Assessing the impact of marine wind farms on birds through movement modelling

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INTRODUCTION: Many countries are increasing their use of renewable energy, particularly wind energy, to reduce the effects of climate change but wind farms can have negative effects on birds. When birds exhibit avoidance behaviour towards turbines, wind farms may act as barriers to movement [1], increasing flight distances and energy expenditure. A lack of avoidance puts birds at risk from collision mortality [2]. We present movement models based on observed behaviour of common eider Somateria mollissima to the Nysted offshore wind farm in Denmark to predict and identify potential measures to reduce impacts. We show how movement models can contribute to the spatial planning of wind farms.

METHODS: Using a model that describes movements of common eider around wind turbines [3], we ran simulations to investigate:
1. The effect of wind farm dimensions on the number of birds passing between turbines
   We varied distance between rows and number of columns of turbines using the Nysted wind farm as a template (8 turbines per column). We simulated 100 trajectories for each combination.
2. The effect of different configurations of turbines on the permeability of a wind farm
   Permeability was assessed by computing a straightness index [4]. We investigated the permeability of a 100 km² area containing 100 turbines in different scenarios. For each scenario we simulated 100 trajectories.

RESULTS:
1. By varying turbine row spacing, we influenced the number of birds entering the wind farm. As the number of rows increased, the greater the inter-turbine distance before birds flew between turbines (Fig. 1). Birds continued to pass between peripheral turbines however, so eliminating corners may be beneficial.
2. Permeability was least when turbines were spaced equally across the central 25 km² (Fig. 2c, h). The diamond scenario was less permeable than a square (Fig. 2a, b, f, g) so may reduce the number of birds entering a wind farm. Four blocks of turbines had greatest permeability (Fig. 2d, i), so may be better than one larger wind farm when barriers effects are the main concern.

CONCLUSIONS: We demonstrate that movement models can make new contributions to impact assessments of wind farm developments. In the future, our ability to parameterise such models depends entirely on data availability but at present there is a of lack post-construction monitoring data.

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