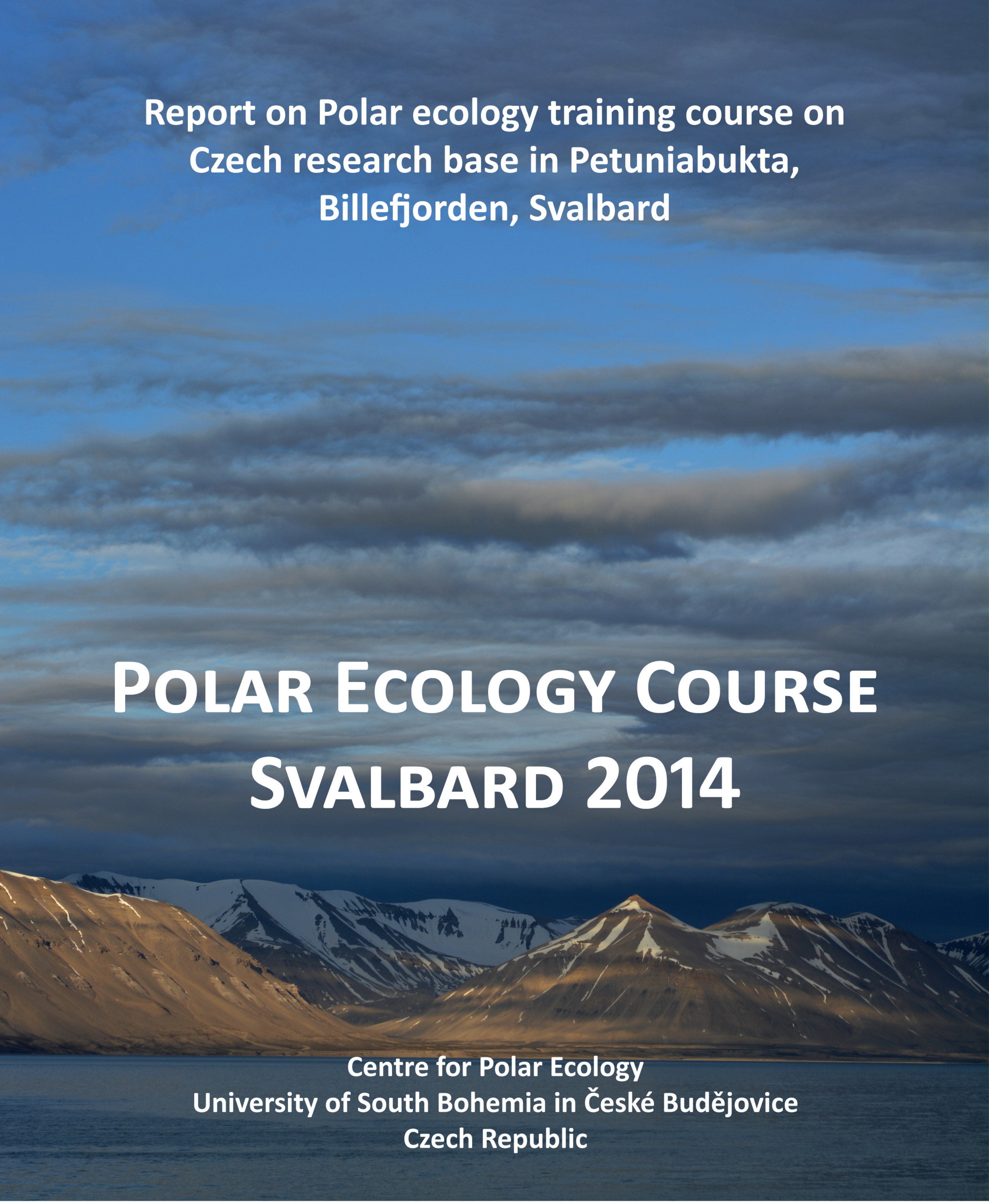


Report on Polar ecology training course on Czech research base in Petuniabukta, Billefjorden, Svalbard

Polar Ecology Course Svalbard 2014

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

european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

Supported by

INVESTMENTS IN EDUCATION DEVELOPMENT

The Polar Ecology course is organized 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 by state budget of the Czech Republic.

Creating of that course was enabled thanks to the infrastructure realized within the project of Czech Ministry of Education (MSMT) LM2010009 CzechPolar - Czech polar stations: Construction and logistic expenses.

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

2014

1. Introduction

The Polar Ecology course is provided by Centre for Polar Ecology (CPE) of the University of South Bohemia in České Budějovice, Czech Republic. The course is focused equally on both physical and life sciences in the Polar Region. The course itself consists of 1 week intensive theoretical preparation in respective fields of interest, and of approximately 12 days of field work at the Czech research station in Svalbard.

In 2014, 27 students were selected (Tab. 1.1.). The theoretical part of the course took place in CPE facilities in České Budějovice during spring semester (12/05 – 16/05 2013). For the field work during the summer season in Svalbard, students were divided into six groups according to their specialization. The groups performed their field work in Svalbard on 04/07-21/07 2014 (botany/plant physiology + zoology/parasitology), on 18/07-04/08 2014 (geology/geomorphology + climatology/glaciology), and on 01/08-18/08 2014 (hydrology/limnology + microbiology/phycology).

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

Tab. 1.1. The instructors and students (in alphabetical order) according to their specialization.

Group	Instuctors		Students	
GEO	Zbyněk Engel	UK+JU	Ondřej Bárta	MU
	Martin Hanáček	MU+JU	Martin Hložek	UK
			Lenka Ondráčková	MU
			Marcela Pastiriková	MU
CLIMA	Zuzana Chládová	UFA+JU	Roman Březina	UPOL
	Kamil Láska	MU+JU	Václav Nedbal	JU
			Martin Svatoň	MU
			Tereza Uhlíková	UK
HYDRO	Jan Kavan	JU	Martin Caletka	MU
			Eliška Kalčíková	JU
			Tereza Sankotová	UK
			Petra Vinšová	UK
MICRO	Josef Elster	JU+IBOT	Terezie Englová	JU
	Jana Kvíderová	IBOT+JU	Klára Hajšmanová	JU
	Otakar Strunecký	JU+IBOT	David Ryšánek	UK
			Luděk Sehnal	MU
BOTA	Alexandra Bernardová	JU	Viktorie Brožová	JU
	Tomáš Hájek	JU+IBOT	Eliška Lehejčková	JU
	Jitka Klimešová	IBOT + JU	Kamila Machová	JU
	Petr Macek	JU	Kateřina Sochorová	MU
	Jakub Žárský(MICRO)	JU + IBOT		
ZOO	Miloslav Devetter	ISB+JU	Tereza Hromádková	UK
	Oleg Ditrich	JU	Martina Kubátová	JU
	Václav Pavel	UPOL+JU	Zuzana Literáková	MU
	Tomáš Tyml	JU+PARU	Veronika Michálková	MU
			Kristýna Muchová	OSU
			Anna Mynářová	JU
			Petr Přikryl	OSU

Abbreviations:
Groups: BOTA - botany/plant physiology; CLIMA - climatology/glaciology; GEO - geology/geomorphology; HYDRO - hydrology/limnology; MICRO - microbiology/phycology; ZOO - zoology/parasitology.
Affiliations: IBOT – Institute of Botany AS CR, Třeboň; ISB – Institute of Soil Biology, Biology Centre AS CR, České Budějovice; JU – University of South Bohemia, České Budějovice; MU – Masaryk University, Brno; OSU – University of Ostrava, Ostrava; PARU – Institute of Parasitology, Biology Centre AS CR, České Budějovice; UFA – Institute of Atmospheric Physics AS CR, Prague; UK – Charles University, Prague; UPOL – Palacký University, Olomouc.

2. Physical Sciences (Geosciences)

2.1. Geology and Geomorphology

Instructors: ***Zbyněk Engel & Martin Hanáček***
Students: ***Ondřej Bárta, Martin Hložek, Lenka Ondráčková & Marcela Pastiriková***

The program of geoscientific course in 2014 consists of three main parts: sedimentological research, periglacial processes research and field excursion.

Sedimentological research

The field party continued with the research of glaciomarginal delta sediments in the southern part of the Bertilbreen valley, which started in 2013. Sediments have been deposited during the Pleistocene-Holocene transition and nowadays form a terrace at 50 m a.s.l. New clast lithological analyses from till and deltaic foreset and topset have been undertaken. Each analysis comprised 100 clasts of the 32–64 mm b-axis fraction. Petrology, clast axes lengths for shape analysis, roundness and presence of striation on clast surfaces have been determined. Facies description (basing on grain-size and bedding types) has been performed at natural section faces. Fabrics of platy pebbles in topset sediments have been measured. Four profiles have been survey using ground penetrating radar to ascertain the geometry of the whole accumulation. Horizon with bivalves in living positions has been found in deltaic sediments. The following species have been detected: *Mya truncata*, *Macoma calcaera*, *Hiatella arctica*. Striae alignment has also been measured in a few bedrock exposures below the deltaic sediments.

Fig. 2.1.1. Students during the clast petrological analyses of the 50m terrace, Bertilbreen valley.

Periglacial processes research

Periglacial processes research continued with the backup of ground temperature data recorded in patterned ground and solifluction lobes. In addition, horizontal displacement of clasts was measured on the surface of sorted stripes monitored since 2011.

Field excursions

Excursion to the Nordenskiöldbreen northern margin with the presentation of terminoglacial environment, Little Ice Age and pre-LIA roche moutonnées and lateral moraine (Fig. 2.1.2.).

Excursion to Ebbadalen with the presentation of ice-cored moraines and medial moraine of Ebbabreen and proglacial stream with well-evolved facies changes of sediments in the downstream direction.

Excursion to Hørbyebreen with the presentation of typical facies of an esker, hummocky moraine (supraglacial tills) and braided outwash fan.

Excursion to the Mumien summit with the presentation of sorted polygons and stripes and the bird's view of the whole Petuniabukta topography.

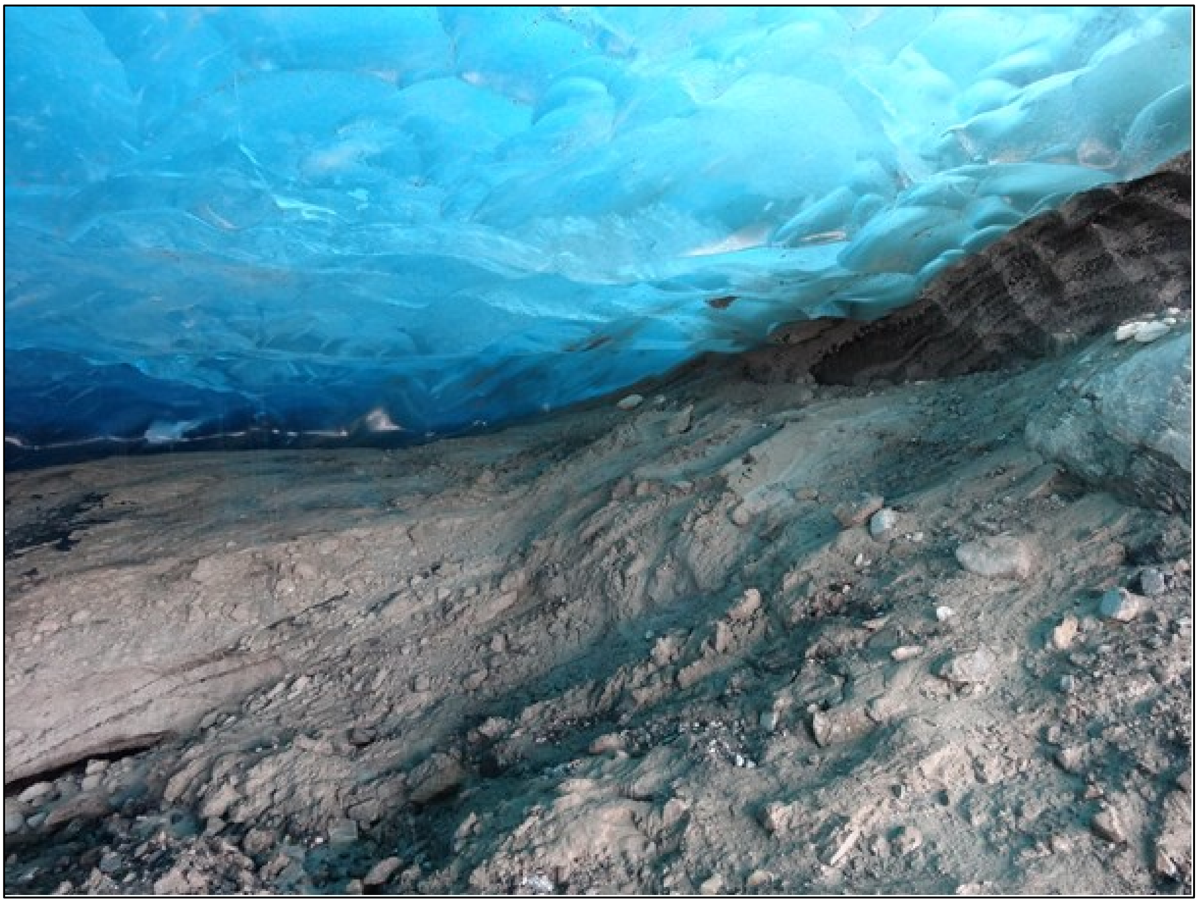


Fig. 2.1.2. Subglacial cavity at the Nordenskiöldbreen front.

2.2. Climatology and Glaciology

Instructors: ***Kamil Láska & Zuzana Chládová***

Students: ***Roman Březina, Václav Nedbal, Martin Svatoň & Tereza Uhlíková***

In a frame of the Polar Ecology Course, meteorological observation and glaciological survey were performed in the coastal ice-free zone of Petuniabukta and selected glaciers in the period from July 20 to August 3, 2014. The main goal of the fieldwork activities was to carry out the standard meteorological measurements and observations at Petuniabukta according to the Guide to Instruments and Methods of Observations No. 8 prepared by the World Meteorological Organization. Moreover, students focused on evaluation of the relationship between prevailing weather conditions, cloudiness, cloud genera and atmospheric circulation pattern over the central part of Spitsbergen. During the fieldwork activities the students regularly carried out the observations every hour during a day and every two hours at night time. They observed cloudiness (total cloud cover), cloud genera, cloud type and varieties, height of the cloud base, visibility, present and past weather conditions during last hour. Especial attention was devoted to measurement of precipitation amount and occurrence of the selected phenomena such as rain, drizzle, fog, photometeors, etc. (Figs. 2.2.1., 2.2.2 and 2.2.3.).

Fig. 2.1.1. Example of weather situation with the high-level, middle-level and low-level clouds (*cirrus*, *altocumulus and stratocumulus*) occurring at Petuniabukta on July 20, 2014.

Fig. 2.1.2. Irization on *altocumulus* clouds at Petuniabukta (Billefjorden, Spitsbergen).

Fig. 2.2.3. Rainbow on the low-level clouds at Petuniabukta (Bille-fjorden, Spitsbergen).

Other activities included installation of new meteorological station on the Bertilbreen glacier at the height of 280 m a. s. l. The measurements of air temperature, relative humidity, net radiation, surface wind speed and direction were put into operation at the beginning of August (Fig. 2.2.4a.). Moreover, new anemometer was installed on the top of the Mumien Peak (Fig. 2.3.4b.).

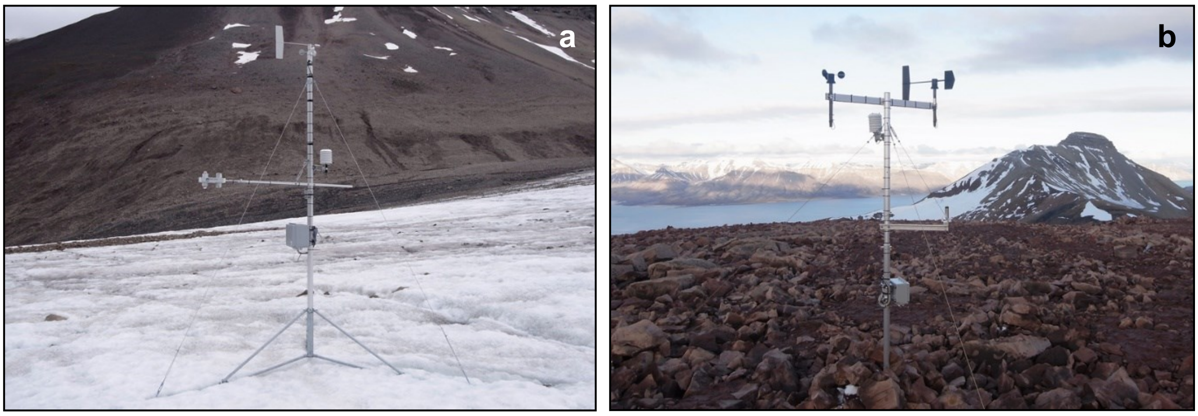


Fig. 2.2.4. Meteorological instruments on **(a)** the Bertilbreen glacier and **(b)** Mumien Peak.

Glaciological observations were carried out on Bertilbreen and Ferndinandbreen glaciers. These glaciers are situated northwest and north of Pyramiden settlement. Bertilbreen is one of the glaciers on which long-term measurement of ablation and glacier changes are carried out under the Centre of Polar Ecology (Univ. South Bohemia). In summer 2014, geodetic and ground penetrating radar (GPR) survey was conducted on Ferdinandbreen (Fig. 2.2.5.). Surface elevation data obtained using dual-frequency differential GPS receiver will be used for calculation of glacier surface DEM. Glacier volume and subglacial topography will be derived from GPR data. Together with the last year GPR measurement on Bertilbreen, we are able to estimate ice thickness, areal and volumetric changes, which are important indicators of regional climate changes.

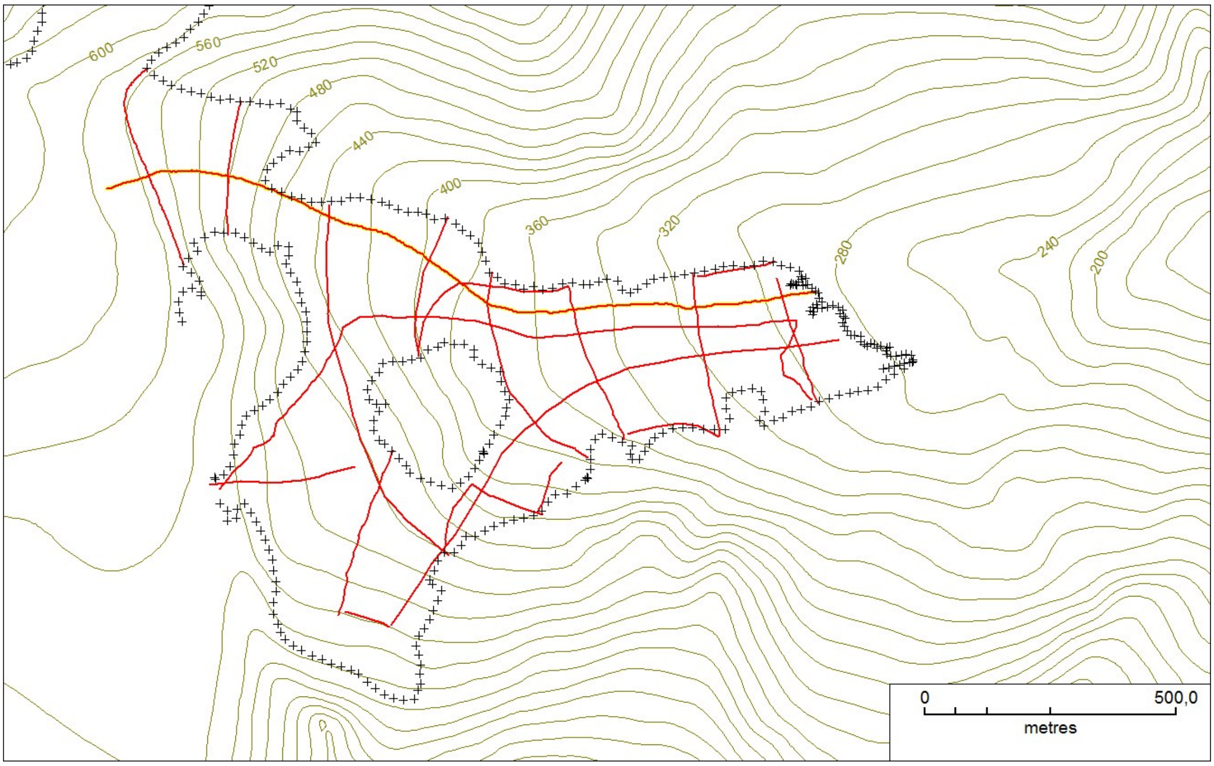


Fig. 2.2.5. Location of GPR transects (red lines) on Ferndinand Glacier. Cross symbols mark the boundary of the glacier during the survey conducted July 31, 2014.

The short-term study of spatiotemporal variation of surface temperatures has been undertaken in the coastal zone of Petuniabukta. We compare a set of thermal images provided by the infrared camera OPTRIS. The system was used to measure differences in surface temperatures on the selected coastal areas of Petuniabukta (Fig. 2.2.6.). We mainly focused on the sites with specific vegetation cover, occurrence of plant species, pattern grounds, etc. The results were evaluated for different categories of tundra vegetation, global radiation intensity and surface wetness.

Fig. 2.2.6. Measurements of surface temperature in the coastal area of Petuniabukta by the OPTRIS infrared camera system.

2.3. Hydrology and Limnology

Instructors: ***Jan Kavan***

Students: ***Martin Caletka, Eliška Kalčíková, Tereza Sankotová & Petra Vinšová***

The main goal of hydrology/limnology group (Fig. 2.3.1.) was to demonstrate specific features of polar aquatic ecosystems and how these can be studied directly in the field. All students have participated on two common long-term research projects that are carried out by the research team. The first and main one was the study of lake ecosystems in the Billefjorden area. The second one was focused on study of hydrological and thermal regime of selected water streams. Apart that, all students have their own specialized projects focusing on one particular hydrological and limnological features of the polar environment.

Fig. 2.3.1. Hydrology/limnology group on Nordenskioldbreen.

The whole group has participated on measurements of the basic physico-chemical parameters (temperature, pH, conductivity, dissolved oxygen), as well as on sampling of biological material for further analyses. Biological samples were then examined using microscopy techniques directly at the research station. Samples of diatoms from previous season were used for demonstration of diatom diversity among different types of lakes.

Discharge measurements have been done on chosen water streams to demonstrate different reactions of catchments to climatic forcings. Field techniques of hydrological measurements have been demonstrated, and all students participated on the long-term project of establishing a hydrological monitoring network. Students had the opportunity to study this data after they have been downloaded at the end of expedition. Special focus has been put on demonstrating fluvial activity of polar water ecosystem especially in highly glaciated and thus variable Bertilbreen and Svenbreen catchments, where M. Caletka elaborated his individual research project.

Besides this, a paleolimnological study on lakes Mimerdalen 2 and Mathiessondalen 3 has been done. Students were made familiar with techniques used for lake sediment sampling, processing of the sampled material and preparation for further analyses. We especially focused on using gravity corer to extract sediment cores from deeper lake basins and then process basic sample division and preparation for transport. Samples and data collected during this study will serve for continuation of Master thesis of M. Roman and E. Pinseel as well. Fig. 2.3.2. represents core taken in Garmaksla (11.8.2014) lake for further pigment analyses.

Fig. 2.3.2. Garmaksla core.

Marine environment has been studied as well. A gradient from Nordenskiold tidewater glacier towards deep sea environment was examined again after a year. (Figs. 2.3.3. and 2.3.4.). Basic physico-chemical parameters were measured and the influence of freshwater inflow to marine environment was demonstrated. Vertical stratification of selected measured features was shown. Zooplankton samples were collected and later examined in the laboratory (E. Kalčíková). A gradient from glacier front to the deep sea environment of the fjord has been established and sampled four times per season. Marine plankton net was used to sample zooplankton from 80 meters depth where possible. Dynamics of *Calanus hyperboreus* population was studied in spatial and temporal scale as shown in Fig. 2.3.5. Possible relationship with marine water properties (especially changes in salinity and fresh water inflow from glacier were taken into account) was studied – study design regarding the salinity distribution is shown in figure X. Basic features of tidal movement and ocean currents and wave erosional force was demonstrated during several field trips.

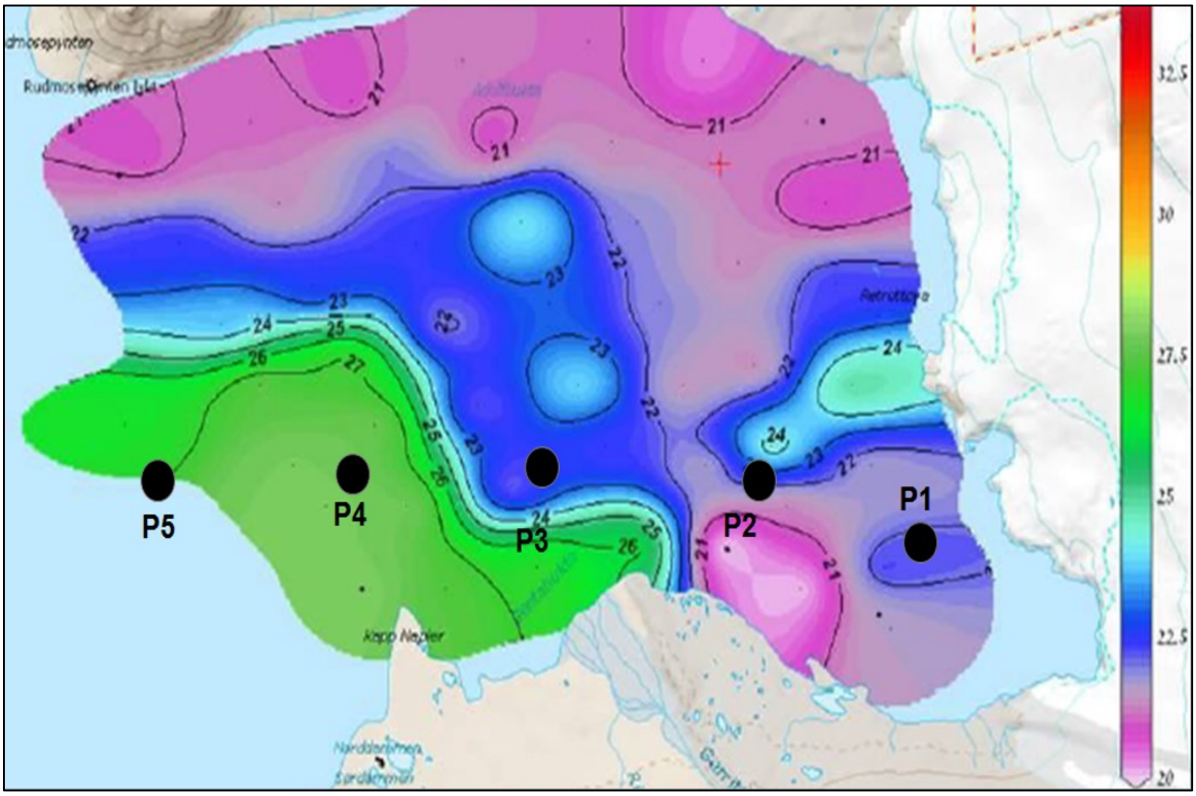


Figure. 2.3.3. Adolfbukta salinity map with location of 5 sampling points.

Fig. 2.3.4. Zooplankton sampling near Nordenskiold glacier.

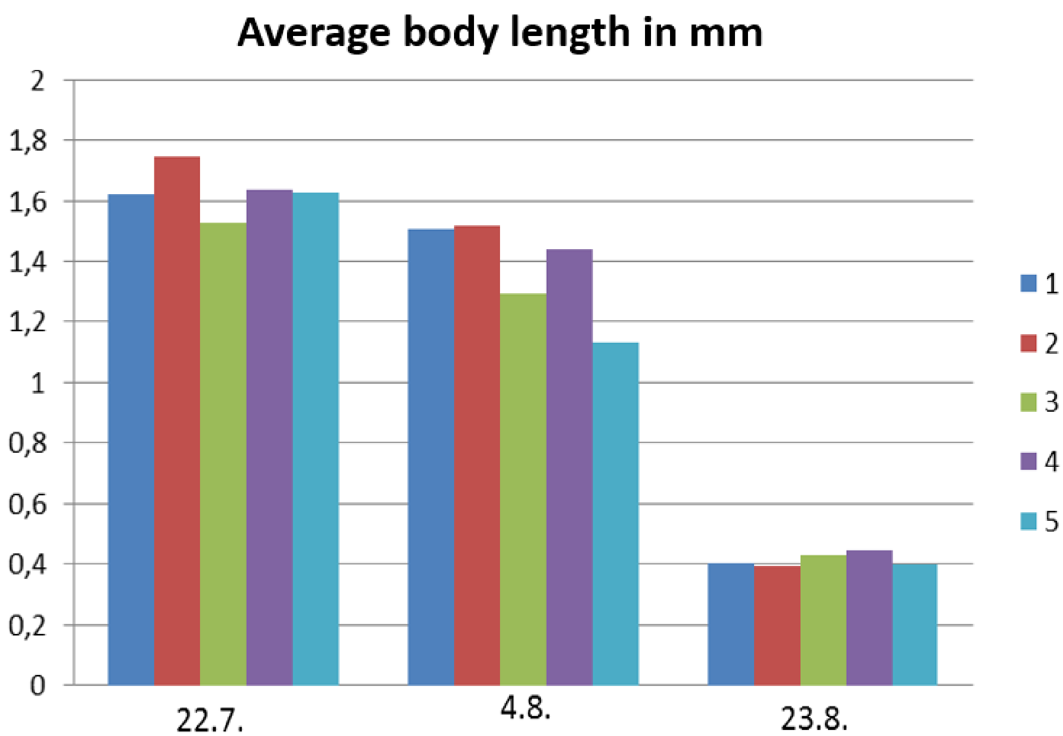


Fig. 2.3.5. Average body length of *Calanus hyperboreus* sampled in the studied area.

Fig.2.3.5. Installing sampling buckets on Nordenskioldbreen

Special attention this season was paid on glacial ecosystems, especially within a research project on Nordenskiold glacier. This locality was visited several times focusing on surface hydrology of a supraglacial lake in the central part of the Nordenskioldbreen. A subglacial features were demonstrated in the ice cave on the right side of Nordenskild glacier, where a safe insight in the body of glacier is possible. A special research project focused on cryoconite diatom community composition was carried out by Petra Vinšová with help of Jakub Žárský as well. Report on this work is to be found in the Research report (Fig. 2.3.5.).

A common work on studying lake ecosystems was supported by an individual project of Tereza Sankotová with her interest in bathymetry mapping (Fig. 2.3.6.). Several lakes were measured to make the bathymetry collection complete (most of the lakes were measured during previous seasons). An interesting work has been done on Ragnar lake which is directly affected by retreating Ragnar glacier changing progressively its morphology both of its bottom but also the shore line. Repeated bathymetry measurement of the same area as in 2011 show increase of depth of more than 8 meters in some parts of the lake. This study will be processed in more detail next season.

Fig. 2.3.6. Working at Garmaksla lake with rubber boat (sediment sampling and bathymetry mapping).

3. Life Sciences (Biosciences)

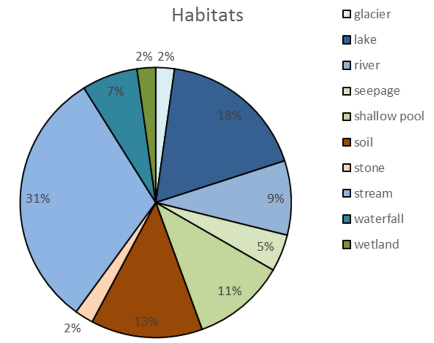
3.1. Microbiology and Phycology

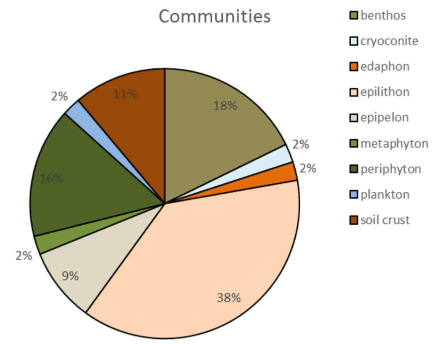
Instructors: ***Josef Elster, Jana Kvíderová & Otakar Strunecký***

Students: ***Terezie Englová, Klára Hajšmanová, David Ryšánek & Luděk Sehnal***

The long-term aim of the microbiology/phycology group is to characterize the microbial diversity of algae and cyanobacteria in various freshwater and aero-terrestrial biotopes (streams, pools and lakes, seepages, soil surface, wet rocks, snow, snow cryoconites). We focus not only on taxonomical diversity, but also on diversity in ecology and physiology.

In 2014, total of 43 samples were collected at 23 different localities during the course and we found 121 species/genera identified at species or genus levels. The proportions of sampled habitats, communities and abundance of individual classes of algae and cyanobacteria are summarized in Fig. 3.1.1.





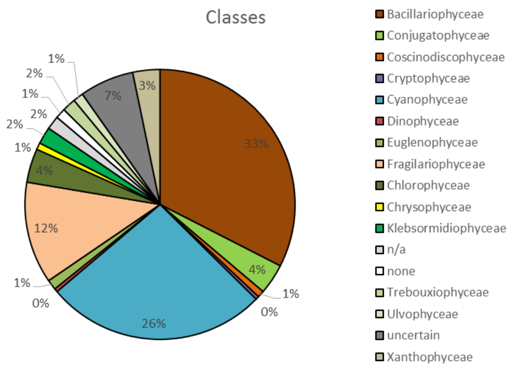


Fig. 3.1.1. The proportions of habitats and communities sampled, and abundances of individual algal and cyanobacterial classes observed by the ALGO2014 group. The data were exported from Sample database of the Centre for Polar Ecology.

Diversity of phototrophic microorganisms

In total we found 121 genera of organisms, including 30 genera of cyanobacteria, 19 genera/species of green algae *sensu lato* (Chlorophyta and Streptophyta), and 50 genera/species of diatoms.

Majority of taxons observed, like *Nostoc* sp., *Hydrurus foetodus* or *Hannaea arcus*, was the same as in previous years. Contrary, we observed yellow-green alga genus *Tribonema* more frequently (Fig. 3.1.2a.), especially in streams where green filamentous algae had dominated. In small pools eutrophized by bird excrements, the algal community was dominated by *Euglena* sp. and a green flagellates of genera *Lobomonas* sp. and *Chlamydomonas* sp. (Fig. 3.1.2b.). At pond effluent, the cascade was covered by *Ulothrix* sp. (Fig. 3.1.2c.). In soil crust near bird nests, taxons typical for soil crusts elsewhere were observed, like *Nostoc* sp. or *Gloeocapsa* sp. (Fig. 3.1.2d.)

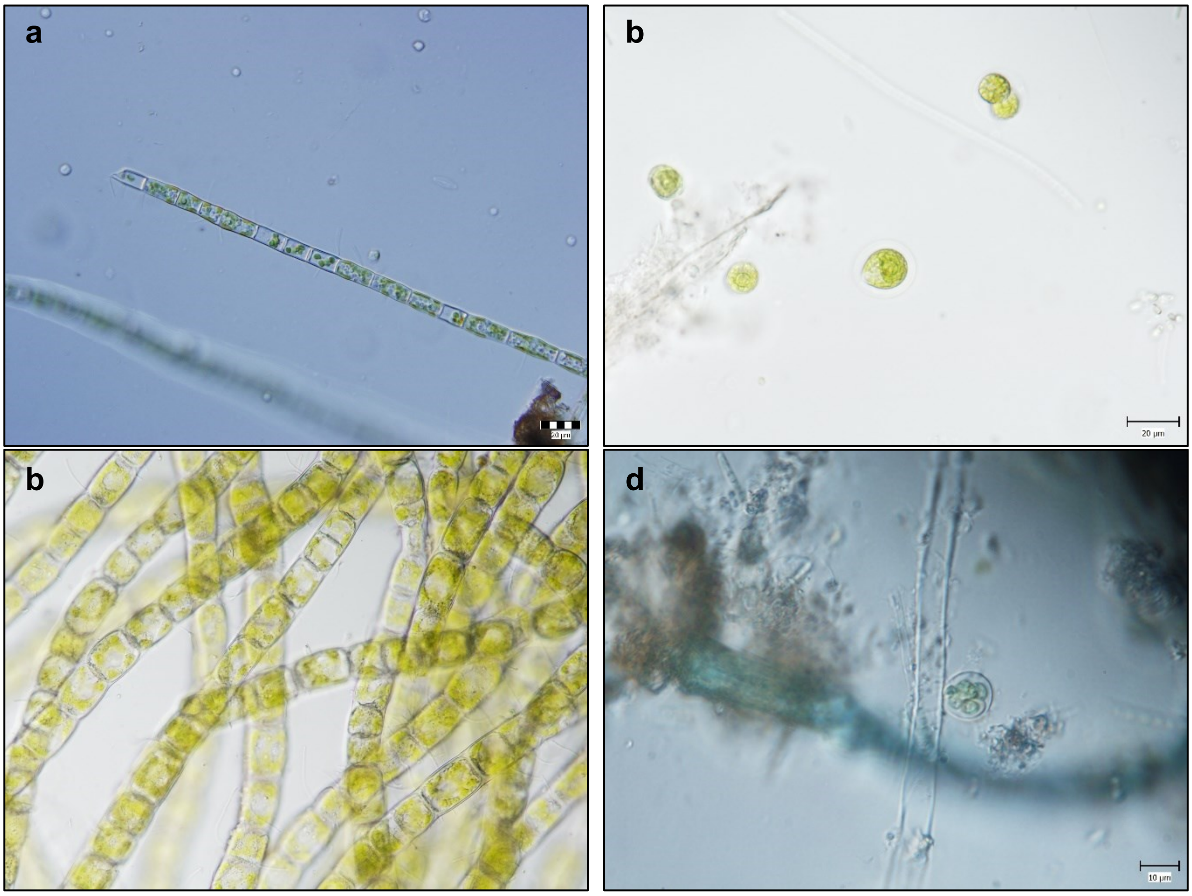


Fig. 3.1.2. Some interesting algal taxons observed during Polar Ecology Course 2014. **(a)** *Tribonema* cf. *vulgare*, **(b)** *Chlamydomonas* sp., **(c)** *Ulothix* sp., **(d)** *Gloeocapsa* sp.

Measurements of microbial activity in soils

Klára Hajšmanová focused on diurnal measurement of microbial activity and greenhouse gasses emissions of methane (CH_4) and nitrous oxide (N_2O) in soils with different vegetation developed in Petuniabukta, Billefjorden.

There were selected three different locations: dry meadows, soil crusts and wet meadows (Fig. 3.1.3). On these three selected locations there were determined greenhouse gasses emission of CH_4 and N_2O with different types of vegetation. Measurements were made using chambers in a few reps on the variant from 12 to 29 August 2014. At each site of measurement were taken soil samples for laboratory analysis (Fig 3.1.4.).

Fig. 3.1.3. Field measurement of greenhouse gasses production.

Fig. 3.1.4. (a) Air sampling for emissions of methane (CH_4) and nitrous oxide (N_2O), **(b)** soil sampling.

The results show that with the increasing involvement of vegetation, microbial activity is growing. It is connected with maintaining constant microclimate, large quantities of nutrients and organic matter. Methane emissions further depends on the thawing rate, level of water, temperature and humidity of locations. With the increasing soil temperature, the activity of soil microorganisms increases too and therefore is low to negative values for soil crusts for dry and wet meadows positive emissions. On unfrozen and flooded areas (saturated), methane production prevails over oxidation and there are positive emissions. On unfrozen, drier areas, but not completely dried out there is the decomposition of organic matter, and oxidation of methane emissions prevails over production and there are negative emissions. For unfrozen and slightly flooded soils is production of methane and also oxidation of methane (Fig. 3.1.5.).

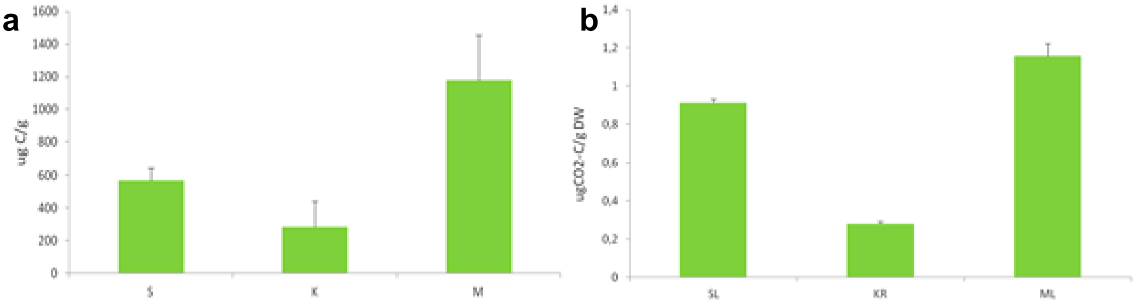


Fig. 3.1.5. (a) Microbial biomass and **(b)** respiration in different vegetation types. Abbreviations: S – Dry meadows; K – Soil crusts; M – Wet meadows.

Diurnal cycles of photosynthetic processes

Luděk Sehnal measured diurnal cycles of photosynthetic processes in soil crust and lichen, which were carried out in Petuniabukta, Spitsbergen. For field measurements, a method of induced fluorescence of chlorophyll was used. Measurements of photosynthetic activity were taken as repetitive measurements of effective quantum yield of photosystem II (Φ_{PSII}). The short-term field measurements were carried out for 10 days in summer 2014. Φ_{PSII} was recorded each 5 minutes as well as microclimatic data (air temperature, air humidity, photosynthetically active radiation - PAR). For measuring of diurnal course of Φ_{PSII} and PAR we used multichannel monitoring fluorometer Moni–PAM 2000 (Heinz Walz, Germany; Fig. 3.1.6.). The fluorometric system was installed in a close vicinity of Petunia station located at Petunia Bay from 5 to 15 August 2014. To determine changes of environmental conditions during the field experiment, basic microclimatic data were recorded. Temperature and relative air humidity were measured in each five minute by Minikin datalogger (EMS Brno, Czech Republic).

In general, physiological activity of both biological soil crust and lichen showed daily courses. Typically, most of Φ_{PSII} values ranged 0.6 – 0.7 in both model organisms. The results have shown that photosynthetic activity was strongly correlated with all observed abiotic factors in both study objects. Particularly important was the relation found between PAR and Φ_{PSII} in soil crust. When the soil crust was exposed to high PAR doses of irradiation (about 2300 µmol m^{-2} s^{-1}) photoinhibition of primary processes of photosynthesis was observed as Φ_{PSII} decrease, while photosynthetic activity of lichen remained at same level. Furthermore, it has been demonstrated increasing that *in situ* photosynthetic activity increased in both soil crust and lichen with a decrease in temperature.

Fig. 3.1.6. Fluorometric system Moni–PAM (Walz, Germany).

Diversity of genus *Klebsormidium* in polar region

In temperate zone the genus *Klebsormidium* is very diverse and has cosmopolitan distribution (Rindi et al. 2011, Ryšánek et al. 2014). Current knowledge showed that strains in this genus have strong ecological preferences (Novis 2006, Škaloud and Rindi 2013, Škaloud et al. 2014), and substrate specificity looks like more important than geographic distribution. On an already obtained strains from arctic and Antarctic from bone proved that same genotype are occurred in both polar regions and also temperate zone on same substrate. So David Ryšánek wanted to collect the same habitats (sandstone, limestone, basalt etc.) like in temperate zone (the Czech Republic) to compare importance of substrate and geographic distribution on diversity of the genus *Klebsormidium*. In Svalbard, David collected 26 samples from sandstone, coal, basalt, soil crust, limestone, orthogenesis, etc. Then on laboratory every samples were maintained on two agar plates slants with modified Bold´s Basal Medium (Bischoff and Bold 1963) at 15°C under 24h of light. Algal microcolonies grown up after 6-10 weeks and were isolated into to single strain cultures. In total, 9 strains (3 strains from sandstone, 3 from coal, 2 from basalt, 1 orthogenesis) were used for molecular analysis. The sequences of the *rbc*L gene were obtained by polymerase chain reaction (PCR). It was obtained 4 genotypes from 9 strains. The result showed that the diversity on Svalbard is very low to compare to temperate regions, more often David found mainly genus *Xanthonema* on agar plates, which have very similar morphology and are also more typical for the polar regions (Rybalka et al. 2009). Majority strains from polar are from clade B and strains from clade B had cosmopolitan distribution, they are found arctic, Antarctic and temperate zone. (Fig. 3.1.7.).

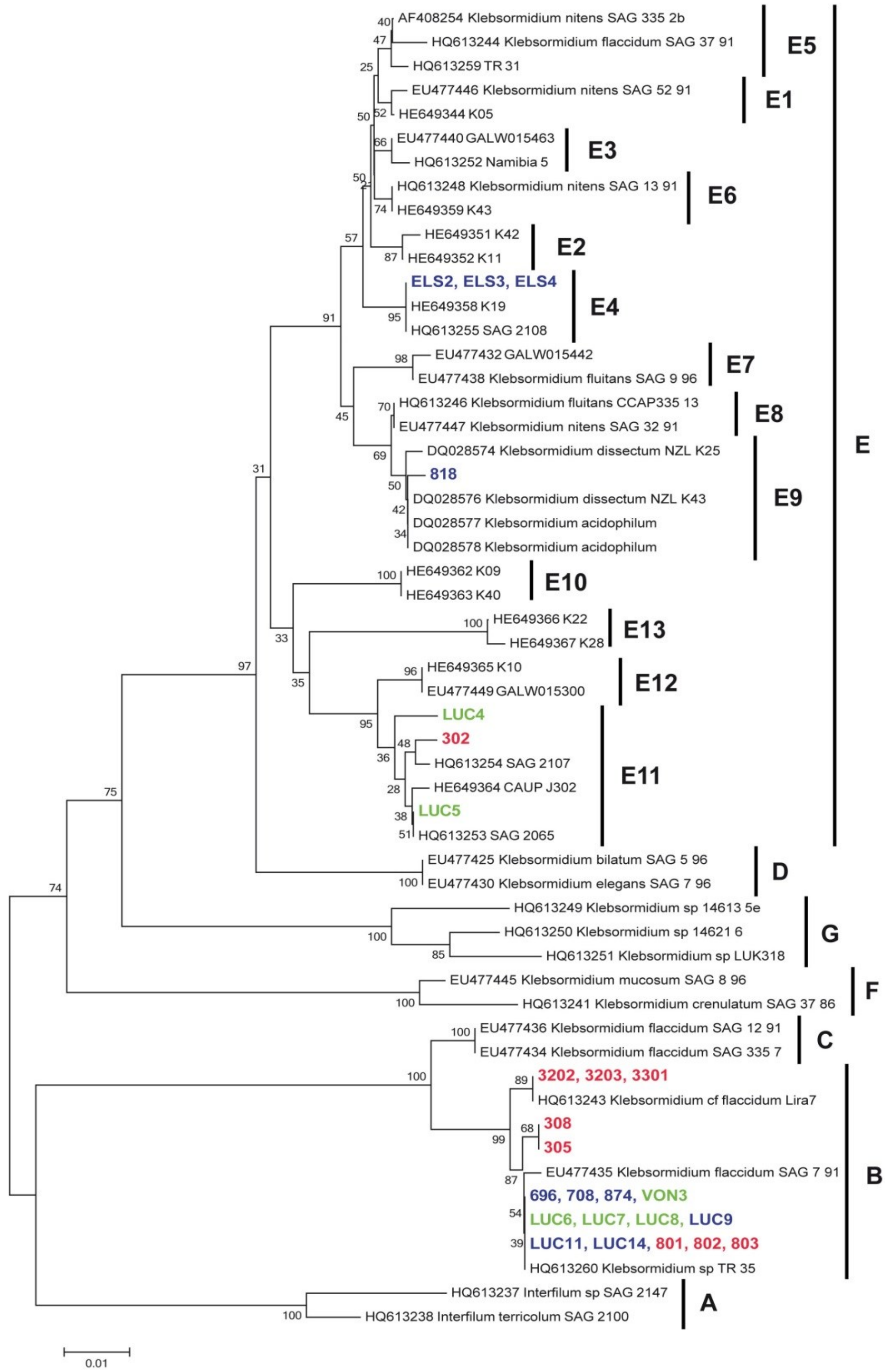


Fig. 3.1.7. Phylogenetic tree obtained from Bayesian analysis based on *rbc*L dataset, showing the position of investigated *Klebsormidium* strains and their relatives. Red colour show David's strains from Svalbard, green colour show strains from artic region, and blue colour show strains from Antarctic.

References:

Bischoff H, and Bold HC (1963) Some soil algae from Enchanted Rock and related algal species. Phycological Studies IV. Univ Texas Publ 6318: 1-95.

Novis PM (2006) Taxonomy of *Klebsormidium* (Klebsormidiales, Charophyceae) in New Zealand streams and the significance of low-pH habitats. Phycologia. 45:293-301.

Rindi F, Mikhailyuk TI, Sluiman HJ, Friedl T, López-Bautista JM (2011) Phylogenetic relationships in *Interfilum* and *Klebsormidium* (Klebsormidiophyceae, Streptophyta). Mol Phylogenet Evol. 58:218-231.

Rybalka N, Andersen RA, Kostikov I, Mohr KI, Massalski A, Olech M, Friedl T (2009) Testing for endemism, genotypic diversity and species concepts in Antarctic terrestrial microalgae of the Tribonemataceae (Stramenopiles, Xanthophyceae). Environ Microbiol 11(3): 554-565.

Ryšánek D, Hrčková K, Škaloud P (2014) Global ubiquity and local endemism of free-living terrestrial protists: phylogeographic assessment of the streptophyte alga *Klebsormidium*. Environ Microbiol.

Škaloud P, Lukešová A, Malavasi V, Ryšánek D, Hrčková K, Rindi F (2014) Molecular evidence for the polyphyletic origin of low pH adaptation in the genus *Klebsormidium* (Klebsormidiophyceae, Streptophyta). Plant Ecol Evol 147 (3): 333-345.

Škaloud P, Rindi F (2013) Ecological differentiation of cryptic species within an asexual protest morphospecies: a case study of filamentous green alga *Klebsormidium* (Streptophyta). J Eukaryot Microbiol. 60: 350-362.

Diversity of diatom flora of polar streams

Terezie Englová compared diatom flora in different types of streams in Petuniabukta whence the first type were streams which were supplied by melting snow and the second type were streams which were supplied by glaciers.

There were selected two representatives of each type, glaciers streams were concretely supplied by Ferdinandbreen and the other by Ebbabreen. Diatoms were collected on three typical places: near their sources, next to marine terrace and near the sea in these selected streams. Collection of samples were done by a method of scraping periphyton from the whole surface of each stone and from three stone on each place. It were also measured some ecological variables like temperature of water, pH and conductivity. Then it was obtained empty frustules by a chemical method using nitric acid and determined species and their frequency based on Blanquet´s scale.

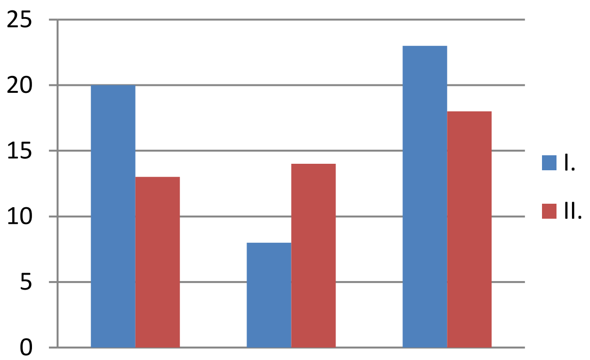


Fig. 3.1.8. Diversity at each place in streams supplied by metling snow. Groups (from left): near source – intermediate part at terrace - near sea).

In streams which were supplied by melting snow the divergence was biggest near the sea which was probably caused by the slowest rate of flow (Fig. 3.1.8.).

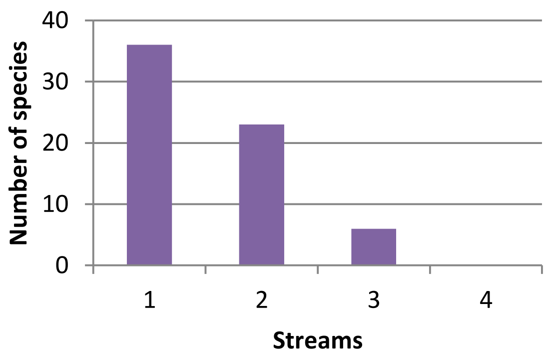


Fig. 3.1.9. Diversity of streams which were. 1 and 2 - snowmelt streams, 3 and 4 glacial streams.

It was found out, according to attached graph, that in glacier streams the diversity of diatom species were really low or none probably because of a big influence of abrasion of stones caused by entrained particles and big flow (Fig. 3.1.9.).

Additional experiments should be focused on a life of strategy of succesful species with high frequency (f.e.: *Hannaea arcus, Cymbella arctica*, *Gomphonema micropus*, *Gomphonema* cf.

productum…) but also on less frequent species which were typical for different spaces because these are the main bioindicators.

3.2. Botany and Plant Physiology

Instructors: ***Alexandra Bernardová, Tomáš Hájek & Jitka Klimešová***

Students: ***Viktorie Brožová, Eliška Lehejčková, Kamila Machová & Kateřina Sochorová***

Botanical group (Fig.3.2.1.) focused on two projects:

1. Assessment and analysis of plant functional traits
2. A role of cushion plant *Silene acaulis* in spatial arrangement of plant communities

Fig. 3.2.1. The botanical group and part of the zoology group just before departure to Svalbard at Prague airport.

Assessment and analysis of plant functional traits

During field course we continued the sampling of plant functional traits, which we already started in previous years. This year we focused on leaf traits. Plants growing in beneficial conditions with enough of moisture and nutrients and in environment of mild climate have fast growth, i.e. high specific leaf area (area per unit of leaf weight), short lifespan of leaves, palatable and easily decomposable leaves as they have favorable nutrient composition of leaves. On the other hand plants inhabiting Svalbard are not growing in favorable conditions and thus we can expect that their leaves will have lower specific leaf area, longer lifespan, and they will not be palatable and easily decomposable as they nutrient composition will not be as favorable for decomposers as plants from warmer zones. We first measure specific leaf area, the trait which is fundamental for understanding a strategy of plant growth in relation to productivity of a substrate. Our results supported theoretical expectations, our plants from Svalbard (cca 70 species) have lower specific leaf area than plants belonging to the same genera but growing in continental Europe (Fig. 3.2.2.). We continue with further analyses of the dataset.

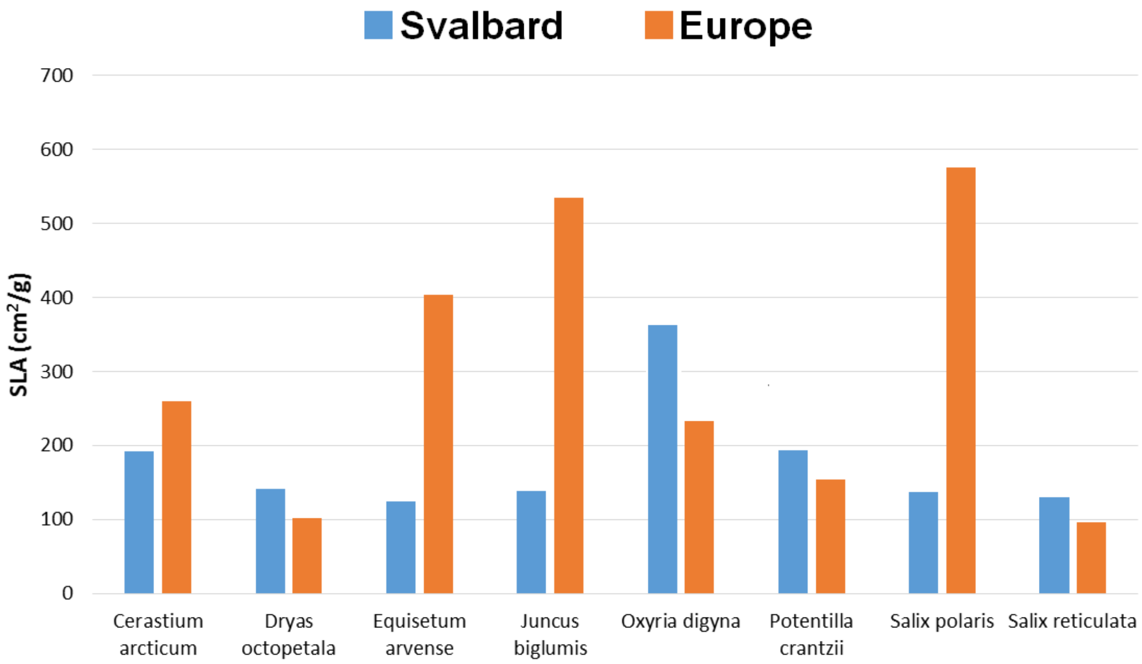


Fig. 3.2.2. Comparison of specific leaf area (SLA) in selected species growing in both, Svalbard and continental Europe.

Silene acaulis in spatial arrangement of plant communities

Cushion plants are famous ecosystem engineers as they affect by their growth environmental conditions in a community. As the cushion growth form occurred preferentially in stressful environments, for example affected by frost or dryness, it may be beneficial for other plants to growth inside of cushion plant than outside of it. So far researches mainly report the cases that there are more favorable environmental conditions inside of cushion and that plants of the community prefer to growth inside of it, studies from high Arctic are, however, very rare. In our project we studied whether in community with cushion plant *Silene acaulis* (Fig. 3.2.3.) are some species which prefer to grow inside of cushion than outside and whether environmental conditions in the cushions differ from surrounding. From our measurements follows that inside of cushion of studied species there is higher temperature, lower moisture and deeper substrate than outside of it. However, most importantly, less ramets and less species grow inside the cushions, i.e. *Silene acaulis* does not facilitate the establishment and/or grow of other plants.

Fig. 3.2.3. Does the cushion environment of *Silene acaulis* facilitate growth of other plant species?

3.3. Zoology and Parasitology

Instructors: ***Miloslav Devetter*, *Oleg Ditrich*, *Václav Pavel* & *Tomáš Tyml***
Students: ***Tereza Hromádková, Martina Kubátová, Zuzana Literáková, Veronika Michálková, Kristýna Muchová, Anna Mynářová & Petr Přikryl***

The field part of the course was split into an introduction to animal diversity in the area of polar station and demonstration of various methods of sampling in the field. Several trips to remote localities were arrange to observe birds and their behaviour (Skansbukta, Fortet – Fig. 3.3.1.) or to dive in water with better visibility (Brucebyen). Great part of the course, students also worked on individual projects under our guidance. Representatives of a marine zooplankton (e.g., *Calanus* ssp., Chaetognatha, and also veliger, planktonic larva of bivalves – see Fig. 3.3.2.) were collected by plankton net. For parasitological examination, gill nets were laid in littoral marine habitats and usual fish species were caught there (i.e., *Myoxocephalus scorpius*, *Gymnocanthus tricuspis*, *Clupea harengus*, *Mallotus villosus*, *Boreogadus saida*, *Lumpenus lampretaeformis*).

Great part of the course, students worked on their individual projects under our guidance. In this report, two student projects are introduced since they are not overlapping with other projects mentioned in the "Report on field activities of the Czech research group (2014)".

Fig. 3.3.1. Part of zoological group on the top of Fortet.

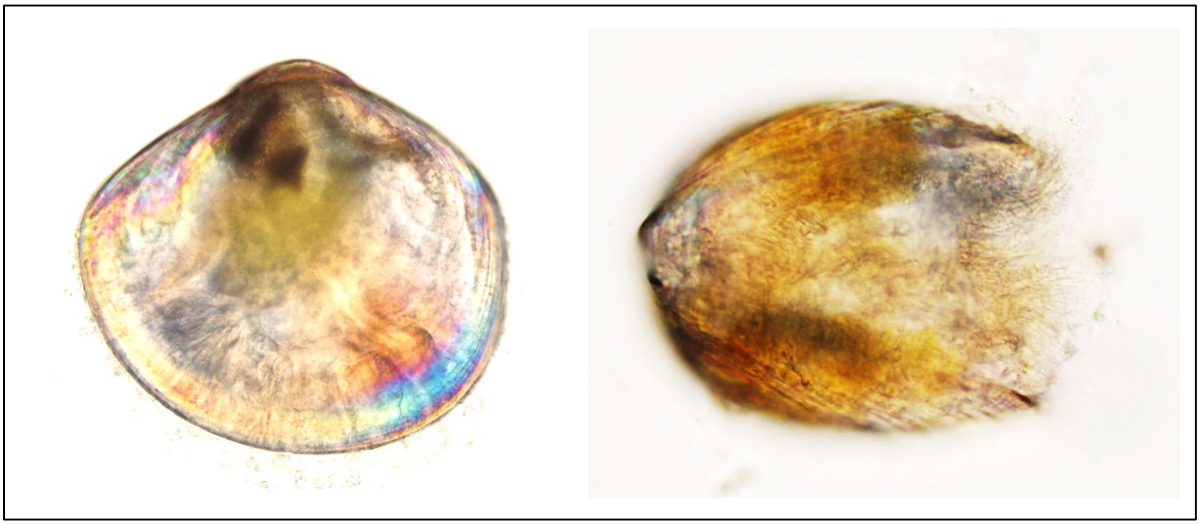


Fig. 3.3.2. Veliger, a planktonic larva of some bivalve species. Billefjorden.

Veronika Michálková focused her activity on screening gills and fins of various fish species. She looked for monogenean, a metazoan group of ectoparasites with direct life-cycle that are typical for fish. She succeeded and obtained enough material for a subsequent processing. In total, 61 specimens of Gyrodactylidae family were fixed, measured, and drawn. Four fish species were infected: Capelin (*Mallotus villosus*), Atlantic herring (*Clupea harengus*), Snake blenny (*Lumpenus lampretaeformis*), and Arctic staghorn sculpin (*Gymnacanthus tricuspis*). The highest prevalence was observed on capelins where three species were identified: *Gyrodactyloides andriashewi* (Fig. 3.3.3a.), *G. petrushewskii* (Fig. 3.3.3b.), *Laminiscus gussevi*.

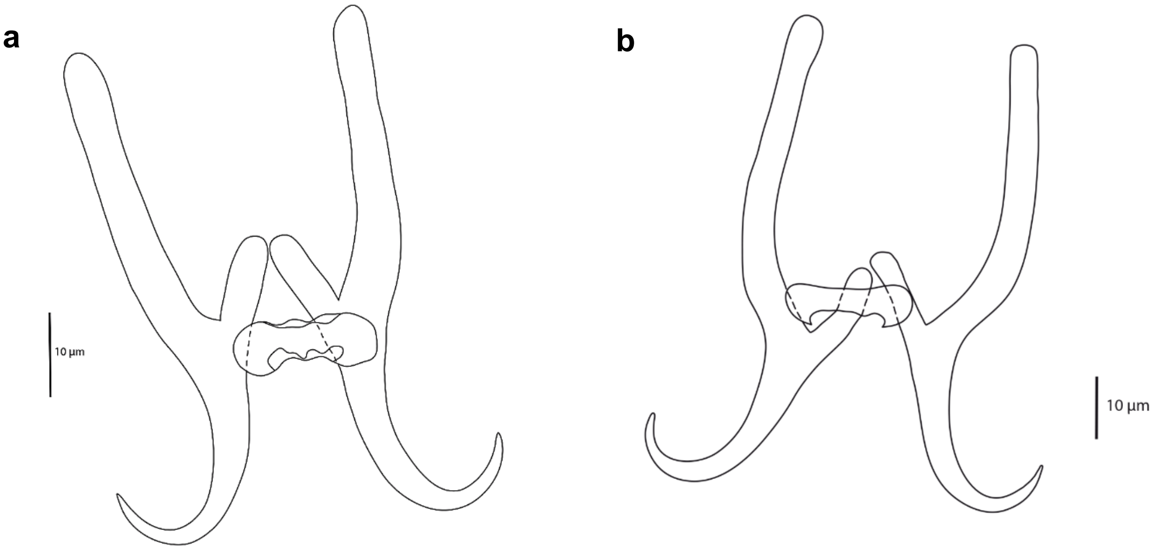
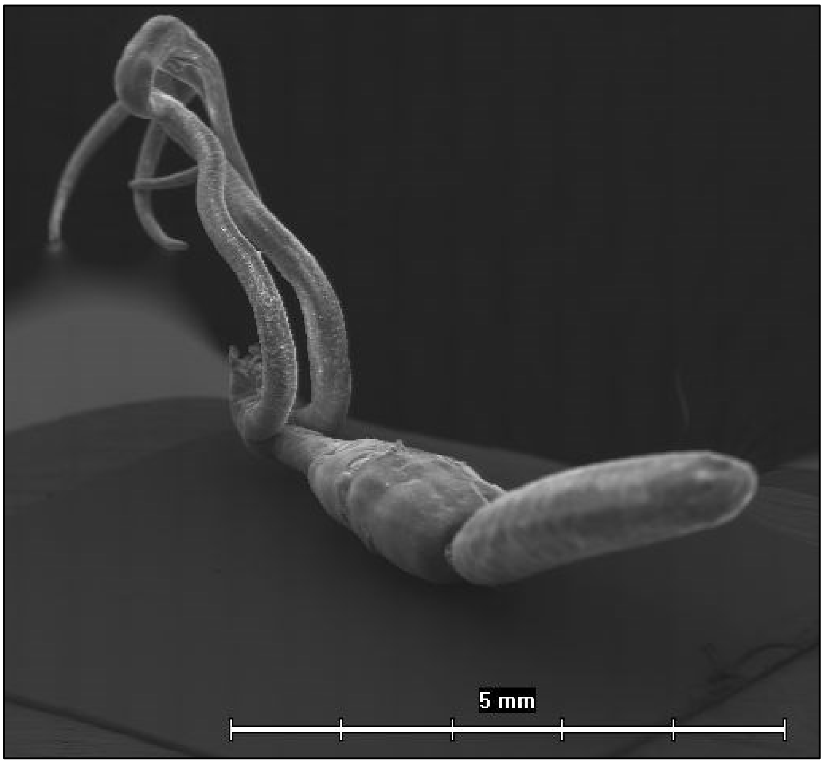


Fig. 3.3.3. Sclerotized part of haptors of **(a)** *Gyrodactyloides andriashewi* and **(b)** *Gyrodactyloides petrushewskii*.

Petr Přikryl has been focused to marine crustaceans, particularly to "cryptic species" of spider crabs *Hyas araneus* and *Hyas coarctatus* that are known from Svalbard. Petr looked for their endoparasites with aim to assess if there are some differences. He will continue on this topic in future and add also samples from Longyearbyen. Another group of crustaceans has become his interest - ectoparasitic copepod strongly modified bodies (Fig. 3.3.4.). He has identified species that were collected during last expeditions as well this year around Longyearbyen. He has



started with their morphological and molecular characterization. For us, the topical issue is comparing of Polar cod (*Boreogadus saida*) and Atlantic cod (*Gadus morhua*) since they are competing species and Atlantic cod is a newcomer there.

Fig. 3.3.4. Ektoparasitic copepod, *Schistobrachia ramose* found on gills of Thorny skate (*Amblyraja radiata*). Scanning electron microscope.

We have obtained permission for virological examination of 100 specimens of Black-legged kittiwakes (*Rissa tridactyla*) in their colonies in Pyramiden. Once captured, they were examined for ectoparisetes (Fig. 3.3.5.) and their fecal samples for parasites.

Zuzana Literáková found Gull head lice *Saemundssonia lari* in more than 70 % if kittiwakes.

Fig. 3.3.5. Adult Gull head lice *Saemundssonia lari*

Anna Mynářová recorded microsporidia *Enterocytozoon bieneusi* in 10 % and *Encephalitozoon* sp*.* in 8 % of kittiwakes (Fig. 3.3.6.).

Fig. 3.3.6. Examination of a kittiwake in abandoned building in Pyramiden.