Use of multi-events framework to explore breeding strategies in a long-breeding-cycle species

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Abstract: According to life-history theory, individuals are expected to maximize their number of offspring while minimizing costs on their survival. In long-lived species, breeding season usually occurs once a year and mature individuals can therefore breed every year. However, several strategies are found among these species, breeding attempts regularly occurring every year or irregularly depending on external condition.
In seabirds, the king penguin *Aptenodytes patagonicus* is a singular species with its unusual breeding cycle. A successful breeding cycle lasts more than a year in this species, and the laying period extends from November to March. Depending on the onset of a reproductive event, the breeding cycle can therefore last from couples of month (breeding failure) to up to 14 months (success to fledge a chick).
We used a 10-year dataset of king penguins breeding in a colony at Possession Island, on Crozet Archipelago. Individuals implanted with a passive transponder tag are identified by underground antennas buried on usual pathways used by the birds to leave or enter their colony, allowing continuous and automatic data collection.
We investigated survival and breeding propensity according to the previous breeding status and schedule of the breeding attempt using several multi-events models. In a first step, we explored involved mechanisms using seasonal (3 phases covering the entire 14-month breeding cycle) and annual models. Breeding initiation date and previous breeding status, for the previous breeding cycle and for each phase of the current breeding cycle, strongly affect survival and breeding performance. In a second step, we investigated potential patterns by including heterogeneity or memory in our models. Our results suggest that both heterogeneity and memory may shape breeding strategies in king penguins.
The multi-event framework is a powerful and useful tool to have new insights on demographic parameters and life-history strategies.