

CRYPTOGAMIC ORGANISMS AS A KEY COMPONENT OF THE VEGETATION OF SVALBARD: EDUCATIONAL AND TOURISM POTENTIAL

Project No 13\12

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The project was carried out in 2013–2015 and resulted in a guide-book about cryptogams in Pyramiden area, on Svalbard archipelago. Book consists of two parts: atlas of cryptogams, with short descriptions of species, and presentation of excursions in Pyramiden area, with special attention to cryptogams.

Why were chosen cryptogamic organisms?

Mosses, liverworts, lichens and cyanoprokaryotes are an essential part of ecosystems of Svalbard. Their diversity is much higher than that of vascular plants. Cryptogamic plants take important place in the natural life both of vertebrates and invertebrates; in the ecological succession and in sustainable environment of the Arctic. However, most people know little about these small and inconspicuous organisms. Our motivation was to introduce local residents and tourists to world of cryptogams, their biology, ecology, and role in arctic ecosystems.



Aplodon wormskjoldii (Hornem.) R.Br. often can be found near the skua nests (left)

Sauteria alpina (Nees) Nees – thallose liverworts one of the commonest in Svalbard (right).

Why is Pyramiden area?

A team of scientists from Polar-Alpine Botanical Garden-Institute includes internationally recognized experts in all groups of cryptogamic organisms. We have a large experience of study of bryophytes, lichens and cyanoprokaryotes in different parts of archipelago: on the West Spitsbergen, Nordaustlandet and Barentsøya. Area of the Pyramiden town was chosen because this territory has typical flora of cryptogams for carbonate and shale bedrocks, and abandoned

town gives opportunity to look at cryptogamic communities on all stages of secondary ecological succession. Moreover the area is easily accessible for visitors and there are a lot of attractive natural sites.



The scenic “town” of Odinfjellet

The memorial to the last ton of ore mined in the Pyramiden

How did we prepare a guide-book?

We collected the data for a book during two field seasons. We examined a wide range of habitats, collected samples of mosses, liverworts, lichens and cyanoprokaryotes, took pictures of cryptogams and ecosystems, made brief description of vegetation and habitat and determined location of specimens using GPS. Collected specimens were indentified in laboratory using light and dissect/ stereoscopic microscopes.



Collecting of bryophytes

And what is the result?

We found altogether 168 lichens, 147 mosses, 68 cyanoprokaryotes and 38 species of liverworts in Pyramiden area, including 4 lichens, 1 moss, 2 liverworts and 11 cyanoprokaryota new for archipelago.

40 lichens, 26 mosses, 19 cyanoprokaryota and 13 liverworts species were selected for the guide-book, both species that were widespread in the archipelago and some rare species.

Among them are inhabitants of the soil, silt, rocks or drift wood, the species growing in dry or wet habitats, settling on undisturbed and ruderal places, pioneer species of outcropping substrates and bare soil. There is presented brief descriptions of their morphology, taxonomic features, ecological preferences and occurrence in the archipelago and in the Pyramiden area.

The book is annotated and supplied with a Glossary.

Answering the demands of growing tourism activity in Pyramiden area we elaborated five excursion routes. They are designed in such a way that tourists can not only explore cryptogams but also enjoy amazing places and interesting unusual bedrocks and landscapes, look at anthropogenic objects. Following excursion routes, traveler can walk along the Sea and on various bedrocks (including sandstones, siltstones and gypsum), climb in the mountain to watch miraculous walls and towers of weathered outcrops and hike to river valleys to discover a variety of waterfalls.

What is outcome of the project for protection of Svalbard environment?

- The data on diversity of cryptogams in Pyramiden area can be used for landscape planning and as a base for environmental management, to avoid construction in areas of distribution of vulnerable bryophytes, lichens and cyanoprokaryotes.
- We found cryptogamic species included in the Norwegian Red List for Species: 1 lichens, 10 mosses and 2 liverworts. These data will be input in the Red List of Species for Svalbard.
- The project has implementation on mapping of red-listed species in the archipelago.
- Data about species ecology, frequency and distribution provide the basis for further monitoring of plants and lichens in changing environment, resulting from global climate change and anthropogenic influence.
- We offer attractive routes that specify well-defined goals and objectives for the excursion of tourist groups. The routes will streamline their movement to avoid trampling of slopes and valleys during the chaotic movement of tourists in surroundings of Pyramiden town. Designed one-day radial excursion routes, allow doing without undesirable camping in natural places, avoiding danger of possible polar bear attacks and negative impacts of trampling on ground cover.



Chroococcus subnudus
(Hansg.) Cronberg et Kom. New
cyanoprokaryota species for
Svalbard



Sarcosagium campestre (Fr.) Poetsch & Schied. Lichen species new for Svalbard and rare in the Arctic.

What are main recommendations to protect cryptogams in Pyramiden area?

Protection of cryptogamic organisms diversity on Svalbard goes along with a global objective of reducing the rate of biodiversity loss. Major principles on Svalbard flora management and area protection are laid down in Svalbard Environmental regulations, such as Environmental Act, issued in 2002 and revised in 2012 and Regulations relating to large nature conservation areas and bird reserves in Svalbard as established in 1973. In spite of the predominance of bryophytes and lichens in many arctic habitats, there is still far too little known how to assess threatened species in the Arctic, and what are principal threats for bryophytes, lichens and Cyanoprokaryota in the Arctic. We can still make only general suppositions regarding the consequences large-scale changes in climate may have for the distribution of cryptogams on Svalbard. Decreasing of number of habitats available for cryptogams leads to reduce of their diversity and occurrence. Fires, road construction, vehicle traffic and trampling probably have a significant negative impact in destroying of habitats and reducing diversity of cryptogams, just like of other plant species. Large-scale collecting also was reported among principal threats to mosses and lichens.

Among measures taken to preserve diversity of cryptogams in Pyramiden area are some general actions i.e. to prevent fires resulting from fuel poured or uncontrolled traffic. Specific actions to protect cryptogams include measures to preserve their habitats and improve their quality.

Among conservation proposals to maintain biodiversity in Pyramiden area is to keep variety of habitats for bryophytes and lichens – for example not to remove decaying logs, animal remains, dungs, etc., especially from the area of delta of Mimerelva river. We recommend not destroying the colony of kittiwakes at an abandoned building in the outskirts of Pyramiden. Bird droppings enrich here the soil with phosphates and nitrates. Mosses, which tend to avoid calcareous rocks, grow here together with ornithophilous species, and this increases the overall diversity of the area.

Moreover, this guide-book could raise new interest in study cryptogams of Svalbard, and new registers of species created by enthusiasts could help in their conservation.



Colony of black-legged kittiwake in an abandoned building



Ornithogenic vegetation under a colony on an abandoned industrial building

What is social benefit of the project?

- The guide-book will attract attention to cryptogamic organisms as key components of the Arctic ecosystem, which are little known to the public. This allow them to look at the wildlife more comprehensively and objectively recognize the interconnectedness and interdependence of all natural objects and will contribute to the formation ecological scientific worldview. It will serve as a tool for environmentally friendly activities on archipelago.
- Results of the project can be used by botanists and ecologists in further studies of diversity on Svalbard archipelago.
- Information on the structure, biological characteristics and ecology of many species of mosses, lichens and cyanoprokaryota expands cognitive component of eco-tourism on Svalbard, thereby increasing its attractiveness and promoting environmental education of local people, tourists and their guides.



Some mosses readily grow on artificial substrates (left) and *Cerastium alpinum* flowering inside a jar, as in miniature glass-house (right).

The results of our work in Pyramiden area were published:

<http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22Vedlegg3.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274505251516&ssbinary=true>
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