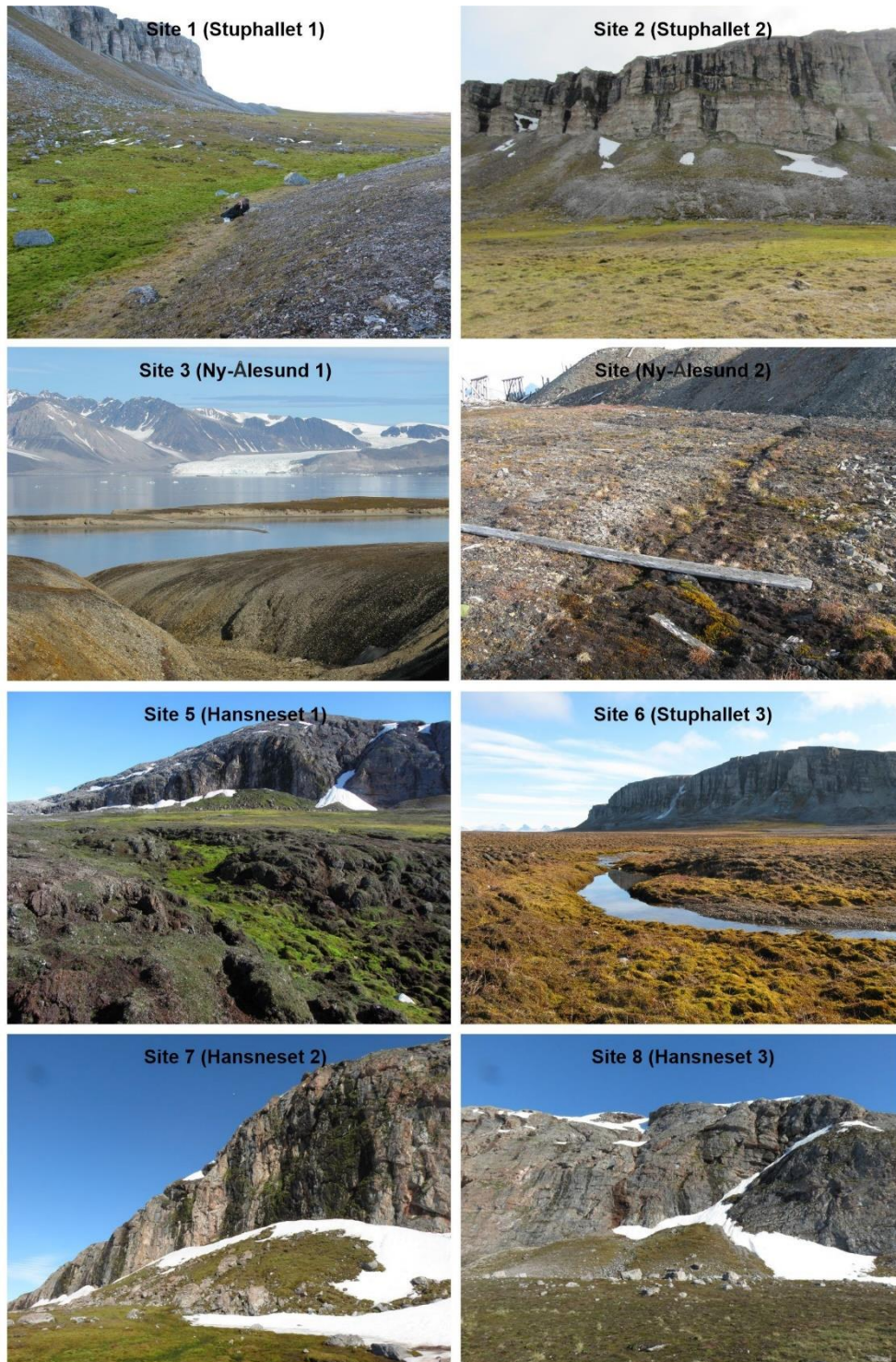
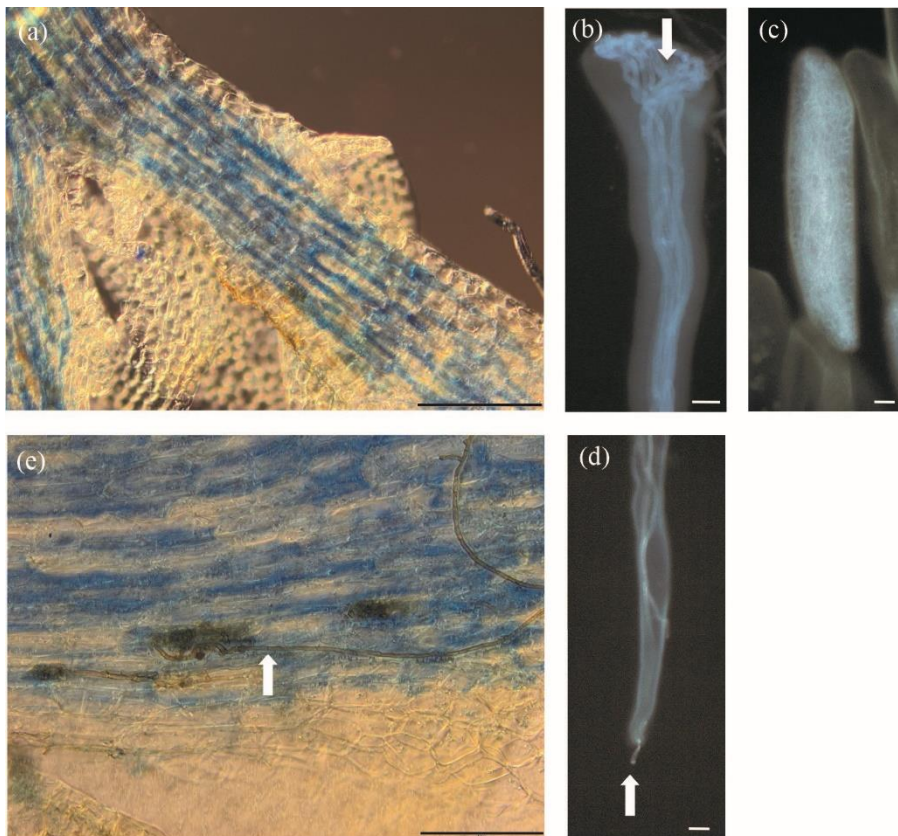


Supplementary material for: Newsham K.K. & Goodall-Copestake W.P. 2021. Liverworts frequently form mycothalli on High-Arctic Spitsbergen. *Polar Research* 40. Correspondence: Kevin Newsham, British Antarctic Survey, Natural Environment Research Council, High Cross, Cambridge CB3 0ET, UK. E-mail: kne@bas.ac.uk



Supplementary Fig. S1. Sampling sites on Brøggerhalvøya and Blomstrandhalvøya on Spitsbergen. Details of sites are shown in Supplementary Table S1.



Supplementary Fig. S2. Images of fungal structures in the tissues of High-Arctic leafy liverworts. (a) Aniline blue-stained hyphal coils in stem epidermal cells of *Lophozia excisa* viewed under light microscopy. (b–d) Aniline blue-stained fungal structures in liverwort tissues viewed under ultraviolet epifluorescence, showing (b) a hyphal coil (arrowed) formed in the base of the rhizoid cell of *Barbilophozia hatcheri*, (c) a stem epidermal cell of *Pseudolophozia sudetica* colonized by tightly convoluted septate hyphae and (d) a hypha (arrowed) apparently entering the tip of a rhizoid cell of *Trilophozia quinqueidentata*. (e) A dark septate hypha (arrowed) colonizing the stem surface of *L. excisa*. Note the aniline blue-stained hyphal coils in underlying cells. Scale bars in (a), (b–d) and (e) are 200 μm , 5 μm and 100 μm , respectively.

Supplementary Table S1. Details of the sampling sites on Brøggerhalvøya and Blomstrandhalvøya, with liverwort taxa collected and underlying soil chemistry. See Materials and methods section of main article for details of analyses.

Site no. and name ^a	Brief site description	Latitude, longitude	Liverwort species collected	Soil chemistry ¹					
				C (%) ^b	$\delta^{13}\text{C}$ (‰) ^b	N (%) ^b	$\delta^{15}\text{N}$ (‰) ^b	pH ^b	Moisture (%) ^b
1 Stuphallet 1	Sloping face of rock glacier below bird cliff	78° 57.487' N, 11° 40.456' E	<i>Barbilophozia hatcheri</i> , <i>Cephaloziella varians</i> , <i>Lophozia excisa</i> , <i>Ptilidium ciliare</i> , <i>Trilophozia quinqueidentata</i> , <i>Sphenolobus minutus</i>	33.8 ± 6.7	-25.9 ± 0.5	1.9 ± 0.6	4.1 ± 1.8	7.4 ± 0.2	71.4 ± 7.3
2 Stuphallet 2	Vertical cliff face	78° 57.543' N, 11° 38.982' E	<i>Lophozia excisa</i>	36.6 ± 6.0	-26.1 ± 1.3	2.3 ± 0.7	6.6 ± 2.1	7.4 ± 0.9	80.1 ± 3.8
3 Ny-Ålesund 1	Dry stream bed	78° 55.088' N, 11° 56.863' E	<i>Blepharostoma trichophyllum</i> , <i>Ptilidium ciliare</i> , <i>Schljakovianthus quadrilobus</i>	15.5 ± 7.5	-25.6 ± 0.9	0.7 ± 0.4	1.9 ± 0.8	7.2 ± 0.7	27.5 ± 12.1
4 Ny-Ålesund 2	Mine tailings to south of settlement	78° 54.911' N, 11° 54.613' E	<i>Blepharostoma trichophyllum</i> , <i>Cephalozia bicuspidata</i> , <i>Cephaloziella varians</i> , <i>Gymnocolea inflata</i> , <i>Scapania undulata</i>	21.3 ± 13.3	-25.0 ± 1.6	0.7 ± 0.4	2.0 ± 1.3	4.5 ± 1.3	53.3 ± 22.0
5 Hansneset 1	Gullies close to foreshore on Blomstrandhalvøya	78° 59.198' N, 11° 58.556' E	<i>Blepharostoma trichophyllum</i> , <i>Cephaloziella varians</i> , <i>Schljakovianthus quadrilobus</i> , <i>Sphenolobus minutus</i> , <i>Trilophozia quinqueidentata</i>	39.0 ± 8.5	-26.7 ± 0.8	2.2 ± 0.6	1.9 ± 1.5	7.3 ± 0.5	80.6 ± 2.6
6 Stuphallet 3	Hummocks in flat plain	78° 57.774' N, 11° 34.777' E	<i>Barbilophozia hatcheri</i> , <i>Cephaloziella varians</i> , <i>Lophozia excisa</i> , <i>Ptilidium ciliare</i> , <i>Sphenolobus minutus</i> , <i>Trilophozia quinqueidentata</i>	36.7 ± 12.8	-25.4 ± 0.9	0.9 ± 0.4	3.8 ± 2.5	6.5 ± 0.9	80.9 ± 2.6
7 Hansneset 2	Scree below bird cliffs on Blomstrandhalvøya	78° 59.174' N, 11° 59.608' E	<i>Barbilophozia hatcheri</i> , <i>Lophozia wenzelii</i> , <i>Pseudolophozia sudetica</i>	20.3 ± 10.3	-26.7 ± 0.7	1.4 ± 0.4	8.4 ± 2.0	7.1 ± 0.7	67.3 ± 8.4
8 Hansneset 3	Scree below bird cliffs on Blomstrandhalvøya	78° 59.068' N, 11° 59.363' E	<i>Pseudolophozia sudetica</i> , <i>Schljakovianthus quadrilobus</i> , <i>Trilophozia quinqueidentata</i>	10.2 ± 6.0	-26.3 ± 0.7	0.8 ± 0.3	2.3 ± 0.7	7.6 ± 0.3	53.3 ± 12.8

^a Site numbers and names correspond to those shown in Fig. 1 and Supplementary Fig. S1. ^b Means ± standard deviations.

Supplementary Table S2. Liverwort specimens from which fungal DNA was amplified.

Liverwort species	Collection no. ^a (site number ^b)
<i>Barbilophozia hatcheri</i>	00172 (1), 00264A (7), n.d. ^c (7)
<i>Gymnocolea inflata</i>	00200A (4), 00209 (4)
<i>Pseudolophozia sudetica</i>	00260A (7)
<i>Schljakovianthus quadrilobus</i>	00273A (7), 00283A (8)
<i>Sphenolobus minutus</i>	00229 (5), 00244A (6), 00248A (6)
<i>Lophozia excisa</i>	00183A (2), 00186A (2)
<i>Lophozia wenzelii</i>	00258 (7)
<i>Trilophozia quinquedentata</i>	00158A (1), 00222A (5), 00245A (6)
<i>Cephaloziella varians</i>	n.d. (1), n.d. (1), 00197A (4)
<i>Cephalozia bicuspidata</i>	00198A (4), n.d. ^c (4)
<i>Scapania undulata</i>	00207 (4)
<i>Blepharostoma trichophyllum</i>	00223A (5)
<i>Ptilidium ciliare</i>	00151A (1), 00192 (3)

^a Collection numbers are those in the Newsham, K.K. collection in the British Antarctic Survey herbarium (Index Herbariorum code AAS; see <https://data.bas.ac.uk/metadata.php?id=GB/NERC/BAS/AEDC/00023>). ^b Site numbers correspond to those shown in Fig. 1, Supplementary Fig. S1 and Supplementary Table S1. ^c Specimen not deposited in AAS.