Biotic and physical forces as determinants of Adélie penguin population location and size

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Abstract

Adélie penguins (*Pygoscelis adeliae*) are among the most thoroughly studied wild animals, which is remarkable considering they are sea-ice obligates, living only in the Antarctic, one of the most remote regions on Earth. Building on several decades of research on the Ross and Beaufort Island metapopulation, I have focused on understanding the underlying mechanisms related to colony size and growth patterns. I have found that life for a penguin at a large colony is extremely competitive, and that the ultimate size of these colonies is determined by the trade-off between the needs of parents and chicks, with penguins at large colonies approaching an energetic limit not reached at smaller colonies. However, some individuals are consistently able to utilize the available resources within these limits more efficiently than others by diving more deeply and recovering more quickly, especially when environmental conditions are less favorable. It is likely that these individuals thereby exhibit increased fitness in terms of their genetic contribution to the population. At smaller colonies, this kind of advantage does not necessarily translate to increased fitness, since there appear to be ample resources for all, or for none, depending more closely on simple yet extreme physical environmental stochasticity. Finally, in the larger context of Adélie penguin life-history throughout the annual cycle, they are confronting large scale changes in their environment that have been occurring for millennia, but which are currently in an unusual state of flux. Ultimately a lack of sufficient daylight overlapping the region of sea ice that is accessible to them during the inter-breeding period may constrain their populations.

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