ARCTIC STATION

FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

Annual Report 2010

R/V Porsild

About the report

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

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 "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 (*http://arktiskstation.ku.dk/*).

ARCTIC STATION

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The Chairman's report

The Arctic Station at Qeqertarsuaq, Disko was founded in 1906 by the Danish botanist Morten P. Porsild. He was the leader of the station for 40 years. In 1953 the station was turned over to the University of Copenhagen. Since 1978 the Board of Arctic Station comprises of members from the departments (biology and geography, geology) and the Natural History Museum of Denmark under the Faculty of Science. All-year research has top priory, and the scientific leader lives at the station throughout the year so guests are welcome at any time.

The members of the Board (in 2010) are professor Reinhardt Møbjerg Kristensen, (chairman, zoology), professor Bo Elberling (geography), professor Kirsten S. Christoffersen (zoology), associate professor Gunver Krarup Pedersen (logistics, geology) and associate professor Poul Møller Pedersen (vice chairman, botany). In addition, an external member of the Board, professor Kirsten Hastrup, Institute of Anthropology, joined the board in 2007.

In 2010 the station was visited by 163 guests, and they spent 1828 nights at the station. Furthermore, R/V "Porsild" was used by these groups in 109 days.

Gitte Henriksen is a board member appointed by the Faculty. She is secretary for the station, and all bookings of courses and specific research programs are passing her hands. In addition, and quite important she is responsible for the station's budget and financial transactions.

Outi Maria Tervo (zoology) was appointed as scientific leader from 1 March, 2007. She was later the same year matriculated as PhD student. Her PhD project "Bowhead whale *Balaena mysticetus* acoustic behavior in Davis Strait" is supervised by associated professor Susan E. Parks (Pennsylvania State University, USA) and professor Reinhardt M. Kristensen. The project was supported by "*A.P. Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal*" in 2009.

Frantz Nielsen has since 1 May, 2009 been the technical manager of the station. All Greenlandic staff members including Frederik Grønvold, the captain of "R/V Porsild" have taken good care of the station, car, snow mobils and the boats. Antoinette Mølgaard has been the cleaner and, in addition, she has been a fantastic cook for several courses and workshops.

Reinhardt Møbjerg Kristensen

Research projects

HERBS ARE HURT, SHRUBS WILL SURVIVE – IN A CHANGING ARCTIC CLIMATE

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

The purpose of the field work this year was primarily to inspect permanent plots established in 1989 for monitoring populations of Arctic Poppy (*Papaver radicatum*). All poppy plants have now vanished, and are to some extend replaced by Arctic Willow (*Salix arctica*). The major change in performance of the poppies took place in 1996, coinciding with a marked change in winter ice coverage and duration on Disko Bay. The change in the vegetation composition is thought to be an early response to climatic change, which we see as an accelerated secondary succession in plant community structure.

The second part of the field work concerned herbivore behaviour on Arctic Willow (*Salix arctica*). We have previously shown that the sex ratio in *S. arctica* populations is strongly biased in favour of female plants, and we believe that the surplus of female plants is a result of herbivore preference for male plants. In the field we have seen more damage to male than to female plants, which has been confirmed in a cafeteria experiment with larvae of a sawfly (*Amauronematus sp.*). Alongside we made field observations of a preference for male willow plants by the 'Woolly Bear' caterpillar (*Gynaephora groenlandica*). During our stay at the Arctic Station we had the rare chance of field observation of the mating of newly hatched adult moths of *Gynaephora* although cocoons were scarce this year. The mating took several hours, and immediately after the fertilized female began laying eggs on a neighbouring stone, which was the highest available 'peak' near the mating place.

EXPLORATION OF A COLD TRAIL: ARCTIC PIECES TO THE PUZZLE OF EVOLUTION

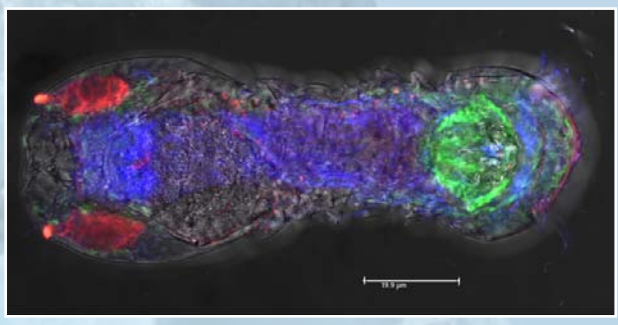
Arctic Workshop 2010, 26 July to 9 August
Reinhardt M. Kristensen, Natural History Museum of Denmark (NHMD) (team leader and grant holder, Carlsberg Foundation)
Martin V. Sørensen (NHMD)
Katrine Worsaae, Department of Biology, University of Copenhagen
Casey W. Dunn, Browns University, USA
Greg Edgecombe, Natural History Museum, London, UK
Gonzalo Giribet, Harvard University, USA
Andreas Hejnol, Sars International Centre for Molecular Marine Biology, Norway
Ricardo Neves, University of Aviedo, Portugal
Greg Rouse, Scripps Institution of Oceanography, USA
Wolfgang Sterrer, Bermuda Aquarium, Museum and Zoo, Bermuda

The objective of the project was to collect a range of rare, marine and limnic microinvertebrates for morphological and molecular examinations. The working group has for almost a decade been compiling data for phylogenetic analyses of animal kingdom, the samplings made during the stay on Arctic Station were a direct continuation of this collaboration, in order to improve taxon sampling and to supplement the existing datasets

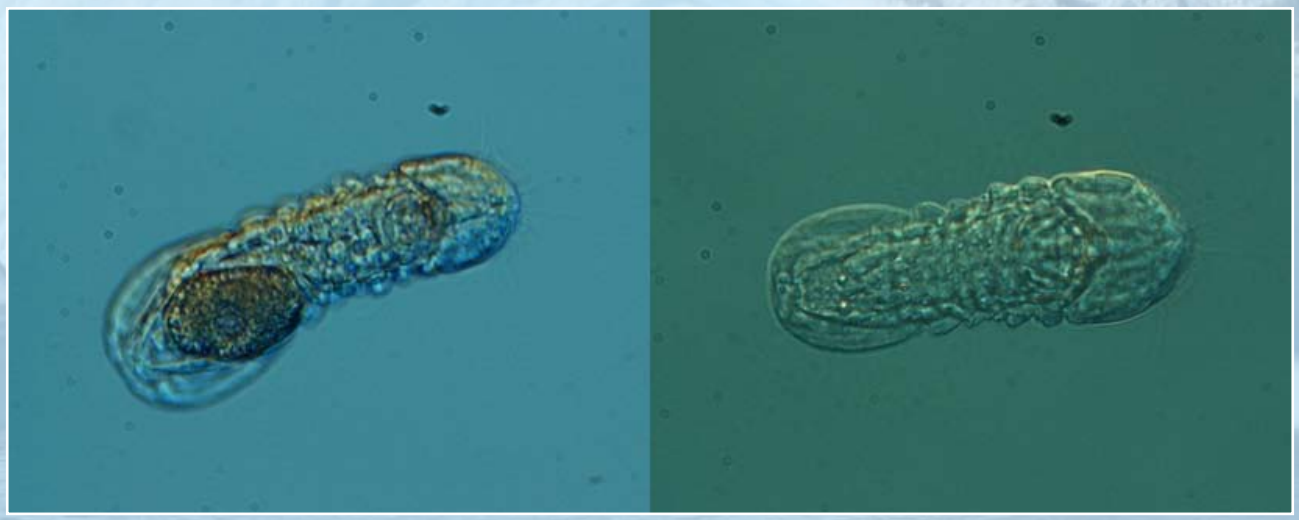
The team of Arctic Worshop 2010 in front of Arctic Station. (Photo: Martin V. Sørensen)

The type locality, Isunngua spring, of Limnognathia maerski*. The team of Arctic Workshop 2010 is collecting the microscopic animal by squeezing the water mosses.*

The team working in the main laboratory of Arctic Station. (Photo: Peter Henriksen)



Limnognathia maerski *with the newly discovered caudal glands by immuno staining. (Photo: Katrine Worsaae)*



Limnognathia maerski *live female and juvenile specimen.*

with information from rare and "hard to get" species.

The main target species was *Limnognathia maerski* – the only known species from Micrognathozoa, which is the most recently discovered animal phylum. Micrognathozoa was discovered in 1994 during an Arctic Biological Field Course from University of Copenhagen; however, the species was first described and formally named *Limnognathia maerski* (to honour Mærsk Mc-Kinney Møller) by the Danish zoologists Reinhardt Møbjerg Kristensen and Peter Funch in 2000. Only a handful of genes have been sequenced for it to date (Giribet et al, 2004). Fortunately the Carlsberg Foundation agreed, that it was time for greater molecular approach to *L. maerski*, and Carlsberg Foundation sponsored the Arctic Workshop 2010 at the Arctic Station. *Limnognathia maerski* lives in a small, heterothermic spring (Isunngua spring) on the northeast coast of Disko Island, and the team went there to collect submerged mosses from the spring, hoping to find a sufficient amount of specimens to carry out all planned studies. The ambition was to reach an amount of 400 specimens for sequencing of Expressed Sequence Tags (EST) or eventually the complete genome, and in addition to obtain at least 50 specimens for immunohistochemical- and gene expression studies. No previous single campaign had produced this amount of specimens, but the collecting was successful and after the following 10 days sorting, we had more than 600 specimens. 500 got grinded for molecular sequencing and preliminary results indicate a surprisingly good recovery of sequences. The remaining 100+ were fixed for morphological studies.

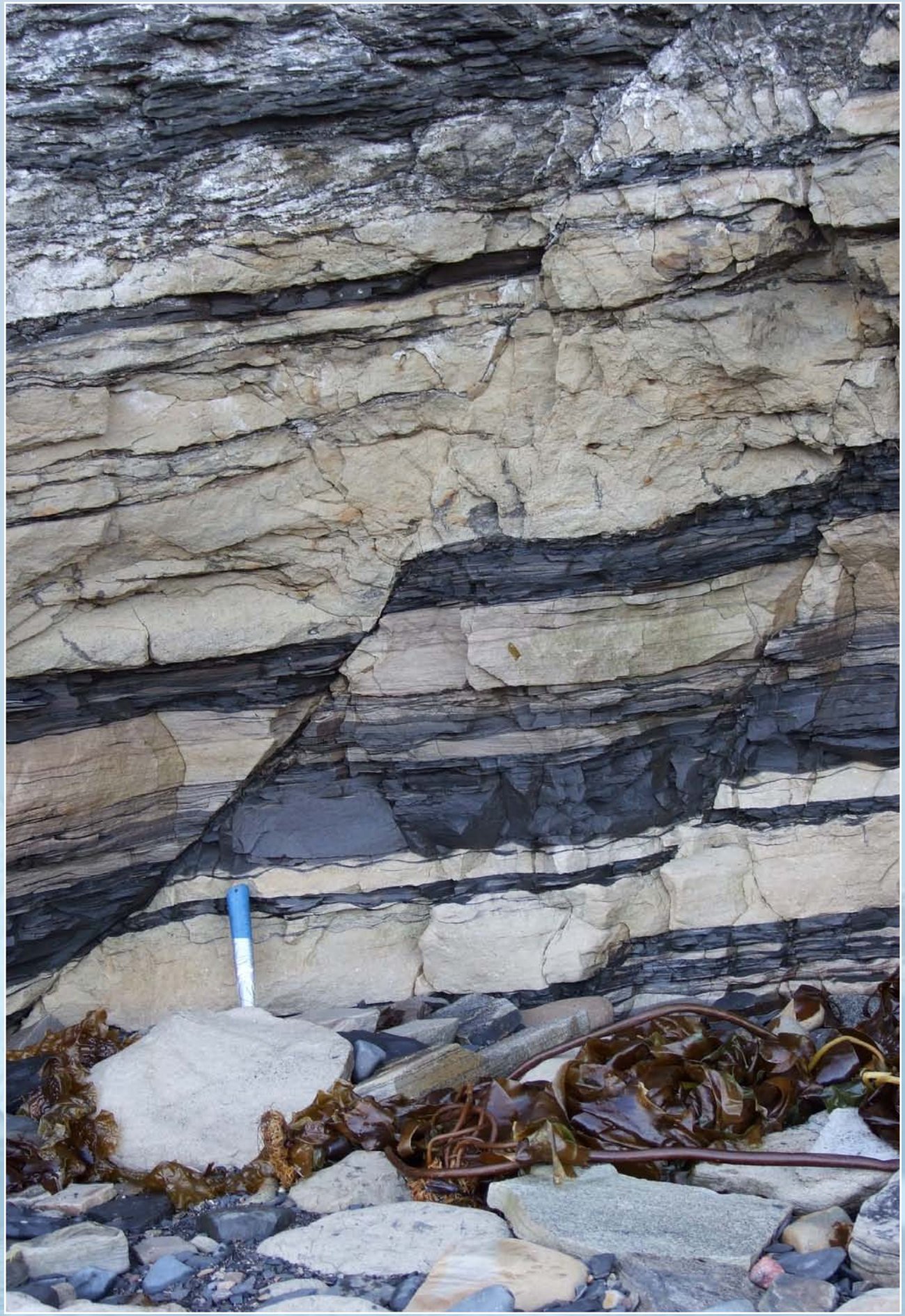
One additional target group was Diurodrilidae – a family of microscopic worms that used to be considered part of the basal annelids. However, recent studies have questioned their position within Annelida, and even indicated that diurodrilids may not even be closely related with annelids. Hence, in order to obtain EST data to test their phylogenetic position, specimens of *Diurodrilus westheidei* were collected along the sandy coasts from Skansen to Flakkerhuk, on the east coast of Disko Island. In addition, specimens were fixed for immunohistochemical- and gene expression studies.

Additional taxa of particular interest and possibly significant evolutionary history included the annelid taxa *Psammodrilus, Protodriloides*, and the aberrant gastrotrich *Diuronotus aspetos*. All three genera together with *Diurodrilus westheidei* were found together in the same van Veen grab sample in 2006 at Iterdla close to Skansen at 2.5 m. Collecting of specimens from these taxa in 2010 also turned out successfully, and we were able to bring back a sufficient amount of material for molecular and morphological studies. Likewise we were able to collect various regional marine nematodes, rotifers, annelids, and bivalves to be included in future studies and collections.

Collected animals were studied, photographed and video-recorded alive before fixation, exploiting the good light microscopy and laboratory facilities of Arctic Station.

Studies of cilia, muscles and nervous systems using immunostaining and confocal laser scanning microscopy will be initiated in the spring of 2011, and gene expression studies will follow when the relevant genes have been sequenced.

EST data from the collected specimens will be included in a larger phylogenetic framework that focuses on platyzoan and ecdysozoan interrelationships. To obtain an even more complete taxon sampling for the analyses, EST from additional taxa will be required; several of these last important taxa will be collected by the same team during an additional collecting campaign to France in 2011.



SEDIMENTOLOGICAL STUDIES OF DELTAIC AND MARINE CRETACEOUS SEDIMENTS IN THE NUUSSUAQ BASIN

Outcrops of the Atane and Itilli Formations at Asuk (Disko) and Kingittoq (Nuussuaq) were studied in July-August by geologists from Department of Geography and Geology (IGG), University of Copenhagen, and the Geological Survey of Denmark and Greenland (GEUS). The field work related to a number of projects briefly described below. Arctic Station supported the field work by allowing us to rent a zodiac, to borrow some field equipment, and to use "Porsild" for transport to and from the tent camps at the Vaigat coasts.

SEDIMENTARY FACIES ANALYSIS OF THE ATANE FORMATION AT ASUK

Gunver Krarup Pedersen, IGG, University of Copenhagen

The mid Cretaceous, deltaic Atane Formation is well exposed in a vertical coastal cliff at Asuk. Sedimentary structures and lateral facies variations may be documented. The succession is divided into depositional units and bounding surfaces are described and interpreted. Several phases of transgression and delta progradation are recognized.

SEDIMENTARY STRUCTURES AND DEPOSITIONAL ENVIRONMENT OF THE ITILLI FORMATION AT ASUK

Nikolaj Blichfeldt, MSc student, IGG, University of Copenhagen

Geological fieldwork for my MSc project was carried out in July 2010, assisted by Morten Nielsen, DTU. The aim of the project is to investigate the sedimentary structures and depositional environment of the middle Cretaceous sandstones and mudstones of the Kussinerujuk Member, Itilli Formation. These sediments overlie a marked erosional boundary to the underlying Atane Formation. They are interpreted as being of marine to estuarine origin and show a large variety of facies. The field data are currently being analyzed.

QUATERNARY LANDSLIDES AND CRETACEOUS FAULTS AT ASUK

Gunver Krarup Pedersen, IGG; Stig Schack Pedersen, GEUS; Marc Lenniger, IGG, and Nikolaj Blichfeldt, IGG.

The presence of Quaternary landslides at Asuk is well established. We measured the orientation of beds and faults in the Itilli Formation in a search for Cretaceous fault deformations. The field data are being analyzed at present and suggest that the landslides mainly displaced the volcanic formations, and that the sediments were affected by a mid Cretaceous phase of faulting.

CHEMOSTRATIGRAPHY OF LATE CRETACEOUS DELTAIC AND MARINE SEDIMENTARY ROCKS FROM HIGH NORTHERN PALAEOLATITUDES

Marc Lenniger, IGG, University of Copenhagen

Field work was carried out on the north coast of Disko and in the south of Nuussuaq. To reach these localities the research vessel "Porsild" was used. The aim of the field work was to investigate the lithostratigraphy and the chemostratigraphy of Upper Cretaceous deltaic and marine sedimentary rocks of the Nuussuaq Basin. For this purpose several profiles were measured and sampled. The collected samples should help to get a better understanding of the Upper Cretaceous carbon cycle in high latitudes.

"BURNING" MUDSTONE IN A LANDSLIDE AT ASSOQ

Stig Schack Pedersen, GEUS

"Burning" mudstone was observed at Assoq, east of Qeqertarsuaq, in early May 2010. A landslide led to self-combustion in carbonaceous mudstone, referred to the Assoq Member of the Atanikerluk Formation, and smoke was visible for several days. The landslide was visited in late July 2010, at which time the smoke had ceased and no thermal activity could be recognized, but newly formed minerals included red ferri-hydroxides and yellow jarosite coatings on partly burned or corroded mudstones. The mineralogy of the samples is being examined. The landslide may be characterized as a rock avalanche, dominated by volcanic boulders derived from the slope above the black mudstones at Assoq.

The red colour is caused by self-combustion in mudstones at Assoq

ACOUSTIC BEHAVIOUR OF BOWHEAD WHALES *BALAENA MYSTICETUS* IN DISKO BAY, WESTERN GREENLAND 2007-2010

Outi Tervo, Reinhardt Møbjerg Kristensen, Mads Fage Christoffersen, and Susan Parks.

The aim of the project was to collect passive acoustic recordings of bowhead whale acoustic behaviour, coupled with behavioural observations and biopsy to better determine the function of these sounds. The data has been used to 1) describe the bowhead whale repertoire and seasonal trends in acoustic behaviour; 2) determine the physical characteristics of the song including sound production abilities and source level of the song; 3) measure the ambient noise level in Disko Bay in order to estimate the communication range of bowhead whales in Disko Bay; and finally 4) to determine the gender of the singing bowhead whale individuals.

Disko Bay is one of the best places in the world to observe and study bowhead whales. Every year the whales arrive in Disko Bay in early February and stay until late May providing an unique opportunity for field research. This research is part of the PhD degree of Outi Tervo.

Acoustic recordings of bowhead whale song 2007-2010

Acoustic recordings of the song of bowhead whales were made in Disko Bay in the vicinity of Qeqertarsuaq from February to May in 2005-2010. The recordings were made using underwater microphones deployed from R/V Porsild, from open boats, from land and through holes in the ice, depending on the ice and weather conditions. The data have shown that bowhead whales are vocally more active during the winter months of February and March than later in the spring as well as the songs they sing earlier during winter are more complex than in the spring (Tervo et al. 2009). It has also been shown that bowhead whales change their song repertoire completely from year to year – each year the whales sing completely new songs (Tervo et al., in press). Bowhead whales are able to produce two sounds simultaneously, like song birds, and this is one way of creating very complex songs (Tervo et al., in review). Bowhead whales produce very loud songs which in the quiet environment of Disko Bay can travel hundreds of kilometres (Tervo et al., in prep.). This means that bowhead whales most likely can communicate with each other throughout the Disko Bay area.

Collection of biopsy samples and ID pictures 2010

In 2010 the project included the collection of biopsy samples and identification photographs of the bowhead whales. We collected 23 biopsy samples coupled with recordings of the acoustic vocalisation of the whales. These biopsy samples will be analysed for gender and ID which will be used to determine the sex of the singing individuals (Tervo et al., in prep.). In addition to the biopsy samples, ID photographs were collected of the different individuals encountered and this will allow us to look at the intra- and inter-annual changes in the individual composition of bowhead whales in Disko Bay. This will be the topic of a bachelor project at the University of Copenhagen and the data collection will continue to 2011.

Underwater filming of bowhead whales 2010

In 2010 bowhead whales were filmed under water for the first time in Disko Bay. Our photographers managed to film rarely seen behaviours underwater, such as whale skim feeding at the surface. This unique footage will be made available for the public in order to promote the bowhead whales of Disko Bay.

Acknowledgements

This study was funded by A.P. Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal (grant to Reinhardt Møbjerg Kristensen and Outi Tervo, Arctic Station, University of Copenhagen, 12.11.2008). We wish to thank the staff of Arctic Station, the people helping in the data collection on the field often in difficult, arctic conditions, and our co-authors on the publications.

THE ANATOMY OF SLEEP SYSTEMS IN THE BRAINS OF MARINE MAMMALS

Paul R. Manger, School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, South Africa

The purpose of the stay was to obtain brains from marine mammals for subsequent immunohistochemical analysis in the laboratory in South Africa. The brains were harvested from animals that were killed for hunting and the heads perfused with formalin.

The immunohistochemical analysis is ongoing, however, the specimens collected were in excellent condition and are beginning to provide some excellent results.

CLIMATE CHANGE AND BALEEN WHALE TROPHIC CASCADES IN WEST GREENLAND

M.P. Heide-Jørgensen, Greenland Institute of Natural Resources
K. Laidre, Polar Science Center, Applied Physics Laboratory, Seattle
Mikkel Villum Jensen, 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 produc-

tion, 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.

This was the 3rd year of the project and conclusions will await further analysis in 2011.

SEX DISTRIBUTION OF THE GREENLAND SEED BUG (*NYSIUS GROENLANDICUS*) ACROSS AN ALTITUDINAL GRADIENT

Jens Böcher, Natural History Museum of Denmark, University of Copenhagen

There was merely used GPS (position, altitude) and pooter (for collection of bugs). In the laboratory the catch was counted, sexed and preserved in 80 % alcohol.

In total 36 samples each of ½ hours´ searching were taken in places with a southern aspect but differing altitude (from almost sea level to 810 m a.s.l., the highest place with coherent vegetation), always in sunny weather. The main result was that in the Godhavn/Qeqertarsuaq area there was no indication of a decline in male percentage across an altitudinal gradient. On the contrary, there was generally a small surplus of males. This is in striking contrast to results obtained from similar investigations in Northeast Greenland (Zackenberg), where females generally dominate, in some cases making up 100 % of a sample.

GENETIC STRUCTURE IN THE ROCK PTARMIGAN (*LAGOPUS MUTUS,* MONTIN 1776) FROM DISKO AND ZACKENBERG BASED ON NONINVASIVE GENETIC SAMPLING

Frode Bergan, Telemark University College, Norway

The aim was to collect fecal samples from birds in the Lyngmark, Blæsedal and Skarvefjeld area for genetic analysis. First extract DNA from the samples by using a designed kit, then set up PCR reactions to see if the extracts give good enough products to further examine differences in genetic structure within the subspecies (*Lagopus mutus* ssp. *saturatus*) and between the *saturatus* and *captus* subspecies. *Captus* is the subspecies present in the Zackenberg area.

Samples were collected by using sturdy cross country skies since the area was mainly snow covered. Habitats for the Rock Ptarmigan were searched up, and fecal pellets were picked up from the ground or snow and stored in zip-lock bags, which were put in freezer on return to the station.

Guests and staff at the Arctic Station in August 2010 including participants in the Arctic Workshop and COP-15 students and other guests. (Photo: Peter Henriksen)

COP-15 STUDENT EXCURSION, AUGUST 2010

Participants
Ankit Joshi, India
Komal Habib, Pakistan
Denisa Cubi, Albania
Maija Bertule, Latvia
Ndifor Ernest Bache, Cameroun

Leaders
Poul Møller Pedersen and Bente Brix Madsen

In connection with COP-15 in Copenhagen some international students were invited to study at Danish universities. Five of these students were selected to participate in an excursion to Greenland with financial support from the Danish Agency for International Education.

Among the activities the group visited the Greenland Environmental Research Institute in Nuuk. A lecture on the effect of climate change was given at the institute, and the group visited the site of the institute's large monitoring programme (NUUK BASIC) in Kobbefjorden and got a good introduction to the programme.

After a two days boat trip along the coast the group arrived in Ilulissat and had the opportunity to see the Ilulissat glacier and huge icebergs in the Disko Bay area.

After a few days in Ilulissat the group went to the Arctic Station. A lecture on acoustic behaviour of the bowhead whale was given by the scientific leader, Outi Tervo. Furthermore, they learned something about the geology of the area by associate professor Gunver Krarup Pedersen, who passed by after field work on the Nuusuaq peninsula. The members of the group also participated in scientific lectures given by members of the workshop (see above). Furthermore, the group studied the effect of climate change on the perennial brown alga, *Ascophyllum nodosum*, which has its northern limit on the island of Disko. This species is characterized by the growth pattern, and the growth is terminated each year by the formation of a bladder. Therefore, the internodes between the bladders represent the length of the growth season. Earlier the internodes were very short, but now they are comparable to plants from more southern latitudes.

THE BOWHEAD WHALE AND OTHER ARCTIC WHALES

Hanne Strager, Natural History Museum of Denmark, University of Copenhagen

The Natural History Museum of Denmark plans a new, big whale exhibition. In this connection knowledge on research and local exploitation of the bowhead whale and other species in the Disko Bay area is collected.

Knowledge was collected on acoustic and tagging studies on bowhead whales through participation in field work from Arctic Station and Greenland Environmental Research Institute. The visit at Arctic Station was also used to make preparations to get a skeleton of a bowhead whale to the museum. This was done in May in collaboration with hunters from Ilulissat.

The historic and cultural aspects of the presence in Greenland of bowheads and other Arctic whales will be an important component of the upcoming exhibition. Continuous cooperation with Arctic Station and GERI is imperative as well as cooperation with the museum in Qeqertarsuaq.

COLLECTION OF BIOLOGICAL SAMPLES FOR AMAP (ARCTIC MONITORING AND ASSESSMENT PROGRAMME)

Lars O. Mortensen, National Environmental Research Institute, Denmark

The aim of the sampling was to collect biological samples from ringed seals in the Qeqertarsuaq area. Samples included liver, kidney, blubber, muscle etc. to be used in the Arctic Monitoring and Assessment Program (AMAP).

Samples were collected from seals shot by hunters. Seals were measured and weighted before sampling. Samples will be analysed for environmental contaminants (e.g. heavy metals, PCB and DDT) in order to monitor contaminant levels in the area. The project is indefinit.

FREQUENCIES AND EFFECTS OF HYBRIDISATION BETWEEN TWO ARCTIC PLANT SPECIES: *PYROLA GRANDIFLORA* AND *P. MINOR*

Thure P. Hauser, Department for Agriculture and Ecology, LIFE, University of Copenhagen
Marianne Philipp, Section for Ecology and Evolution, Department of Biology, University of Copenhagen
Knud Brian Nielsen, Section for Ecology and Evolution, Department of Biology, 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

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

ARCTIC SPRING MICROALGAE

Nina Lundholm, Natural History Museum of Denmark, University of Copenhagen

The purpose was to explore the diversity of the phytoplankton spring bloom and to study potentially toxic phytoplankton species.

Phytoplankton was sampled and cultures established by single cell isolation using light microscopy. Live cultures were brought back to Denmark. The diversity is being examined by microscopy and molecular tools.

Several cultures of different spring phytoplankton have been established. The spring blooms was mainly composed of different dia-

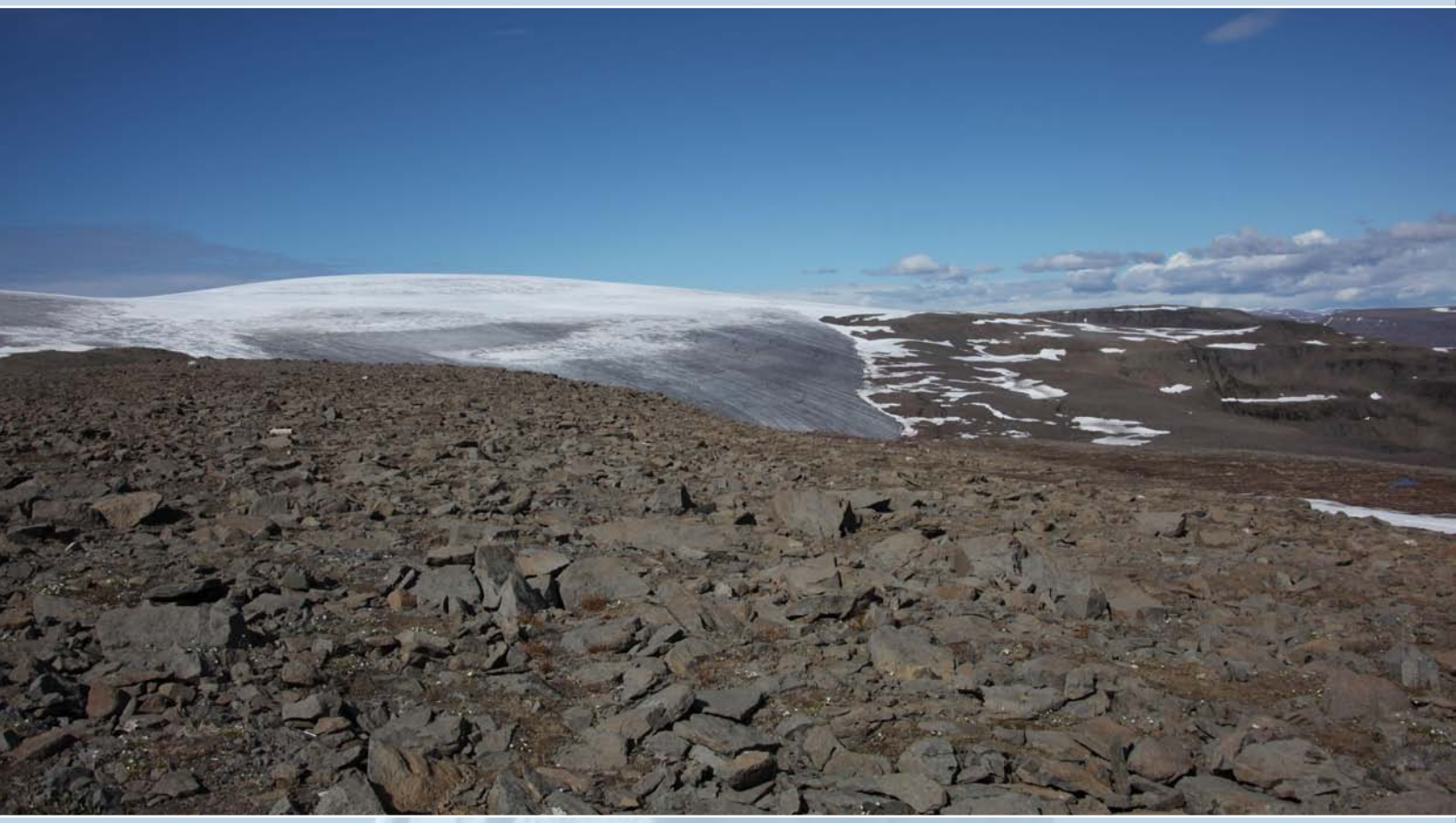
toms belonging to the genera *Chaetoceros* and *Fragilariopsis* and the haptophyte *Phaeocystis*. The diversity of the two diatom genera is being examined using morphological and molecular tools. Cultures of potentially toxic phytoplankton species were established, and they are being studied for toxin production

PLANKTON DYNAMIC IN THE DISKO BAY WITH EMPHASIS ON THE IMPACT OF CLIMATE CHANGE

Torkel Gissel Nielsen, DTU Aqua
Morten Hjort, NERI, University of Aarhus
Signe Jung-Madsen, NERI, University of Aarhus
Julie C. Grenvald, University of Copenhagen
Hanna Alfredsson, University of Copenhagen
Marie Vestergaard Henriksen, University of Aarhus
Sara Zamora Terol, Institut de Ciències del Mar, Barcelona
Birgit Søborg, NERI, University of Aarhus

The aim of the project is to investigate the impact of climate change and oil exposure on the pelagic processes with emphasis on the early life stages of *Calanus*.

The project had a field component where the vertical distribution of the copepods in relation to water column properties was investigated. From the field female copepods were sampled and brought to the laboratory, where they produced the eggs providing the base of the cohorts, which were exposed to different temperature and oil scenarios. The nauplii cohorts were fol-



lowed over 6 weeks in the laboratory, and after the experiments they were terminated and their growth quantified.

SEX OF THE SINGER IN BOWHEAD WHALE

Outi Tervo, Arctic Station, University of Copenhagen
Mads Fage Christoffersen, Arctic Station, University of Copenhagen
Aningaaq Dahl, Arctic Station, University of Copenhagen
Camilla Ilmoni, Stø Hvalsafari, Norway
Jonas Thormar, University of Copenhagen
Martin Macnauchton, University of Copenhagen

The purpose of this study was to

1) determine the sex of the singing individual in bowhead whales (*Balaena mysticetus*). Bowhead whales produce complex songs while in Disko Bay, but the sex of the singing individual has been unknown until now.
2) collect video and still footage of bowhead whale natural behaviour underwater, and
3) collect ID pictures of the encountered animals.

We used stereo hydrophones, "false ears", from two listening platforms to locate the singing individual. Biopsy, a small skin and blubber sample, was collected from the individual at approximately 20m range using a cross bow and a specially designed arrow with a hollow tip.

ID pictures were taken opportunistically of every animal seen.

We were able to collect 22 biopsy samples and app. 40 hours of acoustic recordings.

Our divers, Jonas Thormar and Martin Macnaughton captured bowhead whales on video film as well as documented underwater flora and fauna in Disko Bay with still photos. We had app. 100 encounters with bowhead whales where we were able to take ID pictures of the individuals.

The analyses of these data are still ongoing.

SEASONAL AND DECADAL CHANGES IN WATER MASS CHARACTERISTICS IN THE DISKO BAY, WEST GREENLAND 1924-2010

Marc O. Hansen, Department of Geography and Geology, University of Copenhagen

The study focuses on the temporal variation in water mass characteristics over more than 80 years. The Disko Bay area, 300 km north of the polar circle, is an arctic, high-productive area of great importance for fishery and the Greenland society. A good knowledge of the dynamics in the physical and chemical parameters is imperative to understand variations in the planktonic food webs. Great variations exist in the large (10,000 km^2) Disko Bay.

We have analysed the coupling between the weather conditions and the dynamic over a year in the water body. The upper 150 m of the sea is strongly influenced by air temperature, sea ice, and wind velocity, while the deeper water body is less fluctuating, and to a lower extent influenced by local climatic conditions. We can show that a remarkable increase in temperature and salinity occurs in 1996-97 at depths greater than 150 m by inflow of warmer subpolar water. The effect of the circulation pattern, ice distribution and productivity will be discussed in a paper to be submitted to Limnology and Oceanography

*Northern wheatear (*Oenanthe oenanthe leucorhoa*)*

IMPACTS OF CLIMATE CHANGE ON A LONG-DISTANCE MIGRATORY BIRD, THE NORTHERN WHEATEAR

Adam Seward and Ruth Lovell, Cardiff University

The aim of this study was to simulate a climate-driven change in food availability of the Greenland race of northern wheatear (*Oenanthe oenanthe leucorhoa*) by providing ad libitum supplies of dried and live mealworms. The weights of fuelling migratory wheatears (individually colour ringed) attending feeding stations in August and September were remotely monitored to investigate the fuelling rates, fuel loads and departure times compared to control wheatears captured during the study and not using feeding stations. Geolocators were attached to 28 wheatears for the purpose of tracking their movements on migration between Greenland and West Africa, and back again. Returning wheatears carrying geolocators will be recaptured in 2011 to retrieve the data. 131 different Greenland wheatears were captured in total. 11 colour ringed wheatears were recorded attending feeding stations. The recorded weights of these birds will be used to construct fuel accumulation curves, to enable comparison with the fuel accumulation strategies of Greenland wheatears leaving West Africa and on stopover in the northern UK. Despite the availability of an unlimited food supply, the wheatears did not obtain the very high fuel loads recorded on a stopover location in the north of the UK (Fair Isle). The highest weight observed in this study was 38.5 g, while Greenland wheatears of similar size stopping over on Fair Isle in the autumn were regularly recorded weighing 45 g or more. Possible reasons why maximum fuel loads are not reached in wheatears in this area are the need to leave early to arrive at stopover locations while food is still abundant, or to keep body weight lower to reduce predation risk. It is hoped that the data obtained from the geolocators will reveal whether the wheatears do indeed stopover in southern Greenland, or if they leave straight for Iceland or north-west Europe.

OBSERVATORY MAINTENANCE

Jürgen Matzka, DTU Space, Copenhagen

Visit 09/08 to 13/08 2010
DTU Space operates a geomagnetic observatory in Qeqertarsuaq. During this visit, the observatory magnetometers were checked and the thermal isolation of the variometer house was investigated with a thermocamera. A second data logger was set up and connected to DSL, giving now online access to both the primary and secondary observatory magnetometer. Plans for isolating the variometer house were made. Visitors: Jürgen Matzka and assistant.

Visit 21/09 to 26/09 2010
The purpose of the visit was to make repair work at DTU Space's geomagnetic observatory in Qeqertarsuaq and to help a TV team with making a movie about Greenland and about the geomagnetic work of DTU Space. The film team got the possibility to report also about the work at the Arctic Station, and enjoyed this very much. For the geomagnetic observatory, a new local operator was trained and the variometer house was partly isolated and repaired with the help of a company from Qeqertarsuaq. Visitors: Jürgen Matzka (DTU Space) and 6 members of a TV-team (MDR).

SCIENCE IN GREENLAND

Trine Jensen, Danmarks Journalisthøjskole

The aim of the stay was to make a report from Arctic Station with interviews of the staff.

OLD GREENLAND CARIBOU REMAINS FOUND AT SKARVEFJELD

A local hunter searching for ptarmigans discovered remains from Greenland caribou at the top of Skarvefjeld in September 2007. These remains have turned out to be very old and tell us, that Disko had caribou populations long back in time. The small ice cap at the mountain has been melting back during the last 6-8 years leaving more and more ground open. Anything previously hidden by ice and snow will therefore appear again. As the hunter was passing the edge of the ice cap he saw antler and bones on the ground. Knowing that these pieces might be old, he didn't remove anything but informed the staff at the Arctic Station.

On behalf of the station manager by that time Kjeld Akaaraq Mølgaard and a group of scientists (teachers and students from the Arctic Biology course) the old caribou remains were re-located and brought down to Arctic Station in August 2008. The remains were later send to University of Copenhagen for registering and dating.

The C14-dating took place at University of Lund during 2009-10 and the results were rather surprising. It appeared that the antlers dated back to approx. 3545 ± 50 years from present time (1950). This is the first evidence of a caribou population at Disko from pre-historical times. The findings hitherto are only a few hundred years old. The discovery that caribous occurred at Disko back in time matches very well with our knowledge of caribou populations from other areas in western Greenland.

The discovery from Skarvefjeld can however not tell us how long caribous have been living at Disko or how big the population was. The nearest population of caribous is at the Uummannaq peninsula, and it is known from present times, that this population can pass the narrow strait during ice winters. It might well be that several immigration events have occurred during the last 3500 years.

Foto: Marianne Phillip

It is most likely that caribous have been common at Disko back in time as findings similar to the one at Skarvefjeld have been recorded from other places where the ice cap is melting e.g. at Lyngmarksfjeld.

Hopefully, it will be possible to conduct more analyses in the coming years and help us to understand how the caribou populations have varied over times. As the case from Skarvefjeld perfectly illustrates, it is very important with good communication between local people and scientists. Hopefully, the increased recreational use of the environment by e.g., tourists will leave historical remains untouched.

Professor Kirsten S. Christoffersen
Department of Biology

Education/Courses

NATURAL SCIENCE FOR EVERYBODY – A FOLLOW-UP COURSE FOR GREENLAND HIGH SCHOOL TEACHERS. 28 JUNE – 2 JULY

Participants
Jakob Bach, HTX Sisimiut
Søren Isager, HTX Sisimiut
Gudrid Johansen, Sydgrønlands Gymnasium
Lisbeth Rauff, Sydgrønlands Gymnasium
Jane Buus Sørensen, Nuuk Gymnasium
Mette Buresø-Holst, Socialpædagogisk Seminarium, Ilulissat
Jørgen Kristensen, Socialpædagogisk Seminarium, Ilulissat

Teachers
Reinhardt M. Kristensen, Natural History Museum of Denmark
Hans Henrik K. Bruun, Department of Biology
Kirsten S. Christoffersen, Department of Biology
Trine W. Perlt, Department of Biology
Mads Christoffersen, Arctic Station

The aim is to give the participants the latest knowledge on a variety of disciplines, geography, geology and biology. Emphasis will be placed on how basic science can be used in environmental administration, conservation, and exploitation of natural resources.
The course was based on hands-on (simple experiments and excursions (both terrestrial and marine)) and lectures.

FIELD COURSE IN ARCTIC BIOLOGY, 4 JULY TO 23 JULY, 2010

Participants
Hannah Blossom, Dept. of Biology, University of Copenhagen
Tine Dencker Bædkel, Dept. of Biology, University of Copenhagen
Maria Laugmann Laubacher, Dept. of Biology, University of Copenhagen
Signe Lett, Dept. of Biology, University of Copenhagen
Signe Larsen, Dept. of Biology, University of Copenhagen
Maria Lund Paulsen, LIFE, University of Copenhagen
Daniel Hoffmann, Dept. of Biology, University of Copenhagen
Lea Stenfeldt, Dept. of Biology, University of Copenhagen
Thomas Warnar, Dept of Biology, University of Copenhagen
Karina Juhl Rasmussen, Dept. of Biology, University of Copenhagen
Anders Hostrup, Dept. of Biology, University of Copenhagen
Michael Frisk, Dept. of Biology, University of Copenhagen

PhD student
Bjørn Tirsgård, Dept. of Biology, University of Copenhagen

Teachers
Niels Daugbjerg, Dept. of Biology, University of Copenhagen
John Fleng Steffensen, Dept. of Biology, University of Copenhagen

Guest teacher
Peter Bushnell, IU South Bend, Indiana

Others
Kirstine Fleng Steffensen

Five student projects were centred on two main themes in marine biology (i) physiology of Greenland cod (*Gadus ogac*) and (ii) diversity and ecology of marine phytoplankton.

The specific titles were:
1. Metabolic rates in Greenland cod (Uvak), *Gadus ogac*
2. Cardio-respiratory and ventilation in Greenland cod: normoxia and hypoxia
3. The Cardiac function of the Greenland cod (*Gadus ogac*)
4. Species diversity and abundance of potential harmful marine microalgae
5. Biomass and productivity of marine phytoplankton with an emphasis on the contribution by picoplankton.

GU AASIAT (GYMNASIUM OF NORTHERN GREENLAND) – EXCURSION FOR A BIOLOGY CLASS, 25-29 AUGUST 2010.

Participants
Augustine Therkelsen
Avatannguaq Mathiassen
Cecilia Groth
Ilasiannguaq Martinsen
Jakob Olsen
Karen Mette Zeeb
Kitura Malu Degn
Natacha Davidsen
Paneeraq Evaldsen
Paninnguaq Kristensen
Paarnannguaq Inûsugtok

Teacher
Uffe Bybæk Pedersen

YOUNG CLIMATE RESEARCHERS IN GREENLAND

Participants
Andreas Breenfeldt Andersen, Faaborg Gymnasium
Emilie Frey Bendix, Faaborg Gymnasium
Sarah Østergaard Brun, Faaborg Gymnasium
Frederikke Kaagh Poulsen, Faaborg Gymnasium
Astrid Hansen Moesby, Erikstrupskolen, Stevns
Jannick Michell Karstensen, Erikstrupskolen, Stevns
Kia Bjerregaard Meng, Erikstrupskolen, Stevns
Siff Emilie Moni Schwarz, Erikstrupskolen

Teachers
Aff Hjarnø, naturfagsformidler, Erikstrupskolen
Louise Pilegaard, naturfagsformidler, Ellehøjskolen
Peter Eduard, naturfagsformidler NTS center Sorø
Finn Skaarup, pædagogisk konsulent UV & Formidling

They stayed on Arctic Station 5 days in April.

Publications

Andersen, O.N., K. Laidre and M.P. Heide-Jørgensen. Benthopelagic fauna on a bowhead whale foraging ground in Disko Bay, West Greenland. *Marine Biology Research*. Submitted

Balsamo, M., Guidi, L., Ferraguti, M., Pierboni, L., Kristensen, R.M. 2010. *Diuronotus aspetos* (Gastotricha): new morphological data and description of the spermatozoon. *Helgol. Mar. Res.* 64: 27-34.

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

Dünweber, M., R. Swalethorp, S. Kjellerup, T.G. Nielsen, K.E. Arendt, M. Hjorth, K. Tönneson & A.F. Møller 2010. Succession and fate of the spring diatom bloom in Disko bay, Western Greenland. *Mar. Ecol. Prog. Ser.* 419: 11-29.

Heide-Jørgensen, M.P., Garde, E., Nielsen, N.H., and Andersen, O. N. Biological data from the hunt of bowhead whales in West Greenland 2009 and 2010. *J. Cetacean Res. Manage.* Submitted.

Heide-Jørgensen, M.P., Laidre, K.L., Wiig, Ø., Lindqvist, C., Postma, L., Dueck, L.P., Bachmann, L. Large scale sexual segregation of bowhead whales. *Endangered Species Research*. In press.

Laidre, K.L., M.P. Heide-Jørgensen, M. Logsdon, L. Delwiche, T.G. Nielsen. A whale of an opportunity: Examining vertical structure of chlorophyll-a in high Arctic waters using instrumented marine predators. *Marine Biology Research*. In press.

Naturvidenskab for alle. Rapport fra et efteruddannelseskursus for grønlandske gymnasielærere. Arktisk Station 28. juni-2. juli 2010. Intern rapport.

Simon, M., M. Johnson, P. Tyack, P.T. Madsen 2009. Behaviour and kinematics of continuous ram filtration in bowhead whales (*Balaena mysticetus*). *Proc. R. Soc.* B: 1-10. Published online.

Wiig Ø., Bachmann L., Heide-Jørgensen M.P., Laidre K.L., Postma L.D., Dueck L., Palsbøll P.J. 2010: Within and between stock re-identifications of bowhead whales in Eastern Canada and West Greenland. *Rep Int Whal Comm* SC62/BRG65

A huge iceberg with the mountains along the south coast of Nuussuaq in the background

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