DFG Travel grant KON 485/2007 JA 1800/1-1

Reproduction of the copepods *Rhincalanus gigas*, *Calanus simillimus* and *Pleuromamma robusta* during an iron induced phytoplankton bloom (EIFEX) in the Southern Ocean

Sandra Jansen*[1,2], Ulrich Bathmann[2]

[1]Leibniz-Institut für Meereswissenschaften GEOMAR, Kiel, Germany
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
* Sandra.Jansen@awi.de

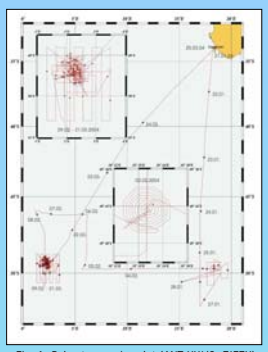


Fig. 1: Polarstern cruise plot (ANT XXI/3: EIFEX)

Introduction

The Southern Ocean is characterized by low temperatures and a short growth season for primary producers, which potentially limit zooplankton growth and reproduction. Different copepod species seem to exhibit a spectrum of adaptations and life cycles are diverse. However, the association of spawning events with phytoplankton concentrations is not clearly demonstrated yet. The European iron fertilization experiment (EIFEX) provided an unique opportunity to follow the reproductive response of the calanoid copepods *Rhincalanus gigas*, *Calanus simillimus* and *Pleuromamma robusta* during the entire development of a diatom dominated phytoplankton bloom.

? Can spawning of copepods be induced by enhanced phytoplankton concentrations?

Conclusions

The observation that *R. gigas* reacted in autumn on enhanced food concentration with increasing egg production, suggests that this species can react on favourable conditions and that their reproduction during this study was neither dependent on lipid reserves, nor on seasonal aspects. The fast reproductive response indicates that *R. gigas* was food limited during the period of this study in the Antarctic Polar Front region.
Throughout the experiment the phytoplankton assemblage was dominated by chain-forming and large diatoms. Deformed N2 nauplia from *R. gigas* were observed during the hatching experiments.

Deformed N2 nauplia of *R. gigas*, observed during hatching experiments

The three different copepod species showed different responses to the induced phytoplankton bloom:

Laboratory Experiments

Pleuromamma robusta

Number of egg producing females:
In patch <10%
Out patch <10%

Pleuromamma sp. produced almost no eggs during the whole fertilization experiment. Egg production rate (EPR) was low or zero, with no differences with regard to the chlorophyll concentration.

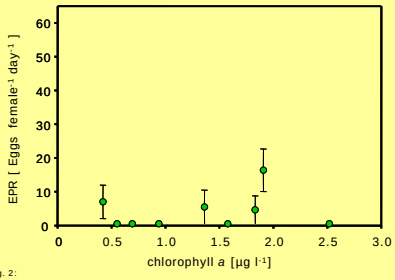


Fig. 2:
Egg production rate (EPR) from *Pleuromamma robusta* dependent on Chl *a* concentration during EIFEX

Hatching success
in patch 70%
(determined at one in patch station only)

! no
Spawning seasonally timed ?
Independent from phytoplankton concentrations

Calanus simillimus

Number of egg producing females:
In patch 50-85%
Out patch 50-60%

C. simillimus produced constantly ~18 eggs female^{-1} day^{-1} at stations where chlorophyll concentration exceeded 0.6 µg Chl *a* l^{-1}.

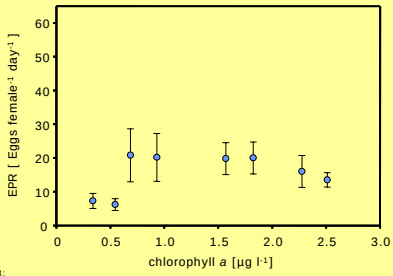
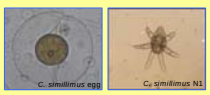


Fig. 3:
Egg production rate (EPR) from *Calanus simillimus* dependent on Chl *a* concentration during EIFEX

Hatching success
out patch 0-50%
in patch 0-85%



! maybe
Threshold at about 0.6 µg Chl *a* l^{-1}
Maximum rate reached at 0.8 µg Chl *a* l^{-1}

Rhincalanus gigas

Number of egg producing females:
In patch 60-90%
Out patch 0-15%

R. gigas did not produce eggs at the start of the experiment. Egg production increased "in patch" until day 30 after fertilization with an average of 50 eggs female^{-1} day^{-1}. The egg production rate "out patch", corresponding to low chl *a* concentrations remind close to zero during the entire experiment.

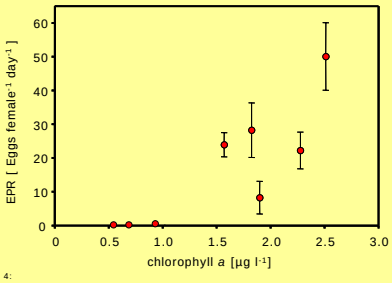


Fig. 4:
Egg production rate (EPR) from *Rhincalanus gigas* dependent on Chl *a* concentration during EIFEX

Hatching success
in patch 44±1,5%

! yes
Threshold at about 1.5 µg Chl *a* l^{-1}
Maximum rate not reached at 2.7 µg Chl *a* l^{-1}

Field observations

Field study

Most studies of spawning have been made on temperate and high latitude species. One area of interest is the possibility that laying of eggs is timed to take advantage of phytoplankton increase or blooms. The association of spawning events with phytoplankton concentrations is not clearly demonstrated. During the iron fertilization experiment EIFEX we observed three different responses to enhanced phytoplankton concentrations from three different abundant copepod species. Results from the experiments were reflected in the egg abundance in the field (Fig. 5).

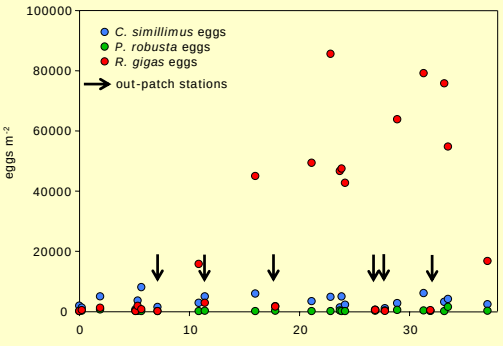


Fig. 5: Egg abundance from Multinet samples during the course of EIFEX

Material and Methods

Egg production experiments were performed with *Rhincalanus gigas*, *Calanus simillimus* and *Pleuromamma robusta* during the iron fertilization experiment EIFEX in the beginning of 2004. In response to the iron fertilization a diatom bloom developed with chlorophyll *a* concentrations up to 3.1 µg Chl *a* l^{-1}. Samples were taken inside and outside the fertilized patch. Females were caught with Bongo nets and incubated individually for ~24 hours in 100 ml beakers with filtered seawater. All females were included in the calculation of the egg production rates, whether they spawned or not.

Further reading:
Sandra Jansen, Christine Klaas, Sören Krägefsky, Lena von Harbou, Ulrich Bathmann (2006). Reproductive response of the copepod *Rhincalanus gigas* to an iron-induced phytoplankton bloom in the Southern Ocean. Polar Biology 29 (12):1039-1044