THE RESPIRATORY ETS IS THE CASUAL BASIS FOR THE ALLOMETRIC RELATIONSHIP IN KLEIBER'S LAW

M. Gómez, I. Fernández-Urruzola, A. Herrera, F. Maldonado-Uribe, I. Martínez, N. Osma and T. Packard

Biological Oceanography Laboratory, Department of Biology. University of Las Palmas de Gran Canaria.

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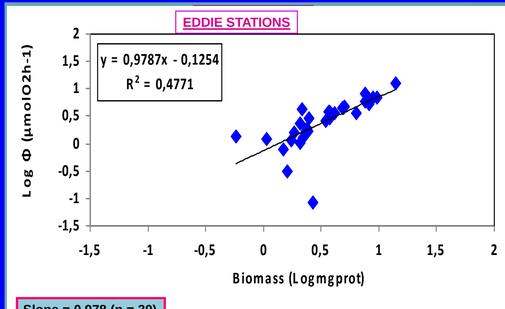
Kleiber's Law, relating an organism's biomass (M) with its respiration rate (R), follows the allometric equation, $R=aM^{0.75}$. It holds over 20 orders of magnitude for R and has gained increasing importance in recent years, because it serves as the basis for the Metabolic Theory of Ecology. (Brown et al, 2004). Why does the M-R relationship in Kleiber's Law work? We argue that because Φ is the respiratory V_{max}, because, through stoichiometry, potential respiration (Φ) is equivalent to the activity of the respiratory electron transport system (ETS), and because the ETS is constitutive, both ETS and Φ would track biomass better than R. To investigate this, zooplankton samples from the Canary Islands Transition Zone and from cultures of artemia (*Artemia sp.*), mysids (*Leptomysis lingvura*) and protozoa (*Oxyrrhis marina*) were analysed for agreement with Kleiber's Law.

Zooplankton samples

Leptomysis lingvura

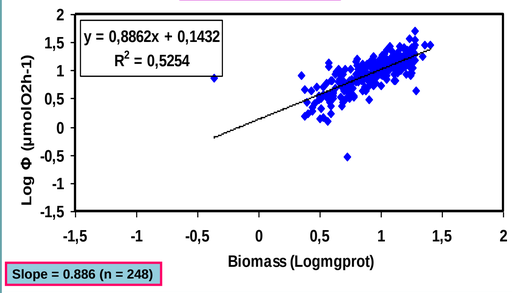
FIELD EXPERIMENTS

EDDIE STATIONS



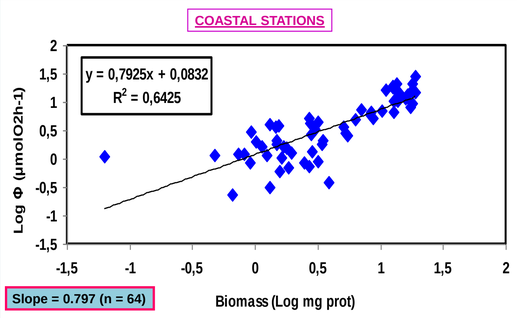
Slope = 0.978 (n = 30)

UPWELLING STATIONS



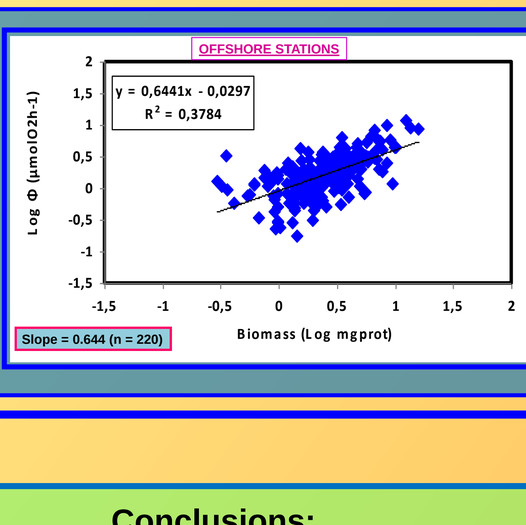
Slope = 0.886 (n = 248)

COASTAL STATIONS



Slope = 0.797 (n = 64)

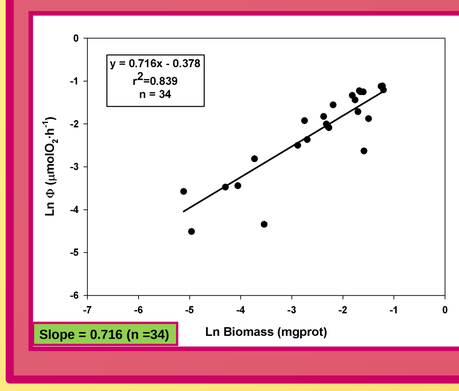
OFFSHORE STATIONS



Slope = 0.644 (n = 220)

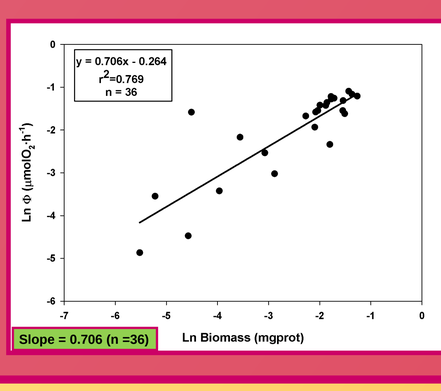
LABORATORY EXPERIMENTS

MYSIDS FED 300 ARTEMIA NAUPLII



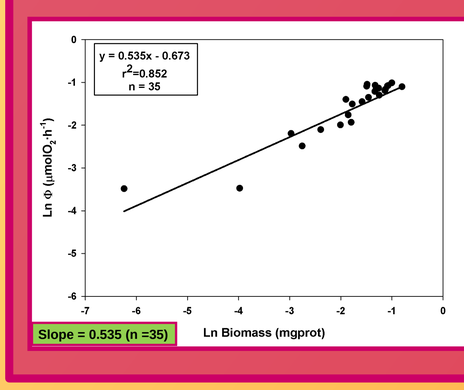
Slope = 0.716 (n =34)

MYSIDS FED 150 ARTEMIA NAUPLII



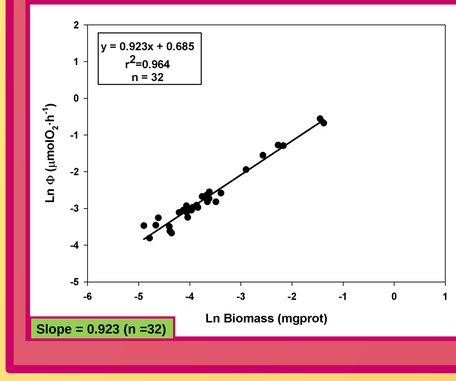
Slope = 0.706 (n =36)

MYSIDS FED 20 ARTEMIA NAUPLII



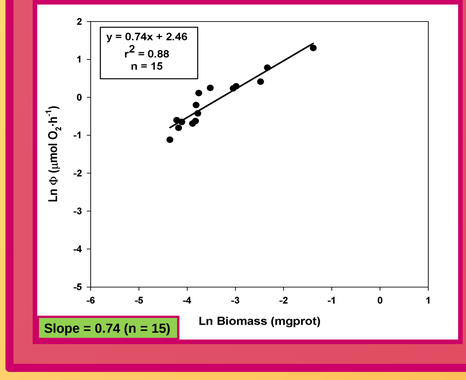
Slope = 0.535 (n =35)

MYSIDS WELL FED



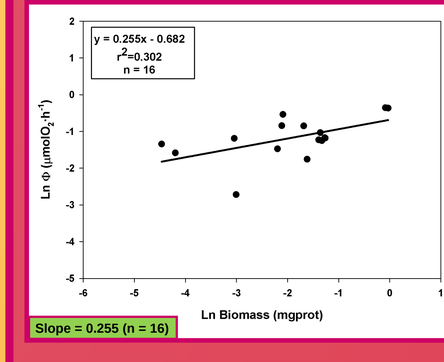
Slope = 0.923 (n =32)

MYSIDS IN STANDARD CULTURES

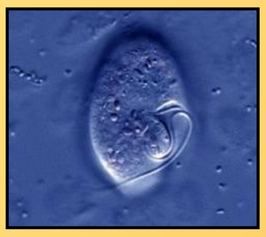


Slope = 0.74 (n = 15)

ARTEMIA IN LOW FOOD CONDITIONS

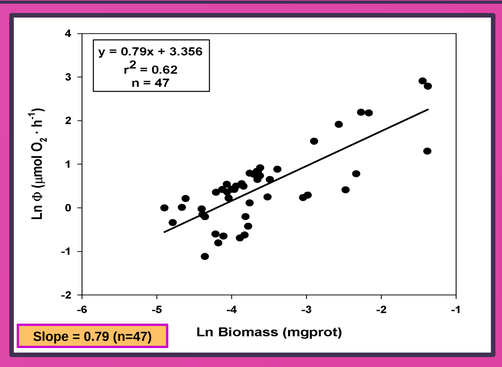


Slope = 0.255 (n = 16)



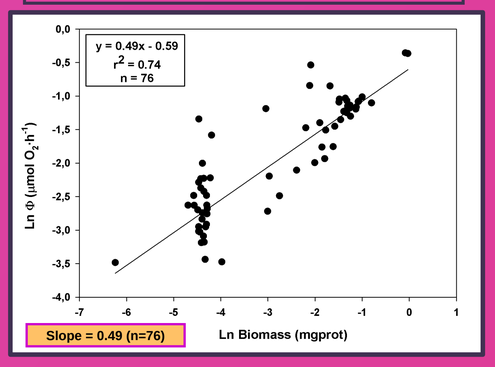
Oxyrrhis marina

ALL MYSIDS WELL FED (200 ARTEMIA NAUPLII)



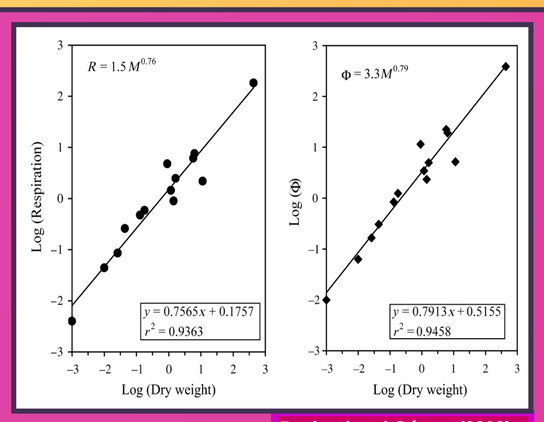
Slope = 0.79 (n=47)

MYSIDS, ARTEMIA & OXYRRHIS STARVED



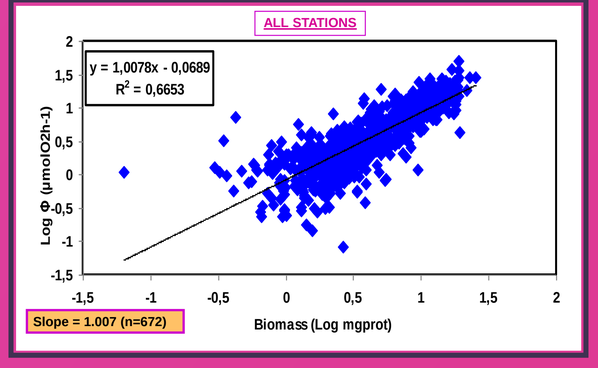
Slope = 0.49 (n=76)

Artemia sp.



Packard and Gómez (2008)

ALL STATIONS



Slope = 1.007 (n=672)

Conclusions:

1.- In well-nourished organisms (Upwelling and cyclonic eddy areas and mysids well fed) the slope of the log-log plots of Φ-M is near 1, indicating a direct relationship. This means that Φ and M are directly linearly related and do not follow the allometric equation and consequently do not require a logarithmic transformation.

2.- In coastal stations, in mysid cultures in standard conditions, and in fresh zooplankton samples (Packard and Gómez, 2008), the slope of log-log plots of Φ -M is lower than in well-fed organisms and closer to Kleiber's law (0.75).

3.- In starved organisms, in cultures maintained on low food levels, and in the offshore (oceanic) stations, the log-log Φ -M slope is lower than Kleiber's Law (b < 0.75).

4.- In general, considering all the pooled field data (lower right), the exponent in the Φ - M relationship is closer to 1 than it is in Kleiber's Law.