From individual interactions to population dynamics: individual resource partitioning simulation exposes the causes of nonlinear intra-specific competition

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Abstract

Intra-specific competition defines the relationship between population density and the performance of individual organisms (*R*-function). Observation of this relationship in nature shows it to be frequently nonlinear, and it has been argued, on intuitive grounds, that this nonlinearity is due to the type of competition (scramble or contest) being expressed. Here, we use an individual-based simulation model to investigate the effects of three resource partitioning schemes, representing different types of competition, on the form of the *R*-function. Results indicate that all resource partitioning schemes can give rise to concave or convex functions depending on the balance between maximum individual birth rate, maintenance cost, and demand for resources. Given high growth rates and maintenance costs, contest competitors tend to exhibit less concavity than scramblers. Therefore, population stability can be strongly affected by the strategy of resource partitioning. Life histories and environmental conditions that encourage the homogeneous distribution of resources among individuals lead to complex and unstable dynamics. Stable dynamics is fostered by heterogeneous resource distribution, which could result from such things as social hierarchies, individual and environmental variability, and large, indivisible resource packets.