From Individuals to Populations: Incorporating Dynamic Energy Budget (DEB) Models into Matrix Population Models.

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Connecting individual processes of feeding, respiration, growth, and reproduction to population dynamics is a major task of theory in biology (Nisbet et al 2000). To approach this problem, we start by describing the growth of an individual using dynamic energy budget (DEB) theory (Kooijman 2000). Using the DEB model, we show how to calculate the vital rates of a population represented by a simple matrix population model. We do this by making a correspondence between the state variables of the DEB model (structure and reserves) and the i-states of the matrix model (size classes or physiological condition stages). The growth dynamics generated by the DEB model then determines the transitions among i-states in the matrix model.

The result is a demographic model in which individual process appear explicitly, and which is calculated from a mechanistic description of those physiological processes. It provides a step towards matrix population models that can account for food availability and the energetics of growth. Using these models in environments where food supply fluctuates requires special care in matching the state variables of the DEB model and the matrix population model.

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