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Potential impact of offshore wind farm collisions on the Gannet population of the British Isles explored using PVA

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Offshore wind farms around the coasts of the British Isles have the potential to provide significant amounts of energy, and in addition to installed wind farms, there are large areas earmarked for further development, extending into deeper waters farther from the coast. However, these developments have the potential to impact on birds, in particular through collisions with moving turbine blades.

Their large size, flight height and far-ranging habits put Gannets *Morus bassanus* at potentially high risk of collision. The British breeding population of Gannets represents over 70% of the European population and over half of the world population.

A population model was developed for this population to explore the potential impacts that mortality resulting from collisions could have on the population. This work was funded by The Crown Estate through the Strategic Ornithological Support Services (SOSS). The model used a matrix formulation and included environmental and demographic stochasticity. Two forms of the model were developed with adult survival modelled as either density-dependent or density-independent.

In the absence of additional mortality, the baseline model prediction was for an average population growth rate of 1.28% per annum, which is close to the rate of 1.33% observed between 1995 and 2004. The risk of the British Isles Gannet population declining by more than 5% within 25 years was predicted to be very low: 0.5%.

Collision risk modelling (CRM) was conducted using the recently revised methods for offshore wind farms (SOSS-02). All existing and consented offshore wind farms (Rounds I and II) were included in the calculations. Mortality was apportioned amongst Gannet colonies to reflect current understanding of movements and foraging ranges for each breeding colony. Collisions were estimated using an avoidance rate of 98%, in line with current Scottish Nation Heritage (SNH) guidance. This is considered to be a precautionary level and is used for those species for which specific rates have yet to be studied and agreed.

Based on observed Gannet densities at offshore wind farm sites, annual collision mortality of 2603 adult and 1056 immature birds was estimated for existing and consented wind farms around the British Isles.

The population model predicted that, on average, Gannet numbers would continue to increase with additional mortality up to a threshold of approximately 10 000 additional birds killed annually. At this level of additional mortality, 50% of simulations would have negative population growth. A much lower level of risk, with 95% of simulations maintaining positive population growth, was achieved with additional mortality of up to 3500 birds per year.



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Threshold annual mortalities which could be sustained by each UK Special Protection Area (SPA) colony in the study area were estimated using the model. This indicated, for example, that the Bass Rock population would continue to grow on average until additional mortality exceeded 2000 birds per year.