Permanence in diversity
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Rosenbergdalen, green valley in the barren land of Edgeøya, Spitsbergen
Hester D. Heinemeijer & Arend J. van Dijk

Introduction
In the summer of 1977 the vegetation of Rosenbergdalen in Edgeøya was described and mapped. The research took place as part of the Reindeer Environment Expedition Svalbard (REES '77), organised by the Netherlands Foundation for Arctic Research (de Bie et al. 1979). Piet Oosterveld was the leader of this project. The aim of the expedition was an integrated study of the reindeer and its environment. A landscape ecological map was made of the whole island of Edgeøya (Lebouille & de Nies 1978) and the total island population of Svalbard reindeer was studied (Alendal, de Bie & van Wieren 1979). In order to acquire insight into the details of the classification of the vegetation of the landscape ecological map of Edgeøya (c. 5 000 km², scale 1:200 000), the vegetation of Rosenbergdalen was described and mapped in more detail (15 km², scale 1:10 000). The results of the study in Rosenbergdalen were published in a report (Heinemeijer 1979).

Rosenbergdalen
Investigation took place in an area of c. 3 x 5 km in the western part of Rosenbergdalen in the northwest corner of Edgeøya (78°05N, 20°55E) just south of Kap Lee. Rosenbergdalen is a U-shaped valley, surrounded by plateau-shaped mountains, 300 m high, with both gentle and steep slopes. The small river Rosenbergdalselva streams from glaciers situated up to 15 km inland in the east to the salt water coastline of Storfjorden in the west. The rocks are predominantly horizontally situated sandy shale and sandstone with some limestone. Doleritic outcrops dominate the landscape mainly along the rocky coast. The soil in Rosenbergdalen consists of stones, gravel, sand, loam and clay. In summer the uppermost layer of the soil thaws to a depth of approximately 0.5 - 1 m. Due to permafrost drainage is poor and parts of the flat and gently sloping areas are humid or wet. Polygons and solifluction are regular features. Large parts of the flat and gently sloping areas of Rosenbergdalen are covered with dense moss tundra. The steep
slopes and the plateaux are poorly covered with mossy fjellmark scree or have nearly barren rocks and gravels.

Climate and weather

Edgeøya is influenced by the cold sea stream from the northeast and the relatively warm north Atlantic gulf stream. In summer temperature fluctuations are primarily due to alternating influences of mild, southerly air streams and cold arctic air invading from the north and east. Fog is a regular phenomenon in summer. In July the temperature along the west coast of Spitsbergen in general is 1° - 10°, on average 5° centigrade, and the minimum temperature in the winter is between –8° and – 16° centigrade. The temperature in Edgeøya is somewhat lower. The precipitation, mainly snow, is less then 400 mm per year (Hisdal 1976). When we arrived in mid-July large parts of Storfjorden and Freemansundet were covered with sea ice. At the end of the month the ice had disappeared. At the beginning of September some sea ice shelfs (and Polar Bears) occurred in NO-Edgeøya. At Kapp Lee we measured maximum temperatures of 8-13° between 16 July and 8 August. In the course of August the maximum temperature dropped slightly to minus 1 degree at the end of the month and at the beginning of September. By mid-September however the maximum temperature was 1° –
During the 55 days of our stay, 51 days were overcast. There was drizzle on ten days and during three days it snowed (total amount 43.2 mm, pH 7). Fog appeared on twelve days. In general the wind speed was <7 m/second but on five days up to 16 m/second. In Svalbard, March and April of 1977 were unusually cold (up to minus 35°). May, in general, was cool and June had normal temperatures. In the first half of July it was quiet and relatively warm. The rest of July and large parts of August and September had a lot of cloudy weather with frequent precipitation. In general the summer of 1977 was rather cool (Hisdal 1978).

**Method**

Before leaving for Edgeøya literature concerning Arctic vegetation, especially Musci (mosses), Hepaticae (liverworts) and Lichenes was studied in the library and herbarium of the Netherlands Foundation for Arctic Research. With the help of enlarged aerial black and white photographs (1:25 000) and a topographic map (1:10 000) of Rosenbergdalen (Norsk Polarinstittut 1971-74) a provisional map (1:10 000) with information on the structure and elevations of the area was prepared using the mechanical slotted template method (Lebouille & de Nies 1978). In the first days a full reconnaissance of Rosenbergdalen and the plant communities or vegetation segments was carried out. In July and August entities in the vegetation cover were recognised and the samples of the recognised segments were selected subjectively without preconceived bias (Mueller-Dombois & Ellenberg 1974).

In view of the size of the study area, the mosaic pattern of the vegetation, the ‘minimal area’ of the Arctic vegetations, and the scale of the map, sample stands (relevés) of 1 m² were chosen. Most authors dealing with the description of vegetation in Svalbard used relevés of 0.5 - 2m² (range 0.02 - 25m²) (e.g. Hadač 1946, Rønning 1965, Philippi 1973). Estimating the coverage of Musci and Lichenes in areas larger than 1m² turned out to be difficult and inaccurate. Description of the vegetation in Rosenbergdalen was

Figure 1. Distribution of the vegetation community-types in Rosenbergdalen, with information on the distribution of landunits (inset, Lebouille & de Nies 1978). Some mosaic or otherwise patchy vegetations were lumped or combined on the map: Community A and B were lumped in some localities and combined with fractions of H, I and U (marked as AB). Community D was combined with fractions of C, F, K, L, M, U and community P with fractions of D. Communities H and I were combined (marked as H), as was the case with F, J and N (marked as N) and S and T (marked as S) (map: Arend J. van Dijk).
Vegetation map Rosenbergdalen, Edgeøya, Svalbard

H.D. Heinemeijer & A.J. van Dijk

1977

Figure 1

Community-type
A Papaver-Festuca brachyphylla-Poa abbreviata
B Ranunculus lanuginosum
C Arenaria-Skweine
D Dryas-Salix
E Papaver-Minuartia rubella
F Saxifraga rivularis-Luzula-Poa alpigina
G Diurium alpinum and I Tomentypnum-Drepanocladus uncinatus
H Saty-Polygonum-Aulacomnium turgidum
I Cardamine bellidifolia-Saxifraga foliosa-Palustre
J Ranunculus hyperboreus-Dupontia
K Bryum cryophyllum-Poa alpigina, J Orthocladion-Tomoptypnum and
L Ranunculus pygmaeus-Minuartia biflora
M Alpinus-Poaceae nivalis, Cerastium regelii
N Deschampsia-Poa alpigina
O Saty-Coenopodium
P Papaver-Frullania algida-Rhacomitrum canescens
Q Pucciniaatra phyraegodes and T. Potentilla rubra-Festuca rubra
R Drepanocladus uncinatus-Cerastium

... River (bank), brook
... Barrett
... Snow cover

Topographical base: Norsk Polarinstitutt
not restricted to the most typical communities and stands, which often seems to be the case in the literature. Also, the vague transition areas in-between were included. In 119 relevés scattered all over the area, the coverage and abundance of Tracheophyta (vascular plants), Musci, Hepaticae and Lichenes were estimated using the method of Braun-Blanquet (1964) refined by Barkman, Doing & Segal (1964). The vegetation found in 119 relevés was classified by tabular comparison (Braun-Blanquet 1964, Mueller-Dombois & Ellenberg 1974) and roughly ranked from dry to wet. Twenty-one community-types were recognised and described. In the relevés the texture and humidity of soils, elevation, exposition, depth of permafrost and occurrence of polygons were measured and described.

At the end of August and in September the vegetation was mapped, predominantly using the description of the vegetation segments based on the provisional classification of relevés. Furthermore, the physiognomy, structure and sometimes coloration of vegetation were taken into account as well as differences in humidity, elevation and angle of inclination. Evaluation and adjusting were done through the repetitive describing and mapping of the same vegetation segments at different times by two different persons. Comparison of mapped vegetation segments with patterns on the aerial photographs improved the accuracy and efficiency of mapping. In general, areas smaller than 50 x 50 m were not mapped separately.

The communities described were drawn on the map in the field and corrected afterwards. Some mosaic or otherwise patchy vegetations did not always fit in the scale of the map for this publication and were lumped into a complex of two or more communities. In addition, some minor alternations were implemented. Only larger patches of snow and barren ground are marked (for details see Heinemeijer 1979).

Tracheophyta were identified with the use of Svalbard’s Flora of Rønning (1964, 1979). Specimens of the genera Colpodium, Puccinellia, Draba, Potentilla, Festuca, Poa and Saxifraga, as well as all species of Musci, Hepaticae and Lichenes found in the relevés were collected and identified later in The Netherlands with the use of Arnell (1956), Becher et al. (1966), Nyholm (1954-69, 1986), Poelt (1969), Polunin (1959) and Rønning (1962). Species which were difficult to distinguish were noted as spec. (e.g. Draba spec.) or as follows: Festuca brachyphylla and F. hyperborea as F. brachyphylla, Saxifraga rivularis and S. hyperborea as S. rivularis, Dupontia pelligera, and D. psilosantha as D. pelligera and Distichium capillaceum and D. inclinatum as D. capillaceum.
For general remarks, problems concerning identification of plant species and other details see Heinemeijer (1979).

Results

Community-types
The classification tables of Tracheophyta, Musci, Hepaticae and Lichenes are summarised in table 1 and 2. Each community is characterised by the description of landscape features, relief, texture of the soil, abundance of polygons, moisture and the coverage and composition of the vegetation. The most abundant and typical species of Tracheophyta and Musci are listed in alphabetic order. The community-types described in Rosenbergdalen are compared with descriptions mentioned in other references concerning Svalbard. The distribution of the communities in Rosenbergdalen is shown in figure 1.

A Community of Papaver-Festuca brachyphylla-Poa abbreviata
Slopes (inclination up to 35°), shale ridges, fan-shaped scree with many gullies and rill erosion, grit hillocks and small outcrops. Also found on valley floor. Gravels with sandy loam, schists with some clayloam. No polygons found, approximately 10% (permanently) snow-covered. Dry poorly covered (locally up to 25%) fjellmark, mainly with Tracheophyta. Most abundant species: Cerastium arcticum, Festuca brachyphylla, Minuartia rubella, Papaver dahliani, Poa abbreviata, Saxifraga cespitosa, S. cernua, S. oppositifolia and Tortula ruralis. Many epilithic Lichenes present.

Resembles Papaveretum dahliani (Hofmann 1968) and Saxifragaetum oppositifolii (Hadač 1946), also with reference to the habitat and list of species. Typical species Potentilla pulchella and Braya purpurescens were however scarce in Rosenbergdalen and restricted to types C and O.

B Community of Racomitrium lanuginosum
Almost flat (inclination up to 7°) doleritic outcrops. Gravelly and stony clays and loams with some polygons. Some (permanent) snow-cover. Mainly dry, drained and medium covered (65%) moss tundra; Lichenes relatively abundant. Mist (air-humidity) is an important feature (Hadač 1946). Most abundant species: Cerastium arcticum, Encalypta rhabdocarpa, Luzula confusa, Polygonum viviparum, Racomitrium lanuginosum, Salix polaris, Stellaria crassipes, Saxifraga cespitosa, S. nivalis, S. oppositifolia,
Table 1. Summarised classification of Tracheophyta with indication of the abundance of species per community-type. Filled = found in >50%, O = in 25-50% and o = in <25% of the relevés; blank = not found. Other species (all <25%) found in the relevés are: Braya purpurascens (community-type O), Chrysosplenium tetratum (K,M,O), 7 Draba fladnizensis (F,K), D. oxyccarpa (F), D. lactea (A,G,J,O,P), D. nivalis (F), D. adamsii (I,R), D. subcapitata (B,C,J,R), Equisetum scirpoides (E,F,K,M), E. variegatum (D,F,O), Festuca vivipara (A,E), Melandrium apetalum (B,C,J,R), Puccinellia angustata (C,T), Saxifraga flagellaris (A,C,I,J,P), S. hieracifolia (B,H,J,K,P) and Taraxacum arcticum (A,F,I) (source: Heinemeijer, 1979).
Table 2. Summarised classification of Musci (upper part), Hepaticae (middle) and Lichenes (under) with indication of the abundance of species per community-type. Legend and information on mean coverage and moisture see table 1. For other less common species found see Heinemeijer (1979) (source: Heinemeijer, 1979).
Tortula ruralis. Many epilithic Lichenes e.g. Neuropogon sulphureus, Rhizocarpon spec. Umbilicaria spec. and Xanthoria spec. Resembles Rhacomitrietum lanuginosi (Hadač 1946), Sphaerophoro-Rhacomitrietum lanuginosi (Hofmann 1968) and Rhacomitrium lanuginosum community (Philippi 1973), but the latter mentioned fewer species in the nearby area of Freemansundet.

C Community of Arenaria-Silene
Flat coastal beach-ridge with remains of whale bones. Gravelly, sandy clayloam. Many polygons. Dry to moist and medium covered (50%). Most abundant species: Arenaria pseudofrigida, Distichium capillaceum, Polygonum viviparum, Salix polaris, Saxifraga oppositifolia, Silene acaulis and Tortula ruralis. Carex subspathacea was growing locally in damp places, and in dry places Potentilla pulchella.

Some similarity with whale bone beach vegetation of Neilson (1970), however Salix, Polygonum and Saxifraga oppositifolia are not mentioned by Neilson and Carex ursina and Braya purpurascens were not found in Rosenbergdalen in this community.
D Community of Dryas-Salix
Almost flat (inclination up to 7°), undulating, southerly exposed doleritic outcrops. Silty to sandy loam with gravels and boulders and with some polygons. Dry to moist, drained and richly covered (80%) tundra, mainly with Tracheophyta. Most abundant species: Distichium capillaceum, Drepanocladus uncinatus, Dryas octopetala, Pedicularis hirsuta, Polygonum viviparum, Salix polaris, Saxifraga oppositifolia and Tortula ruralis.

Resembles Dryadatum minoris (Hadač 1946) and Polari dryadetum (Rønning 1965), but in comparison with Spitsbergen fewer species were found in Rosenbergdalen. According to Rønning (1965) similar to Tomentohypnetum involuti (Hadač 1946), but in Rosenbergdalen we found differences (see I).

E Community of Papaver-Minuartia rubella
Slopes along the coast (inclination up to 15°), scree. Stony, gravelly, sandy clayloams, locally polygons. Dry to moist poorly covered (40%) fjellmark, mainly with Musci. Most abundant species: Cerastium arcticum, Drepanocladus uncinatus, Papaver dahlianum, Minuartia rubella, Polygonum viviparum, Salix polaris, Saxifraga cespitosa and Timmia austriaca.
No similar community found. In Rosenbergdalen probably related to A but vegetation of E was more dense and humid.

**F Community of Ranunculus pygmaeus-Minuartia biflora**

Slopes (inclination up to 30°), southwesterly exposed, beneath bird cliff. Sandy to silty clayloam with boulders and locally polygons. Moist and richly covered (80%) tundra. Most abundant species: *Cerastium arcticum, Draba alpina, Drepanocladus uncinatus, Festuca rubra, Minuartia biflora, Oxyria digyna, Poa arctica, Polygonum viviparum, Ranunculus pygmaeus, Salix polaris, Saxifraga cernua, S. cespitosa, Stellaria crassipes, Timmia austriaca* and *Tortula ruralis*. Typical species: *Erigeron humilis, Ranunculus nivalis* and one specimen of *Trisetum spicatum*.

Resembles parts of Drepanoclado-Poetum alpinae and Trisetum spicati spitbergense (Hadač 1946), but fewer species were determined in Rosenbergdalen. Quite similar to bird cliff vegetations mentioned in Hofman (1968), Eurola & Hakala (1977; *Oxyria digina-Poa arctica community*) and Neilson (1970).

Flowering *Polygonum viviparum*. This plant is favourite by grazing Pink-footed and Barnacle Geese. (photo: Arend J. van Dijk).
G Community of Saxifraga nivalis-Luzula-Poa alpigena
Almost flat and undulating (inclination up to 7°), partly barren gravelly tundra Beneath slopes. Silty clay to gravelly clayloam with some polygons. Moist to locally wet with stagnating melting water, medium covered (60%) tundra. Most abundant species: Aulacomnium turgidum, Campylium stellatum, Cerastium arcticum, C. regelii, Distichum capillaceum, Drepanocladus uncinatus, Dricanum flexicaule, Hylocomnium splendens, Luzula confusa, Orthothecium chryseum, Philonotis fontana, Polygonum viviparum, Polytrichum alpinum, Poa alpigena, Ranunculus sulphureus, Salix polaris, Saxifraga cernua, S. cespitosa, S. nivalis, S. oppositifolia, Stellaria crassipes and Tomenthypnum nitens.
No similar community found. In Rosenbergdalen probably a transition Between A, I and L but with differences in coverage and humidity.

H Community of Dicranum elongatum
Lower plateaux in valley floor, somewhat undulating (inclination up to 3°) and gravelly. Silty and sandy clayloam. Many polygons: mud-circles and hummocks. Moist and richly covered (90%) moss tundra. Most abundant species: Alopecurus alpinus, Aulacomnium turgidum, Cerastium arcticum, C. regelii, Dicranum elongatum, Hylocomnium splendens, Poa arctica, Polygonum viviparum, Polytrichum alpinum, Ranunculus sulphureus, Salix polaris, Saxifraga cernua, S. cespitosa and Stellaria crassipes.
Resembles Dicranum angustum-tundra (Philippi 1973) but the important typical species Hypnum callichroum was not found in Rosenbergdalen, while Polygonum was found to be more common. Philippi mentioned Dicranum angustum as common and D. elongatum as rare in the Freemansundet area while in Rosenbergdalen only the latter was recognised. In accordance with Kuc (1973) D. elongatum is one of most numerous musci in Svalbard. Probably D. angustum is also common but there are few records.

I Community of Tomentypnum-Drepanocladus uncinatus
Lower plateaux in valley floor, somewhat undulating (inclination up to 3°) and gravelly. Silty and sandy clayloam. Many polygons. Moist to dry richly covered (90%) moss tundra; Lichenes relatively abundant. Most abundant species: Alopecurus alpinus, Cerastium arcticum, Distichum capillaceum, Ditrichum flexicaule, Drepanocladus uncinatus, Encalypta rhabdocarpa, Festuca rubra, Luzula confusa, Poa alpigena, P. arctica, Polygonum viviparum, Ranunculus sulphureus, Salix polaris, Saxifraga cespitosa, S.
J. Community of Orthothecium-Tomenthypnum
Slopes (inclination up to 15°), undulating, along the coast and some beneath bird cliff. Gravely, stony, silty clayloam and locally polygons. Moist and richly covered (90%) tundra. Most abundant species: Campylium stallatum, Cerastium regelii, Distichum capillaceum, Ditrichum flexicaule, Drepanocladius revolvens, Equisetum arvense, Orthothecium chryseum, Philonotis fontana, Polygonum viviparum, Ranunculus sulphureus, Salix polaris, Saxifraga cespitosa, S. cernua, S. hirculus, S. oppositifolia, Stellaria crassipes and Tomenthypnum nitens.

Some resemblance to Orthothecium chryseum-community (Philippi 1973) in the Freemansundet area, but Tomenthypnum, Salix and Polygonum with higher coverage in Rosenbergdalen.

K. Community of Salix-Polygonum-Aulacomnium turgidum

Resembles the community Calliergon giganteum-Drepanocladius revolvens (Philippi 1973), but Salix, Polygonum, Aulacomnium turgidum and Philonotis, found commonly in Rosenbergdalen, were lacking or scarce in the community of Philippi. In Rosenbergdalen this community forms a transition between the somewhat higher situated community I and the very wet community M.
L. Community of Cardamine bellidifolia-Saxifraga foliolosa-Paludella

Undulating, almost flat areas beneath snow patches and along small streams with melting water. Gravelly, sandy and silty clayloam, with some polygons. Approximately 5% (permanently) snow-covered. Humid and wet through stagnating melting water. Nearly totally covered (99%) moss tundra. Most abundant species: Alopecurus alpinus, Aulacomnium palustre, A. turgidum, Cardamine bellidifolia, Dupontia pelligera, Hylcomnium splendens, Paludella squarrosa, Philonotis fontana, Plagiomnium ellipticum, Poa arctica, Polytrichum alpinum, Saxifraga foliolosa and Tomenthypnum nitens.

Resembles Meesia triquerta community (Philippi 1973), but the typical species Calliergon sarmentosum was lacking in this community in Rosenbergdalen. On the other hand we found Cardimine bellidifolia to be much more common.

M. Community of Ranunculus hyperboreus-Dupontia


Resembles Bryetum cryophyllum (Philippi 1973) and Calliergo-Bryetum cryophyllum (Hofmann 1968). In Rosenbergdalen Meesia was more common and the species typical in Rosenbergdalen, Ranunculus spitsbergensis, Eriophorum scheuchzeri and Arctagrostis latifolia, were not mentioned by either author. In the approximately simular community Bryo-Dupontietum fisheri (Hadač 1946), Ranunculus hyperboreus is not mentioned.

N. Community of Bryum cryophilum-Poa alpigena

Small brooks in undulating (inclination up to 7°) nearly barren gravelly and stony tundra beneath slopes, some with bird cliff. Silty and sandy clayloam without polygons. Very wet, with stagnating and seeping melting water. Poorly covered (20%); Lichenes almost absent. Most abundant species: Alopecurus alpinus, Aulacomnium turgidum, Bryum cryophilum, Calliergon
giganteum, Drepanoclados revolvens, Philonotis fontana, Poa alpigena, Saxifraga cernua and Tomentypnum nitens.

No similar community found.

O Community of Alopecurus-Poa arctica-Cerastium regelii
Almost flat river floodplain, borders and banks. Stony and gravelly, silty clay and sandy loam.

Locally some polygons. Wet, richly covered (75%) moss tundra. Most abundant species: Alopecurus alpinus, Brachythecium turgidum, Drepanoclados uncinatus, Luzula arctica, Poa arctica, Saxifraga cespitosa, S. oppositifolia, Stellaria crassipes and Tomentypnum nitens. Locally Eriophorum scheuchzeri, Dupontia pelligera and Phippsia concinna.

The only vegetation description found which corresponded somewhat to this was the river delta vegetation of Punsvik & Syvertsen (1978). In Rosenbergdal however the coverage of Musci was higher and Calamagrostis neglecta and Minuartia biflora were lacking in Rosenbergdaleneiva.

P Community of Deschampsia-Poa alpigena
Gently undulating slopes (inclination up to 7°) with much solifluction. Gravelly, silty clayloam, with locally some polygons. Very wet to moist, stagnating and seeping melting water especially at the beginning of the growing season. Poorly covered (30%) Deschampsia mark. Most abundant species: Alopecurus alpinus, Barbula recurvirostris, Brachythecium turgidum, Campylium stallatum, Cerastium regelii, Cochlearia officinalis, Colpodium vaccillans, C.vahlianum, Deschampsia alpina, Drepanoclados revolvens, Distichum capillaceum, Ditrichum flexicaule, Juncus biglumis, Koenigia islandica, Orthothecium chryseum, Poa alpigena, P. alpina and Saxifraga nivalis.

Almost similar to the description of Deschampsia communities in Rønning (1969) and Brattbakk & Sendstad (1975).

Q Community of Salix-Colpodium
Lower plateaux in valley floor, somewhat undulating (inclination up to 3°) and very gravelly. Clayloam and sandy clayloam. Elongated polygons with vegetation and barren soil in ridges. Moist to dry richly covered (80%) moss tundra; Lichenes relatively abundant. Most abundant species: Alopecurus alpinus, Aulacomnium turgidum, Cochlearia officinalis, Colpodium
vhalianum, Drepanocladus revolvens, Distichum capillaceum, Ditrichum flexicaule, Koenigia islandica, Luzula arctica, Philonotis fontana, Polygonum viviparum, Salix polaris and Tomentypnum nitens.

No similar community found. In Rosenbergdalen this community forms a transition between the communities A, C and I.

**R Community of Papaver-Phippsia algida-Rhacomitrium canescens**

Highest upland plateaux, undulating (inclination up to 7°). Gravelly, sandy clayloam and clayloam. Solifluction and elongated polygons with vegetation in ridges. Mosaic is wet and dry. Wet parts with stagnated water with Musci. Poorly covered (35%) fjellmark. Most abundant species: Bartramia ithyphylla, Campylium stallatum, Cardamine bellidifolia, Cerastium regelii, Cochlearia officinalis, Drepanocladus uncinatus, Ditrichum flexicaule, Luzula arctica, Orthothecium chryseum, Papaver dahlianum, Phippsia algida, Rhacomitrium canescens, Saxifraga cernua, S. oppositifolia and Stellaria crassipes.

The vegetation in dryer parts resembles the Rhacomitrium canescens community and in humid parts the Hygrohypnum polare community (Hofmann 1968, Philippi 1973). Philippi’s description of the sub-association Orthothecium of the Rhacomitrium canescens community fits in with the mosaic vegetation as a whole as observed in Rosenbergdalen.

**S Community of Puccinellia phryganodes**

Almost flat coastal floodplain mark, beaches and beach ridges, influenced by salt water. Sandy clayloam and silty clay, without polygons. Moist to wet poorly covered (20%). Most abundant species: Cochlearia officinalis, Colpodium vahlianum, Koenigia islandica, Puccinellia phryganodes. Locally Arenaria pseudofrigida, Carex ursina, Colpodium vaccillans, Phippsia concinna, Saxifraga rivularis, Silene acaulis and Stellaria humifusa.

Similar to Puccinellietum phryganodis (Hadač 1946). In Rosenbergdalen more species appeared in this community, which is in accordance with Hofmann (1968) in Barentsøya. We found no similarity with Caricetum ursinae (Hadač 1946).

**T Community of Potentilla rubricaulis-Festuca ubra**

Coastal almost flat sandy beach vegetation. Dry sands and sandy loam, without polygons. Only near base-camp, probably anthropogene influence. Poorly covered (15%); Musci and Lichenes almost absent. Most abundant
species: *Alopecurus alpinus*, *Cerastium regelii*, *Festuca rubra*, *Papaver dahlianum* and *Sagina intermedia*. Locally *Potentilla rubricaulis*. No similar community found.

**U Community of Drepanocladus uncinatus-Calliergon**
Small (often V-shaped) valleys, gullies, sheltered depressions on slopes (inclination up to 15°); so called ‘snow bottom’ vegetation. Approximately 10% (permanently) snow-covered; often shadow sides of hang. Silty clay and sandy clayloam, without polygons. Very wet, seeping melting water, richly covered (85%) moss tundra. Most abundant species: *Bryum ovatus*, *Calliergon cordifolium*, *C. giganteum*, *C. stramineum*, *Campylium stallatun*, *Drepanocladus uncinatus*, *Paludella squarrosa*, *Philonotis fontana*, *Saxifraga cernua*. Locally *Cochlearia officinalis*, *Colpodium vaccillans*, *Cardamine nymani* and *Phippsia algida*.

Some resemblance with *Drepanocladus uncinatus ‘snow bottom (sneeboden)’* of Hofmann (1968) and Philippi (1973).

The 21 communities are ranked in order of elevation: = is barren and * is snow cover.

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<th>Community-type</th>
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<tr>
<td>Higher plateaux R, B</td>
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<td>Slope A, E, =, *</td>
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<tr>
<td>Lower plateaux G, B, L, P, D, F, J, N, U, =, *</td>
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<td>Valley floor H, I, M, K, Q, U, *</td>
</tr>
<tr>
<td>Flood plain O, =</td>
</tr>
<tr>
<td>Coastal plain C</td>
</tr>
<tr>
<td>Beach =, S, T</td>
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</tbody>
</table>

**Coverage of vegetation**
The total coverage of the vegetation (fig. 2) clearly shows the most densely vegetated areas to be in the valley floor and (in depressions) on the lower plateaux, and, to a lesser extent, in some gently sloping areas and locally along the coast. Approximately 60% of the ground in Rosenbergdalen is covered with vegetation. Musci and Hepaticae account for 61% of the covered area, Tracheophyta for 32% and Lichenes for 7%. Steep slopes, deep V-shaped valleys (with snow cover), the river bed and the beach are
the most barren areas. Some mountain tops as high as over 300m are however fairly well covered, mainly with Musci. In general the most dense vegetations are predominantly found in areas with a permanent supply of water (cf. Rønning 1969). The seeping or stagnating water from melting snow is a permanent source of water. This is also the case with gently streaming small brooks or the thaw of permafrost. Water is not the only important feature, as is shown in the poorly covered but wet community of Bryum cryophyllum-Poa alpigena (N). The opposite holds true for the well covered but dry to moist community of Dryas-Salix (D). So other items are important in this respect e.g. snow cover in winter, the number and composition or nutrients (doleritic and rich bird cliff vegetation) and the composition, drainage and pH value of the soil. In Rosenbergdalen there seemed no big difference in moss coverage between the south and west sides of the mountain slopes exposed to the sun and the north and east facing slopes.
Discussion

**Number of species**

In tundras the contribution of Musci, Hepaticae and Lichenes to the vegetation is relatively high. In Rosenbergdalen in 1977 we found in total 239 plant species, Tracheophyta 79 species, Musci/Hepaticae 85 and Lichenes 75. The most abundant species found in the relevés are listed in table 1 and 2. The list of Tracheophyta is the most complete one, because the research was predominantly focussed on flowering plants in the whole area of Rosenbergdalen. Investigation of the other groups was more or less restricted to the relevés and surroundings.

Compared with the other areas visited in Edgeøya, Rosenbergdalen and Grunnlinesletta/Plurdalen along the southwest coast are among the most densely covered regions of the island with the largest numbers of Tracheophyta and Musci. In the two areas, 79 and 92 species of Trachyophyta were recorded respectively, whilst in the northeast part of Edgeøya (Berrflòta) the number was 60. In the southwest, *Equisetum scirpoides*, *Honkenya peploides*, *Ranunculus lapponica*, *Arctophyla fulva* and the *Carax*-species *lachenalii*, *glareosa*, *misandra* and *saxatilis* were recorded, among others. The only species unique to Rosenbergdalen was *Ranunculus nivalis* (Van Dijk & Heinemeijer 1979). These findings coincide with the phytosociological subdivision of the European Arctic areas, where the western part of Edgeøya (together with large parts of Svalbard) is situated in the Northern Arctic tundra zone. The northeastern part of Svalbard, including eastern Edgeøya, is allocated in the cooler Arctic polar desert zone and the inner part of Spitsbergen to the somewhat milder Middle Arctic tundra zone (Elvebakk 1989). Rosenbergdalen lies within the relatively milder part of Edgeøya and this partly explains the relatively high number of tracheophyta established and the relatively dense vegetation cover.

*Community-types in Svalbard*

All community-types distinguished in Rosenbergdalen were compared with the classified associations and communities in Hadač (1946), Rønning (1965), Philippi (1973) and with the vegetations described in Hofmann (1968) and Neilson (1970). The latter three also gathered information in the area of Edgeøya and Barentszøya.

The descriptions of most community-types (16 out of 21, 76%) in Rosenbergdalen resemble the descriptions of other workers in Svalbard, but
there is of course variation. In six of the more or less similar communities (I, J, L, P, R, U) the coverage of the vegetation and/or the species composition in Rosenbergdalen and in the reference areas are more or less alike, in three communities (K, M, S) the coverage and/or the species composition in Rosenbergdalen predominates the others, while in four communities (A, B, D, H) it is the other way round. Some differences can be explained by the location of the described communities, e.g. in the areas in Spitsbergen with a more favourable climate. Less similarity was found in three communities, types C the beach-ridge, F beneath the bird-cliff and O river banks. No similarity was found in 5 community types, of which N and T were found in a very small area and T also near the base camp (antropogene influence?). In the description of the other three types the probability of a transition type has already been mentioned. These three communities are E (transition to A), G (transition to A, I, L) and Q (transition to A, C, J).

Comparison of landscape ecological mapping and vegetation mapping
Comparison of the results of the landscape ecological mapping of Edgeøya (Lebouille & de Nies 1978) and the mapping of the vegetation of Rosenbergdalen (Heinemeijer 1979) is hampered through differences in approach, methods and results. Differences had not only to do with the scale and area (Edgeøya 5 000 km², scale of map 1:200 000, Rosenbergdalen 15 km², scale of map 1:10 000), but also with the fact that Rosenbergdalen is an a-select area within Edgeøya. The number of mosaic patterns is not at discussion, because both mappings had to deal with this phenomenon at different scales. In the landscape ecological mapping, the preliminary interpretation of aerial photographs, resulting in the distinction of landunits such as landform, soil and vegetation, was essential, as was the selection of representative sample areas by stratified sampling. Both were carried out before leaving for Edgeøya. In 131 pre-selected areas relevés of 75-300 m² were made in homogeneous vegetation. Measurements were focussed on the coverage of all plant species, but in the species lists primarily on Trachophyta (in 36 relevés also Musci, Hepaticae and Lichenes). Classification of the vegetation by tabular comparison was done afterwards and partly with a clustering programme.

In Rosenbergdalen the aerial photographs were used for reconnaissance and for the adjustment of boundaries of vegetations in the field. After the reconnaissance of entities in the vegetation cover, samples of the recognised segments in the vegetation were selected subjectively without
preconceived bias. This was done integrally in the whole valley. 119 relevés of 1m² were selected on the spot in homogeneous and heterogeneous vegetation in all preliminarily selected vegetation segments. Measurements dealt with the number of species and the coverage of all Tracheophyta, Musci, Hepaticae and Lichenes. The classification of the vegetation by tabular comparison was done in essence during fieldwork, as the results were needed for mapping purposes.

Despite the differences between the two projects, some remarks can be made about the comparison of the results. Eight of the 25 recognised landunits of Edgeøya are found in Rosenbergdalen (see inset in fig. 1). As might be expected most landunits are split into several recognised community-types in Rosenbergdalen. The landunit 5, Braided river floodplain, largely fits in with the community-types O, A, B, the river and river banks. The same appears for landunit 11, the doleritic mosstundra area, and the community-types D, P and S. In Rosenbergdalen, in landunit 13, the valley floor mosstundra, 17 different community-types are described, some of them more or less restricted to this landunit (e.g. C, H, I, K, L, M, Q and U) while of other types only parts lay within this landunit (e.g. A, B and G).

Landunit 16, mossy fjellmark scree, appeared along the coast of Rosenbergdalen and also more inland. The coastal distribution of this unit fits in almost completely with community-type E, and the inland part largely with community-type G. The ‘problem’ with G is that this type itself consists of a mix of four types and transitions in-between (A, I, L and P), so hardly any conclusion can be drawn. Landunit 17, barren steep slope, has both a coastal and an inland distribution. Along the coast this unit fits in with the legend ‘Barren’. In the inland sites community-type A accounts for the major share, but types R, B and G also occur. The vegetation cover at the inland sites in Rosenbergdalen however was 25-65% and not barren, as is the case in unit 17. Landunits 18, barren V-shaped gully, and 19, highly situated open mosstundra, are distinct merely because of the landform. The vegetation is mainly a mix of the types A, B, R and U. Landunit 22, highest mossy poppy fjellmark plateau, is predominately covered with the community-types R and A, but the descriptions of the vegetation in Lebouille & de Nies (1978) and Heinemeijer (1979) differ remarkably.

Samenvatting
In de zomer van 1977 is de vegetatie van Rosenbergdalen op Edgeøya in het oosten van Svalbard beschreven en in kaart gebracht, met als doel
inzicht te krijgen in detaillering ten opzichte van de landschapsecologische kaart van geheel Edgeøya. Met behulp van 119 opnamen van 1m² is de vegetatie van vaatplanten, blad-, lever- en korstmossen beschreven en in 21 verschillende vegetatie-eenheden ingedeeld (tabel 1 en 2). De vegetatie-eenheden zijn gekarakteriseerd aan de hand van het type landschap, de samenstelling en vochtigheid van de bodem, bedekkingspercentages plantengroepen en de meest voorkomende en typerende plantensoorten. De verspreiding van de vegetatie-eenheden is op een kaart ingetekend (fig. 1). Op steile berghellingen is de vegetatie meestal schaars en soortenarm. Op hooggelegen plateau’s is de bedekking door planten en het aantal soorten wat hoger, maar in het dal worden de hoogste waarden bereikt (fig. 2).

In totaal werden in Rosenbergdalen 239 plantensoorten vastgesteld, 79 soorten vaatplanten, 85 blad- en levermossen en 75 korstmossen. Het aantal vaatplanten en de bedekking van de vegetatie is voor Edgeøya aan de hoge kant, wat onder andere samenhangt met de relatief gunstige ligging ten opzichte van de milde luchstromingen uit het zuiden. Het leeuwendeel (76%) van de vastgestelde vegetatie-eenheden kwam tot op zekere hoogte overeen met beschreven vegetaties elders in Svalbard. De overige vormden vaak overgangen tussen beschreven eenheden. Verschillen in onder andere de aanpak en werkwijze bemoeilijken een vergelijking tussen de landschapsecologische kartering van Edgeøya en de vegetatiekartering van Rosenbergdalen. Acht van de 25 landschapsecologische eenheden komen in Rosenbergdalen voor. Elke landschapsecologische eenheid is in Rosenbergdalen opgesplitst in drie tot maximaal 17 verschillende vegetatie-eenheden. Drie van de 21 vegetatie-eenheden in Rosenbergdalen pasten nagenoeg geheel in een landschapsecologische eenheid, maar de meeste eenheden kwamen in meer dan een landschapsecologische eenheid voor.

References
Aerial photograph 1:25 000 of North West Edgeøya (1971) and Topographical map 1:10 000 of Rosenbergdalen (part of E9; 1974), Oslo: Norsk Polarinstitutt, 1971-74.


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