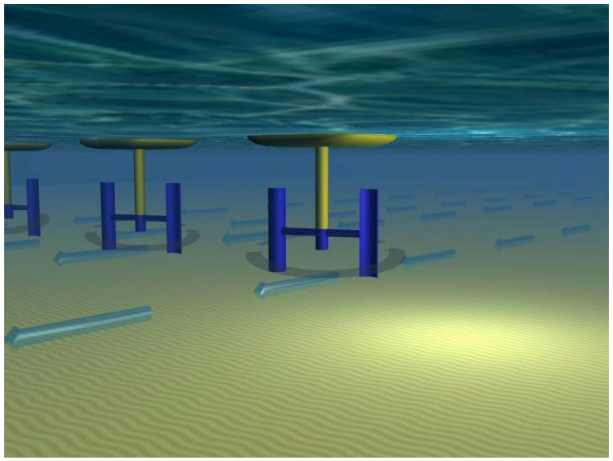
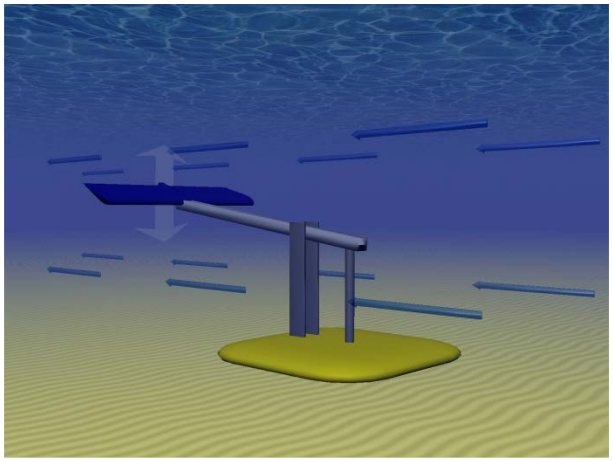
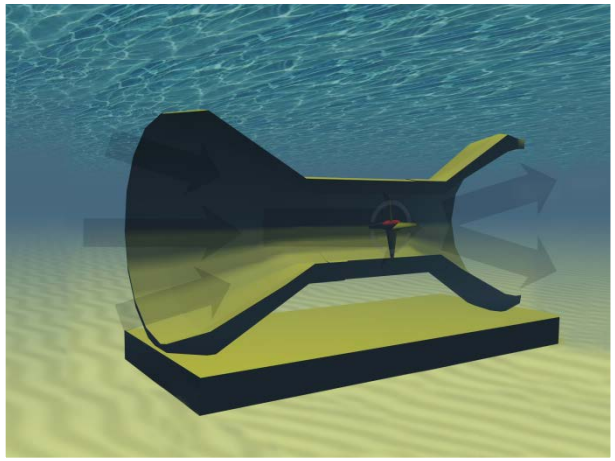
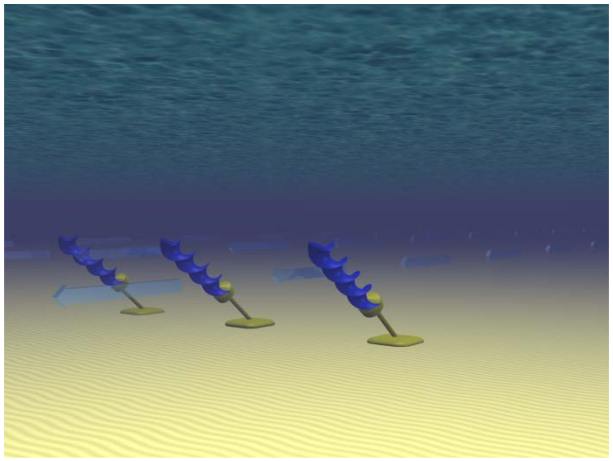
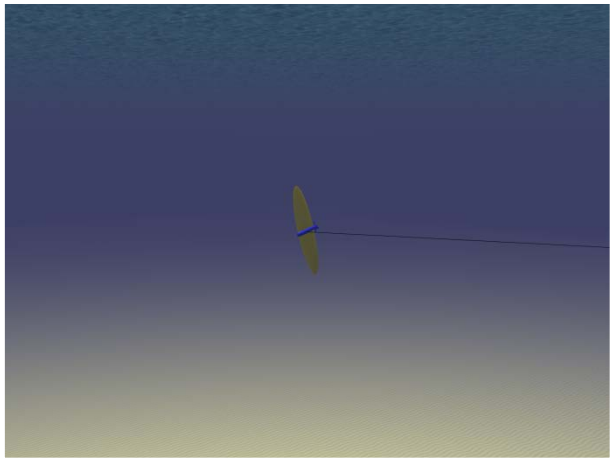
1. Band collision risk model (CRM)
2. SRSL encounter rate model (ERM)
3. Exposure time modelling approach (developed by RPS under contract to SNH)



Collision Risk Modelling



CRM – tidal turbine designs…

Bird foraging and diving behaviour

Data are required on foraging and diving behaviour to calculate likely exposure to tidal turbine

- Pro

The accuracy of any model prediction is dependent on the quality of input data!

tal speeds

- D
  - Dive d ion
- Alterna e meth estin ive freque
  - Dives/trip, trip d on, proportion time at foraging location, rips/day

Literature review - scope

We reviewed 18 diving parameters for 22 species of marine birds occurring in UK waters.

Literature review - methods

- Values calculated for each parameter:
  - Maximum, mean maximum and global mean

- We prioritised studies where direct methods have been used to provide a measure of confidence for the data [1].

Confidence Measure	Definition
High	>5 direct studies
Moderate	2-5 direct studies
Low	Indirect measures or only 1 direct study
Uncertain	Survey-based estimates
Poor	Few survey estimates or speculative data

[1] Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W., and Burton, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation* 156: 53-61.

European shag - data rich

	Global Mean	Locations (Studies)	Confidence
Dive Depth (mean)	23.2m	3 (13)	High
Dive Duration	41.7s	5 (16)	High
Pause Duration	33.8s	3 (10)	High
Dives/Bout	20.9	1 (5)	Moderate
Ascent Speed	1.5 ms^{-1}	1 (4)	High
Descent Speed	1.8 ms^{-1}	1 (4)	High
Dives/Trip	26.6	1 (8)	Moderate
Forage Trip Duration	91.2 min	1 (5)	Moderate
Forage Trip Frequency	2.8/day	1 (7)	Moderate

Black guillemot - data moderate/ poor

	Global Mean	Locations (Studies)	Confidence
Dive Depth (mean max)	26.5m	2 (2)	Low
Dive Duration	77.1s	Shag – 41.7s	
Pause Duration	31.2s	1 (1)	Poor
Dives/Bout	8.75	Shag – 20.9	
Ascent Speed		*No data*	
Descent Speed		*No data*	
Dives/Trip		*No data*	
Forage Trip Duration		*No data*	
Forage Trip Frequency		*No data*	

Red-throated diver – data poor

	Global Mean	Locations (Studies)	Confidence
Dive Depth (mean)	5.3m	Shag – 23.2m	
Dive Duration	26.1s	Shag – 41.7s Black Guillemot – 77.1s	
Pause Duration	12.2s	1 (2)	Poor
Dives/Bout		*No data*	
Ascent Speed		*No data*	
Descent Speed		*No data*	
Dives/Trip		*No data*	
Forage Trip Duration	39.8 min	Shag – 91.2 min	
Forage Trip Frequency	10/day	Shag – 2.8/day	

Summary

Current knowledge is variable across parameters and species:

- Presentation of parameters within studies is not always comparable.
- Poorly studied parameters, such as horizontal speeds at depth, are likely to be particularly relevant for tidal turbine collision risk.
- Some species are more difficult to study, however, improvements in technology may increase the potential for future studies.

Conclusions

- Some of the more vulnerable species are difficult to study and confidence in these data is lower.
- There is a need to measure poorly understood parameters, i.e. horizontal speed.
- Well studied species, such as shag, gannet and guillemot will provide a useful opportunity for studying effects of renewables.
- The biggest unknown is how species will interact with devices and if they will exhibit avoidance behaviours…

… and will require robust post-construction monitoring to inform future assessments!

Thank-you for listening

This review is being undertaken collaboratively between:

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