



## PREFACE

### **Petuniabukta, Billefjorden in Svalbard: Czech-Polish long term ecological and geographical research**

The Czech research team has been invited to participate in the Arctic climate and biological diversity programme which has been proposed as an interdisciplinary (biology and climatology) research project. This research programme has been prepared under the auspices of the International Polar Year (IPY 2007–2008). The project has been proposed with an aim to explore the diversity of both climates and ecosystems, at the landscape scale within the Arctic region by applying new intensive measurements of key biological and physical variables and processes at multiple circum-Arctic observation sites. In 2005, the Norwegian Polar Institute (Dr. Jon Børre Ørbæk) started to prepare and coordinate the project. Sixteen countries (research teams, among them the Polish and Czech research groups) has participated in the project.

At the beginning of the project (2007), the Czech research team established a small research station in a temporary research containers located at the port jetty of Pyramiden, the old Russian coal mining town (Fig. 1) in the central part of Svalbard (Isfjord, Billefjorden, Petuniabukta, Fig. 2). In addition, the Russian coal company *Arktikugol* has give us an access to their old house (Petuniahytta, Fig. 3) for several research seasons. Petuniabukta area was choosen because of a need to include the central part of the Svalbard archipelago in the mentioned above multidisciplinary international research project. From the beginning of the project, it was a great privilege and honour for the Czech research group to find that colleagues (mostly geographers) from Adam Mickiewicz University in Poznań (Poland) have been working in the same area since 1984. It was a matter-of-course that the Polish and Czech research groups developed a close research collaboration.

The expeditions of Adam Mickiewicz University in Poznań to Petuniabukta during the 1980's were mainly focused on paleogeographical studies, with less attention paid to contemporary geomorphological processes in the Petuniabukta basin (see *Polish Polar Research* 10 (3), 1989). Since 2000, every summer the campaigns have been organized, using the old cabin Skottehytta, located on the eastern coast of the bay in agreement with the Svalbard Governor Office (Fig. 4). Several



Fig. 1. Temporary research containers of the Czech Arctic team located on the port jetty of the old Russian coal mining town Pyramiden.

projects concerning geo-ecology and geology, both in terrestrial and marine environments, have been completed before and during the 4<sup>th</sup> International Polar Year 2007–2008. According to the changes in cultural heritage protection regulations in Svalbard, since 2010, new organization of fieldworks were applied, crowned by setting up the containers of Adam Mickiewicz University Polar Station, located in the neighbourhood of Skottehytta (Fig. 5).

During four summer seasons (2007–2010), the Czech research team (represented by three institutions: the University of South Bohemia in České Budějovice, the Institute of Botany, Academy of Sciences of the Czech Republic, and the Masaryk University in Brno) has been working on the following research tasks:

- investigate biological variability – diversity – productivity parameters modified by abiotic parameters at the same habitat sites;
- investigate climate variability modified by physical processes in the atmo-, pedo- and hydro-cryosphere on several different scales;

Within the last research projects carried out by the Polish group, during the years 2008–2010, the investigations embraced three main directions of activities:

- give a background of environmental studies in the scope of meteorological and bioclimatic conditions related to local and regional patterns of geoecosystems functioning;



Fig. 2. The coasts of Petuniabukta with Ebba and Nordenskjöld glaciers in the background.

- investigate the reaction of the cryosphere on environmental changes, especially in the scope of its most sensitive element constituted by glaciers ice masses;
- quantify the energy and matter circulation in the geocosystem as the expression of environmental changes dynamics.

The landscape surrounding the selected locality (mostly the Petuniabukta area) offers a diverse environment in which several transects from glacial fronts up to seashore are available. The terrestrial area covers diverse microbial and plant communities (glaciers, snow fields, ice and soil deserts, barren deglaciated soils, various vascular plant, moss, lichen and soil crust communities, lentic and lotic wetlands).

Of the cyanobacterial diversity in the terrestrial part of Petuniabukta, eight distinct habitats of different species composition with more than 80 morphospecies were recognised. Only about 1/3 of the morphospecies have been described up to now (Komárek *et al.*, this issue). Strunecký *et al.* (this issue) isolated 25 strains of *Phormidium autumnale* (filamentous cyanobacteria) in various habitats across Svalbard and compared their genetic identity (16S rDNA and 16S-23S rDNA) with available strains from surrounding regions. The results showed that the Svalbard strains were identical with strains originating from Ellesmere Island (Canadian Arctic) and Abisko (Northern Sweden). The rate of colonization of *Ph. autumnale* from various habitats is relatively high and Strunecký *et al.* (this issue) suggested that geese could be the main transition vector bringing new genotypes



Fig. 3. Petuniahytta – the Russian coal company *Arktikugol* old house used by the Czech Arctic research team.

from surrounding lands to Svalbard. The vegetation and flora (vascular plants, mosses and lichens) of the Petuniabukta area were described at various spatial scales, including distinguishing vegetation units, by Prach *et al.* (this issue).

On the basis of these research papers describing plant diversity and their spatial distribution in the Petuniabukta area, additional research focused on the functional ecology and ecophysiological features of selected plant species (Elster *et al.*, this issue; Klimešová *et al.*, this issue; Barták *et al.*, this issue) was conducted. Climate change significantly influences current temperature and moisture conditions in Arctic ecosystems. In a field experiment, Elster *et al.* (this issue) simulated warming effects on Arctic wetlands. Three passive open-top chambers and three control cage-like structures equipped with soil temperature and soil volumetric water content probes for continuous microclimatic measurements were installed in a wet hummock meadow. The warming effects on ecophysiological features in cyanobacterial colonies of *Nostoc commune* s.l. were investigated. This species plays an important role in the local carbon and nitrogen cycles. The ability to grow clonally is generally considered an important feature of Arctic vascular plants. Klimešová *et al.* (this issue) assessed the clonal growth of 78 plant species in the Petuniabukta area. These authors distinguished five categories of clonal growth organs and showed that clonal plants prevailed in wetland habitats. Diurnal ecophysiological parameters of photosynthesis, effective quantum yield of photo-





Fig. 4. Skottehytta – the base of Adam Mickiewicz University in Poznań (Poland) expeditions between 1984 and 2009.

system II and the photosynthetic electron transport rate were measured in three dominant species of the Arctic tundra (*Silene acaulis*, *Dryas octopetala*, *Salix polaris*) by Barták *et al.* (this issue). In all species, the photosynthetic electron transport rate was related to incident photosynthetically active radiation and leaf temperature.

Plant diversity and functional ecology, as well as studies concerning the eco-physiological features of selected plant species, were extended to paleoecological studies (Bernardová and Košnar, this issue) and vegetation succession on the deglaciated landscape of the Petuniabukta area (Prach and Rachlewicz, this issue). The Czech contribution to this special issue of *Polish Polar Research*, which describes the present ecological state of the Petuniabukta area in central Spitsbergen, was followed by monitoring of the principal climatic components (Láska *et al.*, this issue). Following previous experiences in the subject of the post Little Ice Age 20<sup>th</sup> century deglaciation patterns, Prach and Rachlewicz (this issue) discuss possibilities of biotic development of new born surfaces. Similar problems addressed to bioclimatology were undertaken in the research within large post-glacial and partly glacier covered valley – Ebbadalen on the eastern coast of Petuniabukta. Climatic and environmental conditions descriptions met in works connected with glaciological problems and catchment-based studies, with references to chemical and mechanical denudation. However, this last more geographical part of the re-



Fig. 5. Adam Mickiewicz University in Poznań Polar Station, built in 2011 on the eastern coast of Petuniabukta.

sults, closely related with research provided by our colleagues from Poznań University, will be introduced separately, within the forthcoming issues.

Since 2007, the Czech Arctic research in Petuniabukta, Billefjorden, central part of Svalbard has been sponsored by the Ministry of Education, Sports and Youth of the Czech Republic under the following research projects:

- Biological and Climate Diversity of the Central Part of the Svalbard Arctic Archipelago (INGO LA341);
- Czech Polar Project – Czech Polar Stations: Construction and Management (LM2010009);
- Creation of the Working Team and Pedagogical Conditions for Teaching and Education in the Field of Polar Ecology and Life in Extreme Environments (CZ.1.07/2.3.00/20.0064, co-financed by the European Social Fund).

The Polish group has been working since 2008 within two projects sponsored by the Ministry of Sciences and Higher Education of Poland:

- Research network *Multidisciplinary research of polar regions geo-biosystem* (35/E-41/BWSN-0081/2008).
- The functioning of the geoecosystem of Petunia Bay (Billefjorden, Central Spitsbergen), existing hazards and possibilities of protection (N305 098835).

The following research papers were also published during the research project. These papers supplement information given in this special issue:

- BEDNORZ E. and KOLENDOWICZ L. 2010. Summer 2009 thermal and bioclimatic conditions in the Ebba Valey region. *Polish Polar Research* 31 (4): 327–348, doi: 10.2478/v10183-010-0009-x.
- KVÍDEROVÁ J., ELSTER J. and ŠIMEK M., 2011. In situ response of *Nostoc commune* s.l. colonies to desiccation, in Central Svalbard, Norwegian High Arctic. *Fottea* 11 (1): 87–97.
- MAŁECKI J., BUCHWAŁ A., RACHLEWICZ G., RYMER K., STRZELECKI M. and WAWRZYŃIAK T. 2011. Environmental studies in northern Billefjorden – Institute of Geoecology and Geoin-

- formation A. Mickiewicz University 15<sup>th</sup> Expedition – Svalbard 2010. In: G. Rachlewicz and K. Małecki (eds) *Institute of Geoecology and Geoinformation A. Mickiewicz University Polar Reports, Vol. 1*. Bogucki Wydawnictwo Naukowe, Poznań: 52 p.
- PRACH K., KOŠNAR J., KLIMEŠOVÁ J. and HAIS M. 2010. High Arctic vegetation after 70 years: a repeated analysis from Svalbard. *Polar Biology* 33: 635–639, doi: 10.1007/s00300-009-0739-6.
- RACHLEWICZ G. 2010. Paraglacial modifications of glacial sediments over millennial to decadal time-scales in the high Arctic (Billefjorden, central Spitsbergen, Svalbard). *Quaestiones Geographicae* 29 (3): 59–67, doi: 10.2478/v10117-010-0023-4.
- RACHLEWICZ G., KOSTRZEWSKI A., MARCINIAK M., SZPIKOWSKI J. and ZWOLIŃSKI Z. 2012. Function of contemporary physical-geography processes in polar regions (Dickson Land, Svalbard). In: P. Churski (ed.) *Contemporary issues in Polish geography*. Bogucki Wydawnictwo Naukowe, Poznań: 95–110.
- REDCHENKO O., KOŠNAR J. and GLOSER J. 2010. A contribution to lichen biota of the central part of Spitsbergen, Svalbard Archipelago. *Polish Polar Research* 31 (2): 159–168, doi: 10.4202/ppres.2010.09.
- STRUNECKÝ O., ELSTER J. and KOMÁREK J. 2010. Relationship in geographically separate *Phormidium* like cyanobacteria: Is there a link between north and south Polar Regions? *Polar Biology* 33: 1419–1428, doi: 10.1007/s00300-010/0834/8.

Finally, we would like to thank the Committee on Polar Research of the Polish Academy of Sciences and the Editors of *Polish Polar Research* for their support for the idea of this special issue. We also appreciate the help given by Keith Edwards for language revision.

Josef ELSTER<sup>1</sup> and Grzegorz RACHLEWICZ<sup>2</sup>

Guest Editors

<sup>1</sup> Centre for Polar Ecology, Faculty of Science, University of South Bohemia, Branišovská 31, CZ-37005 České Budějovice and Institute of Botany, Academy of Sciences of the Czech Republic, Dukelská 135, CZ-379 82 Třeboň, Czech Republic <jelster@prf.jcu.cz>

<sup>2</sup> Uniwersytet im. Adama Mickiewicza, Instytut Geoekologii i Geoinformacji, ul. Dzięgielowa 27, PL-61-680 Poznań, Poland <grzera@amu.edu.pl>