MOSSES ON GLACIERS OF SVALBARD

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In 2002-2009 while studying many glaciers on Vestspitsbergen B. Mavlyudov found few moss populations on ice of Austre and Vestre Grønfjordbreen, Tavlebreen (Nordenskiöld Land), Bertilbreen, Svenbreen, Cambridgebreen, Mittag-Lefflerbreen (Dickson Land), Elfenbeinbreen (Sabine Land), Murray (Prins Karls Foreland).

Fig. 1. The localities of Svalbard, where mosses on glaciers ice were found.
Glaciers:
1 – Austre Grønfjordbreen
2 – Vestre Grønfjordbreen
3 –Tavlebreen
4 – Bertilbreen
5 –Svenbreen
6 –Cambridgebreen
7 – Mittag-Lefflerbreen
8 –Elfenbeinbreen
9 –Murraybreen

Few specimens of the mosses were collected and identified by O.Belkina: on Bertilbreen – *Paludella squarrosa* (Hedw.) Brid. and on Austre Grønfjordbreen – *Ceratodon purpureus* (Hedw.) Brid., *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs, *Sanionia uncinata* (Hedw.) Loeske, *Hygrohypnella polare* (Lindb.) Ignatov et Ignatova (*Hygrohypnum polare* (Lindb.) Loeske). They had a same growth-form – "large cushions". Some of them had a lenticular or spheroidal shape (that are known as «unattached mosses», «moss ball», «globous mosses»).

In August 2009 we studied the populations of two latter species on the northern gentle slope in ablation zone of the Austre Grønfjordbreen. The polsters lied on ice pedestals 2.5-10 cm high at a distance 0.3-10 m from each other and had average sizes 11cmx13 cm.

There was a cryoconite core inside every globular cushion. It consisted of very fine mineral grains (5.5-$14 \cdot 10^{-3}$ mm in size) and organic matter. Cryoconite grains covered moss leaves and stems in inner parts of polsters.

A habitus of all plants within one cushion was the same but sometimes was not similar in different cushions. So we consider plants to be brought onto the surface of the glacier repeatedly. A form of leaves of *Hygrohypnella polare* varied essentially, from concave to more flat, falcate to straight, obtuse to acuminate. Distinctions in different samples of *Sanionia uncinata* were less pronounced (leaves longer or shorter, their margins almost entire or denticulate, alar cells distinctly or slightly limited).

Neither sporophytes nor archegonia were found in moss specimens. The lack of sporophytes is due to deficiency of nutrient supply as well as low temperature for all period of vegetation.

A temperature on different parts of the polsters and of an air was measured. The temperature changes from 1.1-2.9°C in the lowest layer of curshions near an ice surface to 4.8-6.4°C in the middle and to 6.1-7.4°C in the upper parts of polsters and generally is higher than the air temperature (3.3°C).

Almost all moss species on glaciers grew on fine earth but *Sanionia uncinata* and few plants of *Ceratodon purpureus* occurred on mammal's bone lied on ice. They formed two spheroidal cushions on both butt-ends of the bone.

The following features provide success of the mosses as glacier ice inhabitants: 1) hydro- and hygro-hydrophytic habit, 2) tolerance to low temperature, 3) ability to grow on the mobile cryoconite and fine earth substrate, 4) asexual reproduction and distribution by vegetative plants and their parts, 5) patients (=stress-tolerance) life strategy (not Ceratodon purpureus).

Theoretically, mosses could be transported to the ice slope by the ways: 1) cushions rolled down from surrounding slopes; 2) little parts of polsters were brought by wind; 3) mosses appeared on the surface from an ice of melting glacier; 4) fascicles of plants were carried by seagulls.

The moss populations on Austre Grønfjordbreen exist more than six years on the same place.
For Mittag-Lefflerbreen another type of colonization was discovered by B. Mavlyudov, when pioneer mosses (*Bryum* sp.) grew on thin ring of cryoconite on the ice. It was initial stage of primary succession on the glacier.

Fig.2. Populations of *Hygrohypnella polare* (Lindb.) Ignatov et Ignatova and *Sanionia uncinata* (Hedw.) Loeske on ice of Austre Grønfjordbreen

Fig.3. A cushion of *Hygrohypnella polare* (Lindb.) Ignatov et Ignatova on ice pedestal (Austre Grønfjordbreen, Vestspitsbergen).

Fig.4. A cushion of *Sanionia uncinata* (Hedw.) Loeske on ice (Austre Grønfjordbreen, Vestspitsbergen)

Fig.5. Leaves variability in different cushions of *Hygrohypnella polare* (Lindb.) Ignatov et Ignatova (shape, top of leaf, nerve).

Fig.6. Primary succession on Mittag-Lefflerbreen – the pioneer mosses grow around aggregation of cryoconite.

LITERATURE

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