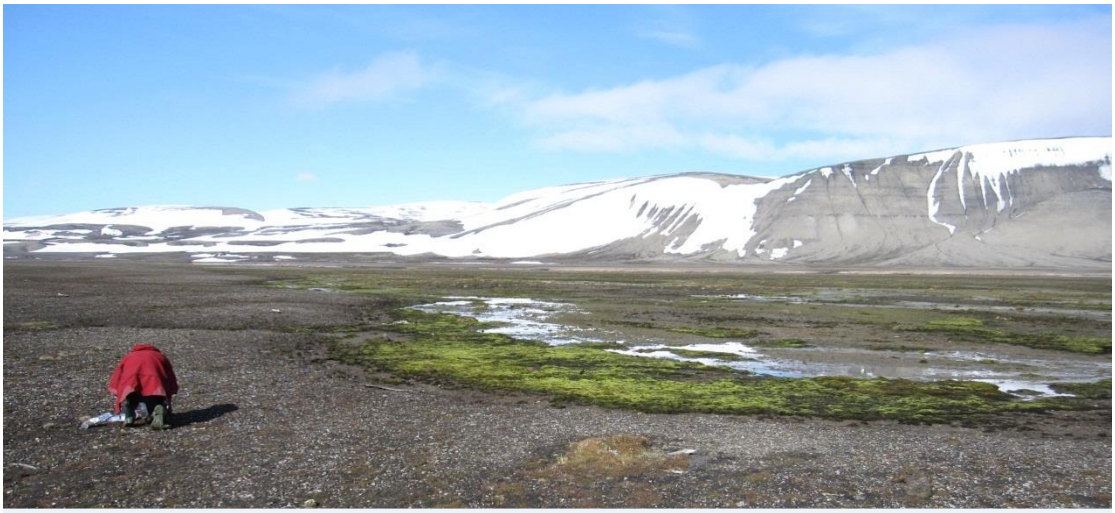
Are you part of the next generation of Arctic experts?

- Possible master/bachelor projects in Arctic Terrestrial biology



The University Centre in Svalbard (UNIS) is the world's northernmost institution for higher education and research, located in Longyearbyen, Spitsbergen at 78°N. See www.unis.no

I am currently seeking new students to exiting master or bachelor projects within the Arctic Biology Department, UNIS.

The master projects (30-60 ECTS depending program requirements) will be based at UNIS, but run in co-operation with a suitable co-supervisor depending on project at any mainland university in Norway. If your home university is another Norwegian University, or a University abroad, we require that you are enrolled in a master program at your home institution and have a co-supervisor there besides us at UNIS.

Bachelor projects are run as an UNIS-course, AB-207 Research Project in Arctic Biology (15 ECTS), with open application date. Course requirements are 60 ECTS within general natural sciences, of which 30 ECTS within the field of biology. You must be enrolled in a programme at Bachelor level, or document that the courses are approved into your current study programme.

All projects have initially a field component, often combined with a lab component, however, there are possible to have a pure laboratory or model based project based on already collected samples/data. Some possible topics and projects are listed below (projects will be adjusted to fit a master or bachelor project).

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Projects are available within the following topics/projects:

The origin of an isolated, high-arctic hot-spot of biodiversity: Recent dispersal or relict survival?

Subject keywords: Climate change, Phylogeography, species diversity, genetic diversity, dispersal, survival

Project background: The last decade, several exciting registrations of new species and populations have been made in Ringhorndalen, situated at the eastern side of Wijdefjorden, Svalbard; especially of thermophilic species that are rare in Svalbard. For instance was *Pinguicula alpina* L. (fjelltettegras) found new to Svalbard in Ringhorndalen in 2013, which underscores the reported unique climatic and edaphic conditions in this area. Pinguicula alpina is a relatively thermophilic species, and the population registered in Ringhorndalen seems to be the northernmost known site for this species. The inner part of Wijdefjorden in general and Ringhorndalen in particular, seems to represent a relict arctic oasis, with remnant vegetation from the warmer postglacial period ending about 5000 years ago. Alternatively, these isolated populations are resent establishments, possibly as a result of again increasing temperatures. The latter is also plausible, as former studies have shown frequent long-distance dispersal to Svalbard.

Aim: Through phylogeographic analyses of selected species determine whether the populations in Ringhorndalen are remnants from a former more widespread vegetation from the warmer postglacial period, or more recent colonizers as a result of again increasing temperatures.

Methods: Field collections in Ringhorndalen, and from reference areas within and outside Svalbard, molecular analyses (sequencing, microsatellite analyses), population genetics -, ordination- and phylogenetic analyses.

Preferred educational background/competences: evolutionary understanding, molecular laboratory experience.

Contact information: Pernille Bronken Eidesen (pernillee@unis.no).

Species diversity versus functional diversity in high-arctic fungal communities

Project background: Loss of fungal diversity in response to climate change is considered a major threat because of its importance for ecosystem functions, but there is a lack of conclusive evidence regarding consequences of diversity loss. Recent investigations by high-throughput sequencing (HTS) of the ITS region (DNA-barcoding) have revealed a vast diversity of both soil-dwelling and root-associated fungi in Svalbard. However, only a small fraction of this diversity could be explained along measured environmental gradients. Could some of this diversity be explained by shared functionality? Thus, that different species provide similar functions?

Aim: Investigate possible functional diversity of high-arctic fungal communities along various environmental gradients

Methods: data-mining of available HTS-data, map variation of functional traits or species groups with certain trait characteristics in relation to environmental gradients (available gradients are e.g. temporal succession and soil nutrients, or within an experimental set-up with increased snow-depth)

Preferred educational background/competences: skills in bioinformatics, microbiology/mycology

Contact information: Projects within this topic would be linked to the PhD work of Magdalena Wutkowska. Please contact Pernille Bronken Eidesen (pernillee@unis.no) for further information.

Plant-symbiont interactions

We have a range of data mining projects related to root-associated fungi in *Bistorta vivipara*, including a large dataset with the possibility to link various plant traits (plant fitness parameters) to symbiotic community, environmental parameters and plant genotype. Please contact Pernille Bronken Eidesen (pernillee@unis.no) for further information.

Trade-off between sexual outcrossing and generation of genetic diversity, and insurance of reproduction (selfing) under marginal energy budgets

Subject keywords: reproduction, genetic diversity, establishment, dispersal, survival, pollination

Project background: There is a well-documented trend that the numbers of plant species with the possibility of asexual reproduction increase towards the poles, along with harsher and more fluctuating climate, shorter growing seasons, fewer pollinators and limited availability of nutrients. Several arctic plants also ensure their reproduction through self-pollination. Still, some plants go for out-crossing: *Silene acaulis* is one of the most hardy, arctic-alpine plants, and it increases the number of female flowers versus hermaphrodites to ensure out-crossing in more hostile environments.

Aim: Some project ideas are

Female fitness in the compass-flower Silene acaulis:

- Compare genotypes, seed weight and germination success between hermaphrodites (possible inbreed) and females, along a given environmental gradient, or within certain size classes. There is also a huge difference between north facing versus south facing flowers in terms of energy input and phenology. Does reproductive output differ within a cushion depending on position of flowers, as the microclimate experienced by each flower is different?
- Compare population genetics and pollen chemistry among populations with contrasting pollinator guilds.

Another study-plant we use to study trade-offs regarding reproduction is *Bistorta vivipara*, which is mainly clonal, but can reproduce sexually from time to time.

Methods: Depending on project aim

Preferred educational background/competences: evolutionary understanding, population dynamics

Contact information: Pernille Bronken Eidesen (pernillee@unis.no).

Evolutionary consequences of autopolyploidy

Subject keywords: polyploidy, adaptations, niche expansion

Project background: Polyploidy (the process of chromosome doubling) has played an important role in the evolution of all angiosperms. Allopolyploidy is when the chromosome sets are from different species. Autopolyploidy is when chromosomes come from the same species. The latter process is often overlooked, and the knowledge of its effect is less known. *Saxifraga oppositifolia* is a good model system to study the effect of autopolyploidy. *Saxifraga oppositifolia* thrives in a wide range of habitats, from early-melting, extremely dry ridges with long growing season, to moist snow beds with short growing season. Two main ploidy levels are recorded (2n = 26 and 52, functionally diploid and tetraploid; triploids occur). Resent investigations of growth form and ploidy-levels within this species show that these are linked, and that they differ in various traits. Thus, autopolyploidy in *S. oppositifolia* has probably expanded the ecological amplitude of this species complex.

Aim: Effect of autoploidy in relation to extension of niche-space. There are many possibilities to explore, like:

- Investigate pH optimum between ploidy levels.
- Phenology between ploidy levels, and relation
- Freeze tolerance and drought tolerance between ploidy levels.
- Evaluate phenology, pollination, pollen/seeds production and quality between ploidy levels.
- Morphological characterization of ploidy levels – do morphological characters exist?
- Compatibility among ploidy levels through crossing experiments.

Methods: Depending on project aim

Preferred educational background/competences: evolutionary understanding, population dynamics

Contact information: Pernille Bronken Eidesen (pernillee@unis.no).

Mapping seasonal diet variation in Svalbard Rock Ptarmigan using non-invasive diet-analyses.

One of the few resident vertebrate species in Svalbard is the Svalbard rock ptarmigan (Lagopusmuta muta hyperborea). Two key forage plants are important before and during breeding. The hens feed predominantly on Salix polaris to build up body reserves prior to egg-laying and incubation, whereas Bistorta vivipara is the only known food item exploited by newly hatched chicks (Unander & Steen 1985). We have recently tested various molecular techniques for analyses of feces to infer diet, with good results.

Aim: Map year around variations in Ptarmigan diet using DNA barcoding of feces, with special focus on selected food items

Methods: Field collections, methodology development, molecular analyses

Preferred educational background/competences: understanding of trophical interactions, molecular laboratory experience.

Contact information: Pernille Bronken Eidesen (pernillee@unis.no).