Diving and foraging behaviour of seabirds in a high-energy tidal stream: implications for encountering tidal stream devices

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INTRODUCTION

- Diving seabirds may encounter and collide with tidal turbine installations while foraging underwater.
- The consequences of collisions has the potential to impact on seabird populations, which there is a legal requirement to assess.
- For birds with foraging and diving preferences within high energy tidal streams the devices may have important behavioural and ecological implications.
- Studies have found different species exploited different states of the tidal cycle [2]. However, our knowledge base on how they utilise high-energy tidal streams (HETS) in a UK context is still very limited [3, 4, 5].

METHODS

- We undertook behavioural observations from three vantage points along the length of Bluemull Sound, Shetland (fig. 1).
- Observations were carried out in summer 2011, winter and summer 2012.
- Data collected included >1,000 focal observations; during each observation the location and duration of behaviours were recorded.
- Data are being analysed with tidal current speed and direction data, collected through an Acoustic Doppler Current Profiler (ADCP) deployed in Bluemull Sound in 2004.

RESULTS

- Initial analyses suggest that diving frequency in some species, such as puffin show significant correlation with the mean current speed (mean current speed, p=0.014*. N=114, dev. explained =51.8%; fig 2).

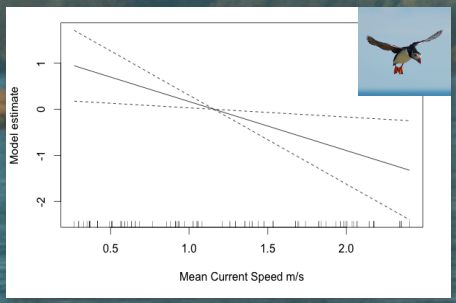

Figure 2. Atlantic puffin diving frequency by mean current speed (m/s). Binomial GAM: Dive frequency ~ Focal duration + mean current speed

AIM

To develop our understanding of seabird foraging and diving behaviour under different tidal conditions within a high-energy tidal stream.

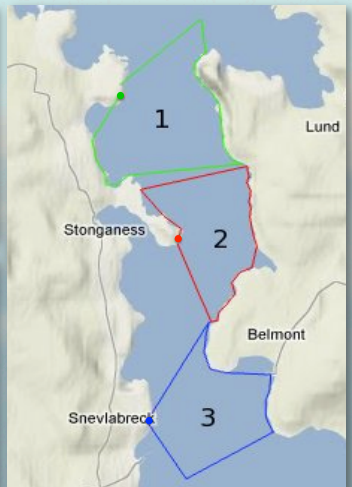

Figure 1. Vantage points in Bluemull Sound

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BENEFITS OF FOCAL OBSERVATIONS

- Focal observations enable identification of behavioural adaptations to HETS that are missed by traditional site scans.
- E.g. black guillemot undertaking short flights upstream, against the current, before landing, diving and drifting downstream with the current (fig. 3).
- This behavioural pattern of using the currents as a "feeding conveyor-belt" has been described for the closely related, pigeon guillemot [2].
- We suggest this maximises foraging within a smaller area. However, it also has potential implications for turnover rates and estimated abundances of birds within development sites.

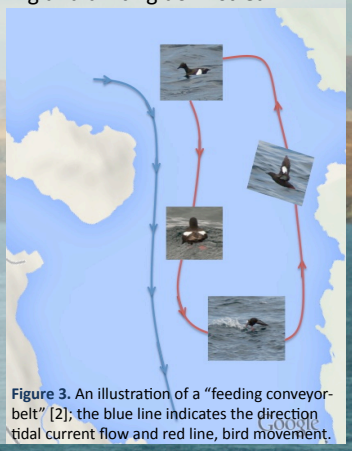

Figure 3. An illustration of a "feeding conveyor-belt" [2]; the blue line indicates the direction tidal current flow and red line, bird movement.

CONCLUSIONS

- Our initial findings show that diving frequency varies under different tidal conditions. A better understanding of these preferences can help inform a species' sensitivity to tidal developments and any impact assessments. For example:
- Species that dive more frequently in faster flows are more likely to encounter a tidal device at maximum velocity. Similarly, preferences for currents at certain depths can determine a species' sensitivity to the location of turbines within the water column.
- Our study highlights the importance of focal observations in understanding behavioural usage of tidal environments. We suggest these observations can provide context to site abundance and density estimates, and can give an indication of turnover within development sites. This can lead to a more accurate assessment of the impacts of marine renewable energy developments.

KEY REFERENCES

[1] Heath and Gilchrist, 2010 Heath, J., and Gilchrist, H., 2010. When foraging becomes unprofitable: energetics of diving in tidal currents by common eiders wintering in the Arctic. *Marine Ecology Progress Series*, 403: 279-290.
[2] Holm, K.J and Burger, A.E. 2002. Foraging behavior and resource partitioning by diving birds during winter in areas of strong tidal currents. *Waterbirds* 25(3): 312-325.
[3] Langton, R., Davies, I.M., and Scott, B.E. 2011. Seabird conservation and tidal stream and wave power generation: Information needs for predicting and managing potential impacts. *Marine Policy* 35: 623-630.
[4] Furness, R.W., Wade, H.M., Robbins, A.M.C., and Masden, E.A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. *ICES Journal of Marine Science* 69(8): 1466-1479.
[5] Scott, B.E., Langton, R., Philpott, E.M. and Waggitt, J.J. 2014. Seabirds and Marine Renewables: Are we Asking the Right Questions? In Marine Renewable Energy Technology and Environmental Interactions. Shields, M. A. & Payne, A. I. L. (eds.). Springer , p. 81-92 11 p. (Humanity and the Sea)

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