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Aquatic Sciences Meeting

Influence of pCO_2, temperature, and feeding on the extracellular pH of *Calanus glacialis* during diapause

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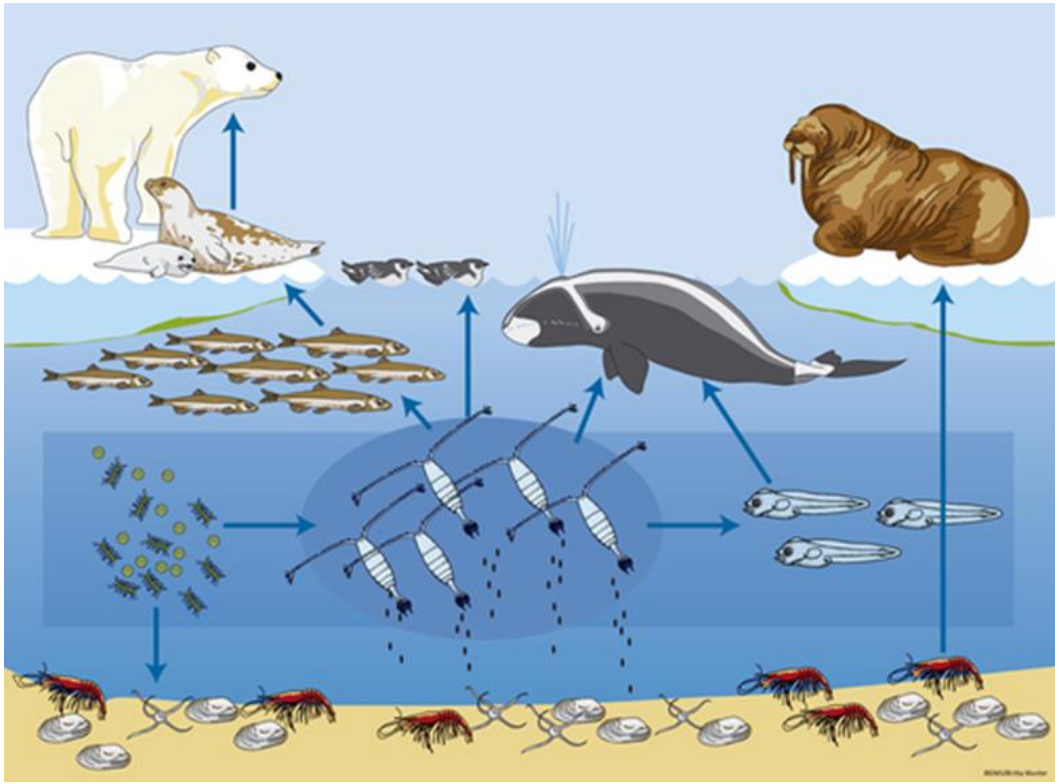
Copepods of the genus *Calanus*

- Important grazers of ice algae and phytoplankton
- Biomass can be > 80% of zooplankton community
- Store lipids in high quantities
- Important food source for fish, whales and birds



From: Greenland Institute of Natural Resources (2010)

Objectives

1. **To investigate the influence of environmental conditions on extracellular pH (pH_e) of *Calanus glacialis* during and at the end of the diapause**

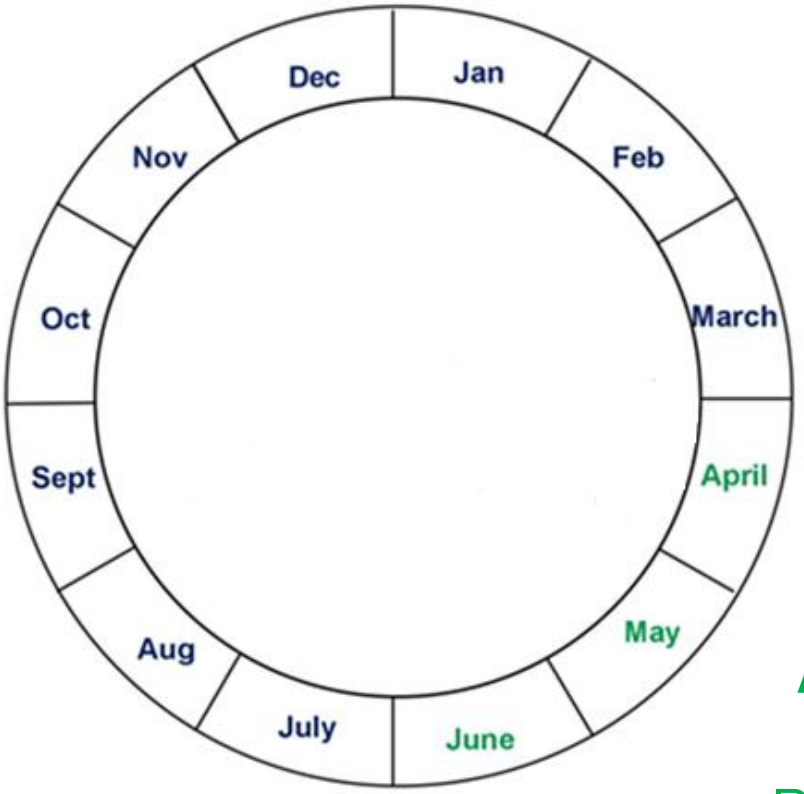
   Environmental conditions:
   - **Ocean acidification**
   - **Warming**
   - **Feeding**

2. **To compare pH_e in CV and ♀ to elucidate differences in developmental stage**

Life cycle of *Calanus glacialis*

Diapause

- Reduced development
- Reduced growth
- Reduced metabolism
- Starvation
- No locomotion



Activity

- Reproduction
- Feeding
- Growing
- Lipid accumulation

Modified from: Diel (1991)

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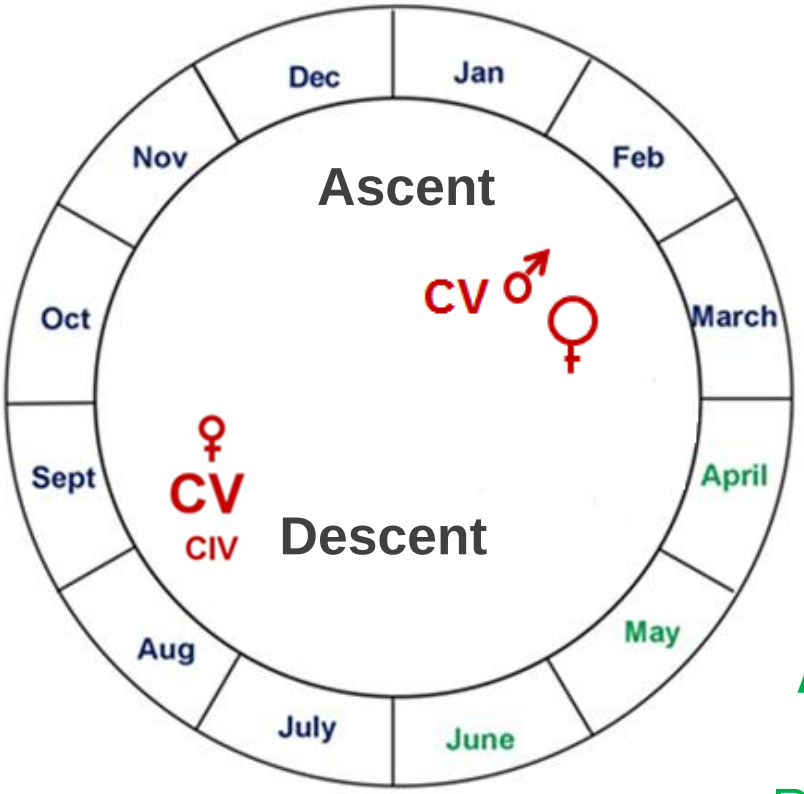

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- Reproduction
- Feeding
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Regulation of ions and pH_e

- Diapause conducted at depth

- **Ion regulation**
  - To reach neutral buoyancy
  - High density ions replaced by low density ions
  - Antarctic copepods replace Na^+ by NH_3 (Sartoris *et al.* 2010;Schründer *et al.* 2013)
  - NH_3 is toxic

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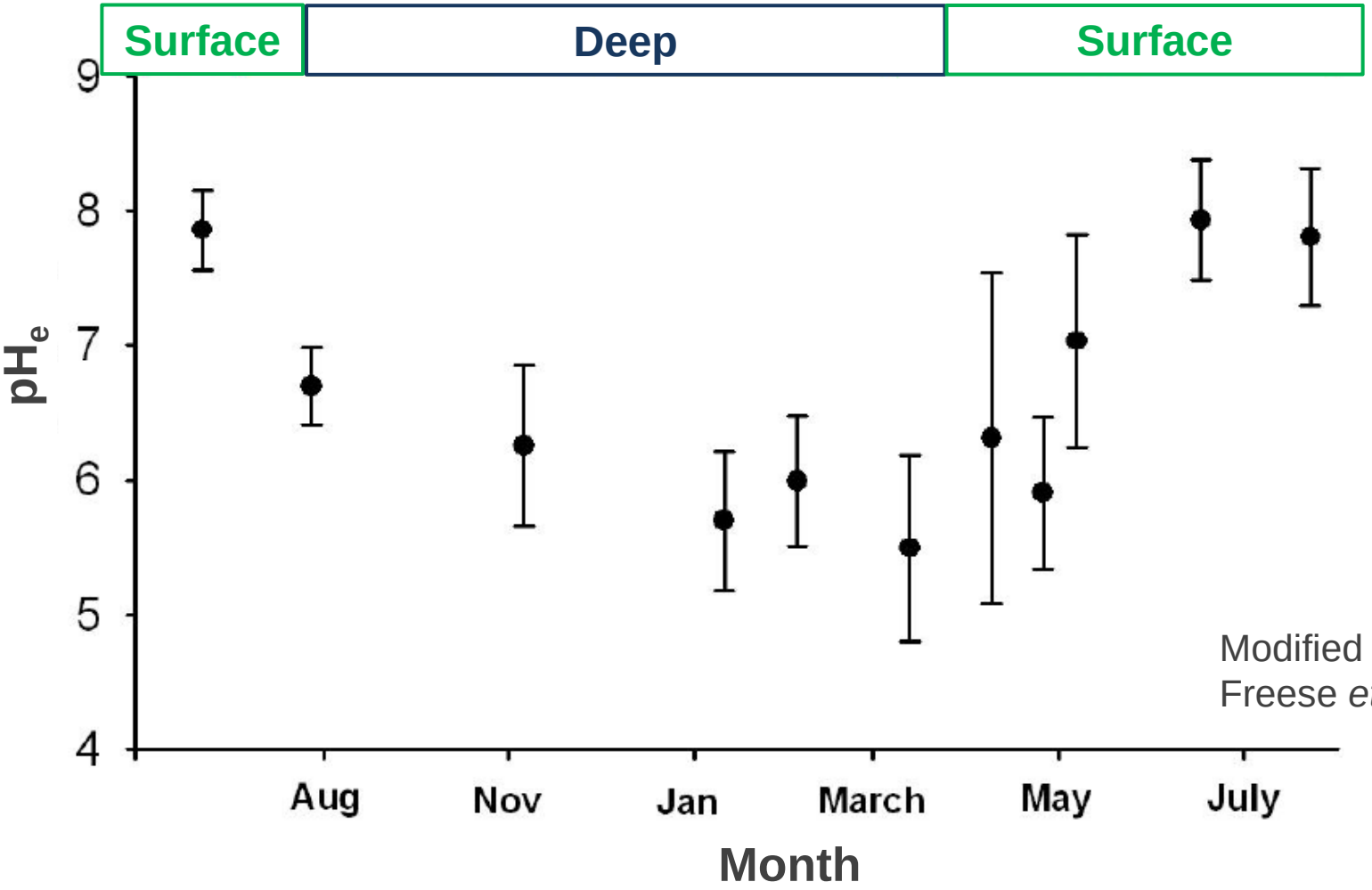
- **Regulation of pH_e**
  - To withstand toxicity
  - At low pH_e: NH_3 -> NH_4^+
  - NH_4^+ is not toxic
  - Low pH_e might trigger metabolic depression

- During winter (diapause) -> pH_e is low

Seasonality of pH_e in *C. glacialis* CV

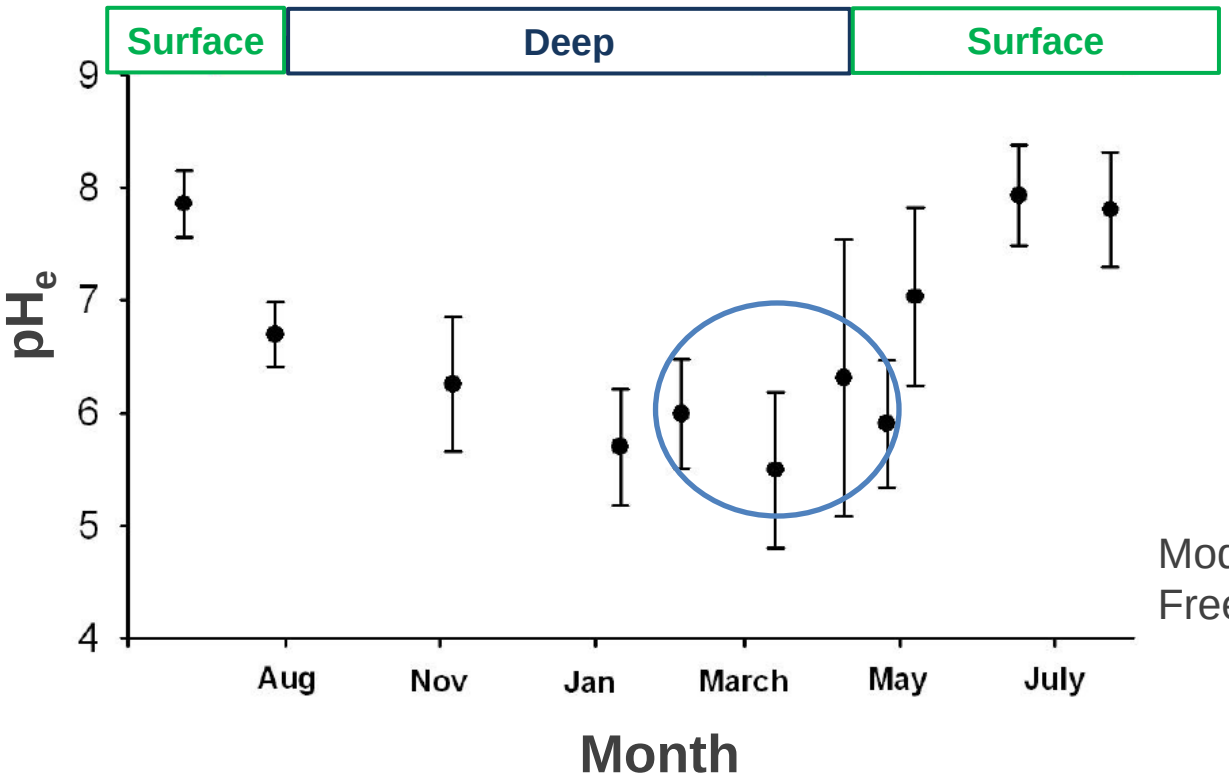
pH_e was low in autumn/winter and high in spring/summer



Modified from:
Freese *et al.* (submitted)

Climate change

- **Ocean acidification**: reduction of pH with 0.3 - 0.6 units (Povopa *et al.* 2014)
- **Warming**: increase in sea surface temperature (IPCC 2007)



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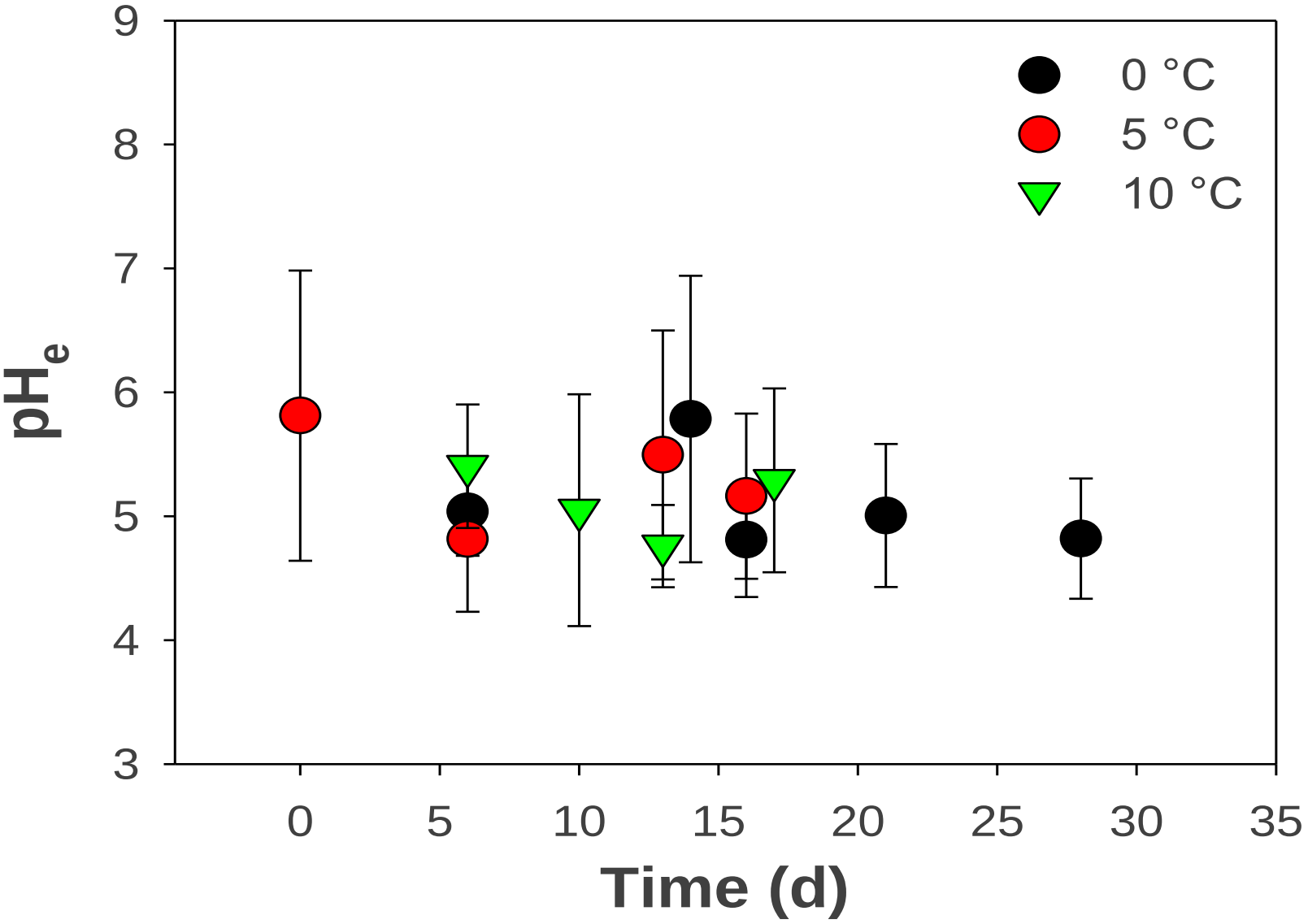
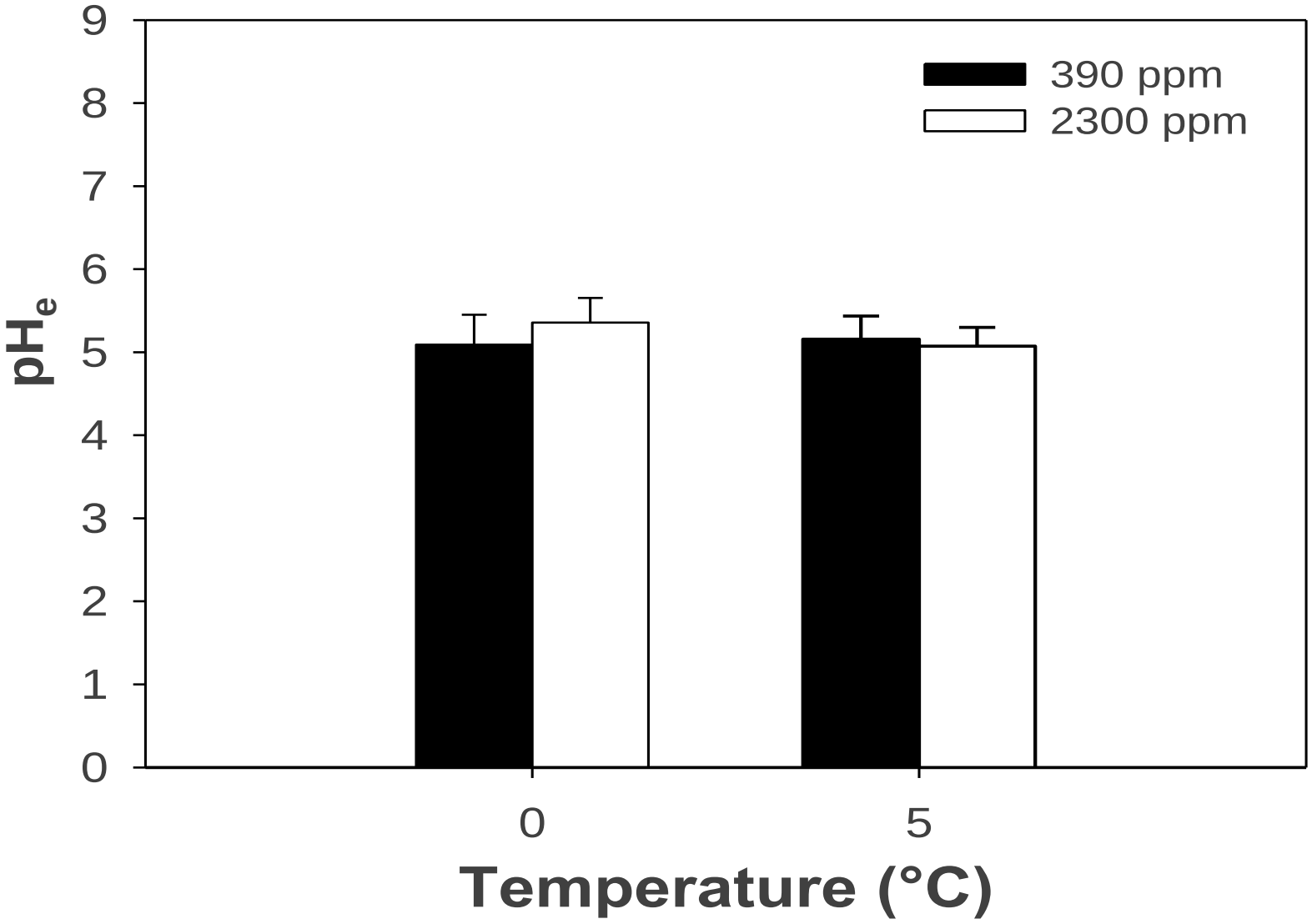
Experimental set-up

	Experiment 1: during diapause	Experiment 2: end diapause	Experiment 3: end diapause
Sampling area	Billefjorden	Billefjorden	Billefjorden
Sampling time	September 2013	January 2014	January 2014
Amount animals	3600	750	~ 200
Stage	CV	CV	♀
Species	*C. glacialis*	*C. glacialis*	*C. glacialis*
Incubation time (d)	15 – 30	31	37
Temperature (°C)	0, 5, and 10	0	0
***p*CO_2 (ppm)**	390 and 2300	500 and 1500	-
Food available	no	no	yes / no

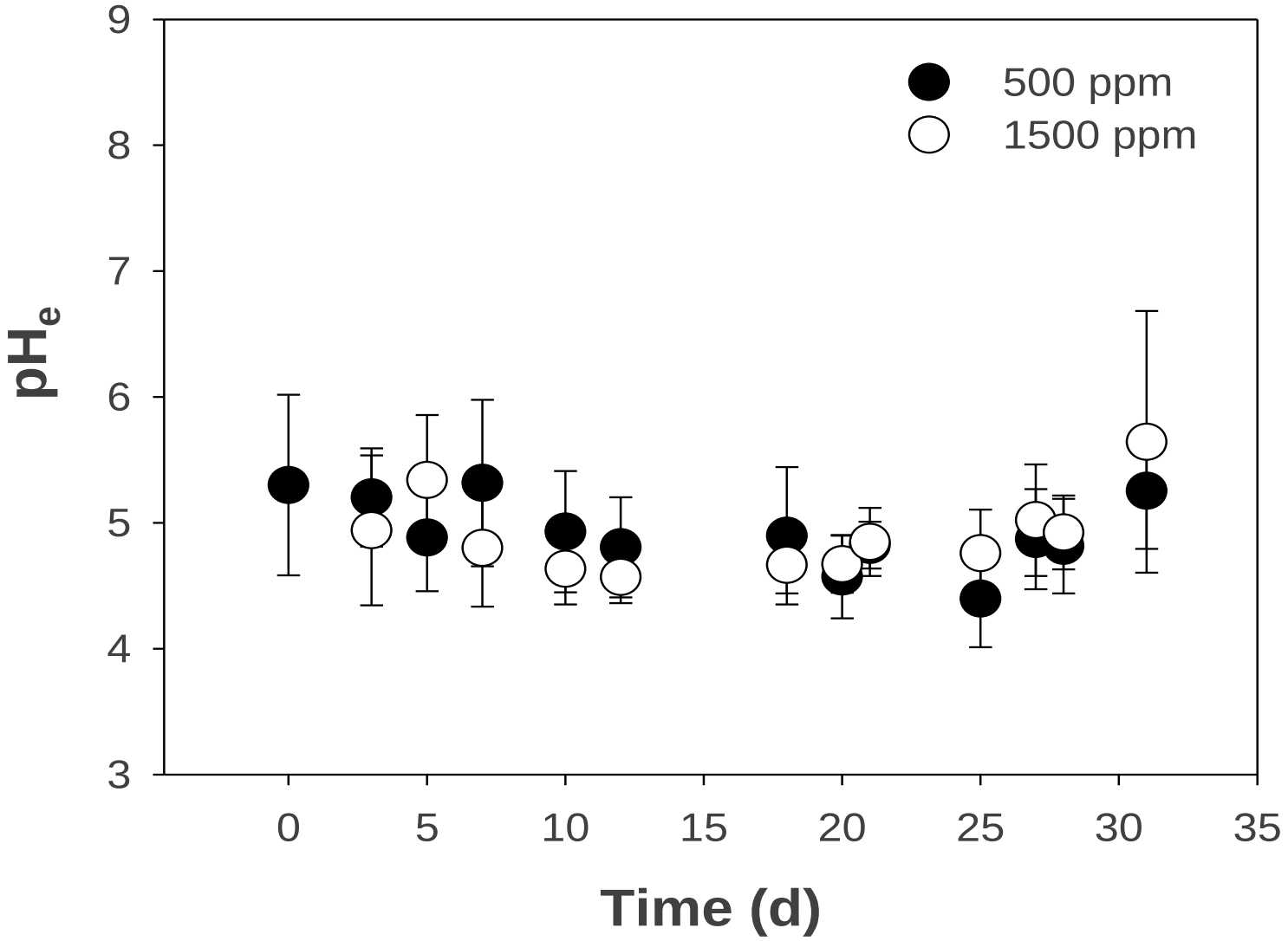
Results: No influence of temperature on pH_e during the diapause (exp.1)



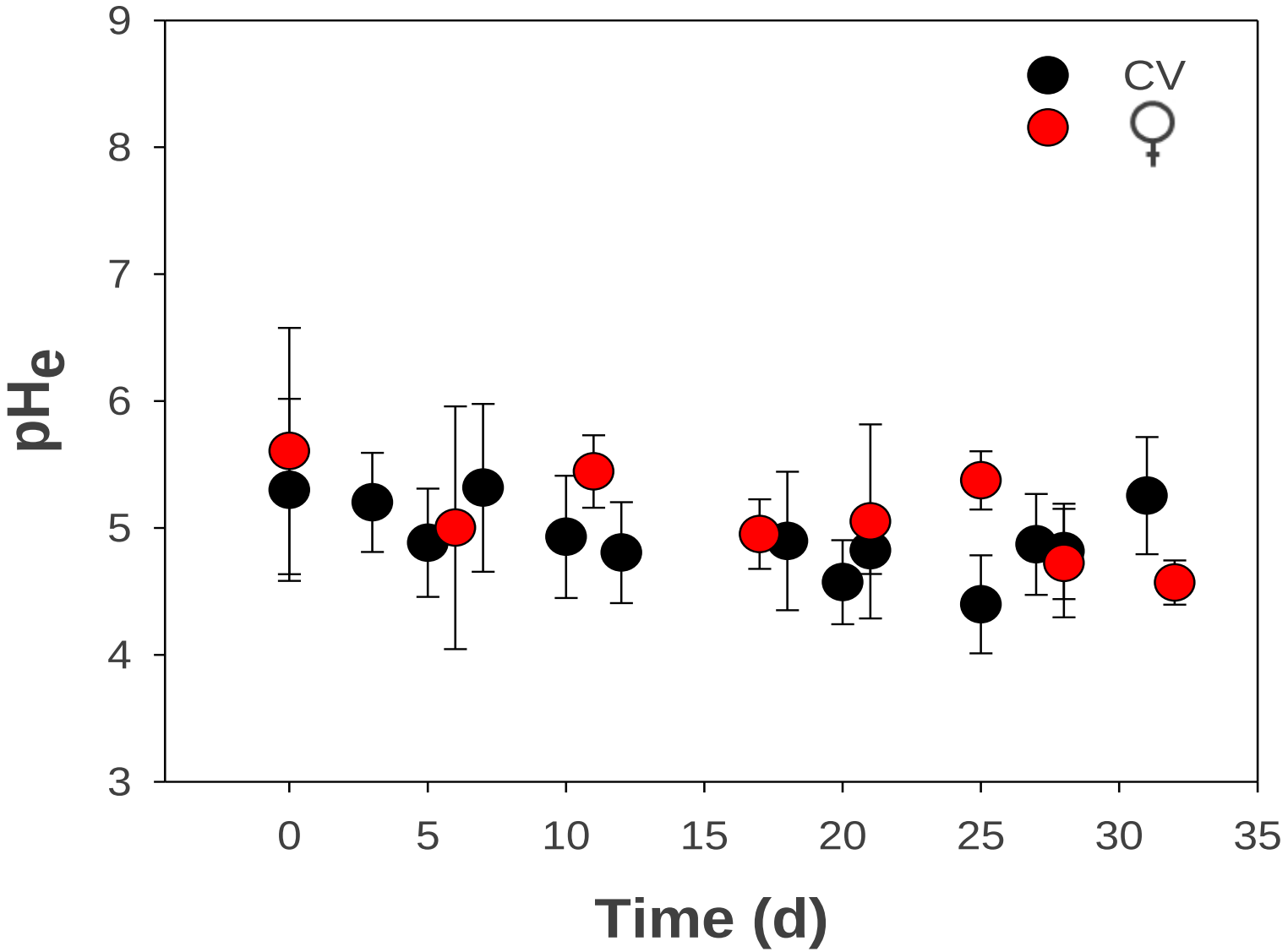
Results: No influence of pCO_2 on pH_e during the diapause (exp.1)



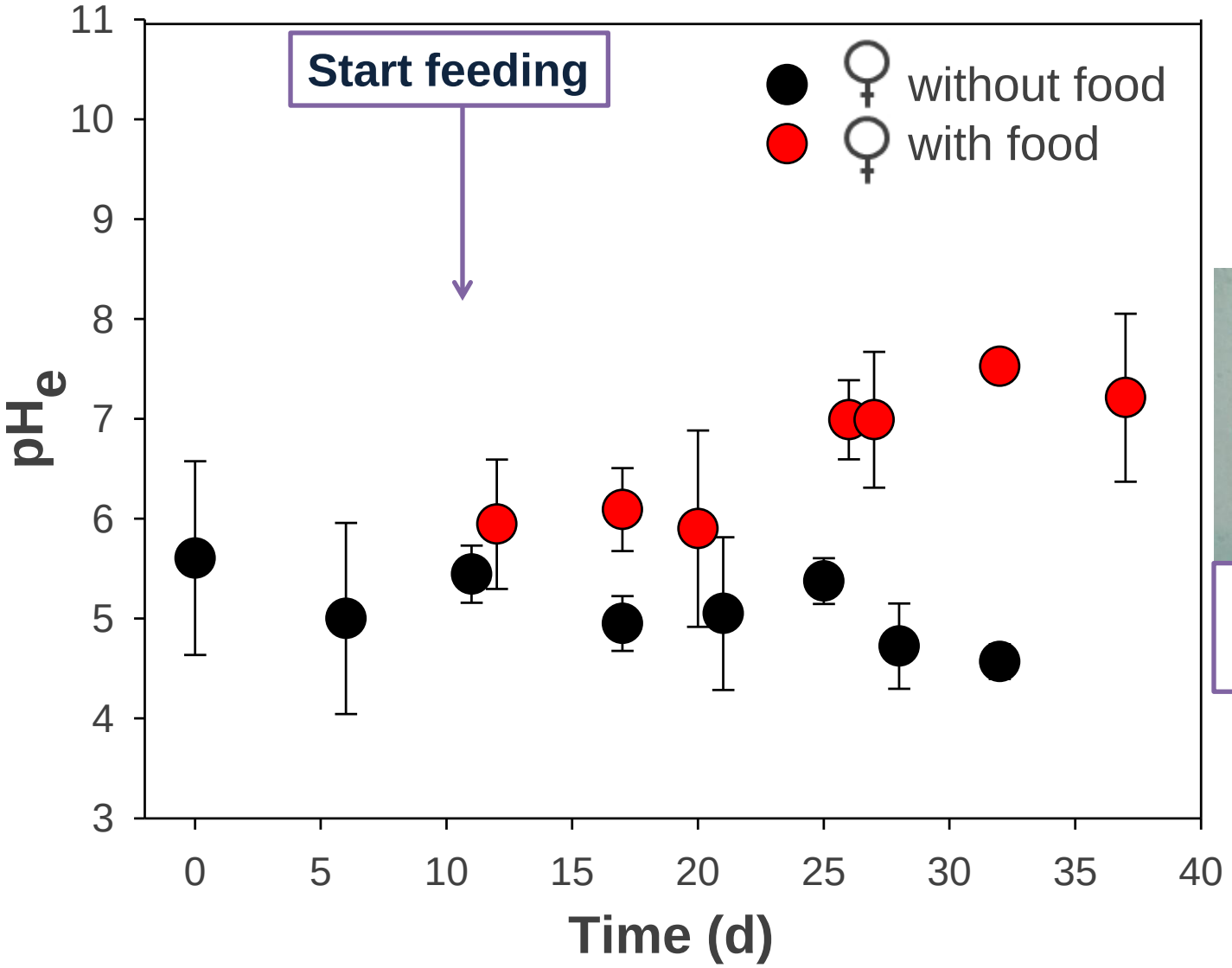
Results: No influence of pCO_2 on pH_e at the end of the diapause (exp.2)



Results: No difference in pH_e of CV and ♀ at the end of the diapause (exp.2)



Results: Feeding increased pH_e at the end of the diapause (exp.3)



Thalassiosira weissflogii

Synthesis

- pH_e was not related to the environmental conditions
- No difference in pH_e of CV and ♀
- Feeding increased pH_e of ♀ -> copepods became active

Diapausing *C. glacialis* CV and ♀ will be able to regulate pH_e at environmental conditions predicted for the end of the century

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We can confirm that feeding is crucial in the transition from diapause towards activity

- Future research -> climate change might change food quality

  can *Calanus* spp. cope?

Thank you!

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