BOTTOM-UP AND TOP-DOWN INFLUENCES ON DEMOGRAPHIC PARAMETERS OF SOUTHERN OCEAN ALBATROSSES

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Evaluating the nature of climate and fisheries interactions using marine top predators and their life-history traits requires robust statistical methods. In collaboration with scientists, Dr. Richard Phillips and Dr. Deborah Pardo at the British Antarctic Survey (BAS) in Cambridge, UK, we analysed the relationship between the demographic parameters of four species of Macquarie Island albatross and oceanographic variables using E-SURGE, a new analytical tool in mark–recapture multi-event modelling (Choquet, et al., 2009) over a three month period.

During this visit I was able to gain access to longline and trawl fisheries effort data from 12 regional fisheries management authorities and dataholders that cover the known Macquarie Island albatross distribution. Furthermore, I was able to acquire historical data on rabbit numbers and vegeatation quality from the Chief Officer of the State of the Antarctic Ecosystem SCAR program, Dr. Aleks Terauds. The condition of the nesting slopes of Black-brow, Grey-headed and Wandering Albatross on Macquarie Island has fluctuated from dense tussock cover to barren eroded slopes with changes in rabbit population densities. With the acquired data we aim to test the long hypothesised theory that the degradation in breeding habitat quality reduces breeding probability and chick survival.

Changing slope condition over the last two decades has also affected the ability of researchers to recapture individuals. With slopes becoming inaccessible and more frequent landslips occurring during periods of intense rabbit grazing detection probability decreased. Detection probability was therefore an important component of this analysis and was determined for all four species (Fig. 1). With constant intense investigator effort from 1994 to 2014, a decline in dection probability was identified for both Black-brow and Grey-headed albatross which nest on the south-west slopes of Macquarie Island. This area has faced the most intensive grazing from rabbits over the last thirty years and as a result the breeding slopes are in the poorest condition of anywhere on the island.

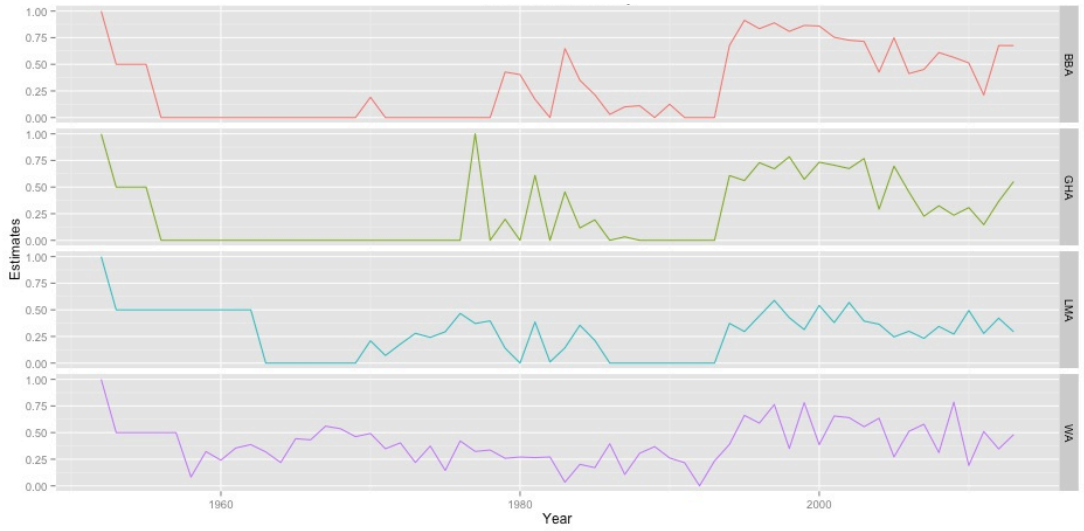

Figure 1. Detection probability estimates for Macquarie Island albatross from 1953 to 2014.

To the best of our knowledge, demographic modelling that includes at-sea drivers of oceanography, large scale climate patterns and human fishing effort, and breeding site drivers such as habitat quality and local weather have not previously been completed on any long term multi-species seabird dataset. This highlights an important gap in our knowledge of how communities respond to environmental change. By quantifying the links between environmental variation and demographic rates across multiple species we have much greater capacity to identify the major determinants of population trends in top predators, and ultimately to assess the possible impact of future changes to the Southern Ocean.

During my visit to Cambridge, I was able to develop demographic models to test the influence of oceanographic variables (SST, SSHa, sea ice extent, wind strength) on the Macquarie Island Wandering Albatross demographic traits of survival, return probability, breeding probability and breeding success. The results of this preliminary analysis showed a significant relationship with warmer winter SST and reduced return probability. This suggests an influence of sea surface temperature on prey availability within the winter foraging area of this species.

Testing oceanographic covariates on demographic parameters requires a sound knowledge of the population at-sea distribution. For the Macquarie Island albatrosses this was determined from a time-spent analysis of historical tracking data (Fig. 2) collected using geolocators and satellite tags. Oceanographic covariates for the demographic models were selected using explanatory models on the tracking data to identify the important ocean features that drive foraging distribution. The opportunity to work with this data at BAS with experts in marine predator foraging ecology solidified and developed these methods.

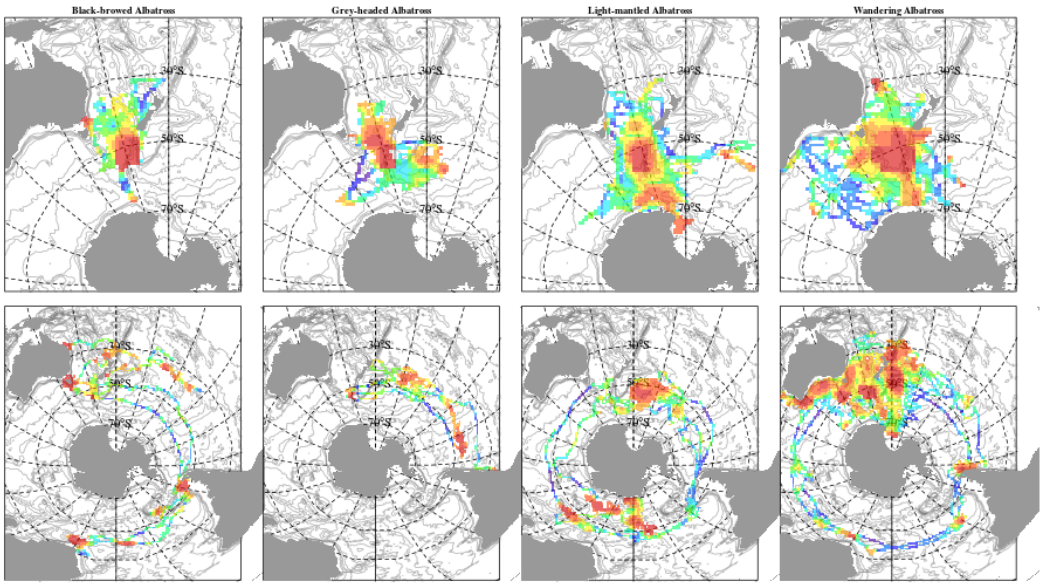

Figure 2. Time-spent analysis of Macquarie Island albatross tracking data (1999-2009, n=41).

This collaboration has opened me up network of researchers, provided access to data and invaluable skills in demographic modelling. During my visit to Cambridge, the demographic modelling of Macquarie Island's albatross population was run in parallel with comparable data from South Georgia, with the overall aim to assess how both of these populations respond to environmental change.

I am currently working on a manuscript to publish looking at the environmental drivers of at-sea foraging of Macquarie Island albatrosses to support the choice of environmental covariates in demographic modelling. I will be returning to Cambridge this year to build on my first research visit and further develop my current demographic models and run new models to predict future population scenarios for these species given changes in climate and fishing effort. I am appreciative to Antarctic Science for giving me the opportunity to make these connections and further develop my skills as an early career scientist.