A diffusion-based approach to stochastic individual growth and energy budget, with consequences to life-history optimization

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I present an analytical framework, based on diffusion processes, for studying optimal life history under starvation risk and exogenous hazards (e.g., the energy-predation tradeoff). The total body mass of an individual is divided into reversibly- and irreversibly-growing components, e.g., reserves and structure. The dynamics of reserves is described by one-dimensional time-homogeneous diffusion, where the mean growth rate and the diffusion coefficient are both size-dependent (i.e., functions of two variables: the mass of reserves and the mass of structure). Exogenous mortality rate is also size-dependent. I provide expressions for optimal life history when the individual must grow from a given initial body size to some target size, at which reproduction occurs, or some other terminal reward is obtained. Optimal life history includes both reversible state-dependent transitions (e.g., behavioral shifts), as well as irreversible ones (e.g., structural growth). I compare my model with previous work on risk-sensitive foraging and the energy-predation tradeoff, and outline applications to specific evolutionary questions.