Stochasticity and variability in the dynamics and genetics of populations

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Summary (EN)

Population dynamics is a temporal description of the number of individuals in a population. Many models exist that quantify the process of population growth. In this thesis, the subject is approached with the goal of bringing together several of these models into a simple general one. Although carrying capacity is often invoked as a mechanism for density dependence (the regulation of growth rates according to the population's size), the general version does not resort to this mechanism. For certain conditions, however, carrying capacities emerge. Other conditions lead to populations that explode in size. However, certain kind of random perturbations can drive the dynamics of the population in a way that they mimic density dependence. This provides alternative testable explanations for the demographic diversity in natural populations.

The evolution of quantitative traits depends on the frequencies of many alleles involved, which can rarely be measured. An approximation is developed borrowing methods from statistical mechanics to predict the dynamics of observable quantities, such as the mean and variance of a trait. Populations are shown to evolve to an entropy maximum, subject to constraints on the expected values of observable quantities. The method gives the equilibrium state exactly and is accurate even when there are abrupt changes in directional or stabilizing selection.

Applications to selection for multiple characters are also studied, and data of evolving traits of the common frog *Rana temporaria* is analyzed in order to gain insights on the limitations of the method. We also initiate a discussion on the interpretation of entropy in evolution as information created by natural selection.