

Project information

Project title

Pelagic ecosystems in ice-covered and ice-free fjords under climate change

Year

2013/2014

Project leader

Claudia Halsband, ApN

Participants

- Claudia Halsband (Akvaplan-niva) – project leader and WP2.1
- Else H. Nøst Hegseth (University of Tromsø), WP1
- M. Fredrika Norrbin (University of Tromsø), WP2.2
- Tove M. Gabrielsen (University Centre in Svalbard), WP1
- Janne E. Søreide (University Centre in Svalbard)WP2.3

Flagship

Fjord and coast, Theme: Structure, function and change in Arctic and boreal fjord ecosystems

Funding Source

Fram Centre

Summary of Results

WP1 (Gabrielsen, UNIS and Hegseth, UiT)

Weekly sampling was performed in Adventfjorden, Svalbard, throughout 2013 and monthly from January to September in Billefjorden to determine the seasonal progression of the local hydrography, protist communities and primary production in and under the sea ice and in the water column. The pico- and nanoplankton protist communities are analysed using metabarcoding of the SSU nrDNA and 454 pyrosequencing. Additional samples from early spring were grown in lab culture to identify the spring inoculum in Billefjorden and Adventfjorden. Billefjorden was ice-covered, while Adventfjorden was open, such that the effect of ice-cover can be included in the interpretation of results.

WP2.1 (Halsband, APN)

The ZooScan technique was implemented at APN and samples from two Svalbard fjords in different seasons were used to build a learning set for automated identification of organisms (Fig. 1). A first preliminary data analysis (Table 1) shows good recall (identification) of organisms, while contamination levels (false positives) need to be improved by refining the learning set with more samples and taxonomic categories. Isfjorden was dominated by copepods in early October, where *Calanus* spp. represented more than 50% of all organisms > 1 mm. Cirriped larvae were also important, a few hydrozoans were present as well as pteropods (Table 2).

WP2.2 (Norrbin, UiT)

Video Plankton Recorder (VPR) has been deployed in Billefjorden in January and in Porsanger in August and October (plus one planned in December). In October, two MSc students were brought along to learn about the methods in preparation for their theses. A total of 24 VPR stations were taken in Porsanger (Fig. 2). Additional zooplankton net samples, sea water samples for phytoplankton and Chl a determination and acoustic data were collected to help determine the "predator field" for the zooplankton. One pelagic trawl was also taken in the middle part of Porsanger. The data from the VPR are being processed, while preserved samples will be counted for the MSc theses. In August the zooplankton community was diverse and still actively feeding, and numerous large scyphozoans and ctenophores were observed in the area. In October, *Calanus* spp. had descended to overwintering depths, and krill and chaetognaths were abundant. The pelagic trawl contained mainly krill (*Meganyctiphanes norvegica*) and Tverrhalet langebarn (*Leptoclinus maculatus*), along with some large cod.

WP2.3 (Søreide, UNIS)

Sampling was performed in Adventfjorden (biweekly to weekly) and Billefjorden (monthly from January to September) to determine the seasonal development of micro- and mesozooplankton populations. Zooplankton community data were analysed microscopically at UNIS and at IOPAS, Poland. Mapping of the micro- and mesozooplankton sample collection at UNIS has been done to be implemented in existing or new databases (e.g. at NPI or elsewhere), incl. a >10-year zooplankton time series from Billefjorden. In January, video plankton recordings were for the first time conducted in Billefjorden (with F. Norrbin, WP 2.2) to map high resolution vertical distribution of zooplankton (Fig. 3).



Fig. 1: Examples of ZooScan vignettes. a *Calanus* sp., b *Metridia* sp., c cirriped nauplius, d chaetognath, e hydrozoan medusa (*Aglantha* sp.), f decapod larvae, g polychaet, h detritus, i mollusc (*Limacina* sp.), j mollusc (*Clione limacina*).

Table 2: Proportion of taxa in the large size fraction (>1 mm) of a zooplankton sample taken in Isfjorden on 6th October 2013.



Fig. 2: Sampling stations in Porsanger fjord in October 2013

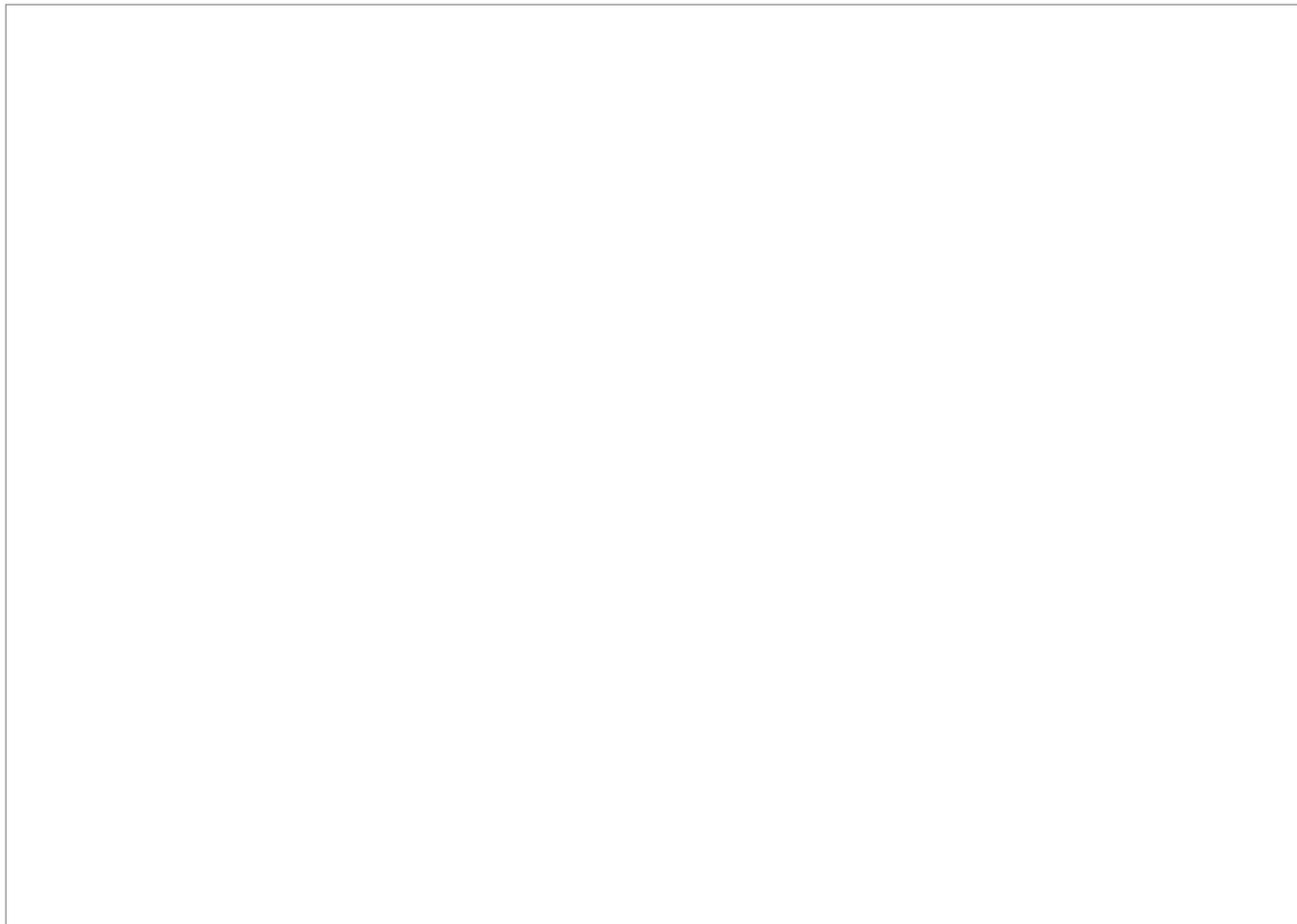


Fig. 4: High resolution vertical distribution of *C. glacialis* at high resolution in Billefjorden on 10th January 2013 with densities of >2000 ind. per m⁻³, estimated from Video Plankton Recording and image analysis processed in Matlab. In comparison, ordinary zooplankton nets estimated densities of only ~500 ind m⁻³ of *C. glacialis* due to much lower vertical resolution. *C. glacialis* is mainly found at depth, but the population has started to ascend.

For the Management

Zooplankton start important reproductive processes already in late autumn, suggesting that arctic marine pelagic systems are vulnerable to human impacts also in winter.

Published Results/Planned Publications

- Norrbin MF 2013. Patterns of zooplankton diversity and distribution in sub-arctic fjords, determined using an Autonomous VPR. ASLO Aquatic Sciences Meeting, New Orleans, February 2013 [Oral presentation]
- Puisais, A., 2013. Reconnaissance et classement automatique des images de zooplancton obtenues avec le VPR : Performance de classification par rapport à la méthode de classement manuelle et possibilités d'améliorations. Master thesis, Univ. Nantes/Univ. Tromsø. 28 pp.
- Hatlebakk, M., Søreide, J.E., Johnsen, G. (2013) Er reproduksjonsstrategien hos *Calanus glacialis* bestemt av individenes lagrede fettressurser? Nordisk havforskermøte, Oktober 2013.
- Boissonnot, L. (2013) Ecological effects of an earlier sea-ice decrease on overwintering arctic zooplankton : focus on *Calanus glacialis* strategy during the winter-spring transition. Master thesis, University Pierre et Marie Curie, France and University Centre in Svalbard, Norway, 39 pp.

Communicated Results

Workshop: In March 2013, a small workshop focusing on copepod reproduction was arranged at UNIS. Expert Barbara Niehoff, Alfred Wegner Institute, taught visitors from Tromsø, and UNIS staff and students how to determine the reproductive state of copepods in live and fixed individuals in 4% formaldehyde-seawater solution.

UiT Jentedag, 3. Nov 2013: Promoting marine ecology as a career path, with advice to girls graduating from high school ('vidergående skole'), visiting UiT from all over Norway. Presentation entitled "Fjord, fjell og fun i fjerne land: livet av en dyreplanktonøkonom".

Interdisciplinary Cooperation

Through integration with other funded projects (e.g. CLEOPATRA II, MicroFun, etc.) close cooperations are in place with physical oceanographers at SAMS, UK and Jørgen Berge (UiT/UNIS) for maintaining and processing continuous hydrography data collections on moorings at sampling locations in Billefjorden and Isfjorden. The project further benefits from a co-operation with the Shirshov Institute Moscow, Russia (NFR/NOR-RUSS, 'Fate of CO₂ secondary production in a changing Arctic' COPPY, 2013-2016).

Budget in accordance to results

Flagship money has financed necessary equipment, supported sampling efforts in Svalbard and mainland fjords, ZooScan analyses and a conference presentation in the US. Personnel was hired, e.g. to perform the weekly sampling in Adventfjorden and to run Zooscan analyses. Regular sampling efforts are costly, and would not have been possible without funding from the Flagship. Some funds were used to purchase field equipment (Niskin bottles) and part of a Microscope PAM. A person was hired to find and categorize, physically and digitally, all micro- and mesozooplankton samples stored at UNIS.

Some of the methods and results developed in this project were the basis for a proposal to NFR's Havet & Kysten program in September in cooperation with the University of Nordland and international partners, entitled "Arctic ecosystems under change: How marine plankton size structure affects pelagic productivity" (EcoSize). We expect to hear from NFR by the end of the year.

Could results from the project be subject for any commercial utilization

No

Conclusions

WP1

The phytoplankton spring inoculum from Billefjorden and Adventfjorden will be compared to the bloom that appeared later in spring in these fjords, as well as the spring season in Balsfjorden near Tromsø. Billefjorden was ice-covered, while Adventfjorden was open, such that the effect of ice-cover can be included in the interpretation of results. PAM microscopy will measure photosynthesis and growth in single cells and in germinating spores. The latter has never been done before, but this new equipment will enable us to try this. The spring germination of diatom resting spores is vital for the initiation of the spring bloom, with implications for the entire ecosystem.

The second part of the project will focus on the spring period in Balsfjorden, starting in midwinter. The first sampling is under planning and will be performed in December 2013 as a reference point for the spring of 2014, which will be the main field season in Balsfjorden. Sampling of water, sediment and hydrographical data will be included, among these also transmission data to identify the bottom nepheloid layer, which is potentially important for cells and spores on the bottom. Upon completion of field work in Balsfjorden and associated data analysis, the fjord systems in Svalbard and Balsfjorden will be compared in relation to ice cover, timing of bloom onset and species composition.

WP2.1

Zooplankton community data will be compared between ZooScan and manual microscopic analyses. Size structure analysis, based on parameters measured by ZooScan in every vignette, will be performed next year, together with further sample analysis from the other fjords (Billefjorden, Balsfjorden and Porsanger) to compare the zooplankton size structure between ice-covered/Arctic (Billefjorden, inner Porsanger), ice-free/Arctic (Isfjorden) and ice-free boreal (Balsfjorden and outer Porsanger) fjords.

Collaborations are planned across flagships with a proposal on microplastics pollution in Arctic pelagic systems to be submitted to 'Miljøgifter'.

WP2.2 and 2.3

It is hoped that VPR can be deployed more extensively in the Svalbard fjords for comparisons of vertical zooplankton structure there and in Porsanger and Balsfjorden. A larger VPR campaign in Billefjorden, involving a master student, is planned for autumn 2014, contingent of continued flagship funding. Most of the data analysis from the 2013 cruises and field campaigns will also be done in 2014.