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

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Polar ocean ecosystems
Distinct seasonality in primary production

Many polar copepod species are feeding on phytoplankton

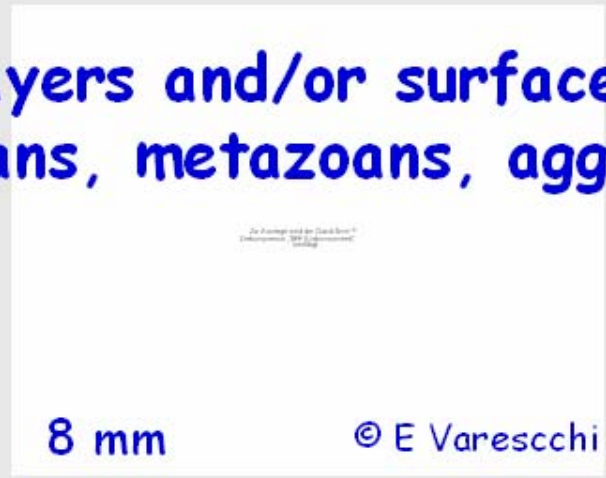
How do they survive the polar winter when food is extremely sparse in the water column?

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

Overwintering strategies

Overwintering in greater depth, non-feeding

Calanoides acutus

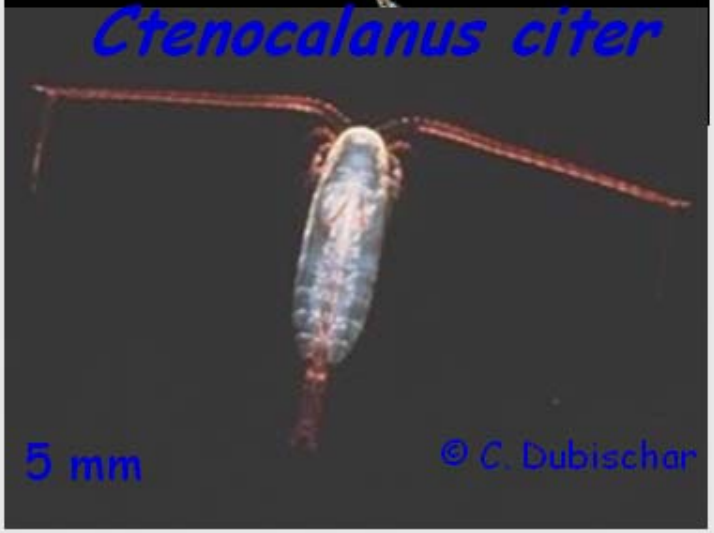
Rhincalanus gigas

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

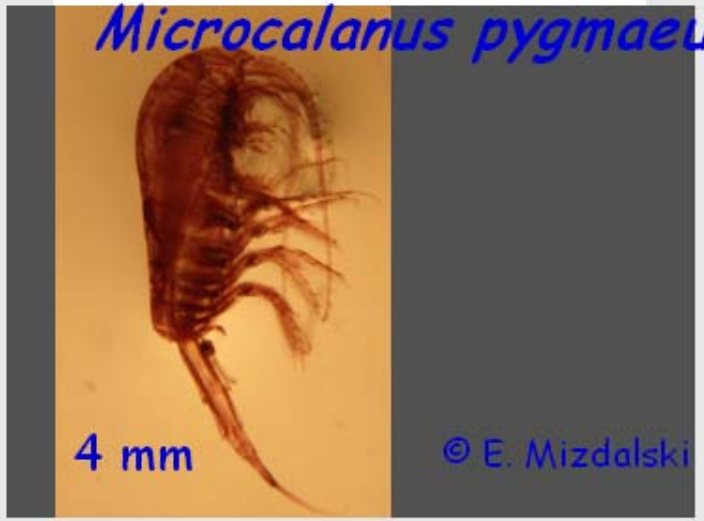
Calanus propinquus

Metridia gerlachei

Ctenocalanus citer



Microcalanus pygmaeus



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

Overwintering in sea ice, feeding

Stephos longipes

Paralabidocera antarctica

and near the seafloor ?

5 m

Dubischar

4 mm

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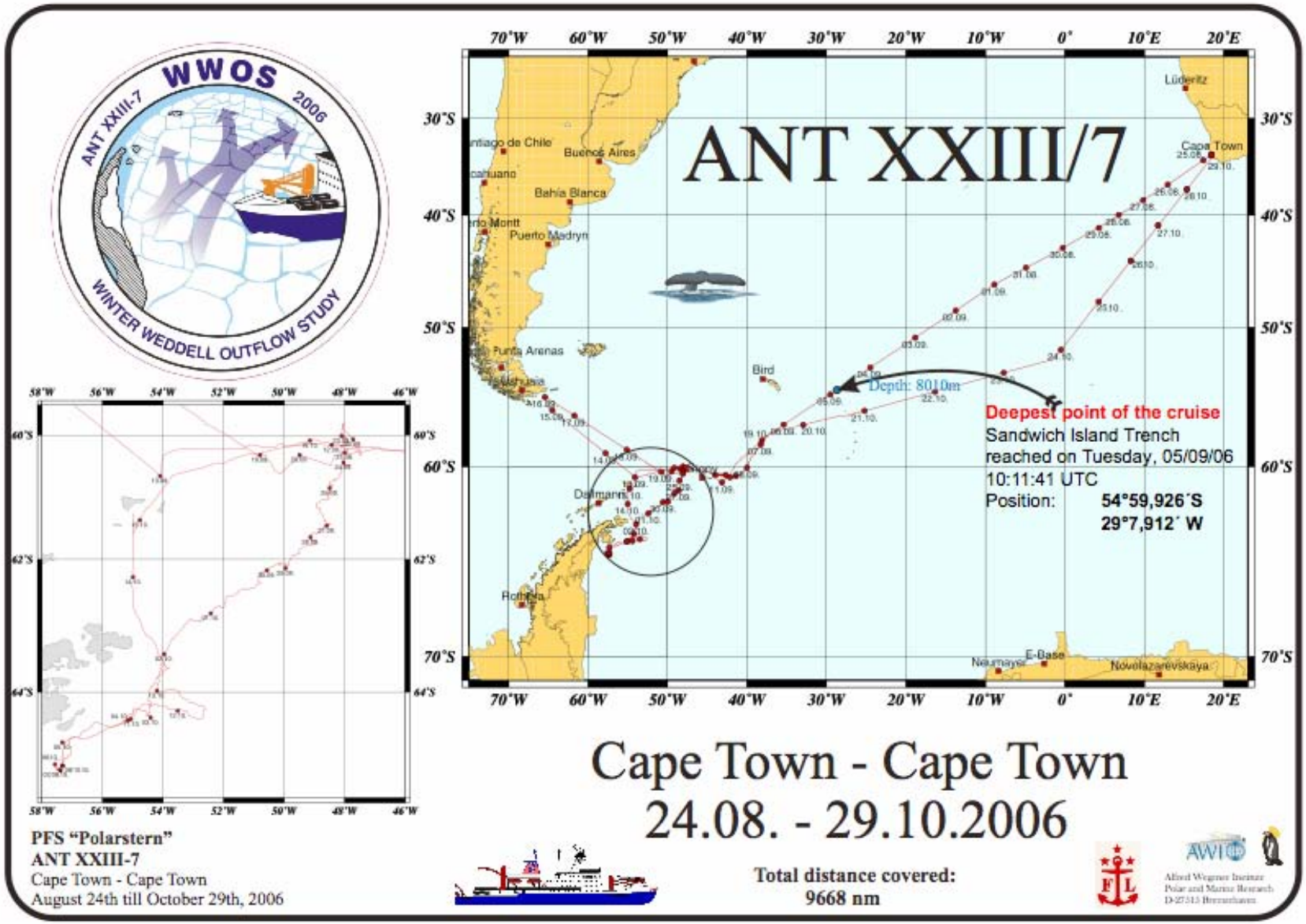
© Ingo Arndt

Cruise track and investigation area



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

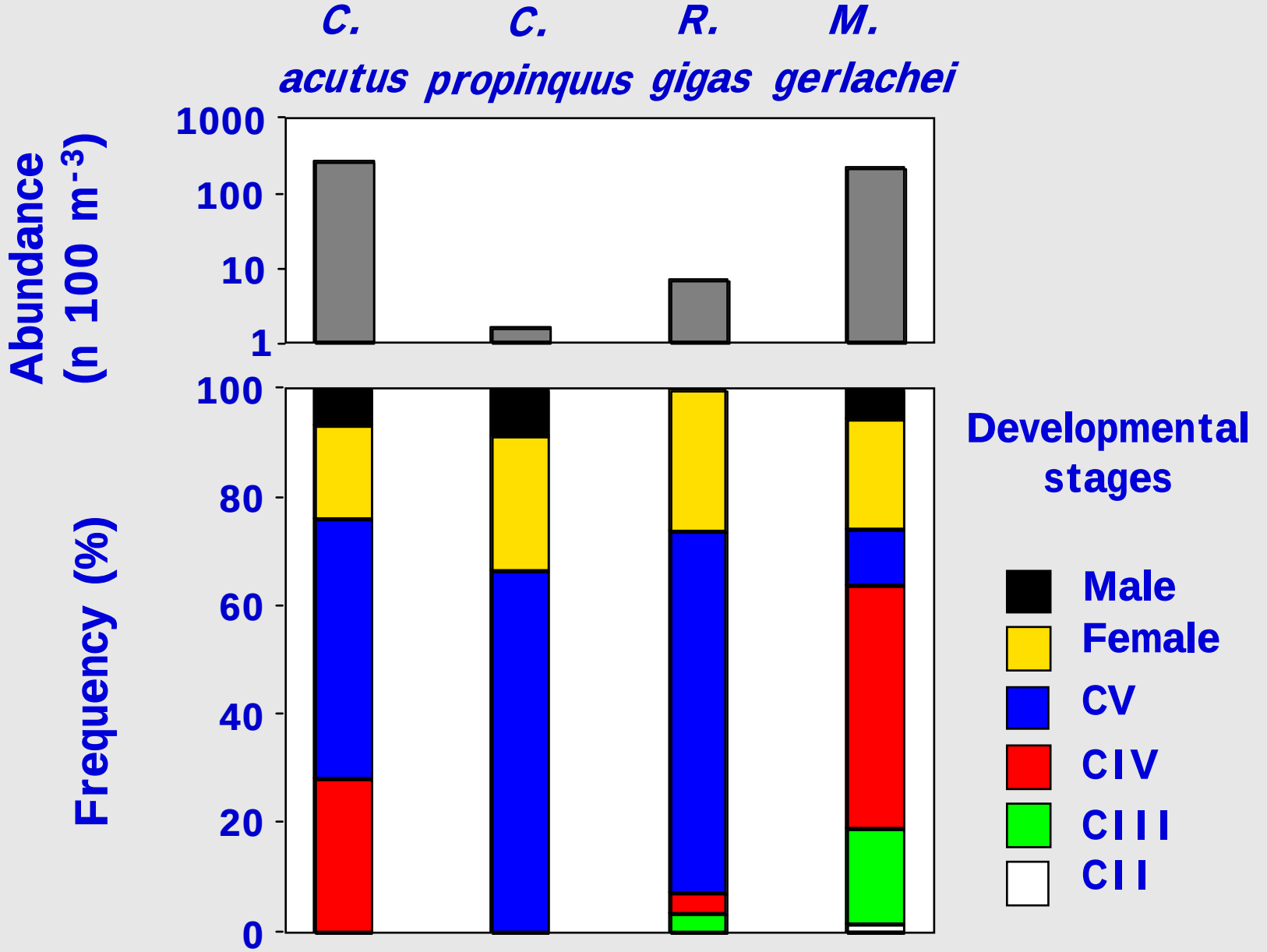
Biochemistry

- C:N
- stable isotopes
- lipids
- proteins

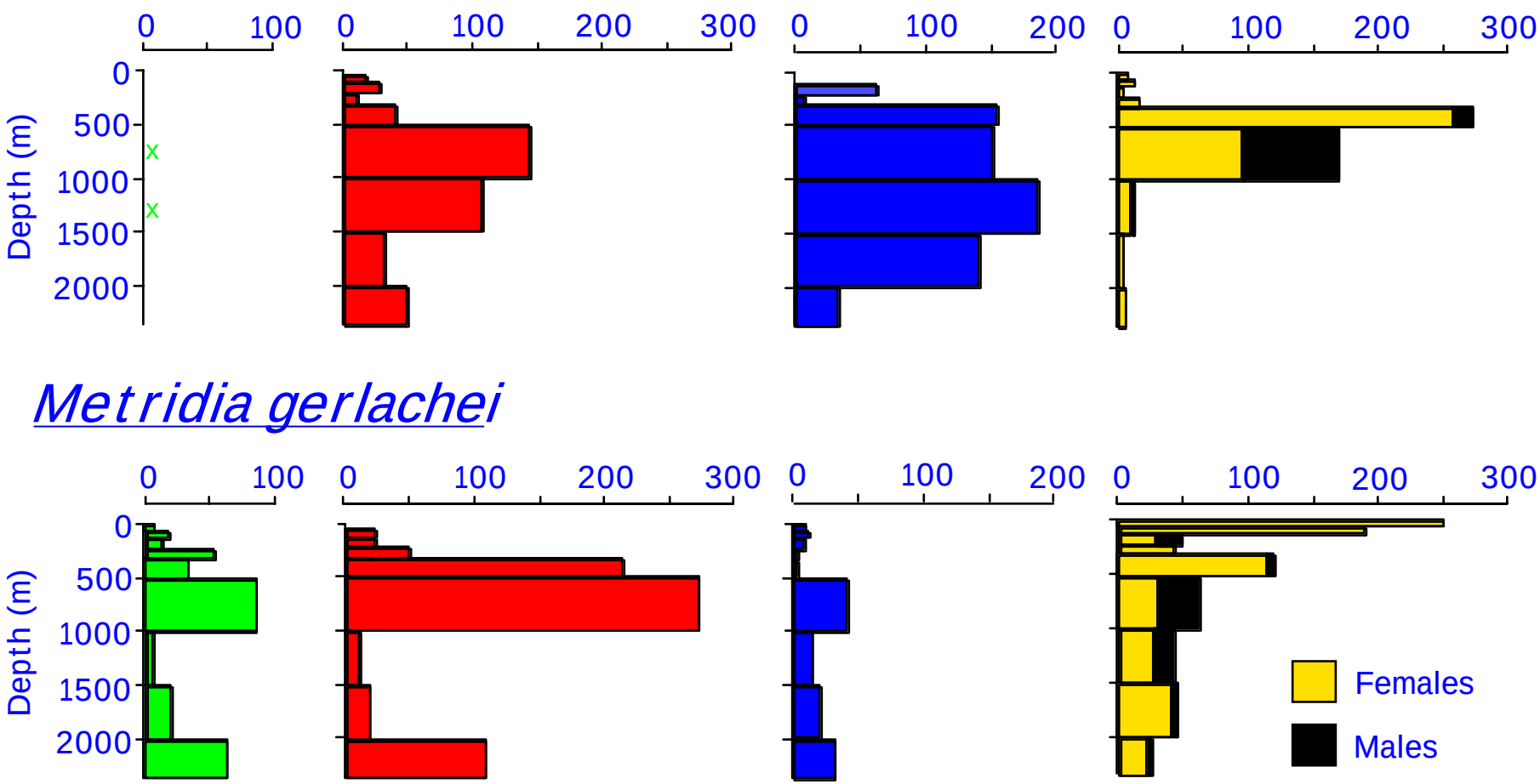
Physiology

- inorganic ions (Na^+, NH_4^+, K^+, Mg^{++}, Ca^{++})
- anions

Abundance and age structure

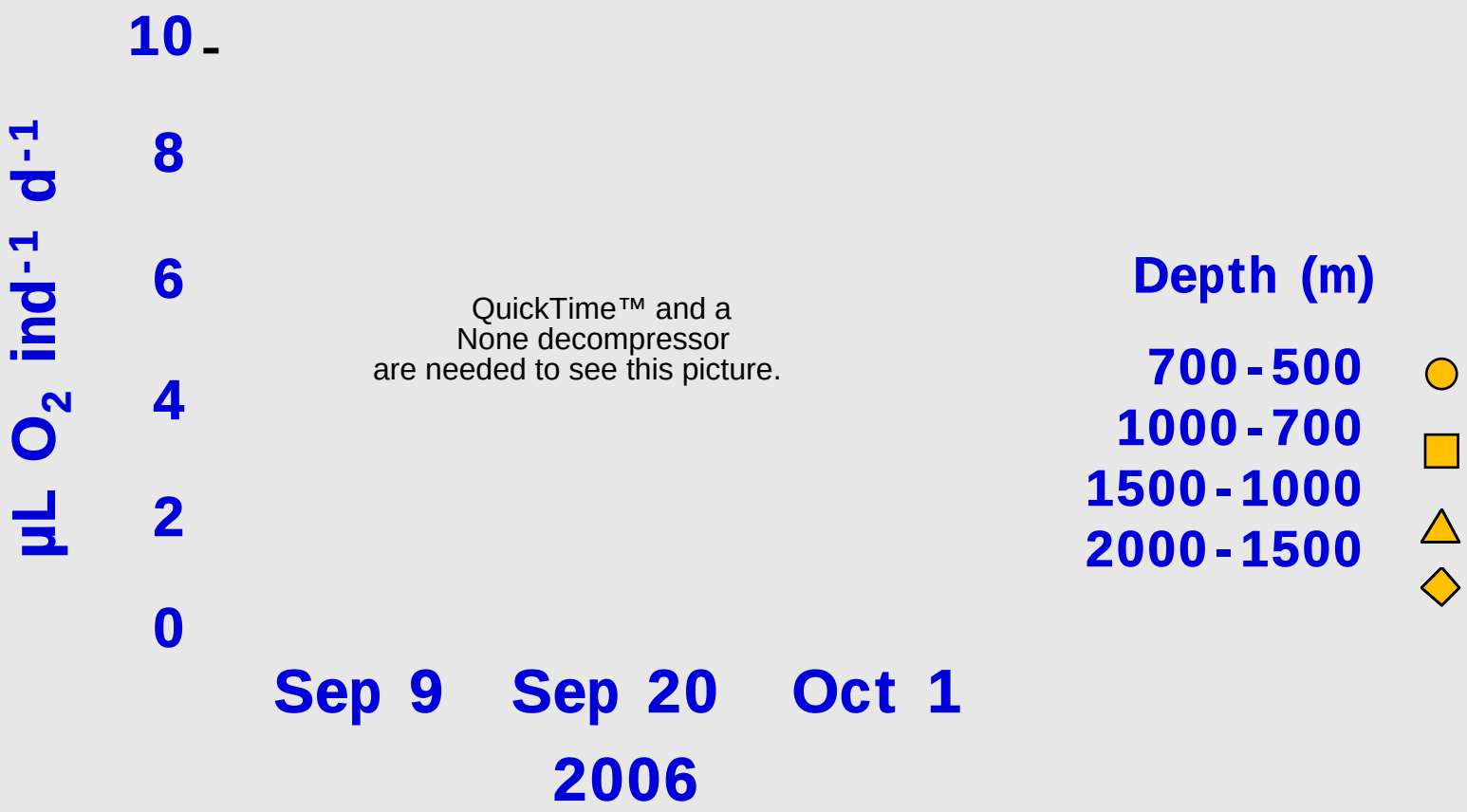


Vertical distribution



Respiration

Calanoides acutus females



Summary

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^+, NH_4^+, K^+, Mg^{++}, Ca^{++})
- anions

Why magnesium?

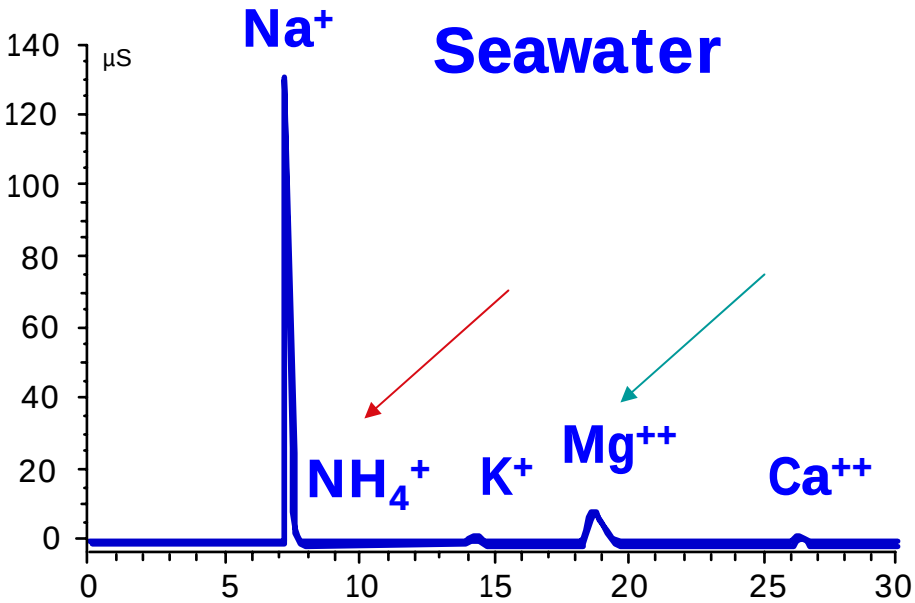
In decapods

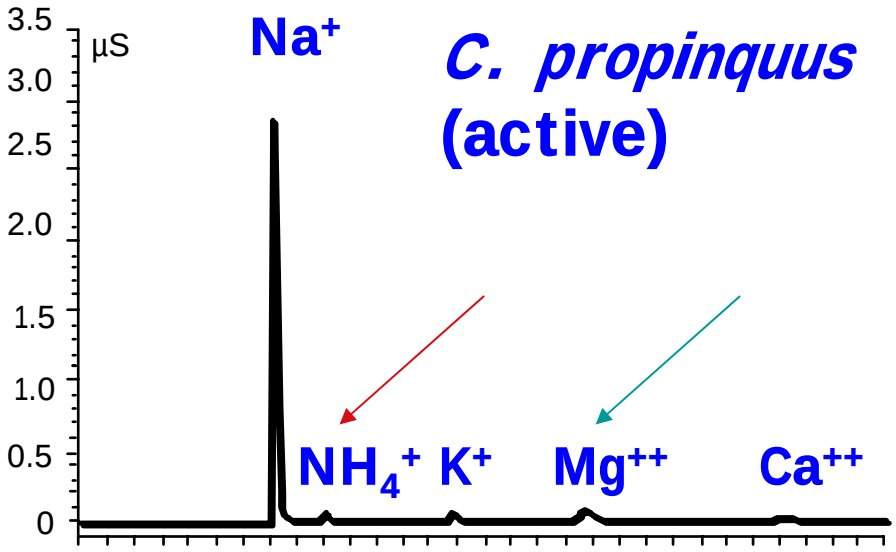
low activity high

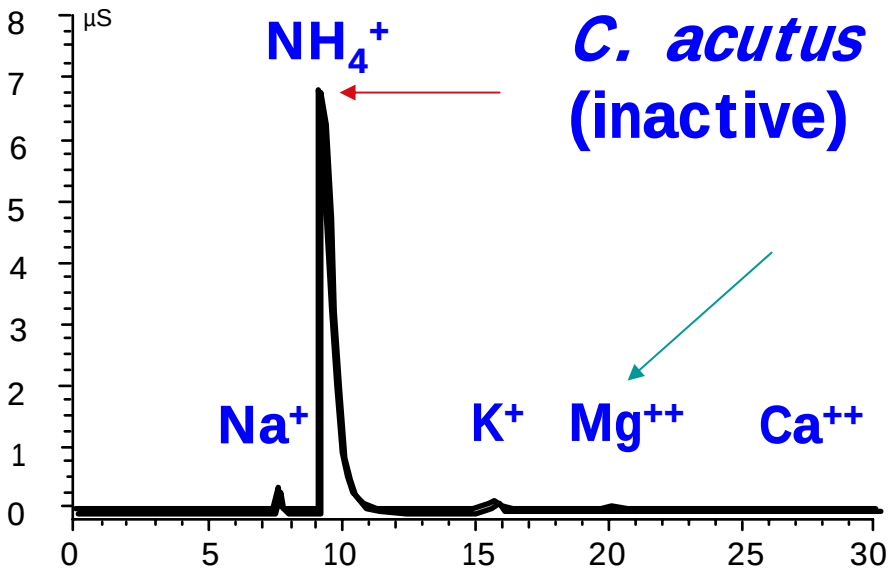
high magnesium low

In copepods ?

Hypothesis
Higher [Mg^{++}] in inactive species in winter?


Na+
Seawater
µS
140
120
100
80
60
40
20
0
0
5
10
15
20
25
30
NH4+
K+
Mg++
Ca++


Na+
C. propinquus
(active)
µS
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
NH4+
K+
Mg++
Ca++


NH4+
C. acutus
(inactive)
µS
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
Na+
K+
Mg++
Ca++

Ammonium

High ammonium values in

Calanoides acutus

Rhincalanus gigas

inactive overwintering

but not in

Calanus propinquus

Paraeuchaeta exigua

Stephos longipes

active overwintering

Summary

Expectation

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

What we found

No higher levels of magnesium

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

buoyancy ?

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Thanks for your attention