

Emergence of spatially structured populations by area-concentrated search

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Abstract

The idea that populations are spatially structured has become a very powerful concept in ecology, raising interest in many research areas. However, despite dispersal being a core component of the concept, it typically does not consider the movement behavior underlying any dispersal. Using individual-based simulations in continuous space, we investigate the emergence of a spatially structured population in landscapes with spatially heterogeneous resource distribution and with organisms following simple area-concentrated search (ACS); individuals do not, however, perceive or respond to any habitat attributes per se but only to their foraging success. We investigated effects of different resource clustering pattern in landscapes (single large cluster vs. many small clusters) and different resource density on spatially structure of populations and movement between resource clusters of individuals. As results, we found that foraging success increased with increasing resource density and decreasing number of resource clusters. In a wide parameter space, the system exhibited attributes of a spatially structured populations with individuals concentrated in areas of high resource density, searching within areas of resources, and ‘dispersing’ in straight line between resource patches. ‘Emigration’ was more likely from patches that were small or of low quality (low resource density), but we observed an interaction effect between these two parameters. With the ACS implemented, individuals tended to move deeper into a resource cluster in scenarios with moderate resource density than in scenarios with high resource density. ‘Looping’ from patches was more likely if patches were large and of high quality. Our simulations demonstrate that spatial structure in populations may emerge if critical resources are heterogeneously distributed and if individuals follow simple movement rules (such as ACS). Neither the perception of habitat nor an explicit decision to emigrate from a patch on the side of acting individuals are necessary for the emergence of spatial structure.

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