M.Sc. projects in Zooplankton Ecology 2018 -2019

Supervisor: Fredrika Norrbin, Assoc. Prof., Arctic Marine System Ecology, AMB

Please contact me by e-mail if you are interested in doing a MSc thesis on one of these themes, or a similar topic! Email: fredrika.norrbin@uit.no

A. Depth distributions, size spectra, oil storage and seasonal variation of plankton from Video Plankton Recorder data and net samples.

The past several years we have collected extensive data sets on zooplankton using the Video Plankton Recorder in North Norwegian fjords and Arctic waters. Large parts of this material have been worked up, but there is much interesting information to be found here. We are also preparing for continued sampling in new projects.

Fig. 1. The VPR is a kind of underwater microscope, which collects images of the water column and simultaneous CTD-data (temperature, salinity pressure/depth) and chlorophyll fluorescence (indicating phytoplankton). In post-processing, the image content is analyzed for zooplankton organisms and other particles, and this information is then combined with the environmental information. It is possible to find depth information for all parameter to an accuracy of a few centimeters. Furthermore, the instrument enables detection and enumeration of fragile organisms, some of them invasive species, which are destroyed by conventional sampling. We always take ordinary net samples on the side when sampling with the VPR.

Fig. 2 This is how we see the plankton and other particles with the VPR:
Several possibilities for projects using data from this instrument exist. Some examples are given below.

1) **Evidence of nutritional condition from Video Plankton Recorder images.**

We have large quantities of images from both North Norwegian fjords and Svalbard waters that were used for the study of depth distribution of major plankton groups and marine snow particles. In some copepod species, lipids are stored in a visible oil sac, which helps them survive winter and initiate egg production the following spring. One student made a pilot study of *Calanus* lipid sac size estimates from VPR images. She showed that at least 20% of all clear images could be used (depending on the orientation of the copepod in the pictures) to measure lipid sac area and copepod size. This can give important information about the condition of the copepods for the winter, and the reserves available for reproduction. It is possible to focus either on Norwegian fjords or the Arctic, and relevant field activity may be added to the project.

![Image of Calanus sp. with oil sac](image)

**Fig. 3.** Oil sac size varies with depth. In the VPR images, we see the outline of the oil sac clearly in side view or from above (white line in the pic of *Calanus* sp.).

**Questions:**

(a) Is lipid sac size of *Calanus* different at different localities at a given time, i.e. do some localities seem to be better for survival?

(b) Is lipid content related to depth? This may show that undernourished individuals remain in the upper parts of the water column, while others descend for overwintering in deep areas.

(c) Can this be related to hydrographic factors like temperature, to zooplankton population size and stage composition, or chlorophyll?

**Methods:** Analyzing a subset of VPR images from North Norwegian fjords and coastal areas on a computer. Analyzing zooplankton samples from the same stations. Doing a specialized study in the field, where VPR images are compared to plankton population parameters and lab-analyzed oil content over a period of time (late summer/fall or fall/winter)
2) **Gelatinous plankton in North Norwegian fjords**

– species distribution using VPR and DNA methods. This is in collaboration with Sanna Majaneva (GooseAlien project) who is currently barcoding the ctenophores in Norway, in order to build a reference library using metagenomic analysis. We have had cruises focusing on ctenophores, but hydromedusa and siphonophores are other interesting groups.

3) **Seasonal zooplankton distributions in Håkøybotn, a small bay near Tromsø.**

We have monthly samples from July 2009 – June 2010 consisting of one plankton-net station and several VPR stations.

**Questions:**

(a) How are the vertical distributions of plankton changing with the seasons, in relation to algal blooms, changing mixing situations and occurrence of predator organisms?

(b) An earlier seasonal series was taken at the same location 20 years earlier with plankton nets. How does the timing of seasonal events (phenology) compare over time? Can we see evidence of shifts in timing?

**Methods:** Analysing images from the VPR data sets using a computer and dedicated programs. We work primarily with Matlab. Much of the zooplankton net data has already been analyzed. It is possible for a MSc student to revisit the stations and collect fresh data for comparison and field experience – 10 years later!

**B. Phenology of small copepods from North-Norwegian fjords.**

This is related to Project A.3), but deals only with plankton net samples. I earlier analyzed gonad maturation and stage composition in the copepods *Pseudocalanus* spp and *Acartia longiremis* (and *Microcalanus* sp) from Balsfjorden, Håkøybotn and the Barents Sea. Together, this gave a lot of information about the seasonal cycles and overwintering strategies of these species. I would be interested in getting a 25 years old data set from North Norwegian fjords analyzed with respect to these parameters, and compared to recent samples. This could tell us how variable seasonal cycles in small copepods are between years, and if there is a possible trend due to climate change. The older samples are from several fjords and stations along the coast from Tromsø to Porsanger, recently we have mostly sampled Porsanger. We will select a suitable subset of samples to work on.

**Questions:**
(a) Are the plankton populations at the same stage in the different fjords (Porsanger, Altafjord, Balsfjorden) at key points in time (February, May, September, November)?

(b) Is there a difference between older and more recent samples?

(c.) Can we make inferences about the length of the growing season, differences in number of generations and about the timing of diapause in different localities based on these data?

**Methods:** Count and stage zooplankton samples and sort out older copepodites of *Acartia* and *Pseudocalanus* (possibly also *Calanus* and *Metridia*). Stain these with borax carmine, and dehydrate for gonad analyses.

Participate in some HMD (Havmiljødata/Marine hydrographical survey) cruises to sample zooplankton from the present year, in order to gain field experience and another set of data for comparison.