Dynamic Energy Budget (DEB) theory summary notes

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List of parameters and variables

Parameter	Definition
E	energy reserve
$[E]$	energy reserve per volume
e	scaled energy reserve

Overview

Summarised notes from DEB workshops, telecourses, lectures, and discussions.

Reserve mobilisation

Conductance determines mobilisation rate from reserve to structure
The larger the SA of reserve, the more mobilisation is possible and thus faster maintenance and growth because due to more SA - SA scales slower than volume-specific flows

Reserve dynamics f = 1 (max feeding rate)

$$\frac{dE}{dt} = \frac{f\{\dot{p}_{AM}\}}{L} - \frac{\dot{v}[E]}{L}$$

$[E_M]$ = max reserve. Reserve doesn't change.

$$= \frac{\{\dot{p}_{AM}\}}{L} - \frac{\dot{v}[E_M]}{L}$$

$$\therefore [E_M] = \frac{\{\dot{p}_{AM}\}}{\dot{v}}$$

Scaled reserve

$$e = \frac{[E]}{[E_M]}$$

$$\frac{de}{dt} = \frac{[E]/[E_M]}{dt} = \frac{f\dot{v}}{L} - \frac{e\dot{v}}{L}$$

$$= \frac{\dot{v}(fe)}{L}$$

Under steady state, reserve doesn't change

$$0 = \frac{\dot{v}(fe)}{L} \quad \text{or} \quad f = e$$

Length

Getting maximum length L_m

$$\frac{dV}{dt} = V\dot{r}$$

Can rewrite r using scaled reserve e

$$\dot{r} = \dot{v}\frac{\frac{e}{L} - (1 + \frac{L_T}{L})/L_m}{e + g}$$

Getting L_m

$$\frac{dV}{dt} = V\dot{r}$$

To find $V_m = Lm^3$, set $f = 1$ and $\frac{dV}{dt} = 0$, then solve for $V = V_m$

$$L_m = \frac{\kappa\{\dot{p}_{Am}\}}{[\dot{p}_M]}$$

Weak homeostasis

Structural isomorphy implies weak homeostasis
Weak homeostasis depends on ratio of reserve to structure $\frac{d[E]}{dt}$