

## Project information

### Keywords

Microsetella, copepods, biological pump, vertical flux regulation, carbon cycling, marine snow

### Project title

Marine snow, pelagic-benthic coupling and the impact of the harpacticoid copepod *Microsetella norvegica*, and other agents in a high-latitude fjord (MICROSNOW)

### Year

2019

### Project leader

Camilla Svensen

### Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

Balsfjord (69, 22E N, 19, 06 E)

### Participants

Camilla Svensen, UiT - project leader

Fredrika Norrbin, UiT

Ingrid Wiedmann, UiT

Jofrid Skardhamar, IMR

Coralie Barth-Jensen, UiT

Marja Koski, DTU-Aqua, Technical University of Denmark, Lyngby

Morten Iversen, MARUM, University of Bremen, Germany

Klas Ove Müller, Helmholtz-Zentrum Geesthacht, Zentrum für Material- und Küstenforschung GmbH

### Flagship

Fjord and Coast

### Funding Source

Fram Centre Fjord and Coast

### Summary of Results

We quantified, for the first time, the impact of *Microsetella* on the biological carbon pump in a high-latitude coastal ecosystem by combining high-resolution in situ sampling with experiments on particle degradation rates of *Microsetella*. We hypothesized that 1) *Microsetella* substantially reduce the vertical carbon flux by feeding on sinking aggregates, and 2) that the importance of *Microsetella* on the efficiency of the biological pump (i.e. the attenuation curve) is influenced by aggregate type.

### Main findings:

- *Microsetella* stayed above the pycnocline both years, despite differences in temperature, suspended particle concentrations and type (diatom aggregates vs krill faecal pellets).
- Importance of *Microsetella* starts already in the shallow layer above the pycnocline in the particle productive zone, by grazing aggregates at the depth that they are formed
- *Microsetella* grazed both aggregate types but at different rates
- *Microsetella* colonized faecal pellets in the surface, and were transported to deeper waters by these fast sinking particles
- Regulation of flux attenuation depended on the interaction between particle production by feeding krill and particle degradation and sinking

Our observations provide insight into the complex processes of carbon remineralization and particle degradation in the surface ocean, and highlight the importance of small-sized copepods for global

biogeochemical cycles. Knowledge on regulation mechanisms for the biological pump is of crucial importance for understanding the consequences of climate-induced ecosystem changes for CO<sub>2</sub> drawdown.

Master and PhD-students involved in the project

Coralie Barth-Jensen, PhD student

Peter Glad, MSc 2018

Julie Larcher, exchange BSc from CNAM-Intechmer, France May-June 2018. Supervisor C. Svensen

Quentin Bernier, exchange MSc from University of La Rochelle, France April-June 2018. Supervisor F. Norrbin

Theo Berujon, intern student 2017. Supervisor F. Norrbin

For the Management

Fjorder er hjemmet til ulike dyregrupper, som plankton, bunndyr, fisk, pattedyr og sjøfugler. En årsak til den høye biodiversiteten, er at fjorder ofte er næringsrike og produktive. Balsfjord er en produktiv fjord i Troms som er godt studert. Likevel mangler vi kunnskap om hvordan næringsnettet er strukturert på de lavere trofiske nivåer.

I prosjektet MICROSNOW forsket vi på et mikroskopisk (0.5 mm) krepsdyr, *Microsetella norvegica*, som viste seg å være ekstremt tallrike i Balsfjord. *Microsetella* har spesialisert seg på å spise på synkende partikler, såkalt marin snø. Vår hypotese var at *Microsetella* påvirker mengden biologisk materiale som synker fra de grunne produktive delene av vannsøyla og ned til havbunnen. Vi gjennomførte omfattende feltarbeid og laboratorieeksperimenter for å teste vår hypotese.

Vi fant ut at *Microsetella* koloniserer og spiser på synkende partikler i Balsfjord. Dette har ikke vært dokumentert tidligere. Videre fant vi at dette lille krepsdyret kan påvirke kvaliteten, mengden og den vertikale fordelingen av marin snø i vannet. Dette har betydning for hvordan energien i økosystemet fordeles, og viser hvordan prosesser i vannsøyla er koblet sammen med bunnavlevende organismer. Vi tror *Microsetella* er en viktig art som kan påvirke karbonomsættningen i kystøkosystem.

Biologi og klima henger sammen, og for å forstå karbonkretsløpet trenger vi solid kunnskap om biologiske prosesser. Man kan måle primærproduksjonen fra verdensrommet med satellitter, men man kan ikke forutsi hvor denne energien ender opp til slutt. Til det trenger vi fokuserte og hypotesedrevne studier som bidrar med en brikke i det store puslespillet som er økosystemet. Vårt prosjekt har bidratt med ny kunnskap om en lite studert planktonart i Balsfjord, og dermed også med ny kunnskap om oppbygningen av næringsnettet i fjorden. Produktiviteten til bunndyrene er avhengig av prosesser i vannsøyla. Dyreplankton som *Microsetella* kan trolig bidra til økt resirkulering av næring i overflaten, noe som betyr mindre mat til bunndyrene.

Published Results/Planned Publications

Publications:

Svensen C, Antonsen M, Reigstad M. (2018) Small copepods matter: Population dynamics of *Microsetella norvegica* in a high-latitude coastal ecosystem. J. Plankton Res. 40(4):446-457, <https://doi.org/10.1093/plankt/fby019>

Kubiszyn A, Svensen C. (2018) First record of a rare species *Polyasterias problematica* (Prasinophyceae) in Balsfjord, northern Norway. Botanica marina 61(4):421-428, <https://doi.org/10.1515/bot-2017-0123>

Published abstracts:

C. Barth-Jensen, P. Glad, C. Svensen. Reproductive rates of small copepods in a changing Arctic: present and future? Arctic Frontiers,

Tromsø January 2019

M.F. Norrbin, T. Beroujon, M. Iversen, M. Koski, H. K. Michelsen, C. Svensen. Microhabitats for small Zooplankton created by Marine Snow Aggregates and Fecal Pellets. ICES Annual Science Conference 9-12 September, 2019. Gothenburg

MSc Thesis:

P. Glad. Seasonal occurrence of *Oithona similis* (cyclopoida), *Microsetella norvegica* (harpacticoida) and *Microcalanus* spp. (calanoida), and productivity of *O. similis* in three high-latitude Norwegian fjords (UiT/AMB, 2018)

Submitted paper:

C. Barth-Jensen, Ø. Varpe, M. Koski, P. Glad, O.S. Wangensteen, K. Præbel and C. Svensen. Temperature-dependent reproduction and seasonal egg production rates of small copepods with different reproductive strategies (JPR)

Papers in prep:

C. Svensen, M. Iversen, M. Koski, F. Norrbin, K.O. Müller, I. Wiedmann, J. Skardhamar, C. Barth-Jensen. *Microsetella* the mighty; the impact of an aggregate feeding copepod determines the efficiency of the biological carbon pump

C. Barth-Jensen et al. Secondary production and seasonal copepod population dynamics in three high-latitude fjords

M.F. Norrbin, T. Beroujon, M. Iversen, M. Koski, H. K. Michelsen, C. Svensen. Microhabitats for small Zooplankton created by Marine Snow Aggregates and Fecal Pellets

Communicated Results

C. Svensen et al. ARCTOS colloquium on Freshwater influenced sub-Arctic and Arctic marine systems – biogeochemistry and marine food webs, UiT 12 November 2019

C. Svensen et al. Seminar series DTU-Aqua, Technical University of Denmark, May 2019

C. Barth-Jensen et al. Arctic Frontiers conference, Tromsø January 2019

F. Norrbin et al. ICES Annual Science Conference 9-12 September, 2019. Gothenburg

Möller, K.O. "Get it from the picture: Extending the scope of plankton and particle imaging beyond distribution patterns" during the ARTIFACTZ workshop, Villefranche sur-mer (April 2019)

Budget in accordance to results

Yes

Could results from the project be subject for any commercial utilization

No

If Yes

No

Conclusions

The project was successfully completed. Two field campaigns with national and international participants were conducted. Comprehensive datasets on physical, biological and biogeochemical components of the Balsfjord ecosystem are produced, in addition to experimentally obtained rates of *Microsetella* feeding, reproduction and respiration. In 2019 we organized a writing workshop for the project participants, and a paper draft including the main results is now in progress and will be submitted in 2020.

Over the duration of the project, 1 PhD, 1 MSc and 4 BSc/exchange students were involved, benefiting from the team of national and international researchers. Parts of the project results are included in one PhD thesis and one Master thesis.

Results from Microsnow has been presented orally at several international conferences (ASLO, Arctic Frontiers, ICES) as well as national workshops (ARCTOS, research group meetings and UiT seminars). Dissemination also includes presentation for artists (Svalbard and Røst open Air conference) and school children (Forskningsdagene).

Results and perspectives from Microsnow has been further developed in two ERC proposals (P.I. M. Koski), submitted to HORIZON2020 in 2018 and 2019.