

LICHENS FROM SISIMIUT IN WEST GREENLAND AND THEIR CLIMATIC PREFERENCES

Eric Steen HANSEN

Natural History Museum of Denmark, University of Copenhagen, Universitetsparken Str. 15,
 Copenhagen DK-2100, Denmark
 E-mail: erich@snm.ku.dk

Abstract

Hansen E.S., 2019: Lichens from Sisimiut in West Greenland and their climatic preferences. – *Botanica*, 25(2): 102–110.

A total of 165 lichen taxa collected from Sisimiut in West Greenland in summer 2017 were reported and categorized toward their climatic preferences. Almost 68% of the 165 lichens are more or less equally distributed in continental and oceanic areas of Greenland. More than 26% of the lichens occur most frequently in oceanic areas and more rarely in continental areas. Almost 5% of the lichens occur most frequently in continental areas and more rarely in oceanic areas. Two lichens are distinctly oceanic. No distinctly continental lichens were found in the present investigation. The results are in good accordance with those obtained from similar investigations in West Greenland. Two different climatic scenarios and their influence upon the lichen communities are discussed.

Keywords: distribution types, ecology, global warming, lichenized ascomycetes, West Greenland.

INTRODUCTION

When BÖCHER (1954, 1959) carried out his extensive floristic and ecological studies on the oceanic and continental vegetation complexes in Southwest Greenland, he included many lichens, which had been identified by the lichenologist M. Skytte Christiansen. The succeeding exploration of the lichen flora of West Greenland during more than 70 years has resulted in a more precise understanding of the distribution of lichens in relation to climatic factors such as the degree of oceanicity and continentality. Climatic distribution types have so far been compiled for numerous lichens in selected areas in Southwest Greenland, central West Greenland and Southeast Greenland (K. HANSEN, 1971; E.S. HANSEN, 2010, 2012a, b, 2013). Contrary to K. Hansen, who has originally defined the distribution types for macrolichens from Southwest Greenland, in the present study, the author deals with both micro- and macrolichens. DEICHMANN BRANTH & GRÖNLUND (1888) have mentioned

some macro- and microlichens from “Holstensborg” (= Sisimiut), but the list is far from complete. The author decided to study the lichen flora more thoroughly and, accordingly, carried out a floristic investigation of the surroundings of Sisimiut in summer 1991 (E.S. HANSEN, 1998). The present paper aims to stimulate future research on the occurrence and distribution of lichens toward climate change. No doubt, global warming, which now accelerates melting of the Greenland inland ice and glaciers and in some coastal areas formation of virgin landscapes with sand and loess, will give a possibility for colonization of lichens such as soil crust lichens (E.S. HANSEN, 2001).

Study area

Sisimiut locality (66°06' N, 53°40' W) is situated in the north-western part of the peninsula near the outer coast. A broad valley with lakes extends from the town towards the east. The valley is flanked by mountains such as Kællingehætten composed of Archaean gneiss (ESCHER & STUART WATT, 1976). The

siliceous rocks in the Sisimiut area are comparatively rich in iron, which is reflected by the occurrence of many ferruginous lichens. Climatically and floristically, Sisimiut area is located in the low arctic, oceanic area (JENSEN, 1999). The mean temperature of the warmest month (July) is c. 7 to 8°C and of the coldest month (January) c. – 15 to 20°C. Annual precipitation is c. 397 mm (E.S. HANSEN, 1998).

MATERIALS AND METHODS

Lichens were collected from numerous sampling plots in the lowland (< 200 m a. s. l.) near Sisimiut in July 2017. A total of 300 lichen specimens were studied using Zeiss light microscopes and identified by the author. The nomenclature in the list is presented after NORDIN et al. (2011) with some exceptions. The specimens are deposited at the Botanical Museum of the University of Copenhagen (C). The substrate preference and the main plant communities in which the lichens occur were noted for all collected specimens. The type of distribution toward oceanity or continentality was estimated for all lichens by all available information about their total distribution in Greenland, in particular the distribution maps compiled by THOMSON (1984, 1997) and the information given by E.S. Hansen (1995a).

The following oceanity-continentality indices originally defined by K. Hansen (1971) with later modifications (E.S. HANSEN, 2010, 2012a, b, 2013) were used:

- CCO – somewhat continental lichens occurring most frequently in subcontinental and continental areas and more rarely in oceanic areas.
- CO – lichens with almost equally high frequency in continental and oceanic areas.
- COO – somewhat oceanic lichens occurring most frequently in oceanic areas and more rarely in continental areas.
- OO – distinctly oceanic lichens occurring exclusively in oceanic areas.

RESULTS

Floristic observations of particular interest

Different types of dwarf shrub heath rich in lichens occur in Sisimiut area. *Empetrum hermaphroditum* heath patches with species such as *Arctocetraria*

andrejevii, *Cetraria delisei*, *Cladonia bellidiflora*, *C. mitis*, *C. sulphurina*, *Nephroma arcticum*, *Peltigera scabrosa* and *Stereocaulon alpinum* are common near the coast (E.S. HANSEN, 1995b). Mixed dwarf shrub heaths dominated by *Betula nana*, *Ledum palustre* and *Vaccinium uliginosum* occur in more dry places east of the town. They support macrolichens such as *Alectoria nigricans*, *A. ochroleuca*, *A. sarmentosa*, *Bryocaulon divergens*, *Cetraria muricata*, *Nephromopsis cucullata*, *N. nivalis*, *Peltigera leucophlebia*, *Sphaerophorus fragilis*, *Stereocaulon glareosum* and *Thamnolia vermicularis* var. *subuliformis*. *Alectoria sarmentosa* often forms extensive populations in more or less heavily windblown fell-fields. This heath type is also fairly rich in microlichens, for example, *Lepraria subalbicans*, *Ochrolechia alaskana*, *Pertusaria dactyllina*, *P. geminipara*, *Psoroma tenue* var. *limosa*, *Protopannaria boreale*, *Protomicarea pezizoides* and *Trapeliopsis granulosa*. *Arthrorthaphis citrinella*, *Baeomyces placophyllus*, *Bilimbia lobulata* and *Solorina crocea* preferably grow on bare soil in these heaths, while, for example, *Caloplaca nivalis* grows on mosses. *Solorina crocea* is particularly common in snow patches. Lichens growing on wood and twigs, for example, *Amandinea punctata*, *Caloplaca caesiorufella*, *Lecanora fuscescens*, *Rinodina archaea* and *R. turfacea* grow on twigs and occasionally on wood. *Caloplaca caesiorufella* has previously been known from Central Greenland and East Greenland (HANSEN et al., 1987). It is new to the Sisimiut area. Saxicolous lichens influenced by the sea and manured by birds are common along the coast. *Acarospora molybdina*, *Caloplaca alcarum*, *Candelariella arctica*, *Lecanora contractula*, *L. straminea* and *Physcia tenella* var. *marina* are fairly typical examples. *Verrucaria ceuthocarpa* occurs in the lowest, often inundated zone. Inland bird rocks support lichens such as *Acarospora fuscata*, *Candelariella vitellina*, *Parmelia sulcata*, *Physcia caesia*, *P. dubia*, *Pleopsidium chlorophanum*, *Polycauliona candelaria*, *Rhizoplaca melanophthalma*, *Rusavskia elegans* and *Umbilicaria arctica*. Most of these species preferably grow on exposed rock faces. However, *Pleopsidium chlorophanum* is most often found growing on overhanging rock faces. Rocks more or less rich in iron hold species such as *Miriquidica atrofulva*, *M. leucophaea*, *Porpidia flavicunda*, *P. melinodes* and *Tremolecia atrata*. Among the numerous saxi-

colous lichens occurring in the Sisimiut area, the following three species are of particular importance, viz. *Frutidella caesioatra* and *Lobarina scrobiculata*, both new to Sisimiut, and *Porpidia confluens*, new to West Greenland.

Annotated list of species

The following list represents 165 lichen taxa. Oceanity-continentiality indices are stated for all taxa. "Ap." and "pe." – mean presence of apothecia and perithecia, respectively; "st." means that the specimen is sterile. Annotations are given regarding substrate of the lichens.

- CO *Acarospora badiofusca* (Nyl.) Th.Fr. – on manured siliceous rocks, together with *Amandinea cacuminum*, *Candelariella arctica*, *Rhizocarpon bolanderi* and *R. copelandii*; ap.
- COO *Acarospora molybdina* (Wahlenb.) A.Massal. – on siliceous rocks near the sea, together with *Lecanora contractula* and *L. straminea*; ap.
- CO *Alectoria nigricans* (Ach.) Nyl. – on soil in dwarf shrub heaths; st.
- CO *Alectoria ochroleuca* (Hoffm.) A.Massal. – on soil in dwarf shrub heaths; st.
- COO *Alectoria sarmentosa* (Ach.) Ach. – on soil in dwarf shrub heaths; st.
- COO *Allantoparmelia alpicola* (Th.Fr.) Essl. – on siliceous rocks, together with *Pseudophebe minuscula*; ap.
- COO *Amandinea cacuminum* (Th.Fr.) H.Mayrhofer & Sheard – on manured siliceous rocks, together with *Candelariella arctica* and *Polycauliona candelaria*; ap.
- CO *Amandinea punctata* (Hoffm.) Coppins & Scheid. – on wood; ap.
- COO *Amygdalaria panaeola* (Ach.) Hertel & Brodo – on siliceous rock; st.
- COO *Arctocetraria andrejevii* (Oxner) Kärnefelt & A.Thell – on soil in dwarf shrub heath; ap.
- CO *Arctoparmelia centrifuga* (L.) Hale – on siliceous rocks; st.
- CO *Arctoparmelia incurva* (Pers.) Hale – on siliceous rock; st.
- COO *Arthorhaphis citrinella* (Ach.) Poelt – on bare mineral soil; st.
- CO *Aspicilia berntii* A.Nordin, Tibell & Owe-Larss. – on siliceous rock, together with *Lecanora leucococca*; ap.
- CCO *Baeomyces carneus* Flörke – on mosses on soil; st.
- CCO *Baeomyces placophyllus* Ach. – on soil; st.
- COO *Bellemerea alpina* (Sommerf.) Clauzade & Cl.Roux – on siliceous rock; ap.
- CO *Bellemerea subsorediza* (Lyngé) R. Sant. – on siliceous rock rich in iron, together with *Miriquidica atrofusca* and *Tremolecia atrata*; st.
- CO *Bilimbia lobulata* (Sommerf.) Hafellner & Coppins – on mineral soil; ap.
- CO *Brodoa oroarctica* (Krog) Goward – on siliceous rocks; st.
- CO *Bryocaulon divergens* (Ach.) Kärnefelt – on soil in dwarf shrub heath; st.
- CO *Bryonora castanea* (Hepp) Poelt – on mosses on soil; ap.
- CO *Bryoria fuscescens* (Gyeln.) Brodo & D.Hawksw. – on soil in dwarf shrub heath; st.
- CO *Buellia papillata* (Sommerf.) Tuck. – on soil in dwarf shrub heath; ap.
- COO *Caloplaca alcarum* Poelt – on manured siliceous rock near the sea, together with *Lecanora contractula*; ap.
- COO *Caloplaca caesiorufella* (Nyl.) Zahlbr. – on twigs of *Salix glauca*, together with *Rinodina archaea*; ap.
- COO *Caloplaca fraudans* (Th.Fr.) H.Olivier – on strongly weathered siliceous rock; ap.
- COO *Caloplaca nivalis* (Körb.) Th.Fr. – on mosses; ap.
- CO *Calvitimela aglaea* (Sommerf.) Hafellner – on exposed siliceous rock; st.
- CO *Calvitimela armeniaca* (DC.) Hafellner – on siliceous rock, together with *Orphniospora moriopsis*; ap.
- OO *Candelariella arctica* (Körb.) R.Sant. – on siliceous rock near the sea; st.
- CO *Candelariella placodizans* (Nyl.) H.Magn. – on soil rich in humus; st.
- CO *Candelariella vitellina* (Hoffm.) Müll.Arg. – on manured siliceous rock, together with *Amandinea cacuminum*; ap.
- CO *Cetraria delisei* (Bory ex Schaer.) Nyl. – on soil in dwarf shrub heaths; ap.
- CO *Cetraria islandica* (L.) Ach. – on soil in dwarf shrub heaths; ap.
- CO *Cetraria muricata* (Ach.) Eckfeldt – on soil in dwarf shrub heaths; st.

- CO *Cetraria nigricans* Nyl. – on soil in dwarf shrub heath, together with *Ochrolechia alaskana*, st.
- COO *Circinaria caesiocinerea* (Nyl. ex Malbr.) A.Nordin, S.Savic & Tibell – on manured siliceous rock, together with *Lecidea tessellata*; ap.
- CO *Cladonia amaurocraea* (Flörke) Schaer. – between mosses on soil in dwarf shrub heath; st.
- COO *Cladonia bellidiflora* (Ach.) Schaer. – between mosses on soil in dwarf shrub heaths, together with *Cladonia borealis*; ap.
- CO *Cladonia borealis* S. Stenroos – on soil in dwarf shrub heaths; ap.
- CO *Cladonia carneola* (Fr.) Fr. – on soil rich in humus in moist dwarf shrub heath, together with *Cladonia ecmocyna*, *C. sulphurina* and *Pertusaria oculata*; st.
- CO *Cladonia chlorophaea* (Flörke ex Sommerf.) Spreng. s. lato – on soil in dwarf shrub heath; st.
- CO *Cladonia cenotea* (Ach.) Schaer. – between mosses on soil in dwarf shrub heath; st.
- COO *Cladonia crispata* (Ach.) Flot. – between mosses on soil rich in humus in dwarf shrub heaths, together with *Cladonia bellidiflora*; st.
- COO *Cladonia ecmocyna* Leight. – between mosses on soil rich in humus in dwarf shrub heaths; ap.
- CO *Cladonia fimbriata* (L.) Fr. – on soil rich in humus in dwarf shrub heath; st.
- CO *Cladonia gracilis* (L.) Willd. – on soil in dwarf shrub heath, together with *Cladonia chlorophaea* and *C. mitis*; st.
- CO *Cladonia luteoalba* Wheldon & A.Wilson – on soil in dwarf shrub heath; st.
- CO *Cladonia macroceras* (Delise) Hav. – between mosses on soil in dwarf shrub heath; ap.
- CO *Cladonia macrophyllodes* Nyl. – on soil rich in humus in dwarf shrub heath; ap.
- CO *Cladonia mitis* Sandst. – between mosses on soil in dwarf shrub heaths; st.
- CO *Cladonia pyxidata* (L.) Hoffm. – on soil in dwarf shrub heath; st.
- CO *Cladonia rangiferina* (L.) F.H.Wigg. – on soil in dwarf shrub heath, together with *Cladonia ecmocyna*; st.
- CO *Cladonia stellaris* (Opiz) Pouzar & Vězda – on soil in dwarf shrub heath; st.
- CO *Cladonia stygia* (Fr.) Ruoss – on soil in dwarf shrub heath, together with *Cetraria islandica*; st.
- COO *Cladonia sulphurina* (Michx.) Fr. – on soil rich in humus in dwarf shrub heath; st.
- COO *Cladonia trassii* Ahti – between mosses on soil in plant communities; st.
- CO *Cladonia uncialis* (L.) F.H.Wigg. – on soil in dwarf shrub heath; st.
- CO *Dactylina arctica* (Hook.) Nyl. – on soil in dwarf shrub heath; st.
- COO *Frutidella caesioatra* (Schaer.) Kalb. – on mosses on siliceous rock; ap.
- CO *Hypogymnia austerodes* (Nyl.) Räsänen – on siliceous rock; st.
- CCO *Lecanora argopholis* (Ach.) Ach. – on siliceous rock; ap.
- CCO *Lecanora atromarginata* (H.Magn.) Hertel & Rambold – on manured siliceous rock, together with *Rusavskia elegans*; ap.
- CO *Lecanora atosulphurea* (Wahlenb.) Ach. – on strongly weathered siliceous rock; ap.
- COO *Lecanora chloroleprosa* (Vain.) H.Magn. – on manured siliceous rock, together with *Rhizocarpon bolanderi* and *R. copelandii*; ap.
- COO *Lecanora contractula* Nyl. – on manured siliceous seashore rocks; ap.
- CO *Lecanora fuscescens* (Sommerf.) Nyl. – on twigs of *Salix glauca*, together with *Rinodina turfacea*; ap.
- CO *Lecanora leucococca* Sommerf. – on siliceous rock; ap.
- CO *Lecanora polytropa* (Ehrh. ex Hoffm.) Rabenh. – on siliceous rocks; ap.
- COO *Lecanora straminea* Wahlenb.ex Ach. – on manured siliceous seashore rock; ap.
- CO *Lecidea auriculata* Th.Fr. – on siliceous rock; ap.
- CCO *Lecidea confluens* (Weber) Ach. – on siliceous rock; ap.
- CO *Lecidea lapicida* (Ach.) Ach. var. *lapicida* – on siliceous rock; ap.
- COO *Lecidea lapicida* (Ach.) Ach. var. *pantherina* (DC.) Ach. – on strongly weathered siliceous rock; ap.
- CO *Lecidea tessellata* Flörke – on siliceous rock; ap.

- CO *Lecidella bullata* Körb. – on siliceous rock; ap.
- COO *Lecidoma demissum* (Rutstr.) Gotth. Schneid. & Hertel – on soil in dwarf shrub heath; ap.
- CO *Lepraria neglecta* (Nyl.) Lettau – on soil near snow patch.
- CO *Lepraria subalbicans* (I.M.Lamb) Lendemer & B.P.Hodk. – between mosses on soil in dwarf shrub heaths.
- CO *Lichenomphalia umbellifera* (L.:Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys – on peaty soil.
- CCO *Lobarina scrobiculata* (Scop.) Nyl. ex Cromb. – on siliceous rock; st.
- CO *Massalongia carnosia* (Dicks.) Körb. – on mosses on soil in dwarf shrub heath, together with *Lepraria subalbicans*; st.
- CO *Melanelia hepatizon* (Ach.) A.Thell – on siliceous rocks, together with *Pseudephebe minuscula*; ap.
- CO *Melanelia stygia* (L.) Essl. – on siliceous rock; ap.
- COO *Miriquidica atrofulva* (Sommerf.) A.J.Schwab & Rambold – on siliceous rocks rich in iron; st.
- COO *Miriquidica leucophaea* (Flörke ex Rabenh.) Hertel & Rambold – on siliceous rocks rich in iron; ap.
- COO *Miriquidica nigroleprosa* (Vain.) Hertel & Rambold – on manured siliceous rock, together with *Ophioparma ventosa* and *Orphniospora moriopsis*; st.
- COO *Nephroma arcticum* (L.) Torss. – between mosses on soil in dwarf shrub heath; st.
- CO *Nephroma parile* (Ach.) Ach. – on siliceous rock; st.
- CO *Nephromopsis cucullata* (Bellardi) Divakar, Crespo & Lumbsch – between mosses on soil in dwarf shrub heaths; st.
- CO *Nephromopsis nivalis* (L.) Divakar, Crespo & Lumbsch – between mosses on soil in dwarf shrub heaths; st.
- CO *Ochrolechia alaskana* (Verseghy) Kukwa – between mosses and plant remains in dwarf shrub heaths; ap.
- COO *Ochrolechia grimmiae* Lyngé – on *Racomitrium lanuginosum* in dwarf shrub heath; ap.
- CO *Ochrolechia lapuënsis* (Räsänen) Räsänen – on soil rich in humus in dwarf shrub heath; st.
- COO *Ochrolechia tartarea* (L.) A. Massal. – on siliceous rock; st.
- CO *Ophioparma ventosa* (L.) Norman – on manured siliceous rock; ap.
- CO *Orphniospora moriopsis* (A. Massal.) D. Hawksw. – on siliceous rocks; ap.
- CO *Pannaria hookeri* (Borrer ex Sm.) Nyl. – on strongly weathered siliceous rock; ap.
- CO *Parmelia omphalodes* (L.) Ach. – between mosses on soil in dwarf shrub heath; st.
- CO *Parmelia saxatilis* (L.) Ach. – on siliceous rocks; st.
- CO *Parmelia sulcata* Taylor – on manured siliceous rocks; st.
- CO *Parvoplaca tirolensis* (Zahlbr.) Arup, Søchting & Frödén – between mosses on strongly weathered siliceous rock; ap.
- CO *Peltigera aphthosa* (L.) Willd. – between mosses on soil in dwarf shrub heath; st.
- CO *Peltigera canina* (L.) Willd. – between mosses in dwarf shrub heath; st.
- CO *Peltigera extenuata* (Nyl. ex Vain.) Lojka – between mosses on soil in dwarf shrub heaths; st.
- CO *Peltigera leucophlebia* (Nyl.) Gyeln. – between mosses on soil in dwarf shrub heath; st.
- CO *Peltigera malacea* (Ach.) Funck – between mosses on soil in dwarf shrub heaths; st.
- CO *Peltigera ponojensis* Gyeln. – between mosses on soil in dwarf shrub heath; ap.
- CO *Peltigera rufescens* (Weiss) Humb. – between mosses on soil in dwarf shrub heaths; ap.
- CO *Peltigera scabrosa* Th.Fr. – between mosses on soil in dwarf shrub heath; ap.
- CO *Pertusaria coriacea* (Th. Fr.) Th.Fr. – on soil in dwarf shrub heath; ap.
- CO *Pertusaria dactylina* (Ach.) Nyl. – between mosses on soil in dwarf shrub heaths; ap.
- CO *Pertusaria geminipara* (Th. Fr.) C.Knight ex Brodo – between mosses on soil in dwarf shrub heath; st.
- COO *Pertusaria oculata* (Dicks.) Th.Fr. – on soil rich in humus in dwarf shrub heath, together with *Protopannaria pezizoides*; ap.
- COO *Phylliscum demangeonii* (Moug. & Mont.) Nyl. – on strongly weathered siliceous rock; ap.

- CO *Physcia caesia* (Hoffm.) Fűrnr. – on manured siliceous rocks, together with *Rhizocarpon grande*; st.
- CO *Physcia dubia* (Hoffm.) Lettau – on manured siliceous rocks; st.
- COO *Physcia tenella* (Scop.) DC. var. *marina* (A. Nyl.) Lynge – on manured siliceous rock near the sea; st.
- CCO *Physconia muscigena* (Ach.) Poelt – between mosses on soil in dwarf shrub heath; st.
- CO *Placynthium asperellum* (Ach.) Trevis. – on manured siliceous rock, together with *Rusavskia elegans*; st.
- COO *Placynthium pannariellum* (Nyl.) H.Magn. – on moist siliceous rocks; st.
- CO *Pleopsidium chlorophanum* (Wahlenb.) Zopf – on overhanging face of siliceous rock; st.
- CO *Polycauliona candelaria* (L.) Frödén, Arup & Söchting – on manured siliceous rock; st.
- CO *Porpidia flavicunda* (Ach.) Gowan – on siliceous rocks rich in iron, together with *Tremolecia atrata*; ap.
- CO *Porpidia melinodes* (Körb.) Gowan & Ahti – on weathered siliceous rocks rich in iron; st.
- CO *Protomicarea limosa* (Ach.) Hafellner – on mosses in dwarf shrub heath; ap.
- COO *Protopannaria pezizoides* (Weber) P.M.Jørg. & S.Ekman – on soil rich in humus in dwarf shrub heath; ap.
- CO *Protoparmelia badia* (Hoffm.) Hafellner – on manured siliceous rock; ap.
- CO *Pseudephebe minuscula* (Nyl. ex Arnold) Brodo & D.Hawksw. – on siliceous rocks; st.
- CO *Pseudephebe pubescens* (L.) M. Choisy – on siliceous rocks; st.
- CO *Psoroma tenue* Henssen var. *boreale* Henssen – on mosses on soil in dwarf shrub heath; ap.
- COO *Rhizocarpon bolanderi* (Tuck.) Herre – on siliceous rocks; st.
- COO *Rhizocarpon copelandii* (Körb.) Th.Fr. – on siliceous rocks; ap.
- CO *Rhizocarpon geminatum* Körb. – on siliceous rock, together with *Lecanora polytropha*; ap.
- CO *Rhizocarpon geographicum* (L.) DC. – on siliceous rocks; ap.
- CO *Rhizocarpon grande* (Flörke) Arnold – on siliceous rock; ap.
- CO *Rhizocarpon inarense* (Vain.) Vain. – on siliceous rocks, together with *Rhizocarpon praebadium*; ap.
- CO *Rhizocarpon praebadium* (Nyl.) Zahlbr. – on siliceous rock; ap.
- CO *Rhizocarpon superficiale* (Schaer.) Vain. – on siliceous rock rich in iron, together with *Sporastatia testudinea*; ap.
- CO *Rhizoplaca melanophthalma* (DC.) Leuckert & Poelt – on siliceous rock; ap.
- COO *Rinodina archaea* (Ach.) Arnold – on twigs of *Salix glauca*; ap.
- CO *Rinodina turfacea* (Wahlenb.) Körb. – on twigs of *Salix glauca*; ap.
- CO *Rusavskia elegans* (Link) S.Y.Kondr. & Kärnefelt – on manured siliceous rocks; ap.
- CO *Solorina crocea* (L.) Ach. – on soil in snow patch; st.
- CO *Sphaerophorus fragilis* (L.) Pers. – between mosses on soil rich in humus in dwarf shrub heaths, together with *Bryoria fuscescens*, *Cladonia mitis* and *Ochrolechia alaskana*; ap.
- CO *Sporastatia polyspora* (Nyl.) Grummann – on strongly weathered siliceous rock; ap.
- CCO *Sporastatia testudinea* (Ach.) A.Massal. – on siliceous rock rich in iron; ap.
- CO *Stereocaulon alpinum* Laurer – on soil in dwarf shrub heaths; st.
- CO *Stereocaulon arenarium* (L.I.Savicz) I.M.Lamb – on soil in dwarf shrub heath; st.
- CO *Stereocaulon glareosum* (L.I.Savicz) H.Magn. – on soil in dwarf shrub heaths; st.
- CO *Stereocaulon paschale* (L.) Hoffm. – on soil in dwarf shrub heath; st.
- CO *Thamnolia vermicularis* (Sw.) Schaer. var. *subuliformis* (Ehrh.) Schaer. – between mosses on soil in dwarf shrub heath.
- COO *Trapeliopsis granulosa* (Hoffm.) Lumbsch – on soil rich in humus in dwarf shrub heaths, together with *Ochrolechia alaskana* and *Pertusaria oculata*; st.
- COO *Tremolecia atrata* (Ach.) Hertel – on siliceous rocks rich in iron; ap.
- CO *Umbilicaria arctica* (Ach.) Nyl. – on manured siliceous rock; ap.
- COO *Umbilicaria cylindrica* (L.) Delise ex Duby var. *delisei* Nyl. – on siliceous rocks; ap.
- COO *Umbilicaria deusta* (L.) Baumg. – on temporarily moist siliceous rock; st.

- COO *Umbilicaria havaasii* Llano – on siliceous rocks; st.
 CO *Umbilicaria hyperborea* (Ach.) Hoffm. – on siliceous rocks; ap.
 CO *Umbilicaria lyngei* Schol. – on siliceous rock; st.
 CO *Umbilicaria proboscidea* (L.) Schrad. – on siliceous rock; ap.
 COO *Umbilicaria torrefacta* (Lightf.) Schrad. – on siliceous rock; ap.
 CO *Umbilicaria vellea* (L.) Hoffm. – on siliceous rocks; st.
 OO *Verrucaria ceuthocarpa* Wahlenb. – on siliceous rocks influenced by sea water; pe.

DISCUSSION

A total of 111 of the 165 lichens listed above appear to be more or less equally distributed in continental and oceanic areas. This is in fairly good accordance with the many different types of lichen biotopes in the Sisimiut area ranging from sea-shore rocks to inland rocks and from coastal dwarf shrub heaths to dry inland heaths. In addition, many CO-lichens are characterized by being fairly tolerant and adapted to changing climatic conditions within certain limits. It is in good accordance with the fact that many arctic-alpine lichens extend their distribution to temperate areas (THOMSON, 1984). However, the particular preference as regards habitat of different lichens changes rather much and is reflected in the quantity of the species in different parts of South West Greenland. Thus, a gradual decline in quantity from the oceanic areas to the more or less continental areas is observed as regards many terricolous macrolichens (K. HANSEN, 1971). This applies to species such as *Alectoria nigricans*, *A. ochroleuca*, *Bryocaulon divergens*, *Cetraria delisei*, *C. islandica*, *C. muricata*, *Cladonia borealis*, *C. cenotea*, *C. gracilis*, *C. macroceras*, *C. mitis*, *C. rangiferina*, *C. stellaris*, *C. stygia*, *C. uncialis*, *Dactylina arctica*, *Nephromopsis cucullata*, *N. nivalis*, *Peltigera aphthosa*, *P. canina*, *P. extenuata*, *P. leucophlebia*, *P. malacea*, *P. ponojensis*, *P. rufescens*, *P. scabrosa*, *Solorina crocea*, *Stereocaulon alpinum*, *S. arenarium*, *S. glareosum*, *S. paschale* and *Thamnomia vermicularis* var. *subuliformis*. Most of these lichens occur in different types of dwarf shrub heaths and fell-fields with scattered dwarf shrubs. Some also grow in

lix glauca thickets and a few in snow patches, for example, *Solorina crocea*. Present and future global warming influence the terricolous lichens in different ways. Two different climatic scenarios and their influence upon the lichens are discussed in the following. Under the first scenario with melting inland ice, thawing permafrost and precipitation increasing, the water supply is not a problem in many, in particular coastal, areas in Greenland. However, the thawing permafrost results in unstable soil conditions, which influence both higher plants and lichens in a negative way. The warmer climate also results in increased competition with higher plants, which are favoured by higher contents of nutrients in the soil. These conditions will presumably result in reduction of some lichen populations in, for example, the dwarf shrub heaths. As regards the mountain flora, the lowest plant zones with more or less dense *Salix* thickets and scattered lichens such as *Cladonia cenotea*, *C. fimbriata* and *Peltigera extenuata* will presumably expand to higher levels on the mountains at Sisimiut, and the plant mosaics of the heaths and fell-fields occurring at greater altitudes will change in a warmer climatic scenario. Epiphytic lichens probably will be more common in the *Salix* thickets. This is in need of long term studies of the vertical distribution of lichens on the mountains (E.S. HANSEN, 1978). Many biotopes will probably dry up during continuing global warming. Under this second, more inland climatic scenario, a great part of the above-mentioned terricolous macrolichens presumably will be threatened and rare, unless they are able to disperse to more moist habitats. The steppe- and desert-like areas in North East Greenland and continental areas in West Greenland, for example, the Kangerlussuaq area, already now demonstrate this clearly with fewer and often fragmented macrolichens (ALSTRUP et al., 2000; E.S. HANSEN, 2000). In the same way, many terricolous microlichens such as *Lepraria subalbicans*, *Massalongia carnosa* and *Psoroma tenue* var. *boreale* are threatened and risk desiccation in a future scenario characterized by warm summers. With respect to the group of saxicolous macro- and microlichens belonging to the CO-category, the abundance of many species is almost the same in coastal and inland areas. This applies to fairly sturdy and common species such as *Arctoparmelia centrifuga*, *A. incurva*, *Brodoa oro-*

arctica, *Lecanora polytropa*, *Lecidea lapicida* var. *lapicida*, *L. lapicida* var. *pantherina*, *Lecidea tessellata*, *Melanelia hepatizon*, *Orphniospora moriopsis*, *Parmelia omphalodes*, *P. saxatilis*, *Pseudephebe minuscula*, *P. pubescens*, *Rhizocarpon geographicum*, *Umbilicaria hyperborea* and *U. proboscidea*. Widely distributed, nitrophilous, CO- lichens such as *Candelariella vitellina*, *Physcia caesia*, *P. dubia*, *Polycauliona candelaria* and *Rusavskia elegans* probably will expand under warmer and drier climatic conditions. This also applies to widely distributed lichens growing on wood such as *Amandinea punctata* and *Rinodina turfacea*.

The COO-category represented in the Sisimiut area consists of 44 lichens. They occur most frequently in coastal areas and more rarely in inland, more or less continental areas. In the same way these species occur in smaller quantity in inland areas than in coastal areas. Generally, the lichens occurring in moist heaths, bogs and snow patches thrive rather well at present, but in a future scenario with a warmer and drier climate a part of these lichens will be threatened. This applies to species such as *Alectoria sarmentosa*, *Arctocetraria andrejevii*, *Cladonia bellidiflora*, *C. crispata*, *C. ecmocyna*, *C. sulphurina*, *C. trassii*, *Lecidoma demissum*, *Nephroma arcticum*, *Pertusaria oculata*, *Protoparmelia pezizoides* and *Trapeliopsis granulosa*. The saxicolous seashore lichens belonging to the COO-category, *Acarospora molybdina*, *Amandinea cacuminum*, *Caloplaca alcarum*, *Candelariella arctica*, *Lecanora contractula*, *L. straminea*, *Physcia tenella* var. *marina* and *Verrucaria ceuthocarpa*, all have their main distribution in the arctic region and are adapted to a cool climate (THOMSON, 1997; E.S. HANSEN, 1995a). Under warmer climatic conditions, these lichens will probably extend their distribution area northwards concurrently with melting of the ice along the coasts of North Greenland. There is a risk of reduction of the southernmost populations of the arctic sea shore lichens under future warmer climatic conditions. It is important to follow their development along the arctic coasts. The saxicolous lichens growing on iron-containing rocks, such as *Amygdalaria pannaecola*, *Miriquidica atrofulva*, *Porpidia flavicunda*, *P. melinodes* and *Tremolecia atrata*, is another group of COO-lichens, which it is of great interest to monitor (E.S. HANSEN, 1999). These lichens have a distinct

preference for moist rock faces more or less coated by limonite and are supposed to be threatened in a warm and dry climate.

Only eight species are recorded as CCO-lichens. *Lobarina scrobiculata* is restricted to south-facing rocks and large boulders in *Salix* thickets, where it occurs together with, for example, *Nephroma parile*. *Lecanora argopholis* and *L. atromarginata* also prefer rather dry rock habitats. *Baeomyces placophyllus* and *Physconia muscigena* are best developed in inland heaths. These species will probably expand their distribution area under warmer and dry climatic conditions. They both belong to a very characteristic community of soil crust, which is well-developed and rich in CCO-lichens in the Kangerlussuaq area situated west of Sisimiut close to the inland ice (E.S. HANSEN, 2001). The soil crust community is best developed on neutral to slightly basic soil, for example, loess. Under a warm and dry climatic scenario the soil crust lichens and other lichens with a more or less continental distribution will presumably expand to bare, nutritious soil in the Sisimiut area. Generally, the Greenland lichen diversity is, however, supposed to be reduced, if global warming continues with the present high and in the future possibly higher carbon dioxide contents in the atmosphere.

ACKNOWLEDGEMENTS

I thank Torben Jürgensen, Mia Mouridsen and Lena Wilken for practical help during the trip to Sisimiut. Mia Mouridsen collected *Dactylina arctica*. I also wish to thank Ulrik Søchting for determination of *Caloplaca caesiorufella*, and Peer Corfixen for technical assistance.

REFERENCES

- ALSTRUP V., HANSEN E.S., DANIELS F., 2000: Lichenized, lichenicolous and other fungi from North and North-East Greenland. – *Folia Cryptogamica Estonica*, 37: 1–20.
- BÖCHER T.W., 1954: Oceanic and continental vegetation complexes in Southwest Greenland. – *Meddelelser om Grønland*, 148: 1–336.
- BÖCHER T.W., 1959: Floristic and ecological studies in Middle West Greenland. – *Meddelelser om Grønland*, 156: 1–68.
- DEICHMANN BRANTH J.S., GRÖNLUND C., 1888: Grøn-

- lands Lichen – Flora. Meddelelser om Grønland, 3: 449–513.
- ESCHER A., STUART WATT W., 1976: Geology of Greenland. – Copenhagen.
- HANSEN E.S., 1978: Notes on vertical distribution of lichens on three mountains in the Angmagssalik District, South East Greenland. – Botanisk Tidsskrift, 73: 55–61.
- HANSEN E.S., 1995a: Greenland Lichens. – Copenhagen.
- HANSEN E.S., 1995b: Sisimiuts lavflora. – Tidsskriftet Grønland, 7–8: 267–276.
- HANSEN E.S., 1998: The lichen flora near Sisimiut, Kangaamiut and Maniitsoq in Central West Greenland. – Herzogia, 13: 199–206.
- HANSEN E.S., 1999: Epilithic lichens on iron- and copper-containing crusts at Qeqertarsuaq, Central West Greenland. – Graphis Scripta, 10: 7–12.
- HANSEN E.S., 2001: Lichen-Rich Soil Crusts of Arctic Greenland. – Ecological Studies, 150: 57–65.
- HANSEN E.S., 2010: Lichens from five inland and coastal localities in South-West Greenland and their present climatic preferences in Greenland as regards oceanity and continentality. – Bibliotheca Lichenologica, 104: 143–154.
- HANSEN E.S., 2012a: Lichens from two inland localities in West Greenland and their climatic preferences. – Botanica Lithuanica, 18: 19–26.
- HANSEN E.S., 2012b: Lichens from five localities in south-east Greenland and their exposure to climate change. – Bibliotheca Lichenologica, 108: 123–134.
- HANSEN E.S., 2013: Lichens from three localities in Central West Greenland with notes on their climatic preferences. – Botanica Lithuanica, 19: 28–36.
- HANSEN E.S., POELT J., SÖCHTING U., 1987: Die Flechtengattung *Caloplaca* in Grönland. – Meddelelser om Grønland. Bioscience, 25: 1–52.
- HANSEN K., 1971: Lichens in South Greenland, distribution and ecology. – Meddelelser om Grønland, 178: 1–84.
- JENSEN D., 1999: Grønlands Biodiversitet – et landestudie. – Nuuk.
- NORDIN A., MOBERG R., TØNSBERG T., VITIKAINEN O., DALSAËTT Å., MYRDAL M., SNITTING D., EKMAN S., 2011: Santesson's Checklist of Lichen-forming and Lichenicolous Fungi – <http://130.238.83.220/santesson/home.php>
- THOMSON J.W., 1984: American Arctic Lichens. I. The macrolichens. – New York.
- THOMSON J.W., 1997: American Arctic lichens. II. The microlichens. – Wisconsin.

KERPĖS IŠ SISIMIUT VIETOVĖS VAKARINĖJE GRENLANDIJOJE IR JŲ KLIMATINĖS PREFERENCIJOS

Eric Steen HANSEN

Santrauka

2017 metų vasarą Sisimiut vietovėje (vakarinė Grenlandija) buvo surinktos 165 kerpių rūšys, kurios buvo kategorizuotos pagal jų klimatinės preferencijas. Beveik 68 % iš nustatytų 165 rūšių yra maždaug tolygiai paplitusios tiek kontinentinio, tiek ir okeaninio klimato Grenlandijos teritorijose. Kiek daugiau kaip 26 % rūšių yra dažnesnės okeaninio nei kontinentinio klimato vietovėse. Apie 5 % rūšių dažnes-

nės kontinentinio nei okeaninio klimato vietovėse. Dvi rūšys aptinkamos tik okeaninio klimato zonoje. Rūšių, randamų tik kontinentinio klimato zonoje, šio tyrimo metu neaptikta. Tyrimo metu gauti rezultatai atitinka gautuosius panašių tyrimų vakarinėje Grenlandijoje metu. Straipsnyje aptariami du skirtingi klimato pokyčių scenarijai ir galima jų įtaka kerpių bendrijoms.