# A PHYTOSOCIOLOGICAL CLASSIFICATION OF THE AVALON PENINSULA HEATH NEWFOUNDLAND



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# A PHYTOSOCIOLOGICAL CLASSIFICATION
# OF THE
# AVALON PENINSULA HEATH
# NEWFOUNDLAND

by

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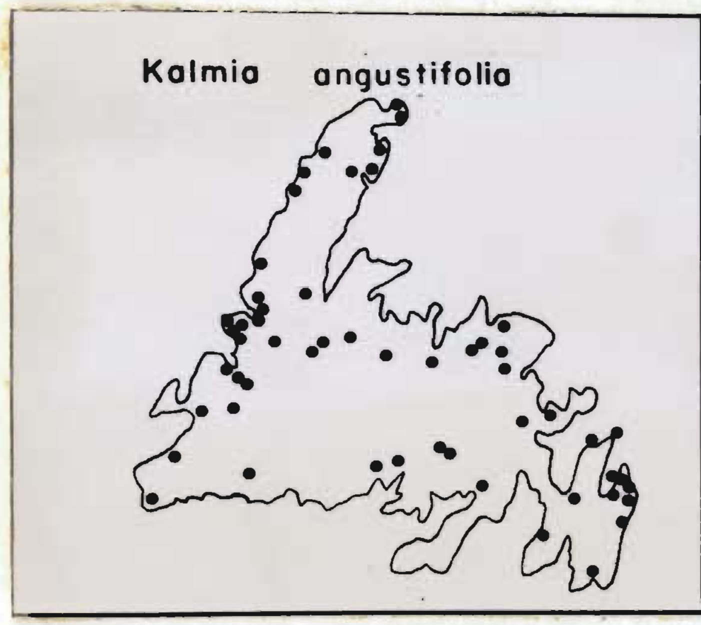



In Europe the term "heath" is used to describe "barrens" because of the dominance of the common heather (Calluna vulgaris). Heather occurs sporadically in Newfoundland as an introduced species and the sheep laurel (Kalmia angustifolia) is the most common heathland plant.

Photographer: Dr. A.W.H. Damman

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ABSTRACT

Using depth of humus, structural physiognomy of the vegetation and the occurrence of sociological species groups as criteria, the Avalon Peninsula heathlands have been classified into three morphological types:

1. ROCK BARRENS
2. HARD GROUND HEATH
3. SOFT GROUND HEATH

The vegetation of each of these morphological types is classified using the methods of the Zurich Montpellier School of Phytosociology. Rock Barrens are represented by the association *Diapensio - Arctostaphyletum alpinae*. Hard Ground Heath has two naturally occurring associations (*Empetro - Rhacomitrietum lanuginosae*; *Empetro - Potentilletum tridentatae*) and two anthropogenic associations (*Luzulo - Polytrichetum commune*; *Luzulo - Empetretum nigrae*). The Soft Ground type is represented by three dry heath associations (*Kalmietum angustifoliae*; *Kalmio - Alnetum crispae*; *Abietetum balsameae hudsoniae*) and three wet heath associations (*Kalmio - Myricetum gale*; *Kalmio - Sphagnetum nemori*; *Piceetum marianae semiprostratae*).

Ecological investigations on a heath slope revealed the presence of a soil-vegetation catena. The upper slope is characterized by Rock Barrens and Hard Ground Heath whereas

the lower slope is characterized by Soft Ground Heath. Temperature recordings taken between March and July showed a correlation between the date of substrate thaw and the vegetation cover.

The Avalon Peninsula is divided into the following four ecoregions based on the distribution of described associations and other floristic, ecological and morphological characteristics:

1. ALPINE HEATH
2. SUBARCTIC HEATH
3. BOREAL HEATH
4. BOREAL FOREST

Floristic comparisons revealed that the Avalon heath has its closest floristic relationship with the Boreal-Atlantic Region in northwest Europe. The association Kalmio - Sphagnetum nemori is related to the class Oxycocco - Sphagnetea in existing hierarchical vegetation classification. However, endemism in the vascular flora between North America and Europe made it impossible to relate the remaining Avalon heath associations to the existing European classification. The heath associations are structured into a tentative hierarchical classification of the northeastern North American heath.

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# CHAPTER I. INTRODUCTION

## Objectives

Heathlands cover approximately 623,316 hectares of the land surface on the Avalon Peninsula. Historically this land resource has been primarily utilized for commercial blueberry production and to a lesser extent as pasture for sheep. The barrens in their natural state are also important habitats for game such as the willow ptarmigan and caribou.

At present, government agencies are assessing the capability of these lands for forestry, agriculture, wildlife and recreation. It has become evident, however, that inventory alone is not sufficient for management purposes and an ecologically-orientated system of land classification is required. As Rowe (1971) points out, the development of such a classification extends beyond the knowledge of any single investigator. Rowe states;

> "A full description of the land requires attention both to the genetic structural features and to the parameters that adhere to them."

In the context of this statement this study is primarily concerned with the vegetation as a parameter of the land and has the following objectives:

a) to provide a morphological classification of the Avalon heath,

b) to delineate and describe the floristic subunits comprising the larger morphological heath types,

c) to describe the ecoregions (vegetative zones) of the Avalon.

The field work was limited to the Avalon Peninsula of Newfoundland where 74 sites were visited and 283 releves obtained. The study area and the location of sampled sites are shown in Figure 1-1. The locations are documented in Appendix III.

Botanical sources used for nomenclature are as follows:

VASCULAR PLANTS - Fernald (1950) for North American species except: Polygonum viviparum L. (Rouleau 1956)

- Clapham et al. (1958) for European species

LICHENS - Hale (1969) except:
Alectoria nigricans Ach. (Anders 1928)
Cladonia elongata (Jacqu.) Hffm. (Anders 1928)

MOSSES - Nyholm (1954-1969)

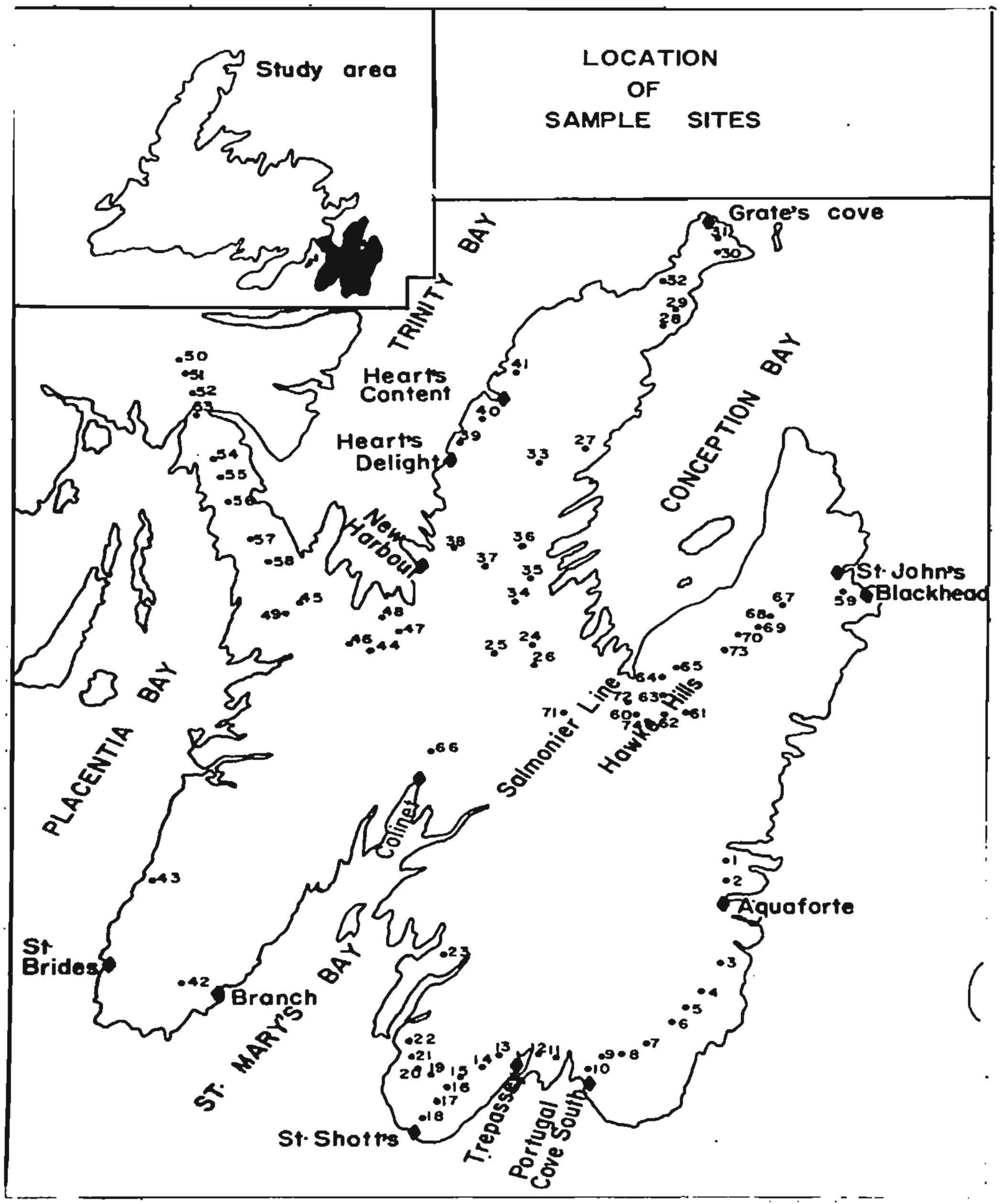


Figure 1-1: Study area and the location of sample sites.

Only the most conspicuous liverworts, *Ptilidium ciliare*, *Bazzania trilobata*, *Mylia anomala* and *Cephalozia connivens*, were recorded in this survey. Their nomenclature follows Arnell (1956). A checklist of all species recorded in the survey is presented in Appendix IV.

## Previous Research

Ecological research on the vegetation of the Avalon Peninsula is very limited. Preliminary floristic surveys have been carried out by Fernald (1918), Rouleau (1956) and Damman (1965a). Studies on peatland vegetation are in progress (Wells, pers. comm.). Smith (1970) has considered some of the successional relationships of aquatic vegetation.

Agricultural research pertaining to the effect of fertilization and prescribed burning on the fruit productivity of the lowbush blueberry is presented by Rayment (1971) and Penney and Rayment (1972).

Descriptions of wildlife habitats are presented by Hunter (1964), Peters (1958), Ahti (1959), Bergerud (1970), Pollett and Meades (1972), and Tuck (1972).

Research on the forest vegetation of the Avalon is limited to Wilton (1956), Page and Van Nostrand (1970), and Rowe (1972).

Syers (1960) gives a brief commentary on vegetation in his study on soils in the Cape Shore area and Terasmae (1963) has performed the only palynological studies on the Avalon.

## Geographic Setting

### Landscape

The landscape of the Avalon Peninsula is characterized by extensive nonforested terrain comprised of alternating peatlands and ericaceous heathlands (Figure 1-2). The dominance of the heathland flora by shrubs, phytogeographically concentrated in northeastern North America, creates a scenery which is unique to eastern and southwestern Newfoundland. In autumn the crimson hues of *Kalmia*, *Rhodora*, *Viburnum*, and *Vaccinium* contrast sharply with the surrounding coniferous vegetation. During winter, strong winds expose dark patches of mineral soil at the summit of knolls while depositing deep drifts against the sheltered lower slopes. Renewed growth in spring produces a luxuriant green carpet distinguishing the heath from the orange-brown sedge dominated peatlands.

### Topography

The topography of the Avalon Peninsula is characterized by irregularities. The Peninsula is joined to the mainland by a narrow isthmus with four large bays running in a

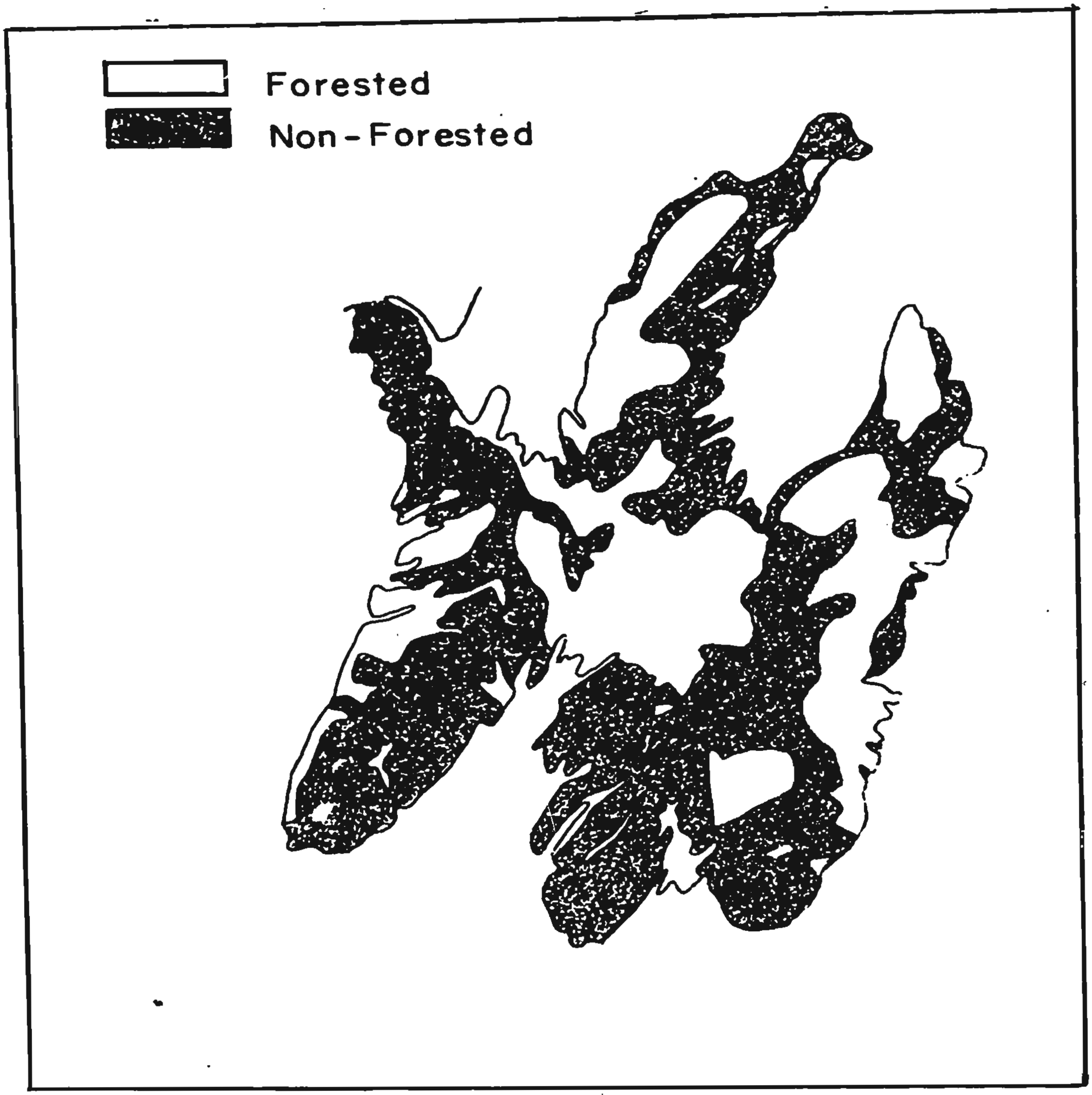


Figure 1-2: The distribution of forested and non-forested land on the Avalon Peninsula (modified after Wilton 1956).

northeast-southwest direction. As a result of this shape the most inland position is within 19.3 km. of the coast. The Peninsula is approximately 241 km. in length and 96.6 km. from east to west. Generally the elevation ranges from 150 M. to 300 M. with considerable undulation in the microrelief. The coast is rocky, characterized by numerous deep fiords, small islands and drowned valleys typical of a submerged coastline (Wilton, 1956).

Geology and Soils

Geologically the Avalon Peninsula is distinguished from the remainder of Newfoundland by the prominence of bedrock composed of Pre-Cambrian volcanics interspersed with sedimentary deposits. The soil mantle of the pre-pleistocene era was entirely removed by glaciation and the remaining bedrock is predominantly of the Hadryian era.

The western arms of the Peninsula, which subtend Trinity Bay and Placentia Bay as well as the extreme eastern coast from Torbay to Cape Broyle, are comprised of siltstones, arkose, conglomerate, slate and acidic to intermediate volcanics of the Musgrave, Cabot and Hodgewater Groups. Within this area localized Cambrian deposits contain small quantities of limestone and magnesium. These are usually surrounded by late Hadryian deposits of the Random Formation.

The remainder of the Avalon is characterized by slate, siltstone, conglomerate and minor volcanic rocks of the Conception Bay Group. The interior of this portion of the Peninsula contains an intrusion of acidic to mafic volcanics which are Hadryian or earlier. The Hawke Hill Range is predominantly granite and quartz diorite of the Holyrood plutonic series. At the base of Conception Bay isolated Cambrian deposits, containing limited quantities of limestone, are frequently encountered near the coast.

The lack of base rich rocks throughout most of the Avalon has resulted in the dominance of acid soils, composed mainly of humo-ferric podzols. However, portions of the Avalon, especially the isthmus, are characterized by ferro-humic podzols with placic ferro-humic podzols along the coastline (Heringa CDA, pers. comm.).

Climate

The climate is typically maritime with temperature extremes modified by the ocean. The mean annual temperature is 4.44$^{\circ}$C with a mean minimum of -17.78$^{\circ}$C and a mean maximum of 26.67$^{\circ}$C. There is considerable fluctuation in winter temperatures. For example, the mean minimum January temperature varies from -17.78$^{\circ}$C on the coast to -23.33$^{\circ}$C inland, whereas the mean January maximum temperature is 7.22$^{\circ}$C. The summer temperatures do not show such a wide variability with a mean maximum and minimum July temperature of 18.33°C and 10°C respectively. The fluctuations in winter temperature are significant because the rise in temperature from -2.22°C (28°F) to 0°C (32°F) constitutes a freeze-thaw cycle (Fraser 1959). Freeze-thaw cycles are considered a primary cause of soil-frost disturbance.

The mean rainfall on the Avalon Peninsula is 139.7 cm, the highest for any region in Newfoundland. The mean winter rainfall on the Avalon varies from 19.05 cm in the north to 25.4 cm in the south. The mean annual snowfall is 254 cm in the north and 203.2 cm in the south. This indicates a somewhat milder winter climate on the southern Avalon. This is further substantiated by the date of commencement of the vegetation season; May 25 to May 30 at the southern extremity, May 20 in the north, and May 15 in the central portion of the Avalon. The vegetation season varies from 160 days in the north to 150 days in the south.

The lack of topographical obstructions or an extensive forest cover throughout most of the Avalon makes this Peninsula extremely susceptible to prevailing westerly and southwesterly winds. The mean winter season windspeed is 32.2 k.p.h. with maximum gusts to 160 k.p.h. Mean summer windspeeds are 16.1 k.p.h. with maximum gusts to 128.7 k.p.h.

## Choice of Methods

A major phytosociological problem today is in choosing the most favorable method based on the wide variety of techniques available. Moore et al. (1970) estimated that there are more than 50 methods of numerical analyses alone. From the results of comparative studies on phytosociological methodology presented by Bridgewater (1970), Moore et al. (1970), and Shimwell (1972) it was decided that the methods of the Zurich-Montpellier School (Z-M) were most compatible with the objectives of this study. However, whether or not a method adequately satisfies the objective of a study cannot be evaluated until the study is completed and applied. In this sense the present work is, in part, a test of the suitability of the Z-M techniques for classification of heath.

The experience of previous investigators is frequently useful as a guideline to the suitability of a method. Damman (1964, 1967) and Pollett (1972) have successfully applied the Z-M methods to classify forest and peatland vegetation in Newfoundland. The use of similar methods for heathland studies would have an additional advantage of incorporating Newfoundland terrestrial vegetation within a uniform hierarchical classification. Also, the Z-M method has been used to classify the British heath

(Bridgewater 1970). Its use in this study will provide some basis for comparison of heath at an international level.

In an effort to determine the most suitable method to survey the vegetation of Ireland, Moores et al. (1970) tested and compared the following methods:

1. The Braun Blanquet method (Z-M method)
2. Association and inverse analysis of Williams and Lambert
3. Cluster analysis based on different coefficients of similarity
4. Principal component analysis performed on matrices of different coefficients (ordination).

It was concluded that: "The Braun-Blanquet method is considered to combine several advantages of other methods and to be most economical in terms of "efficiency" (ratio of time input to information emerging)." Furthermore, Shimwell (1972) states, "The results of comparative studies and studies on the best method for a particular problem have shown: (a) that there is no general 'best method'; and (b) with respect to time involved and information obtained the methods of the so-called traditional schools of phytosociology present a better overall understanding of the complexity of the nature of vegetation."

Method

The most recent accounts of Z-M methodology are presented by Westhoff and Den Held (1969), Bridgewater (1970), Pollett (1972), and Shimwell (1972). Earlier accounts presented by Braun-Blanquet (1932), Poore (1955), Becking (1957), Ellenberg (1956), and Damman (1964) are also reliable sources for technique but contain remnants of outmoded terminology.

The techniques of the Zurich-Montpellier School can be divided into two phases; 1) analysis, and 2) synthesis. In the following summary the description of analysis follows Bridgewater (1970) and Moore et al. (1970), whereas synthesis follows Shimwell (1972).

Analysis

The main function of analysis is to describe the vegetation of the study area. The term releve is used throughout the text to denote the data collected at each site in the process of description.

Selection of site is of primary importance in this phase since it is essential that the sampled area must be homogenous. Homogeneity can be obtained by determination of the minimal area either through the use of statistics or visual assessment, depending on the nature of the vegetation. In the current study, visual assessment was used as advocated by Moore et al. (1970) who stated: "A properly trained field worker in the Braun-Blanquet school will choose areas for description on the basis of two criteria:

1. that the main physiognomic and floristic types of vegetation seen in the area being studied are reasonably sampled,

2. that the sample plots seem uniform in regard to vegetation and to obvious ecological features; this is aimed at avoiding the inclusion of two vegetation types within one releve."

Based on this assessment, plots are selected and all plant species present are listed and given a combined value on the scales of cover/abundance and sociability (Appendix I). In addition, the altitude, slope, aspect, percent coverage of cryptogams and phanerogams, and ecological features of the site are also noted.

Synthesis

When a representative sample of releves has been collected they are aggregated in a 'raw table'. This is rapidly achieved using squared paper, with species names listed on the left and each releve assigned a vertical column. In the finished table it soon becomes apparent that while no two releves are necessarily alike, certain combinations of species recur which may be mutually exclusive. These species, as well as species having a restricted occurrence in the raw table, are outlined and transferred to a 'partial table'. The transfer of data is facilitated by transfer strips (see Shimwell 1972, pp. 191-194). The species in the partial table are extracted and used to rearrange the table in both a vertical and horizontal manner. Repetition of this procedure highlights the existence of mutually exclusive groups of species referred to as differential species. Continued sorting results in an association synthesis table (Appendix II). The value of these tables is summarized by Becking (1957) as follows:

> "These synthesis tables give considerable information regarding the sociological and ecological properties of the associations species assemblage and permit assessment of the width of floristic variation of the association, giving points of reference for identifying its optimal and marginal range of distribution."

The vegetation units derived from synthesis are placed into a hierarchy. The terms referring to class, order, alliance, etc. are an integral part of this hierarchical classification system proposed by Braun-Blanquet (1921) and now widely used throughout the world, particularly in Europe.

The following example, taken from a tentative classification in Chapter VI of this study, can be used to illustrate the hierarchy and the endings used to denote the taxa;

| Rank | Ending | |
|---|---|---|
| Class | -etea | Kalmio-Vaccinetea |
| Order | -etalia | Kalmio-Ledetalia |
| Alliance | -ion | Kalmion |
| Association | -etum | Kalmietum angustifoliae |
| Subassociation | -etosum | Hylocomietosum |
| Variant | no ending | Ptilium crista-castrensis |

Rules for naming the vegetation units of all ranks follow Bach, Kuoch, and Moor (1962). In this study taxa have been classified to the rank of association and a type releve is provided for each association in compliance with the procedure for phytosociological nomenclature (Moravec 1969). The purpose of the type releve is similar to that of type specimens used in plant taxonomy.

Terminology

The terms heath, plant community and association are frequently used in phytosociological investigations of heath vegetation. However, there is considerable variation in the meaning of these terms throughout plant ecological literature. For the purpose of this study these terms are defined as follows:

Plant Community (after Bridgewater 1970)

This term is used in the concrete sense to mean a group of individual plant species, the composition of which is determined by environmental conditions and mutual relationships of component species.

Association (after Westhoff and Den Held 1969)

An association is an abstraction of a number of plant communities which agree in floristic composition and the demands they make upon the environment.

Heath

Heath is an oceanic or suboceanic vegetation dominated by ericaceous shrubs, usually growing on mineral soil of the podzolic order but occasionally underlain by bedrock.

# CHAPTER II. A MORPHOLOGICAL CLASSIFICATION OF THE AVALON PENINSULA HEATHLANDS

## Introduction

European heathland classifications have traditionally emphasized the distinction between two morphological types variously described as:

i) Heath (Heide) and Heather Moor (Heidemoor), Smith (1911)

ii) Upland Heath and Lowland Heath, Tansley (1949)

iii) Hard Ground Heath and Soft Ground Heath, Gimingham (1964)

Gimingham (1964) distinguished the hard and soft ground types according to the depth of the raw humus as follows, "Differences in the depth of this horizon contribute to the general distinction made by gamekeepers and shepherds between "hard ground", on which the organic mantle is quite thin (up to about 5 cm.), and "soft ground" which incorporates podzolic soils with deeper organic horizons and peats". Tansley (1949) after an intensive review of the floristic composition of upland heath and heather moor stated, "Taking all these facts into consideration, we cannot but conclude that the vegetational distinction between upland heath and heather moor is very slight". Gimingham (1964) is in agreement with this statement and cites Erica cinera and Arctostaphylos uva-ursi as the only reliable species distinguishing hard and soft ground heath in Scotland.

Cursory examination of the Avalon heath suggests that there is limited floristic variation with morphological types because of the consistent occurrence and frequent physiognomic dominance of the following species:

| | |
|---|---|
| Kalmia angustifolia | Cornus canadensis |
| Vaccinium angustifolium | Cladonia arbuscula |
| Ledum groenlandicum | Cladonia mitis |
| Vaccinium vitis-idaea | Cladonia rangiferina |
| Empetrum nigrum | |

However, on closer examination of the vegetation the presence of sociological species groups (species normally occurring together but not necessarily having the same ecological amplitude (Damman 1967)) becomes obvious. Because these groups are adapted to variation in climatic exposure and anthropogenic disturbance, they may be used in conjunction with the structural physiognomy and substrate characteristics of the heath to define the following three morphological types which comprise the Avalon Peninsula heath:

1. Rock Barrens
2. Hard Ground Heath
3. Soft Ground Heath

Rock Barrens

Rock barrens are confined to sites experiencing severe climatic exposure. Prevailing winds, gusting to velocities of 161 k.p.h., do not permit accumulation of snow cover and also erode the thin ($<$ 5 cm) organic mantle characteristic of these sites. This erosion introduces severe soil-frost disturbance creating a landscape dominated by morainic debris in which sorted and nonsorted polygons (Washburn 1956) are conspicuous. The rock barrens are normally encountered at altitudes in excess of 300 m but also occur at sea level in areas where severe climatic conditions prevail.

The chamaephyte and geophyte life forms (Raunkiaer 1934) are the most common life forms in this type of heath. Its structural physiognomy is characterized by vegetation cushions, dominated by Empetrum nigrum and/or Rhacomitrium lanuginosum, and surrounded by exposed mineral soil. The heath is divided into a primary stratum represented by the vegetation cushion and a secondary stratum dominated by geophytic species (Figure 2-1).

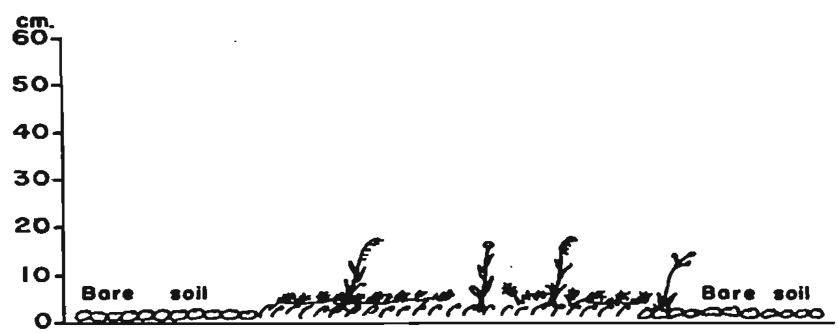


Figure 2-1: Structural physiognomy of Rock Barrens

Floristically this heathland type may be identified by the presence of the Cetraria nivalis Sociological Species Group:

| | |
|---|---|
| Cetraria nivalis | Juncus trifidus |
| Arctostaphylos alpina | Diapensia lapponica |
| Loiseleuria procumbens | Lycopodium selago |
| Cetraria cucullata | Platismatia glauca |

Hard Ground Heath

Hard ground heath is characterized by a thin humus usually less than 10 cm in depth. This type of heath originates either naturally, as a result of moderate climatic exposure, or anthropogenically through repeated accidental and prescribed burning of existing vegetation.

a) Natural

On the southern extremities of the Avalon, extensive areas of hard ground heath are encountered whereas elsewhere on the Peninsula this heath type is more restricted to exposed knolls and coastal heathlands. The presence of a shallow winter snow cover is significant since it protects the thin humus from erosion and limits extensive soil-frost disturbance. However, scattered frost scars do occur. The shallow snow cover only poorly protects the vegetation from prevailing winds and consequently the physiognomic appearance is often similar to vegetation patches located in the rock barrens.

Physiognomically this heath type is characterized by the phanerophyte, chamaephyte and geophyte life forms. Structurally the chamaephytes form extensive carpets in which lichens are more prominent than mosses with the exception of *Rhacomitrium lanuginosum*. A second stratum is dominated by geophytes and a third stratum is comprised of sporadically occurring phanerophytes. A closed shrub canopy is rarely observed in hard ground heath (Figure 2-2).

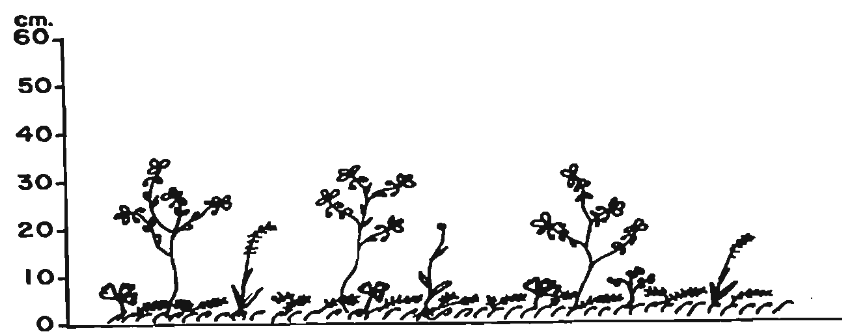


Figure 2-2: Structural physiognomy of Natural Hard Ground Heath

Floristically this heath type may be identified by the presence of the Potentilla tridentata Sociological Species Group:

| | |
|---|---|
| *Potentilla tridentata* | *Rhacomitrium lanuginosum* |
| *Vaccinium uliginosum* | *Sphaeophorus globosus* |
| *Cladonia boryi* | *Prenanthes trifoliolata* |

b) Anthropogenic

In the northern portion of the Avalon large acreages of heath under prescribed burning management are burned in efforts to increase the commercial blueberry harvest. This has resulted in deterioration of the raw humus layer and consequently these sites may also be classified as hard ground heathland.

The physiognomy of the vegetation is somewhat different than natural hard ground heath in that the vegetation carpet is replaced by a sporadic coverage of lichens and mosses over a charred organic substrate. The secondary stratum is dominated by Vaccinium angustifolium with geophytes subordinate (Figure 2-3).


Figure 2-3: Structural physiognomy of Anthropogenic Hard Ground Heath

After three to five years the second stratum may be superceded by ericaceous phanerophytes and revert to soft ground heath. Alternatively, if the fire is too intense or the burning is too frequent, succession may result in the formation of grassland.

Floristically these heathlands are recognized by the presence of the Luzula campestris Sociological Species Group:

| | |
|---|---|
| Luzula campestris | Lycopodium obscurum |
| Polytrichum commune | Hieracium mororum |
| Solidago rugosa | Achillea millefolium |
| Anthoxanthum odoratum | Lycopodium sabinaefolium |

Soft Ground Heath

Soft ground heathland on the Avalon Peninsula is restricted to climatically favorable sites such as sheltered slopes and topographic depressions. Humus accumulation is usually in excess of 10 cm and winter snow accumulation is deep. Consequently soil-frost disturbance is infrequently observed in this heathland type.

Physiognomically the phanerophyte life form is most prominent in soft ground heath with the chamaephyte and geophyte forms less conspicuous. Structurally, the ground strata is comprised of lichens superimposed on a moss carpet. Chamaephyte species are sparsely dispersed throughout these two strata. The third vegetation stratum is characterized by geophytic species accompanied by the chamaephyte, Vaccinium angustifolium. Phanerophytes such as Kalmia angustifolia, Ledum groenlandicum, Myrica gale and Rhododendron canadense form a closed canopy constituting the fourth vegetation stratum (Figure 2-4).

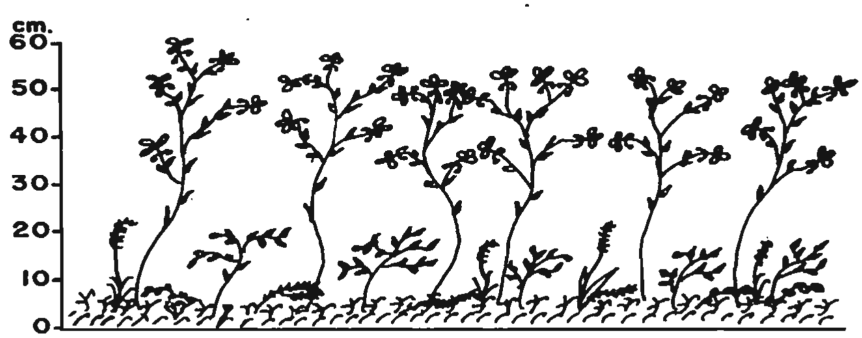


Figure 2-4: Structural physiognomy of Soft Ground Heath

Floristically the soft ground heath is conveniently distinguished by the absence of sociological species groups previously described. Furthermore, it displays its optimum development in the presence of the Hylocomium splendens Sociological Species Group:

| | |
|---|---|
| Hylocomium splendens | Pleurozium schreberi |
| Dicranum scoparium | Ptilium crista-castrensis |

Summary

In this chapter structural characteristics have been stressed in classifying the Avalon heathlands into three distinct morphological types. In the following chapter these heath types are phytosociologically divided into sub-units to gain a better insight into their ecological relationships.

# CHAPTER III. A PHYTOSOCIOLOGICAL CLASSIFICATION OF THE AVALON PENINSULA HEATHLANDS

## Purpose

> "For the human race, classification is a natural and inherent, intuitive process; to create some semblance of order from an otherwise disorderly matrix by the pigeon-holing and categorization of the matrix entities." (Shimwell 1972)

For the purpose of this particular investigation the "disorderly" matrix is represented by large areas of heath vegetation. The disorder is only apparent due to a lack of understanding of the relationships existing between the heath vegetation and its environment. To discover the nature of this relationship the first priority is to delineate and describe the plant communities comprising this vegetation. Classification is a means of achieving this goal and at the same time can offer a systematic framework for comparison. Through comparison of the recognized communities; 1) with each other, 2) with descriptions documented in the literature, 3) with personal field observations, it is possible to present ecological interpretation. It is this interpretation which reveals the orderly relationship existing between the heath communities and their habitat - a prerequisite to predicting the effect of disturbance and natural succession on the floristic composition of the heath.

By using the techniques of the Zurich-Montpellier School of Phytosociology it was determined that the heath of the Avalon Peninsula is represented by eleven associations which are grouped within the morphological classification as follows:

A. Rock Barrens (Figure 3-1)

1. _Diapensio - Arctostaphyletum alpinae_
   (Diapensia Heath)

B. Hard Ground Heath (Figure 3-9)

2. _Empetro - Rhacomitrietum lanuginosae_
   (Rhacomitrium Heath)
3. _Empetro - Potentilletum tridentatae_
   (Empetrum Heath)
4. _Luzulo - Polytrichetum commune_
   (Vaccinium Heath)
5. _Luzulo - Empetretum nigrae_
   (Kalmia-Vaccinium Heath)

C. Soft Ground Heath (Figure 3-24)

6. _Kalmietum angustifoliae_
   (Kalmia Heath)
7. _Kalmio - Alnetum crispae_
   (Alder Tuck)
8. _Abietetum balsameae hudsoniae_
   (Fir Tuck)

9. *Kalmio - Myricetum gale*
(Myrica Heath)
10. *Kalmio - Sphagnetum nemori*
(Sphagnum Heath)
11. *Piceetum marianae semiprostratae*
(Spruce Tuck)

Figure 3-1: Rock barrens occur above the tree line and on the more exposed coastal headlands. Soil frost disturbance combined with wind and water erosion remove the humus, leaving a bare mineral soil.

## 1. DIAPENSIO - ARCTOSTAPHYLETUM ALPINAE ASSOCIATION (DIAPENSIA HEATH)

### Differentiation of the Association

This association is readily distinguished by the presence of a majority of the following differential species:

| | |
|---|---|
| *Diapensia lapponica* (IV) | *Cetraria nivalis* (III) |
| *Arctostaphylos alpina* (IV) | *Loiseleuria procumbens* (II) |
| *Juncus trifidus* (II) | *Salix uva-ursi* (I) |
| *Polygonum viviparum* (I) | *Cetraria cucullata* (+) |
| *Lycopodium selago* (+) | *Stereocaulon paschale* (+) |
| *Platismatia glauca* (II) | |

The association is defined on the basis of Synthesis Table 1, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 74C Hawke Hill

| | |
|---|---|
| Slope 20° N | Latitude 47°19'45" |
| Altitude 240 M. | Longitude 53°07'00" |

b) Species Composition

Phanerogams (70% Cover)

*Arctostaphylos alpina* 1.2

*Diapensia lapponica* 1.2

*Loiseleuria procumbens* 1.2

<u>Juncus</u> <u>trifidus</u> 2.2
<u>Larix</u> <u>laricina</u> +
<u>Potentilla</u> <u>tridentata</u> +
<u>Vaccinium</u> <u>vitis-idaea</u> 2.2
<u>Empetrum</u> <u>nigrum</u> 3.3
<u>Deschampsia</u> <u>flexuosa</u> 1.2
<u>Vaccinium</u> <u>angustifolium</u> 1.1
<u>Kalmia</u> <u>angustifolia</u> 1.1

Cryptogams (70% Cover)

<u>Platismatia</u> <u>glauca</u> 1.2
<u>Cetraria</u> <u>nivalis</u> 2.2
<u>Sphaeophorus</u> <u>globosus</u> 1.2
<u>Cladonia</u> <u>boryi</u> 1.2
<u>Cladonia</u> <u>mitis</u> 1.2
<u>Cornicularia</u> <u>aculeata</u> 1.2
<u>Cetraria</u> <u>islandica</u> 1.2
<u>Cladonia</u> <u>elongata</u> +
<u>Pleurozium</u> <u>schreberi</u> +
<u>Rhacomitrium</u> <u>lanuginosum</u> 2.2
<u>Cladonia</u> <u>rangiferina</u> 1.2
<u>Cladonia</u> <u>arbuscula</u> 1.2
<u>Ochrolechia</u> <u>frigida</u> +
<u>Cladonia</u> <u>uncialis</u> 1.2
<u>Cladonia</u> <u>coccifera</u> +

Ecological Interpretation

The vegetation of the *Diapensio - Arctostaphyletum alpinae* is characterized by cushion forming species typical of chionophobous plant communities. On sites experiencing high wind velocity *Diapensia lapponica*, *Loiseleuria procumbens* and *Arctostaphylos alpina* form discontinuous carpets. Surrounding these carpets is mineral soil which has had the humus layer removed through wind and water erosion and soil-frost disturbance. In this morainic debris the tussock forming species, primarily *Calamagrostis pickeringii*, *Deschampsia flexuosa* and *Juncus trifidus*, are recolonizing the bare soil. Other species, not unique to this association, but which play an important role in development of the cushion-like vegetation mats are: *Empetrum nigrum*, *Vaccinium vitis-idaea* and *Rhacomitrium lanuginosum*. The only species occurring above the carpet are grasses which can complete the above ground portion of their life cycle during the summer. Ericaceous shrubs are infrequently encountered displaying a reduced vitality. The cryptogamic flora of this association is dominated by wind-hardy lichens such as *Cetraria nivalis*, *Platismatia glauca*, *Cetraria cucullata*, *Cladonia boryi* and *Sphaeophorus globosus*. Other lichen species occurring in sheltered locations are present but display low coverage. Similar observations have been made from Jan Mayen Island (Sheard,1968) and the Swedish mountains (Gjaerevoll, 1965).

The differential species of the *Diapensia - Arctostaphyletum alpinae* are more frequently encountered at high elevations. However, the occurrence of high onshore winds and offshore ice probably creates a severe climate extending the range of this association to near sea level on coastal headlands (Figure 3-2).

Gimingham (1964) observed a similar relationship between the *Calluna - Empetrum hermaphroditum* communities on Shetland Islands and the *Vaccinium - Empetrum hermaphroditum* communities above the tree line on Scottish mountains. Spence (1960) found that the mean monthly temperatures at sea level on the Shetland Islands were equivalent to mean monthly temperatures at an altitude of 359 M. in the central Highlands, and temperatures at 305 M. in Shetland were equivalent to 762 M. in mountainous regions. Gimingham concludes, "The climate in which these communities under discussion develop may, therefore, properly be described as sub-alpine and relationships with other sub-alpine communities may be expected". In this context the *Diapensio - Arctostaphyletum alpinae* may possibly be considered a sub-alpine association whose differential species have affinities to alpine vegetation whereas the companion species relate it to maritime heathland.

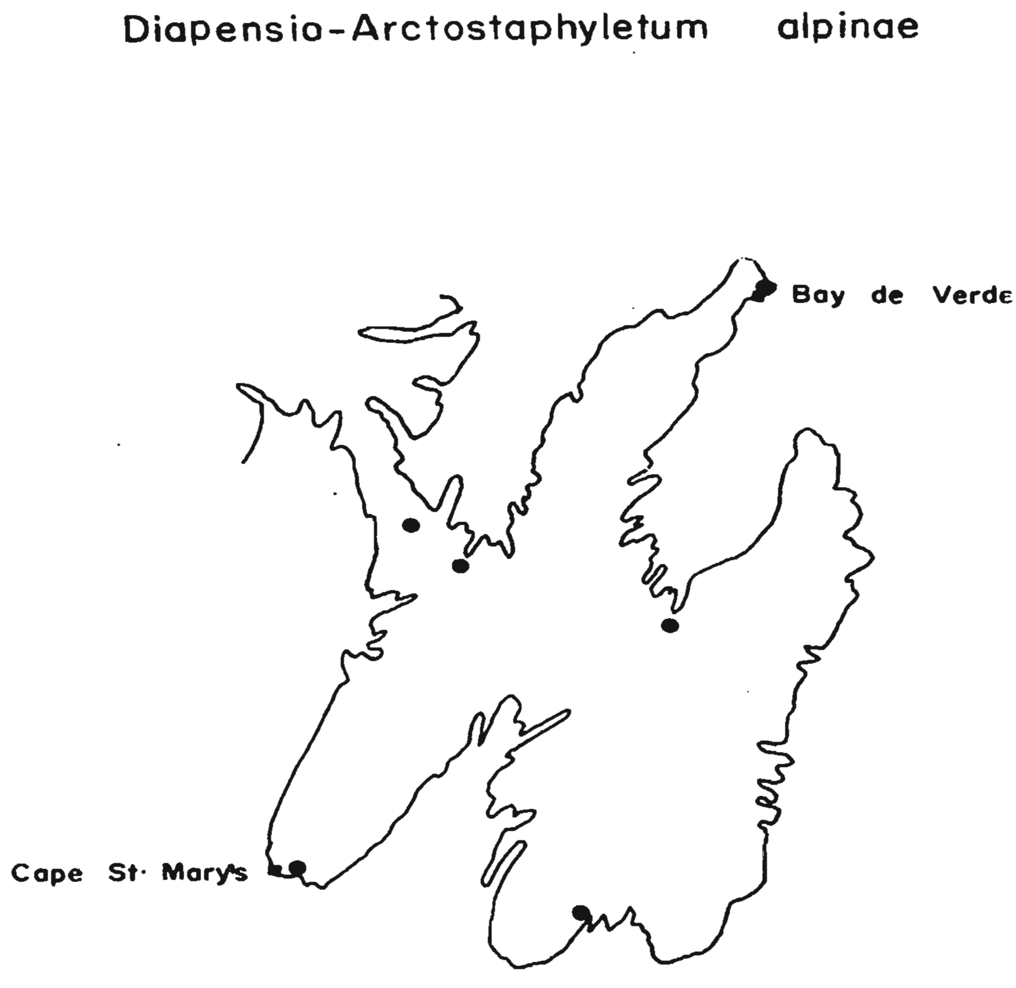


Figure 3-2: The Diapensio - Arctostaphyletum alpinae is located on climatically exposed headlands and at higher elevations inland.

The association is divided into three distinct variants;

(i) Polygonum viviparum Variant

(ii) Juncus trifidus Variant

(iii) Alectoria nigricans Variant

(i) Polygonum viviparum Variant

Identifying Species:

| | |
|---|---|
| Polygonum viviparum | Salix uva-ursi |
| Betula pumila | Empetrum eamsii |

This variant is located on coastal headlands near the communities of Trepassey, Cape St. Mary's and Bay de Verde. The humus is characteristically less than 5 cm but soil-frost disturbance is limited to frost boils (Lewis, 1970). The mineral soil is very shallow and frequently absent with the organic substrate sometimes growing directly over bedrock.

Both Polygonum viviparum and Salix uva-ursi are rare species on the Avalon (Figure 3-3). Damman (1965a) suggests that Polygonum viviparum is a basiphilic species restricted to calcareous soils of the west coast and Northern Peninsula of Newfoundland. Its occurrence on the Avalon may be due to an anthropogenic influence. The sites investigated were in close proximity to settlements and agricultural fertilization of surrounding land could strongly influence the base status of the soil.

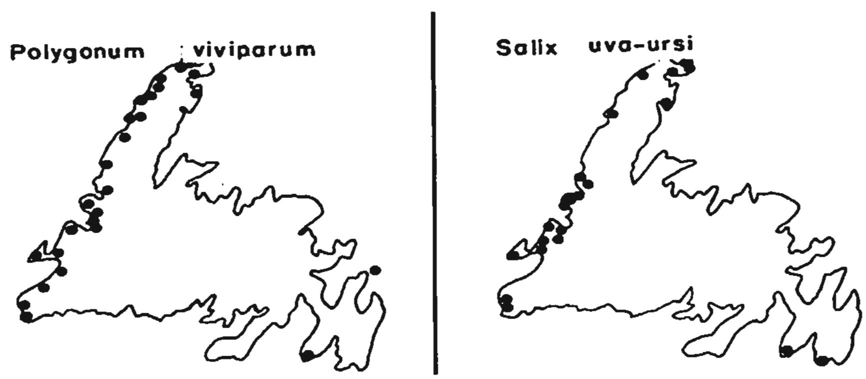


Figure 3-3: The distribution of <u>Polygonum viviparum</u> and <u>Salix uva-ursi</u> in Newfoundland.

*Salix uva-ursi* is also rare in eastern Newfoundland, and is referred to by Damman (1965a) as a species rare or absent east of the Long Range Mountains.

The occurrence of the *Polygonum viviparum Variant* on the Avalon Peninsula indicates an east-west disjunction possibly due to anthropogenic influences, but more probably related to the similarity in severe climatic conditions experienced by coastal headlands in eastern and western Newfoundland.

(ii) *Juncus trifidus Variant*

Identifying Species:

| | |
|---|---|
| *Juncus trifidus* | *Platismatia glauca* |
| *Larix laricina* var. *depressa* | *Cetraria cucullata* |
| *Picea mariana* f. *empetroides* | *Lycopodium selago* |

The *Juncus trifidus Variant* is located on the northern extremity of the Hawke Hill Range at elevations up to 300 M. A dramatic change in landscape occurs on the Hawke Hill Range. A sharp boundary separates the forest and tall ericaceous heath at 200 M. from an alpine tundra characterized by morainic debris interspersed with carpets of *Empetrum nigrum* (Figure 3-4).

Figure 3-4: Alpine tundra is defined by Bliss (1962) as treeless expanses beyond climatic timberline on high mountains. The hill in this picture is 300 M. above sea level.

In winter the correlation between the distribution of snow cover and the spatial relationship of different heath types is most evident. The valleys are occupied by soft ground heath with a deep snow cover, the windswept level expanses have a shallow snow cover where hard ground heath dominates and ridges devoid of snow cover display the Juncus trifidus Variant (Figure 3-5).

Figure 3-5: The Juncus trifidus Variant occupies the ridges devoid of snow cover seen in the background of this picture.

A unique feature of this site is the occurrence of patterned ground either in the form of miniature sorted and nonsorted polygons or in the form of intermediate patterns between these types. Washburn (1956) described similar patterns for Northeast Greenland and concluded that both sorted and nonsorted types of miniature polygons originate primarily as a result of desiccation. Whether the polygons are sorted or nonsorted is dependent on the availability of stones in the immediate area. The bordering stones are accumulated in cracks through gravitational soil movement, washing and frost action (Figure 3-6).

Figure 3-6: Miniature sorted polygons are evident in the foreground of this photo where the large rocks surround smaller stones.

Sigafoos (1952) concluded, "Frost action in ~~the~~ soil (congeliturbation) because its intensity fluctuates widely and frequently is the most important factor in the development of tundra plant communities". The absence of Vaccinium uliginosum var. alpinum, Ledum groenlandicum and Prenanthes trifoliolata from the Juncus trifidus Variant may be a result of intense soil-frost disturbance. These species are more common in less exposed communities in this association.

The occurrence of Juncus trifidus in this variant is significant since it has only been recorded from one other locality on the Avalon Peninsula. Elsewhere in Newfoundland its distribution is mainly in the Long Range Mountains and severely exposed coastlines (Figure 3-7).

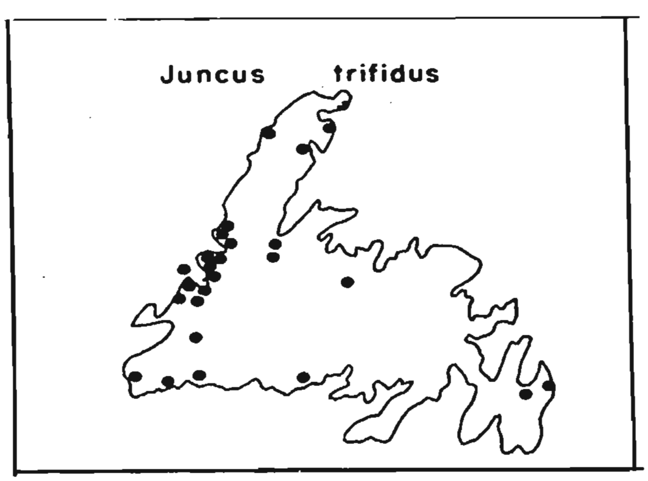


Figure 3-7: The distribution of Juncus trifidus in Nfld.

Raup (1969), in studies on species tolerance to site factors, describes Juncus trifidus, Lycopodium selago, Cetraria cucullata, Stereocaulon paschale as species displaying a stable tolerance to frost disturbance. This suggests that the Juncus trifidus Variant indicates sites experiencing intense frost disturbance.

Although frost action plays a leading role in the development of this variant the high wind velocity (with gusts of 161 k.p.h.) considerably alters the structural physiognomy of the vegetation. Warren Wilson (1959) reports that the wind speed at ground level may be only 15 per cent of that at one metre above the ground. This possibly explains the adaptation of many taller species such as Kalmia angustifolia and Vaccinium angustifolium to the cushion growth form in this habitat. One extreme example of this is Picea mariana f. empetroides (Figure 3-8).

Figure 3-8: The form "empetroides" of Picea mariana is characterized by the absence of an above ground trunk (Fernald, 1950).

(iii) <u>Alectoria nigricans Variant</u>

Identifying Species:

*Alectoria nigricans* *Alectoria ochroleuca*

The *Alectoria nigricans* Variant is a geographic variant occurring on severely exposed ridges of the isthmus of Avalon. The lichens used to identify this variant are epiphytic species attached to the branches of dead shrubs and grow over the humus substrate.

The prominent ecological factors prevalent in this variant are essentially similar to the *Juncus trifidus* Variant - strong gale force winds, shallow snow cover and soil-frost disturbance. Patterned ground is not as widespread and occurs only as sporadic frost scars.

Figure 3-9: Hard Ground Heath is widespread throughout the southern portion of the Avalon being localized elsewhere to knolls and coastal headlands. High winds reduce the winter snow cover and retard the growth of ericaceous shrubs.

## 2. EMPETRO - RHACOMITRIETUM LANUGINOSAE ASSOCIATION (RHACOMITRIUM BARRENS)

### Differentiation of the Association

The Empetro - Rhacomitrietum lanuginosae is recognized by the absence of differential species of the Diapensio - Arctostaphyletum alpinae and the presence of the following differential species group:

Rhacomitrium lanuginosum (V)
Cladonia boryi (IV)
Vaccinium uliginosum var. alpinum (IV)
Sphaerophorus globosus (IV)
Cetraria islandica (II)

The complete floristic composition of the association is presented in Synthesis Table 2, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 20B Peter's River

Slope Hummock Latitude 46°44'00"

Altitude 150 M. Longitude 53°32'30"

b) Species Composition

Phanerogams (50% Cover)

Vaccinium uliginosum var. alpinum 1.1
Potentilla tridentata +
Vaccinium vitis-idaea 1.2
Calamagrostis pickeringii 2.1

*Empetrum nigrum* 2.2
*Cornus canadensis* +
*Vaccinium angustifolium* 1.1
*Myrica gale* +
*Deschampsia flexuosa* +
*Andromeda glaucophylla* +

Cryptogams (80% Cover)

*Rhacomitrium lanuginosum* 4.4
*Sphaerophorus globosus* 1.2
*Cladonia boryi* 1.2
*Cetraria islandica* +
*Cladonia uncialis* 2.2
*Cladonia terrae-novae* 1.2
*Cetraria nivalis* +

Ecological Interpretation

The southern portion of the Avalon Peninsula is characterized by large expanses of hard ground heath which have developed under cold-damp climatic conditions. This heath expanse is dominated by the *Empetro - Rhacomitrietum lanuginosae* association on the summit of knolls and on earth hummocks, whereas the *Empetro - Potentilletum tridentatae* association (Chapter III-3) forms the heath matrix in the less climatically exposed microhabitats of depressions and slopes (Figure 3-10).

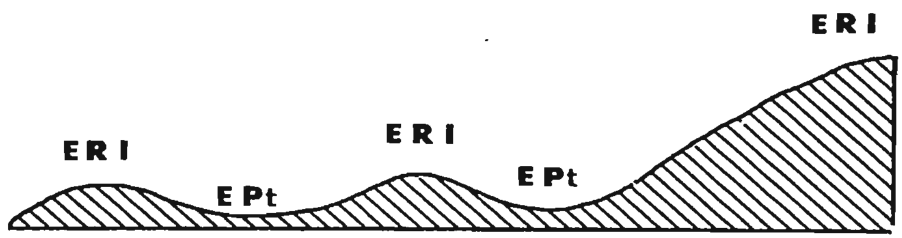


Figure 3-10: The spatial relationship of the Empetro - Rhacomitrietum lanuginosae (ERl) and the Empetro - Potentilletum tridentatae (EPt) associations.

Prevailing southwesterly winds (approx. 32 k.p.h.) influence the heath development west of Trepassey and from Branch to St. Brides. It is in this region that the *Empetro - Rhacomitrietum lanuginosae* reaches its maximum development. Elsewhere on the Avalon this association occurs sporadically on ridges and coastal headlands (Figure 3-11).

The vegetation of the *Empetro - Rhacomitrietum lanuginosae* is dominated by a mat of *Rhacomitrium lanuginosum* interspersed with *Empetrum nigrum*. Woody species including *Kalmia angustifolia*, *Vaccinium angustifolium*, *Myrica gale* and *Ledum groenlandicum*, although present, are not conspicuous because of their low growth form in the vegetation carpet. The grasses *Calamagrostis pickeringii* and *Deschampsia flexuosa* are conspicuous, growing 10-20 cm above the other species (Figure 3-12). Similar communities to the *Empetro - Rhacomitrietum lanuginosae* have been described from Iceland (McVean,1955), Jan Mayen Island (Warren Wilson, 1952), Scotland (McVean,1964), and Faeroe Island (Bocher,1940).

Empetro-Rhacomitrietum lanuginosae

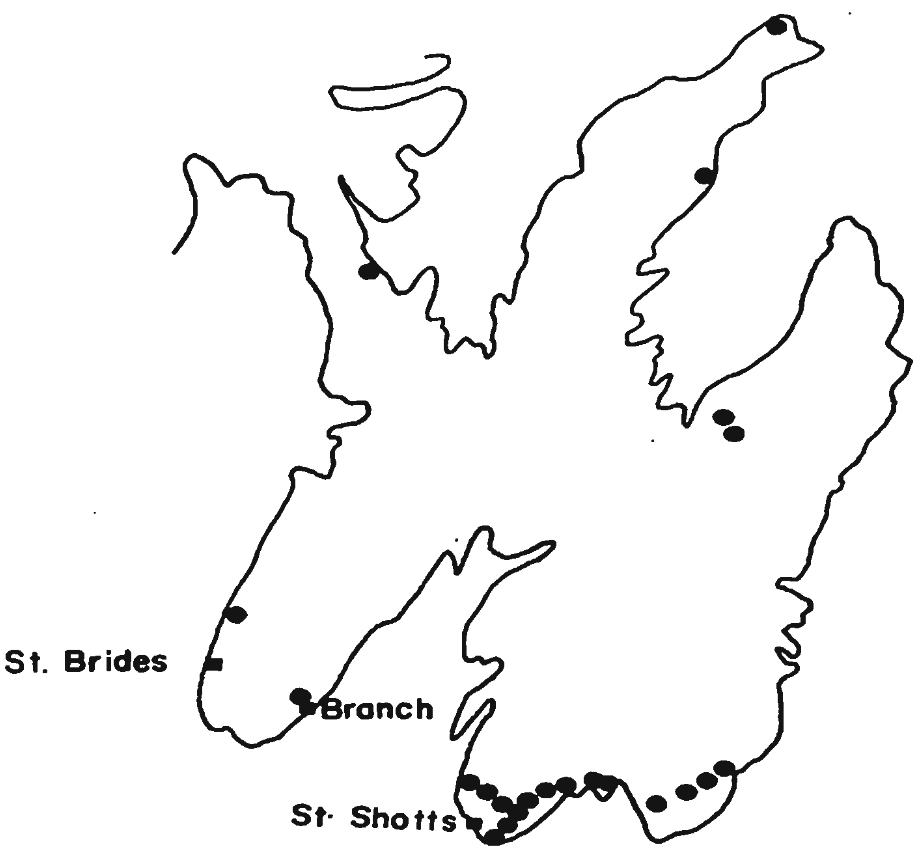


Figure 3-11: The distribution of the Empetro - Rhacomitrietum lanuginosae association is concentrated in the southern portion of the Avalon Peninsula and extends northwards on exposed ridges and coastal headlands.

Figure 3-12: Species occurring in the Empetro - Rhacomitrietum lanuginosae association are characterized by a low growth form.

One of the unique features of this association is the occurrence of earth hummocks. This is patterned ground which Washburn (1956) describes as 'a particular type of nonsorted net with a mesh characterized by a three dimensional knob-like shape and cover of vegetation'. Earth hummocks were frequently observed on the southern heathland expanse and on the Hawke Hill Range varying in diameter from 1-2 m. The hummocks usually consist of a thick carpet of Rhacomitrium moss over mineral soil mounds.

Gradients of climatic exposure, soil disturbance and soil moisture as well as geographic location result in formation of six distinct variants within this association:

(i) Cetraria nivalis Variant
(ii) Trientalis borealis Variant
(iii) Cladonia squamosa Variant
(iv) Smilacina trifolia Variant
(v) Dicranum fuscescens Variant
(vi) Cornicularia aculeata Variant

(i) Cetraria nivalis Variant

Identifying Species:

Cetraria nivalis    Loiseleuria procumbens

This variant is characteristic of sites experiencing severe climatic exposure and floristically has a close affinity with the *Diapensio - Arctostaphyletum alpinae* association. This variant is restricted to sites located between St. Shotts and Peter's River where large expanses of open heath, in juxtaposition to blanket peats, provide little protection from prevailing winds. Consequently the winter snow cover is shallow or absent, favoring species adapted to a cushion growth form. It was noted that *Ledum groenlandicum* rarely occurs in this variant and in the *Diapensia* Heath strongly indicating that it is poorly adapted to these wind-exposed habitats.

(ii) *Trientalis borealis Variant*

Identifying Species:

*Trientalis borealis* *Cladonia elongata*
*Cladonia uncialis*

The majority of sites represented by this variant are located on earth hummocks between the communities of Branch and St. Brides (Figure 3-13). *Cladonia uncialis* occupies the crown of the hummock whereas *Cladonia elongata* frequents the sheltered border. The presence of *Trientalis borealis*, more typically a forest species, is associated with the presence of fir tuck in this area.

Figure 3-13: The Trientalis borealis Variant occurring on earth hummocks near Branch.

(iii) Cladonia squamosa Variant

Identifying Species:

Cladonia squamosa    Cornicularia aculeata

The Cladonia squamosa Variant occurs on sites where the Rhacomitrium carpet and underlying humus have been removed by wind erosion. Occasionally these areas may also be disturbed by the activities of ants forming nests in the side of hummocks. The compacted humus provides a suitable substrate for Cladonia squamosa and Cornicularia aculeata, both of which favor disturbed microhabitats throughout the heath. This indicates that these lichens may be important pioneer species (Ahti, 1959).

(iv) Smilacina trifolia Variant

Identifying Species:

Smilacina trifolia    Chamaedaphne calyculata

Pyrus floribunda    Kalmia polifolia

The Smilacina trifolia Variant occurs in more sheltered microhabitats on the side of slopes or hummocks. There is an increase in soil moisture content in such microhabitats which is reflected by the occurrence of Coptis groenlandica, Andromeda glaucophylla and Vaccinium oxycoccus within this variant. These species are more characteristic of wet heath and peatland vegetation.

(v) Dicranum fuscescens Variant

Identifying Species:

Dicranum fuscescens

The Dicranum fuscescens Variant is typical of climatically exposed sites on the summit of knolls or coastal headlands. The Rhacomitrium carpet is usually discontinuous on these sites and Dicranum fuscescens forms small patches on the dark crusty humus. The sporadic occurrence of Ochrolechia frigida, Hypogymnia physodes and Ptilidium ciliare in this variant is also indicative of the degenerate nature of the humus. Earth hummocks are absent from this variant.

(vi) Cornicularia aculeata Variant

Identifying Species:

Lycopodium clavatum    Cornicularia aculeata

The Cornicularia aculeata Variant represents vegetation of this association occurring in close proximity to frost boils. Lycopodium clavatum extends from the surrounding humus to form a network pattern over the nearby exposed mineral soil. It appears that this species may be acting as a pioneer in re-vegetation of frost boils. Cornicularia aculeata also occupies the thin eroded humus around the circumference of the frost boil. The species complement of the Cornicularia aculeata Variant, as a result of soil-frost disturbance, is numerically low in comparison with the remainder of variants comprising the association. A similar variant is evident in the *Empetro - Potentilletum tridentatae* association.

## 3. *EMPETRO - POTENTILLETUM TRIDENTATAE ASSOCIATION* (POTENTILLA HEATH)

### Differentiation of the Association

This association is differentiated by the absence of differential species of the *Diapensio - Arctostaphyletum alpinae* and *Empetro - Rhacomitrietum lanuginosae* and by the occurrence of the following species:

*Potentilla tridentata* (V)
*Deschampsia flexuosa* (III)
*Calamagrostis pickeringii* (IV)
*Prenanthes trifoliolata* (II)
*Solidago uliginosa* (III)

The complete floristic composition of the association is presented in Synthesis Table 3, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 19D Peter's River

Slope Level Latitude $46^{o}42'45''$

Altitude 120 M. Longitude $53^{o}30'00''$

b) Species Composition

Phanerogams (70% Cover)

*Potentilla tridentata* 1.1

*Solidago uliginosa* +

*Myrica gale* 1.1
*Ledum groenlandicum* 1.1
*Vaccinium uliginosum* 1.1
*Pyrus floribunda* +
*Sanguisorba canadensis* 1.1
*Spiraea latifolia* +
*Calamagrostis pickeringii* r
*Deschampsia flexuosa* 1.2
*Kalmia angustifolia* 1.1
*Vaccinium vitis-idaea* 2.2
*Vaccinium angustifolium* 1.1
*Chamaedaphne calyculata* 1.1
*Kalmia polifolia* +

Cryptogams (70% Cover)

*Cladonia terrae-novae* 3.3
*Cladonia mitis* 1.2
*Cladonia rangiferina* 2.2
*Cetraria islandica* +
*Dicranum scoparium* 2.2
*Cladonia elongata* 1.2
*Hylocomium splendens* 2.2
*Pleurozium schreberi* 2.2

## Ecological Interpretation

The *Empetro - Potentilletum tridentatae* association represents vegetation occupying less exposed microclimates in the hard ground heath often occurring in close proximity to the *Empetro - Rhacomitrietum lanuginosae* association. These two hard ground associations together are equivalent to the *Kalmia - Rhacomitrium - Cladonia* association described by Ahti (1959). The distribution pattern of these associations is similar with exception of the more frequent occurrence of the *Potentilla* Heath on exposed ridges of the isthmus of Avalon (Figure 3-14).

Physiognomically both associations are characterized by a low growing vegetation of carpet-forming species. One evident difference is the dominance of *Empetrum nigrum* rather than *Rhacomitrium lanuginosum* in the carpet of the *Empetro - Potentilletum tridentatae*. Occasionally *Juniperus communis* may form extensive patches throughout the heath matrix (Figure 3-15).


Figure 3-14: The Empetro - Potentilletum tridentatae has a distribution pattern similar to that of the Empetro - Rhacomitrietum lanuginosae. However it occurs more frequently on the isthmus of the Avalon Peninsula than the latter association.

Figure 3-15: The foreground of this picture illustrates the dominance of Empetrum nigrum in the ground vegetation; in the center of the photograph an isolated patch of Juniperus communis is evident.

The lichens Cladonia arbuscula, Cladonia rangiferina and Cladonia mitis have high cover values in the association whereas the mosses Pleurozium schreberi, Dicranum scoparium and Hylocomium splendens usually occur singly or in isolated patches. Above the ground vegetation Solidago uliginosa, Calamagrostis pickeringii and Deschampsia flexuosa exhibit a high coverage and frequency. These species are better adapted than woody plants to withstand the strong winds sweeping the surface of these barren expanses (Figure 3-16).

Figure 3-16: This photograph demonstrates the dwarf posture of woody plants as compared with the erect posture of grasses in the association, an apparent adaptation to strong winds.

An anomalous situation within this association and the Empetro - Rhacomitrietum lanuginosae of the southern Avalon barrens is the sporadic occurrence of Sanguisorba canadensis, Lonicera villosa, Juniperus horizontalis and Spiraea latifolia. These species are more typical of fen peat soils than dry heathland soils (Pollett and Bridgewater, in press). Huxter (1964) suggests that the occurrence of these species can be explained by the constant high humidity and frequency of coastal fogs in the area which satisfies their moisture requirements. The higher precipitation and the deposition of sea salts from high winds could satisfy the nutrient requirements of these species (Pollett, pers. comm.).

Four variants are recognized in this association:

(i) Ptilium crista-castrensis Variant
(ii) Myrica gale Variant
(iii) Lycopodium clavatum Variant
(iv) Linnaea borealis Variant

(i) Ptilium crista-castrensis Variant

Identifying Species:

Ptilium crista-castrensis
Hylocomium splendens

The Ptilium crista-castrensis Variant usually occupies the more protected microhabitats between hummocks but occasionally occurs on hummocks sheltered by slopes or the near proximity of tuck vegetation. Because of this sheltered position woody plants grow somewhat taller and provide a partial canopy creating sufficient shelter and shade for the establishment of a moss carpet.

(ii) Myrica gale Variant

Identifying Species:

Myrica gale    Chamaedaphne calyculata

This variant is located in topographic depressions where snow accumulation provides increased moisture and protection from wind damage. Pyrus floribunda, Viburnum cassinoides, Myrica gale and Chamaedaphne calyculata increase in frequency in these habitats.

The occurrence of these shrubs provides protection and shade for the ground vegetation resulting in some gradation with the Ptilium crista-castrensis Variant.

(iii) Lycopodium clavatum Variant

Identifying Species:

Lycopodium clavatum

The Lycopodium clavatum Variant is similar to the Cornicularia aculeata Variant described for the Empetro - Rhacomitrietum lanuginosae association. It occurs in close proximity to frost boils or other habitats devoid of humus. Lycopodium clavatum is, along with lichens and mosses, the first species to colonize these sites. By forming a branched network over the exposed mineral soil it appears to play an important role in stabilizing the soil enabling other species to form a vegetation carpet over the scar (Figure 3-17).

Figure 3-17: Eroded patches of mineral soil displayed in this picture is a favorite habitat of Lycopodium clavatum. This species may be an important pioneer in the renewal of the vegetation carpet.

(iv) Linnaea borealis Variant

Identifying Species:

Linnaea borealis    Coptis groenlandica

This variant is located at the base of slopes or near drainage channels and stream borders where periodic flushing creates a slightly more nutrient rich substrate (Figure 3-18).

Figure 3-18: The Linnaea borealis Variant occurs where periodic flushing creates a more nutrient rich substrate as illustrated in the center of this photograph.

The sporadic occurrence of Sanguisorba canadensis, Lonicera villosa and Betula pumila in this variant also indicates nutrient enrichment as these are species more commonly encountered in nutrient rich fens (Pollett and Bridgewater, in press).

## 4. LUZULO - POLYTRICHETUM COMMUNE ASSOCIATION (VACCINIUM HEATH)

### Differentiation of the Association

This association is identified by the occurrence of the following differential species group:

| | |
|---|---|
| Luzula campestris (V) | Lycopodium obscurum (IV) |
| Polytrichum commune (V) | Taraxacum officinale (II) |
| Solidago rugosa (V) | Hieracium murorum (II) |

Also, Kalmia angustifolia, Ledum groenlandicum and Empetrum nigrum are rare or absent. The floristic composition of this association is presented in Synthesis Table 4, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 38H New Harbour Rd.

Slope 10° S Latitude 47°35'15"

Altitude 80 M. Longitude 53°31'15"

b) Species Composition

Phanerogams (70% Cover)

Luzula campestris 1.2

Lycopodium obscurum 1.1

Vaccinium angustifolium 3.1

Cornus canadensis 1.1

Maianthemum canadense 1.1
Spiraea latifolia +
Viburnum cassinoides r
Rubus pubescens +
Solidago rugosa +
Achillea millefolium +
Deschampsia flexuosa 1.2
Potentilla tridentata 1.1
Prenanthes trifoliolata 1.1
Vaccinium vitis-idaea 2.2
Alnus crispa +
Hieracium mororum +

Cryptogams (70% Cover)

Polytrichum commune 1.1

Ecological Interpretation

The Luzulo - Polytrichetum commune and the Luzulo - Empetretum nigrae (Chapter III-5) represent anthropogenic heath associations derived by the cultural practices of prescribed burning and commercial blueberry picking. Livestock grazing, especially by sheep, has also contributed to the development of these heath types in close proximity to settlements.

Characteristic of the Luzulo - Polytrichetum commune is the dominance of Vaccinium angustifolium, the absence of other shrubs and the scarcity of lichens and pleurocarpous mosses (Figure 3-19).

Figure 3-19: This association is characterized by scarcity of lichens and pleurocarpous mosses in the ground vegetation and the physiognomic dominance of Vaccinium angustifolium.

Some sites are semi-grassland with both *Deschampsia flexuosa* and *Luzula campestris* throughout. The humus layer underlying the *Vaccinium* Heath is very thin (2-5 cm) and sometimes broken. Such a substrate is preferred by particular heath species e.g. *Prenanthes trifoliolata* and *Potentilla tridentata* (Böcher, 1954). Only the lichens *Cladonia cristatella* and *Cladonia arbuscula* occur in the ground layer, both with a sporadic distribution and never carpet forming. A moss carpet is also lacking, however *Polytrichum commune*, *Dicranum scoparium* and *Dicranum fulvum* form small patches.

Randomly dispersed through the *Luzulo - Polytrichetum commune* are numerous "weed" species, which are anthropogenic in origin and distribution. Fernald (1950) describes *Anaphalis margaritacea*, *Luzula campestris*, *Taraxacum officinale*, *Hieracium murorum* and *Achillea millefolium* as being locally adventive from Europe. All these species occur in this association.

To appreciate the development and distribution (Figure 3-20) of the *Luzulo - Polytrichetum commune* it is necessary to understand man's use of fire on the Avalon. Early settlers to the northern Avalon were from Ireland, Scotland and England; areas where burning of heathland for production of sheep pasture is traditional in rural life (Gimingham, 1964). It is possible that early settlers continued this

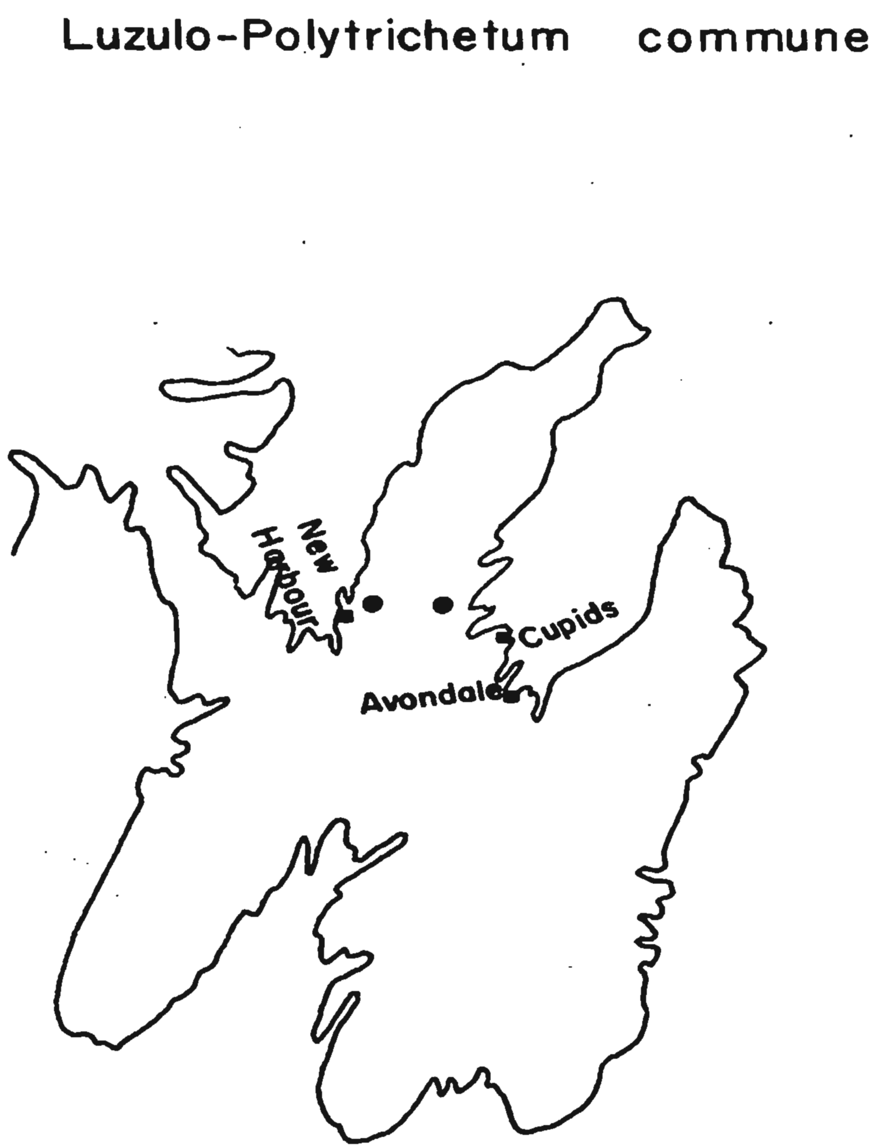


Figure 3-20: The Luzulo - Polytrichetum commune is located on two recently burnt heathlands near New Harbour.

practice in Newfoundland. Unfortunately the landscape history of this region is too poorly documented to substantiate this theory (Story, pers. comm.). Terasmae (1963) performed palynological studies on the northern Avalon and concluded,

> "A definite expansion of heathland did occur in historic time and this seems to correlate with the human influence; beginning in the 15th and 16th centuries, when fishermen established camps along the shores of Newfoundland and either by accident or on purpose began to set fire to the forests."

John Guy established the first settlement in Newfoundland at Cupids, a community in close proximity to the present day distribution of the *Luzulo - Polytrichetum commune* association.

Commercial blueberry picking began in the 1930's in Newfoundland, however with the frequency of accidental fires there was no requirement for prescribed burning to sustain blueberry yields. With improved fire prevention, prescribed burning was required and to date 30,000 acres have been subjected to burning for blueberry production (Hendrickson, 1972). Prescribed burning involves repeated incineration of heath sites every two or three years to eliminate species in competition with *Vaccinium angustifolium*. Burning in addition to altering natural succession, also reduces the thickness of the underlying humus, destroys portions of the litter and results in a release of nutrients. Hansen (1969) recorded an initial increase of all elements analyzed in substrate of Danish heath within seven days after burning.

On the Avalon the effect of recent heath burns on succession was cursorily investigated near Avondale. It was found that the border areas of the experimental plots as well as the control plots, maintained natural heath. Plots burned within the last three years were characterized by the *Luzulo - Polytrichetum commune* association whereas plots burnt more than three years were identified by the association *Luzulo - Empetretum nigrae* (Chapter III-5).

Within the *Luzulo - Polytrichetum commune* associations two variants are recognized:

(i) *Achillea millefolium Variant*

(ii) *Rosa nitida Variant*

(i) *Achillea millefolium Variant*

Identifying Species:

*Achillea millefolium* *Fragaria virginiana*

This variant represents sites within the anthropogenic heath which are close to roadsides or footpaths. Both these species are commonly encountered in old fields and roadside ditches on the Avalon. However, they only occur as a heath element where there is human intrusion and disturbance is frequent.

(ii) Rosa nitida Variant

Identifying Species:

*Rosa nitida* *Lonicera villosa*

The occurrence of these species is indicative of nutrient rich soils, both species occur in nutrient rich fens (Pollett and Bridgewater, in press). This variant usually occurs at the base of slopes or in drainage channels subject to periodic flushing from upland soils.

## 5. LUZULO - EMPETRETUM NIGRAE ASSOCIATION (KALMIA-VACCINIUM HEATH)

### Differentiation of the Association

The *Luzulo - Empetretum nigrae* is differentiated with respect to the *Luzulo - Polytrichetum commune* by the following species:

*Empetrum nigrum* (IV)
*Ledum groenlandicum* (III)
*Kalmia angustifolia* (II)
*Vaccinium vitis-idaea* (III)
*Lycopodium clavatum* (III)
*Pleurozium schreberi* (III)

The association is differentiated with respect to all other associations described in this study by the presence of some or all of the differential species of *Luzulo - Polytrichetum commune* association. The complete floristic composition of the association is presented in Synthesis Table 5, Appendix II.

### Type Releve

a) Site Characteristics

| | | | |
|---|---|---|---|
| Releve Number | 35A | Hodgewater Line | |
| Slope | $30^{\circ}$E | Latitude | $47^{\circ}30'30''$ |
| Altitude | 75 M. | Longitude | $53^{\circ}18'45''$ |

b) Species Composition

Phanerogams (60% Cover)

*Kalmia angustifolia* 1.1

*Empetrum nigrum* 2.2

*Vaccinium angustifolium* 1.1

*Lycopodium annotinum* 2.2

*Solidago uliginosa* +

*Trientalis borealis* +

*Gaultheria hispidula* 1.2

*Deschampsia flexuosa* 2.2

*Ledum groenlandicum* 1.1

*Kalmia polifolia* +

*Juniperus communis* 1.2

*Lycopodium clavatum* 2.2

*Cornus canadensis* 1.1

*Linnaea borealis* 2.2

*Potentilla tridentata* 1.1

*Luzula compestris* 1.2

Cryptogams (30% Cover)

*Cladonia arbuscula* 2.2

*Cladonia mitis* 1.2

*Cladonia rangiferina* 2.2

*Dicranum scoparium* 2.2

Ecological Interpretation

The *Luzulo - Empetretum nigrae* occurs on sites which have undergone moderate disturbance from natural fire or from anthropogenic activities, particularly prescribed burning, berry picking or animal grazing. This association also signatures sites previously occupied by the *Luzulo - Polytrichetum commune*. The latter sites have had a period of regeneration (3-5 years) in which those species previously eliminated by fire have re-established. Distribution of the *Luzulo - Empetretum nigrae*, in the study area, is similar to that of the *Luzulo - Polytrichetum commune*; however, the former association is more common.(Figure 3-21). The more common occurrence of the *Luzulo - Empetretum nigrae* is in part related to the implementation of strict fire control regulations and a corresponding reduction in prescribed burning on the Avalon over the past ten years. This situation has resulted in a decrease of areas favoring development of the *Luzulo - Polytrichetum commune* association; and has also enabled areas occupied by this association to regenerate towards the *Luzulo - Empetretum nigrae* type of cover.

Luzulo-Empètretum nigrae

Figure 3-21: The Luzulo - Empetretum nigrae association has its maximum distribution in close proximity to settlement in Conception Bay South.

The Luzulo - Empetretum nigrae, like the Luzulo - Polytrichetum commune, is physiognomically characterized by high cover of Vaccinium angustifolium, Deschampsia flexuosa and Potentilla tridentata. Other similarities in vegetation include the sporadic occurrence of anthropogenic elements such as Luzula campestris, Hieracium murorum, Taraxacum officinale and Solidago rugosa. Unlike the Luzulo - Polytrichetum commune, the Luzulo - Empetretum nigrae is characterized by the presence of Empetrum nigrum, Juniperus communis, Ledum groenlandicum and Kalmia angustifolia in the above ground vegetation and Pleurozium schreberi, Polytrichum strictum and numerous lichens in the ground layer (Figure 3-22).

Figure 3-22: Charred humus with small clumps of Luzula campestris surrounded by less disturbed heath with Empetrum nigrum dominant. This is characteristic of vegetation within the Luzulo - Empetretum nigrae.

Interpretation of succession indicates the approximate time elapsed after burning of particular sites. The occurrence of *Empetrum nigrum* and *Juniperus communis* in the *Luzulo - Empetretum nigrae* association is significant because both species are slow in establishing after intense fire. Peters (1958), studying Newfoundland heath, and Hansen (1964), studying Danish heath, observed that more than ten years is required for these species to gain their original vitality.

Hansen (1964) also suggests that this is attributable to the reproductive characteristics of *Juniperus communis* and *Empetrum nigrum*. Both species rely solely on seed as a means of dispersal whereas many other shrubs disperse vegetatively and become established more rapidly. *Vaccinium angustifolium*, for example, attains its maximum coverage of sites within two years following fire. *Ledum groenlandicum* and *Kalmia angustifolium* require 6 to 9 years to regain their original vitality. Fire also results in a greater flower production and seedling establishment by *Deschampsia flexuosa* (Scurfield,1954).

It is possible to predict the general pattern of succession following intense burning. In the first three years after fire the Luzulo - Polytrichetum commune association is evident with Vaccinium angustifolium dominant. After this period, the cover of Kalmia angustifolia and Ledum groenlandicum progressively increases coincident with a decline in the fruit productivity and coverage of Vaccinium angustifolium. This decline in blueberries results in a lower incidence of human intrusion on the site. Competition from ericaceous species, combined with decreased human activity, may reduce the anthropogenic species elements characteristic of the Luzulo - Empetretum nigrae association. It is difficult to predict the time required for elimination of the anthropogenic species element from the heath.

The physiognomic and phytosociologic characteristics of the anthropogenic heath are also affected differently by accidental and prescribed burns. Prescribed burning results in a uniform burn whereas accidental burning is often discontinuous, leaving patches of unconsumed vegetation. Consequently, after prescribed burning the Luzulo - Polytrichetum commune is dominant. After an accidental burn the Luzulo - Polytrichetum commune occurs in a mosaic, in juxtaposition with the Luzulo - Empetretum nigrae and other heath types.

The intensity of controlled fires is considerably less than that of accidental fire. The surface temperature of prescribed burns is 300-500°C whereas in windy weather the surface temperature in accidental burns may exceed 800°C. However, the repeated prescribed burning of a site may cause more permanent differences in the flora than the occasional severe fire (Gimingham, 1964).

Under normal circumstances succession following fire tends towards establishment of vegetation present on the site prior to burning. However, if fire is extremely frequent or intense it depletes the insulating humus layer and introduces soil-frost disturbance. This results in the establishment of hard ground heath. Also, intense burning may deplete organic matter in the mineral soil resulting in poor drainage due to compaction of the B horizon (Chancey, 1958). When this occurs, succession leads to a wet heath vegetation.

These circumstances create three distinct variants within the *Luzulo - Empetretum nigrae* association:

(i) *Kalmia angustifolia Variant*

(ii) *Ledum groenlandicum Variant*

(iii) *Cladonia arbuscula Variant*

(i) Kalmia angustifolia Variant

Identifying Species:

Kalmia angustifolia    Juniperus communis
Ledum groenlandicum    Linnaea borealis

Sites occupied by this variant have experienced intense ground fire. Both the lichens and the lichen substrate have been destroyed and shrubs identifying the variant have low cover values. Ahti (1959) claims that several decades may be required for the slow growing lichens Cladonia arbuscula, Cladonia rangiferina and Cladonia mitis to regain significant cover after fire. Consequently, the shrub canopy is open and the ground vegetation is comprised of patches of mosses and grasses colonizing bare mineral soil.

(ii) Ledum groenlandicum Variant

Identifying Species:

Kalmia angustifolia    Cladonia mitis
Ledum groenlandicum    Cladonia rangiferina
Cladonia arbuscula

The floristic composition of the Ledum groenlandicum Variant is similar to certain sites included in the Kalmietum angustifoliae (Chapter III-6). However, the sporadic occurrence of Luzula campestris throughout these sites indicates anthropogenic disturbance is a factor in development of this variant. Succession in this vegetation will probably tend towards the establishment of the Kalmietum angustifoliae association.

(iii) Cladonia arbuscula Variant

Identifying Species:

| | |
|---|---|
| Cladonia arbuscula | Cladonia mitis |
| Cladonia rangiferina | Lycopodium clavatum |

Coincident with the occurrence of this variant is the increased frequency of large frost scars. This is especially true at the summit of knolls where the Empetro - Potentilletum tridentatae association was probably the dominant vegetation prior to burning (Figure 3-23).

Figure 3-23: The exposed knolls in the background are presently occupied by the Luzulo - Empetretum nigrae; prior to burning the Empetro - Potentilletum tridentatae association probably occupied this site.

Burning removed the protective plant cover and destroyed the underlying litter and humus, resulting in an exposed substrate. With no humus insulation and a lack of protective snow cover, frost churning results in the exposed soil. This frost action retards re-establishment of *Kalmia angustifolia* and *Ledum groenlandicum*, and the landscape resembles the rock barren heath. *Dicranum fuscescens* is conspicuous on patches of humus which have survived fire disturbance. Succession of heath development on sites occupied by the *Cladonia arbuscula* Variant will possibly be toward vegetation of the *Empetro - Potentilletum tridentatae* association.

Figure 3-24: Soft Ground Heath occurs throughout the isthmus, northern and central Avalon, but only occurs on the more sheltered slopes where snow accumulation is deep.

## 6. KALMIETUM ANGUSTIFOLIAE ASSOCIATION (KALMIA HEATH)

### Differentiation of the Association

This association is differentiated by the absence of differential species of all other heath associations and is characterized by the frequency and abundance of the following species:

*Kalmia angustifolia* (V)
*Vaccinium angustifolium* (V)
*Ledum groenlandicum* (IV)
*Empetrum nigrum* (III)
*Vaccinium vitis-idaea* (III)
*Cladonia arbuscula* (V)
*Cladonia mitis* (IV)
*Cladonia rangiferina* (IV)
*Cladonia alpestris* (III)
*Cornus canadensis* (IV)

The complete floristic composition of the association is given in Synthesis Table 6, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 41D   Heart's Content

Slope   Level   Latitude $47^{\circ}53'30''$

Altitude   60 M.   Longitude $52^{\circ}22'00''$

b) Species Composition

Phanerogams (70% Cover)

Kalmia angustifolia 2.1

Vaccinium angustifolium 1.1

Ledum groenlandicum 2.1

Chamaedaphne calyculata 2.1

Rhododendron canadense 1.1

Nemopanthus mucronata +

Amelanchier bartramiana 1.1

Abies balsamea k

Empetrum nigrum 1.1

Kalmia polifolia +

Vaccinium oxycoccus 1.2

Betula papyrifera r

Cryptogams (80% Cover)

Pleurozium schreberi 4.4

Ptilium crista-castrensis 2.2

Hylocomium splendens 1.2

Dicranum scoparium 2.2

Cladonia alpestris 3.2

Cladonia mitis 1.2

Cladonia rangiferina 2.2

Cladonia arbuscula 2.2

Ecological Interpretation

The *Kalmietum angustifoliae* association is largely concentrated in the central, northern and isthmus of the Avalon and occupies sheltered sites having moderate drainage (Figure 3-25). Severe climatic conditions restrict its distribution elsewhere in the study region.

The *Kalmietum angustifoliae* is divided into two subassociations:

a) *Hylocomietosum*

b) *Typicum*

a) *Hylocomietosum*

Identifying Species:

| | |
|---|---|
| *Hylocomium splendens* | *Ptilium crista-castrensis* |
| *Pleurozium schreberi* | *Dicranum scoparium* |
| *Vaccinium oxycoccus* | *Gautheria hispidula* |

The subassociation *Hylocomietosum* occurs primarily at the lower portions of heath slopes and along the edges of heath when bordering forest. These habitats are conducive to deep snow accumulations and also receive drainage waters from upper heath slopes resulting in a moist surface layer. *Kalmia angustifolia* and *Ledum groenlandicum* grow vigorously in such habitats, sometimes exceeding 50 cm in height. A dense canopy is created by these shrubs which provides shade and lessens surface evaporation. These factors are

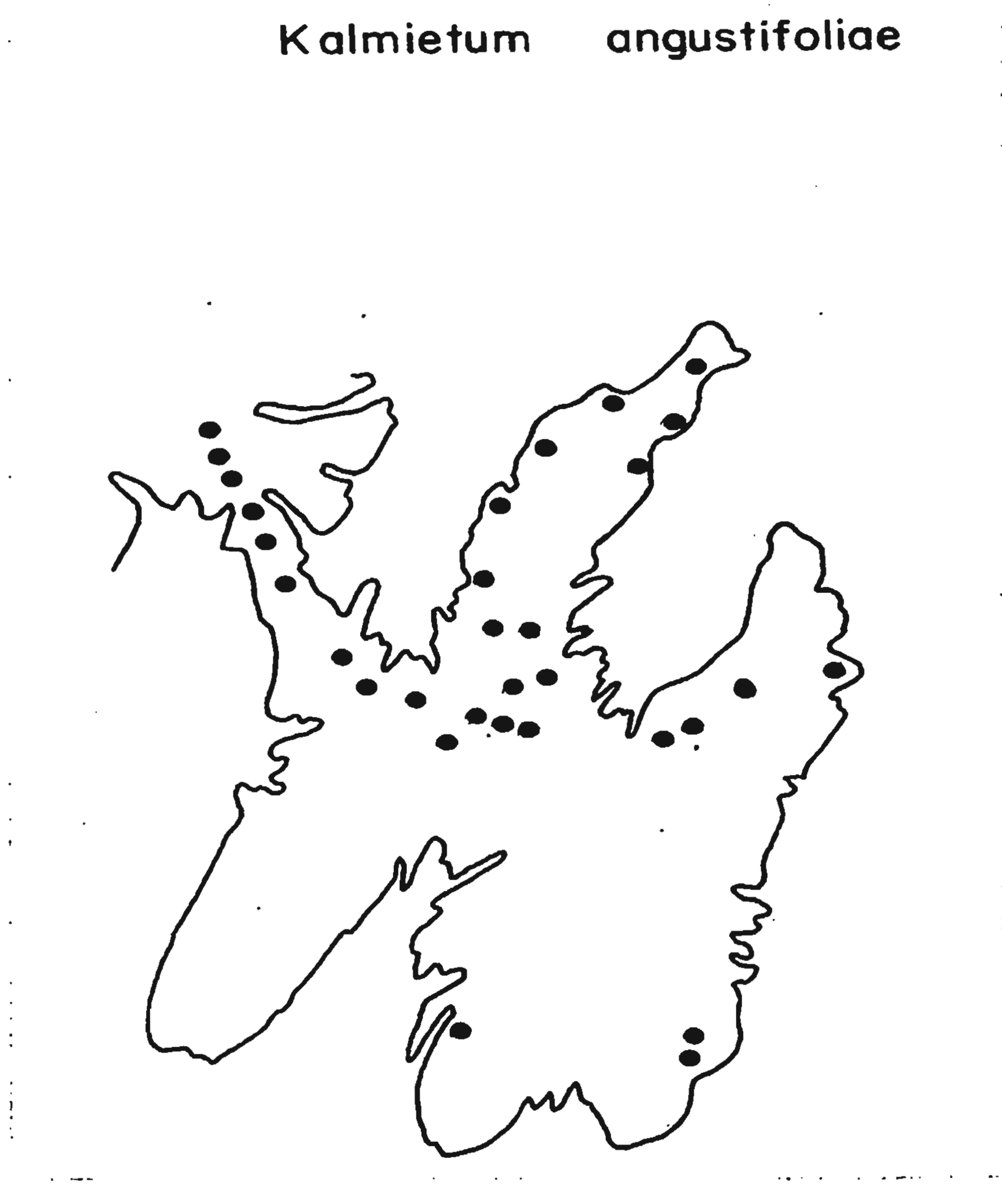


Figure 3-25: The Kalmietum angustifoliae association is characteristic of sheltered heathland sites throughout the central and northern portions of the study area.

favorable for the formation of a moss carpet which characterizes the subassociation (Figure 3-24).

Figure 3-26: The vigorous growth of ericaceous shrubs creates a dense canopy providing sufficient shade and moisture for the development of a continuous moss carpet characteristic of the Hylocomietosum.

The Hylocomietosum subassociation consists of the following four variants:

(i) Ptilium crista-castrensis Variant

(ii) Juniperus communis Variant

(iii) Cornicularia aculeata Variant

(iv) Viburnum cassinoides Variant

(i) Ptilium crista-castrensis Variant

Identifying Species:

Ptilium crista-castrensis    Nemopanthus mucronata

This variant represents the most sheltered sites encountered in the Kalmietum angustifoliae occurring at the base of slopes or in juxtaposition to forest. The humus development on these sites is usually in excess of 30 cm.

There is a noticeable decrease in the occurrence and coverage of Empetrum nigrum and Vaccinium vitis-idaea within this variant, possibly resulting from the competition of ericaceous shrubs. On less sheltered sites throughout this association where the growth of ericaceous shrubs is less vigorous, these species display greater coverage.

Within this variant there is a subvariant identified by the following species:

| | |
|---|---|
| Lycopodium clavatum | Anthoxanthum odoratum |
| Lycopodium obscurum | Calamagrostis pickeringii |
| Solidago uliginosa | Deschampsia flexuosa |

This species assemblage has a close affinity with the Luzulo - Polytrichetum commune and the Luzulo - Empetretum nigrae associations. The occurrence of this variant may be attributed to the close proximity of the Kalmietum angustifoliae to certain anthropogenic heath sites.

(ii) Juniperus communis Variant

Identifying Species:

Juniperus communis

This variant is characterized by sporadic patches of Juniperus communis in the heath matrix. These patches vary in size from 0.5 to 2 M. in diameter and also occur in the Typicum subassociation.

The occurrence of Juniperus communis in the heath matrix is usually a reliable indication that fire has not occurred in the last ten years (Peters, 1958). However, other factors should be considered in making this type of an assessment because it is possible that this variant represents isolated patches of heath that escaped recent fire.

A subvariant is recognized by the occurrence of Rhacomitrium lanuginosum where outcrop protrudes through the humus creating an exposed microhabitat.

(iii) Cornicularia aculeata Variant

Identifying Species:

Cornicularia aculeata

Small areas of the humus sometimes become dry and erode through the action of fire, wind or the activities of insects. In these microhabitats Cornicularia aculeata and less consistently, Cladonia elongata and Cladonia uncialis, appear to be pioneer species.

(iv) Viburnum cassinoides Variant

Identifying Species:

Viburnum cassinoides    Nemopanthus mucronata

This variant occurs in both the Hylocomietosum and Typicum subassociations and is characterized by the presence of non-ericaceous shrubs, Amelanchier bartramiana, Pyrus floribunda, Viburnum cassinoides and Nemopanthus mucronata.

The occurrence of this variant may be related to succession following burning. The low coverage of Empetrum nigrum and Vaccinium vitis-idaea indicates that these sites have experienced intense fire during some stage in their development. Also the increased frequency of horn lichens, Cladonia crispata, Cladonia cristatella and Cladonia macrophylla, suggest that the burn occurred in the last ten years (Ahti, 1959).

The non-ericaceous species characteristic of this variant seem to establish on heath shortly after fire when competition from ericaceous species is minimal. As competition from ericaceous species intensifies this variant is gradually replaced by the Ptilium crista-castrensis Variant. In the Ptilium crista-castrensis Variant, Nemopanthus mucronata occurs sporadically and other non-ericaceous shrubs are rarely encountered.

b) Typicum

The Typicum subassociation represents less sheltered sites within the Kalmietum angustifoliae usually where there is a gradation between hard and soft ground heath. This frequently occurs near the summit of knolls or on coastal headlands where the Kalmietum angustifoliae is in juxtaposition to the Empetro - Potentilletum tridentatae (Figure 3-27).

Figure 3-27: Vegetation represented by the Hylocomietosum is prominent on the lower slope whereas near the summit of the slope the Typicum subassociation is dominant and in juxtaposition to vegetation of the Empetro - Potentilletum tridentatae association.

The floristic affinity of the Typicum to hard ground heath associations can be seen in the increased frequency of the following species:

| | |
|---|---|
| Prenanthes trifoliolata | Calamagrostis pickeringii |
| Deschampsia flexuosa | Cetraria islandica |
| Cladonia squamosa | Cladonia crispata |

The humus development on these sites rarely exceeds 20 cm. but is sufficiently deep to prevent the establishment of many of the differential species characterizing hard ground heath associations.

Most sites represented by the Typicum are located near the summit of slopes where there is some degree of exposure to wind. Consequently the shrub canopy is poorly developed in comparison to the Hylocomietosum and the surface humus is more susceptible to drying. This surface drying is caused by frequent high winds and by drainage of ground water from the summit towards the lower slope. Many sites, because of this drying, lack a moss carpet and have a ground vegetation in which lichens and grasses are conspicuous.

There are two additional variants in the Typicum sub-association in addition to the Viburnum cassinoides Variant previously described:

(i) Juniperus communis Variant

(ii) Cornicularia aculeata Variant

(i) Juniperus communis Variant

Identifying Species:

Juniperus communis | Calamagrostis pickeringii
Deschampsia flexuosa

This variant represents patches of Juniperus communis similar to those encountered in the Hylocomietosum. The only noticeable differences are the smaller size of the patches and the lower growth form of the plants. The shallow humus underlying the patches is a suitable substrate for the grasses Deschampsia flexuosa and Calamagrostis pickeringii.

(ii) Cornicularia aculeata Variant

Identifying Species:

Cornicularia aculeata | Cladonia squamosa
Cladonia macrophylla | Cladonia coccifera

This variant occurs where the shrub canopy is discontinuous and the substrate is extremely dry and crusty (Figure 3-28).


Figure 3-28: The Cornicularia aculeata Variant occurs where the shrub layer is open and the ground layer has a dry crusty humus.

The frequency of red ants and other insects in these microhabitats suggests that they may play an important role in the creation of a suitable habitat for species characteristic of the *Cornicularia aculeata Variant*.

## 7. KALMIO - ALNETUM CRISPAE ASSOCIATION
(ALDER TUCK)

### Differentiation of the Association

The *Kalmio - Alnetum crispae* is differentiated with respect to all other heath associations by the occurrence of the following species group which forms a tall tuck vegetation within the matrix of soft ground heath:

| | |
|---|---|
| *Alnus crispa* (V) | *Viburnum cassinoides* (V) |
| *Pteridium aquilinum* (IV) | *Nemopanthus mucronata* (V) |
| *Rhododendron canadense* (V) | |

The complete floristic composition of this association is presented in Synthesis Table 7, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 74 Soldiers Pond

| | |
|---|---|
| Slope 40° E. | Latitude 47°19'45" |
| Altitude 200 M. | Longitude 53°07'00" |

b) Species Composition

Phanerogams (90% Cover)

*Alnus crispa* 3.2
*Prunus pennsylvanica* 1.1
*Pteridium aquilinum* 2.1
*Rhododendron canadense* 2.1

*Viburnum cassinoides* 1.1

*Amelanchier bartramiana* +

*Sorbus decora* 1.1

*Kalmia angustifolia* 2.1

*Vaccinium angustifolium* 1.1

*Nemopanthus mucronata* +

*Maianthemum canadense* +

*Cornus canadensis* +

Cryptogams (Absent)

Ecological Interpretation

The *Kalmio - Alnetum crispae* has a restricted distribution on the Avalon Peninsula (Figure 3-29). This pattern of distribution is possibly related to the preference of *Alnus crispa* for tree line stands in Newfoundland (Ahti, 1959). This association has its optimal development on the Hawke Hill Range at altitudes of 150-300 M. Wilton (1956) has observed that productive forests rarely exceed the 150 M. contour on the Avalon Peninsula. Therefore, the *Kalmio - Alnetum crispae* is representative of a tree line transition vegetation (Figure 3-30).


Figure 3-29: The Kalmio - Alnetum crispae association is restricted to heathland near the Hawke Hill Range and the community of Aquaforte. Although not recorded in this survey a similar vegetation is common on the isthmus of the Avalon Peninsula.

Figure 3-30: The Kalmio - Alnetum crispae association occurs on the Hawke Hill Range approximating a tree line transition. It is identified by its darker tone throughout the heath matrix.

This association is characterized by the physiognomic dominance of Alnus crispa to a height of 2-3 M. The alder clumps act as a shelter belt enabling Rhododendron canadense, Pteridium aquilinum, Viburnum cassinoides and Nemopanthus mucronata to form a dense shrub understory. The litter fall from these shrubs and Alnus crispa appears to be a limiting factor in the development of the ground vegetation. Maianthemum canadense, Cornus canadensis and Trientalis borealis are the only consistent species in the ground vegetation.

There are two variants in the Kalmio - Alnetum crispae:

(i) Pyrus floribunda Variant

(ii) Amelanchier bartramiana Variant

(i) Pyrus floribunda Variant

Identifying Species:

| | |
|---|---|
| Pyrus floribunda | Calamagrostis pickeringii |
| Clintonia borealis | Dicranum scoparium |
| Myrica gale | Smilacina trifolia |

This variant is located in sites where the Kalmio - Alnetum crispae occupies intermittent stream channels. In winter the snow cover is usually deep and snow beds are persistent into late spring. The periodic flushing of these sites from upland heaths results in development of a dense shrub cover limiting the development of a ground vegetation.

Figure 3-31: The Pyrus floribunda Variant is characterized by a dense shrub canopy and occurs in drainage channels where snow cover is persistent.

(ii) Amelanchier bartramiana Variant

Identifying Species:

*Amelanchier bartramiana* *Prunus pennsylvanica*

This variant, located on freely drained upper heath slopes, is lacking in hydrophylic species such as *Myrica gale*, *Smilacina trifolia* and *Clintonia borealis*. The shrub canopy is less dense than that in the *Pyrus floribunda* Variant, and a number of lichens and mosses occur as additional species. The height of *Alnus crispa* is usually less than 2 M. in this variant, possibly the result of its exposure to winds on the upper slopes.

## 8. ABIETETUM BALSAMEAE HUDSONIAE ASSOCIATION (FIR TUCK)

### Differentiation of the Association

This association may be distinguished from all other heath associations by the presence of the following differential species group:

*Abies balsamea* f. *hudsoniae* (V)
*Orchis rotundifolia* (+)
*Listera cordata* (+)
*Dryopteris spinulosa* (+)

The complete floristic composition of this association is presented in Synthesis Table 8, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 17A    St. Shotts Road

Slope    Level    Latitude $46^{\circ}38'30''$

Altitude 75 M.    Longitude $53^{\circ}34'15''$

b) Species Composition

Phanerogams (80% Cover)

*Abies balsamea* 4.4
*Clintonia borealis* 1.1
*Trientalis borealis* 1.1
*Linnaea borealis* 1.1
*Osmunda cinnamomea* +
*Cornus canadensis* 1.1

Cryptogams (60% Cover)

*Gaultheria hispidula* 1.2

*Rhytidiadelphus triquetrus* 3.3

*Dicranum scoparium* 2.2

*Polytrichum commune* 1.2

*Dicranum bergeri* 1.2

*Hylocomium splendens* 3.3

*Ptilium crista-castrensis* 2.2

*Pleurozium schreberi* 2.2

Ecological Interpretation

The *Abietetum balsamae hudsoniae* is a conspicuous component of heath vegetation on the northern and southern coastal extremities of the Avalon Peninsula. It also occurs on sites inland, above the tree line, where climatic conditions restrict the formation of productive forest (Figure 3-32).

The species composition of this association closely coincides with that of the *Hylocomietosum* of the *Abietum* association described for central Newfoundland forests (Damman 1964). However, the presence of *Abies balsamea* in the form *hudsonia* and its spatial relationship to the heath matrix warrants inclusion of tuck in a classification of heath vegetation.

# Abietetum balsamae hudsoniae

Figure 3-32: The Abietetum balsameae hudsoniae is distributed on the northern and southern coastal extremities of the Avalon and occurs at higher elevations inland.

This association occurs only in areas experiencing severe climatic conditions. The *Empetro - Potentilletum tridentatae* and *Empetro - Rhacomitrietum lanuginosae* associations are the major components of the surrounding heath matrix with the fir tuck usually restricted to the lee side of slopes or depressions where snow accumulation is deeper and more persistent. The stunted growth, characteristic of this tuck, results from mechanical damage inflicted by wind and/or drought. Winter snow cover provides protection for the base of the plant. Drifting ice particles prune the shoot apices restricting perpendicular growth (Figure 3-33).

Figure 3-33: On this site the tuck formation is covered by approximately 1 M. of snow. The apical buds of balsam fir are removed by drifting ice particles. This, combined with drought caused by continuous air movement, results in the development of fir tuck.

The resulting formation of dense fir clumps provides a microclimate suited to the development of a ground vegetation similar to balsam fir forest.

There are three variants in this association:

(i) Linnaea borealis Variant
(ii) Clintonia borealis Variant
(iii) Empetrum nigrum Variant

(i) Linnaea borealis Variant

Identifying Species:

| | |
|---|---|
| Linnaea borealis | Picea mariana |
| Maianthemum canadense | Amelanchier bartramiana |
| Ptilidium ciliare | |

This variant is located near Bay de Verde in close proximity to the seashore. The presence of the Abietetum balsamae hudsoniae in this instance is probably related to the consistency of high onshore winds. The surrounding heath is predominantly of the Empetro - Potentilletum tridentatae association growing on a very thin humus over bedrock.

The tuck in this variant has a height of 1 M. and is referred to locally as "low tuck". Sufficient light penetrates "low tuck" for the establishment of the ericaceous shrubs Kalmia angustifolia and Vaccinium angustifolium.

(ii) Clintonia borealis Variant

Identifying Species:

Clintonia borealis

Ptilium crista-castrensis

Dicranum bergeri

Linnaea borealis

Rhytidiadelphus triquetrus

Abies balsamea up to 3 M. forms this variant and is locally referred to as "tall tuck". The highest growth is usually in the center of the stand and tapers to ground level near the circumference. The taller growth provides more shelter for the ground vegetation and an extensive forest-moss carpet is usually present. The ground is usually damp providing a suitable habitat for the ferns Osmunda cinnamomea and Dryopteris spinulosa and the lily, Clintonia borealis. Competition for light and/or nutrients appears to be detrimental to the establishment of Kalmia angustifolia and Vaccinium angustifolium.

(iii) Empetrum nigrum Variant

Identifying Species:

Empetrum nigrum          Vaccinium vitis-idaea

Ledum groenlandicum

This variant occurs near the community of St. Brides forming extensive patches of "low tuck" surrounded by the Empetro - Rhacomitrietum lanuginosae association (Figure 3-34).

Figure 3-34: The Empetrum nigrum Variant near St. Brides occurring in juxtaposition to the Empetro - Rhacomitrietum lanuginosae association.

Ericaceous shrubs are abundant in this variant and sometimes extend in height above the tuck canopy. Mosses present in this variant do not form extensive carpets but occur in patches where shade and moisture conditions are adequate.

## 9. KALMIO - MYRICETUM GALE ASSOCIATION (MYRICA HEATH)

### Differentiation of the Association

Floristically the *Kalmio - Myricetum gale* is closely related to the *Kalmietum angustifoliae* but is differentiated by the abundance of the following species:

*Myrica gale* (V)     *Cladonia alpestris* (IV)

The complete floristic composition of this association is presented in Synthesis Table 9, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 55C   Arnolds Cove

Slope $30^{\circ}$ S     Latitude $47^{\circ}47'15''$

Altitude 30 M.     Longitude $53^{\circ}58'00''$

b) Species Composition

Phanerogams (80% Cover)

*Myrica gale* 2.1
*Vaccinium angustifolium* 1.1
*Ledum groenlandicum* 1.1
*Vaccinium vitis-idaea* 1.2
*Kalmia angustifolia* 2.1
*Chamaedaphne calyculata* 1.1
*Empetrum nigrum* 3.3
*Osmunda cinnamomea* 1.1

Cryptogams (70% Cover)

<u>Hylocomium splendens</u> 3.3
<u>Dicranum scoparium</u> 2.2
<u>Cladonia rangiferina</u> 2.2
<u>Cladonia alpestris</u> 2.2
<u>Cladonia elongata</u> 1.2
<u>Pleurozium schreberi</u> 2.2
<u>Ptilium crista-castrensis</u> 3.2
<u>Cladonia mitis</u> 1.2
<u>Cladonia arbuscula</u> 1.2

<u>Ecological Interpretation</u>

The <u>Kalmio - Myricetum gale</u> is distributed throughout the Avalon Peninsula on moderately moist soils (Figure 3-35). Typically this association occurs near the middle of slopes usually as a transitional vegetation between dry heath (<u>Kalmietum angustifoliae</u>) at the summit and wet heath (<u>Kalmio - Sphagnetum nemori</u>, Chapter III-10) at the base. Also this association frequently forms a border vegetation around ponds and near small basin peat deposits. Less frequently the <u>Kalmio - Myricetum gale</u> is present on earth hummocks in juxtaposition to the <u>Kalmio - Sphagnetum nemori</u> association which occupies the intervening hollows (Pollett and Meades,1972).

## Kalmio-Myricetum gale

Figure 3-35: The Kalmio - Myricetum gale occurs on moderately moist heath soils throughout the study area.

Ericaceous shrubs attain a height of 1 M. in this association and form a very dense canopy (Figure 3-36).

Figure 3-36: The Kalmio - Myricetum gale (center of photo) forms a tall and dense ericaceous canopy.

The moist conditions of the humus, and the shade provided by the overstory of shrubs, are optimal for the growth of Hylocomium splendens which attains its maximum coverage in this association. Hylocomium, together with Dicranum scoparium and Pleurozium schreberi, forms an extensive moss carpet. Cladonia mitis, Cladonia arbuscula, Cladonia rangiferina and Cladonia alpestris also form a luxuriant lichen stratum throughout the Kalmio - Myricetum gale association.

Four variants are recognized in the Kalmio - Myricetum gale:

(i) Rhacomitrium lanuginosum Variant
(ii) Coptis groenlandica Variant
(iii) Osmunda cinnamomea Variant
(iv) Rhododendron canadense Variant

(i) Rhacomitrium lanuginosum Variant

Identifying Species:

Rhacomitrium lanuginosum
Clintonia borealis
Juniperus communis
Deschampsia flexuosa

This variant is located in the southern region of the Avalon near the communities of Branch and Trepassey. Climate is so harsh on sites occurring in this variant that even the lee side of slopes has species indicative of severe exposure. The variant occurs in troughs in juxtaposition to the Empetro - Rhacomitrietum lanuginosae association. The presence of Clintonia borealis is indicative of the moisture accumulated in the microhabitat of troughs.

(ii) Coptis groenlandica Variant

Identifying Species:

Coptis groenlandica    Pyrus floribunda

Amelanchier bartramiana    Cladonia uncialis

This variant is present on sheltered sites in the central Avalon and normally occurs on the leeward side of steep slopes or near pond borders. The presence of Coptis groenlandica is probably indicative of freely drained and slightly higher nutrient concentrations in the humus. Vaccinium vitis-idaea and Empetrum nigrum are absent from this variant possibly because of the shelter associated with these sites.

(iii) Osmunda cinnamomea Variant

Identifying Species:

Osmunda cinnamomea    Chamaedaphne calyculata

This variant was found on only two sites occurring on the isthmus of the Avalon Peninsula. Both sites have poorly drained soils and humus accumulation is in excess of 40 cm.

(iv) Rhododendron canadense Variant

Identifying Species:

Rhododendron canadense

Rhododendron canadense is rare on the southern Avalon Peninsula. This variant represents sheltered sites, usually below the tree line (150 M. contour), in the northern, central and along the isthmus of the Avalon.

## 10. KALMIO - SPHAGNETUM NEMORI ASSOCIATION (SPHAGNUM HEATH)

### Differentiation of the Association

The *Kalmio* - *Sphagnetum nemori* is representative of wet heath on the Avalon Peninsula and is characterized by *Sphagnum nemoreum* (V), a peat forming species. The following species have their greatest abundance and cover in this particular heath variety:

*Vaccinium oxycoccus* (IV)
*Ptilium crista-castrensis* (IV)
*Polytrichum strictum* (III)
*Chamaedaphne calyculata* (III)
*Gaultheria hispidula* (II)
*Sarracenia purpurea* (I)
*Drosera rotundifolia* (I)
*Mylia anomala* (I)
*Aulacomnium palustre* (I)
*Sphagnum papillosum* (+)

Most of the species listed above are more characteristic of peatland than of heath vegetation; however, the absence or low abundance of *Scirpus cespitosus* and most species of the genus *Carex* may be used to differentiate wet heath with respect to peatland associations (Pollett,1972). The complete floristic composition of this association is presented in Synthesis Table 10, Appendix II.

Type Releve

a) Site Characteristics

Releve Number 51A Goobies

Slope 20° W Latitude 47°56'30"

Altitude 90 M. Longitude 53°07' 00"

b) Species Composition

Phanerogams (80% Cover)

Kalmia angustifolia 3.1

Ledum groenlandicum 1.1

Nemopanthus mucronata +

Vaccinium vitis-idaea 1.2

Vaccinium oxycoccus 1.2

Clintonia borealis 1.1

Rhododendron canadense 2.1

Vaccinium angustifolium 1.1

Amelanchier bartramiana +

Empetrum nigrum 1.2

Gaultheria hispidula 2.2

Cornus canadensis 1.1

Cryptogams (70% Cover)

Sphagnum nemoreum 3.3

Ptilium crista-castrensis 2.2

Cladonia rangiferina 3.2

Cladonia mitis 1.2

<u>Pleurozium schreberi</u> 3.3

<u>Polytrichum strictum</u> 1.1

<u>Cladonia arbuscula</u> 1.2

<u>Cladonia alpestris</u> 2.2

<u>Ecological Interpretation</u>

The <u>Kalmio</u> - <u>Sphagnetum nemori</u> is distributed throughout the Avalon Peninsula on waterlogged heath soils (Figure 3-37). The spatial relationship of this association to the <u>Kalmio</u> - <u>Myricetum gale</u> has been discussed (Chapter III-9) and the successional relationship between these associations is considered in Chapter IV.

The occurrence of waterlogged heath soils may be related to iron pan formation in the soil. The rapid root prolification of ericaceous shrubs, combined with the cold humid climate of the study area, creates excessive humus accumulation under soft ground heath. This thick raw humus is kept wet through a well distributed precipitation throughout the year providing persistent moist conditions in the surface mineral horizon. The result is a poorly drained surface soil over a well drained and aerated subsoil. When ferrous ions reach the interface between the wet and dry horizons they are oxidized and precipitated to form a thin but durable iron pan (Damman, 1965b). On the upper portion of heath slopes moisture is not retained because of downslope drainage. However, at the base of


Figure 3-37: The _Kalmio_ - _Sphagnetum_ _nemori_ occurs throughout the Avalon Peninsula on waterlogged heath soils.

the slope surface drainage is impeded and the iron pan restricts percolation beyond the B horizon. The result is a constantly waterlogged soil; optimum for the growth of *Sphagnum nemoreum*.

The area covered by the *Kalmio - Sphagnetum nemori* varies considerably with the degree of slope. On sharp slopes exceeding 30° there is little transition from wet to dry soils and the area covered by this association rarely exceeds 4 square meters; however, on gradual slopes the area is sometimes much greater.

The floristic composition and physiognomy of the *Kalmio - Sphagnetum nemori* is closely related to vegetation represented by the *Kalmio - Sphagnetum fusci* association (Pollett 1972, Pollett and Bridgewater, in press). Similar species to both associations include *Vaccinium oxycoccus*, *Drosera rotundifolia*, *Sarracenia purpurea* and *Mylia anomala*. Physiognomically the ericaceous shrubs have a very poor height growth in relation to other heath associations even though the sites are sheltered and have deep snow accumulation. This lack of vigor is due to excessive moisture and low nutrient concentrations in the peat substrate which approximates moisture substrate conditions of blanket peat. Even though the height growth is poor, the combined coverage of phanerogams and cryptogams is high. The shrub layer is dominated by *Kalmia* angustifolia and Ledum groenlandicum whereas the ground layer is covered by Sphagnum nemoreum, forest mosses and lichens (Figure 3-38).

Figure 3-38: The Kalmio - Sphagnetum nemori association.

The variants present in this association are microtopographic and/or geographic, consequently considerable gradation exists. Five variants are recognized:

(i) Nemopanthus mucronata Variant

(ii) Calamagrostis pickeringii Variant

(iii) Rhododendron canadense Variant

(iv) Sphagnum recurvum Variant

(v) Rhacomitrium lanuginosum Variant

(i) Nemopanthus mucronata Variant

Identifying Species:

| | |
|---|---|
| Myrica gale | Viburnum cassinoides |
| Nemopanthus mucronata | Pteridium aquilinum |

This variant is located at the base of steep slopes having deep, persistent, snow cover in winter. The presence of Myrica gale may be attributed to the excessive moisture in these localities whereas Nemopanthus mucronata and Viburnum cassinoides probably benefit from the increased shelter of the slope. A Pteridium aquilinum subvariant is located near the community of Holyrood and may be an anthropogenic introduction. Tansley (1949) refers to the Bracken as an introduced species in European heath

(ii) Calamagrostis pickeringii Variant

Identifying Species:

Calamagrostis pickeringii
Mylia anomala
Aulacomnium palustre
Solidago uliginosa
Drosera rotundifolia

This variant occurs in areas where the accumulation of peat is greatest and has resulted in lowering of the water table. Calamagrostis pickeringii and Solidago uliginosa are better adapted to this habitat than to the saturated substrate present in other variants. Mylia anomala, Drosera rotundifolia and Aulacomnium palustre are also well adapted to periodic drying as their presence on peat hummocks indicates (Pollett, 1972a).

(iii) Rhododendron canadense Variant

Identifying Species:

Rhododendron canadense

This variant is similar to the Rhododendron canadense Variant occurring in the Kalmio - Myricetum gale in that it identifies sites occurring in the central, northern and isthmus of Avalon. This species is rare on the southern Avalon Peninsula probably as a result of the greater climatic severity of that region. This phenomenon is considered in more detail in Chapter V of this study.

(iv) Sphagnum recurvum Variant

Identifying Species:

Sphagnum recurvum

The Sphagnum recurvum Variant is located in small depressions on level heathland. Most of these sites are poorly drained and the nutrient input is probably less than in other variants of this association. Also there is less shrub cover than in other variants and many of the shade tolerant mosses are absent.

(v) Rhacomitrium lanuginosum Variant

Identifying Species:

Rhacomitrium lanuginosum    Cladonia boryi

This variant is typical of sites recorded on the southern Avalon Peninsula where species indicative of climatic severity may display a sporadic occurrence even on the lee side of slopes. The Empetro - Rhacomitrietum lanuginosae and Empetro - Potentilletum tridentatae associations frequently occur in juxtaposition to the Kalmio - Sphagnetum nemori in this region.

## 11. PICEETUM MARIANAE SEMIPROSTRATAE ASSOCIATION (SPRUCE TUCK)

### Differentiation of the Association

The *Piceetum marianae semiprostratae* association is differentiated with respect to all other heath associations by the presence of the following species:

*Picea mariana* (V)
*Usnea longissima* (III)
*Bazzania trilobata* (IV)
*Alectoria sarmentosa* (II)
*Sphagnum recurvum* (II)

The complete floristic composition of this association is presented in Synthesis Table 11, Appendix II.

### Type Releve

a) Site Characteristics

Releve Number 66B Colinet

Slope Level — Latitude 47°15'30"

Altitude 45 M. — Longitude 53°32'15"

b) Species Composition

Phanerogams (80% Cover)

*Picea mariana* 3.3
*Kalmia angustifolia* 2.1
*Vaccinium angustifolium* 1.1
*Empetrum nigrum* 1.1
*Cornus canadensis* +

*Ledum groenlandicum* 1.1

*Vaccinium oxycoccus* 1.2

*Viburnum cassinoides* +

*Abies balsamea* k

*Gaultheria hispidula* 1.2

Cryptogams (70% Cover)

*Pleurozium schreberi* 2.2

*Hylocomium splendens* 2.2

*Dicranum scoparium* 1.2

*Ptilidium ciliare* 1.2

*Sphagnum recurvum* 3.3

*Cladonia rangiferina* 1.2

*Cladonia mitis* 1.2

*Cladonia arbuscula* 1.2

*Usnea longissima* +

*Alectoria sarmentosa* +

*Bazzania trilobata* 1.2

*Cladonia elongata* 1.2

Ecological Interpretation

The *Piceetum marianae semiprostratae* is distributed in the central Avalon Peninsula where forest is the dominant vegetation (Figure 3-39). The presence of spruce tuck in this region may be related to the widespread occurrence of poorly drained soils in close proximity to extensive peat

## Piceetum marianae semiprostratae

Figure 3-39: The _Piceetum marianae semiprostratae_ occurs in the central portion of the Avalon Peninsula where forest is the dominant vegetation.

deposits. Although some wind damage is evident, excess soil moisture appears to be a more important factor leading to the formation of this vegetation.

The _Piceetum marianae semiprostratae_ has a close floristic relationship with the _Kalmieto - Piceetum_ association described by Damman (1964) for central Newfoundland forests. However, this association is included within the heath classification for essentially the same reasons as those expressed for the _Abietetum balsamaeae hudsoniae_ association. Furthermore, it is unlikely that this association will develop into a productive forest type unless drained.

The spruce tuck is characterized by _Picea mariana_ in the depressed form _semiprostrata_ forming a dense coniferous canopy 2-3 M. in height. There is usually an underlying stratum of ericaceous shrubs, _Kalmia angustifolia_, _Vaccinium angustifolium_ and _Ledum groenlandicum_ (Figure 3-40).

Figure 3-40: The Piceetum marianae semiprostratae is characterized by a canopy dominated by dwarf spruce with an underlying shrub layer.

A forest moss carpet comprised of *Pleurozium schreberi*, *Dicranum scoparium* and *Hylocomium splendens* covers most of the substrate with *Sphagnum nemoreum* and *Sphagnum recurvum* forming patches in moist depressions.

The micro-relief under the *Piceetum marianae semiprostratae* creates three distinct variants:

(i) *Sphagnum nemoreum Variant*

(ii) *Sphagnum recurvum Variant*

(iii) *Cladonia arbuscula Variant*

(i) *Sphagnum nemoreum Variant*

Identifying Species:

*Sphagnum nemoreum*

This variant occurs in the transition between peat on mineral soil on the border of the tuck formation. The canopy in this position is somewhat open and many of the forest mosses are absent or display low coverage. The species composition of this variant is closely related to the *Kalmio - Sphagnetum nemori* except for the dominance of *Picea mariana*.

(ii) *Sphagnum recurvum Variant*

Identifying Species:

*Sphagnum recurvum* *Gaultheria hispidula*

The ground beneath the Piceetum marianae semiprostratae frequently has a hummock-hollow pattern. The Sphagnum recurvum Variant is located in the hollows where excess moisture accumulates. Sphagnum recurvum also forms a distinct variant where depressions occur in the ground beneath spruce forests (Damman,1964).

(iii) Cladonia arbuscula Variant

Identifying Species:

| | |
|---|---|
| Cladonia arbuscula | Juniperus communis |
| Cladonia mitis | |

The Cladonia arbuscula Variant occurs on hummocks beneath the spruce tuck, however there is considerable gradation with the Sphagnum recurvum Variant where infilling of the hollows has taken place.

A Juniperus communis subvariant is located on the tops of extremely dry hummocks or where rocks protrude through the substrate.

This variant has considerable floristic affinity with the Cladonietosum subassociation of the Kalmieto - Piceetum (Damman,1964).

## Summary

The Avalon Peninsula heathlands are comprised of eleven distinct associations, each adapted to its own combination of environmental gradients. The floristic relationships of these associations are summarized in Table 3-1.

The *Diapensio - Arctostaphyletum alpinae*, *Empetro - Rhacomitrietum lanuginosae* and *Empetro - Potentilletum tridentatae* associations occupy climatically exposed sites and are floristically, physiognomically and spatially closely related. These associations collectively form an extensive heathland expanse on the southern Avalon Peninsula and are localized on exposed knolls and headlands elsewhere in the study area. Prevailing winds, frequent coastal fog, lack of winter snow cover and a short vegetation season are factors important in the origin and development of these associations. Physiognomically these associations are characterized by a community stratification in which the fourth vegetation stratum is absent and the ground vegetation is dominated by *Empetrum nigrum* and/or *Rhacomitrium lanuginosum* forming extensive carpets.

Table 3-1. A summary of floristic variation in the Avalon heath vegetation demonstrated by the differential species of associations 1 to 11.

| Morphological Heath Type | Rock Barrens | Hard Ground Heath | | | | Soft Ground Heath | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture Status | Dry Heath | | | | | | | | Wet Heath | | |
| Association Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Arctostaphylos alpina | IV | • | • | • | • | • | • | • | • | • | • |
| Loiseleuria procumbens | II | I | • | • | • | • | • | • | • | • | • |
| Diapensia lapponica | IV | • | • | • | • | • | • | • | • | • | • |
| Cetraria nivalis | III | I | • | • | • | • | • | • | • | • | • |
| Juncus trifidus | II | • | • | • | • | • | • | • | • | • | • |
| Lycopodium selago | + | • | • | • | • | • | • | • | • | • | • |
| Cetraria cucullata | + | • | • | • | • | • | • | • | • | • | • |
| Platismatia glauca | II | • | • | • | • | • | • | • | • | • | • |
| Rhacomitrium lanuginosum | V | V | • | • | + | I | • | • | II | I | • |
| Cladonia boryi | IV | IV | • | • | I | • | • | • | + | I | • |
| Sphaeophorus globosus | V | IV | • | • | + | • | • | • | • | + | • |
| Cetraria islandica | III | II | I | • | + | I | • | • | I | • | • |
| Vaccinium uliginosum | IV | IV | II | • | + | I | • | + | • | + | • |
| Potentilla tridentata | V | V | V | III | IV | • | • | • | • | I | • |
| Deschampsia flexuosa | IV | IV | III | IV | V | II | • | • | II | I | • |
| Calamagrostis pickeringii | + | IV | IV | I | II | II | I | • | III | I | • |
| Prenanthes trifoliolata | IV | II | II | III | I | I | • | • | • | + | • |
| Solidago uliginosa | I | II | III | + | I | I | • | • | I | I | • |
| Polytrichum commune | • | • | • | V | • | + | + | • | + | • | • |
| Achillea millefolium | • | • | • | III | • | • | • | • | • | • | • |
| Fragaria virginiana | • | • | • | II | • | • | • | • | • | • | • |
| Rosa nitida | • | • | • | II | + | • | • | • | • | • | • |
| Luzula campestris | • | • | • | V | V | • | • | • | • | • | • |
| Solidago rugosa | • | + | I | V | I | I | • | • | + | • | • |
| Lycopodium obscurum | • | • | + | IV | I | I | • | • | • | • | • |
| Taraxacum officinale | • | • | • | II | I | • | • | • | • | • | • |
| Hieracium murorum | • | • | • | II | I | I | • | • | • | • | • |
| Spiraea latifolia | • | • | I | I | I | • | • | • | • | • | • |
| Anaphalis margaritacea | • | • | • | I | + | • | • | • | • | • | • |
| Kalmia angustifolia | II | V | IV | • | II | V | V | III | V | V | V |
| Vaccinium angustifolium | IV | V | V | V | V | V | V | III | V | V | V |
| Empetrum nigrum | V | V | V | • | IV | III | • | II | III | IV | IV |
| Ledum groenlandicum | I | V | IV | • | III | IV | + | II | IV | V | IV |
| Vaccinium vitis-idaea | V | V | V | I | III | III | I | II | IV | IV | IV |
| Cornus canadensis | II | IV | I | IV | IV | IV | V | III | IV | IV | IV |
| Cladonia arbuscula | V | V | IV | • | IV | V | + | • | V | IV | IV |
| Cladonia mitis | IV | V | IV | • | III | IV | + | • | V | IV | IV |
| Cladonia rangiferina | V | V | IV | • | III | IV | + | • | V | IV | IV |
| Alnus crispa | + | • | • | + | + | I | V | • | • | • | • |
| Pteridium aquilinum | • | • | • | • | • | + | IV | • | + | I | • |
| Rhododendron canadense | • | • | I | + | + | II | V | • | II | • | I |
| Viburnum cassinoides | • | • | I | + | I | II | V | • | III | II | III |
| Nemopanthus mucronata | • | + | I | + | • | III | V | • | III | II | III |
| Abies balsamea f. hudsonia | • | • | • | • | • | • | • | V | • | • | • |
| Orchis rotundifolia | • | • | • | • | • | • | • | + | • | • | • |
| Listera cordata | • | • | • | • | • | • | • | + | • | • | • |
| Dryopteris spinulosa | • | • | • | • | • | • | • | + | • | • | • |
| Myrica gale | • | II | III | • | + | • | I | • | V | II | • |
| Cladonia alpestris | + | II | II | • | • | III | • | • | IV | III | • |
| Sphagnum nemoreum | • | • | • | • | • | • | • | • | • | V | I |
| Vaccinium oxycoccus | + | I | I | • | I | I | • | • | + | IV | • |
| Ptilium crista-castrensis | • | • | II | • | • | II | • | II | I | IV | I |
| Sarracenia purpurea | • | • | • | • | • | • | • | • | • | I | • |
| Drosera rotundifolia | • | • | • | • | • | + | • | • | • | I | • |
| Mylia anomala | • | • | • | • | • | • | • | • | • | I | • |
| Aulacomnium palustre | • | • | • | • | • | • | • | • | • | I | • |
| Picea mariana f. semiprostrata | + | • | • | • | + | • | + | • | • | + | V |
| Bazzania trilobata | • | • | • | • | • | + | • | I | • | • | IV |
| Sphagnum recurvum | • | • | • | • | • | • | • | • | • | I | II |
| Usnea longissima | • | • | • | • | • | • | • | • | • | • | III |
| Alectoria sarmentosa | • | • | • | • | • | • | • | • | • | • | II |

Floristically these associations are related through the common occurrence of the following species:

| | |
|---|---|
| Potentilla tridentata | Calamagrostis pickeringii |
| Vaccinium uliginosum | Prenanthes trifoliolata |
| Cladonia boryi | Solidago uliginosa |

These species are also common to the anthropogenic heaths, Luzulo - Polytrichetum commune and Luzulo - Empetretum nigrae. This relationship appears to be a consequence of the adaptation of these species to a thin humus (less than 10 cm).

The Luzulo - Polytrichetum commune and the Luzulo - Empetretum nigrae association represents heathlands experiencing anthropogenic disturbance through frequent accidental and prescribed burning. Physiognomically these associations are characterized by a poorly developed ground vegetation and a shrub canopy dominated by Vaccinium angustifolium. These anthropogenic heath associations are floristically distinguished from all other associations by the presence of the following species:

| | |
|---|---|
| Luzula campestris | Rosa nitida |
| Polytrichum commune | Solidago rugosa |
| Achillea millefolium | Lycopodium obscurum |
| Fragaria virginiana | Taraxacum officinale |

Hieracium murorum    Anaphalis margaritacea
Spiraea latifolia

The occurrence of these species may be related to the continual intrusion of man on these sites to manage and harvest blueberries (Vaccinium angustifolium). Without the use of fire the blueberry is replaced by other ericaceous shrubs and the anthropogenic species complement is reduced. At this time the Luzulo - Empetretum nigrae association becomes more prevalent. The anthropogenic associations usually exhibit a close spatial relationship with each other where burning has been uneven leaving patches undisturbed by fire. Also on exposed ridges these associations are in close proximity to the Typicum subassociation of the Kalmietum angustifoliae and the associations Empetro - Potentilletum tridentatae and Empetro - Rhacomitrietum lanuginosae.

The Kalmietum angustifoliae, Abietetum balsameae hudsoniae and Kalmio - Alnetum crispae occupy sheltered and well drained heathland sites. Collectively these associations and the hard ground heath associations represent dry heath on the Avalon Peninsula.

The *Kalmietum angustifoliae* association with respect to gradients in climatic severity, soil moisture and anthropogenic disturbance is differentiated by the absence of species indicative of these factors. Floristically, this association is closely related to the *Kalmio - Alnetum crispae*. The *Typicum* subassociation exhibits some floristic similarity to the *Empetro - Potentilletum tridentatae* association where the two are spatially related near the summit of inland knolls and coastal headlands. Physiognomically, the community stratification is typically four strata growing 30-50 cm in height. This association is widely distributed on sheltered heathlands usually in juxtaposition to the *Kalmio - Alnetum crispae*, *Kalmio - Myricetum gale* and the *Kalmio - Sphagnetum nemori* associations.

The *Abietetum balsameae hudsoniae* association represents fir tuck restricted to sheltered microhabitats located on the lee side of slopes and depressions within the exposed heathland expanse. Floristically this association is most closely related with forest and sheltered heath; however, climatic exposure prevents the tuck from developing to productive forest. Physiognomically, the association is characterized by *Abies balsamea* in its depressed form *hudsonia* forming a fifth vegetation stratum. Spatially, the association is usually encountered in juxtaposition to the *Empetro* - *Potentilletum tridentatae* and the *Empetro* - *Rhacomitrietum lanuginosae* associations.

The *Kalmio* - *Alnetum crispae* association has a very restricted distribution on Avalon Peninsula heathlands occurring on the Hawke Hill Range and near the community of Aquaforte. This distribution appears to be associated with the occurrence of tree lines on these sites. The association occupies the lee side of hills and also occurs in sheltered drainage channels. Physiognomically, it is a tuck vegetation with *Alnus crispa* dominant in the fifth vegetation stratum. With the exception of the fifth stratum and sparse development of the ground vegetation, the *Kalmio* - *Alnetum crispae* is floristically similar to the surrounding heath matrix.

The *Kalmio* - *Myricetum gale*, *Kalmio* - *Sphagnetum nemori* and *Piceetum marianae semiprostratae* associations are located on slopes or in depressions where excess moisture, in addition to shelter, is the prominent direction of ecological variation. These associations, considered collectively, represent wet heath on the Avalon Peninsula.

The *Kalmio* - *Myricetum gale* and the *Kalmio* - *Sphagnetum nemori* occur together on heath slopes throughout the study area. Floristically, these associations are closely related with the *Kalmio* - *Myricetum gale* being distinguished by the absence of *Sphagnum nemoreum* and associated peatland species. Both associations possess many hydrophylic species that serve to differentiate them from dry heath. Physiognomically, the *Kalmio* - *Myricetum gale* resembles the *Hylocomietosum* subassociation of the *Kalmietum angustifoliae* whereas the *Kalmio* - *Sphagnetum nemori* is closely related to community stratification in peatland associations. Where these associations occur on climatically exposed heath their variants reflect a floristic relationship with the *Empetro* - *Potentilletum tridentatae* and *Empetro* - *Rhacomitrietum lanuginosae*.

These associations and the *Kalmietum angustifoliae* and *Kalmio* - *Alnetum crispae* associations seem to have originated through the destruction of previous forest vegetation by repeated burning. The formation of a thick organic substrate impedes regeneration of forest species and maintains heath as a semi-climax vegetation.

The *Piceetum marianae semiprostratae* association represents spruce tuck occurring in the central forested region of the Avalon. Floristically, this association is closely related to black spruce forest whereas physiognomically, the closest relationship is with the *Abietetum balsameae hudsoniae*. The dwarf nature of the tree species in this association is caused by poor drainage near the border of peat deposits. It is not likely that this association will develop to productive forest unless changes in the soil moisture regime take place.

# CHAPTER IV. INVESTIGATION OF THE SOIL-VEGETATION CATENA

## Purpose

Observations during current field studies strongly suggested that the spatial relationship between a number of associations previously described in Chapter III were topographically determined. This contention was reinforced by the studies of Gimingham (1964) on Scottish heath and Strang (1972) on the barrens of Nova Scotia. Both authors reported a soil vegetation catena displaying floristic variation from freely drained soils, to those of impeded drainage, to those seasonally or permanently waterlogged. Since this pattern is also characteristic of many heath slopes on the Avalon Peninsula, an investigation of the ecological relationships of plant communities on a slope was initiated.

## Methods

a) Selection of Study Site

To obtain the maximum benefit from this study it was desirable to examine a slope with vegetation representative of a wide variety of associations within a practical working area. A heath slope located near Four Mile Pond on the Trans Canada Highway was selected because it is an accessible site with Rock Barrens, Hard Ground

Heath, and Soft Ground Heath within a 100 sq. m. plot (Figure 4-1). The general landscape represents a tree line vegetation occurring at an elevation of 220 M. The underlying bedrock is Holyrood Granite (McCartney 1954).

b) Vegetation Analysis

A line transect of 33 one meter quadrats was used to record the vegetation from the top of the ridge to a basin peat deposit at the bottom of the slope. Species were recorded as present or absent in each quadrat and the data synthesized to determine the major vegetation units on the slope.

c) Soil Profile Studies

A soil pit varying from 40-80 cm in depth was excavated in the middle of each vegetation unit. Pits were placed at 5, 12, 16, 21, 26 and 31 M. along the transect. At each pit the thickness of each horizon was measured and a sample of the humus was obtained for pH analysis. The pH was determined using the "sticky point" method (Jackson, 1958).

d) Soil Temperature Analysis

To determine the approximate date of thaw within each soil profile, temperature readings were taken once a week during the period March 19 to June 4, 1972.

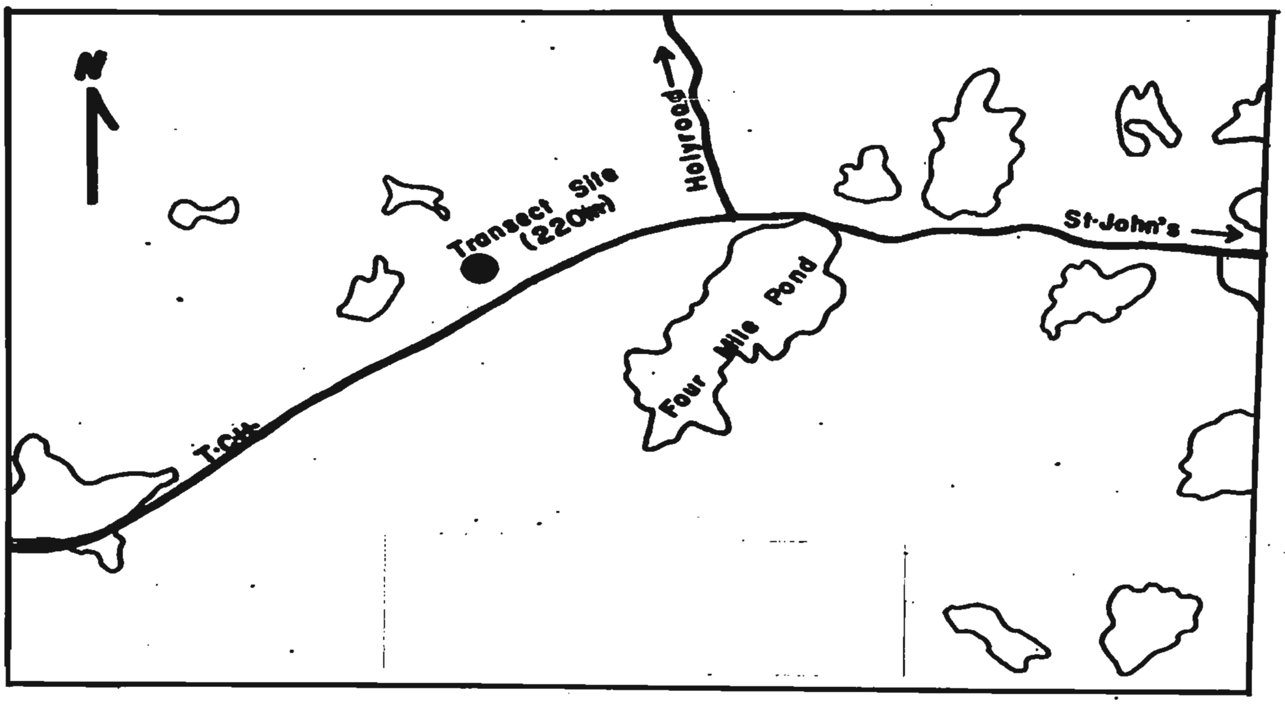


Figure 4-1: The location of the study site near Four Mile Pond on the Trans Canada Highway.

One further reading was taken on July 11. Readings were recorded for 0, 10, 15, and 20 cm depths in all communities. Readings were taken at 50 cm only on the middle and lower slope where organic horizons were thicker. All recordings were made on YSI Model 42SF Tele-Thermometer.

The surface temperatures were recorded by laying the probe horizontally on the humus surface. To obtain soil temperature readings a hole was made by driving a steel bar to the desired depth, after removing the bar temperature probes were inserted and the soil pressed around the probes. Because of the friction created by driving the bar through the soil it was necessary to wait at least two minutes for the temperature to stabilize. Care not to move the inserted probes also had to be exercised since this would have caused a sharp rise in temperature. Using a switch box and four probes it was possible to record the first four depths simultaneously. However, where 50 cm recordings were to be made the 20 cm hole was extended to 50 cm before the temperature was recorded at that depth. The readings were taken at approximately noon each week to avoid variation due to diurnal temperature fluctuations. Notes were taken on cloud cover and precipitation to account for large variations in surface temperature.

## Results

a) Floristic Variation on the Slope

The results of vegetation analysis indicated considerable floristic diversity between the hard ground heath on the exposed upper slope and the soft ground heath on the sheltered middle and lower slope. This division is defined by two vegetation complexes, each comprised of a number of distinct plant communities (Table 4-1). Differential Species Groups are used to identify the vegetation units. Their spatial relationship on the slope is illustrated in Figure 4-2.

Potentilla tridentata Complex

Differential Species Group:

| | |
|---|---|
| Potentilla tridentata | Prenanthes trifoliolata |
| Sphaeophorus globosus | Cladonia boryi |
| Ochrolechia frigida | Cladonia amaurocraea |

These species display a distinct preference for the top of the slope (1-13 M.) where the humus is less than 10 cm in depth. Snow cover is shallow or absent in this portion of the transect through most of the winter and the vegetation does not possess a well developed shrub canopy (Figure 4-3).

Table 4-1. The plant communities of a heath slope determined by presence and absence of species in a line transect.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Differential Species of the *Potentilla tridentata* Complex | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Potentilla tridentata | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . |
| Sphaerophorus globosus | + | . | + | + | + | + | + | + | + | . | + | . | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . |
| Ochrolechia frigida | + | + | + | + | + | + | + | . | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . |
| Prenanthes trifoliolata | + | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . |
| Cladonia boryi | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia amaurocraea | . | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | + | . | + | . | . | + | . | . | . | . | . | . |
| i) Differential Species of the *Juncus trifidus* Community | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Platismatia glauca | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Juncus trifidus | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Juniperus communis | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Alectoria ochroleuca | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Loiseleuria procumbens | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Alectoria nigricans | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| ii) Differential Species of the *Rhododendron canadense* Community | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rhododendron canadense | . | . | . | . | . | . | . | . | + | + | + | + | + | . | . | . | . | . | . | . | + | . | . | . | . | . | + | + | . | . | . | . | . |
| Dicranum fulvum | + | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | . | + | + | + | + | . | . | . | . | . | . | . | . | . |
| Cladonia cristatella | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | . | + | + | + | + | + | + | + | + | + | + | . | . | . |
| Cetraria islandica | . | . | . | . | . | . | . | . | . | + | + | . | + | + | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . |
| Cladonia macrophylla | . | . | . | . | . | . | . | . | . | + | + | + | + | + | . | . | . | . | . | . | . | . | . | + | . | + | . | . | . | . | . | . | . |
| Cladonia elongata | . | . | . | . | . | . | . | . | . | + | + | . | + | . | + | + | . | + | + | . | . | + | + | + | + | + | + | . | . | . | . | . | . |
| Differential Species of the *Ledum groenlandicum* Complex | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ledum groenlandicum | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + | + | + | + | + | + |
| *Coptis groenlandica | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | . | - | - | - | - | - | - | + | + | + | + | + |
| Kalmia polifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | . | + | + | . | + | . | . | + | + | + | + | + |
| *Dicranum scoparium | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | + | + | - | - | - | - | - | . | . | . | . | . |
| Pleurozium schreberi | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | + | + | . | . | + | + | + | + | + | + | + | + |
| Vaccinium oxycoccus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | . | + | + | . | + | . | + | + | + | + | + | + |
| iii) Differential Species of the *Myrica gale* Community | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Myrica gale | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | . | . | - | - | - | - | - | + | + | + | + | + | + |
| *Chamaedaphne calyculata | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | + | . | . | - | - | - | - | - | + | + | + | . | . | + |
| Clintonia borealis | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | . | + | . | . | . | + | + | + | + | . | . | . | . |
| *Pyrus floribunda | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | + | . | . | + | . | . | - | - | - | - | + | + | + | + | + | + | + |
| *Hylocomium splendens | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | + | + | . | . | . | - | - | - | - | - | - | . | . | . | . | . |
| *Ptilium crista-castrensis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | + | + | . | . | . | - | - | - | - | - | + | . | . | . | . | . |
| iv) Differential Species of the *Sphagnum nemoreum* Community | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sphagnum nemoreum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | - | - | - | - | - | - | - | . | . | . | . |
| *Sarracenia purpurea | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | - | - | - | - | - | - | - | + | + | + | + |
| *Drosera rotundifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | - | - | - | - | - | - | - | + | + | + | + |
| *Mylia anomala | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | - | - | - | - | - | - | - | + | + | + | + |
| vi) Differential Species of the *Scirpus cespitosus* Community | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sphagnum fuscum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Sphagnum subnitens | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Scirpus cespitosus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Sphagnum rubellum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Sphagnum magellanicum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Aster radula | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | - | - | - | - | - | - | - | + | + | + | + |
| Non-Differential Species | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vaccinium angustifolium | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | + |
| Vaccinium vitis-idaea | + | + | + | + | + | + | + | . | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . |
| Cladonia arbuscula | + | + | + | + | + | + | + | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + |
| Cladonia mitis | + | + | + | + | + | + | + | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + |
| Cladonia rangiferina | . | + | + | . | + | + | + | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + |
| Cornus canadensis | . | . | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | + | + | + | + | + | + | + |
| Kalmia angustifolia | . | . | . | . | + | . | . | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + | + | + | + | + | + |
| Polytrichum juniperinum | . | + | . | . | + | + | + | + | + | + | + | + | + | + | + | + | . | . | + | + | + | + | + | + | + | + | + | + | + | . | + | + | + |
| Hypogymnia physodes | + | + | + | + | + | + | + | . | + | + | + | + | + | + | + | + | + | + | . | . | . | + | + | + | + | + | + | + | + | . | . | . | . |
| Maianthemum canadense | + | + | . | + | . | . | + | . | + | + | + | + | + | + | . | . | . | . | . | . | + | + | + | . | + | . | + | . | . | + | + | + | . |
| Deschampsia flexuosa | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | + | + | + | + | . | . | . | . | + | + | . | . | . |
| Cornicularia aculeata | + | + | + | + | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | + | + | + | + | + | + | + | . | . | . | . | . | . |
| Empetrum nigrum | + | + | + | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | + | + | . | + | + |
| Cladonia squamosa | + | . | . | . | . | . | + | . | . | + | + | + | + | + | . | . | + | . | . | . | + | + | + | + | . | + | + | . | + | + | . | . | . |
| Rhacomitrium lanuginosum | + | . | + | . | . | + | . | . | . | . | . | . | + | . | . | . | . | . | . | . | + | + | + | . | + | . | . | . | + | + | + | . | . |
| Cladonia coccifera | . | . | . | . | . | . | + | + | + | + | + | + | + | + | + | + | + | + | + | . | + | + | + | + | + | + | . | . | + | + | . | . | . |
| Cladonia crispata | . | . | . | . | . | . | + | . | . | + | + | + | + | + | . | + | . | . | . | . | + | + | + | + | + | + | . | . | + | . | . | . | . |
| Cladonia verticillata | . | . | . | . | . | . | . | . | + | + | + | . | . | . | . | + | . | . | . | . | . | + | + | + | + | + | + | . | . | . | . | . | . |
| Dicranum fuscescens | . | . | . | . | . | + | . | . | . | . | + | + | + | + | + | + | + | + | . | . | . | . | . | + | + | + | + | + | + | . | . | . | . |
| Nemopanthus mucronata | . | . | . | . | . | . | . | . | . | . | + | + | + | . | . | . | + | + | + | + | + | + | + | . | . | + | . | . | . | . | . | . | . |
| Amelanchier bartramiana | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | + | . | . | . | . | + | + | + | + | . | . |
| Cladonia deformis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | + | + | . | + | + | + | + | . | . | + | . | + | . | . | . | . |
| Viburnum cassinoides | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . | . | + | + | . | . | + | + | + | . | . | . | . |
| Pteridium aquilinum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + | . | . | . | . | . | . | . | . |
| Dicranum undulatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | + | . | . | . | . | + | . | . | . | . |
| Buxbaumia aphylla | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | + | . | + | + | . | . | . | . | . | . |
| Trientalis borealis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | . | . | . | . | . | . | . | . | . |
| Solidago uliginosa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | + | + | + | + | + |
| Calamagrostis pickeringii | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | . | + | + | + | + | + | + | + |
| Linnaea borealis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | + | + |
| Carex oligosperma | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . |
| Dicranum spurium | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Pellia fabroniana | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cephalozia connivens | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + |
| Sphagnum flavicomans | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + |
| Larix laricina | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + |

* The absence of these species is used to differentiate the *Kalmia angustifolia* Community

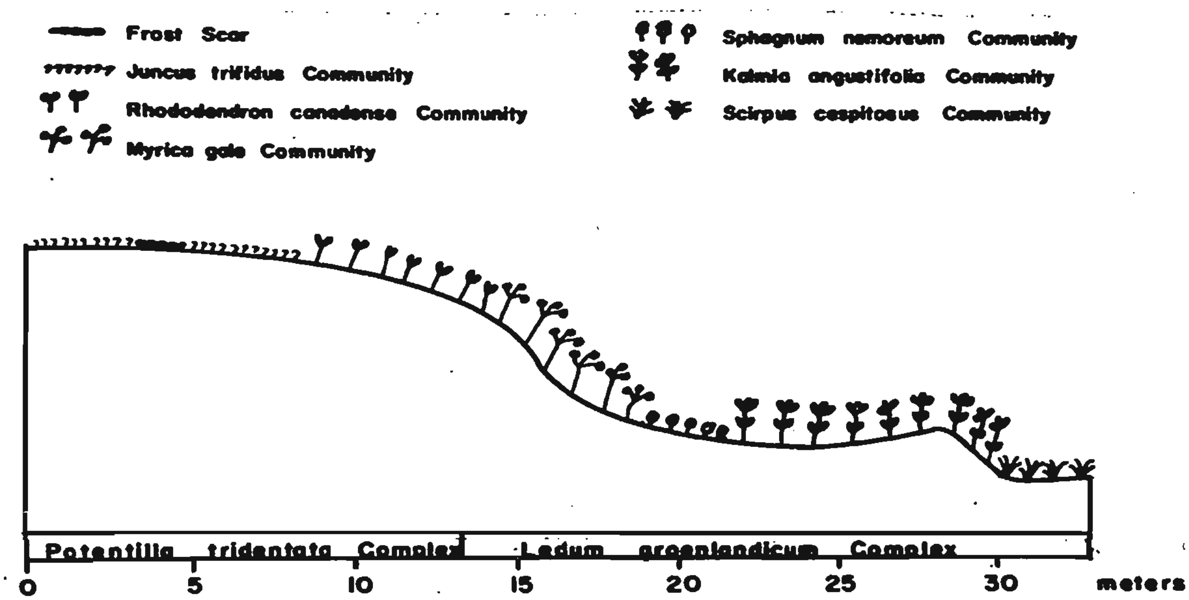


Figure 4-2: The spatial relationship of the plant communities on the transect.

Figure 4-3: The foreground of this picture illustrates the extent of snow cover and the dwarf physiognomy of the Potentilla tridentata Complex.

Within the Potentilla tridentata Complex two distinct plant communities are recognized;

i) The Juncus trifidus Community

ii) The Rhododendron canadense Community

i) The Juncus trifidus Community

Differential Species Group:

Juncus trifidus
Platismatia glauca
Loiseleuria procumbens
Alectoria ochroleuca
Alectoria nigricans
Juniperus communis

This community represents a discontinuous vegetation on level ground dominated by carpets of Empetrum nigrum in juxtaposition to frost scars. The species composition reflects a strong relationship to the Juncus trifidus Variant of the Diapensio - Arctostaphyletum alpinae association. Morphologically, this community may be classified as Rock Barren.

ii) The Rhododendron canadense Community

Differential Species Group:

| | |
|---|---|
| Rhododendron canadense | Cetraria islandica |
| Cladonia elongata | Cladonia macrophylla |
| Cladonia cristatella | Dicranum fulvum |

This Differential Species Group serves to differentiate this community with respect to the Juncus trifidus Community, whereas the differentials of the Potentilla tridentata Complex serve to differentiate it with respect to other communities on the transect.

The Rhododendron canadense Community is located at the beginning of the slope between 9-13 M. on the transect. The vegetation is more continuous, apparently resulting from less intense frost disturbance, than is evident in the Juncus trifidus Community. The dwarf shrubs are sporadic in occurrence and do not form a closed canopy. The ground layer is dominated by lichens in the absence of an extensive moss carpet. This community has considerable floristic affinity with releves recorded for the hard ground heath associations.

Ledum groenlandicum Complex

Differential Species Group:

| | |
|---|---|
| Ledum groenlandicum | Dicranum scoparium |
| Coptis groenlandica | Pleurozium schreberi |
| Kalmia polifolia | Vaccinium oxycoccus |

The Ledum groenlandicum Complex occupies the middle and lower slopes from 14 to 33 M. on the transect. The depth of the humus varies from 15 to 47 cm on mineral soil and is in excess of 1 M. in the basin peat. Winter snow cover is usually deep and the dwarf shrubs form an extensive canopy. Frost scars are not apparent in this portion of the transect and a continuous moss carpet covers the humus substrate (Figure 4-4).

Figure 4-4: The foreground of this photograph marks the boundary between the Rhododendron canadense Community and the Ledum groenlandicum Complex.

Within the Ledum groenlandicum Complex four distinct plant communities are recognized;

iii) The Myrica gale Community

iv) The Sphagnum nemoreum Community

v) The Kalmia angustifolia Community

vi) The Scirpus cespitosus Community

iii) The Myrica gale Community

Differential Species Group:

*Myrica gale*

*Chamaedaphne calyculata*

*Clintonia borealis*

*Pyrus floribunda*

*Hylocomium splendens*

*Ptilium crista-castrensis*

The presence of these species in combination with the absence of differential species of the Sphagnum nemoreum Community serves to differentiate this community.

The Myrica gale Community is characterized by the presence of a tall and dense shrub cover with an extensive moss carpet in the ground vegetation. The community is located on the upper slope from 14-19 M. on the transect where the slope is 40° N. and the humus is 47 cm in depth. The Myrica gale Community has a similar species composition to releves included in the *Kalmio - Myricetum gale* association.

iv) The Sphagnum nemoreum Community

Differential Species Group:

*Sphagnum nemoreum* *Drosera rotundifolia*

*Sarracenia purpurea* *Mylia anomala*

The *Sphagnum nemoreum Community* is unique because of its extensive peat development (47 cm) and its location in a depression at the base of the slope. The shrub canopy is well developed, however it is dwarfed because the height growth of the ericaceous shrubs is impeded by saturated soil conditions. This community is closely related to the *Kalmio - Sphagnetum nemori* association.

v) The *Kalmia angustifolia Community*

The *Kalmia angustifolia Community* is characterized by the absence of many differential species described for the other communities (Table 4-1). The community is located on raised ground near the base of the transect between 22-29 M. Because of its raised position the humus is eroded and dry with lichens being more dominant than mosses. A number of species characteristic of the *Potentilla tridentata Complex* occur in this community because of the microhabitat provided by a boulder protruding through the humus substrate. The *Kalmia angustifolia Community* displays a close floristic relationship with the Typicum subassociation of the *Kalmietum angustifoliae*.

vi) The *Scirpus cespitosus Community*

Differential Species Group:

*Sphagnum fuscum*
*Sphagnum subnitens*
*Scirpus cespitosus*
*Sphagnum rubellum*
*Sphagnum magellanicum*
*Aster radula*

The *Scirpus cespitosus Community* characterizes the basin peat deposit located at the extreme end of the transect (30-33 M.). The peat is in excess of 1 M. in depth and the water table is at a depth of 5 cm below the surface. Because of the position near the base of the slope, this community receives nutrients through drainage from the surrounding mineral soil.

b) Variation in Soil Profiles of the Communities

The soils represented on the transect form a catena incorporating the Kelligrews and Holyrood series of the National Soil Survey Committee of Canada (Peter Heringa pers. comm.). Figure 4-5 illustrates the soil profiles occurring beneath each plant community on the transect. The upper slope is dominated by an Orthic Humo-Ferric Podzol corresponding closely to the area covered by the

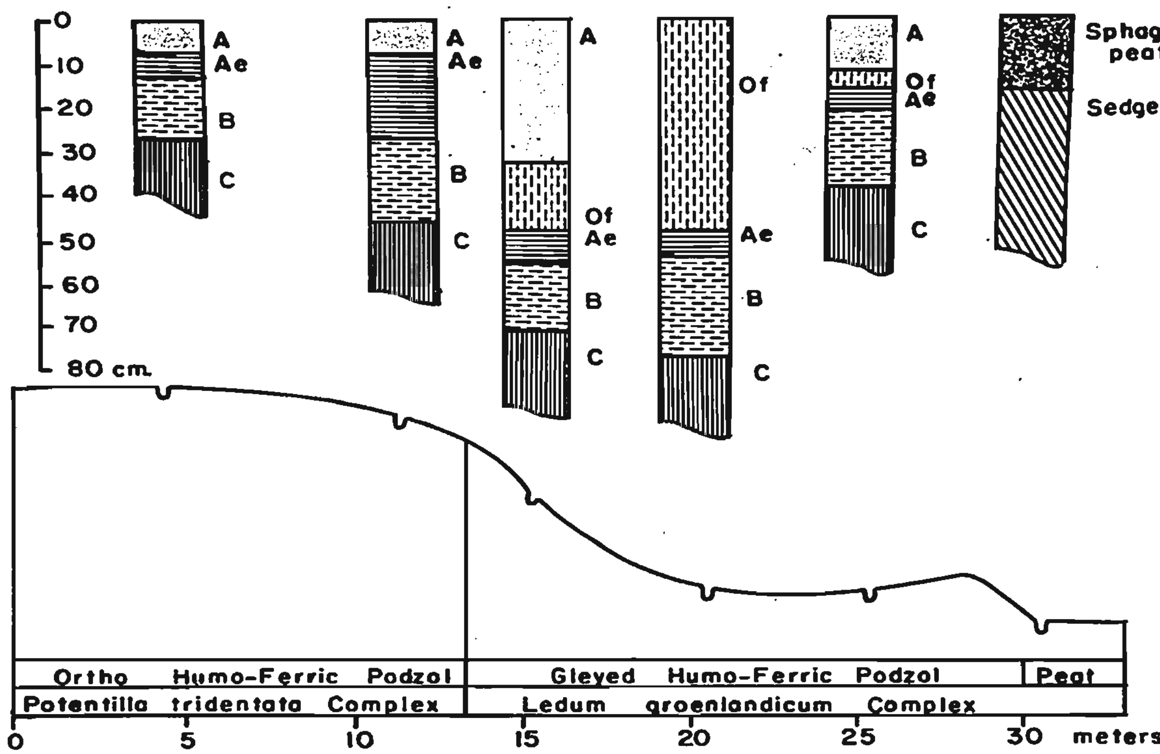


Figure 4-5: The soil-vegetation catena on the transect.

Potentilla tridentata Complex. Towards the middle and lower slope there is a transgression to a Gleyed Humo-Ferric Podzol where the Ledum groenlandicum Complex is the dominant vegetation. The extreme end of the transect is occupied by a basin peat deposit composed of Sphagnum and Sedge peat dominated by the Scirpus cespitosus Community. The thickness and composition of the A and Ae horizons varies considerably between plant communities.

The profile beneath the Juncus trifidus Community is shallow in comparison to other communities. This may partially be explained by downslope movement of soil (Warren Wilson, 1952). The A horizon is only 7 cm in depth and often eroded by wind, water, and soil-frost disturbance. The absence of a deep insulating snow cover, as illustrated in Figure 4-4, is a primary factor related to severe frost heaving in the soil (Washburn 1967, Raup 1969, Sigafoos 1951).

In the Rhododendron canadense Community the profile is somewhat deeper due to the excessive development of the Ae horizon (20.5 cm thick). This represented the Ae horizon on the slope and may be related to the excessive run-off experienced in this position at the beginning of the slope. The B and C horizons beneath the Juncus trifidus Community and the Rhododendron canadense Community are similar in depth and composition.

Within the Ledum groenlandicum Complex (14-33 M.) winter snow cover becomes progressively deeper towards the base of the slope. With the increased snow depth there is a corresponding increase in the thickness of the surface humus. This increased humus depth is analogous to the development of soft ground heath in Scotland (Gimingham, 1964) and the Gaylussacia baccata Communities in the barrens of Nova Scotia (Strang, 1972). The Gleyed Humo-Ferric Podzols encountered on the lower slope possess a water-impenetrable hard pan in the B horizon. When excavating the soil pits in this portion of the transect it was observed that upon penetration of the B horizon water freely seeped from the region of the iron pan and eventually filled the bottom of the soil pit. Both Strang (1972) and Gimingham (1964) made similar observations and concluded that the iron pan was responsible for vegetational change due to impeded drainage in the surface horizons. There is little distinction in the mineral soil profiles of the three plant communities of the Ledum groenlandicum Complex, however there is considerable variation in the development of the humus horizons.

The Sphagnum nemoreum Community is characterized by the accumulation of 48 cm. of Sphagnum nemoreum peat over mineral soil whereas in the Kalmia angustifolia Community and Myrica gale Community there is an ericaceous humus superimposed on a peat horizon. The peat layer has been designated as an organic fibric (Of) horizon. The implication is that the whole lower slope was at one time dominated by the Sphagnum nemoreum Community. Succession to the moderately moist Myrica gale Community and the dry Kalmia angustifolia Community could have occurred through surface drying of the Sphagnum peat after it had accumulated beyond the water table. Alternatively, a slight fall in the water table throughout the slope could have resulted in succession to dryer vegetation types.

The peat under the Scirpus cespitosus Community is comprised of an upper horizon of Sphagnum fuscum and a lower horizon of sedge peat. The undecomposed Sphagnum peat represents the ombrotrophic hummocks occurring throughout the basin, whereas the finely decomposed sedge peat is indicative of the hollows and flats. In this instance a hummock has formed through progressive accumulation of Sphagnum peat in a position formerly occupied by a hollow.

c) Variation in Substrate pH of the Communities

The results of pH analysis of the surface humus are as follows:

| | Community | pH |
|---|---|---|
| i) | Juncus trifidus | 4.10 |
| ii) | Rhododendron canadense | 3.80 |
| iii) | Myrica gale | 3.50 |
| iv) | Sphagnum nemoreum | 3.45 |
| v) | Kalmia angustifolia | 3.45 |
| vi) | Scirpus cespitosus | 4.57 |

The communities in the Potentilla tridentata Complex have a significantly higher pH than the Ledum groenlandicum Complex. This is possibly related to the occurrence of frost scars at the slope summit. Wind and water convey mineral soil particles from the frost scars to the surrounding humus. Water moving over the frost scars into the humus would also be appreciably higher in nutrient content. On the lower slope nutrients are carried away by downslope drainage and leaching of the humus horizon resulting in lower values for the Ledum groenlandicum Complex.

The basin peat has the highest substrate pH as would be expected, since it accumulates nutrients from drainage waters originating in the surrounding mineral soils.

d) Variation in Spring Thaw of the Communities

While recording temperatures it was observed that the ground was still frozen at readings below 1.11°C (34°F). For this reason thaw was considered to have occurred in the communities on the date when temperatures from depths 5 to 20 cm was equal to or greater than 1.11°C (Table 4-2). Using this criterion, the sequence of thaw for various substrata was as follows, occurring on or before:

| | |
|---|---|
| April 11 | Frost Scar |
| April 15 | *Juncus trifidus* Community |
| May 7 | *Rhododendron canadense* Community |
| | *Myrica gale* Community |
| | *Kalmia angustifolia* Community |
| May 14 | *Sphagnum nemoreum* Community |
| | *Scirpus cespitosus* Community |

The early thaw of the frost scars surrounding the *Juncus trifidus* Community results from the absence of both an insulating surface humus and an insulating snow cover. During the period of measurement from March 19 to July 11 the frost scars were constantly thawed with exception of April 3 and April 15. By contrast, the *Juncus trifidus* Community substrate remained frozen until April 15. This demonstrates the importance of even a very thin surface humus (8 cm) in preventing freeze-thaw

Table 4-2. Sequence of spring thaw in the soils beneath plant communities on a heath slope (1972). The thaw occurs at temperatures $\geq$ 1.11°C (34°F).

| Depth (cm.) | Mar 19 | Mar 26 | Apr 3 | Apr 11 | Apr 15 | May 7 | May 14 | May 22 | June 4 | July 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Frost Scar** | | | | | |
| 0 | 11.11 | 1.11 | 2.78 | $\boxed{3.89}$ | 5.00 | 6.11 | 15.00 | 6.67 | 21.11 | 26.67 |
| 5 | 6.67 | 2.22 | 1.11 | $\boxed{2.78}$ | 2.22 | 7.50 | 12.22 | 7.78 | 18.33 | 26.67 |
| 10 | 3.06 | 1.67 | 0.28 | $\boxed{1.67}$ | 0.56 | 6.67 | 11.11 | 7.22 | 17.78 | 25.56 |
| 15 | 1.11 | 1.67 | 0.56 | $\boxed{1.11}$ | 1.11 | 6.39 | 10.00 | 6.67 | 17.22 | 20.56 |
| 20 | 1.11 | 1.11 | 0.56 | $\boxed{1.11}$ | 1.11 | 5.83 | 6.11 | 6.11 | 16.67 | 22.22 |
| | | | | | **Juncus trifidus Community** | | | | | |
| 0 | 15.00 | 1.11 | 1.11 | 5.00 | $\boxed{4.44}$ | 5.56 | 10.00 | 6.67 | 20.56 | 25.56 |
| 5 | 1.11 | 0.56 | 0.56 | 0.56 | $\boxed{2.22}$ | 6.11 | 11.11 | 7.22 | 15.00 | 24.44 |
| 10 | 0.56 | 0.56 | 0.28 | 0.56 | $\boxed{2.22}$ | 5.83 | 8.89 | 6.67 | 15.00 | 22.78 |
| 15 | 0.56 | 0.56 | 0.28 | 0.56 | $\boxed{1.11}$ | 5.28 | 6.67 | 6.67 | 13.89 | 18.89 |
| 20 | 0.00 | 0.56 | 0.56 | 1.67 | $\boxed{1.11}$ | 5.00 | 5.56 | 6.11 | 14.44 | 16.67 |
| | | | | | **Rhododendron canadense Community** | | | | | |
| 0 | 12.22 | 1.11 | 0.28 | 1.67 | 0.56 | $\boxed{3.89}$ | 11.11 | 4.44 | 19.44 | 24.44 |
| 5 | 1.11 | 0.56 | 0.56 | 0.56 | 0.56 | $\boxed{3.61}$ | 8.33 | 6.67 | 16.67 | 22.22 |
| 10 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | $\boxed{3.61}$ | 8.33 | 6.11 | 13.33 | 21.11 |
| 15 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | $\boxed{2.22}$ | 7.22 | 6.11 | 11.11 | 19.44 |
| 20 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | $\boxed{1.67}$ | 2.22 | 5.00 | 10.00 | 17.78 |
| | | | | | **Myrica gale Community** | | | | | |
| 0 | 0.00 | 1.11 | 0.00 | 1.67 | 0.56 | $\boxed{4.72}$ | 10.00 | 5.00 | 18.33 | 23.33 |
| 5 | 0.00 | 0.00 | 0.28 | 0.56 | 0.56 | $\boxed{1.94}$ | 5.00 | 7.22 | 15.56 | 18.89 |
| 10 | 0.00 | 0.00 | 0.56 | 0.56 | 0.56 | $\boxed{2.22}$ | 1.67 | 6.11 | 12.22 | 15.56 |
| 15 | 0.00 | 0.28 | 0.28 | 1.11 | 0.56 | $\boxed{1.67}$ | 1.11 | 5.00 | 11.11 | 14.44 |
| 20 | 0.56 | 0.28 | 0.28 | 1.11 | 1.11 | $\boxed{2.22}$ | 1.67 | 3.89 | 8.89 | 14.44 |
| 50 | 1.67 | 1.67 | 0.56 | 2.22 | 1.11 | $\boxed{2.50}$ | 2.78 | 3.89 | 8.89 | 13.33 |
| | | | | | **Sphagnum nemoreum Community** | | | | | |
| 0 | 0.00 | 1.11 | 0.28 | 1.67 | 0.56 | 2.22 | $\boxed{10.00}$ | 4.44 | 18.33 | 26.67 |
| 5 | 0.00 | 0.28 | 0.28 | 0.56 | 0.56 | 5.00 | $\boxed{7.78}$ | 7.78 | 18.33 | 22.22 |
| 10 | 0.00 | 0.28 | 0.28 | 0.56 | 0.56 | 4.44 | $\boxed{6.11}$ | 7.22 | 16.11 | 21.11 |
| 15 | 0.56 | 0.28 | 0.28 | 0.56 | 0.56 | 0.56 | $\boxed{5.00}$ | 6.11 | 14.44 | 19.44 |
| 20 | 1.11 | 0.56 | 0.28 | 0.56 | 0.56 | 0.56 | $\boxed{2.22}$ | 6.11 | 10.00 | 17.78 |
| 50 | 1.67 | 2.22 | 1.11 | 1.67 | 1.67 | 2.78 | $\boxed{5.00}$ | 5.00 | 8.89 | 13.33 |
| | | | | | **Kalmia angustifolia Community** | | | | | |
| 0 | 11.11 | 1.11 | 0.28 | 2.22 | 1.11 | $\boxed{3.33}$ | 12.22 | 6.67 | 20.56 | 26.67 |
| 5 | 0.00 | 0.28 | 0.28 | 1.11 | 0.56 | $\boxed{5.28}$ | 12.22 | 7.78 | 18.89 | 23.33 |
| 10 | 0.00 | 0.28 | 0.28 | 0.56 | 0.56 | $\boxed{3.89}$ | 10.00 | 7.22 | 17.78 | 20.56 |
| 15 | 0.00 | 0.28 | 0.28 | 0.56 | 0.56 | $\boxed{1.67}$ | 6.67 | 6.11 | 15.00 | 17.78 |
| 20 | 0.56 | 0.28 | 0.28 | 0.56 | 0.56 | $\boxed{1.11}$ | 2.22 | 5.00 | 12.78 | 15.56 |
| 50 | 1.11 | 1.11 | 1.39 | 2.22 | 1.67 | $\boxed{2.78}$ | 4.44 | 6.11 | 8.89 | 15.56 |
| | | | | | **Scirpus cespitosus Community** | | | | | |
| 0 | 11.67 | 1.11 | 0.56 | 1.67 | 0.56 | 4.44 | $\boxed{11.67}$ | 5.00 | 19.44 | 28.89 |
| 5 | 1.11 | 0.56 | 0.28 | 0.56 | 0.56 | 3.89 | $\boxed{14.44}$ | 7.78 | 17.22 | 23.33 |
| 10 | 1.11 | 0.56 | 0.28 | 0.56 | 0.56 | 1.67 | $\boxed{9.44}$ | 6.11 | 13.89 | 18.33 |
| 15 | 1.11 | 0.56 | 0.28 | 0.56 | 0.56 | 0.56 | $\boxed{10.00}$ | 5.56 | 12.78 | 17.22 |
| 20 | 0.56 | 0.56 | 0.28 | 0.56 | 0.56 | 1.67 | $\boxed{3.89}$ | 5.00 | 9.44 | 15.00 |
| 50 | 2.22 | 2.22 | 2.22 | 3.33 | 1.94 | 2.78 | $\boxed{4.44}$ | 5.00 | 7.78 | 11.11 |

cycles. The earlier thaw of the Juncus trifidus Community with respect to other communities is probably related to a lack of snow cover and the influence of thawed soils in the surrounding frost scars. The substrate of communities dominated by ericaceous shrubs thawed on May 7. All such communities had an insulating snow cover. The Sphagnum nemoreum and Scirpus cespitosus Communities also possessed an insulating snow cover but thaw was probably delayed until May 14, for the following reasons:

1) The Sphagnum mosses dominating the surface vary in color from light brown to red and are not as effective as a dark ericaceous humus in absorbing solar radiation after the snow cover has melted.

2) The water-retaining ability of Sphagnum increases the moisture content of the substrate underlying these communities. This increases the quantity of ice in these substrates and therefore these communities would be expected to require a longer period for thaw to occur.

Summary

"In areas of uneven topography snow is swept from the windward slopes and prominences and deposited on the lee slopes and in hollows. Winter after winter the same areas remain thinly covered, while others nearby accumulate excessive drifts and are covered for longer periods." This observation by Daubenmire (1947) appears to be the most tenable explanation for floristic variation on heathland slopes throughout the Avalon Peninsula.

In the absence of protective winter snow cover species adapted to the cryptophyte and chamaephyte life forms are at a competitive advantage on the slope summit. Where typical phanerophyte species occur, they usually display suppressed growth and simulate a cushion growth form. This provides protection from mechanical damage and excess evaporation due to continuous air movement.

Since winter snow cover is shallow, thaw occurs two to three weeks earlier on the slope summit than on the lower slope. The commencement of growth during this period requires specialized physiological adaptation because of the wide fluctuations in macroclimate.

Frequently, through constant wind erosion or intense burning, the thin insulating humus is depleted, introducing freeze-thaw cycles, which render these surfaces unfavorable to plants by soil stirring, sorting and transport by frost action (Benninghoff, 1952). These conditions were observed in the Potentilla tridentata Complex and are probably prevalent in related associations.

Along the lower slope these characteristics become progressively reversed with the increased probability of a protective winter snow cover and shelter from prevailing winds. Within the Ledum groenlandicum Complex the phanerophyte life form assumes physiognomic dominance and the vigorous growth of *Kalmia angustifolia*, *Ledum groenlandicum*, *Chamaedaphne calyculata* and *Myrica gale* stimulates the development of a deep humus horizon. Damman (1971) performed productivity studies on a *Kalmia* heath in western Newfoundland which was similar in species composition to heath communities of the Ledum groenlandicum Complex. Results showed an accumulation of approximately 293 tons/ha of raw humus horizon over a period of 65 years, approximately four times the humus accumulation recorded for spruce and fir forests considered in the same study. The effect of this deep humus on the overall development of communities on the slope can be summarized as follows:

1. The deep organic horizon, combined with extensive snow cover, insulates the underlying subsoil and impedes thaw for two to three weeks later than the slope summit. Therefore species within the Ledum groenlandicum Complex do not commence growth until the macroclimate is stabilized. This reduces the necessity for physiological adaptation to extreme temperature variation.

2. The presence of a thick humus horizon is believed to be closely associated with iron-pan formation in the mineral soil (Muir 1934, Crampton 1956, Damman 1965b). On well drained slope positions moderately moist conditions associated with the Myrica gale Community are maintained, favoring the occurrence of mesophytic species. However, in depressions paludification occurs, resulting in invasion by hydrophytic species typical of the Sphagnum nemoreum Community and the Scirpus cespitosus Community.

The presence of a peat horizon beneath the humus of the Myrica gale Community and the Kalmia angustifolia Community indicates a dynamic relationship between the communities on the lower slope. The Sphagnum nemoreum Community probably occupied the area now covered by the Kalmia angustifolia Community and the Myrica gale Community. Succession to the dry substrate now present in these communities conceivably occurred through peat accumulation beyond the water table, stimulating the accumulation of ericaceous litter at a faster rate than the growth of Sphagnum.

Analysis of substrate acidity showed only slight variation (pH 3.5-4.10) between heath communities on the upper and lower slope. This variation is probably related to drainage patterns on the slope.

In general, floristic variation due to nutrient gradients is rarely encountered on the Avalon Peninsula because the soil parent material is lacking in base rich rocks. Consequently many of the species cited by Damman (1965a) and Pollett (1972b) as species of nutrient rich sites in Newfoundland are not prominent in the Avalon heath vegetation.

# CHAPTER V. ECOREGIONS OF THE AVALON PENINSULA

The Avalon Peninsula is included in Section B30 of the Boreal Forest Region described by Rowe (1972) as follows:

> "Throughout this cool and windy area the forests have been destroyed or badly decimated by fires and cultural practices, and the prevailing character of the vegetation today is that of a patchy but dense growing young coniferous forest interrupted by extensive barrens."

The distribution patterns of the heath associations described in Chapter III in combination with an understanding of the floristic, ecological and morphological characteristics of the study area now make it possible to subdivide the Avalon into four distinct ecoregions:

1. THE ALPINE HEATH
2. THE SUBARCTIC HEATH
3. THE BOREAL HEATH
4. THE BOREAL FOREST

The range of each ecoregion is shown in Figure 5-1.

## 1. THE ALPINE HEATH ECOREGION

This ecoregion includes the interior plateau of the Avalon Peninsula extending from the Hawke Hill Range southward to the headwaters of the Chance Cove and Biscay

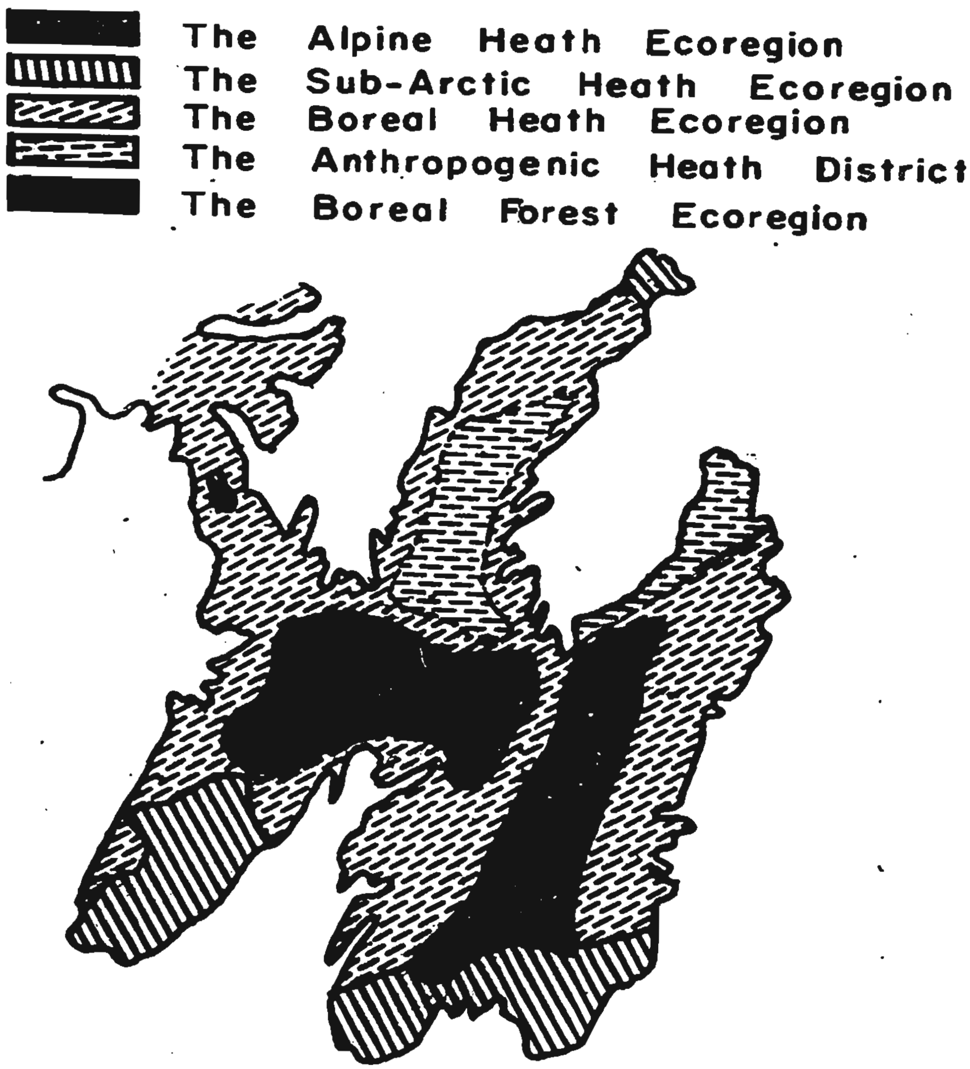


Figure 5-1: Ecoregions of the Avalon Peninsula.

Bay Rivers. This ecoregion also includes the highest summits throughout the Isthmus of the Avalon.

The altitude of the ecoregion is atypical for alpine vegetation varying from 150-300 M. However, according to Wilton (1956) this altitude is above the limit of productive forests on the Avalon.

Where coniferous trees occur they are in a depressed growth form. Fir, Abies balsamea, only occurs in the form hudsonia and spruce, Picea mariana, in the form empetroides. The fir is restricted to tuck formation whereas spruce grows in cushions rarely exceeding 10 cm. in height. Larch, Larix laricina, and alder, Alnus crispa, are also common in this ecoregion. Ahti (1959) refers to these species as being indicative of tree lines in Newfoundland.

Phytosociologically this ecoregion is characterized by the Diapensio - Arctostaphyletum alpinae association; however, as illustrated in Figure 5-2, other associations are prominent in the landscape.

Figure 5-2: Typical landscape in the Alpine Heath Ecoregion. The *Diapensio - Arctostaphyletum alpinae* occupies the immediate foreground whereas the continuous vegetation in the center of the picture is dominated by the *Empetro - Potentilletum tridentatae* and the *Empetro - Rhacomitrietum lanuginosae*. The background has the *Abietetum balsameae hudsoniae* in sheltered depressions and the *Kalmio - Myricetum gale* and *Kalmio - Sphagnetum nemori* occupy seepage areas on the lee slope.

Another unique feature of this vegetation is the occurrence of nutrient enriched aapa fens. These fens have a shallow peat often interspersed with mineral soil and rocks. Both floristically and morphologically this peatland is unique in this ecoregion on the Avalon Peninsula. The only comparable peatland type in Newfoundland occurs on the Buchans Plateau and on the Long Range Mountains (Pollett 1973, pers. comm.).

Floristically the Alpine Heath Ecoregion is characterized by species with subarctic affinities such as:

| | |
|---|---|
| *Loiseleuria procumbens* | *Diapensia lapponica* |
| *Juncus trifidus* | *Lycopodium selago* |
| *Arctostaphylos alpina* | *Empetrum eamsii* |
| *Cetraria nivalis* | *Cetraria cucullata* |

Damman (1965a) describes the distribution of these species in Newfoundland as follows:

> "On exposed headlands along the coast, exposed parts of the barrens of eastern Newfoundland, and at higher elevations elsewhere, becoming progressively more common toward the northern part of the Long Range Mountains."

The following species are unique to the aapa fens of this area (Pollett and Meades, 1972):

| | |
|---|---|
| *Sphagnum strictum* | *Carex folliculata* |
| *Epilobium palustre* | *Lycopodium inundatum* |
| *Habenaria psycodes* | *Carex stylosa* |

Most of this ecoregion is relatively inaccessible and meteorological data is not available. The vegetation unique to this ecoregion has its closest relationship with that described as Alpine Lichen Tundra by Ahti (1959) on the Long Range Mountains. Concerning the climate of these mountains Hare (1952) states,

> "In many cases this treeless mossy and sedgy vegetation occurs on highlands where the climate is truly Arctic, and in such cases the barrens form true Alpine lichen tundra."

Rock barrens are unique to this ecoregion characterized by a discontinuous vegetation carpet interrupted by patterned ground. The pattern is mainly in the form of nonsorted nets, however miniature sorted polygons also occur. The phanerophyte life form is conspicuous in sheltered microhabitats.

From an ecological viewpoint it is unlikely that this ecoregion was forested. Freeze-thaw cycles, the absence of a deep winter snow cover except in depressions, and the widespread occurrence of bare soil are conductive to severe soil-frost disturbance. These factors, in combination with high winds (gusting to 161 k.p.h.), deter the establishment of forest and sustain the present vegetation.

## 2. THE SUBARCTIC HEATH ECOREGION

This ecoregion includes the southern portion of the Avalon and also parts of the Isthmus and the northernmost tip of the peninsula. The altitude varies from sea level up to 200 M. with closed forests limited to the most sheltered valleys and coastal inlets.

Phytosociologically the *Empetro - Potentilletum tridentatae* dominates the heath east of Trepassey and the *Empetro - Rhacomitrietum lanuginosae* west of this point. However, both associations occur in juxtaposition throughout this ecoregion. This vegetation has also been described as the *Kalmia - Rhacomitrium - Cladonia* association (Ahti, 1959) and is described by Ahti as a maritime heath formation.

On moist slopes the *Kalmio - Myricetum gale* and the *Kalmio - Sphagnetum nemori* associations occupy habitats where deep snow accumulates in winter. The *Abietetum balsameae* also has its maximum cover in this ecoregion and is generally located on the protected side of knolls and in river valleys.

Another major component of the landscape in this area is large blanket peatlands which rarely exceed a depth of 2 M. These blanket bogs and fens occupy valleys and poorly drained slopes and may extend, unbroken, for distances of 8 km. The landscape is almost totally devoid of forest cover (Figure 5-3).

Figure 5-3: A landscape typical of the Subarctic Heath Ecoregion with the Empetro - Potentilletum tridentatae and Empetro - Rhacomitrietum lanuginosae dominating the foreground and an extensive blanket bog occupying the valley in the background.

Floristically this ecoregion is characterized by the frequent occurrence of the following species which are common in the Alpine Heath Ecoregion but are not found in combination with the characteristic species of the Alpine Heath:

| | |
|---|---|
| *Potentilla tridentata* | *Rhacomitrium lanuginosum* |
| *Vaccinium uliginosum* | *Prenanthes trifoliolata* |
| *Leucobryum glaucum* | *Hypnum imponens* |
| *Cladonia terrae-novae* | *Sphaeophorus globosus* |
| *Cladonia amaurocraea* | *Ochrolechia frigida* |
| *Solidago uliginosa* | |

Certain species, typical of wet heath or peatland vegetation, occur on dry heath soils only in this ecoregion;

| | |
|---|---|
| *Aster nemoralis* | *Kalmia polifolia* |
| *Sanguisorba canadensis* | *Andromeda glaucophylla* |
| *Aster radula* | *Juniperus horizontalis* |
| *Myrica gale* | *Chamaedaphne calyculata* |

Comparison of climatic factors between the Subarctic and Boreal Ecoregions indicates that the Subarctic Ecoregion experiences slightly colder summers. The Subarctic Heath Ecoregion is also characterized by a shorter vegetation season accompanied by less snowfall and more winter rainfall with significantly higher windspeeds (Table 5-1).

Table 5-1: A comparison of climatic data within the Subarctic and Boreal Heath Ecoregions

| | Subarctic Heath Ecoregion | Boreal Heath Ecoregion |
|---|---|---|
| Duration of the Vegetation Season (Hare, 1952) | < 150 days | 150-160 days |
| Mean Air Temperature January (Hare, 1952) | > -3.89°C | -6.67°C - -3.89°C |
| Mean Air Temperature July (Hare, 1952) | < 12.78°C | 12.78°C - 15.56°C |
| Mean Annual Snowfall (Hare, 1952) | < 190.5 cm | 190-254 cm |
| Mean Winter Rainfall (Thomas, 1953) | > 25.4 cm | 19.05 - 25.4 cm |
| Mean Winter Season Wind Speed (Thomas, 1953) | > 32.2 kph | 24.1 kph-32.2 kph |

Morphologically, this ecoregion is dominated by hard ground heath; soft ground heath is restricted to sheltered microhabitats as wet heath or tuck vegetation. These heathlands are also unique in that they are characterized by areas of patterned ground in the form of earth hummocks.

The successional status of this heath is not evident. No investigations have yet been undertaken to determine if this ecoregion was previously forested. Many observers feel this was the case prior to settlement and that subsequent fires destroyed the forest and resulted in development of the heath vegetation. The landscape, at the time of early settlement, has been partially described by the British geologist, J.B. Jukes, who travelled extensively in Newfoundland during the years 1839 to 1840 (Jukes, 1842). The following description by Jukes relates to the *Abietetum balsameae hudsoniae* association:

> "These consist of a kind of dwarf juniper or other fir tree with very thick short stumps and strong flat interlacing branches. They grow breast high and are so close, firm, and level at the top, that in some places a man can walk on them."

Describing the extensiveness of the barrens in this area he tells of meeting a man travelling on horseback from Peter's River to Trepassey;

> "... this was the only space of ground of that extent that I saw anywhere in Newfoundland where such a thing was possible without a regularly constructed road."

These observations indicate that the landscape of this area has not changed appreciably in the last 150 years. Also specimens of _Vaccinium uliginosum_ and _Juniperus horizontalis_ collected near Peter's River were found to be more than 50 years old. The closeness of growth rings beyond this age made accurate age determination impossible. However, the following observations on the existing vegetation indicate that the difference in climate, illustrated in Table 5-1, may be equally important as fire in preventing succession from heath to coniferous forest at the present:

1. The floristic element used to characterize this ecoregion has an obvious affinity to subarctic and montane vegetation (Damman 1965a, Ahti 1959).

2. The _Empetro - Rhacomitrietum lanuginosae_ association is both morpholcgically and floristically related to subarctic oceanic heath in Iceland (McVean,1955), Jan Mayen Island (Warren Wilson,1952), Faroes Island (Böcher,1940) and northern Scotland (McVean,1964). In Newfoundland vegetation comparable to this association only occurs on the Burin Peninsula. Also, patterned ground in the form of earth hummocks associated with this ecoregion is a phenomenon of subarctic and alpine environments (Washburn,1956).

3. In the Boreal Heath Ecoregions regeneration to coniferous forest is inhibited by the development of a deep organic mantle under ericaceous vegetation. This is not the case in this ecoregion where hard ground heath, characterized by a humus less than 10 cm, dominates.

4. Where forest and tuck occur in this region it is restricted to the most sheltered depressions and river valleys. Furthermore, Pinus sylvestris, planted on these barrens in afforestation trials during 1951 now occurs in a layered growth form, rarely exceeding a height of one meter.

5. Soil pits excavated for the purpose of classifying soils on these barrens did not reveal any evidence in the form of large roots or fallen trunks that would indicate a forest cover in recent history (Peter Heringa, pers. comm.).

3. THE BOREAL HEATH ECOREGION

The Boreal Heath Ecoregion includes the central, northern and a large part of the isthmus of the Avalon Peninsula and is characterized by an undulating topography, usually below the 120 M. contour. Above the 120 M. contour elements indicative of the Subarctic Heath Ecoregion have a sporadic occurrence.

The vegetation of this ecoregion is characterized by the Kalmietum angustifoliae, Kalmio - Myricetum gale and Kalmio - Sphagnetum nemori associations. Collectively these associations are equivalent to the Kalmia - Vaccinium Cladonia association described by Ahti (1959) as maritime heath. The undulating topography and scattered stands of forests of this ecoregion provide the shelter required for the development of these associations over large areas in valleys and on the side of slopes. The Empetro - Rhacomitrietum lanuginosae and Empetro - Potentilletum tridentatae associations are restricted to windswept knolls and coastal headlands. The small forest stands that occur in this ecoregion are of poor quality, especially with respect to height growth and are frequently interspersed with heath. Picea glauca commonly occurs in these stands near the coast (Figure 5-4).

Figure 5-4: A typical landscape in the Boreal Heath Ecoregion with sheltered heath in juxtaposition to a small stand of poor growth forest.

In this ecoregion species characteristic of the Subarctic Heath Ecoregion are infrequently encountered in the most exposed microhabitats. Also, Rhododendron canadense, Nemopanthus mucronata, Amelanchier bartramiana, and Alnus crispa display their maximum distribution in this area (Figure 5-5).

Climatically, the ecoregion has a longer vegetation season with warmer summers and colder winters; however, lower winter wind speeds, combined with less precipitation in the form of rain, favor deeper snow accumulations than in the Subarctic Heath Ecoregion (Table 5-1).

Morphologically, the ecoregion, with the exception of the Anthropogenic Heath District, is dominated by soft ground heath. Hard ground heath is also encountered on the summit of exposed knolls. Patterned ground occurs in the form of frost scars where intense burning or other disturbance has removed patches of humus.

Most of this ecoregion probably had a more widespread forest cover than is evident at the present (Terasmae,1963). However, a combination of repeated burning and a cold humid climate with high wind velocities appears to have favored the establishment of semi-permanent heath. Damman (1971) states, "Although these sites once supported forest, no natural regeneration to forest is now taking place, and the Kalmia heath appears to maintain itself indefinitely".

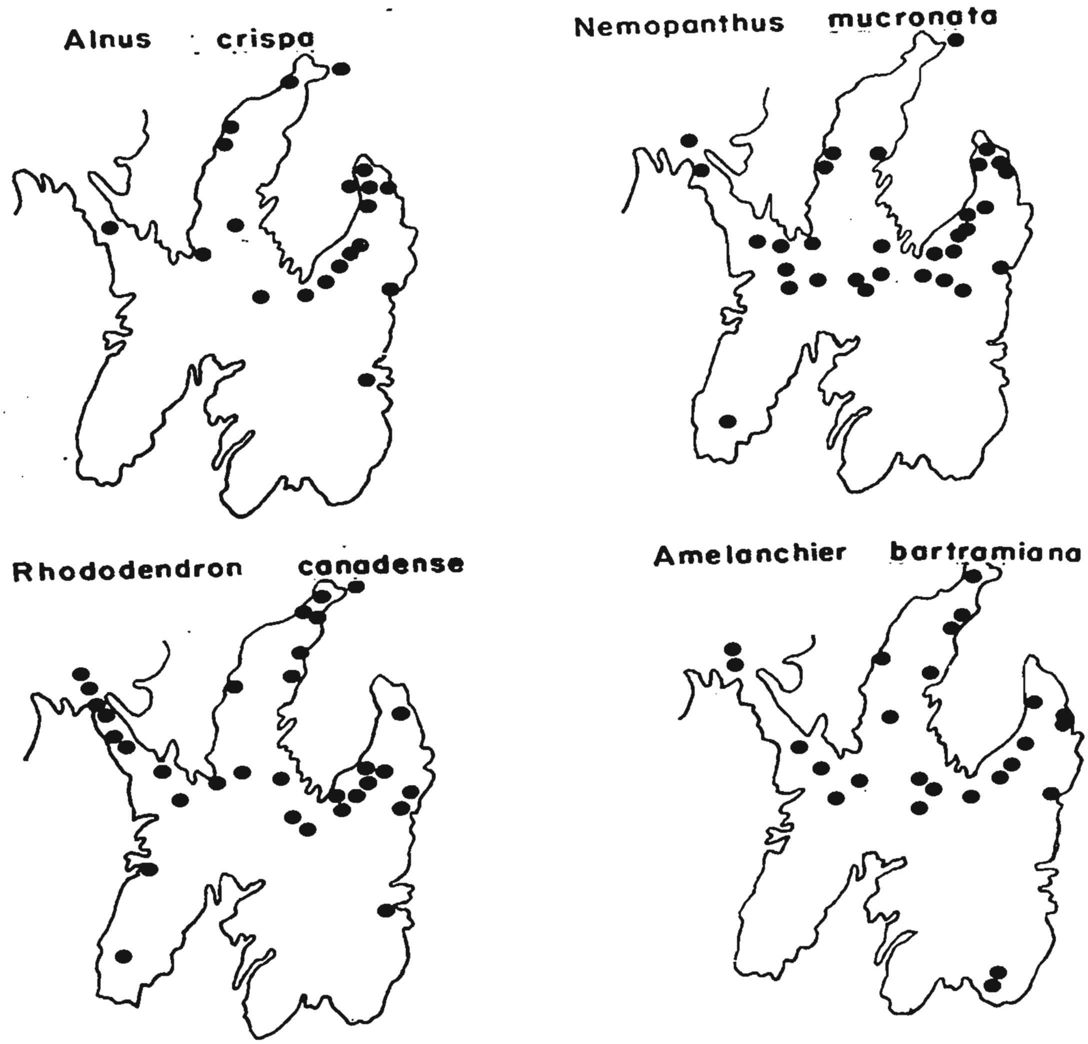


Figure 5-5: These species are primarily restricted to the Boreal Heath and Boreal Forest ecoregions on the Avalon.

The primary reason for poor regeneration on these sites, where exposure is not a limiting factor, may be related to the invasion of ericaceous heath plants. The rapid root proliferation of these shrubs results in the accumulation of a deep humus. This deep organic mantle is an unfavorable seedbed for coniferous species.

The Anthropogenic Heath District (Figure 5-1) represents a subdivision of the Boreal Heath Ecoregion located along the more populated coastline of Conception Bay. Cultural practices on heathlands are responsible for the development of anthropogenic heath vegetation. Continuous prescribed burning to increase the commercial blueberry crop, combined with increased human intrusion to harvest the crop, are the primary factors responsible for the occurrence of a number of species of European origin. Livestock grazing, especially by sheep, is also a lesser contributing factor. Within this district many sites close to settlement have reverted from heath to grassland pasture through cultivation or excessive grazing.

The vegetation of this district is represented by the Luzulo - Polytrichetum commune and Luzulo - Empetretum nigrae. Other associations more typical of the Boreal Heath Ecoregion and poor growth forest occur on the periphery of these sites (Figure 5-6).

Figure 5-6: A typical landscape of the Anthropogenic Heath District. Natural heath and depauperate forest surround the anthropogenic heath.

Floristically, this district is characterized by the distribution of Luzula campestris, Fragaria virginiana, Anaphalis margaritacea and Achillea millefolium (Figure 5-7). Other introduced species unique to the heath of this district include:

| | |
|---|---|
| Taraxacum officinale | Hieracium murorum |
| Polytrichum commune | Anthoxanthum odoratum |

4. THE BOREAL FOREST ECOREGION

The Boreal Forest Ecoregion occupies the Northeast River, Rocky River and Salmonier River watersheds in the Central Avalon (Figure 5-1). The dominant tree species are the same as in scattered forest stands occurring in other ecoregions; however, the topographical diversity of this ecoregion results in a greater variety of vegetation types. Unlike the Boreal Heath Ecoregion, the forest vegetation in this area is continuous and rarely interrupted by heath vegetation.

The dominant tree species is Abies balsamea (Balsam Fir) having good diameter growth but rarely exceeds 15 M. in height. It forms mixed stands with lesser quantities of Picea mariana (Black Spruce) and Betula papyrifera (White Birch). On poor upland soils and poorly drained lowland soils Picea mariana is sometimes dominant. This is the case near Whitbourne where the Piceetum marianae semiprostratae association occurs on gently rolling land

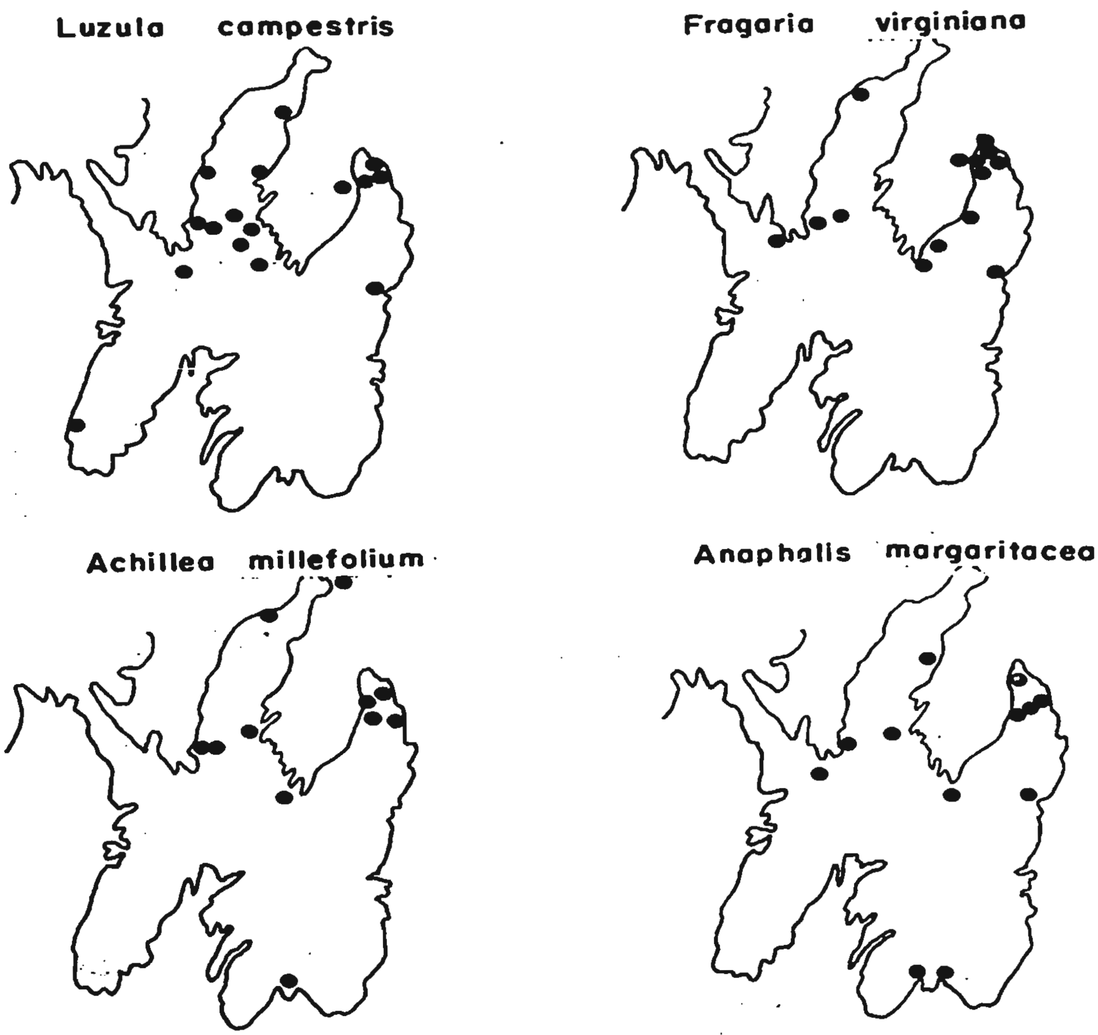


Figure 5-7: The distribution of four introduced species characteristic of the Anthropogenic Heath District.

in juxtaposition to large bogs. Tree species unique to these forests on the Avalon include Betula alleghaniensis (Yellow Birch) and Acer spicatum (Mountain Maple). Pinus strobus (White Pine) may have been widespread in this area at one time but cutting and disease have reduced the numbers of this species which is now rare on the Peninsula (Wilton,1956). The forests are also characterized by the abundance of pendulous lichens attached to the trunks and branches of coniferous tree species. Alectoria sarmentosa, Alectoria jubata and Usnea longissima are the most common lichen species and their abundance in the Avalon forests may be a result of frequent fog and ground mist.

The blanket bogs of this ecoregion have a more domed appearance than elsewhere on the Avalon and Rhacomitrium lanuginosum is conspicuous on the bog hummocks. Hydroseral succession is common in this ecoregion and consequently marsh vegetation is common (Figure 5-8).

Figure 5-8: This picture illustrates marsh vegetation around a pond border surrounded by coniferous forest typical of this ecoregion.

Swamp vegetation as defined by Damman (1964) is rarely encountered on the Avalon but has a limited occurrence in this ecoregion located on alluvial deposits near the mouth of rivers. This swamp vegetation is dominated by Alnus crispa, Myrica gale and Spiraea latifolia.

These forests have been burnt and cut over in the past but it appears that succession to semi-permanent heath typical of the Boreal Heath Ecoregion has failed to take place for the following reasons:

1. The soils of this ecoregion are generally of a better quality and well drained. These conditions favor natural regeneration of forest.

2. The numerous river valleys in this ecoregion make it the most sheltered portion of the Avalon which promotes the development of good quality forest.

3. This ecoregion has had, and maintains at present, the lowest density of population on the Avalon Peninsula. Consequently the frequency and intensity of cutting and burning has been less significant than in the Boreal Heath Ecoregion.

# CHAPTER VI. PHYTOGEOGRAPHICAL RELATIONSHIPS AND HIERARCHICAL CLASSIFICATION OF THE AVALON HEATH

The phytosociological classification of European heath has been nearly completed (Lohmeyer et al.,1962), whereas in North America classification studies are only beginning (Pollett 1972a, Damman 1964, 1967). To understand the relationship of the associations described in this study to the existing European hierarchical classification, a knowledge of their phytogeographical position is essential.

Heathland classifications using various methods have been established throughout Northern Europe by the following researchers:

| | |
|---|---|
| Smith (1905, 1911) | Scotland |
| Du Rietz (1925) | Sweden |
| Braun-Blanquet (1932) | France |
| Tuxen (1937) | Netherlands |
| Tansley (1949) | England |
| Nordhagen (1943) | Norway |
| Böcher (1943) | Denmark |
| Damman (1957) | Sweden |
| Gimingham (1964) | Scotland |
| McVean (1964) | Scotland |

| | |
|---|---|
| Malmer (1965) | Sweden |
| De Smidt (1966) | Netherlands |
| Westhoff and Den Held (1969) | Netherlands |
| Bridgewater (1970) | England |

However, floristic comparisons of European and North American heath are difficult because of the large number of endemic shrubs which dominate heath vegetation on either continent. Schofield (1969) states, "... thus all tree species and most shrubby species are endemic to North America (exception _Alnus crispa_)."

The following species, common in European heath, are absent or at least limited to sites displaying anthropogenic disturbance in North America:

| | |
|---|---|
| _Calluna vulgaris_ | _Vaccinium myrtillus_ |
| _Erica tetralix_ | _Potentilla erecta_ |
| _Pedicularis sylvatica_ | _Festuca ovina_ |
| _Nardus stricta_ | _Molinia caerula_ |
| _Sieglingia decumbens_ | _Luzula campestris_ |

Similarly, in North America the following shrubs are a conspicuous component of heath vegetation but are not found in European heath:

| | |
|---|---|
| _Kalmia angustifolia_ | _Pyrus floribunda_ |
| _Ledum groenlandicum_ | _Viburnum cassinoides_ |
| _Rhododendron canadense_ | _Vaccinium angustifolium_ |

*Chamaedaphne calyculata* *Amelanchier bartramiana*
*Nemopanthus mucronata* *Potentilla tridentata*

De Smidt (1967) divided the North European heath into five phytogeographic regions (Figure 6-1);

1. South-Atlantic
2. Boreal-Atlantic
3. Boreal-Subatlantic
4. Boreal-Subcontinental
5. Sub-Atlantic

The following characteristic species combination of the Boreal-Atlantic Region forms a connecting element between that region and the associations described from the Avalon Peninsula;

*Empetrum nigrum* *Vaccinium vitis-idaea*
*Deschampsia flexuosa* *Juniperus communis*
*Hylocomium splendens* *Ptilium crista-castrensis*
*Rhacomitrium lanuginosum* *Leucobryum glaucum*
*Cladonia arbuscula* *Cladonia rangiferina*
*Lycopodium clavatum* *Lycopodium selago*

Ahti (1959) states, "If compared with the maritime heath vegetation occurring in the Atlantic parts of western Europe, the Newfoundland heaths probably most nearly resemble those formed on the coasts of central Norway." This area is included in the Boreal-Atlantic Region. Floristic

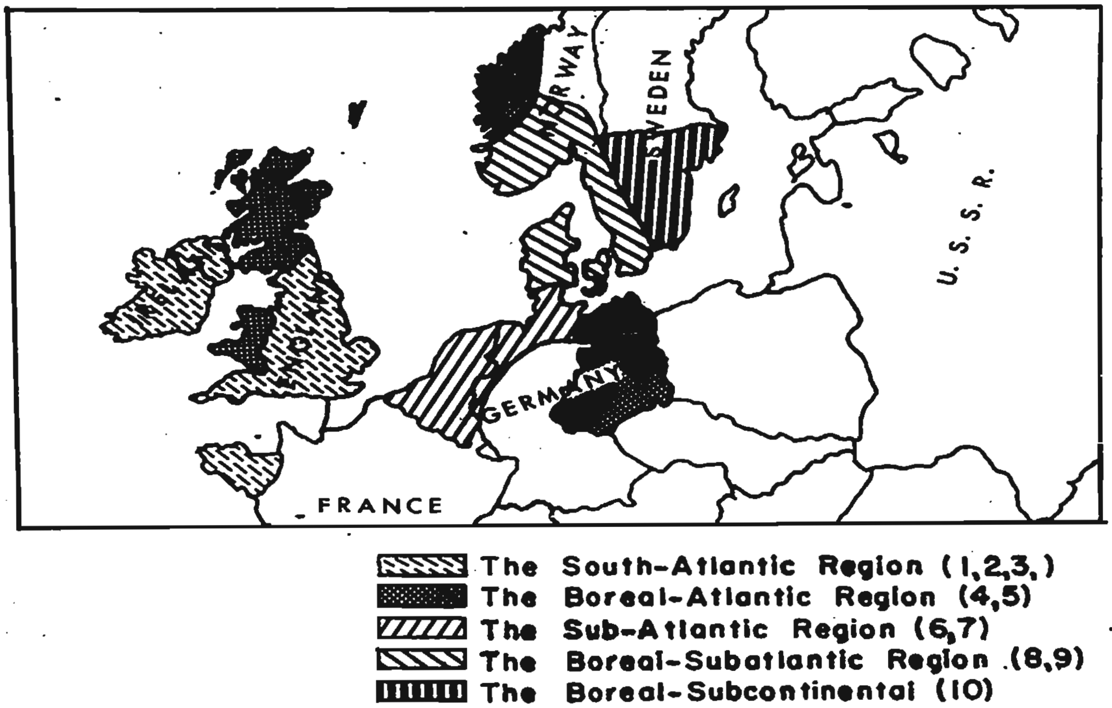


Figure 6-1: Phytogeographic regions of the North West European Heath. The numbers in brackets refer to the regions surveyed by De Smidt (1967):

1) Brittany
2) Southern England
3) Ireland
4) Scotland and Wales
5) Western Norway
6) Southern Netherlands and Belgium
7) Northern Netherlands, N. Germany
8) Northern Jutland
9) Southwest Sweden
10) Southeast Sweden

relationships of the Avalon heath to other European heath regions are quite tenous or lacking.

Within the European hierarchical classification of vegetation the wet heath is included in the class Oxycocco - Sphagnetea (Braun-Blanquet and R. Tuxen, 1943) and the dry heath is included in the class Nardo - Callunetea (Preising 1949) according to Westhoff and Den Held (1969). If the associations described for the Avalon heath are to be placed within this hierarchy two prerequisites must be satisfied;

1. They must possess the same kentaxa (identifying species) used to define these classes.
2. These kentaxa must have as broad a geographical range and as wide an ecological amplitude in the North American heath as they do in the European heath.

One association described for the Avalon, the Kalmio - Sphagnetum nemori, has the following species in common with the Oxycocco - Sphagnetea and can be termed wet heath in the European context:

| | |
|---|---|
| Drosera rotundifolia | Mylia anomala |
| Aulacomnium palustre | Sphagnum nemoreum |

These species have wide geographic and ecological ranges within both the wet heath and peatland vegetation of Newfoundland (Pollett, 1972). It is probable, therefore, that the *Kalmio - Sphagnetum nemori* may eventually be grouped with the North American bog associations as part of the *Oxycocco - Sphagnetea*.

The kentaxa of the *Nardo - Callunetea* include: *Sieglingia decumbens*, *Calluna vulgaris*, *Potentilla erecta*, *Cuscuta epithmum*, and *Carex pilulifera*. These species are either absent in North America or present as an anthropogenic element (Fernald, 1950). Also the kentaxa of orders and alliances within the *Nardo - Callunetea* have a similar relation. Consequently, the dry heath associations on the Avalon Peninsula, unlike wet heath or peatland vegetation, cannot be grouped within the systematic framework of the European hierarchical classification. A separate hierarchy will have to be established to incorporate this vegetation.

Unfortunately, phytosociological research on the Atlantic North American heath vegetation is lacking and only a schematic outline derived from cursory surveys, checklists and floras can be attempted at this time.

In Table 6-1 the Northeastern North American heath, with the exception of tuck vegetation, is grouped within a single class *Kalmio - Vaccinetea* identified by species

Table 6-1. A tentative hierarchical classification of the northeastern North American heath vegetation.

CLASS: Kalmio-Vaccinetea

<u>Kentaxa</u>: Kalmia angustifolia, Empetrum nigrum, Vaccinium angustifolium, Dicranum scoparium, Cornus canadensis

A. ORDER: Empetro-Potentilletalia

<u>Kentaxa</u>: Prenanthes trifoliolata, Vaccinium uliginosum, Rhacomitrium lanuginosum, Potentilla tridentata, Cladonia boryi, Vaccinium vitis-idaea, Corema conradii

ALLIANCE: Arctostaphylion

<u>Kentaxa</u>: Arctostaphylos alpina, Arctostaphylos uva-ursi, Loiseleuria procumbens, Diapensia lapponica, Lycopodium selago

ASSOCIATIONS: Diapensio-Arctostaphyletum alpinae
Vaccinio-Empetretum nigri (Pollett 1972a)

ALLIANCE: Potentillion

<u>Kentaxa</u>: This alliance may be differentiated by the presence of Kentaxa of the order and absence of Kentaxa of the Arctostaphylion.

ASSOCIATIONS: Empetro-Potentilletum tridentatae
Empetro-Rhacomitrietum lanuginosae
Betulo-Vaccinietum uliginosi (Pollett 1972a)
Vaccinio-Cladonietum boryi (Pollett 1972a)

B. ORDER: Kalmio-Ledetalia

<u>Kentaxa</u>: This order may be differentiated by the presence of the class Kentaxa and absence of the Empetro-Potentilletalia Kentaxa

ALLIANCE: Kalmion

<u>Kentaxa</u>: Ledum groenlandicum, Viburnum cassinoides, Rhododendron canadense, Nemopanthus mucronata, Cornus canadensis, Hylocomium splendens, Pleurozium schreberi, Gaylussacia baccata, Gaultheria procumbens

ASSOCIATIONS: Kalmietum angustifoliae
Kalmio-Alnetum crispae
Kalmio-Myricetum gale

ALLIANCE: Luzulion

<u>Kentaxa</u>: Luzula campestris, Comptonia peregrina, Polytrichum commune, Anaphalis margaritacea, Vaccinium angustifolium

ASSOCIATIONS: Luzulo-Empetretum nigrae
Luzulo-Polytrichetum commune
Comptonio-Vaccinietum (Lavoie 1968)

having a wide ecological amplitude throughout the northeastern United States and adjacent Canada (Fernald, 1950). This class is divided into two orders: Empetro - Potentilletalia and Kalmio - Ledetalia.

A. Empetro - Potentilletalia

The order Empetro - Potentilletalia represents heath developed under severe climatic exposure and is characterized by species having a more northerly distribution (Damman,1965a). The heath of this order includes the natural heath associations which occur on the sites generally unfavorable to forest growth. The alliance Arctostaphylion includes alpine heath vegetation related to Alpine Lichen Tundra (Ahti, 1959). This vegetation, represented by the Diapensio - Arctostaphyletum alpinae on the Avalon Peninsula and by the Vaccinio - Empetretum nigri (Pollett,1972a) on the Northern Peninsula of Newfoundland, also occurs at lower elevations. Vegetation similar to these associations is encountered on coastlines in Cape Breton Island and Nova Scotia (Roland, 1942).

The alliance Potentillion represents coastal heath characterized by the absence of arctic-alpine species. The associations Empetro - Rhacomitrietum lanuginosae and Empetro - Potentilletum tridentatae make up this alliance on the Avalon whereas the Vaccinio - Cladonietum boryi

(Pollett, 1972a) has been described for coastal stations in southwestern and northern Newfoundland. The *Corema conradii Community* described by Strang (1972) represents a more southern distribution of this vegetation in Nova Scotia.

B. *Kalmio - Ledetalia*

The order *Kalmio - Ledetalia* represents heath vegetation characterized by the absence of species having obvious northern affinities in this range. This vegetation occupies heathlands developed through the burning of forests. Due to a combination of climate and site degradation, regeneration is inhibited and the heath is maintained as semi-permanent vegetation. On the Avalon Peninsula the *Kalmion* alliance is represented by the associations *Kalmietum angustifoliae*, *Kalmio - Alnetum crispae* and *Kalmio - Myricetum gale*. In Ahti's (1959) description of Newfoundland heath the *Kalmia - Vaccinium - Cladonia* association and the Subalpine Lichen Barrens are together comparable with the *Kalmion* alliance. Also, descriptions of vegetation and other floristic data presented by Hustich (1939, 1951, 1965, 1970), Linteau (1955), Rouleau (1956) and Wilton (1965) confirm that the heaths of southern Labrador closely resemble the *Kalmion*. The *Gaylussacia baccata Community*, *Rhododendron canadense Community* and *Mixed Shrub Community* described by Strang (1972) are also representative of this alliance in the Nova Scotian heath.

The Luzulion alliance includes anthropogenic heath resulting from repeated prescribed burning to increase the abundance and fruit productivity of blueberry (Vaccinium angustifolium). The associations Luzulo - Empetretum nigrae and Luzulo - Polytrichetum commune characterize anthropogenic heath on the Avalon. The only other association having a similar origin in northeastern North America is the Comptonio - Vaccinietum. This association is derived from repeated burning of Jack Pine (Pinus divaricata) forests (Lavoie 1968, Payette and Lavoie 1971).

On the basis of floristic criteria the tuck vegetation of the Avalon, represented by the associations Abietetum balsameae hudsoniae and the Piceetum marianae semiprostratae belong to the schematic forest class Abieto - Piceetea (Damman 1967). In this study they were classified as heath vegetation because of their dwarf structural physiognomy and spatial relationship with the heath matrix. Similarly, the pine barrens of the northeastern United States, described by Buell and Cantlon (1950), Reiners (1967), must be placed in the schematic order Vaccinio - Picion (Damman,1967).

The classification presented in this chapter and the forest classification of Damman (1967) are suggested as a working basis only for the development of a more complete phytosociological classification. The establishment and naming of circumboreal forest and heath vegetation units within a workable hierarchical classification requires the collection of more detailed information from other parts of the boreal forest zone.

# CHAPTER VII. SUMMARY AND CONCLUSIONS

The heathlands of the Avalon Peninsula can be divided into three morphological types;

1. Rock Barrens
2. Hard Ground Heath
3. Soft Ground Heath

Rock Barrens occur above the tree line and on the more exposed coastal headlands where soil-frost disturbance, combined with wind and water erosion, remove large portions of the humus substrate leaving bare mineral soil. The *Diapensio - Arctostaphyletum alpinae* association characterizes cushions of heath throughout the morainic debris.

Hard Ground Heath (humus less than 10 cm) is characterized by either a natural climatic heath or, in areas of settlement, by anthropogenic heath.

Natural Hard Ground Heath is widespread throughout the southern portion of the Avalon, being localized elsewhere to knolls and coastal headlands. High winds reduce the winter snow cover and the growth of ericaceous shrubs is retarded. The *Empetro - Potentilletum tridentatae* is located in more sheltered habitats whereas the *Empetro - Rhacomitrietum lanuginosae* occupies the more exposed microhabitats at the crown of hummocks and near the summit of slopes. Physiognomically, these associations have three or less vegetation strata with Empetrum nigrum and/or Rhacomitrium lanuginosum dominant as carpet-forming species.

Anthropogenic Hard Ground Heath occurs on the northern portion of the Avalon, in close proximity to densely populated settlements. The humus on these sites has been partially destroyed through accidental and prescribed burning. The frequency of human intrusion is increased because of the blueberry harvest. This appears to promote the introduction of anthropogenic species characteristic of the Luzulo - Empetretum nigrae and Luzulo - Polytrichetum commune.

Soft Ground Heath occurs throughout the isthmus, northern and central Avalon, but only occurs in the more sheltered microhabitats on the south coast. This heathland type occupies sites where high winds are not frequent and snow accumulation is deep. The vigorous growth of ericaceous shrubs leads to the development of a thick surface humus which may attain a depth up to 50 cm. On well drained sites the Kalmietum angustifoliae is the dominant heath vegetation being partially replaced near tree line by the Kalmio - Alnetum crispae. The Abietetum balsameae hudsoniae, also a soft ground heath type, occurs in sheltered depressions within the Hard Ground Heath matrix. The Kalmio - Myricetum gale and Kalmio -

*Sphagnetum nemori* associations are located on sites with poor drainage such as the base of slopes, depressions and around the shores of ponds. The *Piceetum marianae semiprostratae* association occurs on Soft Ground Heath in juxtaposition to peat deposits in the central portion of the Avalon.

Ecological investigations on a representative heath slope confirmed the existence of a soil-vegetation catena pattern displaying floristic variation from freely drained soils, to those of slightly impeded drainage, to those seasonally or permanently waterlogged. Similar patterns exist in the heathlands of Scotland (Gimingham, 1964) and of Nova Scotia (Strang, 1972). Wind and topography are closely related edaphic factors controlling the development of the catena. Topography influences the pattern of drainage and in combination with wind determines the extent and distribution of winter snow cover. On the slope summit wind velocity is high and snow cover is shallow or absent, whereas on the middle and lower slope, sheltered conditions result in the accumulation of snow. Consequently the slope summit is characterized by Hard Ground Heath and associated vegetation, whereas on the middle and lower slopes Soft Ground Heath and related vegetation dominates.

It was determined that the Avalon Peninsula is divided into the following four ecoregions using floristic, ecological and morphological criteria:

1. ALPINE HEATH
2. SUBARCTIC HEATH
3. BOREAL HEATH
4. BOREAL FOREST

The Alpine Heath Ecoregion occurs above the tree line on the Avalon and is characterized by a montane species element. Morphologically, most of this area can be classified as Rock Barrens which never supported productive forests.

The Subarctic Heath Ecoregion is concentrated on the south coast of the Avalon and occurs sporadically near Bay de Verde and on ridges throughout the Isthmus. This ecoregion is characterized by the dominance of hard ground heath possessing a northern species element. It is impossible to conclude from existing evidence if this region ever supported productive forest. Historical references imply that this landscape has been barren for at least one hundred years and afforestation trials indicate that succession to productive forest will not take place under existing climatic conditions.

The Boreal Heath Ecoregion is climatically more favorable than the Subarctic Heath Ecoregion and the northern species element only occurs on extremely exposed knolls. The dominant morphological type is Soft Ground Heath; however, in close proximity to settlements frequent burning has created Anthropogenic Hard Ground Heath. Much of the Boreal Heath has been derived from previously forested land by cutting and burning since the time of early settlement (Terasmae, 1963). Since this disturbance, a thick organic surface horizon has developed on these sites and regeneration to forest is not evident.

The Boreal Forest Ecoregion includes climax Balsam Fir forest occurring in the sheltered river valleys of the central Avalon.

In comparison with the North West European heath, the Avalon heath has its closest floristic affinity with the Boreal Atlantic Region (De Smidt, 1967). However, because of the large number of endemic shrubs in the heath vegetation of Europe and eastern North America, floristic agreement between these widely separated areas is limited. Consequently the *Kalmio - Sphagnetum nemori* appears to be the only association described in this study which could be incorporated into the existing hierarchical classification. To provide a working basis for future heathland classification in eastern North America, the following tentative taxa have been described:

Class: *Kalmio - Vaccinetea*

Order: *Empetro - Potentilletalia*

Alliance: *Arctostaphylion*

Alliance: *Potentillion*

Order: *Kalmio - Ledetalia*

Alliance: *Kalmion*

Alliance: *Luzulion*

From the results of this investigation it can be concluded that the Z-M method offers satisfactory techniques for the classification and ecological interpretation of heathland vegetation. The results obtained, although preliminary in the development of increased understanding of landform patterns on the Avalon, do provide a framework for future qualitative and quantitative research on other physical and biological parameters.

Based on this study the following recommendations are made with respect to forestry, agriculture, wildlife and recreation.

FORESTRY

Future attempts at afforestation in the Alpine or Subarctic Heath ecoregions should be restricted to the development of shelter belts. It is questionable whether any portion of this area could support commercial forests. In the Boreal Heath and Boreal Forest ecoregions afforestation may be feasible for re-establishment of productive forest sites degraded by ericaceous shrubs following fire or cutting. Similar recommendations have been made by Strang (1971) for the barrens of Nova Scotia. Preference in site selection for afforestation trials should be given lower heath slopes where exposure is less and snow accumulation is deeper. However, basic research on the role of *Kalmia angustifolia* and other ericaceous shrubs in mineral cycling and iron pan formation should be undertaken concurrently with afforestation trials.

## AGRICULTURE

### Blueberry Production

Prescribed burning undertaken to increase blueberry production should be encouraged throughout the Avalon. By expanding the industry blueberry harvesting could be practiced on a rotation basis. Studies should be initiated to determine the environmental impact of repeated burning on these sites over long periods. Emphasis should be placed on areas characterized by the Kalmia Heath to assess the degree of burning required to convert such areas to productive blueberry barrens.

Pasture Land

Hard Ground Heath appears to be the more suitable for the development of pasture land because natural grasses such as Calamagrostis pickeringii and Deschampsia flexuosa have their greatest abundance on these sites.

Comparisons with pasture land development in European heath (i.e. Scotland) should be made with caution. In Europe the dominant heath shrub is Calluna vulgaris which is a palatable food source for sheep. In Newfoundland Kalmia angustifolia is dominant and is poisonous to livestock. Attempts to introduce Calluna vulgaris to pasture land could prove successful. This species at present is found only in 3-5 locations on the Avalon.

WILDLIFE

The caribou herds on the Avalon are located in the Alpine Heath ecoregion. Care must be exercised in management of these areas since overgrazing, trampling and the use of all terrain vehicles may result in the destruction of large portions of the soil humus. This would be particularly devastating in this ecoregion because of shallow snow cover which induces severe soil frost disturbance.

RECREATION

The Avalon Peninsula is the most densely populated part of Newfoundland and with increasing population it is urgent that recreational lands be set aside. The lower portion of the Salmonier Valley is one of the most scenic areas on the Avalon and displays probably the greatest diversity of vegetation and wildlife habitats. It is therefore recommended that this area should have a high priority in future development of recreational land.

Also the Hawke Hill Range, because of its unique flora on the Avalon, and because of its suitability for hiking, should be afforded a high degree of protection, particularly from any motorized traffic.

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# APPENDIX I

## THE SCALES USED IN DESCRIBING THE VEGETATION

### Abundance/Cover

+ – one occurrence

1 – plentiful but covering less than 5%

2 – abundant but covering less than 25%

3 – covering 25–50%

4 – covering 50–75%

5 – coverage greater than 75%

r – present in close proximity, but not in the sample site

### Sociability

1 – growing singly (k = seedling)

2 – growing in tufts or trailing (i.e. *Vaccinium oxycoccus*)

3 – large groups or patches

4 – extensive patches covering greater than 50% of the sample area

5 – forming extensive carpets over 75% of the sample area

### Presence Class

This value is calculated as the percent occurrence of a species within a particular association.

+ – a single occurrence in the association

I – 0–20% of the total number of releves

II – 21–40% of the total number of releves

III – 41–60% of the total number of releves

IV – 61–80% of the total number of releves

V – 81–100% of the total number of releves

# APPENDIX II

**SYNTHESIS TABLE 1: DIAPENSIO-ARCTOSTAPHYLETUM ALPINAE ASSOCIATION**

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 30 | 70 | 70 | 70 | 90 | 90 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | |
| Slope | L | L | L | L | L | L | L | L | 20 | 20 | 20 | 20 | 20 | L | L | L | |
| Aspect | – | – | – | – | – | – | – | – | N | N | N | N | N | – | – | – | |
| % Phanerogam | 70 | 70 | 80 | 80 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | |
| % Cryptogam | 50 | 60 | 70 | 60 | 60 | 50 | 60 | 60 | 70 | 70 | 70 | 70 | 70 | 70 | 60 | 70 | |
| Relevé Number | 151 B | 137 A | 138 B | 138 A | 141 A | 141 B | 49 E | 49 G | 74 B | 74 C | 74 E | 74 D | 74 A | 49 I | 49 B | 49 D | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | |
| Polygonum viviparum | 3.1 | 1.1 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Leontodon autumnalis | + | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Betula pumila | . | + | 2.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Salix uva-ursi | . | 2.2 | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Empetrum eamsii | . | 2.2 | 1.2 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Larix laricina | . | . | . | . | . | . | . | . | + | + | + | + | + | . | . | . | II |
| Juncus trifidus | . | . | . | . | . | . | . | . | 1.2 | 2.2 | + | 1.2 | . | . | . | . | II |
| Platismatia glauca | . | . | . | . | . | . | . | . | . | 1.2 | + | 1.2 | 1.2 | . | . | . | II |
| Alectoria nigricans | . | . | . | . | . | . | . | . | . | . | . | . | . | + | 1.2 | + | I |
| Alectoria ochroleuca | . | . | . | . | . | . | . | . | . | . | . | . | . | + | 1.2 | + | I |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | |
| Arctostaphylos alpina | + | + | 1.2 | . | 2.1 | . | 2.1 | 2.1 | 2.2 | 1.2 | . | 1.2 | 2.2 | 3.3 | . | . | IV |
| Diapensia lapponica | . | . | 2.2 | 2.2 | 1.2 | 1.2 | 3.2 | 3.2 | 2.2 | 1.2 | 2.2 | 1.2 | . | . | 2.2 | 3.3 | IV |
| Cetraria nivalis | . | . | 1.2 | . | . | 1.2 | 2.2 | . | 1.2 | 2.2 | 1.2 | 2.2 | . | . | . | + | III |
| Loiseleuria procumbens | . | . | . | 1.2 | . | . | . | . | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | . | II |
| **Companion Species** | | | | | | | | | | | | | | | | | |
| Potentilla tridentata | + | 2.1 | 1.1 | . | 1.1 | 1.1 | + | 1.1 | + | + | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | V |
| Vaccinium vitis-idaea | 1.1 | 1.1 | 2.2 | 1.2 | 1.1 | 2.1 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | V |
| Sphaerophorous globosus | 1.2 | 1.2 | 1.2 | 1.1 | 1.2 | . | 2.2 | 3.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 1.2 | 3.2 | 1.2 | V |
| Rhacomitrium lanuginosum | . | + | 3.3 | 1.2 | 1.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 3.2 | 1.2 | + | 2.2 | 2.2 | V |
| Vaccinium uliginosum | 2.2 | 2.1 | 2.2 | 1.2 | 1.1 | 2.2 | 2.2 | 2.2 | . | . | . | . | . | 2.2 | 3.3 | 2.2 | IV |
| Prenanthes trifoliolata | + | + | + | + | + | + | + | + | . | . | . | . | . | + | + | . | IV |
| Empetrum nigrum | 3.3 | . | 1.1 | . | 2.2 | 3.3 | 1.2 | 1.2 | 2.2 | 3.3 | 3.2 | 3.2 | 2.2 | + | 3.3 | 2.2 | V |
| Deschampsia flexuosa | + | 1.1 | + | 1.1 | + | . | . | . | + | 1.2 | + | 1.2 | 1.2 | 1.2 | 1.2 | + | IV |
| Vaccinium angustifolium | . | . | + | 1.1 | . | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | IV |
| Cladonia boryi | + | 1.2 | . | 1.2 | 1.1 | . | 1.2 | . | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | . | 1.2 | IV |
| Cladonia arbuscula | + | 1.2 | . | + | + | + | + | 1.2 | 2.2 | 1.2 | 2.2 | + | 1.2 | 1.2 | 2.2 | + | V |
| Cladonia rangiferina | + | 2.2 | 1.2 | 1.1 | . | 1.2 | + | 1.2 | + | 1.2 | 2.2 | + | . | 2.2 | 2.2 | 1.2 | V |
| Cladonia mitis | + | 2.2 | 1.2 | + | . | 1.2 | . | + | 1.2 | 1.2 | 2.2 | 1.2 | + | + | . | . | IV |
| Cornicularia aculeata | + | . | . | + | 1.2 | . | + | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | IV |
| Ochrolechia frigida | 1.2 | . | + | + | + | + | . | . | + | + | . | . | 1.2 | . | . | + | III |
| Cetraria islandica | . | . | . | . | . | 1.2 | . | . | 1.2 | 1.2 | + | 1.2 | 1.2 | . | . | 1.2 | III |
| Cladonia uncialis | + | + | . | . | 1.1 | + | . | + | 1.2 | 1.2 | . | 1.2 | 1.2 | . | . | . | III |
| Cladonia elongata | . | . | . | . | . | . | 1.2 | 1.2 | + | + | + | + | + | . | . | . | III |
| Juniperus communis | . | . | 1.1 | + | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Cornus canadensis | . | 2.1 | . | 1.1 | . | . | 1.1 | . | . | . | . | . | + | . | 1.1 | + | II |
| Kalmia angustifolia | . | . | + | . | . | . | . | . | 1.1 | 1.1 | + | + | . | . | . | . | II |
| Trientalis borealis | + | . | . | . | + | + | . | . | . | . | . | . | . | . | . | . | I |
| Cladonia coccifera | . | . | . | . | . | . | . | . | + | + | . | . | + | . | . | . | I |
| Maianthemum canadense | . | . | . | . | . | . | . | . | . | . | . | . | + | . | 1.1 | . | I |
| Hypogymnia physodes | + | + | . | . | 1.2 | + | . | . | . | . | + | . | . | . | . | . | II |
| Ledum groenlandicum | . | . | . | . | . | . | . | . | 1.1 | . | . | . | 1.1 | . | . | . | I |
| Solidago uliginosa | . | . | + | . | . | + | . | . | . | . | . | . | . | . | . | . | I |
| Polytrichum juniperinum | . | . | + | . | . | . | . | + | . | . | . | + | . | . | . | . | I |
| Pleurozium schreberi | + | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | I |
| Dicranum fuscescens | . | . | . | . | . | . | . | . | + | . | . | . | 1.2 | . | . | . | I |
| Total Number of Species | 24 | 22 | 23 | 20 | 18 | 18 | 17 | 18 | 27 | 26 | 25 | 25 | 23 | 16 | 17 | 19 | |

**Additional Species**

49G: – Cladonia alpestris (+); Smilacina trifolia (+)
74D: – Lycopodium selago (+)
137A: – Hypnum imponens (+); Campanula rotundifolia (+)
151B: – Vaccinium oxycoccus (1.1); Calamagrostis pickeringii (+); Euphrasia randii (+); Cladonia pyxidata (+)
138B: – Pyrus floribunda (+)
141A: – Alnus crispa (r)
74B: – Picea mariana f. empetroides (+)
74E: – Stereocaulon paschale (+); Cetraria cucullata (+)

SYNTHESIS TABLE 2: EMPETRO-RHACOMITRIETUM LANUGINOSAE ASSOCIATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 75 | 150 | 150 | 150 | 110 | 75 | 110 | 120 | 120 | 120 | 120 | 120 | 120 | 150 | 120 | 120 | 150 | 120 | 120 | 110 | 110 | 45 | 150 | 120 | 120 | 75 | 150 | 170 | 110 | 45 | 240 | 140 | 30 | 45 | 200 | 140 | 30 | 150 | 110 | 230 | 230 | 75 |
| Slope | L | L | N | L | L | H | L | S | H | N | N | N | N | L | N | N | L | N | N | L | 60 | L | L | 40 | L | N | L | 30 | 30 | N | 30 | 60 | L | L | L | N | N | L | 40 | L | L | L |
| Aspect | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | S | – | – | S | – | – | – | S | W | – | W | N | – | – | – | – | – | – | S | – | – | – |
| % Phanerogam | 70 | 70 | 50 | 80 | 80 | 80 | 80 | 70 | 70 | 70 | 70 | 70 | 70 | 90 | 70 | 70 | 80 | 70 | 80 | 80 | 70 | 90 | 75 | 70 | 80 | 70 | 80 | 70 | 80 | 80 | 70 | 80 | 80 | 80 | 70 | 60 | 70 | 40 | 70 | 80 | 80 | 30 |
| % Cryptogam | 50 | 70 | 80 | 70 | 60 | 60 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 30 | 80 | 70 | 70 | 80 | 70 | 70 | 70 | 40 | 50 | 50 | 60 | 70 | 70 | 60 | 50 | 70 | 70 | 40 | 20 | 60 | 80 | 60 | 80 | 80 | 70 | 60 | 60 | 70 |
| Relevé Number | 17 C | 20 D | 20 B | 20 A | 16 D | 17 E | 16 C | 42 B | 42 E | 42 F | 42 G | 42 I | 42 J | 20 C | 42 D | 42 K | 57 C | 42 C | 42 A | 16 B | 22 C | 11 C | 15 D | 14 D | 14 C | 17 B | 15 E | 21 D | 22 A | 12 A | 62 B | 13 B | 18 C | 11 D | 61 A | 43 B | 18 D | 20 F | 30 B | 33 G | 33 A | 5 B |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cetraria nivalis | + | 3.3 | + | 1.2 | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| Trientalis borealis | . | . | . | + | . | . | . | + | 1.1 | 1.1 | + | + | . | + | + | + | + | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . |
| Cladonia elongata | . | . | . | . | . | . | . | 1.1 | + | 1.1 | + | 1.1 | 1.1 | . | . | + | + | 1.1 | + | + | . | . | . | . | . | . | 1.2 | + | + | . | . | . | . | . | . | 1.2 | . | . | + | . | . | + |
| Cladonia uncialis | . | . | 2.2 | . | + | . | . | 2.2 | 1.2 | 1.2 | 1.2 | 2.2 | 1.2 | + | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 |
| Cladonia squamosa | . | . | . | + | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | 1.2 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cornicularia aculeata | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | + | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 2.2 | . |
| Lycopodium clavatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . |
| Smilacina trifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . |
| Pyrus floribunda | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.1 | 1.1 | + | + | 1.1 | 1.1 | 1.1 | . | . | . | . |
| Chamaedaphne calyculata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . |
| Kalmia polifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | r | . | + | . | . | . | . | . | . | . |
| Dicranum fuscescens | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | 3.2 | 3.2 | 2.2 |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rhacomitrium lanuginosum | 2.2 | 1.2 | 4.4 | 2.2 | 3.3 | 2.2 | 2.2 | 3.3 | 3.3 | 3.3 | 3.3 | . | . | 2.2 | 4.4 | 3.3 | 3.3 | 4.4 | 3.3 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | . | 3.3 | . | 2.2 | 2.2 | 3.3 | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 4.4 | 4.4 | . | + | 2.2 | 4.4 |
| Vaccinium uliginosum | + | 2.1 | 1.1 | 2.1 | 2.1 | + | 2.1 | . | 1.1 | 3.1 | 3.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 3.1 | 3.1 | 2.1 | 2.2 | 2.1 | 3.1 | 1.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | 2.1 | 1.1 | . | . | 2.2 | 2.1 | 3.2 | 2.2 | 3.2 | . |
| Sphaerophorus globosus | 2.2 | 1.2 | 1.2 | 1.2 | 2.2 | 2.2 | 3.3 | . | 1.2 | 2.2 | + | 2.2 | 1.2 | + | + | . | . | . | + | . | . | . | 1.2 | 1.2 | . | 2.2 | 2.2 | + | . | . | . | . | . | . | . | . | . | . | + | + | + | 1.2 |
| Cladonia boryi | 1.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | . | . | 2.2 | . | 1.2 | + | + | r | 2.2 | 2.2 | + | . | 2.2 | + | + | 2.2 | 2.2 | . | . | r | . | . | . | 2.2 | 1.2 | . | . | 2.2 | 2.2 | 1.2 | . | 2.2 |
| Cetraria islandica | 1.2 | 1.2 | + | . | + | + | 1.2 | . | . | 1.2 | + | + | + | . | + | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Potentilla tridentata | + | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 2.1 | + | 1.1 | 1.1 | 2.1 | 1.1 | + | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Deschampsia flexuosa | 2.2 | 1.2 | + | 1.2 | 1.2 | 2.2 | 1.2 | . | 2.2 | . | 1.2 | 2.2 | . | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | + | . | + | . | . | 2.2 | 2.2 | . | 1.2 | . | 1.2 | . | . | 1.2 | . | . | . | + | 1.2 | 1.2 | 1.2 | 1.2 |
| Calamagrostis pickeringii | + | . | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | . | + | . | . | . | . | . | 1.1 | 2.1 | 1.1 | . | 1.1 | 1.1 | . | 3.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | + | 1.1 | 1.1 | 1.1 | . | . | 1.1 |
| Prenanthes trifoliolata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | . | + | . | . | . | . | . | . | 1.1 | + | . | . | + | + | r | 1.1 | 1.1 |
| Solidago uliginosa | . | . | . | + | + | + | + | . | . | . | . | . | . | . | . | + | . | . | . | + | . | + | . | . | + | + | + | + | . | . | . | . | + | . | . | + | + | + | . | . | . | + |
| Vaccinium angustifolium | 1.1 | + | 1.1 | 1.1 | + | 1.1 | + | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | + | 1.1 | . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | 1.1 | 2.1 | . | + | 2.1 | 2.1 | 2.1 | 1.1 |
| Vaccinium vitis-idaea | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 3.3 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | . | 1.2 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| Kalmia angustifolia | + | + | + | 1.1 | 2.2 | 1.2 | 2.2 | 1.1 | 1.1 | . | . | + | + | 1.1 | . | 1.1 | 1.1 | + | + | 2.2 | . | 1.1 | . | 1.1 | . | 2.2 | 2.1 | 2.1 | 2.1 | . | 2.1 | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.2 | . | r | 1.1 | . | 1.1 |
| Ledum groenlandicum | . | . | . | . | . | + | . | 1.1 | 2.1 | . | + | + | + | + | + | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | . | + | . | . | . | . | + | 1.1 | 2.1 | 1.1 | 1.1 | . | 1.1 | + | 1.1 | . | 1.1 | . | r | . |
| Empetrum nigrum | 2.2 | 3.3 | 2.2 | . | 4.4 | 4.4 | 3.3 | 3.3 | 3.3 | 3.3 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | 3.3 | 2.2 | 3.3 | 3.3 | 2.2 | 4.4 | . | 3.3 | 2.2 | 3.3 | . | 2.2 | . | 3.3 | . | . | 3.3 | 2.2 | . | 2.2 | r | . | 2.2 | 3.3 | 2.2 | . |
| Cladonia rangiferina | + | 2.2 | . | 2.2 | 1.2 | 1.2 | 1.2 | 2.2 | . | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | + | 1.2 | 2.2 | + | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 3.3 | 3.2 | . | 3.2 | . | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | 3.2 | 2.2 | 2.2 | . |
| Cladonia arbuscula | 1.2 | 2.2 | . | 2.2 | 2.2 | 2.2 | . | 1.2 | 1.2 | 2.2 | 1.2 | + | 1.2 | 1.2 | + | + | 3.2 | + | 2.2 | 3.2 | 2.2 | 2.2 | . | 2.2 | 2.2 | 1.2 | . | 2.2 | 2.2 | 2.2 | 2.2 | . | + | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | 2.2 | . |
| Cladonia mitis | + | 2.2 | . | 1.2 | 1.2 | 1.2 | 1.2 | + | + | 1.2 | 1.2 | . | 2.2 | 1.2 | + | + | 1.2 | + | 1.2 | 2.2 | 1.2 | 2.2 | 3.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | . | 1.2 | . | . | . | 1.2 | 2.2 | 3.2 | . | 1.2 | . | 1.2 | 2.2 |
| Cornus canadensis | 1.1 | . | + | + | 1.1 | + | + | 1.1 | 2.1 | 1.1 | 1.1 | . | . | . | 2.1 | + | . | 1.1 | 1.1 | + | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | . | + | . | 1.1 | 1.1 | 1.1 | + | . | . | + | . | . | . |
| Cladonia alpestris | . | 2.2 | . | 3.2 | . | . | 1.2 | . | . | . | . | + | 2.2 | . | . | . | 1.2 | . | . | 2.2 | . | 1.2 | . | . | 1.2 | . | . | 1.2 | . | . | . | . | . | 2.2 | 3.2 | . | . | . | 2.2 | . | 1.2 | . |
| Juniperus communis | 3.3 | . | . | . | 1.2 | . | . | 3.3 | 2.2 | 1.2 | 3.2 | 1.2 | . | 4.4 | . | 1.2 | . | . | . | 1.2 | . | 2.2 | . | . | . | . | . | . | . | . | + | + | . | 3.3 | + | . | 2.2 | . | . | . | r | . |
| Myrica gale | . | . | + | + | . | . | . | . | . | 1.1 | 1.1 | . | . | . | . | . | . | . | 1.1 | . | 1.1 | 1.1 | . | . | + | . | 2.1 | + | + | 1.1 | . | . | 1.1 | . | 2.1 | 1.1 | + | . | . | . | . | . |
| Maianthemum canadense | 1.1 | . | . | . | + | 1.1 | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | + | + | + | 1.1 | . | . | . | . | . | . | . | 1.1 | . | . | 1.1 |
| Dicranum scoparium | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | 1.2 | . | . | . | . | 2.2 | . | . | . | . | . | . | 2.2 | . | . |
| Pleurozium schreberi | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | 1.2 | . | . | 2.2 | . | . | . | . | . | . | . | 1.2 | . | . |
| Hypogymnia physodes | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | 1.2 | 1.2 | . |
| Ochrolechia frigida | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | + | + |
| Andromeda glaucophylla | . | . | . | + | + | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . |
| Linnaea borealis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | 1.2 | . | . | . | . | . |
| Vaccinium oxycoccos | . | . | . | . | + | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | + | . | . | . | . | . |
| Cladonia amaurocraea | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . |
| Lonicera villosa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | r | . | . |
| Sanguisorba canadensis | . | . | . | . | 1.1 | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . |
| Sorbus decora | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | k | . | . |
| Scirpus cespitosus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Leucobryum glaucum | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Aster radula | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | + | . | . | . | . | . | . | . | . | . |
| Ptilidium ciliare | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Betula pumila | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . |
| Coptis groenlandica | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . |
| Lycopodium annotinum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| Loiseleuria procumbens | . | . | . | . | 2.2 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | 2.2 | . | + | . | . | . | . | . | . | . | . |
| Lycopodium complanatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| Cladonia terrae-novae | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . |
| **Total Number of Species** | 21 | 17 | 17 | 22 | 25 | 22 | 22 | 17 | 20 | 19 | 19 | 18 | 17 | 19 | 17 | 19 | 18 | 18 | 18 | 24 | 14 | 19 | 15 | 20 | 20 | 19 | 21 | 22 | 20 | 16 | 18 | 20 | 21 | 21 | 23 | 17 | 16 | 12 | 21 | 19 | 20 | [illegible] |

Additional Species

11D: – Pinus sylvestris (+)
15E: – Cladonia verticillata (+)
17B: – Cladonia cornuta (1.2)
8C: – Dicranum undulatum (+)
27C: – Nemopanthus mucronata (r); Solidago rugosa (+)
30G: – Nephroma arcticum (1.2)
5B: – Lycopodium sabinaefolium (1.2)
30A: – Geocaulon lividum (+)

SYNTHESIS TABLE 2: [illegible]_ASSOCIATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 120 | 120 | 120 | 120 | 120 | 150 | 120 | 120 | 150 | 120 | 120 | 110 | 110 | 45 | 150 | 120 | 120 | 75 | 150 | 170 | 110 | 45 | 240 | 140 | 30 | 45 | 200 | 140 | 30 | 150 | 110 | 230 | 230 | 75 | 110 | 110 | 15 | 30 | 150 | 30 | 45 | |
| | H | H | H | H | H | L | H | H | L | H | H | L | 60 | L | L | 40 | L | H | L | 30 | 30 | H | 30 | 60 | L | L | L | H | H | L | 40 | L | L | L | 40 | L | L | 25 | 30 | L | L | |
| | – | – | – | – | – | – | – | – | – | – | – | – | S | – | – | S | – | – | – | S | W | – | W | H | – | – | – | – | – | – | S | – | – | – | S | – | – | H | H | – | – | |
| | 70 | 70 | 70 | 70 | 70 | 90 | 70 | 70 | 80 | 70 | 80 | 80 | 70 | 90 | 75 | 70 | 80 | 70 | 80 | 70 | 80 | 80 | 70 | 80 | 80 | 80 | 70 | 60 | 70 | 40 | 70 | 80 | 80 | 30 | 70 | 70 | 70 | 70 | 70 | 80 | 80 | |
| | 70 | 70 | 70 | 70 | 70 | 30 | 80 | 70 | 70 | 80 | 70 | 70 | 70 | 40 | 50 | 50 | 60 | 70 | 70 | 60 | 50 | 70 | 70 | 40 | 20 | 60 | 80 | 60 | 80 | 80 | 70 | 60 | 60 | 70 | 70 | 70 | 60 | 40 | 70 | 70 | 40 | |
| | 42 K | 42 F | 42 G | 42 I | 42 J | 20 C | 42 D | 42 E | 57 C | 42 C | 42 A | 16 B | 22 C | 11 C | 15 D | 14 D | 14 C | 17 B | 15 E | 21 D | 22 A | 12 A | 62 B | 13 B | 18 C | 11 D | 61 A | 43 B | 18 D | 20 F | 30 B | 33 C | 33 A | 5 B | 30 A | 30 C | 7 A | 10 C | 57 B | 8 C | 27 C | Presence Value |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | 1.1 | 1.1 | + | + | . | + | + | + | + | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | II |
| | + | 1.1 | + | 1.1 | 1.1 | . | . | + | + | 1.1 | + | + | . | . | . | . | . | . | 1.2 | + | + | . | . | . | . | . | . | 1.2 | . | . | + | . | . | + | . | . | . | . | . | . | 2.2 | II |
| | 1.2 | 1.2 | 1.2 | 2.2 | 1.2 | + | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | 2.2 | . | II |
| | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | 1.2 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | + | . | . | . | . | . | + | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 2.2 | . | . | . | 1.2 | 1.2 | 1.2 | . | . | II |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.2 | 1.2 | 1.1 | 1.2 | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.1 | 1.1 | + | + | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | r | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | 3.2 | 3.2 | 2.2 | 2.2 | 2.2 | . | . | . | . | . | I |
| | 3.3 | 3.3 | 3.3 | . | . | 2.2 | 4.4 | 3.3 | 3.3 | 4.4 | 3.3 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | . | 3.3 | . | 2.2 | 2.2 | 3.3 | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 4.4 | 4.4 | . | + | 2.2 | 4.4 | . | . | 2.2 | . | 2.2 | 3.3 | 2.2 | V |
| | 1.1 | 3.1 | 3.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 3.1 | 3.1 | 2.1 | 2.2 | 2.1 | 3.1 | 1.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | 2.1 | 1.1 | . | . | 2.2 | 2.1 | 3.2 | 2.2 | 3.2 | . | . | . | . | . | . | . | . | IV |
| | 1.2 | 2.2 | + | 2.2 | 1.2 | + | + | . | . | . | + | . | . | . | 1.2 | 1.2 | . | 2.2 | 2.2 | + | . | . | . | . | . | . | . | . | . | . | + | + | + | 1.2 | . | . | 1.2 | . | . | + | . | IV |
| | 2.2 | 1.2 | . | . | 2.2 | . | 1.2 | + | + | r | 2.2 | 2.2 | + | . | 2.2 | + | + | 2.2 | 2.2 | . | . | r | . | . | . | 2.2 | 1.2 | . | . | 2.2 | 2.2 | 1.2 | . | 2.2 | 3.2 | 2.2 | . | 1.2 | . | . | . | IV |
| | . | 1.2 | + | + | + | . | + | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | + | + | . | . | . | . | . | II |
| | 1.1 | 1.1 | 1.1 | 2.1 | + | 1.1 | 1.1 | 2.1 | 1.1 | + | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 2.1 | 1.1 | + | 1.1 | + | V |
| | 2.2 | . | 1.2 | 2.2 | . | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | + | . | + | . | . | 2.2 | 2.2 | . | 1.2 | . | 1.2 | . | . | 1.2 | . | . | . | + | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | IV |
| | 1.1 | . | . | + | . | . | . | . | . | 1.1 | 2.1 | 1.1 | . | 1.1 | 1.1 | . | 3.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | + | 1.1 | 1.1 | 1.1 | . | . | 1.1 | . | . | 1.1 | . | . | 1.1 | . | IV |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | + | + | . | + | . | . | . | . | . | . | 1.1 | + | . | . | + | + | r | 1.1 | 2.1 | . | 1.1 | . | . | + | 1.1 | . | II |
| | . | . | . | . | . | . | . | + | . | . | . | + | . | + | . | . | + | + | + | + | . | . | . | . | + | . | . | + | + | + | . | . | . | + | . | . | + | + | . | + | . | II |
| . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | + | 1.1 | . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | 1.1 | 2.1 | . | + | 2.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 1.1 | 1.1 | + | 2.1 | 1.1 | V |
| : | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 3.3 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | . | 1.2 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | + | V |
| . | 1.1 | . | . | + | + | 1.1 | . | 1.1 | 1.1 | + | + | 2.2 | . | 1.1 | . | 1.1 | . | 2.2 | 2.1 | 2.1 | 2.1 | . | 2.1 | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.2 | . | + | 1.1 | . | 1.1 | + | . | 1.1 | 2.1 | 1.1 | 2.1 | 2.1 | V |
| . | 2.1 | . | + | + | + | + | + | 1.1 | 1.1 | 1.1 | 1.1 | + | + | 1.1 | . | + | . | . | . | . | + | 1.1 | 2.1 | 1.1 | 1.1 | . | 1.1 | + | 1.1 | . | 1.1 | . | r | . | 2.1 | 1.1 | . | 1.1 | . | 1.1 | 2.1 | V |
| 3 | 3.3 | 3.3 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | 3.3 | 2.2 | 3.3 | 3.3 | 2.2 | 4.4 | . | 3.3 | 2.2 | 3.3 | . | 2.2 | . | 3.3 | . | . | 3.3 | 2.2 | . | 2.2 | r | . | 2.2 | 3.3 | 2.2 | . | 3.3 | 3.3 | 3.2 | . | 3.3 | 3.3 | . | V |
| ! | . | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | + | 1.2 | 2.2 | + | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 3.3 | 3.2 | . | 3.2 | . | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | 3.2 | 2.2 | 2.2 | . | . | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | V |
| : | 1.2 | 2.2 | 1.2 | + | 1.2 | 1.2 | + | + | 3.2 | + | 2.2 | 3.2 | 2.2 | 2.2 | . | 2.2 | 2.2 | 1.2 | . | 2.2 | 2.2 | 2.2 | 2.2 | . | + | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | 2.2 | . | 2.2 | 1.2 | . | . | 1.2 | 2.2 | 1.2 | V |
| | + | 1.2 | 1.2 | . | 2.2 | 1.2 | + | + | 1.2 | + | 1.2 | 2.2 | 1.2 | 2.2 | 3.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | . | 1.2 | . | . | . | 1.2 | 2.2 | 3.2 | . | 1.2 | . | 1.2 | 2.2 | 3.2 | 1.2 | 2.2 | 2.2 | 3.2 | 2.2 | 1.2 | V |
| . | 2.1 | 1.1 | 1.1 | . | . | . | 2.1 | + | . | 1.1 | 1.1 | + | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | + | . | + | . | 1.1 | 1.1 | 1.1 | + | . | . | + | . | . | . | + | + | + | . | + | + | + | IV |
| | . | . | . | + | 2.2 | . | . | . | 1.2 | . | . | 2.2 | . | 1.2 | . | . | 1.2 | . | . | 1.2 | . | . | . | . | . | 2.2 | 3.2 | . | . | . | 2.2 | . | 1.2 | . | 2.2 | 2.2 | 2.2 | + | 2.2 | . | . | II |
| ) | 2.2 | 1.2 | 3.2 | 1.2 | . | 4.4 | . | 1.2 | . | . | . | 1.2 | . | 2.2 | . | . | . | . | . | . | . | . | + | + | . | 3.3 | + | . | 2.2 | . | . | . | r | . | . | . | . | 2.2 | . | . | 2.2 | II |
| | . | 1.1 | 1.1 | . | . | . | . | . | . | . | 1.1 | . | 1.1 | 1.1 | . | . | + | . | 2.1 | + | + | 1.1 | . | . | 1.1 | . | 2.1 | 1.1 | + | . | . | . | . | . | . | . | 2.1 | . | . | . | . | II |
| | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | + | + | + | 1.1 | . | . | . | . | . | . | . | 1.1 | . | . | 1.1 | 1.1 | 2.1 | | | | | | II |
| | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | 1.2 | . | . | . | . | 2.2 | . | . | . | . | . | . | 2.2 | . | . | . | 2.2 | . | . | . | . | 3.3 | I |
| | . | . | . | . | . | 2.2 | . | . | . | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | 1.2 | . | . | 2.2 | . | . | . | . | . | . | . | 1.2 | . | . | . | + | . | . | . | 1.2 | . | I |
| | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | 1.2 | 1.2 | . | . | 1.2 | . | . | . | . | + | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | + | + | . | . | . | . | . | + | . | I |
| | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | r | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | k | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | + | . | . | . | . | . | I |
| | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | 2.2 | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | I |
| | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| .7 | 20 | 19 | 19 | 18 | 17 | 19 | 17 | 19 | 18 | 18 | 18 | 24 | 14 | 19 | 15 | 20 | 20 | 19 | 21 | 22 | 20 | 16 | 18 | 20 | 21 | 21 | 23 | 17 | 16 | 12 | 21 | 19 | 20 | 19 | 17 | 20 | 18 | 16 | 16 | 22 | 19 | |

SYNTHESIS TABLE 3: EMPETRO-POTENTILLETUM TRIDENTATAE ASSOCIATION

| Relevé Number | 48 C | 15 A | 57 A | 19 C | 33 B | 45 A | 49 L | 43 E | 43 D | 19 B | 43 A | 6 A | 43 C | 20 E | 19 D | 18 E | 19 A | 14 B | 56 G | 55 B | 7 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 90 | 150 | 150 | 120 | 230 | 170 | 240 | 140 | 140 | 120 | 140 | 90 | 140 | 150 | 120 | 30 | 120 | 120 | 120 | 30 | 15 |
| Slope | 50 | H | 50 | 20 | 30 | 10 | 60 | H | H | L | H | 20 | H | L | 20 | 40 | L | L | 60 | L | L |
| Aspect | S | - | N | W | E | W | E | - | - | - | - | W | - | - | W | S | - | - | W | - | - |
| % Phanerogams | 80 | 80 | 70 | 80 | 70 | 80 | 70 | 70 | 70 | 80 | 70 | 80 | 70 | 80 | 70 | 90 | 80 | 90 | 70 | 80 | 90 |
| % Cryptogams | 70 | 70 | 70 | 60 | 70 | 70 | 80 | 70 | 70 | 20 | 80 | 50 | 70 | 70 | 70 | 30 | 50 | 50 | 80 | 70 | 30 |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | |
| Ptilium crista-castrensis | 3.3 | 2.2 | 3.3 | . | 1.2 | 2.2 | 2.2 | 1.2 | . | . | 1.2 | 2.2 | 2.2 | . | . | . | . | . | . | . | . |
| Hylocomium splendens | . | . | 2.2 | 2.2 | 2.2 | 2.2 | 3.2 | 1.2 | 1.2 | 2.2 | 2.2 | . | 2.2 | 3.3 | 2.2 | . | . | . | . | . | . |
| Myrica gale | . | . | . | . | . | . | . | . | . | 1.1 | 2.1 | 1.1 | 2.1 | + | + | 2.1 | . | 1.1 | . | . | + |
| Chamaedaphne calyculata | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | . | + | 1.1 | . |
| Lycopodium clavatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Linnaea borealis | . | + | 1.2 | 1.2 | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . |
| Coptis groenlandicum | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | |
| Potentilla tridentata | 1.1 | . | + | 1.1 | 1.1 | 1.1 | . | 1.1 | 1.1 | + | + | 1.1 | + | + | 1.1 | + | 1.1 | + | 2.1 | 1.1 | 2.1 |
| Deschampsia flexuosa | . | . | 1.2 | 1.2 | 1.2 | . | . | 1.2 | 1.2 | . | . | 1.2 | . | + | 1.2 | 1.2 | 1.2 | . | . | 1.2 | 1.2 |
| Calamagrostis pickeringii | 1.1 | 1.1 | 1.1 | 1.1 | . | . | 1.1 | 1.1 | . | . | 1.1 | 2.1 | + | + | r | 1.1 | 2.1 | . | 1.1 | 1.1 | 1.1 |
| Prenanthes trifoliolata | + | . | . | + | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Solidago uliginosa | 1.1 | + | + | . | . | . | . | . | . | . | + | . | . | . | + | . | . | + | + | . | + |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | |
| Vaccinium angustifolium | 2.1 | 2.1 | 3.1 | 1.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | . | 1.1 | . |
| Vaccinium vitis-idaea | 2.2 | 2.2 | 1.2 | 2.2 | . | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | . | 1.2 | 2.2 |
| Empetrum nigrum | . | 4.4 | 3.3 | 3.3 | . | 3.3 | 1.2 | 3.3 | 3.3 | 2.2 | 3.3 | . | 3.3 | 4.4 | . | 2.2 | 3.3 | 3.3 | . | 3.3 | 4.4 |
| Kalmia angustifolia | 3.1 | . | 2.1 | 1.2 | 1.1 | 1.1 | . | 1.1 | 1.2 | + | 2.2 | 2.1 | 2.2 | 1.1 | 1.1 | 2.1 | + | 1.1 | . | 2.1 | 1.1 |
| Ledum groenlandicum | 2.1 | + | . | . | 1.1 | 1.1 | 3.1 | 1.1 | . | . | 2.1 | 1.1 | 2.1 | 1.1 | 2.1 | 1.1 | + | . | 1.1 | 1.1 | . |
| Cladonia rangiferina | 2.2 | 2.2 | 1.2 | 2.2 | 3.2 | 2.2 | 1.2 | 2.2 | 2.2 | . | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | . | 1.2 | 3.2 | . | 1.2 | 2.2 |
| Cladonia arbuscula | . | 2.2 | 2.2 | 3.3 | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | . | 2.2 | . | 1.2 | . | 3.3 | . | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 |
| Cladonia mitis | . | 3.2 | 2.2 | 2.2 | 2.2 | 2.2 | + | 2.2 | 2.2 | + | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | + | 1.2 | 1.2 | . | 2.2 | 2.2 |
| Cornus canadensis | 1.1 | 1.1 | + | . | . | + | 1.1 | 1.1 | 1.1 | . | + | . | . | + | . | + | 1.1 | 1.1 | + | + | . |
| Cladonia alpestris | 2.2 | + | . | 1.2 | 1.2 | 3.2 | . | . | . | . | 1.2 | . | . | . | . | . | 2.2 | 1.2 | . | 2.2 | . |
| Vaccinium uliginosum | . | . | . | 1.1 | . | . | 1.1 | 3.1 | 2.1 | 1.1 | . | . | . | 1.1 | 1.1 | 1.1 | 2.1 | 2.1 | 3.3 | . | . |
| Pleurozium schreberi | 2.2 | 2.2 | 2.2 | . | 1.2 | 3.3 | 1.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | 2.2 | . | . | 2.2 | 1.2 |
| Dicranum scoparium | 3.2 | . | 2.2 | 2.2 | 2.2 | 1.2 | 3.2 | . | . | 1.2 | . | . | . | . | 2.2 | . | 1.2 | . | . | . | . |
| Juniperus communis | . | . | . | 2.2 | 2.2 | . | . | 1.2 | 3.2 | 4.4 | . | 3.3 | . | 1.2 | . | . | 2.2 | . | 1.2 | . | . |
| Cornicularia aculeata | . | . | . | . | 3.2 | 2.2 | . | . | . | . | . | . | . | . | 1.2 | . | + | . | . | 1.2 | . |
| Cladonia elongata | . | + | 1.2 | . | . | . | 2.2 | . | . | . | 1.2 | 1.2 | 1.2 | + | 1.2 | . | . | . | . | . | . |
| Pyrus floribunda | . | . | . | . | . | . | . | . | + | . | . | + | + | + | . | + | . | . | . | . | . |
| Maianthemum canadense | . | . | . | + | . | . | . | . | . | . | . | + | . | . | . | + | + | 2.1 | . | . | . |
| Cetraria islandica | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | + | . | + | . | 1.2 | . | . |
| Trientalis borealis | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | + |
| Sanguisorba canadensis | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.1 | . | . | . | . | . |
| Lonicera villosa | . | . | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . |
| Smilacina trifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . |
| Kalmia polifolia | . | . | . | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . |
| Hypogymnia physodes | . | + | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Rhododendron canadense | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . |
| Nemopanthus mucronata | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Amelanchier bartramiana | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Viburnum cassinoides | . | . | . | . | . | . | . | . | . | . | r | 1.1 | 1.1 | . | . | . | . | . | . | . | . |
| Vaccinium oxycoccus | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . |
| Lycopodium complanatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia macrophylla | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | . |
| Cladonia amaurocraea | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia squamosa | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . |
| Ochrolechia frigida | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Lycopodium annotinum | 1.2 | . | + | . | . | + | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . |
| Cladonia coccifera | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Solidago rugosa | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia uncialis | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Dicranum undulatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . |
| Spiraea latifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | + | . |
| Leucobryum glaucum | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Betula pumila | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . |
| Osmunda cinnamomea | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Gaultheria hispidula | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Total Number of Species | 18 | 18 | 20 | 20 | 17 | 25 | 19 | 18 | 16 | 12 | 21 | 18 | 18 | 21 | 25 | 20 | 25 | 16 | 10 | 21 | 13 |

| Relevé Number | 3 B | 9 C | 5 A | 62 A | 9 A | 11 A | 29 B | 8 D | 10 A | 69 B | 29 D | 18 A | 18 B | 12 B | 17 D | 8 A | 32 A | 23 A | 59 A | 32 F | Presence Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 60 | 30 | 75 | 240 | 30 | 45 | 70 | 30 | 30 | 180 | 90 | 30 | 30 | 45 | 75 | 30 | 90 | 150 | 60 | 90 | |
| Slope | 30 | L | 10 | L | 25 | 5 | H | L | L | 30 | 60 | 50 | 30 | 10 | 20 | 40 | 40 | L | 10 | L | |
| Aspect | E | - | S | - | N | E | - | - | - | E | S | S | S | S | S | N | N | - | E | - | |
| % Phanerogams | 90 | 80 | 80 | 70 | 70 | 70 | 80 | 80 | 90 | 70 | 70 | 80 | 80 | 80 | 80 | 70 | 70 | 60 | 90 | 70 | |
| % Cryptogams | 20 | 10 | 70 | 80 | 50 | 60 | 70 | 30 | 30 | 60 | 70 | 70 | 20 | 70 | 60 | 50 | - | 30 | - | 20 | |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | |
| Ptilium crista-castrensis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Hylocomium splendens | . | . | . | . | . | . | 3.3 | . | . | . | . | . | . | . | 3.3 | . | . | . | . | . | II |
| Myrica gale | 3.2 | 1.1 | 1.1 | 1.1 | + | 2.1 | . | . | . | . | . | 2.1 | 1.1 | . | . | . | . | . | . | . | III |
| Chamaedaphne calyculata | 1.1 | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | II |
| Lycopodium clavatum | . | . | . | . | 1.2 | 1.1 | 1.2 | r | 1.1 | 2.2 | 2.2 | . | . | . | . | . | . | . | . | . | I |
| Linnaea borealis | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | . | . | II |
| Coptis groenlandicum | . | . | . | . | . | . | . | . | . | . | + | 1.1 | 1.1 | + | 1.1 | . | . | . | . | . | I |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | |
| Potentilla tridentata | + | 1.1 | 2.1 | . | 1.1 | 1.1 | + | 2.1 | . | + | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | V |
| Deschampsia flexuosa | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | 2.2 | 1.2 | 1.2 | . | . | 1.2 | III |
| Calamagrostis pickeringii | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.1 | . | 1.1 | . | . | 2.1 | 2.1 | 1.1 | + | . | . | . | . | . | IV |
| Prenanthes trifoliolata | . | 1.1 | + | . | 1.1 | + | . | . | 1.1 | + | + | + | + | + | . | . | 1.1 | . | 1.1 | . | II |
| Solidago uliginosa | . | . | 1.1 | 1.1 | + | + | . | . | . | . | . | + | . | + | + | 1.1 | . | . | 1.1 | . | III |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | |
| Vaccinium angustifolium | 1.1 | 1.1 | 2.1 | 1.1 | 2.1 | 1.1 | 3.1 | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | . | 3.1 | 3.1 | 1.1 | V |
| Vaccinium vitis-idaea | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 2.2 | 1.2 | . | 2.2 | 2.2 | . | 1.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | V |
| Empetrum nigrum | 2.2 | 3.3 | . | 2.2 | 3.3 | 3.3 | 1.1 | 4.4 | 5.5 | 2.2 | . | 3.3 | 2.2 | 3.3 | 3.3 | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | V |
| Kalmia angustifolia | 3.1 | 1.1 | 1.1 | 2.1 | . | 1.1 | + | 1.1 | 1.1 | 1.1 | . | + | + | 1.1 | + | 1.1 | . | . | . | . | IV |
| Ledum groenlandicum | 2.1 | 1.1 | . | 2.1 | 1.1 | 1.1 | 2.1 | 2.1 | + | 1.1 | . | + | + | 1.1 | 1.1 | + | . | . | 1.1 | . | IV |
| Cladonia rangiferina | . | 1.2 | 3.2 | 2.2 | . | 3.3 | 3.3 | 2.2 | 2.2 | + | 3.3 | . | . | 2.2 | . | 2.2 | . | . | . | . | IV |
| Cladonia arbuscula | . | . | 1.2 | 2.2 | 2.2 | . | 2.2 | . | . | + | 2.2 | + | . | + | . | . | . | 2.2 | . | 1.2 | IV |
| Cladonia mitis | 2.2 | . | 1.2 | 1.2 | . | 2.2 | 2.2 | 2.2 | 1.2 | + | 2.2 | . | . | + | . | 2.2 | . | . | . | . | IV |
| Cornus canadensis | 1.1 | + | 1.1 | . | + | . | + | 1.1 | . | + | 1.1 | 1.1 | 1.1 | + | + | 1.1 | . | + | 1.1 | + | IV |
| Cladonia alpestris | . | . | 2.2 | 3.2 | . | 2.2 | . | 2.2 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | II |
| Vaccinium uliginosum | . | . | . | . | . | . | . | . | . | . | . | 2.1 | 1.1 | . | 2.1 | . | . | 1.1 | 1.1 | 3.2 | II |
| Pleurozium schreberi | . | . | . | . | 2.2 | . | 2.2 | 1.2 | . | . | . | . | . | 3.2 | . | 1.2 | . | . | . | . | III |
| Dicranum scoparium | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | 2.2 | . | 1.2 | 1.2 | . | . | . | . | . | II |
| Juniperus communis | . | 3.3 | 2.2 | 2.2 | . | . | . | . | . | . | 1.2 | . | . | 3.3 | 2.2 | . | 3.3 | . | 1.2 | . | III |
| Cornicularia aculeata | . | . | 1.2 | 2.2 | . | . | . | + | . | 3.2 | . | . | . | . | . | 1.2 | . | 2.2 | . | 2.2 | II |
| Cladonia elongata | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | II |
| Pyrus floribunda | 1.1 | . | . | . | + | . | . | . | . | . | . | 1.1 | 1.1 | + | . | . | . | . | + | . | II |
| Maianthemum canadense | 1.1 | . | 1.1 | 2.1 | . | . | . | 1.1 | . | + | 2.1 | + | . | . | + | . | . | . | . | 1.1 | II |
| Cetraria islandica | . | . | 1.2 | . | 1.2 | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Trientalis borealis | . | . | + | . | . | . | + | + | 1.1 | . | . | + | + | + | . | 1.1 | . | . | . | . | II |
| Sanguisorba canadensis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | I |
| Lonicera villosa | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | r | . | . | . | 1.1 | . | I |
| Smilacina trifolia | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | I |
| Kalmia polifolia | 1.1 | . | . | + | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | I |
| Hypogymnia physodes | . | . | 2.2 | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Rhododendron canadense | . | . | . | . | . | . | 1.1 | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | I |
| Nemopanthus mucronata | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | I |
| Amelanchier bartramiana | . | . | . | . | . | . | 2.1 | . | . | . | + | . | . | . | . | . | . | . | . | . | I |
| Viburnum cassinoides | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | + | . | I |
| Vaccinium oxycoccus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Lycopodium complanatum | . | . | . | 1.2 | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Cladonia macrophylla | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Cladonia amaurocraea | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | I |
| Cladonia squamosa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Ochrolechia frigida | . | . | . | 3.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Lycopodium annotinum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Cladonia coccifera | . | . | . | + | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | I |
| Solidago rugosa | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Cladonia uncialis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | I |
| Dicranum undulatum | 2.2 | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | I |
| Spiraea latifolia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Leucobryum glaucum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | I |
| Betula pumila | . | . | . | . | . | . | . | . | . | . | . | . | 3.2 | . | . | . | . | . | . | . | I |
| Osmunda cinnamomea | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | I |
| Gaultheria hispidula | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | 1.1 | . | . | . | . | I |
| Total Number of Species | 16 | 13 | 21 | 20 | 19 | 17 | 21 | 17 | 15 | 21 | 16 | 19 | 17 | 24 | 22 | 16 | 6 | 9 | 14 | 10 | |

**Additional Species**

11A: – Pinus sylvestris (r)
9A: – Sphagnum fuscum (1.2); Polytrichum juniperinum (1.1)
12B: – Hypnum imponens (2.2); Carex bigelowii (1.2)
69B: – Lycopodium obscurum (1.2)
45A: – Dicranum fulvum (1.2); Cladonia crispata (+)
20E: – Cladonia terrae-novae (2.2); Juniperus horizontalis (+)
43E: – Rhacomitrium lanuginosum (2.2)
19A: – Cladonia boryi (2.2); Aster radula (+); Sphaerophorus globosus (1.2)
49L: – Ribes glandulosum (+)
17D: – Rhytidiadelphus triquetrus (2.2)
33B: – Ptilidium ciliare (2.2)
10A: – Aster nemoralis (+)
14B: – Andromeda glaucophylla (+)
18B: – Clintonia borealis (1.1)

SYNTHESIS TABLE 4. LUZULO-POLYTRICHETUM COMMUNE ASSOCIATION

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | 150 | 80 | 80 | 50 | 50 | 150 | 80 | 80 | 150 | 150 | 150 | 80 | 150 | 150 | 50 | |
| Slope | 40 | 10 | 10 | 25 | L | L | 10 | 10 | L | L | 20 | 10 | 30 | 30 | 25 | |
| Aspect | S | S | S | S | – | – | S | S | – | – | S | S | S | N | S | |
| % Phanerogam | 70 | 70 | 70 | 70 | 75 | 60 | 70 | 70 | 80 | 70 | 70 | 80 | 70 | 70 | 70 | |
| % Cryptogam | 40 | 10 | 10 | 10 | 20 | 40 | 10 | 10 | 50 | 10 | 60 | 20 | 60 | 5 | – | |
| Relevé Number | 37 A | 38 G | 38 D | 38 B | 38 C | 37 G | 38 H | 38 E | 37 B | 37 J | 37 F | 38 F | 37 E | 37 I | 38 A | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | |
| Achillea millefolium | + | + | + | 1.1 | 1.1 | + | + | . | . | . | . | . | . | . | . | III |
| Fragaria virginiana | + | r | 1.1 | + | . | . | . | . | . | . | . | . | . | . | . | II |
| Rosa nitida | . | + | . | . | . | . | . | 1.1 | + | 1.1 | . | . | . | . | . | II |
| **Differential species of the Association** | | | | | | | | | | | | | | | | |
| Luzula campestris | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | V |
| Polytrichum commune | . | 1.1 | 1.1 | 1.1 | 2.2 | 2.1 | 1.1 | 1.1 | 2.1 | . | 2.1 | 1.1 | 2.2 | + | 1.1 | V |
| Solidago rugosa | 1.1 | + | + | 1.1 | 1.1 | 1.1 | + | . | 2.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | . | V |
| Lycopodium obscurum | . | 1.1 | . | . | . | . | 1.1 | + | + | 1.1 | 1.1 | 1.1 | . | 1.1 | . | IV |
| Taraxacum officinale | + | . | + | . | 1.1 | . | . | . | + | . | . | + | . | . | . | II |
| **Companion Species** | | | | | | | | | | | | | | | | |
| Vaccinium angustifolium | 3.1 | 2.1 | 2.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 4.1 | 3.1 | 3.1 | 3.1 | 1.1 | 3.1 | 1.1 | V |
| Deschampsia flexuosa | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 1.2 | . | 2.2 | 1.2 | . | 2.2 | . | 2.2 | IV |
| Cornus canadensis | 1.1 | + | 1.1 | . | . | 1.1 | 1.1 | 1.1 | . | 1.1 | 1.1 | 1.1 | . | 2.1 | . | IV |
| Potentilla tridentata | . | 3.1 | 2.1 | 1.1 | + | 1.1 | 2.1 | 2.1 | . | . | . | 1.1 | . | . | 1.1 | III |
| Maianthemum canadense | . | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | 1.1 | 1.1 | V |
| Prenanthes trifoliolata | 1.1 | 1.1 | . | . | . | 1.1 | 1.1 | + | . | + | + | . | . | . | . | III |
| Hieracium murorum | . | . | + | 1.1 | 2.1 | . | + | . | . | . | + | . | . | . | 2.1 | II |
| Calamagrostis pickeringii | 1.1 | . | . | . | . | 1.1 | . | . | . | 1.1 | . | . | . | . | . | I |
| Trientalis borealis | + | + | . | . | . | . | . | + | . | + | . | . | . | . | . | II |
| Dicranum scoparium | 3.3 | . | . | . | . | . | . | . | . | . | . | 1.2 | 3.3 | . | . | I |
| Lonicera villosa | 1.1 | + | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | I |
| Anaphalis margaritacea | . | . | . | 1.1 | + | . | . | . | . | . | . | . | . | . | . | I |
| Spiraea latifolia | . | . | 1.1 | 2.1 | . | . | + | . | . | . | . | . | . | . | 3.1 | I |
| Vaccinium vitis-idaea | . | . | . | . | . | 2.2 | 2.2 | . | . | . | . | + | . | . | . | I |
| Pyrus floribunda | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | 2.1 | . | I |
| Dicranum fulvum | 2.2 | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | I |
| Coptis groenlandica | . | . | . | . | . | 1.1 | . | 1.1 | . | . | . | . | . | . | . | I |
| Cladonia cristatella | . | + | . | . | . | . | . | . | . | . | . | . | . | . | + | I |
| Osmunda cinnamomea | . | . | . | . | . | . | . | . | . | . | . | . | 3.1 | 1.1 | . | I |
| Aster radula | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | 1.1 | . | I |
| Amelanchier bartramiana | . | . | . | + | . | . | . | . | . | + | . | . | . | . | . | I |
| Viola adunca var minor | . | . | + | . | . | . | . | . | . | . | . | + | . | . | . | I |
| Buxbaumia aphylla | . | . | . | . | . | . | . | 1.1 | . | . | . | 1.1 | . | . | . | I |
| Total Number of Species | 16 | 15 | 14 | 13 | 11 | 13 | 17 | 13 | 8 | 13 | 14 | 15 | 7 | 11 | 13 | |

Additional Species

38A: – Kalmia angustifolia (2.1); Lycopodium clavatum (2.2); Cladonia arbuscula (+); Nemopanthus mucronata (1.1).
37A: – Polytrichum juniperinum (1.1); Rhododendron canadense (2.1).
38F: – Solidago uliginosa (+).
37I: – Cladonia elongata (+).
38H: – Viburnum cassinoides (r); Alnus crispa (+); Rubus pubescens (+).
37J: – Cladonia squamosa (+).

SYNTHESIS TABLE 5: LUZULO-EMPETRETUM NIGRAE ASSOCIATION

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | 150 | 45 | 15 | 150 | 150 | 75 | 75 | 75 | 150 | 90 | 90 | 150 | 90 | 15 | 90 | |
| Slope | 40 | L | 30 | L | 20 | 30 | 10 | L | L | L | L | L | 20 | 30 | L | |
| Aspect | E | – | E | – | E | E | W | – | – | – | – | – | E | E | – | |
| % Phanerogam | 90 | 70 | 90 | 80 | 70 | 60 | 70 | 70 | 70 | 70 | 70 | 70 | 80 | 90 | 80 | |
| % Cryptogam | 60 | 70 | 60 | 30 | 20 | 30 | 60 | 50 | 90 | 70 | 60 | 30 | 20 | 70 | 20 | |
| Relevé Number | 36 B | 27 B | 39 A | 36 C | 36 A | 35 A | 35 E | 34 E | 36 D | 29 C | 29 A | 37 H | 24 A | 39 B | 24 D | Presence Value |
| **Differential Species of the Subvariant** | | | | | | | | | | | | | | | | |
| Dicranum fuscescens | . | . | . | . | . | . | . | . | . | 2.2 | 2.2 | . | . | . | . | I |
| Cladonia elongata | . | . | . | . | . | . | . | . | . | 1.2 | + | . | . | . | . | I |
| Ptilidium céleare | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | . | . | . | . | I |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | |
| Ledum groenlandicum | 2.1 | . | + | 1.1 | 1.1 | 1.1 | 1.1 | + | . | . | . | . | . | . | . | III |
| Kalmia angustifolia | . | 3.1 | . | + | 1.1 | 1.1 | 1.1 | + | . | . | . | . | . | . | . | II |
| Juniperus communis | . | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | . | . | 1.2 | . | . | . | . | . | . | II |
| Linnaea borealis | 1.2 | 3.2 | . | 1.2 | . | 2.2 | 1.2 | . | . | . | . | . | . | . | 1.1 | II |
| Cladonia rangiferina | . | . | . | . | . | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 3.2 | + | 1.2 | 1.2 | . | III |
| Cladonia arbuscula | . | . | 2.2 | . | . | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | IV |
| Cladonia mitis | . | . | . | . | 1.2 | 1.2 | + | 2.2 | 1.2 | 2.2 | 2.2 | + | 1.2 | . | . | III |
| Lycopodium clavatum | . | . | . | 1.1 | . | 2.2 | . | . | 1.2 | . | 1.2 | 3.3 | 1.2 | . | 3.3 | III |
| Hieracium murorum | . | . | . | . | . | . | . | . | + | . | . | . | 2.1 | . | 2.1 | I |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | |
| Luzula campestris | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | + | V |
| Empetrum nigrum | 2.2 | . | 4.4 | 4.4 | . | 2.2 | 2.2 | . | 1.2 | + | 2.2 | . | . | 3.3 | 1.1 | IV |
| Dicranum scoparium | 3.2 | 3.3 | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | . | . | 2.2 | . | 2.2 | 2.2 | 3.3 | . | IV |
| Vaccinium vitis-idaea | . | . | 2.2 | . | 2.2 | . | . | . | . | 2.2 | 2.2 | 1.2 | . | 2.2 | 1.2 | III |
| Pleurozium schreberi | 2.2 | . | . | 2.2 | . | . | 3.3 | . | . | 2.2 | 1.2 | . | + | . | + | III |
| Polytrichum juniperinum | . | 1.1 | . | . | 1.2 | . | 1.1 | . | 1.1 | . | . | 1.1 | . | . | + | II |
| Taraxacum officinale | . | . | . | . | + | . | . | . | + | . | . | . | . | . | . | I |
| Solidago rugosa | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| **Companion Species** | | | | | | | | | | | | | | | | |
| Vaccinium angustifolium | 3.1 | 2.1 | 1.1 | 2.1 | 2.1 | 1.1 | 1.1 | 2.1 | 2.1 | 2.1 | 3.1 | 2.1 | 3.1 | 1.1 | 2.1 | V |
| Deschampsia flexuosa | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 3.2 | 2.2 | 1.2 | 1.2 | . | 2.2 | 2.2 | . | 3.2 | V |
| Potentilla tridentata | . | . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | . | 3.1 | 3.1 | 1.1 | 1.1 | . | . | . | IV |
| Cornus canadensis | . | + | 1.1 | + | . | 1.1 | 1.1 | . | . | . | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | IV |
| Maianthemum canadense | . | . | 1.1 | . | 1.1 | . | . | + | . | 2.1 | 1.1 | . | . | 1.1 | . | II |
| Calamagrostis pickeringii | . | . | . | . | . | . | 2.1 | 1.1 | . | . | . | 1.2 | . | . | 1.2 | II |
| Gaultheria hispidula | . | . | . | 1.2 | . | 1.2 | + | . | . | . | 1.2 | . | . | . | . | II |
| Spiraea latifolia | 1.1 | . | . | 1.1 | . | . | . | . | 1.1 | . | . | . | . | . | . | I |
| Trientalis borealis | . | . | + | . | . | + | . | . | . | . | . | . | + | . | . | I |
| Solidago uliginosa | . | . | . | . | . | + | . | + | . | . | . | . | 1.1 | . | . | I |
| Osmunda cinnamomea | . | . | + | . | . | . | . | . | . | . | + | . | . | . | . | I |
| Lycopodium obscurum | . | . | . | 1.1 | . | . | + | . | . | . | . | . | 2.1 | . | . | I |
| Amelanchier bartramiana | . | . | . | . | . | . | . | . | . | . | + | . | . | . | + | I |
| Viburnum cassinoides | . | 1.1 | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | I |
| Cladonia boryi | . | . | . | . | 1.2 | . | . | 2.2 | . | . | . | . | . | . | . | I |
| Ochrolechia frigida | . | . | . | . | . | . | . | + | . | + | . | . | . | . | . | I |
| Lycopodium annotinum | 2.2 | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | I |
| Hypnum imponens | 1.2 | . | . | . | + | . | . | . | . | . | . | . | 1.2 | . | . | I |
| Anthoxanthum odoratum | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | I |
| Ptilium crista-castrensis | 1.2 | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | I |
| Cladonia coccifera | . | . | . | . | . | . | . | . | + | . | . | 1.1 | . | . | . | I |
| Vaccinium oxycoccus | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | 1.2 | . | I |
| Cornicularia aculeata | . | . | . | . | . | . | . | . | . | 2.2 | . | . | + | . | . | I |
| Prenanthes trifoliolata | . | . | . | . | . | . | . | . | + | . | . | . | . | 1.1 | + | I |
| Total Number of Species | 14 | 15 | 16 | 16 | 19 | 20 | 20 | 16 | 18 | 19 | 21 | 14 | 21 | 15 | 18 | |

Additional Species

27B: – Betula papyrifera (+); Picea mariana (K); Rosa nitida (1.1); Rhododendron canadense (1.1)
36A: – Dicranum fulvum (1.2); Alnus crispa (1.1); Rhacomitrium lanuginosum (3.3); Sphaeophorus globosus (+)
34E: – Lonicera villosa (+); Pyrus floribunda (+)
36D: – Anaphalis margaritacea (+); Vaccinium uliginosum (+)
37H: – Coptis groenlandica (+)
24A: – Cladonia cristatella (+); Cladonia squamosa (+); Cladonia pyxidata (+); Cladonia verticillata (1.1)
39A: – Aster radula (1.1)
24D: – Lycopodium complanatum (1.1); Larix laricina (r)
29C: – Hylocomium splendens (+)
35A: – Kalmia polifolia (+)
35E: – Rhytidadelphus triquetrus (2.2); Dicranum spurium (1.2)
29A: – Cetraria islandica (1.2); Pyrola rotundifolia (+); Coccaulon lividum (r)
39B: – Myrica gale (+); Viola adunca var minor (+); Mnium hornum (2.2)

SYNTHESIS TABLE 6: KALMIETUM ANGUSTIFOLIAE ASSOCIATION

| Altitude (M.) | 45 | 75 | 75 | 75 | 60 | 90 | 70 | 60 | 75 | 30 | 70 | 25 | 140 | 140 | 75 | 15 | 15 | 140 | 70 | 90 | 30 | 120 | 140 | 140 | 140 | 75 | 75 | 90 | 170 | 110 | 90 | 110 | 110 | 90 | 90 | 240 | 150 | 90 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope | [illegible] | 25 | 25 | 25 | 10 | 20 | 50 | L | N | 50 | 30 | L | 20 | 20 | 10 | L | 5 | 10 | L | N | 30 | N | 20 | L | 10 | L | L | L | 20 | 40 | 20 | 20 | 10 | N | 20 | 10 | 50 | 50 | 15 |
| Aspect | S | S | S | S | E | E | E | - | - | N | E | - | W | W | N | - | W | W | - | - | S | - | W | - | W | - | - | - | E | E | W | E | E | - | W | N | E | E | S |
| % Phanerogams | 70 | 80 | 80 | 90 | 80 | 80 | 70 | 70 | 70 | 70 | 80 | 90 | 70 | 90 | 80 | 70 | 90 | 80 | 70 | 70 | 80 | 70 | 70 | 70 | 70 | 70 | 90 | 80 | 80 | 80 | 60 | 60 | 70 | 70 | 70 | 70 | 80 | 70 | 80 |
| % Cryptogams | 70 | 40 | 20 | 70 | 70 | 70 | 80 | 80 | 70 | 80 | 80 | 60 | 60 | 60 | 70 | 70 | 70 | 60 | 70 | 70 | 70 | 80 | 50 | 60 | 70 | 60 | 60 | 70 | 70 | 70 | 40 | 80 | 70 | 70 | 60 | 70 | 40 | 70 | 50 |
| Relevé Number | 27 A | 34 B | 34 A | 34 C | 41 A | 47 A | 25 A | 41 D | 35 D | 54 C | 54 B | 39 E | 40 D | 40 E | 28 B | 39 C | 39 D | 40 C | 58 A | 25 C | 55 A | 52 C | 40 A | 31 A | 40 B | 28 A | 35 C | 51 C | 46 B | 44 C | 4 B | 44 B | 44 A | 25 F | 4 A | 64 C | 26 C | 47 C | 26 A |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lycopodium clavatum | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Lycopodium obscurum | 2.1 | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Solidago uliginosa | . | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | + | . | . | . | . | . | . | . | . | . |
| Anthoxanthum odoratum | . | 1.2 | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Calamagrostis pickeringii | . | 1.1 | 2.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | 2.1 | 2.1 | . | . | . | . | . | . | 2.1 | . |
| Deschampsia flexuosa | 1.2 | 1.2 | 2.2 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . |
| Rhacomitrium lanuginosum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3.3 | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Juniperus communis | 2.2 | 1.2 | . | . | . | . | . | . | . | . | . | 2.2 | 2.2 | 4.4 | 2.2 | 3.2 | 3.3 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | . |
| Cornicularia aculeata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | + | + | 1.2 | + | 2.2 | 1.2 | . | . | . | . | . | . | . | . | . | . | 3.2 | . | 1.2 | . |
| Cladonia squamosa | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia coccifera | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | + | + | . | . |
| Cladonia cristatella | . | 1.2 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | 2.2 | . | + | . | . |
| Viburnum cassinoides | + | . | . | + | + | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | + | 1.1 |
| Nemopanthus mucronata | . | 1.1 | . | + | 1.1 | 2.1 | + | + | + | + | . | + | . | + | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | 1.1 | + | 1.1 | 1.1 | + | . | + | 1.1 | 1.1 | . |
| Ptilium crista-castrensis | . | . | 2.2 | 4.4 | 2.2 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | 1.2 | 2.2 | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| **Differential Species of the Sub-Association** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dicranum scoparium | 3.3 | . | 1.2 | 1.2 | 2.2 | 3.2 | 1.2 | 2.2 | . | 2.2 | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | . | 2.2 | . | . | 2.2 | 1.2 | 2.2 | 2.2 | . | 2.2 | 2.2 | . | . | 2.2 | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | . | . | . | . |
| Pleurozium schreberi | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 4.4 | 3.3 | 3.2 | 2.2 | 2.2 | 1.2 | . | 2.2 | 2.2 | 3.2 | . | 2.2 | + | 3.2 | 1.2 | . | . | + | . | 2.2 | 2.2 | 3.3 | 1.2 | . | 1.2 | 1.2 | + | . | . | . | . | . |
| Hylocomium splendens | . | . | 1.2 | 2.2 | 3.3 | . | 2.2 | 1.2 | 2.2 | . | 2.2 | 3.3 | 2.2 | 2.2 | 3.3 | 2.2 | 3.2 | 2.2 | 2.2 | + | . | . | . | 3.2 | . | . | 2.2 | . | 2.2 | 1.2 | . | . | . | . | . | . | . | . | . |
| Vaccinium oxycoccus | . | . | . | + | . | . | 1.2 | . | . | 1.2 | . | 1.2 | . | . | . | . | . | . | . | 1.2 | . | 1.2 | 1.2 | . | 1.2 | . | . | 1.2 | 1.2 | . | . | . | . | . | . | . | . | . | . |
| Gaultheria hispidula | . | . | . | 1.2 | 1.2 | . | 1.2 | . | . | . | 2.2 | + | . | . | 1.2 | . | . | . | . | 1.2 | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kalmia angustifolia | 3.1 | 2.1 | 3.1 | 4.1 | 4.1 | 3.1 | 3.1 | 2.1 | 3.1 | 3.1 | 1.1 | 3.1 | 1.1 | . | . | 1.1 | 2.1 | 1.1 | 1.1 | 2.1 | 2.1 | 2.1 | + | 1.1 | 1.1 | + | 1.1 | 3.1 | 1.1 | 2.1 | 1.1 | 2.1 | 3.1 | 2.1 | 1.1 | 2.1 | 3.1 | 2.1 | 3.1 |
| Vaccinium angustifolium | 1.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 3.1 | 1.1 | 2.1 | 2.1 | + | 2.1 | 1.1 | 1.1 | 1.1 | 3.1 | 2.1 | + | 1.1 | 2.1 |
| Cladonia arbuscula | 2.2 | . | . | . | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | + | 1.2 | 1.2 | 2.2 | . | + | 3.2 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 3.3 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | 3.2 | 1.2 | 2.2 | 1.2 |
| Cladonia mitis | 1.2 | . | . | . | 1.2 | 2.2 | + | 1.2 | 1.2 | + | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 1.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | + | + | 1.2 | 1.2 | 1.2 | . | 2.2 | 2.2 | 1.2 | . | 1.2 | 1.2 | 3.2 | . |
| Cladonia rangiferina | 3.2 | . | + | . | 3.3 | 3.3 | 1.2 | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 3.2 | 2.2 | 1.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 3.2 | 3.3 | 3.2 | 1.2 | 3.3 | 3.2 | 3.3 | 2.2 | 3.3 | 3.3 | 3.2 | . | 2.2 | 1.2 | 2.2 | . |
| Ledum groenlandicum | . | 3.1 | + | 2.1 | 1.1 | . | 2.1 | 2.1 | . | . | 2.1 | 2.1 | 1.1 | + | 3.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 2.1 | 2.1 | 2.1 | . | . | 2.1 | 1.1 | 2.1 | 1.1 | 2.1 | 2.1 | . | 1.1 | + | 1.1 | 1.1 | 1.1 |
| Cornus canadensis | . | 2.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | . | 1.1 | . | 1.1 | 1.1 | 1.1 | 1.1 | . | 1.1 | + | . | + | + | 1.1 | + | 1.1 | 1.1 | + | 2.1 | + | + | . | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 2.1 | 1.1 | . | 1.1 | + |
| Empetrum nigrum | 1.2 | . | 1.2 | 1.2 | . | . | 1.1 | 1.2 | . | 2.2 | . | 3.3 | 3.3 | 3.3 | . | 3.3 | 2.2 | 3.3 | 3.3 | . | 3.3 | + | 3.3 | 3.3 | 3.3 | 2.2 | 4.4 | . | 3.3 | . | . | . | . | 2.2 | . | . | . | . | . |
| Vaccinium vitis-idaea | . | . | . | . | . | . | . | + | . | . | + | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 1.2 | 1.2 | . | 1.2 | + | 2.2 | 2.2 | 2.2 | 2.2 | . | 1.2 | 1.2 | . | . | . | . | . | 1.1 | 2.2 | . | . | . |
| Cladina alpestris | 2.2 | . | . | . | 2.2 | 2.2 | 2.2 | 3.2 | . | 1.2 | . | . | . | + | . | + | + | 1.2 | 3.2 | 3.3 | 3.2 | 3.2 | 1.2 | . | 1.2 | . | . | 3.2 | 2.2 | 2.2 | . | 2.2 | 3.2 | 1.2 | . | . | . | 1.2 | . |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maianthemum canadense | 1.1 | 1.1 | 1.1 | . | + | . | . | . | 1.1 | . | . | 1.1 | . | 1.1 | 1.1 | . | . | 1.1 | . | . | . | . | . | 1.1 | . | 1.1 | 1.1 | . | + | . | . | . | . | . | . | 1.1 | . | 1.1 | . |
| Trientalis borealis | . | + | + | . | . | . | + | . | . | . | . | + | . | + | + | + | . | + | + | . | . | . | . | + | . | + | . | . | 1.1 | + | + | . | . | . | + | . | + | + | + |
| Linnaea borealis | 2.2 | 1.2 | 1.2 | 2.2 | . | . | . | . | 2.2 | 1.2 | . | . | 1.2 | + | . | . | . | + | . | . | . | . | . | . | 1.2 | . | . | . | . | . | 2.2 | . | . | . | 2.2 | . | . | . | 1.2 |
| Rhododendron canadense | 1.1 | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | r | . | . | . | . | . | . | 2.1 | . | . | . | . | . | 1.1 | 2.1 | . | . | . | . | . | . | 1.1 | . | . | . |
| Pyrus floribunda | . | 1.1 | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | 1.1 | . | 1.1 | . | . | . | . | 1.1 | . | . | . | . | . |
| Amelanchier bartramiana | . | . | . | . | + | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | + | 1.1 | . | . | r | + | . | . | . | 1.1 | . | . |
| Chamaedaphne calyculata | . | . | . | . | . | . | . | 2.1 | . | . | . | 1.1 | . | . | . | . | 1.1 | . | . | . | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . |
| Dicranum fuscescens | . | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | 2.2 | . | . | . | . | . | 1.2 | 2.2 | . | . | . | 2.2 | 3.2 | . | . | . | . | . | . | . | 2.2 | . | . | 1.2 | . | . |
| Polytrichum juniperinum | . | 1.1 | 1.1 | . | . | . | . | . | 1.1 | + | 1.1 | . | . | 1.1 | + | . | + | . | 1.1 | . | + | 1.1 | 1.1 | . | . | . | 2.1 | 1.1 | . | . | . | . | 1.1 | + | . | . | . | 1.1 | 1.1 |
| Hypogymnia physodes | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | + | 2.2 | . | + | . | . | . | . | . | . | + | + | . | . | 1.2 | . | . | . |
| Osmunda cinnamomea | . | . | . | + | . | . | 2.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . |
| Coptis groenlandica | . | 1.1 | 1.1 | . | . | . | 2.1 | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | 1.1 | . |
| [illegible] lividum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia verticillata | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 |
| Dicranum fulvum | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | 1.2 | . | . | 3.2 | . | 2.2 | . | . | . | . | . | . | . | . | . | + | . | . | . | 2.2 |
| Kalmia polifolia | . | . | . | . | . | . | 1.1 | + | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . |
| Cladonia macrophylla | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | . | . | . |
| Prenanthes trifoliolata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | + | . | . | . |
| Larix laricina | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Hieracium aurorum | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia crispata | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | 2.2 | 3.2 | . | . |
| Clintonia borealis | . | . | 1.1 | 1.1 | . | . | . | . | . | . | . | . | r | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | 1.1 | . | . | . |
| Alnus crispa | . | . | . | . | + | . | . | . | . | . | . | r | . | . | . | . | r | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + |
| Cladonia elongata | . | + | . | . | . | . | . | . | + | . | . | . | . | . | . | . | 1.2 | 1.2 | 1.2 | . | . | . | 1.2 | . | . | . | . | . | 1.2 | . | . | 1.2 | 1.2 | . | . | . | . | . | 2.2 |
| Cetraria islandica | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Lycopodium complanatum | + | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.1 |
| Lycopodium annotinum | . | . | . | . | . | . | . | . | 2.2 | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . |
| Cladonia deformis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . |
| Abies balsamea | . | . | . | k | k | . | . | . | . | . | . | . | . | . | . | . | k | . | . | . | . | . | k | . | . | k | . | . | . | k | . | . | . | . | . | . | . | . | . |
| Cladonia uncialis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | 1.2 | . | . | . | 1.2 | . | 1.2 | 1.2 | . | . | . | . | . | . |
| Solidago rugosa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| Pyrola rotundifolia | . | . | . | 2.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | r | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Ochrolechia frigida | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Betula papyrifera | . | . | . | . | . | . | . | r | . | . | k | . | . | . | . | . | . | . | k | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Mnium hornum | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Alectoria ochroleuca | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Smilacina trifolia | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| Aster radula | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| Dicranum undulatum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Rubus chamaemorus | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| Equisetum sylvaticum | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Ptilidium ciliare | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . |
| Dicranum spurium | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex trisperma | . | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Sorbus decora | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Total Number of Species | 22 | 24 | 25 | 24 | 20 | 14 | 21 | 18 | 17 | 18 | 16 | 22 | 19 | 20 | 15 | 18 | 21 | 18 | 19 | 20 | 18 | 20 | 20 | 16 | 21 | 18 | 17 | 16 | 21 | 23 | 12 | 17 | 17 | 16 | 15 | 20 | 15 | 16 | 14 |

Additional Species

24B: – Lycopodium sabinaefolium (3.1)
36E: – Rosa nitida (+)
30A: – Cetraria nivalis (1.2); Alectoria nigricans (+)
26C: – Pteridium aquilinum (2.1)
70A: – Prunus pensylvanica (+)
35C: – Bazzania trilobata (1.2)
35D: – Rubus pubescens (+)
40E: – Orchid sp. (+); Rhytidiadelphus triquetrus (2.2)
44C: – Drosera rotundifolia (+)
54C: – Carex pauciflora (+)
4A: – Cladonia cornuta (1.2)
27A: – Cladonia gracilis var. elongata (+); Lonicera villosa (+)
37D: – Polytrichum commune (+); Viola adunca (+)
39C: – Cladonia amaurocraea (2.2)
40A: – Nephroma arcticum (+)

SYNTHESIS TABLE 6: KALMIETUM ANGUSTIFOLIAE ASSOCIATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 140 | 140 | 75 | 15 | 15 | 140 | 70 | 90 | 30 | 120 | 140 | 140 | 140 | 75 | 75 | 90 | 170 | 110 | 90 | 110 | 110 | 90 | 90 | 240 | 150 | 90 | 150 | 200 | 200 | 150 | 75 | 60 | 90 | 90 | 60 | 150 | 150 | 90 | 120 | 150 | 150 | 30 | 230 | 60 | |
| L | 20 | 20 | 10 | L | 5 | 10 | L | N | 30 | N | 20 | L | 10 | L | L | L | 20 | 40 | 20 | 20 | 10 | N | 20 | 10 | 50 | 50 | 15 | 40 | L | 10 | 10 | 30 | 30 | 10 | 40 | 20 | 40 | 5 | L | 20 | 20 | 50 | L | 30 | |
| – | M | M | M | – | M | M | – | – | S | – | M | – | M | – | – | – | E | E | M | E | E | – | M | M | E | E | S | E | – | E | E | M | S | S | M | N | E | M | – | S | M | E | – | E | |
| 90 | 70 | 90 | 80 | 70 | 90 | 80 | 70 | 70 | 80 | 70 | 70 | 70 | 70 | 70 | 90 | 80 | 80 | 80 | 60 | 60 | 70 | 70 | 70 | 70 | 80 | 70 | 80 | 70 | 80 | 80 | 70 | 80 | 70 | 70 | 80 | 70 | 80 | 70 | 70 | 70 | 80 | 80 | 70 | 80 | |
| 60 | 60 | 60 | 70 | 70 | 70 | 60 | 70 | 70 | 70 | 80 | 50 | 60 | 70 | 60 | 60 | 70 | 70 | 70 | 40 | 60 | 70 | 70 | 60 | 70 | 40 | 70 | 50 | 50 | – | 20 | 40 | 5 | 70 | 60 | – | 30 | 30 | 40 | 70 | 50 | 60 | 70 | 80 | 40 | |
| 39 | 40 | 40 | 28 | 39 | 39 | 40 | 58 | 25 | 55 | 52 | 40 | 31 | 40 | 28 | 35 | 51 | 46 | 44 | 4 | 44 | 44 | 25 | 4 | 64 | 26 | 47 | 26 | 70 | 70 | 36 | 34 | 59 | 48 | 32 | 59 | 23 | 37 | 24 | 50 | 26 | 23 | 54 | 65 | 3 | Presence |
| K | D | E | B | C | D | C | A | C | A | C | A | A | B | A | C | C | B | C | B | B | A | F | A | C | C | C | A | D | A | K | D | B | D | C | C | C | D | B | A | B | B | A | C | A | Value |
| 22 | 19 | 20 | 15 | 18 | 21 | 18 | 19 | 20 | 18 | 20 | 20 | 16 | 21 | 18 | 17 | 16 | 21 | 23 | 12 | 17 | 17 | 16 | 15 | 20 | 15 | 16 | 14 | 12 | 10 | 13 | 18 | 13 | 16 | 14 | 8 | 11 | 13 | 18 | 23 | 15 | 14 | 23 | 19 | 16 | |

SYNTHESIS TABLE 7: KALMIO-ALNETUM CRISPAE ASSOCIATION

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 230 | 180 | 180 | 200 | 200 | 180 | 180 | 180 | 180 | 180 | 75 | 75 | |
| Slope | 30 | 40 | 40 | 40 | 40 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | |
| Aspect | W | E | E | E | E | W | W | W | W | W | NW | NW | |
| % Phanerogam | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 70 | 90 | |
| % Cryptogam | 30 | – | 30 | – | – | – | – | – | – | – | 20 | 30 | |
| Relevé Number | 65<br>B | 69<br>C | 69<br>A | 70<br>B | 70<br>C | 73<br>A | 73<br>B | 73<br>C | 73<br>D | 73<br>E | 1<br>B | 1<br>C | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | |
| Pyrus floribunda | 1.1 | 2.1 | 1.1 | . | . | . | . | . | . | . | . | . | II |
| Clintonia borealis | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | I |
| Smilacina trifolia | 1.1 | + | . | . | . | . | . | . | . | . | . | . | I |
| Myrica gale | . | 2.2 | 2.2 | . | . | . | . | . | . | . | . | . | I |
| Calamagrostis pickeringii | . | 1.1 | 2.1 | . | . | . | . | . | . | . | . | . | I |
| Dicranum scoparium | 2.2 | . | 1.2 | . | . | . | . | . | . | . | . | . | I |
| Prunus pennsylvanica | . | 1.1 | . | 1.1 | 1.1 | . | . | 1.1 | . | . | 2.2 | + | III |
| Amelanchier bartramiana | . | . | . | 1.1 | 1.1 | . | 1.1 | + | . | . | . | 2.1 | III |
| **Differential Species of the Association** | | | | | | | | | | | | | |
| Alnus crispa | 3.3 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 2.2 | V |
| Pteridium aquilinum | 3.3 | 1.1 | 2.1 | . | 2.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | . | . | IV |
| Rhododendron canadense | 1.1 | 1.1 | 1.1 | 3.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 2.1 | + | . | V |
| Viburnum cassinoides | 2.2 | 1.1 | 2.2 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | 1.1 | V |
| Nemopanthus mucronata | 1.1 | + | + | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | V |
| **Companion Species** | | | | | | | | | | | | | |
| Vaccinium angustifolium | 1.1 | 1.1 | . | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | V |
| Kalmia angustifolia | 1.1 | . | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 3.1 | 2.1 | 2.1 | 3.1 | V |
| Cornus canadensis | . | . | + | 1.1 | + | + | + | 1.1 | + | + | 2.1 | 1.1 | V |
| Maianthemum canadense | 1.1 | . | . | 1.1 | + | . | . | . | . | . | . | . | II |
| Trientalis borealis | . | . | . | . | . | . | + | . | + | . | . | 1.1 | II |
| Sorbus decora | 1.1 | 2.2 | . | . | 1.1 | . | . | . | . | . | . | 1.1 | II |
| Osmunda cinnamomea | . | . | 1.1 | . | . | . | . | . | . | . | . | 1.2 | I |
| Vaccinium vitis-idaea | . | . | + | . | . | + | . | . | . | . | . | . | I |
| Cladonia arbuscula | . | . | . | . | . | . | . | . | . | . | 2.2 | + | I |
| Total Number of Species | 16 | 13 | 16 | 10 | 12 | 9 | 10 | 10 | 9 | 8 | 11 | 17 | |

Additional Species

1C: – Betula papyrifera (2.2); Picea mariana (K); Linnaea borealis (1.1); Cladonia cristatella (+); Dicranum undulatum (2.2)
1B: – Cladonia coccifera (+); Cladonia macrophylla (1.2); Dicranum spurium (2.2)
65B: – Solidago macrophylla (2.1); Polytrichum commune (2.2); Dicranum fuscescens (2.2)
69A: – Cladonia rangiferina (2.2); Cladonia mitis (1.2); Pleurozium schreberi (1.2)
69C: – Ledum groenlandicum (2.1)

SYNTHESIS TABLE 8: ABIETETUM BALSAMEAE HUDSONIAE ASSOCIATION

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | 140 | 90 | 90 | 170 | 170 | 75 | 110 | 170 | 110 | 120 | 120 | 120 | 120 | 120 | |
| Slope | L | L | L | 30 | 20 | L | L | 20 | 30 | 20 | 20 | 20 | 20 | 20 | |
| Aspect | - | - | - | S | S | - | - | S | W | N | N | N | N | N | |
| % Phanerogam | 80 | 80 | 90 | 70 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | |
| % Cryptogam | 70 | 70 | 70 | 60 | 70 | 60 | 70 | 60 | 70 | 30 | 30 | 30 | 30 | 30 | |
| Relevé Number | 31 B | 29 F | 29 E | 21 C | 21 A | 17 A | 16 A | 21 B | 22 B | 42 K | 42 L | 42 M | 42 N | 42 O | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | |
| Linnaea borealis | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 1.2 | . | . | . | . | . | . | . | . | II |
| Maianthemum canadense | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | I |
| Ptilidium celéare | 2.2 | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | I |
| Picea mariana | . | 2.2 | + | . | . | . | . | . | . | . | . | . | . | . | I |
| Amelanchier bartramiana | + | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Ptilium crista-castrensis | . | . | . | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | . | . | . | . | II |
| Clintonia borealis | + | . | . | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | II |
| Rhytidiadelphus triquetrus | . | . | . | . | 2.2 | 3.3 | 2.2 | . | . | . | . | . | . | . | I |
| Dicranum undulatum | . | . | . | . | 1.2 | 2.2 | 2.2 | . | . | . | . | . | . | . | I |
| Empetrum nigrum | . | . | . | . | . | . | . | . | . | 1.2 | 2.2 | 2.2 | 2.2 | . | II |
| Vaccinium vitis-idaea | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | + | + | . | II |
| Ledum groenlandicum | . | . | . | . | . | . | . | . | . | 1.1 | + | 1.1 | + | + | II |
| **Differential Species of the Association** | | | | | | | | | | | | | | | |
| Abies balsamea f. hudsonia | 4.4 | 3.3 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 3.3 | 4.4 | 4.4 | V |
| **Companion Species** | | | | | | | | | | | | | | | |
| Pleurozium schreberi | 1.2 | 3.3 | 1.2 | 2.2 | 3.3 | 2.2 | 3.3 | 3.3 | 3.3 | 2.2 | 3.3 | 2.2 | + | 2.2 | V |
| Hylocomium splendens | . | 2.2 | . | 2.2 | 1.2 | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | . | . | + | 1.2 | IV |
| Dicranum scoparium | . | 2.2 | . | 2.2 | 1.2 | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | . | . | + | 1.2 | IV |
| Cornus canadensis | . | 1.1 | + | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | + | . | . | . | . | . | III |
| Vaccinium angustifolium | 1.1 | 1.1 | 1.1 | . | . | . | . | + | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | . | III |
| Kalmia angustifolia | 1.1 | . | 1.1 | . | . | . | . | . | + | + | + | 1.1 | + | 1.1 | III |
| Bazzania trilobata | . | . | . | . | . | . | . | . | . | . | + | + | . | . | I |
| Osmunda cinnomomea | . | . | . | . | 1.2 | + | . | . | . | . | . | . | . | . | I |
| Trientalis borealis | . | . | . | . | 1.1 | 1.1 | . | + | . | . | . | . | . | . | I |
| Cladonia elongata | . | . | . | . | . | . | + | . | . | 1.1 | + | . | 1.1 | . | II |
| Gaultheria hispidula | 1.2 | . | . | . | . | 1.2 | 1.2 | . | . | . | . | . | . | . | I |
| Total Number of Species | 10 | 10 | 10 | 10 | 14 | 14 | 11 | 11 | 8 | 10 | 9 | 8 | 11 | 6 | |

Additional Species

17A: - Polytrichum commune (1.2)
21A: - *Orchis rotundifolia (+); *Listera cordata (+)
21B: - Coptis groenlandica (+); Sorbus decora (+)
21C: - *Dryopteris spinulosa (1.2); Ribes glandulosa (+)
29E: - Dicranum fuscescens (1.2)
42N: - Vaccinium uliginosum (+)

* These species also serve as association differentials

SYNTHESIS TABLE 9: KALMIO-MYRICETUM GALE ASSOCIATION

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 140 | 120 | 120 | 120 | 120 | 120 | 180 | 90 | 90 | 90 | 120 | 30 | 170 | 150 | 170 | 40 | 120 | 120 | 230 | 90 | |
| Slope | 20 | 30 | 30 | 30 | 30 | 30 | 50 | 50 | 50 | L | 40 | 30 | 20 | L | 20 | L | L | 20 | L | 30 | |
| Aspect | S | W | W | W | W | W | E | E | W | - | E | S | E | - | E | - | - | S | - | S | |
| % Phanerogam | 90 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 60 | 80 | 70 | 80 | 70 | 80 | 90 | 60 | 80 | 70 | 70 | 80 | |
| % Cryptogam | 40 | 70 | 70 | 70 | 70 | 70 | 80 | 80 | 80 | 40 | 80 | 70 | 60 | 60 | 60 | 70 | 70 | 80 | 80 | 70 | |
| Relevé Number | 13 C | 42 P | 42 Q | 42 R | 42 S | 42 T | 60 C | 47 B | 25 B | 24 C | 50 B | 55 C | 46 C | 15 C | 46 A | 53 A | 52 A | 50 C | 63 A | 48 A | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | |
| Deschampsia flexuosa | + | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Juniperus communis | 2.2 | 1.2 | 1.2 | + | 2.2 | 3.3 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Rhacomitrium lanuginosum | . | 2.2 | 3.2 | 3.3 | 4.4 | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Clintonia borealis | . | 1.1 | + | 2.1 | 1.1 | 1.1 | 1.1 | + | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Nemopanthus mucronata | . | . | + | . | + | + | 1.1 | 1.1 | + | + | + | . | . | . | . | . | . | + | . | . | III |
| Amelanchier bartramiana | . | . | . | . | . | . | 1.1 | + | . | + | 1.1 | . | . | . | . | . | . | . | . | . | I |
| Coptis groenlandica | . | . | . | . | . | . | . | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | I |
| Pyrus floribunda | . | . | . | . | . | . | . | . | 1.1 | 1.1 | + | . | . | . | . | . | . | . | . | . | I |
| Cladonia uncialis | . | . | . | . | . | . | . | . | + | 1.2 | 2.2 | . | . | . | . | . | . | . | . | . | I |
| Chamaedaphne calyculata | . | . | . | . | . | . | . | . | . | . | . | 1.1 | 1.1 | . | . | . | 1.1 | . | 1.1 | . | I |
| Osmunda cinnamomea | . | 1.1 | . | . | 1.1 | + | . | . | . | . | . | 1.1 | 1.2 | . | . | . | . | . | . | . | II |
| Rhododendron canadense | . | . | . | . | . | . | . | 1.1 | . | . | 1.1 | . | . | . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | . | II |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | |
| Myrica gale | + | 2.1 | 1.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | + | 2.2 | 2.1 | 2.1 | 1.1 | 2.1 | 1.1 | + | 2.1 | 2.1 | 1.1 | + | V |
| Cladonia alpestris | 1.2 | + | 1.2 | 1.2 | 1.2 | . | . | 3.2 | 4.4 | . | 3.2 | 2.2 | 2.2 | . | 2.2 | 2.2 | 3.2 | 3.2 | 2.2 | 1.2 | IV |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | |
| Kalmia angustifolia | 3.1 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 3.1 | 3.1 | 2.1 | 3.3 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 2.1 | 1.1 | 3.1 | 2.1 | 2.1 | V |
| Vaccinium angustifolium | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | . | 1.1 | 1.1 | 1.1 | 3.1 | 1.1 | 1.1 | 1.1 | 2.1 | 2.1 | 3.1 | V |
| Cladonia rangiferina | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 3.3 | 2.2 | 3.3 | 1.2 | . | 2.2 | 2.2 | 1.2 | 3.2 | 2.2 | 1.2 | 2.2 | 3.2 | 3.2 | 3.2 | V |
| Cladonia arbuscula | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 2.2 | + | 2.2 | 2.2 | + | 3.2 | 1.2 | 2.2 | 2.2 | 1.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | V |
| Cladonia mitis | 2.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2.2 | 1.2 | + | 1.2 | 2.2 | 2.2 | 1.2 | V |
| Vaccinium vitis-idaea | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | . | . | . | . | 1.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | IV |
| Ledum groenlandicum | + | + | 1.1 | 1.1 | 1.1 | + | . | . | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | IV |
| Hylocomium splendens | 1.2 | 3.2 | 2.2 | 3.3 | 2.2 | 2.2 | 3.3 | . | . | . | . | 3.3 | . | 3.3 | + | . | . | . | . | . | III |
| Cornus canadensis | . | + | 1.1 | + | 1.1 | 1.1 | + | 1.1 | + | . | . | . | + | . | + | + | 1.1 | 1.1 | . | 1.1 | IV |
| Dicranum scoparium | . | . | . | . | . | . | 2.2 | . | . | 2.2 | 1.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | . | III |
| Pleurozium schreberi | . | . | . | . | . | . | 1.2 | 2.2 | . | . | 2.2 | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 2.2 | 3.3 | . | 2.2 | III |
| Empetrum nigrum | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 2.2 | . | . | . | . | . | 3.3 | . | 2.2 | 1.2 | 1.2 | . | . | . | . | III |
| Viburnum cassinoides | + | . | + | + | + | + | 1.1 | + | + | 2.2 | + | . | . | 1.1 | . | . | + | . | . | . | III |
| Calamagrostis pickeringii | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | . | . | 2.1 | . | 1.1 | . | 1.1 | . | . | . | . | . | 1.1 | 1.1 | III |
| Trientalis borealis | . | + | + | + | + | + | + | . | . | + | . | . | . | + | . | . | . | . | . | 1.1 | III |
| Cladonia elongata | . | 1.1 | + | + | + | . | . | 2.2 | . | . | . | 1.2 | . | 1.2 | 1.2 | . | . | . | . | . | II |
| Polytrichum juniperinum | . | . | . | . | . | . | . | 2.1 | . | 1.1 | . | . | . | . | . | 1.1 | 1.1 | . | + | . | II |
| Maianthemum canadense | + | . | . | . | . | . | 1.1 | . | . | . | . | . | + | + | + | + | . | . | 1.1 | . | II |
| Smilacina trifolia | + | . | . | . | . | . | . | . | . | . | . | . | + | . | 1.1 | . | . | . | . | . | I |
| Ptilium crista-castrensis | . | . | . | . | . | . | . | . | . | . | . | 3.2 | . | . | 2.2 | . | . | 2.2 | . | . | I |
| Kalmia polifolia | . | 1.1 | + | . | + | . | . | . | . | . | + | . | . | . | + | . | . | . | . | . | II |
| Hypogymnia physodes | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | + | + | . | . | . | I |
| Cornicularia aculeata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | + | I |
| Cetraria islandica | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | 1.2 | + | . | . | . | I |
| Cladonia squamosa | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | + | . | . | . | . | I |
| Solidago uliginosa | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | + | . | I |
| Cladonia macrophylla | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | I |
| Linnaea borealis | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | + | . | . | . | . | . | . | I |
| Total Number of Species | 19 | 21 | 22 | 20 | 23 | 20 | 17 | 19 | 16 | 16 | 20 | 17 | 20 | 18 | 21 | 22 | 18 | 15 | 19 | 18 | |

**Additional Species**

13C: – Betula pumila (+)
15C: – Ptilidium ciliare (2.2)
60C: – Pteridium aquilinum (1.1)
24C: – Gaultheria hispidula (1.2)
46A: – Hypnum imponens (1.2)
46C: – Aster radula (+); Polytrichum commune (+)
47B: – Eriophorum spissum (3.2)
48A: – Lycopodium clavatum (2.2); Lycopodium annotinum (1.2); Solidago rugosa (+); Cladonia boryi (+)
53A: – Rubus chamaemorus (+); Vaccinium oxycoccus (1.2)
63A: – Cladonia amaurocraea (1.2); Ochrolechia frigida (3.2); Cladonia coccifera (+)

SYNTHETIC TABLE 10: KALMIO-SPHAGNETUM [illegible] ASSOCIATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (m.) | 200 | 240 | 280 | 90 | 170 | 75 | 30 | 90 | 15 | 90 | 40 | 120 | 40 | 30 | 30 | 90 | 60 | 60 | 75 | 90 | 90 | 70 | 240 | 240 | 240 | 30 | 120 | 45 | 45 | 170 | |
| Slope | 30 | 60 | 60 | 60 | 30 | 60 | 60 | 30 | 45 | 30 | 20 | H | 30 | 60 | 40 | 20 | 30 | 30 | L | L | L | 60 | 60 | 60 | 60 | 30 | 60 | 40 | 45 | 20 | |
| Aspect | E | N | N | W | S | N | N | N | W | S | N | – | E | N | N | W | E | – | — | – | – | E | N | N | N | N | W | N | E | NE | |
| % Phanerogam | 80 | 80 | 80 | 90 | 70 | 70 | 70 | 70 | 70 | 80 | 80 | 90 | 70 | 70 | 70 | 80 | 90 | 80 | 90 | 90 | 60 | 70 | 70 | 70 | 70 | 70 | 70 | 80 | 70 | 80 | |
| % Cryptogam | 80 | 80 | 70 | 70 | 80 | 80 | 70 | 80 | 90 | 70 | 70 | 80 | 90 | 70 | 70 | 70 | 90 | 80 | 70 | 90 | 80 | 80 | 80 | 80 | 80 | 90 | 80 | 60 | 80 | 80 | |
| Relevé Number | 72 A | 64 A | 60 A | 6 C | 45 B | 5 C | 10 D | 51 B | 7 G | 48 B | 53 B | 52 B | 53 G | 9 D | 8 B | 51 A | 41 C | 41 E | 35 B | 35 D | 25 E | 58 C | 49 J | 49 E | 49 H | 54 B | 56 B | 11 B | 41 D | 45 C | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pteridium aquilinum | 1.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Myrica gale | . | . | 1.1 | 2.1 | 2.1 | 1.1 | 2.1 | . | 2.1 | 1.1 | . | . | . | 2.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | 2.1 | II |
| Nemopanthus mucronata | + | + | 1.1 | + | 1.1 | 1.1 | + | + | + | 1.1 | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | II |
| Viburnum cassinoides | 1.1 | + | + | 3.2 | + | 2.1 | 2.1 | + | 2.1 | 1.1 | . | . | . | . | 2.2 | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | II |
| Mylia anomala | . | + | . | . | . | . | . | . | . | 1.2 | 1.2 | 2.2 | 1.2 | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Aulacomnium palustre | . | . | . | . | . | . | . | . | . | 1.2 | 1.2 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Drosera rotundifolia | . | . | . | . | . | . | . | . | . | 1.1 | + | 1.1 | + | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | I |
| Solidago uliginosa | . | . | . | + | . | . | . | . | + | + | + | . | . | + | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Calamagrostis pickeringii | . | . | . | . | . | . | . | . | 1.1 | 1.1 | 1.2 | . | . | 2.1 | 2.1 | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | 1.1 | I |
| Sphagnum fuscum | . | . | . | . | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | 3.3 | 2.2 | 2.2 | 2.2 | . | . | . | . | . | . | . | . | I |
| Rhacomitrium lanuginosum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | 1.2 | . | . | . | . | . | . | I |
| Cladonia boryi | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | I |
| Rhododendron canadense | . | . | . | . | . | . | . | 1.1 | . | . | 1.2 | 2.1 | 1.1 | . | . | 2.1 | 1.1 | 2.1 | 1.1 | . | . | . | . | . | . | . | . | . | . | . | II |
| **Differential Species of the Association** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sphagnum nemoreum | 3.3 | 3.3 | 4.4 | 3.3 | 3.3 | 3.3 | 2.2 | 3.3 | 4.4 | 4.4 | 3.3 | 4.4 | 3.3 | 3.3 | 3.3 | 3.3 | 5.5 | 3.3 | . | 3.3 | 4.4 | 3.3 | 3.2 | 2.2 | 2.2 | 2.2 | 4.4 | 2.2 | 4.4 | 3.3 | V |
| Vaccinium oxycoccus | 1.2 | . | . | 1.1 | 1.2 | + | . | 1.2 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | . | 1.1 | 1.2 | 1.2 | 2.2 | 1.2 | 2.2 | . | . | 1.2 | 1.2 | 1.2 | 1.2 | - | . | 1.2 | 1.2 | IV |
| Ptilium crista-castrensis | 1.2 | . | . | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | . | . | . | . | . | 3.3 | 1.2 | 2.2 | 2.2 | 3.3 | 2.2 | . | . | . | IV |
| Gaultheria hispidula | . | 1.2 | . | . | . | . | 1.2 | . | . | . | . | . | . | . | 1.1 | 2.2 | . | . | 1.2 | . | 1.2 | 2.2 | 1.2 | 2.2 | 2.2 | . | 2.2 | . | + | . | II |
| Polytrichum juniperinum | . | . | . | . | + | . | . | 1.1 | 1.1 | 1.1 | . | . | 1.1 | . | . | 1.1 | 1.1 | 1.1 | 1.1 | . | . | . | 1.1 | . | 1.1 | . | 1.1 | 2.2 | . | . | III |
| Chamaedaphne calyculata | . | . | + | 1.1 | + | 1.1 | . | . | . | . | . | 1.1 | 1.1 | 1.1 | . | . | 1.1 | 2.1 | 1.1 | 1.1 | . | . | . | . | . | . | . | 1.1 | 2.1 | 1.1 | III |
| **Companion Species** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kalmia angustifolia | 2.1 | 2.1 | 3.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 3.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 1.1 | . | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | 3.1 | 1.1 | V |
| Vaccinium angustifolium | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | . | . | 1.1 | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | V |
| Ledum groenlandicum | 1.1 | 2.1 | 1.1 | 1.1 | 1.1 | . | + | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | . | 1.1 | + | 2.1 | 1.1 | 1.1 | 1.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 1.1 | V |
| Pleurozium schreberi | 3.3 | 2.2 | 2.2 | 2.2 | 3.3 | 2.2 | 3.3 | 3.3 | 2.2 | 2.2 | + | 2.2 | 2.2 | 2.2 | 2.2 | 3.3 | 1.2 | 1.2 | 2.2 | . | . | 2.2 | 1.2 | 1.2 | 2.2 | 2.2 | 3.3 | 1.2 | 2.2 | 2.2 | V |
| Vaccinium vitis-idaea | 1.2 | . | . | 1.1 | 1.2 | 1.1 | . | + | + | . | 1.2 | 1.2 | 1.2 | 1.1 | + | 1.2 | . | 1.2 | . | . | . | . | 2.2 | 2.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | 1.2 | IV |
| Empetrum nigrum | 2.2 | . | . | 1.1 | . | + | 1.1 | 1.2 | . | 3.3 | 3.3 | + | 3.3 | 2.2 | 1.1 | 1.2 | 1.1 | . | 3.3 | . | . | . | 2.2 | + | 1.2 | 2.2 | 2.2 | 2.2 | . | . | IV |
| Cornus canadensis | + | 1.1 | + | . | 1.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | + | . | + | 1.1 | + | . | + | . | . | + | + | + | + | + | + | 2.1 | 1.1 | + | IV |
| Cladonia rangiferina | 3.2 | 2.2 | . | 1.2 | 2.2 | 1.2 | . | 3.2 | . | 1.2 | . | 1.2 | + | 2.2 | 3.2 | 3.2 | . | 2.2 | 2.2 | . | . | 3.2 | 2.2 | + | 1.2 | 2.2 | 1.2 | 2.2 | 3.3 | 1.2 | IV |
| Cladonia arbuscula | 1.2 | 3.2 | 1.2 | . | + | . | . | 2.2 | . | . | . | 1.2 | 1.2 | 1.2 | . | 2.2 | . | 2.2 | 2.2 | . | . | 2.2 | 2.2 | + | 1.2 | 2.2 | 2.2 | 2.2 | 2.2 | 1.2 | IV |
| Cladonia mitis | 1.2 | 2.2 | 1.2 | . | 1.2 | . | 1.2 | 1.2 | . | 1.2 | . | + | + | 1.2 | 2.2 | 1.2 | . | 1.2 | 1.2 | . | . | 1.2 | 1.2 | + | + | + | + | 2.2 | 1.2 | + | IV |
| Cladonia alpestris | 2.2 | . | . | . | 1.2 | . | . | 2.2 | . | . | - | + | 1.2 | . | - | 2.2 | . | 2.2 | . | . | . | . | 1.2 | . | + | 2.2 | 3.2 | . | 3.2 | + | III |
| Dicranum scoparium | 1.2 | 2.2 | 2.2 | . | . | 2.2 | 1.2 | . | 1.2 | . | 3.2 | 2.2 | . | . | 1.2 | . | . | . | 1.2 | . | . | 2.2 | 1.2 | 1.2 | . | . | . | . | . | 2.2 | III |
| Hylocomium splendens | 2.2 | . | 2.2 | 2.2 | 2.2 | 3.3 | 2.2 | 2.2 | 3.2 | 2.2 | . | . | . | . | 2.2 | . | . | . | 2.2 | . | . | 2.2 | 2.2 | 3.2 | 3.2 | 2.2 | 2.2 | . | . | . | III |
| Cladonia elongata | 1.2 | . | . | 1.2 | + | + | 1.1 | . | . | . | . | . | . | . | 1.2 | . | . | . | + | . | . | 2.2 | + | 1.2 | . | 1.2 | 1.2 | . | . | . | II |
| Clintonia borealis | . | 1.1 | + | . | . | . | . | 1.1 | . | . | . | . | 1.1 | . | . | 1.1 | . | . | 1.1 | . | . | . | . | . | . | 1.1 | . | 2.1 | . | . | II |
| Osmunda cinnamomea | 1.1 | 1.1 | . | 1.2 | + | 2.2 | . | . | . | . | . | . | . | . | . | . | . | . | 2.1 | . | . | 1.1 | . | + | + | 3.2 | . | . | . | . | II |
| Coptis groenlandica | . | . | 1.1 | 1.1 | . | 1.1 | . | . | 1.1 | . | . | 1.1 | . | . | 1.1 | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | 1.1 | II |
| Kalmia polifolia | . | . | . | 1.1 | . | 1.1 | . | . | . | + | + | . | . | . | . | . | 1.1 | 1.1 | . | + | . | . | . | . | . | 1.1 | . | 1.1 | . | 1.1 | II |
| Amelanchier bartramiana | . | . | . | . | . | + | . | + | + | . | . | . | . | . | . | + | . | . | + | . | . | . | . | . | . | . | . | . | . | + | I |
| Pyrus floribunda | . | . | . | 1.1 | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | + | . | . | . | . | . | . | + | . | 1.1 | I |
| Deschampsia flexuosa | . | 1.2 | . | 1.2 | . | . | . | . | . | . | 2.2 | . | 1.2 | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | I |
| Linnaea borealis | + | 1.2 | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | 1.2 | . | 1.2 | . | . | I |
| Maianthemum canadense | . | 1.1 | 1.1 | . | . | . | + | . | . | . | + | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | I |
| Lycopodium annotinum | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | + | + | . | . | . | . | . | I |
| Sanguisorba canadensis | . | . | . | r | . | r | . | 1.1 | . | . | 1.1 | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Potentilla tridentata | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | . | . | I |
| Sarracenia purpurea | . | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Dicranum undulatum | + | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2.2 | . | . | I |
| Lycopodium clavatum | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.1 | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | I |
| Juniperus communis | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | I |
| Andromeda glaucophylla | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | 1.1 | I |
| Larix laricina | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | r | . | . | . | . | . | . | . | . | . | + | I |
| Cladonia uncialis | . | . | . | . | 1.2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | I |
| Hypogymnia physodes | . | . | . | . | . | . | . | . | . | . | . | 1.2 | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | I |
| Betula papyrifera | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | I |
| Cladonia coccifera | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | I |
| **Total Number of Species** | 23 | 22 | 20 | 26 | 26 | 24 | 18 | 24 | 19 | 22 | 21 | 23 | 23 | 19 | 19 | 20 | 13 | 17 | 38 | 9 | 7 | 17 | 24 | 23 | 19 | 21 | 20 | 26 | 14 | 23 | |

Additional Species

11B: – Prenanthes trifoliolata (2.1); Aster radula (1.1); Pinus sylvestris (r); Leucobryum glaucum (1.2)
41C: – [illegible] lividum (+)
45B: – Dicranum spurium (+)
45C: – Cladonia gracilis var. elongata (+)
49J: – Vaccinium uliginosum (1.1); Ptilidium ciliare (1.2); Sphaerophorus globosus (+)
53G: – Sphagnum papillosum (+); Eriophorum spissum (+)
54B: – Carex trisperma (2.2)
54B: – Epilobium angustifolium (1.1)
49H: – Smilacina trifolia (+)
51B: – Picea mariana (r); Abies balsamea (r)
60A: – Cladonia cristatella (+)
64A: – Betula pumila (r)

SYNTHESIS TABLE 11. PICEETUM MARIANAE SEMIPROSTRATAE ASSOCIATION

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude (M.) | 45 | 45 | 45 | 45 | 140 | 45 | 45 | 45 | 140 | 140 | 45 | 45 | 45 | 140 | 140 | |
| Slope | L | L | L | L | 30 | L | L | L | 30 | 30 | L | L | L | 30 | 30 | |
| Aspect | – | – | – | – | E | – | – | – | E | E | – | – | – | E | E | |
| % Phanerogam | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 70 | |
| % Cryptogam | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | |
| Relevé Number | 66 I | 66 J | 66 D | 66 F | 71 C | 66 A | 66 B | 66 H | 71 A | 71 E | 66 C | 66 E | 66 G | 71 B | 71 D | Presence Value |
| **Differential Species of the Variants** | | | | | | | | | | | | | | | | |
| Sphagnum nemoreum | 4.4 | 4.4 | . | . | . | . | . | . | . | . | . | . | . | . | . | I |
| Gaultheria hispidula | . | . | 1.2 | 1.2 | . | 1.2 | 1.2 | 1.2 | . | . | . | . | . | . | . | II |
| Sphagnum recurvum | . | . | 4.4 | 4.4 | 3.3 | 3.3 | 4.4 | 3.3 | 2.2 | 3.3 | . | . | . | . | . | III |
| Cladonia arbuscula | . | . | . | . | . | 1.2 | + | 1.2 | 2.2 | + | 2.2 | 1.2 | 2.2 | 1.2 | 2.2 | IV |
| Cladonia mitis | . | . | . | . | . | 1.2 | + | 1.2 | 1.2 | + | 2.2 | 1.2 | 2.2 | 1.2 | 1.2 | IV |
| Juniperus communis | . | . | . | . | . | . | . | . | . | . | . | . | .. | 1.2 | 1.2 | I |
| **Differential species of the Association** | | | | | | | | | | | | | | | | |
| Picea mariana f. semiprostrata | 2.2 | 2.2 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 2.2 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 2.2 | V |
| Bazzania trilobata | . | 1.2 | 2.2 | . | 1.2 | . | 1.2 | 1.2 | 1.2 | + | 1.2 | 2.2 | . | . | + | IV |
| **Companion Species** | | | | | | | | | | | | | | | | |
| Kalmia angustifolia | 2.1 | 2.1 | 2.1 | 1.1 | 1.1 | 2.2 | 2.1 | 2.1 | 2.1 | 1.1 | 2.1 | 2.1 | 2.1 | 1.1 | 2.1 | V |
| Vaccinium angustifolium | 1.1 | 1.1 | 1.1 | 2.1 | + | 1.1 | 1.1 | 1.1 | 1.1 | + | 1.1 | 1.1 | 1.1 | 2.1 | 1.1 | V |
| Cladonia rangiferina | + | 2.2 | . | . | . | 1.2 | 2.2 | 2.2 | 3.2 | 2.2 | 3.2 | 3.3 | 2.2 | 2.2 | 3.2 | IV |
| Ledum groenlandicum | 1.1 | 1.1 | 1.1 | . | . | . | 1.1 | 1.1 | + | . | 1.1 | + | 1.1 | + | + | IV |
| Viburnum cassinoides | . | + | . | + | 1.1 | . | + | . | 1.1 | + | . | + | . | 1.1 | . | III |
| Empetrum nigrum | 2.1 | 2.1 | + | 1.1 | . | 1.1 | 1.1 | 1.1 | .. | . | + | 1.1 | 2.1 | . | 2.2 | IV |
| Cornus canadensis | + | + | + | + | + | + | + | + | + | + | . | . | . | + | + | IV |
| Pleurozium schreberi | . | 1.2 | 1.2 | 1.2 | 2.2 | 2.2 | 1.2 | 3.2 | 3.3 | 2.2 | 3.3 | 3.3 | 3.3 | 4.4 | 2.2 | V |
| Hylocomium splendens | . | . | + | . | 3.3 | 2.2 | 2.2 | 2.2 | 2.2 | 3.3 | 2.2 | 2.2 | . | . | . | IV |
| Dicranum scoparium | . | . | 1.2 | . | 1.2 | 1.2 | + | 1.2 | 1.2 | 1.2 | 2.2 | 1.2 | . | 2.2 | 1.2 | IV |
| Ptilidium cèlèare | . | . | . | . | 1.2 | 1.2 | . | 1.2 | + | + | + | 1.2 | . | 1.2 | + | III |
| Cladonia elongata | . | 2.2 | . | . | . | . | 1.2 | 2.2 | 1.2 | 1.2 | 2.2 | 1.2 | 2.2 | . | + | III |
| Usnea longissima | + | . | + | + | . | + | + | + | . | . | . | . | + | . | . | III |
| Alectoria sarmentosa | . | . | + | . | . | + | + | + | . | . | . | . | + | . | . | II |
| Abies balsamea | . | . | . | K | . | . | K | 2.2 | K | . | . | K | . | + | . | II |
| Vaccinium oxycoccus | 1.2 | 1.2 | . | + | . | . | 1.2 | . | . | . | . | . | . | . | . | II |
| Hypogymnia physodes | . | . | 1.2 | + | . | . | . | 1.2 | . | . | 1.2 | + | + | . | . | II |
| Peltigera canina | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | I |
| Ptilium crista-castrensis | . | . | . | . | . | . | . | . | 2.2 | 1.2 | . | 1.2 | . | . | . | I |
| Nemopanthus mucronata | . | + | . | . | 1.1 | . | . | + | 1.1 | 1.1 | . | + | . | 1.1 | + | III |
| Cladonia alpestris | . | . | . | . | + | . | . | . | 2.2 | . | . | 3.2 | . | 2.2 | . | II |
| Amelanchier bartramiana | . | . | . | . | + | . | . | . | + | . | . | . | . | . | . | I |
| Rhododendron canadense | . | . | . | . | + | . | . | . | . | . | . | . | . | . | 1.1 | I |
| Total Number of Species | 11 | 14 | 15 | 13 | 15 | 16 | 21 | 22 | 22 | 17 | 15 | 21 | 13 | 18 | 18 | |

Additional Species

71A: – Cladonia crispata (+).
71B: – Calamagrostis pickeringii (+); Dicranum undulatum (1.2).
71D: – Kalmia polifolia (+).

# APPENDIX III

LOCATION OF SITES INVESTIGATED ON THE AVALON PENINSULA

| Site No. | Nearest Place Name | Latitude | Longitude |
|---|---|---|---|
| 1 | Aquaforte | 47 00 15 | 53 00 45 |
| 2 | Fermeuse | 46 58 30 | 53 02 15 |
| 3 | Cappahayden | 46 51 30 | 53 01 45 |
| 4 | Portugal Cove South | 46 44 30 | 53 15 45 |
| 5 | Portugal Cove South | 46 44 15 | 53 15 00 |
| 6 | Portugal Cove South | 46 43 45 | 53 15 00 |
| 7 | Portugal Cove South | 46 43 30 | 53 14 45 |
| 8 | Portugal Cove South | 46 43 15 | 53 15 00 |
| 9 | Portugal Cove South | 46 43 00 | 53 15 00 |
| 10 | Portugal Cove South | 46 42 45 | 53 15 15 |
| 11 | Trepassey | 53 20 00 | 46 44 30 |
| 12 | Trepassey | 46 44 15 | 53 20 15 |
| 13 | Trepassey | 46 43 45 | 53 25 15 |
| 14 | Trepassey | 46 43 15 | 53 27 00 |
| 15 | Trepassey | 46 43 15 | 53 27 30 |
| 16 | St. Shotts | 46 38 45 | 53 33 15 |
| 17 | St. Shotts | 46 38 30 | 53 34 15 |
| 18 | St. Shotts | 46 37 30 | 53 35 30 |
| 19 | Peter's River | 46 42 45 | 53 30 00 |
| 20 | Peter's River | 46 44 00 | 53 32 30 |
| 21 | Peter's River | 46 45 15 | 53 34 45 |
| 22 | Peter's River | 46 45 45 | 53 35 45 |
| 23 | Riverhead | 47 02 15 | 53 28 45 |
| 24 | Old Man's Pond | 47 25 30 | 53 20 00 |

| Site No. | Nearest Place Name | Latitude | Longitude |
|---|---|---|---|
| 25 | Hodgewater Pond | 47 26 30 | 53 23 30 |
| 26 | Roaches Line Int. T.C.H. | 47 25 00 | 53 19 30 |
| 27 | Sprout Cove | 47 49 00 | 53 08 30 |
| 28 | Job's Cove | 47 58 15 | 53 02 00 |
| 29 | Lower Island Cove | 47 49 15 | 52 59 45 |
| 30 | Grates Cove | 48 09 30 | 52 55 30 |
| 31 | Grates Cove | 48 08 45 | 52 56 15 |
| 32 | Old Perlican | 48 03 15 | 53 01 30 |
| 33 | Halfway House | 47 48 30 | 53 17 15 |
| 34 | Hodgewater Line | 47 29 15 | 53 19 00 |
| 35 | Hodgewater Line | 47 30 30 | 53 18 45 |
| 36 | New Harbour Road | 47 35 00 | 53 23 30 |
| 37 | New Harbour Road | 47 34 15 | 53 26 15 |
| 38 | New Harbour Road | 47 35 15 | 53 31 15 |
| 39 | Islington | 47 46 15 | 53 28 45 |
| 40 | Hearts Desire | 47 50 00 | 53 25 00 |
| 41 | Hearts Content | 47 53 30 | 53 22 00 |
| 42 | Lance Cove | 46 53 15 | 54 01 15 |
| 43 | Gooseberry Cove | 47 04 30 | 54 05 00 |
| 44 | Argentia Access Road | 47 23 00 | 53 36 30 |
| 45 | Long Cove | 47 32 00 | 53 44 00 |
| 46 | Chapel Arm | 47 31 45 | 53 43 45 |
| 47 | Spread Eagle Peak | 47 28 00 | 53 36 00 |
| 48 | Colliers Bay | 47 42 45 | 53 44 45 |
| 49 | Chapel Arm | 47 30 30 | 53 44 00 |
| 50 | Black Brook | 47 59 30 | 53 57 30 |

| Site No. | Nearest Place Name | Latitude | Longitude |
|---|---|---|---|
| 51 | Goobies | 47 56 30 | 53 57 15 |
| 52 | Goobies | 47 54 30 | 53 56 30 |
| 53 | Sunnyside | 47 51 15 | 53 56 45 |
| 54 | Sunnyside | 47 48 45 | 53 57 00 |
| 55 | Arnold's Cove | 47 47 15 | 53 58 00 |
| 56 | La Manche | 47 43 30 | 53 55 15 |
| 57 | Rantem Station | 47 40 00 | 53 53 00 |
| 58 | Chance Cove | 47 38 30 | 53 52 00 |
| 59 | Cape Spear | 47 31 15 | 52 37 45 |
| 60 | Hawke Hills | 47 20 00 | 53 07 00 |
| 61 | Witless Bay Line | 47 20 30 | 52 58 00 |
| 62 | Witless Bay Line | 47 20 15 | 53 02 30 |
| 63 | Witless Bay Line | 47 20 15 | 53 03 30 |
| 64 | Witless Bay Line | 47 21 15 | 53 02 45 |
| 65 | Witless Bay Line | 47 22 00 | 53 02 45 |
| 66 | Colinet | 47 15 30 | 53 32 15 |
| 67 | Cochrane Pond | 47 27 15 | 52 53 30 |
| 68 | Thomas Pond | 47 27 30 | 52 55 30 |
| 69 | Soldiers Pond | 47 25 15 | 53 00 15 |
| 70 | Soldiers Pond | 47 24 00 | 53 01 30 |
| 71 | Salmonier Line | 47 19 45 | 53 14 00 |
| 72 | Hawke Hills | 47 19 15 | 53 08 15 |
| 73 | Butterpot Park | 47 23 45 | 53 01 30 |
| 74 | Hawke Hill | 47 19 45 | 53 07 00 |

RELEVES CONTRIBUTED BY E.D. WELLS[1]

| Site No. | Nearest Place Name | Latitude | Longitude |
|---|---|---|---|
| 137 | Cape St. Mary's | 46 49 20 | 53 11 30 |
| 138 | Cape St. Mary's | 46 49 25 | 53 11 20 |
| 141 | Chance Cove | 47 39 10 | 53 51 30 |
| 151 | Cape Race | 46 39 40 | 53 13 30 |

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# APPENDIX IV

## SPECIES CHECKLIST ACCORDING TO HEATHLAND HABITAT

1. Species displaying a distinct preference for extremely exposed rock barrens.

(i) VASCULAR PLANTS

*Diapensia lapponica*
*Loiseleuria procumbens*
*Arctostaphylos uva-ursi*
*Empetrum eamsii*
*Salix uva-ursi*
*Campanula rotundifolia*
*Picea mariana* f. *empetroides*
*Arctostaphylos alpina*
*Lycopodium selago*
*Juncus trifidus*
*Polygonum viviparum*
*Euphrasia randii*
*Carex deflexa*

(ii) MOSSES

*Rhacomitrium lanuginosum* is extremely abundant in this habitat but also frequents moderately exposed hard ground heath.

(iii) LICHENS

*Cetraria nivalis*
*Alectoria ochroleuca*
*Alectoria nigricans*
*Platismatia glauca*
*Cetraria cucullata*
*Stereocaulon paschale*

2. Species displaying a distinct preference for hard ground heath.

(a) Moderately Exposed Hard Ground Heath

(i) VASCULAR PLANTS

*Potentilla tridentata*
*Deschampsia flexuosa*
*Prenanthes trifoliolata*
*Carex bigelowii*
*Vaccinium uliginosum* var. *alpinum*
*Calamagrostis pickeringii*
*Solidago uliginosa*
*Betula pumila*

(i) VASCULAR PLANTS (Cont'd)

| | |
|---|---|
| _Lycopodium sabinaefolium_ | _Lycopodium complanatum_ |
| _Abies balsamea f. hudsonia_ | |

(ii) MOSSES

| | |
|---|---|
| _Rhacomitrium lanuginosum_ | _Leucobryum glaucum_ |

(iii) LICHENS

| | |
|---|---|
| _Cladonia boryi_ | _Sphaeophorus globosus_ |
| _Cetraria islandica_ | _Cladonia terrae-novae_ |
| _Cladonia uncialis_ | _Cornicularia aculeata_ |
| _Cladonia amaurocraea_ | _Nephroma arcticum_ |

(b) Species commonly encountered on peatlands; displaying a sporadic occurrence on dry heath soils in the southern region of the Avalon Peninsula.

(i) VASCULAR PLANTS

| | |
|---|---|
| _Aster nemoralis_ | _Juniperus horizontalis_ |
| _Sanguisorba canadensis_ | _Andromeda glaucophylla_ |
| _Aster radula_ | _Kalmia polifolia_ |

Note: Lichens and mosses do not display this habitat preference.

(c) Introduced species displaying a preference for anthropogenic hard ground heath.

(i) VASCULAR PLANTS

| | |
|---|---|
| _Luzula campestris_ | _Taraxacum officinale_ |
| _Hieracium murorum_ | _Spiraea latifolia_ |
| _Anaphalis margaritacea_ | _Achillea millefolium_ |

(i) VASCULAR PLANTS (Cont'd)

| | |
|---|---|
| *Fragaria virginiana* | *Rosa nitida* |
| *Anthoxanthum odoratum* | *Leontodon autumnalis* |

Note: *Solidago rugosa* and *Lycopodium obscurum* are not introduced species but do display a preference for anthropogenic heath. *Pinus sylvestris* is an introduced species used in afforestation trials.

(ii) MOSSES

Note: *Polytrichum commune*, although not an introduced species displays a notable increase in abundance on anthropogenic heathlands. The circumboreal distribution of many mosses and lichens makes their assessment under this category difficult.

(iii) LICHENS

The frequency of fire in anthrogenic heath generally inhibits the development of lichens in this habitat. The following may be considered pioneer species following burning;

| | |
|---|---|
| *Cladonia verticillata* | *Cladonia cristatella* |
| *Cladonia crispata* | *Cladonia deformis* |
| *Cladonia squamosa* | *Cladonia macrophylla* |
| *Cladonia coccifera* | *Cladonia pyxidata* |

3. Species displaying a preference for wet heath.

Note: Many of these species are common on peatlands and are only rarely (r) encountered on wet heath.

(i) VASCULAR PLANTS

Myrica gale
Sarracenia purpurea
Chamaedaphne calyculata
Picea mariana f. semiprostrata
Smilacina trifolia
Lycopodium annotinum
Rubus chamaemorus (r)
Carex pauciflora (r)
Coptis groenlandicum
Vaccinium oxycoccus
Drosera rotundifolia
Carex trisperma (r)
Scirpus cespitosus (r)
Clintonia borealis
Osmunda cinnomomea
Equisetum sylvaticum (r)
Eriophorum spissum (r)

(ii) MOSSES

Sphagnum nemoreum
Ptilium crista-castrensis
Sphagnum recurvum
Sphagnum fuscum (r)
Aulacomnium palustre
Sphagnum papillosum (r)
Mnium hornum (r)

Note: Mylia anomala, Bazzania trilobata and Ptilidium ciliare are leafy liverworts commonly encountered on wet heath or moist micro-habitats in dry heath.

(iii) LICHENS

Cladonia alpestris is the only lichen displaying a preference for wet heath. Usnea longissima and Alectoria sarmentosa are epiphytes in black spruce tuck occurring on poorly drained soils. As a general rule lichens display a greater abundance and coverage on dry heathland soils.

4. Common species displaying no obvious habitat preference with respect to presence or absence but some having a greater abundance and coverage on exposed heath (e) or sheltered heath (s).

(i) VASCULAR PLANTS

| | |
|---|---|
| Kalmia angustifolia (s) | Ledum groenlandicum (s) |
| Pteridium aquilinum (s) | Rhododendron canadense (s) |
| Nemopanthus mucronata (s) | Gaultheria hispidula (s) |
| Abies balsamea (s) | Sorbus decora (s) |
| Amelanchier bartramiana (s) | Empetrum nigrum (e) |
| Viburnum cassinoides (s) | Juniperus communis (e) |
| Vaccinium vitis-idaea (e) | Cornus canadensis |
| Lycopodium clavatum (e) | Larix laricina |
| Maianthemum canadense | Pyrus floribunda |
| Trientalis borealis | Betula papyrifera |
| Linnaea borealis | Cyripedium acaule |

Note: Vaccinium angustifolium is distributed throughout all heathland types but has a much greater coverage on recently burnt heathland (1-3 yr.). Alnus crispa is most frequently encountered on tree line sites.

(ii) MOSSES

| | |
|---|---|
| Dicramum scoparium (s) | Pleurozium schreberi (s) |
| Hylocomium splendens (s) | Rhytidiadelphus triquetrus (s) |
| Dicranum fuscescens (e) | Polytrichum juniperinum |
| Buxbaumia aphylla | |

(iii) LICHENS

Cladonia arbuscula (s)

Cladonia rangiferina (s)

Cladonia cornuta (e)

Hypogymnia physodes

Cladonia mitis (s)

Cladonia elongata (e)

Ochrolechia frigida (e)

5. Species whose occurrence is too sporadic to comment on their habitat preference.

(i) VASCULAR PLANTS

Geocaulon lividum

*Orchis rotundifolia

Viola cucullata

Rubus pubescens

*Listera cordata

*Dryopteris spinulosa

Ribes glandulosum

* These species were only recorded in Balsam Fir tuck.

(ii) MOSSES

Dicranum fulvum

Dicranum spurium

Pohlia nutans

Dicranum majus

Hypnum imponens

Dicranum elongatum

Rhytidium rugosum

(iii) LICHENS

Cladonia gracilis var. elongata

Peltigera canina

Total Flora 147 species