Dynamic Energy Budget theory for metabolic organization

S.A.L.M. Kooijman

Dept Theoretical Biology, Vrije Universiteit, Amsterdam

bas@bio.vu.nl; http://www.bio.vu.nl/thb/

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Metabolic organization of individual organisms is basic to life. It seems to follow 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 DEB theory applies to all species of organisms (unicellular as well as multicellular ones) and links various levels of biological organization; this multi-level approach is considered to be essential for the understanding of life processes. Many popular empirical models turn out to be special cases of the standard DEB model, or very close numerical approximations. The lecture will discuss some key-issues:

- The evolution of various forms of homeostasis, which has close links with the process of symbiogenesis (the stepwise integration of mitochondria and chloroplasts in the evolution of eukaryotic cells), and of other forms of symbioses that are based on syntrophy. Homeostasis comes which stoichiometic contraints on growth and reproduction.

- The dynamic interactions between surfaces and volumes at the various levels of organisation (cellular membranes, individuals, ecosystems, system earth). These interactions determine growth potentials, and are basic to explanations for intra- and inter-specific body-size scaling relationships of natural history parameters (rates of respiration, growth, reproduction, juvenile period, life span, etc).

- The turnover of cellular components. Substrates are converted into one or more types of reserves, and reserves are converted into (one or more types of) structural mass, after "payment" of somatic maintenance costs. The latter costs concern, a.o., the turnover of structural mass, while the reserve has an implied turnover at a rate that is inversely proportional to the body length in isomorphs. The combination of these different forms of turnover can explain the dynamics of the dual functions of many cellular components as source of energy and of building blocks.

A general introductory paper to the DEB theory can be found at
http://www.bio.vu.nl/thb/research/bib/Kooy2001.html