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The effect of landscape heterogeneity on spread and persistence in integrodifference equations

The spread of non-indigenous species and diseases poses a major risk to ecosystems and human health worldwide. The key challenges to management and control of such invasions are to understand the conditions of spread and the different factors influencing the speed of spread. Of particular interest is the effect of landscape heterogeneity on the spread of organisms. We formulate a discrete-time model for growth and dispersal, where both of these processes vary in space. We then present approximation formulas for the spread rate in such a heterogeneous landscape and demonstrate their validity by comparison with numerical simulation. We also give rules of thumb for the conditions under which a species is able to spread in a heterogeneous landscape. We separately consider the two cases with and without Allee effect in the population growth function. Our results provide simple recipes for calculation of spread rates in complex landscapes together with their limits of validity.