Report on Czech research activities in Petuniabukta, Billefjorden, Svalbard, performed in summer season 2014

RESEARCH ACTIVITIES SVALBARD 2014

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

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Cover photo: Jan Kavan
Editors: Jana Kvíderová & Martin Hanáček

1. Introduction

First of all, the Czech Polar Research Station in Longyearbyen (Fig. 1.1.), operated by Centre for Polar Ecology, Faculty of Science, University of South Bohemia in České Budějovice, Czech Republic, was opened on June 24, 2014. At the opening ceremony, representatives of Norwegian and Czech governmental and scientific institutions involved in polar research were presented (Fig. 1.2.).

Fig. 1.1. The new Czech Polar Research Station in Longyearbyen.

Fig. 1.2. Group photo of representatives of Norwegian and Czech governmental and scientific institutions participating at Opening Ceremony on June 24, 2014.

In 2014, we started our eighth season of field activities in Svalbard. As in previous years, our research programme followed on research project *Biological and Climatic Diversity of the Central Part of the Svalbard Archipelago* (INGO LA341) in 2007-2010 and present project *Czech Polar Stations: Construction and Logistics Expenses* (LM2010009). Major part of the scientific activities was connected with a new 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 by state budget of the Czech Republic.

In this year, the research activities were performed at two distinct places. Traditionally, we worked in Petuniabukta in Russian hunting hut at its west coast and the containers located in Pyramiden port facility served for storage. For the first time, the research was also performed in Longyearbyen area.

Evelyne Pinseel who had visited the field station in Petuniabukta in the last year successfully defended her master thesis at University of Antwerp. Her thesis has been nominated for the EOS award 2014 for best scientific master thesis at a Flemish University (BE). Tobias Vonnahme who conducted field observation in this year, successfully defended his thesis University of Konstanz (DE). Martina Pichrtová and Jakub Žárský defended successfully their doctoral theses at Charles University in Prague (CZ) and University of Innsbruck (AT), respectively.

For more information visit polar.prf.jcu.cz, please.

2. Season 2014 Research Programme

The field research started on June 19, 2014, and was completed on September 1, 2014. The list of expedition participants and their periods of stay is summarized in Tab. 2.1.

Tab. 2.1. List of expedition participants with their affiliations and their periods of stay.

	Affiliation(s)	Group	Dates
Alexandra Bernardová	JU	BOTA	22/06-31/08
Denisa Čepová	UPOL	HYDRO	14/08-01/09
Miloslav Devetter	ISB+JU	ZOO	27/06-21/07
Oleg Ditrich	JU	ZOO	19/06-11/08
Josef Elster	JU+IBOT	MICRO	19/07-27/06 27/07-18-08
Jana Elsterová	JU	ZOO	04/07-25/07
Zbyněk Engel	UK+JU	GEO	18/07-04/08
Tomáš Hájek	JU+IBOT	BOTA	04/07-21/07
Martin Hanáček	MU+JU	GEO	18/08-18/08
Zuzana Chladová	UFA+JU	CLIMA	18/07-04/08
Jan Kavan	JU	HYDRO	22/06-31/08
JitkaKlimešová	IBOT+ JU	BOTA	27/06-21/07
Jana Kvíderová	IBOT+JU	MICRO	01/08-18/08
Kamil Láska	MU+JU	CLIMA	18/07-04/08
Petr Macek	JU	BOTA	27/06-21/07
Peter Mida	UK	GEO	14/08-01/09
Eva Myšková	JU	ZOO	27/07-18/08
Václav Pavel	UPOL+JU	ZOO	04/07-18/08
Eveline Pinseel	UA+BGM	HYDRO	01/08-18/08
Ekaterina Pushkareva	JU	MICRO	01/08-31/08
Lenka Raabová	CU	MICRO	01/0/-18/08
Arnošt Sizling	UK	BOTA	14/07-28/07
Otakar Strunecký	JU+IBOT	MICRO	01/07-19/07
Marie Šabacká	BAS	MICRO	27/06-21/07
Tomáš Tyml	JU+PARU	ZOO	19/06-11/08
Tomáš Uxa	UK	GEO	14/08-01-09
Tobias Vonnahme	UKON	MICRO	27/06-31/08
Kateřina Voráčová	JU	MICRO	01/08-18/08
Jakub Žárský	JU+IBOT	MICRO	11/07-02/08

Abbreviations:
Affiliations: BAS – British Antarctic Survey, Cambridge (GB); BGM - Botanic Garden Meise, Meize (BE); CU – Commenius University, Bratislava (SK); IBOT – Institute of Botany AS CR, Třeboň (CZ); ISB – Institute of Soil Biology AS CR, České Budějovice (CZ); JU – University of South Bohemia, České Budějovice (CZ); MU – Masaryk University, Brno (CZ); PARU – Institute of Parasitology AS CR, České Budějovice (CZ); UA – University of Antwerp, Wilrijk (BE); UFA – Institute of Atmospheric Physics AS CR, Prague (CZ); UK – Charles University, Prague (CZ); UKON - University of Konstanz, Konstanz (DE); UPOL – Palacký University, Olomouc (CZ).
Groups: BOTA - botany/plant physiology; CLIMA - climatology/glaciology; GEO - geology/geomorphology; HYDRO - hydrology/limnology; MICRO - microbiology/phycology; ZOO - zoology/parasitology.

3. Field work progress reports

3.1. Geology and Geomorphology

3.1.1. Vegetation dynamics with relation to geomorphic processes and micromorphology on active debris flow fan

Alexandra Bernardová, Jan Blahůt & Jan Kavan

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 Fig. 3.1.1. 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 (Fig. 3.1.2).

Fig. 3.1.1. 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 oppossitifolia*, 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.

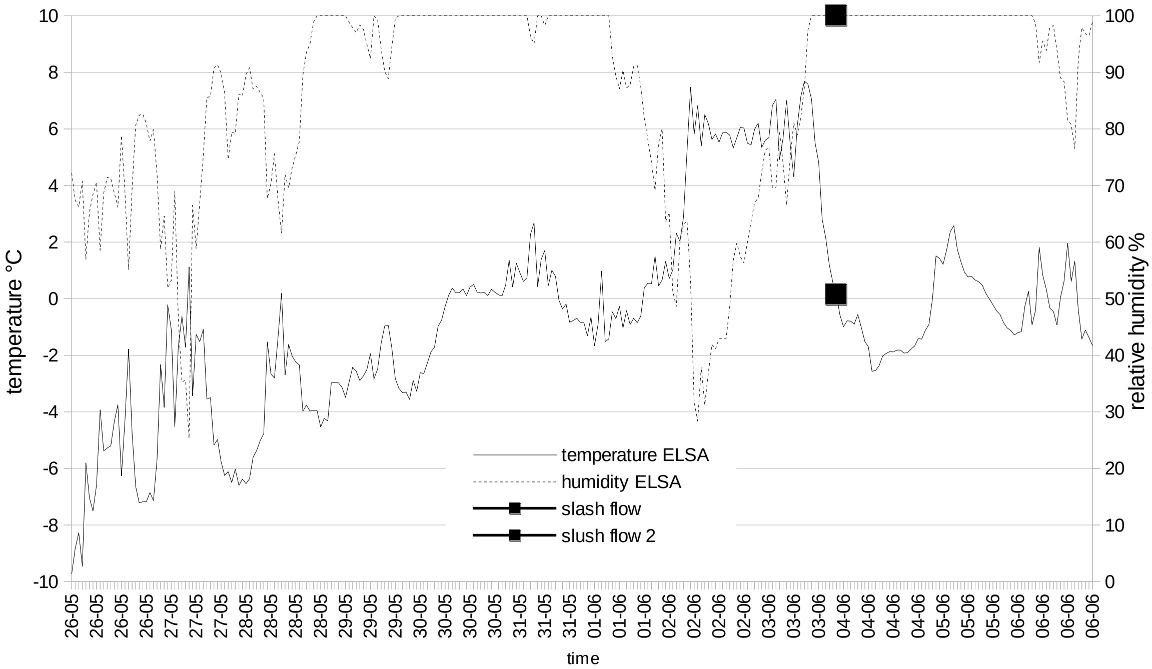


Fig. 3.1.2. Atmospheric conditions precedent to the sudden slush flow event between June 3rd/June 4th (marked with black dots).

3.1.2. Fossil coarse-grained glaciomarginal delta in the front of Bertilbreen

Martin Hanáček, Daniel Nývlt & Zbyněk Engel

We advanced in the research of the glaciomarginal delta according to the former plan in 2014. The fieldwork focused on one site – terrace at the 50 m a.s.l. in the southern part of the Bertilbreen valley.

Horizon with *in situ* bivalves, for which the species diversity has been evaluated, has been detected in deltaic sediments. *Mya truncata* predominates among the species, less common are *Macoma calcaera* and *Hiatella arctica*. Remnants of echinoids and algae have been found beside the bivalve shells (Fig. 3.1.3.)

Fig. 3.1.3. *In situ* preserved bivalve shell *Mya truncata* in the Bertilbreen valley.

Further clast petrological analyses has been done from both the tills and foreset and topset deltaic deposits. Each analysis contained 100 clasts and two analyses have been done from each sedimentary unit (till, foreset and topset deposits). Clast petrology, roundness, shape and surface striation presence have been ascertained for each clast.

Areal distribution of gravel, diamicton and pre-Quaternary bedrock (Old Red sandstone) has been mapped on the surface of the terrace. The terrace internal structural has been survey by ground penetrating radar. Four GPR profiles (one longitudinal and three transversal ones) have been acquired. The radargrams detected the geometrical relationship between the bedrock and overlying sediments and the main orientation of sedimentary bodies.

The orientation of striation on the surface of sporadic bedrock outcrops in the underlying position to the deltaic sediments has been measured beyond the original plan. Imbrications of platy cobbles and bedding dip have been measured in deltaic topset and foreset respectively. All measured parameters show that the original glacier moved towards the Mimerbukta and glaciomarginal delta prograded in the same direction. The acquired findings should be sufficient to prepare a well-documented paper.

The plan for the 2015 season:

Sedimentological and palaeontological research and ground penetrating survey of other available section and sites in Mimerdalen.

3.1.3. Research of periglacial processes and landforms

Tomáš Uxa & Peter Mida

Between 11.8.2014 and 31.8.2014, field work was focused on mapping, morphometric measurements, ground thermal monitoring and sedimentological analyses of active, permafrost-related sorted patterned ground in the surroundings of Petuniabukta. Well-developed sorted patterned ground (Fig. 3.1.4.) was examined at sixteen study sites, located mainly on raised marine terraces and adjacent flat-topped mountain ridges. Monitoring of near-surface ground temperatures (Fig. 3.1.5.) has been carried out at five sites since the seasons of 2011 and 2013. The sorted patterned ground is composed of fine-grained center, which is surrounded by coarse borders consisting of open-work fabric. The diameters of the studied patterned-ground features range from several decimeters to up to ~5 m. Their heights reach up to ~0.5 m.

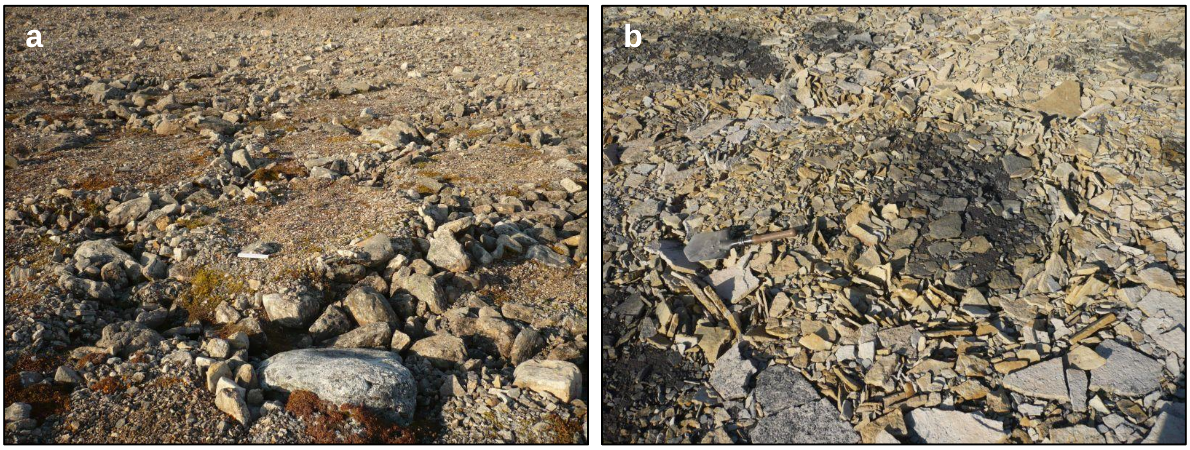


Fig. 3.1.4. Examples of **(a)** studied sorted polygons near Nordenskiöldbreen and **(b)** sorted circles in the saddle between Mt. Mumien and Mt. Pyramiden.

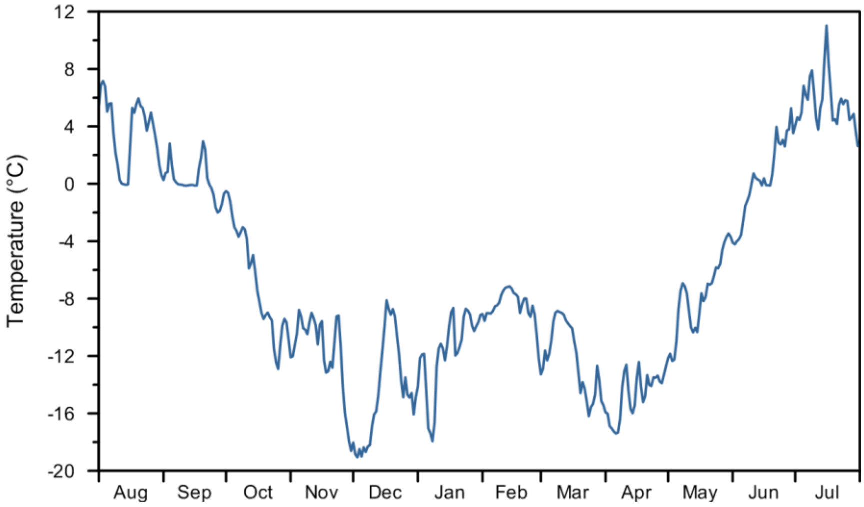


Fig. 3.1.5. Mean daily ground temperatures recor-ded at depth of 15 cm within the sorted circle in the saddle between Mt. Mumien and Mt. Pyramiden from August 2013 to July 2014.

3.1.4. Research of quartz grain microtextures of glaciofluvial sediments

Tomáš Uxa & Peter Mida

The field work was focused on collection of glaciofluvial sediments for analysis of quartz grain micromorphology (sample preparation, processing and laboratory analyses will be performed by Mgr. Klára Krbcová). Sampling transects were located downstream from glacier fronts down to river mouths. Main aim is to assess the changes in the frequency distribution of distinct quartz grain microtextures in relation to distance from the glacier snout (i.e. the length of fluvial transport). A total of 116 samples from five glacial valleys (Fig. 3.5.6.) were collected and extended the dataset gathered during the seasons of 2012 and 2013.

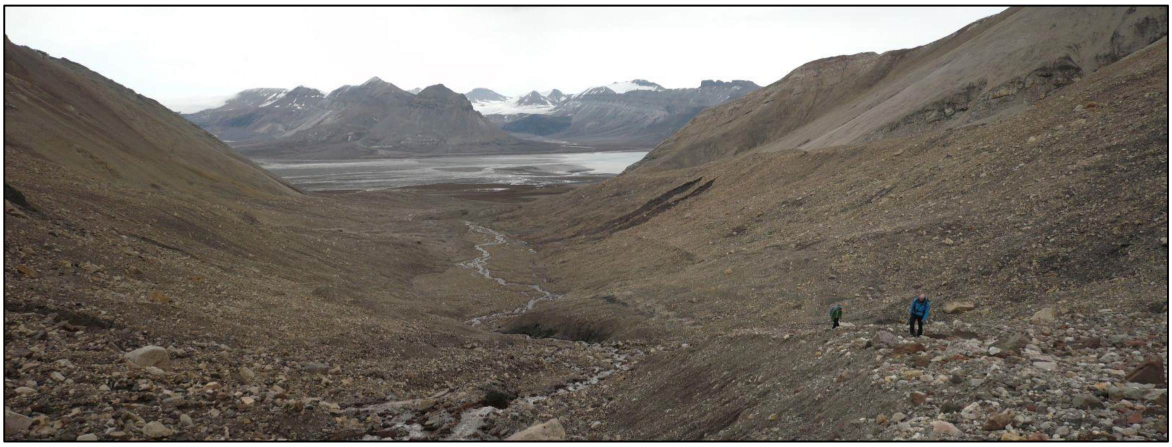


Figure 3.5.6. Ferdinanddalen is one of the glacial valleys where samples for analysis of quartz grain micromorphology were collected.

3.2. Climatology and Glaciology

3.2.1. Meteorology and climatology

Kamil Láska & Zuzana Chladová

The meteorological measurements and observations were performed in the coastal ice-free zone of Petuniabukta, northern branch of Billefjorden in July–August 2014. Eight automatic weather stations (hereafter AWS) has been operated along the western and northwestern coast of Petuniabukta (Fig. 3.2.1.) in the following locations:

- AWS1 – old marine terrace at the altitude of 15 m a. s. l. (operated since 2008)
- AWS2 – old marine terrace at 25 m a. s. l. (since 2008)
- AWS3 – foreland of Hørbye Glacier at 67 m a. s. l (since 2008)
- AWS4 – mountain ridge of Mumien Peak at 475 m a. s. l. (since 2008)
- AWS5 – top of Mumien Peak at 770 m a. s. l. (since July 2013)
- AWS6 – top of Pyramiden Peak at 935 m a. s. l. (since 2009)
- AWS7 – Bertil Glacier at 464 m a. s. l. (since 2011)
- AWS8 – Bertil Glacier at 280 m a. s. l. (since 2014)

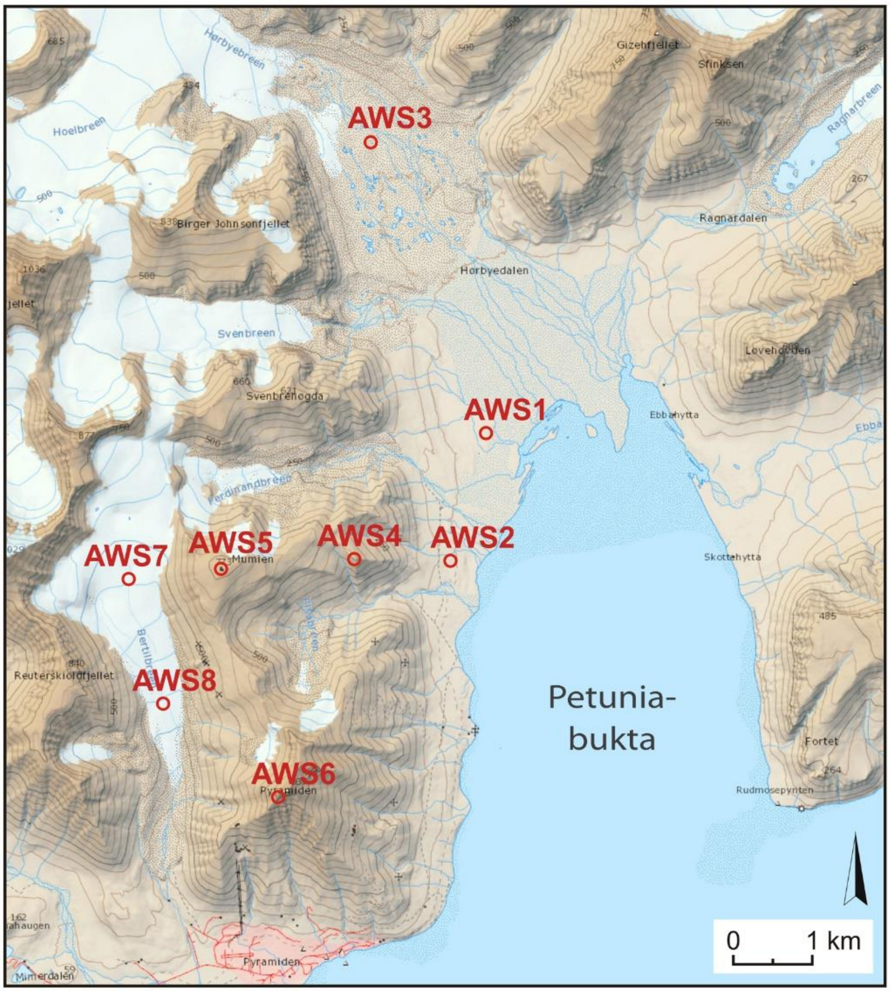


Fig. 3.2.1. Location of the automatic weather stations (AWS) in the vicinity of Petuniabukta (Billefjorden, central Spitsbergen) in July–August 2014. Credit: Svalbardkartet, Norwegian Polar Institute, 2014.

The main objectives of summer field campaign and research activities in Petuniabukta were:

- Study of surface energy balance and microclimate conditions of the tundra vegetation and comparison with the satellite measurements
- Monitoring of surface wind characteristics and their influence on heavy metal deposition in mushrooms
- Observation of summer weather conditions and their evaluation in the context of large-scale atmospheric circulation over Spitsbergen
- Surface temperature measurement of different types of terrain with thermal camera system and its evaluation
- Maintenance and calibration of the selected meteorological instruments (Fig. 3.2.2.)

Fig. 3.2.2. Automatic weather stations **(a)** in the forelands of Hørbye Glacier (AWS3) and **(b)** Bertil Glacier (AWS8).

The effect of vegetation on air temperature, humidity and components of surface energy balance were studied during summer expedition and compared with the LANDSAT data. The results confirm that vegetation pattern has a significant effect on the individual energy fluxes between atmosphere and ground surface. Moreover, the increase of vegetation cover (biomass) is reflected in the increase of latent heat flux, while turbulent heat flux together with surface temperature was decreasing (Fig. 3.2.3.).

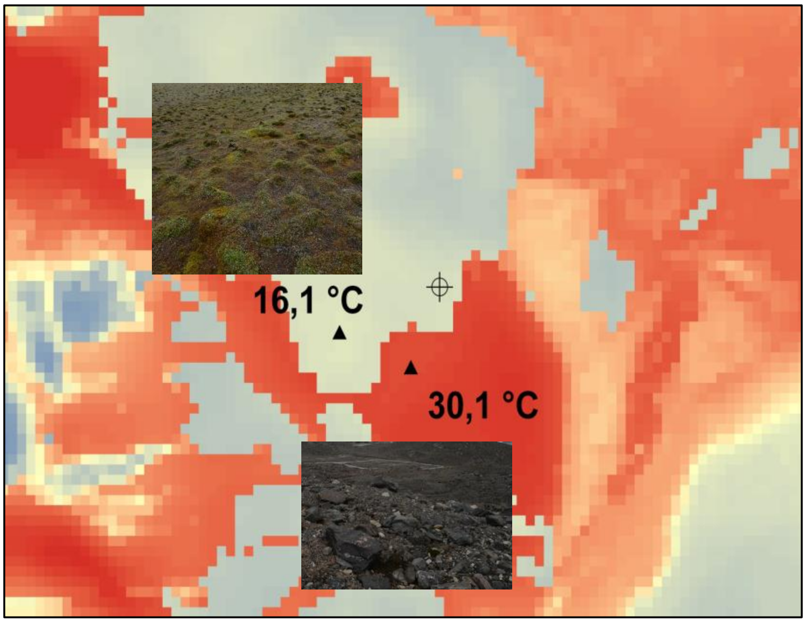


Fig. 3.2.3. Map of surface temperature showing different surface types in Petuniabukta based on the LANDSAT data.

Surface wind field experiment and study of heavy metal deposition in the mushrooms was carried out in the region of Isfjorden and specific settlements in particular. Calculations were based on the measurements of wind characteristics at the AWS1 located in the coastal zone of Petuniabukta and Norwegian AWS close to Svalbard airport (Longyearbyen). The preliminary results show the highest contamination by heavy metal near Longyearbyen due to industry, incinerator, transportation and tourism. In the Pyramiden area there was contamination caused by former coal mining and transport lines. The coastal zone between Hørbye glacier and Pyramiden has not been burdened by heavy metal yet. Together with the individual experiments we carried out the maintenance, calibration and replacement of the measuring instruments at all AWS. At the same time, data downloading and quality control of the individual meteorological parameters were performed before further data processing. New AWS was installed in the ablation zone of Bertil Glacier (see Fig. 3.2.2.).

In the study period, the atmospheric circulation and pressure pattern changed several times. In the period of July 21–22, 2014, the high-pressure ridge from southeast was spread at the 500 hPa geopotential height around Svalbard archipelago. The cloud types of *cirrus*, *cirrostratus*, *altocumulus lenticularis*, *cumulus humilis* and *cumulus mediocris* dominated over Spitsbergen in the air mass flowing in this time. From July 22 to 24, the cyclonic type of circulation started to prevail. This resulted in prevailing cloudy weather conditions in the central Spitsbergen with a cloudiness of 6–8 oktas and cloud types: *stratus nebulosus opacus*, *altostratus* and *altocumulus* (Fig. 3.2.4). In the third period (July 25–30, 2014), the weather conditions were formed by southwest to northwest cyclonic circulation and baric col. In the last period (August 1–3, 2014), the northwestern cyclonic circulation and baric col formed over study area and affected the presence of low-level cloud types (*stratus* and *stratocumulus*). Changes in atmospheric circulation and local weather conditions were clearly indicated in the variation of air temperature and surface wind speed measured at Petuniabukta (Fig. 3.2.5.).

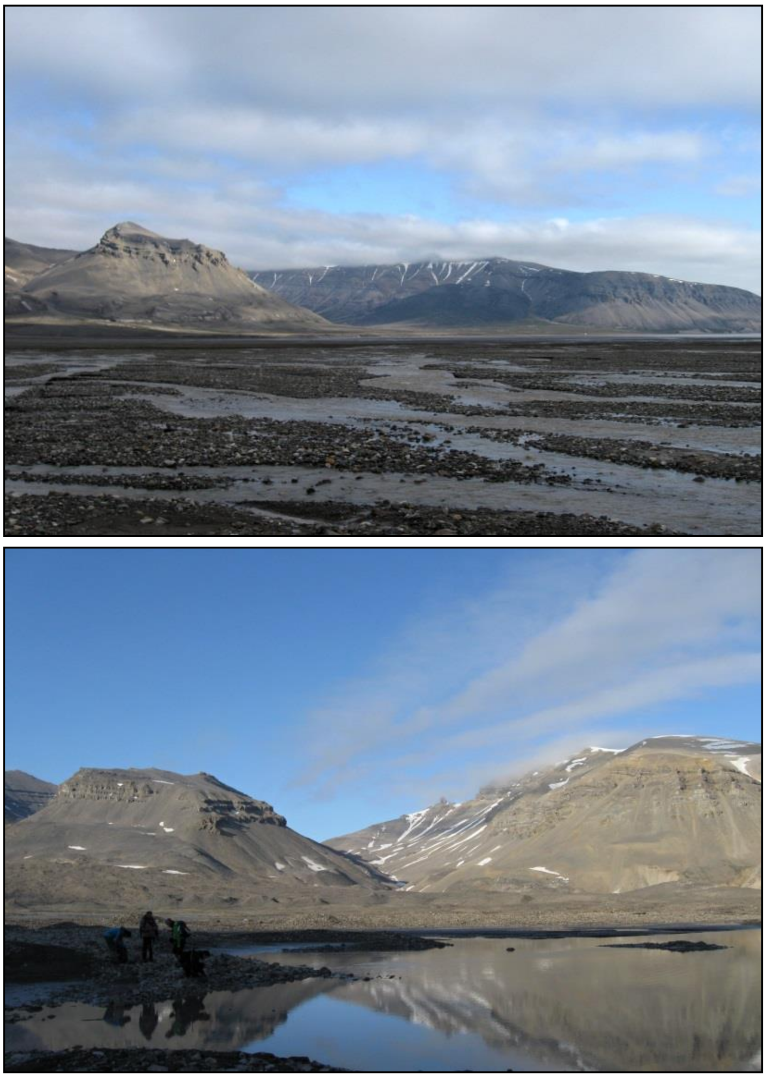


Fig. 3.2.4 Examples of middle-level and low-level clouds of *stratocumulus* and *altocumulus* at Petuniabukta on July 22, 2014.

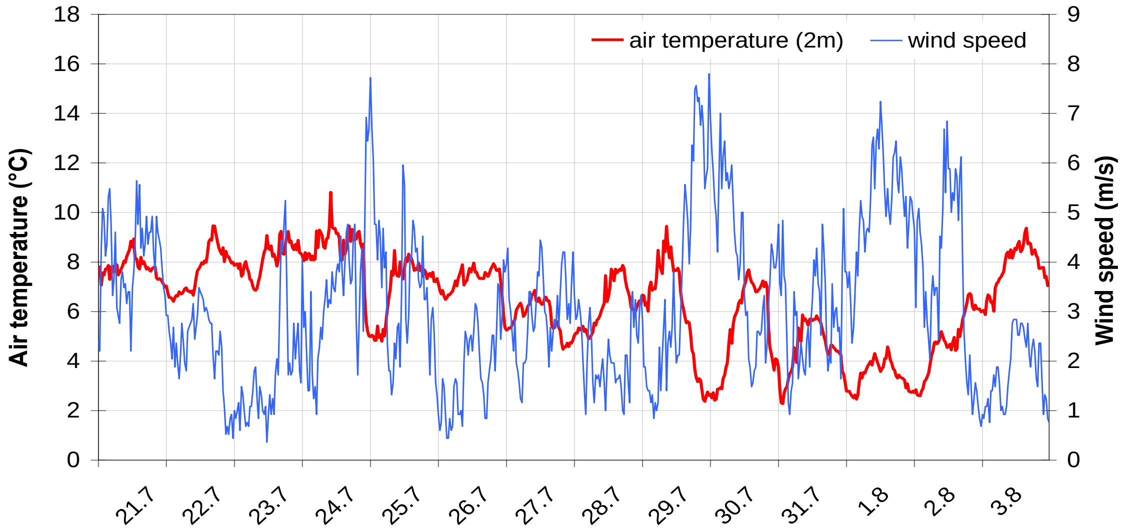


Fig. 3.2.5. Variation of air temperature and surface wind speed recorded on the AWS1 (Petuniabukta) in the period from July 21 to August 3, 2014.

3.3. Hydrology and Limnology

3.3.1. Lake ecosystem evolution and diatom succession on the Herbye Glacier foreland

Denisa Čepová, Eveline Pinseel, Jan Kavan & Kateřina Kopalová

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.

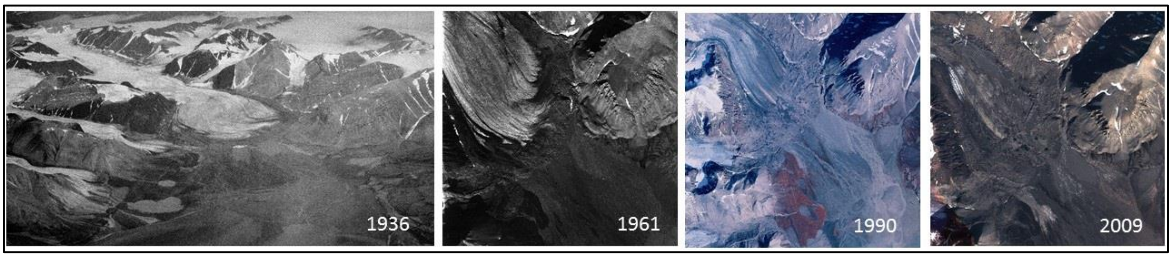


Fig. 3.3.1. A series of aerial photographs from 1936, 1961, 1990 and 2009 (Norwegian Polar Institute).

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, Fig. 3.3.1.) 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 (Fig. 3.3.2.).

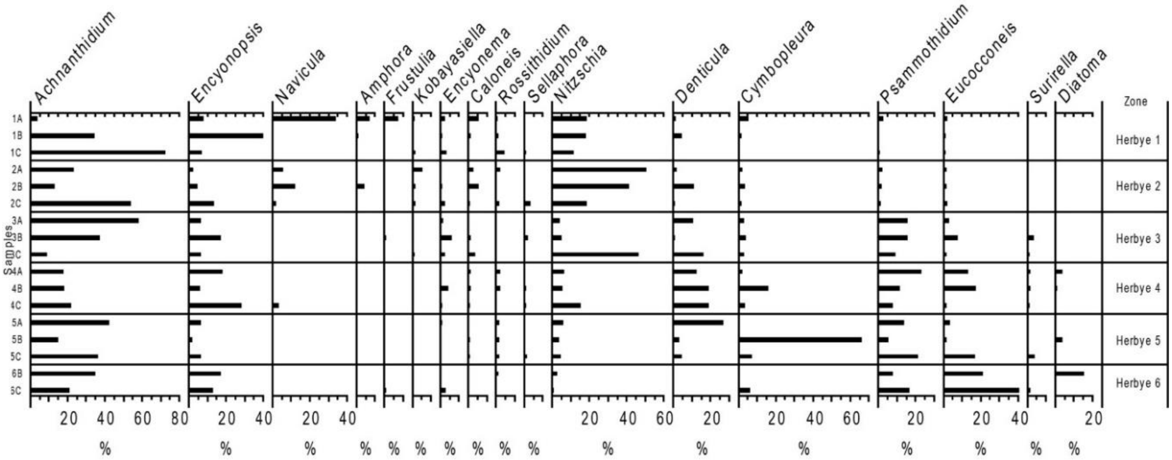


Figure 3.3.2. Most abundant diatom genera of the six lake groups (zones) in the Herbye glacier foreland. The X-axis indicates the percentages of the total counted diatom valves. The scale bar of the X-axis is identical for all graphs. The six zones are indicated on the graph (Herbye 1 is the furthest from the glacier and Herbye 6 is the closest to the glacier).

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

3.3.2. Runoff monitoring and glacier mass balance estimation

Jan Kavan

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. After finishing with discharge measurements (Fig. 3.3.3.) this year it is evident 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.

Fig. 3.3.3. Discharge measurements on Bertilelva.

3.3.3. Fluvial dynamics and bedload transport in the proglacial area of Bertilbreen, central Svalbard

Jan Blahůt* & *Jan Kavan

Climatic driven changes in polar as well as alpine environments cause rapid retreat of glaciers 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 retreating due to climate change. 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 work was to describe and explain processes 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, UAV ortophoto shooting and timelapse cameras (Fig. 3.3.3).

Fig. 3.3.3. Work with terrestrial laser scanner on the Bertilbreen outwash plain (photo: JK).

3.3.4. Aerial transport of diatom valves & diatom communities in cryoconites

Petra Vinšová & Jan Kavan

Diatoms in 'Cryobuckets'

During this summer season (August, 2014) were placed 14 passive-catching traps (plastic buckets) on latitudinal (from the side) and altitudinal (from the sea) gradients on Nordenskiöld glacier (Figs 3.3.4. and 3.3.5.). These were left on site for 20 days. The study site was chosen by the prevalent wind flow direction. The aim of this research was to observe changes in composition of diatom communities along these transects. Out of 14 samples, 10 were usable for the further work.

Fig.3.3.4. Position of passive traps placed on the Nordenskiöld glacier. (source: NPI, 2014).

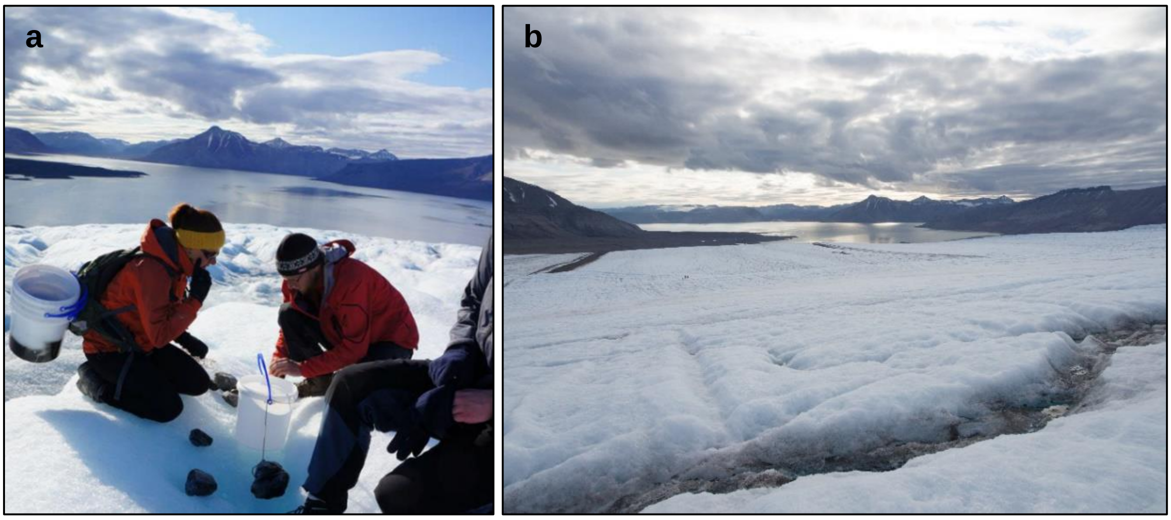


Fig. 3.3.5. (a) placing of the passive traps, **(b) o**verview of the study site on Nordenskiöld glacier (photo: Petra Vinšová)

Diatom communities in Cryoconites

Although cryoconites has shown theirs importance recently, as a small habitats for many microorganisms, diatoms seems not as much common and were observed before only in small numbers (Fig. 3.3.6.). During the 2014 field campaign, cryoconite samples were collected on the same transect as *cryobuckets* were placed. The goal was to observe the differences and partly also to compensate the high possible failure in catching diatom's valves. Samples were prepared traditionally, since observation of living samples and searching for diatoms had shown as rather impossible (coincidentally 1-2 individuals found during other observations of cryoconites in the field laboratory) also due to high amount of sediment (for this, some new approach would be needed).

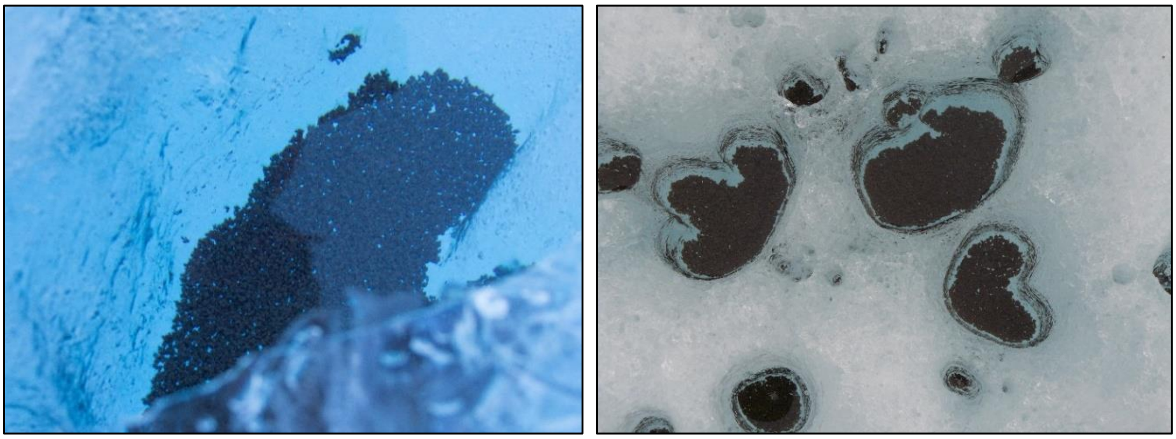


Fig. 3.3.6. Cryoconites on the Nordenskiöld glacier surface (photo: Petra Vinšová).

All samples were prepared for observation at Charles University in Prague (Department of Ecology), and partly also at National Botanic Garden in Meise, where also all the microscopy was made. Identification to the species level was made predominantly after 'Diatoms in Petuniabukta' guide from Eveline Pinseel, with a significant help of Prof. Bart Van de Vijver.

Preliminary results shown slightly better transportation of diatom valves from the side than from the sea. For changes in diatom communities, more sufficient data would be needed. Observed diversity was generally higher, than was expected (43 taxa in 22 genera for cryobuckets and 79 taxa in 40 genera for cryoconites). However, mostly only individuals were observed and also a lot of broken or unclear cells. Preliminary comparison with nearby lotic sites revealed totally different species composition. We assume better transportation of soil species to our sites based on the findings (e.g., *Pinnularia borealis, Hantzschia amphioxys*). Moreover, many of species previously not recorded from Svalbard's fresh-water habitats were found. Some of the most preserved and abundant species from cryoconites you can see in Figure 3.3.7. Some of them seems to be able to live within these extreme habitats (e.g., *P. intermedia, Luticola nivalis, Eunotia curtagrunowii*). In further research, accurate genera level comparison will be made after data from the study site, previous data from nearby sites and previous diatom studies of cryoconites.

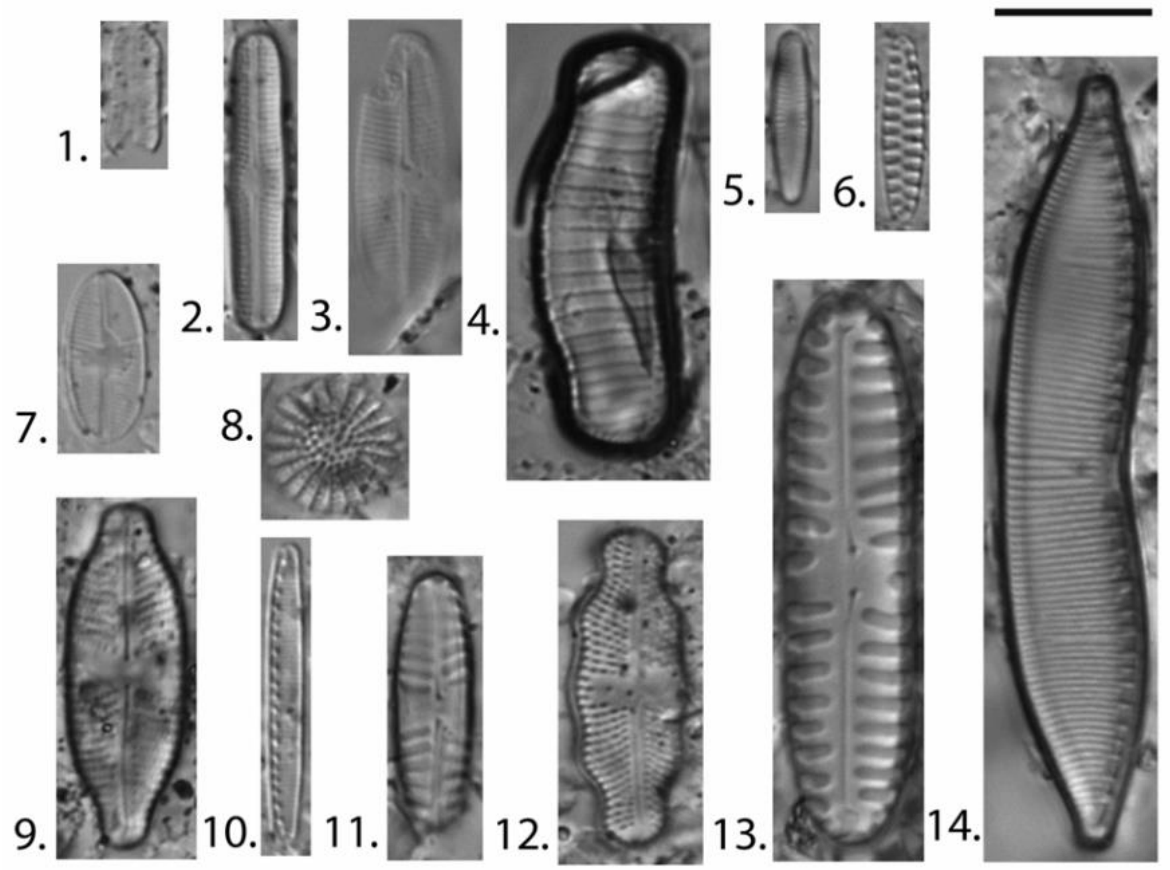


Fig. 3.3.7. Abundant diatom species found on Nordenskiöld glacier (Cryoconites). Scale bar of 10μm. 1 - *Humidophila* cf. *contenta*, 2 - *Chamaepinnularia* sp., 3 - *Rossithidium petersenii*, 4 - *Eunotia curtagrunowii*, 5 - *Achnanthidium* sp1., 6 - *Staurosirella* sp., 7 - *Psammothidium* sp1., 8 - *Stephanodiscus* cf. *minutulus*, *9 - Gomphonema* sp1., 10 - *Nitzschia perminuta* forma, 11 - *Pinnularia intermedia*, 12 - *Luticola nivalis*, 13 - *P. borealis* complex, *14. Hantzschia amphioxys* complex.

3.4. Microbiology and Phycology

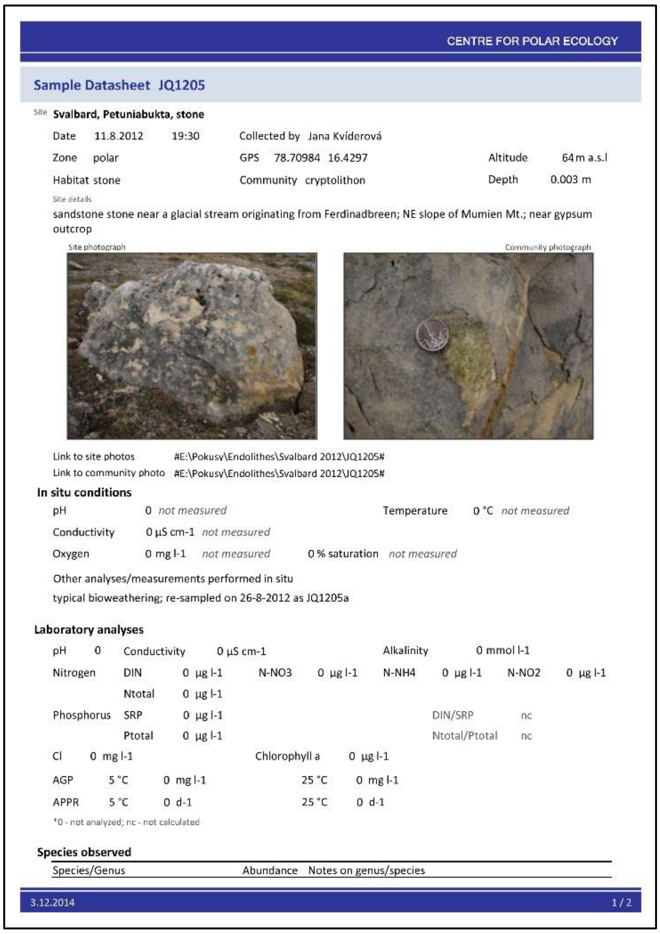
3.4.1. Sample database of the Centre for Polar Ecology

Jana Kvíderová

The increasing number of observations and samples led to development of systems for data storage and management. The Sample database (SampleDTB) is a relational database running in MS Access® environment. The SampleDTB is designed for microbiological, phycological or hydrobiological types of data.

The SampleDTB consists of

- data tables containing detailed information on site, its environment, types of habitats and communities, including data on taxonomic diversity
- queries for providing source data for reports/exports, or for defined specific searches
- forms for data entry or modifications
- reports for summaries, datasheets, lists and charts for export


CENTRE FOR POLAR ECOLOGY

Sample Datasheet JQ1205

Site Svalbard, Petuniabukta, stone

Date 11.8.2012 19:30 Collected by Jana Kvíderová

Zone polar GPS 78.70984 16.4297 Altitude 64 m a.s.l

Habitat stone Community cryptolithon Depth 0.003 m

Site details

sandstone stone near a glacial stream originating from Ferdinadbreen; NE slope of Mumien Mt.; near gypsum outcrop

Site photograph

Community photograph

Link to site photos #E:\Pokusy\Endolithes\Svalbard 2012\JQ1205#

Link to community photo #E:\Pokusy\Endolithes\Svalbard 2012\JQ1205#

In situ conditions

pH 0 *not measured* Temperature 0 °C *not measured*

Conductivity 0 µS cm-1 *not measured*

Oxygen 0 mg l-1 *not measured* 0 % saturation *not measured*

Other analyses/measurements performed in situ

typical bioweathering; re-sampled on 26-8-2012 as JQ1205a

Laboratory analyses

pH 0 Conductivity 0 µS cm-1 Alkalinity 0 mmol l-1

Nitrogen DIN 0 µg l-1 N-NO3 0 µg l-1 N-NH4 0 µg l-1 N-NO2 0 µg l-1

Ntotal 0 µg l-1

Phosphorus SRP 0 µg l-1 DIN/SRP nc

Ptotal 0 µg l-1 Ntotal/Ptotal nc

Cl 0 mg l-1 Chlorophyll a 0 µg l-1

AGP 5 °C 0 mg l-1 25 °C 0 mg l-1

APPR 5 °C 0 d-1 25 °C 0 d-1

*0 - not analyzed; nc - not calculated

Species observed

Species/Genus	Abundance	Notes on genus/species

3.12.2014 1 / 2

Fig. 3.4.1. Example of a datasheet (the first page only).

At present (December 2014), the Sample DTB contains records on total of 318 samples from 137 sites. Total of 245 taxons (genera or species) were observed.

For each sample, a specific datasheet is generated in which all data on particular sample are summarized (Fig. 3.4.1.). Such datasheet may be included into Sample catalogue. See Kvíderová (2014) for detailed database description.

References:

Kvíderová J. (2014): Sample database of the Centre for Polar Ecology - Database design and data. Czech Polar Reports 4(2): .

3.4.2. The coverage of biological soil crusts in Petuniabukta

Otakar Strunecký, Alexandra Bernardová & Jana Kvíderová

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. 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. In our study, we measured the coverage of soil crust by phototrophic organisms.

The study site 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. Soil crusts were sampled using metal ring of 6.8 cm diameter. 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

The fluorometric studies revealed their usability in estimation of percentage of coverage by algae (Fig. 1). 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.

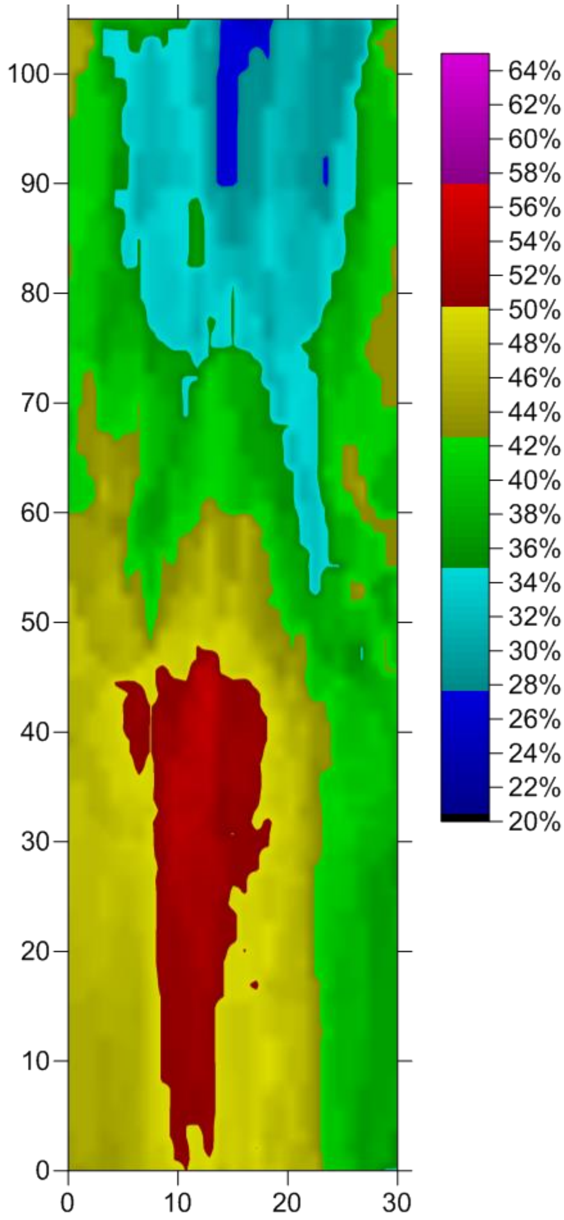


Fig 3.4.2. The map of study site coverage by biological soil crust in %.

3.4.3. Cryoconite food webs

Tobias Vonnahme, Miloslav Devettter, Jakub Žárský, Marie Šabacká & Josef Elster

During the whole summer season the community structures of microalgae, invertebrates and ciliates in cryoconites (depressions filled with meltwater and bioactive sediments) have been assessed on three glaciers around Petuniabukta. Besides, some environmental controls have been measured directly in the field and samples for further analysis have been collected.

The aim of this field study was to understand possible controls on microalgal populations in cryoconites. Namely, top-down controls by grazing and bottom-up controls by environmental factors in a seasonally changing system have been investigated.

The sampled glaciers were the big tidewater outlet glacier Nordenskiöldbreen, and the relatively large valley glaciers Hørbyebreen, and Ebbabreen. On Nordenskiöldbreen two additional sampling sites have been chosen, due to their unique environment. Firstly, the glacier margin close to a known bird colony of Arctic terns on Retretøya, which is thought to provide a high nutrient input by guano, and secondly a supraglacial lake, which drained periodically via moulins and crevasses.

Fig. 3.4.3. *Nostoc* sp. colony.

Fig. 3.4.4. Tardigrade (left) and *Macrotrachella* sp. (right).

Cyanobacteria and green algal biovolumes have been assessed using epifluorescence and light microscopy back in the field station. Dominating species were the cyanobacteria *Nostoc* sp. (Fig. 3.4.3.) *Leptolyngbya* sp., and *Phormidium* sp., the Zygnematophyceae *Ancylonema nordenskioldii* and *Cylindrocystis brebissonii*, and the Chlorophyceae *Chlamydomonas nivalis*. Hørbyebreen was, surprisingly, dominated by *Nostoc* sp., which were already visible as cyanobacterial mats on the bare ice. The sampling sites close to Retretøya were, interestingly, dominated by green algae. Invertebrate and ciliate abundances have been counted, using a stereomicroscope (contribution by Miloslav Devetter). The dominating invertebrates were tardigrades (Fig. 3.4.4.left), and the bdelloid rotifer *Macrotrachella* sp. (Fig. 3.4.4.right). Samples for bacterial abundances and diversity have been fixed and will be analyzed later by Marie Šabacká.

The measured environmental variables were the slope, and cryoconite hole depth as proxy for the stability of the habitat; the sediment coverage (by Jakub Žárský), the organic matter-, and water content, and the granule size as proxy for the sediment input and structure, and the distance from the closest deglaciated land and from the closest bird colony as proxy for the inoculum and nutrient sources. For later nutrient analysis, sediments have been collected and were frozen in the field station.

So far, the first results support a bottom-up regulated food web with high spatial but low temporal variability and an additionally weak, but statistically significant top-down control by grazing. A joined publication with Jakub Žárský, Marie Šabacká, and Josef Elster is currently in progress.

3.4.4. Airborne cyanobacteria and algae on bone remnants and man-made substrates in central Spitsbergen (Svalbard)

Lenka Raabová

Anthropogenic impact on polar environments is significant. One of the most aftermats on polar nature is colonization of the new substrate by phototrophic microorganisms, mainly cyanobacteria and green algae. The primary goal of this project was to know, which cyanos and algal species are the main colonizer.

A pilot survey of microphototroph on bones remnants and man-made substrates was performed on 25 selected sites in Longyerbyen and in vicinity of Penutiabukta. In total 75 samples were collected by aseptic cotton tampons with which were different substrates (e.g. from wood, concrete, facade, glass, plastic and iron, Fig. 3.4.5.) wiped. The tampons were transferred to the lab for detail microscopic study of isolated strain cultures.

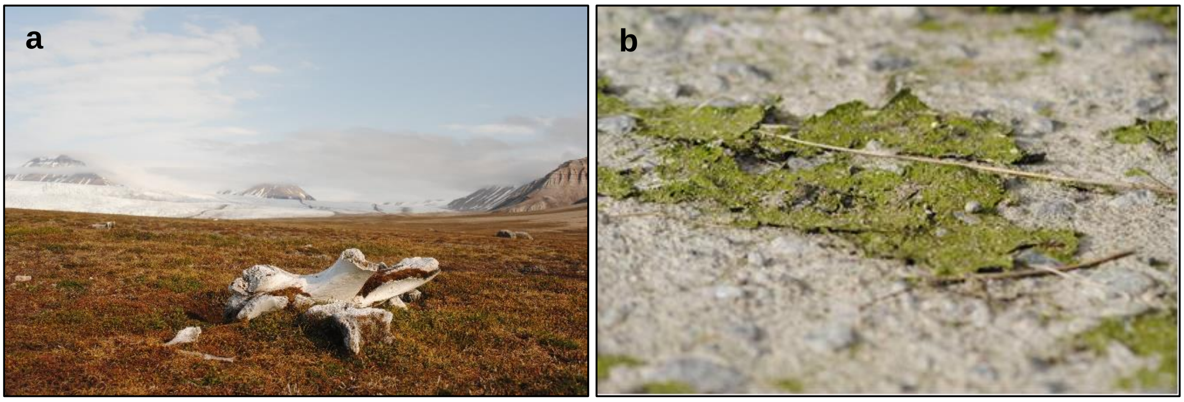


Fig. 3.4.5. (a) Whale bone remnants in tundra, Petuniabukta bay, **(b)** Epilithic mats on concrete way in Pyramiden.

3.4.5. Glacial microbioloby

Jakub Žárský

The fieldwork during July 2014 included sampling of ice algae and cryoconite on Nordenskjöldbreen and Hørbyebreen adjacent to the Petunia bay. The two glaciers represent a pronounced difference in the community composition of supraglacial habitat depending on different ratio of nutrient input. Both glaciers were subject of investigation focusing on the interaction of metazoan consumers in cryoconite, the primary producers (cyanobacteria and algae) and bacteria. The investigation was carried out by Tobias Vonnahme, myself, Marie Šabacká and Miloslav Devetter, whereby the data are in the stage of analysis and writing output in the form of an impact paper (Tobias Vonnahme as first author).

Data on slope variability were collected on Nordenskjöldbreen and Hørbyebreen in order to characterize the temporal stability of cryoconite sediment (potential for erosion rate). First the measurements with a 2.5 m avalanche probe in transect and measurement of the slope by using a mountaineering compass (precision of ~ 1°) were used. Later the use of a quadrucopter with attached camera was involved in cooperation with Jan Blahut ÚSMH AV ČR to retreive a set of photographs for 3D model of the terrain. In combination with points measured with the total station, such method would enable to collect at the same time data about slope distribution and cryoconite coverage. We have a successfully completed model of an area about 200 x 200 m in the lower ablation zone of Nordenskjöldbreen. Currently we work with Dr. Blahut on the development of a protocol where the quadrucopter will be replaced by a camera fixed on a pole of about 3 m long, which can be operated by one person with remote control of the camera and a circular libella on the pole to ensure all the pictures were taken under the same angle. Such improvement would enable to cover larger areas in the ongoing season just with a small team independently on conditions suitable for the operation of the quadrucopter (wind speed). The quadrucopter would be evt. used for repeated measurement of smaller regions in a pre-set grid to demonstrate the redistribution of cryoconite depending on the meteorological conditions (transfer of heat via conduction *versus* radiation).

These data will enable advanced upscaling of results from small-scale microscopical, molecular or chemical data and will strenghten the interpretation of such type of data from glacial envrionment.

The sampling of ice algae was conducted in order to transport living samples to laboratories in Czech Republic and to run first cultivation tests in order to retreive unialgal cultures for future investigation (a submitted proposal at GA UK, November 2014). The cryoconite was sampled from 10 different sites at Nordenskjöldbreen and Hørbyebreen to build up a robust sample set for testing of a high-resolution elemental analysis of organic matter and organisms in cryoconite. The tests are planed at the laboratory of x-ray microanalysis (Elektronová mikroskopie a mikroanalýza, LAREM) of the Czech Geological Survey. The samples were transported frozen and at the moment the ongoing tests are in the stage of negotioation with the laboratory.

Both, the (ice-)algal cultures and the tool for elemental microanalysis will be used in the futer for novel approach to the investigation of nutrient cycling, ecological stoichiometry of the inhabitants of the glacial ecosystems and the improved insight into the biogeochemistry of glacial catchments.

3.4.6. 454 pyrosequencing of arctic soil crust cyanobacteria from Petunia Bay, Svalbard

Ekaterina Pushkareva, Igor Stelmach-Pessi, Annick Willmotte & Josef Elster

The aim of this work was to characterize cyanobacterial community composition in different soil crusts from Petunia Bay, Svalbard, using 454 pyrosequencing. Four different soil crusts (cyanobacterial crust, crusts with mixture of lichens and cyanobacteria and well-established crusts with a rich community of lichens) were studied (Fig. 3.4.6.).

Pyrosequencing analysis of partial 16S rRNA gene amplicons generated 292 210 sequences from the soil crust samples. After bioinformatic analysis and manual removal of spurious sequences, 94 592 cyanobacterial sequences, representing 149 OTUs at 97.5% similarity, remained.

Taxonomic assignment of sequences revealed a dominance of Synechococcales, Oscillatoriales and Nostocales across all four samples. The abundance of unicellular cyanobacteria (mainly Chroococcales) was low in studied soil crusts. In general, cyanobacterial communities were dominated by phylotypes related to the form-genera *Leptolyngbya, Calothrix, Coleofasciculus, Oscillatoria, Stigonema, Microcoleus* and *Phormidium*.

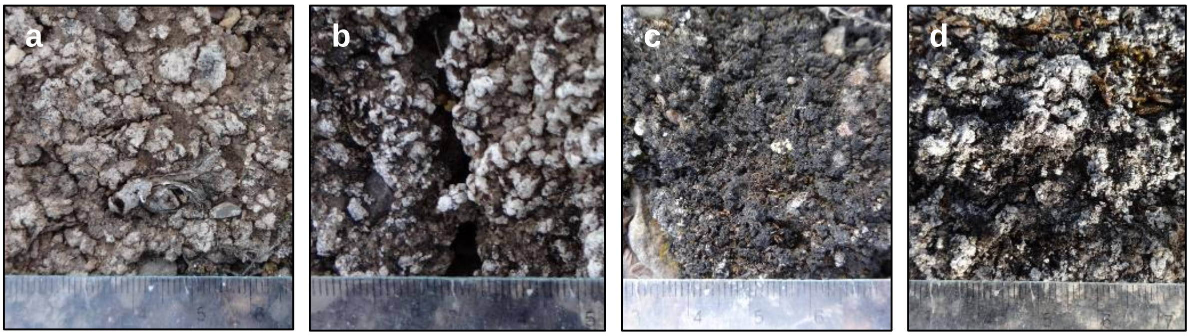


Fig. 3.4.6. Soil crusts from Petunia Bay, Svalbard. **(a)** cyanobacterial soil crust, **(b,c)** soil crusts with a mixture of lichens and cyanobacteria, **(d)** well-established soil crust with a rich lichen community.

3.5. Botany and Plant Physiology

3.5.1. Pollen traps

Alexandra Bernardová

In the area of Petuniabukta, content of two pollen monitoring traps (http://www.pollentrapping.net/; Fig. 3.2.1.). in the tundra on the terrace in the vicinity of AWS1 and the second one at the terrace ca 1km of distance from the Russian hut in the sparse tundra with ridge vegetation was collected and replaced for a new one. Vegetation samples around each trap were processed by special software according the protocol of Pollen monitoring programme. Because there was not enough pollen in the moss samples collected last year, they were sampled again to get sufficient data about recent pollen spectra. Next year, the content of the trap will be taken out again and analysed for pollen and replaced for the new one for next season.

Fig. 3.2.1. Detail of the pollen trap.

3.5.2. Where was the lawn born?

Alexandra Bernardová & Tomáš Hájek

The central square of Pyramiden is covered by well-developed grassland. This unusually dense plant community has been established on non-native soil transported from former Soviet Union. There are several theories about the soil origin; one says that it comes from Murmansk area in northern Russia. Another theory, even more provocative, says that it is chernozem transported from Easten Ukrainian Donbas region. We decided to challenge the theories of origin by the means of paleoecological and chemical analyses.

We made three soil trenches on the square and sampled material for analyses. The depth of the quality soil was 10–25 cm and the core contained several distinct layers with gravel at the bottom (Fig. 3.5.2.).

The soil will be now subjected to chemical analysis and to the analyses of fossil pollen grains and macroscopic organic remains. The results will finally shed light on the soil origin in Pyramiden, which is necessary prerequisite for detailed studies on this unintentional but valuable "soil transplant experiment".

Fig. 3.5.2. Soil trench for paleoecological and chemical analyses.

3.5.3. Diversity of plant communities and land snails along North-South gradient

Arnošt Sizling

The activity performed on Svalbard is a part of global research that analyses plant and land snails data that were collected by a standardized method at sites distributed along North-South gradient (Fig. 3.5.3.). Our aim is to compare plant and land snail assemblages in terms of diversity and species composition between sites with various climatic conditions. We believe that our analyses will shed light on the, yet unsolved, question on the origin of the latitudinal diversity gardient. The data from Svalbard are the last piece of jigsaw that we need to finish our research. No land snail was found by the standardized method there on Svalbard, which can also be considered as a result.

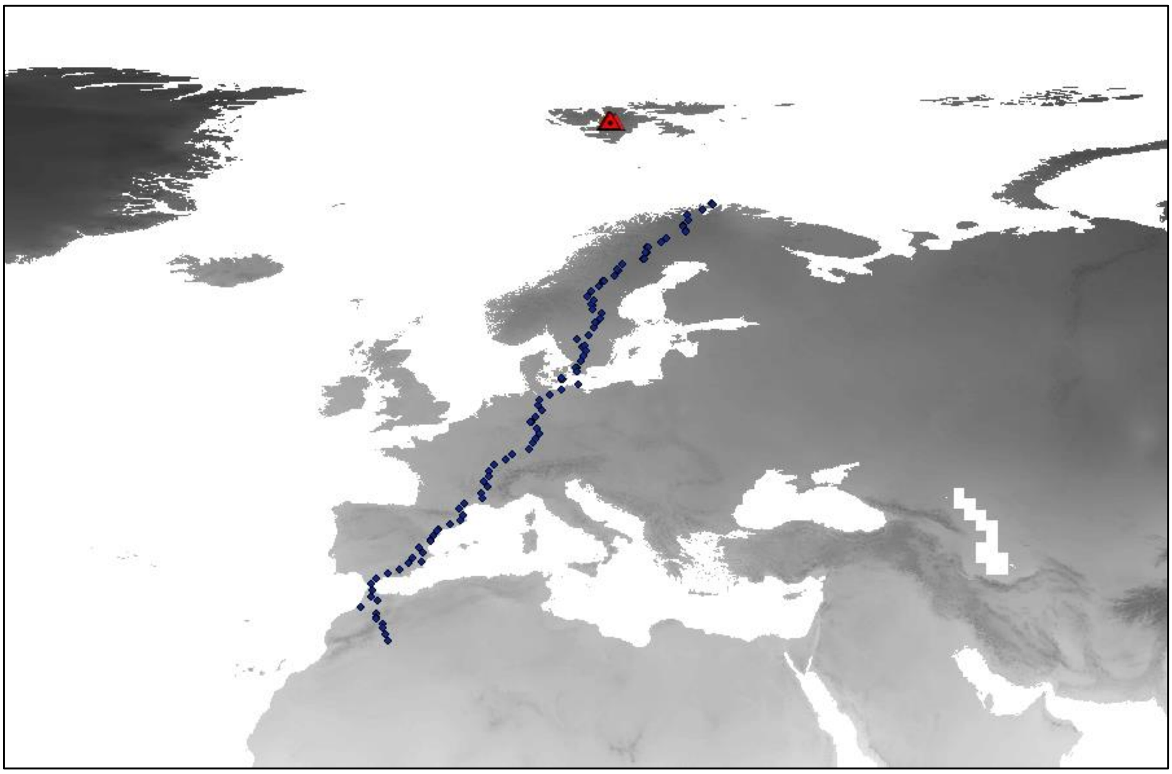


Fig. 3.5.3. The North-South gradient. The points indicate sample collection.

3.6. Zoology and Parasitology

3.6.1. Zoology and parasitology

Oleg Dittrich, Eva Myšková & Tomáš Tyml

Members of zoology/parasitology group took a chance to work at the newly opened Czech Research Arctic Station in Longyearbyen and split the summer season to work around the field camp in Billefjorden as well as in Longyearbyen, in Adventfjorden and surroundings. As before, the main topic was devoted to studying of fish or marine invertebrates parasites. Apart from collecting and processing of all revealed parasites, we have concentrated on elucidation of life cycles of some, previously identified parasites.

Number of dissected fish

Fish examined	Billefjorden	Longyerbyen	Total
Myoxocephalus scorpius	51	61	112
Gadus morhua	1	75	76
Gymnocanthus tricuspis	15	30	45
Amblyraja radiata	0	36	36
Mallotus villosus	20	0	20
Clupea harengus	13	0	13
Lumpenus lampretaeformis	8	3	11
Boreogadus saida	10	0	10
Pollachius virens	0	10	10
Hippoglossoides platessoides	0	9	9
Melanogrammus aeglefinus	0	7	7
Anarhichas minor	0	1	1
Sebastes cf. *mentella*	0	1	1
Triglops cf. *pingelii*	0	1	1

In Longyearbyen, all fish we caught using gill nets laid in a littoral zone (maximum depth 40 m), the same method we use also in Billefjorden. Catches at both sites differed distinctly. Neither Atlantic herrings, *Clupea harengus* nor Capelins, *Mallotus villosus* were caught around Longyearbyen. Nevertheless, there were additionally new fish species examined (e.g., *Amblyraja radiata*, *Anarhichas minor*, and *Sebastes*) and new parasites were also found (notably attractive cestodes – see Fig. 3.6.1.). Further other cod species were caught and examined (Saithe, *Pollachius virens* and Haddock, *Melanogrammus aeglefinus*) and also the large number of Atlantic cods (*Gadus morhua*) were dissected. We focused on parasites from cods since there have been already more cod species than the circumpolar one, Polar cod (*Boreogadus saida*). In the last five seasons, we have examined in total 25 individuals of *B. saida* as well as 13 individuals of *G. morhua* in Billefjorden area. Several groups of parasites were found and identified of which myxosporeans from renal system represented the most important one. The other cod species were also infected by these myxosporean parasites. We have obtained a lot of material of them for following study using histological, electron microscopy, and molecular methods.

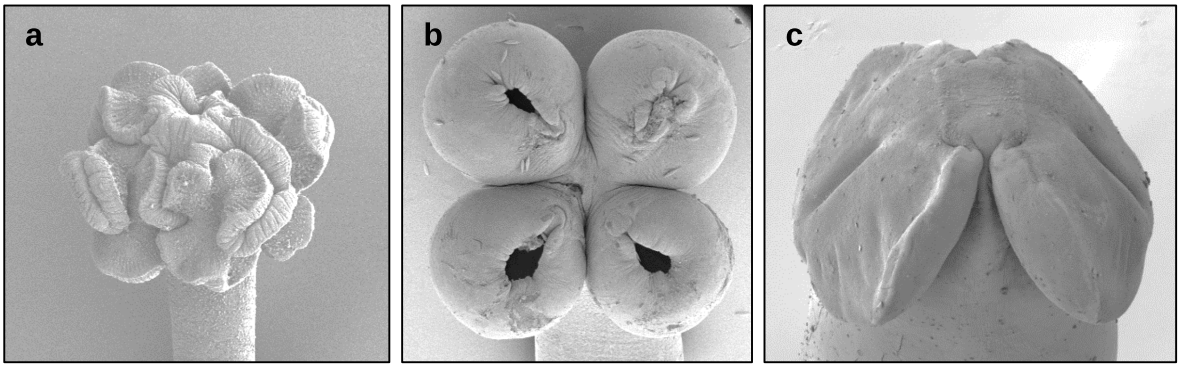


Fig. 3.6.1. Cestodes of three different genera **(a)** *Echeneibothrium*, **(b)** *Pseudanthobothrium*, **(c)** *Grillotia* from Thorny skate (*Amblyraja radiata*) as seen in scanning electron microscope (not the same scale).

Number of dissected invertebrates

Invertebrates examined	**Billefjorden**	**Longyerbyen**	**Total**
Mya truncata	66	0	66
Hyas araneus/coarctatus	73	0	73
Buccinum glaciale	39	8	47
Buccinum undatum	34	3	37
Buccinum polare	0	1	1
Colus kroeyeri	2	0	2
Serripes groenlandicus	5	0	5
Hiatella arctica	3	0	3
Euspira pallida	9	1	10
Chlamys islandica	3	1	4
Astarte rugosa	10	0	10
Astarte sp.	0	1	1
Clinocardium ciliatum	1	0	1
Margarites olivaceus	1	0	1
Golfingia margaritacea	4	0	4

3.6.2. Ornithology

Václav Pavel

Three nesting colonies of Arctic terns (*Sterna paradisaea*) at two distant localities (Nordenskiöldbreen, Longyearbyen) were monitored by mini video cameras to obtain data on their behaviour during incubation. We have recorded predations of nests by Glacous gull (*Larus hyperboreus*), by Polar fox (*Vulpes lagopus*) and even by Polar bear (*Ursus maritimus*). Furthermore, 24-hours observations were done at both localities to survey of varoious predator presence during the polar day. During the continuous 24-hours watch, we have noticed a difference between reactions of defended adults at both localities, i.e., uninfluenced by human (Nordenskiöldbreen) or influenced by human (Longyearbyen).

3.6.3. Virology

Jana Elsterová

A risk of influenza infection circulating in migratory birds is known throughout the world. The role of the migratory birds breeding in high Arctic is unknown, though. To my knowledge there are no such studies concerning the prevalence of influenza virus in birds breeding in Svalbard Islands.

The aim of the field research was to sample Black-legged gull (*Rissa tridactyla*; Figs. 3.6.2. and 3.6.3.) during their breeding season. A colony of these gulls, belonging to *Laridae* family, nest in the Pyramiden town, where also the base of Czech polar ecology research takes place. A hundred of samples of blood were taken using an anticoagulant (Heparin sodium salt from porcine intestinal mucosa, Sigma-Aldrich). The blood was centrifuged 24 hours post sampling and blood serum was kept cooled down (from 2 to 8°C) until transport to the laboratory. Also oropharyngeal and cloacal swabs were taken from each sampled bird. Swabs were put to RNA stabilizing solution (RNA*later*® Stabilization Solution, Ambion) immediately after sampling and stored cooled down until the transport to a laboratory. The samples will be tested for specific antibodies anti-influenza virus and the presence of genomic RNA of influenza virus will be tested in the swab samples.

Fig. 3.6.2. Black-legged kittiwake marked to avoid resampling of a same bird**.**

Fig. 3.6.3. Blood collection from the *vena brachialis* of Black-legged kittiwake.

According to peliminary results, antibodies anti-influenza virus were recorded and Black-legged gull represents risk of bird influenza infection for human.