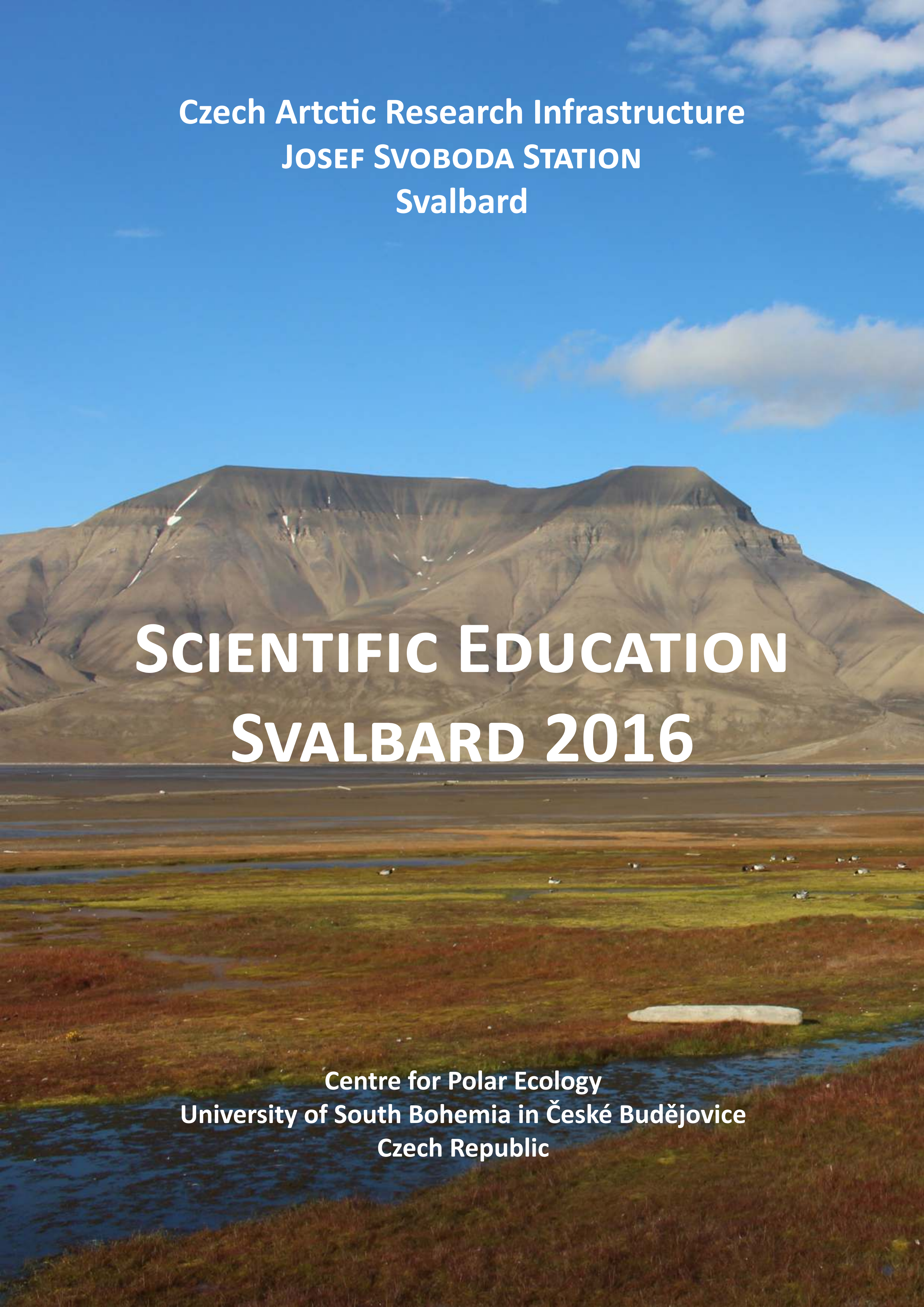


Czech Artctic Research Infrastructure
JOSEF SVOBODA STATION
Svalbard

SCIENTIFIC EDUCATION SVALBARD 2016

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

Polar ecology course-bio sciences, č. NF-CZ07-ICP-1-029-2014 and Polar ecology course II- bio sciences, NF-CZ07-ICP-4-316-2016.

Creating of that course was enabled thanks to the infrastructure realized within the project of Czech Ministry of Education (MSMT) LM2015078 - CzechPolar2 - Czech Polar Research Infrastructure. The course organizers would also like to thank to the Czech Arctic Research Infrastructure "Josef Svoboda Station" (as a part of the Czech Polar Research Infrastructure, CzechPolar2) and its crew for their support.

Cover photo: Jana Kvíderová
Editor: Jana Kvíderová

2016

1. Introduction

In the 2016, the Winter Arctic Ecology was organized by the Centre for Polar Ecology, Faculty of Sciences, University of South Bohemia for the first time. Ten students were divided into botany (02 – 17/04) and phycology, microbiology and zoology (16 – 30/04) groups (Tab. 1.1.).

Tab. 1.1. The instructors and students (in alphabetical order) of the Winter Ecology Course according to their specialization. Refer to Tab. 1.2. for abbreviations explanations.

Group	Instuctors		Students	
MICRO	Hynek Adámek	NG	Libor Borák	OSU
+ ZOO	Devetter Miloslav	UPB+JU	Tomáš Jedlička	UHK
	Josef Elster	JU+IBOT	Matěj Pokorný	UK
	Karel Janko	IAPG+JU	Dominika Prochová	UK
	Václav Pavel	UPOL+JU	Pužejová Kateřina	JU
	Jakub Žárský	UK+JU	Vojtěch Richtr	UPOL
			Kateřina Trumhová	UK
BOTA	Jitka Klimešová	JU+IBOT	Adam Klimeš	UK
	Petr Macek	JU+IBOT	Anita Petrů	UK
			Pavlína Šámalová	UK
			Veronika Vosáhlová	UHK

The 6th Polar Ecology course was organized by the Centre for Polar Ecology, Faculty of Science, University of South Bohemia in České Budějovice and supported by Polar ecology course-bio sciences, č. NF-CZ07-ICP-1-029-2014 and Polar ecology course II- bio sciences, NF-CZ07-ICP-4-316-2016. The course itself consists of 1 week of intensive theoretic preparation in respective fields of interest, and of approximately 14 days of field work at the Czech research station in Svalbard. Eleven students were selected (Tab. 1.2.).

In 2016, The theoretical part of the course took place in CPE facilities in České Budějovice during spring semester (09/05 – 13/05 2015. For the field work during the summer season in Svalbard, students were divided into three groups according to their specialization. The groups performed their field work in Svalbard on 02/07-16/07 2016 (botany/plant physiology + zoology/parasitology), and on 02/08-17/08 2016 (microbiology/phycology).

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

Tab. 1.2. The instructors and students (in alphabetical order) of the Polar Ecology Course according to their specialization.

Group	Instuctors		Students	
MICRO	Josef Elster	JU+IBOT	Dovile Barcyte	UK
	Jana Kvíderová	JU	Zuzana Gajarská	JU
	Marie Šabacká	JU	Jana Müllerová	JU
			Anna Polášková	JU
			Karolína Vávrová	UK
BOTA	Tiit Hallikma (ext)	ESTU	Viktorie Brožová	JU
	Lauri Laanisto (ext)	ESTU	Barbora Jonášová	JU
	Petr Macek	JU+IBOT	Klára Kopicová	JU
	Petr Sklenář	JU		
ZOO	Oleg Ditrich	JU	Alena Bartoňová	JU
	Václav Pavel	UPOL+JU	Martins Briedis	UPOL
	Tomáš Tyml	JU+MU	Nikol Kmentová	MU

Abbreviations:
(ext) – extrenal lecturer
Groups: BOTA - botany/plant physiology; MICRO - microbiology/phycology; ZOO - zoology/parasitology.
Affiliations: ESTU – Estonian University of Life Sciences, Tartu (EE); IAPG – Institute of Animal Physiology and Genetics AS CR, Liběchov; 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; NG – National Geographic Česko; PARU – Institute of Parasitology, Biology Centre AS CR, České Budějovice; OSU – University of Ostrava, Ostrava; UHK – University of Hradec Králové, Hradec Králové; UK – Charles University, Prague; UPOL – Palacký University, Olomouc.

2. Winter Arctic Ecology Course

2.1. Microbiology, Phycology and Zoology

Instructors: ***Hynek Adámek, Devetter Miloslav, Josef Elster, Karel Janko, Václav Pavel & Jakub Žárský***

Students: ***Libor Borák, Tomáš Jedlička, Matěj Pokorný, Dominika Prochová, Pužejová Kateřina, Vojtěch Richtr & Kateřina Trumhová***

Students were given a basic training in safety procedures required in the early spring conditions, which included use of skis and their maintenance, navigation (traditional and GPS based), emergency camp setup (emergency equipment), radio communication, avoiding of avalanche danger and use of avalanche transmitters and polar bear safety measures (safe handling of firearms, use of signal flares, target shooting and camp guards).

During excursions, the students were introduced to the description of snow pack and its characteristic features in the High Arctic (e.g. superimposed ice, mechanisms of ice layers formation). A number of snow profiles was excavated in the close vicinity of Longyearbyen, in the terminal part of Adventdalen and Bjørnadlen in order to demonstrate variability in snow pack structure and the factors shaping this variability. Samples of algal mats were taken from several localities, where the superimposed ice production allowed to reach the soil surface. This limited amount of material was subsequently used to measure change of oxygen concentration changes (dark/different levels of light incubations) in an experimental setup based on the VisiSens (PreSens) optical system, which was used the first time for this type of application and the experience acquired in this experiments will be used for an incubation design in the future (Figs. 2.1.1. and 2.1.2.).

Fig. 2.1.1. Microscopic survey of glacier surface for snow algae presence. Author: Josef Elster.

Fig. 2.1.2. Sample preparation. Author: Jakub Žárský.

2.2. Botany

Instructors: ***Jitka Klimešová & Petr Macek***

Students: ***Adam Klimeš , Anita Petrů, Pavlína Šámalová & Veronika Vosáhlová***

We organized the first year of a course Winter Arctic ecology. The course was divided into two parts, Botany and plant physiology (2 - 17 April 2016) and Algology, microbiology and zoology (14 - 30 April 2016). The courses were financially supported by Norway funds, and were held at Payers house (Czech Arctic research station of Josef Svoboda) in Longyearbyen, Svalbard. The course was organized under winter conditions, with temperatures reaching far below zero (around -20°C), when the high pressure governs Arctic regions eventually resulting in favorable and equalized conditions suitable for field research. Additionally, the daylight is already for most of the night. The course was visited by students from universities across the Czech Republic. The main content of the course was to introduce students into the problematics of winter conditions in high Arctic, including all the necessary safety rules for successful field research. Among other topics we focused on studies of snow and glaciers, and the effect of snow on survival of selected organisms during winter (Figs. 2.2.1.-2.2.4.).

Fig. 2.2.1. Winter conditions in Longyerbyen. Author: Dominika Prochová.

Fig. 2.2.2. Svalbard reindeers. Author: Dominika Prochová.

Fig. 2.2.3. Ice-drilling and sampling of organisms. Author: Dominika Prochová.

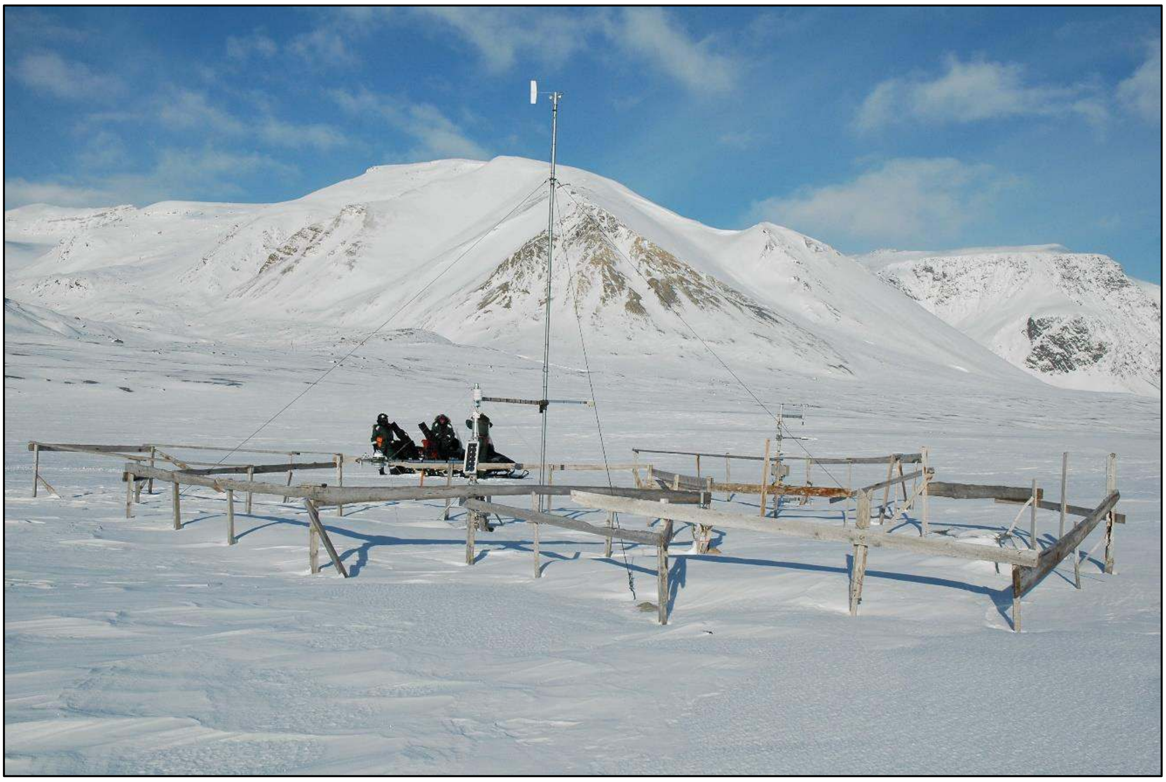


Fig. 2.2.4. Permanent experimental plots with AWS and open top chambers. Author: Josef Elster.

3. Polar Ecology Course

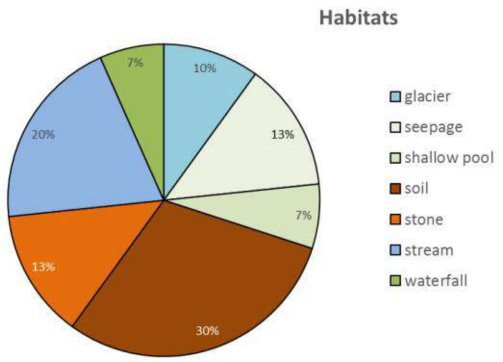
3.1. Microbiology and Phycology

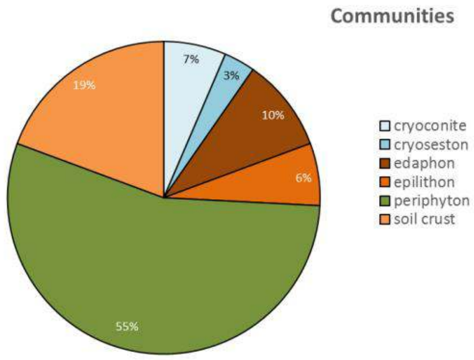
Instructors: ***Josef Elster, Jana Kvíderová & Marie Šabacká***

Students: ***Dovile Barcyte, Zuzana Gajarská, Jana Müllerová, Anna Polášková & Karolína Vávrová***

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 2016, total of 31 samples were collected at 14 different localities during the course and we found 26 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. 2.1.1.





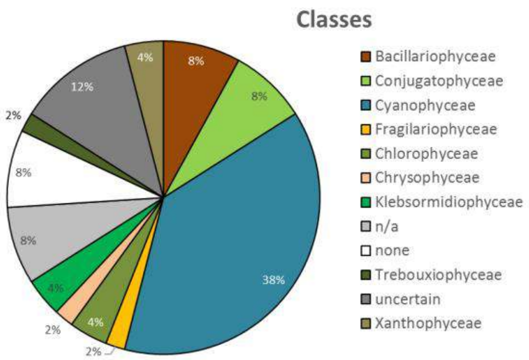


Fig. 2.1.1. The proportions of habitats and communities sampled, and abundances of individual algal and cyanobacterial classes observed by the ALGO2016 group. The data were exported from Sample database of the Centre for Polar Ecology (Kvíderová 2014, Kvíderová et al. 2015).

Diversity of coccoid green algae from Svalbard: linking their phylogeny and ecology

Coccoid green algae or the " little green balls" are common residents of different extreme habitats. However, the study of them has long been neglected in comparison to true extremophiles, i.e. algae having special adaptations for survival. Small size and uniform morphology make them unattractive and difficult objects for biodiversity studies. Therefore, the diversity of coccoid green algae still stays rather unexplored even in the era of molecular phylogenetics. However, extreme habitats could veil a great deal of new yet unknown organisms.

The aim of the study was to contribute to biodiversity knowledge of coccoid green algae from polar regions. The objectives were following:

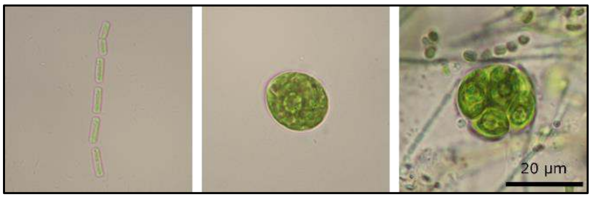


Fig. 2.1.2. Coccoid green algae found under the barells with waste at the field camp "Nostoc".

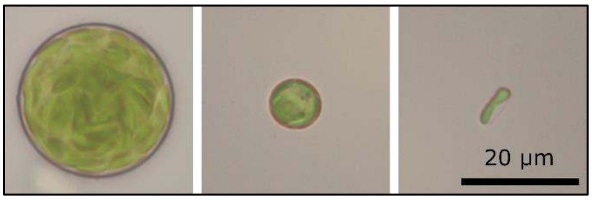


Fig. 2.1.3. Coccoid green algae found in Pyramiden at a porch of an abandoned house.

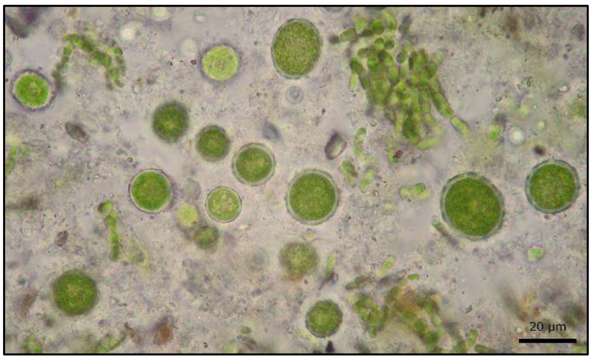


Fig. 2.1.4. Coccoid green algae found on the bones of dead animals. Note a thick cell wall.

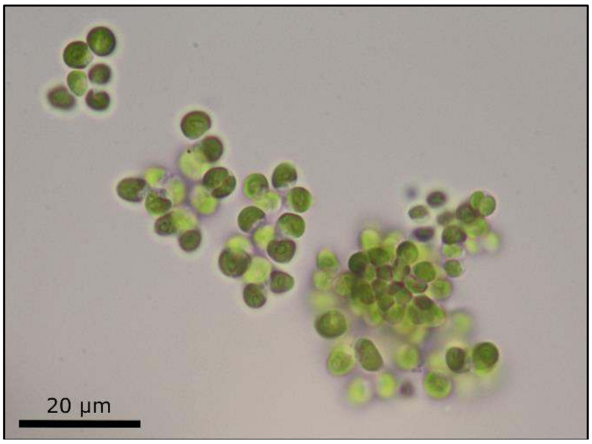


Fig. 2.1.5. Small coccoid green algae found growing on the waterfall stone in Fortet.

1. To find out what microalgal species are found in Svalbard and what are their phylogenetic relationships?
2. To reveal the distribution of the isolates. Do they exhibit polar or polar-temperate biogeography?
3. To elucidate ecological preferences of the found species.

Different microhabitats were sampled during the field trips in Petuniabukta, Svalbard. Isolation of coccoid green algal strains is currently taking place on agar in Petri dishes or using a serial dilution in microplates at the Department of Ecology, Faculty of Science, Charles University in Prague. Microphotographic documentation of the strains will be made on a Nicon microscope ECLIPSE E400 equippted with a digital camera Canon EOS D650. Two molecular markers (18S rRNA and ITS-2) will be amplified for every isolate and send to Macrogen (The Netherlands) for sequencing.

A number of different places, e.g., Fortet, Skansbukta, Mathiesondalen, Sven Glacier, Pyramiden, were visited and many microhabitats, e.g., soil, stones from waterfalls, remnants of animals, etc. were sampled during the two-week stay in Czech polar field camp "Nostoc" located in Petuniabukta, Svalbard. Spotted green biomass was easily scratched with a knife or a pipette to a collection tube or a piece of soil/wood and stones were taken to a zip plastic bag.

Collected samples were investigated using a light microscope both in the field camp and in the laboratoty in Prague. Different species of

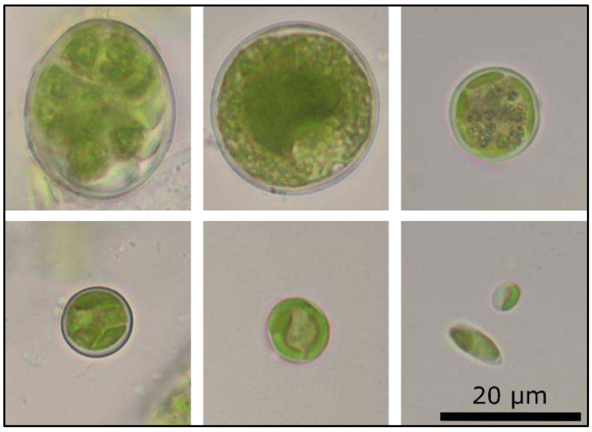


Fig. 2.1.6. Diversity of coccoid green algae from Mathiesondalen.

coccoid green microalgae were detected in the samples (Figs. 2.1.2.-2.1.6.).

In conclusion,

1. Coccoid green algae inhabit a number of microhabitats in the polar regions
2. Many coccoid green algae in the polar regions are probably allochthonous species able to growth and reproduce only when conditions allow
3. With climate change many habitats could shift to "more friendly" for new algal species.

Cyanobacteria and microalgae associated with mosses in wet meadow (central part of Svalbard)

The aim of the project (which is still in the process) is to develop a method which would allow identification and quantification of cyanobacteria/microalgae associated with mosses in different part of wet meadow in central part of Svalbard (Petuniabukta). It is a follow-up of Lesniak´s work done in summer 2012: "Diversity and ecophysiological performance of cyanobacteria in wet meadow" (Lesniak 2012). Among other things he measured the nitrogenase activity (using acetylene reduction assay) but was unable to compare it to the cyanobacteria biomass which would enable to make maybe a nice correlation.

The wet meadow was divided into 5 zones (Fig. 2.1.7.) Wet meadow divided into 5 zones) according to the color (Lesniak 2012): green, grey, water, red, orange and set of 3 samples of mosses (in our case mainly *Scorpidium cossinii*) per zone was taken with a Plexiglas corer (5 cm inner diameter)

Fig. 2.1.7. Wet meadow divided into 5 zones.

The samples were air-dried and brought to the laboratory in Třeboň (Figs. 2.1.8. and 2.1.9.).

Fig. 2.1.8. Sampling at wet meadow.

Fig. 2.1.9. Air-drying of samples.

Two mechanical methods allowing the following determination of the biovolume of cyanobacteria and microalgae (μm^3 mg^{-1} of mosses) with the use of fluorescence microscope are tested:

- Moss is frozen in liquid nitrogen is melted to soft "flour" and afterwards diluted in distilled water
- Moss in distilled water is sonicated using ultrasonic processor (Heilscher UP100H)

The cyanobacteria/microalgae associated with the mosses are also analyzed on the molecular level using the Sanger sequencing. The project is still running and samples are currently being analyzed.

Presence of cyanotoxins in Arctic lichens

The aim of the project was to determine the presence of toxins produced by symbiotic *Nostoc* in cyanolichen *Peltigera* sp.collected in the surroundings of Petuniabukta and Longyearbyen, Svalbard and to compare the toxin production with the toxin production of free-living soil cyanobacteria collected from the lichens´ surroundings.

Overall 18 cyanolichens with the heterogenized moss and soil samples in their proximity were collected from 3 different locations of Svalbard: Skansbukta, Fortet and Adventdalen (Figs. 2.1.10. and 2.1.11.).

Fig. 2.1.10. *Peltigera* sp. collected from the slope of a bird cliff.

Fig. 2.1.11. *Peltigera* sp.sampling locations.

For microcystin and lipopeptide screening, the dry thalli of *Peltigera* sp. were extracted with 70% MeOH and screened for microcystin and lipopeptide presence using LC-MS. For cylindrospermopsin, anatoxin a and saxitoxin screening, the dry thalli of *Peltigera* sp. were extracted with 80% acetonitrile +0,1% formic acid and screened for the presence of saxitoxin, cylindrospermopsin and anatoxin a using LC-MS.

The soil and moss samples and their solutions (stock, 5x, 25x) were spread over the agar plates (Fig. 2.1.12.). Nostoc colonies were isolated and their cultivation in liquid medium was started.

So far the screening showed absence of microcystins, lipopeptides, saxitoxin, cylindrospermopsin and anatoxin a in all of the Peltigera thalli. Further screening will be done on the free living soil cyanobacteria isolated from the moss and soil samples.

Fig. 2.1.12. Isolation of cyanobacteria from moss and soil samples

Influence of nitrogen concentration on algal growth

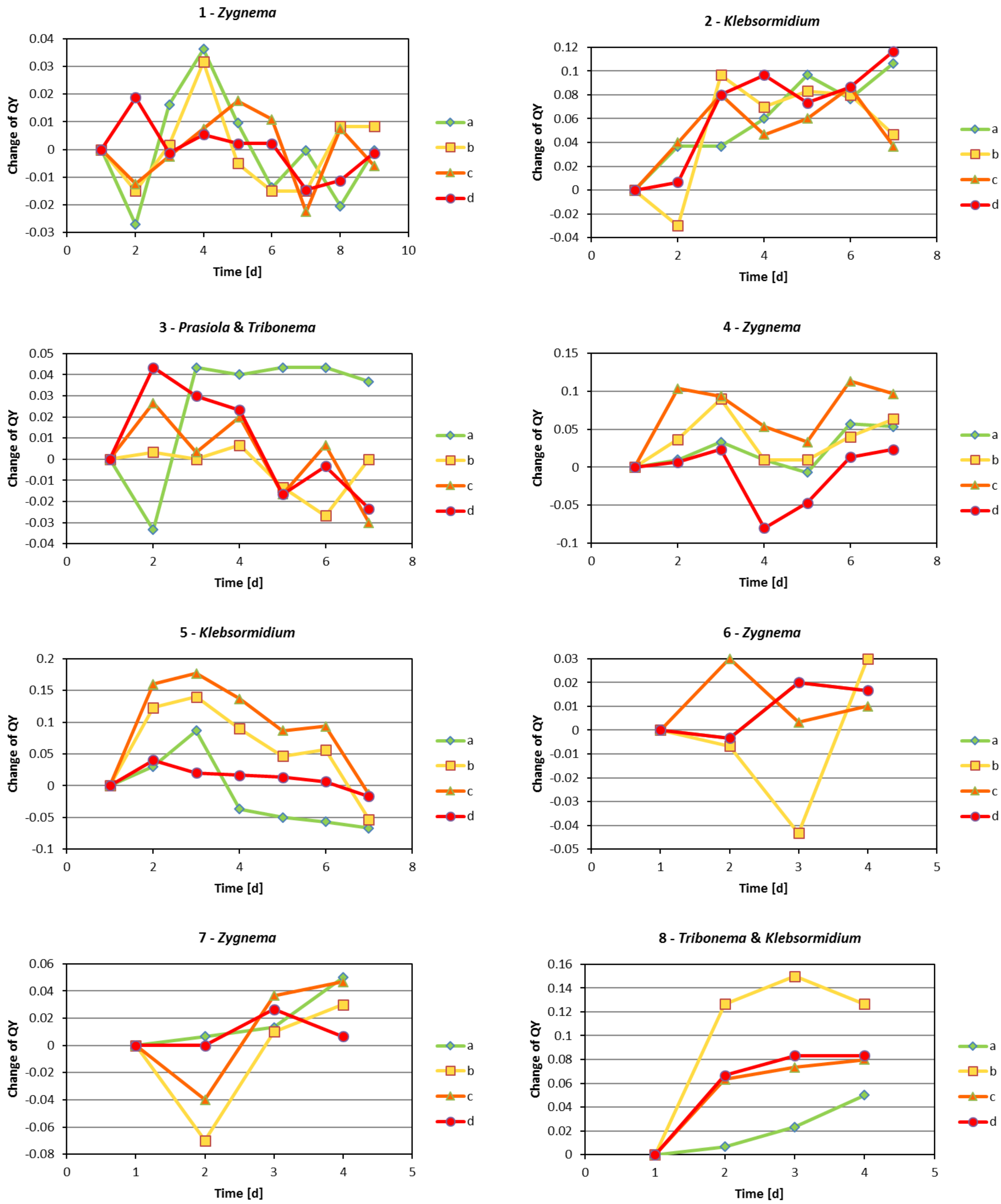
The primary aim of this project was to examine the influence of nitrogen concentration on physiological state of photosynthesis and possible changes in cellular morphology of algae from nine different localities in Svalbard.

The algal communities were examined under microscope and concentration of nitrate and nitrite ions in water was measured. Then algal biomass was divided to four plastic containers. Each sample was cultivated for several days in original water with addition of three different concentrations of $NaNO_3$ (0.25 g l^{-1}, 0.5 g l^{-1}, 1 g l^{-1}), one container was left as a control.

Quantum yield of photosynthesis (QY) of each sample was measured every day and the values obtained from four different nitrogen concentrations in cultivation media were compared. Each sample under microscope was examined after few days for changes in morphology and abundance as well.

Communities 1, 2, 6 and 7 did not express any stable change of QY during cultivation. In communities 3 and 9 were measured highest increases of QY in control sample. In communities 4 and 5 were observed highest QY in samples with 0.5 g l^{-1} $NaNO_3$, higher concentrations of nitrate might be therefore slightly toxic. In community 8 was highest QY measured in sample with 0.25 g l^{-1} $NaNO_3$ (Fig. 2.1.13.).

The results show that nitrogen concentration influence algal growth and photosynthesis, but the reactions differs between communities.



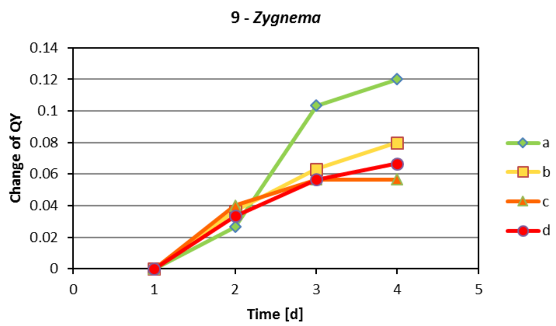


Fig. 2.1.13. Changes of QY. Legend; a: control; b: 0.25 g l^{-1} $NaNO_3$; c: 0.5 g l^{-1} $NaNO_3$; d: 1 g l^{-1} $NaNO_3$.

References:

Kvíderová, J. (2014) Sample database of the Centre for Polar Ecology – Database design and data management. Czech Polar Reports 4(2): 140-148.

Kvíderová, J., Elster J, & Iliev, I. (2015) Exploitation of databases in polar research – Data evaluation and outputs. Czech Polar Reports: 5(2): 143-159.

Lesniak, V. (2012): Diversity and ecophysiological performance of cyanobacteria in wet meadow, Petunia Bay, Central Svalbard. MSc. thesis, Universite Balise Pascal, Clermont-Ferrand, France, 38p.

3.2. Botany and Plant Physiology

Instructors: ***T Hallikma , Lauri Laanisto, Petr Macek & Petr Sklenář***

Students: ***Viktorie Brožová, Barbora Jonášová & Klára Kopicová***

This year, the course of botanical group was held at two locations. Its first part was in Longyearbyen and its surrounding, and this time was dedicated mainly to plant identification. While the first lectures were held in Adventdalen region, later on we went to one of the richest location at Svalbard, at Colesbukta (Figs. 2.2.1. and 2.2.2.) The flora of western part of Svalbard markedly differs from the one it central part, namely by the presence of oceanic and thermophilic plant species. This bay also hosts some otherwise rare species at the archipelago.

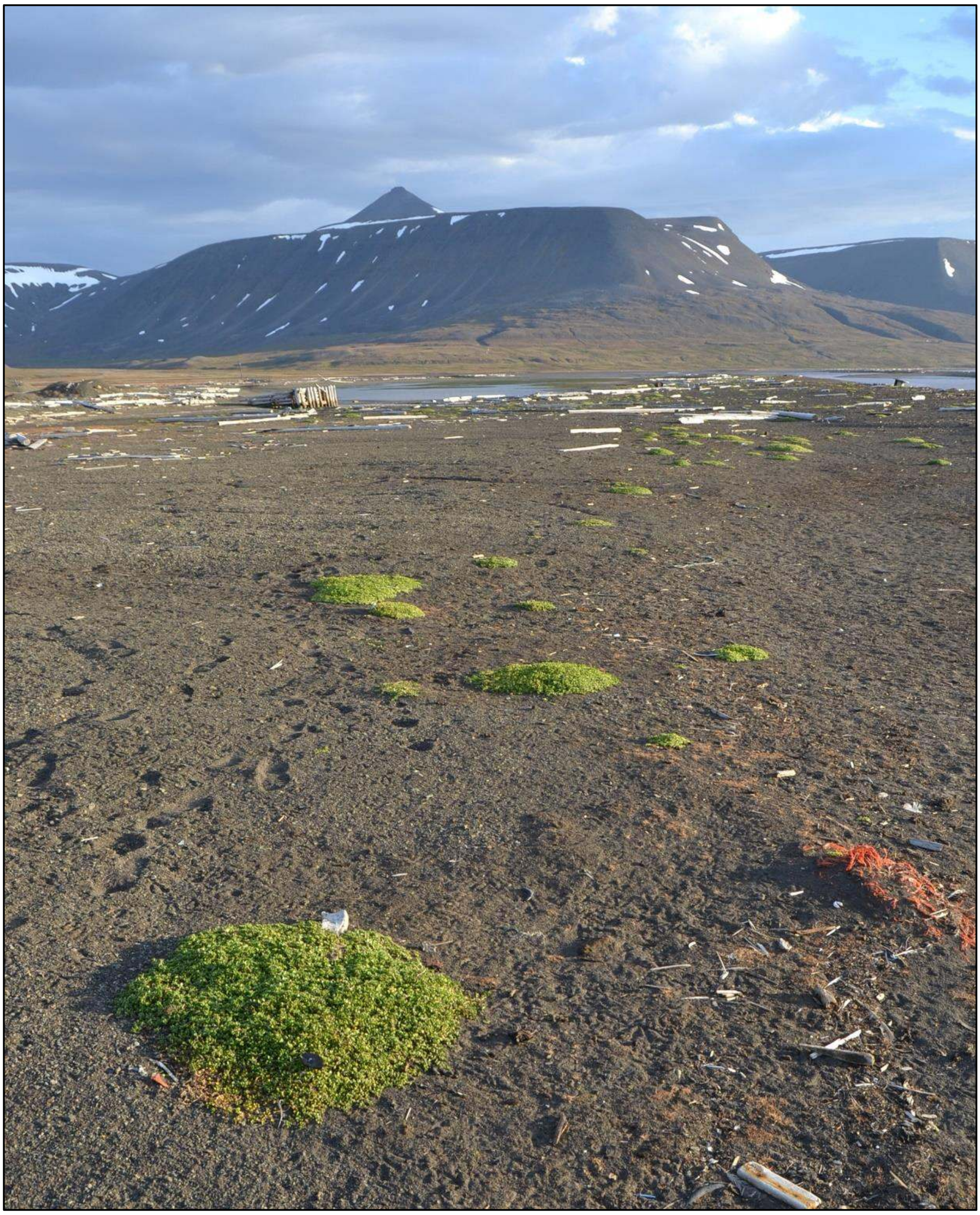


Fig. 2.2.1. *Honkenia peploides* at Colesbukta, Spitsbergen (Caryophyllaceae).

Fig. 2.2.1. (cont.) *Honkenia peploides* (Caryophyllaceae)at Colesbukta, Spitsbergen.

Fig. 2.2.2. *Salix reticulata* (Salicaceae) at Colesbukta.

Besides, thanks to favourable snow conditions and early timing of the course, we organized a half-day trip on the snow with the focus on snow algae and the role of the snow for plants.

The second part of the course we spent in the central part of the archipelago, in Petunia bay, and we monitored the ongoing permanent experimental plots. Two manipulative experiments were set up recently. In the first one, we ask on how microclimate and herbivory affect plant-plant interactions in communities associated to cushion plant *Silene acaulis* (Fig. 2.2.3.).

Fig. 2.2.3. One of the locations where permanent installations for studies of microclimate and herbivory load effects on plant-plant interactions is set up, Munindalen.

Second, we monitored a growth of two types of *Saxifraga oppositifolia* along a successional gradient. In both experiments, the experimental setting was repaired and damages after winter season were eliminated. We checked the installation of thermometers which measure leaf temperature during the season, and we also did a regular measurement of physiological status (using chlorophyll fluorescence) of selected target plant species.

Finally, we carried a first basic survey for another permanent experiment questioning the productivity-diversity relationship in herbaceous plant communities. More specifically, the experiment will ask on the effect of nutrients on plant diversity. This experiment was started in collaboration with colleagues from the Estonian University of Life Sciences in Tartu (Fig. 2.2.4.), and is a part of global initiative led by scientists from University of Minnesota, USA. In the first year of the experiment, the basic habitat characteristics were measured.

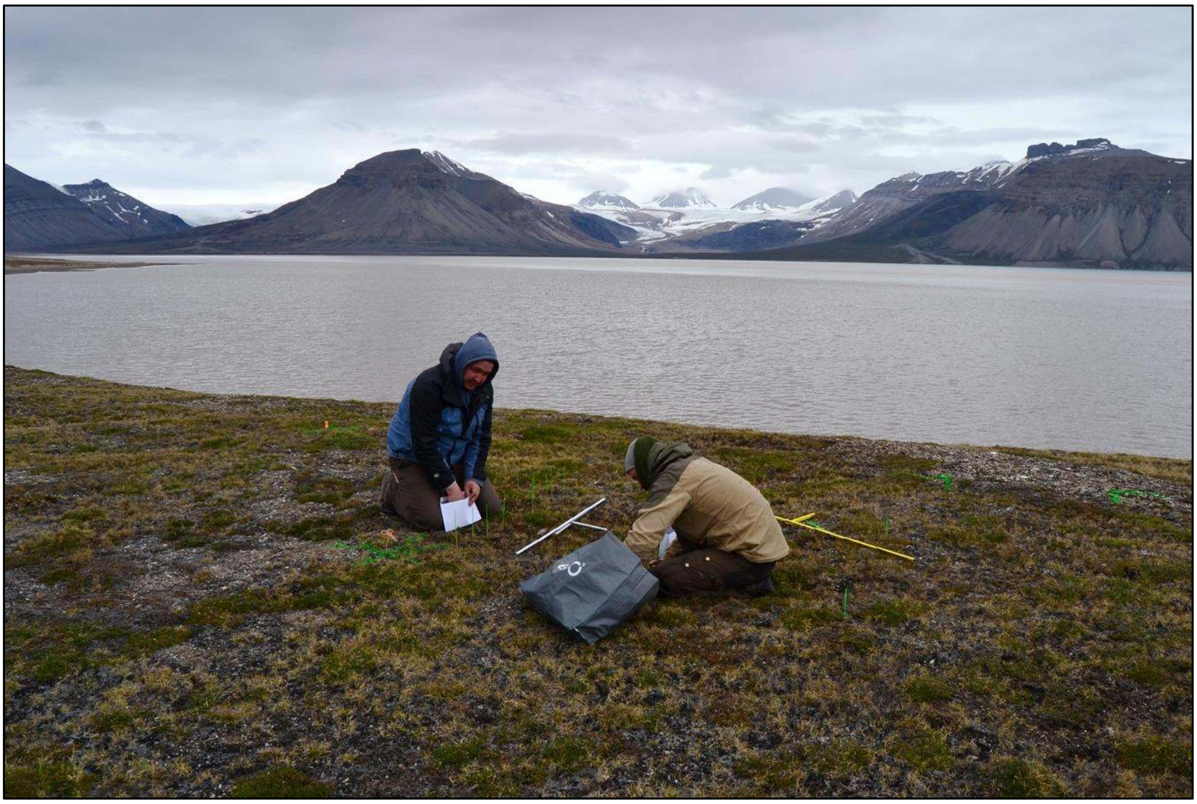


Fig. 2.2.4. Estonian colleagues performing a non-invasive vegetation analyses at the newly established permanent plots where productivity-diversity relationship will be investigated, Petuniabukta.

3.3. Zoology and Parasitology

Instructors: ***Oleg Ditrich*, *Václav Pavel* & *Tomáš Tyml***
Students: ***Alena Bartoňová, Martins Briedis & Nikol Kmentová***

Ornithology

Two main objectives were studied during the summer season 2016.

The first object was to supplement the obtained information in previous seasons with the longer-term data on general ecology (nesting success, size of the colony, start of breeding season etc.) of the Arctic tern *Sterna paradisaea*. The nesting success was studied on two breeding colonies which differ by presence of human (urban and non-urban). Based on the long-term data and thanks to the other simultaneous studies we will be able to: evaluate the effect of high predation events, which occurs every year, on the breeding success and the size of colony of Arctic terns in the non-urban colony; and also evaluate changes in the nesting ecology of the Arctic terns in consequence of breeding close to human (Fig. 2.3.1.).

Fig.2.3.1. *Sterna* nest.

The second object was carried out additional studies and prepare for the fieldwork to study in the next season. The goal for the next season is to study the migration strategy of the Arctic terns *Sterna paradisaea*. In the respect of this goal we studied the probability of return of Arctic terns to nesting colonies and the possibility of resight and recapture marked individuals. We found out that more suitable colony for the study of migration strategy is the urban colony which is smaller and is easier to detect marked individual.

Similar study was carried out in Arctic tern colonies in Greenland and yielded interesting results (Egevang et al. 2010, Fig. 2.3.2.).

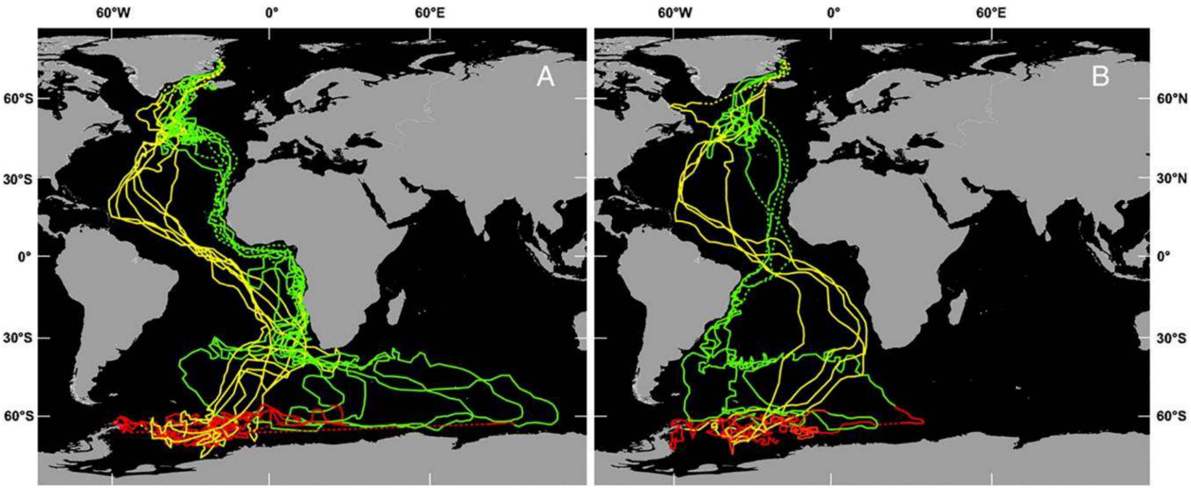


Fig.2.3.2. *Sterna* migration (Egevang et al. 2010)

Parasitology

Two parasitological topics were studied in this season

- Orthonectids (Mesozoa) in Brittle Stars

  Parasitological dissection of 126 *Ophiocten sericeum* from Petuniabukta yielded negative results: no orthonectids were found.

- Monogenea in Svalbard skates and fishes

  Fish captured to gill nets were dissected with special attention to monogeneans. Isolated specimens were partialy mounted on slides with GAP (glycerin ammonium pycrate) and partialy fixed preservation in 96% EtOH. GAP preparations were used for morphometry and astra blue + acetocarmine staining, while EtOH material for the molecular analyses.

  - *Amblyraja radiata* DONOVAN 1808 (Fig. 2.3.3.) captured near Longyearbyen (23 specimens) were dissected. Two monogenean species were found.

Fig. 2.3.3. *Amblyraja radiata*.

- On gills, *Rajonchocotyle* cf. *emarginata* OLSON 1876 (Fig. 2.3.4.) has been recorded with the prevalence of 27 %.
- On the surface of fins, *Pseudacanthocotyla* cf. *verrilli* GOTO 1899 (Fig. 2.3.5.) has been found with the prevalence of 73 %.

  Final determination using molecular analysis and more detailed morphological studies are performed.

Fig. 2.3.4. *Rajonchocotyle* cf. *emarginata*.

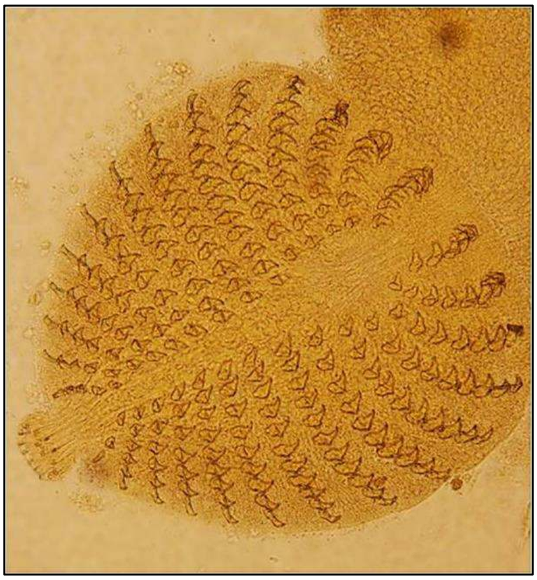


Fig. 2.3.5. *Pseudacanthocotyla* cf. *verrilli*.

- Parasitological dissection of 11 specimens of juvenile Lumpsuckers *Cyclopterus lumpus* LINNAEUS 1758 (Fig. 2.3.6.) yielded *Gyrodactylus cyclopteri* SCYBORSKAYA 1948 (Figs. 2.3.7.) on gills with the prevalence of 14 %.

No monogenean has been found on pelagic fishes.

Our records represent the first findings of Monogeneans in Svalbard.

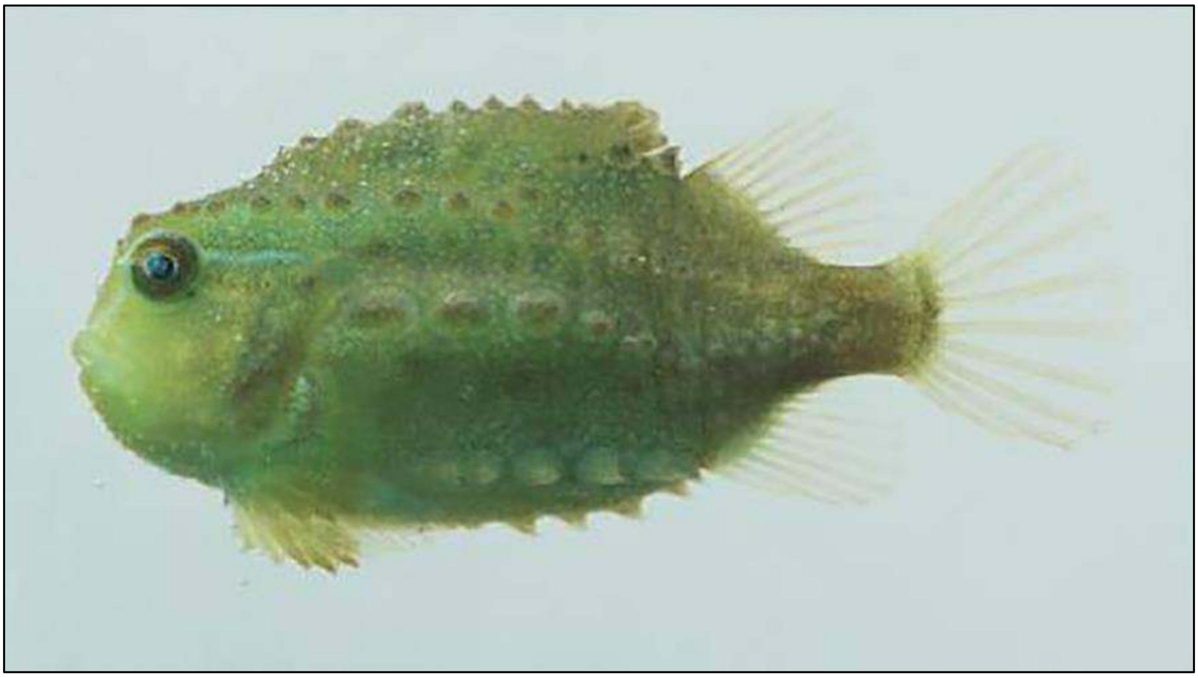


Fig..2.3.6. *Cyclopterus lumpus*.

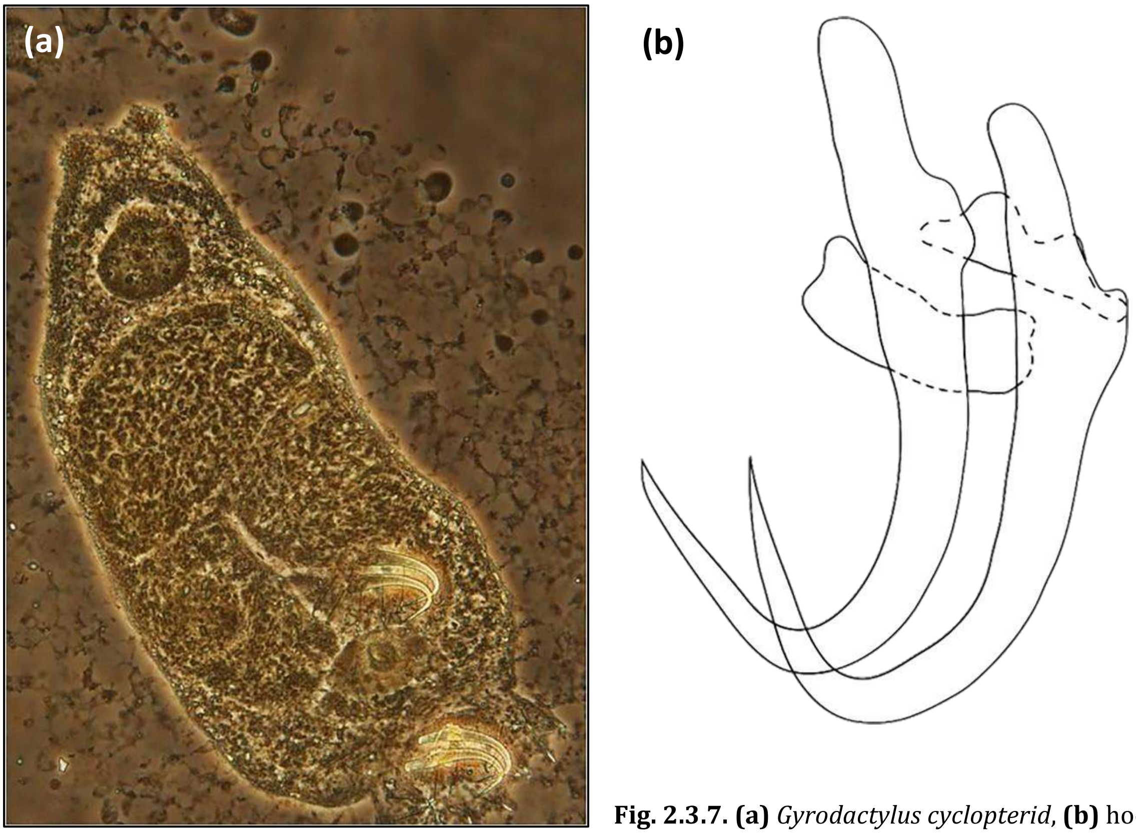


Fig. 2.3.7. (a) *Gyrodactylus cyclopterid*, **(b)** hooks.

References:

Egevang, C, Stenhouse, I.J., Phillips, R.A., Petersen, A., Fox, J.W. & Silk, J.R.D. (2010) Tracking of Arctic terns *Sterna paradisaea* reveals longest animal migration. PNAS 107(5): 2078-2081.

3.4. Virology

Instructor: ***Jiří Černý***
Student: ***Jana Müllerová***

Arboviruses

During the expedition on Svalbard, the main objective was monitoring arboviruses, especially focusing on collection of mosquitoe species *Aedes nigripes* in order to spread and complete the research performed in years 2013 - 2015. In this research, first occurrence of arboviruses in polar regions – Svalbard, Jan Mayen, Bjørnøya and Greenland – is to be found. However, because of early autumn lined up in Artica this year, only about 60 indivudulas of *Aedes nigripes* were collected. All mosquitoes were caught in Brucebyen. These samples will be tested together with others (from Oleg) during this October.

Influenza

In this project, influenza virus is to be found in samples of droppings from barnacle goose (*Branta leucopsis*) and black-legged kittiwake (*Rissa tridactyla*). About 60 samples of droppings from barnacle goose were gathered in Petunia, Brucebyen and Longyearbyen. Further samples were droppings from colonies of black-legged kittiwakes in Pyramiden. About 80 samples were collected from buildings. These samples will be tested for influenza during this November.