ICES/PICES 6th Zooplankton Production Symposium
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ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Influence of food quality on carbon and nitrogen budget of *Calanus glacialis* (Copepoda)

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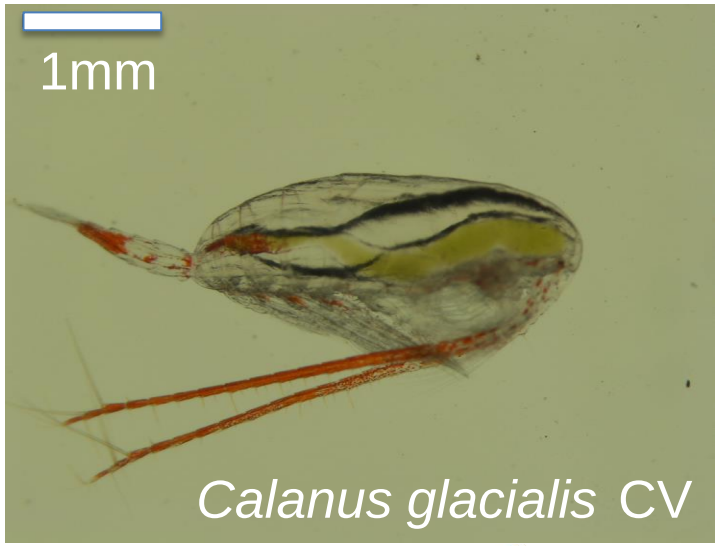
Calanus glacialis

- Key species Arctic shelf
- Up to 80% of zooplankton biomass
- Grazes on ice algae and phytoplankton (diatoms)
- Accumulates lipids
- Energy-rich food source for higher trophic levels



Climate change

- Expected changes at basis of food web:
  - Higher sea surface temperature favors small cells: (dino)flagellates more dominant
    (Brussaard et al. 2013; Li et al. 2009; Seuthe et al. 2010)
  - Ocean acidification might change algal stoichiometry and biochemical composition
    (Riebessel et al. 2007; Bellerby et al. 2008; Engel et al. 2008)
- Might change food quality for *Calanus* spp.
  (Sterner and Elser 2009; Urabe et al. 2003)

Aim

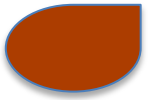
to show the functional responses of *Calanus glacialis* to food of different quality

by studying the carbon and nitrogen budget

and digestive enzyme activities

Food quality

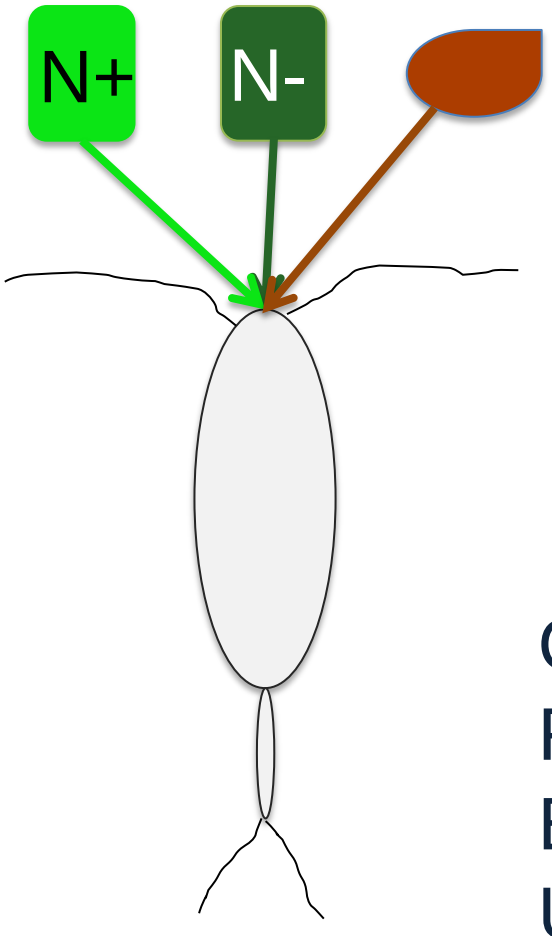
- Stoichiometry approach:
  - Cell carbon (C) and nitrogen (N) content
  - Cell C:N ratio

- Food sources (´lab rats´):
  - Diatom: *Conticribra weissflogii* (C:N 4.5) N+
  - Diatom: *C. weissflogii* (C:N 11.4) N-
  - Dinoflagellate: *Oxyrrhis marina* (C:N 4.4) 

Incubation

- *Calanus glacialis* CV
- Sampled on Svalbard in July 2015
- Incubated for 25 days at 0 °C
- With different algal food N+ N-

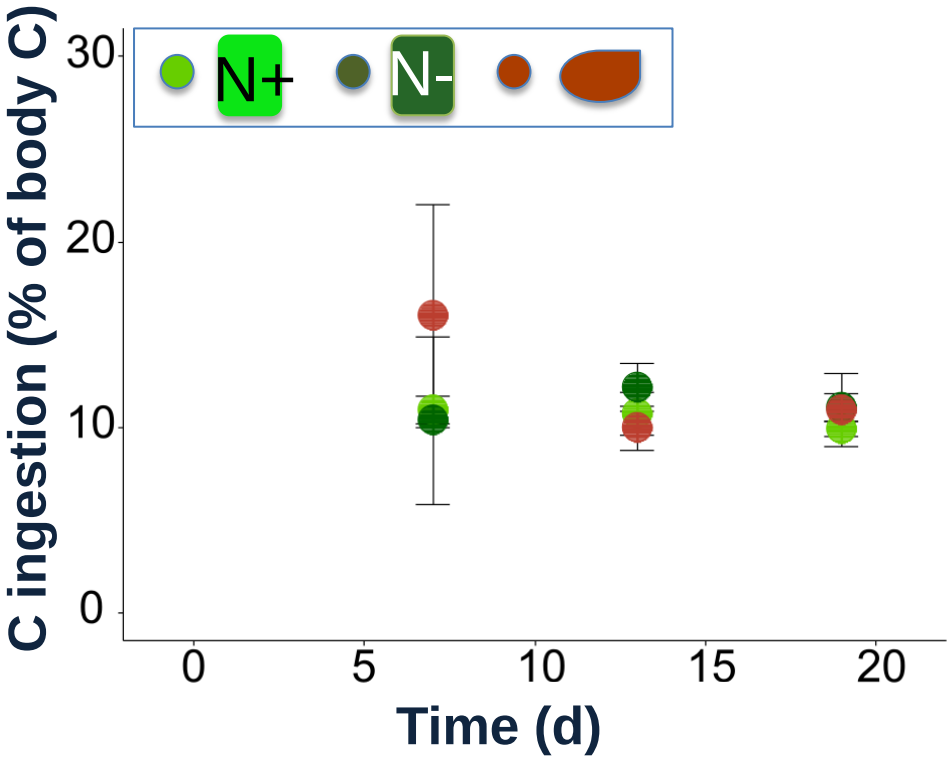
Budget of C and N

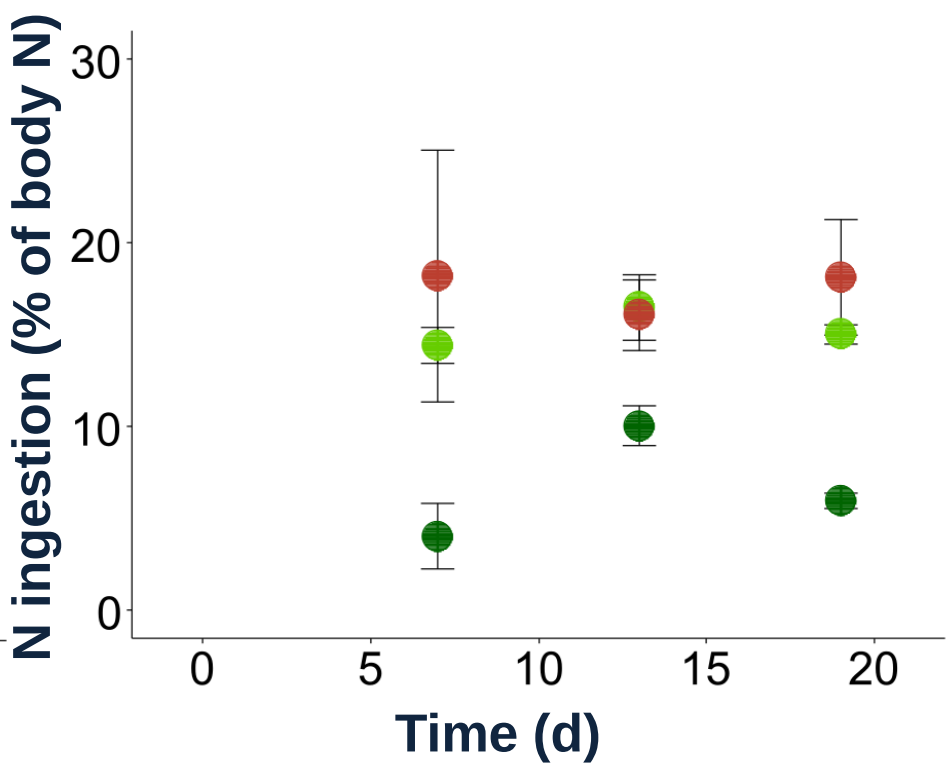


$$I = G + R + E + U$$

I: ingestion (consumption)
G: somatic growth (gain of C and N)
R: respiration (only C)
E: egestion
U: excretion (not measured)

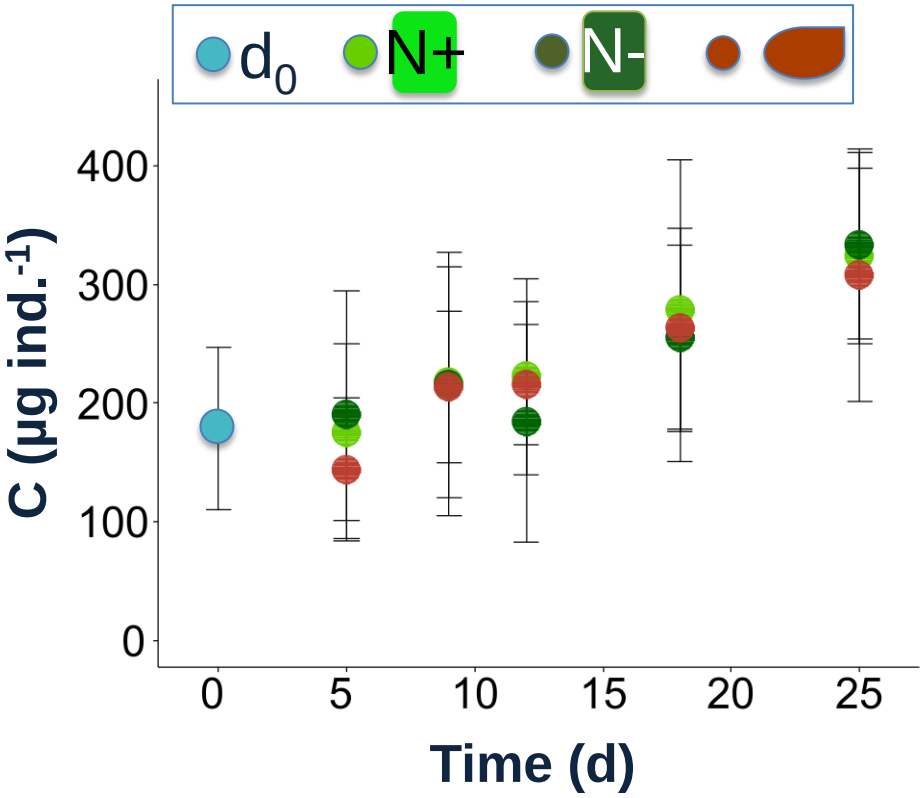
Ingestion

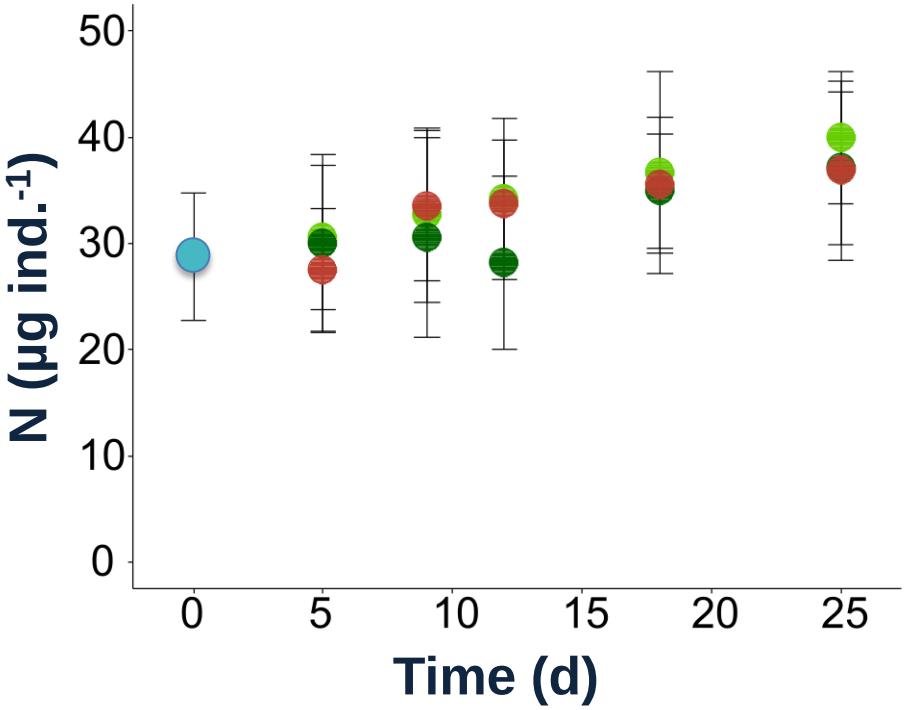




- C ingestion independent of food source
- Lowest N ingestion when feeding on N-limited diatom

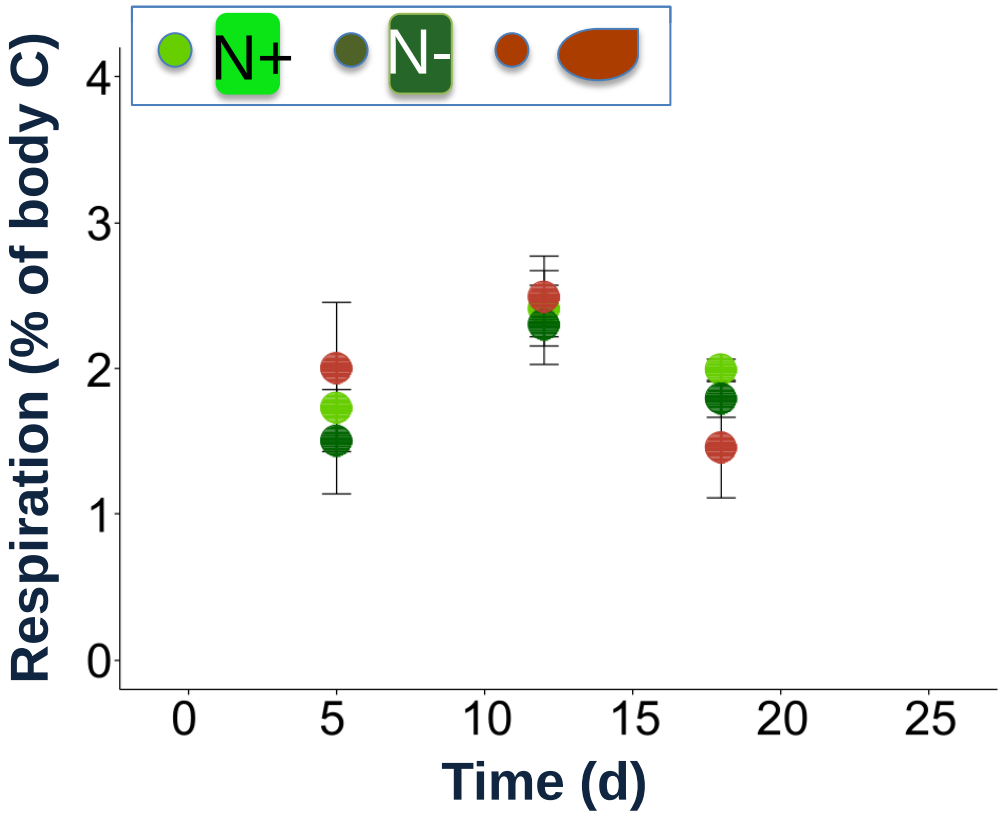
Somatic growth





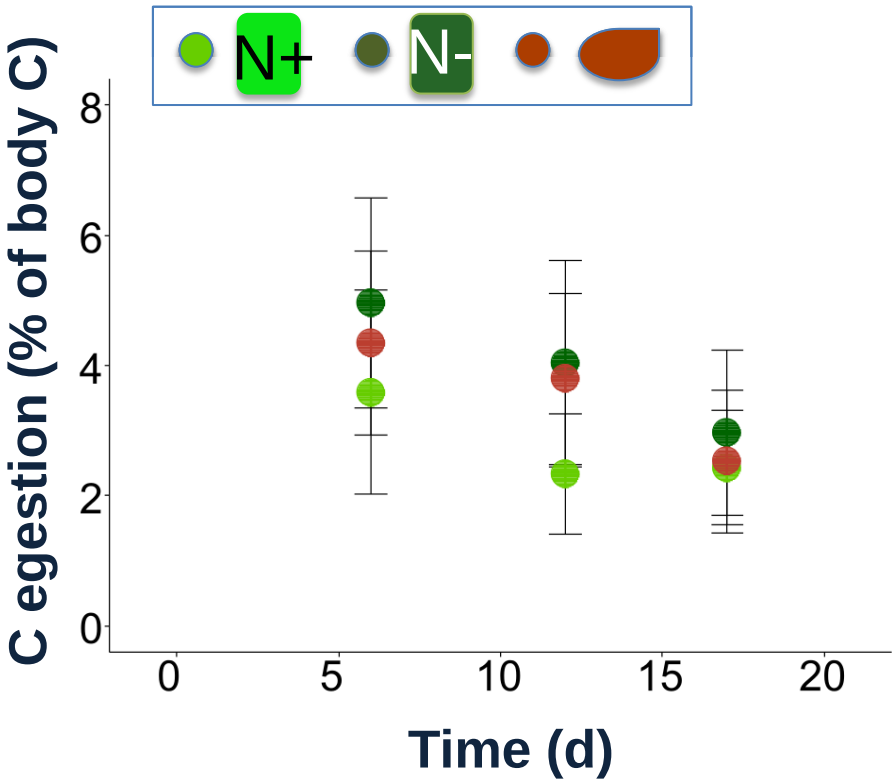
- Increase in C and N content independent of food source
- C:N ratio increased from 6 to > 8 in all copepods
- Suggests storage of lipids

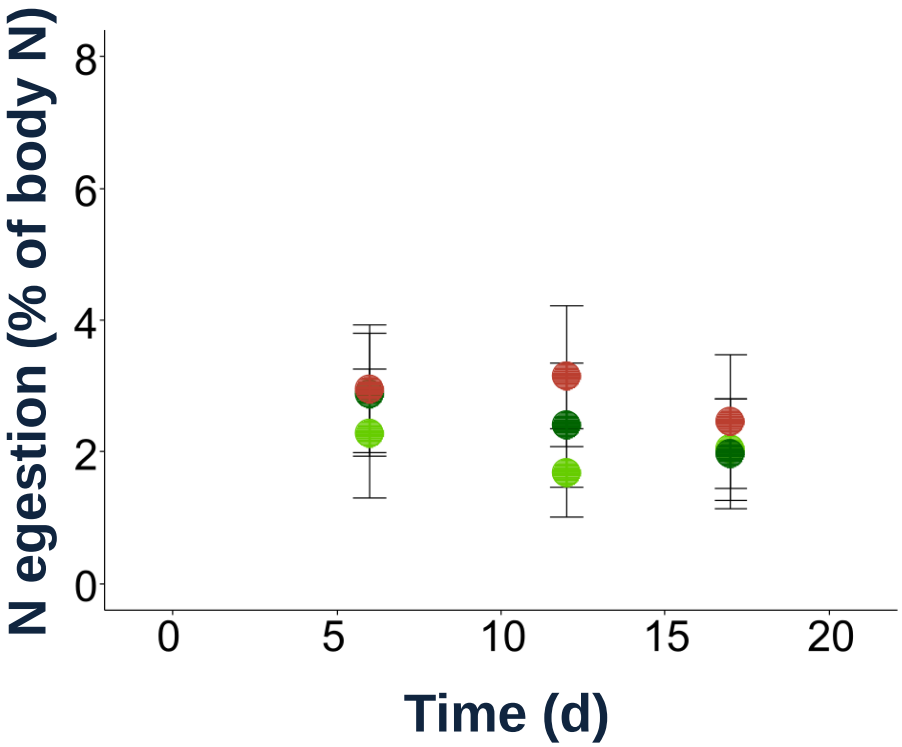
Respiration



- Respiration rate independent of food source

Egestion (faecal pellets)





- C egestion highest when feeding on N-limited diatom
- N egestion highest when feeding on *O. marina*
- Food source influenced faecal pellet C:N ratio

Budget of C and N

% of body C

	I	=	G	+	R	+	E	∂
N+	10.6		3.1		2.1		2.9	2.5
N-	11.2		3.3		1.9		4.0	2.0
	12.4		2.8		1.0		3.6	5.0

% of body N

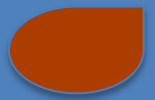
I	=	G	+	U	+	E	∂
15.3		1.5		na		2.0	11.8
6.7		1.1		na		2.3	3.3
17.5		1.1		na		2.9	13.5

- Egestion is likely main mechanism to discard excess C
- Excretion is likely main mechanism to discard excess N

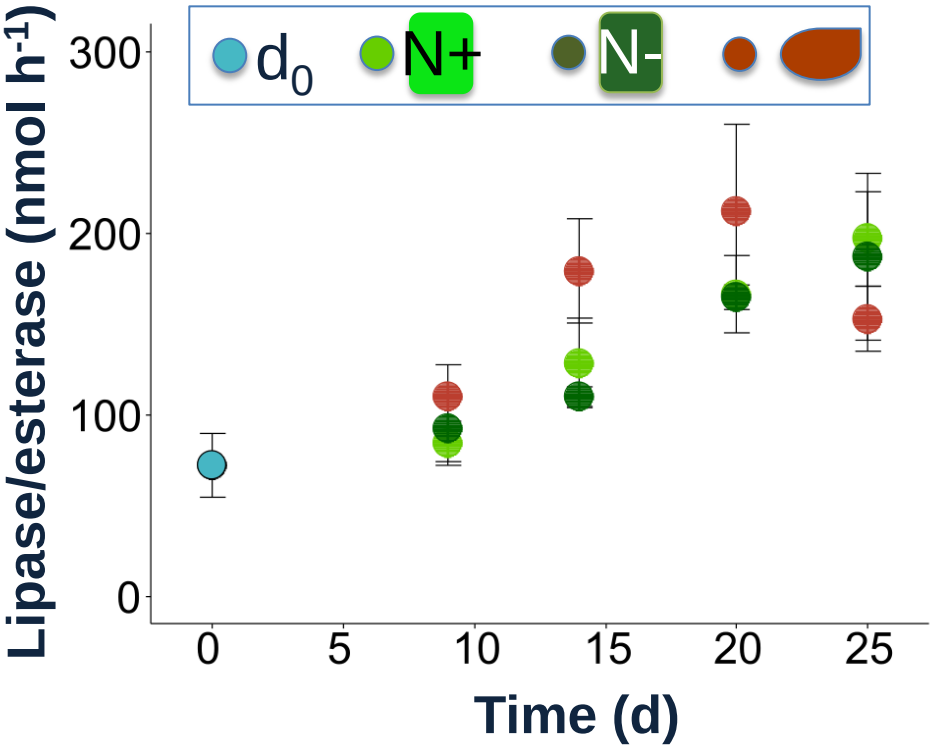
Assimilation efficiency (AE)

$$AE = \frac{(\text{Respiration} + \text{Egestion} + \text{Growth})}{\text{Ingestion}} * 100$$

(Båmstedt *et. al* 2000)

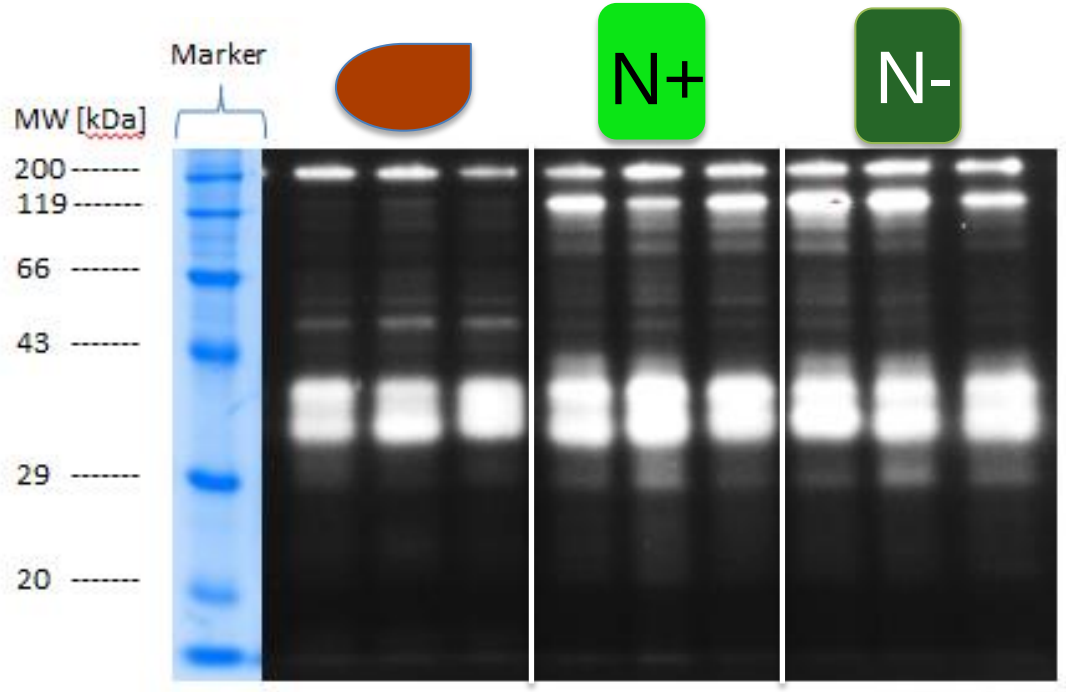
	N+	N-	
AE of carbon (%)	70	77	65
C:N ratio food	4.5	11.4	4.4
C:N ratio animals (end)	8.0	8.9	8.2
C:N ratio faecal pellets	8.8	10.8	7.5

Lipase/esterase activity



- Lipase/esterase activity increased over time
- Indicates lipid-based metabolism

Lipase/esterase patterns



- Food quality affected enzymes patterns after 25 days
- *Calanus glacialis* CV adapts to food quality by synthesizing different isoenzymes

Conclusions

- *Calanus glacialis* CV increased in body mass in all treatments
- Copepods were not homeostatic but increased in C:N ratio, likely due to lipid accumulation
- Respiration rates did not contribute to discard excess C
- Egestion and excretion balanced the C:N ratio
- Synthesis of specific isoenzymes contributed to the adjustment to feeding on food of different quality

Calanus glacialis CV coped well with food of different quality

This suggests that they have the capacity to adapt to changes in the food regime

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Calanus glacialis CV can cope with food of different quality

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