ARCTIC STATION

FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

ARCTIC STATION

Annual Report 2012

Cover photo by Outi Tero

Bog rosemary (Andromeda polifolia). Photo by Ole Martin.

About the report

The Board of the Arctic Station is pleased to inform the public and the many users of the station about the status and activities of the station. The report is compiled by the Board based on contributions from researchers, guests, and the staff at the station.

The "Annual Report of the Arctic Station" contains brief descriptions of research projects, field courses and other educational activities, international meetings, and official visits. It also contains a summary of the research activities carried out at or in collaboration with the station, plus a list of publications resulting from these activities.

The report is published as a pdf file, which can be downloaded directly from the website (*arktiskstation.ku.dk*), where it is also possible to find additional information about the activities of the Arctic Station.

ARCTIC STATION

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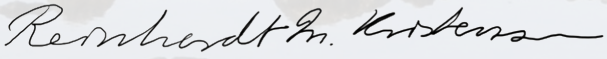
The Chairman's report

The members of the Board (in 2012) are: Professor Reinhardt Møbjerg Kristensen, (chairman, zoology), Professor Bo Elberling (geography), Professor Kristen Seestern Christoffersen (freshwater biology), Associate Professor Gunver Krarup Pedersen (logistics, geology) and Associate Professor Poul Møller Pedersen (vice chairman, marine botany). In addition, an external member of the Board, Professor Nils Overgaard Andersen the Dean of Faculty of Science joined in September 2012; after his resignation from the post of Dean he continued as an external board member, appointed by the Rector of the University of Copenhagen. On 17 June 2012 our vice chairman Poul Møller Pedersen passed away. He has worked for Arctic Station since 1977, and his death was a great loss. Please see obituary on the following page.

In 2012 the station was visited by 198 guests, who spent a total of 1822 nights at the station. Students contributed 1116 of these, which is a doubling of the number from 2011. Furthermore, the research vessel R/V Porsild was in use for 80 days. Frantz Nielsen, who has been the chief of logistics since 1 May 2009, resigned on 31 March 2012. The post was taken over by Kjeld Akaaraq Mølgaard from 1 April 2012. All Greenlandic staff members including Captain Frederik Grønvold of R/V Porsild have taken good care of the scientists and students. Antoinette Mølgaard has handled the cleaning of the Station, and has furthermore been a fantastic cook for several courses and workshops.

Gitte Henriksen, the Board member appointed by the Faculty, has done outstandingly fine work in 2012. She is the secretary for the station, and all the bookings of courses and specific research programmes pass through her hands. In addition she is responsible for the station's budget and all the financial transactions.

2012 was beginning of a new era for the Arctic Station. Several new monitoring programmes have been established at the Station. For instance, a brand new Automatic Climate Station has been installed in Østerlien. The INTERACT programme and the new centre CENPERM are both strongly associated with the Arctic Station. The main event in 2012 occurred when Martin Lidegaard, the Danish Minister for Climate, Energy and Buildings and his Greenlandic colleague Jens B. Frederiksen Naalakkersuisoq visited Arctic Station on 16-17 August 2012. The host at the Arctic Station was board member Nils Overgaard Andersen.



Reinhardt Møbjerg Kristensen

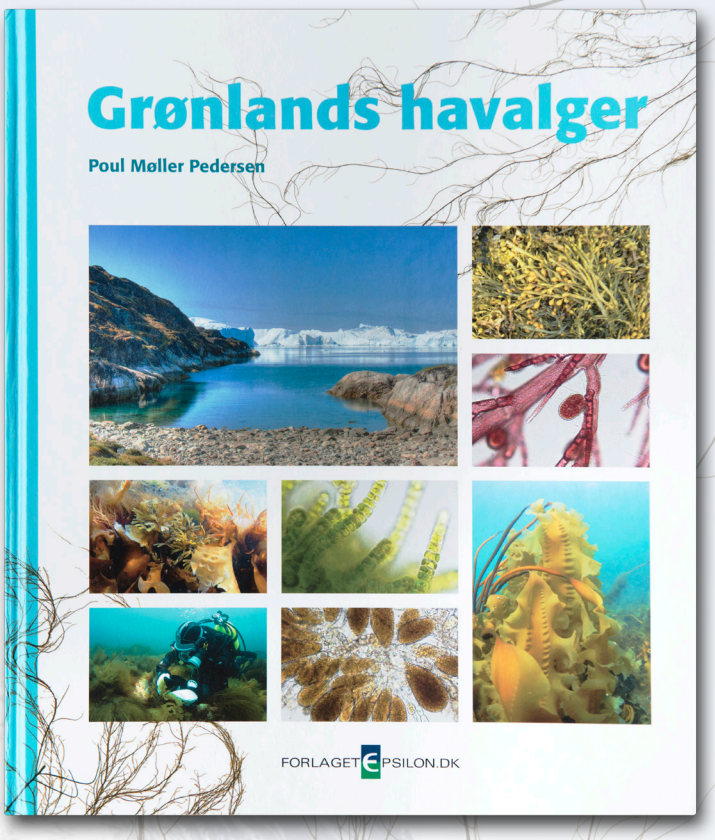
Obituary for Poul Møller Pedersen

The Board of the Arctic Station has lost its Vice Chairman, and the field of Arctic Biology will miss this international Arctic researcher, Poul Møller Pedersen, who lost his final battle against cancer in the early summer 2012.

Poul studied biology at the University of Aarhus, where he found a mentor in Lisbeth Matthiesen (Institute of Botany), who was an expert in algae. Poul was employed to collect algae under her supervision. However, at that time the study programme had to be completed at the University of Copenhagen, so Poul had to move. In Copenhagen Poul began his Master's programme at the Institute for Spore Plants under Tyge Christensen's supervision. As a student of macroalgae, Poul participated in the Kap Farvel Expedition in 1970 under the leadership of Ulrik Ib Røen from the Institute of Comparative Anatomy, University of Copenhagen. He obtained his PhD degree in 1976 under the title: "Marine benthic algae from southernmost Greenland".

Poul changed his systematic algae studies to focus more on studies of the lifecycles of brown algae, and he conducted growth experiments with brown algae under special conditions of temperature and light. I first met him in 1977 at the Arctic Station, where I was the scientific leader and he was the member of the Nordic Marine Biology Course. At this time he was especially interested in threadlike brown algae,

Photo from "Grønlands havalger" by Peter Bondo Christensen



e.g. *Pilayella arctica*'s lifecycle, and worked at the facility that the Arctic Station had at that time at the abandoned Loran Station in Nipissat. In 1981 Poul defended his Dr. scient thesis: "Studies on primitive brown algae (Fucophyceae)" with flying colours. In 1985 he was given an associate professorship at the Institute for Spore Plants. Here he taught numerous students about "Thallophytes", and he was known by practically all students at the institute, as they participated in field courses in Frederikshavn, where he taught until the field station was finally closed in 2010.

Poul's interest in the Arctic never waned. He travelled all over the Arctic and he soon built close friendships with other North Atlantic researchers, especially Professor Robert Wilce of the University of Massachusetts in Amherst, USA. In 1999, Poul was elected as the botanic member of the Board of Arctic Station, and in 2004 he took over the vice chairmanship – which he kept until he passed away. In 2006 we celebrated the 100th Anniversary of the Arctic Station in Qeqertarsuaq, and Poul was one of the co-editors of the anniversary book "Arktisk Station 1906-2006" (ed. Lone Bruun, Rhodos Forlag). At approximately the same time, he got the idea of publishing a book about Greenlandic seaweeds. Many of the microphotographs in the book were taken by Poul using facilities at the Arctic Station. In 2010 we were together at the Arctic Station, and he told me that he wanted to return to his research in South West Greenland. He managed to do so. On 12 May 2011, we celebrated the publication of his book "Grønlands Havalger", and later that summer he went to South West Greenland with Senior Advisor Susse Wegeberg of Aarhus University to continue working on their common project: "Nordic Seaweed Project".

Poul published approximately 80 scientific publications and the book "Grønlands Havalger" ended his career with a beautiful flourish.

We honour his memory.

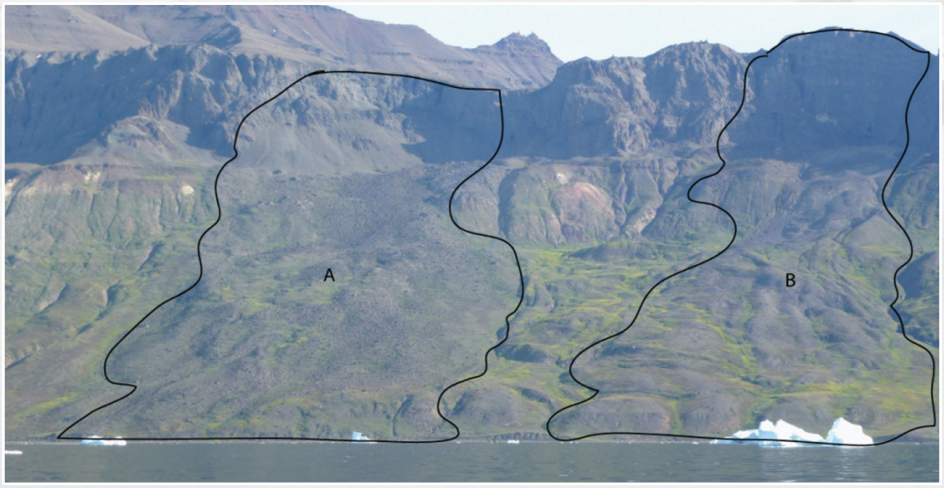
Reinhardt Møbjerg Kristensen

Research projects

TSUNAMIS AND ICEBERG ROLL EVENTS RECORD IN COASTAL LACUSTRINE ENVIRONMENTS OF GREENLAND: IMPLICATIONS FOR RECONSTRUCTION OF SEA-LEVEL HISTORY, ICE-STREAM DYNAMICS AND ASSESSMENT OF NATURAL HAZARDS

Antony Long, Sarah Woodroffe, Tim Dowson, Tom Lawrence, Nick Rosser, Department of Geography, Durham University, United Kingdom
Witold Szczucinski, Matt Strzelecki, Institute of Geology, Adam Mickiewicz University, Poland

The purpose of the visit was threefold: (1) to collect new field observations of the 2000 Paatuut landslide and associated tsunami as recorded on the north and south margin of Vaigat, (2) to collect sedimentary evidence for palaeo-tsunami in the same region, sampling lakes and former marine sediments, and (3) to undertake preliminary laser scanning of large rock avalanche deposits elsewhere in Vaigat. Fieldwork was undertaken over the course of three to four weeks in Vaigat, aided by R/V Porsild and the use of a Zodiac boat borrowed from the Arctic Station. The working methods involved: mapping of surficial deposits associated with the Paatuut landslide-triggered tsunami of 2000, and collection of sediment cores from lakes and raised marine deposits using coring devices and shallow excavations. Samples are being examined in the laboratory using a range of methods to reconstruct past environmental change and evidence for palaeo-tsunamis. Finally, rock avalanches were mapped using a terrestrial laser scanner and dGPS survey. We successfully mapped the environment (spatial extent, grain-size characteristics, depositional and erosional landforms) associated with the 2000 Paatuut landslide at sites close to and distant from the source. We have developed new estimates of maximum wave run-up, calibrated against photographic evidence held by the Police in Ilulissat. We also collected sediment samples from lakes and raised marine sequences that contain evidence of at least one previous large event – perhaps a palaeo-tsunami or storm – from the south side of Vaigat. Finally, we have established preliminary datasets regarding the topography of several rock avalanches of different ages in Vaigat. Dr Rosser is seeking funds to return to the region in 2013 to develop this research further by studying the dynamics, evolution and controls on rock avalanches in Arctic settings through collection of airborne data and cosmogenic radionuclide dating.



View from c. 500 m offshore looking onto two adjacent rock avalanches, of apparently very different ages. The failure on the left [A] has sharp, well-defined morphology, with a carapace of coarse elastic material. The failure on the right [B] shows a more rounded topography despite being sourced from the same rock and falling over comparable heights and distances. Photo by Antony Long.

LITTER TRACE: IMPACTS OF SUMMER AND WINTER WARMING ON NITROGEN CYCLING FROM DECOMPOSING LEAF LITTER THROUGH SOILS, PLANTS AND MICROBES IN A CLIMATE GRADIENT FROM LOW- TO HIGH-ARCTIC TUNDRA

Daan Blok, Department of Geography and Geology, University of Copenhagen, Denmark

I installed so-called "litter-bags", bags with evergreen and deciduous tundra shrub plant leaves, in all plots in the warming experiment described above. The leaf material that was used for these bags was collected from plots that were sprayed with a solution of 15N-enriched urea during the growing season. This will allow us to not only look at the effects of summer and winter warming on leaf decomposition rates, but also simultaneously follow the fate of the nitrogen being released from the leaf upon decomposition through plants, microbes and soil. Apart from our low-Arctic site at Disko, 15N-enriched litter bags were installed in similar experiments in a mid- and high-Arctic site in Zackenberg, Northeast Greenland, and at Longyearbyen, Svalbard, to scale up our findings to a regional scale.

ITEX (INTERNATIONAL TUNDRA EXPERIMENT) – ASSESSMENT OF RECENT HERBIVORY IN SAMPLE PLOTS MONITORED SINCE 1989

Per Mølgaard, School of Pharmaceutical Sciences, University of Copenhagen
Karen Christensen, Ida Mølgaard Hammer, Nanna Mølgaard Hammer, Laura Louise Mølgaard Hammer

The ITEX plots have been monitored since 1989. During the observation period a severe decline in the number and size of Papaver radicatum has been observed alongside an increase in ground cover of *Salix arctica*. The change in performance

Illustration 12. Eurois caterpillar feeding on willow. Photo by Peter Mølgaard.

of the two main species in the sample plots started in 1996, at the same time as a dramatic decrease in winter ice cover duration and thickness at the Disko Bay. This change in plant performance may also have an influence on animal life, as the plants are sources of food and cover. During fieldwork from the Arctic Station on Disko, we encountered caterpillars of the Great Brocade Moth (*Eurois occulta*), also known as the Great Gray Dart. The larvae are very greedy, and in Greenland they prefer to forage on dwarf shrubs, especially willows, e.g. *Salix glauca*. This is a new Northern border for the moth: its distribution limit used to be near Sisimiut-Kangerlussuaq, along the Arctic Circle. Apart from very rare encounters, neither the moth nor its larvae have previously been seen on Disko, nor have remnants been observed in sediment cores from the neighbouring Lake Fortunebay covering the last 4000 years. In 2004 and 2005 an immense number of larvae were seen in the Sisimiut-Kangerlussuaq area, and it is probably from that outbreak the newly encountered larvae at Disko derive.

Overview of the snow fence experiment in Blæsedalen. Photo by Kent Pørksen.

ABOVE- AND BELOWGROUND FUNCTIONAL AND COMMUNITY RESPONSES OF PLANTS AND MICROBES TO SUMMER AND WINTER WARMING IN LOW-ARCTIC TUNDRA

Daan Blok, Department of Geography and Geology, University of Copenhagen, Denmark

The aim of our study, which is part of the CENPERM project, is to measure the effects of seasonal warming on carbon and nitrogen cycling through plants, permafrost and microbes. As yet, much is unknown about the impacts of seasonal warming events on tundra ecosystems. It is important to generate more knowledge about the effects of climate warming on the sensitive Arctic tundra ecosystem, as changes in high latitudes may feed back to the global climate through the release of greenhouse gases and changes in surface conditions by shifts in plant cover. Most previous research has focused on the effects of summer warming on tundra vegetation and soil-microbial processes. However, most of the warming that is predicted for the coming century will likely occur during the winter period. By locally elevating the snow height using snow fences we will mimic predicted increases in winter precipitation and raise winter soil temperatures through the insulating effect of snow compared to control plots with ambient snow levels in a low-Arctic shrub tundra site on Disko Island in West Greenland. Summer soil temperatures will be raised in selected plots using plexiglas open-top chambers. Finally, we will evaluate the cooling effect of shrub canopies on summer soil conditions by clipping the shrub biomass from half of the plots. Shrubs are known to profit from higher air temperatures by growing denser and taller, and thus potentially providing a negative feedback to permafrost warming by shading the soil surface and lowering soil temperatures. Our experiment will provide a unique opportunity to test the effects of winter and summer warming as well as summer soil cooling on plant growth and the exchange of carbon and nitrogen through permafrost, plants and microbes. This novel experiment will be intensively studied during the entire snow-free period in 2013 by a large CENPERM research campaign. We will study the effects of the summer and winter warming treatments on above- and belowground plant performance, greenhouse gas emissions, root development, soil fauna assemblages, microbial functioning, and nitrogen cycling.

ROOT DYNAMICS IN THE ARCTIC

Marie Frost Arndal, Department of Geography and Geology, University of Copenhagen, Denmark

This project is part of the snow-fence experiment described above. The aim of the project is to investigate the effects of increased snow accumulation, removal of aboveground shrub biomass and seasonal warming on root dynamics. In order to investigate this, minirhizotrons will be used to determine changes in rooting depth, length, diameter, and lifespan on individual roots through repeated measurements during several growing seasons, starting in 2013. Minirhizotrons are transparent tubes installed in the soil, and are a non-destructive method whereby the birth and death of individual roots can be followed through time with a camera or scanner. Only a few studies in the Arctic have looked at root dynamics in minirhizotrons and none in snow-fence experiments, so far. Soil samples were taken in connection with minirhizotron installation between 16 and 20 July 2012. Soil cores were 6.5 cm in diameter and 48 minirhizotrons were installed at an angle of 45 degrees in the precored holes, to a maximum depth of 40 cm in each plot. The minirhizotrons were secured to a steel rebar and the aboveground part of the tubes was painted white. The root biomass dry weight will be measured in Copenhagen.

INTERACT – SYMBIO

Kari Saikkonen, Pedro Gundel, Otto Saikkonen, MTT Agrifood Research, Finland
Marjo Helander and Serdar Dirihan, University of Turku, Finland
Henry Väre, University of Helsinki, Finland

Our project explores the abundance and distribution of the grass-fungal endophyte symbiosis in northern Europe, and evaluates the geographic variation in symbiosis effects on host plants.
In particular, we are working on the symbiosis between the perennial grass *Festuca rubra*, native and common in north and subarctic Europe, and its systemic endophyte, *Epichloë festucae*. So far we have (2011-12) sampled *F. rubra* populations in different sites: Spain, Finland (south and north), Faroe Islands, northern Norway, Greenland and Iceland, and in different environments: low and high altitudes, riverbanks, meadows, and seashore meadows. We have evaluated the endophyte status and ploidy level of every plant, and taken samples to detect the genetic diversity in grass and endophyte populations. This information will allow us to determine the frequency of the symbiosis, population structure, and the association between these variables and the ecological variation. This year we started reciprocal-transplant experiments in Spain, southern and northern Finland, and the Faroe Islands to determine the variation in the effect of the symbiosis among sites, environments and populations.
For this summer season, our main goals were to expand the collection of *Festuca rubra* populations to Greenland and northern Norway, and to start the reciprocal transplantation experiments. During our fieldwork, we identified and collected plants from three populations in northern Norway and two populations on Disko, Greenland. From each population, we collected more than 50 *F. rubra plants*. Whole plants were taken with soil attached and brought to MTT, Jokioinen, Finland. The plants are maintained in a greenhouse and their endophyte status and ploidy level is examined. During the winter of 2012-2013 we will start the evaluation of the genetic diversity of the plants and fungi. All this information will be used to achieve the main objectives of the project: (1) to determine the abundance and distribution of the grass-endophyte symbiosis in northern Europe, and (2) to evaluate the geographic variation in symbiosis effect on host plants.

Jens Larsen in the exact motive of one of his grandfather's paintings from his stay at Arctic Station in 1925. Photo by Johanne Eli Funder.

DOCUMENTARY OF PAINTER JOHANNES LARSEN'S LIFE

Erland Porsmose, Interviewer and Director of Østfyns Museer, Denmark
Jens Larsen, a grandchild of Johannes Larsen
Erik Skibsted, cameraman and producer
Johanne Eli Funder, travel organiser and assistant

Johannes Larsen, a famous Danish painter, participated in a scientific bird expedition in Greenland in 1925 as a painter. We are making a documentary about his life, and the purpose of our visit to the Arctic Station was to gather material and footage about his stay at the Arctic Station. We searched for traces of the work he did during his stay at the Arctic Station and of his friendship with Morten Pedersen R/V Porsild, founder of the Arctic Station. Among other things, we hoped to find some preserved plumages from the period which Johannes Larsen might have painted. As Johannes Larsen was generally interested in the local nature, we also hoped to find some interesting plants in the herbarium to compare with corresponding paintings. Finally, we wanted to film the biological diversity of the surroundings which he painted.

Unfortunately, we did not find any of the plumages in question, but we did find a plant of interest in the herbarium, a bog rosemary (*Andromeda polifolia*), which Johannes Larsen painted a famous picture of. Outside we found the exact motif of another of Johannes Larsen's paintings. Besides this, we had the pleasure of discovering other traces of a documentary nature, such as an old Greenlandic reader, "A B D", the water from the hot spring, the Røde Elv, and the amazing icebergs, all mentioned in Larsen's diary from his stay at the Arctic Station.

The documentary is scheduled to be shown on Danish television around Easter 2013, and the results from the Arctic Station will make up part of the four-hour series.

MIGRATION PATTERNS AND MIGRATION ECOLOGY OF NORTHERN WHEATEARS (*OENANTHE OENANTHE*)

Jannika Boström, Emil Assarsson, Gabriel Norevik, Petter Olsson, Lund University, Sweden

The purpose of the fieldwork was to recapture northern wheatears which were equipped with geolocators in 2011. The birds were located by sight and caught with spring traps to remove the geolocators. Geolocators are small light logging devices that log sun light and intensity, which are later downloaded and used to approximate where the birds have been during different times of the year (e.g. migration route, stopover sites and overwintering area). Three birds with loggers were found and two loggers were retained. We are currently in the process of analysing the data from these loggers, but we already know that both of them have been fully functional throughout the entire period.

POTENTIAL FOR BIODEGRADATION OF CRUDE OIL IN THE ARCTIC MARINE ENVIRONMENT

Katrine Scheibye, Department of Plant and Environmental Sciences, University of Copenhagen, Denmark

The objective of this thesis project was to assess the potential for biodegradation of crude oil in the marine environment in the Disko Bay off the western shore of Greenland. The main hypothesis was that microorganisms present in the deep marine waters of the Disko Bay have the capacity to degrade oil components with a limited supply of oxygen. Furthermore it was hypothesised that: (1) within the experimental timeframe, microbial degraders would be able to degrade components of oil before oxygen supply was limiting, (2) under the experimental conditions, oil would be affected by physical processes such as dissolution, and by biodegradation, and (3) changes in oil fingerprint are linked to the growth of specific microbial degraders, ensuring that changes in oil fingerprint are caused by biodegradation. Water samples were gathered from the water column at a 150-metre depth from R/V Porsild. A CTD measurement was also performed at the sampling site. A total of 100 litres were sampled and transported to laboratories in Copenhagen, where microcosms were set up to expose natural indigenous microorganisms to oil at different concentrations. After 0, 8, 15, 29, 50, and 71 days of incubation the oil phase was extracted and analysed by GC-MS to obtain the oil fingerprint. Additionally, subsamples were taken from microcosms to perform MPN enumerations (at GEUS), which enabled a quantification of three specific microbial degraders. Results obtained from the present study indicated that should a deep-sea oil spill occur in the Disko Bay, the saturated hydrocarbon fraction and alkyltoluene fraction of crude oil will be rapidly biodegraded by indigenous marine microorganisms. PAHs and their alkylated homologs may be biodegraded to a lesser extent. The study furthermore indicated that the indigenous microbial community of the Disko Bay is readily able to biodegrade saturated hydrocarbons while adaptation is required for biodegradation of aromatic compounds.

LOCAL PERCEPTIONS OF LARGE-SCALE ECONOMIC PROJECTS IN AASIAAT AND QEQERTARSUAQ

Nina Nikola Doering, University of Oxford, United Kingdom

As part of my research for an M. Phil. thesis in Development Studies at the University of Oxford, I spent three weeks at the Arctic Station in Qeqertarsuaq interviewing members of the local population. These interviews focused on past developments of the town, economic changes, opinions on current economic issues, and the wider Greenlandic society. A larger number of interviews was also conducted in Aasiaat and will form the basis of a study on Greenland's current and future economic development and the role of its population in this process.

HUMPBACK WHALE FORAGING ECOLOGY

Malene J. Simon, Greenland Institute of Natural Resources, Greenland
Peter T. Madsen, Aarhus University, Denmark
Mark Johnson, University of St. Andrews, United Kingdom

Baleen whales such as fin, blue, and humpback whales migrate annually to West Greenland to feed in the productive ecosystem. With decreasing sea ice and longer ice-free periods, the whales seem to stay for longer in their West Greenlandic feeding grounds. This direct effect of climate change can lead to an increased top-down regulation of the ecosystem. To understand the effect these whales have on the ecosystem, we aimed to identify the prey choice of humpback whales and to quantify the prey density in a single feeding lunge of a humpback whale using DTAGs, hydroacoustics and prey trawling. The DTAGs provide high-resolution data on the behaviour of undisturbed diving whales. We used this new sensor technology to investigate the lunging behaviour of humpback whales. The tags were attached to the humpback whales with suction cups using a handheld carbon fibre pole from a small boat. In order to couple the foraging behaviour directly to the prey, another boat or ship concurrently surveyed the prey field with a scientific echosounder to estimate the distribution, density and abundance of prey. Samples from potential prey layers were taken simultaneously using a small pelagic trawl. The catch of fish and euphausiid prey will be identified at the species level. These parameters will be used for the modelling of humpback whale energy uptake. The preanalysis showed that humpback whales target capelin in shallow spawning areas and planktonic organisms further from shore. It is currently thought that baleen whales will target the prey layer with the highest density. However, our preanalysis shows that the whales sometimes target the layer with lowest density in an area. This is surprising and leads us to start a more detailed analysis of the species composition, and in the future to investigate the energy content of the preferred species composition.

Humpback whale lunge with fish. Photo by Malene Simon.

INDUCIBLE UV-PROTECTIVE PIGMENTATION AMONG MARINE ZOOPLANKTON IN ARCTIC AND TEMPERATE SYSTEMS

Samuel Hylander, National Institute of Aquatic Resources, Technical University of Denmark

Very little is known about latitudinal differences in pigment and sunscreen dynamics in zooplankton, and I will therefore compare a high UV system (Arctic) with a low UV system (temperate latitudes). Sampling was performed in depth gradients to test the hypothesis that pigments are accumulated as UV protection. Since predation may be of great importance, I also sampled for the non-pigmented sunscreens (so-called MAAs) to evaluate whether these substances are used as an alternative UV-protective substance giving protection without making the animal conspicuous to visually hunting predators (mainly fish). These depth-stratified samples were complemented with bi-weekly depth integrated samples collected by another group during spring and summer 2012. I successfully completed two field samplings with the help of R/V Porsild, one during the daytime, and one during night time. In this way I can assess day and night as well as vertical differences in amounts of MAAs and carotenoids in zooplankton. The concentrations of MAAs in zooplankton showed a distinct increase following the ice-out. Over a few weeks, concentrations of MAAs in copepods increased three- to fourfold compared to pre-ice conditions. Different species of zooplankton displayed different seasonal dynamics and I now plan to link these differences to other measured parameters such as UV exposure, chlorophyll concentration and temperature. I will also compare the concentrations of MAAs and carotenoids between temperate and Arctic systems, and in this way I hope to achieve a mechanistic understanding of the variation in pigmentation among marine zooplankton. It will also enable us to predict the cost of different pigment blends and how the transfer of important dietary pigments to higher trophic levels functions.

Fresh polar bear tracks. Photo by Mikkel Sinding.

BOWHEAD WHALE ACOUSTICS

Mikkel Sinding, Natural History Museum, University of Copenhagen

The purpose of my stay was to assist Outi Tervo in her work recording the season's spring song of the bowhead whales in Disko Bay. The whales' spring song seems to change every year, and by recording the song, researchers gain insight into the diversity and multiplicity of the acoustic abilities of the bowhead whale and its behaviour. We recorded the song by establishing recording stations, which are basically hard disks with a program that records sound from attached hydrophones in the water. A polar bear had been spotted in the Disko Bay while we were there, so during fieldwork we always brought a riffle. We never saw the bear, but we saw some very fresh tracks.

GRAZING ON TOXIC PHYTOPLANKTON BY COPEPODS IN DISKO BAY, GREENLAND

Nina Lundholm, Anna Tammilehto, Olwen Grace, Natural History Museum of Denmark, University of Copenhagen, Denmark

The purpose of this project was to examine copepods grazing on toxic phytoplankton, and to explore whether and to what extent the toxic phytoplankton affects the copepods. Do grazing and toxin accumulation differ among the three major species of copepods in the area? How will variations in concentrations of toxic phytoplankton affect toxin levels in copepods? And, given a choice between toxic algae mixed in a natural community, will copepods reject the toxic phytoplankton? Sampling of copepods and phytoplankton was done using multi-nets, WP2 nets, and small plankton nets, either through holes in the ice, from R/V Porsild, or from local hunter boats (when R/V Porsild was locked in the ice). Live samples were brought back to the laboratory and kept and sorted in the cooling container, where growth and grazing experiments were also conducted. We know from previous studies that copepods accumulate toxins when grazing on the toxic phytoplankton, and that different copepods accumulate toxins to different degrees. We can see that the toxic phytoplankton is grazed even when the copepods are given a choice between toxic and non-toxic food. The remaining results are still being processed.

Sampling copepods with local hunters using their boats while R/V Porsild was still ice-locked. Photo by Nina Lundholm.

CENTRE FOR SCIENCE EDUCATION STUDIES – STRATEGY SEMINAR

Nana Benjaminsen, Centre for Science Education Studies, Denmark
Stefan Hermann, Metropolitan University College, Denmark
Henrik Pedersen, University College UCC, Denmark
Hanne Løngreen, Aarhus University, Denmark
Nils Overgaard Andersen, University of Copenhagen, Denmark
Peter Olesen, the Danish Strategic Research Council, Denmark
Anne-Marie Engel, the Lundbeck Foundation, Denmark

The board of Centre for Science Education Studies feels that the educational institutions, the public and private foundations, and the political system do not always adapt the allocation and disposing of resources in a way that supports the common national agenda of strengthening the scientific chain of education and didactic research optimally. We know from experience that a coordinated effort between the foundations and the educational and political systems can make a difference. When coordination is lacking, it is very easy to waste funds on even very well-intentioned projects. We have had the opportunity to bring up this topic with Morten Østergaard, the Danish Minister for Research, Innovation, and Higher Education, and he is willing to meet with us and discuss the topic. The meeting at the Arctic Station is meant as a preparation for the meeting with the Minister.

Black cyanobacterial crust. Blæsedalen. Scale 1 cm. Photo by Stefano Ventura.

STRUCTURE AND FUNCTION OF MICROBIAL COMMUNITIES IN CHALLENGING, POLAR TERRESTRIAL HABITATS: A PAN-ARCTIC SURVEY (MICROTEA)

Stefano Ventura, National Research Council of Italy, Institute of Ecosystem Study, Italy
Sesto Fiorentino, Ondrej Komarek, Czech Academy of Sciences, Czech Republic
Federico Rossi, Department of Agricultural Biotechnology, University of Firenze, Italy

The visit to the Arctic Station was a step toward a characterisation of pan-Arctic terrestrial microbial communities in the process of adaptation to climate warming. The study focuses on biological soil crusts (BSC), epilithic colonisations, and springs and seepages. These extreme terrestrial Arctic environments are exposed to fluctuating water regimes and availability, and to local constraints such as radioactivity or homeothermy for springs. During the study, we investigate the structure, function, and microbial diversity of BSC to verify whether common patterns of development of BSC exist throughout the Arctic, and to what extent these patterns are controlled by water regime and temperature. The dominating members of fungal and cyanobacterial populations colonising exposed rock surfaces in different microclimatic conditions, springs, and seepages in the region around the Arctic Station will be identified from collected samples, and characterised and compared to those from other Arctic locations being studied. Comparisons with Antarctic cyanobacterial populations will be also made. The sampling campaigns at Arctic Station allowed us to collect a large number of samples of BSCs that are investigated with regards to the composition of their microbial communities and the role of the polysaccharidic matrix embedding the microbial cells and soil particles. Also, several lamina of Nostoc cf. commune were collected in different sites around the Arctic Station. Samples from biological soil crusts and cyanobacterial macrocolonies have been included in a larger study aimed at addressing microbial diversity and functions of terrestrial habitats around the Arctic; this study is partially sponsored by the project INTERACT. We gathered approximately 70 samples of freshwater Cyanobacteria and algae from freshwater habitats in the vicinity of the Arctic Station, measured their physiologic activity and saved them for isolation of cyanobacteria, cultivation and further molecular procedures. We also sampled rock surfaces in several sites in order to look for epi- and endolithic microbes (fungi and cyanobacteria) and to extend our previous observations in other Arctic locations.

Bjørn-Ove Husøy removes a small amount of concrete from the top of the pillar to make room for the repaired cable. Photo by Lars William Pedersen.

MAINTENANCE OF GEOMAGNETIC OBSERVATORY

Lars W. Pedersen, DTU Space, Technical University of Denmark
Bjørn Ove Husøy, Tromsø Geophysical Observatory, Norway

DTU Space runs a geomagnetic observatory in Qeqertarsuaq, where the geomagnetic field is measured with very high precision. One of the fluxgate magnetometers needed repairs and calibration. Furthermore, the cable for the high-precision GPS station placed on the rocks behind the library needed repairs, and the hardware needed upgrading. Both the magnetometer and GPS were repaired successfully.

COMMUNITY STRUCTURE AND ECOLOGY OF THE INTERTIDAL AND NEAR SHORE MARINE ENVIRONMENTS OF THE DISKO WEST AREA

Susse Wegeberg, Peter Bondo Christensen, Aarhus University, Denmark
Lene Düwel, University of Copenhagen, Denmark
Jozef Wiktor, Institute of Oceanology, Polish Academy of Science, Poland

In case of an oil spill, the risk of the oil beaching is imminent. The advising and regulation for oil spill contingency and response will depend on the extent and scale of ecological knowledge of the possibly impacted shorelines as to assess which shorelines need protection priority. Shorelines of high ecologically importance will need a

high degree of protection. Such areas could be those of importance for animal abundance and reproduction (e.g. seabird colonies and coastal haul-outs especially for seals) as well as intertidal zones with a rich primary production. The intertidal canopy of macro algae is important for higher levels of the food chain, therefore this shallow ecosystem can be vulnerable to oil contamination on many levels. However, some shorelines are highly impacted by natural parameters such as wave action and ice scouring, and the intertidal will therefore naturally sustain a relatively lower production or may appear as barren grounds. These sections of shoreline may be easier to clean for oil or even be self cleaning, and thus be considered as worth offering for oil exposure in relation to possible protection of other, more sensitive shorelines in an environmental cost-benefit analysis. To perform these analyses a robust baseline knowledge on inter- and subtidal ecology is essential. Furthermore, in order to assess the level of environmental recovery and thus the assessment of the need for further cleaning efforts as well as monitoring after potential oil spill contamination, baseline data are necessary. The aims of the studies performed at the Disko Island were therefore to investigate: (1) Intertidal community structure by macroalgal and faunal biomass as well as species specific coverage or number in relation to degree of wave / ice exposure, (2) Genetic variation in fucoid species to estimate the oil spill recover capacity of the intertidal vegetation, and (3) Subtidal extent of kelp species in relation to degree of wave exposure. The data from Disko will add to existing data from 60°N, 64°N and 71°N in West Greenland collected during 2010-2012 in other projects. Another field campaign is planned within the GCRC project in 2013 in the Uummannaq and Upernavik areas (71-73°N) which will complete the collection of data along a gradient from the sub-Arctic to the high-Arctic. A thorough analysis of the results will be performed after completion of sampling along this geographical climate gradient. The following activities were planned and conducted during this year's stay: (1) Data collection at Disko for large scale analysis of change in intertidal community structure along West Greenland including wave and ice exposure as physical parameters, (2) Collections and measurements of fucoid species for taxonomy and population genetic variation compared with collections from Uummannaq, and (3) Data for large scale analysis of change in subtidal kelp species depth distribution along West Greenland climate gradient in relation to degree of wave / ice exposure. Data analyses are still on-going and a similar field campaign are planned for the Upernavik area in 2013 to complete the data set for the west coast of Greenland.

Susse Wegeberg. Photo by Peter Bondo Christensen.

SPRING BLOOM DYNAMICS IN THE DISKO BAY

Torkel Gissel Nielsen, Rasmus Dyrmose Nørregaard, Laila Espersen, Thomas Frank-Gopopolos , Malene Møhl, National Institute of Aquatic Resources Technical University of Denmark
Eva Friis Møller, Birgit Søborg, Aarhus University, Denmark
Per Juel Hansen, Christina Thoisen, Nina Lundholm, University of Copenhagen, Denmark
Penelope Lindeque, Plymouth Marine Laboratory, United Kingdom

The aim of this project was to monitor the spring-bloom dynamics in relation to ice cover. In addition we investigated the role of high and low pH in the dynamics and succession of the spring bloom and the most important protozoan grazers. We also studied the potential impact of crude oil (pyren as oil proxy) on the feeding and reproduction of the key copepod *Calanus hyperboreus*. We used R/V Porsild, the CTD and our own nest to investigate the bloom dynamics and collect plankton. In addition, we conducted our experiments with different plankton groups in the cold container. Most of the samples are currently being processed, so we do not have a full overview of the results yet.

AMAP – ARCTIC MONITORING AND ASSESSMENT PROGRAMME

Anders Galatius, Department of Bioscience, Aarhus University, Denmark

The purpose of this project is to monitor xenobiotics in the Arctic food webs. Samples of ringed seal organs, fish and mussels were collected during the stay. Ringed seal organs were collected in cooperation with local hunters. Fish were caught using fishing poles from a boat, while mussels were collected at low tide from a boat.

The results will be published in the AMAP Assessment Report, which will be available at http://www.amap.no/

COLLECTING ANNELID WORMS FOR PHYLOGENOMIC STUDIES

Torsten H. Struck, Zoological Research Museum Alexander Koenig, Germany
Conrad Helm, Anne Weigert, University of Leipzig, Germany

The purpose of our stay at the Arctic Station was to collect polychaete worms for analyses of their phylogenetic relationships with other annelids. The primary goal was to collect *Apistobranchus tullbergi* (Apistobranchidae) in the area of Qeqertarsuaq as well as other annelids in this area and in the Bay of Iterdla. We collected samples at the sampling areas of a previous study by Kristensen and Nørrevang in 1982 (Godhavn Havn and Lyngmarksbugt), as well as in the part of the harbour with the gas station. We found the following species, which have not been recorded previously: *Eteone longa* (Phyllodocidae) in both parts of the harbour of Qeqertarsuaq, *Sthenelais* cf. boa (Sigalionidae) in the harbour of Qeqertarsuaq as well as Lyngmarksbugt, *Exogone naidina* (Syllidae) and *Mediomastus* sp. (Capitellidae) in the Godhavn Havn area. *Apistobranchus tullbergi* was found in the Lyngmarksbugt area at depths of about 40 m. The second site was the type locality of *Psammodrilus aedificator* (Psammodrilidae) at the Bay of Iterdla. We were able to find *Psammodrilus aedificator* as well as the other polychaete taxa listed previously. An important result was that the depth at which the species were listed before was not important: the granulometric characteristic described by the previous study were more important. Therefore, for future collecting efforts in this bay it might be more important to pay attention to the sediment type rather than the depth of the sample.

Photo by Svend Erik Nielsen

Courses

FIELD COURSE IN ARCTIC BIOLOGY, 9-29 JULY 2012

TEACHERS
Anders Michelsen, Kirsten Seestern Christoffersen, Department of Biology, University of Copenhagen, Denmark

STUDENTS
Casper-Emil Tingskov Pedersen, Morten Mejlhede Rolsted, Lene Seierø, Nanna Schrøder Baggesen, Kathrine Petersen, Carina Grøntved Jøenck, Toke Andreasen, Haidi Cecilie Petersen, Ditte Marie May, Julie Koch Sheard, Heidrikur Bergsson, Mathis H. Hjelmsø, University of Copenhagen
Hélène Prouillet-Leplat, Umeå University, Sweden

The overall purpose of this combined MSc and PhD field course was to focus on principal biological mechanisms of arctic organisms and how they cope with the freshwater and terrestrial ecosystems. Seven student projects were carried out to study to which degree the organisms were capable of adapting to environmental changes due to climatic impacts. A number of field and laboratory experiments were carried out, and the experimental setups in the field were either established on a single site close to the Station or at several sites that were all within few hours sailing from Qeqertarsuaq using R/V Porsild. Most of the collected samples were analysed in the laboratory, while some were only pre-treated at the Arctic Station and brought back to Copenhagen for further analysis. Each of the student groups worked with their projects and completed the laboratory analysis, performed statistical analyses and wrote scientific papers for the course report during August and September.

The following themes were studied:

- Spatial variability in bacterial abundance and ammonia-oxidising Archaea in arctic soil and freshwater sediment (Mathis Hjort Hjelmsø)
- The effects of temperature and precipitation on plant production and carbon balance along a moisture gradient in arctic tundra (Lene Seierø and Nanna Schrøder Baggesen)
- Plant responses to grazing and gall parasitism along a moisture gradient in an arctic tundra (Toke Andreasen, Morten Mikkel Mejlhede Rolsted and Carina Grøntved Jønck)
- 15N-enriched urea uptake by plants and microorganisms in arctic tundra in West Greenland (Hélène Prouillet-Leplat)
- Short-term growth response of *Lepidurus arcticus* on different food items and predation of *Colymbetes dolabratus* on *Branchinecta paludosa* and *Lepidurus arcticus* (Haidi Cecilie Petersen and Ditte Marie May)
- Biodiversity of macroinvertebrates, zooplankton and phytoplankton in arctic lakes and the impact of top predators (Kathrine Petersen and Casper-Emil Tingskov Pedersen)
- Morphology of Arctic charr (*Salvelinus alpinus*) and morphometry of freshwater lakes on Disko Island, Greenland (Julie Koch Sheard and Heiðrikur Bergsson)

Findings and conclusions can be found in the report "Arctic Biology Field Course – Qeqertarsuaq 2012", which can be obtained free of charge from Kirsten Seestern Christoffersen (kchristoffersen@bio.ku.dk).

Participants in the 2012 Arctic Biology Field Course. Photo by Jørgen Skafte.

Experiments on permafrost with Ole Stecher in Blæsedalen. Photo by Tom Koch Svennesen.

SCIENCE-TALENT GREENLAND

TEACHERS
Maya Høffding Nissen, Hanne Hautop, Mærsk McKinney-Møllers Science Centre, Sorø, Denmark
Tom Koch Svennesen, GU-Aasiaat, Aasiaat, Greenland

PARTICIPANTS
Secondary school students from Denmark and Greenland

ScienceTalent Greenland, which promotes national talent in natural science among young students (12-20 years), visited the Arctic Station in September 2012. The purpose of the Science-Talent Greenland project is to create a concept of talent care which bridges the gap between secondary school and university for talented Greenlandic students. A group of eight Danish and eight Greenlandic third-year secondary-school students was put together. All students are among their nations' best students in the field of natural science, and all wish to pursue a higher education within this field. ScienceTalent Greenland consists of two camps: the first in is Greenland in Ilulissat and at the Arctic Station on Disko Island, and the other will be in Mærsk McKinney-Møllers Science Centre in Sorø, Denmark. In Greenland the students formed four groups (across nationalities), and each group worked on a different project. Topics such as ice, water, permafrost and the Greenlandic climate, flora, and fauna were covered during the stay at Ilulissat and Arctic Station.

Students in the field. Photo by Svend Erik Nielsen.

GLOBAL CHANGE – SECONDARY-SCHOOL PROJECT

TEACHERS
Svend Erik Nielsen and Carsten Filskov Sørensen, Frederiksborg Upper Secondary School and Higher Preparatory Examination Course, Denmark

PARTICIPANTS
Students from GU-Aasiaat and Frederiksborg Upper Secondary School

In August 2012, students from GU-Aasiaat and Frederiksborg Upper Secondary School and Higher Preparatory Examination Course visited the Arctic Station as part of a project that aims to increase student awareness of the historical, social and environmental effects of global climate change. During the visit, the students formed groups across nationalities and worked on the following themes:

- Biotope examinations of warm springs (Kuannit) and warm hillsides (Østerlien), including biotic and abiotic factors
- Whales and whaling
- Climate change (measurements of CO_2 and O_2 in wet and dry tundra).
- Adaptations
- Labour physiology (including metabolic measurements during rest and labour)

In addition to the group themes, the students also worked on small projects of their own design. These projects spanned a broad field of topics from cold stress in the human body to insect diversity in different locations.

FATE OF THE ARCTIC SPRING BLOOM, PHD COURSE

TEACHERS
Torkel Gissel Nielsen, Technical University of Denmark
Birgit Søborg, Aarhus University, Denmark
Thomas Juul-Pedersen, Kristine Arendt, Greenland Institute of Natural Resources, Greenland
Enric Saiz, Albert Calbet, Institut de Ciències del Mar, Spain
Ástþór Gíslason, Marine Research Institute, Iceland
Øystein Varpe, Norwegian Polar Institute, Norway

PARTICIPANTS
Mette Dalgaard Agersted, Ana Sofia Ferreira, Julie Sainmont, Mie Hylstofte Sichlau, Dorte Søgaard, Anders Torstenson, Matilda Haraldsson, Peter Sylvander, Anna Tammilehto, Laura Helenius, Clare Webster, Erlend Kjeldsberg Hovland, My Mattsdotter, Teresa Silva, Wiedmann Ingrid

The aim of this course was to demonstrate the loss processes associated with the intense spring bloom in the Arctic. Through lectures, in situ sampling and laboratory experiments, the students were given a hands-on opportunity to investigate the diverse routes of organic matter related to the termination of the spring bloom. The course was based on a combination of field trips with R/V Porsild and laboratory work. On the sea, CTD profiles were taken to characterise the water column. Based on the water column structure, water and net samples were taken. The collected water and organisms formed the basis of the experiments conducted in the laboratory and cold containers by the students, supervised by the teachers. The course aimed to give the students a comprehensive view of state-of-the-art concepts in biological oceanography with emphasis on the most important event in the annual productive cycle of Arctic pelagic ecosystems. The specific topics which were covered are:

- Water column properties and how to measure and interpret it.
- Phytoplankton succession and how to measure it.
- Key food-web processes retaining and exporting carbon from the euphotic zone, e.g. grazing and faecal pellet production by dominant zooplankton species, and grazing by microzooplankton.
- Key processes increasing the vertical flux, e.g. phytoplankton aggregation, production of sinking particles by zooplankton (faecal pellets), and impact by vertical migration of copepods quantified by Multinets and VPR.
- Key processes keeping the material in the photic zone after the spring bloom, e.g. demineralisation of particles by bacteria and protozoa, and consumption of sinking particles by small zooplankton
- Biochemical composition of vertical flux and how to measure (sediment traps).
- Laboratory experiments demonstrating impact of temperature on key organisms and processes

Group photo from the PhD programme. Photo by Line Reeh.

Official visits

VISIT BY THE DANISH MINISTER FOR CLIMATE, ENERGY AND BUILDING

During his visit to Greenland in August 2012, the Danish Minister for Climate, Energy, and Building, Martin Lidegaard, visited the Arctic Station along with his Greenlandic colleague Naalakkersuisoq Jens B. Frederiksen. The Danish Minister visited Greenland in order to discuss the roles of Denmark and Greenland in relation to climate change. Nils Overgaard Andersen hosted the visit at Arctic Station.

Martin Lidegaard (center, black jacket), the Danish Minister for Climate, Energy and Building and his Greenlandic colleague Jens B. Frederiksen Naalakkersuisoq (center, blue sweater) visited Arctic Station in August 2012. Photo by Ole Stecher.

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Sampling in the tidal zone in frames of 25 x 25 cm. Here removing barnacles. Photo by Lene Düwel Andersen

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