

Who wins when the competition heats up? Effects of climate change on interactions among three Antarctic penguin species

Supervisors

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Project description

Predicting the effects of climate change upon biodiversity is one of the major challenges facing ecologists today. Most research to date has focused on single species, but recent studies show responses to climate change may vary according to levels of inter-specific competition and that competitive dominance can be conditional upon environmental conditions. Further investigation of these interactions is at the forefront of current research into climate change impacts.

The Western Antarctic Peninsula (WAP) is among the most rapidly warming regions globally. It hosts important populations of three penguin species (Adlie, chinstrap and gentoo) that are mostly segregated latitudinally by environmental preferences. Adlie penguins prefer cold environments with extensive pack ice and ice-free land for nesting; gentoos warmer climates with little or no ice; while chinstraps have intermediate environmental requirements.

Adlie and chinstrap penguin numbers have declined but those of gentoos have increased over the past 35 years. These trends are thought to result from a regional loss of sea ice, which has caused a decline in Antarctic krill availability. This will have contributed to the decline of both Adlie and chinstrap penguins owing to inter- and intra-specific competition for food. Against this backdrop, competitive dominance is conditional on local sea ice extent and duration of the sea ice season: gentoo and chinstrap breeding numbers and success are depressed in years of extensive pack ice whereas those of Adlie penguins are less affected. However, the changes in foraging behaviour that link the contrasting demographic responses of the three species to variability in the sea ice conditions are currently unknown. Moreover, differences in the timing of breeding (allochryony) are thought to be important for creating spatio-temporal niche partitioning among the three penguin species. The timing of seabird breeding (phenology) is closely related to temperature. Therefore, any climate-induced changes in phenology that reduce the level of allochryony may exacerbate inter-specific competition.

The student will: (1) Analyse long-term demographic & diet datasets from Signy Island, South Orkneys, to identify how each of the species responses to environmental drivers differ; (2) model tracking data to elucidate the environment-dependent changes in foraging behaviour that underpin competitive interactions and; (3)

develop individual-based models to link climate-dependent foraging behaviour (e.g. trip duration and meal masses) with demography (e.g. breeding success and chick growth), which will be validated against historic data before making predictions under future environmental scenarios.

References: Forcada & Trathan 2006. *Global Change Biol.* 12: 411-23; Lynnes *et al.* (2002) *Marine Biol.* 141: 1165-74.



Adélie (left), gentoo (middle) and chinstrap penguins (right) co-occur on Signy Island