Tarek Refaï 2013

Dynamic Energy Budget theory

Introduction

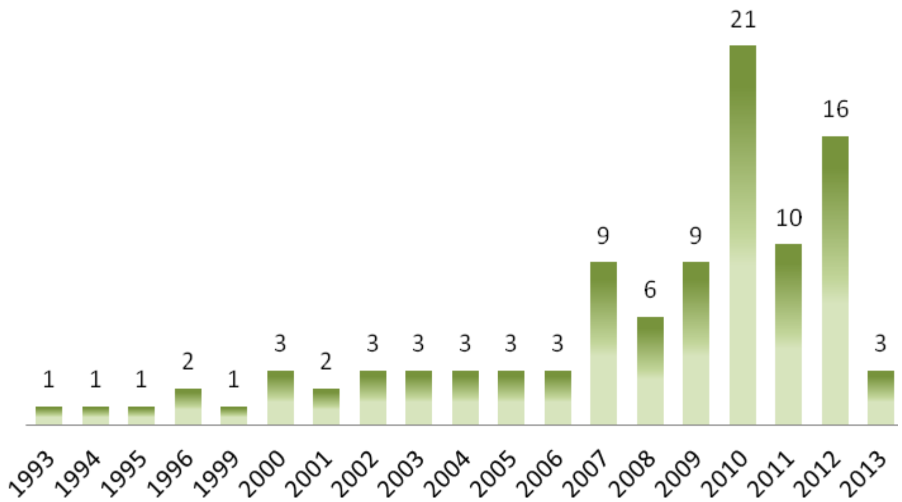
Metabolism is a complex process that allows organisms to acquire energy and materials from their environment and to use them for vital functions. In this context, the Dynamic Energy Budget (DEB) theory was developed to provide quantitative rules explaining metabolism of individual including maintenance, growth, and reproduction.

Dynamic Energy Budget

The DEB theory assumes that food assimilation and maintenance rates are dependent on surface area or body volume. It explains therefore the distribution of energy flows over the different processes that take place in the organism. For the more DEB theory deals with starvation, respiration…etc.

In my essay I chose to describe a literature search that I conducted on Embase[i] about DEB, as the theory is extensively described in the manual and essays, then to compare it with similar theories.

My search strategy is "Dynamic Energy Budget". I identified 101 references. The distribution of references by year is described in the graphic below:



The number of published articles jumped from 2 to 12 (average value) between the periods of [1993; 2006] and [2007; 2012].

The majority of articles were published respectively in Philosophical Transactions of the Royal Society B: Biological Sciences journal (n=14), Ecotoxicology journal (n=9) and in the Journal of Theoretical Biology (n=8).

The model was likely applied to the following animals and species (mentioned in papers key words): Daphnia Magna (cited over 14 times), Acrobeloides Nanus, Alga, Annelid, Anthozoa, Anura, Bacterial toxin, Bivalve, Bryozoa, Caenorhabditis elegans, Chironomus, Chironomus riparius, cockle, coral, coral reef, crab, Crinia georgiana, Crustacea, Cyanobacterium, Diatom, Enterobacter aerogenes, Flatfish, Fungus, Gastropod, Geocrinia vitellina, Haptophyta, Lactobacillus, Lactococcus lactis, Larva, larval stage, Lettuce, lizard, Lymnaea, Lymnaea stagnalis, Metschnikowia, Microalga, Microcystis aeruginosa, Mollusc, Mouse, Mussel, Mytilus, mytilus californianus, Mytilus galloprovincialis, Nematode, Oyster, Phytoplankton, Pseudomonas aeruginosa, Pseudophryne bibronii, Salmon, Salmonid, Seashore, Snail, Thunnus orientalis, Tilapia, Tuna, Valvata piscinalis, Worm, Yeast, Zebra fish and Zooplankton.

Comparison of DEB theory with other biological theories

I found that there are currently only two main metabolic theories DEB and West, Brown and Enquist's 'Metabolic Theory of Ecology' (WBE)[Louwrens[ii]].

WBE theory states that metabolic rate is limited by the transport of materials to all parts of an organism through fractally branching, linear networks. Energy distribution systems incorporate a branching network in which the sizes of the tubes decrease predictably. Under this model, metabolic rate therefore scales with body mass to the 3/4 power.

When searching articles in Embase for WBE (the same as for DEB) we find only 15 references.

Few data is available, the comparison between the two theories cannot be established in term of outcomes. Only structural comparisons are possible (assumptions, parameters and equations).

DEB theory is much more referenced as a method for modeling biological systems.

Conclusion

Actually, there is no consensus as to which theory is the most correct, more evidences available in literature support DEB theory versus WBE theory. More empirical studies comparing DEB to WBE should be done (only one where found: Kearney 2012[iii]) to provide empirical data.

To conclude, I thought that it is impossible to create a model for biological systems. After learning the DEB theory, I understood how this system may works and I believe that one day he will be a useful tool for humanity.

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[i] Online information source of published literature designed to support information managers;
[ii] Kimberley Louwrens. An evaluation of two controversial metabolic theories of ecology.2011.
[iii]Kearney M.R.Testing metabolic theories. 2012.