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Symmetric competition as a general model for single-species adaptive dynamics

Michael Doebeli, Iaroslav Ispolatov

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Adaptive dynamics is a widely used framework for modeling long-term evolution of continuous phenotypes. It is based on invasion fitness functions, which determine selection gradients and the canonical equation of adaptive dynamics. Even though the derivation of the adaptive dynamics from a given invasion fitness function is general and model-independent, the derivation of the invasion fitness function itself requires specification of an underlying ecological model. Therefore, evolutionary insights gained from adaptive dynamics models are generally model-dependent. Logistic models for symmetric, frequency-dependent competition are widely used in this context. Such models have the property that the selection gradients derived from them are gradients of scalar functions, which reflects a certain gradient property of the corresponding invasion fitness function. We show that any adaptive dynamics model that is based on an invasion fitness functions with this gradient property can be transformed into a generalized symmetric competition model. This provides a precise delineation of the generality of results derived from competition models. Roughly speaking, to understand the adaptive dynamics of the class of models satisfying a certain gradient condition, one only needs a complete understanding of the adaptive dynamics of symmetric, frequency-dependent competition. We show how this result can be applied to number of basic issues in evolutionary theory.

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