Life cycle strategies of dominant Antarctic calanoid copepods in late winter/early spring

Sigrid Schnack-Schiel\textsuperscript{1}, Franz Josef Sartoris\textsuperscript{1}, Astrid Cornils\textsuperscript{1}, Stathys Papadimitriou\textsuperscript{2}, David N. Thomas\textsuperscript{2}

\textsuperscript{1}Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven, Germany
\textsuperscript{2}Ocean Sciences, University of Wales-Bangor, UK
Polar ocean ecosystems
Distinct seasonality in primary production

Many polar copepod species are feeding on phytoplankton
How do they survive the polar winter when food is extremely sparse in the water column?
Overwintering strategies

Overwintering in greater depth, non-feeding
Calanoides acutus  Rhincalanus gigas

Overwintering in mid-water layers and/or surface, active feeding on ice algae, protozoans, metazoans, aggregates

5 mm  © I Arndt

8 mm  © E Varescchi
Overwintering strategies

Overwintering in greater depth, non-feeding

Calanoides acutus
Rhincalanus gigas

Overwintering in mid-water layers and/or surface, active feeding on ice algae, protozoans, metazoans, aggregates

Calanus propinquus
Ctenocalanus citer

Metridia gerlachei
Microcalanus pygmaeus

5 mm © C. Dubischar
4 mm © E. Mizdalski
Overwintering strategies

Overwintering in greater depth, non-feeding

*Calanoides acutus*  
*Rhincalanus gigas*

Overwintering in mid-water layers and/or surface, active feeding on ice algae, protozoans, metazoans, aggregates

*Calanus propinquus*  
*Metridia gerlachei*  
*Ctenocalanus citer*  
*Microcalanus pygmaeus*  
*Stephosa longipes*  
*Paralabidocera antarctica*

Overwintering in sea ice, feeding and near the seafloor

5 mm  
4 mm  
© E. Mizdalski

© Ingo Arndt
Cruise track and investigation area

ANT XXIII/7

Cape Town - Cape Town
24.08. - 29.10.2006

Total distance covered:
9668 nm
Main topics

- Life cycle strategies of copepods during the winter - spring transition
- How do resting and non-resting species differ in their physiological status?
Sampling gear

**Multinet**

**XL**
- mouth area: 0.25 m²
- 5 nets, 100 µm

**XXL**
- mouth area: 0.5 m²
- 9 nets, 100 µm

±2000 m

Formaldehyde
Ethanol
Experiments
Physiology, Biochemistry
Field studies
- distribution
- diversity
- population structure

Experiments
- ingestion
- excretion
- respiration
- reproduction

Biochemistry
- C:N
- stable isotopes
- lipids
- proteins

Physiology
- inorganic ions
  - (Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺)
- anions
Abundance and age structure

Abundance (n 100 m$^{-3}$)

Frequency (%)

Developmental stages

- Male
- Female
- CV
- CIV
- CIII
- CII

C. acutus

C. propinquus

R. gigas

M. gerlachei
Vertical distribution

**Calanoides acutus**

**Abundance (Ind 100 m⁻³)**

- **CIII**
- **CIV**
- **CV**
- **Adults**

**Metridia gerlachei**

Depth (m)

- 0
- 500
- 1000
- 1500
- 2000

Depth (m)

- 0
- 100
- 200
- 300

- Females
- Males
Respiration

**Calanoides acutus females**

<table>
<thead>
<tr>
<th>µL O₂ ind⁻¹ d⁻¹</th>
<th>10</th>
<th>8</th>
<th>6</th>
<th>4</th>
<th>2</th>
<th>0</th>
</tr>
</thead>
</table>

- Sep 9
- Sep 20
- Oct 1
- 2006

Depth (m):
- 700-500
- 1000-700
- 1500-1000
- 2000-1500

QuickTime™ and a None decompressor are needed to see this picture.
Calanoides acutus (inactive in winter) in early September between 1500 - 1000m (CV), in late October between 700 - 300m (females) non-feeding, non-reproducing in early September lower respiration rate at greater depth, lower respiration in early September than in late October

Calanus propinquus (active in winter) in upper water layers feeding and reproducing
Field studies
- distribution
- diversity
- population structure

Experiments
- ingestion
- excretion
- respiration
- reproduction

Biochemistry
- C:N
- stable isotopes
- lipids
- proteins

Physiology
- inorganic ions
  - (Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺)
- anions
Why magnesium?

In decapods

low activity high

high magnesium low

In copepods?

Hypothesis
Higher [Mg++] in inactive species in winter?
Seawater

C. propinquus (active)

C. acutus (inactive)
High ammonium values in *Calanoides acutus* and *Rhincalanus gigas* but not in *Calanus propinquus*, *Paraeuchaeta exigua*, or *Stephos longipes*.
Summary

Expectation

Higher $[\text{Mg}^{++}]$ in „winter inactive species“ ($C. \text{ acutus}$) than in „winter active species“ ($C. \text{ propinquus}$)

What we found

No higher levels of magnesium

High amounts of ammonia in „winter inactive species“, no ammonia in the active species

buoyancy ?
Acknowledgement

Many thanks to:

Crew of RV Polarstern
Ruth Alheit
Kerstin Nachtigall
Louiza Norman

Sloan Foundation
Census of Marine Zooplankton
Thanks for your attention