Nauplii grazing on bacteria: A short circuit in the microbial loop?

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Nauplii have high phosphorus (P) demands due to their rapid growth[1]. In oceanic regions phytoplankton carbon: phosphorus (C:P) ratios are extremely low, and may decline with increasing temperatures and carbon dioxide concentrations[3].

How will nauplii cope with increased P deficiency?

We hypothesize that nauplii will utilize bacteria as a P source.

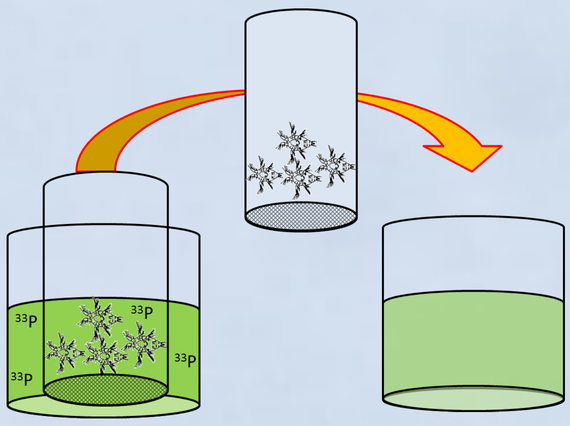
Nauplii can consume bacterial sized particles[2], and bacteria have lower carbon: phosphorus stoichiometry than phytoplankton.

We predict that bacterial grazing and assimilation of P will be higher when phytoplankton are P deficient, at high C:P ratios.

Parvocalanus crassirostris nauplii (NII-NIV) were fed phytoplankton (*Tsochrysis lutea)* at 0.1 mg l^{-1} or bacteria (*Alteromonas sp.*) at 10^7 cells l^{-1} or a mix of bacteria and 50% phytoplankton. In each treatment either phytoplankton or bacteria was labelled with ^{33}P or ^{14}C.

This was repeated for P rich (low C:P) and P deficient *T. lutea* (high C:P ratio).

Ingestion, incorporation and assimilation of ^{14}C or ^{33}P for 240 nauplii with three replicates was measured for each treatment.



Ingestion

10 min in labelled food.

Incorporation

4 h in labelled food.

Assimilation

10 min in labelled food + 30 min in unlabelled food.

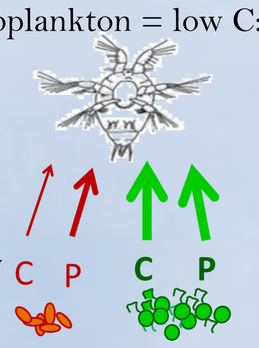
Ingestion, Assimilation, Incorporation

$$= \left(\frac{Nauplii\ specific\ activity}{Isotope\ activity\ ml^{-1}}\right) * seston\ C\ or\ P\ content$$

$$\text{Assimilation efficiency} = \frac{Assimilation}{Ingestion}$$

$$\text{Incorporation efficiency} = \frac{Incorporation}{Ingestion}$$

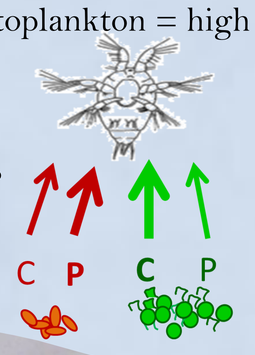
P rich phytoplankton = low C:P (100-200:1)



Nauplii ingest and assimilate bacteria at low rates.

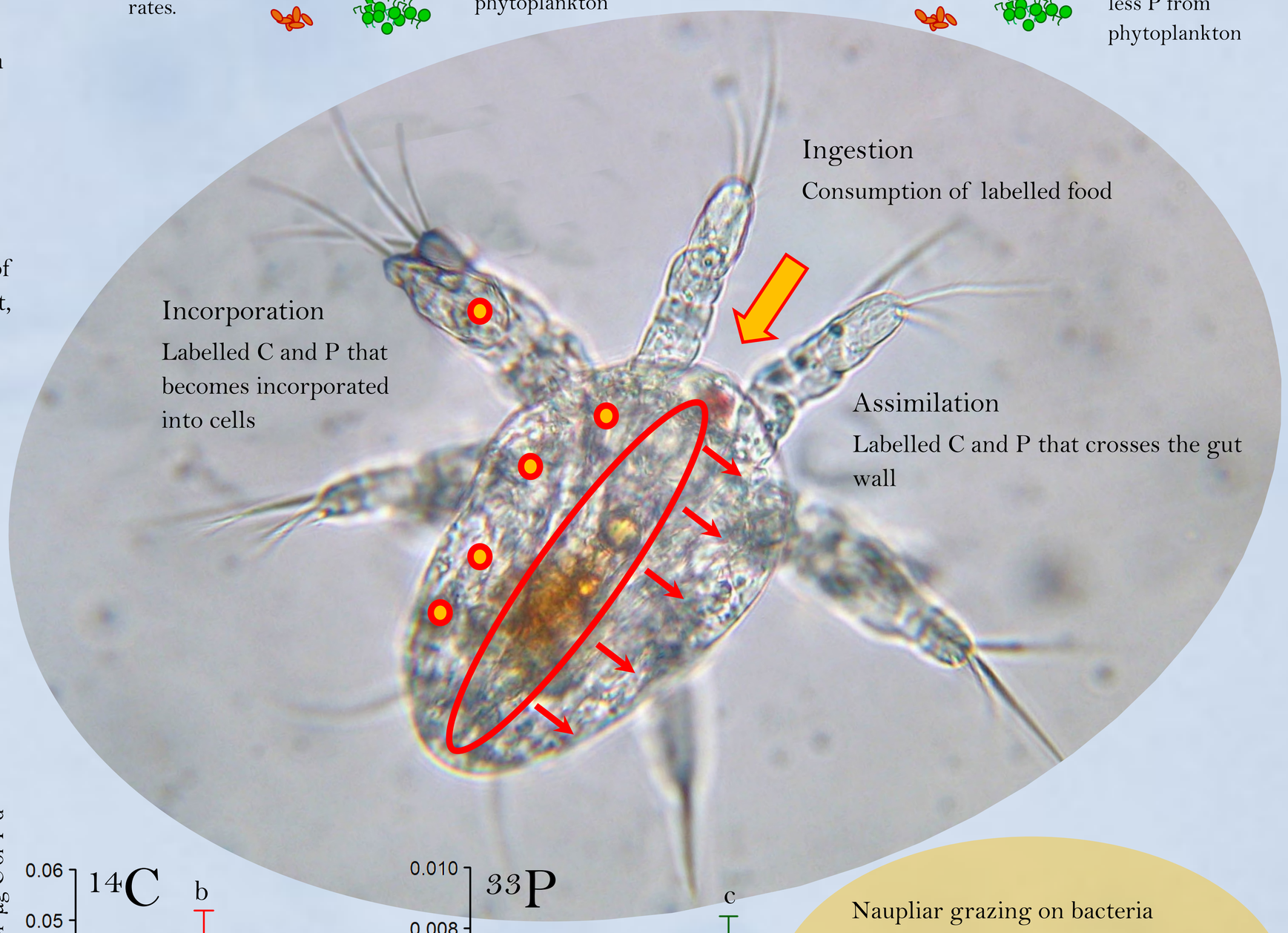
Most C and P is ingested and assimilated from phytoplankton

P deplete phytoplankton = high C:P (~1000:1)



More bacterial P is ingested and assimilated.

Nauplii ingest C at high rates, but assimilate less P from phytoplankton



Ingestion

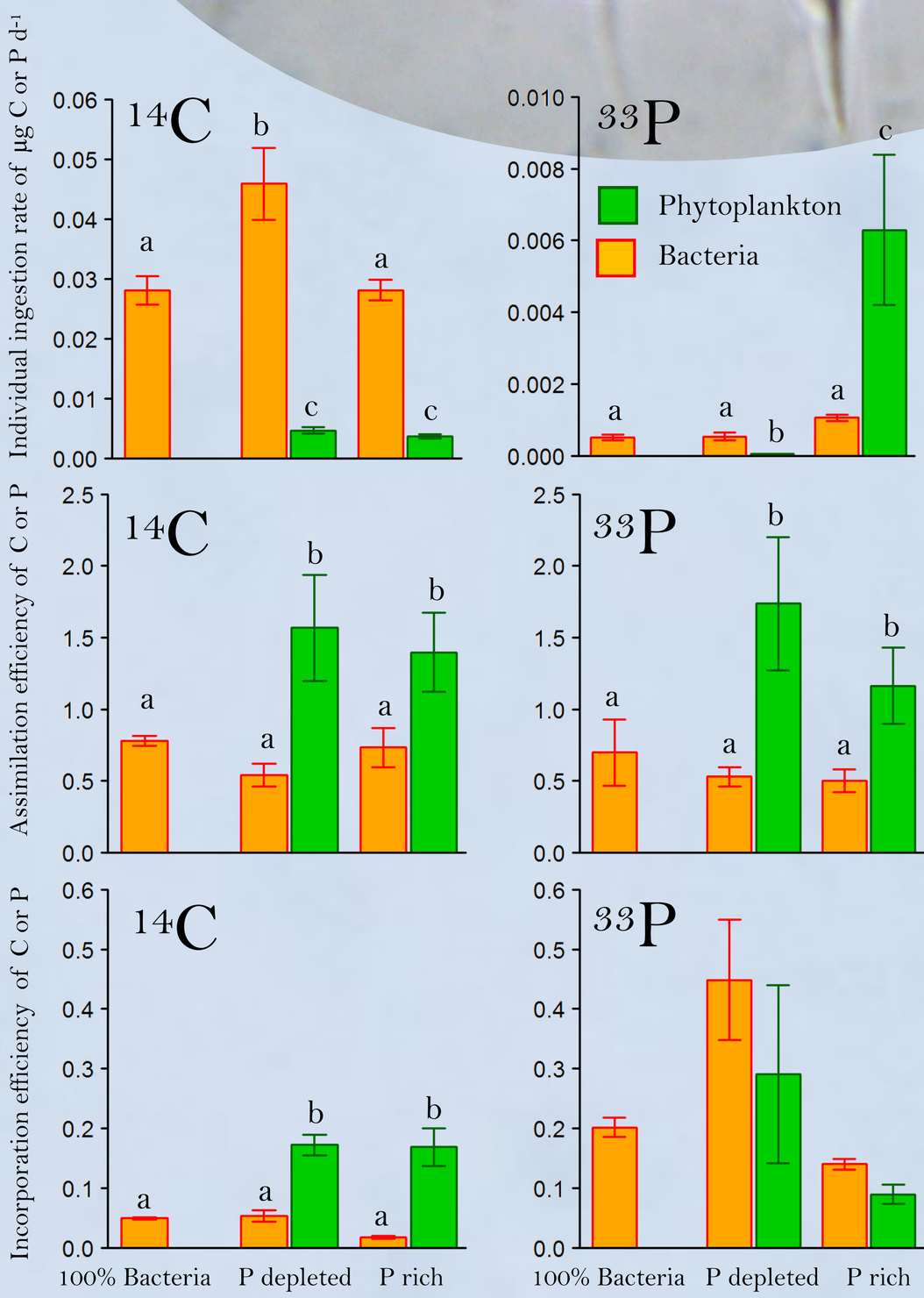
Consumption of labelled food

Incorporation

Labelled C and P that becomes incorporated into cells

Assimilation

Labelled C and P that crosses the gut wall



Naupliar grazing on bacteria provides a direct link from bacteria to higher trophic levels—short circuiting losses due to multiple trophic transfers associated with the microbial loop.

P. crassirostris nauplii grazed on bacteria at high rates. Ingestion of bacterial C was higher when fed with P depleted phytoplankton.

Most P was ingested from P rich phytoplankton. Bacteria were a P source, but neither ingestion nor assimilation efficiency of bacterial P changed with phytoplankton stoichiometry.

Although nauplii ingested bacteria, phytoplankton C and P was assimilated and incorporated (for C) more efficiently into naupliar body mass.

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References

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