Metapopulation Dynamics in the *Cakile maritima-Alternaria brassicicola* Host-Pathogen Interaction

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Keywords: Abundance, Bayesian modelling, Disease ecology, Metapopulation dynamics, Multispecies model, Plant epidemiology, Spatial ecology

Abstract: Spatial structure is an important determinant of epidemiological dynamics in host-pathogen systems, and is therefore central to explaining observed patterns of disease. However, the characteristics of individual populations can counterbalance metapopulation processes. Our goal was to quantify how much of disease dynamics at the population level was explained by individual population characters *vs.* metapopulation structure. A total of 61 populations of *Cakile maritima* - *Alternaria brassicicola* dispatched into three distinct metapopulations along the cost south to Sydney (New South Wales, Australia) were surveyed during 5 years (42 observation times). At each observation time the abundances of healthy and diseased plants were recorded. Local environment was characterized by physical variables (*e.g.* beach size, exposure) and climatic variables (*i.e.* temperature and rainfall). In order to analyse this dataset, we developed a spatially explicit metapopulation model for two species in interaction. Inference was performed within a Bayesian framework. Plant dynamics were mainly local which is consistent with the dispersal mode of *C. maritima*. In contrast the pathogen dynamics were mainly driven by metapopulation processes. Plant exchanges among beaches were higher from small and rocky beaches, but colonization was easier and populations were more perennial in large and sandy beaches. Beach exposure played also an important role with exposed and open-to-sea beaches favoring plant exchanges but with sheltered beaches hosting more perennial plant populations. Monthly cumulative rainfall had a positive effect on the pathogen dynamics and a negative effect on the plant. Increase in temperature favored both the plant and the pathogen. The model we developed allowed us to assess correlations between demographic and environmental parameters while taking into account the spatial structure. This framework could be used to study the metapopulation dynamics and pattern of coexistence among interacting species.