Effects of species interactions on the spatial scales of population synchrony: Competition and predation

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In virtually all major taxa it has been observed that the population fluctuations around the equilibrium at different locations are usually correlated over large geographical scales [1]. This spatial synchronization of the species population dynamics is an extremely important characteristic, since it has been found that the degree of population synchrony tends to be correlated with the regional extinction risk of the species [2]. It has been found that the population synchrony can be affected by inter–species interactions (e.g., [3]). Here, we employ two-species models to analyze how interspecific interactions affects the characteristic spatial scales of population synchrony.

First, we employ spatial two-competitor models to analyze the effects of competition [4]. In such models, we assume that species are able to disperse between locations of the habitat. When the environmental fluctuations affecting the competitors are uncorrelated, competition generally increases the spatial scales of population synchrony of both competitors (Fig. 1). When the environmental fluctuations affecting the competitors are correlated, competition generally increases the spatial scale of population synchrony of at least one, but often both species.

Second, we study the effects of predation in the spatial scales of population synchrony, employing predator-prey models. On the one hand, the spatial scale of population synchrony of the predator is greater than (or, at least, similar to) the spatial scale of the prey (Fig. 2). On the other hand, the presence of the predator increases the spatial scale of synchrony of the prey. These results point that in real ecosystem the spatial scaling of population synchrony is expected to increase with the trophic level.

Finally, harvesting can modify the degree of population synchrony of the harvested species [5], and also of the other interacting unharvested cohabitants [4]. Hence, since a higher synchronization on the species dynamics would increases the regional extinction risk, our results are relevant for the development of improved sustainable harvesting strategies.

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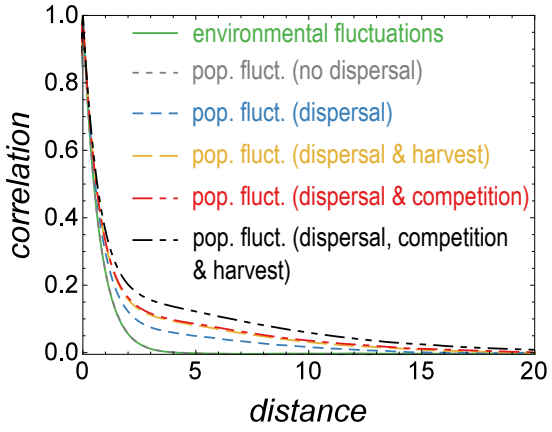

Fig. 1. Autocorrelation functions for environmental (green solid line) and population fluctuations (dashed lines): for no-harvested and no-dispersing species (grey); for dispersing species (blue); for harvested dispersing species (yellow); for dispersing species in the presence of a competitor (red); and for harvested dispersing species in the presnce of a competitor (black).

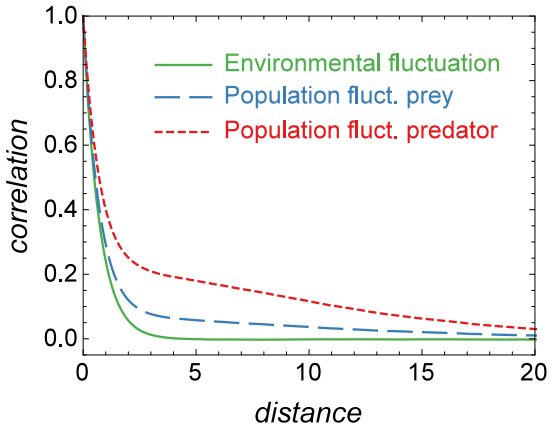

Fig. 2. Autocorrelation functions for environmental and population fluctuations in a predator-prey model. In green solid line, autocorrelation function of the environmental conditions affecting the prey. In blue dashed line, autocorrelaton function of the population fluctuations of the prey. In red dashed line, autocorrelation function of the population fluctuations of the predator.