



POLAR ECOLOGY CONFERENCE 2020

February 12th-15th 2020

České Budějovice, Czech Republic

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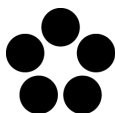
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KEYNOTE ABSTRACTS



Buried but not dead: Microbiomes of Arctic Cryosols

BÁRTA J., ŠANTRŮČKOVÁ H., VARSADYIA M., PETTERS S., URICH T., RICHTER A., WILD B., GITTEL A., SCHNECKER J., GENTSCH N., GUGGENBERGER G., LIEBMANN P., HUGELIUS G., CryoCARB/MiCryoFun/CRYOvulcan TEAM

Arctic permafrost soils contain about half of the global soil organic C (approx. 1300 Pg). One third of this C is stored in subducted organic matter (cryoOM) by the cryoturbation processes.

We here present results from the Arctic project that aimed at identifying the role of microbial functioning for OM decomposition in cryoturbated soils (Siberia, Greenland, Canada) and at assessing the potential vulnerability of this OM in a future climate.

Our main findings were:

Abundance of bacteria and fungi closely correlates with carbon loss.

Low fungal to bacterial ratio may be one of the reasons of slow decomposition of cryoOM and can be used as cryoOM vulnerability predictor. The microbial community is distinctly different from topsoil and more similar to surrounding subsoil communities. There is, therefore, a mismatch between microbial community composition and OM quality that added to the retarded decomposition of cryoOM.

OM availability is reduced and N cycling decelerated. In several incubation experiments including experiments with labelled substrates we demonstrated different nutrient limitations of the microbial communities in cryoOM. The N-containing substrates led to a significant priming effect, indicating a strong N limitation of the microbial community. High portion of cryoOM is bound to clay minerals which may contribute to lower availability for microbial decomposition and lower vulnerability of cryoOM.

In summary, we demonstrate that, in addition to unfavorable environmental conditions, decomposition processes in cryoturbated arctic soils are retarded by a combination of changes in microbial community composition, reduced OM availability and decelerated N cycling.

The Changing Arctic Ocean Ecosystems

GRADINGER ROLF

UiT Norges Arktiske Universitet Postboks 6050 Langnes N-9037 Tromsø Norge

The Arctic marine environment has considerably changed over the last decades with for example increasing water temperatures, reduced surface water salinity and/or decreasing summer sea ice extent. The presentation will provide a very brief introduction into the closely coupled Arctic marine ecosystems (habitats ice, water, sea floor), provide examples for observed changes and will also discuss suggested and partially contradictory scenarios regarding the future of Arctic marine ecosystems.

The life strategy of the Arctic tern

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Living in the environmental conditions of the Arctic is challenging to multiple organisms, and Arctic terns (*Sterna paradisaea*) adjusted their life strategy to successfully breed here. Short breeding season and extreme climate can be listed as the main limiting conditions which define the parameters of their breeding. Nevertheless, rising human population in the Arctic region is another recent factor, which may substantially affect the local populations of birds. We studied the incubation and migration behaviour of one of the northernmost breeding population of Arctic terns in Svalbard, Norway. Using continuous video recording of nests, we assessed the impact of human (non)activity near their breeding colonies on the incubation behaviour. Results showed that the presence of people significantly increased the frequency of leaving the nest, thus attention paid to the nest was smaller and calm incubation (sleeping on the nest) significantly shortened in more disturbed colonies. Moreover, we found strong differences in reaction to the human intruder in the proximity of the nest. Terns' reaction was more aggressive toward intruders in colonies with common human activity. On the other hand, disturbed parents returned to the nest faster in colonies with common human activity. Presence of people had no effect on other displays connected with nesting such as average clutch size or nesting success.

Other interesting aspect of the life history of this species is its migratory behaviour. Arctic terns belong to the most spectacular flyers among birds. They migrate from the Arctic to the Antarctic every year after the breeding season, covering more than 80 thousand of kilometres yearly. It is highly profitable to adjust their migration behaviour to various environmental factors encountered en route to reduce their energy expenditure and increase their chances of survival. We used small devices called geolocators to track the long-distance migration of the Arctic Terns. We tested how individual migration routes and stopover sites are adapted to take advantage of the prevailing wind patterns and food availability along the flyways. During both migration seasons (autumn and spring), birds profited from tailwind support along their chosen migration routes. The tailwind support was, however, considerably stronger during the northbound spring migration leading to overall higher migration speed and shorter migration duration compared to the

southbound migration. Stopover sites were typically located in areas with high ocean productivity compared to migration corridors that passed over relatively barren areas. Our results indicate that Arctic terns adjust their migration pattern according to the prevailing environmental conditions en route.

Linking land and sea: Arctic coastal responses to riverine inputs of terrestrial

POSTE AMANDA

The rate of warming in the Arctic is nearly twice the global average and is resulting in permafrost thaw, melting glaciers, and changes in precipitation and runoff patterns. These changes are leading to increased lateral fluxes of freshwater and terrigenous material (including carbon, nutrients and mercury) from land to sea. However, the timing, magnitude, and geochemical characteristics of these inputs remain poorly characterized for large portions of the pan-Arctic catchment, and even less is known about the fate of these inputs in coastal waters, and how they can impact coastal ecosystem structure and function.

In this presentation, I will identify critical knowledge gaps and highlight the central role of pan-Arctic coastal processes in shaping coastal biogeochemical and ecological responses to changing inputs from land and in determining the fate of terrigenous inputs to the Arctic Ocean. I also will present results from ongoing interdisciplinary research on Svalbard, where several Norwegian and international collaborators are working to generate quantitative information about terrestrial inputs to coastal waters in Svalbard, and on how these inputs affect coastal biogeochemistry and ecology. More specifically, I will present detailed data on seasonality and geochemistry of riverine inputs to Svalbard's coastal waters, as well as impacts of these terrestrial inputs on coastal water and sediment chemistry, benthic and pelagic community structure, food web interactions, and contaminant cycling.

TALK ABSTRACTS



Arctic tern – a potential carrier of multi-drug resistant bacteria and ARG's into pristine polar environments?

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Frequent use and misuse of antibiotics in treatment of bacterial infections of humans and in animal production systems has resulted in the emergence of drug resistant mutants across the world. Emergence and spread of drug resistant mutants is of great concern to public health professionals and medical practitioner world over. In the present study role of inter-hemisphere migrant Arctic tern (*Sterna paradisaea*) has been analysed in the dissemination of multi-drug resistant (MDR) bacteria and antibiotic resistance genes (ARG's) to pristine polar environments. In 2017 cloacal samples were collected from 22 birds, those were nesting near Longyearbyen, and analysed for the presence of MDR bacteria. The test result revealed that many of the isolates were multidrug-resistant. The birds were released with geolocators for tracking their extraordinary migration between Arctic breeding and Antarctic wintering areas and the relation to the antibiotic pollution. Sixteen birds were recaptured during 2018 summer from same nesting places. Faecal samples and geolocators recollected from these birds and analysed for faecal microflora and the migration route respectively. The birds were migrating through high productive upwelling places and through polluted coastal areas. Eighty bacterial isolates were randomly selected and subjected to antibiotic sensitivity testing against 14 different antibiotics, using disk diffusion assay. Results revealed multi-drug resistance among several of the isolates. High resistance against Ceftazidime/Clavulanic acid (86%) followed by Nalidixic acid (75%), Ceftriaxone (75%) and Trimethoprim (60%) were observed. Comparison of the 2-year results showed that Arctic tern can act as a reservoir of Antibiotic-resistant bacterial pathogens and could act as potential carrier of ARGs to the pristine Arctic.

Habitat changes of polar bears in summer as assessed by long term observations in North-East Greenland

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Large reductions in sea ice extent are currently affecting the habitats of ice-dependant marine top-predators. The response of polar bears (*Ursus maritimus*) that are dependent on sea ice for hunting seals has been documented every summer on a yearly basis since 1988 in a coastal site of Traill Island, in its North-East Greenland range. Summer occurrence of polar bears, measured as the probability of encountering bears and the number of days with bear presence, has increased significantly from the 1990's to present. The strongest changes took place in the early 2000s. The shifts in polar bear occurrence coincided with trends for shorter sea ice seasons and less spring sea ice in the Greenland Sea, off the coast of NE Greenland. This resulted in a strong inverse relationship between the probability of bear encounter on land and the length of the sea ice season. Besides their visits at remains of muskox carcasses in tundra dating back to late winter, it was also shown that bears regularly check offshore islets supporting arctic tern (*Sterna paradisaea*) and eider duck (*Somateria mollissima*) colonies. Observations made in this site are in line with similar surveys made on Svalbard, suggesting that increased summer occurrence of polar bears on land and associated negative effects on bird reproduction is now occurring on a large geographic scale in the Arctic.

Open Ocean: Arctic Archipelagos - 2019. Severnaya Zemlya - multidisciplinary expedition towards better conservation of the pristine area of universal outstanding value

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High-Arctic Severnaya Zemlya Archipelago in the very centre of Siberian shelf is equally remote both from Atlantic and Pacific gateways to the Arctic, thus maintains its pristine ecosystems largely un-affected by global change and human impact. Despite limited information on biodiversity and environment, conservation value of Severnaya Zemlya is recognized both in Russia (Solovyev et al. 2017) and globally (Speer et al. 2017). The multidisciplinary expedition “Open Ocean: Arctic Archipelagos – 2019. Severnaya Zemlya” on board RV *Professor Molchanov* aimed at filling gaps in our knowledge about marine and coastal ecosystem of Severnaya Zemlya.

Scientific program included five major themes:

- marine hydrobiology (CTD, sediments, plankton and benthos sampling from vessel, land and underwater);
- vertebrate zoology (at-sea bird and mammals survey, land-based counts);
- terrestrial invertebrates and freshwater studies (entomological surveys, fresh water chemistry, microbiota, plankton and benthos sampling);
- geography, landscape studies and local history (geomorphological surveys, palaeogeography sampling, aerial mapping of coastal habitats);
- plastic pollution surveys and microplastic sampling.

Overall, 21 landings were made on 11 islands, 3 islands were surveyed remotely, 17 dives were performed in 7 locations, 55 hydrobiological stations were taken, 13 lakes and rivers were investigated. Such comprehensive ecological survey covered variety of disciplines, involved variety of methods, sampled variety of environmental and biological components, was conducted in Severnaya Zemlya region for the first time.

Presentation outlines results of expedition projects and highlights major findings. Scientific information obtained during the expedition will also feed national plans of development of protected areas network in the Arctic.

Spatial distribution of organic and inorganic carbon fluxes on a wetland complex: hot spots and leading factors (West Siberia, Russia)

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Northern ecosystems are an important component of global carbon cycle on the planet. Permafrost degradation due to climate change can change both export values and the composition of dissolved organic carbon from cryogenic soils by changing their hydrological regime, structure and functioning of ecosystems. Changes in the amount and composition of dissolved carbon coming from terrestrial ecosystems, in turn, can affect the carbon balance in associated aquatic ecosystems, and also affect the carbon balance of the entire catchment.

The goal of the research was to assess the mechanisms and leading factors of the redistribution of soil and water carbon fluxes for permafrost wetland complex (palsa and surrounding bog) in the north of Western Siberia.

The study included a simultaneous measurement of some labile indicators of soils and natural waters, as well as environmental factors. Research carried out for several years (2016-2019) at the middle of the growing season.

The wetland complex is characterized by a high spatial variability of all properties and processes. The redistribution of carbon compounds and carbon flux largely depends on the topography of the permafrost table. The maximum values of CO₂ efflux and concentration in waters were observed on the edge parts of the palsa and in the wetland close to the palsa. These sites are hot spots in the gas exchange processes between water, soil and atmosphere. Waters near the palsa are supersaturated with dissolved CO₂ (versus the atmosphere) and with temperature rise can be a significant source of this greenhouse gas to the atmosphere.

How to survive winter? Annual study of freshwater diatoms in the arctic.

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Natural conditions in non-marine polar habitats are characterized by many extremes and seem unfavourable for life. Despite this, diatoms apparently adapted well and inhabit a wide range of polar environments. However, it remains unknown, which strategy enables them to survive. Our aim was to study the annual cycle of freshwater diatoms to reveal their seasonal strategy. For the multiple sampling, four study sites (streams, seepage, wetland) with high abundance of diatoms were established in the High Arctic. Diversity and viability of diatom cells were studied in samples collected five times tracing the key events for survival (summer vegetative season, autumn dry-freezing, winter freezing, spring melting). For viability evaluation, a multiparameter fluorescent staining (SYTOX Green, CTC and DAPI) in combination with light microscopy was used and allowed the evaluation of physiological state (active healthy cells, inactive but intact dormant cells, injured but active cells and, injured and inactive dead cells). Four samplings of natural communities performed during one year showed that the relative proportion of each cell category was seasonally dependent. Small amounts of cells were capable to survive winter as active or inactive resting cells but remarkably a relatively high number of cells proved to be active immediately after thawing in winter season. The results emphasize importance of vegetative cells adaptation for winter survival.

Categorizing epibiotic communities from seaweed ecosystem in more ecological way

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Seaweed plays an important role, more than a producer in the marine ecosystem which makes it to be considered as an ecosystem engineer. However, epiphytism is a common phenomenon in the seaweed ecosystem, in which seaweeds provide food, shelter, and habitat to various diverse kinds of invertebrates and small crustacean, various fishes and other aquatic organisms. The classification or categorization of these epibiotic communities in simple terms is still neglected task or limited to epiphytes. The purpose of this study is to differentiate the associated animals in the seaweed ecosystem for a better understanding of epifaunal communities and their possible roles in that ecosystem. The possible epibiotic and associated animals those show abundance nearby seaweeds, the possible potential of utilization and ecological importance were collected from Chioggia, Venice lagoon in the early autumn of 2019. These animals were then observed in the lab under microscopes and naked eyes. The possible categorization of all animals related in seaweed ecosystem was done on the basis of their interaction to seaweeds. Although this work is limited to the natural ecosystem and animals present in the seaweed ecosystem, it will help to manage the risk of epiphytism in seaweed farming on a commercial scale. It is also commenting on the possibilities of integrated multi-tropic aquaculture (IMTA) in the Venice lagoon.

Trophic relationships in cryoconite holes

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The importance of supraglacial consumers is highlighted in several recent studies focused on microbiological processes on glaciers. However, due to the dominance of prokaryotes in supraglacial communities, studies aiming on consumers' role are lacking. Our research shows pioneering results of the isotopic composition of tardigrades and rotifers, which are the top consumers in cryoconite ecosystems. Furthermore, it is a foundation for the exploration of trophic pathways and interactions within cryoconite holes using elemental and stable isotopic analyses. It also presents information about the species composition of tardigrades and rotifers on different glaciers and in different parts of the ablation zone in Petunia Bay (Svalbard). Measured isotopic values showed that tardigrades have significantly different $\delta^{15}\text{N}$ values from rotifers. The $\delta^{13}\text{C}$ values showed similarities between animals from similar glaciers and similar parts of the ablation zone. We also measured the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of organic matter within cryoconite (potential food for consumers) which revealed that the dominant component of cryoconite organic matter can be a food for rotifers but not for tardigrades.

Annual development of mat-forming filamentous algae *Tribonema* sp. in hydro-terrestrial habitats in the Arctic

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Eukaryotic algae play an important role in polar terrestrial and seasonally cold ecosystems in temperate regions. They are widespread here, including extremes, and frequently produce visible biomass. Their combined biomass represents a sizeable pool of global fixed carbon, influencing mineral cycling and energy flow, and affects the mineral and biological development. *Tribonema* sp. (*Tribonemataceae*, *Xanthophyta*) together with other dominants is one of the most important component of these low temperature adapted communities. High Arctic environment is characterized by extremely low and fluctuating temperatures, lack of liquid water and both high and low levels of solar irradiance during summer and winter seasons. This reflects on the viability of the *Tribonema* sp. populations. However, no research concerning the exact amounts of surviving *Tribonema* sp. in the High Arctic hydro-terrestrial environment has been conducted yet. *Tribonema* sp. was chosen as a model eukaryotic alga due to its significant presence in the Svalbard archipelago, where the samples were collected. Its viability was studied in both summer and winter seasons together with whole year habitat's microclimatic conditions measurements. For viability measurements, a multiparameter staining protocol was used. SYTOX green, CTC and DAPI stains were used to enable current viability assessment using fluorescence microscopy. Although the viability in summer season was higher, winter season viability was remarkably high with more than two thirds of studied cells showing signs of activity after thawing. This suggests that *Tribonema* sp. has developed a high degree of resistance to cryoinjuries and its populations are resilient. This research sheds some light on the state of High Arctic algal population survival and opens new research questions in the realm of specific ecophysiological adaptations.

Liquid water as a factor conducive to permafrost degradation in Svalbard

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These studies concern the marginal zone of the Werenskiöld glacier in the south-western part of Spitsbergen. For this area, a comprehensive study of landform changes was made on the basis of comparative analysis of digital terrain models produced from various sources (from digitizing of large-scale topographic map from 1959, via aerial photographs SfM, to contemporary LiDAR data). Thanks to GIS analysis and DEMs of difference, landform evolution caused by, among others, degradation of permafrost through meltwater, rainwater and river waters, leading to mass movements and the phenomenon of suffosion on moraine ridges was described. The extent of permafrost in this zone was examined by geophysical imaging (electrical resistivity tomography and electromagnetic method). On this basis, it is possible to recognize the state of frozen ground within both the accumulative landforms, including moraines and outwash plains, as well as the underlying subsurface (solid rock). The influence of rivers and lakes on the thermal state of the moraine and solid rock was illustrated. The influence of seawater on the extent of permafrost in the Greenland Sea coast was also determined. This is the first so wide geophysical imaging of the state of permafrost under the impact of liquid water in the paraglacial zone. Geophysical imaging points to the strong impact of sea waters on the ground in the coastal zone. There is no ground ice here, although the ground may be in a cryotic state (saline cryotic ground). Thermal impact of lake and river fresh water reaches 40–50 m deep into the ground.

Permafrost active layer thermics controlled by landform features

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The study concerns the thermal state of ground (soil) being also a part of permafrost active layer in the deglaciated area of the Bratteg valley of southwestern Spitsbergen. We analyse data from a network of 20 thermistors located in a drainage basin, including its highest elevations. Measured ground temperatures to a depth of 1.5 m are used to search for terrain determinants of ground thermics, expressed by common land surface parameters derived from 20×20 m DTM and surface area temperature obtained from the LANDSAT 8 scene processing. Correlation and regression calculations was used to build models of spatial distribution of ground temperature. The obtained results show, among others, that ground temperatures near the ground surface (from 0 to –5 cm) are not significantly correlated with any of the tested topographic parameters, and thus depend on the local features of the ground. An expression of this is the strong dependence of temperature in near subsurface (up to depth 20 cm) on surface temperatures estimated from satellite data. From 10 cm below the surface and deeper, there is a significant negative correlation of temperature with elevation: initially stronger with altitude, and at 100 and 150 cm depth – with relative height.

Post-Little Ice Age development of coast in the locality of Kapp Napier, central Spitsbergen, Svalbard archipelago

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Changes in the position of the shore in the vicinity of Kapp Napier in central Svalbard was described. The overall advance of the shore was probably related to high input of the sediment material originating from erosion of the coastal areas south of the Kapp Napier locality and high input of material from adjacent glacialfluvial system of Nordenskiöld Glacier with its marginal water streams. Fast evolution of glacier retreat related processes after the Little Ice Age was a secondary driver of the dynamic changes in the central Svalbard coastal areas especially in the first half of the 20th century. The highly dynamic longshore currents in the area altogether with still ongoing glacio-isostatic uplift played an important role in the process as well. The most active parts of the shore experienced advance of almost 100 meters since 1908 to 2009. On the other hand, a small part of the coast retreated of about 20 meters. Most of the study area experienced aggradation (65%), 30% of the coast was stable and about 5% of the coast has undergone minor retreat. The maximum aggradation rate of 0.96 m/year corresponds well with similar sites in the vicinity.

Reference:

Kavan, J. 2019: Post-Little Ice Age development of coast in the locality of Kapp Napier, central Spitsbergen, Svalbard archipelago. *Marine Geodesy*. <https://doi.org/10.1080/01490419.2019.1674429>

Effects of light and UV radiation on northern aquatic ecosystems

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Underwater light climate is an essential driver of both amount and type of production in aquatic ecosystems. During the polar summer, aquatic ecosystems receive high levels of solar irradiation and adjacent harmful ultraviolet (UV) radiation, forcing biota to use photoprotective strategies. The ongoing climate change increases transport of catchment-originating chromophoric substances, which inhibit penetration of light and UV radiation in the water column but also experience photochemical alteration under light and UV exposure. Particularly polar lakes are facing changes in their light regimes. We explored effects of ambient photoactive radiation (PAR) and UV to biochemical composition of seston in two small subarctic lakes with different UV regimes and levels of terrestrial input. Experimental chambers filled with lake water were placed in a high-altitude clear water lake and a murkier, low-altitude lake in Finnish Lapland for four weeks during high irradiance period. The set-up composed of three light treatments (no light, no UV, and “normal” PAR + UV) with three replicates of each per lake. Multiple limnological and bio-optical factors were measured from the experimental water and seston, including dissolved organic carbon fractions, algal pigments and UV-screening compounds in microinvertebrates (Cladocera). We observed between-lake differences in productivity between the normal light and UV-excluded treatment and an increasing trend in photoprotection of cladocerans under UV exposure. Algal pigments and cladoceran UV responses were further analyzed also from sediment cores of the study lakes to evaluate past biotic responses to changing light regimes.

The origins of Antarctic vascular plants

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Due to the extreme scarcity of paleobotanic data, the question of the origin of the Antarctic hairgrass, *Deschampsia antarctica* Ę. Desv., and the Antarctic pearlwort, *Colobanthu quitensis* (Kunth) Bartl, the only two known Antarctic vascular plants, can be addressed using a rather limited set of methods, including molecular biology. To date, *D. Antarctica* has been studied both by methods for the general genome heterogeneity, such as the amplified fragment length polymorphism (AFLP) technique (Holderegger et al., 2003; Chwedorzewska et al., 2004; Van de Wouwet al., 2007), and those addressing the polymorphism of particular sequences, such as Internal Transcribed Spacers (ITS1 and ITS2) in the 35S ribosomal DNA (rDNA) (Volkov et al., 2010), chloroplast sequences (Van de Wouw et al., 2007) and Intron Length Polymorphisms (ILPs) of Tubulin genes, named TBP for Tubulin-Based Polymorphism (Rabokon et al., 2019).

The above-mentioned studies have revealed low genetic heterogeneity in *D. antarctica*. The pace of evolution of the genome of this species is not known with certainty. Therefore, such an indicator as heterogeneity is not very informative on its own, but it still allows grouping plants based on the geographic location of initial populations. Analyses of specific sequences, on the other hand, has revealed that *D. antarctica* populations likely include independent evolutionary lineages. Whether (and how many) such immigration events took place in the past remains an open question and requires further research using new molecular biology methods.

Temporal and spatial patterns of invertebrate diversity in freshwater springs in Iceland

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Freshwater springs are thermally stable environments largely unaffected by changes in air temperature. They could thus have the potential to buffer rising temperatures and serve as small-scale refugia for aquatic invertebrates in a warming world. To better understand what environmental variables drive invertebrate diversity and community composition, we conducted an extensive field survey on springs in Iceland. Iceland, located just below the Arctic Circle, is of volcanic origin and large parts are geothermally active. Thus, a high number of freshwater springs can be found along the edges of the porous lava fields, ranging in temperature from 2°C to boiling hot. Springs also differ in other characteristics, e.g., altitude, spring type, substrate, and vegetation density. We studied the invertebrate community of 49 springs on a spatial scale, and followed one of them throughout a year to analyse temporal variability.

The most abundant invertebrate groups in Icelandic springs were Chironomidae (Diptera), followed by Ostracoda and Copepoda. One of the main drivers of community composition was temperature, resulting in a distinct species group characteristic for hot springs. Additionally, spring type and geographical position influenced communities. Community composition also differed on a temporal scale within the same spring, with a split into a summer and winter community. This seasonality in the invertebrate community was unaffected by temperature changes but had implications on the apex predator in the system, Arctic charr.

Our results give some insight into the simple and yet complicated Icelandic spring ecosystem, and can hopefully contribute towards conserving a threatened habitat.

Helminths of *Notothenia coriiceps* from the Vernadsky station area (Argentine Islands, Antarctic): current state and alteration of the parasite community during last decades

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The aims of our study were to examine the current state of the parasite community of rock cod, *Notothenia coriiceps* off the Argentine Islands Archipelago and to analyze the changes in the parasite community during last decade. The study has been carried out in 2014–2015 at the Ukrainian Antarctic station "Academic Vernadsky", West Antarctica. More than 8,500 specimens of parasites were collected from 106 specimens of *N. coriiceps* and identified by morphology.

All fishes (100%) were found to be infected with helminths; 24 helminth species were identified. Acanthocephalans were recorded in 96.4% of fish with mean intensity 25.3. Eight species of acanthocephalans (*Metacanthocephalus rennicki*, *M. johnstoni*, *M. campbelli*, *M. dalmori*, *Aspersentis megarhynchos*, *Corynosoma hammani*, *C. pseudohammani*, *C. evae*) were identified. Nematodes were found in 96.2% fishes; with mean intensity 14.8. Larval stages of *Pseudoterranova* sp., *Contracaecum* sp., *Anisakis* sp. and adults *Ascarophis nototheniae* were identified. Trematodes were recorded in 94.3% of fishes with a mean intensity of 33.7. Seven species of trematodes (*Macvicaria georgiana*, *Neolebouria antarctica*, *Lepidapedon garrardi*, *Genolinea bowersi*, *Elytrophalloides oatesi*, *Lecithaster macrocotyle*, *Derogenes johnstoni*) were identified. Larval stages of cestodes *Diphyllobothrium* sp. and tetraphyllidean metacestodes were registered in 78.7% of fish with mean intensity 10.3. Comparison of our data with the results of previous studies performed at the same area in 2002 revealed significant changes in structure of the parasite community of *N. coriiceps*. Six helminth species (trematodes and cestodes) are considered as potential indicator species for future monitoring studies of ecological changes in Antarctic marine ecosystems.

Algal mass cultivation in low temperatures

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The cyanobacteria and micro-algae growing in low temperature environments represent perspective source for low-temperature biotechnology and bioprospecting. Development of low-temperature biotechnology is beneficial for non-summer algal mass cultivation in temperate regions for extension of the cultivation period in present cultivation facilities, and for development of biotechnological applications in the polar environments. Since these cyanobacteria and micro-algae are well adapted/acclimated to low temperatures and other stresses in their original environment (freezing, desiccation, high UV and VIS radiation, low nutrients), they may produce biotechnologically highly valuable compounds like PUFA or screening pigments.

The polar strain of of *Edaphochlorella (Chlorella) mirabilis* was used in following experiments

- Crossed gradient cultivation
- Up-scaling experiment in temperate non-summer conditions
- Up-scaling experiment in Svalbard late summer
- Mass cultivation in temperate winter
- Mass cultivation in Svalbard summer season

to evaluate its growth optima and growth limits, and to test the possibilities of mass cultivation in temperate non-summer and polar summer (polar day) conditions.

Playing hide and seek with intraspecific trait variability

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Ecological studies often cover small, rather than large geographical areas – mostly focusing on single communities or closely located habitats. That could lead to situation where many important ecological patterns remain unrevealed because of limited spatial span.

In recent decade the importance of functional trait variability has arisen and increasing amount of studies in ecology have focused of this topic. However, majority of trait variability studies have concentrated on local scale, although species distribution area often encompasses contrasting abiotic and biotic conditions, therefore creating great amount environmental variation that plants need to cope with.

Our study looked intraspecific trait variability pattern differences in range centres and margins in populations of four plant species distributed both in Estonia (59o N) and Svalbard (79o N). In addition to plant functional traits we assessed the vegetation surrounding the selected individuals (species richness and plant cover within 1x1m square). We investigated how the surrounding vegetation affects leaf trait variability and whether these relationships differ between species and distribution range locations.

Results show that the intraspecific variability of leaf traits is affected by surrounding vegetation. However, there is considerable differences between how vegetation richness and cover affect different plant species on range centres and margins. Our results indicate that the within-species trait variability patterns are significantly affected by the location of studied populations in the distribution range, and that these patterns are also species-specific. This suggest that more detailed and comprehensive approach is needed when studying the role of intraspecific trait variability.

New Ways for Polar Population Health Monitoring: Tools and Results

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Public health risk management in the Arctic is an important aspect of the region's sustainable development. As for vulnerable Arctic ecosystems, accumulated environmental damage of different origin is constantly resulting in human health disorders along with people's lifetime shortening. The Arctic Ocean's coastal zone is of the first concern, meeting a broad array of natural and anthropogenic pollution including nuclear sources. For North-West Federal District of Russian Federation, the most urbanized area in the country, data from different sources: statistical, medical, demographic, and hydrometeorological yearbooks have been aggregated for the purpose of the research. Basically, such kind of information is hardly accessible for general public in Russia. Nevertheless, it contains a lot of useful primary local environmental and health characteristics. On the other hand, environmental and economic conditions can successfully be identified on the base of population' elemental status. If valid connections between elemental chemical composition of natural or anthropogenic origin, coming to people's organisms from environment, and human health exist, then so called population 'environmental passport' could be composed. Cause-effect relations between micro and macro element consumption (lack or abundance) and public health in NWFD-RF have been estimated using the open press sources. Data capturing and visualization made, spatial digital maps presenting element consumption for non-personalized groups as well as their main disorders obtained. Such a 'passport' is aimed at arranging environmental situation of urbanizes regions in a prioritized order to make possible future simulation for the purposes of human health within environmental economy.

Arctic: power politics, natural resources and ecosystem services

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The global warming and advances in technology made it possible that some of the Arctic's mineral riches became accessible for the first time. Instead of polar explorers competing to be first to reach some distant point, mineral prospectors are crossing the Arctic in order to map its resources for later exploitation. Some international diplomacy takes place and more square kilometres of the Arctic seabed are made accessible for claims. Besides hydrocarbon and metal deposits various nations and interest groups are eyeing the opportunities for more shipping lines, fishing rights and tourist groups.

Ecophysiology of the two most common algae in Arctic snow blooms

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Snow algae thrive in habitats of melting snow in mountainous and polar regions. This taxonomically diverse group of phototrophs is adapted to live under extreme conditions including freeze-thaw cycles, high light exposure and limited nutrients. When snow discolorations appear at the surface, many species are already in the stage of immotile, non-dividing but physiologically still active cysts.

While red spherical cysts causing red snow are found worldwide, orange spherical cysts causing orange blooms seem to have a more restricted, circumpolar distribution in the (Sub-)Arctic.

Based on molecular analyses of 42 field samples from Arctic, Antarctic, North and South America as well as Europe, it was demonstrated that these cysts formed one independent lineage in Chlamydomonadales (green algae). The new genus *Sanguina* was recently described with *S. nivaloides* (red cysts) and *S. aurantia* (orange cysts) (Procházková et al. 2019, *FEMS*, fiz064). Both species have a partly overlapping area of geographical distribution, being commonly found together at exposed sites in Arctic and subarctic regions. This contribution is focused on the ecophysiological comparison between the two species. Although the same habitat was shared, they significantly differed in photosynthetic performance, extend of pigment accumulation and the cellular content of polyunsaturated fatty acids.

Soil organic matter structure and cyanobacterial community composition in the soil active layer of Svalbard.

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The soil active layer in the High Arctic is a reservoir for nutrients and microbial communities, but their behavior and interactions remain unclear. Taking into account the drastic environmental changes currently happening in the Arctic reflected in rising temperatures and permafrost thawing, the soil ecosystem will also be strongly affected. Therefore, it is important to better understand continuous cross-interactions between SOM quantity and quality and soil microbial communities.

The objective of this study was to characterize chemical composition of soil organic matter (SOM) and cyanobacterial community in soil active layer of Svalbard. Samples from two different sites and two different soil layers (0-1 and 5-10 cm depth) were collected along a moisture gradient (dry, intermediate, wet) in Ny-Ålesund area. The molecular SOM composition was assessed using pyrolysis-field ionization mass spectrometry (Py-FIMS), which revealed the dominance of lipids/sterols, alkylaromatics and phenols/lignin monomers. Moreover, dehydroergosterol prevailed in a majority of the samples.

To study cyanobacterial community composition along the moisture gradient, high-throughput sequencing (HTS) with general bacterial and cyanobacterial primers was applied. Overall, cyanobacterial community was dominated by filamentous forms (order Synechococales) and the most abundant OTUs (operational taxonomic units) corresponded to *Leptolyngbya*, *Oculatella* and *Chroakolemma*. Moreover, moisture stage had significant effect on the relative abundance of the most dominant OTUs.

Sunlight shapes carbon cycling across the subarctic landscape – tracing solar fingerprints in lake water and sediment biochemistry

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Sunlight governs fundamental biotic and abiotic processes in polar ecosystems including the pathways and fate of carbon across the landscape. Amplified polar warming is disrupting these processes entailing potential for abrupt ecological reorganizations and climate feedbacks. The consequences are however difficult to predict due to the paucity of observational data series from these remote regions. Shallow northern lakes are hotspots of carbon cycling and can provide retrospective insights into the dynamic interlink between climate and the arctic carbon cycle, and the role of sunlight within. For this aim, we first deployed in situ experiments to explore light stimulated variability in the biochemistry of lake water organic matter in two shallow subarctic lakes characterized by divergent carbon regimes: a transparent tundra lake and a lake in the mountain birch woodlands stained with carbon from the surrounding watershed. We then employed biochemical sedimentary techniques to trace past variability in underwater light and parallel changes in aquatic primary production, lake water carbon concentrations, and carbon origins under centennial climate fluctuations. Light exposure left distinct fingerprints in the elemental and isotopic composition of lake water organic matter in both lakes with more conspicuous effects in the more organic rich lake. Changes of similar magnitude were observed in the temporal profiles connected to changing influence of terrestrial inputs, effects of photodegradation, and aquatic production that all shape the sediment biochemical record. Most distinct changes were associated with the past century denoting the pervasive impact of global change on northern lakes.

Chemical weathering characteristics in two glacierised basins reveal a long-term biogeochemical impact of deglaciation

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Most glaciers worldwide are undergoing climate-forced recession, but the long-term impact of glacier changes on biogeochemical cycles is unclear. Our study examines chemical denudation characteristics in two meta-sedimentary basins affected by different stages of glacier recession: Werenskioldbreen, SW Svalbard (glacier cover 60%) and Obrucheve Glacier in Polar Urals, NW Siberia (glacier cover 2%). We determined water chemistry, dissolved solids yields, runoff and sediment submicroscopic features and chemical composition using scanning electron microscopy energy dispersive X-ray spectroscopy (SEM-EDS). The results show that annual specific runoff is similar in both basins (~1.8 m) whereas dissolved solids yield corrected for atmospheric input was an order of magnitude higher at Werenskioldbreen (~120 t km⁻² year⁻¹) than at Obrucheve Glacier (~9 t km⁻² year⁻¹). The SEM-EDS images of sediments collected at two proglacial sites in front of Werenskioldbreen show degradation of pyrite and carbonate grains with age. For instance, the outer part of pyrite grains show a gradual decrease of sulphur and increase of iron oxides. At Obrucheve Glacier, the lack of pyrite grains indicates that leaching of pyrite is completed, which is consistent with a much longer time of proglacial exposure. Also, partial dissolution of albite, a mineral more resistant than pyrite and carbonates, confirms the effect of long-term chemical weathering at Obrucheve Glacier. The solute yields and sediment submicroscopic and chemical features show that enhanced chemical weathering at Werenskioldbreen causes higher solute yields.

Is different lifestyle clue to different survival potential? Effect of climate change on marine polar biota.

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Major climatic changes in the Pleistocene had significant effects on marine organisms and the environments in which they lived. The presence of divergent patterns of demographic history even among phylogenetically closely-related species sharing climatic changes raises questions as to the respective influence of species-specific traits on population structure. In this work we tested whether the lifestyle of Antarctic ocean organisms influenced the concerted population response to Pleistocene climatic fluctuations. This was done by a comparative analysis of sequence variation of mitochondrial gene for dozens organisms belonging to different taxa categories.

There was found that all species underwent more or less intensive changes in population size depending on its life style irrespective of the taxa classification. Contemporary pelagic, eurybathic or deep sea populations are significantly more genetically diverse and bear traces of older demographic expansions than less diverse shelf benthic species that show evidence of more recent population expansions. Our findings suggest that the lifestyles of different species have strong influences on their responses to the same environmental events. Obviously, pelagic or eurybathic species had been less harmed by Pleistocene glaciation than the shelf benthic ones, whose survival may have relied upon ephemeral refugia in shallow shelf waters. These findings suggest that the interaction between lifestyle and environmental changes should be considered in genetic analyses.

Permafrost organic carbon in palsas peatland ecosystems of North-Western Siberia: an intensive response to experimental warming

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Northern peatlands are expected to play a critical role in nearest predictable climate changes due to storing approximately 1/5 of the total terrestrial carbon pool. Most of that pool is perennially frozen and we still know little about environmental variables effect on peatland soils carbon mineralization. This study was focused on estimating the initial response of northern peatlands permafrost organic carbon (C) to abrupt changes in temperature.

In august 2019, we sampled frozen soil cores from permafrost layers in a palsa peatland ecosystem in forest-tundra (65°18'55''N, 72°52'34''E). Carbon mineralization and microbial biomass carbon (C_{mic}) measurements were performed in laboratory and the Q_{10} coeff. was calculated in 5-25 °C range to examine the temperature sensitivity of C. We applied “equal-time” (5 days) and “sequential” methods (20 days) to calculate the temperature sensitivity.

Both methods have revealed the intensive response of C in 5-15 °C range: carbon mineralization rate and C_{mic} content increased sharply and the Q_{10} took the high values (6.9 ± 0.9). No remarkable effect was observed in 15-25 °C range ($Q_{10}=1.3 \pm 0.1$). Our results indicate the short-lived pulses of C and its possible depletion with rising temperatures and incubation time. This fact should be considered when modelling the northern peatlands C feedback to warming climate and its transfer pathways between terrestrial and aquatic ecosystems.

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Effects of a shallow tidewater glacier on under-ice spring blooms

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Glacial meltwater discharge in fjord ecosystems is recognized as a potential source of nutrients, enhancing primary production, either via direct inputs, or via upwelling effects. Tidewater glaciers appear to play a crucial role due to its subglacial discharge supplying meltwater the whole year, and upwelling of nutrient-rich bottom water in front of deep tidewater outlet glaciers. With climate change tidewater glacier are retreating on land and their role for fertilisation might get lost. Our study investigates the seasonal dynamics of the interactions between the shallow tidewater glacier Nordenskiöldbreen and Billefjorden. The glacier has a land terminating and a marine terminating site, separated by a peninsula. In late spring, we found increased nutrient concentrations in front of the glacier, increased primary production, and different algae communities. In summer and autumn, we did not detect any fertilization effects, but found highly stratified and nutrient limited systems in both seasons. In contrast to tidewater glaciers in Greenland and other Svalbard fjords, we found no evidence of nutrient upwelling in summer, but for the first time, fertilizing effects in spring under an ice covered fjord. Upwelling effects in a system protected from wind-induced mixing and direct fertilisation with nutrients derived from bedrock weathering are potential mechanisms enhancing primary production in spring.

Fast response of fungal and bacterial communities to climate change manipulation in two contrasting tundra soils

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Climate models predict substantial changes in temperature and precipitation patterns across Arctic regions, including increased winter precipitation as snow in near future. Soil microorganisms are considered key players in organic matter decomposition and regulation of biogeochemical cycles. However, current knowledge regarding their response to future climate change is limited. Here, we explored the short-term effect of increased snow cover on soil fungal and bacterial communities in two tundra sites with contrasting water regimes in Greenland.

Our metagenomics analysis revealed that soil microbial communities from two tundra sites distinctively differed from each other due to contrasting soil chemical properties. Fungal communities showed higher richness at the dry site whereas richness of bacteria was higher at the wet tundra site. We demonstrated that fungal and bacterial communities at both sites were significantly affected by short-term increased snow cover manipulation. Our results showed much stronger response of the fungal communities to enhanced snow compared to bacteria. The fungal communities showed changes in both taxonomic and ecological groups in response to climate manipulation. Since fungi are considered the main decomposers of complex organic matter in terrestrial ecosystems, the stronger response of fungal communities may have implications for organic matter turnover in tundra soils under future climate. Further, we showed that effects of increased snow cover were manifested after snow had melted implying that the climate manipulation treatments have a legacy effect on soil microbial communities.

Species composition of moss turf subformation on the Galindez Island (Argentine Islands, maritime Antarctic): setting a basis for monitoring of terrestrial environment

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The moss turf subformation is one of the most significant terrestrial communities in the Antarctica. These moss-dominated communities are widespread in the maritime Antarctic region. During a long-term monitoring program of the terrestrial ecosystem in the Argentine Islands, the moss banks on the Galindez Island were studied and mapped.

The estimated area of moss banks patches in the study area varied from 14,9 to 2874 m² and accumulation of peat was from 14,5 to 75 cm of depth. In a preliminary assessment 17 species of bryophytes (14 mosses and 3 liverworts) were recorded. The most common species building the moss turf subformation was *Polytrichum strictum* Brid. It was recorded in all moss banks. The second moss species able to turf-forming, *Chorisodontium aciphyllum* (Hook.f. & Wilson) Broth., was less numerous and occurred only in 25 out of 40 moss banks and usually had a lower coverage (<1 to 20%). This species may be more demanding in terms of habitat and occurs only in a more stable environment. Moss banks were further characterized by presence of *Pohlia nutans* (Hedw.) Lindb. (recorded in all moss banks, mainly in gaps between *P. strictum* cushions) and liverworts *Cephaloziella varians* (Gottsche) Stephani and *Barbilophozia hatcheri* (A. Evans) Loeske (in sheltered places). For a comprehensive survey, an identification and analysis of lichen species forming incrustations in the moss banks remain an important issue (in particular those from the most frequently occur families such as *Sphaerophoraceae* Fr., *Cladoniaceae* Zenker and *Ochrolechiaceae* Lumbsch & I.Schmitt).

The influence of seabird colonies on Arctic shallow benthic communities

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Seabirds are very important links between the ocean and terrestrial ecosystems in the Arctic. They feed on marine resources over the pelagic zone while breed on land, often in huge colonies, where they deposit guano which is extremely rich in nutrients, and is locally crucial for tundra. Nonetheless, ornithogenic nutrients not incorporated into the terrestrial ecosystem can return to the sea, concentrate within the relatively small coastal area immediately adjacent to a colony, and constitute a locally important resource for marine producers and subsequent consumers there. Although this phenomenon has potentially great importance for the marine coastal food webs, it is still very poorly recognised.

Here we present results of three-year studies of shallow benthic communities functioning beneath a large guillemot and kittiwake colony in Isfjorden, west Spitsbergen. With the help of SCUBA we could explore and precisely sample the shallowest, down to ca. 20 m, coastal zone inaccessible with larger ships. The isotopic data obtained, i.e. increased $\delta^{15}\text{N}$ of suspended and sedimentary particulate organic matter, as well as predatory/scavenging whelks and hermit crabs from the colony area, allow assuming that ornithogenic nutrients which returned to sea and concentrated in the vicinity of a seabird colony were used by phytoplankton first, and then entered the bottom food chains through pelagic-benthic coupling. However, local environmental conditions clearly modified the seabird impact thus further studies in different Arctic locations are planned in the nearest future.

POSTER ABSTRACTS



Svalbard reindeer (*Rangifer tarandus platyrhynchus*) antler characteristics reflecting the local environmental conditions

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A new non-invasive method based on picture analysis was used to estimate the conditions in Svalbard reindeer populations. The well-being of an individual subject is often expressed through visual indices. Two distinct reindeer populations were compared based on their antler parameters. Relative antler size and number of tines are variables supposed to reflect correspondingly the environmental conditions of sedentary populations within the growing season. The occurrence areas of two studied populations are distinctly isolated – separated with high mountain ridges, glaciers and fjords. The population in Petuniabukta occupies a sparsely vegetated region with harsh climatic conditions, whereas Skansbukta represents an area with continuous tundra vegetation cover, milder climatic conditions and, consequently, also a longer vegetation season. These environmental factors probably caused significant differences in the relative antler size and number of tines in the studied species. The Skansbukta population exhibited a larger relative antler size and higher number of tines than the population in Petuniabukta (both parameters differed significantly, $p < 0.01$). This difference reflects concisely the different environmental conditions of both locations. A comparison of Skansbukta population antler characteristics between years 2017 and 2018 did not reveal significant changes, most probably due to very similar atmospheric conditions in these two years (in terms of air temperature).

Reference:

Kavan J., Anděrová V. (2019) Svalbard reindeer (*Rangifer tarandus platyrhynchus*) antler characteristics reflecting the local environmental conditions. *Folia Oecologica*, 46, 16-23.

Vegetation patterns around Lake Mývatn in NE-Iceland: Impact of chironomid midges on terrestrial ecosystems

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The typical view about ecosystem linkages is that nutrients and matter are transported downslope from the surrounding to the watershed, only few studies have examined the pathway from lake to land. Our study area is situated around Lake Mývatn in NE Iceland, a shallow, eutrophic lake with high inputs of nutrients from warm and cold springs, resulting in high abundances of chironomid midges (Diptera) that periodically emerge from the lake. In this study, we examined the effect of chironomid-input and topography on terrestrial vegetation patterns and community composition around Lake Mývatn. Sampling included vegetation data on 17 sites at different distances to the lake with a total of 186 vegetation plots. Additionally we collected environmental variables. The effect of chironomids on vegetation was calculated as a function of water area and distance to the lake ('midge fetch') to estimate chironomid, long-term infall trap data were used as reference. Plots with highest midge fetch were rather species poor, showing high abundances of species with high nutrient tolerance (e.g. *Poa pratensis*, *Taraxacum officinale*, *Ranunculus acris*, *Rumex acetosa*). With increasing distance and decreasing midge fetch community composition changed completely with a total species turnover after only 150 m distance to the lake. At 500 m distance, shrubs and perennial herbs dominated (e.g. *Calluna vulgaris*, *Betula nana*, *Arctostaphylos uva-ursi*). Species richness was highest at intermediate distance to the lake. As hypothesized, midge fetch explained most of the variation in vegetation patterns, indicating the importance of nutrient transport from aquatic to terrestrial ecosystems.

Microorganisms from Antarctic benthic biotopes in the water area of the Argentine Islands, Graham Land, West Antarctica

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Gastropod mollusks *Nacella concinna* and bottom sediments samples were collected at different depths (1 m, 3 m, 5 m, 6 m, 8 m, 10 m, 12 m, 16 m) in the water area of the Vernadsky Station (Argentine Islands) at Meek Channel, Skua Creek and Stella Creek straits, coast of Uruguay Island, Grotto Island, Cape Marina Point and the Pitt Island (at the north end of the Biscoe Islands). The strains were isolated from soft tissues, intestinal tube of molluscs, and bottom sediments. The 38 pure bacterial mollusk-associated cultures were studied. Microorganisms at an average of 10^5 CFU/g were isolated from all specimens. Mollusk-associated microflora is halophilic, psychrophilic and mesotolerant (growth at +4°C and +18°C). Isolated bacteria are represented mainly by gram-negative rod-shaped bacteria (56%), as well as cocci and single gram-positive rod-shaped bacteria (7%). 95% of the strains have oxidase activity, and some have pronounced agarase activity. Cell morphology was studied using confocal microscopy. The protocol for extraction genome, program for 16S rRNA gene amplification were modified for DNA barcoding of mollusk-associated bacteria (most likely symbiotic microflora).

What is hidden in reindeer's droppings? A botanical and parasitological study.

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Newly emerged stands in the Arctic, e. g. glacier forelands or riverbanks are typical primary succession stands. Dispersal of diaspores in the Arctic is rather limited due to adaptations to arctic conditions. We wanted to find out, whether reindeer could serve as seed vector via their excrements and thus enhanced species succession. An additional question was if they serve as carriers of intestinal parasites as there are not many studies about intestinal parasites of terrestrial vertebrates in Svalbard. To answer both questions, excrements of Svalbard reindeer (*Rangifer tarandus platyrhynchus*) were collected during several seasons in Svalbard. Samples were subsampled for parasitological examination and the rest was left for seeds analysis.

Faeces were diluted in KOH solution, washed through a 0.25 mm mesh sieve and analyzed for the presence of seeds. Undamaged seeds of *Draba* sp., *Chrysosplenium tetrandum*, or bulbils of *Polygonum viviparum* were found most often. According to the preliminary results, the reindeers could serve as proper vectors of seeds. Moreover, the droppings could help the establishment of seedlings in newly exposed terrain by providing nutrients and substrate for growth.

For the parasitological study, the samples were concentrated by sedimentation and flotation and then examined by microscopy. The molecular diagnostic was used for detection of protists. The molecular detection proved the presence of cryptosporidia (*Cryptosporidium muris* TS03) and microsporidia (*Enterocytozoon bieneusi* – new genotype, *Encephalitozoon cuniculi* – genotype II). Based on findings we can conclude that intestinal parasites transmitted through faecal-oral rout are able to survive in those extreme polar conditions.

Trematoda of the family Hemiuridae in Svalbard

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This research is focused on the hemiuroid trematodes in fishes and chaetognaths on Svalbard. The Hemiuridae is a large family of trematodes with numerous subfamilies mainly from marine fishes, commonly found in their gut. They occur widely throughout the world's oceans. Even though this family is widely studied there are no many studies from Svalbard. The first study on the progenetic metacercaria in chaetognaths on Svalbard was published by Rolbiecki & Walkusz (2005). *Hemiurus levinseni* (Odhner, 1905) was found by Szuks, Lorenz & Steding (1978) in fishes on Svalbard.

During summer 2018 and 2019 the samples were collected in Longyearbyen and Petunia bay. In total 55 out of 322 examined fish from 6 families (Cottidae, Pleuronectidae, Clupeidae, Gadidae, Osmeridae, Stichaeidae) were infected. There were also examined intermediate hosts like *Euspira pallida* and chaetognaths of genus *Pseudosagitta*. Morphological characterization and phylogenetical analyses based on 28S rDNA will be used for identification of obtained individuals.

The trematodes were dissected out from fresh fish, gastropods and chaetognaths and fixed by formaldehyde or ethanol. For morphological characterization, Mayer's hematoxylin was used. The DNA will be extracted by the phenol-chloroform method from individuals fixed by ethanol. Partial sequences 28S rDNA will be amplified using PCR and compared with hemiuroids species from the NCBI GenBank database. The surface morphology was studied using SEM.

In total 55 out of 322 examined fish were infected with hemiurid flukes. The highest prevalence was recorded in species of the family Gadidae (*Gadus morhua*, *Boreogadus saida* and *Melanogrammus aeglefinus*). The second highest prevalence was recorded in *Hippoglossoides platessoides* (Pleuronectidae). *Myoxocephalus scorpius* (Cottidae) was infected rarely. Although the morphological characterization of samples is not finished yet we found at least two different species. The phylogenetic analysis will be carried out in the near future.

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Permafrost thawing and changes in the water regime of palsa mire. How it influences on peat soils properties?

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Predicted climate change causes permafrost degradation and changes in soil moisture regime of palsa mire. It will lead to a change in soil organic matter mineralization rate, additional CO₂ efflux into the atmosphere and can increase the transfer of dissolved organic matter into aquatic ecosystems. The aim of this work is to study the effect of soil moisture dynamics on organic matter mineralization rate of palsa mire peat soils.

In August 2018 soils were studied in the north of Western Siberia (Russia). An experiment was conducted to study the influence of wetting / drying on the peat soil properties. Soil samples were transplanted from dry conditions of the palsa to wet conditions and vice versa. A year later, samples were taken from displaced soils for analysis of dissolved organic nitrogen (DON), basal (BR) and substrate-induced respiration (SIR) in laboratory.

Established that after wetting of soil samples efflux of CO₂ increased by 1.3 times, and after drying of soil samples decreased by 1.8 times. The biological activity (DON, BR, SIR) of wetted samples increased significantly (2-4 times). In the dried samples, there was a decrease in biological activity (1.5-4 times). Dissolved organic carbon (DOC) didn't change.

In the case of permafrost thawing and a change in palsa mire moisture regime, possibly peat soils moisture content will increase or decrease. Both options will lead to a significant change in peat soils biological activity.

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An ice-covered sub-Arctic fjord – Glimpse into the future of Svalbard fjords?

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Freshwater discharge into the ocean from melting glaciers and permafrost is predicted to increase significantly due to rising temperatures in Svalbard. The freshwater input adds nutrients, but also increases the turbidity and stratification in fjord systems, effecting the biomass and composition of microalgae.

As the freshwater is less dense, it stays on top of the water column. It increases the chance of sea ice formation during winter but could in turn act as a physical barrier for microalgae to reach the ice. Furthermore, freshwater ice lacks the feature of brine channels, thus making it inhabitable for microalgae. We hypothesize that a seasonally ice-covered sub-Arctic fjord can be used as a model site to predict future scenarios in Svalbard fjords.

We will test our hypotheses by studying the stratification, microalgal community structure and biomass, gel particles, and nutrient concentrations along a transect from the inner to the central part of the fjord.

Sea ice and water in Ramfjorden (Troms, Norway) was sampled from January to April 2019. Ramfjorden is characterized by a freshwater layer beneath the ice (salinity of 1.5 to 2.8), and low brine salinity and percent volume, ranging from 0.0 to 23.9, and 0.0 to 5.0 in the lower three cm of ice, respectively. In addition, no skeletal layer was observed.

A comparison with the high-Arctic fjord Billefjorden (Svalbard), shows great similarity in sea ice physics and water column stratification right in front of the tidewater outlet glacier Nordenskiöldbreen. In contrast, sea ice in the center of Billefjorden formed a skeletal layer with visible microalgal biomass (under-ice water salinity 36.4), and brine salinity and percent volume of 41.3 and 16.2, respectively.

With increasing freshwater discharge to Svalbard fjords, sea ice associated microalgal biomass could be significantly reduced, leading to a food-limited habitat for higher trophic levels in early spring.

Scandinavian types of beaded stream ecosystem

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Long time field experiences from different subarctic-subalpine localities of Scandinavia (Abisko, Kilpisjärvi, Pallas – Yllastunturi) and Scotland respectively, lead us to preliminary description of Scandinavian types of beaded stream ecosystem. They stay in between arctic beaded stream ecosystem known from continuous permafrost areas of North America and Siberia and „mountain“ beaded streams ecosystem, which has been described in middle european Krkonoše Mountains - area without permafrost. Four subtypes reflecting climatic conditions and character of terrain (including discontinuous or no permafrost at all) can be distinguished: beaded streams connecting 1) with active large tundra polygon system in the vicinity of lakes, 2) with active small stony polygons on basis of seasonal snowfields, 3) with probably former tundra polygons, contemporary in form of zigzag streams flowing from the lake, 4) on vegetated slopes as mostly seasonally occurring phenomenon (in time of spring snow thawing or heavy rainfall). The age of organic base of soil profile of subtype 4 in Kilpisjärvi got to 4557 ± 65 cal. BP, in Pallas-Yllastunturi to 3429 ± 41 cal. BP.

Cyanobacteria in the lake benthic microbial mats around Showa station, East Antarctica

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Microbial mat is an important microflora in the Antarctic ecosystem. Microbial mat is mainly dominated by cyanobacteria and/or microalgae. The cyanobacterial diversity and ecological functions in East Antarctica have not fully understood. Here, some of us participated in the 60th Japanese Antarctic Research Expedition. The sampling campaign was conducted at five coastal lakes around Showa station in Skarvsnes region, East Antarctica, in January 2019. The studied lakes varied in geological and physicochemical properties. We got sedimental sampling collections from these lakes. In order to estimate the cyanobacterial cell biovolume and community composition of each lake, the morphological method was applied under epifluorescence microscopy. Our observation showed some cyanobacterial genus, such as *Leptolyngbya* sp., *Anabaena* sp. and *Nostoc* sp. We will apply the following analysis, nitrogen fixation analysis and molecular method to acquire more understanding of cyanobacterial diversity and their function.

Diversity and life cycles of trematodes from family Opcoelidae in Svalbard

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Family Opcoelidae is the largest family of trematodes, which contains around 900- 1000 identified species (Bray et al. 2016). Distribution of the family is cosmopolitan and many species are abundant even in the Arctic Ocean, where is their diversity and distribution poorly studied. The samples containing larval stages were collected from whelks (family Buccinidae; Gastropoda, especially *Buccinum undatum* and *B. glaciale*) and adult stages from the two most abundant species of fish (sculpins *Myoxocephalus Scorpius* and *Gymnocanthus tricuspis*) in Petunia bay, Isfjord, Svalbard. The prevalence of larval stages in whelks was around 30% and adult stages were in 70- 80% of sculpins. For species identification both morphological analysis (carmine and haematoxylin staining, SEM) and phylogenetic analyses based on 28S rDNA were used. The analyses revealed 2 species of opcoelid trematodes ***Podocotyle atomon*** (Rudolphi, 1802) Odhner, 1905 from *M. scorpius* and *B. undatum* and ***Anomalotrema koiae*** Gibson & Bray, 1984 from *G. tricuspis* and *B. undatum*. During the study there was also recorded one species of trematode from family Fellodistomidae *Steringophorus furciger* (Olsson, 1868) Odhner, 1905 from *G. tricuspis*.

Institute Julius von Payer for Subarctic and Arctic Research

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In recent years, students and teachers of the Faculty of Environment have repeatedly visited and established contacts with educational and research institutions in Northern Europe that deal with the issues of subpolar and polar regions. These were mostly universities and polar stations in Iceland, the Faroe Islands, Finland, Sweden and Greenland. The Faculty of Environment met the requirements for internationalization of its activities and established a project team to study cold regions of Northern Europe.

The newly founded institute is named after the North Bohemian native Julius von Payer. This important geographer and polar explorer was born in 1842 in Teplice-Šanov. During his explorations of the Arctic he discovered the archipelago of Franz Josef Land, where he named, among others, the Gulf of Teplice and the Island of Šanov.

In addition to targeted research, the Institute's main goal will be to popularize the activities of individual team members and to organize meetings of similarly interested specialists. The Payer Institute plans to involve academics across the faculties of the J. E. Purkyně University and to cooperate with external researchers.

At present, the Institute focuses on research activities in the Subarctic region, a geographical area near the Arctic Circle but not exceeding it towards the north. So far, the first key topic has been addressed - *Subarctic Undisturbed Regions – Transdisciplinary Utility Research (SURTUR)*. Other topics will follow.

For more info see <https://www.fzp.ujep.cz/en/institute-julius-von-payer-for-subarctic-and-arctic-research>.

Vertical distribution of zooplankton in the Bransfield Strait (Antarctic Peninsula) at early austral summer 2018

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Vertical profile of zooplankton abundance in the upper 200 m in the Bransfield Strait was studied from 13 to 18 November 2018 during the early austral summer. The data based on four stations 1828, 1827, 1825 and 1735 according to the protocol of international krill synoptic survey in CCAMLR subarea 48.1 in 2019. Stratified samples were collected using WP2 net (0.25 m², 150 µm) with digital flow meter and messenger operated closing Nansen mechanism at layers 0-40, 40-100, 100-200 m. 44 taxa were identified. The highest abundance of zooplankton is observed at the middle layer (40-100 m). The dominant species, *Oithona similis*, was reached 4655 and 3980 ind m⁻³ at the stations 1827 and 1735, respectively, at the middle layer. The lowest abundance have meroplanktonic species which were found sporadically only in samples from shallow stations (1828 and 1825). Naupliar stages were equally distributed throughout the water column. Pulled together, the copepodite stages of small sized copepods of genera *Clausocalanus*, *Scolecithricella*, *Ctenocalanus* and *Microcalanus* were also numerous with up to 1700 ind m⁻³ while the maximal number of adults of these species was 10 times less (e.g. 160 ind m⁻³ for *Scolecithricella minor*). Average abundance of bigger species like *Calanus* spp., *Calanoides acutus*, *Rhincalanus gigas* were varied from 9 to 36 ind m⁻³ per station. Some species as *Subeucalanus longiceps*, *Aetideus armatus*, *Candacia* sp. and *Racovitzanus antarcticus* were rare and presented only in the deeper layer 100-200 m in small numbers 1-3 ind m⁻³. Euphausiacea at calyptopis and furcilia stages were present at all stations and strata.

Green microalgae in polar lakes: diversity, biogeography and methodology comparison

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Due to extreme conditions, photoautotrophic microbes are dominant primary producers in polar habitats. Together with cyanobacteria and diatoms, green algae (Chlorophyta) are important components of these communities, but their diversity is still poorly understood. Use of combination of traditional approach, based on light microscopy and Sanger sequencing of isolated strains and molecular methods and amplicon sequencing (Illumina) allows us to study in detail the diversity of the whole community. Disadvantage of the first approach is that there is a lot of species which are uncultivable and for molecular methods in general there could be a problem with absence of reference sequences in databases.

This study is based on more than 100 samples from lakes in the Arctic (Svalbard, Greenland) and Antarctica (Antarctic Peninsula, continental Antarctica). 18S rDNA and ITS2 were used in both Sanger and Illumina sequencing. Use of 18S rDNA allows us to study samples on generic level and there are more sequences in databases, on the other hand ITS2 is more variable, it allows us to study samples on species level, but there is lack of sequences in the databases. Preliminary analysis of ITS2 data showed a high number of OTUs namely from the classes Chlorophyceae and Ulvophyceae. We expect that amplicon sequencing will yield more species than isolation and Sanger sequencing and that there will be low proportion of genera detected by both morphological and molecular data. We also hypothesize that there will be higher biodiversity in the Arctic, but potentially endemic species will be more abundant in Antarctica.

The Influence of Snow Cover on Soil Temperature in Western Siberia

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Snow cover is an important environmental factor having a significant influence on the soil temperature. Temperature regime affects many soil properties and processes. Thickness of the snow cover determines the depth and speed of the processes of freezing and thawing of soils, the dynamics of permafrost.

The aim of the study is to evaluate the effects of snow cover on soil thermal regimes in West Siberia.

The study area is located on the north of Western Siberia, Russia in discontinuous permafrost zone within the area of distribution of the northern boundary of the taiga zone.

Measurements of snow cover and soil temperature were carried out with temperature loggers the Thermochron iButtons. They were laid on a four key areas that correspond to the four ecosystems: the pine forest, on top of old frozen peatland, the young frozen peatland (in the depression and microelevation).

The maximum snow cover thickness (> 80 cm) and the duration (~ 8 months) were recorded in the forest and in the depression on the young frozen peatland. The minimum of snow cover thickness is observed on the elevated elements, where there is a closer occurrence of permafrost. A significant thermal insulating effect is provided by snow with a thickness of more than 20 cm. This indicator is most appropriate for snow cover characterization. The temperature regime of the lower soil horizons is greatly influenced by the presence and depth of permafrost.

Reproductive traits of arctic plants

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Arctic plants frequently reproduce by vegetative means, yet with ongoing climatic changes driven largely by rising temperatures a balance between sexual and vegetative reproduction is shifting. Warming experiments indicate positive effects on arctic plant reproductive traits, i.e. greater reproductive effort and especially reproductive output, which can be crucial in the life of plants and would probably determine survival and migration possibilities for many species in the near future.

In a recently started Ph.D. project we plan to examine existing reproductive traits of plant species naturally occurring in central Svalbard as well as of those growing under experimentally warmed conditions. We ask on a versatility of (vegetative and) reproductive traits using traits of F1 generation plants from both controlled and warmed conditions.

Greater reproductive effort under warmer climate may also lead to changes in tundra community composition due to migration of new species. We hence ask on a relative importance of dispersal limitation and habitat quality for species occurring in naturally warmer locations neighbouring warmed experimental plots.

Finally, reproductive output of plants grown at warmer conditions is also driven by survival in future environmental conditions. Therefore, ecophysiological limits of plants germinating from seeds formed under warmer conditions will be assessed.

A set of both field and laboratory manipulative experiments (reciprocal transplants, common garden) to approach these goals will be presented.

Predator recognition during nest defence by arctic tern (*Sterna paradisaea*).

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Arctic tern (*Sterna paradisaea*) is known for its vigorous nest defence, it does not hesitate to attack even much larger intruders like arctic fox (*Vulpes lagopus*), polar bear (*Ursus maritimus*) and even human. As their nest is defenceless, the intensive antipredatory behaviour of the parents importantly increases its survival and therefore their own fitness. Nevertheless, the antipredatory behaviour including physical attacks to the intruder is very energy and time-consuming activity, which threatens the parents' lives. Therefore, we would expect that harmless intruders like waterfowl should not be attacked. Additionally, the arctic tern population on Svalbard archipelago faces a limited spectrum of predators as e.g. raptors, owls and corvids do not occur there. In the present study, we tested the behaviour of parents of arctic terns during presentation of dummies at their nests. We presented textile dummies of peregrine falcon (*Falco peregrinus*), a common predator of adult terns not breeding in Svalbard; greater black backed gull (*Larus maritimus*), a common predator of tern nests breeding in Svalbard; common raven (*Corvus corax*), a common predator of tern nests not breeding in Svalbard; common eider (*Somateria mollissima*), a common harmless bird; and human intruder. All intruders were presented two meters from the nest of solitary breeding arctic terns within the area of Longyearbyen, the main human settlement in Svalbard. We showed that terns attack human and gull the most, while the others were attacked equally scarce. This suggests that predators, not occurring in Svalbard, are not recognized as threat by arctic terns.

Homologs of β -tubulin 2 of *Trichostrongylus tenuis* in arctic helminths

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Trichostrongylus tenuis is helminth which parasitizes on Arctic and Subarctic birds like black brants and white-fronted geese. High levels of infection can cause significant reductions in both breeding success and direct mortality. It has been shown that this parasite is largely responsible for the cyclical fluctuations of animal numbers. The parasite is most prevalent when animal stocks have been high, but it may reduce breeding success on low-density moors.

One of the stress-tolerance factors of *T. tenuis* is β -tubulin 2, which has been shown to correlate with resistance to antimicrotubule agents such as taxanes and vinorelbine. The selective toxicity of these agents against helminths results from their higher affinity for parasite β -tubulin than for the same target in higher eukaryotes. Also β -tubulin 2 can participate in the coupling of ATP-ADP translocase and mitochondrial creatine. The aim of this research was to detect homologs of β -tubulin 2 of *T. tenuis* in arctic helminths. Amino acid sequences of *T. tenuis* β -tubulin 2 were taken from the database (<https://www.genome.jp>). By mechanism of “SSDB” the homologs of *T. tenuis* β -tubulin 2 were detected in animal parasites *Haemonchus contortus*, *Ancylostoma duodenale*, *Teladorsagia circumcincta*, *Cyathostomum carinatum*, *Cylicocyclus nassatus* and plant parasite *Bursaphelenchus mucronatus*. The obtained data will be useful in the helminth biodiversity researching and detecting of their resistance properties.

Organic carbon compounds of the palsa catchment (Western Siberia, Russia)

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Permafrost-affected peat soils represent a significant terrestrial carbon store. The carbon fluxes in the palsa catchment can be represented as follows: atmospheric CO₂ is fixed during photosynthesis and is stored in the underground biomass and organic matter of the soil. Then it decomposes with the formation and subsequent release of greenhouse gases. Also, organic carbon loss are possible due to lateral runoff with water flows. The aim of the work was to assess the redistribution of organic carbon compounds in the soil and water flows of the palsa catchment. The research site (Nadym, Russia) was located in discontinuous permafrost zone (north taiga). In the natural waters 3 types of carbon were determined: TOC, DOC and POC; in soil extracts WEOC was measured.

The palsa catchment is characterized by high spatial variability of all properties. This is especially affected by the permafrost table relief, which controls the accumulation and redistribution of organic carbon compounds. DOC content is correlated with the soil temperature ($r = -0,72$, $p\text{-level} < 0,05$). The maximum DOC values (up to 100 mg/l) are characteristic for the border of peat bog. The carbon exchange processes are most active at this location.

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The about JARE (Japanese Antarctic Research Expedition) and nature, research of around Japanese station in Antarctica

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Japan is one of the countries with bases in Antarctica and has been researching in Antarctica for 60 years. Around the station, there are mainly three areas (Langhovde, Skalbsnes, Skallen) known as fertile environments, where research has been conducted mainly. The Langhovde area has biggest moss community and this area is one of the ASPA (Antarctic Specially Protected Area). The Skarbsnes has many lakes and each lake has different characteristics. In Langhovde, moss diversity has been studied. Moss pillar is known as a famous discovery. In Skalbsnes, the characteristics of each lake have been investigated. Also, the around station area has big penguin lucerries, and research on the population variation and behavioral ecology of Adelie penguins has been conducted. We are still doing interesting research.

Deglaciation of small High Arctic catchment and its influence on ecosystem

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Advancing global warming is highly visible in the High Arctic. As the result of rising temperatures we see glaciers melting and its influence on the ecosystems in their surroundings. Decreasing ice surface affects water and thermal regimes, provokes geomorphological processes, as mass movements and erosion, vegetation succession and progress into highest altitudes and before unavailable for growing places. All these processes and activities can be observed in smaller Arctic catchments. One of the example of such catchment may be Bratteggdalen where the research was carried out. Bratteggdalen, is a small high arctic valley in Wedel Jarlsberg Land on SW Spitsbergen, nearby which is located Polar Station of University of Wrocław named Baranowski Polar Station. The upper part of the valley is occupied by a small cirque glacier – Bratteggbreen, which is in the final stage of deglaciation. Thus, we can observe ongoing changes in the area of the glacier. Deglaciation provoked setting-up of a small lake in the foreground of a glacier, also advancing flora and slidings of weathered material can be observed. What is more, a river, Bratteggelva, crossing over the whole valley is powered by outflowing water from Bratteggbreen. Its regime is highly dependent on the glacier existence. Whole ecosystem in the valley, is strongly related to the Bratteggbreen retreat. Consequently the area taken by the glacier influence ecological processes occurring in the valley.

PARTICIPANT LIST

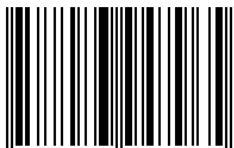


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