Starvation's role in plankton metabolism

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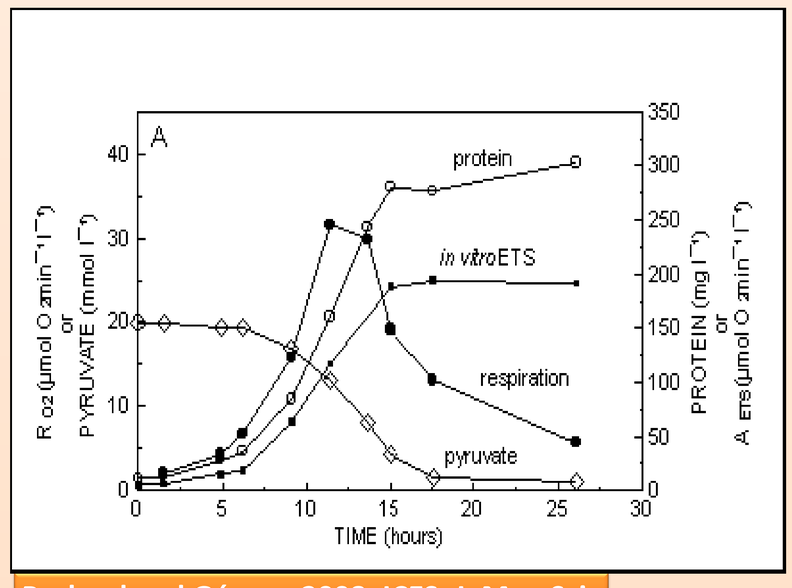
ABSTRACT

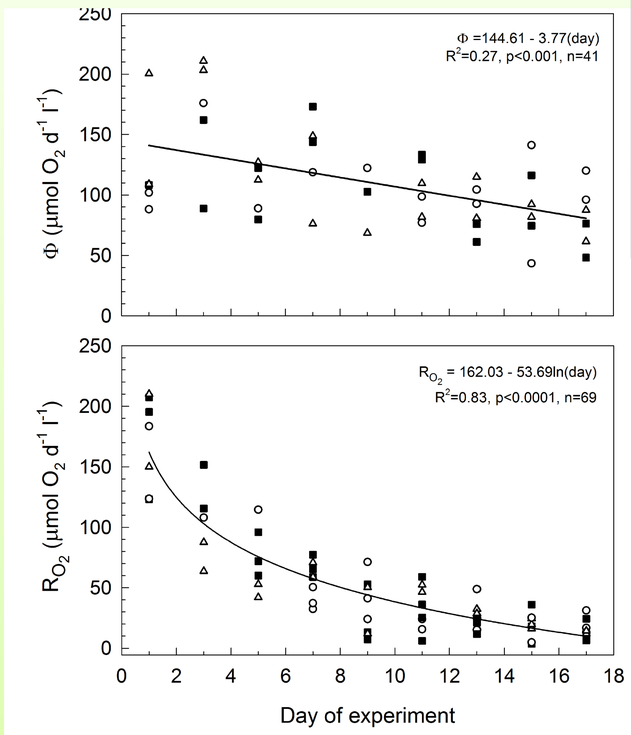
Starvation at all scales of plankton from archaea to medusae is the prevailing condition in marine ecosystems. Such nutrient-limitation will shift the physiological state in these organisms with accompanying changes in their physiology and biochemistry. Here, we review our laboratory's progress in documenting these changes associated with starvation in a range of marine organisms. Specifically, we focused on respiration, ammonium excretion, CO_2 production, RQ, respiratory ETS activity, isocitrate dehydrogenase and glutamate dehydrogenase activity in the mysid, *Leptomysis lingvura*, a dinoflagellate, *Oxyrrhis marina* and two bacteria, *Vibrio natriegens*, and *Pseudomonas nautica*. In all cases, with starvation, the respiration and the ammonium excretion rates decreased, the RQ increased, respiratory ETS activity, IDH activity and glutamate dehydrogenase activity remained relatively constant, but the ratios of the enzyme activities to their associated physiological rates, increased. Incorporation of these new findings should improve the predictions of ecosystem models.

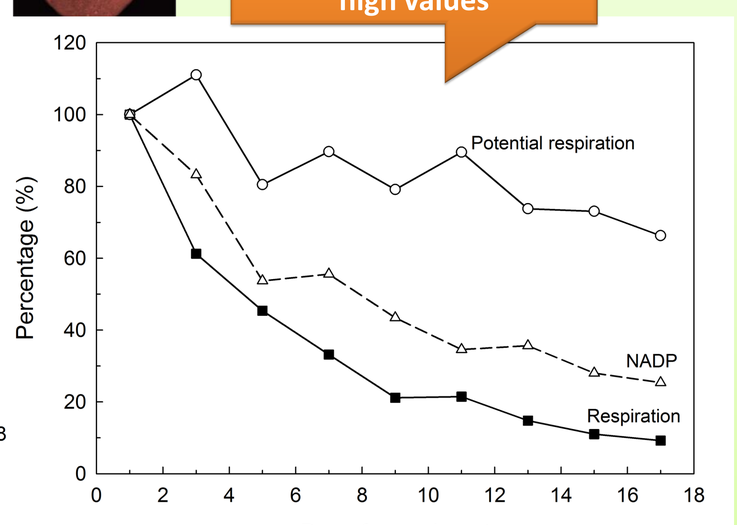


Packard and Gómez, 2008. ICES. J. Mar. Sci.

Oxyrrhis marina

NADPt decreases in the same way that respiration does , but potential respiration continues with high values

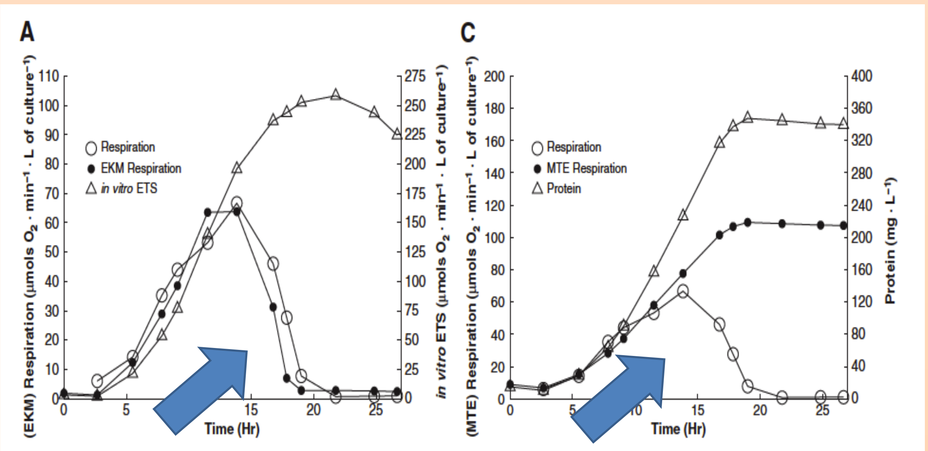




Osma et al., 2016. Protist

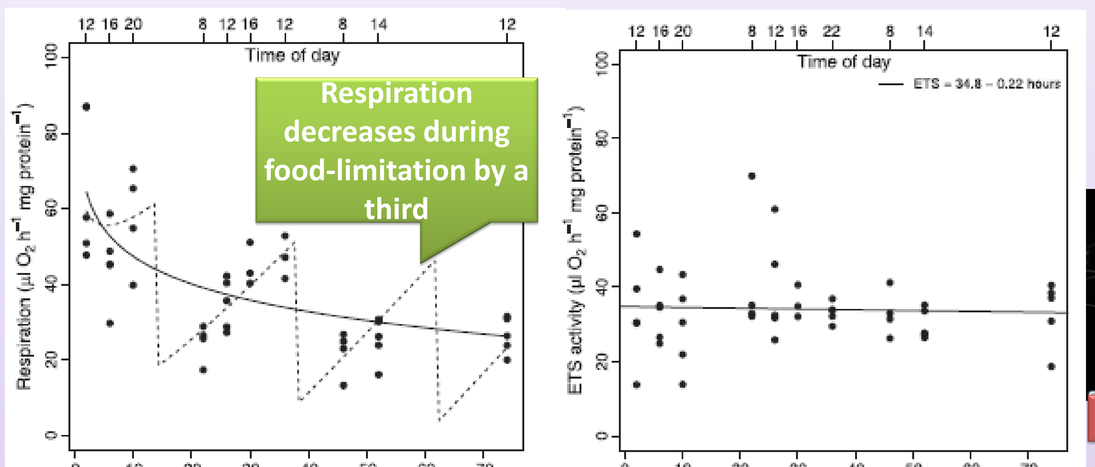
EKM predicts respiration under starvation conditions and the **MTE** does not

Vibrio natriegens
Pseudomonas nautica



Aguiar-González et al., 2012. JEMBE

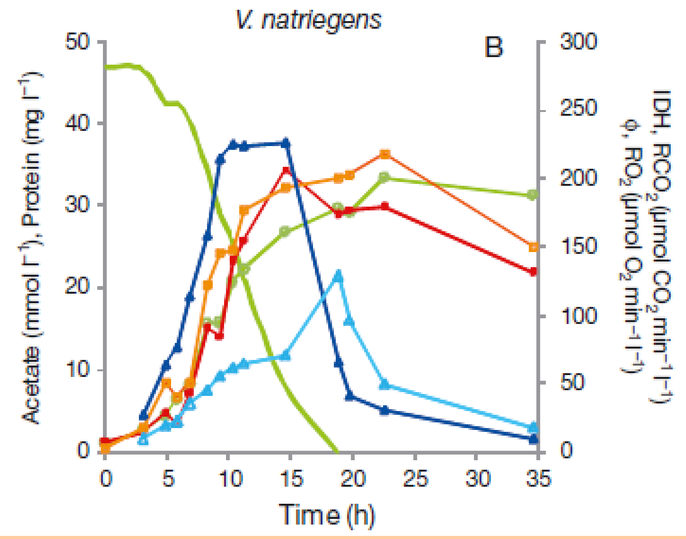
ETS activity is constant during food-limitation



Respiration decreases during food-limitation by a third

Leptomysis lingvura

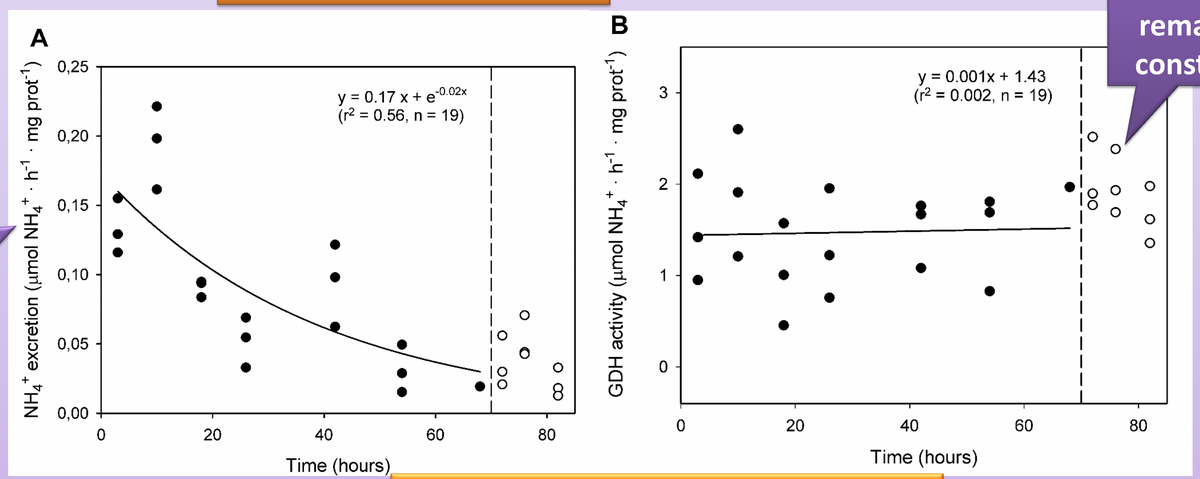
Herrera et al., 2011. JEMBE



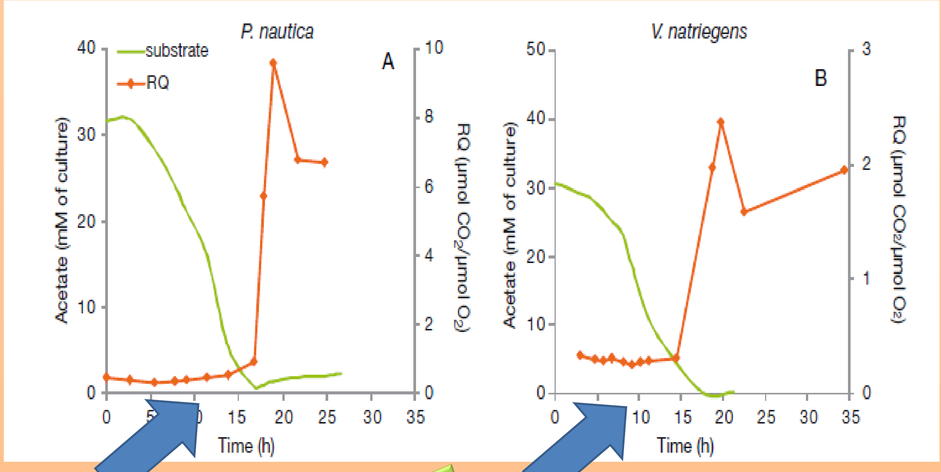
Romero-Kutzner et al., 2015. MEPS

GDH activity remains constant

Starvation causes $NH4^+$ excretion to decrease



Fernández-Urruzola et al., 2011. JEMBE



Under starvation the RQ can increase dramatically almost 10 times!

CONCLUSIONS:

1.- **Starvation** decreases respiration and ammonia excretion, but not their enzyme-based potentials.

2.- Metabolic Theory of Ecology can not predict respiration under conditions of **starvation**.

3.- **Starvation** decreases the energy currency molecules needed for carbon synthesis.

4.- **Starvation** can cause RQ to increase 10-fold.

ACKNOWLEDGMENTS

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