Polar Ecology Conference 2014

Research · October 2016

DOI: 10.13140/RG.2.2.29691.11043

2 authors:

Jan Kavan
Masaryk University
52 PUBLICATIONS **360** CITATIONS
SEE PROFILE

Alex Bernardova
University of South Bohemia in České Budějovice
23 PUBLICATIONS **126** CITATIONS
SEE PROFILE

Polar Ecology Conference 2014

21st – 25th September 2014
České Budějovice, Czech Republic

Scientific committee

Josef Elster
University of South Bohemia in České Budějovice

David Hik
University of Alberta; IASC

Terry Callaghan
University of Sheffield; Lund University; InterAct

Jacek Jania
University of Silesia

Andreas Richter
University of Viena

Organising committee

Jan Kavan

Alexandra Bernardová

Organisation

Centre for Polar Ecology

Faculty of Science

University of South Bohemia in České Budějovice

Supported by:

Conference is realised within the project Creating of Working Team and Pedagogical Conditions for Teaching and Education in the Field of Polar Ecology and Life in Extreme Environment, reg. No. CZ.1.07/2.2.00/28.0190 co-financed by the European Social Fund and the state budget of the Czech Republic.

ISBN 978-80-7394-463-6

Polar Ecology Conference 2014

21st – 25th September 2014

České Budějovice, Czech Republic

Abstracts & Contact list

Edited by:

Jan Kavan

Alexandra Bernardová

České Budějovice 2014

Dear Colleagues,

Time passes so quickly. It is almost two years from the time when the first Polar Ecology Conference was held in České Budějovice. Most participants enjoyed the conference and learned a lot. The conference was an ideal place for exchanging knowledge and experiences, and also helped us to integrate Czech polar ecological research into the international society.

During the previous two years, Czech research programs in the Arctic and Antarctic flourished. Regular Czech Antarctic research has been running under the auspices of Masaryk University in the J.G. Mendel station on James Ross Island since 2006. In the Arctic, the Centre for Polar Ecology of the University of South Bohemia opened a new research station in Longyearbyen, Svalbard and continues to build the Czech Arctic research infrastructure. Both the Czech Antarctic and Arctic research infrastructures are nowadays integrating into the wider international research network (e.g. IASC, SCAR, INTERACT, etc.). Integration of Czech research into international societies has been also followed by publication of a regular interdisciplinary polar scientific journal "Czech Polar Reports" which has recorded international polar research since 2011. A special issue of Czech Polar Reports, Vol. 4, No.2, will be published with articles from this conference. The Editor-in-Chief, M. Barták, Masaryk University in Brno, will invite authors of selected conference oral and/or poster presentations and ask them for Full and/or Short Communication papers.

The conference is again organized by the Centre for Polar Ecology, Faculty of Science, University of South Bohemia in České Budějovice. I would like to acknowledge the support for this conference from the project "Establishing of working team and conditions for education in the field of polar ecology and life in extreme environments", No. CZ.1.07/2.2.00/28.0190. The project is funded by the European social fund and the government of the Czech Republic. The support of the Faculty of Science, University of South Bohemia in České Budějovice is also highly appreciated.

Welcome to České Budějovice, enjoy the Polar Ecology Conference, and enjoy your stay in the beautiful region of South Bohemia!

September 15th 2014 in České Budějovice *Josef Elster*

ABSTRACTS

ANALYSIS OF AIR TEMPERATURE STRATIFICATION IN SVALBARD FJORDS IN 2011

Klára Ambrožová[1], Kamil Láska[1,2]

[1]*Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic*
[2]*Centre for Polar Ecology, University of South Bohemia, České Budějovice, Czech Republic*

KEYWORDS: SVALBARD, AIR TEMPERATURE STRATIFICATION, TEMPERATURE LAPSE RATE

The air temperature stratification in the Svalbard archipelago has not yet been well analysed, mostly due to limited number of meteorological stations and sufficient data quality. In addition, most of atmospheric measurements are localized in the western or south-western part of the archipelago, while the rest of the area remains underexamined (Láska et al. 2012).

In this contribution, evaluation of the air temperature stratification in two regions of the Spitsbergen Island is presented (Fig. 1). Near-surface temperature lapse rates in Petuniabukta (central part of the island) for the whole year of 2011 were derived using hourly air temperature data from two automatic weather stations located on the western coast of the Petuniabukta (30 m and 455 m a.s.l). A similar dataset was also available from Ny-Ålesund in the period May–September 2011. This analysis was based on temperature data from a coastal measuring site (8 m a.s.l.) and from the Zeppelin Mountain, where the Norwegian Institute for Air Research performed the meteorological measurements at altitude of 475 m a.s.l.

In the study period, near-surface temperature lapse rates ranged from -3.1 °C/100 m up to 1.6 °C/ 100 m in Petuniabukta, where the temperature range was larger than in Ny-Ålesund. A clear annual course was found in the frequency of air temperature inversions declining from winter to autumn. Temperature inversions were most common in February (62 % of all cases), while least frequent was observed in July (3 %). The differences in air temperature stratification between Petuniabukta and Ny-Ålesund varied between -1.4 and 1.4 °C/100 m, with the atmosphere being more stably stratified in the Ny-Ålesund area. Furthermore, weak diurnal regime of air temperature stratification (in order of hundredths °C) was identified identically in both sites.

REFERENCES:

Láska, K., Witoszová, D., Prošek, P. (2012): "Weather patterns of the coastal zone of Petuniabukta (Central Spitsbergen) in the period 2008–2010." Polish Polar Research 33 (4): 297-318.

Acknowledgements: The authors thank Dr. Marion Maturilli from the Alfred Wegener Institute for the air temperature data from Ny-Ålesund coastal site. We acknowledge the EBAS database (http://ebas.nilu.no/), from which air temperature data for the Zeppelin Mountain were used. The research was supported by the project LM2010009 CzechPolar (MSMT CR) and project of Masaryk University MUNI/A/0952/2013 „Analysis, evaluation, and visualization of global environmental changes in the landscape sphere (AVIGLEZ)".

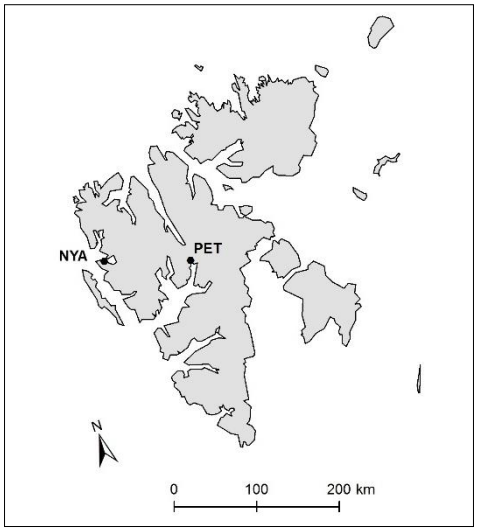


Fig. 1 Location of the study sites and meteorological stations in the Svalbard archipelago: Petuniabukta (PET) and Ny-Ålesund (NYA).

CAPACITY OF ANTARCTIC LICHEN XANTHORIA ELEGANS TO SYNTHETIZE PHOTOPROTECTIVE SECONDARY COMPOUNDS IS AFFECTED BY SUPPLEMENTAL UV-B DOSES

Kateřina Balarinová, Jana Hazdrová, Miloš Barták

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Brno Czech Republic

KEYWORDS: UV-B SCREENS, PHOTOINHIBITION, JAMES ROSS ISLAND, CHLOROPHYLL FLUORESCENCE, SPECTROSCOPY

Introduction

Most organisms developed some strategies to avoid these UV-damages. Lichens from polar regions have several UV-absorbing compounds to cope with UV-B stress. Laboratory-based studies with controlled supplemental UV-B doses are used frequently to evaluate lichen responses to UV_B. The contents of UV-B absorbing compounds may vary considerably due to interspecific differences, different experimental designs and their duration. In these studies, main attention has been given to UV_B effects on the synthesis of variety of secondary lichen substances (mostly phenols). However only a small number of studies investigated both changes in the amount of UV-absorbing compounds during exposition to UV_B radiation simultaneously with changes in photosynthetic processes, and pigment composition. Fluorometric approach to evaluate biophysical processes of photosynthesis measurements was applied in some earlier studies of several authors, but there was no clear relationship between UV-induced biosynthesis of UV-absorbing compounds and alterations in chlorophyll fluorescence parameters. In our study, we addressed this relationship by a detailed fluorometric study in Antarctic lichen *Xanthoria elegans.* First objective of our study was to evaluate the time-and irradiance- relationships of UV damage in thalli of *X. elegans* on photosynthetic processes related to photosystem II. Then, second objective of our study was to investigate protective role of selected antioxidant glutathione, its redox state in particular.

Material and Methods

Lichen thalli of *X. elegans* were collected at James Ross Island (Antarctica). They were dried under natural field conditions and then transported to the laboratory in Brno, Czech Republic. Before experiments, the thalli were re-wetted for 48 h by demineralized water and wet cellulose sheet located beneath the thalli. During re-wetting, the thalli were exposed to a dim light (20 $\mu mol\ m^{-2}\ s^{-1}$ of PAR) at 5ºC. Duration of exposition to free supplemental UV-B was 7 days. Three different intensities of UV-B radiaton were used (0.9 $W.m^{-2}$, 1.4 $W.m^{-2}$ and 3.0 $W.m^{-2}$, in the second cycle 0.9 $W.m^{-2}$, 1.15 $W.m^{-2}$, 1.4 $W.m^{-2}$). Samples for further analysis were taken during the exposition after 5, 10, 24, 48 and 168 h. During the exposition chlorophyll fluorescence parameters were measured using an approach of Kautsky kinetics supplemented with quenching analysis. Time courses of the following parameters were measured: Fv/Fm, Yield PSII, non-photochemical quenching (NPQ, qN) during exposition: 5, 10, 24, 48, and 168 h. After the exposition, UV-B absorbing compounds, pigment contents and concentration of glutathione were measured. UV-B induced synthesis of photoprotective compounds was measured using spectral absorption curves of extracts made in ethanol extracts. Amount of UV-B absorbing compounds was then evaluated according to the analysis of spectral absorbance curves. Chlorophyll and carotenoid contents were measured by a spectrophotometer (Specord, Analytik Jena). Glutathione was analysed using a method of thiol groups labelling.

Results and Discussion

It is apparent from time courses of Fv/Fm and effective quantum yield of PSII that *X. elegans* showed only very limited sensitivity to supplemental UV-B because the two parameters showed either no change or slight decrease after 168 h UV-B treatment. It might be, therefore, concluded that *X. elegans* is much more resistant to UV-B-induced photoinhibition than other species studied earlier in our laboratory, such as *e.g. Usnea antarctica, Usnea longissima, Lasalia pustulata.* Analysis of spectral absorbance curves revealed only limited effect of supplemental UV-B doses on an increase in total content of UV-B absorbing compounds. Follow up studies focused on a detailed analysis of photoprotective mechanisms and compounds induced in *X. elegans* by PAR and UV-B photoinhibitory treatment are planned in future. The aim will be to evaluate capacity of these mechanisms.

Acknowledgements

The authors thank CzechPolar project for support in filed work and laboratory infrastructure.

DAILY COURSES OF DISSOLVED OXYGEN IN TWO MICROBIAL-RICH ANTARTIC LAKES AS AFFECTED BY PHOTOSYNTHETICALLY ACTIVE RADIATION AND WATER TEMPERATURE

Miloš Barták, Peter Váczi, Daniel Nývlt

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Brno Czech Republic

KEYWORDS: ALGAE, CYANOBACTERIA, FIELD STUDY, OXYGEN ELECTRODE, PHOTOSYNTHESIS

Introduction

In Antarctic lakes, dissolved oxygen content (DOC) depends on microbial mat community size and structure, variation of physical and chemical factors such as e.g. incident light, water temperature, and mineral ion content in water column (Montecino et al. 1991). In studies devoted to ecology of Antarctic lakes, DOC is considered both biological and physical factors limiting life and development of autotrophic organisms there. Since 2009, Czech plant physiologists have been studying within- and inter-seasonal variability of water temperature and DOC in several small terrestrial lakes at James Ross Island, Antarctica. In spite of repeated measurements revealed within-seasonal differences between the lakes of different origin, their height above sea level and microclimate (Váczi et Barták, 2011), only limited attention has been devoted to daily fluctuations of DOC in relation to actual irradiance and water temperature. Such studies focusing daily courses of DOC are far from being frequent for Antarctic lakes and even basic information such as e.g. dynamic of daily changes and/or differences in DOC between sunny and overcast days are not common for majority of Antarctic lakes. Therefore, we decided to study two small area lakes of James Ross Island for one month using automatic DOC and water temperature measurements. In this abstract, we present detailed information about the investigated lakes as well as DOCs courses.

Material and Methods

For the study, two lakes rich in microbiological mats were chosen. Lake Dulanek is located nearby Windy Pass at the height of 220 m a.s.l. It is a small lake of area of about 25 m^2 formed in a shallow depression at a SE-facing foothill of the Lachman Crags mesa The depth of water column varies within a season. It is about 1.1 m at the beginning of austral summer and 0.7 at the end of austral summer. Interlago Lake is located in between Big and Small Lachman Lakes. It is a shallow small area located in sedimentary rocks and surrounded by rich moss and lichen vegetation formed in the neighbouring seepages on west side. It is located at 10 m a.s.l. and 100 m distant from sea cost. In February 2014, thermocouples, PAR sensors and oxygen electrodes (WTW) were installed into a depth of 40 cm in each lake and linked to a datalogger (EdgeBox, Environmental Monitoring Systems, CZ). At each site, data were measured and stored in 5 min interval, so that daily fluctuations in environmental characteristics and DOC could be monitored.

Results and Discussion

For the two lakes, 4-week-long data sets of DOC, PAR and water temperature (Tw) were obtained and analysed consequently. Here we present general trends and differences between Dulanek and Interlago lakes. Since there was an episode of freezing temperature lasting for 1 week in a middle of February, we had a chance to study daily courses of both open and frozen lakes. It was found that photosynthetic oxygen production was performed even under 20 cm-

thick ice cover at limited PAR and Tw close to zero. The time of daily peaks of DOC were not related to the times of either maximum daily PAR or Tw. DOC peaks delayed several hours according to a weather of particular day. Shapes of daily courses are discussed as dependent on Tw, PAR availability, and photoinhibition of photosynthesis (MS in prep.).

Acknowledgements The authors thank CzechPolar for support of field works and experimental infrastructure provided during Austral summer 2013/2014.

REFERENCES:

Montecino, V., Pizarro G., Cabrera S. and Contreras M. (1991): "Spatial and temporal photosynthetic compartments during summer in Antarctic Lake Kitiesh.“ Polar Biology, 11: 371- 377.

Váczi, P., Barták, M. (2011): "Summer season variability of dissolved oxygen concentration in Antarctic lakes rich in cyanobacterial mats" Czech Polar Reports, 1 (1): 42-48.

PHOTOSYNTHETIC STUDIES ON ANTARCTIC AUTOTROPHS FROM JAMES ROSS ISLAND, ANTARCTICS: FIELD AND LABORATORY EXPERIENCE

Miloš Barták

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Brno Czech Republic

KEYWORDS: DROUGHT STRESS, CHLOROPHYLL FLUORESCENCE PARAMETERS, OPEN TOP CHAMBERS, PHOTOINHIBITION, WATER LIMITATION

Introduction

In 2007, a newly-built Czech Antarctic station (J.G.Mendel) started to operate at James Ross Island, Antarctica, during austral summer seasons. Thanks to station infrastructure, the research of terrestrial ecosystems of the island has become more complex and diverse. In this presentation, an overview of team work carried out in the field of photosynthesis research of Antarctic autotrophs is given. Since ongoing climate change may increase area, structure and function of vegetation oases in regions neighbouring the Antarctic Peninsula, we focused photosynthesis in a variety of autotrophs ranging from algae and cyanobacteria to mosses and lichens. Within last decade, Czech plant physiologists have carried out several projects aimed to (1) CO_2 fixation and photosynthetic primary processes of absorption/transformation of light energy (photosynthesis, respiration), (2) long-term controlled field experiments aimed to manipulated environment approach (open-top chambers, OTCs), in order to predict the likely changes in biomass production, community structure and biodiversity of Antarctic vegetation under global climate change, (3) long-term study on daily/yearly courses of actual photosynthetic activity measured by an *in situ* chlorophyll fluorescence system, (4) variability of dissolved oxygen in shallow lakes in the northern part of James Ross Island, as dependent on microbiological mat composition, temperature and weather.

Material and methods

To study long-term effects of atmospheric warming, open top chambers (OTCs) were installed over typical vegetation covers at the James Ross Island in 2007/2008. Altogether, 9 OTCs with microclimate and vegetation cover monitoring are recently in operation: 3 OTCs at coastal area, 3 at a plateau of a deglaciated mesa, and 3 at a glacier forefield at a mesa. In this presentation, only moss-dominated coastal location is focused because it shows the highest species richness. At this experimental plot, the below-specified long-term photosynthetic measurements are carried out.

To estimate photosynthetic processes and physiologically active time of *Bryum* sp. inside OTCs and at outside control plots, several fluorometers (Photon Systems Instruments, CZ) were used. Since February 2010, when they were installed in close vicinity of the J.G.Mendel station (northern part of the James Ross Island), they have been permanently in operation. In 1h step, they measure chlorophyll fluorescence and effective quantum yield of photosynthetic processes in photosystem II ($\Phi_{PS\,II}$) as dependent on hydration/dehydration and microclimatic parameters. For the calculations, the equation $\Phi_{PS\,II} = (F´m - Fs)/F´m$ is used, where Fs is steady state chlorophyll fluorescence (Fs) on light and F´m is maximum chlorophyll fluorescence in light adapted state (F´m). In this way, yearly data on photochemical processes of photosynthesis are available showing inhibition of photosynthesis due to e.g. freezing, and unavailability of light during winter season.

In laboratory, several experiment have been done focusing e.g. resistance to PAR- and/or UV-induced photoinhibition of photosynthesis in *Usnea antarctica, Umbilicaria decussata* and *Xanthoria elegans*. Species-specific differences in photoprotective mechanisms have been studied. Resistances to partial dehydration of lichen thalli, low and freezing temperatures have been addressed as well.

Results and Discussion

Analyses of yearly courses of $\Phi_{PS\ II}$ showed that the time of photosynthetic activity during austral summer season and winter dormancy are site-dependent, reflecting differences in microclimate. Inactivation of photosynthesis due to low and freezing temperature is reflected in $\Phi_{PS\ II}$ decline. During austral winter, $\Phi_{PS\ II}$ equals zero, however, several episodic increases due to temperature shift may happen. During austral summer, day-night time courses are distinguishable in chlorophyll fluorescence data, as well a drought-related inhibition of *Bryum* sp. photosynthesis. It is, therefore, concluded that water availability is the most limiting factor for *Bryum* sp. photosynthesis at James Ross Island, Antarctica.

Acknowledgements The author thanks CzechPolar for support of field works and experimental infrastructure.

LEMMING CYCLES IN THE GRIP OF CLIMATE CHANGE - INSIGHTS FROM AN ONGOING LONG TERM STUDY IN THE NORTH EAST GREENLAND NATIONAL PARK

Oliver Bechberger[1,2], Johannes Lang[3], Olivier Gilg[4,5], Benoît Sittler[2,5]

[1]University of Iceland /IS,
[2]Universität Freiburg /GER,
[3]Institut für Tierökologie /GER,
[4]Université de Bourgogne /F,
[5]Groupe de Recherche en Ecologie Arctique (GREA) /F

KEYWORDS: POPULATION DYNAMICS, PREDATOR-PREY INTERACTION

Because it harbours one of the simplest vertebrate communities, the High Arctic offers unparalleled opportunities to provide new insights into the mechanisms that underlie population dynamics and community processes. For now 26 years in a row, fluctuations of a lemming (*Dicrostonyx groenlandicus*) population have been closely monitored in the Karupelv Valley on Traill island in the North East Greenland National Park, along with the functional and numerical responses of four predators (stoat, arctic fox, snowy owl, long tailed skua).

Lemming population fluctuate mostly in a cycling pattern, with winter reproduction as a major trigger of the population outbreaks generally taking place in intervals of four to five years (see figure 1). It could be shown that the cyclic dynamics within this vertebrate community are primarily driven by predator-prey interactions. According to their specific functional and numerical responses, each predator plays a key role at some point of the lemming cycle, but it appears that only the stoat has the potential to drive the cycles. Successful reproduction of predators only occurs in so called good lemming years. Recent lemming population trends including a fading of above mentioned cycles (see figure 1) suggest some main responses to climate change (Gilg et al. 2009) possibly related to significant changes in snow cover, with cascading effects on the whole vertebrate community.

This study also highlights how important long term observations are to detect such changes at the community level. Some new approaches are now included in this project to better apprehend the subtle ongoing changes affecting high-arctic environments.

REFERENCES:
Gilg, O., Sittler B., Hanski, I. (2009): „Climate Change and cyclic predator prey population dynamics in the High Arctic. “ Global Change Biology 15 (11): 2634-2652

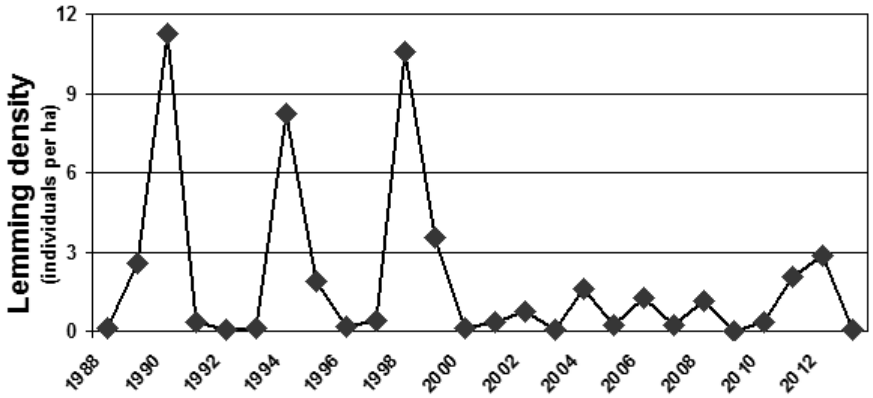


Figure 1: lemming density in the research area with four- to five year Cycles in the 1980s to 2000 and fading cycles since then

DIVERSITY OF MOSSES IN PYRAMIDEN SETTLEMENT (BILLEFJORD, SVALBARD)

Olga Belkina, Alexey Likhachev

Polar Alpine Botanical Garden and Institute, Kola Science Centre of RAS, Russia

KEYWORDS: MOSSES, BIODIVERSITY, PYRAMIDEN, SVALBARD

The diversity of mosses was studied in 2013 in Pyramiden settlement (residential and industrial zones) and adjacent area disturbed by human activity (the mouth of the Mimerelva south of Pyramiden, cemetery and surroundings of the "bottle house". About 520 specimens were gathered from different habitats.

103 species were registered on this territory, one of them new for Svalbard (*Helodium blandowii* (F.Weber & D.Mohr) Warnst.). We failed to find the 50 species growing in neighbouring natural ecosystems (west coast of the Petunia bay, Odinfjellet, Mimerdalen and Tordalen valleys) that were collected by us in 2008.

Most of the mosses are widespread in Pyramiden area (*Campylium stellatum* (Hedw.) C.E.O.Jensen, *Distichium capillaceum* (Hedw.) Bruch et al., *Ditrichum flexicaule* (Schwägr.) Hampe, *Orthothecium chryseon* (Schwägr.) Bruch et al.), but 40 species were collected in the settlement only. Some of them are mentioned further.

1) In places strongly affected by colonies of gulls nesting on buildings and other constructions there have been found some mosses avoiding carbonates (*Aulacomnium palustre* (Hedw.) Schwägr., *Plagiomnium ellipticum* (Brid.) T.J.Kop., *Helodium blandowii* (F.Weber & D.Mohr) Warnst.). *Aplodon wormskioldii* (Hornem.) R.Br., *Warnstorfia tundrae* (Arnell) Loeske have been noted on sites often visited by geese, skuas and gulls.

2) Some of the halotolerant specific or rare mosses (*Bryobrittonia longipes* (Mitt.) D.G.Horton, *Bryum* cf. *salinum* I.Hagen ex Limpr., *Tortula cernua* (Huebener) Lindb., *Hennediella heimii* (Hedw.) R.H.Zander var. *arctica* (Lindb.) R.H.Zander and) were found on extensive flat areas in the Mimerelva estuary splashed by salt water during storms and/or highest tide, or under flooded with seawater. They occupied silt, loamy or sandy soil. The latter two species grow also in ornithogenic habitats in the settlement, and *B. salinum* was collected on street lawns.

3) Many mosses prefer disturbed sites with bare soil and often occur in anthropogenic habitats (*Aongstroemia longipes* (Sommerf.) Bruch et al.). *Psilopilum laevigatum* (Wahlenb.) Lindb. settles on clay and was found to grow on low slopes covered with coals and on the helicopter pad.

4) Some mosses have no ruderal life strategy and can survive only in slightly changed tundra communities (*Abietinella abietina* (Hedw.) M.Fleisch., *Amblystegium serpens* (Hedw.) Bruch et al.) or in streams (*Ochyraea alpestris* (Hedw.) Ignatov & Ignatova) on the Pyramiden outskirts.

Most of the species found in the settlement were also collected outside it. An important role in the composition of Pyramiden vegetation is played by *Ceratodon purpureus* (Hedw.) Brid., *Leptobryum pyriforme* (Hedw.) Wils. and *Bryum* spp. Their total coverage reaches 30% on lawns planted in the last century. On the whole, the grassland of the lawns with *Poa alpigena*

(Blytt) Lindm., *Poa alpina* L., *Deschampsia alpina* (L.) Roem. et Schult., *Festuca vivipara* (L.) Smith. have a low moss diversity. The same refers to grassplots with gull nesting or sitting places.

The high number of *Bryum* species is a taxonomic peculiarity of Pyramiden bryoflora. Many species of the genus have an "explerent" (Ramensky, 1938) or "ruderal" (Grime, 1978) life strategy. They form numerous sporophytes or propagulas and can occupy bare ground very efficiently. Thus, the moss flora of the Pyramiden settlement is rich and differs from the bryoflora of the adjacent territory.

REFERENCES

Ramensky, L. G. (1938): "Introduction to comprehensive soil-plant studies of landscapes" (in Russian). Moskva: Sel'khozgiz. [Раменский Л.Г. (1938). Введение в комплексное почвенно-геоботаническое исследование земель. М.: Сельхозгиз, 619 с.]

Grime, J.P. (1979): "Plant strategies and vegetation processes". Chichester, New-York: John Wiley and Sons. 222 p.

VEGETATION DYNAMICS WITH RELATION TO GEOMORPHIC PROCESSES AND MICROMORPHOLOGY ON ACTIVE DEBRIS FLOW FAN

Alexandra Bernardová[1], Jan Blahůt[2], Jan Kavan[1], Jan Bálek[2]

[1]*Centre for Polar Ecology, Faculty of Sciences, University of South Bohemia*
[2]*Institute of Rock Structure and Mechanics, Academy of Sciences of Czech Republic*

KEYWORDS: SLUSH FLOW, VEGETATION, MORPHOLOGY, ATMOSPHERIC CONDITIONS

Vegetation cover in the Arctic is, among others, influenced also by the geomorphological processes. Abrupt changes in material transport on slopes have direct effect on establishing of plants – mainly pioneers. These are able to germinate rapidly and regenerate from vegetative diaspores. On a debris flow fan, next to the Czech Polar station in Petunia a LiDAR (laser scanning) campaign was performed in order to acquire precise morphological data. HR-DEM of the studied are was made with a 25 cm cell size. Consequently, different morphological areas were delimited using DEM data as well as field mapping. The mapped areas reflect both, the quantitative characteristics (slope, aspect, altitude) as well as dynamics of the processes (frequent vs. non frequent/absent debris/slush flow channel). The area is regularly affected by rapid slope processes – slush flows. Time-lapse camera has been installed to monitor slope dynamics and identify the affected areas. Such event has been observed between June 3rd 23:30 and June 4th 03:30 2013 (UTC) as documented in figure 1. It is probable that it was triggered by local atmospheric conditions. Local air temperature has increased significantly in three preceding days (from 0 to +6°C) complemented with low humidity and high radiation level. Such conditions leaded to fast meltdown and disintegration of snow cover on a steep slope above the debris flow fan. The upcoming atmospheric front that brought precipitation and increased humidity again to 100% has probably triggered the slush flow (figure 2).

Figure 1 – before and after the slush flow event on June 3rd and June 4th 2013

To document geomorphological processes through vegetation cover, vegetation mapping has been done in August 2013 in 4 cross profiles. The profiles has been chosen to cover all specific morphological zones of debris flow fan. Special characteristics of pioneer species, *Saxifraga*

oppositifolia, were measured (size of plant and reproductive status of the plant) as well to assess the morphological characteristic to the age and frequency of debris flow.

It is obvious that fast slope processes such as avalanches or slush flows are one of the most important factors influencing vegetation cover and species diversity especially in the high Arctic mountainous areas.

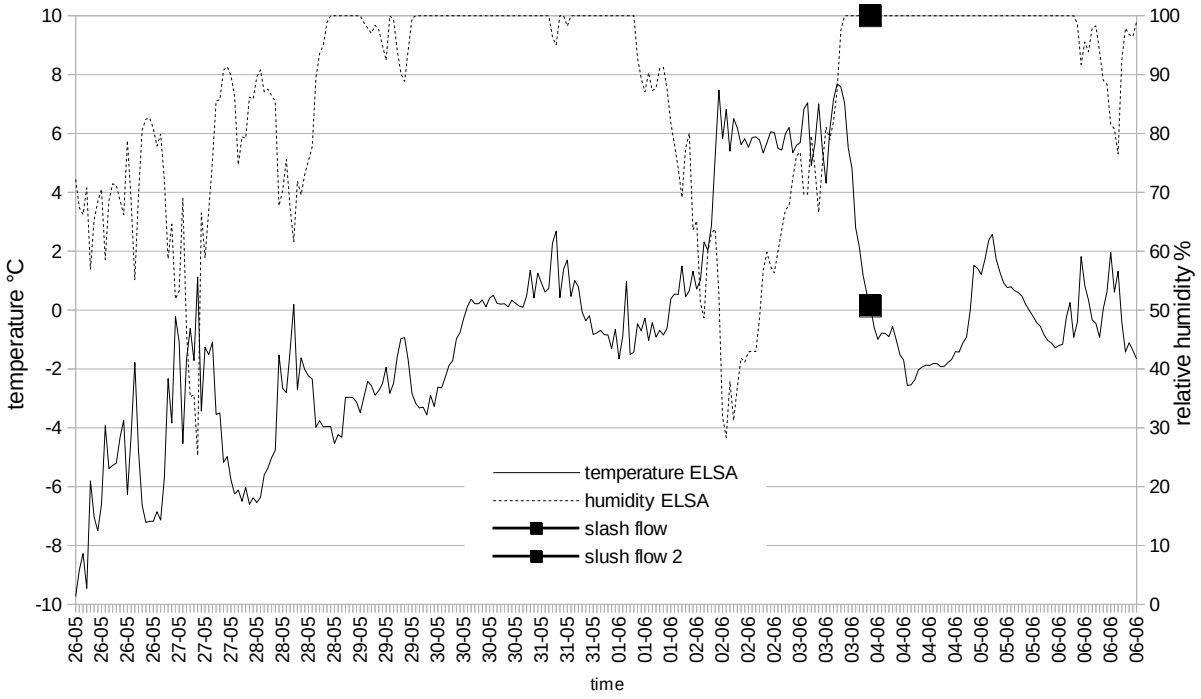


Figure 2 – atmospheric conditions precedent to the sudden slush flow event between June 3rd/June 4th (marked with black dots)

ECOLOGY OF LICHENS ON DEGLACIATED PARTS OF JAMES ROSS ISLAND, THE ANTARCTIC

Olga Bohuslavová[1], Josef Elster[2,3], Kamil Láska[1], Petr Macek[2], Petr Šmilauer[2], Alexey Redchenko[2]

[1]*Masaryk University, Faculty of Science, Brno,*
[2]*University of South Bohemia, Faculty of Science, České Budějovice*
[3]*Institue of Botany ASCR, Třeboň, Czech Republic*

KEYWORDS: LICHEN, *USNEA* SP., MARITIME ANTARCTIC, BIOMASS, ECOLOGY OF LICHENS, ENVIRONMENTAL CONDITIONS, JAMES ROSS ISLAND

The ecology of widespread and abundant lichen *Usnea* sp. present on James Ross Island in the Antarctic is studied in this research. The complex approach was used to study the phenomenon of this species in the Antarctic terrestrial ecosystem. The method for non-destructive estimation of lichen biomass was developed. The method is based on simple field measuring with the use of modified botanical square and digital photography of the experimental plots. The method can be used on similar lichen communities. Furthermore, the focus of other work was on lichen dispersal over the James Ross Island mesas. For this purpose, the simple field experiment was established on Berry Hill and Lachman Crags mesa in the vicinity of newly deglaciated parts. It was found out that even very young deglaciated bare grounds are slowly settled by lichens. For better understanding of microclimate and humidity changes on particular Antarctic cryptogam communities caused by recent climate changes, the long-term experiment simulating temperature increase and humidity changes was established on Johnson mesa. Open-top chambers were used as a reliable method for simulating these changes. Snow barriers were used for the first time in the Antarctic terrestrial ecosystem.

This study was undertaken in the vicinity of the Czech research station J.G. Mendel, James Ross Island (63°48'S, 57°52'W) during two summer months in 2007 and 2008. Three basaltic mesas (Berry Hill, Johnson Mesa, Lachman Crags) rich in *Usnea* species biomass were selected for the study.

Lichen biomass estimation

In thirty-eight experimental squares (non-destructive measurements), the density and height of lichen thalli were measured and digital photography with ground cover evaluation was performed. Lichen biomass was harvested from 14 experimental squares and analyzed for dry mass (DM), chlorophyll *a*, *b* content and thalli surface area (TSA). Predictive linear models were constructed from available non-destructively measured variables with the aim to maximize predictive accuracy for the destructively measured attributes. A total of 82.3% of variability in the TSA values was explained (87.5% for biomass determination). Cross-validated prediction error for lichen thalli surface area estimation was 423 cm^2 (11.5% of the average TSA). In the case of lichen dry mass determination, cross-validated prediction error was 4.53 $g.m^{-2}$ (7.3% of the average dry mass). It was not possible to estimate Chl *a* concentration from the measured values. Chl *b* concentration was dependent on the experimental plot micro-relief.

Seasonal variation of OTCs and Control in the period of 2007–2012

Air temperature data from three OTCs and one Control and their differences are processed on the basis of their monthly means from the period of 2007 (2008) – 2012. Air temperature course

of OTC1 and OTC2 are very similar while OTC 3 differs slightly from them. All OTCs are significantly warmer than the Control mainly in winter season (May–August) when positive differences reaching values of 3°C and even more. Winter monthly means oscillate between -12 and -22 °C. Differences are positive also in summer (0 °C – 2 °C) seasons but not reaching the values of winter positive differences. In Austral summer, three months – December, January and February (DJF) have positive monthly mean air temperature in all seasons. The warmest summer seasons were 2007 and 2008 reaching the monthly mean temperatures almost 5 °C in January, while the coldest summer was in 2009 with monthly mean temperature approx. 2,5 °C. The coldest winter occurred in 2007 where the monthly mean temperature was beneath -20°C in July. The warmest winter was in 2010 (monthly mean between -8 and -14 °C) and the warm one occurred also in 2008 followed by the warmest summer.

REFERENCES:

Bohuslavova, O., Šmilauer, P., Elster, J**.** 2012: *Usnea* lichen community biomass estimation on volcanic mesas, James Ross Island, Antarctica. Polar Biology 35: 1563-1572

Convey, P. 2010. Terrestrial biodiversity in Antarctica – Recent advances and future challenges. Polar Science, s. 135 – 147.

Láska, K., Prošek, P., Budík, L. (2010): Seasonal variation of air temperature at the Mendel Station, James Ross Island in the period of 2006-2009. Geophysical Research Abstracts, 12, EGU2010-3880

LOW HOST PREFERENCE OF ROOT-ASSOCIATED MICROBES AT AN ARCTIC SITE

Synnøve. Botnen.[1,2], Unni Vik[1], T. Carlsen[1], Pernille Bronken Eidesen[2], Marie L. Davey[1], Håvard Kauserud[1]

[1]*Section for Genetics and Evolutionary Biology (EVOGENE), Department of Biosciences, University of Oslo, Norway*
[2]*The University Centre in Svalbard, Longyearbyen, Norway*

KEYWORDS: *BISTORTA VIVIPARA*, *DRYAS OCTOPETALA*, HOST PREFRENCE, MICROBES, *SALIX POLARIS*, SVALBARD

Arctic environments are challenging for plant growth due to factors such as low moisture, low annual mean temperature, extreme variation in radiation and seasonality. Mycorrhizal fungi facilitate plant nutrient acquisition and water uptake, and may therefore be particularly ecologically important in nutrition-poor and dry environments, such as parts of the Arctic. It is also believed that bacteria have an important role in the mycorrhizal symbiosis. Similarly, endophytic root associates are thought to play a protective role, increasing plants' stress tolerance, and likely have an important ecosystem function. Despite the importance of these root-associated microbes, little is known about their plant host specificity in the Arctic. In this study we analysed the mycobiomes and microbiomes of whole root systems of the three plants *Bistorta vivipara, Salix polaris* and *Dryas octopetala* in the High Arctic archipelago Svalbard using high throughput sequencing of the 16S and fungal ITS1 markers. We found a low degree of plant host specificity of the root-associated fungi and bacteria. The lack of spatial structure at small spatial scales indicates that common mycelial networks (CMNs) are rare in marginal arctic environments. Further analyses will focus on the potential of co-occurrence between the fungal and bacterial OTUs.

HEALTH PROBLEMS IN THE POLAR REGIONS

Kristian Brat

Department of Respiratory Diseases, University Hospital Brno and Faculty of Medicine, Masaryk University, Brno, Czech Republic

The polar regions are specific in many aspects. The climatic conditions are very different (or even extreme) and in general, the conditions for life are unfavourable. Moreover, large differences in circadian rhythm are typical for the polar regions. In these conditions, human organism is forced to find adaptation mechanisms to these atypical and extreme conditions. Population density in very low, infrastructure is almost absent and access to health care is usually very limited, particularly in some areas. Even the smallest health problem may become very serious or even life-threatening.

How does human organism adapt to the hostile polar environments? Which adaptation mechanisms are well-documented and understood? Are there any diseases related to or caused by the human presence in the polar regions?

The author of this presentation will try to answer all of these questions. Finally, several practical recommendations (related to health) for those willing to travel to the polar regions will be proposed.

YEAR-ROUND CHANGES IN BACTERIAL ENVIRONMENT AT MENDEL RESEARCH STATION, ANTARCTICA

Kristian Brat[1], Alena Sevcikova[2], Ivo Sedlacek[3], Zdenek Merta[1], Kamil Laska[4] and Pavel Sevcik[5,6]

[1]Department of Respiratory Diseases, University Hospital Brno and Faculty of Medicine, Masaryk University, Brno, Czech Republic
Department of Microbiology, University Hospital Brno, Czech Republic
[3]Czech Collection of Microorganisms, Department of Experimental Biology, Masaryk University, Brno, Czech Republic
[4]Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic
[5]Department of Anaesthesiology and Intensive Care Medicine, University Hospital Ostrava, Czech Republic
[6]Faculty of Medicine, University of Ostrava, Czech Republic

KEYWORDS: ANTARCTICA; RESEARCH POLAR STATION; ANTROPOPHILIC BACTERIA; IMPORTED SPECIES

Introduction
A study of survival of non-native bacteria at a summer-operated research station (Mendel base) in Antarctica during two years.

Methods and materials
Using two different methods, we performed 204 smears, half at opening of the base after 10 months of human absence and half before the base was abandoned. Cultivation was performed in the Czech Republic. MALDI-TOF and Biolog systems were used for identification of the isolated bacteria.

Results
We acquired 469 isolates; of these were 310 identified to the species level, 88 to the genus; 71 remained unidentified. Major differences in the structure of bacterial environment were observed during the stay in Antarctica. In the first series, bacteria of *Bacillus* sp. dominated. High numbers of Gram-positive cocci and of coliforms were found (including opportunistic human pathogens), although the conditions for bacterial life were unfavourable. In the second series, coliforms and Gram-positive cocci dominated. Dangerous human pathogens were also detected.

Discussion and Conclusion
This is the first report of changes in bacterial environment at a summer-only-operated Antarctic research station during a period of two years. A number of studies have been performed previously to determine the potential impacts of human-borne bacteria imported to the polar environments. To date, there is no evidence of epidemics of infectious diseases in Antarctic animals caused by human-borne bacteria. We conclude that: 1) non-native bacteria can survive long periods of human absence, 2) the surviving bacteria might cause severe health problems to the participants of the forthcoming expeditions, 3) hypothetically, the bacteria released to the outer environment might have impacts on local ecosystems, 4) if anthropopathogenic bacteria can survive in Antarctica, an analogous situation may apply for long-duration human spaceflight.

RADIAL GROWTH OF ARCTIC WOODY PLANTS IN PETUNIABUKTA (CENTRAL SPITSBERGEN)

Agata Buchwal[1, 2], Monika Stawska[1], Patrick Fonti[2]

[1]*Institute of Geoecology and Geoinformation, Adam Mickiewicz University, Poznan, Poland*
[2]*Swiss Federal Research Institute, WSL;Birmensdorf, Switzerland*

KEYWORDS: DENDROCHRONOLOGY, WOODY PLANTS, WOOD ANATOMY, SPITSBERGEN

The aim of this study is to present the anatomical structure of radial growth of selected dwarf shrubs and herbaceous plants in the High Arctic. The presented material was collected in central Spitsbergen (Ebbadalen), in the vicinity of Adam Mickiewicz University Polar Station (AMUPS). The presentation includes a comparison of tree-ring growth of selected dwarf shrubs, i.e. *Salix polaris, Salix reticulata*, *Dryas octopetala, Cassiope tetragona* and some commonly distributed arctic herbs, i.e. Silene furcata, Silene uralensis, *Cerastium arcticum*, *Draba alpina*, *Draba corymbosa*, *Pedicularis hirsuta*, *Erigeron humilis*, *Arenaria pseudofrigida*. Herbaceous plants represent a diverse anatomical structure with a majority of semi-ring porous species. Limited size and a fragile wood structure limits preparation of microsections of some herbs. Ring shake features challenge the use of some commonly growing species (*Saxifraga oppositifolia, Saxifraga aizoides*) in dendrochronological studies. Outside of a scientific value of the study, an illustrative part of this work shows a hidden beauty and complexity of Arctic wood anatomy.

COMPARING OPTIMAL AND RULE-BASED BEHAVIOURAL STRATEGIES IN LARVAL FISH MODELS

William E. Butler[1], Christian Jorgensen[2], Anders F. Opdal[2], Nadia Fouzai[3], Gudrun Marteinsdottir[1], Øyvind Fiksen[3]

[1]*University of Iceland, Faculty of Life and Environmental Sciences, Reykjavik, Iceland*
[2]*Uni Research, Uni Computing, Bergen, Norway*
[3]*University of Bergen, Department of Biology, Bergen, Norway*

KEYWORDS: ADAPTIVE BEHAVIOUR, LARVAL ECOLOGY, INDIVIDUAL-BASED MODEL, BIOPHYSICAL MODEL, TRADE-OFF

Coupling Individual-based models (IBMs) for fish larvae (or other living organisms with self-mobility) to hydrodynamic models requires an algorithm or a set of rules to describe the behaviour. How this is formulated is shown to have significant effects on dispersal and survival of modelled larvae. Ideally, the behavioural algorithm would be evolutionarily consistent, reflecting the flexible nature of behaviours such as habitat selection and foraging activity and preferably also their dependence on individual state. These algorithms should be constrained by the individual's limited ability to sense and predict and require little computation so they can be implemented in hydrodynamic models. This raises the questions: (1) How do simple rule-based algorithms compare with evolutionary optimal behaviour—the behaviour that maximises survival in a given environment? (2) How can behavioural algorithms be improved, while retaining simplicity, to capture adaptive behaviour? To address these questions, we developed an IBM to simulate the early life-history of a larval cod from 5 mm to 15 mm. We implemented a variety of simple algorithms that evaluate the trade-off between ingestion and mortality rates. As ingestion may be prioritised at particular times of day and/or internal states of the individual, we assigned the larva a behavioural strategy vector. This provided the larva with information regarding the strength of stimulation to forage, and we incorporated three cues: (1) stomach fullness; (2) rate of change in light intensity; and (3) an individual boldness personality trait. Using survival per mm length interval as a measure of fitness, we carried out an exhaustive parameter search to find the values that maximised fitness throughout ontogeny for each cue. To assess the performance of each parameter combination, a state-dependent optimality model run in an identical environment (70° north) was used as a benchmark. The best strategy utilised all cues, with parameter values changing through ontogeny. This strategy had an accrued probability of survival at 15 mm approximately 50% of the optimal behaviour, and an improvement of 30% over an ontogenetically fixed strategy and 17% over a strategy consisting of the best single length-dependent cue. A distinct difference in the strength of stimulation from behavioural cues was found between length intervals 5-7 mm and 8-15 mm, with the latter obtaining foraging stimulation from a near-empty stomach and the diel light cycle, whereas the former required only continual stimulation from its boldness personality trait. When comparing survival for each mm length interval, the best strategy vector achieved > 90% of the survival of the optimal behaviour with the exception of 5-6 mm (75%), suggesting there is additional information an optimal larva could potentially sense and use that is not captured in the simple behavioural rule. Incorporating multiple behavioural cues and their relative importance throughout ontogeny are shown to be important components of behavioural algorithms. When designing such algorithms for biophysical models, consideration of these traits is recommended, as the emergent behavioural responses are likely to lead to improved survival, which is particularly important for models examining recruitment hypotheses.

HETEROGENEOUS RESPONSES OF ARCTIC AND SUB-ARCTIC VEGETATION TO ENVIRONMENTAL CHANGE: POOR UNDERSTANDING HIDES POTENTIAL CAUSES

Terry V. Callaghan

Royal Swedish Academy of Sciences, Stockholm, Sweden
Department of Animal and Plant Sciences, University of Sheffield, Sheffield, UK
Department of Botany, National Research Tomsk State University, Tomsk, Russia

Observations and experiments of vegetation change responding to a warmer climate have produced a mass of data in the past 25 years since the climate change issue became recognised as particularly important in the Arctic. However, it can be argued that a realistic understanding of the causes of the responses and a balanced presentation of positive, negative and neutral responses is lacking. Most papers focus on increased growth related to summer warming and most experiments increase summer temperatures. However, a rigorous remote sensing analysis of the "Greening of the Arctic" showed that only 37% of Arctic vegetation has significantly greened between 1982 and 2012 while observations (and projections) of temperature show that winter temperatures are increasing far more than summer temperatures. Although significant heterogeneity in response of vegetation to climate warming has recently been documented from field studies throughout the Arctic, the causes remain poorly understood. In contrast, a detailed study of change over 100 years in the Sub-Arctic shows that numerous drivers operate to generate heterogeneous response of vegetation even at the catchment scale and that stochastic events can often over-ride long-term trends of greening. There are indications that genotypes of individual species also respond differently to climate warming. This presentation explores some misconceptions by describing heterogeneous responses at various geographical scales and makes recommendations for improved observations and analyses.

DISCONNECTION BETWEEN MICROBIAL METABOLISM DEMAND AND ENZYMATIC ACTIVITY SUPPLY STABILIZE SOM IN CRYOTURBATED ORGANIC HORIZONS OF PERMAFROST SOILS

Petr Čapek[1], Kateřina Diáková[1], Jan-Erik Dickopp[2], Jiří Bárta[1], Birgit Wild[3,4], Jörg Schnecker[3,4], Georg Guggenberg[5], Norman Gentsch[5], Gustaf Hugelius[6], Nikolaj Lashchinsky[7], Antje Gittel[9, 11], Christa Schleper[9], Robert Mikutta[5], Juri Palmtag[6], Olga Shibistova[5,8], Tim Urich[4,9, 10], Andreas Richter[3,4], Hana Šantrůčková[1]

[1]*University of South Bohemia, Department of Ecosystems Biology, České Budějovice, Czech Republic;*
[2]*Institute of Systematic Botany and Ecology, University of Ulm, Ulm, Germany;*
[3]*University of Vienna, Department of Terrestrial Ecosystem Research, Vienna, Austria;*
[4]*Austrian Polar Research Institute, Vienna, Austria;*
[5]*Leibniz University Hannover, Institute of Soil Science, Hannover, Germany;*
[6]*University of Stockholm, Department of Physical Geography and Quaternary Geology, Stockholm, Sweden;*
[7]*Central Siberian Botanical Garden, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia;*
[8]*VN Sukachev Institute of Forest, Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russia;*
[9]*University of Vienna, Department of Genetics in Ecology, Vienna, Austria;*
[10] *University of Bergen, Department of Biology/Centre for Geobiology, Bergen, Norway;*
[11]*Center for Geomicrobiology, Department of Bioscience, Aarhus C, Denmark*

Cryoturbated organic horizons are special feature of permafrost affected soils. These soils are known to store great amount of organic carbon as soil organic matter (SOM) and cryoturbation undoubtedly contribute to it. Despite this fact there is almost no information about SOM transformation in cryoturbated organic horizons. Therefore we carried out long term incubation experiment in which we inspect SOM transformation in cryoturbated organic as well as in upper organic and mineral soil horizons under different temperature and redox regimes. We found out that lower SOM transformation in cryoturbated organic horizons compared to upper organic horizons is mainly limited by the amount of microbial biomass, which is extremely low in absolute numbers or expressed to SOM concentration. Growth of microbial biomass in cryoturbated organic horizons is restricted by disconnection between demands of microbial metabolism (to energy, carbon and nutrients) and supply of extracellular enzyme products. The most egregious example of such disconnection is different temperature response of microbial metabolism and phenoloxidase activity. Phenoloxidases ensure critical step of biochemical transformation of complex SOM by breaking down complex organic compounds to simple ones. Their activity measured as oxygen consumption rate shows strong temperature response with optimum at 13.7°C. However temperature optimum of microbial metabolism is well above 20°C. Such mismatch in temperature optima necessarily let to disconnection between microbial demands and enzymatic supply. We hypothesize that this is the basic principle of SOM stabilization in cryoturbated organic horizons in longterm.

CHANGE IN SOIL PROPIERTIES IN GRASS-MOSS COMMUNITIES ALONG HERBACEOUS TUNDRA TRANSECT ON THE WEST COAST OF THE ANTARCTIC PENINSULA

Angélica Casanova-Katny [1], Cristina Muñoz [2], Gustavo Torres-Mellado [3], Eric Zagal

[1]Departamento de Microbiología, Facultad de Ciencias Biológicas;
[2]Departamento de Suelos, Facultad de Agronomía
[3]Departamento de Botánica, Fac. de Ciencias Naturales, Universidad de Concepción

KEY WORDS: ANTARCTICA- GLOBAL WARMING – ANTARCTIC FLORA

Native Antarctic tundra communities are distributed along the west coast of the Antarctic Peninsula (WAP), including several offshore Islands and Archipelagos. Recently, it has been shown, that the Antarctic hairgrass *Deschampsia antarctica* is frequently associated to moss carpet communities. In order to detect a potential common pattern and differences in soil characteristics between grass-moss (GM) and grass only communities (GC), we monitored a total of 18 sites on 8 islands through a transect from the Shetland island to Margarite Bay in the WAP comparing composition of plant communities as well as chemical and physical factors of soil beneath them. At every site, we took soil samples and measured *in situ* plant cover (%). Vascular plant (grass) cover changes significantly along the transect, with a maximum value of 67% on Lagotellerie Is. and a minimum <1% in two sites on King George Is. In general, vascular plant cover was significantly higher at sites where mosses dominate (31% and 23% with and without moss carpet), but different patterns were observed: whereas in Admiralty Bay and on Fildes Peninsula, grass cover increases at sites with mosses compared with bare ground, it was higher without mosses on Byers Peninsula, and on Lagotellerie Is. On the other hand, values of soil macronutrients (NPK) are different between the different islands as well as comparing soil beneath GC and GM communities along the WAP. Nitrogen and phosphorous variations were the strongest: N content was highest on Galindez Islands (10 %), but in general, values fluctuated between 0.1-1.0% along the transect; highest P values were found on Galindez Is., Anchorage Is. and Biscoe Point, (397 - 2000 mg/Kg), lowest values at Collins Harbour (6 mg/Kg). K values were variable, in the range of 0.1 to 2.9 mg/Kg and pH varied between 4.5 and 7.1 along the different sites on the WAP. Significant were the changes in N, P, Mg, Ca, C, C/N ratio in soils beneath G vs. GM.
Our data suggest that high grass cover is not dependent on the presence of mosses along the Antarctic Peninsula. Nutrient content in different soils is generally high, probably due to input by seal and birds. The results indicate that under the actual climate change scenario, soil nutrients are not a limiting factor for growth and expansion of vascular plant communities along the Antarctic Peninsula. Grant FONDECYT 1120895.

EFFECT OF EXPERIMENTAL WARMING ON SECONDARY METABOLITES AND SOLUBLE CARBOHIDRATES IN ANTARCTIC LICHENS.

Angélica Casanova-Katny[1], Gustavo Zuñiga–Libano[2], Marisol Pizarro[2] and Gustavo E. Zuñiga[2].

[1]Departamento de Microbiologia, Facultad de Ciencias Biológicas, Universidad de Concepción
[2]Departamento de Biologia, Facultad de Quimica y Biología, Universidad de Santiago de Chile (USACH).

KEY WORDS: ANTARCTICA, ANTARCTIC FLORA, FILDES PENINSULA, GLOBAL WARMING

The vegetation of the Antarctic tundra is dominated by lichens, which occur under all microclimatic conditions along the Antarctic ice-free areas. Currently, the Antarctic Peninsula is one of the fastest warming regions on the world. Previous reports suggest that lichens grow faster in response to global warming. It has been also suggested, that warming would reduce secondary metabolites in plants and other species as a trade-off for increased growth. However, there is still deficient knowledge about lichen metabolism under the new climate conditions. Our study was focused on the effect of passive warming on secondary metabolites and biological activity of two lichens, *Usnea auriantiaco-atra* and *Himantormia lugubris* on Fildes Peninsula, King George Island. We installed open-top chambers (OTC) in 2008 and after two and four years we collected samples of both lichen species for metabolite and soluble carbohydrates analysis. Whereas NSC was significantly higher in OTC for both lichens species, antioxidant activity of extracts measured as DPPH* scavenging or FRAP power did not show differences under the treatments. However, phenolic content profile and compounds were different between both species. In *U. auriantiaco-atra*, an increase in Usnic acid was found under warming. Concordantly, a significant increase of total phenolic compounds was observed in *H. lugubris*, characterized as p-Coumaric acid, Ferulic acid, Gallic acid and Sinapic acid. Total content of phenolic compounds and the amount of individual compounds were higher in *H. lugubris* than in *U. auriantiaco-atra* and higher in *H. lugubris* inside than outside the OTC. Our results suggest that global warming is affecting the metabolism of phenolic compounds in *H lugubris*.

LAKE ECOSYSTEM EVOLUTION AND DIATOM SUCCESSION ON THE HERBYE GLACIER FORELAND

Denisa Čepová[1], Eveline Pinseel[2,3], Jan Kavan[4], Kateřina Kopalová[4,5]

[1]*Faculty of Sciences, Palacký University in Olomouc, Czech Republic*
[2]*Botanic Garden Meise, Department of Bryophyta & Thallophyta, Belgium*
[3]*University of Antwerp, Department of Biology, ECOBE, Wilrijk, Belgium*
[4]*Centre for Polar Ecology, University of South Bohemia in České Budějovice, Czech Republic*
[5]*Charles University in Prague, Czech Republic*

KEYWORDS: DEGLACIATION, LAKES, GLACIER, DIATOMS, SUCCESSION

After the Little Ice Age (LIA) ended in the late 19th century a continuous deglaciation of Svalbard occurred and continues until present. This phenomenon has the consequence of exposing completely new surface due to the retreat of the glacier fronts. After deglaciation many new lakes and permanent water bodies form in the basal moraine sediments. These are of course almost immediately colonized by different algal communities.

The description of the present state of lake ecosystems in these recently deglaciated areas will be the goal of a summer expedition to Svalbard. Thanks to old aerial photographs of the area of Petuniabukta (Billefjorden, central Svalbard), we are able to reconstruct the retreat rate of the glacier and to assess also the age and origin of present lakes. Series of aerial photographs from 1936, 1960, 1990 and 2009 (taken by the Norwegian Polar Institute) are used for such a reconstruction. Several benthic samples were taken on the age gradient (corresponding to the distance from the glacier front) and subsequently analysed to determine the present diatom assemblages. In total 16 lakes were sampled and in every sample 400 diatom valves were counted and taxonomically determined to obtain the relative abundances of the species present. Different diatom communities can be seen within the present transect and based on the species richness within each sample, our hypothesis (different species richness along the age) can be confirmed.

It is obvious that characteristics of diatom assemblages correspond well with estimated age of studied lakes and this approach could be also used as a hint for assessing retreat rate of glaciers where relevant historic photographs or measurements are missing. However, other environmental factors, not related to the age of the lakes, might be of certain importance in determining the diatom communities.

The study was supported by the Grant No. LM2010009 CzechPolar and CZ.1.07/2.2.00/28.0190.

EMERGING VIRAL ZOONOSES IN POLAR AREAS

Jiří Černý[1,2], Jana Elsterová[1,2], Jana Müllerová[1,2], and Daniel Růžek[1,2,3]

[1]Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic
[2]Institute of Parasitology, Biology Center of the Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic
[3]Department of Virology, Veterinary Research Institute, Brno, Czech Republic

Despite emerging and re-emerging viral zoonoses pose a considerable public health problem their occurrence in polar areas is poorly described. Important human pathogens such as rabies virus or influenza virus were previously reported in various arctic areas. Dense populations of blood sucking arthropods and vertebrate hosts (nesting seabird etc.) allow circulation of various arboviruses. Viruses circulating in Arctic may pose important source of new genes enriching genetic pool of pathogens circulating in lower latitudes or they may evolve in newly emerging pathogens.

While influenza virus was previously reported in seabirds in many Arctic areas its prevalence in Antarctica is totally unknown. Here we report preliminary results on search for Influenza virus in both Arctic (Svalbard) and Antarctica (John Ross Island). On Svalbard we collected bird sera which we analysed for presence of anti-influenza antibodies. On John Ross Island bird droppings and oropharyngeal swabs were collected and subsequently analysed by RT-PCR. Presence of Influenza virus antibodies on Svalbard and Influenza virus RNA on John Ross Island will be discussed.

MODELLING OF SURFACE WIND IN PETUNIABUKTA (BILLEFJORDEN, SVALBARD)

Zuzana Chládová[1,2], Kamil Láska[2,3], Jiří Hošek[1]

[1]*Institute of Atmospheric Physics, Czech Academy of Sciences, Prague;*
[2]*Centre for Polar Ecology, University of South Bohemia, České Budějovice, Czech Republic;*
[3]*Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic*

KEYWORDS: WIND, ATMOSPHERIC CIRCULATION, WRF MODEL, WASP MODEL, SVALBARD, ARCTIC

Atmospheric boundary layer processes in Arctic fjords are strongly influenced by complex topography. The topographic effects may include channelling, drainage flows and mountain waves in particular (Láska et al. 2012). Modelling of these effects in the case of small-scale topography requires very high resolution of both wind measurements and suitable tool for parameterisation of the atmospheric boundary layer. There are only few studies which deal with comparison of the observed and estimated wind conditions in the Arctic summer. In this study, the numerical simulation by means of the Weather Research Forecasting (WRF) model (Skamarock et al. 2007) and WAsP Engineering model (Troen and Petersen, 1989) were used. The WRF model can catch a large spatial variation in near-surface variables over fjords. The simulations have previously been evaluated against measurement of the weather stations on Greenland, Svalbard and Arctic Ocean in spring and the results were satisfactory. WAsP Engineering model supports mainly the estimation of loads on wind turbines and other civil engineering structures situated in moderately complex terrain. The wind conditions that are treated are extreme wind speeds, wind shears and wind profiles and turbulence (gusts of all sizes and shapes). The WAsP model calculates with various terrain dependent properties of turbulence.

This contribution presents the measurement and numerical simulation of the wind characteristics in Petuniabukta, northward oriented bay connected with Billefjorden and Isfjorden (central Spitsbergen). The 30-min values of surface wind speed and prevailing wind direction obtained from two automatic weather stations (hereafter AWS) in the period 17–19 July 2013 were analysed. The AWS were located on the western coast of the Petuniabukta at altitude of 15 and 770 m a.s.l. Pattern of atmospheric circulation was identified using 850 hPa geopotential heights. The models were initialised by the European Centre for Medium-Range Weather Forecasts (ECMWF) operational analysis with 0.5° resolution at 6-hour intervals during the simulation. The WRF model overestimated surface wind speeds, especially during transformation and re-development of the pressure field and frontal systems over Svalbard. Therefore, correlation coefficients between observed and modelled data ranged from -0.19 to 0.62 in relation to surface weather conditions. Similarly, WAsP model slightly overestimated wind speeds due to difficulties in capturing effects of steep orographic features.

REFERENCES:
Láska, K., Witoszová, D., Prošek, P. (2012): Weather patterns of the coastal zone of Petuniabukta (Central Spitsbergen) in the period 2008–2010. Polish Polar Research 33 (4): 297-318.
Mäkiranta, E., Vihma, T., Sjöblom, A.,Tastula, E.M. (2011): Observations and Modelling of the Atmospheric Boundary Layer Over Sea-Ice in a Svalbard Fjord. Boundary-Layer Meteorology 140 (1): 105-123.
Skamarock, W.C., Klemp, J.B., Dudhia, J., Gill, D.O., Barker, D.M., Wang, W., Powers, J.G. (2007): A description of the advanced research WRF Version 2. NCAR technical note 468+STR, 88 pp.
Troen, I., Petersen, E.L. (1989): European Wind Atlas. Risø National Laboratory, Roskilde, 655 pp.

Acknowledgements: The research was supported by the project LM2010009 CzechPolar (MSMT CR) and project of Masaryk University MUNI/A/0952/2013 „Analysis, evaluation, and visualization of global environmental changes in the landscape sphere (AVIGLEZ)".

LONG TERM WIND EROSION IN ICELAND

Pavla Dagsson-Waldhauserova[1,2], Olafur Arnalds[1], Haraldur Olafsson[2], Johann Thorsson[3] and Elin Fjola Thorarinsdottir[3]

[1]*Faculty of Environment, Agricultural University of Iceland, Hvanneyri, Iceland.*
[2] *Faculty of Physical Sciences, University of Iceland, Reykjavik, Iceland.*
[3] *Soil Conservation Service of Iceland, Gunnarsholt, Iceland.*

KEYWORDS: DUST STORMS, SALTATION, WIND EROSION, VOLCANIC ASH

Iceland is an island where volcanic sandy deserts and glacially derived sediments cover over 21% of the country. Affected by strong winds, such areas undergo severe wind erosion and dust particles are carried by air currents distances of several hundred km. We used meteorological observations (synoptic codes for dust and visibility) to identify the frequency and severity of dust-storm events in Iceland. The annual mean of dust days in 1949-2011 was > 34 dust days per year placing Iceland among the most active desert regions around the world. The most dust-active decade in NE Iceland was 2000-2010. Winter and sub-zero temperature dust events are often in the southern part of Iceland. The NE dust events are likely affecting the Arctic air quality and climate. Icelandic dust is different from the crustal dust; it is of volcanic origin and dark in colour. It contains sharp-tipped shards and is often with bubbles. Such physical properties allow large particle suspension and transport to long distances, e.g. towards the Arctic. Further, it was found that Icelandic volcanic sand is of similar optical properties as black carbon both deposited on snow or in laboratory.

We have measured saltation and aeolian transport during storms in Iceland which give some of the most intense wind erosion events ever measured. Severe dust storms occurred after the 2010 eruption in the Eyjafjallajökull area impacting the land degradation several years after the event. The BSNE wind erosion samplers to measure an aeolian particle transport were employed together with the saltation sensor (SENSIT) and an automatic weather station *in situ* during several events. Over 30 wind erosion events occurred (June-October) at wind speeds > 10 m s-1 in each storm with gusts up to 38.7 m s-1. Surface transport over one m wide transect (surface to 150 cm height) reached 11,800 kg m-1 during the most intense storm event with a rate of 1,440 kg m-1 hr-1 for about 6.5 hrs. The maximum saltation was of 6825 pulses per minute. The mean grain size of the particles moved and sampled in erosion samplers ranged from 0.13 to 0.69 mm but grains > 2 mm were also moved.

Dust affects the ecosystems over much of Iceland, providing new, un-weathered materials on the surface. It is likely to affect the ecosystems of the oceans around Iceland, and it brings dust that lowers the albedo of the Icelandic glaciers, increasing melt-off due to global warming.

DIVERSITY OF THE CYANOPROKARYOTA OF THE AREA OF SETTLEMENT PYRAMIDEN (SVALBARD)

Denis Davydov

Polar Alpine Botanical Garden Institute Kola SC RAS, 184256, Botanical Garden, Kirovsk, Murmansk Region, Russia

KEYWORDS: CYANOPROKARYOTA, DIVERSITY, SVALBARD

Cyanoprokaryota (Cyanophyta, Cyanobacteria) comprise a prominent and essential autotrophic component of polar biota. Study of the cyanoprokaryotes of Spitsbergen archipelago began in the nineteenth century (Skulberg, 1996). There are numerous publications concerning the diversity of the freshwater and terrestrial cyanoprokaryota of Spitsbergen archipelago.

The present study adds new information on the freshwater and terrestrial cyanoprokaryota on the Spitsbergen archipelago. The investigated area is located in the central part of Spitsbergen, in the eastern part of the Dickson Land, on the western shore of Billefjorden.

Samples were collected during 25 July – 3 August, 2008 and 1 – 10 August, 2013 in the area covering Mimerdalen, Tordalen valleys, Planteryggen, Reuterskiöldfjellet, Pyramiden, Svenbrehøgda mountain slopes

In total, 243 samples were collected. The populations of cyanoprokaryota were identified, measured and photographed using the optical microscope AxioScope A1 (Zeiss©).

A total of 67 cyanobacterial taxa were identified in the habitats of investigated area. The highest number of species was found on wet seepages on the slopes (33 species), in slow tundra streams (26 species) and wet soils (21 species).

Eleven species are first time records for Spitsbergen flora: *Anabaena inaequalis*, *Calothrix aeruginosa*, *Chroococcus spelaeus*, *C. subnudus*, *Gloeocapsa rupicola*, *G. violascea*, *Gloeothece palea*, *Leptolyngbya bijugata*, *Lyngbya martensiana*, *Rivularia coadunate*, *Trichocoleus sociatus*.

Nostoc commune (58 observation), *Calothrix parietina* (11 observation), *Microcoleus autumnalis* (9 observation) were the most abundant species in the investigated samples. Comparison of flora of cyanoprokaryotes in the vicinity of settlement Pyramiden with other Svalbard areas shows significant difference in diversity of different parts of archipelago and quite original species composition in Pyramiden area. Most similar (the difference in species composition over 60 %) are flora of the Grønfjorden west coast (Davydov, 2013) and flora of the Rijpfjorden east coast (Davydov, 2013), but only less than 30 % of species are common.

REFERENCES:

Davydov D. A. (2008): "Cyanoprokaryota." In: Koroleva, N. E., Konstantinova, N. A., Belkina, O. A., Davydov, D. A. , Likhachev, A. Yu., Savchenko, A. N. & Urbanavichiene, I. N. (eds): Flora and vegetation of Grønfjord area (Spitsbergen archipelago): 93–102.

Davydov D. (2013): "Cyanoprokaryota in polar deserts of Rijpfjorden east coast, North-East Land (Nordaustlandet) Island, Spitsbergen." Algol. Stud. 142: 29-44.

Skulberg O. M. (1996): "Terrestrial and limnic algae and cyanobacteria." In: Elvebakk, A. & Prestrud, P. (eds.). A catalogue of Svalbard plants, fungi, algae and cyanobacteria: 383–395.

TERRESTRIAL INVERTEBRATES ALONG A GRADIENT OF DEGLACIATION IN SVALBARD: RELATION TO MICROBIAL COMMUNITIES

Miloslav Devetter[1,2], Michala Bryndová[1,2], Ladislav Háněl[2], Jiří Schlaghamerský[3], Natália Raschmanová[4], and Alica Chroňáková[2].

[1]Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice,
[2]Institute of Soil Biology, Biology Centre Academy of Science of the Czech Republic, České Budějovice,
[3]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic,
[4]Institute of Biology and Ecology, Faculty of Science, University of P. J. Šafárik, Košice, Slovakia

KEYWORDS: SOIL DEVELOPMENT, NEXT GENERATION SEQUENCING, INVERTEBRATE COMMUNITIES, CHRONOSEQUENCES

The changes of terrestrial invertebrate populations along three transects of deglaciation have been studied in Petuniabukta Bay (Billefjorden, central Svalbard). Populations of Rotifera, Tardigrada, Nematoda, Enchytraeidae and Collembola have been studied with respect to quantitative parameters of microbial community studied by 454 pyrosequencing method.

Glacial forehead of three glaciers retreats fastly during last decades. Sites of about 10 years old are one extreme of gradient in contrast of well developped tundra communities on sea terraces of about 10 000 years old. However the range of altitudes is less than 200 m, strong gradient of development is evident along the sites and extremity of arctic environment cause very different conditions in case of temperature and water availability (Kaštovská et al. 2005).

Strong changes of microbial as well as invertebrate populations on gradients are evident and well developped. Nematods as most abundant group reached abundance from 13 to 376 ind 10 cm^{-2}, rotifers from 0 to 78 ind 10 cm^{-2}, tardigrades from 0 to 58 ind 10 cm^{-2}. Quantitative analyses of populations show, that sampling sites differ on transects, as well as transects differ mutually. Although populations generaly increase from young to old plots in case of abundance and diversity, such trend is not universal and in many cases are maxina in younger plots across groups. the most typical looks to be Hørbybreen valley, where the rotifers, tardigrades as well as nematodes are most abundant in third position from the glacier forehead, In total 21 species of bdelloid and monogont rotifers were found if most abundant was *Encentrum arvicola*, *E. lutra*, *Macrotrachela* sp. and *Habrotrocha rosa*.

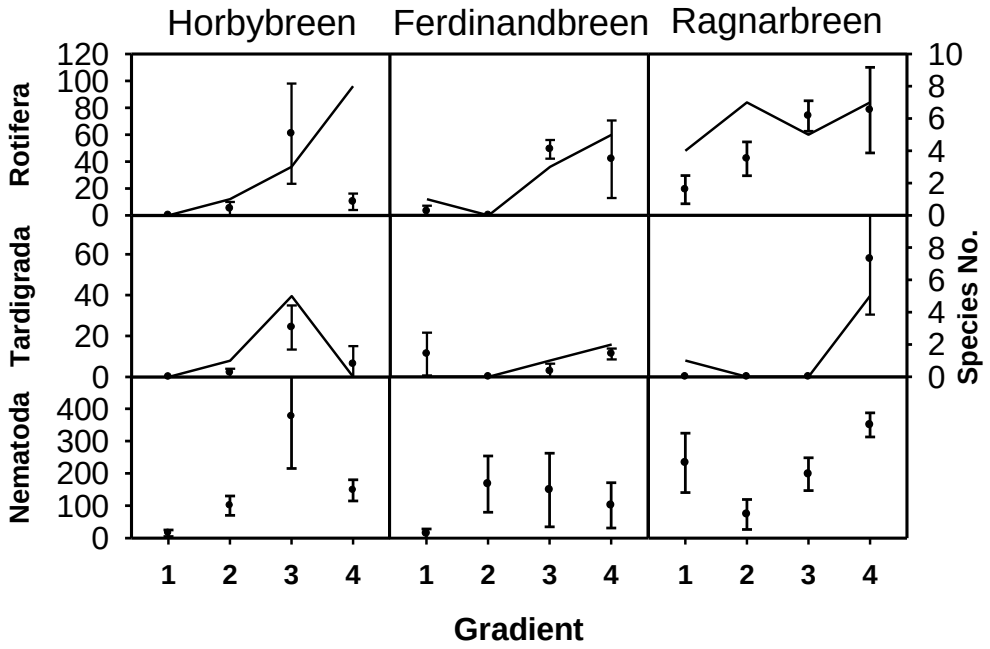


Fig. 1. Changes of abundance and diversity of three invertebrate groups along the gradients

The study was supported by grants No. COST-LD13046 and No. LM 2010009 of the Ministry of Education, Youth and Sports of the Czech Republic.

REFERENCES:

Kaštovská, K., Elster, J., Stibal, M., Šantrůčková. H. (2005): Microbial Assemblages in Soil Microbial Succession after Glacial Retreat in Svalbard (High Arctic) Microbial Ecology 50: 396–407.

PARASITES IN SVALBARD – POTENTIAL SOURCE OF ZOONOTIC DISEASES

Oleg Ditrich[1], Eva Myšková[1,2], Lucie Honsová[1], Martin Kváč[2], Bohumil Sak[2], Tomáš Tyml[1,2]

[1]*Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic*
[2]*Biology Centre AS CRR v.v.i, Institute of Parasitology*

KEY WORDS: PARASITIC ZOONOSES, SVALBARD, NEMATODA, CESTODA, CRYPTOSPORIDIA, MICROSPORIDIA

During the seasons 2011 – 2013, the occurrence of etiological agents of parasitic zoonoses in high Arctic was explored Droppings of terrestrial mammals and birds, collected in central part of Svalbard, were examined for the presence of the helminth eggs and cysts or spores of parasitic protists. Special attention was paid to the parasites that can infect human. Till now, 432 from 16 species have been inspected. Classical coprological methods and much more sensitive molecular analyses (PCR and consequential sequencing) were used for the detection and the determination of parasite species.

Nematoda:
Eggs of roundworm *Baylisascaris transfuga* were revealed in droppings of Polar Bear (*Ursus maritimus*). This is the first record of intestinal parasite in this host. In excrements of Polar Fox (*Vulpes lagopus*) were recorded eggs of roundworm *Toxascaris leonina*, hookworm *Uncinaria stenocephala* and lungworm *Eucoleus aerophilus*. Those nematodes can produce *larva migrans* syndrome in human, and *E. aerophilus* as well pulmonary capillariosis.

Cestoda:
Fox tapeworm (*Echinococcus multilocularis*) was found in droppings and cadaver of one Polar Fox in Nybyen near Longearbyen. The life cycle of this highly dangerous parasite in Svalbard has been enabled by antropogenic unintentional introduction of Sibling Vole (*Microtus levis*). However, two Sibling Voles caught in dog sled base in Longyearbyen were negative for the hydatid cysts. Human settlement in Svalbard represents the cause of propagation of some etiological agents of parasitic zoonoses in Svalbard.

Cryptosporidia:
Intestinal species *Cryptosporidium parvum* genotype IIa was revealed in Pink-Footed Goose (*Anser brachyrhynchos*), *Cryptosporidium* goose genotype II in Barnacle Goose (*Branta leucopsis*) and *Cryptosporidium muris* TS 03 in Svalbard Reindeer (*Rangifer tarandus platyrhynchus*). Intestinal cryptosporidia can cause diarrhoea in immunocompetent persons and systemic infection in immunodefficient patients.

Microsporidia:
Encephalitozoon cuniculi genotype II was found in reindeer (*R.tarandus platyrhynchus*), Polar Fox (*Vulpes lagopus*), Polar Bear (*Ursus maritimus*) domestic dog (*Canis lupus familiaris*) and Barnacle Goose (*Branta leucopsis*). Two new genotypes of *Enterocytozoon bieneusi* were identified, the first one in Svalbard Reindeer and and the second in Pink-Footed Goose. Other genotypes of *E. bieneusi* were recorded in Polar Fox (cf. genotype EbpC), and Black-legged Kittiwake *(Rissa tridactyla*) – probably genotype RO7. Those species of microsporidia are common in healthy people, however, they represent life-threatening infections in immunodeficient patients.

These findings represent the first records of cryptosporidia and microsporidia in Svalbard and the proof that the extreme conditions of high Arctic can enable their surviving and circulation. However, some of parasites common in temperate zone (e. g. *Giardia*) were absent in our material.

The work was supported by the Grant No. LM2010009 CzechPolar (MŠMT ČR) and CZ.1.07/2.2.00/28.0190 (EU).

WARMING EFFECTS ON WET TUNDRA COMMUNITY IN HIGH ARCTIC

Josef Elster[1,2], Jana Kvíderová[1,2], Tomáš Hájek[1,2], Kamil Láska[1,3], Miloslav Šimek[1,4]

[1]Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic;
[2]Institute of Botany AS CR, Třeboň, Czech Republic;
[3]Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic;
[4]Institute of Soil Biology, Biology Centre AS CR, České Budějovice, Czech Republic

KEYWORDS: DECOMPOSITION, NOSTOC, OPEN-TOP CHAMBERS, SIMULATED WARMING, MICROCLIMATE, VEGETATION STRUCTURE, WET TUNDRA

Introduction

Since the wet tundra belongs to the most productive ecosystems in polar regions, estimation of warming effects on its communities is crucial for prediction of its future changes due to expected increase in average temperatures (e.g. ACIA 2005, IPCC 2013). Although the manipulation experiments simulating mild warming are scattered across whole Arctic (Molau and Mølgaard 1996, Elmendorf et al. 2012), no such experiment has been performed in wetlands. In our study, we simulated mild warming using passive open-top chambers (OTCs) and later modified OTCs (mOTC). We evaluated warming effects on microclimatic parameters, ecophysiologogy of *Nostoc* colonies (Cyanobacteria), vegetation structure and decomposition potential. Control cage-like structures (CCSs) were used to avoid herbivory.

Materials and Methods

Four-year experiment (2009–2013) was performed in a wet hummock meadow in Petuniabukta, Billefjorden, Central Svalbard (N 78°43'49'', E 16°16'41'', Fig. 1). The experimental design, microclimatological parameters measurements (near surface soil temperature, air temperature, and volumetric water content) and methods used for ecophysiological measurements on *Nostoc* colonies are described in Elster et al. (2012) in detail. The vegetation changes were tracked by vegetation mapping in small squares. The decomposition potential was measured with cellulose standards using litter bag method.

Fig. 1. The experimental site at wet thufur meadow

Results

The results of the OTC experiments (2009–2011) are presented in Elster et al. (2012). These results indicated that OTC were not efficient for warming simulation at hummock bases in wetland and therefore they were covered by perforated transparent lid (mOTC, Fig. 1) in 2012. After the enclosure, the temperature at hummock base increased by 1 °C in average during vegetation season; however, the lids were damaged by snow in winter 2012/2013. Despite only

minor temperature differences between the OTCs/mOTCs and CCS, the vegetation season was prolonged in OTCs/mOTCs by approximately two weeks.
Photosynthetic performance and nitrogenase activity of *Nostoc* colonies were affected by actual microclimatic conditions and weather, rather than by warming, probably due to minor temperature and water availability differences at hummock bases between OTC/mOTCs and CCSs.
Avoided herbivory resulted in expansion of vascular species cover at the expense of mosses at both, hummock tops (*Equisetum arvense*, *Salix polaris*, and *Polygonum viviparum*) and bases (*Carex* sp.). Nevertheless, potential changes caused by temperature increase were overruled by this strong effect of avoided herbivory.
The decomposition potential was higher at hummock tops than at bases; however, differences between OTCs/mOTCs and CCSs were not observed.

Discussion
In comparison with other warming simulation experiments in drier habitats, the climate manipulation in polar wetlands is quite different. In wetlands, the environment in OTC/mOTCs is connected with its surroundings by surface and ground water inflow that leads to heat and water transfer, and hence, to damping of temperature and water availability changes due to simulated warming. Thus, the warming has negligible effect on ecophysiology of *Nostoc* colonies, vegetation structure and decomposition potential.
With respect to predicted temperature increase in the Arctic (ACIA 2005), the initial changes in polar wetlands would not be as intense as in drier ecosystems. The wetlands would be supplied by melt-water from glaciers and permafrost water of similar temperature as in present. Due to high specific heat capacity of water, the soil temperatures would increase slowly. The surface and ground water layers as well as vegetation cover would serve as thermal insulation for permafrost, and vice versa, the permafrost table would cool the water layers. Hence, the temperature increase and consequent community changes may be slower. However, when the water supply will decline or even cease, e.g. due to glacier retreat and changed water discharge, the wetland habitat would become drier, i.e. warmer and susceptible to community changes. In initial phase of warming, wet-meadow hummock tops will be probably more affected than hummock bases due to sudden decrease in water availability. The response of hummock tops will more resemble that of drier ecosystem, while the bases would remain stable as long as being fed with melt water.

REFERENCES:
ACIA (2005): "Impacts of warming climate: arctic climate impact assessment". Cambridge University Press, Cambridge.
Elmendorf, S.C., Henry, G.H., Hollister, R.D., et al. (2012): Global assessment of experimental climate warming on tundra vegetation: heterogeneity over space and time. Ecol. Lett. 15: 164–175
Elster, J., Kvíderová, J., Hájek, T., Láska, K., Šimek, M. (2012): Impact of warming on *Nostoc* colonies (Cyanobacteria) in a wet hummock meadow, Spitzbergen. Pol. Pol. Res. 33: 395–420.
IPCC (2013): Climate change 2013: The physical science basis. Working group I contribution to the Fifth Assessment Report of the IPCC.
Molau, U., Mølgaard, P. (eds.) (1996): ITEX manual. Danish Polar Centre, Copenhagen, 2nd edition.

PLANT ASSEMBLAGES AT MOUNTAIN TOPS IN ZACKENBERG, NE-GREENLAND: BIOGEOGRAPHY AND SOIL TEMPERATURE RELATIONS

Siegrun Ertl, Christian Lettner, Karl Reiter

Department of Botany and Biodiversity Research, Division of Conservation Biology, Vegetation Ecology and Landscape Ecology, University of Vienna, Vienna, Austria

KEYWORDS: VEGETATION, MONITORING, HIGH-ARCTIC, PHYTOGEOGRAPHY, MOUNTAINS

Monitoring plots at/around mountain peaks can provide valuable information on the effects of aspect (with its differences in the micro/mesoclimatic situation) on species composition in the vegetation. In general, conditions should be harsher on mountain tops due to their exposure to winds, and plant species might be prone to severe water limitation due to the topographical position. However, the observation of current plant distribution patterns over a range of different climatic situations might help to better predict trends and future changes in species composition induced by global change.

We recorded vascular pant species and their abundances in the upper 10 meters of three mountain peaks in Zackenberg, NE-Greenland (c. 74°30'N/21°00'W) in each compass direction, i.e. in four sectors, according to the GLORIA (*Global Observation Research Initiative in Alpine Environments*) protocol. The sites were located in different vegetation zones and elevations (90, 470 and 605 m a.s.l.). Soil temperature was measured hourly 10 cm below ground in the center of each sector with *GEOPRECISION MLog5* loggers.
Distribution types and bioclimatic affinities (following Hultén 1971 and Böcher 1975) of the total vascular plant species inventory of the Zackenberg region were compared to the subsets of species at each site and within sites. Correlations of species abundances with temperature indices were tested.

The lowest site, positioned in the *Cassiope tetragona* vegetation belt, was characterized by *Carex supina* communities. Patchy *Dryas octopetala* and *Salix arctica* heath dominated the fell-fields at the second site. At the highest site, only very scattered vegetation on loose rock, scree and gravel was established, with *Papaver radicatum* and other species typical for rocky habitats.

Almost 70% of the plant species recorded have a circumpolar distribution; amphi-atlantic, western, and eastern species each contribute about 10% to the species pool of both the Zackenberg region and the monitoring sites (154 and 72 spp., respectively). Regarding bioclimatic affinities, arctic widespread species were highly represented in the monitoring sites (60% vs. 40% in the Zackenberg region), while the proportion of low and middle arctic species was much smaller (20% vs. 35% in the regional flora).

Temperature recordings revealed that N- and E-sides were coldest at all sites, W-sides showed warmest temperatures. Although the lowest site harbored the warmest habitats, no clear trend of temperature decline with altitude was observed; lowest temperatures were found at the middle peak. Exposure to weather/winds, shelter effects or temperature inversions thus override the effects of altitude.
In the surveyed sectors, the proportion of high arctic species (weighted by abundance) compared to low and middle arctic species was significantly (negatively) correlated to

temperature indices (Spearman's rank correlation, n = 12, *Rho* = -0.854, p = 0.0004 for number of days with mean temperature > 5°C; *Rho* = -0.844, p = 0.0006 for temperature sums > 5°C).

We conclude that the composition of plant communities' distribution types is largely indicative for the bioclimatic situation on a smaller scale. Harsher environmental conditions at mountain tops and micro/mesoclimatic differences within a site are thus reflected in the species composition.

REFERENCES:

Böcher, T.W. (1975): "Det grønne Grønland" København: 256 pp.
Hultén, E. (1971): "The circumpolar plants. II" K. Svenska Vetensk. - Akad. Handl. 4,13,1: 463 pp.

PLANT LITTER DECOMPOSITION DRIVES PATTERNING IN WET HUMMOCK TUNDRA

Tomáš Hájek[1,2]

[1]*Centre for Polar Ecology, University of South Bohemia, České Budějovice, Czech Republic;*
[2]*Institute of Botany of AS CR, Třeboň, Czech Republic*

KEYWORDS: GRAZING, LIGNIN, MOSSES, ORGANIC MATTER ACCUMULATION, PRODUCTION

Introduction

Slight slopes fed by meltwater in central Svalbard may be covered by hummocky tundra vegetation. Such hummocks are built by organic matter (peat hummocks formed by accumulated plant litter), without signs of periglacial processes that may raise hummocks in mineral soils (earth hummocks). The presence of hummocks reduces water discharge and maintains fine mosaic of wet and dry microhabitats. Such conditions increase biodiversity and productivity of this habitat. However, it is not clear which processes maintain the close coexistence of the hummocks and wet depression in between, i.e. what drives hummock development and maintenance. The accumulation of plant litter is primarily a function of its production and decomposition. The production of wet depression seems to exceed that of dry hummocks. Because the measurement of plant production is a tough proposition I focused on the decomposition characteristics. I hypothesized that hummocks accumulate more biomass either because their dominant plants – mosses – are resistant to decomposition or the hummock environment itself hampers the litter decomposition.

Materials and Methods

I measured decomposition rate of four materials (litters): two dominant moss groups covering both microhabitats, cellulose as a commonly used standard and polysaccharide-rich macrocolonies of cyanobacterium *Nostoc* sp., which may be abundant in the depressions. Dried litters were enclosed to mesh bags and placed belowground in both microhabitats and incubated for 2 and 4 years. Proportion of the remaining litter weight served as a measure of its decomposition rate. Because all litters were incubated in both microhabitats I could also test decomposition potential of the microhabitats. The work was carried out in Petuniabukta, Billefjorden, central Svalbard.

Results and Discussion

Surprisingly, the moss species that completely dominates in wet depressions (*Scorpidium cossonii*) had the most decomposition resistant litter, particularly within its native microhabitat. The relatively dry hummocks tended to be slightly more favourable for decomposition of also the other litters, probably due to warmer and aerated soil conditions. This indicates that moss decomposition itself cannot explain hummock development or maintenance. In contrast to the litter of both moss groups that decomposed relatively slowly (maximum loss of 25% after 4 years), the losses of cellulose and polysaccharides-rich *Nostoc* were >70% suggesting that the moss polysaccharides are well protected against decomposition.

Examination of the peat underlying both microhabitats revealed its contrasting structure. While the moss-derived raw peat was found in depressions, the aerated hummocks are, in addition, entangled by living and dead rhizomes and roots of vascular plants (*Equsiteum arvense*, *Carex* species and *Salix polaris*), although the current vascular vegetation cover is very sparse (Fig. 1). The lignified and therefore decay-resistant rhizomes obviously provide a construction that

keeps the shape of aerated hummocks. Another experiment conducted at the experimental site discovered that the vascular vegetation, especially *Equsiteum* is intensively grazed by pink-footed goose whose population and herbivory pressure increased considerably over the past decades.

Conclusion

It seems that persistence and current existence of the hummocks results from past dominance of vascular plants and their belowground production. As the current vascular production is greatly reduced by herbivory, the future of the peculiar habitat of wet hummock tundra is in question. Signs of hummock degradation are already obvious.

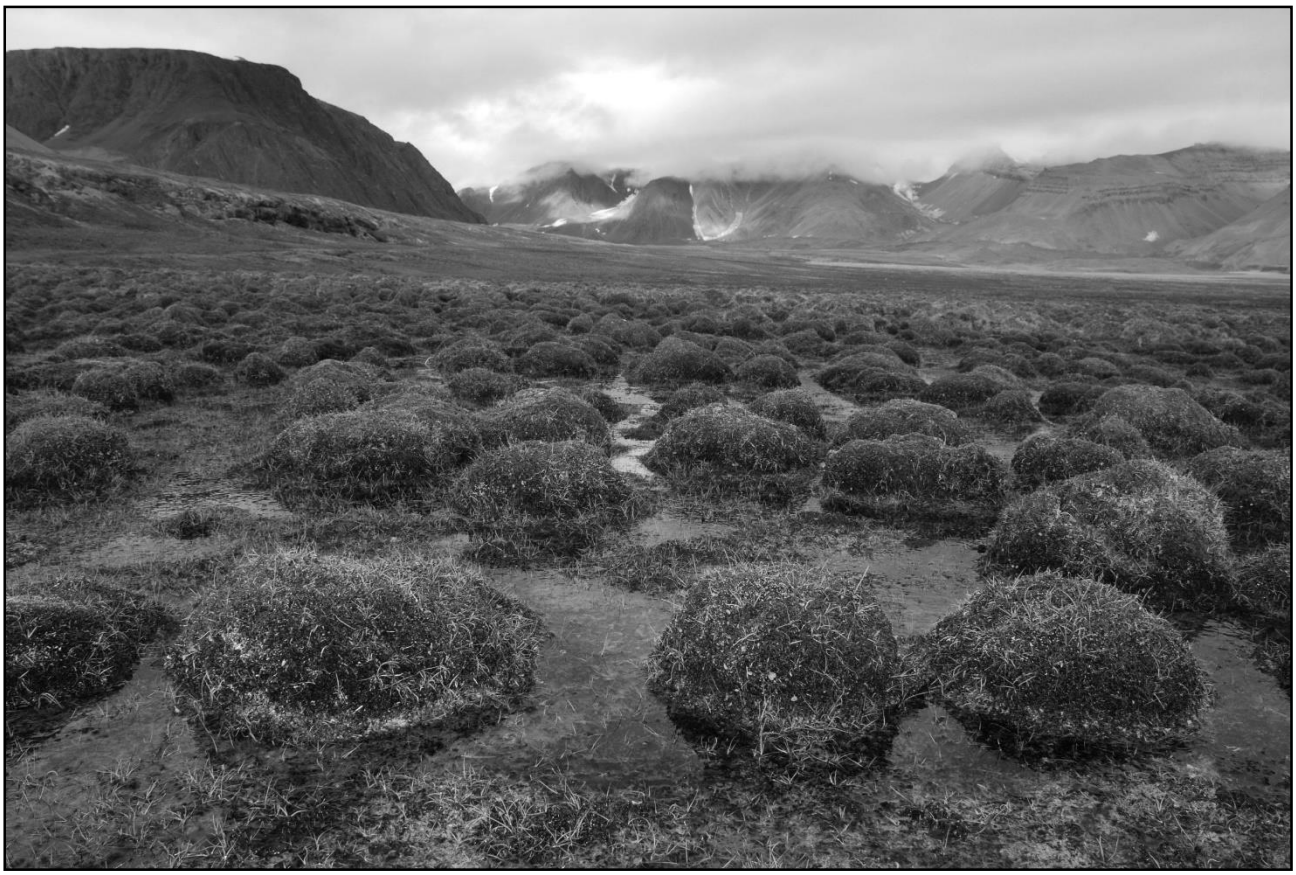


Fig. 1. Current vascular vegetation that covers hummocks in wet tundra is very sparse.

PLANT-HERBIVORE INTERACTIONS IN A WARMING ARCTIC, COMPLEX TROPHIC INTERACTIONS, AND COORDINATION OF FUTURE RESEARCH

David S. Hik

Department of Biological Sciences, University of Alberta, Edmonton, Canada

KEYWORDS: PLANT-HERBIVORE INTERACTIONS, TROPHIC INTERACTIONS, CLIMATE CHANGE, HERBIVORY NETWORK

Plant-herbivore interactions in tundra environments influence biodiversity, energy flows and nutrient cycling. The influences of herbivory are usually widespread and relevant to different herbivores (both vertebrate and invertebrate) and plant communities, but the outcomes of plant-herbivore interactions also vary over space and time, leading to different impacts of herbivory at different sites. The causes of this variation are still not well resolved.

Using several recent examples I will discuss i) evidence that rapid warming in northern ecosystems is simultaneously influencing plants, herbivores and the interactions among them, ii) evidence that taxonomically diverse herbivores may interact with each through shared forage plants, and iii) recent efforts to develop a coordinated pan-Arctic herbivory research and observing network.

i) Recent field experiments have been conducted to examine the effects of current season warming on Arctic moth caterpillars and the subsequent responses of two common tundra plants, *Salix arctica* and *Dryas octopetala*. Warming directly affected caterpillars and their interactions with plants such that they performed worse in warmer plots and shifted their diets towards more nutritious foods. Within-season responses of the focal plants were weak, but suggest that the presence of invertebrate herbivores affected the responses of plants to warming. So invertebrate herbivores at relatively low density might modulate the responses of tundra plants to environmental drivers.
ii) Field experiments have also been used to explore interactions among taxonomically diverse herbivores. In this case, invertebrate herbivory influenced the subsequent foraging choices of a small vertebrate, the collared pika (*Ochotona collaris*), such that pikas actively selected areas with increased, recent invertebrate herbivory. While the underlying mechanisms behind this interaction remain unknown, the results indicate a positive effect of invertebrate herbivores on subsequent vertebrate foraging preferences. So even among distantly related taxa, interactions where one herbivore is cueing on the foraging of another might drive the creation of herbivory hotspots, with cascading effects for ecosystem processes.
iii) Plant-herbivore interactions in Arctic and alpine environments are regionally variable, precluding generalizations about the responses of tundra ecosystems to ongoing environmental changes. This variability calls for coordinated research efforts and highlights the need to consolidate a research network for investigating the role of herbivory in these dynamic tundra ecosystems. To this end, a workshop was organized during the 2014 Arctic Observing Summit in Helsinki. Participants identified the need for common, standardized protocols to address these questions at a global scale, through the use of coordinated distributed observations and experiments. The 'Herbivory Network" (herbivory.biology.ualberta.ca) is developing common, standardized methods to monitor herbivory and its impacts on tundra ecosystems.

LEAF OR ROOT? TISSUE-SPECIFICITY OF ENDOPHYTIC BACTERIA IN ARCTIC PLANT: *OXYRIA DIGYNA*

Cindy Jittrapan Given, Riitta Nissinen

University of Jyväskylä, Survontie 9 C (Ambiotica), Finland

KEYWORDS: ENDOPHYTIC BACTERIA, OXYRIA DIGYNA, TISSUE-SPECIFIC COMMUNITIES, ARCTIC CLIMATE, PSEUDOMONAS, SPHINGOMONAS

Introduction:
Oxyria digyna (mountain sorrel) is a non-mycorrhizal plant species, member of the Polygonaceae and one of the northernmost dicot plants. With the ability to grow in wide latitude range from high arctic to temperate alpine tundra, it is considered having a circumboreal arctic-alpine distribution. It is a typical pioneer species in glacier forefront (Robbins and Matthews, 2009), and can colonize soils with very low nutrient levels.
Plants are always associated with a wide variety of microorganisms (fungi, bacteria and viruses), which sometimes can be potential pathogens, but in most cases are beneficial for the plants. The bacteria that inhabit inside the plant hosts without causing any damage are known as endophytic bacteria. All the plants are likely associated with a diverse species of endophytic bacteria (reviewed in Rosenblueth, M. and Martínez-Romero, E., 2006). They provide a lot of benefits for host plants, for example, nitrogen fixation, production and regulation of phytohormones, biocontrol of pathogens, enhanced stress tolerance and efficient acquisition of mineral nutrients.

Very little is known about diversity and functioning of endophytic bacteria in cold climate plants. In this study, we want to study if our model plant, *Oxyria digyna*, harbor specific endophytic bacterial communities in different tissues as the first step towards understanding the diverse roles of endophytes in this arcto-alpine species.

Methods:
The micropropagated, endophyte free bait plants were planted in the field site in Kilpisjärvi fell area (69°'N; 20°50'E), and harvested 30 days after planting. The bacterial communities were isolated from leaves and roots of bait plants as well as native *O. digyna* plants, and identified by 16S rRNA gene sequencing using the primer pair 27F-1492R. The abundance of different bacterial genera in different tissues was analyzed, and the key members of the bacterial populations were identified by cross-comparison to previous data.

Results and discussion:
One month after planting on the field, culturable bacteria was isolated from leaf and root samples, indicating that the bait plants acquired the communities from their environment. The main genera present in both tissue types were *Pseudomonas* sp., also abundant in the wild *O.digyna* samples, and *Microbacterium* sp. Significantly, several genera showed tissue specificity: *Sphingomonas* sp. was isolated only from leaf samples, while *Flavobacterium* sp. was found only in roots.

Based on 16S rRNA sequence, the majority of our isolates were most closely related to bacterial isolates from other cold environments (arctic and alpine soils, ice and glaciers, other cold adapted plants, Antarctica) indicating a presence of group of cold-adapted bacteria. Further, we detected several isolates that were highly similar to bacterial strains isolated previously from

O. digyna vegetative tissues (Nissinen *et al*., 2012) or from seeds, indicating a very tight association between these strains and their plant host.

REFERENCES

Nissinen, R.M., Männistö, M.K. and Van Elsas, J.D. (2012): "Endophytic bacterial communities in three arctic plants from low arctic fell tundra are cold-adapted and host plant specific." FEMS Microbiology Ecology 82(2): 510-522

Robbins, J.A. and Matthews, J.A. (2009): "Pioneer vegetation on glacier forelands in southern Norway: emerging communities?" Journal of Vegetation Science 20: 889-902

Rosenblueth, M. and Martínez-Romero, E. (2006): "Bacterial endophytes and their interactions with hosts." Molecular Plant-Microbe Interactions 19(8): 827-837

NENETS - TUNDRA - OVERGRAZING: A SIMULATION MODEL OF THE IMPACT

Mikhail Golovatin, Lyudmila Morozova, Svetlana Ektova.

Institute of Plant and Animal Ecology, Ural Branch of Russian Academy of Sciences, Russia, Ekaterinburg

KEYWORDS: REINDEER, OVERGRAZING, SIMULATED MODEL, YAMAL

Introduction

On the Yamal (North of Western Siberia, Russia) there is a unique situation for the tundra zone when a vast area of the whole of this peninsula has been covered by an extremely strong overgrazing of domestic reindeer. In this situation, vegetation is under a constant great stress. This impact has been effecting on all levels of the ecosystem, and it is already about 20 years under steady growth in the number of reindeer (*Golovatin et al.,* 2012). The question is what provides to be constant increasing the number of reindeer in a situation where the system consumers - vegetation is so much stressful. In search of answer, we have made simulated model of this situation.

Methods

The simulated model was based on real inputs. The input characteristics were: reindeer number dynamics since 1931; structure of vegetation cover in different parts of the peninsula; initial levels of forage elements of reindeer: lichens, sedges, grasses, leaves of shrubs; features of the distribution of seasonal feed supplies during the year; restoration levels of different elements of vegetation, depending on a season of feeding. We also take into account the data on the ratio of feed in the diet of reindeer in the initial situation (1930-1932), peculiarities of reindeer migration on the peninsula and, accordingly, the spatial distribution of herds in different seasons.

Results

The simulated modeling demonstrated that sharp reduction of feed lichens resources occurred in the period up to 1948 and after a short recovery period (1950-1960) there was a steady reduction of lichen resources (at 6-8 times in different parts of the peninsula). This was accompanied by redistribution in the use of feed reindeer. Now lichen is about 10-20% of the feed in the winter on the Yamal. The main burden fell on the green fodder - sedges and grass. However, despite the relatively high their reducing ability, there was a steady decline in their supplies. It has become especially pronounced since the early 1980s, when a sharp rise in the number of reindeer started.

Discussion

At present, when the reindeer use basically green fodder, the huge herd of reindeer is supported due to the high restoration abilities of herbs, despite the high pasture load. However, already at the beginning of a period of relatively sharp reduction of green food supplies, other important tundra consumer - lemmings has been virtually deprived their ecosystem importance. After 1988, typical peaks of the lemming number disappeared. System of consumers - vegetation was simplified. Currently, the existing supplies of herbs together their restoration potential yet allows the system to operate, whereby the growth of the reindeer is still in progress. However, the system has lost the original natural form and turned into a "pastoral" ecosystem with their simplified pattern of vegetation - consumers 1 order.

Study was supported by the Program of Presidium Ural Branch of RAS (projects No. 12-P-47-2013 & 12-P-4-1043)

REFERENCES

Golovatin M.G., Morozova L.M., Ektova S.N. (2012): "Effect of reindeer overgrazing on vegetation and animals of tundra ecosystems of the Yamal peninsula" Czech Polar Report 2 (2): 80-91

MICROBIAL BIOGEOCHEMISTRY IN ARCTIC SUBGLACIAL SEDIMENTS

Andrew Gray[1,2], Prof. Andy Hodson[1],

[1]*Geography, University of Sheffield, UK*
[2]*Kroto Research Institute, University of Sheffield, UK*

Subglacial sediments, whether under Arctic and Alpine glaciers or the Greenland and Antarctic ice sheets, play host to extensive and active microbial communities. Due to the relative inaccessibility of this ecosystem, however, fundamental ecological questions remain unanswered, such as how productive the microbes are, or which are the most important interactions with different mineral substrates taking place?

Analysis of subglacial upwellings has provided compelling evidence for a microbial role in the mineral weathering processes and redox reactions that dominate water chemistry in this environment. Determining ecological processes from outflow chemistry is limited, however, by difficulty in separating biotic and abiotic processes under the glacier. The work being carried out for my PhD takes a laboratory approach, in which subglacial sediments, removed from a number of glaciers in Svalbard, Greenland and South Georgia, are being utilised in microcosm experiments that investigate microbial diversity, activity and importance in geochemical processes. It is hoped that the integration of lab-based microcosms into future field studies, can strengthen the conclusions drawn about subglacial ecosystems from geochemical analysis of outflow.

Sediment microbial composition was investigated using fluorescence in situ hybridisation to target bacteria, archaea and eukaryotic domains as well as some bacterial subgroups. A radio label approach has been used to measure bacterial and primary production in the sediments under laboratory conditions, assessing the linkages between metabolism and geochemistry as well as the relative influence of heterotrophy and chemoautotrophy in these dark, cold ecosystems. On-going batch and flow-though microcosm experiments investigating the microbial influence to mineral weathering processes and hydrogeochemistry at an ecosystem scale will also be presented.

SIMULTANEOUS MEASUREMENTS OF PSII ACTIVITY AND THALLUS TEMPERATURE DURING LINEAR COOLING: A METHOD TO ASSESS INTERSPECIFIC DIFFERENCES IN PHOTOSYNTHETIC PROCESSES IN LICHENS FROM POLAR REGIONS.

Josef Hájek, Peter Váczi, Jana Hazdrová, Miloš Barták

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Brno, Czech Republic

KEY-WORDS CRYORESISTANCE, CHLOROPHYLL FLUORESCENCE, LICHEN PHOTOBIONT, LICHEN THALLI, CRITICAL TEMPERATURE

Introduction

Lichens are symbiotic organisms comprising a mycobiont and one or more photobionts. Lichens often dominate habitats with frequent and severe drought, extreme temperature and light as in Arctic and Antarctic regions, at high altitudes, and in dry climates. Due to their adaptations to low and freezing temperatures, lichens remain physiologically active under sub-zero temperatures and may perform photosynthetic processes at -20ºC. Therefore, both algal (or cyanobacterial) and fungal partner must be able to be physiologically active at a subzero temperature. Lichens possessing an alga a photosynthesizing partner developed several mechanisms to avoid injuries and impairment of physiological processes caused by subzero temperatures. Many lichen species are capable to express antifreezing proteins that decrease freezing temperatures of water present in cell compartments. Such antifreezing proteins may also act like ice-bounding proteins that inhibit ice recrystallization in cells. Therefore, injuries of cell organelles caused by sharp ice edges are avoided. Ability of lichens to promote ice formation in extracellular spaces is another mechanism. In such a case, lichens, their mycobionts in particular, produce several compounds, mainly proteins, that support ice nucleation activity at subzero temperatures ranging from 0 to -5ºC. Presence of sugars, polyols and other osmotically active substances both in *Trebouxia* sp. and mycobiont increases the cryostability of lichens. Progressive thallus drying represents another protective mechanism since subzero temperature-induced injuries are much less frequent when a thallus is in dry, *i.e*. physiologically inactive state.

Material and Methods

A comparison of cryoresistance of isolated lichen photobiont and polar lichens is presented. Several species were chosen for this experiment: (1) algal cultures of *Trebouxia glomerata*, *Trebouxia* sp. (2) thalli of *Usnea antarctica*, *Usnea aurantiaco-atra*, *Usnea longissima*, *Umbilicaria decussata*, *Umbilicaria cylindrica.*

All the samples were exposed to temperatures linearly decreasing from +20 °C to -40 °C under controlled conditions. During the experiment, sample temperature and two parameters of chlorophyll fluorescence – (1) potential (F_V/F_M) and (2) effective quantum yield of photochemical processes in photosystem II (Φ_{PSII}) – were measured simultaneously.
Cooling was provided by a KRYO 560-16 (PLANER, United Kingdom) device. For majority of samples, two cooling rates were used: 6 °C min^{-1} (fast) and 2 °C min^{-1} (slow) were used. The chlorophyll fluorescence was measured by a PC-linked PAM 2000 fluorometer (H. Walz, Germany). Measurements of Φ_{PSII} were made every 30 s.

Results and Discussion

For all samples, the response of F_V/F_M and Φ_{PSII} to declining temperature showed an „S curve“ with critical temperatures, indicating high level of cryoresistance of the samples. In an individual sample, critical temperature for F_V/F_M was typically lower than for Φ_{PSII}. Critical temperatures were, however, cooling rate- and sample concentration–dependent (for algal cultures). In general, Φ_{PSII} and F_V/F_M showed gradually decreasing values with temperature decrease with critical temperature found at about -10°C. Inter-specific differences, however, exist. The ability to perform photosynthesis at subzero temperature was attributed to several antifreezing mechanisms present in *Trebouxia*, however, addition of ribitol, one of natural compounds increasing cryoresistance, to algal cultivation medium did not bring significant effects on F_V/F_M and Φ_{PSII} values recorded during cooling (compared to untreated control).

Conclusion

The method of simultaneous F_V/F_M, Φ_{PSII} and sample temperature measurements during linear cooling proved to be an efficient tool in the estimation of extremophilic species sensitivity/resistance to freezing. Interspecific differences in F_V/F_M, Φ_{PSII} were more pronounced when slow cooling rate was used. This may suggest possible exploitation of the method in the assessment of algae/lichen resistance to freezing temperature.

Acknowledgements

The authors thank CzechPolar for infrastructure used in the above-specified experiments.

TRANSPORT HISTORY OF MORAINE-MOUND COMPLEXES MATERIAL – NEW RESEARCH METHOD BASED ON THE STUDY OF RECENT HØRBYEBREEN AND BERTILBREEN POLYTHERMAL GLACIERS, SVALBARD

Martin Hanáček[1], Daniel Nývlt[2, 1]

[1]*Centre for Polar Ecology, University of South Bohemia, České Budějovice, Czech Republic*
[2]*Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic*

KEYWORDS: MORAINE-MOUND COMPLEXES, CLAST TRANSPORT HISTORY, STRIATION, POLYTHERMAL GLACIER SEDIMENTS

Moraine-mound complexes represent parts of polythermal glaciers proglacial zones. They border the line of the maximum glacier extents during the Little Ice Age (LIA) advance and cover also a significant part of the proglacial zone in the backfield of the LIA maximum extent. Moraine-mound complexes material is beside the actively transported debris also made of older sediments eroded by advancing glacier. These are mostly subglacial tills and glaciofluvial sediments (Hambrey et al. 1997).

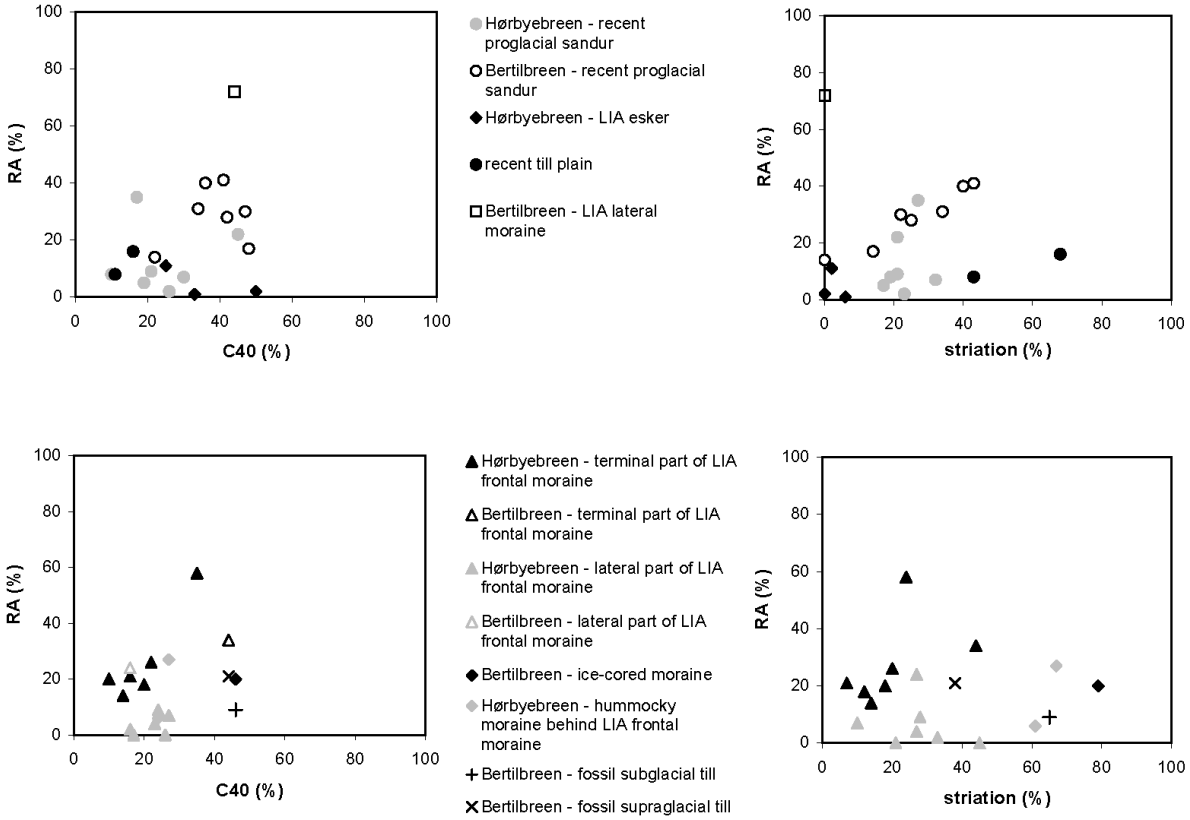
The most commonly applied method to understand clast transport history in glacial system is the C_{40}/RA covariant plot of Benn and Ballyntyne (1994). This method allows differentiating passively transported clasts in supraglacial position from those transported actively in subglacial zone. However, it fails in differentiating of subglacially transported clasts and glaciofluvially transported clasts (Bennett et al. 1997), as both transport types tend to produce similarly rounded clasts. Thus the use of C_{40}/RA covariant plot for the study of the material source in moraine-mound complexes is therefore limited.

The characteristic feature of actively transported clasts in subglacial zone is the presence of exaration striae on their surfaces. Glaciofluvial transport does not on the other hand produce surface striation (see e.g. Hambrey and Glasser 2012). Previous clasts transport history of moraine-mound complexes could thus be identified using the presence and the share of striated clasts.

We newly develop a covariant plot of striation *versus* RA, which compares the share of striated clasts and the share of very angular and angular clasts, for the presentation of clast's differences between subglacial tills and glaciofluvial sediments. Clast roundness degree is better suited for such comparison than the clast form, as clast form is predisposed by the structure of original rock. This plot has been applied to different sediments of proglacial zones of Hørbyebreen and Bertilbreen polythermal glaciers in central Svalbard. Old Red sandstone clasts are abundant in sediments of both glaciers and they have thus been selected for this study. Coarse pebble and cobble fraction have been used for this study.

The results are shown in Fig. 1. Subglacial tills of Hørbyebreen (present till plain) overlap with proglacial glaciofluvial sediments and esker glaciofluvial sediments of the same glacier in the C_{40}/RA covariant plot. Subglacial tills are on the other hand well separated from glaciofluvial sediments in the striation/RA covariant plot. Samples of the Hørbyebreen moraine-mound complex (LIA frontal moraine + hummocky moraine in its backfield) lies in the same field of C_{40}/RA covariant plot as subglacial tills and glaciofluvial sediments of the same glacier. However, the relation of LIA frontal moraine with glaciofluvial sediments on one hand and hummocky moraine in the backfield of LIA frontal moraine with subglacial tills results from

the striation/RA covariant plot. LIA frontal moraine of Hørbyebreen is therefore made of the material reworked mostly from glaciofluvial deposits (proglacial sandar and eskers) and the hummocky moraine behind it is made of reworked subglacial tills or actively modified debris. Similarly analogous are fossil (LGM) subglacial till and recent ice-cored moraine of Bertilbreen. This moraine is an early phase of the hummocky moraine development. Covariant plot of striation/RA is suitable for differentiation of subglacially-modified debris from glaciofluvially-modified debris.



Acknowledgements
This research has been supported by projects CZ.1.07/2.2.00/28.0190, LM2010009 and CZ.1.07/2.3.00/30.0037. We thank to all geoscience group students of the Course of Polar Ecology for the help in the field.

REFERENCES
Benn, D. I., Ballantyne, C. K. (1994): "Reconstructing the transport history of glacigenic sediments: a new approach based on the co-variance of clast form indices". Sedimentary Geology, 91: 215-227.
Bennett, M. R., Hambrey, M. J. and Huddart, D. (1997): "Modification of clast shape in high-arctic glacial environments". Journal of Sedimentary Research, 67: 550-559.
Hambrey, M. J., and Glasser, N. F. (2012): "Discriminating glacier thermal and dynamic regimes in the sedimentary record". Sedimentary Geology, 251-252: 1-33.
Hambrey, M. J., Huddart, D., Bennett, M. R., Glasser, N. F. (1997): "Genesis of 'hummocky moraines' by thrusting in glacier ice: evidence from Svalbard and Britain". Journal of the Geological Society, London, 154: 623-632.

MOSS LAYER AFFECTS SOIL PROCESSES AND INTERACTS DIFFERENTLY WITH VASCULAR PLANT GROWTH FORMS IN ICELANDIC SUBARCTIC TUNDRA

Ágústa Helgadóttir[1,2], Kristín Svavarsdóttir[3], Rannveig Guicharnaud[4] and Ingibjörg Svala Jónsdóttir[1,2]

[1]*University of Iceland, Reykjavík, Iceland*
[2]*University Centre in Svalbard, Longyearbyen, Norway*
[3]*Soil Conservation Service of Iceland, Reykjavík, Iceland*
[4]*European Commission, Joint Research Centre (JRC), Italy*

Mosses are abundant in Icelandic subarctic tundra and therefore we assume that they play an important role in ecosystem functioning. Soil erosion is a serious problem in Iceland, particularly in the highlands. Some efforts have been made to restore these ecosystems. However, successful restoration of moss dominated tundra heathlands demands understanding of the role of mosses in the restoration process. In this study we tested the following hypotheses: 1) At an early restoration stage shallow moss layer stimulates soil processes, and 2) as moss layer depth increases at later stages, its insulation slows down the processes and affects the growth and reproduction of vascular plants.

Relationships between moss depth and selected soil properties were examined along a chronosequence in the Icelandic highlands: eroded heathland, 30 years old restoration site and intact dwarf birch heath. The interaction between moss layer and four vascular plants (*Betula nana, Empetrum nigrum, Silene acaulis, Carex rupestris*) was studied in a moss removal experiment. All sites were located at 65°N, at 480-530 m altitude. Mean July temperature is 8°C and the annual precipitation is 400 mm.

The results show that the moss acts as an insulator. The deeper moss layer the lower soil temperature. However, there is a positive relationship between moss layer depth and soil moisture, soil microbial biomass carbon and nitrogen availability in the chronosequence. Vascular plant responses to moss removal depend on growth form.

The data analysis is in process. So far the results support our hypothesis. Furthermore, the results indicate that the complex moss-soil relationships are a key driver in restoration of tundra heathlands in Iceland.

PROTEOMIC METHODS FOR ANALYSING DIVERSITY AND ECOSYSTEM FUNCTIONS OF MICROORGANISMS IN PERMAFROST

Iva Hlavackova[1], Maria Fernandes[2], Lucie Marsalova[1], Petra Junkova[1], Jiri Santrucek[1], Pernille Bronken Eidesen[3], Sunil Mundra[3], Radovan Hynek[1]

[1]Department of Biochemistry and Microbiology, Faculty of Food and Biochemical Technology, Institute of Chemical Technology, Prague, Czech Republic;
[2]Escola Superior de Biotecnologia, Universidade Catolica Portuguesa, Porto, Portugal;
[3]Department of Arctic Biology, The University Centre in Svalbard (UNIS), Longyearbyen, Norway

KEYWORDS: METAPROTEOMICS, BIOTYPING, MASS SPECTROMETRY, MICROBIOLOGY, PERMAFROST

The proteomics is of increasing importance as a fast and reliable tool for identifying microorganisms in an environment. There are two main approaches; first one is culture-independent metaproteomics which study total protein content of all microorganisms in a sample and, based on protein diversity, returns answer to taxonomic and functional question. Second approach is culture-dependent biotyping, in which the single colony identification is done by comparing its protein mass spectra profile with a suitable database. In our study, we tested the performance of these two proteomic approaches while assessing the microbial diversity and its seasonal changes in the permafrost samples from the Svalbard archipelago.

The samples of permafrost were collected three times during growing season from the rhizosphere of the alpine bistort (*Polygonum viviparum*), a widespread herbaceous arctic-alpine plant. In metaproteomic experiment, proteins were extracted from permafrost using phenol, separated by SDS-PAGE and digested in gel by trypsin. The mass spectra of extracted peptides were collected using LC-ESI-Q-TOF mass spectrometer and, subsequently, proteins were identified by comparing peptide spectra with NCBInr database. In culture-dependent experiment, permafrost samples were cultivated on three different media, proteins from resulting colonies were extracted with ethanol and protein spectra were collected using MALDI-TOF spectrometer. To identify microbial colonies, the protein spectra profiles were compared with the Biotyper database.

By using both proteomic methods we detected altogether 150 bacterial species, 20 fungal species and 5 archaea. The most abundant group in all samples was *Proteobacteria* (especially in summer) and the second largest group was *Actinobacteria* (especially in spring). Most of the fungal species and all archaea were detected in summer samples. The biological functions observed (based on identified proteins) were related mainly to carbohydrate metabolism, xenobiotics biodegradation, protein sorting/degradation and environmental information processing.

In conclusion, the biotyping method shoved to be time inexpensive and very easy to perform. Nevertheless, the metaproteomic approach was more successful in number of species identified and based on identified proteins, the metaproteomics revealed the most abundant biological functions in permafrost. Since the protein production reflects physiological responses of organisms to environmental conditions, this information might be use as a link to ecological functions of particular microorganisms. Therefore the metaproteomics is efficient method for ecosystem ecologists.

This study was supported from specific university research (MSMT No 20/2014 and MSMT No 21/2014).

ACTIVE LAYER DEVELOPMENT ON JAMES ROSS ISLAND DURING THAWING SEASONS 2011/12 AND 2012/13

Filip Hrbáček, Kamil Láska

Masaryk University, Faculty of Science, Department of Geography, Brno, Czech Republic

KEYWORDS: GROUND TEMPERATURE, ACTIVE LAYER, PERMAFROST, JAMES ROSS ISLAND, ANTARCTICA

The active layer and permafrost react very sensitively to temperature changes caused by recent climatic change. The IPCC (2013) presumes that due to climatic change permafrost areas near to surface (3.5 m) should decreased about 37 to 81 % worldwide in the following 80 years. One of the most important characteristic of the active layer is a thickness which is considered as a potential indicator of climate change. This work describes results of the active layer monitoring and its development during two consecutive thawing seasons in 2011–13.

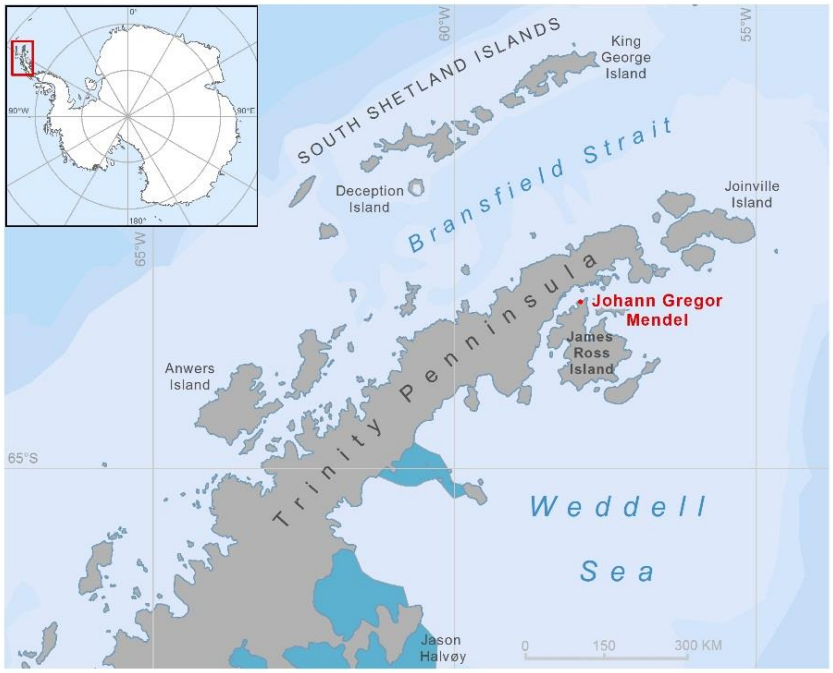


Fig. 1 Location of study site on the northern part of James Ross Island.

Monitoring site providing ground temperature measurement is located at the old marine terrace on the northern shore of the Ulu Peninsula near the Czech Johann Gregor Mendel Station (Fig. 1). Since 2011, the temperature conditions in the uppermost part of permafrost and active layer have been measured in 2 meters deep profile using platinum resistors. Meteorological data of the air temperature, global and reflected radiation and snow thickness are provided by an automatic weather station located several meters from the borehole. The active layer thickness defined as maximum depth of 0 °C isotherm (Guglielmin, 2006) was interpolated from ground temperature dataset.

Thawing seasons defined as periods during which the active layer melts were observed in years 2011/12 and 2012/13. Main characteristics of the thawing seasons such as duration, mean and maximum air temperature and ground temperature in 5 cm, thawing days with minimal ground

temperature > 0 °C, thawing and freezing degree days were determined for both seasons. Correlation analysis was used to determine the influence of air temperature and global radiation on ground temperature for the selected periods.

Main differences between both seasons were found in the relation to specific meteorological conditions pronounced in the length of each thawing seasons. The season 2011/12 started at the beginning of October and was 42 days longer than season 2012/13. Although the mean air temperature (-0.3 °C) was higher in 2012/13, the mean ground temperature was higher and reached 2.3 °C in 2011/12. The highest air and the ground temperatures of 11.5 and 16.0 °C were observed in 2012/13. The significant difference was found in the thawing degree days for ground temperature, which was much higher in 2011/12 (496.1 °C) than 2012/13 (358.3 °C). This difference was caused by different length of the thawing seasons and higher count of the thawing days in 2011/12. Large differences were also found in the correlations analysis. Influence of the air temperature on 5 cm ground temperature was higher in 2011/12 with r=0.80 unlike 2012/13 in which the global radiation affected significantly variation of the ground temperature with r=0.65.

Acknowledgements
The research was supported by the project LM2010009 CzechPolar (MSMT CR) and project of Masaryk University MUNI/A/0952/2013 „Analysis, evaluation, and visualization of global environmental changes in the landscape sphere (AVIGLEZ)".

REFERENCES:
Guglielmin, M. (2006): "Ground surface temperature (GST), active layer, and permafrost monitoring in continental Antarctica." Permafrost and Periglacial Processes, 17 (2): 133-143.
IPCC (2013). "Summary for Policymakers." In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment of the Intergovernmental Panel on Climate Change. [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK. 1-36.

SCALE AND MODE OF RECENT RECESSION OF SVALBARD GLACIERS

Jacek A. Jania, Małgorzata Błaszczyk

Centre for Polar Studies, University of Silesia, Sosnowiec, Poland

KEYWORDS: SVALBARD, GLACIER RETREAT, SURGE, CALVING FLUX

Introduction

Climate warming of the Arctic is more pronounced than in the mid-latitudes. An increase of mean annual air temperatures reaches almost 0.1°C a^{-1} at the Polish Polar Station, Hornsund in Spitsbergen during last three decades. Diminishing of the extension and thickness of Arctic glaciers demonstrate response to a long term climatic trends. The main objective of the paper is to present recent recession rate of Svalbard glaciers with special reference to Southern Spitsbergen. Taking into account leading factors and processes, different modes of retreat are distinguished. Style and rate of deglaciation is important for land and marine ecology of polar regions.

Methods and data used

Front position changes of glaciers were studied basing upon archive cartographic data and aerial photos of the Norwegian Polar Institute (NPI). Glacier extents in the period 1976–2010 were determined using satellite images of Landsat 2 MMS, ALOS AVNIR, ASTER and panchromatic bands of Landsat 7. The geocoded ALOS AVNIR image of 2009 (resolution 10 m) was used as the reference image and co-registered using the NPI topographic maps. Subsequently, the other satellite images were co-registered to this image using the same set of ground control points (Blaszczyk *et al.* 2013). All maps and images were processed into uniform system (UTM 33X and WGS 84 datum). Retreat of glaciers in the Hornsund area was examined for the following periods: 1889-1936-1960/1961-1976-1990-2001-2005-2010 (cf. Fig. 1). Additional observations on geomorphology of glacier's forefields and sea bathymetry near termini of tidewater glaciers were measured during field missions.

Results

Retreat of the majority of Svalbard glaciers was recorded since beginning of the 20th century, except of advances due to surge events. Surge type glaciers compose of large fraction of glaciers (cf. Blaszczyk *et al.* 2013, Sund *et al.* 2014). Front position changes of 128 tidewater glaciers in Svalbard (except Nordaustlandet) were analysed on satellite images from the period 2000-2010. Their retreat rate ranges from 0 to 260 ma^{-1} with an average value of 45 ma^{-1} (±15 ma^{-1}). Only 43 glaciers were characterized by significant recession. Mean recession of glaciers terminating into the Hornsund was significantly higher and reached 70 ma^{-1} in average with the highest values in the inner part of the fiord (Fig. 1). Scale of retreat of land based glacier was in an order of 25 ma^{-1}. Recession of small mountain glaciers is difficult to detect both on satellite images and in the field due to supraglacial debris cover on tongues. The elicited data on diminishing of Hornsund glaciers are in agreement with results of Nuth *et al.* (2010) indicating that Southern Spitsbergen glaciers have the most negative geodetic mass balance on the archipelago. Recession od Hornsund glaciers exposed of c. 142 km^2 of sea bed and c. 32 km^2 of land since 1899, with an average rate of 1.3 $km^2\ a^{-1}$ and 0.3 $km^2\ a^{-1}$ on fiord and land respectively. The highest values were noted in the decade 2001-2010, both for seaward (2.1 $km^2\ a^{-1}$) and land parts (0.8 $km^2\ a^{-1}$) of glacier tongues.

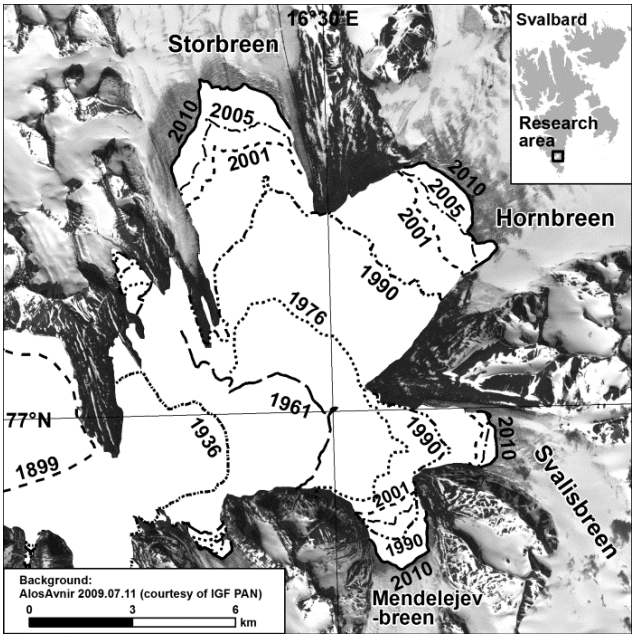


Fig. 1. Selected front positions of tidewater glaciers in the inner part of Hornsund illustrating scale of retreat since beginning of the 20th century. Acceleration of recession in last decades is visible.

Conclusions

Serie of recession modes could be distinguished taking into account type and size of glaciers and characteristics of their marine and land foregrounds: (1) Tidewater glaciers with seasonal fluctuations of the front position up to 100 m of amplitude and systematic recession by c. 50 m a^{-1}; (2) Surge type tidewater glaciers with substantial advance during active phase when ending into shallow sea (e.g. >15 km in case of Nathorstbreen in 2008-2013 - Sund *et al.* 2014), active calving and stagnation with relatively slow areal deglaciation afterwards; (3) Larger land based glaciers with systematic recession by 20-30 m a^{-1}; (4) Surge type land based glaciers with less distinct advance during active phase and areal deglaciation afterwards; (5) Small mountain glaciers with prevailing areal deglaciation of debris covered tongues. Combination of mentioned can be also observed. Dynamic response of glaciers to climate warming by faster flow, calving and surges plays important role in disintegration of glacier-ration of the archipelago and style of liberation of sea and land areas from the glacier ice. Glaciers of Southern Spitsbergen are most sensitive to climate warming in the Svalbard area.

Acknowledgements

The paper presents a part of results of the project "*Arctic climate system study of ocean, sea ice and glaciers interactions in Svalbard area"* - AWAKE2 (Pol-Nor/198675/17/2013), supported by the National Centre for Research and Development within the Polish-Norwegian Research Cooperation Programme

REFERENCES:

Blaszczyk, M., Jania, J.A., Kolondra, L. (2013): "Fluctuations of tidewater glaciers in Hornsund Fjord (Southern Svalbard) since the beginning of the 20th century". Polish Polar Research. 34(4): 327–352.

Nuth, C., Kohler, J., Aas, H.F., Brandt, O., Hagen, J.O. (2007): „Glacier geometry and elevation changes on Svalbard (1936-90): a baseline dataset". Annals of Glaciology 46: 106–116.

Sund, M., Lauknes, T.R., Eiken, T. (2014):"Surge dynamics in the Nathorstbreen glacier system, Svalbard". The Cryosphere, 8: 623–638.

MONITORING OF THE STATE OF THE EARTH'S OZONE LAYER AND SOLAR UV-RADIATION IN ANTARCTICA - THE CONTRIBUTION OF THE CZECH REPUBLIC TO THE VIENNA CONVENTION AND THE MONTREAL PROTOCOL

Michal Janouch[1], Ladislav Sieger[2], Martin Staněk[1], Hector Ochoa[3]

[1]*Solar and Ozone Observatory, Czech Hydrometeorological Institute, Hradec Kralove, Czech Republic*
[2]*Czech Technical University in Prague, Faculty of Electrical Engineering, Prague, Czech Republic*
[3]*Dirección Nacional del Antártico - Instituto Antártico Argentino, Buenos Aires, Argentina*

KEYWORDS: OZONE LAYER, ANTARCTICA, UV-RADIATION, MONTREAL PROTOCOL

Four years ago the Solar and Ozone Observatory of the Czech Hydrometeorological Institute in cooperation with the Argentine Antarctic Institute installed the Brewer ozone spectrophotometer (double MKIII) No. 199 at the Marambio Base - Argentina, Antarctica (B199).

This activity is the project of the Ministry of the Environment of the Czech Republic and the State Environmental Fund of the Czech Republic "Monitoring of the State of the Earth's Ozone Layer and Solar UV-radiation in Antarctica - the Contribution of the Czech Republic to the Vienna Convection and the Montreal Protocol". Cooperation with Argentina is the result of close cooperation in matters relating to the Antarctic between the Government of the Czech Republic and the Government of the Argentina in 2010.

The B199 has been independently calibrated by travelling standard the Brewer No. 17 - International Ozone Service, Toronto Canada (IOS) in 2012. The B199 is regularly checked and maintained each year during austral summer. An information about the data available are discussed and presented.

REFERENCES:

Arola, A., S. Kazadzis, A. Lindfors, N. Krotkov, J. Kujanpää, J. Tamminen, A. Bais, A. di Sarra, J. M. Villaplana, C. Brogniez, A. M. Siani, M. Janouch, P. Weihs, T. Koskela, N. Kouremeti, D. Meloni, V. Buchard, F. Auriol, I. Ialongo, M. Staneck, S. Simic, A. Webb, A. Smedley, and S. Kinne (2009): "A new approach to correct for absorbing aerosols in OMI UV" Geophys. Res. Lett. 36, L22805.

Report of the Eighth Meeting of the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer, Geneva, Switzerland, 2 to 4 May 2011, WMO Global Ozone Research and Monitoring Project, Report No. 53, 194 – 197.

Janouch, M., Řeháková, K., Sieger L. (2013): Workshop on Changes of the Polar Ecosystem, The 13th Annual Meeting of the Polar Section of the Czech Geographical Society, Czech Polar Reports 3, 1-2.

INTERNATIONAL COOPERATION AT THE J.G. MENDEL CZECH ANTARCTIC STATION

Pavel Kapler

Chief of the J.G. Mendel Station, Masaryk University in Brno, Czech Republic

KEYWORDS: ANTARCTICA, MENDEL STATION, JAMES ROSS ISLAND, INTERNATIONAL COOPERATION, OPEN ACCESS,

The Johann Gregor Mendel Czech Antarctic Station is the only Czech research base in Antarctica, it is located on James Ross Island in the Antarctic Peninsula region. It was settled in 2006 and there were eight successful austral summer expeditions held since that year already.

The poster is aimed to possibilities of this exceptional scientific infrastructure - its capacities (15 researchers plus 5 crew members), facilities and equipment (environmental friendly construction, accommodation quarter, living quarter, two laboratories and technical facilities), available means of transportation (zodiac rubber boats) as well as the field camp capabilities. The unique energetic system of the station is characterized here too, including the wind power generator of the new construction meant to be tested already in the next austral summer season.

Presented poster also describes the main current achievements gained so far from the international scientific and logistic co-operation at the J.G. Mendel Czech Antarctic Station. Above all the main purpose is to declare the heartfelt intention of the Czech Republic's Antarctic research programme, to keep the access to its facility opened to be shared according to Antarctic scientific community's ideals and to provide the background facilities to the research in the best manner of international co-operation. Therefore this is also kind of an invitation to the broad international Polar research community to share the possibility of the greatest scientific adventure with the Czech Antarctic research team. We would like to encourage you to contact the author of this contribution for further discussion on this topic.

REFERENCES:

Prošek, P., Barták, M., Láska, K., Suchánek, A., Hájek, J., Kapler, P. (2013): Facilities of J. G. Mendel Antarctic station: Technical and technological solutions with a special respect to energy sources. Czech Polar Reports, Volume: 3/1, pp. 38-57, DOI: 10.5817/CPR2013-1-7

RUNOFF MONITORING AS A USEFULL TOOL FOR ASSESSING GLACIER MASS BALANCE

Jan Kavan

Centre for Polar Ecology, Faculty of Sciences, University of South Bohemia in České Budějovice, Czech Republic

KEYWORDS: RUNOFF, GLACIER MASS BALANCE, HYDROLOGY

The Bertil glacier catchment has been object of intensive glaciological and hydrological monitoring since 2011, when the gauging station has been established as well as a network of ablation stakes. Together with these measurements an automatic rain gauge complemented by set of manual rain gauges is used for monitoring of precipitation during summer period. In April 2014 a field campaign focused on monitoring snow cover properties on the Bertil glacier has been carried out.

Runoff monitoring is being carried out since 2011 using automatic (30 minutes storing interval) water level sensor (hydrostatic pressure sensor) calibrated to runoff using Flowtracker handheld discharge measuring device. The rating curve is based on more than 20 manual measurements during the 3 years. Precipitation measurements are based on continual automatic rain gauge located near shore in Petunia bay (some 3 km from the Bertil glacier). Set of manual rain gauges is designed to cover the altitude gradient from seashore up to 560 m a.s.l.. This helps to estimate the distribution of precipitation over the glacier and make the estimation more realistic. Network of ablation stakes consists of 26 points spread over the glacier surface to cover both ablation and accumulation zones. Snow cover properties has been measured thanks to classical snow probes – 162 point measurements have been done covering the whole surface of glacier. Two detailed snow pits, one in ablation zone, second in accumulation zone have been done to estimate precisely the snow water equivalent.

On the basis of these measurements a simple water balance model has been estimated. The first results show that runoff monitoring is able to substitute sometimes difficult direct ablation measurements and its interpolation. Estimated glacier ice loss based on direct measurement of ablation stakes corresponds very well to estimated glacier ice loss derived from runoff measurements.

The study was supported by the Grant No. LM2010009 CzechPolar and CZ.1.07/2.2.00/28.0190 (EU).

DATA MANAGEMENT CHALLENGES IN POLAR ECOLOGY

SiriJodha S. Khalsa, Lynn Yarmey

National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, USA

KEYWORDS: POLAR DATA MANAGEMENT, IPY

Well-documented and easily accessible data are key to understanding the accelerating changes in the Arctic environment. Observational records spanning the longest possible temporal range and with the broadest spatial coverage are crucial for setting baselines against which to assess change. The International Polar Year (IPY) made progress in promoting data sharing across research communities (Parsons, et al., 2011), yet despite these gains the data that are needed to understand Arctic change remain scattered across the globe in diverse formats having different levels of documentation and accessibility. Polar data are collected by various governments, institutions and industry groups and maintained in separate systems. Researchers often need inside knowledge, time, and luck to find data that has been previously acquired by others.

From the perspective of field researchers, good data management practices are often seen as burdensome and costly. All too frequently data collected in the field, although they may be eventually used in publications, fail to find their way to a digital repository where they can be preserved and accessed by others. This situation is changing in that many funding agencies now require data management plans as a condition of any award, and many leading journals are beginning to require that data used in publications be cited and accessible to others.
This presentation serves purposes. The first is to give an overview of best practices in lifecycle data management, with an emphasis on the collection and documentation phases early in the data lifecycle. The second purpose is to describe the Arctic Data Explorer (Yarmey and Khalsa, 2014), a web-based tool that enables discovery of data across diverse disciplines and scales - whether the interest is in regional sea ice datasets or in data on a specific reindeer herd. The ADE makes local in-situ observations available alongside remote sensing data. The Advanced Cooperative Arctic Data and Information Service (ACADIS) team is building the Arctic Data Explorer tool to maximize data discovery across organizations, research groups, funding agencies, and countries. But a service such as the ADE can succeed only when researchers and the institutions that support them adopt good data management practices.

REFERENCES:
Parsons, M. A., O. Godoy, E. LeDrew, T. F. de Bruin, B. Danis, S. Tomlinson, and D. Carlson. (2011) “A Conceptual Framework for Managing Very Diverse Data for Complex, Interdisciplinary Science.” *Journal of Information Science*. doi:10.1177/0165551511412705.
Yarmey, L. and S.J. Khalsa (2014): “Building on the IPY: Discovering Interdisciplinary Data Through Federated Search” *Data Science Journal* (accepted for publication)

CLIMATE-DRIVEN CHANGES OF PALSA LANDSCAPES AND THEIR SOCIETAL IMPACTS IN WESTERN SIBERIA

Sergey Kirpotin

Tomsk State University

KEYWORDS: PALSA PEATLAND, PERMAFROST, CLIMATE CHANGE, SOCIAL IMPACTS

Study of permafrost state in the era of climate instability is of particular actuality. This is especially true for the vast paludified subarctic areas of Western Siberia, which is one of the hotspots of global warming on our planet (Haeseler, 2012). It's not surprising that climatic changes here are more dramatic compared with other northern regions such as Scandinavia, Canada and Alaska, and changes in permafrost landscapes are more notable due to the severe continental climate (Kirpotin et al, 2011). Thus, Western Siberia is a key region and the most convenient site for studying both the fundamental questions of interaction of climate and permafrost and considering the practical aspects of these changes and evaluation of these social impacts. Understanding climate-permafrost system requires knowledge of climatic effects on carbon (C) cycling and greenhouse gas dynamics in coupled land-water-atmospheric systems, and in-turn, how these feed back into the climate-permafrost system. Palsa peatlands are dominant landscape and occupy extensive areas in West Siberian North. This report aims to fill the gap in knowledge on West Siberian palsas: their distribution, peculiarities and both climate-indication and climate regulator capacities.

LIFE HISTORY STRATEGY OF PEDICULARIS SPECIES IN HIGH ARCTIC: SENESCENCE SIGNS IN HEMIPARASITIC CONGENERS

Jitka Klimešová[1,2], Jana Martínková[1] and Jakub Těšitel[1]

[1]*Faculty of Sciences, University of South Bohemia in České Budějovice, Czech Republic*
[2]*Institute of Botany AS CR, Třeboň, Czech Republic*

Short life-cycle is extremely rare in plants of terrestrial arctic ecosystems where most species are long-lived polycarpic perennials. According to life history theory, this is due to low probability of establishment but virtual immortality of established individuals. Although finding a safe site for establishment is crucial in harsh abiotic environment, we argue that soil movement could affect established plants. This risk is especially important for hemiparasitic plants in tundra communities which are dependent on belowground connections to root system of other plants (hosts) from which they acquire xylem-borne resources. Hence, we can expect that the perennial hemiparasitic species occurring in the Arctic will be rather short lived due to increasing risk of loss of functional connection to the host plants with aging due to cryoturbation in high arctic soils and they will invest preferentially into first reproduction and will therefore show decreasing fitness with aging (senescence).

We test these hypotheses on two perennial hemiparasitic *Pedicularis species* (*P. dasiantha* and *P. hirsuta*) occurring in high arctic tundra communities on the Svalbard archipelago. We assessed plant age and number of past flowering events using morphological markers on belowground organs, which revealed that these plants are indeed short-living and extreme rareness of plants which experienced more two flowering events in their life. The *Pedicularis* species possess rather rare life-history strategy in high Arctic and could be considered as short lived perennials. Our study is also one of rare reports of senescence signs in plants.

SARCOSAGIUM CAMPESTRE (FR.) POETSCH & SCHIED. – THE NEW LICHEN SPECIES WITH EPCHEMEROID FRUIT BODIES FROM SVALBARD

Liudmila Konoreva

The Polar-Alpine Botanical Garden and Institution, Kola Science Center RAS, Kirovsk, Murmansk region, Russia

KEYWORDS: SARCOSAGIUM CAMPESTRE, EPHEMEROID LICHENS, SVALBARD, DISTRIBUTION, ECOLOGY.

In 2013 we have carried out field studies of lichens in the former Russian settlement Pyramiden. During the research, we have found *Sarcosagium campestre* (Fr.) Poetsch & Schied., lichen with ephemeral fruit bodies that last for less than a year.

We used the standard methods of sampling and identification of lichens. We collected lichens from all substrates and micro-habitats on the sample plots: soil, rocks, plant debris and wood. *Sarcosagium campestre* was found on the soil in the anthropogenic grasslands.

Specimens examined: Billefjorden, Pyramiden settlement, between the mechanical workshop and hotel, 78°39'24.4" N, 016°19'37.8" E, alt. 25 m a.s.l., anthropogenic *Poa alpigena*-dominated grasslands, 03.08.2013, KPABG.

Thallus crustose, white-gray-greenish, ± gelatinous, especially when wet. Photobiont chlorococcoid. Apothecia 0.1-0.3 (-0.5) mm diam., sessile, with a fairly narrow base, first globose, than became barrel-shaped to convex, pale red to dark red-brown with white-pruinose flat or slightly concave disc with small pore, which gradually widened. Wet apothecia becomes very bright and ± translucent. Epihymenium colourless, pale yellow. Hymenium in Svalbard's specimens 120-160 μm, in the literature (Smith et al., 2009) 120-170 μm, J+ blue. Asci cylindrical, thin-walled, K/J+ blue, without tholus, multispored. Hamathecium consists of paraphyses, simple or sparingly branched, lax in K, with swollen apices. Ascospores in specimens from Svalbard 5.5-7.0 x 1.7-2.0 μm, in the literature (Smith et al., 2009) 5-8 x 2-2.3 μm, ellipsoid to elongate-cylindrical, colourless, thin-walled, simple, occasionally 1-septate (visible in K/J). Hypothecium colourless or pale.

Ecology: ephemeral species, appearing in autumn on base-rich or acidic soils and mosses.

Distribution: Europe, North America. In the Arctic rare, find only in Beringian Alaska (Kristinsson et al., 2010). For the Svalbard archipelago this species reported for the first time from a single locality (Russian settlement Pyramiden, West Spitsbergen, Billefjorden).

In the field, apothecia of *Sarcosagium campestre* pass through four stages of maturity. Fruit bodies emerge as tiny, pink, pruinose buds; the 'bud phase'. These enlarge and open into pink or purplish barrel-shaped apothecia with a concave disc with true excipulum; this 'mature phase' contains ripe asci. With time the apothecia become more cup-shaped, and their colour changes through orange to a dirty white; the 'white phase'. Soon after this the thecium gelatinizes and disperses to leave an empty white cup composed of the excipulum; the 'empty phase'. This too, rapidly gelatinizes and disperses (Gilbert, 2004).

We observed population on Svalbard in August 2013. In August there were very few fruit bodies in the ‘bud phase’; it was the ‘mature phase’ or ‘white phase’ of maturity of the fruit bodies. It is possible, that the ‘bud phase’ in Svalbard was present at the end of June or in July, ‘mature phase’ – in July and August, ‘white phase’ and ‘empty phase’ – at the end of August and in September before snow has covered the ground. In the British Isles the ‘bud phase’ is presented in August and September, less frequently in July and October, rare – in June and November; the ‘mature phase’ – in September, October and November, rarely – in December and January; ‘white phase’and ‘empty phase’ - in December, January and February, rarely in November. This difference in the dates related with the peculiarities of climatic conditions in the Svalbard and time of snow cover. Most of Svalbard territory is snow covered between early September and early May (Øvstedal et al., 2009). However, our assumptions require detailed studies in other months and replications for several years.

I am grateful to my colleagues working on Svalbard and head of Svalbard’s expedition of the Polar-Alpine Botanical Garden and Institution Dr. Nadezda Konstantinova.

REFERENCES:

Gilbert O. L. (2004): "The phenology of Sarcosagium campestre observed over three years" The Lichenologist 36(2): 159–161.

Kristinsson H., Zhurbenko M., Hansen E. S. (2010): "Panarctic checklist of lichens and lichenicolous fungi" CAFF Technical Report No. 20, CAFF International Secretariat, Akureyri, Iceland. 120 p.

Øvstedal D. O., Tønsberg T., Elvebakk A. (2009): "The Lichen Flora of Svalbard" Sommerfeltia No. 33. Natural History Museum, Oslo. 393 p.

Smith C. W., Aptroot A., Coppins B. J., Fletcher A., Gilbert O. L., James P. W. and Wolseley P. A. (2009): "The Lichens of Great Britain and Ireland" 2nd ed. British Lichen Society. 1046 p.

SPATIAL VARIATION AND GENERAL PATTERNS OF SOIL MICROBIAL COMMUNITY STRUCTURE ACROSS ALTITUDINAL GRADIENTS IN BILLEFJORDEN, CENTRAL SVALBARD, HIGH ARCTIC

Petr Kotas[1,2], Eva Kaštovská[1], Hana Šantrůčková[1], Josef Elster[3]

[1]*University of South Bohemia, Faculty of Science, Department of Ecosystem Biology, České Budějovice, Czech republic*
[2] *Laboratory of Metabolomics and Isotopic Analyses, Global Change Research Centre, Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic*
[3] *University of South Bohemia, Faculty of Science, Centre for Polar Ecology, České Budějovice, Czech republic*

KEYWORDS: PHOSPHOLIPID FATTY ACID, MICROBIAL COMMUNITY STRUCTURE, ALTITUDINAL GRADIENTS, ENVIRONMENTAL GRADIENTS

The temporal and spatial variation of soil microbial communities across altitudinal gradients was documented by several authors in temperate alpine ecosystems. However, there is lack of reports about the microbial community structure across altitudinal gradients in fragile and isolated Arctic ecosystems. In this study, we investigated spatial variation of soil microbial communities following three altitudinal soil transects in coastal mountains in eastern part of Petunia Bay (Billefjorden, Svalbard; 78^0 N, 16^0E) using phospholipid fatty acid (PLFA) analyses. The multivariate analyses of 28 PLFAs specific to fungi, Actinobacteria, Gram-positive (G+) and Gram-negative (G-) bacteria revealed that relative abundances of these microbial groups changed significantly with increasing altitude. We found twofold increase of F/B ratio with rising elevation within all gradients, which shifted the dominance of bacteria in lower elevations towards fungal dominated microbial community in upper parts of the gradients. While the bacterial PLFAs were strongly correlated with total and dissolved soil carbon, nitrogen and sitosterol (as proxy for plant residues in the soil) contents ($R^2 = 0.61$, 0.49, 0.75 and 0.46 respectively), the fungal response to changes in substrate availability was less straightforward. Alongside with dominance of bacteria in conditions with increased soil carbon and nitrogen availability, we found also general patterns connected with rising elevation in composition of PLFA specific to Actinobacteria, G+ and G- bacteria, which indicate different composition of these microbial groups across the altitudinal gradients. The future perspective of this work is to link the compositional data with an extensive dataset of geochemical and microclimatic soil properties to understand which environmental factors predominantly affect particular microbial groups within the vertical gradients. Understanding these relationships can help us to predict future development of Arctic ecosystems under climate changes.

THE INFLUENCE OF THE CLIMATE CHANGE ON THE LEVEL OF SELECTED COMPUNDS FROM POP GROUP IN POLAR ENVIROMENT BASED ON AN ARCTIC CATCHMENT (SVALBARD)

Katarzyna Kozak[1], Marek Ruman[2] Łukasz Stachnik[3], Jacek Namieśnik[1], Żaneta Polkowska[1]

[1]Department of Analytical Chemistry, The Chemical Faculty, Gdansk University of Technology, Gdansk, Poland;
[2] Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland;
[3]Department of Geomorphology, Jagiellonian University, Krakow, Poland

KEYWORDS: ARTIC, CLIMATE CHANGE, POP, LONG RANGE TRANSPORT, GRASSHOPPER EFFECT.

Introduction

The climate changed, observed throughout a few recent decades, is connected to an appearance of a new strong influence on the functioning of the specific ecosystems, among them the particularly sensitive arctic ecosystems. It needs to be emphasised that even a slight change of climatic factors can have serious consequences, manifested by disturbance and upset of the natural mechanisms of the nature's homeostasis. The climatic changes result not only in an increase of temperature, but also in unsettlement of a variety of mutual connections, without which keeping the ecological balance is impossible (Macdonald et. al. 2005). The increase of the temperature, weather anomalies and connected with the intensive rainfall and strong winds entail the spread of contamination, including permanent organic pollution, in abiotic and biotic environment. Susceptibility of the polar ecosystem to the impact of the pernicious substances is directly connected to its simple structure, which consist only of a few major kinds. Such little diversity of the organisms makes the appearance of the biomagnification process quicker than in other ecosystems (AMAP, 2006; ACIA, 2005).

Considering the fact that the high charges of solid compounds are stored in snow and ice, they are thus a potential source of their emission to the environment. In effect, water contamination takes places, and living organisms are exposed to toxic effects of the pollution. Moreover, the ice cap is a habitat for arctic animals (i.e. seals, bears). The decrease of animals' living space is a stressful factor, affecting the decrease in population of those organisms. Other essential climatic factors are rainfalls, winds and associated with them long-range transport of polluted wind (long-range atmospheric transport). The result of the animated cyclonic activity and frequent migration of low pressure accompanied by connected areas of intensive cloudiness, rainfalls and strong winds is the impact on water regimes and thus hydrological factors, which in turn affect the quality of water. Along with the increased association of pollution with the compounds in the atmospheric air the speed of removal from the atmosphere increases, through the dry and wet process of deposition. In addition, along the increase of the pressure gradient, the speed of wind increases and the air pollution is elevated to the higher layers of troposphere and thus the pollution can be transported long distances, contaminating the area of the Arctic (Ma et. al. 2011).

Sampling, methods and materials

Samples of surface waters and were collected especially in the regions of: Revdalenvalley, the catchment of the Revelva river. Within the framework of the project the research were conducted enabling elaboration of the characteristics of pollutants flow in the surface waters (lake, watercourses, river) with differentiating inflow of the precipitation waters. The surface

waters and precipitation were sampled in three season on summer from 2012 to 2013 year. The present investigation reveals the results of the analysis of these samples for their PAH and PCB content. The final extracts were analysed using an Agilent Technologies 7890A gas chromatograph with an Agilent Technologies 5975C mass spectrometric detector and split/splitless injector (7683B). The mass spectrometer was operated in the selected ion monitoring (SIM) mode. The following ions were monitored: (m/z) PAH: 128, 127, 152, 151, 154,153, 166, 165,178, 176, 203, 202, 228, 226, 252, 250, 277, 276, 279 and 278, and PCB: 258, 256, 292, 290, 328, 326,362, 360, 396, and 394.

Discussion

As a result of the climate changes the process of a slow degradation of arctic environment takes place, contributing to the impoverishment of biodiversity. Processes of polar nature's regeneration are slow, and that is why every change caused by anthropogenic actions have a great influence on the quality of the environment. Several scientific research confirm the development of toxic effects among the organisms as a result of migration of pollution in the arctic environment (Letcher et. al. 2010, De Wit et al. 2006, AMAP 2006). Conducting subsequent research on the spread of pollution is required, among which the most prior should be the research on water quality, as it would precisely determine the level of contamination.

Acknowledgements

The project was funded by the National Science Centre allocated on the basis of the decision number DEC-2013/09/N/ST10/04191

REFERENCES

ACIA (2005): Arctic Climate Impact Assessment. ACIA Overview report. Cambridge University Press. 1020 pp

AMAP, 2006. AMAP Assessment (2006): Acidifying Pollutants, Arctic Haze and Acidification in the Arctic, Arctic Monitoring and Assessment Programme, Oslo, 1-112

Ma, J., Hung, H., Tian, Ch., Kallenborn, R. (2011):" Revolatilization of persistent organic pollutants in the Arctic induced by climate change" Nature Climate Change 1: 255-260

Macdonald, R.W., Harner, T., Fyfe, J. (2005): "Recent climate change in the Arctic and its impact on contaminant pathways and interpretation of temporal trend data" Science of The Total Environment 342: 5-86

Letcher, R. J., Bustnes, J.O., Dietz, R., Jenssen, B.M., Jørgensen, E.H., Sonne, C., Verreault, J., Vijayan, M.M., Gabrielsen, G.W. (2010): "Exposure and effects assessment of persistent organohalogen contaminants in arctic wildlife and fish" Science of the Total Environment 408: 2995-3043

BIOGEOGRAPHICAL DIVERSITY OF MICROBIAL COMMUNITIES ASSOCIATED WITH ARCTO-ALPINE PLANTS

Manoj Kumar[1,2], Minna Männistö[3], Jan Dirk Van Elsas[1], Riitta Nissinen[1,2]

[1]*University of Groningen, Department of Microbial Ecology, Groningen, the Netherlands*
[2]*University of Jyväskylä,Department of Biological and Environmental Science, Jyväskylä, Finland*
[3]*Finnish Forest Research Station, Rovaniemi, Finland*

KEYWORDS: T-RFLP, ION-TORRENT, BACTERIA, FUNGI, DIVERSITY, *O. DIGYNA, S. OPPOSITIFOLIA*

We are interested in bio-geographical diversity and functioning of plant associated microbial communities in the Arctic and Alpine plants. In this study we addressed community composition of soil and endophytic bacteria associated with two arcto-alpine plant species, *Oxyriadigyna* and *Saxifragaoppositifolia*by community fingerprinting and ion-torrent sequencing. The samples (plant roots, plant leaves, rhizosphere and bulk soils) were collected from Kilpisjärvi, Finland (sub-arctic climatic zone), Ny-Alesund, Svalbard (high arctic) and Innsbruck, Austria (alpine).

Terminal restriction fragment analysis (T-RFLP) targeting bacterial 16S rRNA and fungal RNA intergenic region (ITS) of was used to address the influence of location, climate and plant species on structure of soil microbial communities. Community fingerprinting revealed that bulkand rhizospheresoil communities of bacteria as well as fungi are primarily shaped by climatic zone and sampling sites. Further, we observed no significant reduction in community richness in relation to increasing latitude in bacterial or in fungal communities. Both bacterial and fungal communities in rhizosphere soils were significantly different from those of the bulk soils, irrespective of climatic regions or sampling site. Further, plant species had a clear impact on bacterial and fungal community structure within climatic zones, suggesting that that plant species select their own rhizosphere microbial community from the available soil community.

Massive parallel ion-torrent sequencing was used to further analyse the soil and endophytic bacterial and fungal communities. In total we analyzed96 samples representing bulk and rhizospheresoils and 204 endosphere samples representing roots and leaves of *O. digyna* and *S. oppositifolia*.

IS THE DARK SIDE OF MICROBIAL MATS AND *NOSTOC* COLONIES REALLY DARK?

Jana Kvíderová[1,2]

[1]*Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic;*
[2]*Institute of Botany AS CR, Třeboň, Czech Republic*

KEYWORDS: MICROBIAL MAT, *NOSTOC* COLONY, PHOTOCHEMISTRY

Introduction

Microbial mats are common in all hydro-terrestrial and terrestrial communities in the polar regions. They may be formed by one species or by several prokaryotic/eukaryotic species and could be up to several mm thick. The internal structure of *Nostoc* colonies (Cyanobacteria), also belonging to dominant phototrophic (micro) organisms in the polar regions, may resemble microbial mats as well (Fig. 1.). Due to light absorption by cells, extracellular matrix and inorganic particles, different irradiance conditions occur at the surface and the bottom of the mat.

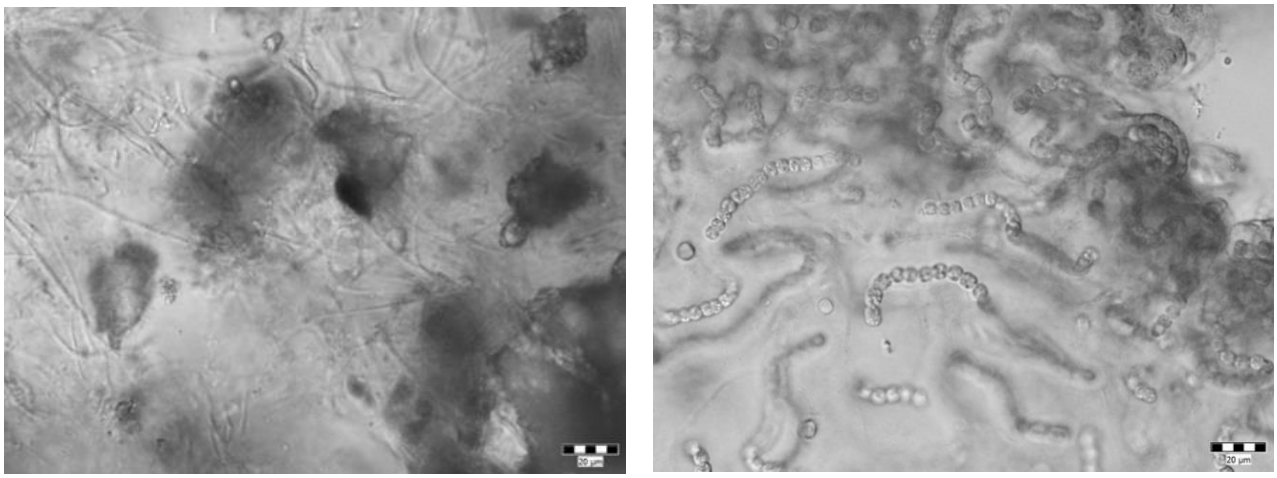


Fig. 1. Similarity in ultrastructure of microbial mats (left) and the *Nostoc* colonies (right).

Material and Methods

The photochemical activity of the microbial mats and *Nostoc* colonies collected near the Czech polar station in Petuniabuka, Svalbard, was evaluated using fluorescence imaging camera FluorCam (Photon Systems Instruments, Czech Republic) and the NPQ protocol was applied. Several fluorescence parameters describing the photochemical performance were calculated using FluorCam7 software (Photon Systems Instruments, Czech Republic): the maximum quantum yield (F_V/F_M), actual quantum yield (QY), non-photochemical quenching (NPQ) and photochemical quenching (qP) according to Roháček (2002).

Results

Different response of mat surface and bottom to incoming light were observed in both high and low light. The decreased values of F_V/F_M and QY of mat surface might indicate photoinhibition. However, lower values of NPQ and increased values of qP are typical for photoacclimated samples. The actinic light of 150 μmol m^{-2} s^{-1} was probably too high for bottom layers and

induced faster activation of photoacclimation mechanisms. At the surface, the microorganisms were acclimated to increased irradiances, even higher than that of actinic light used.
Contrary to microbial mat, *Nostoc* colonies, the differences between the exposed and shaded sides of the colonies were minimal. The irradiance seems to be more important factor affecting whole colony than the structure. The *Nostoc* colonies were photoinhibited during high light treatment as seen from decreased qP and increased NPQ (Fig. 2).

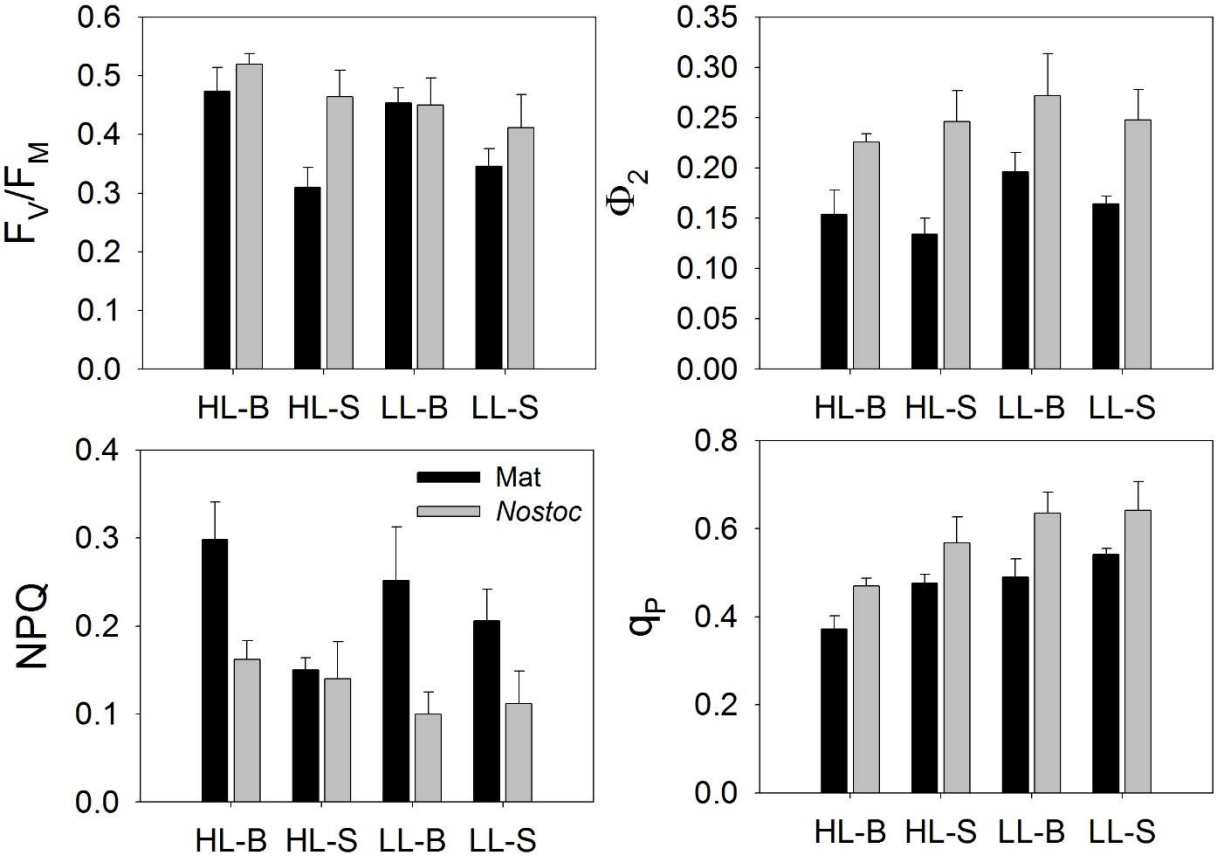


Fig. 2. Fluorescence parameters of surface and bottom layers of the microbial mat and *Nostoc* colony under low and high light. Abbreviations: F_V/F_M – maximum quantum yield, Φ_2 – quantum yield in light, NPQ – non-photochemical quenching, qP – photochemical quenching, HL – high light, LL – low light, S – surface, B - bottom.

Discussion

The different response of the microbial mats and *Nostoc* colonies may be caused by their different ultrastructure. The microbial mat is compact and firm, so more light energy is absorbed by its surface layer, resulting in quite different light conditions at the surface and bottom. The *Nostoc* colonies are more translucent than the mats, since they contain large amounts of translucent extracellular matrix, so the light may penetrate even to bottom layers. Thus, difference in light conditions at surface and bottom of the colony is not so pronounced as in mats.

REFERENCES:

Roháček, K. (2002): "Chlorophyll fluorescence parameters: the definitions, photosynthetic meaning, and mutual relationship" Photosynthetica 40(1): 13-29

SAMPLE DATABASE OF THE CENTRE FOR POLAR ECOLOGY

Jana Kvíderová[12]

Centre for Polar Ecology, Faculty of Science, University of South Bohemia, Na Zlaté stoce 3, CZ-370 05 České Budějovice, Czech Republic[1], Institute of Botany AS CR, Dukelská 135, CZ-379 82 Třeboň, Czech Republic[2].

KEYWORDS: SAMPLES, PHOTOGRAPHS, DATABASE

Introduction

Large number of samples collected by ALGO groups (phycology/microbiology group) during field part of the Polar Ecology courses, provided by Centre for Polar Ecology (CPE), in 2011 to 2014 as well as need to store macro- and microphotographs of sampled site, together with physico-chemical data measured *in situ* and laboratory analyses results (if performed) concerning particular sample, and need to export and calculate statistical data for each season, led to development of the Sample Database (SampleDB).

About the database

The database runs in MS Access 2013 environment. The structure of database is shown in Fig. 1.

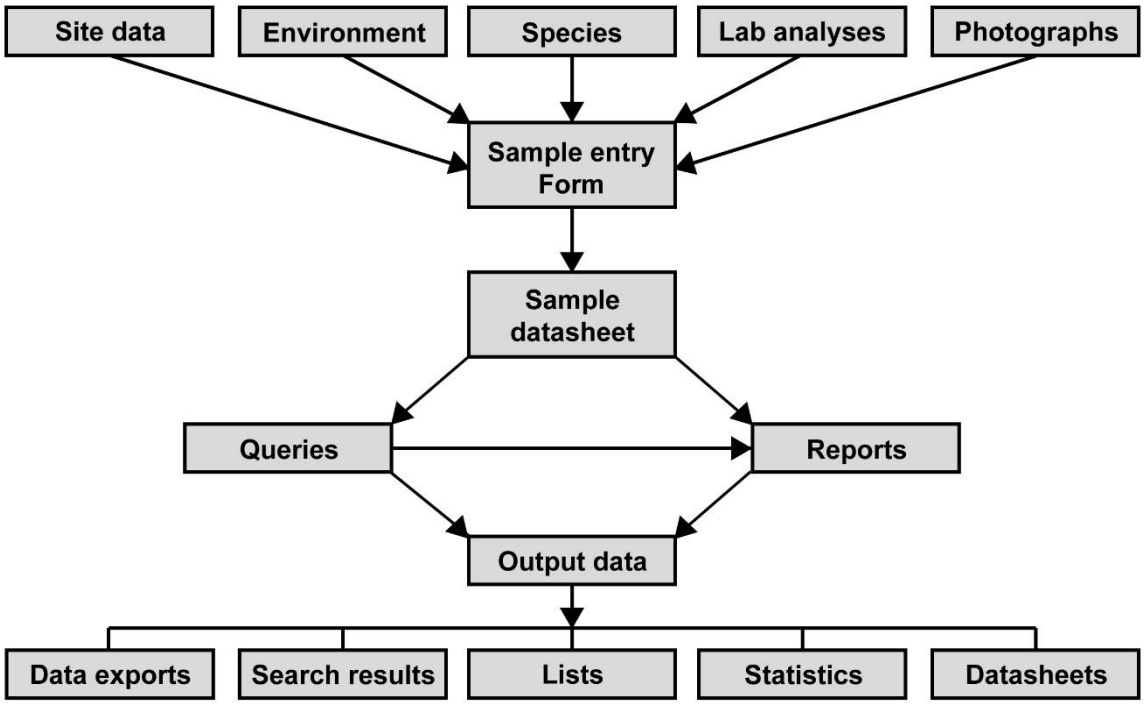


Fig 1. General structure of the SampleDB.

Entry data for the SampleDB

- Sample number (unique alphanumeric code)
- Site data (site description, GPS coordinates, elevation, etc.).
- Environment (*in situ* analyses like physico-chemical parameters)
- Species composition (including abundances)
- Laboratory analyses (nutrient concentration, AGP, APPR)

- Photographs (site, community, microphotographs)

Outputs from the SampleDB

- Exports to GIS, other databases
- Search results based on user-defined queries like…
    - Where have we found *Tribonema* sp.?
    - Could you tell GPS coordinates of that sample of mine under the bird sanctuary to a colleague to go there and re-collect *Prasiola*, please?
    - Where are the microphotographs of *Schizothrix* sp. stored?
- Lists of all samples, genera and/or species observed, etc.
- Statistics like number of samples, of habitats sampled, of communities sampled etc.
- Datasheets

Future development

- List of species/genera with taxonomical remarks
- Diversity indexes calculation
- Connection to future Culture Collection database

Data contributors

- Employees and students of the CPE (in alphabetical order): Josef Elster, Jiří Komárek, Jana Kvíderová, Otakar Strunecký, Katya Pushkareva, Daria Tashyreva, Lukáš Veselý
- Groups ALGO2011, ALGO2012, ALGO2013 and ALGO2014 (see reports on Polar Ecology course at polar.prj.jcu.cz for group members lists, report for year 2014 will be available at the end of the year)

REFERENCES:

Polar Ecology course Svalbard 2011. Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, 20 p.
Polar Ecology course Svalbard 2012. Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, 28 p.
Polar Ecology course Svalbard 2013. Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, 31 p.
Report on Polar Ecology course 2014. Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, (in preparation).

DWARF TUNDRA SHRUB‘S GROWTH PARAMETERS AS A SENSITIVE CLIMATE PROXY FOR LATE HOLOCENE, SW GREENLAND, KOBBEFJORD

Jiří Lehejček

Department of Forest Ecology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague

KEYWORDS: JUNIPERUS COMMUNIS, TREE-RINGS, CELL PARAMETERS, NORTH ATLANTIC

Novel approaches of dwarf tundra shrubs investigations led to significant improvements of climate reconstructions based on this high-resolution climate proxy. Despite one has to pose many obstacles when analysing dwarf tundra shrubs growth (e.g. missing or wedging rings), polar studies with lack of instrumental historical observations can considerably benefit from knowledge gained from such circumpolar archive (Schweingruber and Poschlod 2005).

More than 130 samples of three different species (*Juniperus communis, Salix glauca, Alnus crispa)* were collected in order to obtain climate record for spanning over last centuries. Tree rings and cell parameters (vessel and lumen areas, cell wall thicknesses) were subsequently measured on digital images taken from microsections (Fig. 1.). After standardization of results we cross-dated the growth parameters and created the master chronology. We consider *Juniperus communis* as the most promising species with the oldest individual reaching year 1675 which is more than two centuries longer record than provided by meteorological station in Nuuk (distant 30 km westwards). Strong correlation between growth parameters and climate ($r=0.6$; $P<0.05$) enabled us to present three centuries long dendroclimatological reconstruction.

Ongoing studies in the other parts of the Arctic (central Svalbard, northern Kola peninsula and in future possibly also extended with Jan Mayen) should serve as both precise and spatially distinct basis for reconstruction of recent climate changes and detection of their drivers in Northern Atlantic as a region directly influencing climate in Europe.

REFERENCES:

Schweingruber, F.H. and Poschlod, P. (2005): “Growth rings in herbs and shrubs: life span, age determination, and stem anatomy.“ Forest Snow and Landscape Research 79: 195-415.

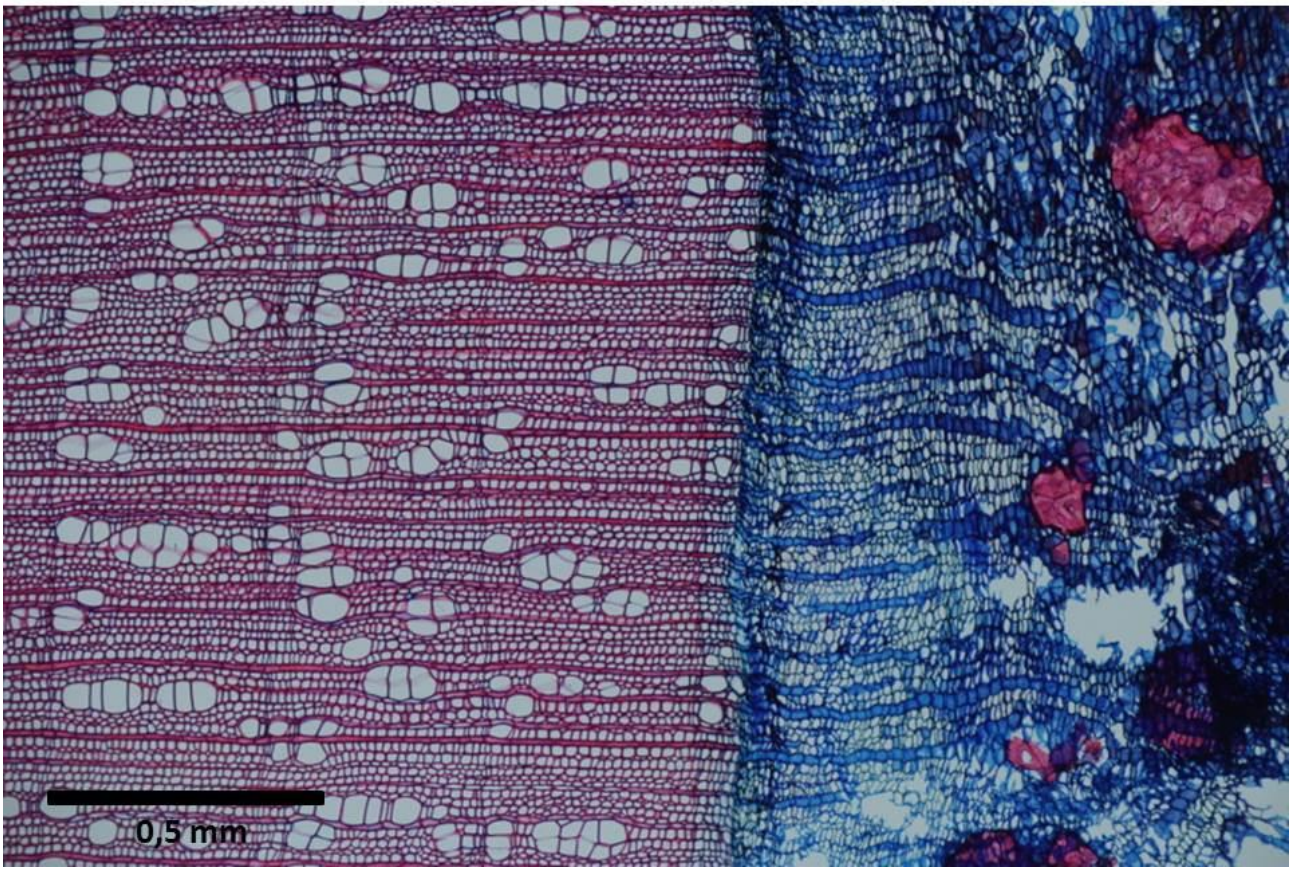


Fig.1. Cross-section of *Alnus crispa* with bark (blue), outermost annual rings, and other analysed growth parameters (vessels, lumens, cell walls) used for climate reconstructions.

"This study was supported by INTERACT Transnational Access (n° 262693) and by Internal Grant Agency (IGA no. A11/14), Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague."

CONTAMINATION OF PROGLACIAL WATERS OF SCOTT RIVER BY FORMALDEHYDE AND PHENOLS (BELLSUND, SPITSBERGEN)

Sara Lehmann[1], Waldemar Kociuba[2], Grzegorz Gajek[2], Łukasz Franczak[2], Leszek Łęczyński[3], Żaneta Polkowska[1]

[1]*Department of Analytical Chemistry, Chemical Faculty, Gdansk University of Technology, Gdansk, Poland;*
[2]*Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University in Lublin, Poland;*
[3]*Institute of Oceanography, University of Gdansk, Poland*

KEYWORDS: ARCTIC, SVALBARD ARCHIPELAGO, GLACIAL RIVER, POLLUTANTS, LONG RANGE ATMOSPHERIC TRANSPORT

Introduction

Studies on the presence of xenobiotics in the flowing water of the Arctic climate were conducted in NW Wedel Jarlsberg Land (SW Svalbard). The main object was Scott River's catchment (of glacial hydrological regime) which covers approximately the area of ca 10 km^2, 40% of which is occupied by the valley Scott's Glacier in the strong retreat. Water sampling points were located in 4 sites at the longitudinal profile of the river (Figure 1).

Pollutants being the result of anthropopression in the Eurasia area reach Scott River catchment due to the global migration of pollutants. Scott River is provisioned in 90% by the glacial waters. In lower run waters of Scott River are provisioned by the waters of the Reindeer Stream which is provisioned from the surface runoff from the seaside plane of Calypsostranda.

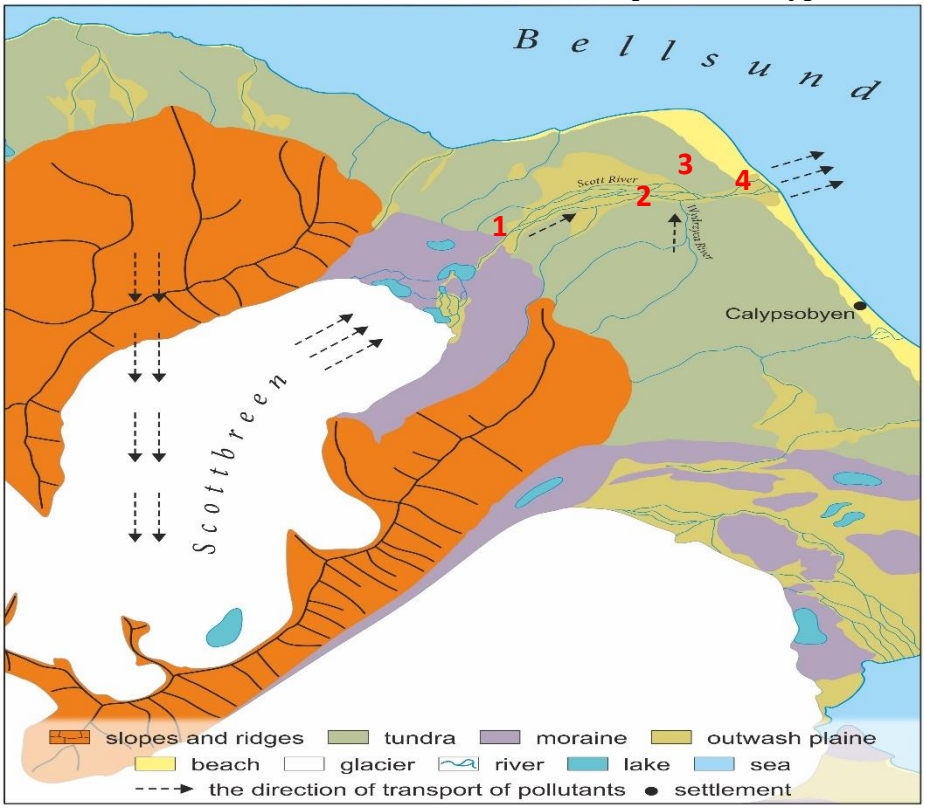


Figure 1. The route of pollutants transfer in the catchment area of the Scott River

Methods and materials

Samples of surface waters were collected from June 13 to August 23, 2012. The aim of studies was examination of presence and differentiation of concentration levels of organic pollutants in the Scott River's catchment. The following parameters were determined: formaldehyde, sum of phenols and conductivity. Spectrophotometer (Spectroquant PHARO 100, MERCK) as well as OK.-102/1 conductometer (by RADELIKS) were used at final determination steps.

Results

Results obtained from water samples was in the ranges of <LOD-0.073 mg/L and <LOD-0.192 mg/L, for formaldehyde and sum of phenols respectively. In table1 there are given initial results devoted to determining concentration levels of analytes observed in particular parts of the Scott River's catchment.

Table 1. The mean values of concentration levels of organic pollutants and physical parameters in 4 sites at the longitudinal profile of the river.

Parameter determined/unit	**Sampling points**			
	(1) Scott moraine (gorge)	**(2) Reindeer Stream**	**(3) Scott River (gorge)**	**(4) Scott River (river mouth)**
	Mean values of concentration			
Sum of phenols [mg/L]	0.192	<LOD	0.058	0.128
Formaldehyde[mg/L]	<LOD	0.073	0.040	0.050
Conductivity [µS]	110.0	340	110.0	120.0

Discussion

Formaldehyde (HCHO) which is present in the atmosphere can be a result of its emission from incomplete combustion of fossil fuels, photochemical reaction and vegetation processes. Formaldehyde present in the air reacts substantially and reversibly with water (Anderson, 1996). While sources of phenols in air are mainly combustion of fossil fuels, tobacco or product of benzene photooxidation, they are toxic even at low concentration. (Busca, 2008). Based on initial studies it can be stated that phenols reached glacial waters in their upper run. While formaldehyde is present only in lower part of the Scott River.

Acknowledgments

The study was conducted in the scope of the 24rd Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, implementing grant of the National Science Centre Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen) no 2011/01/B/ST10/06996.

REFERENCES

Anderson, L.G. et al. (1996): "Sources and sinks of formaldehyde and acetaldehyde: An analysis of Denver's ambient concentration data" Atmospheric Environment 30(12): 2113-2123

Busca, G. et al. (2008): "Technologies for the removal of phenol from fluid streams: A short review of recent developments" Journal of Hazardous Materials 160: 265–288

HIGH ARCTIC MYCORRHIZA OF *CASSIOPE TETRAGONA*

Kelsey Lorberau[1,2], Synnøve Botnen[1,2], Sunil Mundra[2], Pernille Bronken Eidesen[2], Håvard Kauserud[1]

[1]Department of Biosciences, Section for Genetics and Evolutionary Biology (EVOGENE), University of Oslo, Oslo, Norway
[2]The University Centre in Svalbard, Longyearbyen, Norway

KEYWORDS: *CASSIOPE TETRAGONA*, SVALBARD, ECTOMYCORRHIZA, ERICOID-MYCORRHIZA, ILLUMINA SEQUENCING

The High Arctic hosts a few hardy plant species which must thrive in low nutrient and water availability, low soil and air temperatures, and a short growing season, and are therefore particularly dependent on their mycorrhizal partners for increased nutrient acquisition and water uptake. Arctic fungi have been shown to be more diverse than previously thought, especially as the development of high-throughput sequencing techniques has allowed us to examine them on a molecular level. The mechanisms and morphology of the symbiosis differ among types of mycorrhiza, which implies that they impart dissimilar benefits to plant growth and reproduction. *Cassiope tetragona ssp. tetragona*, an ericaceous circumpolar Arctic shrub, has been previously reported to form ericoid- as well as ecto- mycorrhizal associations. We set out to sample *C.tetragona* roots from the High Artic archipelago, Svalbard, and from Northern Scandinavia, and to characterize the fungal communities over a latitudinal gradient, at the north and south of the species' range. We will use microscopy and Illumina sequencing of the internal transcriber region (ITS) to determine the abundance, richness, and composition of the root-linked fungal community and analyse how this relates to geographic, environmental, and edaphic factors, as well as to the ecology, distribution, and colonization history of *Cassiope tetragona*. A characterization of the current variation can give us insight into further questions related to this symbiosis including the role of mycorrhizal fungi in vegetation range shifts, dispersal, establishment, and growth in a changing climate, as well as a clearer picture of the Arctic mycological landscape.

REFERENCES:

Blaalid, R., Davey, M. L., Kauserud, H., Carlsen, T., Halvorsen, R., Høiland, K., Eidesen, P. B. (2014): "Arctic root-associated fungal community composition reflects environmental filtering." Molecular Ecology 23: 649-699

Eidesen, P. B., Carlsen, T., Molau, U., Brochmann, C. (2007): "Repeatedly out of Beringia: *Cassiope tetragona* embraces the Arctic." Journal of Biogeography 34: 1559-1574

Gardes, M., Dahberg, A. (1996): "Mycorrhizal diversity in arctic and alpine tundra: an open question." New Phytologist 133(1): 147-157

Väre, H, Vestberg, M., Eurola, S. (1992): "Mycorrhiza and root-associated fungi in Spitsbergen." Mycorrhiza 1: 93-104

GLACIER THERMAL STRUCTURE IN PETUNIABUKTA, SVALBARD

Jakub Małecki

Cryosphere Research Department, Adam Mickiewicz University, Poznań, Poland

KEY WORDS: GLACIER THERMAL STRUCTURE, GROUND-PENETRATING RADAR, SVALBARD

Adam Mickiewicz University in Poznań, Poland (AMU), has been carrying on research in Petuniabukta, central Spitsbergen, since 1980's. Recent years brought several milestones in understanding the local ice masses. One of them is disussed in the following presentation.

Climate influences distribution of temperature within ice, so climate shifts cause changes in glacier thermal structure. In Svalbard the smallest glaciers are known to be entirely cold, i. e. below the pressure melting point. Glaciers larger than ca. 3-5 km^2 are usually polythermal and contain a 'warm' basal layer - important for their hydrology, dynamics and geomorphological activity. Until now, the issue has not been well investigated in Petuniabukta.

Six glaciers of different size, shape and type have been surveyed with ground penetrating radar. The results show that the smallest glaciers in the study site have very little volume of 'warm' ice, while the larger ice masses contain 'warm' zones up to 60 m thick. Moreover, there is evidence that thermal structure of Petuniabukta glaciers is prone to changes due their documented mass loss.

THE USAGE OF PLANKTONIC SPECIES AS WATER MASS INDICES – A CASE STUDY OF COELENTERATES IN THE ATLANTIC SECTOR OF THE ARCTIC OCEAN

Maciej K. Mańko, Anna A. Panasiuk-Chodnicka, Maria I. Żmijewska, Angelika Słomska

Department of Marine Plankton Research, Institute of Oceanography, University of Gdańsk, Poland

KEYWORDS: COELENTERATES, ARCTIC OCEAN, WATER MASS INDICATORS, CLIMATE CHANGE

Introduction

Tracking water mass deployment is one of the most crucial tools for climate change forecasting. Recent research suggests that climate variability effects will be perceptible for the first time in the polar regions (ACIA, 2005), therefore those areas need. The majority of ongoing investigations suggest superiority of model studies over classical biological oceanography in detecting variations in water mass patterns.

The concept of using pelagic animals as water mass indicators, and therefore as global change indices has been evolving since the Challenger Expedition (1872-76). Already then Agassiz found use of some pelagic coelenterates (*Velella*, and *Physalia*) in guiding course of Gulf Stream. Those initial studies, although as mentioned - once included Coelenterata - were generally focused on Chaetognatha, as they were better studied. Later on, only a few inquiries were proceeded (i.e. Colebrook et al., 1963), but with the beginning of the 80s attempts to establish permanent linkages between plankton, and water masses emerged again, resulting i.e. the listing of biological descriptors of some currents in the Norwegian Sea (Węsławski et al. 1983).

Methods and Materials

Samples for this study were collected on the transect between Norway, and Spitsbergen which comprises the border line of three seas: Greenland, Norwegian, and Barents. Sampling was conducted with Bongo (500μm) net, associated with carrying CTD probe for water mass detection. Samples were then preserved in 4% formalin/seawater solution for later processing, which included taxonomical identification and counting of all coelenterates.

Results obtained from the laboratorial analysis were used during statistical processing where samples variability, PCA, MDS, and SIMPER analyses with Primer v.5. software (Clarke & Gorley, 2001) were conducted in order to elucidate relationship between plankton and environmental data.

Results

In the investigated area, three separate water masses were detected according to their physical characteristics, presence/absence of vertical mixing zones, and gyres taken into account: Arctic Water Mass (ArW), Atlantic Water Mass (AtW), and Coastal Waters (CW).

During plankton taxonomical analysis total of 21 taxa were recorded. The most abundant cnidarian was hydromedusa *Aglantha digitale*, other often encountered species were *Euphysa flammea*, and *Bougainvillia superciliaris*. Ctenophores were also frequently observed, however, due to their small size and preservation techniques their identification was impossible.

The results of Spearman's correlation coefficient confirmed influence of hydrological parameters on the biodiversity of Coelenterata and their abundance, which was used in MDS and SIMPER plotting. Those cumulative methods revealed three taxa and their abundances connection to a particular water mass which were: *Aglantha digitale*-AtW, *Bougainvillia superciliaris*-ArW, and high abundances of ctenophores-ArW.

Discussion

Climate change in the Arctic Ocean is easily observed. Although presence of three water masses remains constant, their spatio-temporal pattern has been changing. What seems to underlie such deployment is variable influx of AtW into investigated area which in the late 80s was estimated for 2.0 Sv (1 Sverdup = $10^6 \cdot m^3 \cdot s^{-1}$) (Blindheim, 1989), and now is 2.3 Sv (Semdsrud et al. 2013). From biological consideration, such fluctuations in warmer waters delivery may accelerate arrival of boreal species, prolong their stay, and facilitate their survival (Błachowiak-Samołyk, 2008).

Coelenterata distribution along investigated transect represents significant water mass association and therefore latitudinal-like variability. Higher species diversity was connected with AtW, but more numerous abundances were noted for cooler ArW.

Gelatinous planktonic animals are perceived as good indicators of water mass distribution, ocean-climate variability and seasonal timing of species arrival (Hays et al. 2005). Therefore, presented here study implies that certain Arctic Ocean species have a solid background for becoming water mass indicators and as a result of simplicity of such research, their usage should become a universal tool.

REFERENCES:

ACIA (2005) "Arctic Climate Impact Assessment." Cambridge University Press UK 1–1042

Blindheim, J. (1989) "Cascading of Barents Sea bottom water into the Norwegian Sea." Rapports et Procès-verbaux de Réunions - Conseil Permanent International pour l'Exploration de la Mer 188: 49-58

Błachowiak-Samołyk, K. (2008) "Contrasting zooplankton communities (Arctic vs. Atlantic) in the European Arctic Marginal Ice Zone." Oceanologia 50: 363-389

Clarke, K.R., Gorley, R. N. (2001) "Primer Version 5." Primer-E, Plymouth, UK

Colebrook, J., Glover, R. S., Robinson, G. A. (1963) "Contribution towards plankton atlas of the North-eastern Atlantic and the North Sea. General introduction." Bulletin of Marine Ecology 6: 78-100

Hays, G. C., Richardson, A. J., Robinson, C. (2005) "Climate change and marine plankton." Trends in ecology and Evolution 20: 337-344

Smedsrud, L. H., Esau I., Ingvaldsen, R. B., Eldevik, T., Haugan, P. M., Li, C., Lien, V. S., Olsen, A., Omar, A. M., Otterå, O. H., Risebrobakken, B., Sandø, A. B., Semenov, V. A., Sorokina, S. A. (2013) "The role of the Barents Sea in the Arctic climate system." Reviews of Geophysics 51: 415–449

Węsławski, J. M., Kwaśniewski, S., Wiktor, J. (1983) "An attempt to use biological indicators to determine the reach and origin of South Spitsbergen Sea Currents" Polish Archives of Hydrobiology 30: 189-197

SALTMARSH PLANTS AND LICHENS OF THE EUROPEAN RUSSIAN ARCTIC – BIODIVERSITY AND ECOLOGY

Eugeniya Markovskaya, Liudmila Sergienko, Angella Sonina, Nadeshda Elkina, Kira Morosova

Petrozavodsk State University, Ecological-biological Faculty, Department of Botany and Plant Physiology, Lenina, 33, Petrozavodsk 185910, Russia

KEYWORDS: SALTMARSH PLANTS, PHYSIOLOGY, LICHENS, POLLEN, LEAVES'ANATOMY

In Russia, most of the population of the Arctic Region is concentrated on the coasts of Holarctic tidal seas. Their environmental security guarantees the increase of the comfort of human life. The ongoing global climate changes lead to the disruption of functioning of natural complex of the Arctic coastal zone, which results in the disturbance of human activity affecting human health.

The plasticity of the morphological-physiological characteristics of saltmarsh plants and lichens of the tidal zone of the White Sea with the comparison the Cornelisson data (Cornelisson et al., 2003) have been done. The analysis showed that the value of the variation of the indicators at saltmarsh plants varies considerably in larger range that gives Cornelisson, which may indicate the higher plasticity in all plants of this ecotopes. The processing of data for the assessment of the plasticity of the two species (*Triglochin maritimum, Plantago maritima*) from the Barents Sea coast has shown that all CV (coefficient of variation) values at *Plantago maritima* was significantly higher than at *Triglochin maritimum* that confirms the results of conducted investigation on the White Sea coast. Probably these data are connected with the high polymorphism level of the genus *Plantago*. The researches allow to make conclusions about the extension property of plasticity in the next row types: *Glaux maritima, Triglochin maritimum, Aster tripolium, Plantago maritima*.

The lichen cover (species of the genus *Verrucaria*) depending on the distance from the water's edge on the model transect around the settlement Rast-Navolok (near Belomorsk-town) on the White Sea coast as the plasticity indicator was estimated. Coverage of this group of lichens on all plots from the water edge up to seashore have been shown the high values of the CV (from 63 to 88%).This indicates a large variety of suitable habitats for this group of organisms.

A study of the variability of the morphology of the leaves of *Aster tripolium* showed that the largest area (1976,0±892,3 mm) leaves at *Aster tripolium* with a high coefficient of variation (51 %) were detected in plants growing in plots near the water edge. When removed from the water's edge up to seashore the leaf surface is decreased almost in 3 times and is 476±187mm (middle part of transect) and 461,0 ± 151,4mm (upper part of transect) respectively. The value of CV for the leaf area along transects varies from 33 up to 51%.

Investigation of the structure of pollen grains of higher vascular plants on plots from the water's edge up to shore (*Triglochin maritimum, Aster tripolium, Glaux maritima*) have been conducted. In this regard, the following trends in the status of pollen grains of the investigated plants have been identified. At the *Aster tripoloum* the disturbance of structure of pollen grains varied from 5.0 up to 15.0%, at the *Glaux maritima* the disturbance of pollen grains varied from 6.0 up to 30.0% and at the *Triglochin maritimum* varied from the 18,0 up to 42.0%. For the

Aster tripolium and *Triglochin maritimum* the smallest amount of the phytoteratological pollen grains is marked at the water's edge, but for the *Glaux maritima* near the seashore, that may be related to their ability to endure the different duration of flood.

This approach will allow to give a full picture of the dynamics of coastal ecosystems in the long-term trend of its development. The allocation of functional types will allow to use more targeted approach for the understanding of the responses of coastal species to climate change, various pollutions and different processes of biomes‘dynamics.

REFERENCES:

Cornelissen J.H.C. (2003): “A hand book of protocols for standardised and easy measurement of plant functional traits worldwide” Australian Journal of Botany 51: 335-380

SEXUAL REPRODUCTION OF *RACOMITRIUM LANUGINOSIM* (BRYOPHYTES) ALONG AN ALTITUDINAL GRADIENT

Fumino Maruo[1], Masaki Uchida[2], Satoshi Imura[2].

[1]*The Graduate University for Advanced Studies (SOKENDAI);*
[2]*National Institute of Polar Research (NIPR)*

KEYWORDS: BRYOPHYTE, MT.FUJI, SEXUAL REPRODUCTION, ALTITUDINAL GRADIENT

Flowering plant populations located at the margins of species' distribution often display reduced sexual reproduction and an increased reliance on asexual reproduction. The one of hypothesis to explain this phenomenon is the declining sexual reproduction at the margins of species' distribution occur in connection with environmental depression of energetic costs to produce reproductive organs.

Margins of a specie's distribution translate a less favourable environment for the species. In our study, we therefore tested the hypothesis that moss populations located in less favourable environments rely less on sexual reproduction.

We conducted our study at alpine zone (2400 to 3700 m) of Mt.Fuji in Japan. Annual mean air temperature at 3776 (top) and 2400 m are -6.1 °C and +2.3 °C, respectively. The study site were placed every 100 m alt. in this zone. We investigated frequency of sporophyte and gametangia of *Racomitrium lanuginosum* (Hedw.) Brid. (Grimmiaceae, dioicous).

As a preliminary investigation, female inflorescences were found from 2400 to 3700 m altitude. Conversely, male one was not found more than 3500 m alt. and the antherdia were not found in the bract leaves at 3300 and 3400m altitude. Sporophytes were found at the site of existed female and male (2400, 2500 and 3000 m alt.).

Our preliminary results support that the trend that the frequency of sexual reproduction (production of sporophyte) decrease with increasing altitude, in line with our hypothesis. We assume that sporophyte's distribution is constrained by the present of male plants, or expression of male inflorescences.

REFERENCES:

Fisher, K. M. (2011): "Sex on the edge: reproductive patterns across the geographic range of the *Syrrhopodon involutus* (Calymperaceae) complex." The Bryologist 114(4): 674-685
Eckert, C. G.. (2002): "Loss of sex in clonal plant." Evolutionary Ecology 15: 501-520

INTERNAL DRAINAGE OF SPITSBERGEN GLACIERS

Bulat R. Mavlyudov

Institute of geography of the Russian Academy of Sciences, Moscow, Russia

KEYWORDS: GLACIAL HYDROLOGY, INTERNAL DRAINAGE OF GLACIERS, GLACIOSPELEOLOGY

The internal drainage is inherent for very many glaciers of Spitsbergen without dependences on glaciers types, dimensions and their thermal conditions. Main direct method of investigations – is speleological. Author begins to study glacier caves in 1982 but only from 2001 he has possibility to visit glacier caves in Spitsbergen. Up to now there are many internal drainage systems of Spitsbergen glaciers were investigated.

But up to now there are only theories of elements of internal drainage systems origin. Ways of occurrence of elements of an internal drainage of glaciers and also origin of internal drainage systems as a whole are considered.

It is shown that elements of an internal drainage can be formed either on the base of fissures and crevasses or by incision of water streams into ice from glacier surface. In last case drainage systems in glaciers situated in ice not very deep (usually at depth up to 15 m, more seldom up to 30 m) and not form subglacial channels. This kind of internal drainage is typical for cold glaciers without crevasses. Essentially internal drainage of glaciers origin on the base of fissures and crevasses. It can explain origin of moulins, cascades, different types of galleries in temperate, polythermal and cold glaciers but cannot explain origin of all internal drainage system as a whole.

Our investigations show that basic way of glacier drainage can formed on the base of sliding plane which is formed closely to glacier bed. This plane has small inclination in direction to glacier tongue and smooth all roughnesses of the glacier bed. Above this plane is moving ice but below it ice almost not move and we can name this ice as dead ice. Up to this plane water can come through fissure and crevasse channels. Spreading of water on the surface of this plane during spring time forms not effective drainage system of glacier however during ablation season planar fissure drainage channels are formed along this sliding plane and it is an effective drainage system of glacier. In cold periods an effective drainage system of glacier changes into not effective drainage system. As this sliding plane has contact with glacier bed on rock ledges (Riegels) internal drainage channels along glacier all time changes from subglacial to englacial and so on.

This offered point of view can explain selective erosion on the glacier bed, spring accelerations of ice movement velocity, formation of eskers and outbreaks of glacier-dammed lakes. It means that internal drainage very important in life of Spitsbergen glaciers.

TEMPERATURE AND MOISTURE VARIABILITY OF THE SELECTED TYPES OF TUNDRA VEGETATION AND ARCTIC SOILS DURING GROWING SEASON, SW SPITSBERGEN

Krzysztof Migała[1], Piotr Muskała[1] Bronisław Wojtuń[2], Wojciech Szymański[3]

[1]*University of Wrocław, Department of Climatology and Atmosphere Protection, Wrocław, Poland*
[2]*University of Wrocław, Faculty of Biological Sciences, Department of Ecology, Biogeochemistry and Environmental Protection, Wrocław, Poland*
[3]*Jagiellonian University, Institute of Geography and Spatial Management, Department of Pedology and Soil Geography, Kraków, Poland.*

KEYWORDS: ARCTIC SOILS, TUNDRA, SOIL TEMPERATURE, SOIL MOISTURE, SPITSBERGEN

The main objective of the study was to describe the range of temperature and moisture differences in tundra and arctic soils in the context of weather changes during the growing season. The studies were carried out in Wedel Jarlsberg Land (SW Spitsbergen) within a small unglaciated catchment, in a close vicinity of the Polish Polar Station in Hornsund. Measurements of air and soil temperature and changes in the volumetric soil water content were carried out between 24 June and 9 September 2008. The established sites represented: (1) moist Turbic Cryosol, poorly covered by vegetation, located within unstable patterned ground with active cryogenic processes; (2) wet Hyperskeletic Cryosol (Reductaquic) covered by a community of wet moss tundra with variable moisture which evolves under the influence of water flowing from the adjacent mountain slopes occupied by Little Auk colonies; and (3) dry Haplic Cryosol covered by lichen-herb-heath tundra, located on a raised marine terrace. Hyperskeletic Cryosol covered by wet moss tundra is the wettest from all the soil profiles studied. This profile shows the greatest fluctuations of water content, related to the rate of snow melting on the mountain slopes. The volumetric soil water content in Hyperskeletic Cryosol (Reductaquic) varies from 29% to 71% with an average value of 49%. The driest is Haplic Cryosol covered with lichen-herb-heath tundra. The mean volumetric soil water content is 6% and it ranges from 3% to 10% in the whole growing season. This is related to the sandy texture and a large number of stones, which leads to the fast infiltration of melting water and rainfall. Turbic Cryosol shows an intermediate volumetric water content ranging from 21% to 38% with a mean value of 30%. Thermal properties of the soils studied are also variable. The warmest was the driest Haplic Cryosol because no influence of cold thawing water was observed. During the measurement period, mean soil temperature at a depth of 10 cm in Haplic Cryosol was 6.3°C. Turbic Cryosol was ca. 1.2°C – 1.5°C colder then Haplic Cryosol. Hyperskeletic Cryosol was the coldest in comparison with the other soils studied because of the moss cover having insulating capacity. Temperatures recorded in this profile at a depth of 10 cm reached a mean value of 3.2°C. The results indicate that cold water inflow from a melting snow cover greatly affect soil temperature in the first part of summer (ablation season). This is related to an increase in solar radiation and air temperature leading to more intensive snow melting. This relationship is particularly evident in the first decade of July. The highest soil surface temperatures (>20°C) were recorded at the beginning of July under intensive solar radiation (25-27 MJ/m^2d^{-1}). In the second part of August, thermal gradients were weaker and soil temperatures in all the pedons studied were almost the same, ranging between +3°C and +6°C. This was due to the limited solar energy inflow and heat migration into the soil transported with rainfall.

REFERENCES:

Climate and Climate Change at Hornsund, Svalbard. Editors: A.A. Marsz and A. Styszyńska (authors: J. Ferdynus, A.A. Marsz, A. Styszyńska - Gdynia Martitime University, E. Łupikasza, T. Niedźwiedź - University of Silesia). The publishing house of Gdynia Maritime University, Gdynia, 402 p. ISBN: 978-83-7421-191-8.

Migała K., Wojtuń B., Szymański W., Muskała P., (2014). Temporal variation in thermal and moisture properties of selected types of tundra and arctic soils during the growing season: a case study from the Fuglebekken catchment, SW Spitsbergen. Catena, 116: 10-18.

Szymański, W., Skiba, S., Wojtuń, B., 2013. Distribution, genesis, and properties of Arctic soils: a case study from the Fuglebekken catchment, Spitsbergen. Pol. Polar Res. 34 (3), 289–304.

PARASITOFAUNA OF NOTOTHENIOID FISH FROM PRINCE GUSTAV CHANNEL, WEDDELL SEA, ANTARCTICA – EXPEDITION 2014

Veronika Michálková[1,2], Šárka Mašová[1] and Pavel Jurajda[2]

[1]*Department of Botany and Zoology, Faculty of Science, Masaryk University, Czech Republic*
[2]*Institute of Vertebrate Biology, v.v.i., AS CR, Brno, Czech Republic*

KEYWORDS: METAZOAN PARASITES; NOTOTHENIOID FISH; JAMES ROSS ISLAND; ANTARCTICA

Antarctica with its unique ecosystems is one of the last places on Earth that still remains almost untouched. Investigating of these areas still brings new information. During the Czech Antarctic expedition 2014 field research was carried out to study metazoan parasites of notothenioid fish from Prince Gustav Channel. Fish belonging to suborder Notothenioidei are largely found in the Southern Ocean and off the coast of Antarctica. As the dominant Antarctic fish taxa, they occupy both sea-bottom and water-column ecological niches. In total 102 specimens of six fish species mostly belonging to the family Nototheniodae (*Trematomus hansoni, T. bernacchii, T. newnesi, Notothenia coriiceps, Pagothenia borchgrevinki* and *Parachaenichthys charcoti*) were examined for parasites from January to March 2014. The fish were caught with gill nets and fish rods in the Prince Gustav Channel (depth about 5–25 m) in front of the Johann Gregor Mendel Station on the James Ross Island. More than 7700 metazoan parasites (mostly Nematoda, Acanthocephala and Monogenea) were found. The spatial distribution on fish gills of more than one thousand monogenean individuals (family Gyrodactylidae, Dactylogyridae and Capsalidae) was determined. Mean overall parasite abundance across the host species was 76. The most parasitized host was *Notothenia coriiceps* with the prevalence of 100 % and the mean parasite abundance of 117. Also the maximum abundance (565) was observed in *Notothenia coriiceps*. The fish were heavily infected with nematodes (mean abundance 37, prevalence 97 %). The prevalence of *Corynosoma* spp. (Acanthocephala) ranged from 39% in *T. newnesi* to 100% in *N.coriiceps*. The differences in the composition and quantity of parasites probably correspond to the different ecological niche of each fish species.

The authors are grateful to the staff of the Antarctic expedition 2014 in the Czech Antarctic Station ''J. G. Mendel'' in the James Ross Island for their help and support. This study was supported by Masaryk University and the Czech Science Foundation (project No. P505/12/G112).

STRONTIUM ISOTOPIC SIGNATURES OF THE TORRENT VALLEY STREAMS, MONOLITH AND PHORMIDIUM LAKES ON JAMES ROSS ISLAND, ANTARCTICA

Jitka Míková, Vojtěch Erban

Czech Geological Survey, Prague, Czech Republic

KEYWORDS: STRONTIUM, ISOTOPES, ANTARCTICA, JAMES ROSS ISLAND

The Antarctic Peninsula and adjacent islands is the third-most warming site worldwide and the fastest warming in the Southern Hemisphere. This warming is not only accelerating retreat of glaciers (leaving fresh rock surfaces exposed to extreme weather conditions) but also the rate of rock weathering. In order to understand processes of chemical weathering we are using strontium isotopes ratio ($^{87}Sr/^{86}Sr$) which is not fractionated by low temperature geochemical reactions (e.g., mineral dissolution and precipitation) or biotic processes, and may thus provide natural fingerprint of rock-water interaction.

Sampling on the Northern part of the James Ross Island was performed during the 2011 and 2012 field campaigns by a team of Czech Geological Survey. Sampling sites were selected in respect to bedrock lithology, consisting of two main geological domains (palagonitized basalts and Mesozoic sediments) with different geochemical and isotopic composition. Isotopic analyses were performed at Czech Geological Survey using ion exchange chromatography separation and TIMS (Finnigan MAT 232).

Data for water samples from Torrent Valley and Brandy Bay (Phormidium Lake and Monolith Lake basins) fall within two isotopically distinct groups. Water samples taken within Torrent Valley have less radiogenic $^{87}Sr/^{86}Sr$ ratios than samples from Brandy Bay. In Torrent Valley the $^{87}Sr/^{86}Sr$ ratios of the stream profile from the glacier to the sea shore become less radiogenic with increasing distance from the glacier. Torrent Valley is dominated by volcanic rocks and the isotopic composition of waters is close to their previously published isotopic data (0.7033 ± 0.0002; Košler et al., 2009), thus implying major contribution of volcanic source of the Sr in the water.

Water samples collected within Phormidium Lake basin have $^{87}Sr/^{86}Sr$ ratios close to marine sediments (0.7085 ± 0.0006; Nývlt et al., 2011) which are in good agreement with the geological situation on site. There are significant isotopic variations in the stream data. Some of the small streams entering Phormidium Lake are more radiogenic and some are less radiogenic than the waters of the lake itself. The $^{87}Sr/^{86}Sr$ ratio of the Phormidium Lake lies on the mixing line between the stream waters. If the assumption that the $^{87}Sr/^{86}Sr$ ratio of the sea water in Brandy Bay is equivalent to the modern-day seawater composition value is true, it seems that the sea spray aerosol contribution is not significant here, even the Phormidium Lake is in the close proximity to the shore. Data for Monolith Lake basin show $^{87}Sr/^{86}Sr$ ratios as a mixture between marine sediments and volcanic rocks as volcaniclastic breccias are quite abundant at this site. Our preliminary results imply that strontium isotopic composition can be successfully used as a tool to discern the proportions of geological materials undergoing chemical weathering at periglacial environment of JRI.

This study was supported by the Czech Ministry of Environment (project No. SPII1A9/23/07), by the Czech Geological Survey, and by the scientific infrastructure of the J.G. Mendel Czech Antarctic Station.

REFERENCES:

Košler, J., Magna, T., Mlčoch, B., Mixa, P., Nývlt, D., Holub, F.V. (2009): "Combined Sr, Nd, Pb and Li isotope geochemistry of alkaline lavas from northern James Ross Island (Antarctic Peninsula) and implications for back-arc magma formation." Chemical Geology 258(3-4), 207-218

Nývlt, D., Košler, J., Mlčoch, B., Mixa, P., Lisá, L., Bubík, M., Hendriks, B.W.H. (2011): "The Mendel Formation: Evidence for Late Miocene climatic cyclicity at the northern tip of the Antarctic Peninsula." Palaeogeography, Palaeoclimatology, Palaeoecology 299, 363–384

AN ORTHOBUNYAVIRUS WAS DETECTED IN TICKS FROM JAN MAYEN

Jana Müllerová[1, 2], Jana Elsterová[1, 2], Jiří Černý[1, 2], Daniel Růžek[1, 2,3] and Steve Coulson[4]

[1]*Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic*
[2] *Institute of Parasitology, Biology Center AS CR, Branišovská 31, České Budějovice, Czech Republic*
[3] *Department of Virology, Veterinary Research Institute, Brno, Czech Republic*
[4] *Arctic biology department, University centre in Svalbard, Longyearbyen, Svalbard*

Arthropod-borne viruses (arboviruses) such as Dengue virus, West Nile virus, Japanese encephalitis virus, Chickungunya virus etc. pose a serious public health threat. Despite they are intensively studies in tropical and mild climate areas their prevalence in polar areas is mostly unknown.

We screened large number of ticks and mosquitoes from Greenland, Jan Mayen, and Svalbard using RT-PCR reaction with universal primers against genera Flavivirus, Orthobunyavirus, Phlebovirus, Orbivirus, and Alphavirus. Tick *I. uriae* from Jan Mayen was positive for an Orthobunyavirus. Subsequent sequencing confirmed presence of representative of Orthobunyavirus genus. Analysis showing phylogenetic relationship between newly described virus and other viruses within Orthobunyavirus will be discusses.

As neither natural host of novel virus nor its prevalence in its population is known we can only speculate about the role of the novel arbovirus in polar ecosystems.

THE VARIATION IN WOOD ANATOMICAL TRAITS OF BETULA NANA ALONG A CLIMATIC GRADIENT IN WESTERN GREENLAND

Sigrid Nielsen, Anders S Barfod, Signe Normand

Ecoinformatics and Biodiversity Group, Department of Bioscience, Aarhus University

KEYWORDS: GREENING OF THE ARCTIC, BETULA NANA, DENDROECOLOGY, VARIATION OF WOOD ANATOMICAL TRAITS

Introduction

Ongoing climate change is affecting ecosystems all over the world. The arctic ecosystem is adapted to a changing climate but the ongoing changes are 2-3 times faster in this area than in the rest of the world and faster than in the Pleistocene-Holocene transition.

One of the most obvious changes to the arctic tundra is known as *Greening of the Arctic* which is due to changes in plant phenology, changes in plant community composition, and an increase in plant biomass. Many studies show that the cover of dwarf shrubs is expanding. This shrubification is caused by higher temperatures, longer growing seasons, altered soil moisture conditions, increased nutrient availability, changes in snow cover, and altered disturbance regimes due to permafrost thaw, tundra fires, anthropogenic factors, and herbivory.

The knowledge about how and why the shrubs are expanding is still limited. It is known that the effect of climate-change on species differ between habitats and along climatic gradients but a more thorough understanding of the drivers behind species-specific variation in time and space is needed.

A dendroecological approach is of great value in the study of woody species, since a well-functioning xylem is essential for survival. *Betula nana* is a circumpolar species that potentially will be able to increase its abundance all over the Arctic. It is therefore interesting to investigate how well this species is able to adapt to different conditions.

Methods and materials

Betula nana was collected from four sites along a climatic gradient in the Nuuk Fjord. The gradient goes from the humid and warm coastal climate to a drier and cooler inland climate. At each site we collected shrubs along an elevational gradient as well as data on topography, plant cover, and composition. In total we collected 174 plants in 29 plots.

Two samples were taken from the aboveground plant-parts to study the wood anatomical variation. Several cross sections were made from each sample. These sections were stained with Safranin and Astrablue in order to distinguish between lignified and non-lignified parts of the wood and to enhance the contrast to make the image analysis easier, thereafter the sections were dehydrated by rinsing with alcohol and xylol. The sections were embedded in Canada-Balsam and oven-dried at 60 °C for about 24 h. Digital photos with 40x magnification were taken of the best cross section from each sample.

The sections were analysed in ROXAS which made it possible to determine vessel size and vessel grouping. ROXAS makes the process much more efficient and reproducible compared to the manual method without losing significant accuracy. The variation in parameters between plots and sites were analysed and put into a climatic context.

Results

Some very promising preliminary results have been obtained from the raw data but data analysis is unfinished.

Discussion

If the knowledge of how well *Betula nana* is able to adapt to different climatic conditions is implemented in models for the distribution of this species under future climatic, these models will be much more precise. If similar knowledge is obtained for other species it will be possible to map the future distribution of the shrub communities in the arctic more accurately. This is of great importance since the destinies of these key species shape the destiny of the rest of the ecosystem.

TIMING OF THE NORTHERN PRINCE GUSTAV ICE STREAM RETREAT AND THE DEGLACIATION OF NORTHERN JAMES ROSS ISLAND, ANTARCTIC PENINSULA DURING THE LAST GLACIAL-INTERGLACIAL TRANSITION

Daniel Nývlt[1], Régis Braucher[2], Zbyněk Engel[3], Bedřich Mlčoch[4], ASTER Team[# 2]

[1]*Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic,*
[2]*Aix-Marseille Université, CNRS-IRD-Collège de France, UM 34 CEREGE, Technopôle de l'Arbois, Aix en Provence, France*
[3]*Faculty of Science, Charles University in Prague, Praha, Czech Republic*
[4]*Czech Geological Survey, Praha, Czech Republic*
[#] *ASTER Team: Maurice Arnold, Georges Aumaître, Didier Bourlès, Karim Keddadouche*

KEYWORDS: NORTHERN PRINCE GUSTAV ICE STREAM; ^{10}BE EXPOSURE DATING; SCHMIDT HAMMER TESTING; PLEISTOCENE-HOLOCENE TRANSITION; JAMES ROSS ISLAND

The Antarctic Ice Sheet extended to the continental shelf edge in many locations during Quaternary glacial stages and commenced its most recent retreat during the last glacial-interglacial transition, i.e. between 15 and 8 ka. Numerous ice streams drained the Antarctic Peninsula Ice Sheet during glacial times flowing down to the continental shelf edge. Northern Prince Gustav Ice Stream located in Prince Gustav Channel along the north-eastern coast of the Antarctic Peninsula drained part of the Antarctic Peninsula Ice Sheet through the present Prince Gustav Channel to the east. Well-preserved glacigenic accumulation with abundant erratic boulders at the neck of Cape Lachman, northern James Ross Island has been left here after its retreat.

Here we present a chronology of its retreat based on *in situ* produced cosmogenic ^{10}Be from erratic boulders at Cape Lachman, northern James Ross Island. Schmidt hammer testing was adopted to assess the weathering state of erratic boulders in order to better interpret excess cosmogenic ^{10}Be from cumulative periods of pre-exposure or earlier release from glacier. The approach applied here reduces sources of potential errors (i.e. the inheritance of cosmogenic ^{10}Be, earlier release from glacier, or later exhumation from sediment) and can provide a reliable measure of timing of the last deglaciation. A weighted mean exposure age is preferred for our dataset, where statistical analysis confirms that ^{10}Be exposure ages are grouped in cluster. Furthermore, Schmidt hammer R-values are markedly inversely correlated with ^{10}Be exposure ages and could be used as a proxy for exposure history of erratic granite boulders in this region.

The weighted mean exposure age of five boulders based on Schmidt hammer data is 12.9 ± 1.2 ka representing the beginning of the deglaciation of lower-lying areas (<60 m a.s.l.) of the northern James Ross Island, when Northern Prince Gustav Ice Stream split from the remaining James Ross Island ice cover and since that time both glacier bodies behaved separately. This age represents the minimum age of the transition from grounded ice stream to floating ice shelf in the middle continental shelf areas of the northern Prince Gustav Channel. The remaining ice cover located at higher elevations of northern James Ross Island retreated during the Early Holocene before 7 ka due to gradual decay of terrestrial ice and increase of equilibrium line altitude. These data provide evidences for an earlier deglaciation of northern James Ross Island when compared with other recently presented cosmogenic nuclide based deglaciation chronologies. Its timing coincides however with the rapid increase of atmospheric temperature in this marginal part of Antarctica.

Acknowledgements
This study was supported by projects: VaV SP II 1a9/23/07 and CZ.1.07/2.3.00/30.0037. We appreciate the use of the Czech Antarctic J.G. Mendel Station scientific infrastructure and the support of its crew during our fieldwork.

SUBMERSED FISSURES OF ICELAND, ECOLOGICAL AND GEOGRAPHICAL MAPPING

Jónína Herdís Ólafsdóttir[1], Jóhann Garðar Þorbjörnsson[1],
Kjartan Guðmundsson[2], Jón S. Ólafsson[3] Bjarni Kristófer Kristjánsson[1]

[1]*Department of aquaculture and fish biology. Hólar University College, Sauðárkrókur, Iceland.*
[2] *Department of life and environmental science. University of Iceland, Reykjavik, Iceland.*
[3]*Institute of freshwater fisheries, Reykjavik, Iceland.*

KEYWORDS: FISSURES, GROUNDWATER, BIODIVERSITY, INVERTEBRATES

The location of Iceland on two diverging tectonic plates has resulted in the formation of numerous fissures paralleling the fault line. Often these fissures provide an opening into aquifers of groundwater being filtered through the porous volcanic rock. No studies have been conducted specifically on the biology of submersed fissures, which offer a unique opportunity to study groundwater habitats. The main objective of the project was to explore and geographically and ecologically map groundwater filled fissures in two locations in Iceland, Þingvellir (SW-Iceland) and Kelduhverfi (NE-Iceland). All samples and measurements were acquired by scuba diving. The biological sampling focused on systematically describing the biological diversity in the fissures as well as caverns and caves that are found within them. A special emphasis was put on invertebrate fauna while presence or absence of fish was also noted. The invertebrate samples are still being analysed. Preliminary results show that the invertebrate life in these fissures is diverse, but with chironomidae species dominating. In all fissures studied Arctic charr could be found and in one fissure the groundwater amphipod, *Crangonyx islandicus*, was found. Previously unknown fissures were discovered during the project. These were measured for the construction of geographical maps. This study lays the groundwork for further systematic studies of the biodiversity of this unique ecosystem. The project was supported by the National Geographic Society.

FLUVIAL DYNAMICS AND BEDLOAD TRANSPORT IN THE PROGLACIAL AREA OF BERTILBREEN, CENTRAL SVALBARD

Jakub Ondruch[1], Jan Kavan[2], Petr Holík[1], Jan Blahůt[3]

[1] *Department of Geography at Faculty of Science, Masaryk University, Czech Republic*
[2] *Centre for Polar Ecology, Faculty of Science, University of South Bohemia, Czech Republic*
[3] *Institute of Rock Structure and Mechanics, Academy of Sciences of Czech Republic*

KEYWORDS: FLUVIAL, PROGLACIAL, SEDIMENT BUDGET, BEDLOAD TRANSPORT

Climatic driven changes in polar as well as alpine environments cause rapid retreat of glaciers (e.g. Machguth et al., 2012) resulting in a formation of proglacial areas. These areas are characteristic by dynamic geomorphological processes. Fluvial processes in proglacial environment represent an important medium of landscape modelling as well as transport of energy and matter that enables the development of various landforms that increase proglacial ecosystems diversity.

A hydrological regime of proglacial streams is tightly related to the dynamics of adjacent glacier. In present days, most of glaciers have been receding due to the climate change (Vaughan et al., 2013). Retreat of glaciers, in turn, causes alterations in magnitude and patterns of energy inputs into the fluvial system. Understanding of recent fluvial processes represents an important contribution to studies on effects of recent as well as palaeo changes in climate on a surrounding environment.

The aim of our contribution is to introduce first results of fluvial dynamics of the channel that flows within the Bertilbreen outwash plain, Svalbard. Sediment samplers were utilised to study the variability in a bedload transport in relation to velocity and discharge measurements. Seasonal and interannual complex changes in a fluvial environment were monitored by applying terrestrial laser scanner.

REFERENCES:

Machguth, H., Haeberli, W., Paul, F. (2012): Mass-balance parameters derived from a synthetic network of mass-balance glaciers. Journal of Glaciology, 58 (211), 965–979

Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang, (2013): Observations: Cryosphere. In: Climate Change 2013: The Physical Sci ence Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

DIVERSITY OF TERRESTRIAL CYANOPROKARYOTES IN POLAR DESERTS OF THE NORTHERN HEMISPHERE

Elena Patova[1], Denis Davydov[2]

[1] Institute of Biology, Komi Scientific Center, Russian Academy of Sciences,
[2] Polar-Alpine Botanical Garden-Institute, Kola Scientific Center, Russian Academy of Sciences,

KEYWORDS: CYANOPROKARYOTES, POLAR DESERTS, ARCTIC

Cyanoprokaryota (Cyanobacteria) are ancient spore phototrophic organisms. They participate in cycles of oxygen, nitrogen, silicon, phosphorus, and many other nutrients in aquatic and terrestrial ecosystems. With reduced competition from higher plants, cyanoprokaryotic mats and films occupy significant territories in polar deserts. The studies on cyanoprokaryot in polar deserts are rare and inhomogeneous due to the problems of the region accessibility. The diversity of cyanoprokaryota species, living in terrestrial conditions in polar deserts of the northern hemisphere, was evaluated using all available published articles as well as samples which were analysed by the authors from North-East Land Island (Svalbard) and Bolshevik Island (Severnaya Zemlya Archipelago).

List of terrestrial cyanoprokaryota was done for 12 areas of the polar deserts. It includes 148 species of 50 genera, 19 families. The highest number of species cyanoprokaryota were revealed for the Franz Josef Land Archipelago (59) (Novichkova-Ivanova, 1972), North-East Land Island (Svalbard) (57 species) (Davydov, 2013), and Bolshevik Island (Severnaya Zemlya Archipelago) (39) (Patova, Belyakova, 2006). The number of species varied from 4 to 57 for the rest territories. The numbers are comparable with other taxonomic lists from different regions of the Arctic and Antarctic. Up to date, the list of cyanoprokaryota species in Barents province of the arctic polar deserts has 107 species, in Canadian province of the arctic polar deserts it includes 29 species (Elster et al., 1999), and in Siberian province - 39.

Dominant complexes forming species of the genera *Nostoc, Microcoleus, Phormidium, Symplocastrum, Aphanocapsa, Chroococcus, Gloeocapsa, Pseudanabaena, Scytonema.*

REFERENCES:

Davydov D. (2013): "Diversity of the Cyanoprokaryota in polar deserts of Rijpfjorden east coast, North-East Land (Nordaustlandet) Island, Spitsbergen" Algological Studies. Vol. 142: 29-44.

Elster J., Lukesová A., Svoboda J., Kopecky J., Kanda H. (1999): "Diversity and abundance of soil algae in the polar desert, Sverdup Pass, central Ellesmere Island" Polar Record. Vol. 194: 231-254.

Novichkova-Ivanova L. N. (1972): "Soil and aerial algae of polar deserts and arctic tundra" Proc. IV Intern. Meeting on the Biological / F. E. Wielgolaski and T. Rosswall, eds. Leningrad:261-265.

Patova E., Belyakova R. (2006): "Terrestrial Cyanoprokaryota Bolshevik Island (Severnaya Zemlya Archipelago)" Novosty systematiki nizchich rasteniy. 40: 83-91. (in Russian).

HOW TO GET A JOB IN RESEARCH?

Riku Paavola

University of Oulu, Finland
Oulanka research station, Kuusamo, Finland

The question on every young researcher's mind is how to land a job, or better yet, a permanent position. When that Holy Grail is finally found, the question in this present day of budget and funding cuts then becomes 'How to keep the job?' In this presentation I will try to answer those questions based on experience gathered during my working years, which include many experiences, both good and bad. I will also devote time to discuss practical questions related to the topic, such as the following: 'How to prepare for and handle a job interview?' and 'How to apply and prepare for a position?'

THE ORGANELLAR GENOMES OF THE POLAR GREEN ALGA *PRASIOLA CRISPA* (TREBOUXIOPHYCEAE)

Marie Pažoutová[1, 2, 3], Jiří Košnar[1], Bradley J. S. C. Olson[4], Akira F. Peters[5], Fabio Rindi[6], Alison Sherwood[7], David R. Smith[8], Heroen Verbruggen[9], Stephane Rombauts[10, 11]

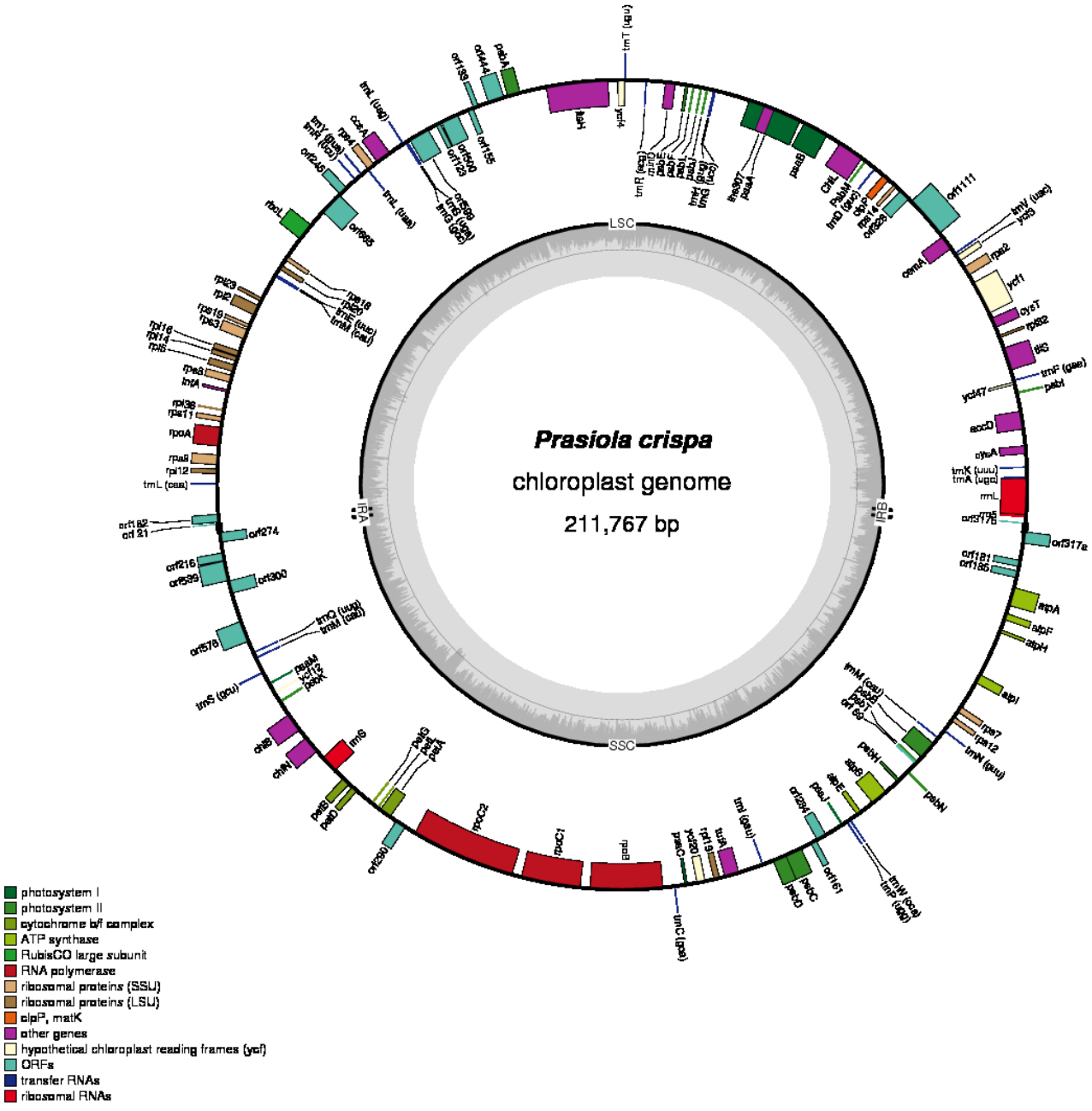
[1]*Department of Botany, Faculty of Science, University of South Bohemia, Ceske Budejovice Czech Republic;*
[2]*Institute of Parasitology, Biology Centre AS CR, Ceske Budejovice, Czech Republic;*
[3]*Centre for Polar Ecology, Ceske Budejovice, Czech Republic;*
[4]*Kansas State University, Manhattan, USA;*
[5]*Bezhin Rosko, 29250 Santec, France;*
[6]*Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italy;*
[7]*University of Hawai'i at Mānoa, Honolulu, USA;*
[8]*University of Western Ontario, London, Canada;*
[9]*School of Botany, University of Melbourne, Melbourne, Australia;*
[10]*Department of Plant Systems Biology, Gent, Belgium;*
[11]*Department of Plant Biotechnology and Genetics, Ghent University, Gent, Belgium*

KEYWORDS: POLAR ALGAE, GENOMICS, ORGANELLES, GREEN ALGAE, *PRASIOLA CRISPA*

To gain a better understanding of biology and evolution of one of the key primary producers in polar regions, we are sequencing the whole genome of *Prasiola crispa* (specimen CCALA 1053, isolated on Falkland Islands), a terrestrial green alga with cosmopolitan distribution in polar and cold temperate zones. As a first result we are presenting here the complete genomes of its organelles (plastid and mitochondrion). With their respective sizes of 211,767nt (pt) and 100,036nt (mt), both organelles are the largest among the trebouxiophytes sequenced so far. Unlike another cold-adapted alga, *Coccomyxa subellipsoidea* (Smith et al. 2011), the GC percentage of *Prasiola* organellar DNA is rather low, 28.8% and 29.3%, as is common in most green algae. The gene content corresponds well with other sequenced trebouxiophyte organellar genomes; only one protein gene and a few tRNAs are missing in the plastid; a similar result was recovered for the mitochondrion. Unlike in mitochondria of other sequenced trebouxiophytes, we found the mitochondrial *rpl*10 gene. Its presence can be interpreted as a plesiomorphy shared with green algal ancestors and lost in some trebouxiophyte lineages. The architecture of green plastids commonly displays a quadripartite structure with presence of two copies of Inverted repeats (IRs): the IR regions are rather conserved among basal green algae as well as in land plants and usually encode the ribosomal proteins; however, they are often missing in trebouxiophytes. In the *P.crispa* plastid, reduced inverted repeats (IRs) were found. They are only 851 bp long and bear no genes, thus, they represent the most derived state of the repeats found so far. While the genes are more or less equally distributed on both strands in the plastid DNA, the mitochondrion shows strong tendency towards a strand-specific transcription (strandedness). Both organelles are rich with unidentified open reading frames (ORFs), which often encode putative mobile elements of non-eukaryotic origin (phage-like integrase/recombinases in the plastid and LAGLIDADG homing endonucleases in the mitochondrion).

The extremely variable organelle genomes of green algae provide a unique source of data for comparative genomics and phylogenomics. By showing the complete annotated organellar genomes of *Prasiola crispa* we shed new light on the evolution of this extremophile organism.

REFERENCES:
Smith, D. R., Burki, F., Yamada, T., Grimwood, J., Grigoriev, I.V., Van Etten, J.L., Keeling, P. J. (2011): "The GC-Rich mitochondrial and plastid genomes of the green alga *Coccomyxa* give insight into the evolution of organelle DNA nucleotide landscape" PLoS ONE 2011,
Fig. 1. Circular map of the *Prasiola crispa* CCALA 1053 chloroplast genome. The inner circle illustrates the GC content (grey bars) and the quadripartite structure (LSC ¬ Large Single Copy region, SSC ¬ Small Single Copy region, IRA, IRB ¬ Inverted Repeats).



BIOGEOGRAPHICAL PATTERNS OF ANTARCTIC CYANOBACTERIA

Igor Stelmach Pessi, Pedro de Carvalho Maalouf, Haywood Dail Laughinghouse IV, Annick Wilmotte

Centre for Protein Engineering, University of Liège, Liège, Belgium

KEYWORDS: 454 PYROSEQUENCING, ANTARCTICA, BIOGEOGRAPHY, CYANOBACTERIA, DGGE

Cyanobacteria are often considered as the dominant phototrophs in Antarctic lacustrine environments, primarily occurring in benthic or floating microbial mat communities. Previous studies have indicated the presence of endemic cyanobacteria in the Antarctic Realm, but the extent and patterns of cyanobacterial bioregionalisation, if any, are still largely unknown. Therefore, our objective is to assess the cyanobacterial diversity in Antarctic lacustrine microbial mats using Denaturating Gradient Gel Electrophoresis (DGGE) and 454 pyrosequencing, in order to determine if cyanobacterial biogeographical patterns are similar to those observed for multicellular organisms. We also tested the relative contribution of geographical and ecological factors for the structure of the microbial communities.

Benthic microbial mats were sampled manually and with an UWITEC gravity corer in the littoral zone and bottom of lakes, respectively. Temperature, specific conductance, pH, salinity, and oxygen concentration were measured in the field using an YSI 600 water quality meter. Water samples for nutrient analysis were collected in sterile Nalgene bottles and frozen until analysis. A stratified random sampling approach and Principal Component Analysis (PCA) were carried out with the limnological properties of over 130 sampled lakes. This resulted in the selection of 50 samples for the analyses, which included the main limnological gradients present in the sampled lakes. A detailed description of the sampling protocol can be found in Verleyen *et al*. (2010) and references therein. DNA was extracted from the microbial mats using the PowerSoil DNA Isolation kit (MO-BIO), according to manufacturer's instructions. The V3-V4 hypervariable region of the 16S rRNA gene was amplified by PCR using the cyanobacterial specific primers 359F and 781Ra/781Rb (Nübel *et al.* 1997). PCR products were purified using the GeneJet PCR Purification kit (ThermoScientific) and submitted to DGGE and 454 pyrosequencing analyses. DGGE was carried out according to Boutte *et al*. (2005), and bands were excised and sequenced in 3730 DNA Analyser (Life Technologies). Sequences were manually curated and clustered into Operational Taxonomic Units (OTUs) at 98.5% similarity using mothur (Schloss *et al*. 2009). OTUs were grouped according to their geographical distribution, after retrieving sequences with >98.5% similarity deposited in GenBank. Finally, differences in community structure between lakes and the importance of geographical and ecological factors were assessed using PCA and Variation Partitioning Analysis (VPA), respectively. For the 454 pyrosequencing analyses, purified amplicons were pooled equimolarly and sequenced using the 454 GS FLX Titanium Platform (Roche/Life Technologies).

DGGE analyses revealed a total of 35 OTUs across all 50 samples (between one and four OTUs per sample), covering all major cyanobacterial orders, namely Oscillatoriales (63%), Chroococcales (20%) and Nostocales (17%). *Leptolyngbya* and *Phormidium* were the most common genera, with seven and five OTUs, respectively. The majority of the OTUs (22 out of 35) had a cosmopolitan distribution. The remaining 13 OTUs were restricted to polar and alpine regions, with five OTUs being potentially endemic to Antarctica. No differences in regional

cyanobacterial diversity was observed by multivariate analyses, with 8.9% and 6.6% of the variation in community structure being explained by geographical and ecological factors, respectively. These results suggest frequent dispersal within the continent, resulting in a more homogeneous cyanobacterial flora in comparison to what has been observed for multicellular organisms. However, the use of high-throughput sequencing technologies such as Roche's 454 pyrosequencing has been proven very valuable for the detection of rare and/or difficult to cultivate taxa, since culture-based methods or molecular methods such as DGGE and clone libraries are known to substantially underestimate the diversity found in natural environments. Therefore, 454 pyrosequencing analyses are being currently carried out, which will provide a deeper picture on the biogeographical patterns of Antarctic cyanobacteria.

REFERENCES:

Boutte, C., Grubisic, S., Balthasart, P., Wilmotte, A. (2006): "Testing of primers for the study of cyanobacterial molecular diversity by DGGE" Journal of Microbiological Methods 65, 542–50

Nübel U., Garcia-Pichel F., Muyzer G. (1997): "PCR primers to amplify 16S rRNA genes from Cyanobacteria" Applied and Environmental Microbiology 63: 3327–3332

Schloss P. D., Westcott, S. L., Ryabin, T., Hall, J. R., Hartmann, M., Hollister, E. B., Lesniewski, R. A., Oakley, B. B., Parks, D. H., Robinson, C. J., Sahl, J. W., Stres, B., Thallinger, G. G., Van Horn, D. J., Weber, C. F. (2009) "Introducing mothur: open-source, platform-independent, community-supported software for describing and comparing microbial communities" Applied and Environmental Microbiology 75: 7537–7541

Verleyen, E., Sabbe, K., Hodgson, D., Grubisic, S., Taton, A., Cousin, S., Wilmotte, A., De Wever, A., Van der Gucht, K., Vyverman, W. (2010) "Structuring effects of climate-related environmental factors on Antarctic microbial mat communities" Aquatic Microbial Ecology 59: 11–24

MIGRATION OF MERCURY IN THE WATER-SOIL-PLANT SYSTEM

Vahagn Petrosyan

Yerevan State University

Introduction

Pollution of environment is very serious hazard for biosphere. Among the pollutants of environment the heavy metals are important factor and present great interest for research. This is due to the fact that even small amount of these metals, which are accumulated in soil, water, plants, have toxic effects on living organisms.

Among the heavy metals the mercury belongs to a number of primary pollutants, which has high intensity to insert into water migration and has property to create humic complexes fixed into soil. Mercury vapors have phytotoxic properties; they suppress the growth of branches and roots of plants and promote aging of plants. Penetrating into human organism high concentrations of mercury are capable to be accumulated in the internal organs (liver, kidney, heart and brain).

Mercury in water: The main appearing way of mercury in the aquatic ecosystems is wastewater inflow into the water. Mercury ions create large amount of complex substances with various organic and inorganic ligands.

Mercury in soil: Pollution of soil with mercury conditioned by production of ferrous metallurgy, usage of mercury-containing fungicides, usage of wastewater for irrigation purposes, mercury mines development etc. In the same elementary landscape mercury primarily accumulates in areas which are rich with organic substances.

Mercury in plants: Surplus of toxic substances, particularly heavy metals, in the soil can cause pollution of plants which are growing on that soil. Absorption of mercury by plants cannot be judged through aggregate amount of mercury in the soil because the accessibility of mercury depends on several parameters: pH, amount of organic substances and carbonates in the soil [1].

Methods

The aim of the work is to study the migration of mercury in water-soil-plant system.

It has been studied the content of mercury in soil, irrigation water and plants (strawberry, potato, onion), which have grown on that soil.

Analyses were performed by AMA 254 mercury analyser, which allows to identify content of mercury in solid, liquid and gaseous samples quickly and effectively [2].

Results

In Table I it is shown the results from experiments:

Table I. Content of mercury in samples

Sample	Content of mercury (mg/kg, mg/l)
Soil (MPC=2.1mg/kg)	0.01189
Water (MPC =0.0005mg/l)	0.0027
Strawberry	0.0029
Potato	0.0160
Onion	0.0013

Conclusions

From findings it is evident that content of mercury in irrigation water exceed maximum permissible concentration (MPC = 0.0005mg/l). Content of mercury in the soil is higher than in water and plants, it is conditioned by soil property to accumulate metals.

REFERENCES

[1] Yanin E.P. "Mercury, people, environment" M. 169p., 1992.

[2] AMA 254 Advanced Mercury Analyser Operating Manual. Copyright. 2000, 2001, 2002 by Altec Ltd., Khodlova 1297, 193 00 Prague 9, Czech Republic.

HIDDEN DIVERSITY IN ARCTIC FILAMENTOUS CONJUGATING GREEN ALGAE (ZYGNEMATOPHYCEAE, STREPTOPHYTA)

Martina Pichrtová[1,2], Jana Kulichová[1], Tomáš Hájek[2,3], Josef Elster[2,3]

[1]Charles University in Prague, Faculty of Science, Prague, Czech Republic;
[2]Institute of Botany AS CR, Třeboň, Czech Republic;
[3]University of South Bohemia, Faculty of Science, Centre for Polar Ecology, České Budějovice, Czech Republic

KEYWORDS: MOLECULAR PHYLOGENY, ZYGOSPORE, ZYGNEMA, ZYGNEMOPSIS

Filamentous Zygnematophyceae belong to the most distinct algal representatives of the Arctic hydroterrestrial environment. They typically form extensive mats in streamlets and meltwater pools and are important primary producers of tundra environment. They have also become good model organisms for experimental studies because in such habitats they have to withstand various environmental stresses including freezing, desiccation and UV irradiation. Numerous authors have reported the occurrence of such *Zygnema* sp. mats in the Arctic (and also in the Antarctica), but nobody has ever attempted to determine them into the species level and their diversity remains thus unknown. The main problem is that *Zygnema* species are traditionally defined according to the morphology of conjugation and zygospores, but nobody has ever reported sexual reproduction in the Arctic so far and there is a generally accepted opinion that in such an extreme environment they do not reproduce sexually at all. Nevertheless, certain differences in vegetative morphology indicated that there is an uncovered diversity within this group in the Arctic. In this study we applied the methods of molecular phylogeny to investigate the diversity of putative *Zygnema* sp. mats on Svalbard for the first time. Numerous localities around Billefjorden were sampled and more than 80 strains were isolated into cultures. Phylogenetic analyses based on rbcL sequences revealed 5 different *Zygnema* sp. genotypes that fall into separate lineages within the genus and thus do not form a monophyletic cluster. Surprisingly, one *Zygnemopsis* sp. with vegetative *Zygnema* morphology was also revealed by molecular methods. Moreover, we provide the first record of sexual reproduction and zygospore formation in Arctic Zygnematophyceae which is a key trait for matching the results of modern molecular analyses with traditional morphological species concept.

DIVERSITY & ECOLOGY OF FRESHWATER DIATOMS (BACILLARIOPHYTA) IN PETUNIABUKTA (SPITSBERGEN)

Eveline Pinseel [1,2], Bart Van de Vijver [1,2], Kateřina Kopalová [3,4]

[1]*Botanic Garden Meise, Department of Bryophyta & Thallophyta, Belgium*
[2]*University of Antwerp, Department of Biology, ECOBE, Wilrijk, Belgium*
[3]*Centre for Polar Ecology, Faculty of Science, University of South Bohemia, Ceske Budejovice, Czech Republic*
[4]*Charles University in Prague, Faculty of Science, Department of Ecology, Prague, Czech Republic*

KEYWORDS: DIATOMS, BACILLARIOPHYTA, SPITSBERGEN, ECOLOGY, NEW SPECIES

Diatoms are one of the most abundant algal groups in polar ecosystems, both in number of specimens as in number of species. Their characteristic silica outer shell (the valve) and the significant responses to changes in their physical and chemical environment, make them excellent bio-indicators used in applied environmental, biogeographical and paleo-ecological studies. Unfortunately, our knowledge of the species composition of High Arctic diatom communities and their ecological preferences are only poorly known, mainly due to historic force-fitting and incorrect identifications of the composing species. The diatom flora of Svalbard in particular is only scarcely studied and most studies published so far are only quite summary.

The present study attempts to contribute to our knowledge concerning the diversity and ecology of freshwater diatoms in the Petuniabukta region (Spitsbergen, Svalbard Archipelago). Samples of both epilithon and epiphyton of 40 lakes and pools were taken during the polar summer of 2013 and several physico-chemical lake characteristics (pH, conductivity and water temperature) were measured. The diatom communities were studied using light microscopy and, when appropriate, scanning electron microscopy.

A total of 315 taxa belonging to 58 genera were observed. Of these, 239 taxa were identified up to the species, subspecies, variety or forma level. The identity of the other 76 taxa is uncertain or only known up to the genus level. At least 10 of the unidentified taxa can with certainty be considered new to science. A new *Gomphonema* species, *Gomphonema svalbardense*, has recently been described and several other taxa are currently being described which confirms that the diatom flora of Spitsbergen is not well known and many taxa remain to be discovered and described.

Cluster analysis and ordination allowed separating the observed diatom communities in four different assemblages. Characterisation of these assemblages based on the measured physico-chemical features proved to be impossible indicating the probable importance of other environmental factors than measured in determining the diatom communities in the study area. Using literature data, it was possible to link the diatom assemblages with differences in environmental characteristics, e.g. presence of streams or currents, vegetation, glacial influence and sea spray.

CYANOBACTERIAL DIVERSITY OF SOIL CRUSTS FROM PETUNIA BAY, SVALBARD

Ekaterina Pushkareva[1], Annick Wilmotte[3], Josef Elster[1,2]

[1]*University of South Bohemia, Faculty of Science, České Budějovice, Czech Republic*
[2]*Institute of Botany, Academy of Sciences of the Czech Republic, Třeboň, Czech Republic*
[3]*University of Liege, Institute of Chemistry, Centre for Protein Engineering, Liège, Belgium*

KEYWORDS: CYANOBACTERIA, PYROSEQUENCING, SOIL CRUST

The object of this study was to describe cyanobacterial community in various types of arctic soil crusts that were collected in the vicinity of Petunia Bay, Svalbard in the 2013 summer season. Four localities with different soil crusts (cyanobacterial crust, crusts with mixture of lichens and cyanobacteria and well-established crusts with a rich community of lichens) were studied. Chemical analyses showed almost no significant difference in pH rate (7,3 – 8,1). This interval is considered as optimum for cyanobacteria. Other chemicals parameters varied according to crust development.

To study diversity of cyanobacteria 454 pyrosequencing of the 16S rRNA gene was used. Pyrosequencing generated 67.924 quality short-read sequences from 36 soil crust samples before quality control and denoising. All non-cyanobacterial OTUs were removed from analyses.

To have evenness between samples, numbers of OTUs were shorten to 997 for each sample. Good's coverage (98.6%) showed that majority of the phylotypes in studied sites has been identified. In most cases, soil crusts were dominated by Stigonema sp., Leptolyngbya sp., Phormidium sp., Calothrix sp. and Nostoc sp.

ANNUAL PERMAFROST ACTIVE LAYER DYNAMICS IN CONTRASTING SVALBARD CLIMATE AND BEDROCK CONDITIONS

Grzegorz Rachlewicz[1], Ireneusz Sobota[2]

[1]*Polar Station "PETUNIABUKTA", Adam Mickiewicz University in Poznań, POLAND*
[2]*Polar Station "KAFFIØYRA" Nicolaus Copernicus University in Toruń, POLAND*

KEYWORDS: PERMAFROST, CLIMATE, GROUND CONDITIONS

Observations of permafrost active layer dynamics were performed in two locations in Spitsbergen (Svalbard). The site at the western coast, located on Kaffiøyra (coastal plain), represent humid, maritime climate conditions, with precipitation of about 400 mm per year. The proximity of open ocean influences also annual air temperature distribution, and dynamic weather changes, due to intensive cyclonic activity. Inner fjord location of the other site in Petuniabukta, at the distance of more than 100 km from the open sea, causes continentalization of the climate, visible in lowering of precipitation down to about 150-200 mm per year and annual air temperature amplitude rise by 2-3^{o}C. In such conditions, at both sites, two similar permafrost active layer dynamics, square test fields were established. Each of test fields has the area of 10000 m^2 and ground temperature measurements profiles, reaching 1.45 m depth, were located in their central parts. Additionally 2-3 times per positive temperatures period, thaw depth was observed with use of steel rods in the net of 10x10 m. Both sites comprised of doubled fields representing dry and wet ground conditions. At the dry sites suprapermafrost waters were reduced to minimum, while in the wet, ground water tables were several tens of cm above the frozen base.

Thaw season starts in this latitudes about the first decade of May, depending on snow cover thickness and air temperature dynamics, varying from year to year between 0 and 100 cm. The most intensive ground-thawing is observed in June and July, but reaches maximum depths at the beginning of September. These depths varies at chosen locations between 130 and 180 cm, however, as the most influential is considered the occurrence of water in the sediments profile. Dry sites are much less dynamic, about 20-30 cm shallower than the wet ones. Regional differences varies also up to 40 cm between locations of the same sedimentological structure. Water is the most energy transferable agent, responsible for heat transfer in the active layer of permafrost profile. Along with this differentiation the ground temperature profile reveals much higher gradient within dry locations.

FILAMENTOUS CYANOBACTERIA ON BONE REMNANTS FROM SVALBARD, ARCTIC

Lenka Raabová[1], Otakar Strunecký[2], Josef Elster[2], Ľubomir Kovacik[1]

[1]Comenius University, Faculty of Natural Sciences, Bratislava, Slovakia;
[2]University of South Bohemia, Faculty of Science, Centre for Polar Ecology, České Budějovice, Czech Republic

KEYWORDS: CYANOBACTERIA, BONES, ARCTIC

The bone remnants frequently dispersed everywhere in coastal areas of polar region represent a specific natural habitat which is colonized by microscopic algae. In general, these microbes appear to be opportunists that have colonized isolated oases that provided nutrients and protection from desiccation and UV radiation. In addition, the bone remnants are ecologically important anthropogenic substrata with high impact to cycle of nutrients in nature.

Here we present filamentous cyanobacteria participated in bioerosion of bone remnants of mammals in Petuniabukta, Billefjorden, the central part of Svalbard archipelago (74-81º N, 10-35º E). Totally 25 unialgal cyanobacterial strains were isolated and their 16S rRNA and 16-23S rRNA intergenic spacer sequences was investigated. The representants of genera *Microcoleus*, *Nostoc*, *Leptolyngbya*, *Phormidesmis*, *Nodosillinea* a *Phormidium* were abundantly present in almost each sample. The *Leptolyngbya nigrescens* and *Nodosillinea epilithica* represent new records from the Svalbard Archipelago. All observed taxa are illustrated and details of their morphology and ecology are included, as well their relationships to the most similar taxa discussed. Further study of mammalian bone remnants from polar regions could bring not only discovery of the new cyanobacterial taxa, but also the new information on their ecophysiological properties.

The study was supported by Comenius University Grant no. UK/305/2014 and Slovak Research and Development Agency APVV (Project no. SK-CZ-2013-0019).

WHAT CONTROLS THE DECOMPOSITION OF ORGANIC MATTER IN CRYOTUBATED PERMAFROST SOILS?

Andreas Richter[1,2], Jiri Barta[3], Petr. Capek[3], Antje Gittel[4], Norman Gentsch[5], Georg Guggenberger[5], Gustaf. Hugelius[6], Christina Kaiser[1,2], Peter Kuhry[6], Robert Mikutta[5], Hana Šantrůčková[3], Christa Schleper[7,2], Jorg Schnecker[1,2], Olga. Shibistova[5], Birgit Wild[1,2], Tim Urich[7,2], and the CryoCARB team (www.cryocarb.net)

[1]Department Microbiology and Ecosystem Science, University of Vienna, Austria;
[2]Austrian Polar Research Institute, Vienna, Austria;
[3]Department of Ecosystem Biology, University of South Bohemia, Czech Republic;
[4]Department of Biology/Center for Geobiology, University of Bergen, Norway;
[5]Institute of Soil Science, Leibniz Universität Hannover, Germany;
[6]Department of Physical Geography and Quaternary Geology, Stockholm University, Sweden
[7]Department of Ecogenomics and Systems Biology, University of Vienna, Austria

The total organic carbon pool in cryoturbated horizons of permafrost soils has been estimated to be about 408 Pg C, more than half of today's atmospheric C pool. A significant proportion of this globally significant C pool is vulnerable to climate warming through permafrost thawing and may become a future source of CO2 and CH4 to the atmosphere. Cryoturbations, i.e. the mixing of soil layers due to freezing and thawing, may thus be one of the most important mechanisms of arctic carbon storage. We have previously shown that organic-rich topsoil material that was buried into deeper soil layers exhibited retarded decomposition by centuries to millennia, that cannot be explained by unfavourable environmental conditions in the subsoil alone (Kaiser et al. 2007).

We here present results from a project that aimed at identifying the major SOM stabilization mechanisms in cryoturbated soils from Siberia (Eastern Siberia – Kolyma, Central Siberia – Taymyr, Western Siberia – Tazovskiy) and at assessing the decomposability of this SOM in a future climate. We address the different mechanisms by which cryoturbated SOM can be stabilized, such as unfavourable temperature and moisture regimes, physical protection by formation of organo-mineral associations, SOM quality, nutrient availability, microbial community composition, and connected with it, plant-microbe inter¬actions (specifically priming).

Our main findings were:

i. Temperature is not the main control for decomposition of cryoturbated organic material. Based on several incubation experiments with OM of various horizons at different temperatures (and soil moisture contents) and found little difference in decomposition rates and similar temperature responses in soils incubated between 60% and 80% soil moisture content. Under anoxic conditions, we did not find a clear temperature response of decomposition. Cryoturbated OM exhibited continuously lower respiration rates and methane production compared to chemically similar topsoil material, demonstrating that factors other than temperature must control decomposition in this OM type.

ii. Mineral associated organic matter (MOM) in cryoturbated organic matter is readily decomposable. A significant proportion (up to 60%) of the OM in cryoturbated horizons (Ojj and Ajj) was already present as mineral-associated organic matter (MOM). Although positive correlations of the clay content and iron oxides with OM were found, the MOM fraction was readily decomposed, when incubated at higher temperature and therefore a strong physico-chemical protection is unlikely.

iii. The microbial community is not able to decompose the organic matter in cryoturbated pockets. The microbial community of the buried material was distinctly different from topsoil communities and more similar to subsoil microbial assemblages, both in PLFA profiles and in in-depth studies using 16S and ITS rRNA genes. Fungal to bacterial ratios were constantly lower in cryoturbated compared to topsoil material (Gittel et al. 2014). It thus seems that there was a mismatch between microbial community and organic matter quality, that added to the retarded decomposition of cryoturbated OM. This was also reflected in the pattern of extracellular enzymes in cryoturbated OM (Schnecker et al. 2014).
iv. In cryoturbated OM nitrogen availability is reduced and N cycling decelerated. An additional SOM priming experiment with labelled glucose, cellulose, amino acids and protein demonstrated different nutrient limitations of the microbial communities: while no priming was observed in topsoil, all added substrates led to strong priming (200-250% of the initial respiration from SOM) in subsoil (Wild et al. 2014). In cryoturbated material, however, only the N-containing substrates led to a significant priming effect, indicating a strong N limitation of the microbial community in this soil, which was not, however, reflected in C/N ratios of the bulk OM. These results were also corroborated by the fact that the whole N cycle (from protein depolymerisation to mineralization and nitrification) was significantly decelerated in cryoturbated OM (Wild et al. 2013).

In summary, we were able to demonstrate that, in addition to unfavourable environmental conditions, decomposition processes in cryoturbated arctic soils were retarded by a combination of changes in microbial community composition reduced nitrogen availability and decelerated nitrogen cycling. The potential decomposability of organic matter in cryoturbated permafrost soils will be discussed.

REFERENCES:
Gittel A, Bárta J, Kohoutová I, Mikutta R, Owens S, Gilbert J, Schnecker J, Wild B, Hannisdal B, Maerz J, Lashchinskiy N, Čapek P, Šantrůčková H, Gentsch N, Shibistova O, Guggenberger G, Richter A, Torsvik VL, Schleper C, Urich T. (2014): Distinct microbial communities associated with buried soils in the Siberian tundra. The ISME Journal 8: 841–853.
Kaiser C, Meyer H, Biasi C, Rusalimova O, Barsukov P, Richter A. (2007): Conservation of soil organic matter through cryoturbation in arctic soils in Siberia. Journal of Geophysical Research 112.
Schnecker J, Wild B, Hofhansl F, Eloy Alves RJ, Bárta J, Čapek P, Fuchslueger L, Gentsch N, Gittel A, Guggenberger G, hofer A, Kienzl S, Knoltsch A, Lashchinskiy N, Mikutta R, Šantrůčková H, Shibistova O, Takriti M, Urich T, Weltin G, Richter A. (2014): Effects of soil organic matter properties and microbial community composition on enzyme activities in cryoturbated arctic soils. PLoS ONE 9: e94076.
Wild B, Schnecker J, Alves RJE, Barsukov P, Bárta J, Čapek P, Gentsch N, Gittel A, Guggenberger G, Lashchinskiy N, Mikutta R, Rusalimova O, Šantrůčková H, Shibistova O, Urich T, Watzka M, Zrazhevskaya G, Richter A. (2014): Input of easily available organic C and N stimulates microbial decomposition of soil organic matter in arctic permafrost soil. Soil Biology & Biochemistry. Soil Biology and Biochemistry 75: 143–151.
Wild B, Schnecker J, Bárta J, Čapek P, Guggenberger G, Hofhansl F, Kaiser C, Lashchinsky N, Mikutta R, Mooshammer M, Šantrůčková H, Shibistova O, Urich T, Zimov SA, Richter A. (2013): Nitrogen dynamics in Turbic Cryosols from Siberia and Greenland. Soil Biology and Biochemistry 67: 85–93.

COMMUNITY COMPOSITION AND DIVERSITY OF N_2-FIXING CYANOBACTERIA ASSOCIATED WITH MOSSES IN SUB-ARCTIC ECOSYSTEMS

Ana J. Russi[1], Ólafur S. Andrésson[1], Ingibjörg S. Jónsdóttir[1,2]

[1]*University of Iceland, Reykjavík, Iceland*
[2] *University Centre in Svalbard, Longyearbyen, Norway*

KEYWORDS: DIVERSITY N_2-FIXATION CYANOBACTERIA MOSSES SUB-ARCTIC

Introduction

Moss associated cyanobacterial communities (MAC) are thought to be major contributors to N input in high latitude regions. However, most studies have been carried out in the boreal forest (1) and the High Arctic (2), whereas biological N_2-fixation in other moss-rich regions such as the sub-arctic may also be largely MAC-based. Our preliminary results suggest that (*i*) MAC contribute significantly to the N-budget of widespread moss-dominated terrestrial sub-arctic ecosystems, and (*ii*) in these ecosystems cyanobacteria show specificity in associating with different moss species. The aim of this study is to evaluate diversity, specificity, abundance and N_2-fixation activity of cyanobacteria associated with four moss species: *Racomitrium lanuginosum*, *Hylocomium splendens*, *Pleurozium schreberi* and *Sanionia uncinata*, all abundant in moss-dominated sub-arctic ecosystems in Iceland.

Material and methods

Moss samples were collected from a moss-heath dominated birch woodland on postglacial basaltic lava in SW Iceland (64°04' N, 21°44' W) and from two International Tundra Experiment (ITEX) sites, one in a mesic dwarf birch heathland (65°13' N, 19°42' W, 450 m altitude) largely covered by mosses, the other a *Racomitrium* moss heath on postglacial lava (64°17' N, 21° 05' W, at 120 m). Cyanobacterial quantification was carried out by phase-contrast and fluorescence microscopy. Further estimation of the types and relative abundance of cyanobacteria was performed by amplification and sequencing of *nifH* genes.

Results

The cyanobacterial strains identified appear to be from the orders *Stigonematales* and *Nostocales*. Sequencing and phylogenetic analysis showed that *N. punctiforme* was the most common cyanobacterial species associated with *R. lanuginosum* and *P. schreberi*, while cyanobacteria associated with *H. splendens* and *S. uncinata* have not been typed yet. The highest diversity of MAC was found in *R. lanuginosum*. The finding of rich MAC in mosses widespread in sub-arctic ecosystems may have substantial impact on our understanding of the nitrogen cycle in this terrestrial environment.

Next steps

In addition to direct microscopic counting, real-time quantitative PCR (qPCR) will be used in order to determine the relative abundance and dynamics of *nifH* genes, which act as proxies for diazotrophic cyanobacteria. The N-fixation activity of MAC will be assessed in parallel with the acetylene reduction assay (ARA) and validated by uptake of isotope labelled nitrogen (^{15}N).

REFERENCES

[1] Rousk, K., Jones, D. L., DeLuca, T. H. (2013): "Moss-cyanobacteria associations as biogenic sources of nitrogen in boreal forest ecosystems" Frontiers in microbiology 4.

[2] Solheim, B., Zielke, M. (2003). Associations between cyanobacteria and mosses. In *Cyanobacteria in symbiosis*. Springer Netherlands. 137-152.

GLACIER ECOLOGY IN THE TROPICS: A CASE STUDY FROM UGANDA

Marie Šabacká[1,2], Jun Uetake[3], Denis Samyn[4]

[1]*British Antarctic Survey, Cambridge, United Kingdom;*
[2]*Centre for Polar Ecology, České Budějovice, Czech Republic;*
[3]*National Institute of Polar Ecology, Tokyo, Japan,*
[4]*Nagaoka University of Technology, Nagaoka, Japan*

KEYWORDS: TROPICAL GLACIERS, AFRICA, GLACIER DYNAMICS, MICROBIAL ECOLOGY

Tropical glaciers are rare phenomena occurring in high altitudes in Asia, Africa, South America and New Guinea. Due to year-round melting season all tropical glaciers are receding rapidly and majority will vanish by 2050. With the disappearance of the ice crucial information regarding palaeo-climate history and ecology of these largely unexplored ecosystems has been lost. In Rwenzori Mountains located just few km north of the equator in Uganda, trends suggest that the Mountains will be ice-free within two decades but it is unclear whether the shrinking is caused by increasing temperatures, decrease in humidity and/or other factors such as the very dark ice cover caused by bioaggregation of mosses and microorganisms. Compared to its polar and alpine counterparts, the surface of Ugandan glaciers harbours much more productive and more diverse microbial communities and has much higher concentrations of essential nutrients, particularly nitrogen. Comprehensive overview of our research results from a multiyear survey into climate conditions; geophysics (mass balance, mapping and glacier dynamics); chemistry (nutrient content and nutrient cycling) and biology (microbial diversity and productivity) of Stanley Plateau, one of the largest glaciers in the Rwenzori Mts will be presented and discussed.

THE DEVELOPMENT OF LAMPENFLORA IN ENGLACIAL SYSTEMS

Birgit Sattler, Philipp Larch.

University of Innsbruck, Institute of Ecology, Innsbruck, Austria

KEYWORDS: ENGLACIAL SYSTEMS, LAMPENFLORA, AUTOTROPHIC ORGANISMS, PRIMARY PRODUCTION, AIRBORNE ORGANISMS

Autotrophic organisms are normally absent in anthropogenic undisturbed dark habitats like caves or englacial systems. If artificial light sources get installed, e.g. to open those habitats to tourism, algal communities known as Lampenflora, develop. Here, we investigate the microbial community within the so called ”Natur Eis Palast” crevasse in the Hintertuxer glacier (Tirol, Austria). Production rates of englacial autotrophic and heterotrophic microbes were assessed using radiotracers ($NaH^{14}CO_3$ and ^{3}H-Leucin, respectively). The effects of the light spectrum on the growth of the lampenflora were also estimated, as well as the penetration depth of light in the ice allowing lampenflora to grow. An experiment using different lamps with various wavelengths was conducted over 10 weeks to investigate how long microbial communities would need to establish and which organisms are the first to inoculate the ice. Original and sterile glacier ice was exposed under in situ conditions (the same lamps and conditions). Our results showed extremely high activity (both heterotrophic and autotrophic) comparable to eutrophic conditions under different spectral conditions of which bare white lamps showed highest production rates. Light spectra influenced not only activity but greatly the structure of the lampenflora communities present. Hence, blue light sources would favour the growth of Klebsiella sp., versus white lamps have been preferred by mainly Stichococcus sp. Chlorophyll values around the light sources exceeded any other value known from extreme environments so far and showed concentrations of several mg Chla/ which penetrated the ice approximately 15cm. The question of which organisms settle the ice of an englacial system can be answered by a great influence of airborne organiams which are mostly autotrophic and capable of settling on the ice surface.This study provides additional information about the establishment of in situ activities and microbial processes in englacial systems also under the aspect of touristic usage.

REFERENCES

Strunecký, O., Elster, J., Komarek, J. (2010): "Phylogenetic relationships between geographically separate *Phormidium* cyanobacteria: is there a link between north and south polar regions?" Polar Biology 33(10): 1419-1428

COMPETITION FOR RESOURCES CAN CREATE BASIS FOR NICHE DIFFERENTIATION BETWEEN TWO LIFE-HISTORY STAGES OF *SOLIDAGO VIRGAUREA* IN THE ARCTIC

Tiina Savolainen, Minna-Maarit Kytöviita

Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland

KEYWORDS**:** COMPETITION, NICHE, RESOURCE USE, STABLE ISOTOPE NATURAL ABUNDANCE, LOW ARCTIC

Competition has been shown to modify the niche breadth of coexisting species, but within species interactions have received little attention. Establishing small juvenile individuals and established, larger, sexually reproducing, older, individuals represent two life history stages within species.

We investigated the effect of established cohort on the resource use of establishing individuals in a simplified system in the low Arctic using *Solidago virgaurea* as model species. Isotopic signatures (foliar $\delta^{15}N$ and foliar $\delta^{13}C$) were analysed to characterize water use and nitrogen acquisition strategy of the plants. The isotopic signatures of the established large plants and the establishing small plants differed significantly and suggested that the establishing cohort used relatively more amino acids or gained N through mycorrhizal symbiosis in comparison to the large established plants.

We conclude that competition mediated differences in resource use may create niche differentiation between two life-history stages and enable them to coexist.

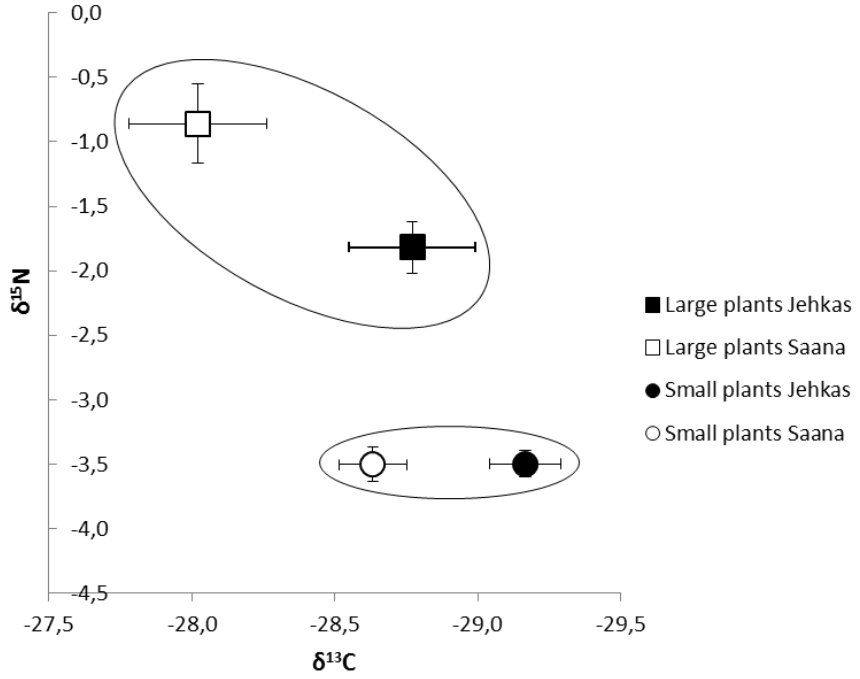


Figure 1: Mean foliar values (± s.e.) of $\delta^{15}N$ and $\delta^{13}C$ in large and small *Solidago virgaurea* plants at the Jehkas and Saana sites.

REPETITIVE PHOTOINHIBITION EFFECTS ON PIGMENTS, PHOSYNTHETIC PROCESSES, AND GROWTH RATE IN THREE ANTARCTIC ALGAE: A PHOTOBIOREACTOR STUDY

Luděk Sehnal, Kateřina Skácelová, Peter Váczi, Miloš Barták

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Kamenice 5, 62500 Brno Czech Republic

KEYWORDS: *CHLAMYDOMONAS REINHARDTII*, JAMES ROSS ISLAND, *KLEBSORMIDIUM* SP., *TREBOUXIA* SP.

Introduction It is well established that majority of Antarctic terrestrial algae has a wide range of tolerance to high doses of photosynthetically active radiation. In our study, we addressed resistance of three Antarctic algal species from James Ross Island to heavy photoinhibitory treatment and their capabilities to recover from high light stress.

Material and Methods
Three algal species were used in laboratory-based photoinhibitory study: (1) *Trebouxia* sp. isolated from *Usnea antarctica*, (2) *Klebsormidium* sp. SNOKHOUSOVA et ELSTER 2008/8, and (3) *Chlamydomonas reinhardtii*. The latter two species were supplied by the Culture Collection of Autotrophic Organisms, Institute of Botany, Třeboň, Czech Republic. Using a FL 400 (P.S.I., CZ) fluorometer with in-built oxygen electrode, simultaneous measurements of effective quantum yield of PS II (yield PSII) and photosynthetic oxygen evolution rate (OER) were done under different light and temperature in order to get photosynthetic light-response curves at 10 and 20^{o}C, respectively. Photoinhibitory study was done in a FMT-400 photobioreactor (P.S.I., CZ) in which algae were cultivated in BBM medium for 14 d and then exposed to repetitive high light treatment (six times 3000 micromols m^{-2} s^{-1} for 1 h within a 72 h-lasting experiment). During the experiment, Chl*a*, Chl*b*, total Carotenoids and algal biomass were evaluated repeatedly. Similarly, photoinhitition-induced changes in effective quantum yield of PS II, and OER were monitored simultaneously.

Results and Discussion
Typical light-response curves of OER and Yield PSII were obtained for *Klebsormidium* sp. and *Trebouxia* sp in both experimental temperatures. When related, OER and yield PSII data showed linear relations throughout a range of light (0-500 micromols m-2 s-1) for both species. However, the slope of the relations differed indicating that higher utilization of photochemical products of primary photosynthetic processes (ATP, NADP) in Calvin cycle (Oberhuber et Edwards 1993) is reached in both species at 10^{o}C than 20^{o}C. It can be, therefore concluded that photosynthetic processes in both algal species worked more efficiently at 10 than 20^{o}C, as supported also by growth rate analyses of algal cultures (Balarinová et al. 2013).

Repetitive photoinhibitory treatment led to a variety of responses and showed species-specific sensitivity to photoinhibition of photosynthesis. In general, repetitive photoinhibition led to a gradual decrease in Chl*a*, Chl*b* contents in *Klebsormidium* and *Trebouxia*, but dramatic photodestruction of almost all Chl*a* and Chl*b* in *Ch. reinhardtii*. Carotenoids content slightly increased in *Klebsormidium*, decreased in *Trebouxia*, but were almost fully destroyed in *Ch. reinhardtii*. These changes indicated high sensitivity of *Ch. reinhardtii* to photoinhibition while the other two species were much more resistant.

Responses of OER and Yield PS II to repetitive photoinhibition varied in a complex manner and depended especially on ascending number of high light treatment and recovery. Here we bring an overview of general trends. *Klebsormidium* sp. was most resistant to photoinhibition, since after each treatment, Yield PSII fully recovered to pre-photoinhibitory value. This was achieved in spite of the experimental high light dose exceeded value that the species could ever experience in nature. *Trebouxia* sp. showed some limited sensitivity to photoinhibition, since full recovery was not reached after individual photoinhibitory treatments. In *Ch. reinhardtii*, photoinhibitory treatment led to a devastating changes to photosyntem II that, as a consequence, heavily and irreversibly limited photosynthetic processes.

Conclusion

Among the three studied species, *Klebsormidium* sp. was found most resistant to photoinhibition of photosynthesis when treated by extremely high light doses. Contrastingly, *Chlamydomonas reinhardtii* showed very low resistance to photoinhibition and exhibited physiological signs of photodestruction of chloroplastic photosynthetic apparatus.

Acknowledgements The authors thank CzechPolar for providing experimental infrastructure.

REFERENCES:

Balarinová, K., Váczi, P., Barták, M., Hazdrová, J., Forbelská, M. (2013): "Temperature-dependent growth rate and photosynthetic performance of Antarctic symbiotic alga *Trebouxia* sp. cultivated in a bioreactor." Czech Polar Reports 3(1): 19-27.

Oberhuber, W., Edwards, G.E. (1993): "Temperature Dependence of the Linkage of Quantum Yield of Photosystem II to CO_2 Fixation in C4 and C3 Plants." Plant Physiology, 101: 507–512.

COMPOSITION OF THE SALTMARSH FLORA AND VEGETATION OF THE SPITSBERGEN ARCIPELAGO AND BARENTS AND WHITE SEA COASTS

Liudmila Sergienko

Petrozavodsk State University, Ecological-biological Faculty, Department of Botany and Plant Physiology, Lenina, 33, Petrozavodsk 185910, Russia

KEYWORDS: SALTMARSH FLORA, VEGETATION, EUROPEAN ARCTIC

Introduction

Arctic coastal ecosystems are vulnerable both to climate change and active industrial development. In the European part of Russia, most of the population of the Arctic Region is concentrated on the coasts of Holarctic tidal seas. The ongoing global climate changes lead to the disruption of functioning of natural complex of the Arctic coastal zone, which results in the disturbance of human activity affecting human health.

Methods and materials

During 2009-2013 years the detailed investigations of the salt marshes at Kapp-Wijk, Ny-Ålesund and Longyerbean (Spitsbergen) have been conducted. At the Barents Sea the points on the coast of Kola Peninsula (Far Zelentsy) - and on the Pechora river mouth have been investigated. More than 18 partial floras have been investigated on the White Sea coasts. The halophytic floristic complex of coastal ecosystems in the Russian Arctic allocated on the basis of the ecological-coenotic optimum of coastal species has been investigated. Ecological-phytocoenotic classification of saltmarsh communities, based on criterias - layer structure, the composition of dominants and subdominant, the constancy of species have been done. The plots for investigation of vegetation cover and species richness; relative position within the intertidal zone have been studied using the general floristic and geobotanical methods.

Results

In Svalbard, the total number of vascular plant species in the coastal marshes estuaries and sandy-pebble beaches is 19 (which are about 12% of the total number of species); more than 80% have the circumpolar arctic areal (*Puccinellia phryganodes, Carex ursina, C. suspathacea, Stellaria humifusa*). The coastal partial flora along the White and Barents Seas has 68/47 of species and subspecies, related to 45/34 genera. On the coast of the Barents Sea there are no representatives at the level of genera: *Bolboschoenus, Blysmus, Spergularia, Parnassia, Angelica, Cenolophium, Conioselinum, Crepis*. On the coast of the White Sea there is no representative species of genera: *Armeria* and *Arctanthemum*. A comparison of the coastal floras on both coasts using the Jaccard's coefficient of similarity, revealed a slight similarity between floras of Barents and White Seas coasts (Kj = 0, 56) and the greatest similarity between them (Ksc = 0, 71), based on the Serensen-Chekanovsky coefficient. Among obligate halophytes 5 species encountered on the saltmarshes of the Barents Sea, are also characterized for coastal flora of Kara and White Seas (*Carex subspathacea, C. glareosa, Stellaria humifusa, Hippuris tetraphylla* and *Triglochin maritimum*). Another 5 obligate halophytes of Barents Sea are common for the coast of Kara Sea (*Calamagrostis deschampsioides, Puccinellia phryganodes, Arctanthemum hultenii, Dupontia psilosantha* and *Ranunculus tricrenatus* – all of them have the arctic circumpolar areal), other 4 obligate halophytes from Barents Sea coast are also common for the coasts of White Sea (*Plantago schrenkii, Carex mackenziei, Potentilla egedii, Agrostis straminea* – all of them have the hypoarctic European areal). On the coast of Spitsbergen in the saltmarsh communities the next associations have been divided: ass.

Puccinellietum phryganodis Hadač 1946, ass. *Caricetum ursinae* Hadač 1946 and the type of *Mertensia maritima* communities. To the coasts of the Barents and White seas the next maim formations of the saltmarsh flora have been described: *Puccinelleta phryganodii, Duponteta psilosanthi, Calamagrostideta deschampsioidii, Leymeta arenarii, Arctophileta fulvi, Puccinellieta tenelli, Cariceta subspathaceae, Cariceta glareosae, Cariceta ursine, Stellareta humifusi, Hippureta tetraphylli, Potentilleta egedi, Arctanthemeta hulteni, Mertenseta maritimi*.

Since the Svalbard, in saltmarsh habitats, noted for their extreme environments, a widely held assumption is that a few large clones dominate plant populations; therefore, we can conclude that at Spitsbergen in the formation of the vegetation of the coastal marshes the syngenetic process is prevailed. On the coasts of the Barents and White seas the role of syngenetic process is decreased and the process of change of phytocenosis under the influence of the environment, made by it (endoecogenesis) begins to dominate.

LIFE STRATEGY OF PLANT PATHOGENIC FUNGUS: *RHYTISMA POLARE* IN THE HIGH ARCTIC

Masumoto Shota[1], Masaki Uchida[1], Motoaki Tojo[2], Satoshi Imura[1]

[1]*National Institute of Polar Research;*
[2]*Osaka Prefecture University*

KEYWORDS: PLANT PATHOGENIC FUNGI, SPITSBERGEN, TAR SPOT, RHYTISMA POLARE, SALIX POLARIS

In the High Arctic, we have less knowledge about plant pathogenic fungi. Although tar spot disease (Fig. 1) had been often observed on *Salix polaris* (polar willow) which is one of the dominant species on Svalbard Islands (Lind 1928; Elvebakk et al. 1996), further studies had been not conducted for this pathogen. Then, we investigated its taxonomical characteristics and have identified the fungus as new species, *Rhytisma polare* (Masumoto et al. 2014). In this study, we investigated ecological features of this species and discussed its life strategy in the High Arctic.

This study was conducted in Ny-Ålesund, Spitzbergen Island, Norway (78.5˚N). In order to know basic characteristics of *R. polare*, we observed the main stages of the life cycle such as ascoma maturation, ascostroma development on living leaf and spore dispersal. To investigate spatial and temporal variability of distribution of *R. polare*, we measured tar spot incidence and environmental factors by line transect method and change of the incidence from 2008 to 2013. In addition, the effect of *R. polare* on host plant was investigated by measuring photosynthetic activities of infected leaves.

In the life cycle observation, *R. polare* matured its ascoma in the short term after snowmelt. Ascostroma of *R. polare* on a living leaf developed within four weeks. On the other hand, spore dispersal area from ascostroma was small (within 2-3 m in radius). To promote ascostroma maturation and spore dispersal, liquid water was needed. As for distribution of *R. polare*, positive correlation was found between spatial distribution of *R. polare* and soil moisture. In addition, *R. polare* occurred repetitively at the same place in every year. For the effect on photosynthetic activity of host leaf, the activity of the infected part fell below detectable limit, but the activities of the other parts were similar to the activity of the non-infected leaf. Using the result of the photosynthetic activity, we estimated net primary production of the host plant. As the result, infection of *R. polare* reduced the production of host leaf by about 9%.

It is considered that the short leaf period of the host will strongly affect survival of *R. polare* in the Arctic. Against this restriction, *R. polare* was able to complete its life cycle by maturing ascoma and developing ascostroma rapidly. On the other hand, the fungus needed liquid water for ascostroma maturation and spore dispersal, however, low precipitation of the Arctic was not enough to accomplish these stages. Therefore, the fungus likes to need snowmelt water for surviving in this site. The necessity to use snowmelt water will limit its distribution to a same place in every year. It is suspected that such a repetitive occurrence causes large negative damage to the host plant. However, the result of effect on photosynthesis suggested that *R. polare* didn't make to die even higher incidence. This will keep a balance for *R. polare* to occur such a same place in every year.

Fig. 1 *Rhytisma polare* on *Salix polaris*. The fungus develops ascostroma on host living leaf.

REFERENCES:

Elvebakk A, Gjærum HB, Sivertsen S (1996) Part 4. Fungi II. In: Elvebakk A, Prestrud P (eds.) A catalogue of Svalbard plants, fungi, algae and cyanobacteria. Norsk Polarinstitutt, Oslo, pp 207–259

Lind JVA (1928) The micromycetes of Svalbard. Skr Svalbard Ishavet 13:1–61

Masumoto, S., Tojo, M., Uchida, M., Imura, S. (2010): " *Rhytisma polaris*: morphological and molecular characterization of a new species from Spitsbergen Island, Norway" Mycological Progress 13:181–188

PHYLOGENOMICS AND EVOGENOMICS OF *NOSTOC* COMMUNE-COMPLEX COLLECTED FROM THREE HABITATS IN THE HIGH ARCTICS (CENTRAL SPITSBERGEN, PETUNIABUKTA, BILEFJORDEN)

Prashant Singh[1], Arun K. Mishra[2], Amita Singh[2] and Josef Elster[3]

[1]Microbial Culture Collection (MCC), National Centre for Cell Science (NCCS), Pune, India;
[2]Department of Botany, Banaras Hindu University, Varanasi, India
[3] University of South Bohemia, Faculty of Science, České Budějovice & Institute of Botany, Academy of Science CR, Třeboň, Czech Republic

KEYWORDS: PHYLOGENOMICS, EVOLUTION, EVOGENOMICS,CYANOBACTERIA

Cyanobacteria are an ancient and key lineage of photoautotrophic group of organisms that were responsible for the initial conversion of the anaerobic earth into an aerobic one. Considering such a long existence, they are also one of the most unique and proficient group of photosynthetic prokaryotes, possessing the capability of oxygenic photosynthesis. Many species are capable of fixing atmospheric nitrogen, some of which differentiate into specialized cells termed as the heterocyst. An elaborate machinery and deft regulation of two highly important metabolic pathways i.e., photosynthesis and nitrogen fixation in the same filament is one of the most interesting features that makes cyanobacteria exciting model organisms of study. In the present scenario of climate vulnerability and the huge focus on the microbe-climate interactions, we aimed to study the cyanobacteria of one of the most extreme climate zones, the Arctics. Phylogenomic and evogenomic investigations of *Nostoc* commune-complex collected from three hydro-terrestrial habitats in and around Petuniabukta, Svalbard have been done in order to assess the genetic diversity and evolutionary pace of cyanobacteria. The structural gene 16S rRNA and the functional gene *nif*H have been used as molecular markers for assessing the phylogenetic inferences that clearly indicate towards an inter-mixed origin of *Nostoc* commune-complex from all the three different habitats. Specimens from Pyramiden, the Old Russian settlement that also has a heavy anthropogenic influence have shown to have the maximum genetic diversity with the best estimates of nucleotide diversity, recombination frequency, DNA divergence and gene conversion tracts. Triphasic DNA divergence assessment has been discussed as a new of its kind approach where habitats have been compared to each other using molecular markers as inputs. The Pyramiden samples outpaced the wet hummock meadow at Petuniabukta followed by the Brucebyen specimens on being estimated on standard evogenomic parameters using molecular tools. Trans-tropical gene flow, short distance aeolian spore transfers, foreign soil, glacial activity and very importantly anthropogenic influences are being indicated as possible drivers of genetic diversity and evolutionary pace of *Nostoc* commune-complex in the high Arctics around Petuniabukta.

REFERENCES:

Sabacka, M., Priscu, JC., Basagic, HJ., Fountain, AG., Wall, DH., Virginia, RA., Greenwood, MC. (2012): "Aeolian flux of biotic and abiotic material in Taylor Valley, Antarctica" Geomorphology 155: 102-111

Elster, J., Rachlewicz, G. (2012): "Petuniabukta, Billefjorden in Svalbard: Czech-Polish long term ecological and geographical research" Polish Polar Research 33(4): 289-295

Singh, P., Singh, SS., Mishra, AK., Elster, J. (2013) "Molecular phylogeny, population genetics and evolution of heterocystous cyanobacteria using *nif*H gene sequences" Protoplasma 250(3): 751-764.

POPULATION STRUCTURE OF SALPIDAE (TUNICATA: THALIACEA) IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN IN THE SUMMER SEASON IN 2009/2010, WITH SPECIAL FOCUS ON *SALPA THOMPSONI*.

Angelika W. Słomska, Anna A. Panasiuk-Chodnicka, Maria I. Żmijewska, Maciej K. Mańko

Department of Marine Plankton Research, Institute of Oceanography, University of Gdansk, Poland

KEY WORDS: SOUTHERN OCEAN, *SALPA THOMPSONI,* HORIZONTAL DISTRIBUTION, MORPHOMETRY AND POPULATION STRUCTURE

Introduction

Antarctica is one of the oldest ecosystems, which is characterized by unique hydrological conditions (Knox, 2006). The Antarctic food web is relatively simple and is based mostly on Antarctic krill – *Euphausia superba* (Ballerini *et al.,* 2014). However, in the last few decades significant changes in the functioning of this ecosystem have been observed, presumably as a result of climate change (McClintock *et al.*, 2008). Among the most striking results of these changes are currently recorded distribution widening of Salpidae, mainly *Salpa thompsoni,* and a decline of krill population (Bombosch, 2008). Previous research has shown that salps do not have enough nutritional value in order to fully meet the energy needs of organisms, which feed mainly on the Antarctic krill (Nicole *et al*., 2000). Therefore, it is vital to monitor the population of salps in order to extend the knowledge about its biology and ecology.

Methods and materials

In this study, samples were collected during the research cruise of the r/v "Akademik Ioffe" along the two transects in the Atlantic sector of the Southern Ocean - Transect I (Cape Town – Weddell Sea) and Transect II (Drake Passage) in the summer 2009/2010.
Additionally, surface water temperature and salinity were also measured. During laboratory works, all species of salps were identified. Detailed analyses including morphological as well as population analyses covering the development stage of blastozooid embryos, or the number of buds present at the reproductive stolon in oozoids, were made only for the specimens of the most dominant species – *Salpa thompsoni*.

Results

In the examined material we observed four species of Salpidae. In both transects the most dominant was *Salpa thomsoni*, however in the region closer to South Africa non-polar species e.g. *Salpa fusiformis*, *Thalia longicauda* and *Iasis zonaria* were also recorded.
The results of the qualitative and population analyses of the most dominant taxa *Salpa thompsoni* showed that the horizontal distribution of this species in the Southern Ocean was uneven and the structure of the population of these animals was strictly dependent on the area in which the samples were collected.
Transect I was characterized by significantly lower numbers of Salpidae, in comparison to the Drake Passage, and they were mostly represented by *Salpa thompsoni.* In this part of the investigation area *S. thompsoni* population was strongly dominated by blastozooids at very young stages of their development.
In the Drake Passage both development stages of *Salpa thompsoni* were recorded and they were clearly dominated by blastozooids. In this area clear horizontal differentiation in the population structure of this species was observed. In the central part of the passage, blastozooids had

embryos in more advanced development stages. Contrastingly, a population which was observed near the South Shetland Island was characterized by slower reproductive process, as very young embryos were only observed.

Discussion

Horizontal variability in the population structure of Salpidae observed in both research areas is most likely connected to the water masses circulation and their productivity. In both transects, *Salpa thompsoni* was the most numerous species, especially in the central parts of these areas. This is probably connected to the distribution of warmer water masses associated with the Antarctic Circumpolar Current and higher primary production (Demidov *et al*., 2012). This is further supported by the horizontal differentiation in the population structure of this species (Harbou, 2009).

In comparison with literature data, much more effective developmental processes of *S. thompsoni* oozooids and blastozooids in the investigated areas, were presumably induced by relatively higher water temperatures and the high concentration of phytoplankton (Demidov *et al*., 2012), (Harbou, 2009).

REFERENCES

Bombosch, A. (2008) "Euphausia superba or *Salpa thomsponi* - Who is going to win?" ANTA., 502, 1-20.

Ballerini, T., Hofmann, E.E., Ainley, D.G., Daly, K., Marrari, M., Ribic, C. A., Smith, Jr. W. O., Steele, J. H. (2014) "Productivity and linkages of the food web of the southern region of the western Antarctic Penninsula continental shelf." Progress in Oceanography, 122, 10-29

Demidov, A.B., Mosharov, Gagarin VI (2012) "Phytoplantkon Production Characteristic in the Southern Atlantic and Atlantic Sector of the Southern Ocean in the Austral Summerof 2009-2010." Marine Biology, 5, 206-218..

Harbou, L. (2009) "Trophodynamics of salps in the Atlantic Southern Ocean." Alfred-Wegener-Institut, 22-33.

Knox, G.A. (2006) "Biology of the Southern Ocean." University of Canterbury New Zealand, Taylor & Francis Group.

McClintock, J., Ducklow, H., Fraser, W., (2008) "Ecological Responses to Climate Change on the Antarctic Peninsula." American Scientist, 96.

Nicol, S., Pauly, T., Bindoff, N.L., Wright, S., Thiele, D., Hosie, G.H., Woehler, E. (2000) "Ocean circulation off east Antarctica affects ecosystem structure and sea-ice extent." Nature, 406, 504-507.

THE EPILITHIC LICHENS OF THE HOLARCTIC SEAS' COASTS – BIODIVERSITY AND ECOLOGICAL PECULIARITIES

Anzhella V. Sonina

Petrozavodsk State University, Ecological-biological Faculty, Department of Botany and Plant Physiology, Lenina, 33, Petrozavodsk 185910, Russia

The species biodiversity and ecological peculiarities of the epilithic lichens at the tidal zone of the European Arctic Seas (White Sea, Barents Sea) have been conducted. In the rigorous Arctic environment the epilithic lichens are a few phototrophic organisms inhabiting the rocky shore. The urgency of our investigation is highly relevant since this group of lichens was not specifically studied.

The study summarizes the results for the period 2007-2013 years on the rocky shores of the White and Barents Seas within the tidal zone (from the low-tide mark to the terrestrial slopes). 113 species of epilithic lichens have been identified, almost 25% of these species for the first time were revealed for some biogeographical provinces of the North-West of Russia. 10 types' ecotopes based on such criteria as the structure of the lichen cover and habitat conditions (nature of the substrate, the angle of the slope of surface, exposure to light) have been allocated. Selected ecotopes from the water line to the terrestrial slopes by the values of the characteristics of the environment and the ecological features of the lichens colonized these habitats, have been placed on determined ecological and dynamic series.

Epilithic lichens of the rocky shores are highly adapted to impact of abiotic factors of the environment (influence of sea: tidal dynamics). Epilithic lichens, having the crustal, squamous and areolate biomorphs, based on the morphological type of the thallus and the specificity of the reproductive organs, are the most environmentally adapted organisms. This feature of the thallus' structure provides them the strong interpenetration with the substrate. The prevalence of sexual reproduction above the vegetative reproduction is the peculiarity of reproductive strategies of the coastal epilithic lichens. Like adaptation to the extreme environmental conditions these adaptations should be considered.

On the example of species *Rusavskia elegans* (Link) S.Y.Kondr. which is widely spreading on the coast of the White Sea, the study of physiological indicators (quantity of the photosynthetic pigments) showed the photobiont leading in the process of adaptation to the environmental conditions of the locality. His high level of the variation (CV=24 %) allows the lichens to be sustainable in the wide range of different conditions of tidal zone.

Thus, epilithic lichens are involved in the formation and maintenance of the functional activity of coastal and saltmarsh communities. High stability of this group of organisms allows them to participate in the early stages of the successional processes in the formation of the coastal biota. Lichens are the most enduring organisms in these unstable conditions and can place the most unsuitable plots for living areas.

RADIAL GROWTH OF DWARF SHRUBS AND PERENNIAL PLANTS IN EBBADALEN (CENTRAL SPITSBERGEN)

Monika Stawska[1], Agata Buchwal[1, 2]

[1]*Institute of Geoecology and Geoinformation, Adam Mickiewicz University, Poznan, Poland*
[2]*Swiss Federal Research Institute, WSL; Dendroecology Group, Birmensdorf, Switzerland*

KEYWORDS: DENDROCHRONOLOGY, DWARF SHRUBS, HABITAT CONDITIONS, PERENNIAL PLANTS, SPITSBERGEN

Global warming observed nowadays causes an increase in geomorphic activity in polar regions. Habitat conditions, in particular water availability and stability of the deposits, have a significant influence on tundra expansion and the rate of shrub succession within newly deglaciated areas.

Dwarf shrubs and perennial plants growing within an alluvial fan and upper marine terraces in Ebbadalen located in central Spitsbergen has been selected to assess their dendrochronological potential. The goal of the study was to determine how geomorphic activity affects the lifespan and wood anatomy of most dominant shrub and herb species.

Within the investigated area microforms differentiated by origin, age and stability were selected to analyse the influence of different habitat conditions on longevity of dwarf shrubs of *Salix polaris* and perennial plants such as *Cerastiun arcticum*, *Draba corymbosa*, *Pedicularis hirsuta*, *Erigeron humilis*. Traditional dendrochronological methods were used, including measurements of tree-ring widths. Additionally, observations of changes in wood anatomy and morphology of annual growth rings of dwarf shrubs indicating mechanical stress caused by geomorphic activity were conducted.

The oldest individual of *Salix polaris* was found within upper marine terraces and was 78 years old. The oldest perennial plant found in the study was *Draba corymbosa* growing within unstable habitat of an alluvial fan and represented the age of more than 30 years. Dwarf shrubs collected from the microsites located within the alluvial fan showed severe changes in wood anatomy such as tension wood, irregular and partially missing rings, multiple scars, and partially injured root.

SPLEEN AND BURSA MASS OF ROCK PTARMIGAN *LAGOPUS MUTA* IN RELATION TO PARASITE INFECTIONS

Ute Stenkewitz[1,2,3], Ólafur K. Nielsen[2], Karl Skírnisson[3] and Gunnar Stefánsson[4]

[1]*Faculty of Life and Environmental Sciences, University of Iceland, Askja, Sturlugata 7, 101 Reykjavík, Iceland*
[2]*Icelandic Institute of Natural History, Urriðaholtsstræti 6-8, 210 Garðabær, Iceland*
[3]*Institute for Experimental Pathology, University of Iceland, Keldur, Keldnavegur 3, 112 Reykjavík, Iceland*
[4]*Science Institute, University of Iceland, Dunhaga 5, 107 Reykjavík, Iceland*

KEYWORDS: SPLEEN, BURSA OF FABRICIUS, PARASITES, ROCK PTARMIGAN, ICELAND

The spleen and bursa of Fabricius in birds are important organs that play a role in fighting parasite infections. The size of these organs is sometimes used by ecologists as a measure of immune investment with larger size implying greater investment. The bursa only occurs in juvenile birds during the development of the B-cell repertoire, whereas the spleen, which is the main site of lymphocyte differentiation and proliferation, is present in both juveniles and adults. We investigated spleen and bursa mass in relation to parasite measures for 541 Rock Ptarmigan *Lagopus muta* collected in northeast Iceland during October from 2007 to 2012. All birds had at least one parasite species. Juveniles had heavier spleens than adults, and adult females heavier spleens than adult males, but there were no sex differences in juveniles. Spleen and bursa mass increased with increasing body condition in juveniles, but decreased in adults, and this effect differed significantly among years. Spleen mass in juveniles was positively associated with parasite species richness and abundance, in particular endoparasite abundance, coccidian parasites being the main predictors. Bursa mass was negatively associated with elevated ectoparasite abundance, two chewing lice being the main predictors. The two immune defence organs appeared to relate to different stimuli. Mean annual spleen mass of juveniles changed in synchrony with ptarmigan body condition and population density over the years of this study. The only parasite measure that showed any relation to density was coccidian prevalence in juvenile birds which traced these trajectories with a c. 2 year time-lag. This suggests that other factors than parasites are probably more important in triggering changes in spleen mass. There is evidence that spleen mass indicates immune investment in Icelandic ptarmigan, but it stays questionable if it is a suitable monitoring tool that reflects parasite burden only. Nevertheless, spleen mass is more suitable than bursa mass because all birds have spleens.

PARASITE INFECTIONS, BODY CONDITION, AND POPULATION CHANGE OF ROCK PTARMIGAN IN ICELAND

Ute Stenkewitz[1,2,3], Ólafur K. Nielsen[1], Karl Skírnisson[2], and Gunnar Stefánsson[4]

[1]Icelandic Institute of Natural History, Urriðaholtsstræti 6-8, Pósthólf 125, 212 Garðabær, Iceland
[2]Institute for Experimental Pathology, University of Iceland, Keldur, Vesturlandsveg, 112 Reykjavík, Iceland
[3]Faculty of Life and Environmental Sciences, University of Iceland, Askja, Sturlugata 7, 101, Reykjavík, Iceland
[4] Science Institute, University of Iceland, Dunhaga 5, 107 Reykjavík, Iceland

KEYWORDS: ROCK PTARMIGAN, PARASITES, POPULATION DENSITY, BODY CONDITION, ICELAND

Parasite communities of wildlife species have rarely been studied over an extended time period. Respective knowledge can give tremendous insight of many aspects of parasite ecology and host-parasite interactions, the latter being one of the driving forces of multiannual cycles in wildlife populations, particularly in Arctic realms. The Icelandic rock ptarmigan *Lagopus muta* population shows multiannual cycles with peak numbers about every 10 years. The parasite fauna of the ptarmigan in Iceland has recently been described and currently 16 species of parasites are known. The aim has been to extend the current knowledge and describe how parasite infections of the ptarmigan relate to host age over a period of seven years, and see how this relates to ptarmigan body condition and population density. We collected 632 ptarmigan in northeast Iceland in October 2006-2012, out of which 631 (99.8 %) were infected with at least one parasite species, 627 (99.2 %) with ectoparasites, and 536 (84.8 %) with endoparasites. Juvenile birds carried overall more parasites than adults. Spring ptarmigan densities reflected the birds' body condition from the previous October, but preceded parasite trajectories, in particular that of coccidians in juvenile birds, by approximately two years. This observation in juvenile birds is of interest as changes in "juvenile excess mortality" drive the ptarmigan cycle in a demographic sense. Up to now, the pattern we observe suggests that parasites may be one of the contributing factors driving the cycle.

THE YES/NO COVERAGE OF ARCTIC SOIL CRUST BY PHOTOTROPHIC ORGANISMS

Otakar Strunecky[1], Alexandra Bernardova[1], Jana Kviderova[1, 2]

[1]Centre for Polar Ecology, University of South Bohemia, Faculty of Science, České Budějovice, Czech Republic
[2]Institute of Botany ASCR, Třeboň, Czech Republic

KEYWORDS: CYANOBACTERIA, FLUORCAM MEASUREMENT, SOIL CRUSTS

Biological soil crusts covers substantial part of the arctic surface. Biological soil crusts perform very important ecological roles. It includes the sequestration of carbon and nitrogen with stabilization of soils and altering the thermal and water regimes. It is believed that the composition of soil crusts depends on geographic and substrate characteristics, climate, disturbances, etc. Biological soil crusts consists both of primary producers as algae, lichens, and mosses, and decomposers involving bacteria and fungi. Decomposers in cold regions are thoroughly studied, especially in the context of global warming and release of sequestered carbon.
The primary producers in arctic become studied since the beginning of 19th century , however for the long time studies investigated higher plants only. Later on, bacteria in soils became the very studied especially with rise of next generation sequencing. Even so there is a different group of organisms combining the autotrophic features of plants and very high endurance of bacteria – cyanobacteria. There is a knowledge for tens of years (Komarek, pers. comm.) that cyanobacteria are the very important part of the soil crusts in arctic.
Cyanobacteria are actually principal composition of the polar soil ecosystems. They form a network of produced polysaccharide sheaths that bind and stabilize soil surfaces. Cyanobacteria are able to withstand extreme environmental conditions. They are well adapted to rapid freezing and desiccation. They are capable survive prolonged periods of drying and rapid start of metabolism within time scale of minutes after being soaked by the water.

In our study, we wanted to measure the coverage of soil crust by photothrophic organisms. This pilot study should reveal the suitability of use of fluorometric measurements for investigation in soil area coverage.

Material and methods
The study site (Fig. 1) was located in the Svalbard in the area of Petuniabukta, close to settlement Pyramiden. The designated area was 30 m wide and 115 m long (study site corners positions from right bottom clockwise: N78° 42.261' E16° 26.448'; N78° 42.278' E16° 26.458'; N78° 42.262' E16° 26.171'; N78° 42.276' E16° 26.171'). The soil crust were sampled using metal ring of 6.8 cm diameter exactly on grid positions. The sampling grid varied - the three scales were applied. The whole area was sampled in squares 5 x 15 m, two squares area of 5 x 5 m were sampled in 1 x 1 m grid and two areas of 1x1 m using grid 25 x 25 cm. The upper 2 cm of soil were cut into petri dishes and transported for analysis. Each sample was photographed and area of soil was measured. The Fluorcam with low and high sensitivity setting was used for measurement of the sampled soil surface. Vegetation sampling (1x1m

quadrats using Braun-Blanquet scale) was done throughout the area to assess the predominant vegetation composition for each type of soil crusts. Altogether, 30 plots were mapped.

Fig 1. Study site

Results and Discussion

Studied area consisted of three types of crusts. The three types of crust formed stripes in longitudinal axe of studied area, black, brown and white. The first – black- was dominated by cyanobacterial assemblages of Nostoc and fungi. The substantial amount of lichens was also documented on site. The second crust – red - was dominated by filamentous cyanobacteria. The third type of crust was visually the rockiest and undeveloped part of our study site.

The fluorometric studies revealed their usability in estimation of percentage of coverage by algae (Fig. 2). The coverage of soil crusts was generally between 60 to 10 percent of soil. This coverage is considered to be high on disturbed soils of our study site.

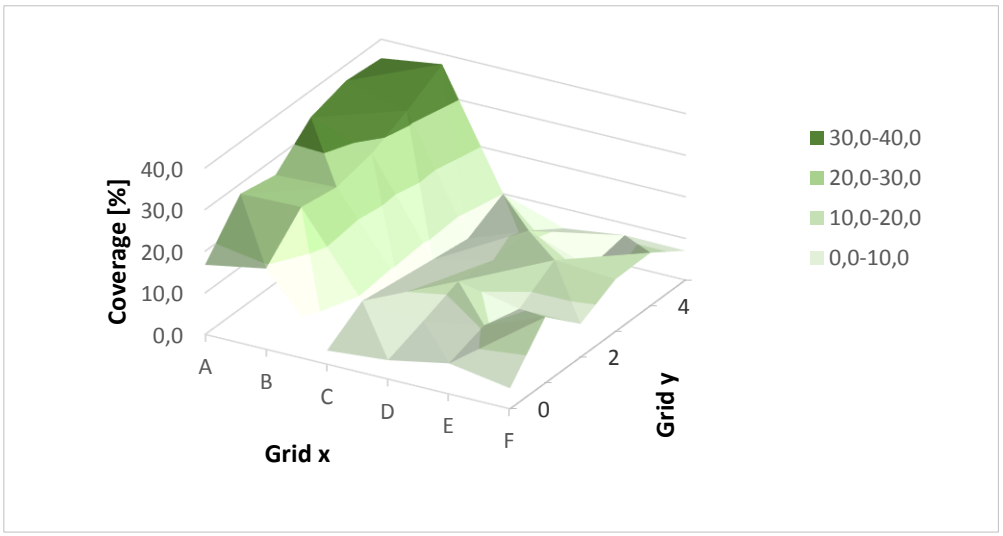


Fig 2: The transition of "black" crust into "red" type of soil crust. Figure show the coverage of soil surface in percent.

IMPACT OF ENVIRONMENTAL POLLUTION NEAR THE SETTLEMENT OF BARENTSBURG (SPITSBERGEN ARCHIPELAGO) ON THE RADIATION PROPERTIES OF SNOW-AND-ICE COVER AND ATMOSPHERE

Pavel. N. Sviashchennikov[1,2], Boris V. Ivanov[2,1], I.A. Govorina[2]

[1] *Saint-Petersburg University, Russia;*
[2] *Arctic and Antarctic research institute, Saint-Petersburg, Russia*

KEY WORDS: SPITSBERGEN, SNOW COVER, ATMOSPHERE, ANTHROPOGENIC POLLUTION

Results of field studies are presented which demonstrate the impact of anthropogenic pollution of snow-and-ice cover and near the ground layer of air. Experiment methodologies are described, preliminary results are discussed which demonstrate the interrelation of "albedo-pollution" and the level of aerosol attenuation in the near the ground layer of air.

CONCENTRATION LEVELS OF FORMALDEHYDE IN PRECIPITATION SAMPLES COLLECTED FROM THE CATCHMENT AREA FUGLEBEKKEN (HORNSUND, SVALBARD ARCHIPELAGO)

Małgorzata Szopińska[1], Katarzyna Kozak[1], Sara Lehmann[1], Marek Ruman[2], Jacek Namieśnik[1], Żaneta Polkowska[1]

[1]*Department of Analytical Chemistry, Chemical Faculty, Gdansk University of Technology, Gdansk, Poland;*
[2]*Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland*

KEYWORDS: FUGLEBEKKEN BASIN, LONG RANGE ATMOSPHERIC TRANSPORT OF POLLUTION (LRATP); POLLUTANTS; FORMALDEHYDE (HCHO), NORWEGIAN ARCTIC

Introduction

Svalbard Archipelago (Norwegian Arctic) is the one of the most remote and least populated region on the Earth. Therefore it should be one of the least polluted (by anthropogenic activities) area. Anthropogenic pollution like HCHO appears on Svalbard primarily due to the long range atmospheric transport of pollutants (LRATP) coming from the areas of Eurasia and North America. Formaldehyde is the simplest of carbonyl compounds and it is widely used industrial chemical to manufacture building materials. A source of HCHO in the atmosphere are also vegetation and photochemical reactions and incomplete combustion of fossil fuels. Therefore, it is present in ambient air. Afterwards HCHO is transported through the atmosphere where it could be changed because of chemical and physical transformations (Li et al. 2009; Seyfioglu at al. 2006). Because of it physicochemical properties it may causes nasopharyngeal cancer and probably leukaemia (HCHO has been classified as a human carcinogen) (Tang et al. 2009).

Materials and methods

Precipitation samples were collected at particular points located in the catchment area Fuglebekken. The Fuglebekken basin is situated in the southern part of the island of Spitsbergen (Norwegian Arctic), on the Hornsund fjord (Wedel Jarlsberg Land). Precipitation samples (rain or snow) were taken from the funnel of the rain to polyethylene containers (volume: 1-1.5 L). These samples were collected during all hydrological year: between 11 September 2010 and 13 September 2011. The aim of studies was examination of presence and differentiation of concentration levels of formaldehyde in this samples. Spectrophotometer (Spectroquant PHARO 100, MERCK) was used at final determination steps.

Results

Table 1 shows result of research.

Table 1 The concentration levels of HCHO in 4 hydrological seasons.

Hydrological seasons:	Autumn			Winter			Spring			Summer		
Sampling date:	09.09.10-29.09.10			01.10.10-26.05.11			01.06.11-10.07.11			14.07.11-13.08.11		
Number of samples:	8			84			3			5		
	Concentration [mg/L]			**Concentration [mg/L]**			**Concentration [mg/L]**			**Concentration [mg/L]**		
	Min	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**
Formaldehyde (HCHO)	*0,02*	*0,07*	*0,1*	*0,02*	*0,08*	*0,08*	*0,07*	*0,16*	*0,25*	*0,03*	*0,03*	*0,03*

* Division on hydrological periods were made on the basis of data available in the literature (Pulina 2004)

Discussion

Based on initial studies it can be stated that in analysed samples of precipitation water are present organic pollutants which may origin both from natural and anthropogenic sources. It also can be concluded that the precipitation are important transport medium of these compounds. The average concentration of formaldehyde in precipitation samples is on a constant basis. Only in the spring mean concentration is clearly larger than in other periods. This could be result of small frequency of precipitation during this period (once precipitation washed out larger quantities of aerosols). Concentration range of HCHO in samples collected between 09.09.2010 and 13.08.2014 was: 0,02 -0,25 mg/L.

Because of cancerous properties even relative small amount of HCHO affect the natural balance of the Arctic ecosystem. Studies of levels of pollution present in precipitation samples in the Svalbard Archipelago are the foundation for monitoring the quality of the environment through which it is possible to take action to protect Arctic ecosystems.

Acknowledgements

The authors would like to thank Katarzyna Cichała – Kamrowska for help in collecting samples and thank the staff of the Polish Polar Station at Hornsund for the opportunity to carry out sampling and for their assistance with this work. Collecting samples was financially supported from the project number: 1173/IPY/2007 MNiSW. Analysis was financially supported from the project number: DEC-2013/09/N/ST10/04191, which was funded by the National Science Centre.

REFERENCES:

Li J., Dasgupta P. K., Luke W. (2005): "Measurement of gaseous and aqueous trace formaldehyde Revisiting the pentanedione reaction and field applications " Analytica Chimica Acta 531: 51–68

Pulina M. (2004): Ziemia Wedela-Jarlsberga (część południowa) i Sorkappland, Warsztaty Glacjologiczne Spistbergen 2004, Stowarzyszenie Geomorfologów Polskich

Seyfioglu R., Odabasi M. (2006): "Investigation of air–water exchange of formaldehyde using the water surface sampler: Flux enhancement due to chemical reaction" Atmospheric Environment 40: 3503–3512

Tang X., Bai Y., Duong A., Smith M. T., Li L., Zhang L. (2009): "Formaldehyde in China: Production, consumption, exposure levels, and health effects" Environment International 35: 1210–1224

MECHANISMS OF NUTRIENTS ENCLOSURE INSIDE BENTHIC MICROBIAL MATS IN ANTARCTIC OLIGOTROPHIC LAKES BY COMBINATION APPROACH OF OBSERVATION DATA AND THEORETICAL STUDY

Yukiko Tanabe[1,2], Akiko Mizuno[3], Masaki Uchida[2], Masumi Yamamuro[4], Sakae Kudoh[2]

[1]Waseda Institute for advanced study, Waseda University, Japan;
[2]National Institute of Polar Research, Japan;
[3]Hydropheric Atmospheric Research Center, Nagoya University, Japan;
[4]Department of Natural Environmental Studies, Graduate School of Frontier Sciences, The University of Tokyo, Japan

KEYWORDS: ANTARCTIC LAKES, FRESHWATER, MICROBIAL MATS, NUTRIENT ENCLOSURE, SEDIMENT–WATER INTERFACE

The most of water bodies of freshwater lakes in Antarctica are considered to be nutrients limited (Hawes et al. 1993, Vincent & Howard-Williams 1994, Laybourn-Parry 2002). Although the lake water are oligotrophic in Antarctic freshwater lakes, the interstitial water of benthic microbial mats surface were 3-220 times higher in ammonium concentrations and 2-102 times higher in phosphate than the lake water (Tanabe et al. submitted). The nutrient concentrations of the interstitial water in Antarctic lakes are either equalling or surpassing that of temperate eutrophic lakes. Also, the nutrient concentrations of the interstitial water have a wide range of variations although lake waters are similar concentrations among the lakes in Antarctica. Then, it is hypothesized that there are any mechanisms the nutrients hardly discharged from lakebeds to water column such like nutrients enclosure. To reveal the mechanisms, we used vertical profiles of the silicate and ammonium concentration inside benthic mats collected from 17 Antarctic oligotrophic lakes, and examined 3 factors considered as controlling nutrients enclosure by model study. The first is turbulence on the boundary layer between mat and water, the second is viscosity of the mats, the third is uptake by phytobenthos.

To confirm the effect of turbulence, we examined that correlation between the both nutrient concentrations affected by the lake surface area and the maximum water depth using generalized linear model and AIC model selection. Then it was revealed that the lake area and the maximum depth have no effect on the correlation because a simplest model without the both variables was selected by each of the criteria AIC. It indicates that the turbulence are thought to be negligible. Next, we established two diffusion models to represent dynamics of silicate and ammonium in water column and the mat on the vertical axis. The model was used to investigate the distribution pattern of nutrient concentration by molecular diffusion affected by mat viscosity and biological consumption, and was compared with observation data. The silicate model showed a wide range of variations of viscosity, and the viscosity values depending on each lake were obtained. The kinetics of the ammonium uptake by phototrophs were obtained by applying the viscosity of each lake to the ammonium model, then this indicated that the phytobenthos surely take in ammonium in the mat surfaces and the uptake kinetics are largely varied in each lake. Our study suggests that a mechanism of nutrients enclosure inside benthic mats in oligotrophic lakes is caused by viscosity of the mats and uptake by phototrophs.

REFERENCES:

Hawes, I., Howard-Williams, C. & Pridmore, R. D. (1993) Environmental control of microbial communities in the ponds of the McMurdo Ice Shelf, Antarctica. Arch. Hydrobiol. 127: 271–287

Laybourn-Parry, J. (2002) Survival mechanisms in Antarctic lakes. Phil. Trans. R. Soc. Lond. B 357: 863–869

Vincent, W. F. & Howard-Williams, C. (1994) Nitrate-rich inland waters of the Ross Ice Shelf region, Antarctica. Antarctic Sci 6: 339–346

SEASONAL DEVELOPMENT OF CYANOBACTERIAL POPULATIONS (*PHORMIDIUM*) IN THE HIGH ARCTIC, SVALBARD

Daria Tashyreva[1, 2], Josef Elster[1, 2]

[1]*University of South Bohemia, Faculty of Science, České Budějovice;*
[2]*Institute of Botany, Centre for Phycology, AS CR, Czech Republic*

KEYWORDS: CYANOBACTERIA, SVALBARD, STRESS RESISTANCE, VIABILITY, FLUORESCENCE MICROSCOPY

Cyanobacteria belonging to the genus *Phormidium* are among the most abundant photosynthetic organisms in the Arctic, and often accumulate high biomass in form of thick biofilms and crusts. They are known for their capability of tolerating multiple stresses that last for most time of the year.

Here, we present the result of 2-year observation of two *Phormidium* populations in close proximity to the Czech Polar Research Station on Svalbard. The selected populations inhabit shallow pools (seepages) that represent quite unstable environments, where cyanobacteria are exposed to drying-rewetting cycles and continuous light during summers, freezing-melting episodes during spring and autumn, and permanent freezing for at least a half of the year. We describe our observations on seasonal development of these populations based on macroscopic community structure, morphology and ultrastructure of cells. Their viability and metabolic activity was evaluated by staining with three fluorescent dyes, which indicate the state of cell plasma membranes (SYTOX Green), nucleoid morphology/presence (DAPI), and respiration activity (redox dye CTC).

Using this approach, we found that cyanobacteria remained physiologically active during the entire vegetative season, whenever liquid water was available, and contained very low number of dead or injured cells. Cyanobacteria from frozen samples collected at the end of winter, resumed their respiration immediately after melting, and contained about 10% of non-viable cells, mainly represented by necridic cells, or those located at the polar ends of filaments. Investigation of cell morphology suggests that *Phormidium* does not produce morphologically distinct cells responsible for survival of stressful conditions. Despite high variability at the end of vegetative season in filament length, thickness of sheaths and amount of storage material, all these cells showed comparable viability and respiration activity. Apparently, survival of populations during unfavourable episodes is provided by biochemical modifications in combination with production of sheaths, which protect filaments against extensive water loss, and mechanical damage by ice crystals.

EFFECT OF WET HYDROGEN SULFIDE DEPOSITION ON MOSS (*RACOMITRIUM LANUGINOSUM*) GROWTH IN ICELAND

Thecla Mutia [1], Þráinn Friðriksson [2], Ingibjörg Jónsdóttir[1]

[1]*Department of Life and Environmental Sciences, University of Iceland, Reykjavik, Iceland;*
[2]*ISOR, Iceland Geosurvey, Reykjavik, Iceland*

KEYWORDS: H_2S, *R. Lanuginosum*, ICELAND, GEOTHERMAL, EMISSIONS

Following environmental concerns on the effect of H_2S gas emissions from geothermal power plant emissions on ecosystems and especially moss heaths in Iceland, an experimental study was designed. The effect of wet H_2S deposition on the moss *Racomitrium lanuginosum* was investigated. Extracted *R. lanuginosum* samples from an area devoid of geothermal activity were re-grown in sixteen 16 x 24 x 8 cm trays in optimal moss growth conditions for a period of three months. The substrate was lava obtained from the sampled area which is well outside the affected emission area of geothermal power plants. Solutions were prepared where H_2S gas was dissolved in distilled water at 30ppb, 100ppb and 300ppb concentrations. The trays were randomly assigned to treatments where they were irrigated with either one of the solutions or distilled water only with four replications. Moss shoot growth was assessed using different methods. This poster presents the observed growth changes and sulphur concentration in the moss shoots at the end of the experiment.

REFERENCES:

Strunecký, O., Elster, J., Komarek, J. (2010): "Phylogenetic relationships between geographically separate *Phormidium* cyanobacteria: is there a link between north and south polar regions?" Polar Biology 33(10): 1419-1428

Armitage, H. F., Britton, J. A., Wal, R., Pearce, I. S. K., Thompson, D. B. A. and Woodin, S. J. (2012): "Nitrogen deposition enhances moss growth, but leads to an overall decline in habitat condition of mountain moss-sedge heath". Global Change Biology, 18: 290–300, doi: 10.1111/j.1365-2486.2011.02493.x

Bargagli, R., Monaci, F., Borghini, F., Bravi., F and Agnorelli, C. (2002): "Mosses and lichens as biomonitors of trace metals. A comparison study on *Hypnum cupressiforme* and *Parmelia caperata* in a former mining district in Italy". Environmental Pollution, 116: 279–287

Glime, J. M. 2007: "Bryophyte Ecology". Vol. 1. Physiological Ecology. Ebook sponsored by Michigan Technological University and the International Association of Bryologists. Accessed on 1st March 2013 at <http://www.bryoecol.mtu.edu/>.

Jónsdóttir, I. S, Crittenden, P, Jägerbrand, A. (1999): "Measuring growth rate in bryophytes and lichens", 91-95. In Hollister, R.D. (editor). (1999): Plant Response to Climate Change: Integration of ITEX Discoveries. Proceedings from the 9th ITEX Meeting January 5-9, 1999. Arctic Ecology Laboratory Report 1, Michigan State University. East Lansing: MI. 117 p.

Ketilson, J. (2012): "Iceland Country Report 2012". IEA Geothermal Implementing Agreement.

CHANGES IN SPECTRAL PROPERTIES AND CHLOROPHYLL FLUORESCENCE OF *NOSTOC COMMUNE* COLONIES FROM SVALBARD DURING DEHYDRATION AND SUPPLEMENTAL UV-B STRESS

Kateřina Trnková[1], Jana Hazdrová[1], Jana Kvíderová[2], Josef Hájek[1], Miloš Barták[1]

[1]*Department of Experimental Biology, Laboratory of Photosynthetic Processes, Faculty of Science, Masaryk University, Brno, Czech Republic;*
[2]*Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic*

KEYWORDS: CYANOBACTERIA, SVALBARD, DEHYDRATION, UV-B, CHLOROPHYLL FLUORESCENCE.

Introduction

Nostoc commune is a worldwide-occurring cyanobacterium, forming macroscopic colonies. It is quite frequent in polar regions, where it grows on wet soil and in shallow wetlands. As a nitrogen fixator, *Nostoc* plays an important role in the nitrogen balance of the Arctic environments. In the field, *Nostoc* is exposed to many stress factors influencing its physiology. Apart from freezing temperatures and long-lasting darkness in winter, desiccation is one of most important stress factor.

Material and Methods

The thalli of *Nostoc commune* were collected in Petuniabukta, Central Spitsbergen, Svalbard. They were used for three experiments focused to (1) desiccation in the field under natural conditions, (2) desiccation in laboratory conditions, (3) laboratory experiment evaluating *Nostoc* responses to elevated UV-B radiation.

Weight of thalli was measured in order to calculate changes in relative water content (RWC). In laboratory desiccation experiment, thallus water potential (WP) was measured by a dew point water potential meter (WP4T; Decagon Devices, USA). Two spectral indices were measured during desiccation: (1) normalized difference vegetation index (NDVI; related to the amount and hydration state of chlorophyll) and (2) photochemical reflectance index (PRI; related to the content of carotenoids). Two different chlorophyll fluorescence parameters were measured to evaluate photosynthesis during desiccation. In the field experiment, fast chlorophyll fluorescence kinetics (OJIP) was used, while effective quantum yield (Φ_{PSII}) was measured in laboratory.

In the experiment with supplemental UV-B radiation, the thalli were exposed to three UV-B doses: (1) 0.8 mW, (2) 1.5 mW, and (3) 3 mW for 5 d. During the experiment, chlorophyll fluorescence was measured by Handy FluorCam FC 1000-H (Photon System Instruments, Czech Republic). The measurements were made 90 min, 3 h, 6 h, 16 h, 40 h, 3 d, and 5 d after the beginning of exposition. In order to analyse their absorbance spectra, part of thalli was removed after 24 h of exposition; the rest was analysed after the end of experiment.

Results and Discussion

The relationship between RWC and WP was nearly hyperbolic, with very slow decrease of WP down to RWC values around 0.2 and a rapid decrease of WP after losing 95% of releasable water. This may indicate that the polysaccharidic envelope contains high amount of water that can be released during initial stages of desiccation and help the thallus to maintain physiological

activity. The OJIP curves flattened with desiccation indicating the decrease of electron transport in PS II, although the total fluorescence signals rose in medium dehydration due to thallus shrinking. Φ_{PSII} was too variable to estimate a desiccation-dependent relationship, maybe because of physical and optical properties of the thallus. The PRI rose with desiccation from -0.3 reached at full hydration to 0 in dry state. NDVI showed a curvilinear relationship with desiccation, with a mild increase during initial dehydration and a decrease in further stages of desiccation.

Photosynthetic chlorophyll fluorescence parameters decreased in all levels of UV-B radiation and the decrease lasted through all the time of exposition. The absorbance spectra showed that exposed thalli contain higher amounts of UV-absorbing compounds per gram of dry weight. The absorbance rose mostly in two ranges of wavelengths – (1) in one broad peak approximately around 380 nm that can be attributed to scytonemin content and (2) in UV-C region, where two narrow peaks at 209 and 260 nm were observed. Higher doses of UV-B caused faster decrease of chlorophyll fluorescence, but the rise of absorbance was similar in all doses. That means *Nostoc* was sensitive even to environmentally relevant level of UV-B radiation. Further field and laboratory experiments are needed to support such conclusion.

Acknowledgements
The authors thank to the project CzechPolar for providing infrastructure.

VERMISTELLA, THE FREE-LIVING AMOEBAE GENUS WITH BIPOLAR DISTRIBUTION

Tomáš Tyml[1,2], Martin Kostka[1,2], Oleg Ditrich[1], Iva Dyková[3]

[1]*Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic*
[2]*Institute of Parasitology, Biology Centre ASCR, České Budějovice, Czech Republic*
[3]*Faculty of Science, Masaryk University, Brno, Czech Republic*

KEYWORDS: ANTARCTICA, ARCTIC, BIPOLAR TAXA, FREE-LIVING AMOEBAE, PSYCHROPHILY, *VERMISTELLA*

Three new *Vermistella* strains were isolated from Arctic marine habitats in the central part of Svalbard archipelago. This is the first report on amoebae belonging to the genus *Vermistella* Moran and Anderson, 2007, the type species of which was described from the opposite pole of the planet (Moran et al. 2007). Psychrophily proved in the new strains qualify the genus *Vermistella* as bipolar taxon. Molecular phylogenetic analyses based on 18S rDNA and actin sequences did not prove an affinity of the genus *Vermistella* to Stygamoebida Smirnov and Cavalier-Smith, 2011. A close phylogenetic relationship was found between *Vermistella* spp. and a sequence originating from an environmental sample from Cariaco basin, the largest marine permanently anoxic system in the world. Possible mechanisms of bipolar distribution are discussed.

REFERENCES:

Moran, D.M., Anderson, O.R., Dennett, M.R., Caron, D.A., Gast, R.J. (2007): "A description of seven Antarctic Marine gymnamoebae including a new subspecies, two new species and new genus: *Neoparamoeba aestuarina antarctica* n. subsp., *Platyamoeba oblongata* n. sp., *Platyamoeba contorta* n. sp. and *Vermistella antarctica* n. gen. n. sp." J. Eukaryot. Microbiol. 54: 169–183

This study was supported by the Grant No. LM2010009 CzechPolar (MSMT CR), and CZ.1.07/2.2.00/28.0190 (EU).

FREE-LIVING VAHLKAMPFIID AMOEBAE FROM LAKES OF VEGA ISLAND, ANTARCTIC

Tomáš Tyml[1,3], Kateřina Skulinová[2], Martin Kostka[1,3], Jan Kavan[1*], Oleg Ditrich[1], Iva Dyková[2]

[1] Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic;
[2]Faculty of Science, Masaryk University, Brno, Czech Republic;
[3]Institute of Parasitology, Biology Centre ASCR, České Budějovice, Czech Republic;
**member of Argentine Antarctic Institute expedition, 2013*

KEYWORDS: ANTARCTIC; FREE-LIVING AMOEBAE; INTERNAL TRANSCRIBED SPACERS; NAEGLERIA SPP.; VAHLKAMPFIIDAE

In the free-living amoeba (FLA) studies, *Naegleria* spp. (Heterolobosea, Vahlkampfiidae) have constantly attracted a lot of attention. Currently, several reasons qualify *Naegleria* spp. for studies targetted at geographical distribution of FLA: (1) life cycle, which in *Naegleria* spp. includes cyst stage; (2) high maximum growth temperature between 37 and 40 °C of strains pathogenic for humans; (3) wealth of data accumulated on FLA from the temperate zone compared with scant data from extreme ecosystems of the planet (including the polar regions); (4) molecular definition of numerous *Naegleria* spp. including *N. gruberi*, the genome of which has been sequenced recently; hence modern approaches in studies of diversity of FLA within protistan assemblages in different microhabitats are greatly facilitated. Recent studies based on molecular definition of species introduced 6 newly described *Naegleria* spp. from Sub-Antarctic freshwater samples collected on Ile de la Possession, Crozet Archipelago (De Jonckheere 2004, 2006). A total of 41 environmental samples (including 11seawater and 30 from freshwater lakes) collected on Vega Island, Antarctica (Argentine Antarctic Institute expedition, 2013*) were screened for the presence of FLA. Agar plates and liquid media were used for isolation attempts carried out simultaneously at 10 and 20 °C. Of 19 primary isolates, 2 marine and 11 freshwater strains were established and characterized using light and electron microscopy. Eight freshwater strains were assigned to the genus *Naegleria* based on morphological features. Ribosomal sequences (5.8S rDNA and ITS region) were obtained from one of the novel strains (F13 strain). Neighbour joining phylogenetic analysis placed the first sequenced strain together with *N. antarctica* and *N. neoantarctica*. Our results suggest that Antarctic is populated by only the one lineage of genus *Naegleria*.

REFERENCES

De Jonckheere, J. F. (2004): "Molecular definition and the ubiquity of species in the genus *Naegleria*." Protist 155: 89 - 103

De Jonckheere, J. F. (2006): "Isolation and identification of free-living amoebae of the genus *Naegleria* from Arctic and sub-Antarctic regions." Eur J Protistol 42: 115–123

This study was supported by the Grant No. LM2010009 CzechPolar (MSMT CR), and CZ.1.07/2.2.00/28.0190 (EU).

SPATIAL VARIABILITY OF CO_2 FLUX AT MOSS TUNDRA IN NY-ÅLESUND, NORWAY

Masaki Uchida[1], Mitsuru Hirota[2], Yasuo Iimura[3], Ayaka Mo Kishimoto[4], Noriko Oura[4], Takayuki Nakatsubo[5]

[1]National Institute of Polar Research;
[2]University of Tsukuba, The University of Shiga Prefecture;
[4]National Institute for Agro-Environmental Sciences;
[5]Hiroshima University

KEYWORDS: HIGH ARCTIC, CO2 FLUX, MOSS TUNDRA

Arctic terrestrial ecosystems are extremely vulnerable to climate change and a major concern is how the carbon balance of these ecosystems will respond to climate change.
Wet tundra ecosystems have been strong sinks for atmospheric CO_2 after the last ice age and contain large amounts of accumulated soil organic carbon (SOC). Climate warming is likely to have a profound influence on this SOC pool by changing carbon balance. However there is little information about carbon cycle in the high Arctic wet tundra ecosystem. Our objective is to investigate ecosystem carbon cycle of the moss tundra. At the first step, we measured CO_2 flux of the moss tundra and investigated factors contributing to spatial variability of the flux.

In summer of 2013, we conducted field measurements of net ecosystem exchange and ecosystem respiration at moss tundra near Ny-Ålesund, Svalbard (79°N). The area was almost totally covered with mosses including *Sanionia uncinata*, *Campylium* sp., *Calliergon richadsonii* and *Tomenthypnum nitens*. A few vascular plants such as *Ranunclus hyperboreus*, *Cardamine nymanii* and *Saxifraga caespitosa* grew in mosses. We set 8 plots at the moss tundra and measured CO_2 flux, thickness of active layer, water table, soil temperature, oxidation-reduction potential and moss biomass.

Although thickness of active layer in each plot was approximately 20cm, we observed flooded plots and non-flooded (lower water table) plots. Gross photosynthetic production (GPP) and ecosystem respiration (ER) of the flooded plots tended to be larger than that of the non-flooded plots. Large part of ecosystem dark respiration derived from green part of moss, whereas CO_2 emission from soil layer was very small. There was significant correlation between GPP, ER and moss temperature. This result suggests that moss temperature would regulate spatial variability of CO_2 flux at the moss tundra.

PATTERNED HETEROGENEITY OF PHOTOSYNTHETIC ACTIVITY IN MICROBIOLOGICAL SOIL CRUSTS

Peter Váczi, Miloš Barták, Kateřina Trnková

Masaryk University, Department of Experimental Biology, Laboratory of Photosynthetic Processes, Brno Czech Republic

KEYWORDS: OXYGEN EVOLUTION RATE; MICROOPTODE MEASUREMENT; CHLOROPHYLL FLUORESCENCE; JAMES ROSS ISLAND (ANTARCTICA)

Introduction

Northern part of James Ross Island (Maritime Antarctica) with wide deglaciated area offers variety of habitats for development of microbiota. The environment ranges from bare rock, soil crusts, and microbiological mats to lakes, small ponds, and streams. The microbiological soil crusts takes place in areas with deposits of fine material and detrit with higher humidity periodically warmed by solar radiation. From cyanobacterial colonization of the crusts can be found abundant species from genera *Nostoc, Microcolleus, Leptolyngbya, Phormidium and Anabaena* (Komárek *et* Elster, 2008).

Micro optode measurement of dissolved oxygen is novel methodological approach and it was recently used *e.g.* in studies of seaweeds (Miller *et* Dunton, 2007), marine diatoms (Mock *et* al. 2002), bacterial mats in caves (Riess *et* al. 1999), however, measurement on soil crust are rare. Simultaneous measurement of quantum yield of photochemical reactions in photosystem II and oxygen evolution rate at different light conditions can help to define an activity surviving of autothrophs in changing extreme environment.

Material and Methods

Soil crusts were collected in almost dry state on flat field areas of northern part of Ulu peninsula (James Ross Island). The crusts were transferred into lab and fully hydrated for 48h at 15°C. After hydration, photosynthetic activity were tested (Φ_{II}>0.5). The crusts were microscopically analysed and typical pattern of cyanobacterial colonization were documented.

The small area of the crust (cca 1 cm^2) were exposed to stepwise increasing irradiance of 0, 40, 130, 270, 410 and 500 $\mu mol.m^{-2}.s^{-1}$ (each step 200s). During exposition, a simultaneous measurement chlorophyll fluorescence (parameters F_S, F_M', Φ_{II}) and oxygen evolution rate has been provided by fluorometer AquaPen AP 100 (PSI, Czech Republic) and oxygen Micro Optode Meter equipped with oxygen MicroOptode OP-430 and temperature sensor OP-Temp (Unisense, Denmark). The crusts were continuously wetted during measurement. The measurement were repeated for representative clusters of the pattern of cyanobacterial colonization of each crust.

Results and Discussion

Preliminary results showed substantial level of heterogeneity in the photosynthetic activity over the pattern of cyanobacterial colonization of analysed microbial crusts. The species composition and their relative abundance within the soil crust were found as main source of the heterogeneity. The evaluation of light response curves of effective quantum yield of fluorescence and oxygen evolution rate provide important information above the effectivity of photosynthetic processes in cyanobiota of soil crusts and potential capacity of primary production of these ecosystems in changing environment.

Acknowledgements: The authors thank CzechPolar for support of field works and experimental infrastructure.

REFERENCES:

Komárek, J., Elster, J. (2008): Ecological background of cyanobacterial assemblages of the northern part of James Ross Island, Antarctica. Polish Polar Research 29(1): 17-32

Miller, H.L., Dunton, K.H. (2007): Stable isotope (C-13) and O-2 micro-optode alternatives for measuring photosythesis in seaweeds. Marine Ecology Progress 329: 85-97

Mock, T., Dieckmann, G.S., Haas, C., et al. (2002): Micro-optodes in sea ice: a new approach to investigate oxygen dynamics during sea ice formation. Aquatic Microbial Ecology 29(3): 297-306

Riess, W., Giere, O., Kohls, O., et al. (1999): Anoxic thermomineral cave waters and bacterial mats as habitat for freshwater nematodes. Aquatic Microbial Ecology 18(2): 157-164

CONTROLS AND INTERACTIONS IN CRYOCONITE FOOD WEBS UPON THREE HIGH ARCTIC GLACIERS ON SVALBARD

Tobias Vonnahme[1,2]

[1]*Department of Biology, Universität Konstanz, Constance, Germany;*
[2]*Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic*

KEY WORDS: FOOD WEB, CRYOCONITE, INVERTEBRATES, GLACIERS, SVALBARD

Despite their lifeless appearance, glaciers are known to harbour a variety of microbial ecosystems. One of the best studied habitats is cryoconite holes, cylindrical cavities filled with meltwater and dark sediments associated with microorganisms. Most attention has been paid to the microbial diversity and biogeochemistry of this supraglacial system. However, there is a lack of knowledge about the controls and interactions in the cryoconite food webs. In particular the role of invertebrate grazers and predators is hitherto hardly known.

The aim of this study is to evaluate the environmental controls on a bottom up regulated food web. Furthermore, the key organisms of each trophic level, as well as the interactions between prokaryotes, eukaryotic algae and invertebrates, will be evaluated. The hypothesis is that the food web consists of phototrophic cyanobacteria as the main drivers of a multi trophic food chain. Additionally, heterotrophic Proteobacteria may play an important role in the carbon fluxes in this food web, and rotifers are probably the most important part of the fauna consisting of both grazers on microalgae and cyanobacteria and predators on other rotifers.

Therefore, an experimental setup involving the dominating rotifer species of this system will be used to quantify the flux of carbon and cells. To that end, the incorporation of radiolabelled algae and fluorescent labelled microspheres into the rotifers will be measured in feeding experiments. These data will help to evaluate the feeding efficiency of invertebrates. Alongside this, fluorescence and light microscopy will be used to quantify and determine the morphotypes of the phototrophic microbes, and the species of grazing invertebrates, throughout one summer season on three Svalbard glaciers. Also, the total bacterial biomass will be estimated via fluorescent staining of bacterial cells. This will help to reveal the community structure and seasonal patterns. An ordination analysis followed by permutation tests will finally help to identify the main controls on this system.

The results of this study will help to understand the trophic interactions and carbon fluxes in this vulnerable ecosystem, as well as the effect of environmental changes and its importance for periglacial ecosystems.

THE PHYTOSOCIOLOGICAL AND NUMERICAL ANALYSIS OF THE SNOWBED TUNDRA COMMUNITIES OF SPITSBERGEN

Michał Węgrzyn, Paulina Wietrzyk

Professor Z. Czeppe Department of Polar Research and Documentation, Institute of Botany, Jagiellonian University, Kraków, Poland

KEYWORDS: ARCTIC, SVALBARD, SNOWBEDS, SYNTAXONS

Intensive development of phytosociological studies of vegetation in Svalbard has occurred in the 20th and in the beginning of the 21st century (Hadač 1946). Since then, many times there have been attempts to create the uniform phytosociological system of the arctic plant communities for Spitsbergen (Hadač 1946, Hadač 1989, Möller 2000, Nilsen i Thannheiser 2013). The recent attempts to develop this system are still not complete (Nilsen and Thannheiser 2013).

The appearance of significant numerical problems in some syntax is the result of the following: using different phytosociological systems; the differentiation of the releves area; the representativeness of research results for the entire area of Spitsbergen; not taking into account the cryptogamic species (especially lichens), and therefore not including them as characteristic species for plant associations and alliances.

With such different literature data, it is extremely difficult to create a uniform and transparent system, in which described syntaxons will be hierarchically arranged, unique and representative for the whole area of Spitsbergen. Despite these difficulties, but through the use of the modern numerical and syntaxonomic computer softwares, detailed studies were conducted on the series of 135 phytosociological releves, own and different authors. These releves were taken during the 20th and early 21st century in Spitsbergen. The analysis process was focused on the alliances *Luzulion nivalis* Nordh. 1936 and *Luzulion arcuatae* Elvebakk 1985, which are related to snowbeds communities (Elvebakk 1994), and whose existence as a result of numerical analysis has been statistically confirmed. However, separate plant groups did not reflect the classification, which was proposed by Elvebakk (1994). After numerical analyses, plant communities assigned to the *Luzulion nivalis* Nordh. 1936 have been grouped into three plant associations: *Deschampsietum alpinae* (Nordh. 1943) Węgrzyn & Wietrzyk 2014 stat. nov., whose status were changed and two new associations: *Saxifragetum hieracifoliae* Węgrzyn & Wietrzyk 2014, *Pedicularietum hirsutae* Węgrzyn & Wietrzyk 2014. Within the alliance *Luzulion arcuatae* Elvebakk, from eight plant communities only two plant associations were distinguished: *Anthelio-Luzuletum arcuatae* Nordh. 1928 with confirmed status and *Gymnomitrietum coralloidis* (Hadač 1946) Węgrzyn & Wietrzyk 2014 stat. nov., which was presented in new terms. The legitimacy of the presented division derives from an objective numerical analysis of the species composition similarity for the each phytosociological releves.

L.I.F.E. (LASER INDUCED FLUORESCENCE EMISSION) AS NOVEL NON-INVASIVE TOOL FOR IN-SITU MEASUREMENTS: CALIBRATION AND APPLICATION ON SAMPLES FROM SVALBARD

Klemens Weisleitner[1], Birgit Sattler[1], Lars Hunger[2], Christoph Kohstall[3], Albert Frisch[3]

[1]University of Innsbruck, Institute of Ecology, Innsbruck, Austria;
[2]University of Innsbruck, Institute of Astro- and Particle Physics, Innsbruck, Austria;
[3]University of Innsbruck, Institute of Experimental Physics, Innsbruck, Austria

KEYWORDS: Laser Induced Fluorescence Emission (L.I.F.E.), NON-INVASIVE, ICE, PHYCOERYTHRIN, CHLOROPHYLL

Continuing global warming has an impact on microbial communities in supraglacial ecosystems and hence on the availability of organic carbon. Only a handful of investigations are published dealing with carbon sink rate estimates in the cryosphere (e.g. Anesio et al., 2009, 2010). Data for these studies were acquired by using standard methods which implies three major problems: A) for high resolution data, the amount of samples are logistically challenging and therefore expensive B) the methodology to detect microbial life implies severe manipulation of the ecosystem which results in falsification of *in situ* conditions (cutting, sawing and melting ice cores) C) ice algae might be a crucial source for carbon sinks but due to low resolution data availability, the supraglacial distribution could not be assessed yet on a larger scale.

We have developed a portable device that ensures high resolution non-destructive *in-situ* measurements in both, terrestrial and ice ecosystems (Storrie-Lombardi & Sattler, 2009, Sattler et al., 2011). We apply a laser-induced fluorescence emission technique (L.I.F.E.) based on the fact that the surface communities of glaciers are highly autotrophic. Fluorescence is one of the most sensitive techniques for detecting biosignatures involving spectral data. In 2013, the instrument was tested during a Mars analog mission in the Kess Kess formation near Erfoud (Morocco) while mounted on a rover (Grömer et al., 2014). Further testing took place in the high Arctic during two expeditions and Antarctica (Lake Obersee, Antarctica).

Here, we present data from laboratory calibration for the detection and quantification of chlorophyll$_a$ and phycoerythrin in samples from the glacier Midtre Lovenbreen in Svalbard in the High Arctic. We found that green lasers (532nm) excite phycobiliproteins in cyanobacteria, red algae and cryptomonads which produce multiple fluorescence signatures between 550nm and 750nm - depending on species and metabolic state. Furthermore, the blue laser (405nm) is detecting chlorophyll$_a$ with highest fluorescence counts at 680-690nm. To validate the data, we compared chlorophyll$_a$ concontrations generated by the newly developed device with traditional methods of chlorophyll extraction and a common double-beam spectrophotometer.

For the first time, obtaining *in-situ* data with a high spatial and temporal resolution of phototrophic organisms in ice ecosystems is possible. No destruction of samples is necessary to obtain high quality results concerning chlorophyll$_a$ and phycoerythrin contents. The instrument can be connected with a rover which enables L.I.F.E. measurements along a virtual grid under remote control. Potentially, large areas can be investigated without difficulties in logistics. This data could contribute to a better understanding of changing carbon fluxes due to climate warming in the cryosphere.

REFERENCES:

Anesio, A.M., Sattler, B., Hodson, A.J., Fritz, A. and Psenner, R. (2009): "High microbial activities on glaciers: importance to the global cycle." Global Change Biology, doi: 10.1111/j.1365-2486.2008.01758.x

Anesio, A.M., Sattler, B., Foreman, C.F., Telling, J., Hodson, A., Tranter, M. and Psenner, R. "Carbon fluxes through bacterial communities on glacier surfaces." (2010) Annals Glaciology, Microbiology and Biogeochemistry: 51(56):32-40

Grömer, G., Sattler, B., Weisleitner, K., Hunger, L., Kohstall, C., Frisch, A., Jozevowicz, M., Meszynski, S., Storrie-Lombardi, M. and Mars 2013 team (2014): „Field trial of a dual-wavelength fluorescent emission (L.I.F.E.) instrument and the Magma White Rover during the MARS2013 Mars analog mission." Astrobiology 14(5): 391-405. DOI: 10.1089/ast.2013.1081

Sattler, B., Storrie-Lombardi, M., Foreman, C. M., Tilg, M. and Psenner, R. (2011): "Laser-induced fluorescence emission (LIFE) from Lake Fryxell (Antarctica) cryoconites. "Annals of Glaciology. 51, (56): 145-152.

Storrie-Lombardi, M.C. & Sattler, B. (2009): "Laser Induced Fluorescence Emission (L.I.F.E.): In Situ Non-Destructive Detection of Microbial Life in the Ice Covers of Antarctic Lakes". Astrobiology 9 (3):659-672.

THE DYNAMIC PATTERN OF BACTERIAL PROTEOSYNTHESIS RATE IN MELTING SNOWPACK ON A HIGH ARCTIC GLACIER

Jakub Zarsky[1, 2], Mats Björkman[3, 4], Rafael Kühnel[3, 4], Katherina Hell[1], Andrew Hodson[5], Birgit Sattler[1] and Roland Psenner[1]

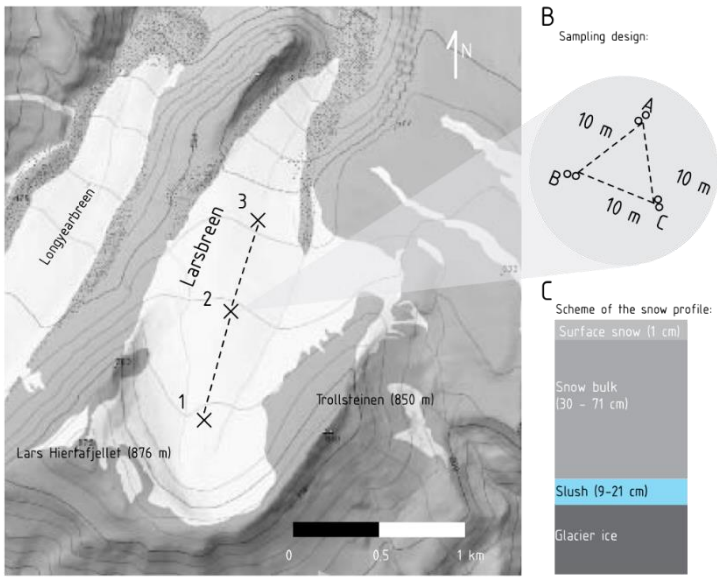
[1]*University of Innsbruck, Department of Ecology, Innsbruck, Austria;*
[2]*University of South Bohemia, Centre for Polar Ecology, České Budějovice;*
[3]*Norwegian Polar Institute, Fram Centre, Tromsø, Norway;*
[4]*Department of Geosciences, University of Oslo, Oslo, Norway;*
[5]*University of Sheffield, Department of Geography, Sheffield, U.K.*

KEYWORDS: SNOWPACK, LEUCINE, BACTERIA

Introduction

Snowpacks host microorganisms capable of active metabolism (Larose et al., 2010, 2011 and 2013) as well as dissolved organic and inorganic compounds (Hodson, 2006), which represent among others also nutrients essential for growth and proliferation of microorganisms. Bioavailable forms of nitrogen are necessary for proteosynthesis, which can become limiting for growth as well as proteomic conversions necessary for acclimation to new conditions (e.g. Sterner and Elser, 2002). The snowmelt represents a short–lasting opportunity to incorporate nutrients available at relatively high concentration (Brimblecombe et al., 1986, Hodson 2006, Lilbæk and Pomeroy, 2008) and retain them for further biological utilization in metabolism of the supraglacial ecosystem (Stibal et al., 2012). Such nutrient–rich "temporal window" seems to last for a longer period in the slush zone at the base of the snowpack, which is typical feature of snow melt in the ablation zones of glaciers in the High Arctic, than in the upper layers of the snow pack due to fast vertical water percolation. Immobilization of nutrients at the input to the glacial ecosystem is an important period in the melt season in general, because it influences the nutrient retention in the glacial catchment and it also provides a base for magnitude of other functional traits present in the microbial community (e.g. primary and secondary production, ammonia oxidation, etc., Larose et al., 2013).

Material and methods



The samples were taken at three altitudinal stations along the central line of a small glacier in west Svalbard (Larsbreen, sampling design see figure 1) in two series at 5. 6. and 11. 6. 2010. The water from the slush layer and samples of snow were taken (see sampling design scheme). The leucine incorporation rate measured as incorporation of [^{3}H] leucine (labelled with tritium [^{3}H], Kirchman, 2001) gives an estimate of proteosynthesis rate. The

major ion concentrations were analysed in filtered meltwater samples using ion chromatography.

Results

The highest leucine incorporation rates were in the slush zone during the initial part of the observation period. High leucine incorporation rates emerged also in the superimposed snow pack in later phase of the melt process and in the lower parts of the glacier.

Quick overview of the core data is available here via dropbox until Oct 2014:

Discussion

The slush layer represents a habitat, which can play an important role in biological utilization or immobilization of solutes by giving the microorganisms relatively more time for acclimation for their metabolic action in compare to the snow pack, which is supported by our first series of measurements. However the later increase of activity in the superimposed snow pack suggests a new source of nutrients at the surface - probably released from previously inaccessible forms.

REFERENCES

Brimblecombe, P., Tranter, M., Tsiouris, S., Davies, T., Vincent, C. (1986). "The chemical evolution of snow and meltwater." IAHS Publ 155: 283–295.

Hodson, A. (2006). "Biogeochemistry of snowmelt in an Antarctic glacial ecosystem." Water Resour. Res. 42: W11406.

Kirchman, D. (2001). "Measuring bacterial biomass production and growth rates from leucine incorporation in natural aquatic environments." in: Methods in Microbiology. Elsevier, pp. 227–237.

Larose, C., Dommergue, A., De Angelis, M., Cossa, D., Averty, B., Marusczak, N., Soumis, N., Schneider, D., Ferrari, C. (2010). "Springtime changes in snow chemistry lead to new insights into mercury methylation in the Arctic." Geochim. Cosmochim. Acta 74: 6263–6275.

Larose, C., Dommergue, A., Marusczak, N., Coves, J., Ferrari, C.P., Schneider, D. (2011). "Bioavailable mercury cycling in polar snowpacks." Environ. Sci. Technol. 45: 2150–2156.

Larose, C., Dommergue, A., Vogel, T.M. (2013). "Microbial nitrogen cycling in Arctic snowpacks." Environ. Res. Lett. 8: 035004.

Lilbæk, G., Pomeroy, J.W. (2008). "Ion enrichment of snowmelt runoff water caused by basal ice formation." Hydrol. Process. 22: 2758–2766.

Sterner, R.W., Elser, J.J., (2002). "Ecological stoichiometry: the biology of elements from molecules to the biosphere." Princeton University Press.

Stibal, M., Šabacká, M., Žárský, J. (2012). "Biological processes on glacier and ice sheet surfaces." Nat. Geosci. 5: 771–774.

HORNSUND – ARTCIC BIODIVERSITY HOTSPOT FOR WATER BEARS (TARDIGRADA)?

Krzysztof Zawierucha[1], Jerzy Smykla[2], Katarzyna Wojczulanis- Jakubas[3], Łukasz Kaczmarek[1], Marta Ostrowska[1]

[1]Department of Animal Taxonomy and Ecology, Faculty of Biology, Adam Mickiewicz University, Poznań, Poland;
[2]Department of Biodiversity, Institute of Nature Conservation, Polish Academy of Sciences, Kraków, Poland;
[3]Department of Vertebrate Ecology and Zoology, University of Gdańsk, Gdańsk, Poland

KEYWORDS: BIODIVERSITY, HORNSUND, NEW RECORDS, TARDIGRADA

Hornsund, is located in West Spitsbergen within the borders of the Sør-Spitsbergen National Park. Due to its diverse and pristine environments as well us unusual climate conditions, has been established one of the *All Taxa Biodiversity Inventory* (ATBI) sites, flagship region for research on biodiversity (Giżejewski et al. 2013).

Studies on the invertebrates in Hornsund have a long tradition, with water bears (Tardigrada) having one of the longest research history (Węglarska 1965). Despites tardigrades constitute persistent element of polar ecosystems, inhabiting both terrestrial (e.g. mosses, lichens, hepatics, soil) and aquatic environments our knowledge about the water bear assemblages in various polar habitats are still fragmented. To full fill these gaps 240 mosses, lichens, hepatics and cryoconite samples were collected and analysed. In total, 49 species of tardigrades were identified. Of that four species were found to be new for science: *Bryodelphax parvuspolaris* Kaczmarek et al., 2012, *Isohypsibius coulsoni* Kaczmarek et al.2012, *I. karenae* Zawierucha, 2013, and one not yet described *Isohypsibius* sp nov. Additionally, five species turned out new for Svalbard fauna, three published: *Milnesium eurystomum* Maucci, 1991, *M. asiaticum* Tumanov, 2006, *Diphascon* (*Adropion*) *prorsirostre* (Thulin, 1928) (Kaczmarek et al. 2012), and two still unpublished: *Microhypsibius bertolanii* Kristensen, 1982 and *Isohypsibius reticulatus* Pilato, 1973.

Up to now, 85 water bear species have been reported from 11 islands within the whole Svalbard archipelago (Zawierucha et al. 2013). Of that 58% were found in Hornsund area. This high tardigrada prevalence in Hornsund can be explained in two ways: 1) the numbers in Hornsund has been biased due to concentration of last research activity in this area or 2) Hornsund, (because of unusual climatic conditions) constitutes an Arctic biodiversity hotspot for tardigrades.

REFERENCES:

Kaczmarek, Ł., Zawierucha, K., Smykla, J., Michalczyk, Ł. (2012): „Tardigrada of the Revdalen (Spitsbergen) with the descriptions of two new species: *Bryodelphax parvuspolaris* (Heterotardigrada) and *Isohypsibius coulsoni* (Eutardigrada)". Polar Biology 35(7): 1013-1026.
Giżejewski, J. et al. (2013): „Geographical environment surrounding the Polish Polar Station, Hornsund". [In] Zwoliński Z. et al. Ancient and modern geoecosystems of Spitsbergen, Bogucki Wydawnictwo Naukowe. pp. 456, ISBN 978-83-63400-54-5
Weglarska, B. (1965): „Die Tardigraden (Tardigrada) Spitzbergens". Acta zoologica Cracoviensis 11: 43-51.

Zawierucha, K., Coulson, S., Michalczyk, Ł., Kaczmarek, Ł. (2013): „Current knowledge of the Tardigrada of Svalbard with the first records of water bears from Nordaustlandet (High Arctic) “. Polar Research 32: 20886.

LANDSCAPE AND ECOSYTEM CONSEQUENCES OF CLIMATE WARMING AND GLACIAL RECESSION IN THE MOUNTAINS SOUTH OF LONGYEARBYEN

Wieslaw Ziaja

Jagiellonian University, Institute of Geography and Spatial Management, Kraków, Poland

KEYWORDS: CLIMATE WARMING, GLACIAL RECESSION, LANDSCAPE AND ECOSYSTEM TRANSFORMATION, SPITSBERGEN

The mountains of central-western Nordenskiöld Land south of Longyearbyen (partly glaciated on their northern slopes) were surveyed in field by the author in 1995, 2001, 2006 and 2012. Complex landscape mapping at a scale of 1:25 000, with special regard to landscape and vegetation changes, was the basic method of this survey.

The contemporary climate warming in Svalbard began at the beginning of the 20th century, just after the end of the Little Ice Age. Since that time, there have been secondary temperature fluctuations. The last one is a big warming. The mean annual temperature increased from –6.45°C in the 1980s to –3.75°C in 2000-2011 at the Svalbard Airport Station (28 m a.s.l., the inner part of Isfjorden). This warming has resulted in a quick recession of mountain glaciers and perennial snow patches nearby (located up to 1030 m within a distance up to 14 km), in spite of a significant increase in precipitation (observed in the form of snow above 500 m but not evidenced in the station).

There are six glaciers in the mountains south of Longyearbyen: three closer ones at a distance of 1-2 km from the town, and next three ones situated more to the south in the Lindströmfjellet-Håbergnuten mountain ridge, ca. 10 km from the town. All the glaciers undergo quick recession due to their surface ablation which leads to their thinning (decrease in thickness). That results in a retreat the glaciers' extents from all the sides, and their frontal retreat is the biggest. More and more extensive marginal zones built of dead ice, covered with a thin (1-2 m) moraine layer, are being formed at the glaciers' fronts, whereas rocky slopes are being ice-freed in the upper parts of glaciers. Quick plant succession (vascular plants at first) proceeds in the areas abandoned by glaciers, initiating soil formation. There is a big difference in the course and results of these processes between two glaciers located at higher altitudes (Larsbreen mostly and Platåbreen entirely above 550 m in 1936) and four remaining valley glaciers (Longyearbreen, Dryadbreen, Håbergbreen and Grumantbreen) reaching down to 200-350 m in 1936. The former ones have not changed in their type, and the latter ones are just transforming from valley glaciers into cirque or slope (hanging) glaciers. The origin of intramarginal sandurs (on dead glacial ice) between their retreating fronts and frontal-and-lateral ice-cored moraine ridges since the 1990s has been a very characteristic feature of their transformation. As a consequence of that, all landscape components undergo quick transformation in the lower parts of valleys abandoned by glaciers. Ablation of dead ice quickly changes the terrain relief, and water drainage and bodies, whereas plant succession is a base of a new ecosystem development there.

Apart from the rise of the glaciers' equilibrium line altitude (of their mass net balance), the altitude of the upper extent of plants is rising quickly. This process is often initiated by birds. Then, this new vegetation attracts bigger animals like reindeer which are numerous in unglaciated valleys, slopes and plateaus there.

Summarizing, the natural vertical landscape boundaries (altitudes of snow, firn and equilibrium lines as well as the altitude of the upper limit of vegetation) have undergone a quick rise: by at least 150-200 m since the end of the Little Ice Ages. Nevertheless, ablation of the uppermost parts of glaciers has been slowed due to the snow cover which has become much thicker after 2006.

LIST OF PARTICIPANTS

Name	Surname	Email	Affiliation	Country
Klára	Ambrožová	376155@mail.muni.cz	Masaryk University, Brno	Czech Republic
Kateřina	Balarinová	KBalarinova@seznam.cz	Masaryk University, Brno	Czech Republic
Miloš	Barták	mbartak@sci.muni.cz	Masaryk University, Brno	Czech Republic
Oliver	Bechberger	olb10@hi.is	University of Iceland	Iceland
Olga	Belkina	belkina_07.list.ru	Kola Science Centre RAS	Russia
Alexandra	Bernardova	sumenka@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Jan	Blahut	blahut@irsm.cas.cz	Institute of Rock Structure and Mechanics of ASCR	Czech Republic
Olga	Bohuslavová	olga.bohuslavova@ceitec.muni.cz	Masaryk University, Brno	Czech Republic
Synnøve	Botnen	synnove.botnen@ibv.uio.no	University of Oslo	Norway
Kristian	Brat	kristian.brat@seznam.cz	University Hospital and Faculty of Medicine, Brno	Czech Republic
Michala	Bryndová	michala.bryndova@seznam.cz	Biology Centre of ASCR	Czech Republic
William	Butler	will@marice.is	University of Iceland	Iceland
Terry	Callaghan	terry_callaghan@btinternet.com	Lund University + University of Sheffield	Sweden
Petr	Capek	petacapek@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Angelica	Casanova-Katny	angecasanova@udec.cl	Universidad de Concepción	Chile
Denisa	Čepová	denisacepova@gmail.com	Palacký University in Olomouc	Czech Republic
Jiří	Černý	cerny@paru.cas.cz	Biology Centre of ASCR	Czech Republic
Zuzana	Chládová	chladova@ufa.cas.cz	Institute of Atmospheric Physics ASCR	Czech Republic
Alica	Chronakova	alicach@upb.cas.cz	Biology Centre of ASCR	Czech Republic
Pavla	Dagsson Waldhauserova	pavla@lbhi.is	University of Iceland and Agricultural UI	Iceland
Denis	Davydov	d_disa@mail.ru	Kola Science Centre RAS	Russia
Miloslav	Devetter	devetter@upb.cas.cz	University of South Bohemia, České Budějovice	Czech Republic
Oleg	Ditrich	oleg@paru.cas.cz	University of South Bohemia, České Budějovice	Czech Republic
Josef	Elster	jelster@ibot.cas.cz	University of South Bohemia, České Budějovice	Czech Republic
Siegrun	Ertl	siegrun.ertl@univie.ac.at	University of Vienna	Austria
Danuta	Frydryszak	danuta.frydryszak@uj.edu.pl	Jagiellonian University, Kraków	Poland
Cindy	Given	cindy.j.given@jyu.fi	University of Jyväskylä	Finland
Mikhail	Golovatin	golovatin@yandex.ru	Ural Branch of RAS	Russia
Andrew	Gray	AIGray1@sheffield.ac.uk	University of Sheffield	United Kingdom
Josef	Hájek	jhajek@sci.muni.cz	Masaryk University, Brno	Czech Republic

Tomaš	Hájek	tomas.hajek@prf.jcu.cz	University of South Bohemia, České Budějovice	Czech Republic
Martin	Hanáček	HanacekM@seznam.cz	University of South Bohemia, České Budějovice	Czech Republic
Ágústa	Helgadóttir	agh3@hi.is	University of Iceland + University Centre in Svalbard	Iceland
David	Hik	dhik@ualberta.ca	University of Alberta	Canada
Iva	Hlavackova	ivahlavackova@gmail.com	Institute of Chemical Technology in Prague	Czech Republic
Filip	Hrbáček	hrbacekfilip@gmail.com	Masaryk University, Brno	Czech Republic
Boris	Ivanov	b_ivanov@aari.ru	Arctic&Antarctic Research Institute	Russia
Michal	Janouch	janouch@chmi.cz	Czech Hydrometeorological Institute	Czech Republic
Pavel	Kapler	kapler@sci.muni.cz	Masaryk University, Brno	Czech Republic
Jan	Kavan	jkavan@prf.jcu.cz	University of South Bohemia, České Budějovice	Czech Republic
SiriJodha	Khalsa	sjsk@nsidc.org	University of Colorado	USA
Sergey	Kirpotin	kirp@mail.tsu.ru	Tomsk State University	Russia
Christina	Kjellerup	christina.kjellerup@gmail.com	Roskilde University	Denmark
Jitka	Klimesova	jitka.klimesova@ibot.cas.cz	Institute of Botany of ASCR	Czech Republic
Liudmila	Konoreva	ajdarzapov@yandex.ru	Kola Science Centre RAS	Russia
Petr	Kotas	kotyno@seznam.cz	University of South Bohemia, České Budějovice	Czech Republic
Ľubomír	Kováčik	kovacik@fns.uniba.sk	Comenius University in Bratislava	Slovakia
Katarzyna	Kozak	katarzynakozak.gda@o2.pl	Gdansk University of Technology	Poland
Manoj	Kumar	makugopa@jyu.fi	University of Jyväskylä	Finland
Jana	Kvíderová	jana.kviderova@ibot.cas.cz	University of South Bohemia	Czech Republic
Kamil	Láska	laska@sci.muni.cz	Masaryk University, Brno	Czech Republic
Dail	Laughinghouse	laughinghouseh@gmail.com	Smith College, Northampton	USA
Jiří	Lehejček	jirilehejcek@seznam.cz	Czech University of Life Sciences, Prague	Czech Republic
Sara	Lehmann	sara.lehmann8@gmail.com	Gdansk University of Technology	Poland
Christian	Lettner	lettner.chr@gmail.com	University of Vienna	Austria
Kelsey	Lorberau	k.e.lorberau@gmail.com	University of Oslo + University Center in Svalbard	Norway
Alena	Lukesova	luksa@upb.cas.cz	Biology Centre of ASCR	Czech Republic
Jakub	Małecki	malecki.jk@gmail.com	Adam Mickiewicz University, Poznań	Poland
Rinat	Manasypov	rmmanassypov@gmail.com	Tomsk State University	Russia
Maciej	Mańko	mmanko@ug.edu.pl	University of Gdańsk	Poland
Evgenia	Markovskaya	muddycoast@gmal.com	Petrozavodsk State University	Russia

Fumino	Maruo	maruo.fumino@nipr.ac.jp	The Graduate University for Advanced Studies	Japan
Shota	Masumoto	masumoto.shouta@nipr.ac.jp	National Institute of Polar Research	Japan
Bulat	Mavlyudov	bulatrm@bk.ru	Institute of geography RAS	Russia
Veronika	Michálková	252787@mail.muni.cz	Masaryk University, Brno	Czech Republic
Krzysztof	Migala	krzysztof.migala@uni.wroc.pl	University of Wroclaw	Poland
Jitka	Míková	jitka.mikova@geology.cz	Czech Geological Survey	Czech Republic
Jana	Müllerová	janca.mullerova@email.cz	University of South Bohemia, České Budějovice	Czech Republic
Thecla	Munanie	tmum@unugtp.is	University of Iceland	Iceland
Piotr	Muskała	piotr.muskala@uni.wroc.pl	University of Wroclaw	Poland
Eva	Myšková	evamyskova@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Sigrid Schøler	Nielsen	sigrid.nielsen@gmail.com	Aarhus University	Denmark
Daniel	Nývlt	daniel.nyvlt@seznam.cz	Masaryk University, Brno	Czech Republic
Jonina	Olafsdottir	jonina109@gmail.com	Holar University College	Iceland
Jakub	Ondruch	jakub.ondruch@gmail.com	Masaryk University, Brno	Czech Republic
Marta	Ostrowska	martaostrowska92@wp.pl	Adam Mickiewicz University, Poznań	Poland
Riku	Paavola	riku.paavola@oulu.fi	University of Oulu	Finland
Anna	Panasiuk-Chodnicka	oceapc@ug.edu.pl	University of Gdańsk	Poland
Elena	Patova	patova@ib.komisc.ru	Komi Scientific Center RAS	Russia
Marie	Pažoutová	marie.pazoutova@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Vahagn	Petrosyan	vahagnpet@gmail.com	Yerevan State University	Armenia
Martina	Pichrtova	drosophila@centrum.cz	Charles University in Prague	Czech Republic
Eveline	Pinseel	eveline.pinseel@gmail.com	University of Antwerp & Botanic Garden Meise	Belgium
Ekaterina	Pushkareva	puekse@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Lenka	Raabová	lenka.raabova@gmail.com	Comenius University in Bratislava	Slovakia
Grzegorz	Rachlewicz	grzera@amu.edu.pl	Adam Mickiewicz University, Poznań	Poland
Andreas	Richter	andreas.richter@univie.ac.at	University of Vienna	Austria
Ana Judith	Russi Colmenares	ajr2@hi.is	University of Iceland	Iceland
Marie	Šabacká	sabacka.marie@gmail.com	British Antarctic Survey	United Kingdom
Birgit	Sattler	birgit.sattler@uibk.ac.at	University of Innsbruck	Austria
Tiina	Savolainen	tiina.savolainen@jyu.fi	University of Jyväskylä	Finland
Luděk	Sehnal	Sehnal9@seznam.cz	Masaryk University, Brno	Czech Republic
Liudmila	Sergienko	muddycoast@gmail.com	Petrozavodsk State University	Russia
Prashant	Singh	sps.bhu@gmail.com	Banaras Hindu University, Varanasi	India

Kateřina	Skulinová	rewsie@gmail.com	Masaryk University, Brno	Czech Republic
Angelika	Słomska	slomska.angelika@gmail.com	University of Gdańsk	Poland
Jerzy	Smykla	jerzysmykla@yahoo.com	Polish Academy of Sciences. Kraków	Poland
Angella	Sonina	Angella_Sonina@mail.ru	Petrozavodsk State University	Russia
Monika	Stawska	mstawska@amu.edu.pl	Adam Mickiewicz University, Poznań	Poland
Igor	Stelmach Pessi	ispessi@ulg.ac.be	University of Liège	Belgium
Ute	Stenkewitz	ute@ni.is	Icelandic Institute of Natural History	Iceland
Otakar	Strunecky	otakar.strunecky@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Martin	Svatoň	svatonius@gmail.com	Masaryk University, Brno	Czech Republic
Małgorzata	Szopińska	szopinska.malgorzata@gmail.com	Gdansk University of Technology	Poland
Yukiko	Tanabe	ukkopu@gmail.com	Waseda University	Japan
Daria	Tashyreva	tashyreva@butbn.cas.cz	University of South Bohemia, České Budějovice	Czech Republic
Kateřina	Trnková	184745@mail.muni.cz	Masaryk University, Brno	Czech Republic
Tomáš	Tyml	tomastyml@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Masaki	Uchida	uchida@nipr.ac.jp	National Institute of Polar Research	Japan
Peter	Váczi	vaczi@sci.muni.cz	Masaryk University, Brno	Czech Republic
Tobias	Vonnahme	tobias.vonnahme@uni-konstanz.de	University of Konstanz	Germany
Michał	Węgrzyn	michal.wegrzyn@uj.edu.pl	Jagiellonian University, Kraków	Poland
Klemens	Weisleitner	klemens.weisleitner@student.uibk.ac.at	University of Innsbruck	Austria
Paulina	Wietrzyk	paulina.wietrzyk@uj.edu.pl	Jagiellonian University, Kraków	Poland
Jessica	Williams	williams.ssej@gmail.com	DePaul University	USA
Jakub	Žárský	j.zarsky@gmail.com	University of South Bohemia, České Budějovice	Czech Republic
Krzysztof	Zawierucha	k.p.zawierucha@gmail.com	Adam Mickiewicz University, Poznań	Poland

NOTES