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IMPROVING ESTIMATES OF SEABIRD BODY-MASS SURVIVAL RELATIONSHIPS

Introduction

The Scottish Government has set ambitious targets for electricity generation from renewable sources. Offshore renewables have the potential to make a significant contribution to achieving these goals. The Scottish Government has a duty to ensure that offshore renewable developments (ORDs) are delivered in a sustainable manner, by protecting habitats and species from adverse impacts.

ORDs may negatively affect seabirds from so-called 'sub-lethal effects' such as displacement and barrier effects. These effects do not kill seabirds instantaneously, but affect their behaviour in the short term, with knock on effects on energetic budgets and, in turn, survival or productivity. These potential effects may be particularly important for breeding seabirds that, as central place foragers, are constrained to obtain food within a certain distance from their breeding colony.

A key potential way in which sub-lethal effects of ORDs can affect demography is the relationship between adult body condition at the end of the breeding season and survival probability the following winter, since most mortality occurs outside the breeding season. Specifically, a lower body mass at the end of the breeding season arising from displacement or barrier effects could lead to a higher probability of mortality in the following winter. This may occur because individuals in poorer condition may have lower fat reserves and be less capable of finding sufficient food as seasonal environmental conditions deteriorate.

Accordingly, the objective of this project was to estimate this relationship in four key species in the Forth/Tay region of Scotland: black-legged kittiwake *Rissa tridactlya*, Atlantic puffin *Fratercula arctica*, common guillemot *Uria aalge* and razorbill *Alca torda*, using data from the 1970s to the present from the UK Centre for Ecology & Hydrology's long-term study of seabird populations on the Isle of May National Nature Reserve. For each species, we developed Bayesian statistical models to estimate survival probabilities as a function of body mass at the end of the preceding breeding season. The models

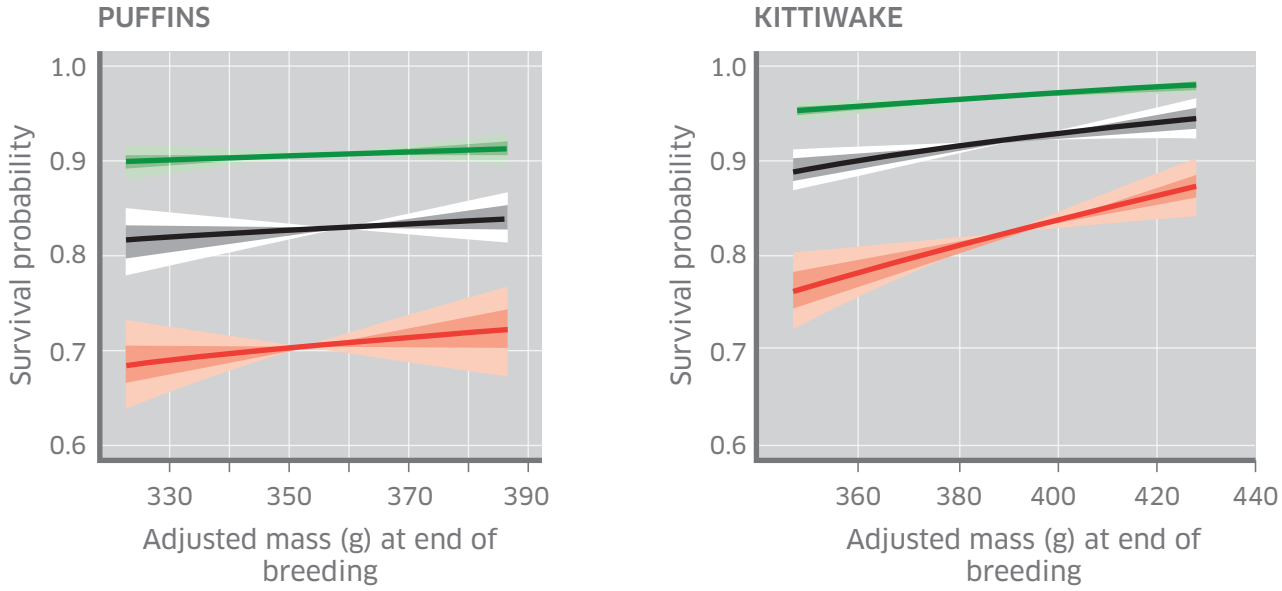

FIGURE 1.
SURVIVAL PROBABILITY OF PUFFINS (LEFT PANEL) AND KITTIWAKES (RIGHT PANEL) IN RELATION TO BODY MASS AT THE END OF THE BREEDING SEASON, ADJUSTED FOR SEX. EACH PLOT GIVES THE RESULTS FOR INDIVIDUALS AT 10 YEARS SINCE FIRST CAPTURE OR SIGHTED AS A BREEDER. THE COLOURS GIVE RESULTS FOR VARYING LEVELS OF YEAR QUALITY, WITH RED BEING THE WORST AND GREEN BEING THE BEST FOR SURVIVAL. THE LINES GIVE THE POSTERIOR MEAN SURVIVAL, WHILE THE DARKER AND LIGHTER SHADED AREAS GIVE 50% AND 90% CREDIBLE INTERVALS RESPECTIVELY.

accounted for sex, an index of age, year and body size. This was the most comprehensive study of its kind in terms of the size of data sets used and the complexity of modelling undertaken.

Results and outcomes

Using the best available UK data and employing advanced methods of statistical analysis, we found evidence in puffins that individuals with higher end-of-breeding season body mass survived better the following winter than those with lower mass (Figure 1). However, the effects were considerably smaller in kittiwakes, guillemots and razorbills (Figure 1).

This process may be an important demographic consequence of sub-lethal effects of ORDs, such as displacement and barrier effects. However, it is important to note that any relationship between body mass and survival arising from natural variation among individuals, as investigated here, may not necessarily translate into a similar relationship between body mass and survival, that has been imposed on birds by a disturbance effect (e.g. displacement from an ORD). Furthermore, sub-lethal effects of ORDs may be apparent on other demographic rates, such as productivity and immature survival. A future research priority is therefore to quantify sub-lethal effects on all key demographic rates so that a comprehensive assessment of population-level impacts can be made.

Further information

The full version of the report can be downloaded here: Scottish Marine and Freshwater Science (SMFS) Vol 11 No 13: Improving estimates of seabird body mass survival relationships **https://doi.org/10.7489/12329-1**