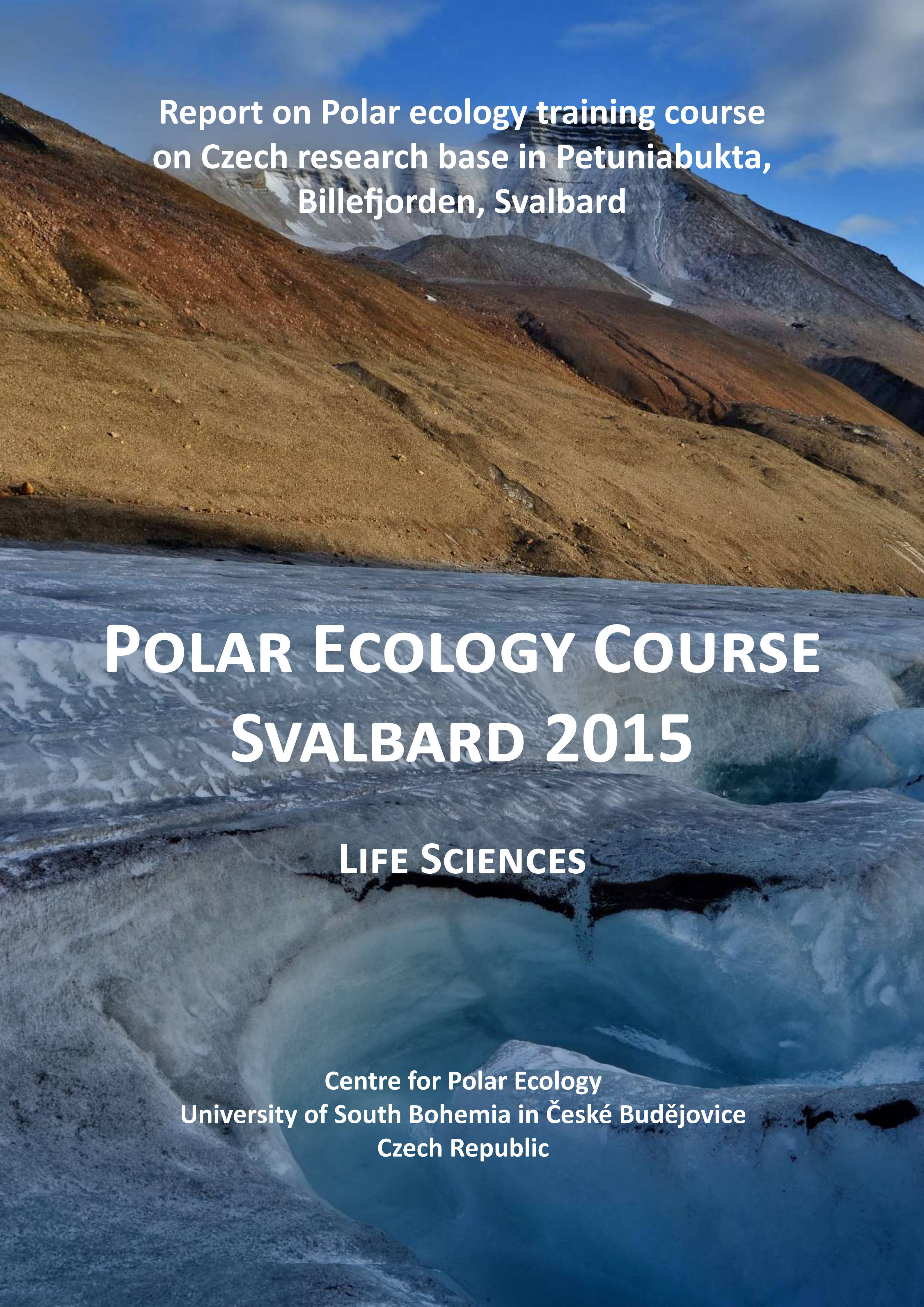


Report on Polar ecology training course on Czech research base in Petuniabukta, Billefjorden, Svalbard

POLAR ECOLOGY COURSE SVALBARD 2015

LIFE SCIENCES

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

Supported by EEA grants & Norway grants NF-CZ07-ICP-1-0532014.

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

1. Introduction

In 2015, the 5th Polar Ecology course was organized by the Centre for Polar Ecology, Faculty of Science, University of South Bohemia in České Budějovice (biotic part) and by the Geography Department, Masaryk University in Brno (abiotic part) and was sponsored by EEA grants & Norway grants NF-CZ07-ICP-1-0532014 and NF-CZ07-ICP-1-0612014. The course itself consists of 1 wee intensive theoretical preparation in respective fields of interest, and of approximately 14 days of field work at the Czech research station in Svalbard. Because of field camp Nostoc construction in Petuniabukta Bay, lectures and student also participated on activities related with camp building.

In 2015, 27 students were selected (Tab. 1.1.). The theoretical part of the course took place in CPE facilities in České Budějovice during spring semester (11/05 – 15/05 2015. 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 01/07-15/07 2015 (geology/geomorphology + climatology/glaciology), on 17/07-03/08 2015 (botany/plant physiology + zoology/parasitology), and on 016/08-30/08 2015 (hydrology/limnology + microbiology/phycology).

Since the physical science part was organized and supported by the Masaryk university in Brno, only the reports of the life sciences groups are included in this report provided by the Centre for Polar Ecology.

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	Jan Petřík	MU
	Martin Hanáček	MU+JU	Barbora Procházková	UK
			Jiří Tomíček	UK
CLIMA	Kamil Láska	MU+JU	Klára Ambrožová	MU
			Tereza Coufalová	MU
			Marek Lahoda	MU
			Vladimír Pískala	UK
HYDRO	Jan Kavan	JU	Eva Hejduková	UK
	Kateřina Kopalová	UK+IBOT	Lenka Ondráčková	MU
			Matěj Roman	UK
MICRO	Josef Elster	JU+IBOT	Jan Fiala	JU
	Jana Kvíderová	IBOT+JU	Martin Lulák	UK
			Michal Růžek	UK
			Jan Svrček	UK
BOTA	Tomáš Hájek	JU+IBOT	Přemysl Bobek	UK
	Petr Macek	JU	Veronika Langová	JU
			Ludmila Vlková	JU
ZOO	Miloslav Devetter	ISB+JU	Marek Brož	JU
	Oleg Ditrich	JU	Michala Bryndová	JU
	Václav Pavel	UPOL+JU	Anna Mácová	JU
	Tomáš Tyml	JU+MU	Michaela Syrová	JU

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; PARU – Institute of Parasitology, Biology Centre AS CR, České Budějovice; UK – Charles University, Prague; UPOL – Palacký University, Olomouc.

2. Life Sciences (Biosciences)

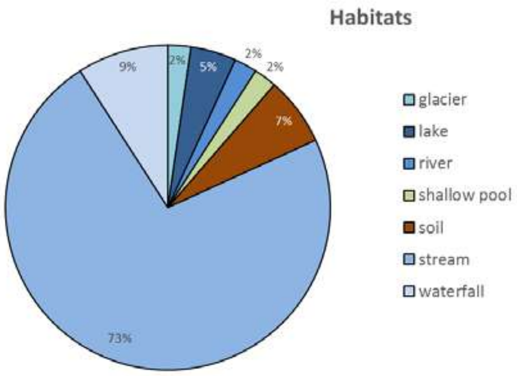
2.1. Microbiology and Phycology

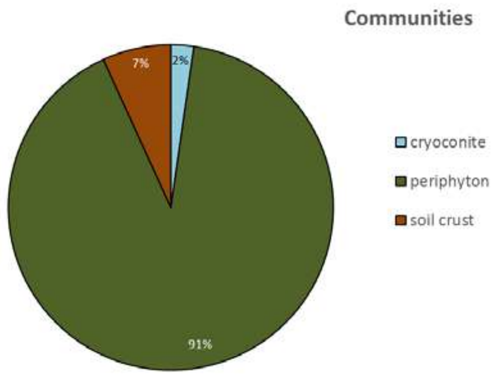
Instructors: ***Josef Elster* & *Jana Kvíderová***

Students: ***Jan Fiala, Martin Luláks, Michal Růžek & Jan Svrček***

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 2015, total of 44 samples were collected at 12 different localities during the course and we found 43 species/genera identified at species or genus levels. The lower number of observed taxons was caused by large specific sampling for *Hydrurus foetidus*. The proportions of sampled habitats, communities and abundance of individual classes of algae and cyanobacteria are summarized in Fig. 2.1.1.





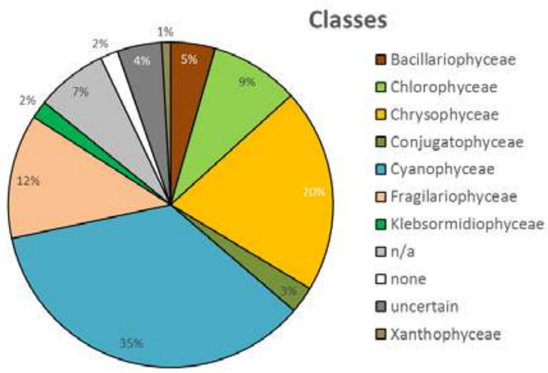


Fig. 2.1.1. The proportions of habitats and communities sampled, and abundances of individual algal and cyanobacterial classes observed by the ALGO2015 group. The data were exported from Sample database of the Centre for Polar Ecology.

Diversity of phototrophic microorganisms

In total we found 113 genera/species of organisms, including 40 genera of cyanobacteria, 23 genera of Chrysophyceae, and 19 genera/species of diatoms. Other algal groups were less abundant.

Majority of taxons observed, like *Nostoc* sp., *Hydrurus foetidus* or *Hannaea arcus*, was the same as in previous years. As mentioned above, we focused on the chrysophyte *Hydrurus foetidus* (Fig. 2.1.2.). This alga dominates in fast-flowing streams in Petuniabukta. The alga was colonized by diatoms *Hannaea arcus* and *Meridion circulare*.

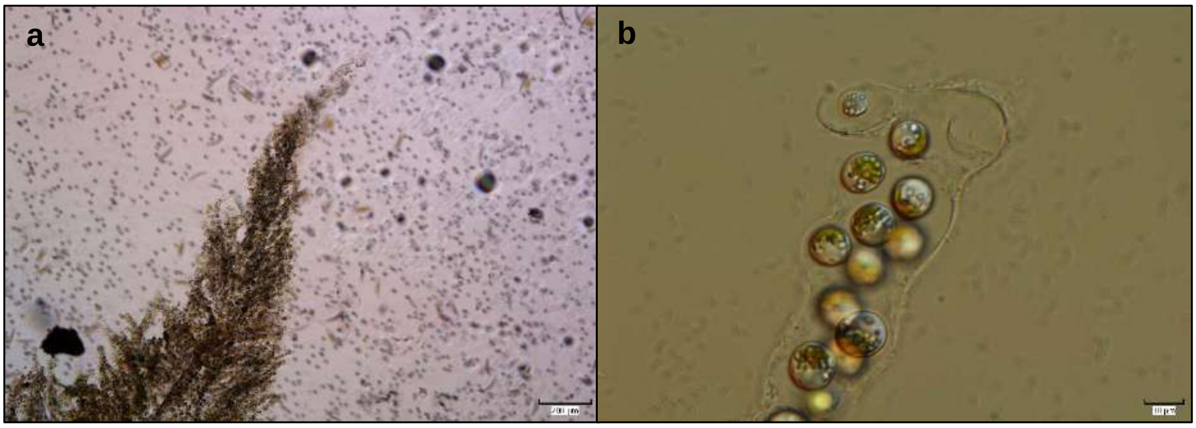


Fig.2.1.2. *Hydrurus foetidus* **(a)** objective magnification 4x **(b)** objective magnification 60x. Microphoto by Tomáš Jedlička.

For the firs time, we observed green filamentous alga belonging to Oedogoniaceae, probably *Oedocladium* sp. (Fig. 2.1.3.). In cryoconites, we found filaments of *Ancylonema bordenskioeldii* (Fig. 2.1.4.)

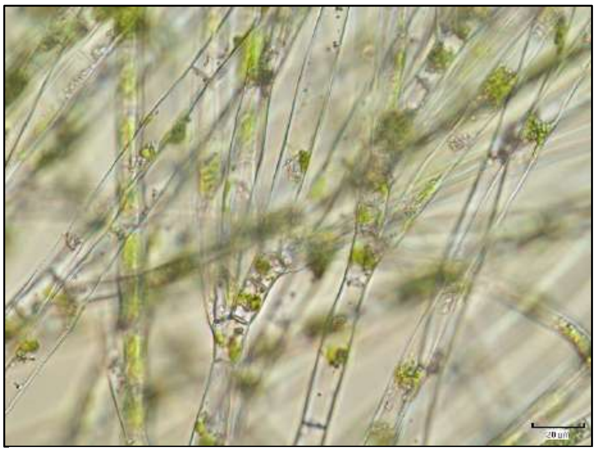


Fig. 2.1.3. cf. *Oedocladium* sp.

Fig. 2.1.4. *Ancylonema nordenskioeldii*.

Since we arrived to Petuniabukta in the second half of August, *Zygnema* sp., a filamentous alga inhabiting seepages and small shallow ponds, was in senescent stage.

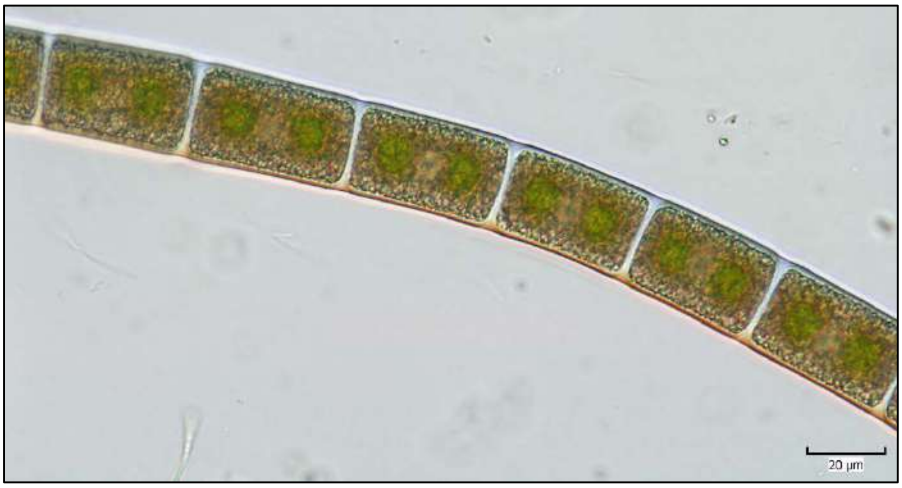


Fig.2.1.5. Senescent *Zygnema* sp. cells.

2.2. Botany and Plant Physiology

Instructors: ***Tomáš Hájek & Petr Macek***

Students: ***Přemysl Bobek, Veronika Langová & Ludmila Vlková***

Botanical group focused on four projects related to our long-term studies at Svalbard:

- Assessment and analysis of plant functional traits.
- How microclimate and herbivory affect plant–plant interactions in communities associated to cushion plant *Silene acaulis*: experiment establishment.
- Morphotypes of *Saxifraga oppositifolia* along a succession gradient at glacier foreland.
- Footprint of forest fires during the Holocene recorded in Arctic sediments.
- Herbivore densities in central Spitsbergen (here we participated on an international study led from Norwegian Polar Institute and University of Tromsø).

Brief description of each project follows.

Assessment and analysis of plant functional traits

During previous years we had started gathering a range of plant functional traits. It ranges from below-ground traits, e.g. clonal ones, to above-ground traits, such as plant height. We focused on easily accessible, so called soft, traits. During this year, we continued in collection of leaf traits started in previous year: specific leaf area (SLA) and nutrients (N, P) content. This activity will clearly provide a baseline for building up a trait database of plants from Svalbard. (Fig. 2.2.1.).

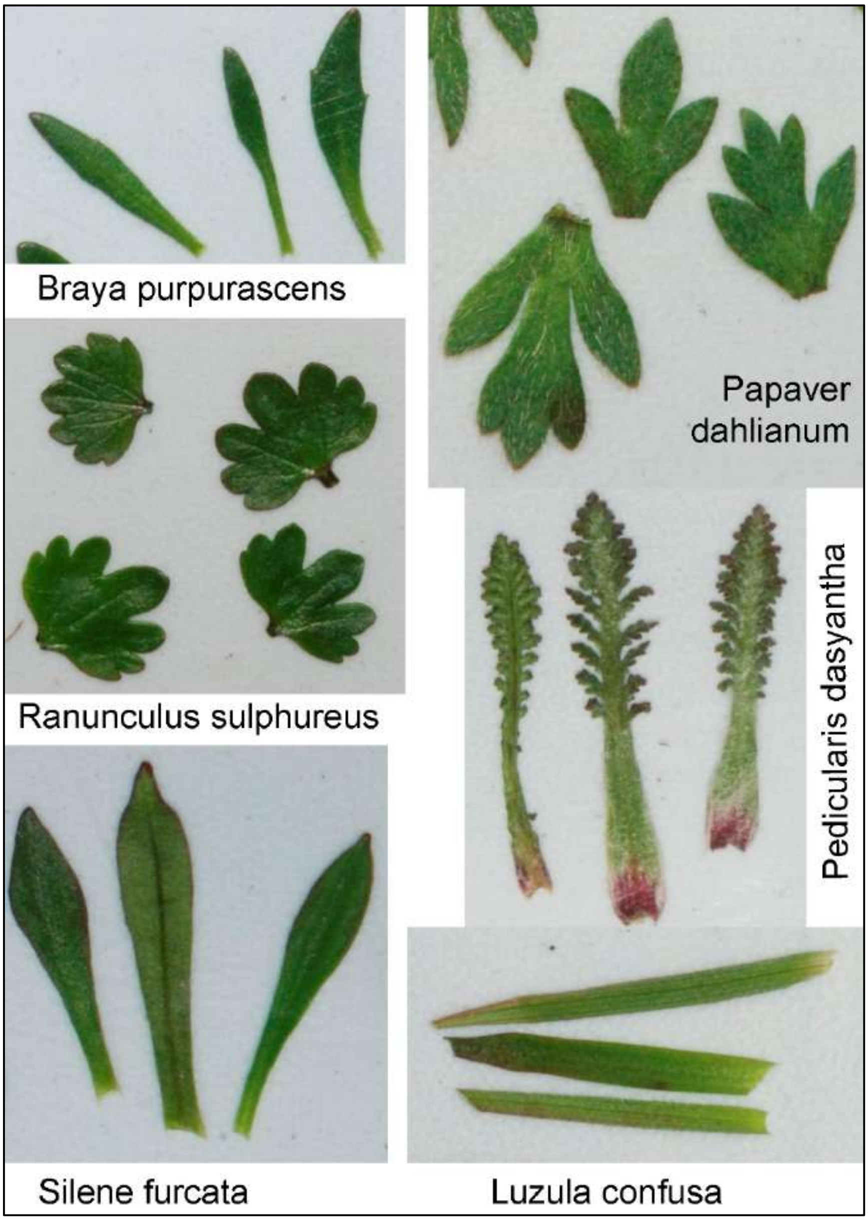


Fig. 2.2.1. Example of leaf morphological variability of some Svalbard plants.

How microclimate and herbivory affect plant–plant interactions in communities associated to cushion plant *Silene acaulis*: experiment establishment

Plant–plant interactions between neighbouring species can range from negative (competition) to positive (facilitation) (Pugnaire & Luque 2001). Positive interactions are expected to increase with increasing environmental harshness (Michalet et al. 2006). Among plants known to facilitate significantly, cushion plants harbor diverse plant communities often of different species assembly as compared to the surrounding environment (Schöb et al. 2013). While in the alpine systems, cushion plants were frequently reported to provide benefits for other species, according to our previous measurements it does not seem to be true in harsh arctic environment (Fig. 2.2.2.).

Fig. 2.2.2. Cushions of *Silene acaulis*, **(a)** from the Alpine zone in Scandes, and **(b)** Arctic at Svalbard, host contrasting communities of subsidiary plants.

Whether this pattern holds under rapidly changing arctic environment remains to be tested. We therefore established a manipulative experiment with two factors, i.e. increase of temperature and preventing of herbivory. Using open-top chambers and herbivore exclusions we investigate how climate change influences the plant–plant interactions and how herbivore pressure interacts with this change. We further started investigating the effect of both treatments on plant traits in both, cushion (*Silene acaulis*) and subsidiary species. The two locations were river terrace close to Pyramiden and marine terraces at the end of Petuniabukta (Fig. 2.2.3.).

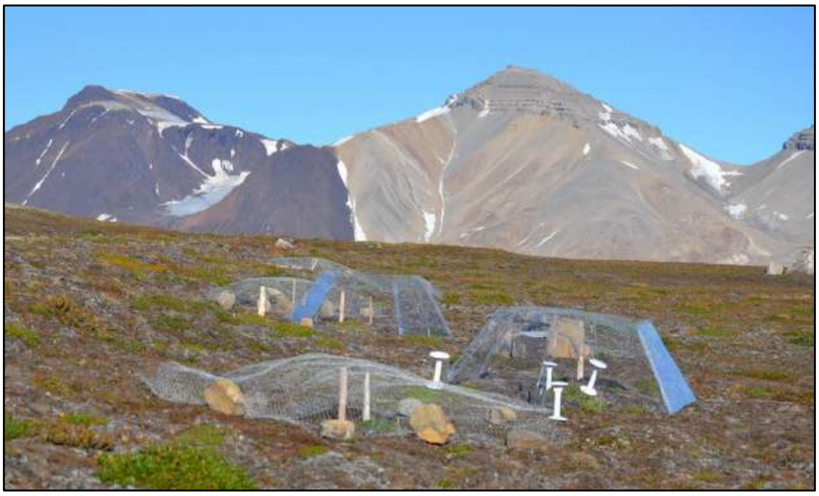


Fig. 2.2.3. A part of experimental plot in Petuniabukta, Svalbard, with open top chambers and herbivore exclusions.

Morphotypes of *Saxifraga oppositifolia* along a succession gradient at glacier foreland

Saxifraga oppositifolia is a common species at Svalbard, and it forms two contrasting morphotypes: prostrate and compact. Both morphotypes, sometimes separated as subspecies, differ in internode length but they often grow together at same sites (Kume et al. 1999) preferring early successional stages. They reproduce both, generatively and vegetatively. In order to reveal ecological differences between both morphotypes of Saxifraga oppositifolia, we established a manipulative transplant experiment along a successional chronosequence after glacier retreat (Fig. 2.2.4.).

Fig. 2.2.4. Fragments of prostrate (left; yellow thread) and compact (right; red thread) forms of *Saxifraga oppositifolia* transplanted along a chronosequence after glacier retreat.

We hypothesized that the prostrate growth form is better adapted to unstable and sparsely vegetated early successional stages, while the compact form grows better in more stable and densely vegetated later successional stages. Furthermore, we asked on phenotypic plasticity of both forms, and hypothesized they will keep these forms regardless of their environment.

Footprint of forest fires during the Holocene recorded in Arctic sediments

There has been a dynamic history of forest fires in the northern hemisphere during the Holocene. Similarly to pollen, micro-particles of charcoal are transported over long distances by atmospheric circulation. Since there has been only sporadic vegetation at Svalbard since last glaciation, the local signal of fires is supposedly very low, and it is therefore reasonable to expect to find traces of a global imprint of large (boreal) forest fires (Senici et al. 2015). We aimed to collect samples from lacustrine and terrestrial locations (Fig. 2.2.5.) in central Svalbard, and investigate whether the sediment contain any particles of charcoal; we then separate them and describe their morphology.

Fig. 2.2.5. The soil profile for further laboratory analyses collected at Brucebyen, Billefjorden, central Spitsbergen.

Herbivore densities in central Spitsbergen: Common currency for "herbivore load" in tundra – a methodological study (Herbivory network, unpublished)

There are many existing field methods for quantification of herbivore load in tundra, using herbivore- and region-specific protocols. For obtaining common currencies that allow comparisons between tundra regions and sites within regions, methods need to be compared. A general protocol for vertebrate herbivore abundance is planned for within the Herbivory Network. The protocol is intended to serve as a tool in obtaining an estimate of herbivore abundance comparable between tundra areas and research and monitoring sites. The final protocol should give an area-representative estimate of herbivore abundance, independent of site-specific habitat classifications. As a step towards such a general protocol, we conduct this method study. The aim is to see how a general, area-representative herbivore load can be effectively assessed in tundra landscapes. Besides, the sampling will reveal the current herbivore load in different locations throughout Svalbard. (Fig. 2.2.6.).

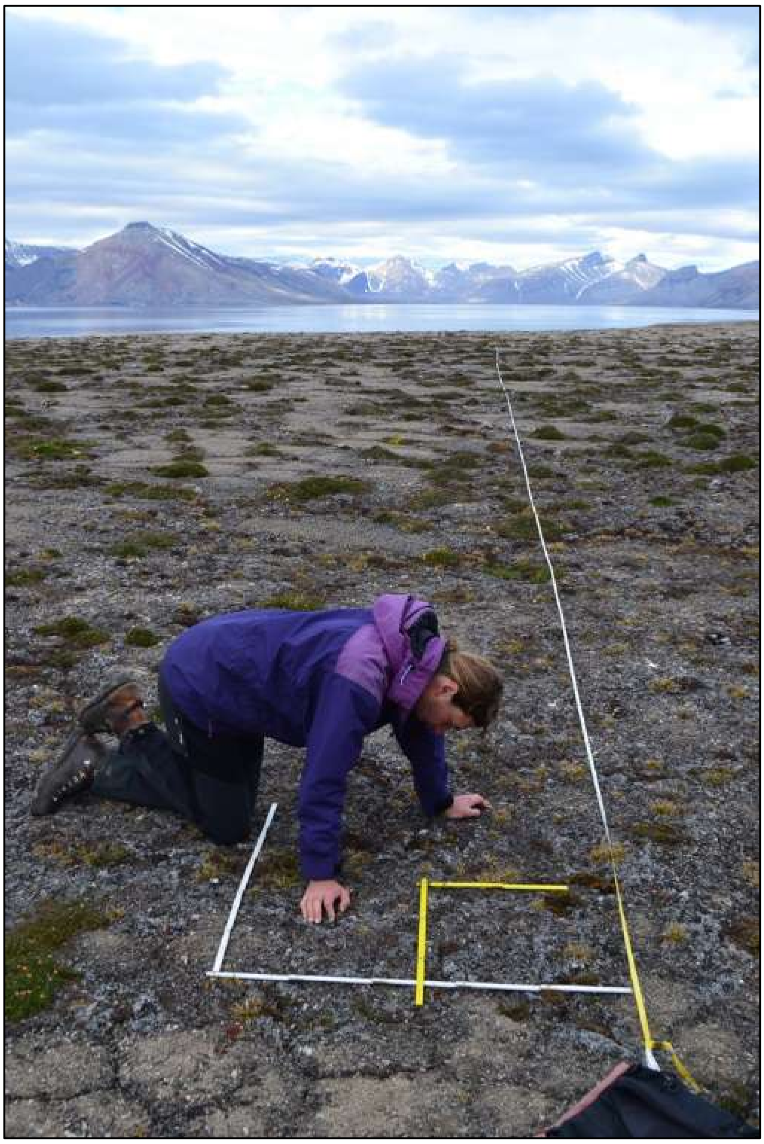


Fig. 2.2.6. A transect counting of herbivore pellets at different scales.

This study compares some of the most commonly used non-removal pellet count methods and other estimates of herbivore abundance (distance sampling or total counts, official statistics, or pellet removal plots). The study takes place in a set of tundra regions that include replicates within landscapes, and where we have existing information about herbivore abundance.

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2.3. Zoology and Parasitology

Botany and Plant Physiology

Instructors: ***Miloslav Devetter*, *Oleg Ditrich*, *Václav Pavel* & *Tomáš Tyml***

Students: ***Marek Brož, Michala Bryndová, Anna Mácová & Michaela Syrová***

Ornithology

We studied antipredation behaviour of Arctic terns (*Sterna paradisaea*; Fig. 2.3.1) in two colonies – Longyearbyen (urban colony) and Petunia (Retrettøya; non-urban colony). Terns defence their nest aggressively not only against natural predators (polar fox, skua,…) but also against humans. Because this type of behavior is energy consuming it needs considering costs and benefits. Therefor the intensity of defense (or costs) vary dependently on clutch size, age of nestlings, state of season, etc.

The intensity of taken risk was studied by measuring the time needed by parents to get back on their nest after frighten away. We tested 56 nests - 23 nests in Longyearbyen and 33 in Petunia. Data were normalized (log transformation) and analyzed (linear model) in program R. We found out that the intensity of response was dependent neither on the clutch size ($df = 1, F = 0.357, p = 0.553$), age of nestlings ($df = 2, F = 1.671, p = 0.199$) nor state of season ($df = 1, F = 0.981, p = 0.327$) but it was strongly dependent on the colony ($df = 1, F = 124.44, p<0.001$; Fig. 2.3.2).

Our two tested colonies mainly differ in presence/ non-presence of humans. Our results say that in the urban colony where nesting pairs are disturbed more often is the latency of return to the nest shorter than in the non-urban colony. It may suggest that this reaction is adaptive behavioral response to presence of humans.

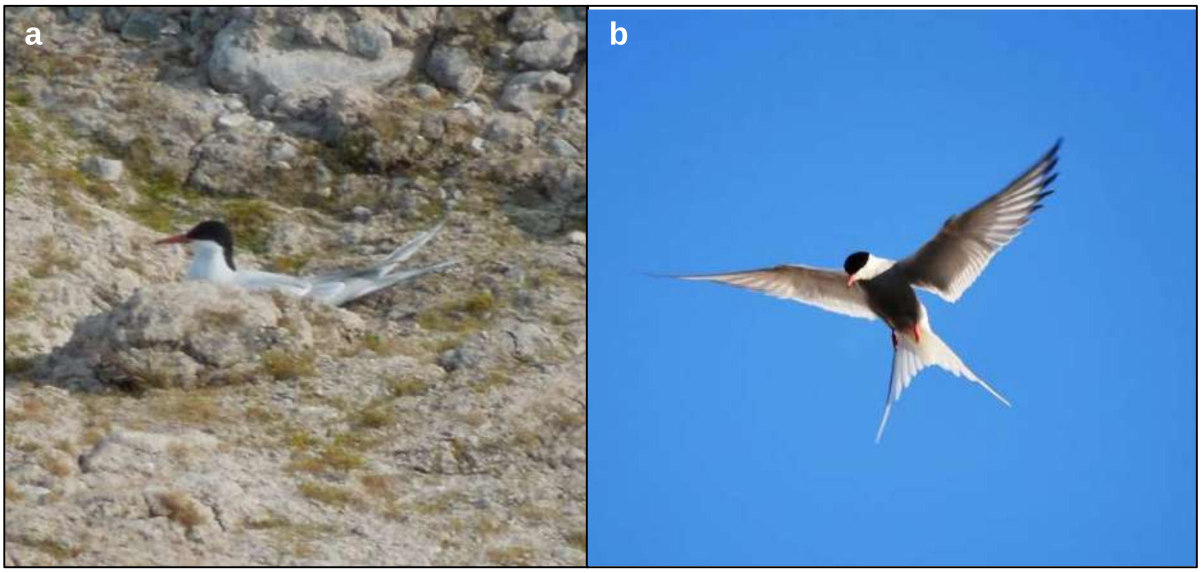

Fig. 3.6.1. Arctic tern **(a)** on the nest, **(b)** frighten away.

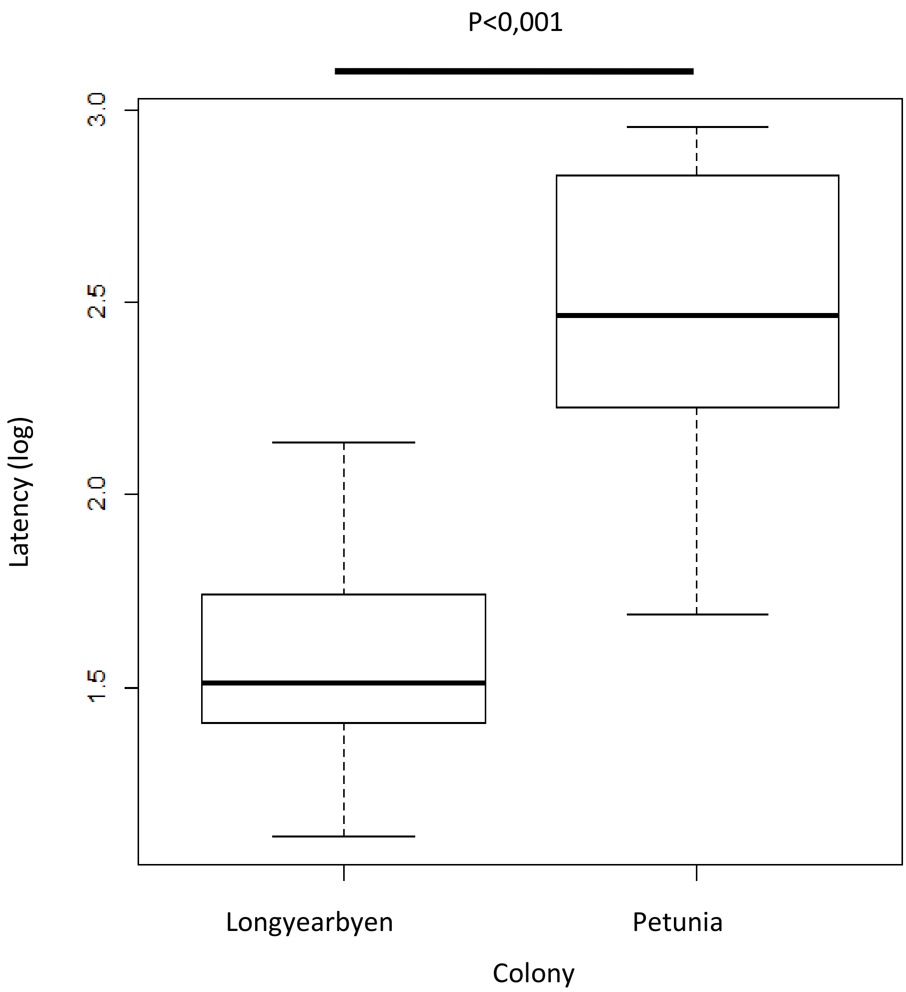

Fig. 2.3.2. Latency of *Sterna paradisaea* return to the nest.

Parasitology

Parasitological examination of terrestrial mammals has been focused to Arctic Fox (*Vulpes lagopus*) and Sibling Vole (*Microtus levis*). Samples of Polar Fox feces were collected mainly in the area of Petuniabukta in the central part of Svalbard (10 samples). Another samples (40 samples) were obtained in collaboration with Eva Fuglei from Norwegian Polar Institute. For analyses are used both microscopic and molecular methods focusing on the latter. The preliminary result indicates the presence of several intestinal parasites. For now, the several different oocysts of coccidia and eggs of roundworm *Toxascaris leonina* were found. No finding of tapeworm *Echinococcus multilocularis* has been recorded yet.

Second part of this project was concerned to rodents and their parasites. In Svalbard, only one rodent species, *Microtus levis*, is present. Because this species has been introduced from Russia, it would be interesting to know more about its phylogeny and phylogeny of their parasites. Traps were located in four places at Longyearbyen (Hundeklubb, Basecamp, horse stables and old dog cages in Nybyen, Fig. 2.3.3.). Altogether 18 individuals were trapped. Each animal was inspected for presence of ectoparasites, 10 individuals harboured ectoparasites (Acari). Rodents from our trapping, together with 23 rodents which were collected during winter, were dissected, their feaces and part of intestine were kept for coprological analysis, and parts of tissue (tail or finger) were kept for molecular analyses. By microscopic analyse, no coccidia or any other parasites (tapeworms, pinworms, roundworm, etc.) were found. Brain tissue was studied for presence of *Toxoplasma*, but no sample contained this parasite. In comparison with voles in continent, extremely low number of parasites was recorded. This fact is very probably a consequence of population bottleneck during vole introduction. DNA from tissue samples (fingers) will be isolated and processed by PCR with specific primers. Sequences will be compared with data from *M. levis* from the Baltic and the Balcans. Phylogenetic trees and haplotype networks will be made.

Fig. 2.3.3 One of *Microtus levis* localities.

The third part of parasitological examination was focused on collecting samples of coccidian parasites of local birds and rodents. We obtained 14 fecal samples from 7 bird species: *Lagopus muta* (1 sample), *Anser brachyrhynchus* (2x), *Branta leucopsis* (3x), *Cepphus grylle* (4x), *Somateria mollissima* (1x), *Larus hyperboreus* (1x), *Rissa tridactyla* (1x), *Plectrophenax nivalis* (1x). Samples were collected in 7 localities (Longyearbyen, Colesbukta, Pyramiden, Nordenskjold, Ferdinanddalen, Mathiesondalen, Horbyedalen) and were processed by standard flotation method. Oocysts of *Eimeria* sp. were found in 6 samples, in one sample oocysts of *Isospora* were found. Part of these samples contained very few oocysts, so that DNA was isolated only from 4 of them (from *B. leucopsis*, *C. grylle*, *A. brachyrhynchus* – all positive on *Eimeria*, and one sample from *P. nivalis* – positive on both *Eimeria* and *Isospora*). PCR with specific primers on 18S rRNA and COI were done, positive result was obtained only for sample from *P. nivalis* (both markers) and *B. leucopsis* (only 18S rRNA). Samples were sent for sequencing. Obtained DNA sequences will be used for constructing phylogenetic trees (datasets will be completed with data from GenBank). Preliminary phylogenetic tree based on COI (Fig. 3.2.4.) shows, that coccidia found in *Plectrophenax* belongs to genus *Isospora*.

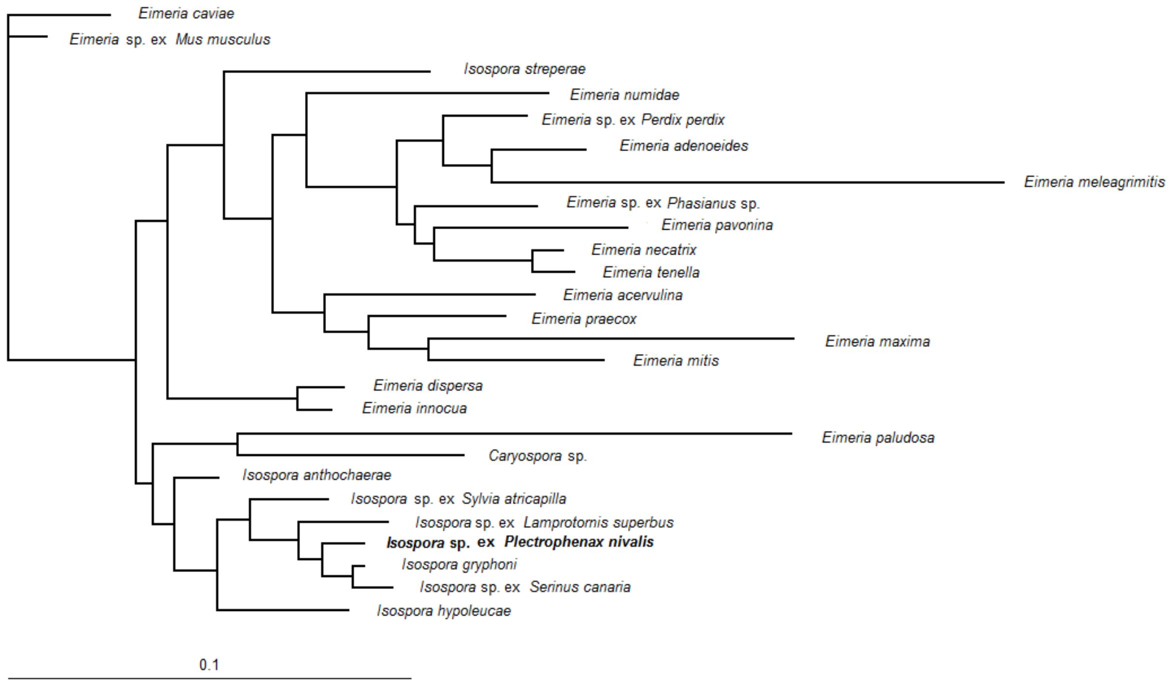

Fig. 2.3.4. Phylogenetic tree of bird coccidians.

Successional changes in tardigrade community after deglaciation

Tardigrades (are cosmopolitan invertebrates living in aquatic environment of soil, water bodies and on the surface of plants. Because tardigrades prefer fluctuating conditions they are among pioneering organisms during succession. For the same reason they have higher relative abundaces in polar areas.

Abundances, species composition and trait composition connected with their feeding behaviour have been measured at three successional gradients after recesion of glaciers Horbybreen, Ferdinandbreen and Ragnarbreen.

Preliminary results show that tardigrades increase in numbers during succession with the highest abundance in fully developed tundra. Tardigrades are rather rare in proglacial areas with average abundance of only 1.2 ± 2.8 individuals/100g dry soil. However, the species Isohypsibius prosostomus prefers earlier stages of succession. Isohypsibius prosostomus is known as algal feeder and considering other published data, early successional stages are dominated by algae and cyanophytes while algae and cyanophytes in tundra are represented by few species with low density (Kaštovská et al. 2005). Analysis of trait composition confer similar information as species composition.

Further we are going to analyse intraspecific trait variation.

Fig. 2.3.5. Targigrades.