DEB theory for metabolic organization

S. A. L. M. Kooijman[1] .

Metabolic organization of individual organisms follows simple quantitative rules that can be understood from basic physical chemical principles. These rules quantify how individuals acquire and utilize energy and nutrients, while cycling through their life stages. Dynamic Energy Budget (DEB) theory identifies the most basic rules, and links them together in a consistent framework.

The theory provides constraints on the metabolic organization of subcellular processes. Together with rules for interaction between individuals, it also provides a basis to understand population and ecosystem dynamics. The theory, therefore, links various levels of biological organization. It applies to all species of organisms and offers explanations for intra- and inter-specific body-size scaling relationships of natural history parameters (respiration, reproduction, juvenile period, life span, etc), which are difficult to understand otherwise. A considerable number of popular empirical models turn out to be special cases of the DEB model, or very close numerical approximations.

With the establishment of the core of the theory, a huge terra incognito became visible of implications of the theory for molecular biology and population and ecosystem dynamics, and of connections with insights within these specializations. The session will expose some of the exiting developments exploring consistent extensions of the theory. We will have the following contributions:

Tania Sousa will make thermodynamic assumptions explicit on which DEB theory is based

[1]Dept Theoretical Biology, Institute of Ecological Science, Vrije Universiteit, Amsterdam (e-mail: bas@bio.vu.nl).

Dina Lika will evaluate the comparative performance of indeterminate and determinate growers in different environment scenarios, within a DEB context

Roger Nisbet will compare the explanations of the DEB theory for body scaling relationships with recent ideas on transport constraints in metabolic networks

Lothar Kuijper will present results of a study on effects of stoichiometric constraints on primary and secondary plankton production, where the chemical composition of biomass can vary according to the DEB rules

Leonid Goloubiatnikov will discuss biological modules in large-scale physical transport models to study primary production

Tineke Troost cross fertilized the DEB theory with Adaptive Dynamics theory for evolutionary speciation, and will present results on the spontaneous evolution of a single-species ecosystem with mixotrophs into a more-species ecosystem with auto- and heterotrophs.