The consequences of being colonial: Allee effects and alternative stable equilibria in seabird metapopulations

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Introduction

Many seabird species are endangered because their breeding habitats are being claimed for human activities. Most seabirds breed in large colonies. This fact signifies that there is an advantage in breeding together. Hence we expect strong Allee effects in seabird colonies inducing alternative stable equilibria, populations below a critical level go extinct, while larger populations grow to equilibrium (Fig. 1).

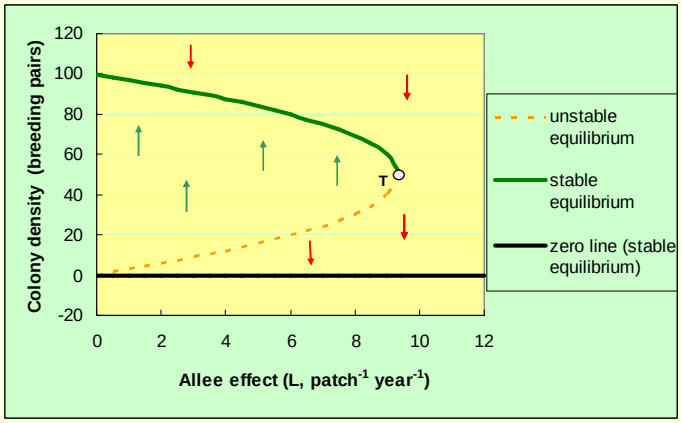

Figure 1. Deterministic alternative equilibria of a Common Tern colony at various levels of the Allee effect (*L*). Arrows indicate under what condition the population is growing (green) or declining (red). Point T indicates a critical threshold. For values of *L* above this threshold the population will not survive.

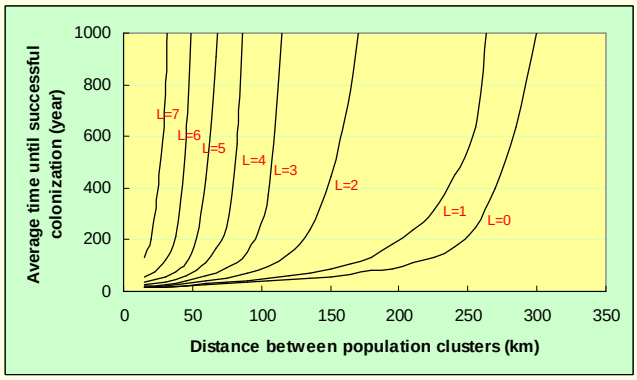

Figure 2. Time until successful colonization of an empty cluster of 16 suitable breeding patches from an other cluster. Note that the Allee effect (*L*) has a large impact on the colonization potential of seabird species of unoccupied breeding patches.

Method

We use a spatially explicit metapopulation model for the common tern (*Sterna hirundo*) to examine the effects of these alternative stable equilibria on a metapopulation scale.

Results and Conclusion

Simulations show that Allee effects may be responsible for a twenty fold decline in the recolonization distances, causing patches and parts of metapopulations to effectively become more isolated (Fig. 2). This results in long recolonization times that, in turn, inhibit or even completely block metapopulation expansion and resilience.

From Schippers et al. 2010 (submitted)
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