MASTS Energy Forum Small Grant project report (MESG6)

Faster, higher, further: do offshore wind farms affect long-distance prospecting movements of immature gannets (*Morus bassanus*)?

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Background and aims of the project

Renewable energy generation from offshore wind farms is an expansive potential anthropogenic risk for wildlife within European marine areas. Seabirds are particularly exposed to collision and barrier effects of offshore wind farms. Current research focuses primarily on the impact of single sites on local or migrating birds. Yet, seabird populations are increasingly understood as metapopulations, networks of colonies connected through emigration and immigration. The connectivity appears to be driven by immature birds as they 'prospect' throughout the metapopulation before selecting a breeding colony. The large spatial scale of these movements may pose an elevated encounter risk with multiple offshore wind farms. However, to-date, our understanding of the scale and the detailed nature of prospecting movement, and consequently of the possible impact of offshore wind farms, is minimal. This study aims to use tracking data from prospecting immature birds to investigate the behavioural responses of immature seabirds to offshore wind farms across the breeding range of a metapopulation. We use Northern gannets (*Morus bassanus*) because a) published prospecting trips in this species ranged over thousands of kilometres b) gannets are classified as vulnerable to collisions with rotors based on their flight heights, c) the literature suggests displacement effects of wind farms on gannets and d) the large body size of immature gannets allows to deploy novel GPS devices for remote data collection.

The aim of this study was to investigate offshore wind farms impacts on immature Northern gannets flight behaviour. Specifically we were interested in determining if immature gannets change their flight behaviour (bearing, flight altitude, but see below) when approaching wind farms and to determine at what distances (detection threshold) to the offshore wind farm they do so. Quantitatively interpreting the flight behaviour of immature gannets in response to encountering wind farms offshore will

allow us to understand if wind farms pose an attraction, an obstacle, a barrier or might lead to fatalities due to collision. Understanding at which distances to wind farms immature gannets modify their flight path might allow conclusions with management relevance, e.g. about the acceptable distance between the location of wind farms and sea bird colonies or known foraging hot spots.

Fieldwork and data analysis

To address the questions above, we deployed state of the art GPS tracking devices on immature Northern gannets in three study colonies; Heligoland in Germany, Grassholm in Wales and the Bass Rock in Scotland. The exposure to existing wind farms in the immediate vicinity of the three colonies and those under construction is quite different (Fig. 1), but based on the huge scale of movements of immature gannets in the area immatures were likely to encounter all wind farms in the area (Jeglinski et al. unpublished).

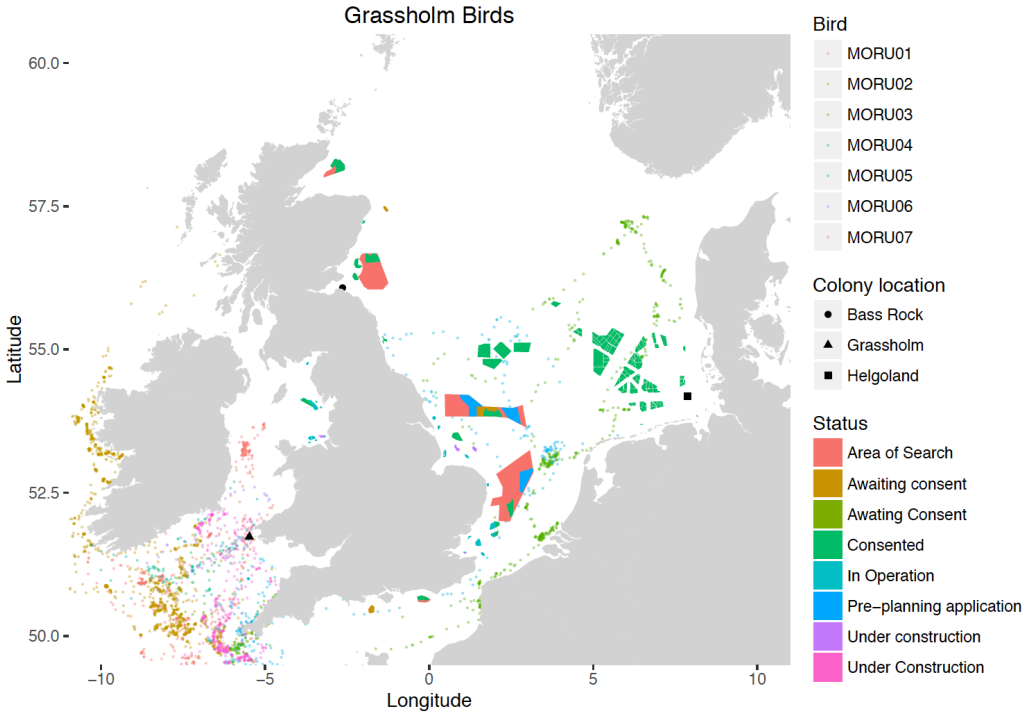

Fig 1: Tracks from birds caught on Grassholm overlaid on the current offshore wind farm locations in the study area.

A total of 31 birds were captured in July and August 2015 in the three colonies using snares or hooks attached to long poles. Morphometrics and weight were taken, and all birds were ringed with BTO or Vogelwarte rings under the required permits and a body feather was taken for molecular sex determination at University of Glasgow. Pathtrack Nanofix or Ecotone Saker solar powered GPS GSM tags were attached to the three middle tail feathers using TESA®tape. The devices use the mobile phone network to send data to the user, can store up 80,000 GPS fixes when out of coverage that are transmitted when back in range. Devices were shed when birds moulted their tail feathers (average transmission period was 30 days), thus provided detailed data for the relevant period (breeding season) while minimising welfare concerns due to possible adverse effects of longer-term logger deployment. Unfortunately, the altimeters did not operate reliably, and thus only GPS locations were available to use for the analusis. The tracking data was uploaded to movebank https://www.movebank.org to facilitate data sharing.

Spatial data on wind farm sites and status were downloaded from websites of the UK government crown estate and acquired from the German Bundesamt fuer Seeschifffahrt and Hydrographie (BSH, Federal Maritime and Hydrographic Agency). All wind farms with the status *'in operation'* were considered for the analysis. To analyse the birds GPS trajectory in relation to the wind farms, we used a vector-based approach modelling the flight vector of the study birds as a function of the distance to the wind farm using Generalised Additive models (gams).

Preliminary results

None of the study birds flew into the any of the operational wind farms in the study area, suggesting that immature gannets generally showed an avoidance response to the wind farms (macro avoidance).

The flight vector relative to the wind farm showed a different response for UK versus German wind farms. The negative component of the flight vector was significant for UK wind farms, suggesting that Gannets modified their flight vector to fly away from and thus avoid UK wind farms within 10 km of the wind farm perimeter (Fig 2A). In contrast, the positive component of the flight vector was significant for German wind farms, suggesting that birds travelled towards those in a perimeter of 15 km (Fig 2B). This preliminary finding is surprising and needs to be interpreted with caution, potentially arising from the difference in distances between gannet colonies (to which tracks are often orientated) in Germany (the nearest wind farm is 35 km away) and in the UK (no operational wind farms close to any gannet colony). Further analysis of the data is required to investigate possible patterns in more detail.

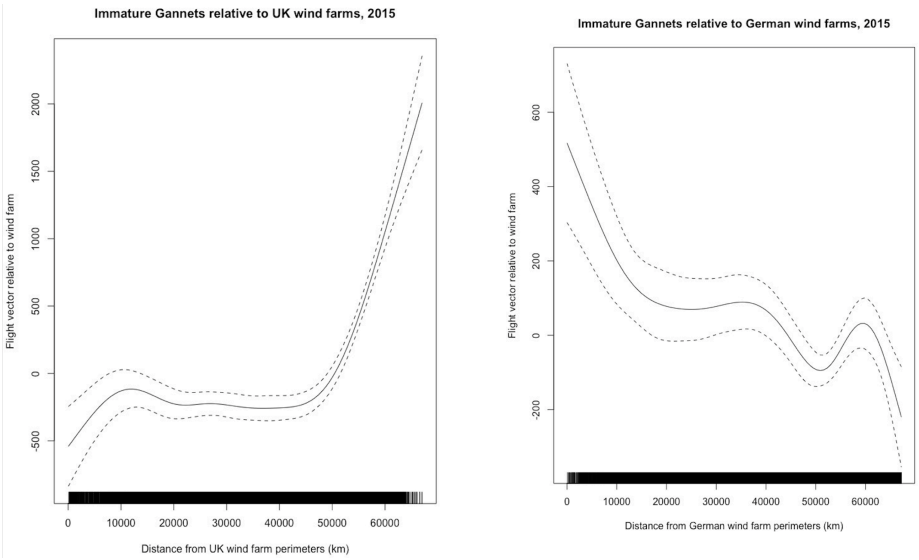

Fig 2 (A): Gam plot showing the negative component of the flight vector of birds up to 10 km distances from UK wind farms, and **B)** positive flight vector components up to 15 km from German wind farms.

Outputs and future plans

The data clearly showed that immature gannets did not fly into operational wind farms, and suggested that at least for UK wind farms there was active avoidance, i.e. deviation from the flight path away from wind farms.

The analysis for this project is on going and we are currently working on a refined model including smaller scale analysis of the flight trajectories to clarify the difference between flight trajectories in relation to German and UK wind farms, and the inclusion of environmental variables such as daily wind speed into the analysis.

How money was spend

The energy Forum small grant provided some of the travel and accommodation costs at the Scottish field site (Bass Rock), as well as the purchase of equipment toward fieldwork and the lab costs to molecularly determine the sex of the study animals at the University of Glasgow. We are grateful for the support received through MASTS.