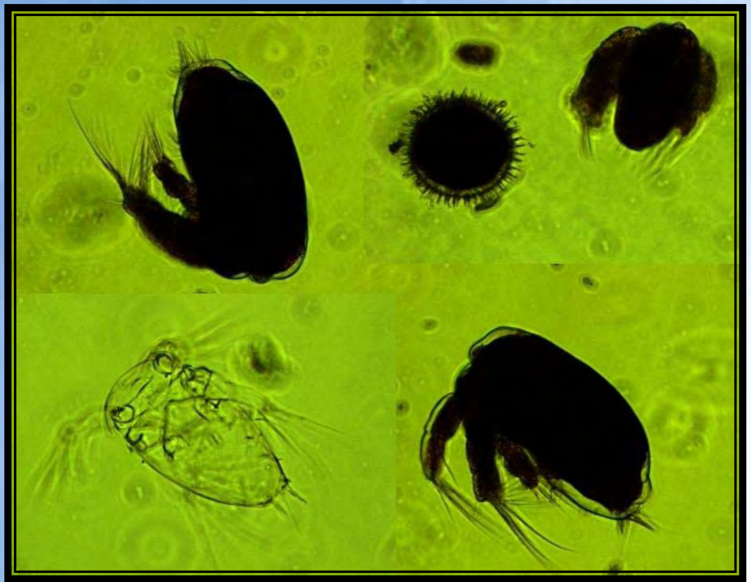
# Effect of temperature and food concentration on the relationship between growth and AARS activity in *Paracartia grani* nauplii

Efecto de la temperatura y de la concentración de alimento en la relación entre el crecimiento somático y la actividad de la enzima aminoacil ARNt sintetasa en nauplios de *Paracartia grani*


**Inma Herrera[1]**, Lidia Yebra[2] and Santiago Hernández-Léon[1]

[1]Institute of Oceanography and Global Change
[2]Instituto Español de Oceanografía

# *Paracartia grani* (Sars, G.O. 1904)



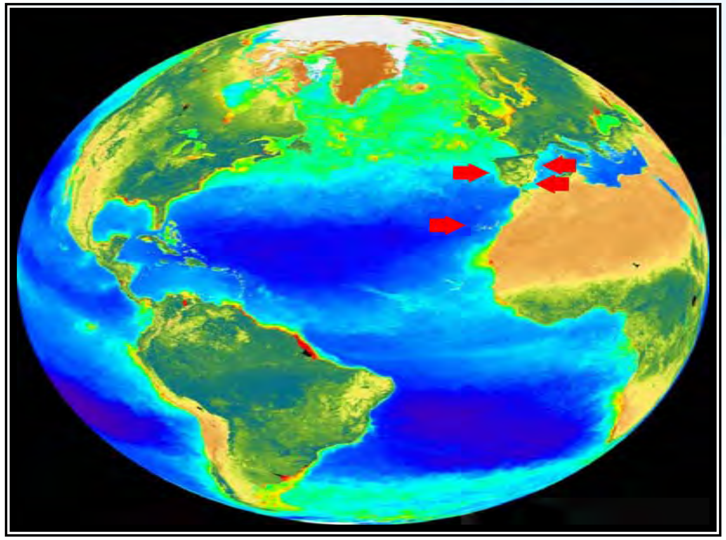
Typical of coastal area

Conditioned:

Physical factors (temperature)
Biological factors (food)

*Acartiidae* are common in coastal and estuarine habitats worldwide.

An important component in the diet of a many of plankton species.



# OBJECTIVE

The effect of temperature and food quantity on the growth of *Paracartia grani* (Sars 1904).

The relationship between direct growth rates and specific $AARS_{situ}$ activities to validate the AARS method as growth index for this species under different temperatures (12-28ºC) and food quantity (0-880 µg $C \cdot L^{-1}$).

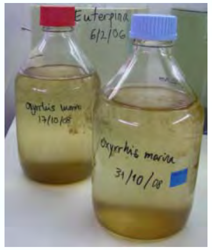
# METHODOLOGY

**ICM**
**Institute of Marine Sciences**

***Paracartia grani***

12h day: 12h night photoperiod

***Oxyrrhis marina***



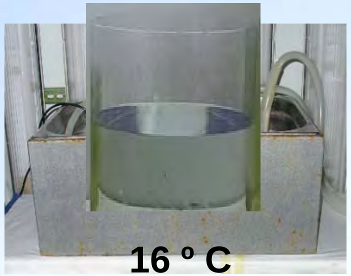
***Rhodomonas baltica***

f/2 medium

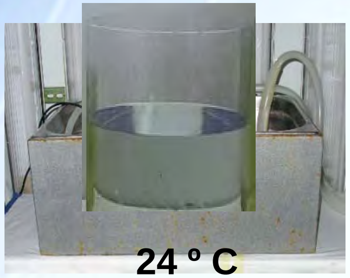
24 hours → Eggs were collected and preserved in the fridge (4ºC)

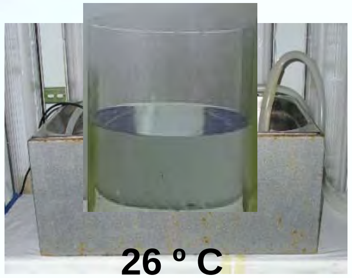
## *Experiments at different temperatures*

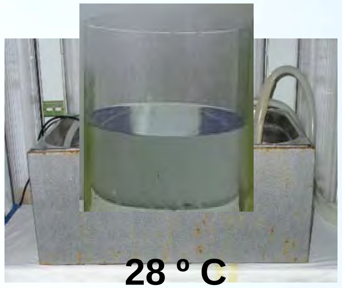

12 º C


16 º C


19.8 º C


24 º C


26 º C


28 º C

Eggs addition:
(22.000-64.548)

↓

16 hours

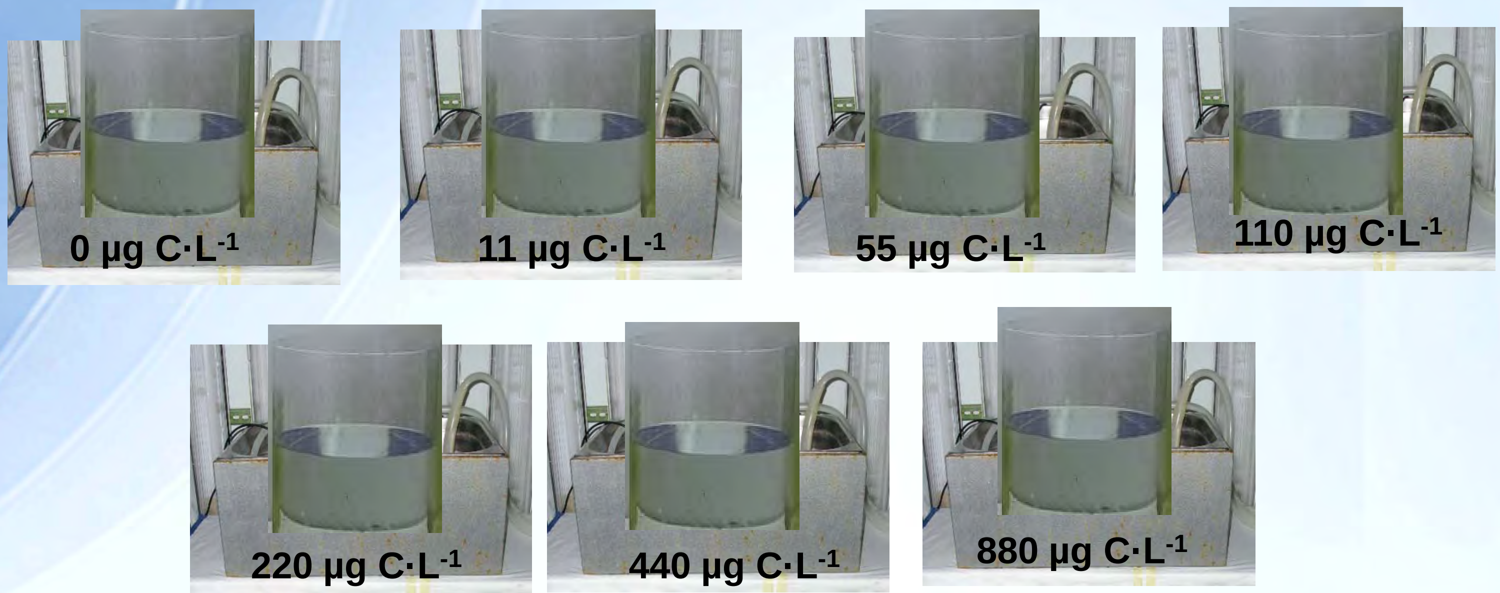
*Oxyrrhis marina*

220-286 µgC·L$^{-1}$

(~2 nauplii mL$^{-1}$)

**METHODOLOGY**

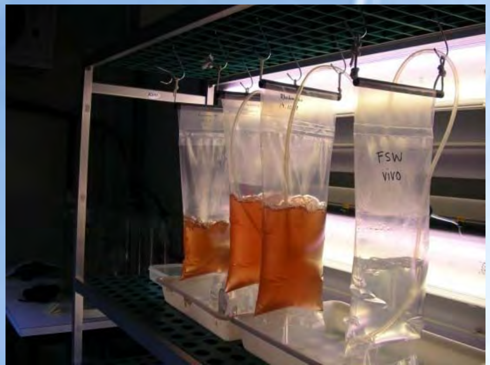
*Experiments under different food concentrations*




(~2 nauplii $mL^{-1}$)

**METHODOLOGY**

## Nauplii growth experiments




Multisizer Coulter Counter

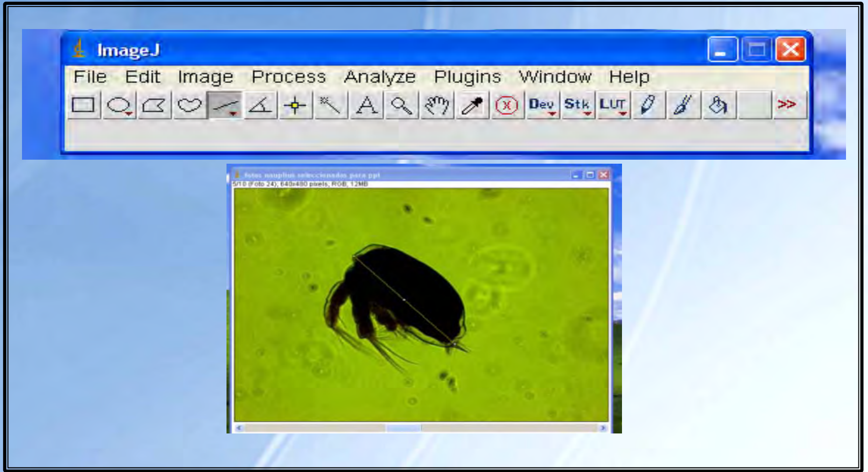
100 ml nauplii culture

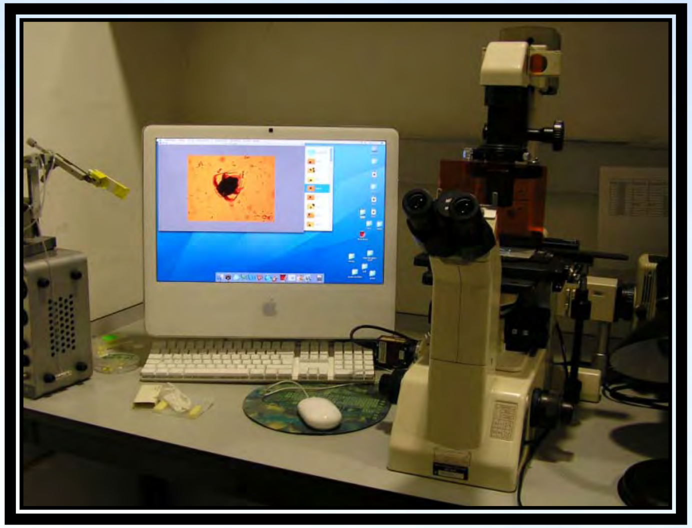
Fixed with Lugol's acid (4%)

Measured of length and abundance

**METHODOLOGY**

## Length measurement and weight-specific growth calculations



Converted in carbon (C) **assuming a carbon/dry weight ratio of 0.40** (Postel et al. 2000).

**Dry weight (dw) / length**
Durbin and Durbin (1978)
*A.clausi*

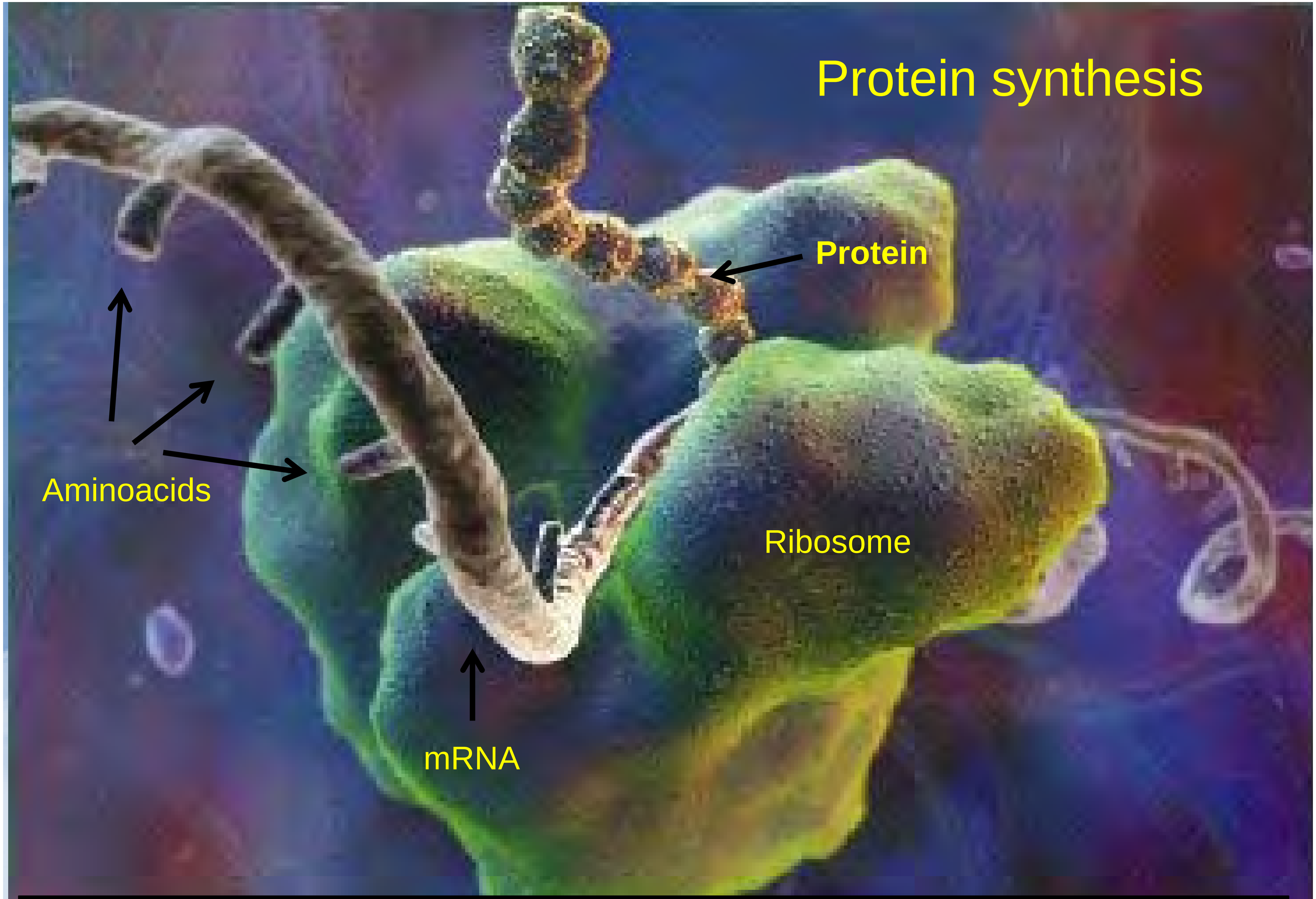
$W = 19.04\ L^{2.849}$, r= 0.99

W = dry weight (µg )
L = prosome length(mm)

Temperature quotient ($Q_{10}$)

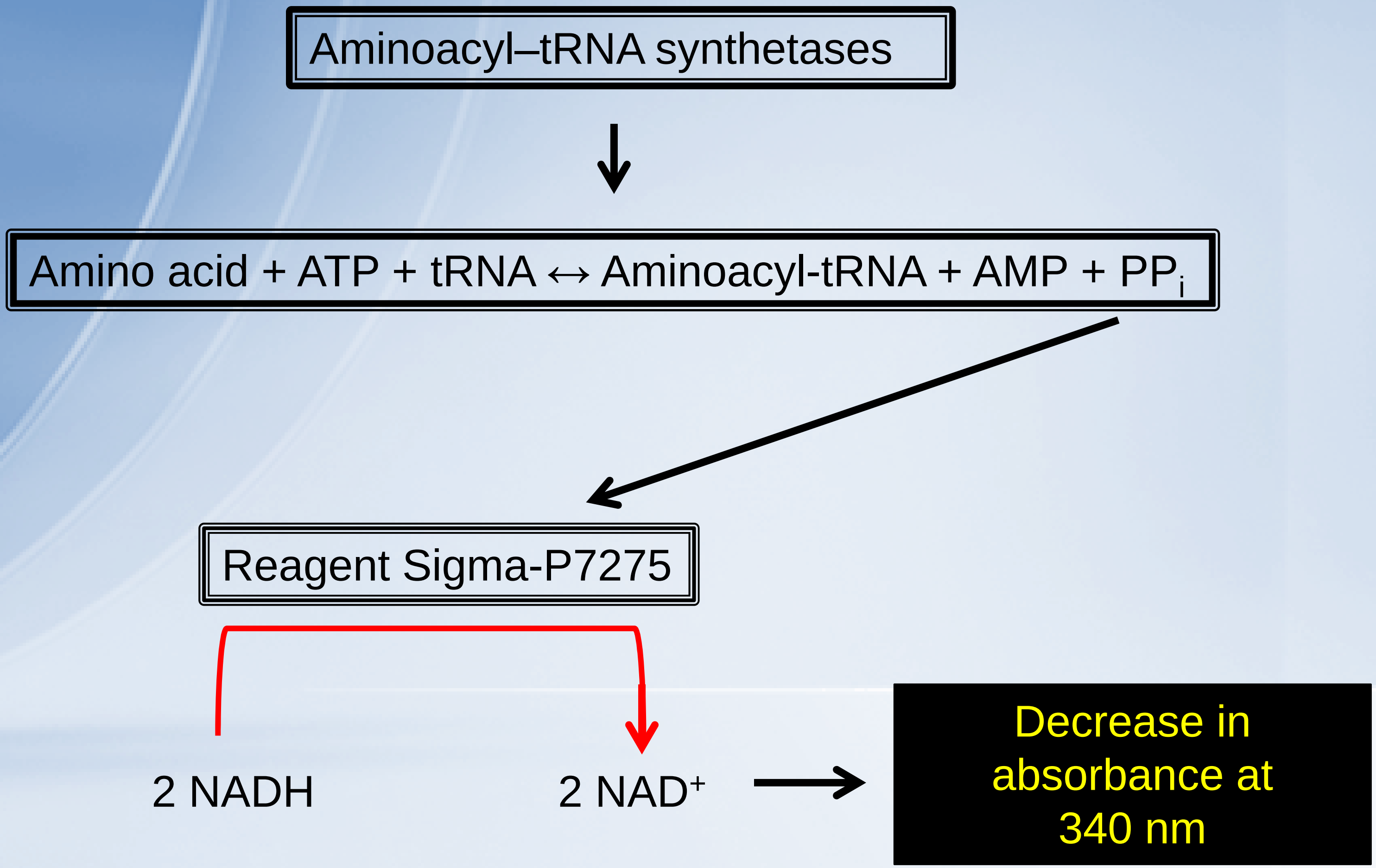
$$Q_{10} = \left(\frac{R_2}{R_1}\right)^{\left(\frac{10}{T_2 - T_1}\right)}$$

$R_1$ and $R_2$ = Growth rates
$T_1$ and $T_2$ = Temperatures



Ribosome reading a RNA chain prior to the synthesis of a protein (Whitesides, 2001).

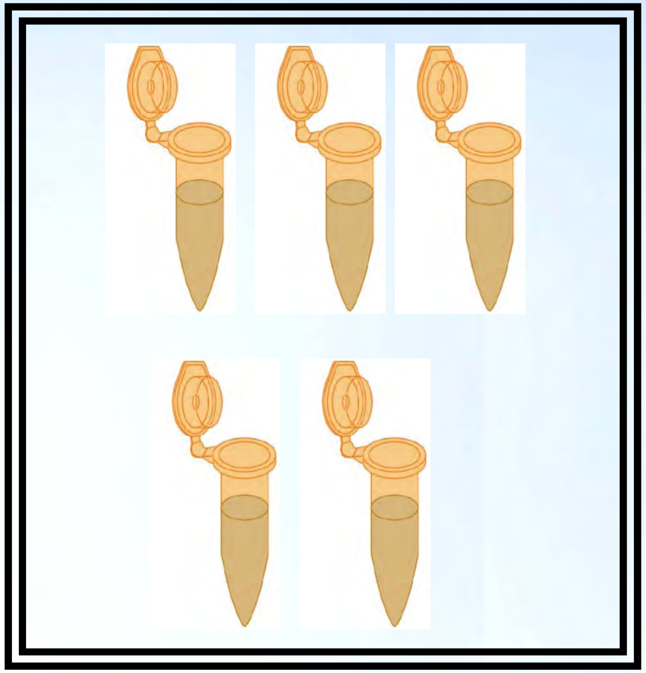
## Biochemical assays




Chang et al., 1984 modified by Yebra & Hernández-León 2004

## Biochemical assays

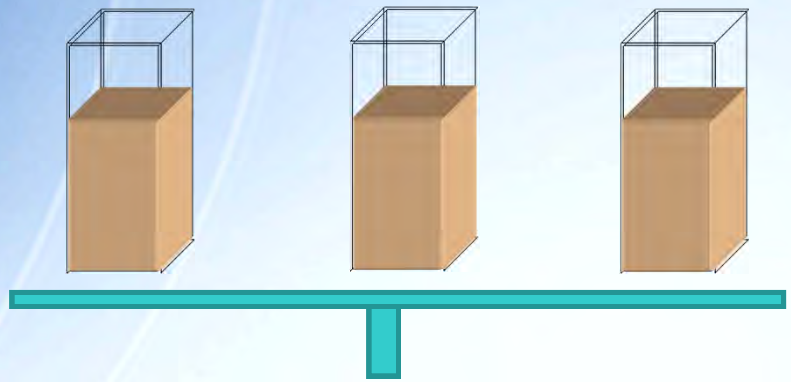
5000 rpm , 10 min, 0 ºC



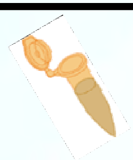
Homogenized

Tris-HCl buffer (20 mM, pH 7.8)

## Biochemical assays

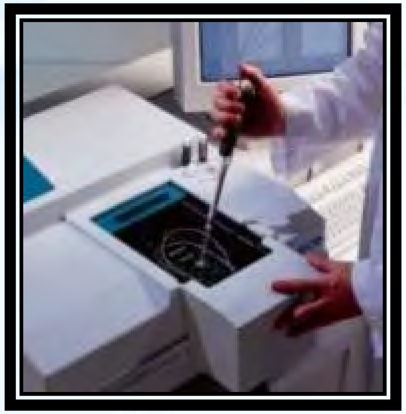


250 µl supernatant



200 µl Pyrophosphate (PPi reagent)

300 µl MilliQ water



340 nm UV
10 min
25 ºC

## Biochemical assays

$$\text{nmol PPi}\cdot h^{-1}\cdot \text{sample ml}^{-1} = (\text{dA}\cdot \text{min}^{-1} \cdot 10^3 \cdot 60) \cdot (V_{rm} \cdot 6.22 \cdot 2)^{-1}$$

(Yebra et al. 2004)

$V_{rm}$ = Volume of the reaction mixture in ml

6.22 = Millimolar absorptivity of NADH at 340 nm

2 = Number of moles of β-NADH oxidized per mole of PPi consumed

**Temperature correction**

$$\text{AARS}_{\text{situ}} = \text{AARS}_{\text{incubation}} \cdot \exp[E_a \cdot (T_{\text{incubation}} - T_{\text{situ}})^{-1} \cdot R^{-1}]$$

(Yebra et al. 2005)

**Ea = 8.57 kcal· mol$^{-1}$**

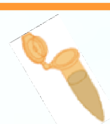
$\text{AARS}_{\text{in situ}}$ activity

## Biochemical assays

Protein content

Lowry et al. (1951) → Rutter (1967)

200 µl supernatant



+ 1000 µl Rutter

→ Sol A: $Na_2CO_3$ 0.90 M
NaOH 0.45 N
Tartatro Na-K 2%
→ Sol B: $CuSO_4 \cdot 5H_2O$

After 10 min

100 µl FOLIN → 1:1 Folin : Water

After 40 min

→ 750 nm Spectrophotometer

5000 rpm ,10 min, 0 ºC

Bovin Serum Albumin (BSA) → protein standard
5 and 500 (µgproteins · $mL^{-1}$)

# RESULTS & DISCUSSION

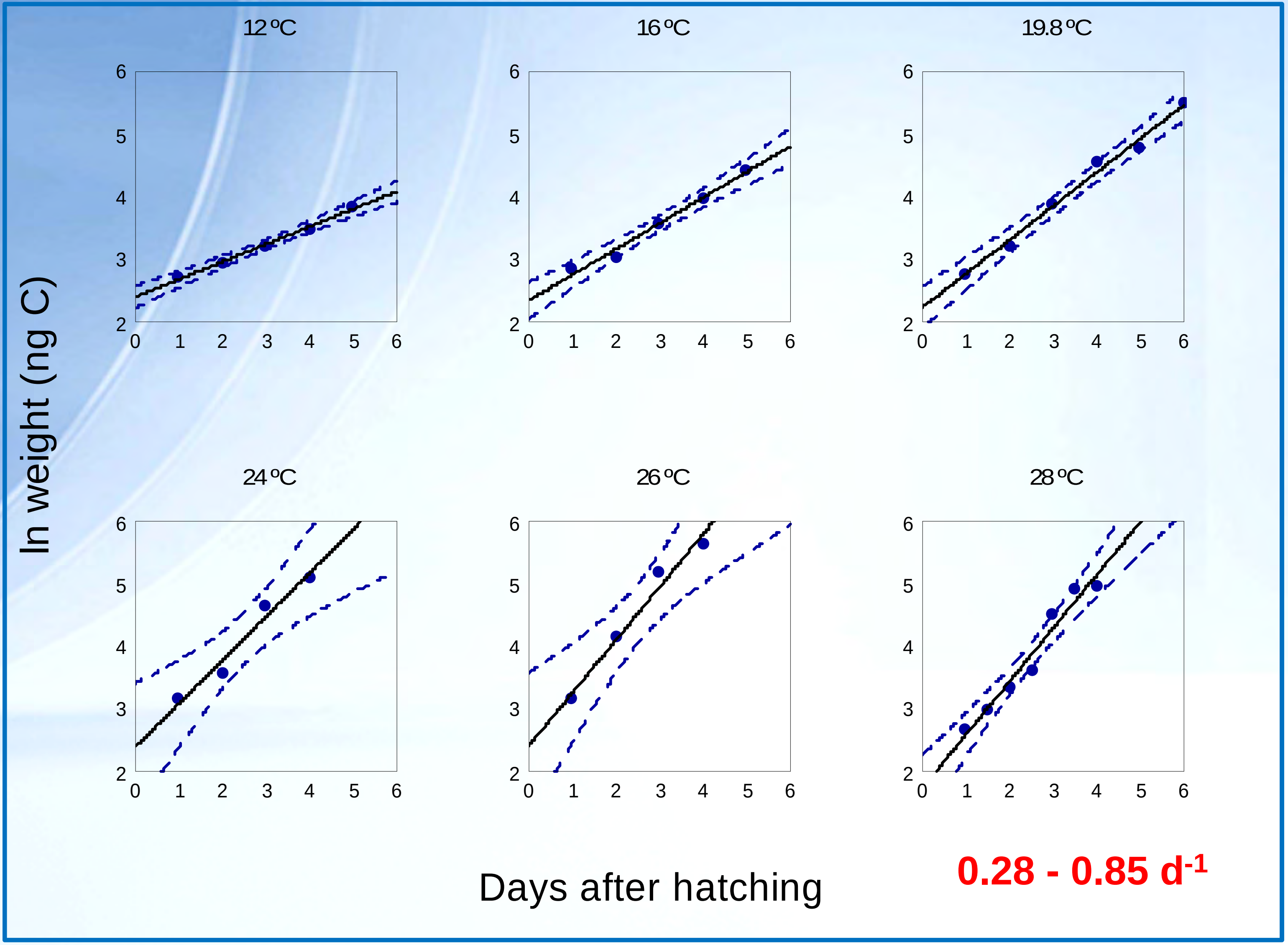



Fig 1. *Paracartia grani* nauplii. Carbon content (ng C) increases at different temperatures.

# RESULTS & DISCUSSION

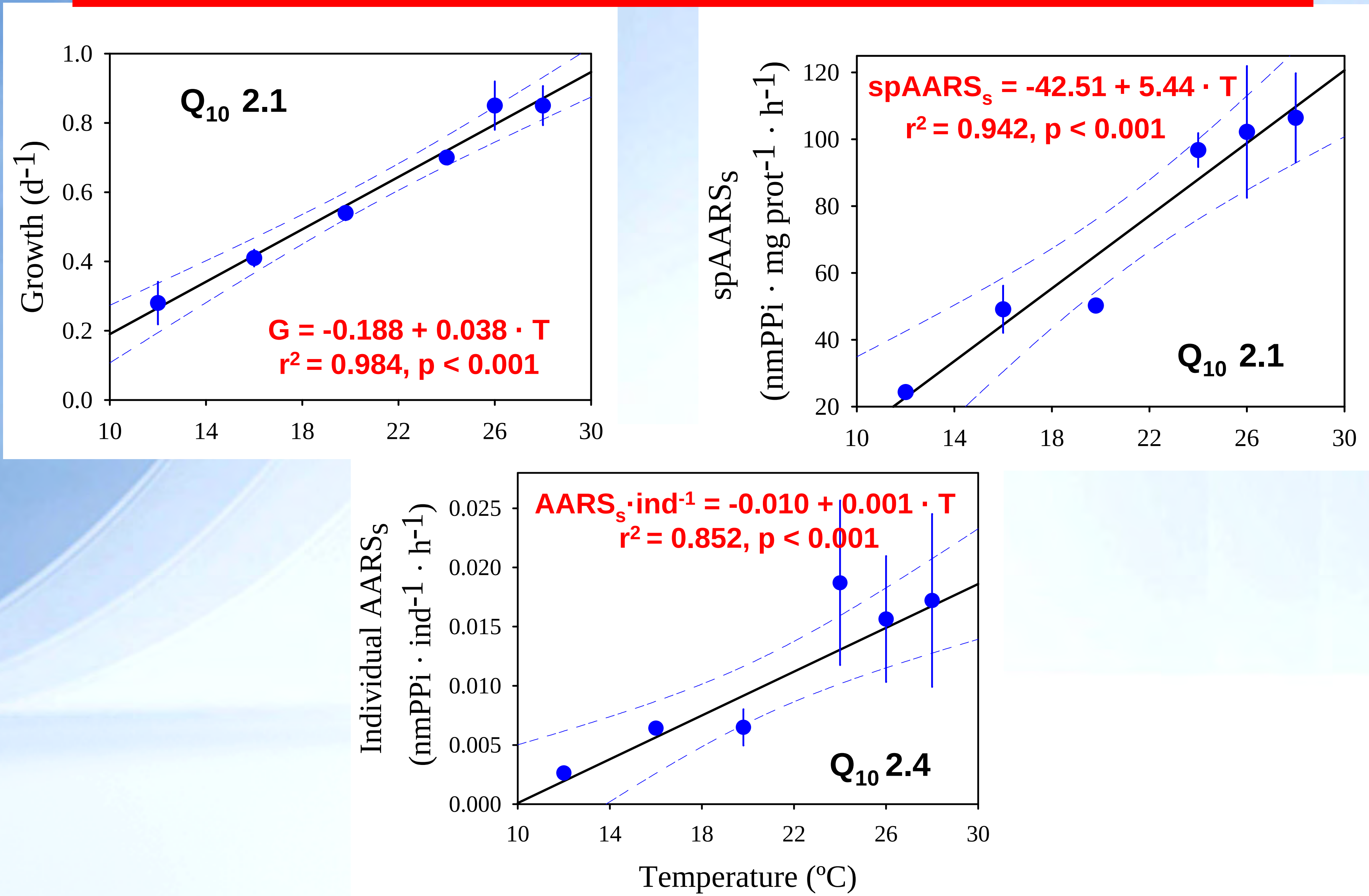
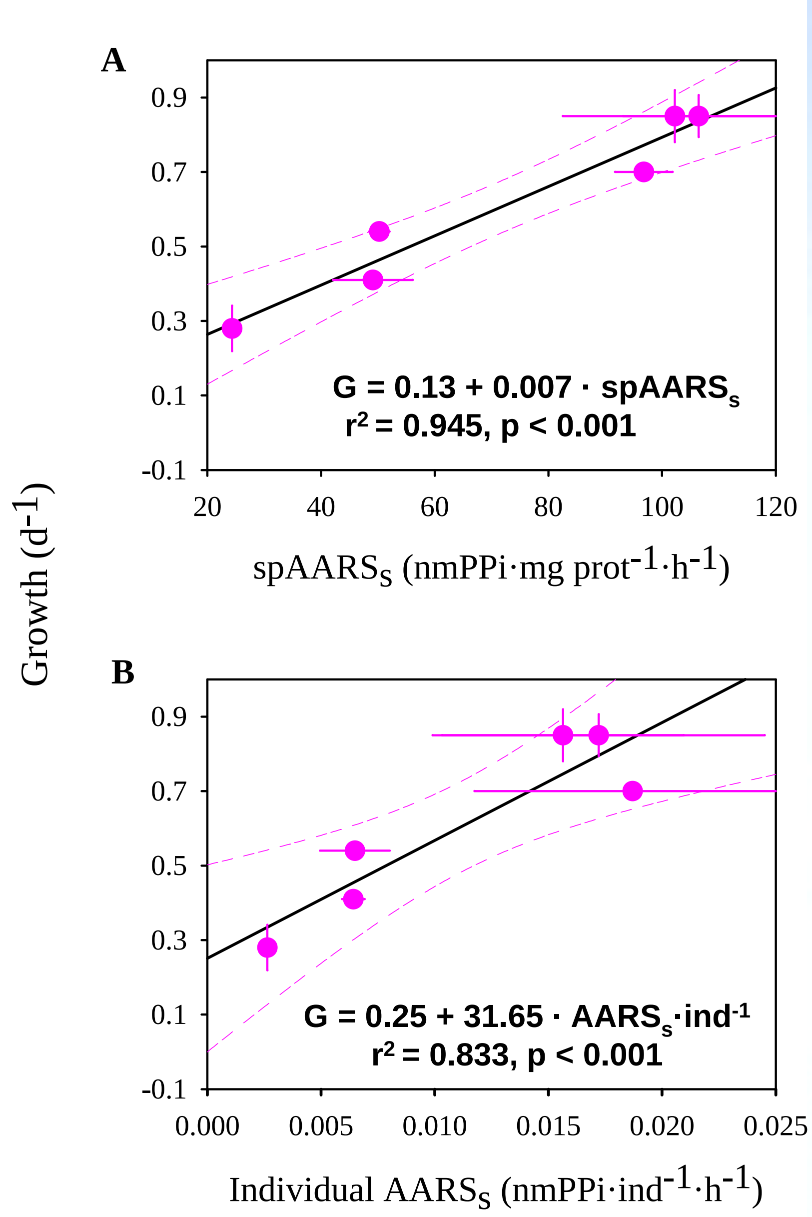



Fig 2. *Paracartia grani* nauplii. Effect of temperature on A) growth ($d^{-1}$), B) $spAARS_s$ ($nmPPi·mg\ prot^{-1}·h^{-1}$), C) individual $AARS_s$ ($nmPPi·ind^{-1}·h^{-1}$).

# RESULTS & DISCUSSION




Yebra et al., 2005

*Calanus helgolandicus*
$R^2$=0.55

Yebra et al., 2006

*Calanus finmarchicus*
$R^2$ = 0.55

Fig 5. *Paracartia grani* nauplii. Relationship between growth rates (d$^{-1}$) and A) specific AARS$_s$ activities (nmPPi·mg prot$^{-1}$·h$^{-1}$), B) individual AARS$_s$ (nmPPi·ind$^{-1}$·h$^{-1}$) at different temperatures (ºC).

# RESULTS & DISCUSSION

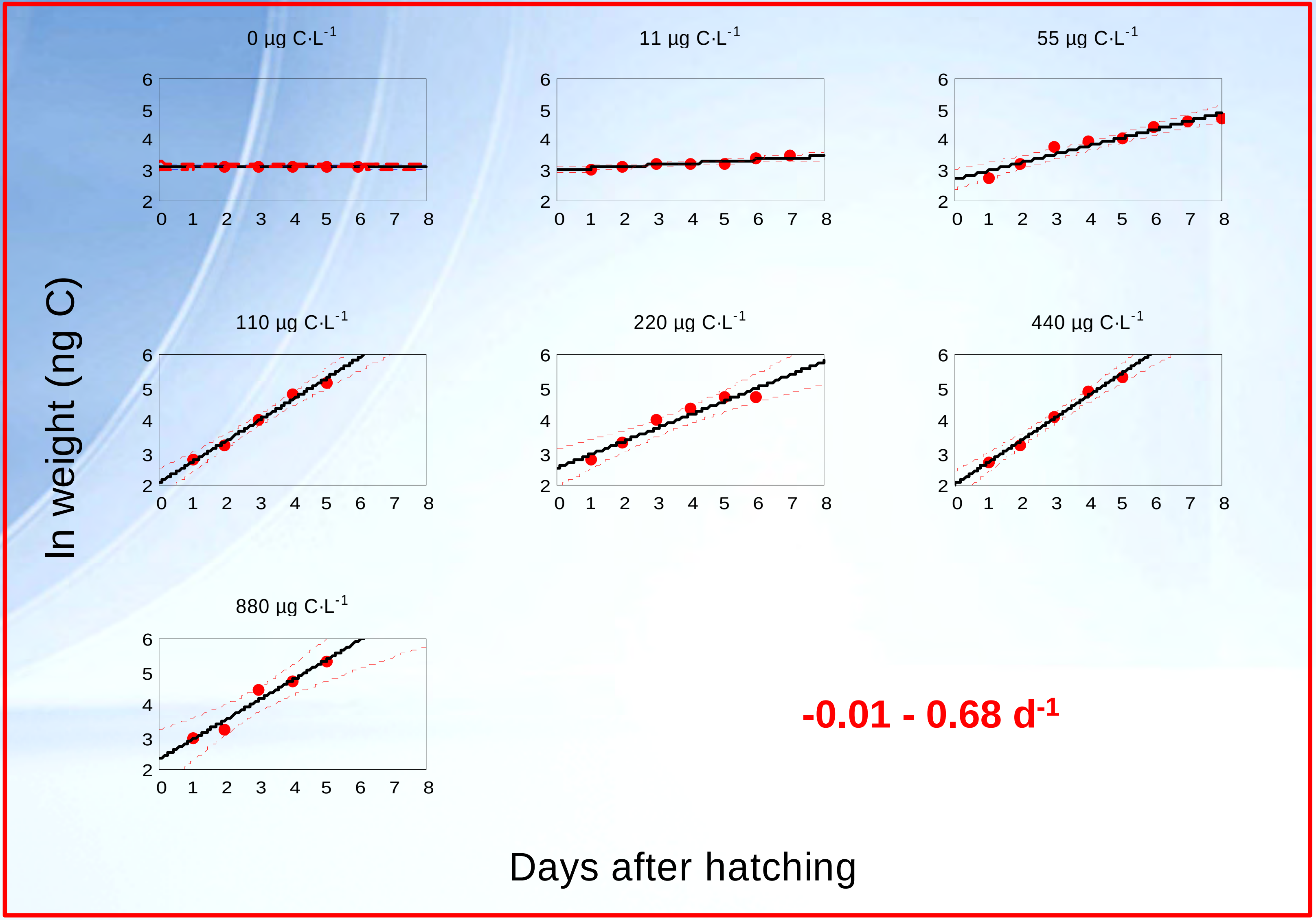



Fig 3. *Paracartia grani* nauplii. Carbon content (ng C) increases under different food concentrations.

# RESULTS & DISCUSSION

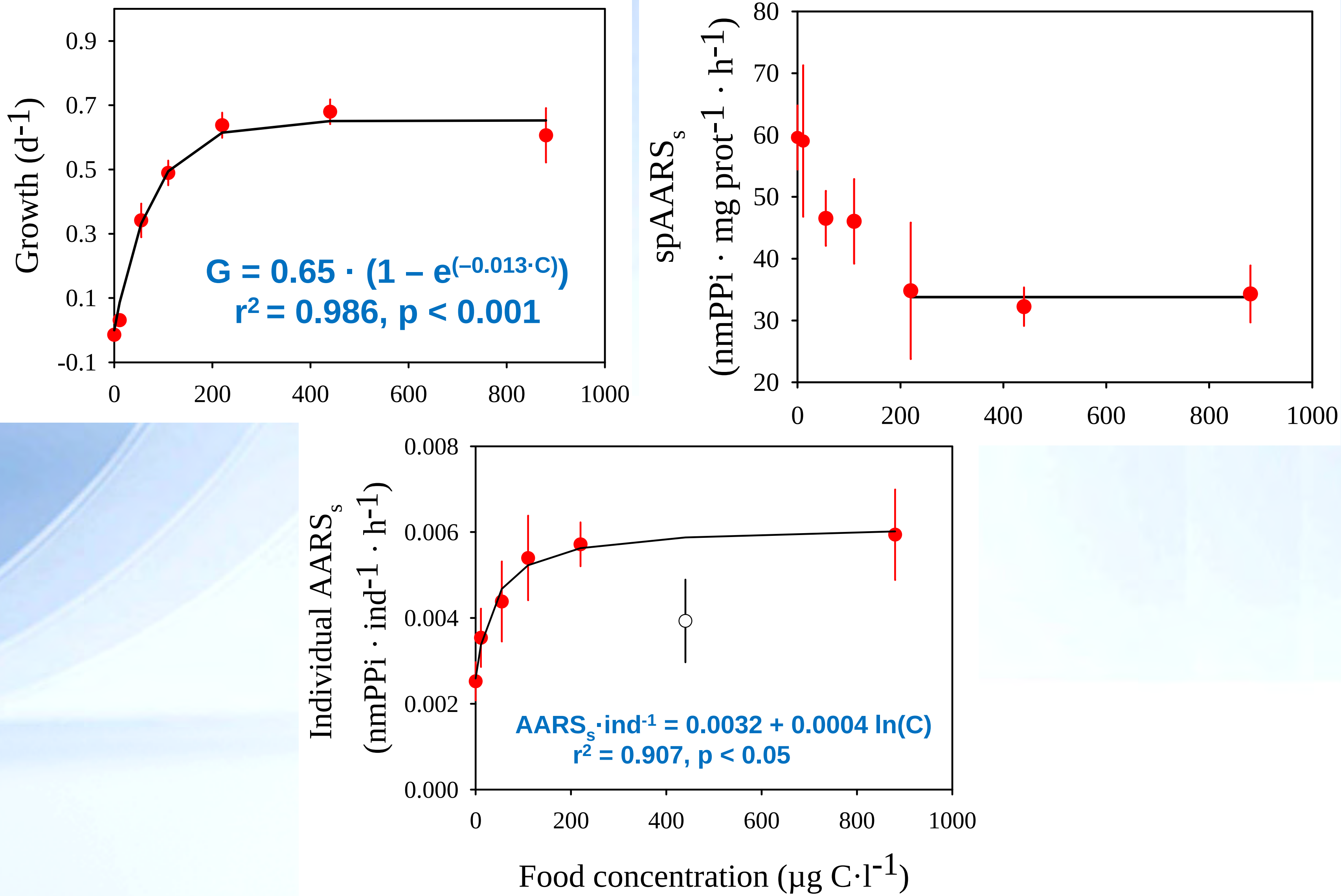



Fig 4. *Paracartia grani* nauplii. Effect of food concentration on A) growth ($d^{-1}$), B) $spAARS_s$ ($nmPPi \cdot mg\ prot^{-1} \cdot h^{-1}$), C) individual $AARS_s$ ($nmPPi \cdot ind^{-1} \cdot h^{-1}$); open circle: value not included in fit (see text).

# RESULTS & DISCUSSION

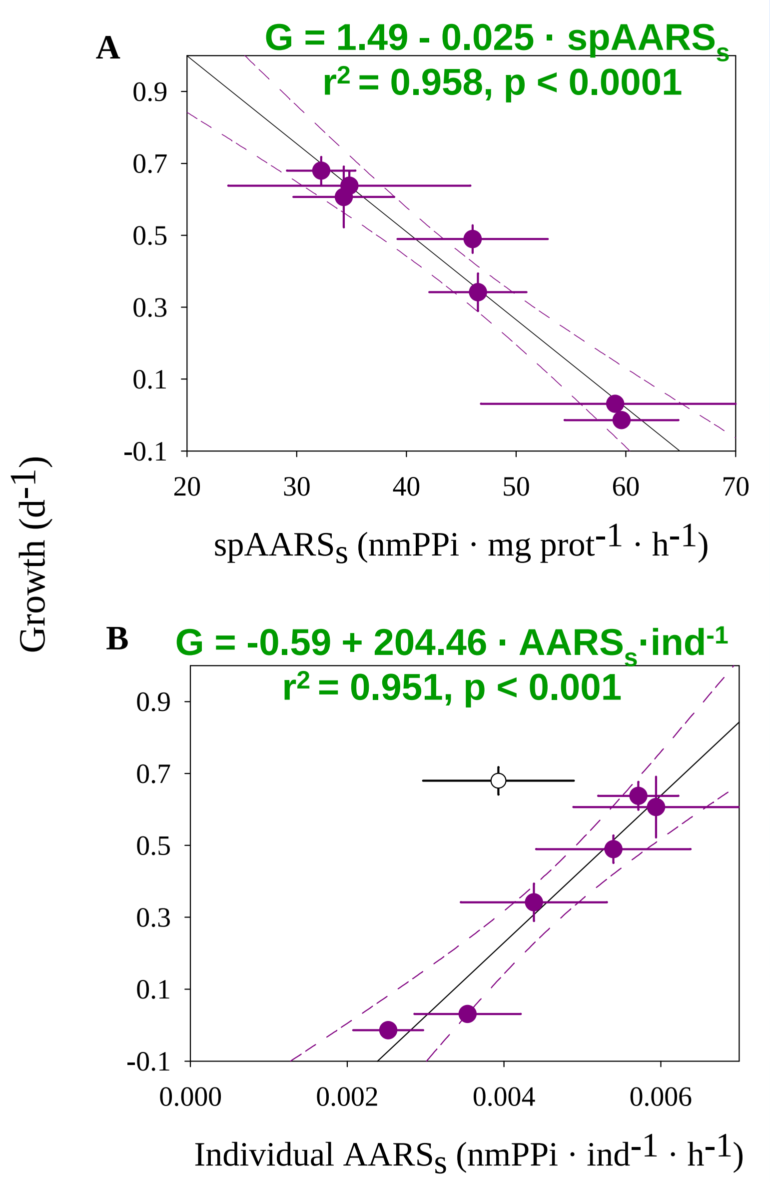



Fig 6. *Paracartia grani* nauplii. Relationship between growth rates ($d^{-1}$) and A) specific $AARS_s$ activities ($nmPPi \cdot mg\ prot^{-1} \cdot h^{-1}$), B) individual $AARS_s$ ($nmPPi \cdot ind^{-1} \cdot h^{-1}$) under different food concentrations ($\mu g\ C \cdot L^{-1}$); open circle: value not included in fit (see text).

# RESULTS & DISCUSSION

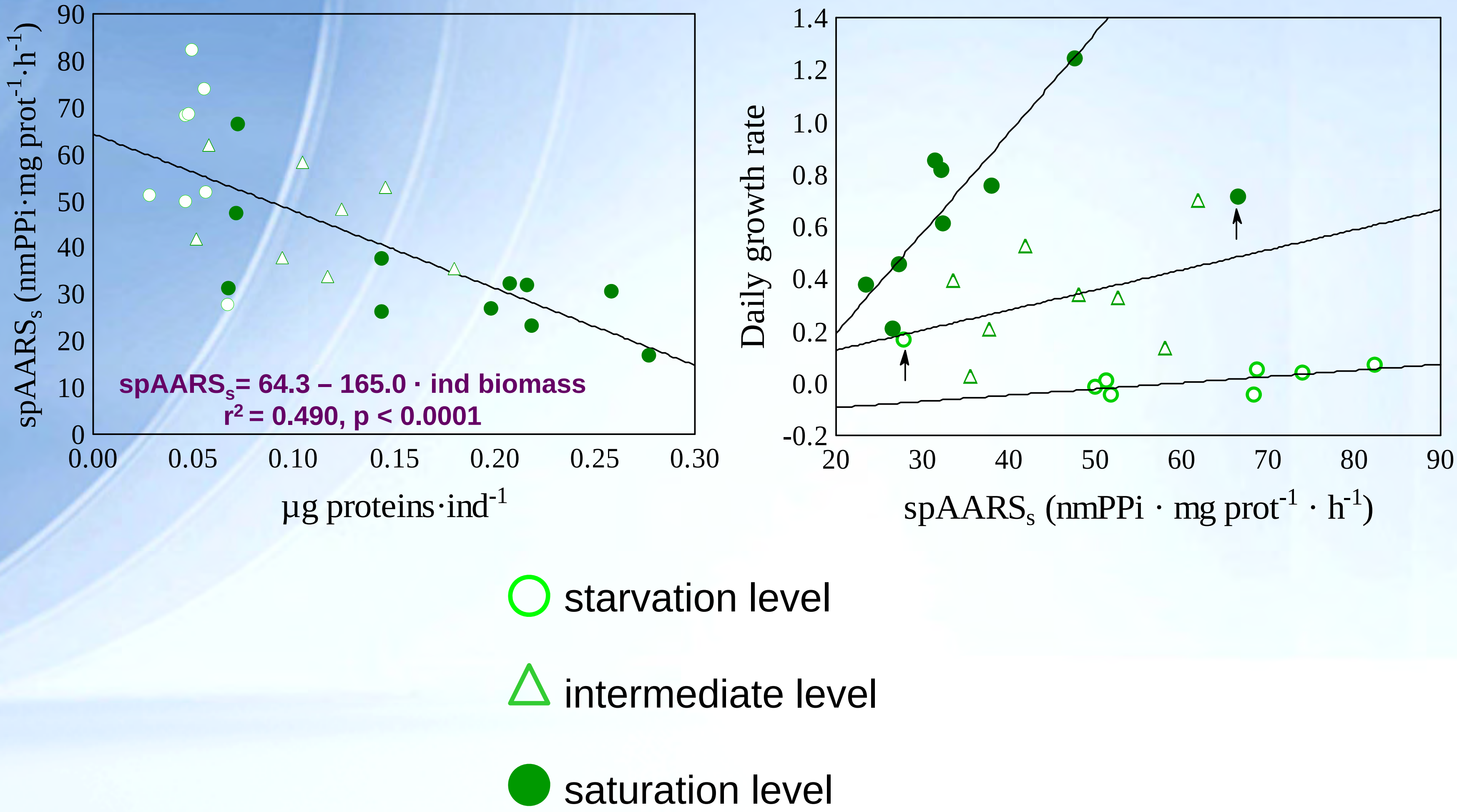



Fig 7. *Paracartia grani* nauplii. A) Relationship between specific AARS$_s$ activities (nmPPi·mg prot$^{-1}$·h$^{-1}$) and individual biomass (μg proteins · ind$^{-1}$); B) Relationships between daily growth rates (d$^{-1}$) and specific AARS$_s$ activities (nmPPi·mg prot$^{-1}$·h$^{-1}$) under different food concentrations.

# CONCLUSIONS

Growth and protein synthesis rates of *Paracartia grani* nauplii depended on temperature and food concentration.

AARS activity is valid as index of somatic growth for *P. grani* nauplii when growth is not limited by food availability.

The results presented here add to previous studies showing that the $AARS_s$ activity is a useful tool for estimating somatic growth in copepods.

# ACKNOWLEDGMENTS

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# Thank you for your attention!

**Inma Herrera**

iherrera@becarios.ulpgc.es