Modelling zooplankton respiration from ETS activity

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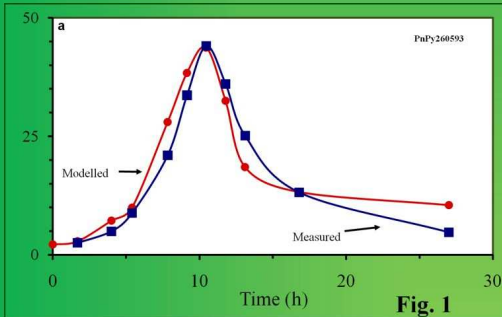

Fig. 1

Calculating respiration from an enzyme kinetic model is feasible in Bacteria (Fig. 1). For zooplankton, should we use this model or the Metabolic Theory of Ecology (MTE) model? The MTE would predict respiration (R) from biomass (M) by the following equation, $R = i M^{0.75}$, where i is a stoichiometric factor. The result would be the red line in Fig 2. The blue line is the measured R.
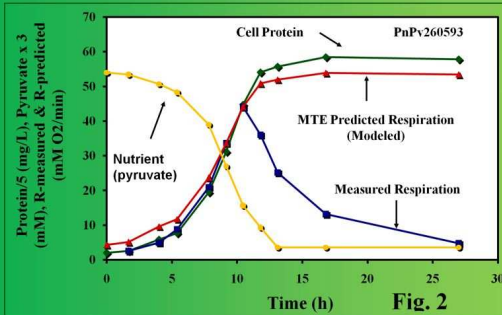

Fig. 2

The MTE cannot predict respiration during nutrient limitation (Fig. 2)! The Enzyme Kinetic Model (EKM) can (Fig. 1). The parallelism in Fig. 2 between decreases in respiration and pyruvate (food source) is caused by the drop in ETS substrates (Fig. 3). That's our hypothesis! Consequently, we argue that a respiration model should incorporate a Michaelis-Menten expression (Fig.4).
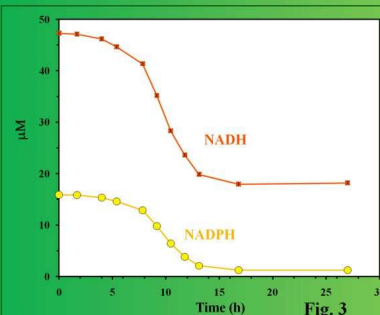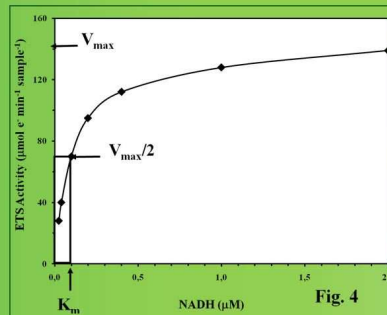

Fig. 3

Fig. 4

$R_0 = SV_{max_0}/(K_m + S)$ is our model. V_{max_0} is potential respiration (ETS).

We use ETS rather than $M^{0.75}$ because ETS is the real cause of respiration. Biomass just packages the ETS.

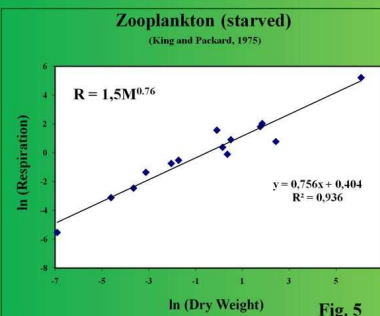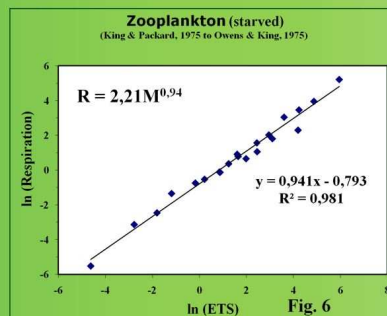The relationship between R and ETS is better and more direct than between R and M (Figs 5, & 6) .

Zooplankton (starved)
(King and Packard, 1975)

$R = 1,5M^{0.76}$

$y = 0,756x + 0,404$
$R^2 = 0,936$

Fig. 5

Zooplankton (starved)
(King & Packard, 1975 to Owens & King, 1975)

$R = 2,21M^{0.94}$

$y = 0,941x - 0,793$
$R^2 = 0,981$

Fig. 6

In Fig. 7 this model transforms ETS = f (Time) into R = f (Time).

In all the time-course plots,the organisms shift their physiological state from a well-fed condition to a starved condition (Figs. 1, 2, 3 & 7).
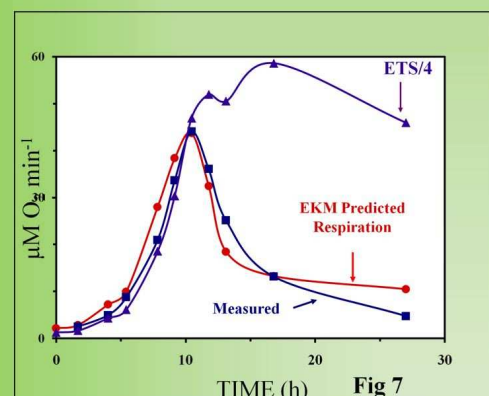

Fig 7