Physiological response to short-term starvation in an abundant krill species of the Northern Benguela Current, *Euphausia hanseni*

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Introduction

Krill occupy a central role in oceanic food webs as consumers as well as producers. They are a major source of nutrition to fish, birds, seals, and whales. A change in a krill population may thus have dramatic impacts on ecosystems.

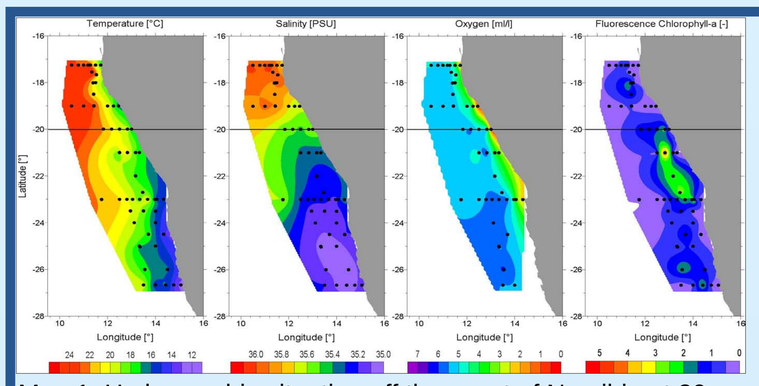
Within the zooplankton community, *Euphausia hanseni* belongs to one of the most abundant krill species of the Northern Benguela Current (Olivar and Barange 1990; Barange et al. 1991).

The aim of this study was to investigate specific adaptations within the life strategy of *E. hanseni*. The animals rely on upwelling pulses that lead to rich plankton patches as a food source. The Benguela Current system is a nutritionally poly-pulsed and stratified environment. During late austral summer, the region is typically characterized by minimum upwelling (Hagen et al. 2001) which goes along with short periods of food deprivation.

The following questions shall be answered:

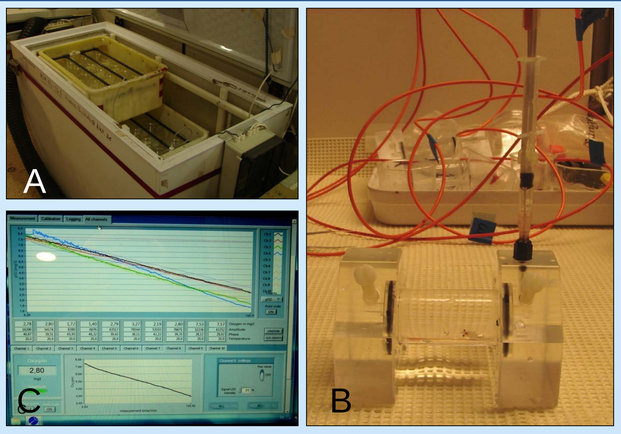
How does *E. hanseni* metabolically adjust during a period of starvation, i.e. between upwelling pulses?

Are there metabolic differences in krill influenced by different water masses (cold Benguela Current and warm Angola Current)?

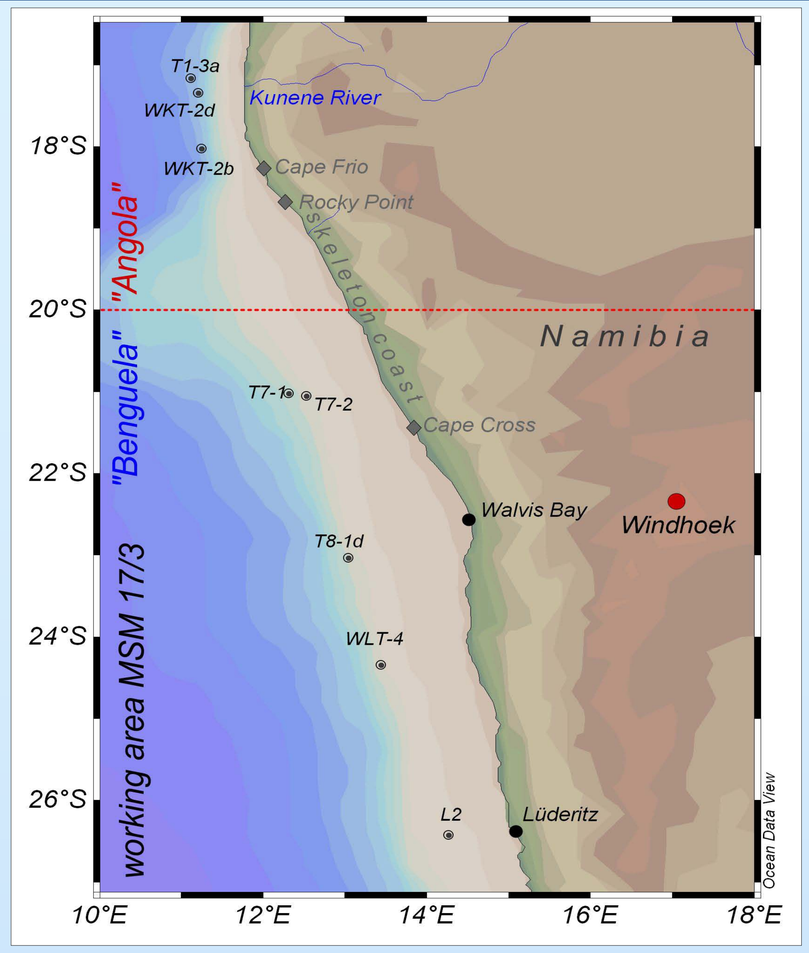


Map 1: Hydrographic situation off the coast of Namibia at 20 m depth. Image is based on CTD data and was created by GENUS-subproject “Physical Oceanography” (Mohrholz et al. 2011).

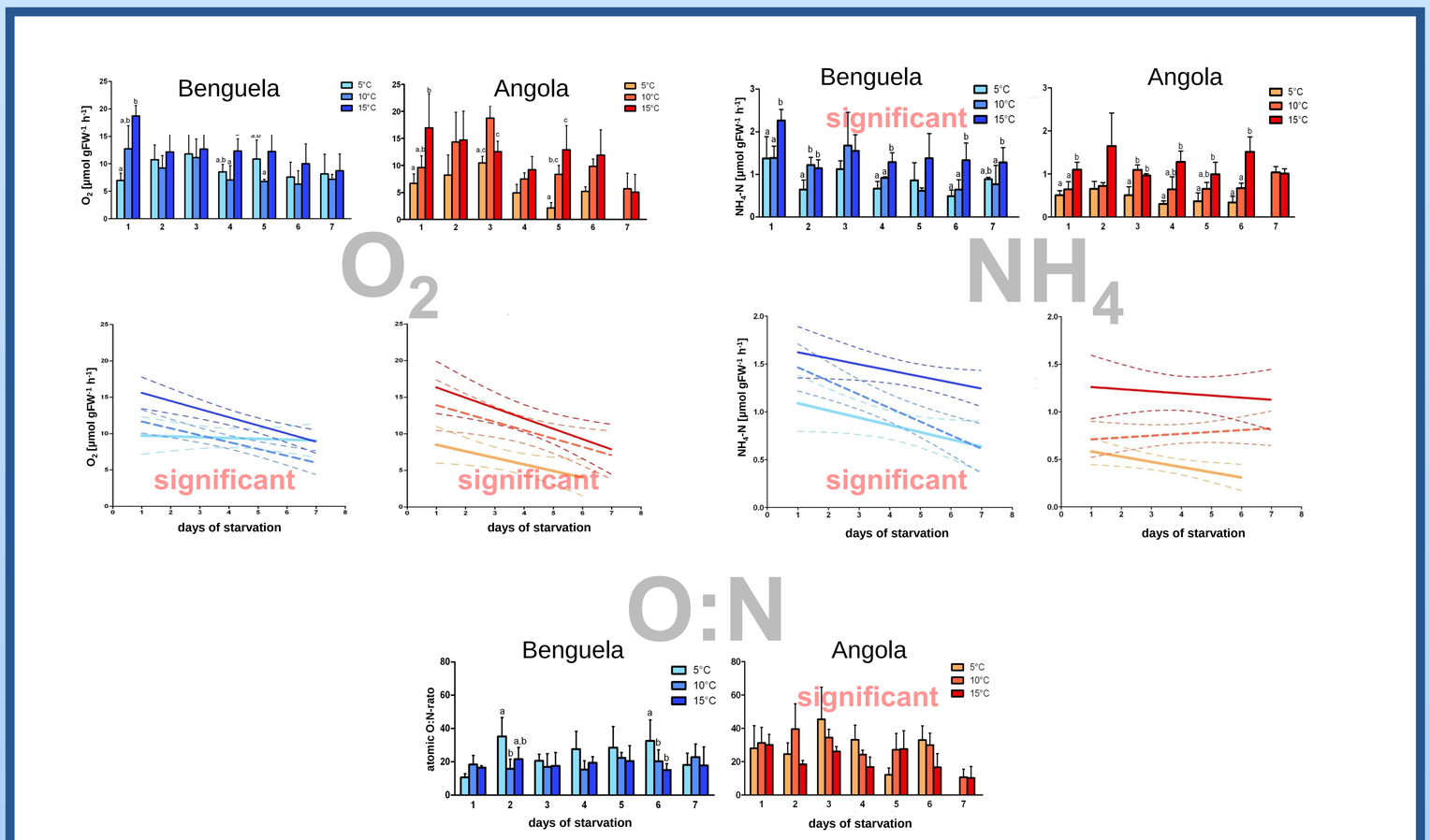
Experimental Design

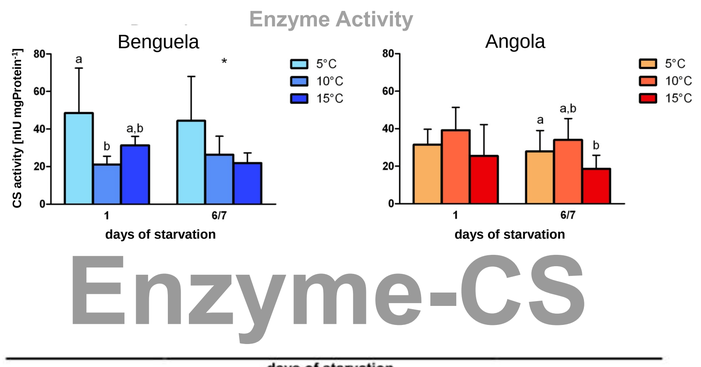


A) Maintenance of krill during starvation experiment (n=48)
B) Krill in respiration chamber with oxygen sensor
C) Respiration measured over time displayed



Map 2: Stations sampled in austral summer 30.01- 7.08.2011 during research cruise of Maria S. Merian (MSM) leg 17/3.
Red dotted line shows border between samples taken from Northern Benguela Current and from Angola Current influenced water masses.

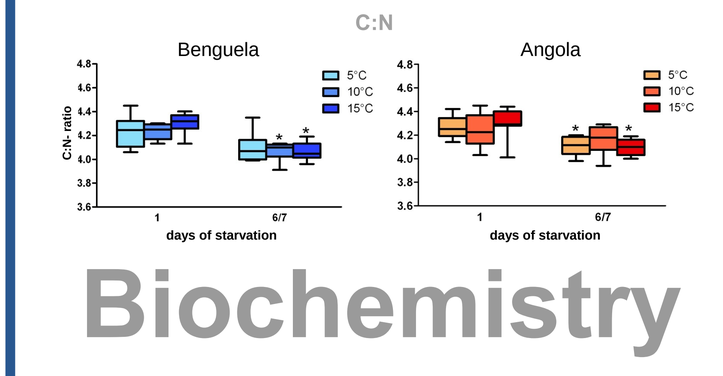




Enzyme-CS

	days of starvation 1	days of starvation 6/7	T-Test
E. hanseni Benguela	16.16 ± 3.15	14.62 ± 4.6	n.s.
Enzyme Efficiency			
E. hanseni Angola	11.75 ± 3.13	9.35 ± 2.72	n.s.
significant			
T-Test	0.0450	0.0361	

Table 1: Michaelis-constants of citrate synthase (CS).
Means ± standard deviations are given in Km[µmol Acetyl- CoA L-1].



Biochemistry

	days of starvation 1	days of starvation 6/7	days of starvation 1	days of starvation 6/7
E. hanseni Benguela	8.9 ± 2.0	7.9 ± 1.8	57.3 ± 4.8	58.5 ± 1.7
	Lipids		Proteins	
E. hanseni Angola	8.7 ± 2.5	8.4 ± 2.3	56.1 ± 0.9	56.7 ± 2.0

Table 2: Proximate biochemical composition.
Given are means ± standard deviation [% gDW-1].

Results

Observations during short-term starvation of 7 days

- significant decrease in **oxygen consumption rates**
- significant decrease of **ammonium excretion rates** in krill from **Benguela region**
- significant decrease of **atomic O:N - ratio** in krill from **Angola region**
- decreasing trend in **proximate biochemical composition**
- decreasing trend in **citrate synthase activity**
- increasing trend in **citrate synthase efficiency**

Benguela Angola

O_2 ↓ ↓

NH_4 ↓ ●

O:N ● ↓

C:N ↓ ↓

$CS_{activity}$ ↓ ↓ $CS_{efficiency}$ ↑ ↑

TP 7 GENUS

NH_4 ↓ ●

O:N ● ↓

$CS_{ef.}$ ↓ ●

Differences between regions

- **significantly lower** ammonium excretion rates of krill from **Angola region**
- **significantly higher** atomic O:N - ratios of krill from **Angola region**
- **significantly higher** CS efficiency in krill from **Angola region**

Conclusion

E. hanseni **adapt fast** to food deprivation by down-regulating metabolic parameters in order to **remain metabolically efficient** over longer times.

Krill’s physiological response to short-term starvation differed with regard to the region (Benguela/Angola). Krill from Angola Current influenced water masses **reacted more sensitively** probably having been previously exposed to unfavourable trophic conditions.

CS activity showed a decreasing trend whereas the turn-over efficiency increased over the period of starvation assuming a **compensatory effect** (Buchholz & Saborowski 2000, 2002).

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