ARCTIC STATION

FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

Annual Report 2007-2009

About the report

This report is the first electronic "Annual Report of the Arctic Station" under the Faculty of Science, University of Copenhagen. Previous reports have been part of the annual reports published by the university administration until 2006.

The Board of the Arctic Station finds it very important to communicate with the public and the many users of the station and has therefore decided to continue the publication of an annual report on the status and activities of the station. The report will be compiled by the Board on basis of contributions from researchers, guests, and the staff at the station. The publication will be available through the web pages of Arctic Station (*http://arktiskstation.ku.dk/*).

The new "Annual Report for the Arctic Station" contains brief descriptions of research projects, field courses, other educational activities, international meetings, and visits. Furthermore, the report contains information about the staff, buildings, and other facilities including the research vessel "Porsild". 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, where it is also possible to find additional information about the work and activities of the Arctic Station.

ARCTIC
STATION

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Photo: Peter Bondo Christensen

The Chairman's report

The Board of Arctic Station comprises since 1978 of members from institutes under the Faculty of Science, University of Copenhagen.

The members of the Board are professor Reinhardt Møbjerg Kristensen, (chairman; zoology), professor Bo Elberling (geography), professor Kirsten S. Christoffersen (zoology), associate professor Gunver Krarup Pedersen (geology), and associate professor Poul Møller Pedersen (botany).

In addition, an external member, professor Kirsten Hastrup, Institute of Anthropology, joined the board in 2007 to strengthen the focus on human impact in the Arctic and the possible effects of global warming.

Gitte Henriksen is a board member appointed by the Faculty, and she is secretary for the station.

Research assistant Henrik Sulsbrück (geography) was the scientific leader of the station until February 28th, 2007. After his return to Denmark, Henrik Sulsbrück defended his ph.d.-thesis entitled: "*From clay to climate. Sediment processes and Holocene sedimentary fjord environments, West Greenland*" at the Institute of Geography and Geology.

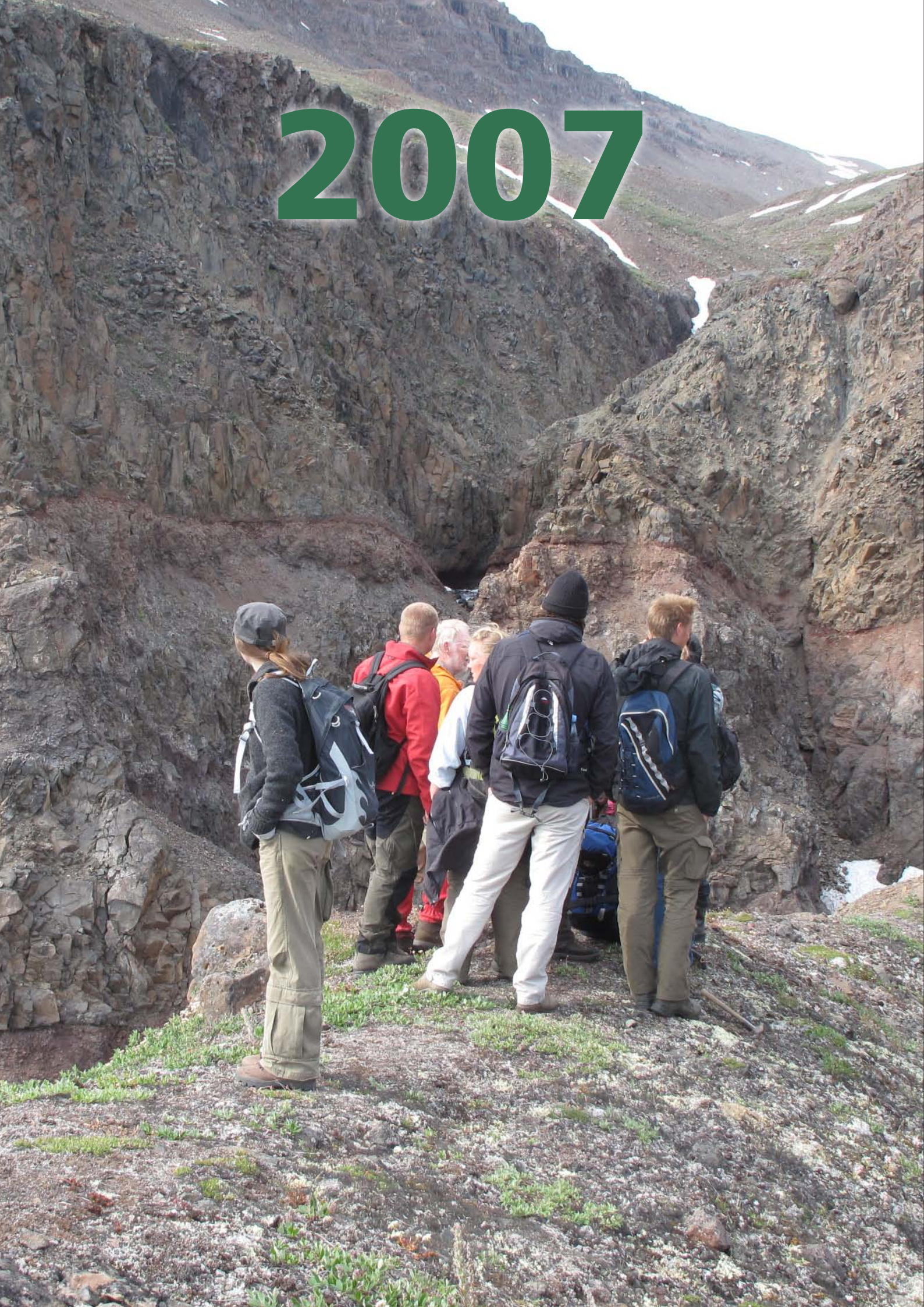
He was replaced by research assistant Outi Maria Tervo (zoology), who was appointed as scientific leader from March 1st, 2007. She was later the same year matriculated as ph.d.-student. Her ph.d.-project "*Bowhead whale* Balaena mysticetus *acoustic behaviour in Davis Strait*" is supervised by associate professor Susan E. Parks (Pennsylvania State University) and professor Reinhardt M. Kristensen.

In 2009 some important changes in the staff occurred. Kjeld Akaaraq Mølgård resigned from his position as technical manager, and he was replaced by Frantz Nielsen from 1 May.

All staff members including Frederik Grønvold, the captain of "Porsild" have taken good care of the station and the boats.

Reinhardt Møbjerg Kristensen

2007



Research projects

The acoustic behaviour of the bowhead whale Balena mysticetus in Davis Strait

Outi Maria Tervo
(scientific leader of the Arctic Station)

The aim of the project is to collect passive recordings of bowhead whale acoustic behaviour. These are coupled with behavioural observations and biopsies with the hope to better understand the function of these sounds. The data will be used to 1) describe the bowhead whale repertoire and the seasonal trends in sound use, 2) describe the structure of the song and determine the sex of the singing individuals, and 3) determine the level of man-made and natural noise in Disko Bay, and describe the impact of noise on bowhead whale acoustic behaviour.

From Clay to Climate: Sediment processes and Holocene sedimentary fjord environments, West Greenland

Henrik Sulsbrück
(assistant scientific leader)

The ph.d.-project investigated a modern glacimarine sedimentary environment in the fjord Kuannersuit Sulluat, Disko, West Greenland. It was concluded that deposition takes place both from sedimentation from the water column and by gravity flows. Present sedimentation rates in the fjord appear to be more than 10 times higher than average annual rates (3-5 mm/a) during the Holocene. This is due to changes in melt-water discharge and shorter distance to the sediment source caused by a glacier surge. Episodic gravity flows may result in a deposition of 12 cm sediment thus resulting in high impact on long-term average sedimentation.

Oceanographic winter exploration of an offshore Arctic ecosystem using tagged narwhals

Kristin Laidre and Mads Peter Heide-Jørgensen, University of Washington and the Greenland Institute of Natural Resources

The Arctic Station was used as a base for field studies of narwhals in the pack ice in the central part of the Baffin Bay during April. The aim was to gather oceanographic data for calibration of satellite-linked time-depth-temperature recorders previously attached to a group of narwhals in the Melville Bay. The narwhals move along the slope of the continental shelf app. 150 km west of Qeqertarsuaq and daily perform dives to depths of 1800 m. They may therefore be used for temperature measurements of the entire water column through the winter. The narwhal's winter habitat was mapped using helicopters, and temperature and salinity measurements were taken from "Porsild" and the ice using standard hydrographical equipment.

It was necessary to use dynamite to get the ship Porsild free of the ice. Five detonations were required before the ship could sail out of the harbour. Photo: Kristin Laidre.

Arctic Willow (*Salix arctica*) and Arctic Poppy (*Papaver radicatum*)

Karen Christensen and Per Mølgaard, University of Copenhagen, Faculty of Pharmaceutical Sciences

The purpose of the was twofold; firstly to examine herbivore behaviour on Arctic Willow (*Salix arctica*) and secondly to inspect sampling fields of Arctic Poppy (*Papaver radicatum*) established for vegetation monitoring purposes in 1989. It has previously been established that the sex ratio in the *S. arctica* population is strongly skewed towards female plants, and it has been hypothesized, that this is due to some herbivore preference for the male plants. This preference is believed to be related to higher concentrations of tannins and phenols in the female plants. An experiment in simulated herbivory was started in 2006 in order to establish the plants' response to herbivory with respect to production of tannins and phenols. Leaves of *S. arctica* were damaged and in 2007 new shoots from the damaged plants were collected and brought back to Denmark for analysis. Also, the herbivory of especially the caterpillar "Woolly Bear" (*Gynaephora groenlandica*) on *S. arctica* was investigated both in the field and in controlled feeding experiments. The second part of the field work concerned the monitoring of sampling fields, which have previously shown a marked change in the vegetation from herbs to shrubs, which coincided with a distinct change in the winter ice cover on the Disko Bay. The change in the vegetation is thought to be an early response to climatic change.

Arctic Poppy (Papaver radicatum). Photo: Todd Kemper (www.PBase.com)

The transition from sedimentary basin to volcanic margin

Laurent Geoffroy, Université du Maine, France

Field work from Svartenhuk Peninsula to south-east Nuussuaq was carried out from the research vessel "Porsild" between June 20th and July 6th 2007 by professor Laurent Geoffroy and two ph.d.-students. The aim of the project was to study the transition between a sedimentary basin and a volcanic margin, to estimate the thermal evolution of the margin from the sedimentary to the volcanic stages and to characterize the syn-sedimentary extension within the sedimentary basin. Finally, data were collected for a reinterpretation of the Basin border fault system. The objectives were fulfilled, and the field party returned with samples of sedimentary, volcanic and basement rocks and tectonic measurements from various fault zones.

Vegetation studies at Skarvefjeld

Flemming Rune, Center of Forest & Landscape, Faculty of Life Sciences, University of Copenhagen

The aim was to study the regeneration of the vegetation in sampling fields at Skarvefjeld, where the vegetation has been cleared in 1991. In some sampling fields a total of up to 20 species of vascular plants in one square meter had reestablished themselves over the past 16 years, while regrowth was sparse in other fields, and the soil subject to substantial erosion. The experimental planting of grass seeds in 1991 no longer had any significant impact on regrowth. The sampling fields were all registered photographically, but ought never the less to be re-marked.

GPS observations

Ruelke and Andreas Richter, University of Technology, Germany

Two German scientists spent some days in the Arctic Station to perform precise GPS observations. A geodetic reference point was established in 2004 and observed for the first time. In 2007 the marker was re-occupied. Using both observation epochs it will be possible to quantify the recent crustal deformation. In combination with results from other observation sites in the Disko Bay it will provide a detailed picture of the recent crustal deformations in the area. The main reason for vertical deformations in Greenland is the response of the Earth crust on recent and historical ice mass changes. Since the "Jakobshavn Isbræ" is one of the most dynamic glaciers in the world, the area of Disko Bay is of special interest. Dramatic changes at the glacier have been reported over the last years, which make Greenland and especially the Disko Bay area a key region in understanding global change processes. The accuracy of the GPS measurements is within a few millimeters per year. The main interest is on vertical crustal deformations, which are closely connected to historical and recent ice mass changes. Additionally, the combination of global sea level rise and land uplift respectively subsidence at the Greenlandic coast will allow to quantify changes of the relative sea level with respect to the land.

Vegetation history

Tina Jørgensen, National History Museum of Denmark, Faculty of Science, University of Copenhagen

The vegetation history was investigated by using samples of seed banks collected from vertically subdivided soil profiles in different types of vegetation around the station. The seeds were identified to species level by germination and, in addition, molecular methods (DNA-sequencing) were used to identify unknown seeds or macrofossils found in the soil. Specimens of 150 species of extant higher plants were collected as voucher specimens and for DNA analysis.

Other visitors and events

Chief Scientist(s): Lars W. Pedersen, Geomagnetism and Space Research, Danish Meteorological Institute

The Danish Meteorological Institute (DMI) runs 14 geomagnetic stations and 3 observatories in Greenland as a part of the international surveillance and research in the geomagnetic area.

One observatory was established in Qeqertarssuaq app. 80 years ago, and is used for measuring the size and direction of the Earths' magnetic field. The observatory is part of the geomagnetic chain on the east coast of Greenland, which is unique because of its northerly position.

The observatory is equipped with sensitive magnetic measuring devices, which require frequent absolute calibrations in order to provide reliable measurements, which in turn requires that manual measurements are performed weekly by a trained observer. Such individuals have over the years been drafted from the local community, and in several instances has it been persons connected to the Arctic Station.

In June this year, Lars W. Pedersen from the DMI visited the Arctic Station in order to train a new observer and perform minor maintenance work on the observatory equipment. The new observer was a person from the town, but as the process of training takes app. 1 week, and since there is rarely any other accommodation in the town; scientists from the DMI have often stayed at the Arctic Station.

Measurements from the observatory in Qeqertarsuaq may be seen at an internal webpage at the DMI, where data from all online stations in Greenland are plotted. *http://web.dmi.dk/fsweb/cgi-bin/DMI_real-time_chain.scr*

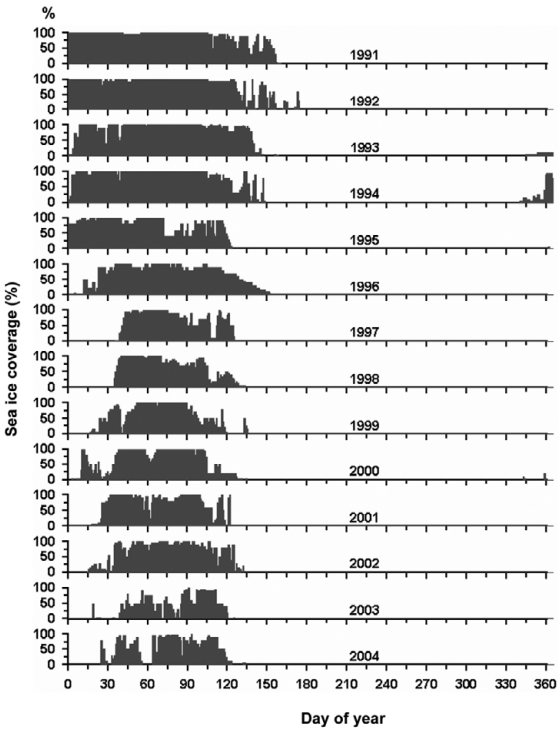
The calibrated data from the observatory are reported to INTERMAGNET (International Realtime Magnetic Observatory Network). h*ttp://www.intermagnet.org/Welcom_e.html under IAGA*

http://swdcft49.kugi.kyoto-u.ac.jp/iaga-div-5/Div_V.html

Monitoring programs

The Arctic Station maintains two automated climate stations, one near the station and one in Akuliit (Mellemfjord, see photo) on the west coast of Disko. The following parameters are registered every 30 minutes: Air temperature, moisture, incoming and outgoing solar radiation, wind velocity, rain/snowfall, and soil temperature in 5, 60, and 150 cm depth. Furthermore, the following parameters are registered daily at the Arctic Station: Snow cover and depth, sea ice coverage, blooming and seeding of selected plant species, and arrival of selected bird species and large sea mammals (whales).

Regular CTD monitoring has been initiated in the fall of 2001, and has been continued since. Furthermore, in 1995 and 1996-97 CTD casts have been made approximately every second week at a permanent station (water depth app. 300 m) near the Arctic Station, monitoring depth, temperature, salinity and fluorescence.



Daily observations of sea ice from the Arctic Station in the period 1991-2004, an example of monitoring data from Arctic Station. (From Hansen et al., Danish Journal of Geography, 106 (1) 45-55, 2006.

Education

Field course in Arctic Natural Geography, University of Copenhagen

The course was attended by 12 students and with Birger Ulf Hansen and Bo Elberling as supervisors from the Institute ofr Geography and Geology in June. The aim of the course was to give the students knowledge of field techniques to collect relevant data for natural geographic questions, in particular the interaction between earth, vegetation, water, and climate. This year, the teaching and the field work were conducted near the Arctic Station. The students studied three themes: 1. Specific gradients in meteorological conditions such as radiation and temperature in the landscape with focus on the permanent climate station located at the Arctic Station, 2. Diel variations in water- and sediment transport in Rødeelv and its tributaries, and 3. Soil profiles under three characteristic types of vegetation, re-established a 10 years old CALM-field for permafrost monitoring, and made soil measurements in a transect from a hot spring. Many excursions to local places of interest were made throughout the course: Kuanit, Lyngmarksfjeld and the surging glacier,

Students from Northern Greenland High School

Teacher(s): Inge Margrethe Aae Christensen & Josua Jepsen, High School of Northern Greenland, Aasiaat.

The Arctic Station was visited by students from the High School of Northern Greenland in September. The third year Biology students did field work for a project on the ecology and nature of Greenland, and second year Chemistry students performed various analyses on water as well as a project concerning the contents of vitamin C in different local plants.

Publications

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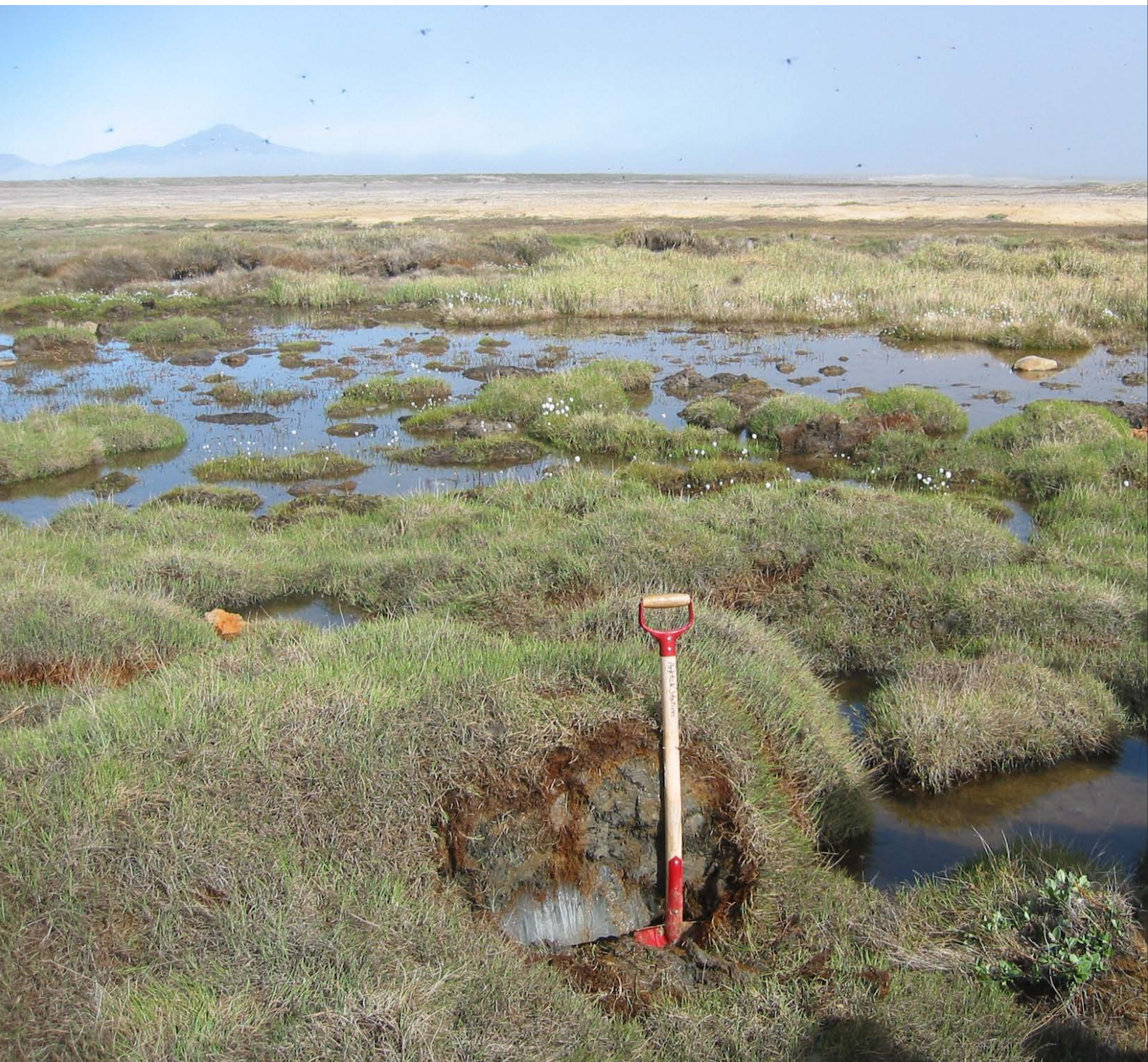

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Møbjerg, N., A. Jørgensen, J. Eibye-Jacobsen, K.A. Halberg, D. Persson & R.M. Kristensen. 2007: New records on cyclomorphosis in the marine eutardigrade *Halobiotus crispae* (Eutardigrada: Hypsibiidae) – J. Limnol. 66: 132-140.

Pedersen, A.K., G.K. Pedersen, L.M. Larsen, T.C.R. Pulvertaft & M. Sønderholm 2007: Geological map of the Nuussuaq Basin in southern Nuussuaq, central West Greenland, 1:100 000, special map Paatuut, with detailed sections. Copenhagen: Geological Survey of Denmark and Greenland.

Pedersen, A.K., G.K. Pedersen, L.M. Larsen, T.C.R. Pulvertaft & M. Sønderholm 2007: Geological map of the south-east coast of Nuussuaq between Ataata Kuua and Saqqaqdalen, central West Greenland, 1:50 000, with detailed sections. Copenhagen: Geological Survey of Denmark and Greenland.

Pedersen, G. K. & R.G. Bromley 2006: *Ophiomorpha irregulaire*, rare trace fossil in shallow marine sandstones, Cretaceous Atane Formation, West Greenland. – Cretaceous Research 27: 964-972.

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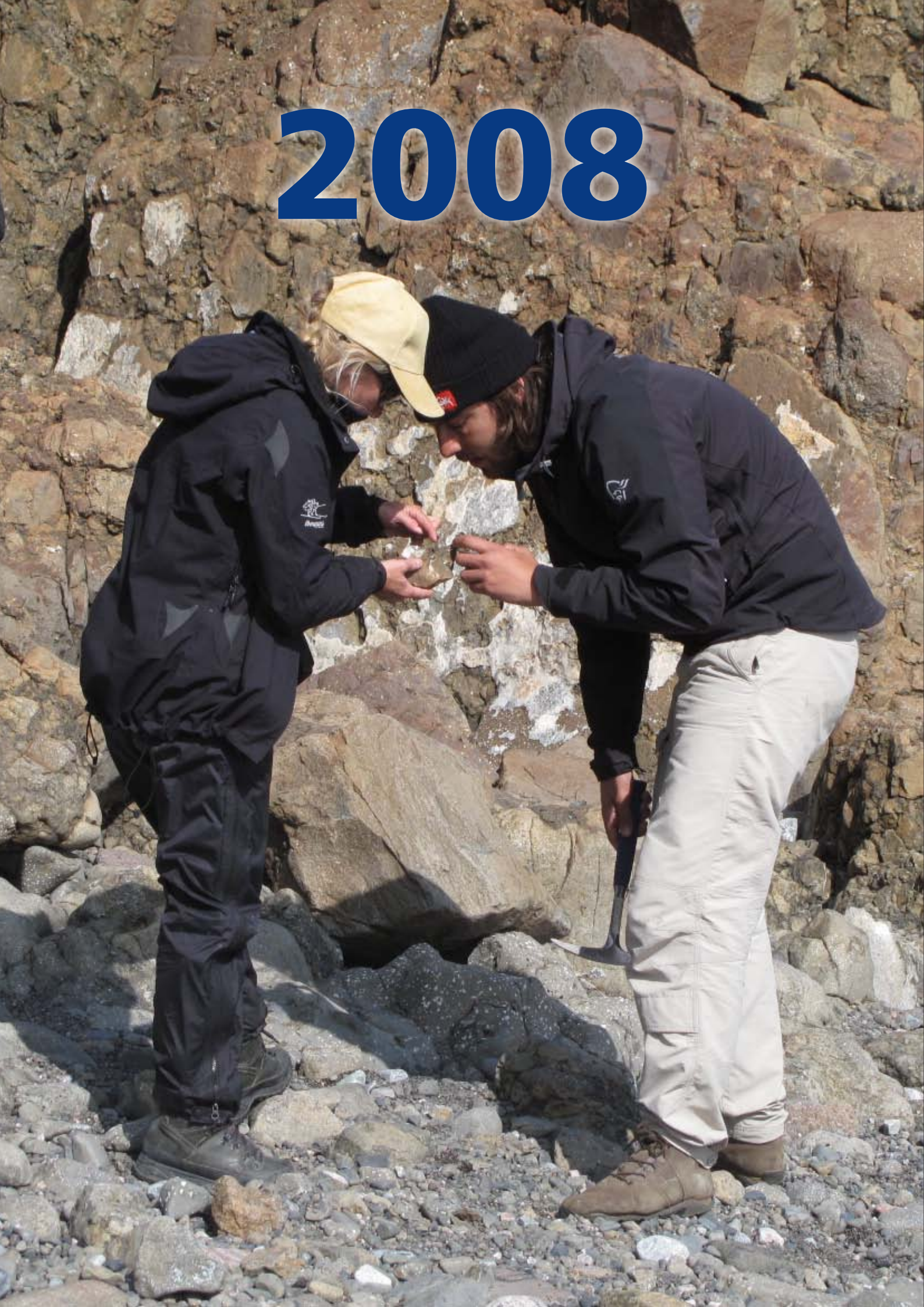
2008



Research projects

Development of the Nuussuaq Basin

Associate professor Gunver Krarup Pedersen, Department of Geography and Geology, University of Copenhagen
Senior research scientist Stig Schack Pedersen, The Geological Survey of Denmark and Greenland

The Nuussuaq Basin comprises sedimentary and volcanic rocks from the Cretaceous and Paleocene at Disko and Nuussuaq, West Greenland. Two localities provide information on two important stages in the development of the basin. At these localities sedimentary logs are measured and samples are collected for palynological and geochemical analyses. The Cenomanian–Turonian boundary is characterised globally by high eustatic sea level and changes in sedimentary facies. It is attempted to recognise this drowning surface in a deltaic succession. Furthermore the interplay between volcanic eruptions and deposition in large, deep lakes is studied in a newly discovered section.

Sedimentological logs have been measured and samples have been collected for examination of spores, pollen and dinoflagellate cysts, as well as sedimentary geochemistry. The vessel "Porsild" was used for transport to the Vaigat area and between the localities.

The investigation is not yet completed, but the palynological samples indicate that one of the studied successions include strata of Cenomanian as well as Turonian age.

Two papers are in preparation. The first focuses on the identification of Cenomanian and Turonian strata in a section from southern Nuussuaq. The second paper describes fluvial and lacustrine syn-volcanic deposits in northeastern Disko.

Vegetation studies at Skarvefjeld

Flemming Rune, Center of Forest & Landscape, Faculty of Life Sciences, University of Copenhagen.

The test fields in which the vegetation has been disturbed or destroyed in 1991 were revisited to follow the changes in the vegetation. As stated in the 2007-report it was necessary to remark the fields, and the position of the entire field was determined by GPS. The changes in the vegetation are ongoing and will continue for decades. In some fields the plant cover is complete and composed of up to 20 species/m^2. In other fields the vegetation is only sparse, and they are exposed to intensive erosion. The total number of species in the fields is ca. 50.

Magnetic Observatory Qeqertarsuaq (GDH)

Jürgen Matzka, Danish Meteorological Institute

The aim was to install new magnetometers and to train the institute's local staff in Qeqertarsuaq.

The magnetic observatory is a part of the Danish Meteorological Institute's 17 magnetic measurement stations in Greenland. The magnetic field has been measured since 1926. Data are transmitted in real time to the institute in Copenhagen, while calibration measurements are made once a week by the local staff.

The Climate Record in Kangerlussuaq (acronym CRIK)

Associate professor Morten Holtegaard Nielsen, Center for Aquatic Technology, Technical University of Denmark
Associate professor Holger Lykke-Andersen, Geological Institute, University of Aarhus
Associate professor Lars Chresten Lund-Hansen, Biological Institute, University of Aarhus
Professor Søren Rysgaard, Greenland Institute of Natural Resources, Nuuk
Associate professor Karen Luise Knudsen, Geological Institute, University of Aarhus
Ph.d.-student Dorthe Reng, Geological Institute, University of Aarhus
Associate professor Bent Hasholt, Institute for Geography and Geology, University of Copenhagen
Professor Morten Pejrup, Department of Geography and Geology, University of Copenhagen
Associate professor Thorbjørn Joest Andersen, Department of Geography and Geology, University of Copenhagen
Forskningsleder Niels Foged, Department of Civil Engineering, Technical University of Denmark
Senior Researcher Ingela Dahllöf, Department of Marine Ecology, National Environmental Research Institute
Researcher Morten Hjorth, National Environmental Research Institute, Department of Marine Ecology

Arctic Station's research vessel Porsild was used to: 1) seismic mapping (using a high frequency boomer) of the sediments in the fiord 2) collection of short (ca. 0.5 m) Box-cores 3) hydrographic measurements (salinity and temperature) as a function of depth and position 4) measurements of distribution of grain size and sedimentation velocity of fine grained sediment 5) measurements of the optical characteristics of the water, e.g. light penetration 6) collection of water samples for nutrient analyses 7) collection of water samples for phytoplankton investigation, and finally 8) collection of net samples for zooplankton investigation.

The extensive mapping of the sediments in the inner part of Kangerlussuaq clearly indicates the positions, where it is feasible to collect long cores for climate records.

Environmental perceptions of changing weather and sea-ice conditions in Qeqertarsuaq

Pelle Tejsner, PhD candidate in Social-Anthropology, University of Aberdeen

Global warming has the last decades reduced the distribution of the sea ice in arctic areas with changing weather conditions as a consequence. This has a strong influence on the inuits' hunting and fishing activities. The aim of the stay on the Arctic Station in 2007 and 2008 was to do socio-anthropologic studies, which describe the knowledge on nature by local hunters and fishermen, and the daily life in an arctic coastal community. The study also deals with the local perception of the changing weather conditions, the condition of the sea ice, and the socio-economic effect of national administration of the resources in the sea.

Tagging of bowhead whales with DTAG

Malene Simon, Greenland Institute of Natural Resources and University of Aarhus
Peter T. Madsen, University of Aarhus
Fernando Ugarte, Greenland Institute of Natural Resources
Anina Simon, assistant
Ole Olsen, assistant

The aim of the study was to tag bowhead whales with DTAG (non-invasive instrument, which records data for a 3-D reconstruction of the whale's swimming behaviour) to describe kinematics and swimming behaviour under foraging.

The increased water resistance from the whale's open mouth under filtration combined with relatively high swimming speed and long diving times makes this physiological impossible unless the whales have adapted in some ways. We tested two hypotheses
1) the bowhead whales open or close the mouth under the foraging dive depending on density of the prey and save energy under periods with the mouth closed.
2) The bowhead whales change the fluking gait and speed to save energy under constant filtration.

NORCLIM

Simon Troelstra, VU University Amsterdam, the Netherlands
Antoon Kuijpers, GEUS, Copenhagen
Naja Mikkelsen, GEUS, Copenhagen
David MacCarthey, Durham University, UK

NORCLIM is about rapid climate change and human activities in the Arctic during the last 2000 years. To this purpose sediment cores were taken at selected localities (Svalbard, Newfoundland and Disko Bay) for climate reconstruction in the framework of the IPY. The cores will be analysed on different physical, chemical and biological parameters.

Collection of the amphipod, *Orchomenella pinguis*

Lis Bach, National, ph.d-student, Environmental Research Institute, Department of Marine Ecology

The aim was to investigate the occurrence of the amphipod, *Orchomenella pinguis*, and to collect specimens for comparison with specimens collected at Sisimiut

Winter collection of water bears (see p. 37). View of Disko Fjord from "Majoren". Photo: Reinhardt Møbjerg Kristensen

Climate change and baleen whale trophic cascades in West Greenland.

Dr. M P Heide-Jørgensen, Greenland Institute of Natural Resources
Dr. K. Laidre, Polar Science Center, Applied Physics Laboratory, Seattle
Mikkel Villum Jensen, Mikkels Værksted
Hans Chr. Schmidt, Mikkels Værksted
Ole Norden Andersen, Mikkels Værksted

The project is focused on two species linked by phenology and spatial and temporal proximity that exploit different levels of the trophic web. A spring component examines the coupling between sea ice recession, primary and secondary production, and foraging ecology of bowhead whales, while a summer component examines the coupling between late-ascent secondary production, forage fish, and the foraging ecology of humpback whales.

Novel methods of data collection such as satellite and archival telemetry will be used to quantify cetacean foraging behavior, focal area use, and phenology. This will be complemented with localized in situ sampling of ocean conditions and remote sensing of sea ice. These data combined into spatial and bioenergetic models will provide insight to the dynamic predator-prey relationships in the West Greenland ecosystem, a marine area currently undergoing large shifts due to climate change.

Calanus and the climate

Professor Torkel Gissel Nielsen, National Environmental Research Institute

The genus *Calanus* is a key element in the arctic ecosystems. It dominates the biomass of mesozooplankton, and the specimens are important grazers on the primary production. In addition, they are food for a number of fish species, sea birds and marine mammals. In Disko Bay the arctic species, *Calanus glacialis,* occurs together with the Atlantic, *C. finmarchicus*. These species are quite similar, but there are some important differences in their physiology and energy content. In a possible warmer environment a change in the ratio between the two species will have significant consequences for the food webs. We have collected both species with short time intervals from February to July and have shown the fundamental differences between the two species both in the sea and by laboratory studies. The southern species, *C. finmarchicus*, is depending on the spring bloom for reproduction, while *C. glacialis* is able to start egg production before the spring bloom using lipid reserves. A temperature increase will probably mean that *C. finmarchicus* will be the dominant species. The lipid content in this species is smaller, and this will potentially have consequences for the food web and ultimately for hunting success and economy of the local population.

Climate change vulnerability and adaptation in Qeqertarsuaq

Dr James Ford, McGill University, Montreal, Canada
Christina Goldhar, Memorial University, St John's, Canada

Semi-structured interviews and socio-economic surveys with community members to develop understanding of how they experience and respond to changing climatic conditions.

Preliminary observations: Observations of changing climate documented with impacts for community members; food system resilient but climate change in context of social stresses creating v ph.d-student, ulnerabilities; community highly adaptable to change.

Collection of biological samples for AMAP (Arctic Monitoring Assessment Program)

Aurore Aubail, National Environmental Research Institute and LIENSS, UMR 6250 CNRS-University of La Rochelle, France

The aim was to collect biological samples from ringed seals at Qeqertarsuaq in connection with the monitoring program, AMAP Core.

The samples will be analyzed for contaminants like heavy metals and PBC and DDT, which are difficult to degrade. The program is depending on local hunters, who donate biopsies from muscle, liver, kidney plus blood and urine samples.

Food Security in Western Greenland: A Case Study from Qeqertarsuaq

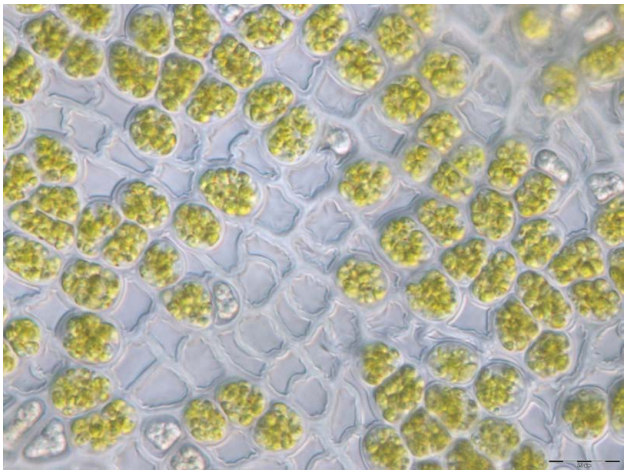
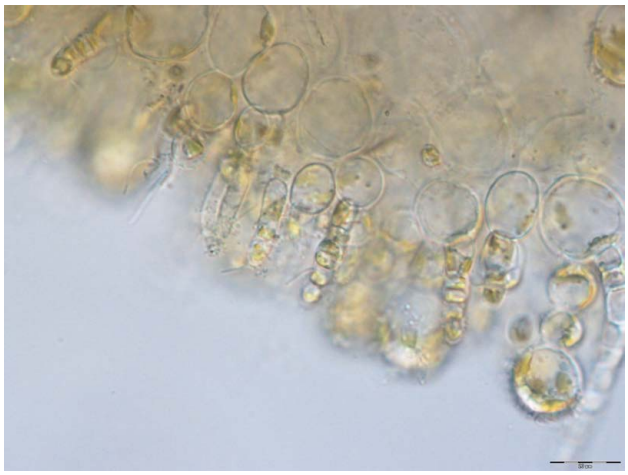
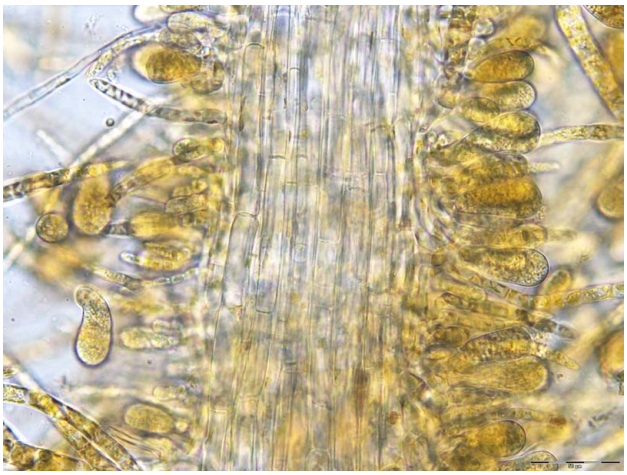
James Ford, Christina Goldhar, Ulloriaq Grønvold and Lea Berrang-Ford
McGill University, Montreal, Canada

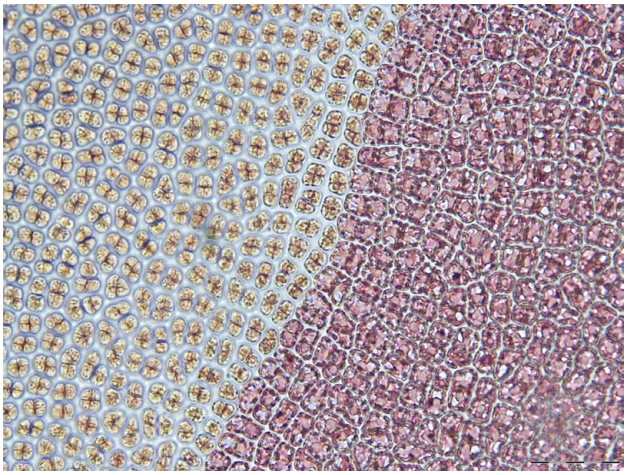
This study explores food security in the community of Qeqertarsuaq, Greenland, characterizing the ability of community members to access culturally relevant foods of sufficient quantity and quality. The study further identifies local determinants of access to appropriate foods and the exposure-sensitivity and adaptive capacity of the food system to climatic change in the context of additional socio-economic and environmental change. Approximately 8% of Qeqertarsuaq residents were classified as food insecure in this study. While food security levels may be high in Qeqertarsuaq, the ability to obtain culturally (and nutritionally) important Greenlandic foods among women, Elders and non-hunters is cause for concern. As Greenlandic food security is contingent upon access to these highly valued foods, further research is needed to identify strategies for increasing traditional food access. These developments are necessary to help achieve community food security in small, mixed subsistence-cash economies in the context of social, economic, and climatic change.

Benthic, marine algae

Poul Møller Pedersen, Associate professor, Biological Institute, Department of Phycology, University of Copenhagen.

The aim was to take digital pictures of marine, benthic algae with the use of the excellent equipment on the Arctic Station. The microscope pictures will be used for illustrations in a book on marine algae from Greenland.



Photos taken by Olympus microscope and digital camera made possible by a grant from FNU.

Other visitors

Presidium of the Danish parliament

The presidium of the Danish parliament visited the Arctic Station in August. The delegation was headed by Thor Pedersen (MP) and also included members of the Greenland administration and Danish administrative persons and spouses to the presidium members. Poul Møller Pedersen represented the board and gave the party a guided tour and an introduction to the activities at the station.

Photographing to book

Ivars Silis, p.t. Ilulissat

Ivars Silis stayed at the Arctic Station in April and June to take photographs to a book with the tentative title *Disko Bugten*. The photographs include illustrations of the whale tagging activities and the investigations of the marine food web. A chapter in the book will be devoted to these central activities of the Arctic Station.

Collecting of material on research to articles to be published in Polarfronten and the Danish Polar Center's home page and lectures on IPY.

Uffe Wilken, Danish Polar Center, Danish Agency for Science Technology and Communication

1) Blog-contribution on the Danish Polar Center homepage on activities on the Arctic Station (see *http://www.dpc.dk/sw15037.asp*).
2) Lecture in the museum at Qeqertarsuaq about ice cores and the ikkaite coloums.
3) Lecture on polar research for new members of the Danish parliament during their visit to the Arctic Station.

Education

Exploration Seminar to Greenland: Ice, Climate, and Culture

Michelle Koutnik, Professor Gerard Roe, Aley Willis, and 14 students
University of Washington, Department of Earth and Space Sciences, United States

The goals of our three-week exploration of Greenland, with additional time in Copenhagen were:

- To learn how fundamental components of the earth system, in particular the atmosphere, ocean, and ice sheets, are interconnected.
- To obtain real-world knowledge about climate change, and how changes in the Arctic will impact Greenland and extend globally.
- To gain a more sophisticated understanding of how to tackle scientific problems and ask scientific questions.
- To appreciate, and be able to estimate, the range of spatial scales and time scales in the natural environment.
- To appreciate the different styles of learning and communicating in science and in society.
- To encourage critical thinking about global issues.

GU Aasiaat biology excursion

Fourteen students and 1 teacher from North Greenland's gymnasium (GU Aasiaat) stayed one week at the Arctic Station to study especially whales and higher plants. The aim was also to give the students an introduction to the ecological conditions in the Arctic.

Arctic Biology field course, Qeqertarsuaq, 2008

The field course took place between the 6th of July and the 26th July and was attended by 12 students from University of Copenhagen (Faculty of Science and Faculty of Life Sciences). The coordinators and supervisors were Marianne Philipp and Kirsten S. Christoffersen from the Department of Biology.
The overall aim of the course was to provide the students with a profound knowledge of the arctic environment, the organisms and the societies that they form as well as how these components interact. It was also the purpose to train the students to plan, perform and report a scientific project.
The following topics were studied:
1) The effect of temperature and food on the production of *Calanus finmarchicus* and *C. glacialis* in Disko Bay, western Greenland.
2) Effect of temperature on pollen germination in *Stellaria longipes*.
3 The effect of *Nysius groenlandicus* on seed weight and germination in *Silene acaulis*.
4) Niche convergence in a low arctic plant community.
5) A gradient analysis based on plant functional traits.
6) A paleolimnologic study in three Greenlandic lakes of interaction between *Lepidurus arcticus, Daphnia pulex, Eurycercus glacialis,* and *Colymbetes dolabratus*, and their relation to climate variations.
7) Genetic and morphological variation in *Lepidurus arcticus* from Disko Island.
8) Food chain structure and importance of the invertebrate predators, *Lepidurus arcticus* and *Colymbetes dolabratus*, in arctic ponds.
All reports are published in Arctic Biology Field Course, Qeqertarsuaq 2008, which can be obtained as pdf or as hard copy free of charge from Kirsten S. Christoffersen (kchristoffersen@bio.ku.dk).

Publications

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Thor, P., T.G. Nielsen & P. Tiselius 2008. Post-spring bloom mortality rates of epipelagic copepods in the Disko Bay, Western Greenland. – Mar. Ecol. Prog. Ser. 359: 151-160.

Vorkamp, K., F. Rigét, M. Glacius, D.C.G. Muir & R. Dietz 2008. Levels and trends of persistent organic pollutants in ringed seal (Phoca hispida) from Central West Greenland, with particular focus on polybrominated diphenyl ethers (PBDEs). – Environmental International 34: 499-508.

2009

Research projects

Bowhead whale (*Balaena mysticetus*) communication in the Arctic

Outi Tervo, Arctic Station, University of Copenhagen, Qeqertarsuaq, Greenland
Malene Simon, Department of Biological Sciences, University of Aarhus and Greenland Institute of Natural Resources, Nuuk, Greenland.
Mads Christoffersen, Arctic Station, University of Copenhagen.
Lee A. Miller, Institute of Biology, University of Southern Denmark, Odense.
Peter Teglberg Madsen, Greenland Institute of Natural Resources
Susan E. Parks

The objectives of this study were to estimate the distances over which bowhead whales can communicate in Disko Bay, Greenland, and to evaluate how increased anthropogenic noise in the arctic might impair this capability. To meet these objectives three types of acoustic measurements were made:
1. To estimate the source level of bowhead whale vocalisations, recordings of singing bowhead whales in Disko Bay were made with a large aperture hydrophone array.
2. Recordings were made throughout the study period in order to measure the ambient noise levels in Disko Bay.
3. Transmission loss of sound was measured by playing back bowhead whale song at known source levels at measured distances from an artificial sound source.

We used an array of four receivers that were synched with µsec timing from satellite signals (Møhl et al. 2001). Each receiver consisted of a B&K 8101 hydrophone, low noise amplifier, M-Audio digital recorder, frequency shift keying device (FSK) connected to a GPS antenna and a computer (Figure 1).

The system allowed for independent recordings to be time linked afterwards in the lab

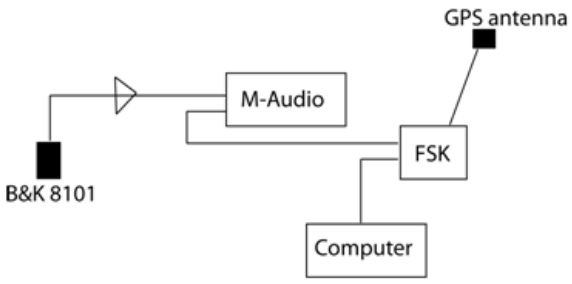


Figure 1

using the GPS timing signal which was converted into a frequency modulated tone. This tone and sounds produced by bowhead whales were recorded simultaneously on each channel of the stereo M-Audio recorder. We used the time of arrival differences (TOAD) of the call between the hydrophones to compute the distance to the whale from the array.

The hydrophones of each recording unit in the array were deployed at ca. 30 m depth through holes in the sea ice at an approximate distance of 1 km from the coast line and spaced between 500 – 1000 m depending on the ice conditions.

The source levels found in this study are 10-30 dB higher than found in previous studies. However, they are comparable to the source levels measured for fin and blue whales. These large rorquals have large active spaces, perhaps across ocean basins. The active space of 60 -100 km found in this study is surprisingly large taking the high frequencies of the calls in consideration. Such ranges come about because of the very quiet environment in which the whales communicate. When ice covers the sea surface no wave noise is present and precipitation from snow gives no noise either. On the other hand, incidents of calving glaciers and icebergs will in shorter periods mask all communication. Also the vocalizing of several bowhead whales simultaneously can for longer periods (hours) increase the noise floor.

For the same source levels, bowheads will have a smaller active space than fin and blue whale due to a calling frequency 1-2 decades higher, where the absorption is higher. The high pitched singing may have evolved because bowheads congregate in a relatively small mating area with very low levels of back ground noise. In a small area high pitched singing can reach enough receivers while allowing for a dynamic song repertoire in a sexual selection scheme as suggested for humpback whales. The estimated active space indicates that bowhead whales can communicate all over the Disko Bay area.

Anthropogenic noise is of very low level when sea ice covers the area, and there is no commercial shipping from late December to late April. Shipping or oil activities or changes in the ice conditions will raise the noise floor thereby restricting the active space significantly for bowhead whales in Disko Bay.

Geological reconnaissance of late Cretaceous and early Paleogene deposits on Disko and Nuusuaq

Bent Erik Kramer Lindow, Natural History Museum, University of Copenhagen
Jam Schulz Adolfssen, Natural History Museum, University of Copenhagen

The geological deposits on Disko and Nuusuaq belong to Late Cretaceous and Early Paleogene. This period is characterized by considerable changes in the Earth's climate and history of life, and, furthermore, it is of great significance for the evolution and extinction of several important animal taxa: sharks, fish species, mammals, birds, and turtles as well asmarine invertebrates.

The aim of the project was to investigate the abundance of fossils and their state of preservation in deposits at various localities in the area (Maarrat Kiilit, Asuk, and Assoq)

The preliminary conclusions are:
1) Maarrat Kiilit, marine gravity flow deposits – some potential, poor conservation.
2) Asuk, marine delta deposits – no potential
3) Assoq, lacustrine slate deposits – some potential, more investigations are needed.

Mineral deposits in the Karrat Group

Nick Rose, Avannaa Resources
Dennis Bird, Stanford University, USA
Daniel Wielandt, Natural History Museum, University of Copenhagen

The purpose was to assess resource potential of metamorphic palaeosols and mineralized shearzones. The field work included mapping and channel sampling. We used a scintillation counter to measure Th in rocks. Some mineralizations have been found but are yet of unresolved origin. Detailed Qemscan and electron microprobe studies at SGS Lakefield and at Stanford University in progress.

Disko west environmental studies

Poul Møller Pedersen, Department of Biology, University of Copenhagen
Michael Bo Rasmussen, National Enviromental Research Institute (NERI), University of Aarhus
Peter Bondo Christensen, NERI
Anette Bruhn, NERI

Base-line investigations of fauna and benthic marine algae were made at depths from 0 to 20 m along a number of transects from Sisimiut to Hareø north of Disko.
The Arctic Station was used as base for a shorter period, and we used the microscope facilities for photographic documentation of some of the benthic algae.

Frequencies and effects of hybridisation between two arctic plant species: *Pyrola grandiflora* and *P. minor*

Thure P. Hauser, Associate professor, Institut for Jordbrug og Økologi, University of Copenhagen
Knud Brian Nielsen, master student, Department of Biology, Section of Ecology and Evolution
Marianne Philipp, Associate professor, Department of Biology, Section of Ecology and Evolution, University of Copenhagen

Main questions of the study
1) How much gene flow occurs between *Pyrola minor* and *P. grandiflora*?
2) How frequently are hybrids produced?
3) Are the present hybrid-like plants F1 and/or backcrosses?
4) How does the reproductive system of the two species influence the hybridization process?

Samples for DNA-analyses were collected from populations of *P. minor* and *P. grandiflora* populations and dried with silicagel. Each specimen was morphologically analysed by means of binocular microscopes, and the soil and vegetation at the locality were recorded. Crossing experiments in the field were carried out to see how frequently F1-offspring is produced by either species.

The DNA-analysis has shown, that gene flow from *Pyrola grandiflora* occurs. The morphological analysis shows, that the *P. grandiflora* and *P. minor* populations as well as the hybrid populations are well separated, and the hybrids are intermediate of the two *Pyrola* species. Analyses of pollen viability, seed set from controlled hybridizations, and germination of hybrid seeds are ongoing.

Arctic plankton dynamic

Torkel Gissel Nielsen, National Environmental Research Institute (NERI)
Eva Friis Møller, NERI
Stiig Markager, NERI
Colin Stedmon, NERI
Signe Juul Madsen, NERI/University of Aarhus
Karen Vestergaard Henriksen, NERI
Marie Vestergaard Henriksen, NERI
Peter Grønkjær, University of Aarhus
Kajsa Tönnesson, University of Gothenburg

The objective of the project is to improve our understanding of the arctic marine ecosystem in order to evaluate the potential effects of future climate change. The focus is on the copepods of the genus *Calanus*, which contains key species in the arctic ecosystem that link the primary production to higher trophic levels such as fish, birds, and whales. Laboratory experiments, field work and modelling will be combined in order to elucidate how changes in the physical environment affect *Calanus* vital rates directly and indirectly, and how these effects may propagate through the marine ecosystem.

The core in the project is weekly measurements of the water column structure (CTD) and depth distribution of nutrients, phyto- and zooplankton at the permanent station off Godhavn.

For the first time we followed the spawning cycle of the largest copepod (*Calanus hyperboreus*) from the early spring. In contrast to the other copepods this species spawn in the bottom near layer and the lipid rich eggs float to the surface, where they hatch just prior to the spring bloom.

Many data and samples are still being analyzed and will provide material for several scientific papers in the near future.

Effects of hazardous substances on arctic copepods

Morten Hjorth, National Environmental Research Institute
Joan Holst Hansen, University of Aarhus

We tested the hypothesis, that *Calanus finmarchichus* and *C. glacialis* have different sensibility towards selected hazardous substances, which may disturb their competition and balance.

Specimens of the two species were used to test effects of various concentrations of sucralose on mortality, feeding, egg production and hatching. The preliminary results show the *C. glacialis* is more sensitive to increased concentrations of sucralose than *C. finmarchicus.*

Back to the future

Elin Jantze, Abisko Research Station/Lund University
Terry V. Callaghan, Abisko research Station/ Sheffield University
Torben R. Christensen, Lund University

The aim was to detect decadal vegetation changes by site re-visit 1970-2009 by vegetation description, percentage frequency, presence of species, and cover abundance. Cassiope, Lycopodium and *Salix glauca* were sampled. Biometry and phenology of *Phleum alpinum* including visual estimation of sexual maturity according to index anthers, length of inflorescence, width of inflorescence, elongation of the youngest internode, number of living leaves, length of the youngest leaf, tiller height, and senescence index for the youngest leaves. In addition, soil sampling for C14 dating was made.

Climate change and baleen whale trophic cascades in West Greenland

Mads Peter Heide-Jørgensen, Greenland Institute of Natural Resources
K. Laidre, Polar Science Center, Applied Physics Laboratory, Seattle, Washington, USA
Mikkel Villum Jensen, Mikkels Værksted
Franz, Mikkels Værksted
Ole Norden Andersen, Mikkels Værksted

The project is focused on two species linked by phenology and spatial and temporal proximity that exploit different levels of the trophic web. A spring component examines the coupling between sea ice recession, primary and secondary production, and foraging ecology of bowhead whales, while a summer

Saccorhiza dermatodea. Photo: Peter Bondo Christensen

component examines the coupling between late-ascent secondary production, forage fish, and the foraging ecology of humpback whales.

Novel methods of data collection such as satellite and archival telemetry will be used to quantify cetacean foraging behaviour, focal area use, and phenology. This will be complemented with localized in situ sampling of ocean conditions and remote sensing of sea ice. These data combined into spatial and bioenergetic models will provide insight to the dynamic predator-prey relationships in the West Greenland ecosystem, a marine system currently undergoing large shifts due to climate change

1. Cardiorespiratory responses to acute temperature change in two arctic sculpin species and the temperate Shorthorn sculpins (*Myoxocephalus scorpius*)
2. An integrated study of feeding and gastrointestinal physiology and potential effects of temperature.
3. How does arctic climate/temperature affect intestinal nutrient uptake in ectothermic animals such as fish.

Professor Michael Axelsson, University of Gothenburg
Phd student Albin Gräns, University of Gothenburg
Post-doc Sam Dupont, University of Gothenburg
Docent Susanne "Sanna" Eriksson, University of Gothenburg
Technichian Christina Hagström, University of Gothenburg
Professor Jörgen Johnansson, University of Gothenburg
Post-doc Fredrik Jutfelt, University of Gothenburg
Assistant professor Elisabeth "Lisa" Jönsson Bergman, University of Gothenburg
Phd student Andreas Kullgren, University of Gothenburg
Phd student Lars Niklasson, University of Gothenburg
Associate professor Catharina Olsson, University of Gothenburg
Post-doc Erik Sandblom, University of Gothenburg
Phd student Henrik Seth, University of Gothenburg
Professor Kristina "Snuttan" Sundell, University of Gothenburg
Technician Linda Svanberg, University of Gothenburg
Associate professor Kerstin Wiklander, University of Gothenburg

In the end six different subprojects were conducted by the various research constellations. A short description of each will be given below

Project 1. Effects of climate changes on marine crustaceans
In this sub-project three different invertebrates were used, a small crustacean (Gammarus ssp), sea stars and sea urchins. The animals were exposed to two different temperatures and pH levels and their behavior was studied. In addition to behavior, heart rate, hemocyte count and haemolymp protein levels were analyzed.

Project 2. Gastrointestinal function and the effects of temperature in two arctic sculpin species
In this sub-project the effect of gastrointestinal barrier function was studied using the Ussing-chamber technique. The aim was to acclimate fish to different temperatures for two weeks and then study the gastrointestinal function. These fish were kept in the six smaller holding tanks with three different temperatures (4°C, 9°C and 14°C).

In this study three different species was used, the short horned sculpin, *Myoxocephalus scorpius*, the arctic staghorn sculpin, *Gymnocanthus tricuspis* and the arctic sculpin *Myoxocephalus scorpioides*. No *in vivo* studies were performed, the animals were taken from the holding tanks and immediately killed by a sharp blow to the head before the gastrointestinal tissue was dissected out and prepared for the Ussing-chambers.

Project 3A. Cardiac output, gastrointestinal blood and gastric electric activity as a function of temperature
In this sub-project three different species was used, the short horned sculpin, *Myoxocephalus scorpius*, the arctic staghorn sculpin, *Gymnocanthus tricuspis* and the arctic sculpin *Myoxocephalus scorpioides*. The animals were anaesthetized in well aerated sea water containing 100 mg Tricaine methanesulfonate (MS222, Sigma) per litre. When the animals reached surgical anaesthesia as defined by Stoskopf (Fish Medicine, 1993) the fish were transferred to an operating table and kept at surgical anaesthetized by continuously pumping well aerated chilled (5-9°C) seawater containing 50 mg M222 per litre over the gills.

The animals were equipped with a Doppler flow probe around the ventral aorta, one flow probe around the common coeliacomestenteric artery supplying the gastrointestinal canal with blood and a pair of stainless steel electrodes that was implanted in the gastric wall to enable recording of the electric activity of the stomach smooth muscles. The fish was then exposed to acute water temperature changes, three different temperatures were tested, 4°C, 9°C and 14°C. The idea was to see if there is a difference in temperature tolerance between the two arctic sculpins and the more temperate short horned sculpin that can be found in water temperatures from +2°C up to 18°C.

Project 3B. Routine and maximal total body oxygen consumption
In a second set of animals the total body oxygen consumptions was recorded in uninstrumented animals. The animals were transferred from the holding tank to a stop-flow respirometer system (three in parallel) and left to recover for at least 12 hours. The experimental protocol was the same as for sub-project 4A.

Project 4, Cardiac scope in the short horned sculpin
In this sub-project the short horned sculpin, *Myoxocephalus scorpius* was used. The animals were anaesthetized in well aerated sea water containing 100 mg Tricaine methanesulfonate (MS222, Sigma) per liter. When the animals reached surgical anaesthesia as defined by Stoskopf (Fish Medicine, 1993) the fish were transferred to an operating table and kept at surgical anaesthetized by continuously pumping well aerated chilled (5-9°C) seawater containing 50 mg M222 per litre over the gills.

The animals were equipped with a single Transonic transit time flow probe around the ventral aorta.

The experimental protocol in this sub-project consisted of recording routine and maximum cardiac output at 9°C, which was the surface water temperature where the animals were caught. This study was a direct follow up on an identical project run during my visit in 2002, at that time the water temperature was +6°C in August.

Project 5. Gastrointestinal function and histology in three sculpin species
In this sub-project the muscular function of the gastrointestinal canal were tested using isolated muscular strips of gastric and intestinal tissue.

In this study three different species was used, the short horned sculpin, Myoxocephalus scorpius, the arctic staghorn sculpin, Gymnocanthus tricuspis and the arctic sculpin *Myoxocephalus scorpioides*. The animals we taken from the holding tanks and immediately killed by a sharp blow to the head before the gastrointestinal tissue was dissected out and prepared for the in vitro tests. Thin strips of the stomach and intestine were cut and mounted in a force transducer that continuously recorded the force generated by the smooth muscles in each preparation. The maximal force generation was tested by adding potassium chloride that excites all the muscles cells in the preparation. This was done at three different temperatures, 4°C, 9°C and 14°C to test for effects of temperature on the force generation capacity.

Project 6. Behavioral ecology in sculpins
In this sub-project three species of fish was used, *Myoxocephalus scorpius*, arctic staghorn sculpin, *Gymnocanthus tricuspis* and the arctic sculpin *Myoxocephalus scorpioides*. In this project we studied the behavior of the animals, the events were recorded using a digital video camera and the recordings are at the moment analyzed. Two size matched fish of different species were introduced into a test tank with only one shelter (PVC tube) and the competition for the shelter of the two individuals studied using a video camera to minimize stress. This was done at the present water temperature in the coastal waters of Qeqertarsuaq that was +9°C in August 2009. After the tests the fish was released into the wild.

Other visitors

Disko Bugten

Photographer and writer Ivars Silis, Qaqortoq, Greenland

The aim was photo documentation of whale research and the first catch of a bowhead whale (*Balaena mysticetus*) after many years of total protection. The photographs will be used for a popular feature in AG (a newspaper in Greenland) and a book, which will be published in 2010.

Requiem for the North

Chris Teerink / Serious Film, Amsterdam / Rotterdam, Holland

The aim was to do research for a documentary film project. Research in Greenland and at the Arctic Station has resulted in a script and project proposal for a feature length documentary.

Inua

Christian Mainz, photographer

The aim is to make a book, which from an artistic/photographic angle shows the great diversity and beauty of geology in Greenland. It is the hope, that the book will increase the general interest for the Greenland nature and geology in particular.

Møller – the Greenland inspector

Steen Neergaard

The main purpose was to gain insight in the placing of Royal Greenland buildings in Qeqertarsuaq in 1843/44 and the most important localities mentioned by Møller, who was inspector (and also zoologist) in Qeqertarsuaq at that time.

Research for the website "polarfocus.dk" (Ministry of Research and Innovation). Subject: bowhead whales in Disko Bay.

Uffe Wilken, Ministry of Research and Innovation

The purpose of the stay was journalistic research.

Royals visit the Arctic Station

The three heirs, Crown Prince Frederik from Denmark, Crown Princess Victoria from Sweden and Crown Prince Haakon from Norway visited the Arctic Station, Qeqertarsuaq on 28 May. They were welcomed by professor Bo Elberling, and on the agenda was a royal discussion on recent climate changes and climate feedback loops, in particular the effect of thawing permafrost and future gas emissions (see picture on back page).

Education

PhD Summer School in Greenland September 2009

The Melting ice: climate change and scales of sustainability

The summer school was a great success, the participants (20) were very enthusiastic, and the physical frames ideal. The participants came from various universities and scientific areas all with a common interest in the social dimension of climate change. The stay was an excellent opportunity to study this *in situ*, and in addition to the seminars in the Arctic Station all participants made field studies in Qeqertarsuaq with a series of "climate portraits" as a common goal.

The course was financially supported by Temaklynge 1 (University of Copenhagen), and substantial support was obtained from the ERC-project, Institute of Anthropology.

Geological field-course for master students, July 2009

The geological field course at Arktisk Station took place from June 30th to July 23rd 2009 with participation of 16 students, two PhD students and one post.doc. The teachers were associate professor Asger Ken Pedersen (Natural Science Museum), associate professor Paul Martin Holm (Department of Geography and Geology, DGG) and associate professor Gunver Krarup Pedersen (IGG). More than half of the time was spent in tents in two camps at Marraat (western Nuussuaq) and Atanikerluk (southern Nuussuaq), with excursions to Sikillingi and Asuk. All travel was by the research vessel "Porsild". The weather was very fine through the course and no days were lost due to adverse weather conditions. In the Marraat area it is possible to study the oldest volcanic rocks from the West Greenland Igneous Province, as well as the occurrence of hydrocarbons in volcanic reservoir rocks. At Atanikerluk exposures of sedimentary rocks from the Nuussuaq Group are easily accessible. Between Marraat and Atanikerluk the excellent outcrops of a volcanic rifted margin was studied.

The participants in the course worked on a number of geological problems: The Precambrian crystalline rocks and their contact to the overlying rocks at Qeqertarsuaq (Udkiggen, Engelskmandens Havn, Fortune Bay); facies analysis of Cretaceous deltaic deposits at Atanikerluk and Asuk; mapping of the Quikavsak Formation at Quikassap Kuua; occurrence of hydrocarbons in volcanic reservoir rocks, the fauna of arenaceous limestones in volcaniclastic breccias, mass flows and lava flows of the Vaigat Formation (Marraat and Sikillingi); contaminated magmatic rocks (Asuk); and volcaniclastic breccias, intrusions, invasive lavas, and subaerial lava flows of the Maligât Formation were studied at Atanikerluk and Qeqertarsuaq (Lyngmarksfjeld, Skarvefjeld, Kuannit). Quaternary and Holocene deposits were studied at Atanikerluk and in Blæsedalen, close to Arktisk Station.

Avannaani Ilinniarnertuunngorniarfik (IA) – The Gymnasium of North Greenland

Excursion for 19 students and 1 teacher. The main objective was to make various simple ecological investigations, for example vegetation investigations using Raunkjær's circles and studies on vegetation types. The local fauna was studied using traps for collecting material.

Publications

Beatty, G.E., M. Philipp & J. Provan 2009. Unidirectional hybridization at a species' range boundary: implications for habitat tracking. – Diversity and Distrubutions 2009: 1-9.

Bonow, J.M., P. Japsen, P.F. Green, R.W. Wilson, J.A. Chalmers, K.E.S. Klint., J.A.M. van Gool, K. Lidmar-Bergström & A.K. Pedersen 2007. A Multi-disciplinary study of Phanerozoic landscape development in West Greenland. – Geological Survey of Denmark and Greenland Bulletin 13: 33-36.

Dam, G., G.K. Pedersen, M. Sønderholm, H.M. Midtgaard, L.M. Larsen, H. Nøhr-Hansen & A.K. Pedersen 2009. Lithostratigraphy of the Cretaceous–Paleocene Nuussuaq Group, Nuussuaq Basin, West Greenland. – Geological Survey of Denmark and Greenland Bulletin 19, 171 p.

Halberg, K.A., D. Persson, N. Møbjerg, A. Wanninger & R.M. Kristensen 2009. Myoanatomy of the marine tardigrade *Halobiotus crispae* (Eutardigrada: Hypsobiidae). – Journal of Morphology 270: 996-1013.

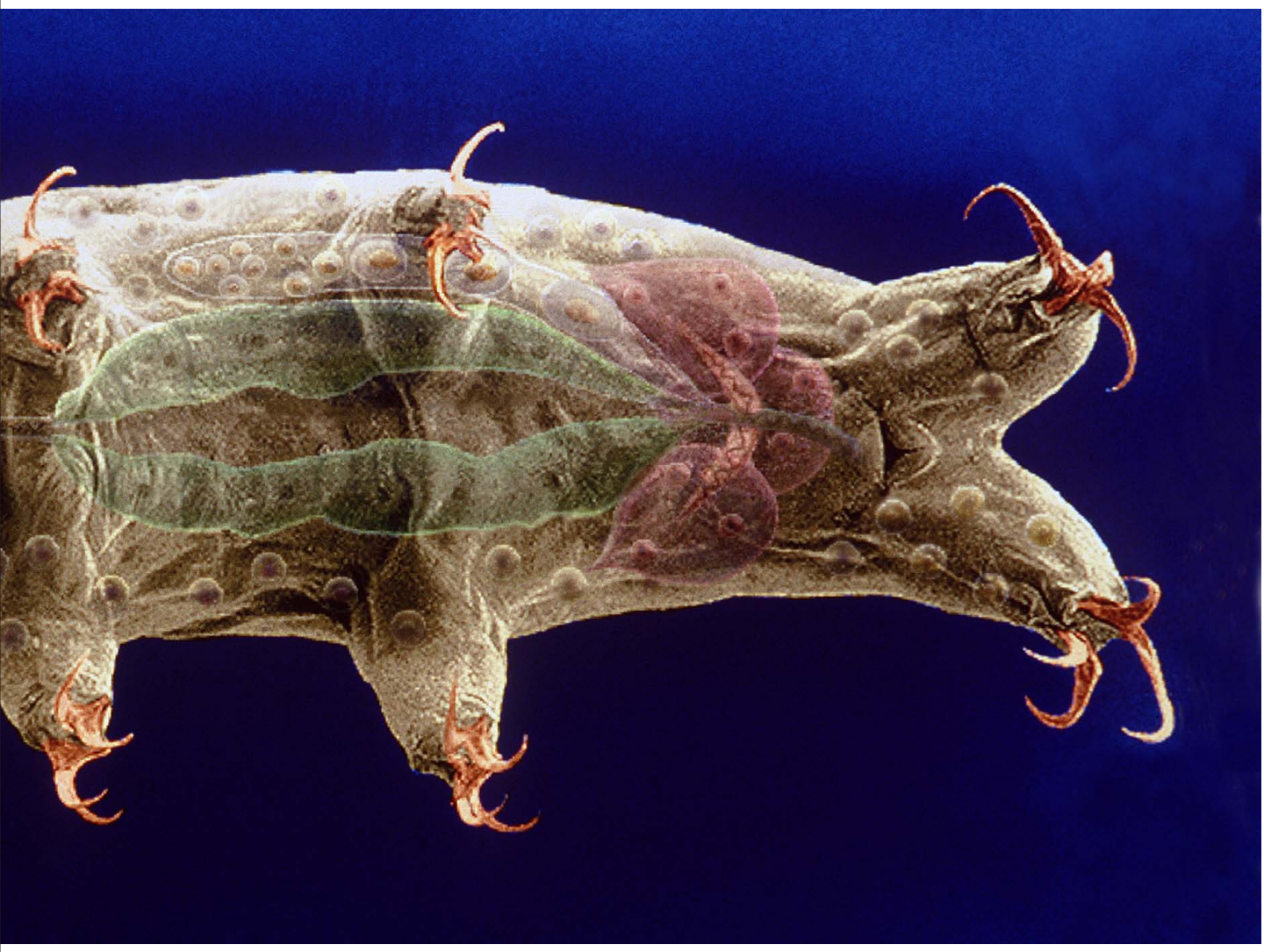
Halberg, K.A., D. Persson, H. Ramløv, P. Westh, R.M. Kristensen & N. Møbjerg 2009. Cyclomorphosis in Tardigrada: adaptations to environmental constraints. – Journal of Experimental Biology 212: 2803-2811.

Heiner, I. & R.M. Kristensen 2009. *Urnaloricus gadi* nov. gen. et nov. sp. (Loricifera, Urnaloricidae nov. fam.), an aberrant Loricifera with a viviparous pedogenetic life cycle. – Journal of Morphology 270: 129-153.

Larsen, L.M. & A.K. Pedersen 2009. Petrology of the Paleocene picrites and flood basalts on Disko and Nuussuaq, West Greenland. – Journal of Petrology 50, 1667–1711.

Neves, R.C., R.M. Kristensen & A. Wanninger 2009. Three-dimensional reconstruction of the musculature of various life cycle stages of the cycliophoran *Symbion americanus*. – Journal of Morphology 270: 257-270.

Tervo, O.M., S.E. Parks & L.A. Miller 2009. Seasonal changes in the vocal behaviour of bowhead whales (*Balaena mysticetus*) in Disko Bay, Western-Greenland. – Journal of the Acoustical Society of America 126: 1570-1580.



The tardigrade (water bear) Halobiotus crispae. Reconstruction: Nadja Møbjerg Kristensen

Master theses

Dünweber, M. 2009. Fate of spring diatom bloom in Disko Bay, western Greenland. – University of Southern Denmark and NERI, Aarhus University.

Kjellerup, S. 2009. Importance of timing vertical migration and reproduction to the arctic spring bloom in a future warmer climate, with emphasis on the potential competition between co-existing *Calanus finmarchicus* and *C. glacialis*. – University of Southern Denmark and NERI, Aarhus University.

Swalethorp, R. 2009. Production of *Calanus finmarchicus, C. glacialis* and *C. hyperboreus* in Disko Bay, western Greenland, with emphasis on life strategy. – University of Southern Denmark and NERI, Aarhus University.

Report from summer school

Anonymous 2009. Portraits from Qeqertarsuaq – anthropological research methods in action.
A joint project by the participants of the ph.d.-summer school, Greenland 2009: "Climate change and scales of sustainability". University of Copenhagen.

Laminaria longicruris. Photo: Peter Bondo Christensen

Winter collection of water bears near Kuanit. The water bears are found in the lichens. Photo: Reinhardt Møbjerg Kristensen

From the royal visit to the Arctic Station May 2009 (see p. 34)

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