

Dynamic Energy Budget Theory with Applications to Ecology and Ecotoxicology

Lectures by Roger Nisbet – winter 2013

Dynamic energy budget (DEB) theory¹ is a powerful theoretical framework for relating suborganismal (biochemical, genetic, physiological) processes to organismal performance and, thereby, to populations and ecosystems. DEB theory is also a powerful tool for ecotoxicology, and has been recently used in models describing the impact of nanomaterials in the environment. Although mastering the *details* of the theory requires considerable time investment, the *principles* of mass and energy budgeting are straightforward and are widely appreciated by biologists.

DEB models describe the rates at which an organism assimilates energy and elemental matter from food and uses them for maintenance, growth, development, and reproduction. These physiological rates depend on the state of the organism (*e.g.*, age, size, maturity) and its environment (*e.g.*, food density, temperature, contaminants). Changes in physiological rates and fluxes of elemental matter impact population and ecosystem dynamics.

The primary objective of these lectures is to introduce DEB principles in a maximally simple context. The theory will be illustrated with examples involving toxicants in whales, the population dynamics of waterfleas, nanotoxicology in bacteria – and more. Students wanting to pursue the topic in more depth will be prepared by the lectures to read S.A.L.M. Kooijman's book and/or to take a longer Internet course to be offered by Kooijman that starts in February 2013 (see <http://www.bio.vu.nl/thb/deb/course/>).

Course Structure

When: There will be 4 90-minute sessions: Tuesdays from 9–10:30 AM Pacific Daylight Time, starting on 31 January 2013. Each session will have a 10-minute break after approximately 40 minutes.

Where: For UCSB participants, the lectures will be in room 4307 in the Life Sciences Building.

Internet: The lectures will be webcast and recorded using ELLUMINATE, and there will be a website with course materials. For access to these materials, please e-mail me (Nisbet@lifesci.ucsb.edu) expressing your interest in the course.

Discussion: ELLUMINATE has a chat box that will permit non-UCSB participants to place short questions during lectures. There are also possibilities for remote participants to join me for skype discussions.

Course outline

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| 31 Jan. | Overview: dynamic energy budgets from molecules to ecosystems. Dynamic Biomass Budgets |
| 7 Feb. | Limitations of biomass-based models. Motivation for DEB models. Kooijman's DEB model – core concepts and equations |
| 14 February | Kooijman's DEB model – further details, including modeling fluxes of elemental matter |
| 21 February | Applications of DEB theory to ecotoxicology and nanotoxicology |

¹ S.A.L.M. Kooijman. *Dynamic Energy Budgets for Metabolic Organization*. Cambridge University Press 2010.