A MOSS FLORA OF SELKIRK AND PURCELL MOUNTAIN RANGES, SOUTHEASTERN BRITISH COLUMBIA

by

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ABSTRACT

The Selkirk and Purcell Mountain Ranges were chosen for a preliminary investigation of the moss flora because of the similarities of mean annual precipitation and vascular plant flora between the interior western hemlock zone and the coastal hemlock zone.

Three summers (1976-78) were spent in this area intensively and extensively collecting moss specimens from various habitats, different vegetation zones and at all elevations. Close to 6000 collections have been analyzed including hundreds of specimens made by Macoun and MacFadden at the turn of the century.

The total moss flora is conservatively established as 366 species belonging to 128 genera and 40 families. Several species either represent new records for the region or are significant extensions of previously local ranges. Others, like Hygroamblystegium noterophilum, Campylium radicale, Mnium arizonicum and Pohlia obtusifolia, are new to the province. Scouleria marginata is reported as new to Canada, and Physcomitrella patens, Dichelyma pallescens and Pohlia lescuriana are new to western North America. Furthermore, Plagiothecium nemorale and Campylium calcareum are reported as
new to North America.

Based on the study, several new binomial combinations are proposed. Likewise, past taxonomic confusion involving species such as *Dichodontium pellucidum* - *D. clypicum*, *Pohlia columbica*, *Barbula revoluta* var. *obtusula* and *Barbula convoluta* - *B. eustegia* are explored in depth and resolved. Erroneous reports of species from the area were exposed by studying the original collections.

A working manual with complete keys to the families, genera and species is presented. Important taxonomic or diagnostic features are given for each species, together with habitat and distribution information. A total of 176 distribution maps for various species are appended to illustrate the different patterns of distributions in the study area, in the province and in a few cases, western North America.

The habitat conditions of each species were also observed and reported. The distribution of the mosses shows a pattern of distribution correlated with the prevailing local physical conditions such as precipitation and substrate pH. Hence, mosses of hygric and mesic habitats are found to be more abundant in kind and numbers of individuals in the northern Selkirk and Purcell Mountains, i.e., the wet and moist subzones of the interior western hemlock biogeoclimatic zone. Equally apparent is a concentration of calcicolous taxa in the
vicinity of the Columbia Trench owing to the existence of calcareous substrata.

Past and present collections of mosses from the Halcyon Hotsprings have been compared to illustrate the drastic effects of logging and burning of the original forest cover on mosses.

To elucidate the origin, possible migratory pathways and phytogeographical affinities of the local moss flora, the species composition is analyzed and grouped into several geographical and floristic elements. The groupings are made separately at various hierarchical levels: the province, North American continent and the world. The results show that nearly 80% of the species belong to widespread and common northern boreal taxa. Around 10% are restricted western North American endemics. There are more species (12%) that are more widespread south of the study area than north of it (5.5%). This is taken to suggest that the more important source of plant migration into the area under study after the last glaciation is from the unglaciated mountains and lowlands south of the Canadian border. Furthermore, there is a slightly higher percentage of continental moss species (12.5%) than oceanic ones (10.1%) in the two mountain ranges investigated, a reflection of the stronger influence of continental climate over the southeastern part of the province.

No species new to science were discovered. Presumably, this indicates that the mountains were thoroughly glaciated and
that no plant populations survived in situ during the glacial period. The interval since glaciation is probably too short for appreciable speciation to have occurred. Routes for southward and eastward migrations of moss taxa from the Arctic and the Coast Mountains are also postulated and their contributions to the evolution of the moss flora of the study area are assessed to be minimal. Westward expansion of moss species from the continental prairies is suggested to be effectively blocked by the Rocky Mountain Range.

It is finally suggested that the association of many locally uncommon hygrophilic moss taxa with several active hot springs in the study area is a phenomenon worth further investigation.
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I. Introduction

It is not an exaggeration to state that the province of British Columbia is a paradise for bryophytes in North America. The combination of many climatological, geographical and topographical factors has produced a large, indigenous moss flora consisting of some 688 species (Schofield, 1980c) representing various phytogeographical affinities. This situation is unmatched elsewhere in North America.

Within the province, the local distribution of many moss species is not clear owing to the fact that only the Coast and Cascade Mountains, the Queen Charlotte Islands, Vancouver Island and the environs of the Greater Vancouver area on the mainland have been relatively well explored.

The study area, namely the Selkirk and Purcell Mountain Ranges, fall within the Interior Western Hemlock (IWH), Interior Douglas Fir (IDF) and interior Subalpine Engelmann Spruce-Subalpine Fir (ESSF) biogeoclimatic zones (Krajina, 1965; Jones and Annas, 1978). The concept of biogeoclimatic zone is well explained by Biel et al. (1976). The area is characterized by a continental climate with a cold winter, relatively high humidity and a total annual precipitation range of 38-170 ml of rain or snow which decreases from north to south. The vascular flora of the IWH and the IDF zones closely
resembles that of coastal western hemlock and Douglas fir forests. It is, therefore, of significant interest to compare the moss floras to see if there is the same degree of similarity.

The area (Map 1) covers most of the watershed of the Columbia and Kootenay Rivers. The two mountain ranges make up the larger part of the southern Columbia Mountains Physiographic region (GSC Map 1254A, 1970) which is also called the Kootenay Region. To the west of the area are the Monashee Mountains and to the east the British Columbia portion of the Canadian Rocky Mountains. In other words, the area under investigation is bounded on the east by the southern Rocky Mountain Trench, on the west and north sides by the Columbia River (including the Upper and Lower Arrow Lakes) and the Kootenay River, and on the south by the International Boundary. It lies between Lat. 49 to 52 W and Long. 115 to 118 W. and covers a total land surface of approximately 40,640 sq. kilometers. It is approximately the size of Ireland, slightly larger than 1/8 of the size of Japan or 1/6 the size of the Philippines. It occupies only 6% of the total land area of British Columbia.

This region has undergone drastic environmental changes through logging, mining, urbanization and construction of dams for hydroelectricity since the arrival of the first European near the end of the 19th century. There is evidence that the extinction of local populations of a handful of plant species
has resulted from the change of vegetation cover (see also
discussion). It is therefore urgent and pertinent today to
record the presence of all plant species in the area before
they are lost through human activities.

The aims of the present study are:

A. To collect and record the species of mosses present
   in the area;

B. To prepare a working manual with keys to the moss
   families, genera, and species;

C. To provide short, diagnostic descriptions and habitat
   information for each moss species recorded;

D. To analyze, compare and interpret the
   phytogeographical affinities of the moss flora at
   the provincial, regional and worldwide levels;

E. To speculate on the origin and evolution of the moss
   flora under investigation.

II. Physical Background
A. **Landforms**

The Selkirk and Purcell Mountains (Map 1) consist of a series of north-south oriented mountains paralleled by deep and narrow valleys containing the main systems of rivers and lakes. In general, the valley floors lie between 400 and 920 m above sea level, and the mountains range from 1520 to nearly 3400 m above sea level.

The overall topography is along a north-south dipping axis with higher peaks clustered in the northern half of the two mountain ranges. The two highest peaks in the area are Mt. Sir Sanford (3380 m), north of Glacier National Park, and Mt. Farnham (3304 m) in the Bugaboo Glacier Range. The natural division between the Selkirk and Purcell Mountains is marked by Kootenay Lake at the southern end, Duncan River in the middle, and Beaver River to the north (see Map 1). The whole area is believed to have been thoroughly glaciated during the Pleistocene Period. This is evident today in the presence of many sawtooth peaks and active alpine glaciers in both mountain ranges. All the major ranges are cut by small, transversely positioned lakes, streams, valleys or passes, the most well-known of which is Roger's Pass (1320 m elev.) at Glacier National Park.

Valleys and the lakes tend to be lowest in the western side of the area and highest in the east. The four major lake
systems which have exerted influence over the local vegetation are (from west to east): Upper and Lower Arrow Lakes (410 m elev.), Slocan Lake (520 m elev.) which subdivides the Selkirk Mountains into the Valhalla and Kokanee Ranges, Kootenay Lake (540 m elev.) and Columbia Lake (870 m elev.) which is the headwaters of the famous Columbia River (Williams, 1973).

The peculiar local topography has caused the Columbia River to flow north from the drainage divisional locale within the southern Rocky Mountain Trench, bend around the Mica Dam site and then continue southward through Washington and westward into the Pacific Ocean. The construction of a series of dams along the Columbia River has created a few artificial lakes such as the McNaughton Lake (or Kinbasket Lake) to the north and Upper and Lower Arrow Lakes to the west. Consequently, some land has now been flooded.

B. Geology

Although detailed accounts of the geology of the Western Cordilleran Mountain System are reported in McKee (1972) and King (1977), there are relatively few studies of the geology of the area itself.

In brief, the Selkirk and Purcell Mountains are reported
to have undergone a series of folding and thrusting during the early part of the Tertiary Period from about 70 to 35 million years ago (Fishtacher, 1977). They then went through an erosional interval during the mid-Tertiary during which the general outline of the present drainage pattern began to emerge (Ryder, 1978). General uplift followed soon after with a series of fissures and volcanic eruptions. Evidence of past tectonic activities is still apparent today by the presence of numerous active hot springs scattered around the study area, notably in the vicinity of Arrow Lake, Kootenay Lake and the Columbia Trench (McDonald et al., 1978).

Studies (Holland, 1976; Ryder, 1978) show that the Selkirk Mountains are underlain by a variety of rocks (see Map 2): Paleozoic sedimentary and metamorphic rocks in the region north of Trout Lake, Mesozoic (Triassic) sedimentary and faulted volcanic rocks forming a wide, east-west belt between Kaslo and Nakusp and also in the area south of Nelson and Trail. The rest of the region is made up of granitic rocks of Cretaceous and early Tertiary age.

Many high and sharp peaks project through the present ice fields and glaciers in the northern portion of the Selkirk Mountains (McKee, 1972). The mountains are more subdued and rounded with fewer rugged peaks and without glaciers in the southern end of the range. A few of the high peaks such as Mt. Sir Sanford and Mt. Templeman consist mainly of limestone, but these are inaccessible by land routes today.
In the case of the Purcell Mountains, the axis of the range lies closer to the western than to the eastern margin. Consequently, the westward drainage of the mountain range is by short, steep streams whereas the eastward drainage is on more gentle gradients and longer tributaries.

The lithology of the Purcell Mountains is more uniform. The mountain range is underlain mainly by sedimentary rocks (largely of Proterozoic age) that are locally intruded by granitic batholiths such as those seen around the Purcell Wilderness Conservancy (see Map 2). Like the Selkirk Mountains, the more northern portion of the range contains many rugged high peaks which are massive when composed of granite or quartzite, and are sharp and pinnacled when composed of slates. Active glaciers are common in many high peaks today. South of Mt. Findlay and Skockumchuck Creek, the mountains become more rounded, lower than 2500 m and often are wooded to the summit (Holland, 1976; Ryder, 1978).

C. Climate

The general pattern of the climate of British Columbia has been summarized by Schofield (1965).

Although the study area is more than 200 miles away from
the Pacific Coast, the residual effects of the moist, mild, westerly, maritime air masses still dominate the local pattern of climate. Only the seasonal influxes of cold, dry air from the Arctic during winter and the hot, dry air from the Great Basin states of northwestern United States during summer break this basic pattern (Williams, 1973).

Owing to the intercepting north-south trend of the various mountain ranges, which places them at right angles to the flow of moist westerlies from the Pacific Ocean, the valleys and mountains east of Arrow Lakes become progressively drier from west to east. The Slocan valley receives an annual precipitation of 78 to 107 ml of rain and melted snow whereas the Columbia Trench receives only 38 to 46 ml of total available precipitation (see Table I). Every year the northern half of the Selkirk and Purcell areas also receives nearly three times more than the segment south of Trail and Cranbrook (Schaefer, 1978). This is because of the modifying effect of the high terrains in the area north of Revelstoke and Golden resulting in lower and cooler local temperatures in the summer.

Within the province, the total annual precipitation ranks second only to that of the Coast Mountains. The area is truly the interior wet belt of the province.

In the study area, the steep mountain summits and narrow valley bottoms often register strong differences in temperature even within the same hour. On the other hand, the lake water
exerts some significant influence over the diurnal changes of the local weather. Owing to the exchange of flow of air masses between mountain peak and lake surface, afternoon thunderstorms are frequent in the valleys during the summer months. Occasionally, local temperature reaches a high of 27 degrees Centigrade and then suddenly drops to -5 to -2 degrees overnight.

All months in an average year have days of rain or snow at least at higher elevations. High mountain tops, generally speaking, being more continuously ventilated by the incoming maritime westerlies, do not show drastic fluctuations in temperature and precipitation throughout the year. Summer is, of course, the driest season everywhere in the study area except in the Columbia Trench, where spring is dry.

Winter in the Selkirk and Purcell Mountains is colder than that in the Okanagan and Coast Regions within the same latitude. The occasional invasion of cold and dry polar air masses during winter can greatly prolong the severity of the cold season. The northern half which is closer to the source of the polar air mass, also suffers yearly from a colder winter than the southern part. The mildest winters occur in the vicinity of Deer Park and Trail.

The orientation and the height of the Rocky Mountains to the east have been credited with providing protection to the study area in winter against the onslaught of cold continental
air masses from the prairie provinces (Kendrew and Ken, 1955). Consequently, the whole area under study has milder winters compared to the region further north in the same longitude.

D. Soil

Mosses are rootless plants that grow on the surface of the substratum. Often, it is the nature of the topsoil layer, instead of the parent rock materials underneath, that appears to influence the species composition of mosses in a particular site. Furthermore, because of the history of glaciation in the area, the topsoil layer in many places differs in mineral composition and even pH from the bedrock below. Hence, a general review of the nature of the soil types in the region of study is pertinent.

Many natural factors are responsible for the genesis and evolution of soil in a particular locality. The processes of soil formation in British Columbia are explained by Lavkulich and Valentine (1978).

Kootenay soils are primarily of two varieties: those which originated on materials produced by glacial action and those deposited by flowing water. The type of soil depends also to a significant degree on the underlying parent rock materials and
the local climatic conditions.

To date, only the soil types of the Columbia Trench and the adjacent valleys have been studied, classified and published in detail (Wittneben and Lacelle, 1978). Nevertheless, enough information for a general description of the regional soil types was gathered from the discussions held with Mr. T. Lord of the Soil (see Map 3). Research Institute, Agriculture Canada, as well as from the scattered literature.

The common occurrence of calcareous soil types (i.e., Eutric Brunisol and Gray Luvisol) in the Columbia Trench is the result of years of erosion of the underlying sedimentary limestones and dolomites from the Rocky Mountains. The low precipitation also causes an incomplete leaching of the soil and the formation of a somewhat hardened carbonate layer at a shallow depth. In contrast, other soil types such as Humo-ferric Podzol and Dystric Brunisol that develop elsewhere in the Selkirk Mountains are mostly acidic. The higher precipitation and the rapid accumulation of organic humus under the forest canopy, along with the non-calcareous parent rock, have contributed to the low pH in the surface soil horizon.

Calcareous soil reappears in the areas around Deer Park and Syringa Park and the Kikomum Creek Park south of Cranbrook. These areas are covered by open Ponderosa pine-grassland vegetation and the underlying parent rocks are calcareous.
Precipitation is also low.

E. Vegetation zones

The forests of the two mountain ranges discussed here are heterogeneous in the sense that there is always a mixture of tree species in any local forest community. Rarely is there a single arboreal species dominating over a large area, except in places where a forest fire has occurred.

Only a general description of the different vegetation zones or biogeoclimatic zones observed will be presented here. For detailed discussions, the reader is referred to the papers of Biel et al., (1976), Jones and Annas (1978), and Krajina (1965, 1969).

The importance of the forest, in essence, is that it provides various shaded microhabitats or substrata for bryophytes to colonize, grow and compete. There are four major biogeoclimatic zones in the Selkirk and Purcell Mountains (see Map 4a): namely, the Interior Western Hemlock (IWH), Interior Douglas-Fir (IDF), Subalpine Engelmann Spruce-Subalpine Fir (ESSF), and the Alpine Tundra (AT).

The Interior Western Hemlock zone occurs mainly in the so-called "interior wet belt" of the Kootenay region. It covers
the western and the northern slopes of the Selkirk and Purcell Mountain Ranges and is distributed generally below 920 m in elevation. It climaxes in the mesic sites with an extensive and well-developed ground cover of herbs and mosses. The principal tree species are Tsuga heterophylla (western hemlock) and Thuja plicata (western red cedar). The shrubby Oplopanax horridum (devil's club), and the large herbaceous Lysichitum americanum (skunk cabbage) can become prominent ground species in the more permanent seepy sites. In many respects, the Interior Western Hemlock zone, as typified by the forests seen around the Mica Dam, is very similar to the Coastal Western Hemlock Zone both in terms of forest structure and species composition. Southward along the Trail-Creston-Nelson-Cranbrook belt where the summers are warmer and drier, individual trees or stands of Pseudotsuga menziesii (Douglas fir), Pinus monticola (western white pine) and Larix occidentalis (western larch) become more frequent. When the original stand of forest is burnt or clear-cut, open and irregular patches of Pinus contorta (lodgepole pine) and species of Populus become established and persist for a period of years. These differences in the seral species of plant succession and in the temperature and precipitation regimes between the northern and southern ends of the Interior Western Hemlock zone have been recognized lately by foresters of the Nelson District. The zone has thus been subdivided into a wet and a moist Interior Western Hemlock subzone (see Map 4b), which in turn reflect more vividly the patterns of distribution.
of the local mosses (see also discussion).

On the other hand, the Interior Douglas-Fir zone occurs mainly near the southern limit of the study area, and in the rain shadow slope of the Purcell Mountain Range. The Interior Douglas-Fir zone generally lies between 360-1060 m elevation in the southeastern dry valleys, and stays close to the valley bottom in areas northward to Golden. The forests can be open or closed depending on the available moisture regime (Brayshaw, 1965; Jones and Annas, 1978). The principal tree species in this zone is *Pseudotsuga menziesii* (Douglas fir) with a few scattered trunks of western hemlock, western white pine and western larch. The Interior Douglas-Fir zone, like the Interior Western Hemlock zone, gradually merges with the Subalpine Engelmann Spruce-Subalpine Fir zone at higher elevations of about 1220 to 1380 m. The merging elevation varies from mountain to mountain.

A large portion of the vegetated slopes in the mountains belong to the Subalpine Engelmann Spruce-Subalpine Fir zone. It is here where the diversity of moss species is greatest, especially in humid sites (see Slack, 1977). The Subalpine Engelmann Spruce-Subalpine Fir zone varies in breadth from site to site, and usually does not ascend above 1980 m elevation. The two principal tree species are *Abies lasiocarpa* (subalpine fir) and *Picea engelmannii* (Engelmann spruce). Occasionally, there persist groves of lodgepole pine and western larch, especially along the upper and lower boundaries of the
Subalpine Engelmann Spruce-Subalpine Fir zone. Trees in the Subalpine Engelmann Spruce-Subalpine Fir zone must tolerate colder, drier and more severe continental winter months with frozen ground. The forest canopy becomes more open with an increase in elevation, until only islands of trees are left in the so-called alpine parklands in the uppermost limit of the zone (Jones and Annas, 1978).

Most mountain peaks above 1980 m elevation support only herbaceous plant communities. Stunted or prostrate trees of "Krummholz form" are rare, found only in the more protected sites. Alpine meadows become well developed in moister, flat or gently sloping sites, and alpine heath communities occupy extensive slopes in summits where the snowcover lasts into the summer. In extremely harsh, exposed and windswept slopes, only lichens and mosses can survive. The alpine tundra zone is a cold, windy and snowy environment with a very short frost-free period favorable to plant growth. It is also here that the common arctic-alpine species of mosses are encountered.

There exists an edaphic climax vegetation, the Ponderosa Pine-Bunchgrass community, which occupies only limited areas (Brayshaw, 1965). It is seen in the vicinity of Deer Park and Castlegar near the southern end of Lower Arrow Lake and also in Kikomum Creek Park area. The zone falls within the driest and warmest parts of the study area. Frequently, fire is the main factor in maintaining this zone. According to Jones and Annas (1978), the Ponderosa Pine-Bunchgrass zone is a seral
vegetation type which climaxes into the Interior Douglas-Fir forest in the Kootenays.

One other minor type of forest characterizes the unstable and disturbed sites along the lake margins, stream or creek banks and floodplains. The common trees in this alluvial community are *Populus trichocarpa* (black cottonwood), *Populus tremuloides* (trembling aspen), and species of *Salix* (willow), *Alnus* (alder) and *Betula* (birch). All are deciduous broad-leaved trees and shrubs.

F. Quarternary vegetational history

The differential renewal of orogeny in the Cascade and Rocky Mountain Ranges which started late in the Tertiary (Pliocene) and the succeeding Pleistocene glaciations are probably the two most important geologic events in shaping the history of vegetation in the study area (McKee, 1972).

That the climate in the province as well as throughout the world fluctuated cyclically from warm to cool in different geologic periods has long been established (Barghoorn, 1953; Dorf, 1959; Rouse & Mathews, 1979; Wolfe, 1971). During the Cretaceous time, the flora of western North America and that of southeastern British Columbia (represented by the Kootenay
coal-bearing formation) was described to be subtropical to tropical in species composition. It was also rather similar to that of Europe and eastern Asia up until the late Cretaceous (Wolfe, 1975; Rouse, 1959). Recent evidence has revealed that the differentiation of local floras between the coastal and interior locales had started as early as the middle Eocene (Rouse, 1959; Rouse et al., 1971; Wolfe, 1969). The appearance of more coniferous-deciduous dicotyledonous arboreal pollens in the interior middle Eocene assemblages, reflects the existence of a more continental environment than the one on the coast during that geologic interval (Rouse et al., 1971). However, the real development of the modern coniferous forests in the south-central interior of British Columbia was initiated in the late mid-Miocene in response to a sudden cooling (Rouse & Mathews, 1979; Wolfe, 1978; Wolfe & Hopkins, 1967). This was followed by major uplift of coastal mountain systems resulting in the development of rain shadows in interior valley systems (Mathews & Rouse, 1963; Rouse & Mathews, 1979).

A different interpretation was presented by Axelrod (1958) who claimed that a variation of local climates existed in western North America towards the end of Cretaceous and Paleocene. He stated further that the existing western Cordilleran floras had since differentiated into a Madro-Tertiary Geoflora (inhabiting the semi-arid and warm regions in southern American Rockies, California and Mexico), an Arcto-Tertiary Geoflora (inhabiting the cold and wet northern boreal
regions) and a Neotropical-Tertiary Geoflora (occupying the wet and warm southernmost tropical parts of the continent).

This discrepancy among authors in the time assigned to the differentiation of local floras is rather academic, because by the end of the Pleistocene, the entire southern interior of British Columbia had been covered by at least one phase of the Cordilleran ice sheet (Dillon, 1956; Douglas, 1970). The onset, development, advances and retreats, and the final melting of the Pleistocene ice at the end of the Wisconsinan stage (ca 10,000 yr BP) has been detailed by Holland (1976) and Clague (1975). Presumably, the flora either was displaced southward, survived periglacially or was wiped out (Gams, 1932; de Vries & Ebird, 1965; Dillon, 1956; Whitehead, 1972). The overall effects of the Pleistocene glaciation on the North American moss flora have been assessed by Steere (1965) and more recently by Miller (1976).

The possibility that some small populations of mosses persisted on a few protruding high and sharp peaks during the maximal glaciation is not to be discounted, although there is no evidence from fossils to support this hypothesis. In the adjacent Rockies, however, evidence points to the possible existence of an ice-free corridor during the Pleistocene glaciation (White et al., 1979).

There is evidence that the ice disappeared in some local sites during the warmer interglacial periods (Fulton, 1968).
Whether or not the accompanied re-invasions of plants into these newly opened, barren lands at this time has exerted any significant influence on the present distributions of plant species is difficult to assess. The sites, of course, had been covered again with a thick layer of ice when the Cordilleran ice-sheet advanced the second time.

As to the postglacial history of the plant migration into the area, much information comes from the analysis and interpretation of the pollen records. With all its limitations, the depositional succession of pollens and spores in a peat core can provide a relatively reliable basis for the reconstruction of past vegetational history of an area (Davis, 1969). Unfortunately, no study of this sort has ever been done in the Selkirk and Purcell Mountains, although palynological investigations were undertaken in the Okanagan valley by Alley (1976) and Hansen (1955).

The pollen and spore records of northern Washington and Idaho, however, have been studied by Hansen (1947) and Mack et al. (1978a, 1978b, 1979). Their studies show an initial formation of a tundra-like vegetation (mostly non-arboreal sedge and grass pollens) when the ice first melted. This is followed quickly by the establishment of a community of grasses and diploxyylon pines (implying a warmer and drier condition). The later appearance of pollens of spruce, fir, and hemlock suggests cooler and moister conditions which took place ca 2400-5000 years B. P. The final stage of the postglacial
succession, of course, differs from site to site reflecting the present dominant vegetation (Daubenmire, 1975).

None of these Holocene vegetational studies reported any spores of bryophytes except those of *Sphagnum*.

G. History of bryological study of southeastern British Columbia

The two naturalists who first came close to the study area to collect bryophytes are Mr. T. Drummond (see Bird, 1967) and Dr. D. Lyall (Mitten, 1865). Both explored the slopes of the Rocky Mountains just east of the Columbia River around 1825-27. The exploration was part of the survey conducted at that time in connection with the establishment of the 49th parallel and also the British Columbia provincial boundary.

The first influx or mass arrival of Europeans in the Selkirk area was in the late 1870's when mining became a lucrative trade (Barlee, 1974). The settlements brought destruction of much of the original forests, but at the same time, called the attention of contemporary naturalists to study the rich local flora, the most notable being J. Macoun.

Early reports of mosses collected from the Interior Kootenay regions were scarce and scattered. Sporadic reports
can be obtained from the publications of Kindberg (1893, 1907), Macoun (1902), Macoun & Kindberg (1892) and Mitten (1865).

Within this region, Macoun collected mainly in 1885 around the Revelstoke area and the Roger's Pass vicinity following the Canadian Pacific Railway. The problem of deciphering a multitude of synonyms that Kindberg and Macoun proposed based on the latter's collections from the Kootenay is therefore not as enormous as is the case with his large collections from the coast (Steere and Crum, 1977). Also, many isotypes of Kindberg and Macoun's new species from the study area are available at CANM for study.

Mrs. F. A. MacFadden made the first extensive collections of moss specimens from southeastern British Columbia. Most of her collections were sent to different authorities for determination. The endeavor culminated in two publications (1926, 1929). The first of these (1926) is a report prepared by MacFadden listing the 268 mosses that she collected from the "south-eastern section" of the province. The south-eastern section was not precisely defined by the author and may well include the whole of the Kootenay Region of today. The list contains a few records of species that have not been collected since. It includes also several names based on misidentification which have persisted in the literature. The MacFadden Herbarium is now permanently housed at the California State University at Fullerton. Some 400 specimens of the MacFadden collections were borrowed for study and
annotation in connection with my research.

Like Macoun (Godfrey, 1977), MacFadden was rather careless in recording the exact date and locality of her collections. Many specimens bearing the same names and locality differ only in collection dates. The specimens which all appear to be pieces of the same collection, usually have a discrepancy in the collection dates that makes it difficult to believe that the collector went back to the same locality in three consecutive months, and in a few cases, in three successive years. Furthermore, the dates that appeared on the other collections indicate the unlikelihood that Mrs. MacFadden travelled from place to place in such a short span of time. When comparison is made between the specimen kept in MacFadden's Herbarium and the duplicates seen at CANM, UBC, and V, it becomes obvious that she retained for herself, in most cases, the packet that contained the poorest material or even the wrong material.

Mrs. F. A. MacFadden also confused her field collection number with her herbarium accession number. Often, she did not put any collection number on the duplicate specimens; or if she did, it is not clear whether the number is her field collection number or the herbarium accession number. All of these oversights are, unfortunately, recorded in the literature. Two packets of seemingly the same specimens from the same locality, but with two different numbers written on them, may not necessarily mean two separate collections.
Information derived from the MacFadden collection has already been incorporated into the three volumes of Grout's Moss Flora of North America (1928-1940) and in the revision works of Frye (1917-18), Ireland (1969), Koponen (1974), Lawton (1957; 1965), Peterson (1979), and Vitt (1973c, 1976).

It is apparent that no report of exclusively Kootenay mosses was published after that of MacFadden (1926). Interest in the moss flora of the Kootenays was rekindled in 1968 when W. B. Schofield began his series of papers on the bryophytes of British Columbia.

Whereas the papers of Schofield (1968a, 1980c) serve as a guide to the proper nomenclature and systematic arrangement of the moss families reported in this thesis, his other paper (1976) provides a wealth of information about the ecology of many mosses in the province.

It is of considerable advantage that the moss flora of the areas surrounding the Selkirk and Purcell Mountain Ranges has been investigated. The results were reported by Ahti and Fagersten (1967), Bird (1968, 1973), Chapman and Sanborn (1941), and Jones (1930). All of these efforts have contributed substantially to the understanding of the regional moss flora being studied.
III. Methods

The present investigation can only be considered as preliminary for several reasons. They are: the large size of the collecting area, the few years devoted to the floristic study, the financial constraint and the distance of the area from the University of British Columbia in Vancouver.

A total of three summers (1976-78) were spent making field collections. The foremost guiding principle in planning the field work was to visit and collect from as many places as possible within the limits of the time, means of transportation and finances available. Because of the local weather conditions, the only feasible months in a year for collecting, especially at higher elevations, are July, August, and early September. An additional one week collection trip was made in the summer of 1979 to the area of Mica Dam. The collecting was assisted by transportation provided by local foresters. Helicopter rides were made available to visit a few sites that are not accessible by roads or trails.

With the help of a field assistant each year, collections of mosses were made from a varieties of habitats, elevations, and biogeoclimatic zones. Observations were recorded concerning the nature of the substratum, habitat conditions, and associated moss species. This information was kept in a field notebook and was transferred later to the prepared
herbarium labels for each of the collections. Precise locality information and date of collection were given particular attention in the recording. Under most circumstances, field determination of moss collections was not attempted in order to have more days available for collecting.

The first summer was spent surveying the whole study area following the main highways and major roads to get acquainted with the local geography. Collections were made mostly along the roadsides and the nearby easily accessible sites.

The second summer was devoted to intensive and extensive collecting in national and provincial parks, notably Mt. Revelstoke and Glacier National Parks, Kootenay and Bugaboo Glaciers Provincial Parks, Champion Lakes Provincial Park, and the Purcell Wilderness Conservancy.

The third summer was spent collecting from the remaining unvisited mountains, several regional parks and mountain lakes often known only to local residents for recreational fishing. These places have unmarked trails or pathways that lead to nameless waterfalls, alpine lakes and hot springs. Local maps with a scale of 1:600,000 (British Columbia Recreational Atlas, 1975) and also local topographical maps with a scale of 1:250,000 and 1:50,000 were used in locating places. Elevations of major collecting sites (see Map 5) were determined with an altimeter.

All field collections were stored temporarily in separate
paper bags and sent back to UBC for processing and drying. Each specimen was then packaged into several replicates for future deposition and distribution. A complete set is left at the UBC Herbarium with incomplete duplicates at CANM, NYBG, V, and NICH.

Careful examination of each of the collections was made with high quality dissecting and compound light microscopes. Specimens were cleared routinely in Hoyer's solution in preparing materials for microscopic observation and cellular measurement, in addition to the use of simple water mounts. When necessary, scanning electron microscopy was also employed.

From each packet, several typical and well-developed individual plants were selected for dissection so that the detailed morpho-anatomical characters needed for correct identification could be determined. Transverse sections of leaf and stem were achieved by free hand sectioning with a new razor blade. Staining was resorted to in the study of Sphagnum collections. Often, specimens from places outside the area of interest were studied for comparison, and to gain an understanding of the range of variation. In a few instances, type specimens and other historical collections housed at US, NY, NICH, and MICH were borrowed to resolve some taxonomic confusions regarding poorly understood taxa or problematic species. In the course of this investigation, some of the newly employed characters have resulted in nomenclatural changes and the development of new taxonomic insights. All
these information gathered are reported in Chapter IV (Taxonomy).

In keying the specimens collected, the three volumes of Grout (1928-40), the moss floras of Crum (1976), Flowers (1973), Lawton (1971), Nyholm (1954-69) and Smith (1978) proved useful. Recent monographs of families and genera were also consulted and are mentioned under the appropriate generic or familial headings.

All collections made from the study area by Macoun, MacFadden, Schofield and others, which are housed in Ottawa (CANM), Victoria (V), University of Calgary (UAC), University of British Columbia (UBC), MacFadden's Herbarium (MACF) and the local herbarium of the Ministry of Forests, Research Division at Nelson District, were studied. Including my own three summer collections, a total of nearly 6000 numbers of herbarium packets were examined, forming the basis of the present thesis.

Abbreviations of different herbaria used or mentioned in the text follows that of Index Herbariorum (1974).

Terminology used in the description of moss taxa follows Schofield (1969b), Crum (1976), and Smith (1978). Where contradiction of definitions occurs, that of Schofield (1969b) is preferred.

Only the important and more commonly reported synonyms are cited under each species. Obscure names whose type specimens
happen to come from the study area and were available for confirmation of their correct identity, are also included. In a few cases, the reduction to synonymy is purely my personal taxonomic judgement, and may not be in agreement with other bryologists.

The specimens cited at the end of each species name illustrate my present species concept. As much as possible, the UBC herbarium materials, which include my own collections, are chosen as representative. It must be emphasized that the citation of specimens does not indicate the range of local distribution or frequency of occurrence.

Chromosomal studies in bryophytes have lagged behind similar efforts in flowering plants. Most of the reported studies deal with the counting of the number of chromosomes, often based on a single population in a locality, rarely concerned with the comparative study of karyotypes. The progress has recently been reviewed by Steere (1972) and Crosby (1980).

number, in many cases, is the same for nearly all the species in the same genus or all the genera in the same family. Thus, the haploid number usually provides no taxonomic significance at the species level. On the other hand, the chromosome number of a few polymorphic species can vary from region to region, and that both intraspecific aneuploids and polyploids exist. To date, only a few cases of taxonomic confusion in mosses have been clarified utilizing the results of cytotaxonomic study (Lowry, 1948; Steere, 1972; Wigh, 1973). As there has been no cytotaxonomic study conducted in the past or present utilizing the Kootenay moss populations and my failure to conduct such studies within the time available, I have not ventured to include the chromosome numbers reported elsewhere by other workers for each of the moss species described in Chapter IV.

Finally, distribution maps were prepared for many of the species reported here. The maps were then compared and analyzed to detect the more common patterns of distribution. Only a selected 176 maps are included to illustrate these basic patterns of distribution. In a few cases, collections made from adjacent areas, such as Radium and Fairmont Hot Springs which are outside the study area, are included in the map to give a better and more complete picture of the local range. All these maps together with the tables are appended at the end of the text.

Appended also at the end for reference purposes are lists
of mosses collected from Mt. Revelstoke and Glacier National Parks. It is interesting, but not surprising, that the two lists are very similar in species composition except that Glacier National Park, which covers part of the Purcell Mountain Range, yields more species of calcicolous mosses.

IV - TAXONOMY

General Key to the Families and Selected Genera -

1. Branches mostly in fascicles; leaf cells dimorphous, consisting of a network of empty, fibrillose hyaline cells surrounded by narrow, chlorophyllose cells

..........................Sphagnum

(Sphagnaceae)

1. Branches not in fascicles; leaf cells not differentiated into hyaline and chlorophyllose cells ..2

2. Capsules borne on a gametophytic pseudopodium, dehiscing by four longitudinal slits ..............Andreaea

(Andreaeaceae)
2. Capsules neither borne on a pseudopodium nor dehiscing by four long-slits ..................................3

3. Adaxial surface of leaf costa lamellate or with chlorophyllose filaments .................4

3. Adaxial surface of leaf costa without lamellae or chlorophyllose filaments or ecostate ...5

4. Leaf cells smooth (or verrucose); peristome teeth 32 to 64, united distally with the epiphragma (membrane) covering the mouth of the capsule .........................Polytrichaceae

4. Leaf cells papillose, at least in the upper half of the leaf; peristome teeth 16 or 32, or wanting; epiphragma absent ..................................................Pottiaceae

5. Gametophyte reduced to protonema, perigonium and perichaetium, microscopic; sporophyte disproportionally large and macroscopic, capsules strongly inclined, obliquely ovate conic or subcylindric, in some cases flattened dorsi-ventrally ..............................Buxbaumia
   (Buxbaumiaceae)

5. Gametophyte macroscopic, with stem and leaves; capsules pyriform, oblong, ovoid to cylindric, never flattened dorsi-ventrally .................................6
6. Stems erect, at times branched, forming tufts or turfs; setae terminal on stems and leafy branches, at times appearing lateral because of innovating branches (acrocarpous) ..........................7

6. Primary stems creeping or ascending, freely and profusely branched, forming interwoven mats, secondary stems sometimes becoming erect; setae lateral on main stems and branches (pleurcarpous) ..........................61

7. Leaves distichous .........................8

7. Leaves not distichous, in many rows; at times appearing "distichous" because of the strongly complanate arrangement of the leaves on the branches ...........10

8. Leaves consisting of two vaginant laminae which clasp the stem, with wing-like extensions apically and dorsally

..............................................Fissidens
(Fissidentaceae)

8. Leaves not differentiated into vaginant, dorsal and apical laminae ........................................9

9. Leaves unicostate and subulate, sheathing at the base, not decurrent; protonema not luminous in the dark

..............................................Distichium
9. Leaves ecostate, not sheathing at base, with broad decurrency; protonema luminous in the dark

.................... Schistostega
(Schistostegaceae)

10. Peristome of four solid, multicellular teeth; flap-like structures present in protonemal phase. 11

10. Peristome of more than four teeth, articulated and of cell wall fragments, or peristome teeth absent; protonemal flaps absent

................................. 12

11. Asexual gemmae present in an apical cup-like structure on an elongate shoot .................. Tetraphis
(Tetraphidaceae)

11. Gemma cups absent .................. Tetrodontium
(Tetraphidaceae)

12. Capsules not operculate (cleistocarpous)

................................. 13

12. Capsules operculate (stegocarpous) ... 14

13. Leaf cells papillate .................. Phascum (Pottiaceae)
13. Leaf cells smooth ......................Physcomitrella  
    (Funariaceae)

14. Plants on dung or nitrogen-rich substrates; capsules with well-differentiated apophysis (neck) equalling or wider than the theca; peristome teeth usually in eight pairs; if not, then the teeth long and coiled ............Splachnaceae

14. Plants not restricted to dung or nitrogen-rich substrates; capsules without well-differentiated and swollen apophysis; peristome teeth not in pairs ............15

15. Leaf cells papillose or mamilllose ....16

15. Leaf cells smooth .........................42

16. Leaf cells mamilllose on both surfaces (in transverse section) .........................17

16. Leaf cells papillose (in transverse section); if mamilllose, then only on the adaxial or upper surface ..............................................................18

17. Leaves strongly squarrose, arranged in 5 regular rows; peristome teeth of double concentric circles .................................................................Paludella  
    (Meesiaceae)
17. Leaves not strongly squarrose, not arranged in regular rows; peristome teeth of single circle. Dicranaceae

18. Leaf cells two layers, mamilllose only on the adaxial surface; endostome consisting of 64 filiform, frequently interconnected, ncdulose cilia; calyptra adhering to the seta after falling from the capsule ... Timmia (Timmiaceae)

18. Leaf cells not in two layers; endostome not consisting of 64 long and ncdulose cilia .................19

19. Leaf cells with rows of cuticular thickenings resembling papillae in transverse section ..........20

19. Leaf cells with discrete papilla(e), one to many per cell .........................................................21

20. Capsules cylindric or oblong, peristome teeth in a single circle or layer .........................Dicranoweisia (Dicranaceae)

20. Capsules globose, peristome teeth in two circles or layers ..................................................Plagiopus (Bartramiaceae)

21. Calyptra campanulate, covering the entire capsule at maturity .................................22
21. Calyptra cucullate or mitrate, covering only a fraction of the capsule at maturity ..................25

22. Calyptra not plicate; basal leaf cells smooth, elongate, with vertical cell walls thin and horizontal walls thick, strongly differentiated from the upper leaf cells

---------------------------------------------------------------------------------------------------Encalypta

(Encalyptaceae)

22. Calyptra plicate; basal leaf cells smooth, occasionally papillose, quadrate-rectangular to oblong, cell walls evenly thick or thin, gradually differentiated from the upper leaf cells ..................23

23. Calyptra hairy ..................Orthotrichaceae

23. Calyptra glabrous ..................24

24. Leaves piliferous, arista long, at least 1/2 the length of the blade; calyptra never papillose ....Coscinodon

(Grimmiaceae)

24. Leaves muticous, if piliferous, then arista short, not more than 1/5 the length of the blade; calyptra papillose or smooth ..................Orthotricaceae

25. Gemmae clustered or scattered at the tip of an attenuate
shoot ........................................... **Aulacomnium**

(Aulacomniaceae)

25. Gemmae not forming tall-like cluster at the tip of an attenuate shoot; gemmae if present, either in the leaf axils or other parts of the gametophyte ........26

26. Perichaetial leaves conspicuously ciliate at the margin ........................................... **Hedwigia**

(Hedwigiaeaceae)

26. Perichaetial leaves entire or serrulate, never ciliate at the margin ...........................................27

27. Peristome teeth wanting or rudimentary ...........................................28

27. Peristome teeth present, in a single or double concentric circle ...........................................31

28. Capsules funnel shaped, with distinct neck region, strongly grooved when dry ............ **Amphidium**

(Orthotrichaceae)

28. Capsules ovoid to oblong-cylindric or globose, without distinct neck region, not strongly grooved when dry ...........................................29
29. Plants very small, stem less than 4 mm tall; strictly calcicloous ........................................... Seligeria (Seligeriaceae)

29. Plants larger, more than 4 mm tall; not strictly calcicloous .............................................. 30

30. Stem covered with thick mats of reddish rhizoids; leaves strongly appressed; upper marginal teeth often double; capsules globose ................................. Anacolia (Bartramiaceae)

30. Stem not covered with conspicuous thick mats of reddish rhizoids; marginal teeth when present never in double rows; leaves loosely imbricate, flexuous or crisped; capsules not globose ............................................. Pottiaceae

31. Peristome teeth in a single concentric circle

.......................................................... 32

31. Peristome teeth in two concentric circles

.......................................................... 40

32. Peristome teeth long, filiform, twisted or erect

.......................................................... 33

32. Peristome teeth lanceolate or ovate, never twisted
33. Leaf cells more or less uniformly elongate to rectangular, outline discrete, thick-walled, smooth, occasionally papillose near the apex .................. Ditrichaceae

33. Upper leaf cells quadrate, oval to transversely elongate, outline often obscured by crowded papillae, thick-walled, but becoming thin-walled, and the cells elongate or oblong near the base ...................... 34

34. Lower leaf cells sinuous in outline .. Grimmiaceae

34. Lower leaf cells not clearly sinuous in outline ................................................................. Pottiaceae

35. Plants very small (stem less than 10 mm tall) ................................................................. 36

35. Plants larger (stem more than 10 mm tall) ................................................................. 39

36. Alar region inflated, hyaline, unistratose; capsules oblong, erect ................................. Orthodicranum (Dicrnanaceae)

36. Alar region inflated, but bistratose, or not
differentiated; if unistratose, then capsules variously shaped and not erect ..................37

37. Plants reaching only 4 mm tall or less, never forming extensive blackish or dark green tufts; calcicolous ........................................... Seligeria
(Seligeriaceae)

37. Plants more than 4 mm tall, usually forming blackish or dark green tufts; not strictly calcicolous ...........................................38

38. Peristome teeth entire, often perforated or cribrose .........................................Grimmiaceae

38. Peristome teeth bifid apically, never perforated .............................................Dicranaceae

39. Basal leaf cells mostly quadrate to short rectangular, not more than 4:1; rhizoids often abundant at base of the costa; peristome teeth entire ..................Scouleria
(Grimmiaceae)

39. Basal leaf cells mostly rectangular to elongate, more than 4:1; rhizoids usually confined to stem; peristome teeth bifid apically .....................Dicranaceae
40. Leaves strongly recurved or squarrose; leaf cells unipapillose, papilla centrally located on each cell

..............................**Paludella**

(Meesiaceae)

40. Leaves not strongly squarrose; leaf cells pluripapillose; if unipapillose, then papilla located at upper the end of each cell .........................41

41. Capsules globose, often asymmetrical when dry, mouth small when compared to the diameter of the theca; exostome teeth various, never reflexed; leaf margins often doubly serrate .................................**Bartramiaceae**

41. Capsules oblong to cylindric, radially symmetrical when dry, mouth large, nearly the same diameter of the theca; exostome teeth often reflexed 180 degrees when dry; leaf margins mostly entire, if serrate, never with double serration ..............................**Orthotrichaceae**

42. Peristome teeth absent or rudimentary 43

42. Peristome teeth present in a single or double rows .................................45

43. Plants very small (less than 4 mm tall); leaf cells long, rectangular to oblong; calcicolous .... **Seligeria**
43. Plants large (more than 4 mm tall); leaf cells rounded, quadrate to rhombic; not calcicclous ... 44

44. Leaves forming a rosette, thin in texture; upper leaf cells rhombic to short rectangular, thin-walled, parenchymatous ................. Entosthodon  

(Funariaceae)

44. Leaves not forming a rosette, firm to thick in texture; upper leaf cells rounded to quadrate, thick-walled, not parenchymatous .................... Scouleria  

(Grimmiaceae)

45. Peristome teeth in a single row ...... 46

45. Peristome teeth in double rows ...... 55

46. Peristome teeth divided into 32 long, filiform papillose appendages ..................... 47

46. Peristome teeth lanceolate, short, each tooth divided apically, striate below and papillose above ........................................ 49

47. Transverse section of leaf costa with at least 2 abaxial
lamellae on costa ....................... **Dryptodon**

(Grimmiaceae)

47. Transverse section of leaf costa without well-developed abaxial lamellae .................. 48

48. Leaves lanceolate-linear, upper leaf cells rectangular oblong, rarely quadrate ............ **Ditrichaceae**

48. Leaves obovate, spatulate or lingulate, upper leaf cells mostly quadrate to isodiametric ........ **Pottiaceae**

49. Alar cells strongly inflated, thin-walled, hyaline or colored ................................. 50

49. Alar cells neither inflated, thin-walled, nor colored ............................................. 52

50. Leaf costa with guide cells and stereid cells in transverse section ....................... **Dicranaceae**

50. Leaf costa without differentiation of guide cells and stereids ............................... 51

51. Peristome teeth bifid apically ........ **Dicranaceae**

51. Peristome teeth entire ...................... **Blindia**
52. Plants very small, less than 4 mm tall; calcicolous

 Seligeria  

 (Seligeriaceae)

52. Plants larger, more than 4 mm tall; not strictly calcicolous .......................53

53. Plants forming extensive dark brown or blackish green, hoary tufts on rock; basal leaf cells mostly quadrate, occasionally rectangular .............Grimmiaceae

53. Plants not forming blackish or hoary tufts, on various substrates; basal leaf cells longer, mostly more than 5:1 ........................................54

54. Peristome teeth filiform, papillose throughout ..............................................Ditrichaceae

54. Peristome teeth lanceolate, only papillose near the apex ................................Dicranaceae

55. Upper leaf cells mostly isodiametric, quadrate to round, at most rhombic or hexagonal ..........Mniaceae

55. Upper leaf cells rectangular, oblong to elongate
56. Capsules small (less than 1 mm long), horizontal, blackish, smooth and shining; plants of wet calcareous sites

.................................................. Catoscopium

(Catoscopiaceae)

56. Capsules large (longer than 1 mm long), erect, curved or inclined, smooth, but not shining, wrinkled or grooved, never blackish ......................... 57

57. Capsules curved or inclined distally from a long tapered neck; endostome segments longer than the exostome teeth

.................................................. Meesiaceae

57. Capsules not curved, neck not long and tapered; endostome segments shorter than the exostome teeth

.................................................. 58

58. Endostome with a low basal membrane or none, cilia and endostomial segments not well-differentiated

.................................................. Orthotrichaceae

58. Endostome with high basal membrane, differentiated into endostomial segments and cilia ........ 59

59. Upper leaves usually forming a rosette, margin often
denticulate near the broad and abruptly pointed apex; upper and middle leaf cells large, rhombic, over 20 um wide, walls thin, never pitted or incrassate; inner peristome segments, when present, opposite the outer peristomial teeth

.................................Funariaceae

59. Upper leaves usually forming coma, very rarely forming rosette as in *Roellia*, margins mostly entire, apex gradually acute or acuminate; upper and middle leaf cells rectangular, elongate to linear, less than 20 um wide, walls thin to thick, at times pitted; endostomial segments when present, alternate with the exostomial teeth ....60

60. Upper leaves forming a rosette, somewhat spreading when dry, obovate to oblong, large, 5-6 mm long and 2-4 mm wide, apex acute; leaf cells rhombic-rectangular, thin-walled

.................................*Roellia* (Bryaceae)

60. Upper leaves not forming a rosette, usually appressed to imbricate when dry (except *Bryum weigelii*), mostly ovate to lanceolate; if obovate, the leaf cells long and thick-walled and the apex long acuminate or plants julaceous and whitish green .................................Bryaceae

61. Upper leaf cells strongly sinucus or nodulose-wavy

.................................62
61. Upper leaf cells not strongly sinuous 64

62. Perichaetial leaves ciliate at the margins

   ----------------------------- Hedwigia
   (Hedwigiaceae)

62. Perichaetial leaves entire ..........63

63. Transverse section cf costa of upper part of leaf without abaxial lamellae .............. Racemitrium
   (Grimmiaceae)

63. Transverse section cf costa of upper part of leaf with at least two abaxial lamellae .......... Dryptodon
   (Grimmiaceae)

64. Calyptra campanulate, plicate .......... Orthotrichaceae

64. Calyptra mitrate or cucullate, not plicate

   ----------------------------- 65

65. Laminal cells quadrate, round, hexagonal or fusiform, less than 5:1 ..........................66

65. Laminal cells elongate to linear, longer than 5:1

   ----------------------------- 87
66. Leaf cells smooth ..........................67

66. Leaf cells papillose .......................82

67. Plants dendroid, secondary stems becoming erect when mature ..............................68

67. Plants not dendroid, secondary stem prostrate, procumbent, or creeping ................69

68. Upper leaf margins strongly serrate or marginal teeth long and conspicuous; paraphyllia absent on the main stem ..................................................Leucolepis
(Mniaceae)

68. Upper leaf margins entire to weakly serrate; paraphyllia abundant on main stem ..........Climacium
(Climaciaceae)

69. Main leafy stem complanate ..............70

69. Main leafy stem not complanate ...........73

70. Paraphyllia abundant, conspicuous on the stem ....................................................72

70. Paraphyllia absent ..........................71
71. Leaves clearly undulate; if not undulate, then leaf cells not lax, walls thick ..............Neckeraceae

71. Leaves not undulate; leaf cells lax, thin-walled

...............................................................Hookeria
(Hookeriaceae)

72. Leaves undulate; costa single; flagelliform branchlets usually abundant .................Metaneckera
(Neckeraceae)

72. Leaves not undulate; costa double and short or absent; flagelliform branchlets absent ........Heterocladium
(Thuidiaceae)

73. Upper leaf cells isodiametric, hexagonal or round, nearly as long as wide .......................74

73. Upper leaf cells rhombic, rectangular or fusiform, longer than wide .........................75

74. Leaf margins clearly differentiated, broad, consisting of linear cells, very different in shape and length from the leaf cells; peristome teeth in double rows

...............................................................Mniaceae
74. Leaf margins not or weakly differentiated, not consisting of linear cells; peristome teeth in a single row

Grimmiaceae

75. Leaf margins strongly dentate-ciliate, the marginal cilia often more than 1 cell long

Fabronia

(Fabroniaceae)

75. Leaf margins not dentate-ciliate

76.

76. Leaf costa with two to three short, supplementary branches radiating at the base

Antitrichia

(Leucodontaceae)

76. Leaf costa single or double, without supplementary costae or branches

77.

77. Leaves broadly ovate to orbicular, strongly concave; small julaceous plants with a silvery hue or whitish green color

Myurella

(Theliaceae)

77. Leaves not broadly ovate or orbicular; if so, then leaves not strongly concave or plants not small, julaceous and whitish green

78.

78. Leaves with numerous quadrate alar cells forming a broad,
well-marked triangular area at basal leaf angles

\[ \text{Antitrichia} \]
\[ \text{(Leucodontaceae)} \]

78. Leaves with only a few alar cells or none, not forming broad and well-marked area at basal leaf angles

\[ \text{79} \]

79. Paraphyllia abundant, foliose \[ \text{Leskeaceae} \]

79. Paraphyllia rare or none \[ \text{80} \]

80. Plants small (leaves not longer than 2 mm); terrestrial

\[ \text{81} \]

80. Plants larger (leaves longer than 2 mm); aquatic

\[ \text{81. Amblystegiaceae} \]

81. Leaves costate, margins near leaf base distinctly denticulate \[ \text{Platydictya} \]
\[ \text{(Amblystegiaceae)} \]

81. Leaves costate, margins near leaf base entire

\[ \text{Amblystegium} \]
\[ \text{(Amblystegiaceae)} \]

82. Paraphyllia abundant, conspicuous on stem
82. Paraphyllia few or wanting ........... 85

83. Paraphyllia foliose or narrowly lanceolate to filamentous, cells not papillose; stem leaves not strongly differentiated from branch leaves; laminal cells generally unipapillose

84. Alar cells inflated, hyaline cells reaching the costa; costa strong at base, percurrent ........ **Cratoneuron**

(Amblystegiaceae)

84. Alar cells not inflated, not reaching the costa; costa not strong at base, reaching 2/3 the length of the leaf or less

.......................... Leskeaceae

85. Plants small, julaceous, whitish green; leaves less than 1 mm long, margins distinctly serrulate .. **Myurella**

(Theliaceae)

85. Plants larger, not julaceous; if julaceous, then not whitish green; leaves more than 1 mm long, margins entire or
serrulate only towards apex; if leaves less than 1 mm, then margins not distinctly serrulate .......86

86. Leaves more than 3 mm long; alar cells numerous, strongly inflated and hyaline ..................Cratoneuron

(Amblystegiaceae)

86. Leaves less than 3 mm long; alar cells not inflated, never hyaline ..........................Pseudpleskeella

(Leskeaceae)

87. Leaf cells papillose ..................88

87. Leaf cells smooth .....................91

88. Alar cells numerous at the leaf base, strongly inflated and hyaline, reaching the costa .......Cratoneuron

(Amblystegiaceae)

88. Alar cells weakly differentiated cr none, not strongly inflated and hyaline, not reaching the leaf costa

..................89

89. Leaf costa single ....................Rhytidiaceae

89. Leaf costa double or none ............90
90. Paraphyllia abundant, copiously branched  

              -------------------------------------Hylocomium

              (Hylocomiaceae)  

90. Paraphyllia none  

              ------------------------Rhytidiadelphus

              (Rhytidiaceae)  

91. Leaf costa single  

              92  

91. Leaf costa double or none  

              104  

92. Paraphyllia abundant  

              93  

92. Paraphyllia none  

              94  

93. Paraphyllia mostly foliose, rarely branched; leaf costa strong at base, percurrent  

              ------------------------Cratoneuron

              (Amblystegiaceae)  

93. Paraphyllia not foliose, copiously branched; leaf costa not strong at base, not percurrent  

              --------Hylocomium

              (Hylocomiaceae)  

94. Leaves long, narrow and setaceous, distinctly falcate-
secund, keeled, arranged in 3 ranks on a long and much branched stem  

              ------------------------Dichelyma

              (Fontinalaceae)
94. Leaves otherwise; if long and narrow, then not keeled, nor arranged in three ranks on the stem ....95

95. Leaves strongly plicate, the plicae extending nearly to leaf apex ...........................96

95. Leaves not plicate, if plicate, then only with a few, short and shallow plicae not extending the entire length of the leaf blade ......................99

96. Leaves strongly falcate- secund or circinate; outer cortical cells of the stem inflated and thin-walled ..................................Drepanocladus (Amblystegiaceae)

96. Leaves straight, erect-spreading, appressed or falcate; if circinate, then stem outer cortical cells not inflated and thin-walled .................................97

97. Stems generally ascending to erect, reddish tomentose; plants common in wet, calcareous sites .Tomentypnum (Brachytheciaceae)

97. Stems otherwise, not reddish tomentose; plants not restricted to wet, calcareous sites ....98

98. Plants terrestrial, or epiphytic or epilithic
98. Plants aquatic, at least lower half partially submerged

..............................Brachytheciaceae

99. Plants aquatic, at least partially submerged in water

..............................Amblystegiaceae

99. Plants terrestrial, in wet to dry sites, not submerged

..............................100

100. Leaves strongly squarrose or wide spreading with long and channeled leaf apices

..............................Campylium (Amblystegiaceae)

100. Leaves not strongly squarrose; if so, then leaf apex not long and channeled

..............................101

101. Plants tumid; leaves strongly concave, imbricate

..............................102

101. Plants not tumid; leaves neither concave nor imbricate

..............................103

102. Plants large, leaves more than 1.5 mm long

..............................Scleropodium (Brachytheciaceae)
102. Plants small, leaves less than 1 mm long

..............................Brachythecium
(Brachytheciaceae)

103. Plants with flagelliform branches; epiphytic or epilithic

..............................Isothecium
(Brachytheciaceae)

103. Plants without flagelliform branches, on ground, trail and creek banks .........................Brachytheciaceae

104. Leaves strongly plicate ...............105

104. Leaves not strongly plicate ...........106

105. Leaves appressed; capsules cylindric and erect

..............................Orthothecium
(Entodontaceae)

105. Leaves erect-spreading or falcate-secund; capsules ovoid or oblong, inclined or curved ..........Rhytidiadelphus
(Rhytidiaceae)

106. Alar cells inflated, forming distinct colored group or auricle ........................................107

106. Alar cells at most enlarged, or not differentiated
107. Stems more or less erect, orange red in color; leaves concave and short apiculate; terrestrial mostly on humic forest floor .................. **Pleurozium** *(Rhytidiaceae)*

107. Stems not erect; if somewhat erect, then not reddish orange in color; leaves not concave, if concave, then apex not apiculate .................. 108

108. Plants terrestrial, epiphytic or epilithic ................................. **Brachytheciaceae**

108. Plants aquatic or at least plant bodies partially submerged .................. **Amblystegiaceae**

109. Plants complanate ...................... 110

109. Plants not complanate ............... 111

110. Leaves with clearly differentiated, broad or narrow decurrent leaf base consisting of often enlarged and thin-walled cells .................. **Plagiotheciaceae**

110. Leaves without decurrent leaf base .. **Hypnaceae**
SUBLASS SPHAGNIDAE

FAMILY SPHAGNACEAE

A monotypic family colonizing wetlands on predominantly acidic substrata throughout the world.

*Sphagnum* L.

The genus *Sphagnum*, established by Linnaeus in 1753, is a worldwide genus of about 150 species (Hill in Smith, 1978). The genus is best known for its porous and fibrillose laminal cells which are of two kinds: hyaline and chlorophyllose cells.

The taxonomy and nomenclature of the genus have been confusing for decades (Isoviita, 1966). In the past, many ecological forms have been given specific rank. Warnstorf in 1911 recognized 342 species and two years later Andrews reduced the number to about 100. Since there is still no general agreement concerning the number of valid species, I chose to follow freely the treatments of Nyholm (1954-1969), Crum (1976) and Hill (in Smith, 1978). The works of Andrews (1913) and
Vitt and Andrus (1977) on the North American *Sphagnum* were also consulted. The photographs of the *Sphagnum* leaf details in Vitt and Andrus (1977) have proven useful. Equally helpful are the unpublished mimeographed keys to the *Sphagnum* species prepared by H. Sjors and H. L. Blomquist.

Species of *Sphagnum* generally inhabit wet to moist sites at all elevations where they characterize very distinct aquatic and semi-aquatic environments of low pH. The ecology of *Sphagnum* bogs and fens has been studied by innumerable European and American botanists (see Vitt, Crum and Snider, 1975; Horton et al., 1979).

In British Columbia, Schofield (1968a) listed 29 species, most of which are reported from the coastal area west of the Cascade Mountain range. Many of these, such as *S. papillosum* Lindb. and *S. tenellum* Ehrh. ex Hoffm. are hyperoceanic species and do not extend into the study area. In recent years, *S. quinquefarium* (Lindb.) Warnst. and *S. subobesum* Warnst. were added to the local *Sphagnum* flora (Crum, 1976; Andrus, 1979). My conservative estimate of the total species number is 29, nine of which are found in the study area. *S. fuscum* (Schimp.) Klinggr. and *S. recurvum* P. Beauv., which are common in the adjacent areas of Wells Gray Provincial Park and the Canadian Rockies are to be expected in the Kootenay Mountains. These taxa are therefore included in the key within the parenthesis. The same is true of *S. magellanicum* Brid., which was reported from Pend’Oreille County in northern Washington State (Andrus and Layser, 1971).
The paucity of *Sphagnum* species in the study area is a reflection of the lack of well developed and extensive bogs. All species of *Sphagnum* collected are the more common taxa inhabiting sedgy fens, lake margin and wet forest floors.

It is of interest to note that at the moment only members of the Sections *Acutifolia*, *Cuspidata*, *Subsecunda* and *Squarrosa* are represented in the area under investigation. An understanding of this phenomenon can come only after more thorough studies on the ecology of each *Sphagnum* species and more extensive collections in all parts of western North America, as well as more comprehensive information about the history of vegetational and floristic changes in the area.

1. Chlorophyllose cells of the branch leaves elliptic in section, equally exposed on both surfaces of the leaf; all hyaline cells of branch leaves with numerous pores arranged in regular rows along the lateral cell walls

..........................*S. subsecundum*

1. Chlorophyllose cells of branch leaves triangular in section, unequally exposed on both surfaces; majority of the hyaline cells of branch leaves with large or small pores not arranged in regular rows ...............2

2. Chlorophyllose cells in section with the broad base facing the concave surface of branch leaves ...3
2. Chlorophyllose cells in section with the broad base facing the convex surface of branch leaves ....7

3. Outer cortical cells of the stem without pores

.................................4

3. Outer cortical cells of the stem with pores

.................................6

4. Upper parts of stem dark brown; plants slender, forming compact hummocks .................(S. fuscum)

4. Upper parts of stem yellow green, light brown, pink to purplish or reddish ..............5

5. Pores on the convex surface of branch leaves becoming very small towards the apex and conspicuously ringed; branch leaves usually arranged in five distinct rows

.................................S. warnstorffii

5. Pores of the convex surface of branch leaves large, not ringed; branch leaves not arranged in five distinct rows

.................................S. capillifolium

6. Plants always green in color; capitula with enlarged terminal bud; stem leaves not fibrilllose, lacerate to erose across the broadly rounded apex ........S. girensohnii
6. Plants variegated green and pink in color; capitula without large terminal bud; stem leaves weakly fibrilllose to none, entire to slightly erose across the acute to broadly obtuse apex .............................................. S. russowii

7. Capitula with distinct large terminal bud; stem leaves broadly lingulate, apices rounded and the hyaline cells extensively resorbed ....................... 8

7. Capitula without distinct terminal bud; stem leaves oblong-triangular to shortly triangular, apices not rounded and hyaline cells not extensively resorbed .......... 9

8. Plants large, stem 2 mm wide; branch leaves strongly squarrose to recurved; upper hyaline cells of branch leaf elongate, as long as the basal ones .... S. squarrosum

8. Plants smaller, stem 1 mm wide; branch leaves imbricate, at most weakly recurved to somewhat spreading; upper hyaline cells of branch leaf distinctly shorter than the basal ones .............................................. S. teres

9. Stem leaves with a deep cleft at the middle of the apex .................................................. S. riparium

9. Stem leaves without an apical cleft ... (S. recurvum)
Sphagnum capillifolium (Ehrh.) Hedw., Fund. Musc. 2: 86. 1782.

S. nemoreum Scoop.
S. acutifolium Ehrh. ex Schrad.
S. capillaceum (Weiss) Schrank
S. rubellum Wils.
S. tenerum Sull. & Lesq. ex Sull.

As treated here, this taxon embraces all the taxa listed as synonyms. Isoviita (1966) and Nyholm (1954-1969) accepted S. rubellum as a distinct species apart from S. nemoreum. Both admitted, however, that distinguishing the two species is sometimes difficult. The name S. nemoreum, as explained by Isoviita (1966) and Crum (1975), is a nomen dubium without a clear typification. They suggested that it be replaced by S. capillifolium.

My limited experience with the variable populations of the so-called S. rubellum and S. capillifolium has led me to conclude that the two species are conspecific, and to accept the broad species concept put forward by Crum (1976) and Hill (in Smith, 1978) for S. capillifolium. Hill (1976) further documented the continued integration of characters between S. rubellum and S. capillifolium (= S. capillaceum) and concluded that the name S. rubellum is not even justified as a
variety of the latter.

The taxon, with its wide range of variation, is fairly non-distinctive in external morphology among the many slender and hummock forming *Sphagnum* species. It is best identified by an elimination process following the set of dichotomous key characters. For the difference between the species and *S. warnstorffii*, see comments under the latter name.

*S. capillifolium* is rather abundant in local sites, though scattered widely in the study area. It prefers the margins of sedgy fens, lakes, seepy meadow and even wet forest floors. Widespread across the continent, it is present also in Europe and Asia; bipolar in distribution.

Representative specimens seen: Echo Lake, S of Revelstoke (UBC B-64C8); Glacier National Park (UBC E-6409); Bugaboo Glacier Provincial Park (UBC E-6410).

*Sphagnum girgensohni* Russ., Beitr. Torfm. 46. 1865.

Another common species in the area, *S. girgensohni* is distinguished in the field by its relatively robust size with long drooping branches, and green color. Small plants of
S. girgensohnii are differentiated microscopically from the closely related S. russowii by the lingulate stem leaves which are lacerate or fringed across the broad apex and the efibrillose hyaline cells in stem leaves of S. girgensohnii. Crum (1976) noted that in most cases, a triangular sieve-like area of large, open, resorbed cells is present at the middle of the base of the stem leaves of S. girgensohnii. I find this character very useful in identifying atypical specimens of S. girgensohnii. Another species that possesses similar structures on the stem leaves is S. fimbriatum which is not yet known in the study area.

In the Kootenays, S. girgensohnii seems to prefer wet, shaded forest floor and cliff faces near waterfalls. It forms only low mounds over small areas. In the process of hummock forming, this is usually the founding species. Scattered throughout the province, the species is common all across North America, Europe and Asia, especially on sloping seepy forest floors.

Representative specimens seen: Revelstoke area (UBC B-6411); Fishermaiden Lake (UBC B-6412); Beatrice Lake, Valhalla Mountains (UEC B-6413).
The only collection of this species (Tan & Ensing 77-1409) came from a muddy depression at a forest margin adjacent to the logging road in Monk Creek vicinity, near Stagleap Park on Hwy. 3 at a subalpine elevation. The deep apical cleft at the middle of the stem leaves is unmistakable. In British Columbia, *S. riparium* is known only from three other places: sedgy wetland on the Canoe Beach of McNaughton Lake ca 15 mi N of Mica Dam, Wells Gray Provincial Park and from Mile 340 of the Alaskan Highway. It is equally rare in Alberta (Vitt & Andrus, 1977). Basically a circumarctic species, the present population in the study area and nearby Pend Oreille County in north eastern Washington State (Andrus & Layser, 1971) and Waterton Lakes National Park in Alberta (Vitt & Andrus, 1977) represent possibly the southermost limit of its distribution in western North America.

Vitt and Andrus (1977) further remarked that *S. riparium* in Alberta is found often in roadside pools and disturbed areas. My collection came from such a habitat.
The species is one of the commonest and most widespread of *Sphagna* in the study area. It may be separated from *S. girensosochnii* by the pinkish color, the not prominent terminal bud and weakly fibrilllose stem leaf cells. For additional differences, see comments under *S. girensosochnii*.

The species appears to have a wide range of tolerance for water, light and pH. It is common in wetlands, sedgy meadows, seepy mountain slopes, shaded coniferous forest floors, lake shores and even marshy to muddy depressions along roadsides. Together with *S. warnstorffii* and *S. teres*, it is usually the hummock species in a hummock-depression complex.

A circumboreal species.

Representative specimens seen: Beatrice Lake, Valhalla Mountains (UBC B-6414); Kokanee Glacier Provincial Park (UBC B-6415); Glacier National Park (UBC E-6416).
Common in the Selkirk and Purcell Mountains, the taxon is easy to recognize in the field by its large size and strongly squarrose, green branch leaves. It is generally in wet, shaded woodland habitats at all elevations, and less frequent in open, seepy sites. Vitt and Andrus (1977) observed that, in Alberta, *S. squarrosum* is found rarely in calcareous sites and alpine tundra habitats. Schofield (pers. comm., 1979) remarked that the species is at subalpine elevations in British Columbia and Washington. It does occur over seepy volcanic rocks, but not associated with calcareous substrata.

The collection, Tan 76-816, is from a submerged population at Gibson Lake, Kokanee Provincial Park. The leaves have lost their squarrosity, but all other characters point to the present species.

Present in all provinces and states in North America north of Mexico. Also found in Europe and Asia.

Representative specimens seen: Beatrice Lake, Valhalla Mountains (UBC E-6417); Glacier Creek, E of Duncan Lake (UBC B-6418); Kckanee Glacier Park (UBC E-6419).
**Sphagnum subsecundum** Nees in Sturm., Deustchl. Fl. 2: 3. 1819.

The species, *sensu stricto*, is most distinctive in its chlorophylllose cells which are elliptic in cross section and in the bead-like arrangement of pores along the lateral margins of the hyaline cells of branch leaves. The only collection from the area, Tan & Ensing 77-1501, is from a wet, marshy site at St. Mary Alpine Park in the Purcell Mountain Range. The specimen has only one layer of cortical stem cells. For the variation of the taxon and the species complex, see Andrews (1959).

In British Columbia, the species is common in rich seepy peatland margins and terraces along the coast (Schofield, 1976). Elsewhere it is known also from a wet and sedgy meadow just north of the Mica Dam site (Tan & Scagel 79-400), from the Prince George area and from Wells Gray Provincial Park.

Also collected from California, Oregon, Alaska, Yukon, and Alberta. Present in eastern North America, Europe and Asia.

The species is related to S. squarrosum and has been treated as a variety of the latter by some authors. Ordinarily it is easy to tell the two taxa apart in the field owing to their difference in size and the nature of the squarrose branch leaves. However, depauperate forms of S. squarrosum may resemble S. teres. Under such circumstances, it is possible to separate the two species based on the length of the upper hyaline cells as compared to the basal cells on the same branch leaf. In addition, S. teres has larger pores on the convex side and upper part of the branch leaves.

The collection, Tan & Ensing 77-458, from an open, wet subalpine meadow site at the upper reaches of Cayuse Creek in Deer Park area, exhibits unusually large pores on the branch leaves. The diameter of the pores is about the same breadth as the hyaline cells themselves.

S. teres is relatively common in the interior of this province where a strong continental climate prevails. It is widely scattered in suitable habitats in the study area at all elevations: preferring very wet and mineral rich sites where it is frequently found growing with Rhizomnium magnifolium. Present also in Washington, Montana, California, and Colorado, north to Yukon and Alaska and east to Labrador. Circumpolar,
mainly arctic and boreal.

Representative specimens seen: Cayuse Creek, Deer Park (UBC B-6420); Glacier National Park (UEC B-6421); O' Bara Lake, Horder Creek (UEC B-6422).


*S. warnstorfiannum* Du Rietz in Sjors

This is one of the commonest species of *Sphagnum* in the study area. The pinkish to reddish upper part of the stem with the branch leaves arranged in five distinct rows is distinctive in the field. Occasionally branch leaves of *S. warnstorfii* are not arranged in distinct rows, and the specimens may be confused with *S. capillifolium*. Nevertheless, under the microscope, the small and ringed pores on the convex side and the upper half of the divergent branch leaves clearly indicate *S. warnstorfii*. 
A MacFadden collection from Silverton swamp at Slocan Lake dated June 16, 1923 and identified as *S. acutifolium* is *S. warnstorffii*.

Reported elsewhere as a calcicole, *S. warnstorffii* appears to have a much wider ecological amplitude in the study area, especially in the degree of pH tolerance. It is true, however, that populations are best developed in the more basic fens along the eastern flank of Purcell Mountain Range.

Widespread in the province from coast to the interior, it is also well distributed across the continent. Also circumpolar, arctic and boreal in distribution outside of North America.

Representative specimens seen: Goldstream River Basin (UBC B-6423); Fishermaiden Lake (UBC B-6424); Purcell Wilderness Conservancy (UBC B-6425).

**SUBCLASS ANDREAEAIDAe**

**FAMILY ANDREAEACEAE**

This is a small family of two genera, mainly distributed
in the temperate zones.

*Andreaea* Hedw.

A large genus of about 115 species widely distributed at high elevations and epilithic on acidic rocks in both northern and southern hemispheres (Chen, 1956). There are five species known to British Columbia and three are present in the study area.

The genus is well-known for the capsules which dehisce by four longitudinal slits and the pseudopodium which serves the function of the seta.

Britton and Emerson (1913) confused the species, *A. rupestris*, and reported it as costate among the four taxa attributed to British Columbia.

The excellent works of Nyholm (1954-1969) and Schultze-Motel (1970) have been consulted which led me to accept only three species for the study area.
1. Leaves ecostate ..................... A. rupestris

1. Leaves costate ........................... 2

2. Plants reddish brown; leaves strongly falcate-secund, upper laminal cells, including the costal region, strongly papillose in transverse section; perichaetial leaves similar to vegetative leaves ..................... A. nivalis

2. Plants blackish; leaves only weakly falcate, upper laminal cells smooth to mamilllose; perichaetial leaves large and convolute, strongly differentiated from vegetative leaves

.......................... A. blyttii


Map 8.

Until the discovery of a population in the study area, A. blyttii was thought to be confined to the mountains near the coast where it is frequent (Schofield, 1976). The only locality known for the species in the study area is Revelstoke National Park (UBC E-4300). Its blackish color and the
stronger leaf costae that are nearly excurrent or subulate
distinguish the taxon from *A. nivalis*. From *A. rothii*, which
is believed to be a coastal species, *A. blyttii* can be
identified by the vaguely defined costa towards the leaf base
and the more elongate basal leaf cells.

In North America, *A. blyttii* has a bicentric east-west
disjunct distribution. It is locally rare although widely
scattered in North America, Greenland, Europe, and Asia.
Schultze-Motel (1970) mapped the worldwide distribution of
*A. blyttii* showing it to be a circumpolar species of high
elevation and latitude.


The species epithet truly reflects its habitat preference,
places where snow persists into summer. The three populations
discovered in the study area are all from wet, granitic rocks
well above 6500 ft at Revelstoke National Park (UBC B-4301),
Microwave Tower Trail, Mica Dam site (UCE E-4340 & 4341) and
Bugaboo Glacier Park (UCE B-4302). Possibly, the species is
also present in other glacier-peaks along the Selkirk and
Purcell mountain ranges.

Populations of *A. nivalis* form conspicuous mats that are strikingly reddish brown especially when wet. The distinctly falcate-secund leaves are also characteristic in the field. See *A. blyttii* for comments.

The distribution pattern of *A. nivalis* in the province and around the world closely parallels that of *A. blyttii*. Nonetheless, the present taxon seems to be more common locally than *A. blyttii*.


A common saxicolous species in the study area, *A. rupestris* is fairly easy to identify in the field. Under the microscope, the ecostate leaves are unmistakable. The color of the populations ranges from greenish to reddish brown, or even blackish. It is the only species of *Andreaea* found below alpine elevations in the study area. Its distribution pattern in the study area, being more common in the Selkirk Mountains (Map 11), reflects the difference in the underlying rock types between the Selkirk and Purcell Ranges.
Within the province, the species is widespread on acidic rocks, scattered throughout, and is less common in the dry Okanagan Interior where suitable substrates are usually absent (Schofield, 1976).

A nearly cosmopolitan species, its reported absence from the vast mainland China (Chen, 1958) is probably an artifact.

Representative specimens examined: Halcyon Hotspring (UBC B-4303 determined as A. obovata); Kckanee Glacier Park (UBC B-4304); Woolsey Creek, Revelstoke National Park (UBC B-4305); Box Lake, Nakusp (UEC B-4306).

**SUBCLASS TETRAFHIDAE**

**FAMILY TETRAPHIDACEAE**

The family is best characterized by the presence of protonemal flaps and four multicellular peristome teeth. Two genera are known, both are in British Columbia.
1. Stems well-developed; leaf costa strong, nearly percurrent; gemma-bearing shoots common ....... *Tetraphis*

1. Stems very short and inconspicuous; leaf costa weak or none; gemma-bearing shoots absent ...... *Tetrodontium*

*Tetraphis* Hedw.

A genus common on rotten logs in shaded forests, *Tetraphis* differs from *Tetrodontium* in the development of a tall stem and the absence of persistent protonemal outgrowths. *Tetraphis* commonly produces lenticular gemmae in a terminal cup subtended by bracts. It is a genus of two species with wide distribution in the northern hemisphere.

1. Setae bent near the base, papillose above

............................... *T. geniculata*

1. Setae straight, curved or flexuose, smooth throughout
The bent and papillose setae are unique to the present taxon. It is uncommon in the study area, often collected in association or intermixed with *T. pellucida* from well-decayed logs in the shade. It is equally uncommon and restricted in distribution in eastern parts of North America. Interestingly, none of the few present collections of the species produce gemmae sheets.

The taxon has a geographical distribution of East Asia and North America.

Representative specimens seen: Crawford Bay, Kootenay Lake (UBC B-4281); Hamil Creek Valley Trail, Purcell Wilderness Conservancy (UBC B-4282); Goldstream floodplain, north of Revelstoke (UBC B-4283).

This is a common and widespread species growing on rotting logs. The abundantly produced gemmae cups help greatly in the field identification, except that occasionally these may be mistaken for Aulacomnium androgynum (Hedw.) Schwaegr. Under the microscope, the difference in the morphology of the gemmae and the papillose leaf cells of Aulacomnium are useful taxonomic characters. Setae of a few individual plants of T. pellucida are sometimes conspicuously bent, thus, can be confused with T. geniculata.

Kindberg (1893) described Georgia trachypoda with straight but papillose seta. Grout (1928-1940) synonymized it with T. geniculata, with whom I agree.

Schneider and Sharp (1962) studied the reproduction and development of the gametophyte in culture and reported many interesting observations on the behavior of frondiform protonemal flap of the present species.
Tetradontium Schwaegr.

This genus is best recognized by the very short stems with a few leaves, almost bud-like in appearance, and the lingulate to narrowly spathulate outgrowths from the protonema. Only one species is known to the study area.


The discovery of a population at the Kokanee Glacier Provincial Park (Tan & Ensing 77-741 or UBC B-4280) is a significant inland extension of the range of this species. It is also the third locality known from the province besides Mt. Seymour and Mt. Garibaldi.

Specimens were collected from the shaded, humid underside of the roof-ledge of a small cave near a waterfalls along the Lemon Creek Trail. The small bud-like plants were partly covered by the creeping Heterocladium procurrens (Mitt.) Rau & Harv. The protonemal flaps clearly show dentate margins which
distinguish it from the more common coastal species, *T. brownianum* (Dicks.) Schwaegr., whereas the flagelliform branches at the base of the stem differentiate it from *T. ovatum* (Funck) Schwaegr.

Also known from Europe, Caucasus, Japan, Alaska, Washington, and New Zealand.

**SUBCLASS PCLYTRICHIDAE**

**FAMILY PCLYTRICHACEAE**

This is a family of worldwide distribution and consists of 18 genera. The family is characterized by a well-developed and fairly large gametophyte with complex differentiation of a stem central strand and lamellate leaves, and also by a sporophyte with a capsule whose mouth is closed by an epiphragm, and whose peristome teeth are made up of many U-shaped fibrous cells.

Six genera are known in the province, most of which are common taxa in the northern hemisphere. Four are reported for the study area.

Many species of this family have erect extensions or
outgrowths from the adaxial surface cells of the leaf costa. These outgrowths serve to increase the photosynthetic surface area and are called lamella(e). The terminal cell of the lamella of each species usually has its own distinctive shape and surface structures. Thus, many of the species can actually be keyed out by merely comparing this feature with accurate illustrations prepared for each of the species.

G. L. Smith revised the generic concepts for the family in 1971, providing new understanding of the genera and insight into their possible inter-relationships. However, the distinguishing features adopted by him in re-defining the genera often are too minute and difficult to observe even with the use of a compound light microscope. It is not surprising, therefore, that the few new segregate genera proposed by him are not widely accepted by bryologists. A good example is the genus *Polytrichastrum* G. L. Smith which differs from the common and well known *Polytrichum* in having "epiphragm fleshy, its dorsal margin entire or fringed with erect, tooth-like processes opposite the peristome teeth and adhering to their inner faces, its ventral margin entire, folded upon the ventral surface when dry, resembling a curtain (the "annulus"); inner surface of the peristome smooth; spores larger, bearing warty papillose projections...." (G. L. Smith, 1974).

The generic treatment presented below is modified from Osada (1965, 1966) and the updated checklist of British Columbia mosses (Schofield, 1980c).
1. Leaf margins distinctly bordered, with marginal teeth in 2 rows ...........................................Atrichum

1. Leaves not bordered, entire or with marginal teeth in a single row ........................................2

2. Calyptra glabrous or with only few hairs; lamellae present on both surfaces of the leaves, not confined to the leaf costa .................................................Oligotrichum

2. Calyptra hairy; lamellae present only on the adaxial surface of the broadened leaf costa ....3

3. Capsules cylindric, exothecial cells mamillose, stomata absent on the hypophysis ..............Pogonatum

3. Capsules mostly angular; or if rounded, exothecial cells smooth, and stomata present on the hypophysis. .................................................................Polytrichum
Atrichum F. Eeauv.

This is a large genus of 40 species that grow on soil in the northern hemisphere. The genus is distinct in having a nearly glabrous calyptra and strongly bordered, doubly serrated leaves. Three species occur in the province, only one is recorded for the study area.


This is the only species of the genus so far collected from the study area. Plants are most common on overturned rootstumps covered with soil, newly cut road banks, cave walls, and creek margins. When dry, the strongly crisped leaves and the long capsules are striking. Confusion has occurred in the past with A. undulatum and A. tenellum. All collections of A. undulatum from the Kootenay Region at UEC, CANM, V and MACF were studied and proved to be the present species. True A. undulatum (Hedw.) F. Beauv. from the coast has small, strongly collenchymatous leaf cells measuring less than 30 um in diameter and, also is strictly monococious (Frye, 1949;
A. tenellum, on the other hand, has narrower leaves (less than 1.5 mm wide) and very few or no teeth on the abaxial side of the leaf. The latter species is very rare in southern British Columbia, though collected a few times from Quebec, Nova Scotia, and Wisconsin (Ireland in Lawton, 1971).

The genus Atrichum has been revised recently by Nyholm (1971) based on European and North American collections. Her species concept of A. selwynii is much broader than the one accepted by most North American bryologists (Ireland in Lawton, 1971; Crum, 1976). It includes part of A. undulatum and A. altercristatum (Ren. & Card.) Irel. My species concept for A. selwynii applies only to what Nyholm called var. selwynii, and is restricted to western North America in distribution.

Specimens examined: Goldstream River basin (UBC B-5450); Purcell Wilderness Conservancy (UBC E-5451); Poplar Creek, Lardeau (UBC B-5452); New Denver (UEC E-5453).
Oligotrichum Lam. & D. C.

This is a genus of about 23 species widespread across the high latitudes of the northern hemisphere. It is distinct in developing lamellae on both surfaces of the leaf and leaf costa. Three species are known from British Columbia, all occurring in the study area.

1. Plants tall, reaching 6 cm; leaves narrowed and not sheathing at base, strongly contorted when dry
   -------------------------------. O. parallellum

1. Plants small, not more than 2.5 cm tall; leaves expanded and sheathing at base, not markedly contorted when dry
   -------------------------------.2

2. Leaves with very few (1-4) lamellae on the abaxial surface; arctic-alpine
   -------------------------------. O. hercynicum

2. Leaves with abundant (6-15) lamellae on the abaxial surface; low elevation to subalpine .... O. aligerum

A common species at low elevations, *O. aligerum* is rather easy to identify. Populations are seen to cover extensively many newly opened sites bordering the forests as well as logged-over areas. It is widespread in the province and coastal parts of western North America.

Present also in Japan, Taiwan, Philippines, and Mexico.

Specimens examined: Glacier National Park (UEC B-5454); Kokanee Glacier Park (UBC E-5455); Valhalla Mountains (UBC B-5456); Poplar Creek, near Larder (UBC B-5457).

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Nearly as small in size as the previous species, *O. hercynicum* is strongly arctic-alpine in distribution, present near all the glaciers visited in the study area. The leaves rarely reach 4 mm long and 3 mm wide. The nearly
glaabrous abaxial surface of the leaf distinguishes it from *O. aligerum*. *Oligotrichum parallelum*, which grows in similar high elevation habitats, is at least two times taller in height than the present species. In addition, *O. hercynicum* has only indistinctly toothed leaf margins whereas *C. parallelum* has strongly serrate leaf margins.

It is present on open tundra sites, and near streams through heather meadows in low alpine zones in mountains throughout the province (Schofield, 1976).

A circumboreal species in the northern hemisphere.

Representative specimens seen: Kokanee Glacier Park (UBC B-5458); summit of Kimberley Ski Mountain (UBC B-5459); Glacier National Park (UBC B-5460).


This is an attractive, large and common species of *Oligotrichum* at high elevations in the study area. The leaves are of a softer texture than the other two species of the genus and are more strongly crisped when dry. See *O. hercynicum* for
further comments on the difference between the small specimens of the present species and other *Oligotricha* in the study area. In the coastal areas, populations have been seen to descend occasionally to sea-level via canyons (Schofield, 1976). It is widespread in most humid parts of the province.


Representative specimens seen: Glacier National Park (UBC B-5461); Revelstoke National Park (UBC B-5462); Meadow Mountain Alpine Recreation Area (UBC B-5463).

*Fogonatum* P. Feauv.

The traditional criterion used in separating the present genus from *Polytrichum* based on the angular or cylindric capsules is not strictly followed here. For strong arguments on the issue, consult G. L. Smith (1971). Instead, the genus is reserved here for those taxa bearing capsules with mamilllose or papillose theca and which lack stcmates on the apophysis. Thus defined, there are three species in the genus for the province, all of which are in the study area. Understandably,
generic identity is difficult to establish when specimens are collected without sporophytes.

1. Leaves strongly contorted when dry .... *P. contortum*

2. Terminal cells of the leaf lamella flat-topped in sectional view, wider than long .... *P. dentatum*
Pogonatum contortum (Schwägr.) Sull., Icon. Musc. Suppl.
58. 1874.

This is usually a robust species (5–10 cm tall), forming loose sods. The leaves become strongly crisped when dry. This feature is the best field character to use in determining the species. It was collected only twice from the wet northern half of the study area where it is rare. Both populations were collected from shaded, moist forest floor inside mature stands of Thuja plicata. The discovery of the Kootenay populations have extended significantly its local range into the humid interior forest of the Columbia Mountains. The report is new to the study area.

Reported also from California, Oregon, Washington, Alaska, and Japan, Korea, Kamchatka, and Sakhalin.

Representative specimens seen: west shore of Canoe Beach of McNaughton Lake, north of Mica Dam (UBC E-5464); Glacier National Park (UBC E-5465).
**Pogonatum dentatum** (Brid.,) Brid., Bryol. Univ. 2: 122. 1827.

**P. capillare** (Rich.) Brid.

This is a rare species on disturbed dampish roadbanks in the study area. The three known populations came from Glacier National Park (UBC E-5466, UBC E-5467) and Mica Dam vicinity (UBC B-5468). Plants are often smaller than *P. urnigerum* and the terminal cells of the leaf lamellae are definitely flat-topped. Osada (1965) observed that the peristome teeth of the present species are lanceolate, pale in color and with a low basal membrane while those of *P. urnigerum* are oblong, dark colored and with a high basal membrane.

Widely scattered in the province. Also reported from Europe, Amur, Kamtchatka, Korea, and Japan.

Lawton (1971) claimed it to be an arctic-alpine species in the Pacific Northwest. The Kootenay populations, however, are only subalpine in elevation. Schofield (pers. comm., 1980) has seen a population from near sea level.
**Pogonatum urnigerum** (Hedw.) Beauv., Prodr. 84. 1805. Map 16.

This is the commonest *Pogonatum* in the area. Like *Oligotrichum aligerum*, the present species often forms extensive pure stands along disturbed roadsides. It is unlikely to be confused with any other species of the family in the study area except *P. dentatum*. See the latter species for further commentary.

Large individuals can sometimes resemble *Polytrichum alpinum*, but the latter has smooth exothecial cells and the terminal cells of the lamellae are conical in shape.

A common and widespread species in the northern hemisphere. Cosmopolitan.

Representative specimens seen: 10 miles north of Slocan (UBC B-5469); Moyie river (UBC B-5470); Glacier National Park (UEC B-5471).
Polytrichum Hedw.

The generic concept adopted here includes Polytrichastrum and Polytrichadelphus sensu North American authors.

My conservative estimate is that the genus has some 60 species described from the north temperate zone. I recognize nine species from the study area. Within the province, two more species can be added. *P. sphaerothecium* (Besch.) C. Muell. is known only from Garibaldi Park near Vancouver (Schofield, 1966) and *P. hyperboreum* R. Fr. is known from the northernmost part of British Columbia.

The majority of the species of *Polytrichum* develop angular capsules and 64 peristome teeth. Exceptions are *P. sphaerothecium* and *P. alpinum*. In addition, *P. longisetum* acquires capsules with only obscure ridges and *P. sexangulare* sometimes has nearly cylindrical capsules.

1. Terminal cell of the lamella papillose or ornamented

1. Terminal cell of the lamella smooth ...3
2. Capsules circular or round in cross-section; calyptra hairy

.................................P. alpinum

2. Capsules angular; calyptra with few hairs

.................................P. lyallii

3. Terminal cell of the lamella notched ..P. commune

3. Terminal cell of the lamella not clearly notched

.................................4

4. Leaf margins serrulate; terminal cell of the lamella round or oblong, cell walls thin throughout ..5

4. Leaf margins entire; terminal cell of the lamella pear-shaped, cell wall strongly thickened at the distal pointed end .................................6

5. Cells of the basal leaf sheath mostly short (3-5:1), mixed with a few longer ones; portion of the leaf without lamellae broad, more than 5 cells wide ..........P. longisetum

5. Cells of the basal leaf sheath narrowly oblong to linear (more than 5:1); portion of the leaf without lamellae narrower, less than 5 cells wide .......P. formosum

6. Leaves with long, whitish or hyaline hairpoints
P. piliferum

6. Leaves with short, reddish hairpoints or cucullate apex

7. Leaf apex cucullate; capsules 5- to 6-angled; alpine

8. Stems covered extensively with tomentose whitish rhizoids; species of fens and bogs

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P. sexangulare

7. Leaf apex not cucullate; capsules 4-angled; not alpine

8. Stems not covered with whitish rhizoids; not strictly of fens and bogs

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P. strictum

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P. juniperinum

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Polytrichum alpinum Hedw., Spec. Musc. 92. 1801.

Fogonatum alpinum (Hedw.) Roehl.

Polytrichastrum alpinum (Hedw.) G. I. Smith
This is a common species on shaded cliff faces, stream banks, forest floor and sometimes overturned rootstumps at nearly all elevations, being more common in subalpine elevations. The plants are variable, and several varieties have been proposed to accommodate the variations. With Kootenay materials, many intermediate specimens were seen and were impossible to determine to variety. However, most specimens collected at subalpine elevations and inside forests, belong to the var. alpinum, which has shorter capsules (3-5 mm long) and also shorter gametophytes (less than 10 cm tall) than the var. macounii. Frye in Grout (1928-1940) and Osada (1965) observed that there are no sharp lines between the many infraspecific taxa. Hence, I have not discussed the varieties for the species.

It is a nearly cosmopolitan species, also known from the Antarctic area.

Representative specimens seen: Syringa Creek (UBC B-5476); Summit Lake Park, Nakusp area (UBC E-5477); Upper Arrow Lake (UBC B-5478); Slocan Lake (UBC B-5479); Glacier National Park (UBC B-5480).
Polytrichum commune Hedw., Spec. Musc. 88. 1801.

Schofield's assertion (1976) that the species is the inhabitant of damp and wet sites is supported by my experience with the taxon in the study area. The notched terminal cells and the strongly serrulate leaf margins are two reliable diagnostic characters. Often populations with marked seasonal growth forming tiers can be observed in the field, and the whole plant can be up to a foot long.

A widespread species north of the Tropics.

Representative specimens seen: Creston Wildlife Valley Center (UBC B-5481); Fishermaiden Lake, Silverton (UBC B-5482); Beatrice Lake, Valhalla Mountains (UBC B-5483); Cooper Lake (UBC B-5484).

Polytrichastrum formosum (Hedw.) G. L. Smith

This species has been confused by many workers with P. longisetum. Indeed, many of the key characters used in the floras are variable and this has led to the confusion in determining the specimens. Typical specimens of P. formosum tend to develop light green and stiff leaves with a narrow leaf margin (4 cells wide or less) on both sides lacking lamellae. On the other hand, well developed specimens of P. longisetum from bogs and swamps in Europe and Iceland show distinctly somewhat contorted leaves with much broader leaf margins (more than 5 cells wide) without lamellae. Intermediate specimens with different combinations of characters exist in the Kootenay region. Thus far, the difference in the dimension of cells of the leaf sheath as noted by Crum (1976) is the least variable character. Crum (1976) was, therefore, reasonable to include the present species as a variety of P. longisetum.

P. formosum grows on wet forest floors and moist boulders or cliffs in the study area. Rarely is it seen growing with Sphagnum in the fens.

Macoun's collections (CANM 195636 and CANM 195649) which
were distributed as *P. ohicense* Ren. & Card. are actually the present species. True *P. chioense* is eastern in distribution in North America.

Widely distributed in North America, Europe, Asia, Oceania, and Africa.

Representative specimens seen: Nakusp Hotspring site (UBC B-5495); Glacier National Park (UBC b-5496); Revelstoke National Park (UBC E-5497).

*Polytrichum juniperinum* Hedw., Spec. Musc. 89. 1801.

This is another common species of the genus in nearly all kinds of habitats that are covered with layer of soil. The reddish excurrent costa and involute leaf margins that partly cover the adaxial surface of the leaf are good diagnostic field characters. It is most common in mesic to xeric sites in the study area.

Also a widespread species in the north temperate and subtropical zones.

Representative specimens seen: Champion Lakes Provincial
Park (UBC B-5485 with *Ceratodon purpureus*); Glacier National Park (UBC B-5486 with *Hylocomium splendens* and *Pleurozium schreberi*); Kckanee Creek Provincial Park (UBC B-5487).


*P. gracile* Dicks.

*P. formosum* var. *aurantiacum* (Brid.) C. J. Hartm.

This is a species very close to *P. formosum* with no apparent or known definite combination of characters for a confident and quick determination. Several collections from the study area have leaves with lamellae nearly filling the entire width of the blade as in *P. formosum*, yet the cells of the basal sheath are short and oblong, very unlike those in *P. formosum*. Others have, on the same stem, leaves with broad margins lacking lamellae and leaves with lamellae extending nearly to the margins. Only one collection (UEC B-5498) from Glacier National Park can be named more or less definitely as the present species. It is possible that true *P. longisetum* is
very rare in the study area or the species does not occur in the Columbian Mountains, and that all suspected specimens at the UBC Herbarium are merely atypical forms of the variable *P. formosum*. The local distribution of *P. longisetum* within the province remains unclear until the problems between the two species are clarified. See also *P. formosum* for additional comments.

The geographical distribution of *E. longisetum* parallels that of *P. formosum*, but locally, it is always rare and uncommon.


*Polytrichadelphus lyallii* Mitt.

*Polytrichastrum lyallii* (Mitt.) G. L. Smith

This is a coarse and robust species on the forest floor and in alpine meadows in the study area. Without capsules, it is almost impossible to distinguish the species from *P. alpinum*, except to rely on the surface view of the lamella,
which in the case of *P. lyallii*, exhibits rows of cuticular thickenings on the terminal cells. *P. alpinum* has the terminal cells of the lamellae (surface view) only papillose. In addition, the stiffness of the leaf and the shorter (not more than 13 mm long), lanceolate-linear leaves in the case of *P. lyallii* help to a small extent in the identification. It is less common than *P. alpinum*.

Widespread in the province, the species is a western North American endemic.

Representative materials seen: Stagleap Park (UBC B-5472); Albert Canyon Hotspring (UBC E-5473); Revelstoke area (UBC B-5474); Kimberley Ski Mountain (UBC E-5475).

*Polytrichum piliferum* Hedw., Spec. Musc. 90. 1801.

This species is adapted to dry and exposed sites. It is common both at low elevations, occurring with species of *Racomitrium* and *Grimmia*, and at alpine sites. Interestingly, it is rare in between the two extremes of altitude. The long whitish or hyaline hairpoints are most striking.

Also a circumboreal taxon in both the northern and
southern hemispheres.

Representative specimens seen: Gray Creek, Kootenay Lake (UBC B-5488; Cayuse Creek (UBC B-5489); Glacier National Park (UBC B-5490).


\textit{P. norvegicum} Hedw.

\textit{Polytrichastrum sexangulare} (Floerke \textit{ex} Erk.) G. L. Smith

In the study area, \textit{P. sexangulare} is strictly an alpine species, present at most alpine sites. The short and five- to six-ridged capsule borne on a long seta are diagnostic. Occasionally, plants can grow to 4-5 cm tall, or remain dwarf and lie close to the exposed ground.

Known also from high elevations in Europe, Siberia, Greenland, and Japan. Absent in eastern North America.

Representative specimens seen: Kokanee Glacier Park (UBC

Only one locality is known for the taxon in the whole study area: margin of Kokanee Glacier Park (UBC B-5491). Aside from the differences that the plant body is covered with whitish rhizcids up to near the apex, and the wet and boggy habitat, the species is not much different from P. juniperinum. The rarity of the species certainly is a consequence of the poor development of extensive bogs or fens in the study area. Around the Great Lakes in eastern North America, P. strictum is often observed to cap the summits of Sphagnum hummocks.

Some authors prefer to treat it as a variety of P. juniperinum under the name var. affine (Funck.) Brid. (Crum, 1976).

A circumboreal species.
SUECLASS EUXBAUMIIDAE

FAMILY EUXBAUMIACEAE

This is a family characterized by a highly reduced gametophyte (mainly cf persistent prothecma) and a well-developed, large sporophyte. Three species are known from British Columbia (Schofield, 1968a). All are collected from the study area. The family is treated here as monotypic with DiphysciuM Mohr and the other related genera placed in the Family Diphysciaceae.

**Euxbaumia** Hedw.

**Euxbaumia** is a genus of about ten species distributed through Europe, Asia, North America, North Africa, Australia and New Zealand. The majority of the species have been reported from east Asia.
1. Cuticle of the upper surface of mature capsules splitting and peeling back to the margin ...........B. viridis

1. Cuticle of the upper surface of mature capsules remaining intact ........................................2

2. Mature capsules glossy, reddish brown, strongly compressed dorso-ventrally, broadly ovoid ........B. aphylla

2. Mature capsules dull, greenish brown or green, not markedly compressed dorso-ventrally, broadly cylindric .......................................................B. piperi


An uncommon species in the study area, **B. aphylla** is, according to Schofield (1976), widespread but rare in the southern half of the province. The dorso-ventrally compressed and glossy, dark reddish brown capsules are unmistakable. In Kootenay, populations were encountered more frequently on soil along trail banks than on decaying logs within the forest. See **B. piperi** for further comments. *Protonema* is implied to be
perennial in nature and is responsible for the annual crops of sporophytes produced (Hancock and Brassard, 1974).

A widespread north temperate species.

Representative specimens examined: Purcell Wilderness Conservancy (UBC B-4290); Glacier National Park (UBC B-4289); Champion Lakes Provincial Park (UBC E-4288).


_A taxon endemic to western North America, the present species is very common in the study area, growing on rotten logs of conifers and on shaded trail banks at all elevations. The taxon becomes less frequent at alpine altitudes, in open sites and regions west of the Cascade Mountains. When present on logs, it is frequently associated with_Cryptothecium strictum_, Hypnum circinale, and species of _Lophocolea_ and _Cephalozia_.

_Buxbaumia piperi_ is a variable species in the Kootenay Mountains. Typical plants produce greenish yellow and lance-shaped to cylindric capsules that are easy to identify and
distinguish from the other two species of *Buxbaumia*. Occasionally, mature capsules can become brownish to reddish brown. They remain either lance-cylindric in shape or become flattened dorsi-ventrally. The former condition (UBC B-4291 and UBC B-4292) strongly resembles *E. minakatae* Okam. which has a geographical distribution of east Asia and eastern North America. On the other hand, dorsi-ventrally flattened capsules of *B. piperi* can be difficult to distinguish from *B. aphylla*. *B. minakatae* and *B. piperi* are differentiated from each other in North America on the basis of their capsules and size of the spores (Grout, 1928-1940). Both criteria were subsequently discovered by Iwatsuki and Sharp (1967) to be variable among the populations of *E. minakatae* in Japan and eastern North America. In addition, the size of the capsules and the seta length of *E. minakatae* were reported by them to be variable. The only constant and discernible difference between *B. piperi* and *B. minakatae* is that the stomates are cryptoporous in the former and phaneroporous in the latter. There is a possibility that *B. minakatae* is present in the province. Because there are a few more novel species of *Buxbaumia* described from China that are close to *B. viridis* and *B. minakatae* in morphology (Chen & Lee, 1964), a worldwide monograph of the genus is urgently needed to resolve the taxonomic difficulties outlined above.

Representative specimens examined: Glacier Creek, north of Duncan Dam (UBC B-4293); Jackson Basin (UBC B-4294); Champion
Vog. Rhen. fasc. 8: 724. 1823.

B. indusiata Brid.

This is the most distinctive species of the genus in the study area. The cuticle of the upper surface of the capsule that ruptures and peels back to the margin of the capsule is characteristic. The taxon, in habitat, resembles B. piperi, but is much less common than the latter in the study area. It is, however, more common than E. aphylla.

Also known from Europe, Siberia, and China. In North America, the taxon is rare on the east coast. Representative specimens examined: Kokanee Glacier Park (UBC E-4299); Whitewater Ski Mountain Lodge, south of Nelson (UBC B-4298); Echo Lake, south of Revelstoke (UBC B-4297).
The conventional segregation of Family Ditrichaceae from the Family Dicranaceae is adopted here.

The family is characterized by leaves lacking differentiated alar regions, cylindric capsules and filiform peristome teeth. Consequently, Saclania and Ceratodon, which possess an intermediate combination of family characters, are sometimes placed within the Family Dicranaceae. I include, conservatively, five genera in the present family, following the tradition. Fleuriidium is the only genus of the family not yet known from the study area.

An illustrated key to the western species of Ditrichaceae was prepared by Frye in 1917 based on the work of Britton (1913). Except for the outdated binomials used, the species concepts of many taxa in the family contained in the papers of Britton (1913) and Frye (1917) still stand today.
1. Leaves distichous .......................... **Distichium**

1. Leaves not distichous ........................2

2. Leaves strongly squarrose ................. **Trichodon**

2. Leaves not squarrose ........................3

3. Leaves plane to tubulose apically .......... **Ditrichum**

3. Leaves keeled apically ........................4

4. Capsules erect, smooth or striate-wrinkled, never strongly ribbed ........................................5

4. Capsules inclined, strongly ribbed .......... **Ceratodon**

5. Leaves glaucous, powdery bluish green  .... **Saelania**

5. Leaves green or yellow green ............... **Ditrichum**
Ceratodon Brid.

A cosmopolitan genus of about 15 species distributed mainly in the Tropics and southern hemisphere. Only one species, *C. purpureus*, is present in the northern boreal and temperate zones.

*Ceratodon purpureus* (Hedw.) Brid., Eryol. Univ. 1: 480.
1826.

A truly cosmopolitan species that has become extremely common in the boreal and arctic zones in North Hemisphere. Frequent in all disturbed sites and on stone walls in both urban and rural areas. The species often forms extensive cover across slashed-burned forest sites, particularly in areas where the nutrients are suspected to be seriously leached out. The dark red setae and the strongly ribbed, slightly inclined capsules that are abruptly differentiated from the seta are diagnostic. Under the microscope, the quadrate laminal cells appear to be papillose and the recurved leaf margins are always serrulate apically. The species is extremely variable and can
be mistaken for *Parhula* and *Ditrichum* when collected without sporophytes.

Representative specimens seen: Revelstoke (UBC B-2949); Kokanee Glacier Park (UBC E-2950); Champion Lakes Provincial Park (UBC E-2951); Glacier National Park (UBC E-2952).

**Distichium** B. S. G.

A cosmopolitan genus of approximately 15 species characterized by truly distichous leaves (Wijk, 1957). Two species are known to North America and both taxa are found in the study area.

1. Capsules cylindric, erect .............. *D. capillaceum*

1. Capsules ovoid, inclined .............. *D. inclinatum*
**Distichium capillaceum** (Hedw.) B. S. G., Bryol. Eur. 2: 156. 1846.

In the study area, the species is frequent in rock crevices or on shaded boulder faces at high elevations, especially where the substratum is basic. When well-developed, it is unlikely to be overlooked in the field. Common throughout the province and the whole northern hemisphere. Sporophytes are commonly produced.

Representative specimens seen: Cayuse Falls (Tan & Ensing 77-351b); headwaters of Lyle Creek, Rettallack (Tan & Teng 78-565); Galena Bay (Tan 76-409).


This a very rare species in the study area. The inclined and ovoid capsule is a reliable character to identify **D. inclinatum** in the field. The only population from the Columbian Mountains is that from Dutch Creek Hoodoos roadside.
near Columbia Lake (UBC E-2948), although elsewhere along the Rocky Mountains, it is not uncommon.

Known also from Europe, Asia and eastern North America.

*Ditrichum* Hampe

The nearly cosmopolitan moss genus, *Ditrichum*, which includes 90 species, has not been revised for decades. In North America, the last revisional study is that of Britton (1913). Grout (1928-1940) and Lawton (1971) have, since, followed Britton's treatment with little modification. Recently, Anderson and Bryan (1958) studied the cytology and systematics of North American autoicous species of the genus, which, unfortunately, includes only one species from the area.

Sterile specimens of *Ditrichum* strongly resemble members of the Family Dicranaceae. The peristome teeth, nevertheless when present, are forked nearly to the base, resulting into 16-32 filiform divisions, very unlike the situation in the Dicranaceae. The peristome teeth of members of Ditrichaceae are never twisted as in many members of Pottiaceae.

There are presently seven species of *Ditrichum* known from
British Columbia, four of which are in the study area. *D. ambiguum* Best., *D. schimperi* (Lesq.) O. Kuntze, and *D. zonatum* (Brid.) Kindb. are, at the moment, interpreted to be coastal species in western North America.

Like *Dictamnella*, species of *Dictrichum* are pioneering species or colonizers in most disturbed sites, both natural and anthropogenic in origin.

1. **Leaf margins plane to incurved** ........2

1. **Leaf margins recurved, at least on one side**  
   .......................... ............................ D. *pusillum*

2. **Plants large, more than (2) 3 cm long; stems branched and forming compact and densely tomentose clumps; vegetative leaves with strong, expanded and sheathing base and a long, fine subula; upper laminal cells mostly oval**  
   .......................... ............................ D. *flexicaule*

2. **Plants smaller and shorter, usually less than 2 cm long; stems mostly simple; leaves without strong, sheathing and expanded base, nor with a long and fine subula; upper laminal cells quadrate to short or long rectangular
3. Upper laminal cells long, at least 3:1; dioicous

\[ \text{D. heteromalla} \]

3. Upper laminal cells short, 2-3:1; autoicous

\[ \text{D. montanum} \]

\[ \text{Ditrichum flexicaule} \] (Schimp.) Hampe, Flora 50: 182. 1867.

\[ \text{D. giganteum} \] R. S. Williams

\[ \text{Distichium macounii} \] C. M. & Kindb. (isotype at CANM!)

This is a variable species and also the most common species of \text{Ditrichum} in the study area. The long, slender and flexuose stems, with abundant rhizoids, growing on wet cliff faces or boulders along the water margin, are highly diagnostic in the field. Plants are most luxuriant and often reach lengths of more than 6 cm when bathed in the spray of waterfalls. Stems are fragile, and probably serve as means of asexual reproduction. Sporophytes are rarely seen.
Many varietal names have been proposed for the morphological variants. Because of its observed morphological variability, there are no good reasons to maintain the infraspecific taxa.

Common in North America and Eurasian continents. Also reported for Panama and Colombia.

Representative specimens seen: head of Slocan Lake (UBC B-2941); Rosebery (UBC E-2942); Pend' Creille River (UBC B-2943); Revelstoke (UBC E-2944).

Ditrichum heteromallum (Hedw.) Britt., N. Am. Fl. 15: 64.
1913.

Next to D. flexicaule, this second common species of Ditrichum in the study area is attractive when well-developed. The light greenish turfs of slender leaves offer a strong contrast against the abundant dark red setae. Under the microscope, the broad costa, which nearly fills the upper portion of the leaf, and the elongate, upper laminal cells are additional reliable characters of D. heteromallum. The setae vary from yellow to dark red, thus, this character is not
taxonomically useful.

Common in the province at all elevations, although in general, the species prefers more humid areas. Known from Alaska to California and east to Montana. It is not rare in North America contrary to Grout (1928-1940). Also present in the British Isles, continental Europe, Iceland and eastern North American.

Representative specimens studied: Rosebery (UBC B-2935); Glacier National Park (UBC B-2936, UBC E-2937).


Map 22.

A west coast endemic species, *D. montanum* has a local distribution generally restricted to montane elevations. It differs mainly from *D. heteromallum* in developing quadrate to short rectangular upper laminal cells. The color of the seta is, to a certain extent, taxonomically useful, and in *D. montanum* is consistently yellow to straw colored. Sporophytes common.

Although uncommon in the study area, the species is said
to be restricted to soil banks in the subalpine forest of Coast Mountains and reappearing in the Columbia Mountains (Schofield, 1976). My observation indicates that the species is much more common in the interior mountain systems than the coastal mountains. Populations of *D. montanum* occasionally may descend to 152.5 m (500 ft) above the sea level in the coastal Douglas fir forest (Schofield, pers. comm., 1980).

Elsewhere, it is known from Washington, Idaho, Alberta, and Oregon.

Representative specimens seen: Kokanee Glacier Park (UBC B-2938); Glacier National Park (UBC E-2939); Salmo area (UBC B-2940).
Ditrichum pusillum (Hedw.) Hampe, Flora 50: 182. 1867.

Ditrichum tortile (Schrad.) Brockm.

Leptotrichum tenue C. Muell. & Kindb. (isotype at CANM !)

This is a variable and unsatisfactorily defined species. Specimens from North America and Europe so named at UBC Herbarium consist of heterogeneous materials. Capsules range from ovoid to cylindrical. Plant size, leaf shape, and leaf marginal serrulation are all variable characters. It is, nevertheless, easy to determine as it is the only species of Ditrichum from the area that has recurved and bistratose leaf margins and occasionally, other bistratose regions. Possibly, a revisional study of the species concept will lead to the creation of new species.

A few specimens at UBC and CANM collected by MacFadden and Macoun have been named Ditrichum tortile and D. ambiguum. As understood today, D. ambiguum is primarily a coastal species in British Columbia. It differs from D. pusillum in being at least two times larger in size and having leaves with longer and more crisped sulci especially when dry, and a longer rostrate operculum. The difference in the ornamentation of peristome teeth that has been employed by many bryologists in
separating the two taxa is, in my opinion, not adequately described or illustrated to be useful. On the other hand, *D. tortile* has been reduced to a synonym of the present species, although a few collections so-named at the MacPadden collection have proven to be *D. montanum*.

Occasionally sterile plants can be mistaken for *Ceratodon purpureus* that occurs in similar habitats. The presence of rhizoidal gemmae will identify *D. pusillum*.

*D. pusillum* is fairly common in the study area in most disturbed, gravelly or silty sites around settlements. Within the province, it is commonly collected around the Greater Vancouver area and Victoria. Other than the area of study, its distribution elsewhere in British Columbia is unknown.

Representative specimens seen: headwater of Lyle Creek on New Denver-Kaslo Hwy (UBC E-2932); Cscar Creek, Ymir (UBC B-2933); Revelstoke (UBC B-2934).
Saelania Lind.

A monotypic genus with a nearly cosmopolitan distribution.


A beautiful, powdery glaucous-blue plant growing on humid cliff faces in deep gorges. Two populations were discovered in the study area: Schofield & Tan 60642 from Falls Creek, approximately 16 miles south of Galena Bay (UBC B-2945) and Tan & Ensing 77-436 at mouth of Cayuse Creek, Lower Arrow Lake (UBC B-2947). Both populations, and also the one from the nearby Cristina Lake (UBC B-2946), are from low elevations. Schofield (1976) and Lawton (1971) reported the species to be mainly subalpine to alpine in elevation. The species is scattered throughout the province, becoming rare in coastal areas.

Also known from eastern North America, Europe, Japan, Asia, Hawaii, New Zealand, and Africa.
Trichodon Schimp.

The genus is, according to Ireland (1978), a weak segregate of Ditrichum. As revised most recently (Ireland, 1978), the genus is represented in North America by one species and two varieties. Trichodon differs from Ditrichum in developing strongly squarrose leaves and papillose laminal cells.

Trichodon cylindricus (Hedw.) Schimp., Coroll. 36. 1856. Map 25.

Ditrichum cylindricus (Hedw.) Grout

A common and easy species to identify in the area, T. cylindricus, with its strongly squarrose or reflexed leaf apices, is unique among the ditrichaceceus taxa. These unique characters justify the separation of the genus from Ditrichum. The illustrations prepared by Ireland (1978) for the species are excellent. Locally, it is common (see Map 25). In North
America, the main area of distribution of *T. cylindricus* is in western North America with a few disjunct, widely separated populations in eastern North America. All the Kootenay collections belong to var. *cylindricus*.

Also known from Europe, Siberia, Japan, and New Zealand.

Representative specimens seen: Dipper Lake, Kimberley (UBC B-2953); Revelstoke (UBC B-2954); Kokanee Glacier Park (UBC B-2955).

**FAMILY SELIGERIACEAE**

This is a family of three genera in North America. The single leaf costa consisting of homogeneous cells and the erect, short, ovicid capsule are characteristic of the family. Only two genera are recorded for British Columbia.

1. Plants large, visible without the aid of magnifying lens; leaves with strongly inflated, colored alar cells

............................. *Blindia*
1. Plants minute, visible only with the use of magnifying lens; leaves without clearly differentiated alar cells

.................................**Seligeria**

**Blindia** B. S. G.

This is a large and attractive genus in wet habitats. The unicostate leaves with oblong laminal cells and strongly inflated basal alar cells are ostentatiously dicranaceous. Nevertheless, the transverse section of the leaf costa shows the lack of internal anatomical differentiation which is so characteristic of the Family Dicranaceae. The erect and ovoid capsule further attests to the distant relationship between the genus and the Family Dicranaceae. Only one species is known from the province.

This species is widespread and common in the study area on wet cliff faces and seepy boulders within the splash of running streams, creeks, and waterfalls. The shape of the capsules which are commonly produced is a useful taxonomic field character.

Common in northern and southern hemispheres.

Representative specimens seen: Silverton area (UBC B-4307); Revelstoke vicinity (UBC B-4308); Ainsworth Hotspring (UEC B-4309).

**Seligeria** B. S. G.

A strongly calcicolous genus, **Seligeria** is uncommon in the study area since extensive calcareous rock outcrops are rare. The scanty records of the genus in the province may be the result of the extremely small size of the plants.
North American species of *Seligeria* have been revised by Vitt (1976). Among the total of 17 species reported for the continent, six are collected from the province and four are now definitely proven to exist in the study area. All reports of the species of *Seligeria* (except *S. recurvata*) are new to the Kootenay mountains.

*S. calcarea* (Hedw.) B. S. G. was reported by MacFadden (1926) from the southeastern section of British Columbia. The report is probably based on misidentification of specimens because *S. calcarea* has been shown by Vitt (1976) to be an eastern North American species. I failed to locate any *S. calcarea* specimens in the MacFadden Herbarium.

1. Capsules without peristome ............... *S. donniana*

1. Capsules with peristome ................. 2

2. Costa of vegetative leaves long excurrent; seta strongly cygneous when wet .................. *S. recurvata*

2. Costa of vegetative leaves shortly excurrent or percurrent; seta straight or, infrequently, flexuose when wet

.................................................. 3
3. Lamina evident to the apex, costa percurrent; columella not exserted and operculum free from it at maturity; spores small, 10-15 um wide .................. *S. campylopoda*

3. Leaves, especially upper and perichaetial leaves, shortly excurrent, a few percurrent; columnella exserted and often attached to the operculum at maturity; spores larger, 16-30 um wide .................. *S. tristichoides*


Often on shaded and damp shales, the present taxon is uncommon in the study area. The setae are frequently flexuose, rarely cygneous, when wet, and can be mistaken for *S. recurvata*. When in doubt, the longer seta (2-3 mm), long excurrent leaf costa and the smaller spores (8-10 mm) of *S. recurvata* are useful taxonomic characters. From *S. tristichoides*, it is distinguished best by the free operculum and the not exserted columnella in mature and dehisced capsules.

In North America, all the three species of *Selligeria* present in the study area exhibit an east-west bicentric
distributions in the arctic-boreal zones as shown by Vitt (1976).

Also known from northern Europe.

Representative specimens seen: Horsethief Creek (UBC B-4316); Active Creek, near Ymir (UBC E-4317); Nakusp Hotspring vicinity (UBC E-4318); Rosebery (MacFadden Herb. 4314).


This is a relatively common species of *Seligeria* in the study area with eperistomate capsules. It is also the easiest taxon in the genus to determine. The leaf costa of *S. donniana* can be variable in the length of the apical subula among individuals of the same population.

This species is equally common in the coastal region including the Queen Charlotte Islands. Future search in the right kind of rock substratum in the dry interior portion of the province may prove fruitful.

See *S. campylorhiza* for comment on the geographical
Representative specimens seen: Arrow Park Ferry (UBC B-4312); Glacier National Park (UBC B-4313); Jumbo Creek (UBC B-4314); Cody Caves Provincial Park, Ainsworth (UBC B-4315).


*S. recurvata* was first reported by MacFadden (1926) from the study area. Its presence in the southeastern mountains of British Columbia was subsequently confirmed by Vitt (1976) with a citation of the MacFadden collection made from Rosebery. Curiously, this MacFadden collection was not indicated in his distribution map (no. 53, 1976) prepared for the species. Neither can I locate any replicate of the same collection number at CANM and UBC as indicated by Vitt (1976). However, there is a MacFadden collection (no. 4314) sharing the same collection date and locality in the MacFadden Herbarium (MACF), which, upon careful examination is a mixture of *S. campylopoda* and *S. recurvata*. Meanwhile, I discovered another collection of MacFadden (no. 4277, MACF) from Horsethief Creek, Wilmer, which is a *S. recurvata*. This latter collection was not seen
S. recurvata is best identified from the similar S. campylopoda by its distinct excurrent costa without any suggestion of laminal cells besides the protruded arista. The seta, which is cygneous when wet in the case of S. recurvata, is not a constant feature. The same condition can be observed in some populations of S. campylopoda. Vitt (1976) has a good discussion on the differences between the two taxa.

S. recurvata is rare and sporadic in North America, occurring mainly in the boreal zone. The MacFadden collections mentioned above are the only specimens known in the province. It occurs also in the adjacent Rocky Mountain Range.


Map 27.

This is a rare taxon in the study area as well as within the province. Two populations were discovered in the study area: Hamil Creek Valley trail, Purcell Wilderness Conservancy (UBC B-4310) and Schroeder Creek, north of Kaslo (UBC B-4311). See S. campylopoda for comments on taxonomic characters and
distribution information.

In British Columbia, the other localities reported for the taxon are Queen Charlotte Islands, Bridal Veil's Falls at Chilliwack and Marble Canyon, near the Okanagan Valley.

Also present in Europe.

FAMILY DICRANACEAE

The large acrocarpous family Dicranaceae has been revised many times in many countries. Currently, it includes from 45 to 57 genera, depending on the individual taxonomic philosophy. The family is rather heterogeneous in its generic composition, and it is not possible to draw any generalizations concerning its family characters. On the other hand, the single peristome with bifid and vertically pitted-striclate teeth (so-called dicrancid teeth) is diagnostic.

Genera such as Ceratodon Frid. and Saelania Lindb. have been excluded from the present family, following the traditional treatment, and Trematodon Mich. is included in the family for the same reason. Trematodon ambiguus Hornsch. was reported by Maccun & Kindberg (1892) from Kootenay. The report
appears to be doubtful. It may well be another incident of mislabelling of the collection site. No specimens of *Trematodon* appear to have been collected from the study area.

*Dicranodontium* B. S. G., on the other hand, prefers the more humid to moist portions of the province. Its presence in the study area, possibly represented by *D. denudatum* (Brid.) Britt. *ex* Williams, is a strong possibility. I have therefore included the genus in the key to the genera, but no collections appear to exist.

Recently, the spores of selected members of Japanese Dicranaceae have been studied by Hirohama (1976) using scanning electron microscopy. He found that the spore exine ornamentation supports three main groupings: *Trematodon-Dicranella* - *Dicranum* - *Aongstroemia* (gemmae type), *Cynodontium-Creas-Oregweisia-Arctoa* (verrucate type), and *Campylopus-Camrylopodium-Dicranodontium* (convolute type). It would be of considerable interest to pursue the study with more taxa from different parts of the world to shed more light on the natural relationship of various genera in the family.
1. Leaf costa broad, occupying nearly 2/3 of the leaf base

2. Leaf costa narrower, occupying less than 1/3 of the leaf base

2. Alar cells differentiated in color or shape; leaf costa without stereid cells

Paraleucobryum

2. Alar cells not differentiated; leaf costae with distinct differentiation of guide cells and stereid cells

(Dicranodontium)

3. Alar cells not differentiated

4. Alar cells differentiated

3. Alar cells not differentiated

4. Leaves imbricate, blunt, stiff and erect when dry

Aongstroemia

4. Leaves crisped, erect-spreading, squarrose, or flexuose when dry, apex not bluntish

5. Leaves strongly crisped when dry

5. Leaves not crisped when dry

10
6. Capsules strumose ........................7

6. Capsules not strumose ......................8

7. Leaves with broad sheathing base ......Onccphorus

7. Leaves without broad sheathing base ...Cynodontium

8. Leaves ovate-lanceolate, occasionally ligulate, apex acute to obtuse ..................Dichodontium

8. Leaves linear-lanceolate, apex long acuminate to subulate .................................9

9. Leaf margins nearly entire, occasionally distantly serrulate towards the apex; capsules smooth or slightly wrinkled .....................Dicranoweisia

9. Leaf margins clearly serrate in the upper half; capsules distinctly grooved when dry .............Cynodontium

10. Leaves ovate-lanceolate, margin sharply serrate owing to the strong papillae or mamillae of marginal laminal cells; leaf cells strongly papillose or mamillose .................................Dichodontium

10. Leaves lanceolate-linear, margins smooth or irregularly
and distantly serrulate; laminal cells smooth

..........................**Dicranella**

11. Leaf costa without differentiation of guide cells and stereid cells ..........................12

11. Leaf costa with guide cells and at least one abaxial stereid band at leaf base ............13

12. Seta thick and short, shorter than 4 mm; capsules barely emergent, peristome teeth widely flaring when dry

..........................**Arctoa**

12. Seta thinner and longer, longer than 4 mm; capsules long exserted, peristome teeth not flaring when dry

..........................**Kiaeria**

13. Alar regions unistratose; capsules erect or slightly inclined ..............................**Orthodicranum**

13. Alar regions bistratose; capsules strongly inclined or arcuate ............................**Dicranum**
**Aconstroemia** B. S. G.

This is a distinctive genus characterized by julaceous, slender stem and leaves that are blunt apically and imbricate, wet or dry. Capsules are erect. It is mainly a Himalayan-tropical genus with only one species widespread in the northern boreal zone.


This is an uncommon species in the study area. Populations occur on wet silts and fine sandy soils in morainal areas and floodplains. Most of my collections came from lower elevations along flooded banks of the Columbia River and other large tributaries. Near the coast, Schofield (1976) reported it to be rare and confined to alpine and subalpine altitudes. Sporophytes abundant.

A common north temperate species.

Representative specimens examined: Goldstream River floodplain (UBC B-4339); Crawford Bay (UEC B-4337); Silvertip Falls, 4 mi N of Revelstoke (UBC B-4336); bank of Horsethief
This genus is strictly arctic-alpine and is united, at times, with *Kiaeria*. Both genera have leaves with the costa showing homogeneous cells in transverse section. The differences between the two genera are not conspicuous. *Arctoa* has a thick and short seta, whereas in *Kiaeria*, the seta is long and thin. *Arctoa* is a genus of three species, but only one is reported here for the study area.

This is an attractive alpine species growing in heath-covered slopes and in non-calcareous rock crevices. The reddish, flaring peristome teeth are most distinctive. The extremely long excurrent leaf costa is equally remarkable, a feature not seen in any species of Kiaeria. The only collection from the study area, Tan & Scagel 79-481A (UBC B-2887), is from a cliff crevice at 3050 m (6000 ft), near the headwaters of Gorge Creek, Fred Laing Range close to Mica Dam.

The species is frequent in coastal and insular high mountains, becoming rare inland.

Vitt & Horton (1979b) recently remapped the total distribution of Arctoa fulvella in North America to show the east-west bicentric distribution pattern. My collection represents a significant inland population near the southern boundary of its range (Map 28). This is its first report from the study area. Known also from Alaska, Yukon, Washington, Oregon, and eastern North America.

In Great Britain, Smith (1978) reported it to prefer basic habitats. Widespread in Europe, Siberia, and Japan. Locally not common.
Cynodontium Schimp.

The poor representation of the genus *Cynodontium* in the Selkirk and Purcell Mountains is surprising, since several species are widespread in the nearby Rocky Mountains. Only two species are represented by existing collections. Furthermore, each species has been collected only once or twice. It is possible that the genus has been overlooked, since specimens superficially resemble the common *Dicranoweisia crispula*. Under the hand lens, the erect capsules of *Cynodontium* are distinctly grooved when dry, and the leaves are distinctly and irregularly serrate to serrulate in the upper half. These two features readily separate the genus from *Dicranoweisia*.

There are about 12 species occurring mainly in Europe and North America, five of which are known in British Columbia. Both *C. strumiferum* (Hedw.) Lindb. and *C. strumulosum* C. Muell. & Kindb. are reportedly widespread in North America and are present in Wells Gray Provincial Park and the Canadian Rocky Mountains. They are, therefore, included in the key although no specimens have been seen from the study area. The best key to the species of *Cynodontium* is by Crundwell (1960).
1. Leaf cells 11-22 μm wide, pellucid, mostly smooth, occasionally slightly mamilllose; leaf margins unistratose

.............................................C. jenneri

1. Leaf cells smaller, 7-14 μm wide, strongly or faintly papillose; leaf margins at least bistratose apically

.............................................2

2. Leaves faintly papillose, a few cells smooth; capsules erect, nearly radially symmetrical, not strumose

.............................................C. tenellum

2. Leaves strongly papillose; capsules curved and strumose

.............................................3

3. Margins of the leaf bistratose; annulus present

.............................................(C. strumiferum)

3. Leaf margins unistratose; annulus wanting

.............................................(C. strumulosum)

This is the only species of Cynodontium known in the study area that has mostly smooth laminar cells and unistratose leaf margins. The capsules are long cylindric, and with a swollen neck but no differentiation of a struma. Only two populations are known from the study area: Sutherland Falls, south of Revelstoke on Hwy 23 (UBC E-2897) and MacFadden Herb. 3634 from Mill Creek, Slocan Lake. Both specimens were from soil over a rock inside disturbed forest.

The British Columbia populations of C. jenneri differ from the European populations in developing, occasionally, slightly mamilllose leaf cells.

Mainly a coastal species in Alaska, British Columbia and Washington, its discovery in the study area is a significant inland extension of the range of local distribution.

Known also from Europe.
Another taxon of *Cynodontium* with erect and grooved capsules, *C. tenellum*, with its mixture of smooth and faintly papillose leaf cells, can be confused easily with *C. jenneri*. Doubtful specimens can be determined with reasonable certainty by studying the cross-sections of the leaves. *C. tenellum* has bistratose leaf margins whereas *C. jenneri* has unistratose margins. Furthermore, the perigonial bracts are apically obtuse in *C. tenellum* and acute in *C. jenneri* (Lawton, 1971).

Distribution of *C. tenellum* within the province is not well documented. Elsewhere, it is reported from more than half of the states and provinces in North America and Europe.

Representative specimens examined: Revelstoke National Park (UBC B-2898); St. Mary Alpine Park (UBC E-2899).
**Dichodontium** Schimp.

*Dichodontium* is a dicranaceous genus with papillose or mamillose leaves but lacking alar cell differentiation. *Dichodontium* consists of six species occurring in both northern and southern hemispheres. Two species are known to British Columbia, and both taxa are in the study area. Recently, Tan & Schofield (1980a) re-evaluated the detailed morphological differences between the two taxa, in terms of gametophytic and sporophytic characters. A modification of their key to the two species is presented below:

1. Upper adaxial surface cells of the leaf costa elongate to long rectangular, very different from the adjacent laminal cells; capsules not strumose; dicicous *D. pellucidum*

1. Upper adaxial surface cells of the leaf costa mostly quadrate, similar to the adjacent laminal cells; capsules strongly strumose; autoicous ..........*D. olympicum*
Dichodontium pellucidum (Hedw.) Schimp., Coroll. 12. 1856.

E. flavescens (With.) Lindb.

A highly variable species that is common and widespread in the study area, D. pellucidum prefers humid to moist cliff faces that are frequently irrigated. Its variability is discussed by Tan & Schofield (1980a) who favor the inclusion of D. flavescens in the synonymy of the present species. For tabulated differences between the present species and D. olympicum, see Tan & Schofield (1980a).

Subglobular, multicellular gemmae have been observed in the upper leaf axils in a few collections (UBC B-2908 & B-2909).

A widespread species in the northern hemisphere.

When fruiting, the strumose capsules are unlikely to be confused with any other dicranaceous taxon. Sterile plants, however, can be difficult to separate from small forms of *D. pellucidum*. Under the circumstances, the differences in the adaxial surface cells of the leaf costa between the two taxa are especially useful (see Tan & Schofield, 1980a).

A Pacific Northwest endemic, *D. olympicum* is found locally in most alpine sites of Kootenay Mountains, and grows on and in rock crevices in late snow melt areas. Another common species seen in similar habitats is *Conostegium tetragonum*. Its total distribution, like *Dicranum pallidisetum*, is across the southern boundary of the last glaciation (see Map 30). The present species is also new to the Kootenay mountains.
Dicranella (C. Muell.) Schimp.

I have followed most authors (Dixon, 1924; Nyholm, 1954-1969; Lawton, 1971; Crum, 1976; Smith, 1978) in accepting a single broad concept for the genus Dicranella. The genus Anisothecium Mitt., characterized mainly by the lack of an annulus, is included in the present genus. The delineating characters between the two genera, in the opinions of Dixon and Smith, are hardly constant enough to be of much practical use to students, and are not supported by cytological data.

As a genus, Dicranella differs from Dicranum by the absence of well-marked alar regions consisting of brownish, swollen cells, in addition to being diminutive in overall plant size. It is a cosmopolitan genus of about 100 species. Most species of Dicranella inhabit disturbed habitats.

Among the 11 species of Dicranella known to British Columbia, nine have been collected from the study area. D. pacifica Schof. is essentially a coastal species. D. howei Ren. & Card., which was interpreted by Crundwell and Nyholm in 1977 as being distinct from the common D. varia, may be found eventually in the study area. Its present North American distribution ranges from California to northern Washington.

The key to the species employs many sporophytic characters observable in the dry state. Fortunately, natural populations
of *Dicranella* often develop sporophytes.

1. Vegetative leaves squarrose ............2

1. Vegetative leaves flexuose, falcate or slightly crisped, rarely erect-spreading ................6

2. Leaf apices broadly acute to obtuse; costa subpercurrent to percurrent, lamina or leaf blade well-defined to the leaf apex ........................................3

2. Leaf apices acute to acuminate; costa percurrent to excurrent, forming distinct subula without or with only one row of laminal cells ......................4

3. Leaf margins entire ......................*D. ralustris*

3. Leaf margins toothed towards the upper 1/3 ....................................................*D. pseudopalustris*

4. Capsules mostly erect; peristome teeth flaring into a funnel shape .......................*D. crispa*

4. Capsules mostly inclined to arcuate; peristome teeth not
flaring .................................5

5. Capsules smooth; upper leaf margins serrulate

..............................D. schroederiana

5. Capsules striate; upper leaf margins entire

..............................D. grevilleana

6. Capsules distinctly strumose .........D. cerviculata

6. Capsules not or obscurely strumose ....7

7. Capsules mostly erect or nearly so ....8

7. Capsules inclined, horizontal or arcuate

.................................9

8. Plants (especially leaf costae and setae) reddish in color; capsules smooth; leaves without distinct "shoulder"; basal marginal cells of leaf short and broad (4–5:1 or less)

.................................D. rufescens

8. Plants greenish in color; capsules striate; leaves with distinct "shoulder"; basal marginal cells of leaf long and narrow (10:1 or more) ..............D. crispa

9. Upper leaf cells long (more than 4:1); costa narrow,
comprising about 1/5 of the leaf base ..10

9. Upper leaf cells shorter (less than 3:1); costa stout,
comprising about 1/3 of the leaf base ..11

10. Capsules striate; leaf margins plane or incurved

.................................D. subulata

10. Capsules smooth; leaf margins recurved at least on one
side ...........................................D. varia

11. Capsules striate; seta bright yellow .D. heteromalla

11. Capsules smooth; seta reddish to brown red

.................................D. varia

Dicranella cerviculata (Hedw.) Schimp., Coroll. 13. 1856.
Map 33.

My own experience with this rather rare species in the
study area confirms the observation of Schofield (1976) that it
is restricted to peaty banks in shrubby peatlands. Only a few
collections are known from elsewhere in the province, namely around the area of Vancouver, Vancouver Island and Kitimat area. It is also reported from Alaska, Yukon, Alberta, Washington and eastern North America (mainly Canada). It occurs infrequently in northern Europe, Siberia and Greenland.

The strongly strumose and striate capsules are commonly produced and are most distinctive.

Representative specimens examined: floodplain of Goldstream River, north of Revelstoke (UBC E-2854); Roger's Pass, Glacier National Park (UBC E-2855) and Pitt Creek Park campsite, south of Mica Dam (UBC E-2856).


There are only two species of *Dicranella* in the province that develop an erect capsule with a somewhat flaring peristome. Of these, *D. crispa* can be segregated easily from the other species, *D. rufescens*, by its leaves that are more or less abruptly constricted into a long acuminate subula from a dilated leaf base. For other differences between the two taxa, consult the key to the species.
D. crispa is fairly common in the Selkirk and Purcell Mountains. It is also a widespread in British Columbia where it inhabits a variety of open and shaded disturbed sites including stream and creek banks, silty and sandy roadcuts or trail margins as well as ditch banks, overturned rootstumps, silty deposits on wet grassy ground and logs.

The species is reported widely from Europe, Siberia and Greenland.

Representative specimens examined: shaded limey roadside bank near Gibson Creek settlement, Castlegar (UBC B-2859); Ski Mountain (North Star Mtn.) at the outskirts of Kimberley City (UBC B-2859); trail along the Hamil Creek valley to Earl Grey Pass, Purcell Wilderness Conservancy (UEC F-2860); Roger's Pass (CANM 115179).

Map 32.

Judging from the Kootenay populations, this species is quite distinct from *D. schreberiana*. The two species differ in many morphological details, and I see no reason to unite
them (Crum, 1976). Aside from the differences presented in the key, Smith (1978) noted that the leaf cells of *D. grevilleana* are smaller in size (6-8 µm instead of 8-14 µm) and the exothecial cell walls are evenly thickened, very unlike those of *D. schreberiana*.

As shown in maps 32 and 36, *D. grevilleana* is a common species in the study area while *D. schreberiana* is rare. *D. grevilleana* is found from low to subalpine elevations. Plants are common on moist, silty ditch banks, new roadcuts and landslides.

Spherical, reddish brown rhizoidal gemmae, consisting of 3-6 cells, are described to be similar to those found in *D. schreberiana*. None were observed from either the rhizoids or leaf axils of any Kootenay specimens of *D. grevilleana*.

A common species of the northern hemisphere.

Representative specimens examined: along banks of an old logging road on Findlay Creek, near Canal Flats (UBC B-2861); damp ditch bank, near Glacier, Glacier National Park (UBC B-2862); creek bank growing with *Chara* sp., Albert Canyon Hotspring (UBC B-2863).
Well-developed plants of *Dicranella heteromalla* are very striking in the field. The dark green, nearly straight, setaceous leaf apices provide a contrasting background against the bright yellow setae and reddish peristomes. The orientation of the mouth of capsules in an oblique manner has prompted Crum (1976) to describe it as "appearing chucked under the chin". Lawton (1971) stressed this feature in distinguishing it from *D. subulata*. Occasionally dry capsules of *D. subulata* can become so deformed as to simulate the obliqueness of the capsule mouth of *D. heteromalla*. The dimensions of upper laminal cells, especially towards the apex, appears to be a far more reliable character to employ in distinguishing the two species. In addition, the seta of *D. subulata* is nearly always reddish. Depauperate specimens of *D. heteromalla* sometimes can resemble *D. varia*.

The species is widespread in the province (Schofield, 1976) and surprisingly, has been collected only sporadically from the study area. It is probably overlooked in many places. Locally, *D. heteromalla* is abundant and common in the Glacier National Park (see Map 34).

The MacFadden collection named *D. heteromalla* (UBC) and
dated June 28, 1926, from Jackson Basin, Sandon, proved to be Kiaeria starkei.

It is also a widespread species in the northern hemisphere, reported recently from Kenya and Bolivia (Smith, 1978).

Representative specimens examined: Glacier National Park (UBC B-2864; B-2866; E-2865).


D. squarrosa (Starke) Schimp.

This is a large and distinctive species of wet cliff faces and seepy ditch banks. It is also common in sedgey margins of lakes and ponds. D. palustris is unmistakable in its strongly squarrose leaves with a blunt apex. The leaves become contorted when dry. Superficially, it sometimes resembles a luxuriant form of Bryum weigelii or Dichodontium pellucidum. However, microscopic examination will reveal a lack of broad,
decurrent leaf bases, an entire leaf margins and smooth laminal cells; all of these characters will quickly identify D. palustris.

The species is common both in the study area and the entire province. It is also a common northern temperate species.

Representative specimens examined: Gibson Lake, Kokanee Glacier Park (UBC E-2867); Monk Creek vicinity, near Stagleap Park (UBC E-2868) and vicinity of Mica Dam site (UBC E-2869).
Dicranella pseudopalustris Tan, nomen nov. Map 36.

Synonyms: D. schreberiana var. robusta Schimp. ex Braith.
D. schreberiana var. elata Schimp.

The taxon was accepted by many students of moss taxonomy as a variety of D. schreberiana on the basis of its toothed leaf margin. The dentation, nevertheless, is of a different nature from that exhibited by D. schreberiana. In D. pseudopalustris, the marginal teeth of the leaf are formed by the protrusion of a whole cell, whereas in D. schreberiana, the dentation is from the protruded end of marginal leaf cells. In addition, the transverse section of the stem and the leaf costa at the level of leaf "shoulder" are different in cellular organization. A more detailed report of these differences will be published elsewhere.

D. pseudopalustris shares with D. palustris in its habitat preference, thus, is more hygic than D. schreberiana.

From D. palustris, the species can be easily separated by its irregularly toothed leaf margin. The plant size of D. pseudopalustris, like D. schreberiana, is variable. The newly proposed species epithet pseudopalustris reflects its superficial resemblance to D. palustris. In general, however,
D. pseudoralustris tends to be larger than D. schreberiana, but smaller than D. palustris. Dixon (1924) claimed that D. schreberiana intergrades with the present species. My observation, derived from the study of many North American and European specimens, is that, other than the plant size, the two taxa are distinctly different and are easy to separate even by using only the leaf marginal character, without resorting to the leaf costal cross-section. D. pseudoralustris, morphologically, is like D. palustris in having larger and wider laminal cells. It should be accepted as a distinct species. Its distribution in the study area and around the world parallels that of D. palustris. In British Columbia, the collections at UBC indicate that it is more common inland than in coast mountains.

Dicranella rufescens (With.) Schimp., Coroll. 13. 1856.

D. rufescens is the only Dicranella that forms reddish patches resulting from the color of leaf costae and setae. The erect capsules assist well in its identity. The species seems to prefer basic substrata in the Purcell Mountains.

It is mainly a coastal species in the province, and
becomes less frequent eastward and rare in the interior Columbian Mountains.

Sporadically spread across Europe, Siberia and Japan.

Representative specimens examined: Tan & Teng 78-1185, on open road tanks, on way to Blue Lake, along Findlay Creek logging road (UBC B-2871); Tan & Teng 78-869, in rock crevice, Mt. Sir Donald Trail, Glacier National Park (UBC B-2870).


Although a widely distributed and common species along the coast of British Columbia, D. schreberiana has been collected only twice from the study area: Tan & Teng 77-1412, on soil over a log, Monk Creek vicinity, south of Stagleap Park on Hwy 3 (UBC B-2872) and Tan & Teng 78-553, on thin crust of soils over a boulder, trail bank, along Hamil Creek valley to Earl Grey Pass, Purcell Wilderness Conservancy (UBC B-2873). For the morphological differences between this species and D. grevilleana, see comments under the latter.

Var. robusta Schimp. ex Braithw. is interpreted to be a
distinct species. See comments under D. pseudopalustris.

D. schreberiana is a widespread north temperate taxon. Reported also from New Zealand.


**D. secunda** Lindl.

This is the third most common species of *Dicranella* in the study area, next to *D. crispa* and *D. grevilleana*. The species is found at all elevations. The subulate leaf apices, longer upper laminal cells (more than 4:1) and the reddish brown setae are all characteristic of the species. The sheathing perichaetial leaves are sometimes squarrose, although the vegetative leaves are only flexuose to erect-spreading. Care should be taken not to interpret the leaf habit of the present species as squarrose as in the case of *D. grevilleana* and *D. schreberiana*. For the differences between it and the closely related *D. heteromalla*, see comments under the latter name.
Within the province, *D. subulata* is more common in the northern part of the province. Outside the study area, it is known also from Yoho and Jasper National Parks. Widely scattered across Canada, United States, Europe, and Asia.

Representative specimens examined: E-2874, B-2875, B-2876, B-2877, E-2878 (all UEC).


The species epithet is most appropriate for this taxon. *D. varia* is perhaps the most variable *Dicranella* in the study area. Plant size, recurved leaf margins, width of leaf costa, inclination and striation of capsules, and dimensions of upper laminal cells are all variable character states.

*D. howei* Ren. & Card. has been shown by Crundwell and Nyholm (1977) to be distinct from *D. varia*. The best features to separate the two taxa are the equally thickened cell walls of exothecial cells in the case of *D. howei*, and the stout (nearly 1/3 of the leaf base), sharply differentiated leaf costa in the case of *D. varia*. The discovery of *D. howei* in the study area is to be expected.
Geographically, *D. varia* has a wide range of distribution in the northern hemisphere, reported from Europe, the Middle East, China, Siberia, North Africa, Macronesia, and North and Central America. In British Columbia, it is more common inland and less frequent in coastal and insular mountain ranges. Schofield (1976) considered the species to be restricted to the southern half of the province and it is more common at low elevations.

Representative specimens examined: E-2880, B-2879, B-2881, E-2882, and E-2883 (all UBC).

**Dicranoweisia Lindl. ex Milde**

A small genus of 24 species occurring in temperate, arctic, antarctic regions and high mountains in the Tropics. It differs primarily from the genus *Orthodicranum* in having weakly differentiated or no alar cells. The strongly crisped leaves and erect, smooth capsules are characteristic. Only one species, *D. crispula*, is known to the study area.
Dicranoweisia crispula (Hedw.) Lindb. ex Milde, Bryol. Siles 49. 1869.

The species is extremely common and widespread in open sites from subalpine to alpine elevations. Plants commonly form thin mats with many capsules covering boulders or cliff shelves and rock crevices. D. crispula is easily distinguished from the other species of the genus in the province, D. cirrata (Hedw.) Kindb. ex Milde, by the development of striae of cuticular thickenings on the surface of the leaf.

There is a specimen at CANM (118151) collected by Macoun from "rocks, Kootenai Lake, B.C." Which is correctly determined as D. cirrata. The inner packet, however, bears a different pencilled date of collection and collection number. It is doubtful that the collection actually came from the study area and that it represents probably an error inadvertently committed by Macoun in packeting and distributing the specimens. I fully support the contention of Schofield (1976) that D. cirrata is a coastal species not found east of the Cascade Mountains within the province. Other specimens named D. cirrata (CANM 118165 & 118156) were also shown to be D. crispula. Because of the variations observed on the alar cells, perichaetal leaves and peristome characters, I have not ventured to recognize any of the varieties treated in Lawton (1971).
Another widespread circumboreal species in northern hemisphere.

Representative specimens seen: Meadow Mountain Alpine Recreation Park (Tan & Teng 78-485, UBC); Glacier National Park (Tan & teng 77-1873, UBC); Stagleap Park (Tan 76-1440b, UBC).

**Dicranum Hedw.**

**Dicranum** is another Hedwigian genus that has undergone many changes through the processes of generic reinterpretation. Peterson (1979) offered an interesting account of the changing generic concept of **Dicranum**. He convincingly argued for the recognition of **Orthodicranum** (C. Muell.) Loeske as a separate genus. It is his most recent generic as well as species concepts that I adopt here with some modifications.

As a "modern" genus, **Dicranum** is still a cosmopolitan taxon of about 150 species. The major differences between it and the genus **Orthodicranum** are the straight capsules and the unistratose alar regions in the latter genus.

The revision of Peterson (1979) has clarified in a substantial way our understanding of the difficult species of
Dicranum. He has also aptly summarized the geographical range of distribution of many North American species. In fact, he has shown that several species, including D. fragilifolium Lindb., D. muehlenbeckii B. S. G., and D. elongatum, are present in the study area. Unfortunately, he gave no citation of any collections from the study area, nor have I been able to locate any named specimens at CANM or Provincial Museum (V) at Victoria. These taxa are therefore included in the key and enclosed by a parentheses. In all cases, the UBC collections, if these can be taken to indicate the local distribution, show that these three species to be mainly coastal or northern in distribution. Until correctly identified specimens are seen, their presence in the study area is best accepted with reservation.

Furthermore, D. drummondii C. Muell. has also been shown by Isoviita (1977) to be an exclusively European species; and that all North American specimens so named should be given the name D. ontariense Peterson. The species is an eastern North American endemic and does not occur in the Pacific Northwest area.

D. lomjeannii DeNot. was reported by MacFadden (1926) from Halcyon Hotspring. The collection (CANM 119482) is D. scoparium.

Among the 15 species of Dicranum listed by Schofield (1968a) for the province, seven are present in the study area,
with three species transferred to *Orthodicranum*.

In 1965, Briggs conducted cultivation studies of four widespread British species of *Dicrana* to evaluate their phenotypic variability. More studies of this nature are needed if only to understand the knotty taxonomic problems between some morphologically closely related taxa, such as *D. fuscescens* and *D. sulcatum*.

1. Leaf tips broken; leaves straight and stiff
   ............................................................................(*D. fragilifolium*)

1. Leaf tips not broken; leaves falcate-secund, crisped or with twisted apex ..................2

2. Most cells in the upper half of the leaf elongate, longer than 4:1, strongly pitted .............3

2. Most cells in the upper half of the leaf short rectangular to quadrate, not pitted .............5

3. Leaves conspicuously and transversely undulate
   .............................................................................4
3. Leaves without transverse undulation ..D. scoparium

4. Plants polysetous; leaves strongly undulate and leaf margins serrate in the upper 1/3 .......D. polysetum

4. Plants monosetous, rarely bisetcos; leaves weakly undulate and leaf margins only slightly serrate or serrulate in the upper 1/3 ..................D. scoparium

5. Leaves undulate or rugose .............6

5. Leaves not undulate or rugose ..........7

6. Plants of wetlands; leaf apices obtuse or broadly acute; leaf costa frequently ending well below the apex
   ........................................D. undulatum

6. Plants not of wetlands; leaf apices acute to acuminate; leaf costa percurrent to excurrent ......D. acutifolium

7. Leaves tubulose, cross-section of the leaf at the upper 1/2 to 1/3 U-shaped in outline with broad and flat costa
   ..........................................8

7. Leaves keeled, cross-section of the leaf at the upper 1/2 to 1/3 V-shaped in outline with stout, raised and narrow costa .............10
8. Transverse section of the costa in the upper half of the leaf without distinct stereid cells .......D. pallidisetum

8. Transverse section of the costa in the upper half of the leaf with distinct stereid cell layers .....9

9. Leaves crisped when dry; upper laminal cells mostly quadrate, thin- to thick-walled; cross-section of costa with differentiated rows of enlarged adaxial and abaxial surface cells

..........................................................(D. muehlenbeckii)

9. Leaves erect-appressed with the apex curled when dry; upper laminal cells elliptic to rectangular, cell walls very thick; cross section of costa with only one differentiated row of enlarged abaxial surface cells ..(D. elongatum)

10. Transverse section of costa in the upper half of the leaf lacking distinct bands of stereid cells; mature capsules yellow ..................D. pallidisetum

10. Transverse section of costa in the upper half of the leaf with two well-developed bands of stereid cells; mature capsules yellow brown to dark red .......11

11. Costal stereid cells with very thick walls, lumens very tiny to nearly obsolete in transverse section

..........................................................12
11. Costal stereid cells with only moderately thick walls, lumens large, ca 3-5 μm in diameter ....14

12. Upper laminal cells variously shaped (triangular, polygonal, quadrate to short rectangular), arranged in loose, irregular pattern; cross-section of cell walls between adjacent cells in the upper half of the leaf bulging on both surfaces .................. D. acutifolium

12. Upper laminal cells mostly quadrate to short rectangular, arranged in regular vertical rows; cross-section of cell walls between adjacent cells in the upper half of the leaf smooth or not bulging on both surfaces .13

13. Leaf costa long excurrent; cross-section of costa at the leaf base with each of the two hands of stereids consisting of three to four rows of cells ........ D. sulcatum

13. Leaf costa percurrent to excurrent; cross section of the leaf costa with each of the two hands of stereids consisting of two rows of cells ................ D. fuscescens

14. Costal cross-sections with clearly differentiated rows of enlarged adaxial and abaxial surface cells .................................................. (D. muehlenbeckii)

14. Costal cross-section with only one differentiated row of

D. hergeri var. acutifolium Lindb. & Arn.

D. acutifolium is rare in the study area, known only from two sites: Tan & Ensing 77-1642 from the junction of "Seligeria Creek", Jumbo Creek and Toby Creek near the boundary of Purcell Wilderness Conservancy Area (UEC B-2910) and Roger's Pass, Glacier National Park (CANM 119973). This species is distinctive in having moderately undulate leaves that are weakly falcate-secund when dry. The upper laminal cells are variously shaped and not arranged in regular rows. These features are enough to distinguish it from D. fuscescens. The costal stereid cells are, like those of D. fuscescens, with very thick-walls and extremely tiny lumens, and are, thus, different from D. brevifolium and D. muehlenbeckii. I have found that the walls between adjacent laminal cells in D. acutifolium sometimes also bulge on both surfaces in

enlarged abaxial surface cells ..........D. brevifolium
transverse section, but not as strongly bulged as in the case of *D. brevifolium*. This is the first report of this species from the study area.

*D. acutifolium* is quite common elsewhere in the boreal region of North America (Peterson, 1979). It is known also from Europe in similar habitats: montane-boreal forests and tundra. Both Peterson (1979) and Ireland in Lawton (1971) stated that the species prefers calcareous substrata.


*D. muehlenbeckii* var. *brevifolium* Lindb.

*D. brevifolium* has been treated as a variety of *D. muehlenbeckii* and probably has been reported in the literature for the province under the latter name. It is presently thought to be distinguishable from *D. muehlenbeckii* by the differentiation of only the abaxial surface row of cells of the leaf costa. From *D. fuscescens* and *E. acutifolium*, it is distinctive in having the stereid cells in the leaf costa.
with large lumens, ca 3-5 μm in diameter. Occasionally, a few leaves are undulate, as in *D. acutifolium*.

*D. brevifolium* is uncommon and widely scattered in the study area (see Map 39), found typically in the protected, but not densely covered, rockscree and talus in montane and subalpine regions. The habit, when one becomes familiar with it, and the manner in which leaves are crisped, are quite different from *D. fuscescens*. Occasionally, the species grows on humid forest floors. All material from the study area belong to the var. *brevifolium* with unistratose lamina. In North America, it is widespread in the western provinces of Canada, with a few populations in midwestern United States, Manitoba, Quebec and Ontario. Also known from Europe and eastern Asia.

Macoun’s collection from Bear Creek, Glacier National Park (CANM 120757) named *D. schraderi*, and MacFadden’s collection from Lake of Hanging Glacier, named *D. fuscescens* (CANM 119965) are the present taxon. On the other hand, Brinkman’s collection from Roger’s Pass (CANM 120742) and MacFadden’s collection from Halcyon Hotspring, which were named *D. brevifolium*, are actually *D. scoparium*.

Other specimens seen are: Grey Creek, Kootenay Lake (UBC B-2911); Kimberley (UBC E-2912); Fairmont Hotspring (UBC B-2913).
Dicranum fuscescens Turner, Musc. Hist. 60. 1804.

One of the most variable species of Dicranum in the study area, this species is one of the most difficult and confusing taxa to resolve. Plants can form small tufts or tall individuals reaching 8 cm tall. Leaves can be strongly falcate secund in one general direction or crisped in various directions. The costa is percurrent to excurrent. The papillosity of the leaf costa and upper laminal cells is also variable. No clear-cut association of these features can be demonstrated in the Kootenay collections. The only reliable descriptive features of the species are: upper laminal cells quadrate to short rectangular, becoming long rectangular, and at times pitted at base, and the leaf costa consisting of two bands of stellate cells in cross-section. It is therefore not surprising that the taxon is often confused with similar species including D. pallidisetum, D. muehlenbeckii, D. sulcatum, D. brevifolium, and D. acutifolium.

D. sulcatum is perhaps the most difficult species to distinguish from D. fuscescens. It has been treated for years as a synonym of D. fuscescens. In an effort to revive D. sulcatum from synonymy, Peterson (1979) stated that the species can be separated from D. fuscescens by the number of rows of cells in each stellate band in the leaf costa, i.e., four rows in the case of D. sulcatum and two rows in
**D. fuscescens.** After studying hundred of thin sections of the leaf costa of *D. fuscescens* collected from various localities, I have concluded that, although most sections of the leaf costa of the present species consist of only two rows of stereid cells in each band, the number may infrequently vary from one to four. The number is not constant even within an individual plant, and definitely does not correlate in a meaningful way with the long excurrent costa said to characterize *D. sulcatum*. See *D. sulcatum* for more comments on this taxonomic problem.

From *D. muehlenbeckii* and *D. brevifolium*, *D. fuscescens* is said to be best distinguished by the thick-walled stereid cells with very tiny lumen in the leaf costa (Peterson, 1979; de Trucco, 1978). I have found subsequently a few specimens of *D. fuscescens* with the lumens of leaf costa stereid cells large in diameter, approximating the dimension in *D. brevifolium*. Under such circumstances, specimens can be difficult to name. Nevertheless, specimens of true *D. fuscescens* generally yield a few leaves that develop the typical strongly thick-walled stereid cells. Additionally, leaf cell walls of *D. fuscescens* in transverse section are smooth on both surfaces, and have not been noted to bulge or form ridges between adjacent cells, as in the case of *D. muehlenbeckii* and *D. brevifolium*.

A few plants of *D. fuscescens* (*sensu lato*) develop a group of 3 to 7, small, thin-walled, parenchymatous cells between the enlarged guide cells and the adaxial stereid band of the leaf.
costa. The occurrence of this feature is erratic and no correlation can be detected to exist with any other leaf characters to provide useful taxonomic interpretation.

To date, distinction between *D. fuscescens* and allied species has been strongly dependent on features of the costal structure, as noted by Peterson (1979) and de Trucco (1978). It is reasonable to question the constancy of characters observable from the cross section of the leaf costa of *Dicranum*. Already, details of the costal structure of the related genus *Campylcus* have been shown to be environmentally modifiable (Florschutz & Waard, 1974). Without further convincing evidence to the contrary, I prefer to accept a broad species concept for *D. fuscescens*.

In habitat, *D. fuscescens* is more common inside forests at low elevations. It grows on decaying logs, rocks, creek banks, humus covered ground, and even trunks of living *Thuja plicata* and other conifers. At alpine elevations, the species seems to be replaced by *D. scoparium* in many places in the study area.

A broadly circumpolar species.

Representative specimens examined: between Revelstoke and Golden (UBC B-2916); mouth of Gold River, near Mt. Sir Sanford (UBC B-2915); Cahill Lake, near Slocan Lake (UEC E-2914).

D. fuscescens f. pallidisetum Bailey

Since the discovery of D. pallidisetum as a distinct species by Ireland (1965), subsequent collections have proven that the species is indeed widespread and relatively common on humus inside forests and on heather slopes at high elevations in the Pacific Northwest. The distribution map prepared by Peterson (1979) shows that the species extends beyond the boundary of the southern limit of the last glaciation, being common in southern British Columbia, Washington, Idaho, and Montana. The leaf costa lacks well developed bands of stereid cells in the upper half of the leaf. A few scattered clumps of stereid cells rarely occur within the costa. The capsules are quite consistently yellow in color when mature. The species has proven to be easy to determine and should not be confused with any related species.

A local endemic in the Pacific Northwest.

Representative specimens seen: Kokanee Glacier Park (UBC B-2919); Glacier National Park (UBC E-2918); Poplar Creek, north of Lardeau (UEC B-2917).

This is a common species in well drained and dry sites in shaded or open forests, especially along the Columbia Trench and the eastern flank of Purcell Mountain Range. It often grows with *Ptilium crista-castrensis*, *Racomitrium canescens*, *D. scoparium* and *Pleurozium schreberi*. The polysetous condition, coupled with the large undulate leaves, makes the plants rather striking. When collected without sporophytes, the strongly serrate leaf margins separate it from any robust forms of *D. scoparium*.

Basically a continental species, it becomes rare westward and does not reach the coast of British Columbia. Common also in Great Britain, Europe, and Asia including Japan.

Representative specimens seen: Spillimacheen area (UBC B-2922); Fairmont Hotspring (UBC B-2921); Purcell Wilderness Conservancy (UBC B-2920).

E. angustifolium Kindb.
E. howellii Ren. & Card.
E. bonjeanii sensu early North American authors

A highly variable species, yet not difficult to identify, D. scoparium is very common and widespread in the study area. The elongate and pitted upper laminal cells are distinctive. Often, the costa develops prominent lamellae or strongly enlarged cells on the abaxial surface. This feature is best seen in transverse sections of the costa.

A cosmopolitan member of the genus Dicranum, the species is also known from southern hemisphere countries like Australia and New Zealand. Peterson (1979) remarked that in North America, D. scoparium is present in all kinds of habitats except arid deserts and dry grasslands.

Representative specimens seen: Golden (UBC B-2924); Bugaboo Glacier Provincial Park (UBC E-2923); Revelstoke (CANM 121120).
**Dicranum sulcatum** Kindb. in Macoun, Bull. Torrey Bot. Club 17: 87. 1890. (isoelectotype at CANM !)

**D. crispulum** C. Muell. et Kindb. (isoelectotype at CANM !)

This species has long been interpreted as a synonym of **D. fuscescens**. Recently, Peterson (1979) concluded that the taxon is worthy of a species status on the ground that the leaf costa is stout with four rows of stereid cells above and below the centrally located band of enlarged guide cells. Moreover, the leaf costa is also long excurrent and laminal cells and the costa are strongly papillose. All of these characters can be observed in **D. fuscescens** occasionally, though not consistently in combination. To clarify the concept, I have studied carefully the three collections of **D. sulcatum** deposited at the UBC Herbarium and also the type specimens at CANM, all of which have been annotated by Dr. W. Peterson. The UBC collections came from Manning Park, British Columbia, Washington, and Oregon. Ten leaves from five plants were obtained for comparison from each of the three packets and sectioned at the base, middle, and upper levels. The results reveal that the number of rows of stereids in the leaf costa, like those of **D. fuscescens**, may vary from three to four, even in a single
plant. Whereas it is true that none of the available Kootenay materials of *D. fuscescens* has yielded sections of leaf costae showing four rows of cells in each of the stereid bands; on the other hand, the examination of the leaf costal anatomy of type specimens do not support the claim of Peterson (1979) concerning the difference in the number of stereid bands between *D. sulcatum* and *D. fuscescens*. Tentatively, I have concluded that *D. sulcatum* is a doubtful or weak species, perhaps best treated as a variety of *D. fuscescens*, and that the inland populations of *D. sulcatum* reported by Peterson (1979) should be re-examined.

More problems concerning the taxonomic validity have arisen as a result of the discovery of two dwarf male plants from the Oregon population determined as "*D. sulcatum*". Peterson (1979) described the male plants of *D. sulcatum* to be equal in size to the female plants. This condition is observed with the type materials of *D. sulcatum*. Earlier Loveland (1956) demonstrated that dwarf males of *Dicranum* are species specific, and do not grow on the female gametophytes of other species. This has cast doubt on the correct species identity of the Oregon plants.

The original description of *D. sulcatum* provided by Kindberg in Macoun (1890) further indicated that the leaf cells are porose. Yet, pitted cells in the upper half of the leaf in *D. fuscescens* and *D. sulcatum sensu* Peterscn are rare. To add further confusion, the original publication of *D. sulcatum*
allied the taxon to *D. fuscescens*. Two years later, in the Catalogue of Canadian Plants, the same author(s) allied it to *D. strictum* and *D. viride*.

Until the lectotype of *D. sulcatum* at S-PA is studied, it is impossible to determine whether what Peterson interpreted as *D. sulcatum* is the same species proposed by Kindberg. Only after the true species identity of *D. sulcatum* Kindb. in Macoun is established beyond doubt can the Oregon specimens with the dwarf males be given a positive name.

Peterson (1979) reported that *D. sulcatum* grows mainly on the trunks of living *Pseudotsuga menziesii* and *Sequoia sempervirens* in humid coast forests.

Peterson (1979) also stated that the species under discussion is endemic to the western region of North America. However, a quick perusal of Takaki's illustrations of Japanese *D. fuscescens* (p. 112, 1964) shows that some populations in Japan do acquire the four rows of cells in the so-called stelar bands of the leaf costa. Possibly, *D. sulcatum*, if proven to be a distinct species, is also present in Japan.

1801. Map 43.

**D. bergeri** Bland. in Sturm

**D. undulatum** has a very distinctive habitat, that of bogs and fens (map 43). The undulate leaves with broadly acute to obtuse apex and subpercurent costa, add to its easy identification. It is common in Canada and the northern part of the United States. The study area, lacking well developed and extensive bog formations, is, indeed, not the ideal place to seek the species. Nevertheless, there are Macoun collections (CANM 121893 & 121900) that are correctly determined as **D. undulatum**. The collections came from Roger's Pass, Glacier National Park.

The species is widespread in boggy and fen habitats in Arctic and circumboreal regions of Europe and Asia, including Japan.
Kiaeria Hagen

This is a northern, high elevation genus characterized by the leaf costa lacking differentiation of guide cells and stereids. Recently, Corley (1979) argued for the inclusion of weak, abaxial stereid bands in the generic delimitation of Kiaeria in order to accommodate K. glacialis (Bergg.) Hag. and K. riparia (Lindb. f.) Ccrley.

Fortunately, all the three species of the genus present in the province are typical in their leaf costal anatomy.

1. Leaves strongly and regularly falcate. *K. falcata*

1. Leaves crisped, flexuose, or irregularly falcate-secund

2. Plants with perigonia beneath the perichaetia; leaves usually with sharply differentiated brown alar cells; capsules ribbed when dry ...............*K. starkei*

2. Plants with perigonia far below or on a branch separate from the perichaetia; capsules smooth to wrinkled when dry;
leaves with poorly defined alar cells intergrading with the rest of the basal laminal cells .......... *K. blyttii*

*Kiaeria blyttii* (Schimp.) Broth., Laubm. Fennosk. 87. 1923.

Although less common than *K. starkei*, *K. blyttii* appears to share the habitat of the former in the study area. In addition, *K. blyttii* grows on the humus covering banks along trails, lake margins and creek banks, places where *K. starkei* is less frequent. For the distinction between the two taxa, see *K. starkei*. Sporophytes occasional.

Schofield (1976) observed that the species becomes rarer in the Columbian and Rocky Mountains of this province.

A widespread north temperate species.

Representative specimens examined: Glacier National Park (UBC B-2903); Kootenay Glacier Park (UBC E-2904 and B-2905).

This is an attractive *Kiaeria* in alpine sites where the snow persists late in summer. The strongly falcate leaves are unique and align themselves in the same general orientation. The perigonium, like that of *K. starkei*, is immediately beneath the perichaetium. When seen with sporophytes, the persistent annulus and the thick-walled exothecial cells can be used as additional diagnostic characters to separate the species from *K. starkei* and *K. blyttii*, with which it often grows.

Within the province, it is frequent along the coast, but rare in the interior mountain systems (see map 44).

Representative specimens examined: Eva Lake, Revelstoke National Park (UEC B-2889); headwater of Gorge Creek, Mica Dam (UEC B-2890).

**Dicranum starkei** Web. & Mohr

A common species on humus among heaths, decaying logs or rocks in open, subalpine to alpine slopes, *Kiaeria starkei* seems to replace species of *Dicranum* at high elevations in the Kootenay. In general, *K. starkei* is easy to distinguish from *K. blyttii*. The close position of androecia to the perichaetium is easy to demonstrate and observe. Other characters outlined to differentiate the two taxa are not sufficiently constant to be reliable. Sporophytes common.

Also common at high elevations in other parts of boreal North America, Europe, and Asia.

Representative specimens examined: Kokanee Glacier Park (UBC B-2900); Jackson Basin, Sandon (UBC B-2901); and head water of Gorge Creek, Mica Dam Site (UEC E-2902).
**Onkophorus (Erid.) Erid.**

This is a beautiful genus characterized by strongly squarrose and crisped leaves and strumose capsules. The genus has a wide distribution both in the northern and southern hemispheres. Of about 13 species of the genus, only two are present in the study area.

1. Leaf bases strongly expanded, obovate; leaf margins plane; alar cells not enlarged ..................O. wahlenbergii

1. Leaf bases gradually broadened, ovate to oblong; leaf margins recurved in the middle; alar cells enlarged, usually forming auricles ..................O. virens
Oncothorus virens (Hedw.) Brid., Bryol. Univ. 1: 399. 1826.

This is a fairly common species on wet cliff faces. It covers moist humic faces of boulders and silty logs in many shaded sites, especially along creek banks. Plant size varies from 1 cm to 6 cm tall, usually with thick mats of rhizoids along the stems. The leaves usually appear yellow green to brownish.

A common northern continental species.

Representative specimens examined: Enterprise Creek, Slocan Lake (UBC B-2891); Bugaboo Glacier Provincial Park (UBC B-2892); Revelstoke National Park (UBC E-2893).

Oncothorus wahlenbergii Brid., Bryol. Univ. 1: 400. 1826.

Map 45.

This is a rare to locally uncommon species in the study area (see Map 45). The plants are larger and stouter than O. virens. The bright to dark green leaves are more strongly squarrose and crisped than their counterparts in O. virens. In
the study area, _C. wahlenbergii_ is frequently encountered on humic substrates on boulders near watercourses and lake margins that are periodically flooded.

It is also a widespread species in the northern continents.

Representative specimens examined: Dipper Lake, Kimberley City (UBC B-2894); Beatrice Creek, Slocan Lake (UBC B-2895); Teepee Creek, south of Cranbrook (UEC E-2896).

_Crthodicranum_ (C. Muell.) Loeske

Species of _Orthodicranum_ are smaller, almost half the size of the average members of _Dicranum_. Morphologically, the taxon differs from _Dicranum_ in having erect or slightly inclined capsules and unistratose alar regions. A total of five species are known to North America, three are recorded for the study area.
1. Leaves with broken tips, stiff and straight
..............................................................................- O. strictum

1. Leaves with intact tips, not straight or stiff
..............................................................................2

2. Plants with flagelliform branchlets in the upper leaf axils; upper laminal cells smooth to weakly papillose
..............................................................................- O. flagellare

2. Plants without brood branchlets in the upper leaf axils; upper laminal cells strongly or distinctly papillose
..............................................................................- O. montanum


Dicranum flagellare Hedw.

Like O. montanum, O. flagellare is more common in the eastern deciduous forests of North America than in the west
coast. Peterson (1979) reported it to be distributed throughout the boreal forests wherever angiosperous logs are available for colonization. But within the province, the species is known only from a few widely spaced localities. MacFadden 3663 from Edgewood, Lower Arrow Lake (UBC B-2925) is the only population known from the study area.

The presence of flagelliform branchlets with only minute and scaly leaves is an unmistakable feature for the species. Without the asexual propagules, it is sometimes difficult to distinguish it from aberrant forms of *C. montanum* which have only moderately crisped leaves.

The reproductive effectiveness of the flagelliform branchlets have been studied by Chrobak & Sharp (1965). The readiness of branchlets to generate masses of protonema was compared to that of the broken pieces of leaves of *C. montanum*. Both methods of asexual reproduction were proven to be efficient. This may well explain the infrequency of sporophytes produced by the two taxa in nature, yet both species manage to attain a widespread status in their total geographical distribution.

Known to be present also in Europe, eastern Asia, and Japan.

Dicranum montanum Hedw.

This is the smallest member of the genus in the study area. O. montanum has strongly crisped leaves, and forms dense, woolly mats on logs and stumps inside forests and occasionally, on the base of living tree trunks. Superficially, the species can be easily mistaken for Dicranoweisia crispula and Amphidium lapponicum, but the presence of enlarged alar cells is sufficient to clarify its identity. Many depauperate specimens of D. fuscescens have been mistaken for O. montanum. Aside from having a straight or erect capsules, O. montanum has unistratose alar regions at the base of the leaf. The small size and the strongly crisped leaves of O. montanum are not matched by D. fuscescens. In some populations of O. montanum, a cluster of slender branches may arise from the stem apex and simulate the flagellate propagules of D. flagellare. Nevertheless, the slender branches of O. montanum develop small lanceolate-linear leaves, very unlike the scaly primordial leaves on the branchlets of D. flagellare.

O. montanum has a local distribution in the study area along the Selkirk Mountain Range, absent in the drier Pinus
ponderosa and *Pseudotsuga menziesii* forest communities to the southern and eastern parts of the Kootenay area (see Map 46). The only population from the study area and mapped by Peterson (1979) is the collection of Brinkman made at Roger's Pass, Glacier National Park. I have subsequently collected additional specimens from the same National Park and elsewhere in the study area. All these constitute the total populations of the present species known from British Columbia.

A widespread species, yet locally always uncommon in Europe, Asia, and Eastern North America.

Other specimens seen: Glacier National Park (UBC B-2926, B-2928); Goldstream Basin, north of Revelstoke (UBC B-2927).


*Dicranum tauricum* Sapehin

A very common species in the study area, *O. strictum* is found mainly on decaying logs together with *Hypnum cirkinale*
and species of *Brachythecium* and *Plagiothecium*. Often, it is the only moss growing in association with *Euxbiumia piperi* on well-advanced decayed logs in humid sites. The broken tips and the dark green color offer useful field characters.

A western North American and European disjunct species.

Petersen (1979) stated that, if treated as a species of *Dicranum*, the correct name should be *D. tauricum* because the combination *D. strictum* Schleicher is a later homonym.

Representative specimens seen: Revelstoke area (UBC B-2931); Kimberley (UBC B-2930); Castlegar area (UBC B-2929).

*Paraleucothryum* Leeske

This is a very characteristic genus with leaves consisting mainly of a broad costa and very narrow lamina. The transverse section of the costa shows two rows of hyaline cells sandwiching a central row of small chlorophyllose cells. None of the other genera in the study area develop a similar costal structure. The genus is a link between the Family Dicranaceae and Family Leucotryaceae (Earnes, 1958). A northern hemisphere genus of 7 species, two are known to the province and the study
1. Leaf costa rough abaxially; leaf margin serrulate especially in the upper half ............P. longifolium

1. Leaf costa smooth abaxially; leaf margin entire, except for a few teeth at the tip ..................P. enerve

Paraleucobryum enerve (Thed.) Loeske, Hedwega 47: 171. 1908.

Dicranum albicans E. S. G.

This is essentially a coastal species. The discovery of P. enerve among Macoun's and Hazelwood's collections from Glacier National Park came as a surprise. Both collections (UBC B-2884, B-2885, B-2886) came from high elevations and wet sites. Its distribution elsewhere in the interior of this province is not clear. Near the coast, it is infrequent, but
locally abundant on peaty terraces of subalpine to alpine tundra (Schofield, 1976).

Also known from high altitudes in Europe, Caucasus, Himalayas, China, and Japan.


*P. sauteri* (Schimp.) Loeske

An uncommon species in cooler and wetter sites in the Columbian Mountains, this species prefers shaded boulders with thick humus cover inside the forest. Occasionally, it can be found on forested mountain slopes at subalpine elevations. I have seen no Kootenay populations growing on rocks by streams or on tree trunks. Plants vary in size and leaf habit. Leaves are pale white when dry and can be either strongly falcate or nearly straight. I agree with Barnes (1958) that the width of the leaf costa is variable, and that *P. sauteri* should be combined with the present species. Specimens of *P. longifolium* have been mistaken for *Dicranodontium denudatum* (see CANM
Dicranodontium denudatum has not been collected from the study area although its presence in the Selkirk and Purcell Mountains can be expected. The nearest population of D. denudatum that I know of is Schofield 27763 collected ca. 5 miles west of Revelstoke cn Trans-Canada Highway. Sporophytically, the seta of P. longifclium is not cygneous as is the case of D. denudatum.

A common northern hemisphere species,

Schofield (1976) stated that the species is restricted to the southern half of the province (see Map 47).

Representative specimens examined: Roger's Pass, Glacier National Park (CANM 116847); Kckane Glacier Park (UBC E-2906); Purcell Wilderness Conservancy (UBC E-2907).

FAMILY FISSIDENTACEAE

This is a very distinctive and homogeneous family of two genera with dicranoid peristome and a distichous and complanate gametophyte. The morphology of the leaf is unique among the true mosses and requires a set of new terms to describe it. The leaf is unicostate, consisting of a split ventrally towards
the lower part of the blade. These two basal halves of the lamina clasp or sheathe the stem and are called vaginant laminae. They are interpreted by Salmon (1899) and Robinson (1972a) as the true leaves. The remaining portion of the leaf above the costa, and the whole lower portion below the costa, are considered modified outgrowths from the vaginant laminae.

A cosmopolitan family with *Fissidens* (including *Octodiceras* Erid.) being the sole representative in the province.

*Fissidens* Hedw.

A large genus of nearly a thousand species and worldwide in distribution. Around eight species are now known to the province, and four are in the study area. *Fissidens limbatus* Sull., *F. incurvus* Starke ex Roehl. and *F. viridulus* (Sw.) Wahlenb. are treated here as synonyms of *F. bryoides* Hedw. following Pursell (1976).

*F. ventricosus* Lesq. has been reported by Ireland and Schofield (1967) to be widespread along the western coast and Idaho. The species is included in the key for future
1. Plants large, rigid, up to 4 cm long or more; leaf blade thick, of several layers of cells .......F. grandifrons

1. Plants smaller, soft, very rarely more than 3 cm long; leaf blade uni- or bistratose ..............2

2. Leaves bordered, at least partially by narrow, elongate cells along the margins of the vaginant laminae.

.........................................................3

2. Leaves not bordered by narrow, elongate cells

..........................................................4

3. Plants small, stems usually less than 1 cm long; leaf borders uni- or bistratose; lamina or blade always unistratose; seta 3-8 mm long ...........F. bryoides

3. Plants larger, stems 1-3 cm long; leaf borders consisting of two to several layers of cells in thickness; lamina wholly or partly bistratose; seta 1-3 mm long

.........................................................(F. ventricosus)
4. Leaf apex coarsely and irregularly serrate; costa clearly percurrent or slightly excurrent .......F. adianthoides

4. Leaf apex finely and evenly serrulate; costa ending well below the apex .........................F. osmundoides


A common species on damp shaded cliffs, stream banks and logs, on margins of lakes or cascades. The strongly and irregularly toothed leaf apex is very characteristic.

A MacFadden collection from New Denver (UBC B-4402) is exceptionally long, reaching 6 cm.

F. adianthoides is related to the eastern North American species F. cristatus Wils. ex Mitt. This latter species is present in the Aleutian Islands and east Asia. For illustrated differences between these two species of Fissidens and other taxa in the genus, consult Crum (1976).

A widespread bipolar species.
Representative specimens seen: Pend' Creille River (UBC B-4389); mouth of Evans Creek, Slccan Lake (UBC E-4390); Champion Lakes Provincial Park (UBC B-4391).


*F. lignatus* Sull.
*F. incurvus* Starke ex Roehl.
*F. viridulus* (Sw.) Wahlent.
*F. exiguus* Sull.

All synonyms listed above differ from *F. bryoides* mainly in the position and extent of the differentiated leaf borders. My own experience with the numerous populations of *F. bryoides* studied supports the claims made by Crum (1976) and Pursell (1976) in synonymizing the numerous binomials with the present taxon. It is the smallest, yet the most widespread and common species of the genus in the study area. As long as there is a thin film of soil or silt, it grows on all kinds of protected substrates, aquatic or terrestrial, at all elevations. In the study area, the species competes to a certain extent with
Schistostega pennata in colonizing overturned rootstumps in most humid sites. When present, either F. bryoides or S. pennata forms extensive cover, but both taxa appear not to co-exist. The tiny reddish capsules of F. bryoides are striking. Under the microscope, the apical portion of the peristome teeth develops spiral ridges.

A near cosmopolitan species.

Representative specimens seen: Sutherland Falls, south of Revelstoke (UBC B-4392); Purcell Wilderness Conservancy (UBC B-4393); St. Leon Hotspring site (UBC B-4394); Kokanee Glacier Park (UBC B-4395).


It is a beautiful, large and often submerged species in the study area. Populations appear dark green in running water. Schofield (1976) reported it to be calcicolous (in streams in calcareous areas). Its local distribution seems to confirm the above observation. It is present in the vicinity of many hot or cold mineral springs in the study area.
Possibly it is widespread in the province.

A circumpolar species. Widespread in North America, south to Guatemala.

Representative specimens seen: Kikomum Creek Park vicinity (UBC B-4399); New Denver (UBC E-4400); Joseph Creek, southeast of Cranbrook (UEC E-4401).


In the study area, this species has similar habitat preference to _F. adianthcides_; it is also equally common. The two species are quickly separated by microscopic examination of leaf apices. _F. osmundoides_ appears to be widespread in appropriate habitats within the province. Most collections in the Kootenay mountains are not submerged in running water, but are on banks or cliffs within the spray or splash of streams and waterfalls.

Another near cosmopolitan species.

Representative specimens seen: Nakusp Hotspring (UBC B-4396); Fry Creek Canyon (UBC B-4397); Glacier National Park (UBC B-4398).
FAMILY ENCALYPTACEAE

This is a family of two genera, only Encalypta is represented in the study area.

Encalypta Hedw.

This is a genus of about 35 species whose distribution is worldwide, the majority of which are circumboreal in the northern hemisphere. The genus is striking in its long, cylindric capsules with a hood-shaped calyptra. Owing to this feature, species of Encalypta have been called "extinguisher mosses". C. Horton of the University of Alberta, who is monographing the family on a worldwide basis, recently gave an interesting account on the history and morphology of the Family Encalyptaceae (Horton, 1979a).

Although populations of Encalypta produce sporophytes frequently, sterile specimens are often collected and sometimes pose problems as to the generic identity. The papillose, chlorophylllose laminal cells which become transparent and
smooth towards the base of the leaves are diagnostic features of both *Encalypta* and some other genera, like *Tortula*. Under the circumstances, the solution lies in the elongate basal laminal cells of *Encalypta* which have cross walls much thicker than the vertical ones. For more differences between *Encalypta* and the other related genera, consult Horton (1979a).

Meanwhile, the keys to the sterile material of *Encalypta* in Grout (vol. I, part 3, 1938) and Flower (1973) are useful. For illustrations of the species, see Ccker (1918).

Within the genus there are some species in which the peristome is lacking, while in others, it is single or double. This phenomenon has caused much debate and discussion among bryologists in their attempts to interpret the evolutionary significance. Horton (1979a) should be consulted for further elucidation on this matter.

In addition, the species of the various species of *Encalypta* appear to be distinctive, and their usefulness in taxonomy has gained recognition in recent years (Vitt and Hamilton, 1974; Horton, 1979b).

Species of *Encalypta* generally prefer calcareous substrata, particularly limy outcrops. The majority of the taxa grow on soil in rock crevices. Since there is a general lack of extensive limy outcrops in the study area when comparison is made with the neighboring Rocky Mountain Range, it is not surprising that the genus is represented locally only
by four common species which, incidentally, also inhabit non-calcareous substrata. Schofield (1968a) has reported 6 species for the entire province.

Calciccles like _E. brevipes_ Schljak, _E. mutica_ Hag. and _E. longicella_ Bruch were reported by Horton (1979a) from many places along the Canadian Rocky Mountain Range. Their discovery in the study area in the future would not be totally unexpected.

1. Basal leaf cells strongly papillose ... _E. affinis_

1. Basal leaf cells not or only sparsely papillose

2. Mature capsules with spirally twisted grooves; plants with filamentous, papillose and multicellular brood bodies in the leaf axils; leaves muticous .......... _E. procera_

3. Mature capsules smooth to longitudinally grooved; filamentous brood bodies absent; leaf margins on fertile stem piliferous .................

4. Leaf costa smooth to scantily papillose abaxially; leaf margins recurved to the middle of the leaf; calyptra
fringed; spores ridged or wrinkled ..... E. ciliata

4. Leaf costa strongly papillose abaxially; leaf margins plane at middle of the leaf; calyptra entire or erose; spores warty with large papillae ........... E. rhaptocarpa
   (including E. vulgaris)


Encalypta apophysata Nees et Hornsch.

A calcicole, E. affinis was collected only once from the study area by MacFadden (UBC B-6399) from Nakimu Caves area, Glacier National Park in 1941. I was unable to visit the site in 1977 and 1978 because the caves were closed to public owing to the serious deterioration of the trail conditions and high incidence of attacks by grizzly bears.

The strongly papillose basal leaf cells that characterize this species give the plant a dull green color in nature.
Its distribution pattern in the study area and the province is not clear. Only a relatively small number of collections appear to be known from the province. Nyholm (1954-1969) reported it to be scattered in Europe, Asia, and North America. Judging from herbarium specimens at UBC, the taxon appears to be more common in the northern part of the province.


Encalypta laciniata (Hedw.) Lindb.

This is the second common species of the genus in the area. E. ciliata is unique in its orange-brown, cylindric capsules with peristome and in its crisped leaves with shining costae when dry. Microscopically, this species is most easily determined by the presence of a band of differentiated square cells at the junction between the fringe and the base of the body of the calyptra.

It is a species of shaded rock crevices or concavities in both calcareous and non-calcareous substrata. It seems to
prefer lower altitudes in the study area (see Map 52). Schofield (1976) observed that the species is widespread in the province but is never common. A circumtropical and also a bipolar species.

Representative specimens seen: Cayuse Creek Falls, Deer Park (UBC E-6399); Champion Lakes Provincial Park (UBC B-6401); Fry Creek Canyon (UEC B-6400).


*Encalypta cucullata* C. M. & Kindb.

The largest and the most common species of *Encalypta* in the area. The long capsules with spirally twisted grooves are unmistakable. The twisting of grooves or furrows, however, varies in degree from specimen to specimen, as does the presence or absence of a central strand in the stem section. *E. procera*, like *E. ciliata*, also has fringed calyptrae, but it differs from the latter species in lacking the several rows of square to shortly rectangular cells which border the basal
part of the fringe. The presence of brood bodies in leaf axils of *E. procera* also assists in the identification. Coker (1918) reported that in this taxon, the basal margins of the leaf are denticulate. I have not observed this to be a consistent feature. The denticulation may or may not be developed. From *E. streptocarpa* Hedw., the taxon differs in being autoicous with pilifercus perichaetial leaves and with a central strand in the stem section (Lawton, 1971). The latter feature, however, does not appear to be reliable. The MacFadden collection from Slocan Lake distributed under the name *Encalypta contorta* (Wulf) Lindb. (*Musci Acrocarpi Boreali-Americani et Europaei 614*) belongs here. *E. contorta* is now treated as a synonym of *E. streptocarpa*. See Crum (1976, p. 97) for comments on the presence of the latter species in North America.

The ecology and distribution pattern of the present species parallel that of *E. ciliata* which is also a circumboreal species.

Representative specimens seen: Zincton (UBC B-6402); Pend Oreille River (UBC B-6403); Dunbar Lake, on way to Bugaboo Glacier (UEC B-6404).
Encalypta rhaptocarpa-vulgaris complex

I include here *E. rhaptocarpa* Hedw., *E. vulgaris* Hedw. and *E. spathulata* C. Muell. The variations in gametophytic as well as sporophytic characters, especially the smooth versus grooved capsule, among the three taxa seem to intergrade (see Flowers in Grout, 1928-1940; Horton, 1979a). Lawton (1971) combined the three taxa under the name *E. vulgaris* Hedw. Most floras and manuals, nevertheless, segregate the plants with smooth capsules but without peristome as *E. vulgaris*; plants with grooved capsules and also with peristome as *E. rhaptocarpa*; and plants with grooved capsules but no peristome as *E. spathulata*. Horton (1979a) currently recognizes all three taxa. She kindly studied my collections of this species complex and informed me (in litt., 1979) "... *E. rhaptocarpa* virtually always has hairpoints and the costae are not particularly prominent...... *E. vulgaris* is characterized by leaves that are muticus, and have a very prominent, brown and shining costa......none of the specimens you sent me approach what I would presently consider to be *E. vulgaris.*" *E. vulgaris*, however, was reported from the study area based on MacFadden collections which were unavailable to me. Thus, I prefer to withhold any opinion concerning the species complex, and treat the complex in a broad sense while awaiting the final analysis of the problem in
the future mcncgraph.

This complex is probably more calcicolous than any of the three previously described species. It is more common in the Purcell Mountains, whose substrata have been much affected by the more basic sedimentary rock formations of the adjacent Rocky Mountain Range. Most of the collections in the study area come from subalpine elevations. A circumboreal taxon.

Representative specimens seen: Stagleap Provincial Park area (UBC B-6405); Purcell Wilderness Conservancy area (UBC B-6406); Duck Lake, Creston (UBC B-6407).

FAMILY POTTIACEAE

A diverse, acrocarpous family characterized by papillose leaf cells and papillose, filiform peristome teeth. The family is rather heterogeneous in generic composition, and has been revised several times. For the species in North America, I follow the treatments of Saito (1975) and Zander (1978a; 1979c). A total of 13 genera are discussed here for the study area. The reader is referred to the original papers of Chen (1941), Saito and Zander for discussions of presumptive
interrelationships among the various taxa in the family.

Spore ornamentation of a number of selected Japanese species of Pottiaceae was examined utilizing the SEM by Saito and Hirohama (1974). The results, thus far, contribute little to the taxonomic understanding.

1. Branching monopodial; perichaetia on specialized axillary branches; leaves arranged clearly in 3 to 5 rows when wet

........................................... Anoectangium aestivum

1. Branching not monopodial; perichaetia terminal on stems; leaves spirally arranged on the stem ...2

2. Leaf costa excurrent; capsules cleistocarpus

........................................... Phascum cuspidatum

2. Leaf costa not excurrent, or if excurrent, capsules not cleistocarpus .........................3

3. Leaves with lamellae or filaments on the adaxial surface of costa; mostly very small xerophytic mosses at low elevation

...........................................4
3. Leaves without lamellae or filaments on the surface of costa ........................................5

4. Leaf costa with lamellae; margins not incurved .......................................................... Pterygoneurum

4. Leaf costa with filaments; margins strongly incurved or involute, forming hooded apices .......... Aloina

5. Leaves oblong, ligulate to linear lanceolate, apex blunt, rounded to truncate; costa in section with median guide cells and dorsal stereid band only ........6

5. Leaves ovate to broadly lanceolate, apex acute to acuminate; costa in section with median guide cells sandwiched by dorsal and ventral stereid bands, the latter usually weakly developed .................9

6. Leaf margins mostly entire, except at at leaf shoulder near the base where the margins become toothed ................................................................. Eucladium verticillatum

6. Leaf margins crenulate to toothed throughout owing to the projected ends of marginal cells ......7

7. Peristome teeth short and erect; sometimes slightly twisted
Desmatodon

7. Peristome teeth long and twisted ....... 8

8. Leaves with strongly differentiated hyaline, smooth basal cells, papillae of laminal cells C-shaped to multiplex; peristome teeth with high tubular basal membrane

..................Tortula

8. Leaves without or with slightly differentiated basal cells, papillae of laminal cells simple, conical, never branched; peristome teeth with short or low basal membrane

..................Barbula

9. When dry, leaves strongly crisped, resulting from the involute apices and incurved margins ...Weissia controversa

9. When dry, leaves imbricate, twisted or crisped, margins plane, recurved to revolute, never strongly incurved or involute .........................10

10. Hyaline basal cells forming a conspicuous V-shaped area

..................Tortella

10. Hyaline basal cells if present not forming a V-shaped area

..................11
11. Leaf margins plane, toothed only at leaf shoulder above the enlarged basal laminal cells ........ Eucladium verticillatum

11. Leaf margins otherwise .................. 12

12. Peristome absent ......................... Gymnostomum

12. Peristome present or rudimentary ...... 13

13. Plants reddish brown in color; cells of the surface of costa with C-shaped papillae; leaf apices irregularly dentate, marginal teeth pellucid and larger than the laminal cells .................................... Bryocerythrophyllum recurvirostrum

13. Plants not rusty red in color; cells of the surface of costa with simple or multiplex papillae; leaf apices without the irregularly dentate marginal teeth .14

14. Cells of the abaxial surface of leaf costa quadrate to short oblong, occasionally mixed with elongate cells; axillary hairs of leaves with brown basal cells ........................................... Didymodon

14. Cells of the abaxial surface of costa linear-oblong, rarely mixed with quadrate ones; axillary hairs of leaves
The genus was recently revised by Delgadillo (1975). A genus of nine species, it is characterized by the chlorophylllose laminal filaments on the adaxial surface of the leaf. Two species are documented to be present from the study area, with possibly a third species, *Alcina bifrons* (DeNot.) Delgadillo (= *A. pilifera* (B. S. G.) Crum & Steere), awaiting discovery. *A. bifrons* has been collected from Idaho State south of the study area.

1. Leaves piliferous ......................(*A. bifrons*)

1. Leaves not piliferous, blunt and cucullate
   ...........................................................................2

2. Leaves broadly ovate to ovate-lanceolate, 2-4 times as long
as wide; synoicous .................. A. brevirostris

2. Leaves lingulate, 4-6 times as long as wide; dioicous
................................................. A. rigida


This is a very small species with rosettes of cucullate leaves. Its distribution in North America has been mapped by Steere (1950) and Delgadillo (1975). It is widespread across the North American continent where dry calcareous or basic silts or clayey soils are available for colonization. Its ecology is reflected in its local distribution pattern in the study area. Within its total distribution, the species exhibits a certain degree of morphological variation. The leaf shape and the leaf coastal stereid hands are two features that are not constant and overlap with the range of morphological expression of _A. rigida_. Both Delgadillo (1975) and Smith (1978) contend that the most reliable character to use in separating _A. brevirostris_ from _A. rigida_, aside from the sexuality, is the length of the leaves. In _A. brevirostris_,
the hyaline leaf base is as long as or slightly longer than the rest of the leaf whereas in the latter, the hyaline leaf base is probably 1/3 or less the entire length of the leaf.

In British Columbia, the species is common in the dry Okanagan valley with eastward extension of populations into the Columbia Trench in the study area (map 53).

A widely scattered north temperate weedy species.

Representative specimens examined: Wycliffe Regional Park (UEC B-3333); Canal Flat (UBC E-3334); Mitten Lake margin, Spillimacheen (UEC E-3335).


This is a much rarer species in the province. Thus far, A. rigida has been collected only a few times from the northern part of the province. It is known also from Idaho, Arizona, and Alberta. Its discovery is not totally unexpected. The only collection known to date was collected from the sagebrush country at Edgewater on Hwy 95 (UBC E-3336). The leaves are narrowly lanceolate, and only female plants were seen. For the differences between the taxon and A. brevirostris, see comments.
under the latter.

Also a circumboreal species.

**Anoectangium** Schwaegr.

A worldwide genus of about 70 species. The taxon is represented locally by one species.


**Anoectangium compactum** Schwaegr.

**Gymnostomum euchloron** Schwaegr.

The lateral position of the sporophytes in **A. aestivum** distinguishes it from all the rest of the members of the family in the study area. However, populations in nature usually lack sporophytes. Under the circumstances, the taxon can be
confused with species of *Gymnostomum*, which also possess gymnostorous capsules, and *Fucladium verticillatum*. The deeply grooved, acaxial side of the leaf along the costa, as noted by Zander (1977), is a good character to use to distinguish *A. aestivum* from related taxa. In transverse section, the leaf forms a narrow V outline with an angle of less than 30° between the two arms. From *F. verticillatum*, the present species can be distinguished by the gymnostomous capsules and the entire or only crenulate leaf basal margins resulting from the papillae of marginal cells. From species of *Gymnostomum*, it can be distinguished by the keeled upper portion of the leaves. Occasionally, sterile material of *A. aestivum* can be mistaken for *Amphidium* and *Zygodon*. The comments of Lawton (p. 87, 1971) and Zander & Vitt (1979) present useful details concerning these taxa.

Although collected only twice from the study area, Revelstoke (UBC E-3350) and Slocan (UBC E-3349), *A. aestivum* is a nearly cosmopolitan species. In British Columbia, Schofield (1976) observed the species to be found largely in humid, shaded cliff crevices, particularly near waterfalls and creek banks. Common on neutral to acidic rocks and largely a species of the coastal areas.

New to the study area. Nearly cosmopolitan.
As redefined by Saito (1975) and Zander (1979c), the genus appears to be rather distinct from *Didymodon*. In general, the leaves of *Barbula* tend to be oblong-lanceolate or lingulate whereas those of *Didymodon* are ovate-lanceolate. The dissimilarity of axillary hairs between the two genera are given taxonomic importance by recent monographers (Saito, 1975; Zander, 1979c). Such structures, however, are difficult to observe because they are caducous. Thus, the difference in the surface cellular details of the abaxial side of the leaf costa is emphasized here to separate the two genera. *Barbula* species, generally, have elongate surface cells on the abaxial side of the leaf costa. For more taxonomic information on the two genera, consult Zander (1978a).

The species of *Barbula* appear to inhabit mostly disturbed sites, especially in calcareous regions, whether wet or dry. It is difficult to estimate the actual size of the genus at the moment. Many species of *Didymodon* are placed under *Barbula* by many workers. Likewise, several species traditionally placed in *Barbula* should perhaps be transferred to other newly segregated genera.

The genus, according to Saito (1975), produces rhizoidal gemmae that are of taxonomic value. I noted none among my...
Kootenay specimens. Therefore, this asexual reproductive structure is not discussed in the text.

In British Columbia, there are four species of Barbula reported by Schofield (1968a). All are found in the study area.

1. Leaf margins strongly revolute .......... *Barbula revoluta*
   var. *obtusula*

1. Leaf margins plate to recurved, never strongly revolute

2. Perichaetial bracts not convolutily sheathing; leaf costa percurrent to short excurrent, often forming a stout apical mucro ............... *Barbula unguiculata*

2. Perichaetial leaves convolutily sheathing; leaf costa at most weakly percurrent, never apiculate

3. Leaf costa, in transverse section, with well-developed guide cells and dorsal stereid bands, occasionally with weak, ventral stereid band; inner perichaetial leaves tightly and convolutily sheathing the base of the seta
3. Leaf costa, in transverse section, more or less homogeneous in cellular composition, rarely with differentiated dorsal stereid band; inner perichaetial leaves loosely sheathing the base of the seta..............Barbula eustegia

Barbula convoluta Hedw., Spec. Musc. 120. 1801.

E. chrysopoda C. Muell. & Kindt. (isotype at CANM!)

A fairly common species in open disturbed sites, especially near human habitation. Populations are often buried or covered by soil and become obvious only after the formation of sporophytes. The tightly convolute and sheathing inner perichaetial leaves at the base of the seta readily separate this species from the rest of the Barbula, except E. eustegia. The inner perichaetial leaves of E. convoluta, although generally with blunt to truncate apices, infrequently have acuminate to acute apices even within a single perichaetium. It is the latter condition of perichaetial leaf apices that
results in the confusion of this species with *E. eustegia* that has only acuminate to subulate perichaetial leaf apices. In separating the two taxa, the habit and arrangement of the inner perichaetial leaves are far more reliable characters, taxonomically, than the leaf apices. In *E. convoluta*, the inner perichaetial leaves wind tightly around the base of the seta and extend or draw up spirally along the seta during maturation. The illustrations of *E. convoluta* in the *Bryologia Europaea* (1836-1855) are accurate in this regard. *E. eustegia*, on the other hand, has the inner perichaetial leaves loosely sheathing the base of the seta and they do not spirally wind upward. The transverse section of the leaf costa of *E. convoluta* is also different from that in *E. eustegia*. See *E. eustegia* for further details.

Widespread in the province. A circumboreal species in the northern hemisphere.

Representative specimens examined: Arrow Park (UBC B-3028); Glacier National Park (UBC E-3029); Revelstoke National Park (UBC E-3030).
B. eustegia is very rare in the study area. In western North America, the species has been confused for decades with the form of B. convoluta that develops acuminate inner perichaetial leaves. It is interesting to note that in the original description of the species (Cardot & Theriot, 1900), the perichaetial leaves were described correctly as semi-sheathing. The difference in the arrangement of perichaetial leaves on the seta between B. eustegia and B. convoluta was also emphasized. It is most unfortunate that these differences were subsequently overlooked by most workers and hence, the confusion that followed. The transverse section of leaf costa of B. eustegia reveals a general lack of strong differentiation of guide cells and stereid bands. On the other hand, one sees a well-differentiated central row of guide cells and a dorsal band of stereid cells in most leaf costae of B. convoluta. Occasionally, an additional ventral band of stereids can be demonstrated to be present in B. convoluta. Zander (1979c) suggested that it is probably better to treat the present taxon as a variety of B. convoluta. I prefer to treat it as a distinct species, based on the morpho-anatomical differences mentioned above and also the unique geographical distribution pattern.
E. eustegia has a range of local distribution in southern British Columbia to Washington, Idaho, Montana, Utah and California (see map 55). Many specimens named B. eustegia from British Columbia (Crum, 1965) are actually E. convoluta. Thus far, Tan & Ensing 77-1236 collected from Cody Caves Provincial Park at Ainsworth (UEC E-2959) is the only authentic specimen seen from the province as well as the study area. Its occurrence in the dry Okanagan valley and southern Vancouver Island is to be expected.

A western North American endemic.

Barbula revoluta Brid. in Schrad. var. obtusula (Lindb.)

Barbula platyneura C. Muell. & Kindr. in Macoun
Pseudocrossidium revolutum var. obtusula (Lindb.) Tan, Taylor & Zander
Barbula hornschuchiana var. obtusula (Lindb.) Podp.

A rare species in North America, E. revoluta var. obtusula was recently discussed by Tan, Zander and Taylor (1980c). As
explained in their paper, the var. *obtusula* is the only variety present in North America. It differs from the common typical variety present in Europe and Asia in developing broadly ovate leaves and less revolute leaf margins.

The type specimen of the *Barbula platyneura* was collected by Maccun from Deer Park, Lower Arrow Lake (isotype at UBC, B-2958). Since then, no other collections have been seen in the study area although the taxon was discovered later from California, Oregon, and Yukon. Recently, Dr. Schofield and Mr. T. McIntosh have discovered many populations in the Okanagan Valley of British Columbia. The populations are probably "ephemeral" in nature, like many pioneering species in disturbed sites.

The type locality of *B. platyneura* is now submerged after the construction of Keenlyside Dam at the Syringa Park.

The type of *Barbula obtusula* Lindl. was also borrowed from the herbarium of the University of Helsinki. The specimen proved to be conspecific with *B. platyneura* with the former being an earlier name. *F. obtusula* (=*B. platyneura*) differs consistently from *B. revoluta* Brid. in Schrad. in a few minor morphological characters. This has led Tan *et al.* (1980c) to accept it as a variety of the latter taxon.

Zander (1979c) has recently effected a controversial transfer placing the species *B. revoluta* under the South American Andean genus *Pseudocrossidium* Williams. If such a
genus is preferred, then the name for the variety becomes

**Pseudocrossidium revolutum** var. **obtusula** (Lindb.) Tan, Zander & Taylor.

The variety is uncommon in Europe.

**Barbula unguiculata** Hedw., Spec. Musc. 118. 1801.

This is a common species in open roadsides and wastelands. Plants vary greatly in sizes. The strongly mucronate leaf costa is very distinctive. One needs only to see this feature once to remember the character for the species. Crum (1976) remarked that the apiculus is "claw-like" and is particularly strong in the upper and perichaetial leaves. The illustrations for the taxon in Flowers (1973) are excellent.

A circumpolar species. Schofield (1976) stated that the species is scattered through the southern half of the province.

Representative specimens examined: Balfour, Kootenay Lake (UBC B-3031); Silverton (UBC B-3032); Three Forks (UBC B-3033).
Erycerephyllum Chen

Erycerephyllum was proposed by Chen in 1941 as a segregate genus from Didymodon. The distinctiveness of the only species in the study area seems to justify the segregation. Species of the genus tend to produce brick red colored tufts, hence, the generic epithet. It is a small worldwide genus of approximately 10 species. The North American species have been revised by Zander (1978b). There are three species recognized by Zander for the province.

Erycerephyllum recurvirostre (Hedw.) Chen, Hedwigia 80: 5. 1941.

Didymodon rubellus B. S. G.

Didymodon recurvirostris (Hedw.) Jenn.

A fairly common species in the study area, B. recurvirostre is easy to identify both in the field and under the microscope. The irregularly dentate margins, though
variable, are always present near the leaf apex.

A common calcicole, *B. recurvirostre* is scattered throughout the province from sea level to alpine elevations. A cosmopolitan species.

Representative specimens examined: Jumbo Creek, Purcell Wilderness Conservancy Area (UBC B-3337); Slocan (UBC B-3338); Beatrice Lake, Valhalla Range (UBC E-3339).

**Desmatodon** Brid.

A genus of about 40 species distributed throughout the world in the northern hemisphere. The genus is basically montane in its distribution in the province. Schofield (1968a) listed three species for British Columbia, all of which have been collected from the study area.

Like *Tortula*, *Desmatodon* can be troublesome to identify when the collections have no sporophytes. Small individuals can be confused with *Pottia*. On the other hand, large specimens of *Desmatodon* can be mistaken for *Encalypta*. 
1. Leaf margins differentiated, at least near the leaf base; capsules cernuous or horizontally inclined

.................................\textit{D. cernuus}

1. Leaf margins not differentiated; capsules erect to suberect

.................................2

2. Costa of the upper leaves long excurrent

.................................\textit{D. latifolius} var. \textit{latifolius}

2. Costa of the upper leaves not excurrent, at most shortly mucronate .........................3

3. Upper laminal cells large (15-21 \textmu m in diameter), distinctly papillose ................\textit{D. latifolius}

\hspace{1cm} var. \textit{muticus}

3. Upper laminal cells smaller (8-15 \textmu m in diameter), only weakly papillose or smooth ...........\textit{D. obtusifolius}

Desmatodon cernuus is most distinctive when collected with sporophytes. The ovoid capsules are characteristically horizontally inclined. The only collection, Tan & Ensing 77-1627, came from the calcareous margin of Lake Lillian in Invermere area.

The species is not common, but rather sporadic in distribution across the continent from Northwest Territories, California to Montana, Utah, and Wisconsin. Also known from Europe and Asia.

Second collection known to the province.


D. latifolius var. latifolius is fairly common in the subalpine to alpine zone in the study area (Map 54). Extensive populations are seen at times covering trail banks, in open
meadows and occasionally on moist cliff faces. Var. muticus, which differs only in the lack of an awned leaf costa, is rare in the study area. Schofield (1976) observed that the species is common in sites where the snow persists late in the summer, or remain humid over a long period of time.

Widespread in the northern hemisphere from Europe, Siberia, China to Japan, and North America.

Specimens examined: Kootenay Glacier National Park (UBC B-3035); Bugaboo Glacier Provincial Park (UEC B-3036); Glacier National Park (UEC E-3038); var. muticus: St. Mary Alpine Park (UEC B-3038); Glacier National Park (UEC E-3039).

Desmatodon obtusifolius (Schwaegr.) Schimp., Syn. 158. 1860.

This species is rare in the province. Collections at UBC indicate that it is confined to the southern end of the province. The obtuse leaf apex and the nearly smooth laminal cells are sufficient to separate the species from the rest of Desmatodon. Occasionally, sterile specimens can be mistaken for Barbula convoluta. The latter, however, has stronger papillose leaf cells and strongly convolute sheathing inner
perichaetal leaves which are absent in *D. obtusifolius*.

The only collection from the study area is from a dry, exposed ground in sagebrush-lodgepole pine community at Edgewater on Hwy 95 (UBC B-3040). In eastern North America, Crum (1976) reported that the species grows on damp, shaded rocks, stone walls and bridge supports, rarely on soil.

Known also from Caucasus, Europe, Asia Minor and Greenland. Fairly widespread in North America.

*Eidymodon* Hedw.

The North American species of the genus have been revised by Zander (1978a). His paper should be consulted for nomenclatural and taxonomic changes, as well as the generic concepts of *Eidymodon* versus *Barbula*.

There are 10 species of *Didymodon* known to British Columbia, only five of which are present in my study area. *D. brachyphyllus* (Sull. in Whippl.) Zander and *D. acutus* var. *icmadophilus* (Schimp. ex C. Müell.) Zander are both included in the key although the two taxa have not been collected from the study area. The local distribution of these
two species is poorly understood, and both are known from the neighboring areas in Alberta, Montana, and Idaho. Their future discovery in the southeastern part of the province is to be expected.

*Didymodon rigidicaulis* (C. Muell.) K. Saito (*=Barbula reflexa* (Brid.) Brid.) was identified by Dr. R. H. Zander among the difficult specimens of my Kootenay pottiaceous collections. The single collection (Tan 76-7321) came from a roadside bark north of Golden. The specimen, nevertheless, lacks the strongly squarrose leaves of the typical *D. rigidicaulis* seen from the coast. Although Zander (1978a) suggested that *D. rigidicaulis* and *E. fallax* are better treated as a single polymorphic species, and that the character variations in the two taxa overlap considerably, I am treating all specimens from the study area as *D. fallax*, and reserving the name *E. rigidicaulis* for the coastal populations that are usually larger and have more strongly squarrose leaves than the typical *D. fallax*.

1. Upper and medial adaxial surface cells of leaf costa elongate ........................................2

1. Upper and medial adaxial surface cells of leaf costa mostly
quadrate, rarely mixed with a few elongate cells

2. Upper leaf margins histratose .......D. rigidulus

2. Upper leaf margins unistratose .......3

3. Leaves ovate to cblong-elliptic, apex at times obtuse, costa ending before the apex; laminal cells more or less quadrate, equally thick-walled .........D. tophaceus

3. Leaves narrowly ovate to lanceolate, apex always acute to acuminate, costa percurrent to shortly excurrent; laminal cells variously shaped, polygonal, horizontally elliptical, quadrate and with strong corner thickenings

4. Leaf costa short to long excurrent; leaf apices often broken ........................................ (D. acutus var. icmadophilus)

4. Leaf costa percurrent; leaf apices intact

......................................................5

5. Leaf margins recurved to near apex; apices of some leaves obtuse .........................................(D. brachyphyllus)
5. Leaf margins recurved to only 1/2 or 2/3 the length of the lamina; apices never cttuse ............6

6. Upper leaf margins bistratose; lamina sometimes bistratose; peristome teeth short and erect ..........D. rigidulus

6. Upper leaf margins unistratose; lamina never bistratose; peristome teeth long and twisted .......7

7. Leaves flexucse cr twisted when dry, ovate to shortly lanceolate, apex acute ..................D. vinealis

7. Leaves crisped when dry, lanceolate to linear-lanceolate, apex long acuminate ..................D. cylindricus

**Eidymodon cylindricus** (Taylor) Tan, comb. nov. Map 57.

**Basicnym**: Zygctrichia cylindrica Tayl. in Mackay, Fl.


**Synonym**: Barbul a cylindrica (Tayl.) Schimp.

**Eidymodon vinealis** var. flaccidus (B. S. G.) Zander

**Barbula horridifolia** C. Muell. & Kindb.
The distinction between the species and *D. vinealis* seems clear-cut. I have had no difficulty in identifying the two species from my Kootenay collections by using the key characters outlined earlier. In habitat, *E. cylindricus* is common on wet cliff faces in deep gorges or near waterfalls, whereas *D. vinealis* is common on dry, roadside banks, open and abandoned fields. Whether the former is merely a luxuriant form of *D. vinealis* in wet and humid environments as hypothesized by Zander (1978a) is open to argument. Smith (1978) in his Moss Flora of Great Britain, treated the two species separately although he commented that occasionally one may encounter intermediate individuals. If treated as an infraspecific taxon of *D. vinealis*, as was done by Nyholm (1954-1969), Lawton (1971) and Zander (1978a), the correct varietal epithet is *flaccidus*.

Both *E. cylindricus* and *D. vinealis* are fairly common and widespread taxa in north temperate regions. For its ecology in British Columbia, see Schofield (1976).

Representative specimens examined: Joseph Creek, Cranbrook (UBC E-3025); New Denver Canyon (UBC E-3026); Ainsworth Hot Spring (UBC E-3027).

Etarula fallax Hedw.

Another common species in the study area, Didymodon fallax is characterized by erecto-patent to widely recurved leaves with elongate adaxial surface cells on the leaf costa. With the variability that it exhibits, it is not surprising that the species has been mistaken for P. rigidulus, D. cylindricus, and D. vinealis. The key characters outlined earlier are sufficient to distinguish the Kootenay collections.

The species is frequent on soil or rocks in calcareous sites. It is widespread across the north temperate region, but interestingly absent in Japan where the appropriate niches have been taken over by P. rigidicaulis (Saito, 1975).

Representative specimens examined: Slocan (UEC B-3019); 27 miles north of Golden (UEC B-3020); Wheeler Lake, Ainsworth (UEC B-3021); Glacier National Park (CANM 128695).
**Didymodon rigidulus** Hedw., Spec. Musc. 104. 1801.

Only one collection of this species was seen from the study area (Hermann 25793, Glacier National Park, UBC). The leaves are only segmentally bistratose towards the apex, and are strongly squarrose when wet. The adaxial surface of the leaf costa consists of a mixture of oblong and quadrate cells. No gemmae were noted. The characters seem to indicate that the specimen may be an atypical form of *D. cylindricus*, *D. vinealis* or *D. fallax*.

Typical specimens of *D. rigidulus* from elsewhere consistently develop bistratose leaf margins apically and produce axillary, multicellular propagules. Steere (*in* Grout, vol. I, 1928) commented that the presence of groups of stalked, spheroidal propagula in the leaf axils is a constant and unmistakable feature of *D. rigidulus*. But Flowers (1973) remarked that western collections of the species often lack them.

It is reported to be widespread in North America (Zander, 1978a) and cosmopolitan (Saito, 1975), although Lawton (1971) excluded the taxon from British Columbia. Obviously, more collections of good specimens are needed to confirm its presence in the study area. The UBC herbarium collections, if accepted for their initial determinations, indicate that the
species is mainly a coastal taxon with inward extension of range into the Kamccp area.

A bipolar species. In North America, it is a species more common south of the boreal zone.


Although considered by most bryclogists as a distinct species, *D. tophaceus* is nevertheless, polymorphic. The three collections that I studied, all from the study area, vary considerably in their leaf apices ranging from obtuse to acute. Leaf costa, likewise, can be percurrent to slightly excurrent. The decurrent leaf base which has been given much taxonomic importance in the past is, as Conard (1945, 1951) stated, present also in *D. vinealis* and *D. cylindricus*. The species is best identified by the following combination of characters: obtuse apices in some leaves, costa ending before the apex, and elongate acxial surface cells on the leaf costa.

It is a cosmopolitan species of calcareous substrata. Populations of *D. tophaceus* sometimes accumulate a limey
encrustation on the leaves and stems, a situation very much like *Gymnostomum recurvirostre*.

Specimens examined: seven miles south of Lardeau (UBC E-3015); Broadwater, Deer Park area (UBC E-3016); Fairmont Hot Springs (UBC E-3017).


Map 56.

*Barbula vinealis* Brid.

According to Zander (1978a), *D. vinealis* is the species of the genus in North America that has the most characters of a true *Barbula*. Indeed, the long and twisted peristome teeth in *D. vinealis* has long been accepted to be a generic character of *Barbula*. Recent monographs by Saito (1975) and Zander (1978a, 1979c), however, argued convincingly for the abandonment of this generic feature in favor of other more critical generic characters. The species is relatively variable within its range. Experimental work is needed to determine how the different environmental parameters affect the expression of its
gametophytic characters. Meanwhile, it appears to me that the species is distinct from *D. cylindricus* both in morphology and ecology. See the latter name for further commentary.

The species is common in the study area and in the southern part of the province.

Representative specimens examined: Meadow Creek, north of Larder (UEC E-3022); Roger's Pass, Glacier National Park (UBC E-3023); Fend' Creille River (UEC E-3024); Ainsworth Hot Springs (CANM 128216 as *Farbula fallax*).

*Eucladium* E. S. G.

This is another small, calcicloous genus of three species occurring in the north temperate region and New Zealand. The leaves have distinct serrulation at the level of the leaf shoulder. Only one species is known to British Columbia.

Contrary to the claim of most manuals, I find that the diagnostic marginal serrulation near the leaf shoulder of this species is not present in all leaves. Like Gymnostomum recurvirostre, populations E. verticillatum can accumulate silt and build up tufa through the years.

Outside of the study area in British Columbia, the present species has been collected from a few localities on Vancouver Island, Texada Island and the Queen Charlotte Islands.

A common northern hemisphere species.

Specimens examined: 7 miles south of Lardeau (UBC B-3282); Meadow Creek Alpine Area, north of Lardeau (UBC B-3284); Jumbo Creek area (UBC B-3286); Cayuse Falls, Deer Park (UBC B-3285).
Gymnostomaum Nees & Hornsch.

A worldwide genus of some 55 species characterized by gymnostomaum capsules. Three species are now known to British Columbia (Schofield, pers. comm., 1980), but only two are collected from the study area. For an interesting discussion of the morphological variation of the genus in the New World, consult Zander (1977).

1. Leaf margins plane; costa stout at the leaf base, occupying at least 1/2 of the total width; operculum free from the columella .................. G. aeruginosum

1. Leaf margins recurved; costa slender at the leaf base, occupying less than 1/2 the total width; operculum attached to columella .................. G. recurvirostrum

Gymnostomum rupestre Schleih. ex Schwaegr.

An uncommon species on damp, calcareous cliffs in the study area. The gymnostomacous capsules, if present, are enough to distinguish it from other species of the Family Pottiaceae, except G. recurvirostrum. Aside from the characters outlined above in the key, G. aeruginosum differs from G. recurvirostrum in having a darker green color when dry, and laminal cells with larger and more crowded (3-5 per cell) papillae.

Within the province, G. aeruginosum has a strong southern distribution.

A cosmopolitan species.

Representative specimens examined: Slocan Lake (CANM 125242 as G. rupestre); Bugaboo Falls (UBC B-3346); Rosebery (UBC B-3347).

Hymenostylium recurvirostrum (Hedw.) Dix.

G. recurvirostrum is a common tufa-building species in the province. It is particularly abundant in sites where both cold and hot mineral springs flow, especially along the road from Kaslo to New Denver. The light green color, partly resulted from the silt and calcareous crust accumulated on the surface of the population, contrasts beautifully with the numerous dark reddish brown capsules.

Zander (1977) argued strongly on both gametophytic and sporophytic differences, that the species be placed in the genus Hymenostylium Frnd. I agree with him that the morphological dissimilarities between the two species of Gymnostomum discussed here are significant. But, the genus Hymenostylium, which is essentially a tropical taxon, is unfamiliar to me in many morphological details. Thus, I follow the traditional treatment here in placing the species in Gymnostomum (Smith, 1978; Crum, 1976).

It is also a cosmopolitan species. Schofield (1976) observed that in the northern half of the province, it becomes
much more common than \textit{G. aeruginosum}.

Representative specimens examined: Revelstoke (CANM 125497); on way to Lake of Hanging Glaciers (UEC E-3343); Fairmont Hotspring Resort (UBC E-3344); Kaslo River (UBC B-3345).

\textit{Phascum} Hedw.

\textit{Phascum} is the only cleistocarpous genus of the family present in the study area. A genus of about 24 species, only one is collected from the study area.


This is probably an annual or ephemeral species growing on ground in open roadsides. Plants are minute, ranging from 2-4 mm tall. Mature capsules are immersed. The laminal cells are
clearly defined under the compound light microscope showing distinctly branched to C-shaped papillae. The Deer Park population (UBC B-3264) was revisited in the same month the second year, and was completely crowded out by species of Bryum and Ceratodon purpureus. The other known collection from the area came from St. Eugene Mission near St. Mary River (UBC B-3265).

Schofield (1976) observed that Phascum cuspidatum is common in the dry interior grassland and becomes rare in the fallow clayey soils at the coast. Its discovery in the dry zone of the study area is an interesting extension of the local range of distribution in British Columbia (see Map 60).

In Europe, the species appear to be variable. Consequently, a whole series of varieties have been proposed. Probably the taxon is cosmopolitan in distribution.

**Pterygoneurum** Jur.

This is a taxon of small plants in tiny sods, green to gray green in color owing to the long hairpoints. The genus is characterized by the development of lamellae on the adaxial
surface of the costa. Its ecology and range of distribution parallel that of Aloina. Two species are now known from the study area.

1. Sporophytes exserted .................. P. ovatum

1. Sporophytes emergent or immersed ...... P. subsessile

Pterygoneurum ovatum (Hedw.) Dix., Rev. Bryol. & Lichenol. 6: 96. 1934.

A distinctive small moss with strongly concave leaves ending in long hairpoints and developing leaf costal lamellae. In the study area, P. ovatum has always been collected together with Aloina brevirostris. Other mosses of similar dry and disturbed basic habitats are Bryum argenteum and Ceratodon purpureus.

Schofield (1976) noted that it is common on clayey earth in sagebrush slopes and flats and on open slopes in the
Douglas-fir and Ponderosa pine forests in the interior.

A widespread species of all continents in the North Hemisphere. Recently reported from northern Africa.

Representative specimens examined: Dry Gulch Provincial Park (UBC B-3340); Munn Lake (Wilmer Lake) (UBC B-3341); Invermere (UBC B-3342).


The recent collection of T. McIntosh (no. 3641) from a calcareous site 29.6 km north of Fort Steele confirms the presence of the species in the study area. The collection contains abundant sessile capsules, highly characteristic of the species. The species seems at the moment to be uncommon to rare in the study area. Both taxa share similar habitat in the Columbia Trench and similar geographical distribution. Capsules are observed by McIntosh (pers. comm., 1980) to appear in the autumn and mature during the following spring season.
Tortella Limpr.

This is a worldwide genus of approximately 60 species, mostly strict calciccles. A V-shaped area formed by the hyaline basal laminal cells is characteristic.

Except for T. humilis, which is a coastal species, all three other species have been collected from the study area. I have included in the key T. humilis because the species is often confused with T. inclinata.

1. Leaves straight to weakly contorted when dry; upper lamina always bistratose; apices fragile, often broken

.......................................................... T. fragilis

1. Leaves strongly crisped or contorted when dry; upper lamina unistratose; apices not fragile ....... 2

2. Leaves gradually long acuminate; median and upper adaxial surface cells of the leaf costa mostly quadrate

.......................................................... T. tortuosa

2. Leaves acute to obtuse, apiculate; upper and median adaxial
surface cells of leaf costa elongate, with a few quadrate cells ........................................3

3. Leaves slightly keeled when wet, not cucullate apically; autoicous .......................................................... (T. humilis)

3. Leaves keeled and cucullate apically when wet; dioicous ................................................................. T. inclinata


The broken tips and the strict, upper leaves are two important taxonomic features of *T. fragilis*. Sometimes, specimens with a few contorted leaves may be encountered. Smith (1978) contended that the broken leaf apices are a means of vegetative propagation for the species.

*T. fragilis* is relatively common and sporadic on seepy calcareous cliffs and banks in the study area (Map 62). The same distribution pattern is observed within the province and across the North American continent.
A widespread species in the northern hemisphere.

Representative specimens seen: Revelstoke (UBC B-6522); Canal Flats (UBC B-6523); Purcell Wilderness Conservancy (UBC B-6524).


*Furcula inclinatula* C. Muell. & Kindb. (isotype at CANM!)

Crundwell and Nyholm (1962a) reported the present species from the province based on a MacFadden collection 4252 (UBC!) from Lake of Hanging Glacier. Earlier, Macoun & Kindberg (1892) had reported it from Revelstoke under the name *Barbula inclinatula* as a species new to science. To date, the collections of MacFadden and Macoun (CANM 126422 & 197790) are the only two populations known from the study area, although other populations have been discovered from nearby Robson Provincial Park and the Glacier National Park in Montana.
**T. inclinata** is rare to uncommon elsewhere in the Province and sporadic in distribution in Europe, Asia and North America. Its total distribution in North America has been mapped recently by Miller (1976) who included also the fossil occurrences known. The result shows a more or less continuous range in the boreal zone.

**T. inclinata** can be mistaken for **T. humilis** which is currently known in British Columbia from a single locality on Texada Island (UEC E-3116). Aside from the differences mentioned in the key to the species, Lawton (1971) reported that the laminal cells of **T. humilis** are smaller in diameter (4-9 μm versus 8-13 μm) than that of **T. inclinata**.


This is a relatively common species in the province and the whole northern hemisphere. It is also the species of the genus that is not restricted to calcareous substrata. The long and gradually acuminate leaf apex with undulations is diagnostic. Primarily a rock dwelling species, **T. tortuosa** has been reported to grow also on trunks of conifers (mainly
Chamaecyparis) in the coastal regions by Schofield (1976).

Representative specimens examined: Pend' Creille River (UEC E-3118); pond margin, approximately 17 miles north of Golden (UBC E-3119); Jumbo Creek (UBC E-3120).

Tortula Hedw.

Cosmopolitan, but mainly temperate, the genus Tortula consists of about 280 species. It is one of the large genera in the family, in terms of average plant size. Among the 12 species reported from British Columbia (Schofield, 1968a), six of which are discussed here. Tortula ruraliformis (Besch.) Dix. is suggested to be a synonym of T. ruralis. Furthermore, reports of T. princeps DeNot and T. muralis Hedw. from the interior mountains in Kootenay are probably errors. No named specimens were retrieved from CANM or MACF in connection with the present study.
1. Plants growing on trees, sometimes on walls; leaves obovate, costa ending before the apex to subpercurrent; multicellular and spherical propagula common on the abaxial surface of leaf ....................T. latifolia

1. Plants predominantly terrestrial; costa usually excurrent as an awn; lacking propagules .........2

2. Leaves bordered by elongate to rectangular marginal cells near the base, often bistratose ........T. subulata

2. Leaves not bordered by differentiated marginal cells, often unistratose .........................3

3. Laminal cells smooth or weakly papillose; costa percurrent, or if excurrent, forming only a short mucro or spine ..........................................................T. mucronifolia

3. Laminal cells strongly papillose; costa excurrent, forming strong awn, short or long, smooth or rough ..........................................................4

4. Leaf hairpoints smooth, reddish except at the very tip; montane plants .....................T. norvegica

4. Leaf hairpoints toothed, hyaline throughout, at times reddish at base only; low elevation plants
Tortula intermedia (Brid.) De Not., Syll. 181. 1838.

*T. intermedia* seems distinctive only in developing a constriction at the middle of the leaf blade, yet, the feature can be absent in some leaves on the same stem. The rounded to emarginate leaf apices, the long, excurrent leaf awns, and the multiplex papillae on the leaf cells are similar to *T. ruralis* and *T. norvegica*. True to its species epithet, the taxon is, in many respects, intermediate in morphology between *T. ruralis* and *T. norvegica*. Even its elevational distribution is between the montane zone and lowlands. At present, only a few collections of *T. intermedia* are deposited at UBC. I suspect either the species is undercollected in the province or has
been placed under other species names. *T. intermedia* is uncommon in the study area.

Perhaps the species is best treated as a synonym of *T. ruralis* following the discussion of Flowers (1973) and Crum (1976). Lawton (1971), does not include the species in her flora.

A nearly cosmopolitan species.

Representative specimens examined: Box Canyon, near Revelstoke (UBC E-3041); New Denver, (UEC E-3042); Kokanee Glacier Park (UBC E-3043).


This is the only species of *Tortula* in the study area that grows on living or dead tree trunks. *T. latifolia* is basically a coastal species around Vancouver, Fraser valley and canyon, and Nanaimo area. Its presence at Duck Lake near Creston (Schofield & Tan 60857) and Edgewood (CANM 132293) are significant extensions of range eastward within the province (see Map 61). The population was observed growing on the bark
of Populus trichocarpa in a swampy margin. T. latifolia is easy to identify by the production of propagula on the leaf. It is also known from Washington, Oregon, and California and disjunctly present in west and central Europe to the Caucasus.


The smooth to weakly papillose laminal cells coupled with short, mucronate leaf apex are good diagnostic characters for the taxon. Tan & Ensing 77-1754 from Bugaboo Falls has leaves with long awns. Nevertheless, the smooth laminal cells point to the present species.

T. mucronifolia is uncommon in the study area. Its local distribution, indicates that the species is a calcicole, restricted to the more calcareous substrata along the Columbia Trench. In Europe, the species is said to be an alpine and high boreal taxon, but in North America, it is distributed at all elevations mainly south of the boreal zone. Vitt (1975) and Brassard (1971) reported fruiting populations from several islands within the Canadian High Arctic. A continental species, T. mucronifolia, westward in British Columbia, reaches
only the Fraser Canyon, absent along the coast (Schofield, 1976). Local habitats include soil, logs, rootstumps, rocks, and trunk bases.


In its well developed form, _T. norvegica_ is distinctive in having reddish and often smooth hairpoints. The long and slender habit (less than 1 mm in stem diameter), plus the high elevation habitats are equally revealing. However, in the study area, there are a few populations that appear to be intermediate in morphological expressions that appear to link up _T. intermedia_ with _T. ruralis_, forming a nearly continuous series of morphological clines with only vague demarcation line between the neighboring taxa. Some of the intermediate forms which have reddish hairpoints and leaf blade constricted at the middle I have named _T. intermedia_ (UBC B-3043). Likewise, lowland populations with reddish hairpoints and strongly squarrose leaves when wet were named as _T. ruralis_. In short, my present species concept of _T. norvegica_ includes only the subalpine to alpine populations with spreading (not squarrose)
leaves whose hairpoints are purplish red in color and whose leaf margins are not recurved to the apex.

Schofield (1976) observed that the species is common in sites where snow persists for a long period in the year.

*T. norvegica* is common at high elevations in the study area. Equally is it common in other parts of North America, Europe, and Asia.

Representative specimens examined: Valhalla Range (UBC B-3046); Glacier Creek, north of Duncan Lake (UBC B-3045); Glacier National Park (UBC B-3044).

T. ruraliformis (Besch) Ingh.

T. rarillosissima (Coppes) Brchth.

After studying many difficult and intermediate specimens of T. ruralis, I have concluded that T. ruraliformis with the gradually acute leaf apices is not worth retaining as a species distinct from T. ruralis. Smith (1578) treats it as a subspecies of T. ruralis. Also, more work is necessary to clarify the relationship between T. ruralis and T. norvegica on one hand, and T. ruralis and T. intermedia on the other hand.

T. ruralis as defined here, is the commonest species of the genus growing on thin layer of scil over dry, exposed boulders at low elevations in the study area. Typical plants are coarse and large, approximately 2 mm in stem diameter. Leaves are strongly squarrose when wet and the margin is recurved nearly to the apex. The strongly rough leaf costae and hairpoints impart a whitish hue to the dry populations in the field.

Collections of MacFadden at CANM named T. princeps DeNot, upon examination, proved to be T. ruralis. T. princeps, fide
Schofield (1976), is a coastal species in British Columbia with inland populations reaching only the Fraser River Canyon.

Var. *hirsuta* (Vent.) Far. is a strongly papillose form of *T. ruralis* and is common in the study area.

A nearly cosmopolitan species, it is frequently seen growing with *Racemmitrium canescens* in many sites.

Representative specimens seen: Halcyon Hotspring (UBC E-3047); Kaslo (UBC E-3C40); Fry Creek Canyon (UBC E-3049); Rosebery (UEC E-3050).


Like *T. latifolia*, *T. subulata* is an uncommon coastal species in the southern portion of British Columbia that barely reaches the interior Columbia Mountains. The present species is best identified by its long, cylindric capsules measuring 5-7 mm long, probably the longest among the species of *Tortula* in the study area. The leaf margins are somewhat differentiated and bistratose. Fortunately, the two populations of *T. subulata* from the study area develop the fairly typical morphology of the species. For a good discussion of the
observed morphological variations in *T. subulata*, consult Rungby (1957).

*T. subulata*, in the Kootenay region, inhabits extremely wet cliff faces (not necessarily calcareous) in the deep gorge at Cayuse Falls, Deer Park vicinity (UBC E-3051) and at the junction of Salmo and Pend' Oreille River (UBC B-3052).

Also known from Oregon, Washington, California, and Europe and Asia. Not known yet from eastern North America.

**Weissia** Hedw.

The genus has been defined in various ways by different bryologists (Nyholm, 1954-1969; Saito, 1975). Smith (1978), in agreement with Saito, includes in the genus three genera: Weissia proper, Astcmum Hampe and Hymenostomum R. Br. Their adoption of a broad definition for the genus is based on the fact that species belonging to these three genera can hybridize. Since no species of Astcmum and Hymenostomum (Andrews, 1922) are known from the study area, I have not studied carefully the generic concepts under discussion. Weissia controversa Hedw. is the only species known from the
Weissia controversa is rather characteristic in its dry state. The narrowly lanceolate leaves become involuted and then twisted. Kootenay populations are scattered widely apart in two localities: Cayuse Falls at Deer Park (UBC B-3238) and Idaho Lookout Tower, New Denver (UEC B-3237). At the latter locality, populations form extensive cover on soil at the trail margin at 2080 m (6800 ft) where it grows with Ceratodon purpureus and Desmatodon latifolius.

A common weed in open, disturbed sites in the northern hemisphere.
FAMILY GRIMMIACEAE

Six genera are recognized for the family in the study area. They are *Coscinodon*, *Dryptodon*, *Grimmia*, *Racemitrium*, *Schistidium*, and *Seculeria*. All are chiefly rupestral mosses with various habits, characterized by leaves with small, quadrate to round, thick-walled, upper laminal cells and elongate lower or basal laminal cells. Capsules have single peristome. Jones *in Grout* (vol. II, part 2, 1933) reported that fossil mosses of a distinct grimmiaceous type existed as early as the Tertiary.

The family is concentrated mainly in the temperate zone with the tropical species restricted to high mountains.

Recently Hirohama (1978a) studied spores of various representative members of the family. The results support the recognition of *Schistidium* and *Coscinodon* as separate genera apart from *Grimmia*.

1. Plants growing on boulders in or beside streams inundated regularly by running water ............2
1. Plants growing on boulders or cliff faces well above the water level of lakes and streams ........3

2. Plants large and coarse, up to 15 cm long, leaf costae often with dense tufts of rhizoids on the back, especially towards the base ......................... Scouleria

2. Plants smaller and more slender, leaf costae without dense tufts of rhizoids on the back ............3

3. Walls of basal laminal cells strongly sinuous or nodulose; peristome teeth filiform .................4

3. Walls of basal laminal cells not strongly sinuous or nodulose; peristome teeth cuneate to lanceolate, never filiform ........................................5

4. Costa ridged or lamellate abaxially in cross-section .......................................................... Dryptodon

4. Costa smooth, without abaxial lamellae or ridges ............................................................... Facmitrium

5. Capsules immersed to slightly emergent 6

5. Capsules clearly exerted ...............7
6. Capsules asymmetrically ventricose; columella persistent, free from the operculum at maturity ....Gr"mia

6. Capsules symmetrically funnel or cup shaped; columella attached to the operculum and falling with it at maturity ............................................Schistidium

7. Calyptra campanulate, plicate, covering the entire capsule even at maturity; peristome teeth strongly cribrose ........................................Coscinodon

7. Calyptra cucullate to mitrate, not plicate, covering only the upper part of the capsules; peristome teeth entire or irregularly perforated .................Grimmia

Coscinodon Spreng.

This is a dioicus genus characterized by cylindric capsules with peristome teeth strongly cribrose and the columella free from the operculum. The calyptra is large and campanulate, nearly covering the entire capsule. Two species are known to British Columbia, but only C. calyptratus is
recorded from the study area.

The genus is at times treated as a subgenus of *Grimmia*.


**Grimmia calypttrata** Hook. *in* Trümm. 

*C. calypttratus* is a common species of the sagebrush grasslands and open woodlands in the dry interior belt of this province (Schofield, 1976). However, it is uncommon in the study area where it is known only from three localities: Deer Park at Lower Arrow Lake (Macoun's Canadian Mosses 96 & Can. Musci 472), Fairmont Hot Springs (Crum & Schofield 5609) and Kaslo Creek (MACF 9344). All the collections at CANM, MACF and UBC were confirmed by me.

Fortunately, the species is collected frequently with sporophytes. The plicately campanulate calyptra, which covers the entire cylindrical capsules is unmistakable. Sterile materials can be difficult to distinguish from equally hoary
species of *Grimmia* such as *G. affinis* and *G. ovalis*. *C. calyptratus*, however, possesses rectangular and thin-walled basal laminal cells which gradually merge with the short rectangular marginal cells. Additionally, capsules of *G. affinis* and *G. ovalis* are ovoid in shape.

There are two other packets of Macoun's collections at CANM named *C. calyptratus* (Canadian Mosses 96). The specimens supposedly came from Revelstoke. The inside packet, nevertheless, was numbered 472 by Macoun himself, the same collection number of his other *C. calyptratus* collection from Deer Park at Lower Arrow Lake. Based on the ecology of *C. calyptratus*, it is likely that the locality was wrongly attributed by Macoun to Revelstoke which lies outside of the dry, sagebrush country of the province.

Present in suitable habitats in all states and provinces of western North America. Common in the entire Rocky Mountain Range. In British Columbia, *C. calyptratus* does not reach as far west as the Coast Mountains (see Map 65).
This is a monotypic genus proposed to accommodate *Grimmia patens* (Hedw.) B. S. G. (an illegitimate name according to Crundwell, 1970) or *Racomitrium patens* (Hedw.) Hueb. The species has upper laminal cells like *Grimmia*, without nodulose cell walls, and a capsule with peristome teeth like those of *Racomitrium*. To resolve the problem, Crum (1976) had argued for the adoption of a separate genus for the taxon, as is done here.

*Dryptodon patens* (Hedw.) Brid., Bryol. Univ. 1: 192. 1826.

The species is relatively common on rocks in the study area. The dark green color, coarse body size, and the ridged or lamellate leaf costae easily distinguish it from any *Racomitrium* which it may superficially resemble.

A widespread circumboreal taxon in the northern hemisphere. In North America, the species has an east-west bicentric disjunct distributions.

Representative specimens seen: Glacier National Park (UBC
B-6519); Fox Canyon on Hwy 1, E of Revelstoke (UBC E-6520); Small Freie Lake (UBC E-6521).

**Grimmia** Hedw.

*Grimmia* as a genus is conceived traditionally in a broad sense. It includes therefore as its subgenera *Coscinodon* Spreng. and *Schistidium* Brid. Nevertheless, most contemporary bryologists are convinced that the differences among the subgenera are sufficiently apparent to warrant separate generic status. The treatments of the family Grimmiaceae by Smith (1978) and Teuchich (1978) are adopted here.

*Grimmia*, *sensu stricto*, is still a large cosmopolitan genus of nearly 170 species occurring on rock. Schofield (1968a) listed 17 species of *Grimmia* for British Columbia, nine of which are presently known from the study area. *Grimmia anomala* is included in the key because the taxon is known from many spots adjacent to the study area, and because its eventual discovery in the study area is to be expected. *G. pachyneurula*, described by Macoun & Kindberg in 1892 as a new species based on a collection made at Revelstoke, is an uncertain taxon. No specimen under such name can be found at
CANM. The original description, like many of Macoun and Kindberg's new taxa, is too ambiguous to provide a meaningful interpretation.

Species of *Grimmia* are defined on the basis of a combination of many sporophytic and gametophytic characters. Many of the leaf characters employed taxonomically vary considerably even in a single specimen. Since no overall study of the morphological variability has been attempted after Sayre (1952), many of the species with only slight gametophytic differences are of dubious taxonomic value. Possibly, many more species should be treated as synonyms. On the other hand, recent study reveals that some species, including *G. alpestris*, are too inclusive in their species delineation.

1. Capsules ventricose, immersed ...........*G. anodon*

1. Capsules not ventricose, exserted .....2

2. Plants submerged or on rock irrigated often by water from the melting snow in alpine areas; leaves muticous, apices cucullate; laminal cells quadrate to short rectangular, thin-walled, nearly uniform to the base of leaf

.............................................*G. mollis*
2. Plants without the above combination of characters  
..................................................................................3

3. Leaves strongly crisped when dry or leaf apices variously twisted or inrolled; capsules on an arcuate seta when wet  
..................................................................................4

3. Leaves not contorted but appressed when dry, at most with leaf apices slightly bent inward; capsules on straight seta  
..................................................................................5

4. Leaves with gemmae on the back of costa; upper abaxial surface of the leaf costa consisting of short hexagonal cells similar to the rest of the laminal cells  
..................................................................................G.  torquata

4. Leaves without gemmae; upper abaxial surface of costa consisting of elongate to linear cells very different from the laminal cells .......................G.  trichophylla

5. Upper laminal cells thin-walled, strongly mamilllose in cross section .................................G.  alpestris  
var. holzingeri

5. Upper laminal cells thick-walled, not mamilllose, in some cases with cuticular ridges which resemble papillae in cross section .................................6
6. Laminal cells with distinct vertical ridge-like cuticular thickenings ........................................ (G. anomala)

6. Laminal cells without ridge-like cuticular thickenings .............................................................. 7

7. Leaves tubulose, channeled or bluntly folded towards apex; costa not prominently keeled; basal paracostal cells long (4-6:1), markedly incrassate, pitted ... 8

7. Leaves sharply keeled above, costa prominent toward apex; basal paracostal cells short to rectangular (2-4:1), not strongly thick-walled, sometimes thin-walled, not pitted ................................................................. 9

8. Autoicous; leaves mostly lanceolate, not clasping at base, margins slightly recurved on one side or plane; middle laminal cells 8-10 um wide .................. G. affinis

8. Dioicous; leaves ovate to broadly lanceolate with clasping expanded base, margins plane to incurved; middle laminal cells 6-8 um wide ......................... G. ovalis

9. Leaves mostly ovate-lanceolate; operculum rostrate, rarely conic; plants of lowland to lower subalpine elevation ................................................................. G. montana
9. Leaves narrowly lanceolate; operculum conic, rarely rostrate; plants of high subalpine to alpine elevations

......................................................... G. alpestris


The asymmetrical ventricose and immersed capsule of G. anodon is highly characteristic among the species of Grimmia in the area. The species was collected only once from the study area (MacFadden 8222 dated June 21, 1925, Lake of Hanging Glaciers, UEC). It is also uncommon in the province, collected only from somewhere between Vernon and Kamloops, and the Bulkley Range. It is known also from Yukon, Alaska, Alberta, California, Washington, Montana, Arizona, Saskatchewan, Ontario and New Brunswick, Europe and Asia. Flowers (1973) observed that G. anodon is one of the most common lowland mosses in the state of Utah.

**G. ovalis** (Hedw.) Lindb. in Jone's treatment in Grout (1933)

Surprisingly, the autoicous *G. affinis* is rare in the study as well as in the rest of the province. The only good collection of the taxon from the Kootenay region that I noted is MacFadden 3849 collected from Taghum, near Nelson, by the Kootenay River (UBC). Other named specimens proved to be either *G. ovalis* or *Coscinodon calyptratus*. The linear-lanceolate leaves with distinctly long and thick-walled paracostal basal cells should aid in the correct identification of the present taxon. Perhaps the species is undercollected in the field because it superficially resembles many other hoary species of *Grimmia*. For more information concerning its taxonomic and nomenclatural confusion with *G. ovalis*, see commentary under the latter name. From *Coscinodon calyptratus*, *G. affinis* is best distinguished by the cucullate to short mitrate calyptra and the ovoid capsule. Sayre (1951) did not consider the species to be rare in North America, and stated that it has a wider geographical distribution than *G. ovalis*.

Nearly a cosmopolitan species.

G. subpapillinervis Kindb. (isotype at CANM!)

G. alpestris is sometimes difficult to distinguish from G. montana, which it closely resembles. It seems best to identify G. alpestris on the basis of its rather short conic opercular lid as opposed to the rostrate lid of G. montana. Furthermore, the leaves of the former are ovate-lanceolate with the broadest part near the base. In contrast, the leaves of G. montana are narrowly lanceolate and the broadest part is about 1/3 above the base of the leaf. Other taxonomic criteria that have been used in the past, including the shape of the capsules and the size of the spores are, in my experience, unreliable.

G. alpestris is the most common taxon of the genus from upper subalpine to alpine elevations while G. montana is confined to lower elevations (see Maps 72 & 73). The same elevational restriction appears to characterize the two taxa in both Europe and North America.

Occasionally, G. alpestris and G. donniana have been confused. Lawton (1971) noted that the basal leaves of
G. donniana have cells with equally or evenly thickened cell walls, very unlike those of G. alpestris in which the horizontal cell walls are thicker than the longitudinal cell walls.

G. microtricha C. Muell. & Kindberg was described by Macoun & Kindberg (1892) to have longer emergent capsules, recurved margins and short perichaetial leaves. Despite not having seen the type materials, Lawton (1971) remarked that Jones in Grout (1933) erred in treating it as a synonym of G. alpestris on the basis that the leaf margins were interpreted as recurved. I have studied the isotype at CANM and noted the leaves to be plane to incurved along the margins. The specimens studied has no sporophyte, although it matches G. alpestris in all other respects.

Representative specimens seen: headwaters of Blazed Creek (UBC B-6297); Kokanee Glacier Park; Bugaboo Glacier Park (UBC E-6299).
Grimmia alpestris var. holzingeri (Card. & Ther.) Jones in Grout, Moss Fl. N. Am. 2: 31. 1933.

There are a few collections of G. alpestris from alpine sites that are characterized by vegetative leaves which are strongly cucullate at the apex and which rarely develop hairpoints. The perichaetial leaves are piliferous, and the capsules exserted. Specimens grow often in mixture with typical plants of G. alpestris. The cross section of the leaves of var. holzingeri reveals conspicuously mamilllose and thin-walled leaf cells, very different from the incrassate to moderately thick-walled laminal cells of the typical variety. It is of particular interest that var. holzingeri strongly resembles the illustration of G. percarinata (Dix. et Sak.) Nog. ex Deguchi discussed in Deguchi's revision of Japanese species of Grimmia (1978). Deguchi stressed the muticous leaves and the thin-walled mamilllose leaf cells of G. percarinata as its main diagnostic features. The Japanese populations of G. percarinata, however, were collected without sporophytes. Deguchi (pers. comm., 1979) further stressed that G. percarinata differs from G. alpestris var. holzingeri in having a recurved margin on one side of the leaf towards the broad leaf shoulder and in having the basal paracostal cells longer than the neighboring laminal cells. I find both features variable in my Kootenay specimens of G. alpestris.
var. holzingeri. Possibly, *G. percarinata* is conspecific with the North American *G. alpestris* var. *holzingeri*, and perhaps should be treated as a distinct species apart from the other infraspecific taxa of *G. alpestris*. Meanwhile, I prefer to reserve my taxonomic opinion on this matter while awaiting an opportunity to study authentic specimens of *G. percarinata* from Japan and the type materials of *G. alpestris* var. *holzingeri*.

The var. *holzingeri* has been overlooked in the past and appears to be widely distributed at alpine elevations in the province. Lawton (1971) reported it from Mt. Rainier of Washington state and Glacier National Park in Montana. In general, it has a distribution pattern similar to *Dichodontium olympicum* in Western North America where it is a local endemic.

Representative specimens seen: Bugaboc Glacier Park (UBC B-6589); Revelstoke National Park (UBC B-6590).


This is a strange, semi-aquatic, arctic-alpine species of *Grimmia* that grows in shallow streamlets at high elevations.
The species is large for the genus, approaching the size of *Racomitrium aquaticum*. Laminal cells are entirely unlike *Racomitrium*. The taxon is known from two localities in B. C. (Mt. Waddington and Mt. Revelstoke). The sporophytes were not seen. The Mt. Revelstoke population was discovered by G. F. Otto in 1970 (UBC E-6300).

Also collected from Yukon, Montana, Colorado and Quebec.

Reported from Central and Northern Europe to Greenland.


*G. tenella* C. Muell. (isotype at CANM !)

A common taxon at low elevations, *G. montana* grows on both siliceous and calcareous substrata. The only taxon that it may be confused with in the study area is *G. alpestris*. For the differences between the two taxa, see comments under *G. alpestris*.

Jones in Grout (1933) observed that the species is
especially abundant on basaltic outcrops in northwestern United States where it is one of the first plants to appear in new successions, and it often precedes the various foliose lichens.

Distribution of *G. montana* in the study area and outside of British Columbia appears to parallel that of *G. alpestris*.

Canadian Musci 223 named *G. calyptrata* collected from Deer Park (CANM!) is a misidentification. The specimen has a cucullate calyptra and is *G. montana*. Also many specimens of *G. tenella* collected from Lower Arrow Lake (CANM!) were studied. The results support Jones' contention in reducing this name to a synonym of *G. montana*. On the other hand, MacFadden coll. 3822 from Mill Creek, Slocan Lake, near New Denver, misidentified as *G. tenerrima* (CANM), is also *G. montana*. In consequence, *G. tenerrima* should be excluded from the list of Kootenay mosses.

Representative specimens seen: Champion Lakes Provincial Park (UBC E-6301); Stagleap Provincial Park (UBC E-6302); Lockhart Beach Park Campsite (UBC E-6303).

G. commutata Hub.
G. ovata Web. & Mohr

G. ovalis has been confused with G. affinis for decades, both nomenclaturally and taxonomically. Sayre (1951) made a significant contribution in clarifying the problem which incidentally involved also G. commutata and G. ovata. Her paper was accepted either with reservations or ignored by most European bryologists. Deguchi (1978) recently argued for the full acceptance of Sayre's taxonomic judgements on G. ovalis and G. affinis, an opinion that Smith (1978) and I are following.

Taxonomically, G. ovalis is distinguished by the emergent capsule which is borne on a straight seta, by the piliferous leaves and by the long (4-6:1), incrassately pitted paracostal basal cells. At times, it is difficult to differentiate this species from G. affinis, which has narrower leaves. The leaves of G. ovalis are ovate-lanceolate with an expanded, clasping leaf base. The laminal cells are also small, measuring 6-8 um at the middle of the leaf.
Nomenclaturally, the present taxon is conspecific with G. commutata in Nyholm (1954-1969). Her G. ovalis, moreover, is G. affinis in the treatment here.

In the study area, G. ovalis was collected from five separate localities: Taghum, near Kootenay River (UBC B-6577); Deer Park at the Lower Arrow Lake (UBC B-6578); Waneta Dam vicinity (UBC E-6579); and Glacier National Park (UBC B-6580).

G. heterophylla Kindb. (= G. chlorotlasta Kindb.) was reported by Maccun from Roger's Pass in Glacier National Park. The specimen at CANM (Can. Musci 328) was studied and found to be G. ovalis.

Reportedly common in Europe, Asia, Africa, the Canary Islands, and eastern North America.


The most common species of Grimmia in the area (see Map 75). It is also the easiest one to identify by virtue of its strongly crisped leaves when dry, and the presence of gemmae. Although the taxon is unlikely to be mistaken for other members
of the genus, care should be taken not to confuse it with sterile materials of *Dicranoweisia crispa* and *Amphidium lapponicum*. The last two taxa, fortunately, are distinctly papillose or have cuticular thickenings on the leaf surface.

Common on shaded dry rock faces, it is widespread in the southern half of the province. Sporophytes are rare. Common also in other parts of the Northern Hemisphere.

Representative specimens seen: Kokanee Glacier Provincial Park (UBC B-6304); Galena Bay vicinity (UBC B-6305); Revelstoke area (UBC B-6306).


Another species with arcuate seta like *G. torquata*, *G. trichophylla* is relatively less common in the study area (see map 74). The leaves of *G. trichophylla* are less crisped when compared with *G. torquata*. The surface cells of the abaxial side of the leaf costa of the two species also differ significantly. Equally distinctive is the ribbed, cylindrical capsule of *G. trichophylla*.

Although I have not seen any gemmae on *G. trichophylla*,
Limpricht (1890) reported and illustrated them from a few German collections. The gemmae are multicellular and develop from the abaxial side of the leaf blade.

Its absence in the Purcell Mountains is probably an artifact of the random collecting efforts done in the area.

It is also a widespread species in Europe, Asia and North America. In most areas, the taxon is more common to the south.

Recently reported from New Zealand and Hawaii.

Representative specimens seen: Nakusp (UBC B-6307); Rosebery (UEC E-6308); Gray Creek, Kootenay Lake (UBC B-6309).

Racomitrium Brid.

A cosmopolitan genus of about 80 species, 11 of which are known from North America (Crum et al., 1973), and 10 of which are found in British Columbia (Schofield, 1968a). The species number will increase or decrease as our understanding on the R. heterostichum complex improves. The genus is most distinctive in its sinuose or nodulose leaf areolation, especially at the base of the leaves. Alar cells may or may not be distinctively differentiated (Ireland, 1976). Most
species grow on rocks.

The genus is extremely variable in western North America, a fact reflected in the numerous species described at the turn of the century which came from this part of the world (Frye, 1917-1918; Moller, 1930).

In the Kootenay area, I recognize only 8 species, excluding the more coastal species, *R. lawtonae* Irel. and *R. varium* (Mitt.) Jaeg. The *R. heterostichum* complex is most troublesome to identify, and many tryologists still do not agree on the definition of some species. The problem lies in the extreme variability of the various taxa involved in the complex, and the numerous names available for them. My species concepts for the genus are based mainly on the field experience and interpretation of literature. Dr. W. B. Schofield has been most helpful in introducing me to the variability exhibited by the *R. heterostichum* complex.

According to Crundwell (1970), the proper spelling for the generic name is *Rhamnmitrium* although the original spelling is *Rhamnmitrium*. A motion to conserve *Rhamnmitrium* against the original spelling was subsequently introduced by Crundwell. Pending the final decision on the conservation motion, I prefer to use the original spelling,
1. Leaf apices muticous, broad and blunt with irregular blunt teeth ................................................. R. aciculare

1. Leaf apices with hairpoints; if muticous, then apices narrowly acuminate and entire ........... 2

2. Apical laminal cells predominantly long (4:1 or longer) .......................................................... 3

2. Apical laminal cells predominantly isodiamicetric or short rectangular (1-3:1) ...................... 6

3. Leaves with hyaline hairpoints ............ 4

3. Leaves without hairpoints or with only rudimentary hairpoint .............................................. R. fasciculare

4. Nearly all laminal cells strongly papillose .......................................................... R. canescens

4. Laminal cells mostly smooth or weakly papillose .......................................................... 5

5. Hyaline hairpoint with erose margin and sharp papillae ...................................................... R. lanuginosum

5. Hyaline hairpoint without erose margin, smooth or with
teeth formed by the protruding ends of individual cells

\[ \text{R. brevipes} \]

6. Leaves with hyaline hairpoints ........7

6. Leaves without hyaline hairpoint or with rudimentary hairpoint ...........9

7. Laminal cells nearly all sharply papillose

\[ \text{R. canescens} \]

7. Laminal cells smooth ..................8

8. Leaf margins unistratose throughout; capsules cylindric to elliptic ..................\text{R. heterostichum, sensu stricto}

8. Leaf margins bi- to multistratose at least in the upper half; capsules elliptic to ovoid ........\text{R. affine}

9. Leaf cells sharply papillose ........ \text{R. canescens var. strictum}

9. Leaf cells smooth or weakly papillose .10

10. Leaf cells weakly papillose; apices narrowly obtuse, blunt, without hairpoint; apical leaf cells mostly
rectangular (2-3:1), never transversely elongate

.................................................. R. aquaticum

10. Leaf cells smooth; apices acuminate, pointy, frequently with rudimentary hairpoint; apical leaf cells isodiametric to transversely elongate, especially along the leaf margin

..................................................8


This is a dark green species on periodically wet rocks and outcrops on margins of watercourses or bodies of water throughout the study area (see Map 78) and the province. The species is not difficult to identify in the field being the only member of the genus with broad and muticous leaf apices. The irregular, blunt, marginal teeth at the leaf apex are also diagnostic.

Known from Europe, Asia, Macronesia, Africa and North America.

Representative specimens examined: Castlegar area (UBC B-4253); Pend' Oreille River gorge (UEC B-4252); Cranbrook area

**Racmmitrium sudeticum** (Funck) B. S. G.

**Racmmitrium macounii** Kindb.

**Racmmitrium heterostichum** subsp. **sudeticum** (Funck) Dixon

**Racmmitrium heterostichum** subsp. **affine** (Schleich) Amann

**Racmmitrium heterostichum** var. **affine** (Schleich.) C. Jens.

**Racmmitrium heterostichum** var. **sudeticum** (Funck) Jones

**Racmmitrium heterostichum** var. **macounii** (Kindb.) Jones

**Racmmitrium sudeticum** var. **macounii** (Kindb.) Banu,

*nom. illeg.*

**Racmmitrium affine** var. **macounii** (Kindb.) Tan,

*ccmt. nov.*


Typical plants are found from subalpine elevation to
alpine. The species is dark green, and usually forms small, thick cushions or extensive patches on boulders and rock faces. The leaves may or may not develop a hairpoint. For the differences between the taxon and *R. heterostichum* and *R. brevipes*, see comments under the latter names.

Banu (1969) was justified in transferring *R. heterostichum* var. *macounii* to *R. affine* (=*R. sudeticum*) on the basis of branching pattern, in bi- to multistratose leaf margins, and the capsular dimension. The var. *macounii* has been collected from Glacier National Park. Other than the var. *macounii*, I recognize no varieties in the belief that the species is too variable, and that the combined characters of subspecific taxa are not constant.

Also, the species concept of *R. alopecurum* Brid., based on determined herbarium specimens studied, seems to be a mixture of *R. affine* and *R. brevipes*. I have not seen the type specimen and cannot be sure whether or not the name should be reduced to a synonym of the present species.

*Racomitrium affine* is an earlier name over *R. sudeticum*, if the two type specimens are conspecific as is claimed by Smith (1978).

The species is widespread in the province, and throughout the north temperate.

Representative specimens examined: Jackson Basin (UBC B-4257); Mill Creek, Slocan Lake (UBC E-4256); Kootenai Glacier Park (UBC B-4255); Revelstoke National Park (UBC B-4254).
Racemitrium aquaticum (Schrad.) Brid., Musc. Rec. Suppl. 4: 80. 1819. Map 76.

This species is characterized by narrowly obtuse to acuminate and muticous leaf apices. In general, R. aquaticum has short rectangular (2:3:1) apical laminal cells. Specimens in the study area develop weaker papillae on the leaf cells and more pointed leaf apices when compared with the coast populations. It is rare locally, growing on rocks near streams and creeks.

The report here is the first for the area. A widespread species.

Representative specimens seen: MacFadden 151 from Mill Creek, New Denver, originally determined as R. affine; MacFadden Herb. 4093 from below New Denver Glacier; MacFadden 8227 from Halcyon Hotspring, Arrow Lake, originally determined as R. varium and Tan & Ensing 77-2990 from Cayuse Falls at the headwaters of Cayuse Creek, Lower Arrow Lake (UBC B4258).

Racomitrium microrus Kindb. in Mac.
Racomitrium heterostichum var. occidentale Ren. & Card.
Racomitrium occidentale (Ren. & Card.) Ren. & Card.
Racomitrium sudeticum var. occidentale (Ren. & Card.) Frye
Racomitrium heterostichum var. ramulesum (Lindb.) Jones

As defined, the taxon consists of plants with a mixture of long and short apical leaf cells, unistratose or bistratose leaf margins, distinct hairpoints and cylindric to elliptic capsules.

Traditionally, plants with apical leaf cells shorter than 3:1 were included by Frye (1917-18), Nyholm (1954-1969), and Smith (1978) in R. affine (=R. sudeticum), sensu lat, whereas those with mixed apical leaf cells longer than 3:1 were recognized as R. microrcarpon (Hedw.) Brid. I am inclined to agree with Persson (1954) and Banu (1969) in accepting the distinction of Kindberg's species, R. brevipes. Lawton (1971) recognizes the present taxon only as a distinct form of R. affine (=R. sudeticum). The diagnostic characters that she employed in separating the two taxa, such as branching
patterns, length and smoothness of hairpoints, are extremely variable. Nonetheless, her illustrations of *R. heterostichum* var. *occidentale* (Plate 76, figs. 1-6) and *R. sudeticum* f. *sudeticum* match exactly my concept and understanding for *R. brevipes*. Noguchi (1974a) further confused *R. brevipes* with *R. lawtcnae* Ireland. The latter has apical laminal cells which are two to three times as long as that of *R. brevipes*.

*R. affine* can be confused with the present taxon especially in the case of plants that have a mixture of short and long (not longer than 3:1) apical leaf cells. However, the ovoid capsule of the former will quickly separate it from *R. brevipes*. Sterile material is extremely difficult to separate.

*R. brevipes* as defined here may still consist of several subgroups that need varietal names as suggested by Banu (1969). Overall, the hoary appearance of the plants, resulting from the hairpoints, is quite diagnostic for *R. brevipes* in the field.

*R. brevipes* is the second widespread species of the genus in the Kootenays, next to *R. canescens* var. *ericoides*. It grows on rock, prefers drier sites, and is distributed from low elevation to sub-alpine, being more common at lower elevations. Also, it is widespread in the north temperate zone.

The small form of *R. brevipes* can be mistaken for *R. microcarpum* (Hedw.) Brid., which is not known from North America. The unistratose leaf margin and the ovoid capsule of
the latter are useful characters to separate the two taxa. All specimens of *R. microcarpon* reported in the literature from the Kootenay based on MacFadden collections are *R. brevipes*. The specimens are deposited at UBC and PACF with duplicates elsewhere. Other specimens of MacFadden collections have been determined and reported as *R. heterostichum* (MacFadden 17168 from Salmo and MacFadden 4111 from Halcyon Hotspring), but these are in reality *R. brevipes*. The last mentioned collection is a mixture of *R. brevipes* and *R. affine*.

*R. brevipes* is a western North American endemic.

Representative specimens examined: Salmo district (UBC B-4261); Galena Bay, Lower Arrow Lake (UEC E-4259); Bugaboo Glacier Provincial Park (UBC E-4260); Halcyon Hotspring (UBC B-4262).
Racomitrium canescens (Hedw.) Brid., Musc. Rec. Suppl. 4: 78. 1819.

E. ericoides (Hedw.) Brid.

A very common, locally abundant and variable species occurring in every open and barren rocky or gravelly substrata, very rarely at the base of stumps. The papillose hairpoints and laminal cells, the many short lateral branches, the thin-walled and enlarged alar cells are all important diagnostic features. Var. ericoides is the commonest variety at all elevations in the area. Var. canescens, which differs from var. ericoides in having fewer short lateral branches to none, contrary to the comments in Lawton (1971), is also present. It is, however, restricted to subalpine and alpine elevations. Heinonen (1971) recommended the acceptance of the two taxa as separate species. I am convinced that the differences are trivial and not constant, deserving only varietal recognition. Intermediate forms are to be found. Another puzzling form of R. canescens is encountered at high alpine elevations above 2140 m (7000 ft) in late snow melt sites. Populations with moderate to few short lateral branches become extremely stunted and prostrate in growth form. This probably results from the harsh environmental conditions that the populations have to
face.

The muticous form called var. strictum Schleich. ex Limpr. (Schofield, 1968) is relatively common in seepy to wet sites at high elevations. Leaves are squarrose to erect spreading when wet and may be either light green or dark green in color. The variety is probably the same as what has been called var. epilosum C. Muell. ex Milde. Dr. Frisvoll (pers. comm., 1980) stated that taxonomically, var. strictum is the muticous modification of R. canescens whereas var. epilosum is the equivalent in R. ericcides.

Representative specimens examined: Gray Creek, Kootenay Lake (UBC B-4263 as var. ericoides); Castlegar (UBC B-4264 as var. canescens); Kokanee Glacier Park (UBC B-4265 as var. canescens); Chief Slocan Cabin, Kokanee Glacier Park (UBC B-4269 as var. epilosum); headwater of Lyle Creek (UBC B-4270 as var. strictum).


This species is fairly easy to recognize owing to its abundant, short lateral branches along the main stem.
R. fasciculare, with its muticus leaves and long apical leaf cells, can be confused only with the muticus form of R. varium. This latter species is presently interpreted as a coastal species and is not known yet from the interior mountains (Schofield, 1976).

Scattered widely in the study area, the species is, likewise, widespread in other parts of the northern boreal zone. R. fasciculare, on the whole, prefers wetter sites than R. canescens.

Representative specimens examined: Nakusp Hotspring (UBC B-4266); Selcan Lake area (UBC B-4267); Arrow Park ferry landing site (UBC B-4268).

Baccharitrium heterostichum (Hedw.) Brid., Musc. Rec. Suppl. 4: 79. 1819.

As defined in the key, this name is restricted to small, slender plants whose leaves have unistratose margins and consist subapically of mostly isodiametric cells, and whose capsules are cylindric. The branching pattern and the length of hairpoints are two variable characters as already contended by Dixon (1924) and Lawton (1971). Thus, they are not used in
defining the species, which in its strict sense, is most closely related to *R. affine*. The differences are that in the latter, the leaf margin is bi- to multistratose, especially towards the apex, and the capsule is usually ovoid. From *R. brevipes*, the species is separated by its nearly uniform small, isodiamic to quadrate apical leaf cells, and the consistently unistratose leaf margin.

In the past, Dixon (1924), Frye (1917-18), Jones in Grout (1933), Nyholm (1954-1969), Lawton (1971), and Noguchi (1974a), all have suggested that *R. heterostichum*, *R. affine* (= *R. sudeticum*), and *R. brevipes* be united into a single polymorphic taxon. I believe, however, that the resulting taxon is too artificial and large. I prefer instead, to follow Banu (1969) in segregating *R. brevipes*, thereby making the remaining members of the complex less heterogeneous.

*R. heterostichum* and *R. affine* overlap to some degree in their diagnostic characters with the presence of intermediate forms in the Kootenay region. It is perhaps best to unite the two taxa. It is for reasons of convenience and in recognition of tradition that I consider the three as separate species until more convincing evidence indicates otherwise or more reliable segregating characters are discovered.

Varieties are not recognized here because of the ill-defined and inconsistent characters ascribed to all subspecific taxa.

As a name, *Racomitrium heterostichum var. affine*
(Schleich.,) C. Jens., is placed in the synonyms of *R. affine* on the basis of its histratose leaf margin. The sometimes long, elliptic capsules, although superficially approximate the length of those of *R. heterostichum*, can still be accommodated within the range of morphological dimension of *R. affine* as shown in the photographs prepared by Banu (1969) for *R. affine* (=*R. sudeticum*).

Its habitat ranges from rock in moist sites to exposed areas. Compared to *R. affine*, the species is less frequent or uncommon in the area. When present, it forms extensive patches at subalpine elevations. Scattered through the north and south temperate regions.

Representative specimens examined: Fend" Creille River gorge (UBC B-4271); Syringa Creek Park area (UBC B-4272); Deer Park (UBC E-4273).


*R. lanuginosum*, although relatively widespread, is uncommon to rare in the study area. Its overall branching pattern, with the long and distinct hairpoints, is unmistakable.
in the field even when wet. The broad, erose, papillose and hyaline hairpoints are unique to this species in the genus.

Being circumpolar in both northern and southern hemispheres, it is the only species of *Racomitrium* common in bogs and fens. Hence, it is always present in abundance along the wet coastal region where there are extensive formations of various types of bogs and fens.

Representative specimens examined: Goldstream floodplain, N of Revelstoke (UBC E-4274); Glacier National Park (UBC B-4275).

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*Schistidium* Erik.

This is a cosmopolitan genus of about 20 species, of which nine are found in British Columbia (Schofield, 1968a). Seven are present in the study area. The genus has always been difficult to most bryologists. Several species were combined and separated many times in the past. The recent trend is to restore full species rank to many of the varieties in the species complexes. Both *S. strictum* and *S. rivulare* are accepted here as distinct species in agreement with Smith (1978) and Deguchi (1978). On the other hand, *S. atrichum* and
S. dupretii are suggested to be conspecific on the basis of their strong morphological similarity and habitat preference. Except for S. atrichum, S. dupretii and S. confertum, other members of the genus listed below are in general widely scattered across the study area and within the province as well. Within the study area, the genus is more strongly represented in the dry, southern portion.

1. Leaves all muticous, very rarely with rudimentary hairpoint

.................................................................2

1. Leaves, at least the perichaetial leaves, with distinct hairpoint ........................................5

2. Plants forming loose tufts or caespitose mats, stems long and creeping, often up to 4 cm long ....3

2. Plants forming compact cushions, stems short, often less than 1 cm long .........................4

3. Leaf margins entire ......................S. alpicola

3. Leaf margins denticulate at apex ......S. rivulare

4. Leaf margins plane or sometimes recurved on one side
4. Leaf margins strongly recurved to near apex, at least on one side .......................... S. atrichum

5. Plants forming compact cushion, stems short, less than 1 cm long .................................. S. confertum

5. Plants forming loose tufts or caespitose mats, stems long and creeping, often up to 4 cm long ....6

6. Plants reddish brown; upper parts of the costa and laminal cells papillose, at least near the apex S. strictum

6. Plants dark green to blackish brown; upper parts of costa and laminal cells smooth .................. S. apocarpum


Grimmia alpicola Hedw.
S. alpicola is best differentiated from S. rivulare by its entire leaf margin although the two taxa share a similar habitat: periodically splashed or irrigated boulders or rocks along the streams, creeks or lake margins. The taxon has been confused for years with S. apocarpum (see Sayre, 1946). For morphological differences between the two species, consult Nyholm (1956, p. 144). The immersed capsules of S. alpicola are mistaken occasionally for S. agassizii which is not known yet from the study area. However, S. agassizii has elongate-oblong vegetative leaves with flat costae and plane margins. The coarse size and loosely tufted habit of S. alpicola should pose no problem in distinguishing it from the small, compact and cushion-forming S. atrichum and S. dupretii.

Var. latifolia (Zett.) Moell. has a more slender habit and more strongly recurved margins than var. alpicola. It was collected once from the headwater of Lyle Creek at 6000 ft (Tan and Teng 78-571) along the New Denver-Kaslo highway. Since the plant size, habit and leaf marginal orientation are known to be variable for S. alpicola, and since I have only a single specimen from the study area on which to base my judgement, I would hesitate to accept the distinctiveness of the variety latifolia.

A recent proposal was submitted to Taxon, vol. 29: 337-338, 1980 by B. Bremer of the University of Stockholm to reject the names Grimmia alpicola or Schistidi um alpicola. According to the author, the type specimen of S. alpicola is
really a S. agassizii, and that all specimens of S. alpicola or G. alpicola should be called S. rivulare.

A widespread species in Europe, Siberia, Himalaya, Japan, North America and Greenland.

Representative specimens seen: Kokanee Glacier Park (UBC B-6310); Erie Creek, near Salmo (UBC B-6311); Farrel Creek, N of Ymir (UBC E-6312).


Grimmia apccarpa Hedw.

S. apccarpum is collected sporadically in the study area as is also S. alpicola. The presence of a hairpoint on the upper leaves of S. apccarpum is a reliable diagnostic feature. The two species, in addition, differ in their ecological preference (see key). Schofield (1976) described the habitat of S. apccarpum as on sunny or shaded rocks and cliffs in mesophytic environs. For further comments, see S. alpicola.

Var. antiqua (Sull.) Jones has plane leaf margins and
longer hairpoints on the upper and perichaetial leaves and has been collected from Rosetery (MacFadden, s. n. June 19, 1926). The specimen at UBC is sterile, and its true affinity is uncertain.

Other varieties described in the past for S. apocarpum such as var. strictum and var. fulvinatum are accorded today with full species rank.

Widespread also in Europe, Asia to Africa, S. apocarpum is truly a polymorphic and near cosmopolitan species.

Representative specimens seen: Pend' Creille River gorge (UBC B-6313); Champion Lakes Provincial Park (UBC B-6314); Cayuse Creek (UBC B-6315).

**Schistidium atrichum** (C. Muell. & Kindb. ex Macoun & Kindb.)

Tan, **comb. nov.** Map 80.


This is the smallest species of **Schistidium** in the study area, and it occupies a similar habitat with S. dupretii. It
also resembles the leaf morphology and sporophytic features of the latter. The only difference between the two species that I have been able to find is that the leaf margin is plane or slightly recurved in *S. atrichum* and strongly recurved, at least on one side, in *S. dupretii*. Nevertheless, populations having both types of leaf margins are not uncommon in the study area. As both species are uncommon to rare and are confined to alpine, open and rocky sites or cliff faces, I have not collected enough material to be confident about my taxonomic judgement for the two species. Flowers (1973) who had studied the type remarked that the original description of *S. atrichum* does not agree well in all particulars with the type specimens he examined. He further noted that the laminal cells, thickness of leaf blade and spore sizes vary according to the age of the plants. In Utah and the adjacent states, many plants are intermediate between *S. atrichum* and *S. dupretii* and it is difficult to decide which name to apply to some of the specimens.

*S. atrichum* is rare in western North America. A locally endemic species found also in Alberta, Washington, Montana, and south to Utah and California.

Representative specimens seen: Jackson Basin (MACF 3824); Idaho Lookout Tower, New Denver and Sanson (UBC B-6316).

Grimmia apocarpa var. conferta (Funck) Spreng.

This is a very rare species in the study area. The only collection (Tan & Ensing 77-1793) came from an alpine rocky ridge at Bugaboo Glacier, close to 2440 m (8000 ft.). Specimens have short but distinct hairpoints in most of the upper and perichaetial leaves. The capsules are immersed and the peristome teeth are strongly papillose, entire and not cribrose. Dr. Deguchi kindly determined the specimen as S. confertum. The taxon is a difficult entity to understand. Both Dixon (1924) and Nyholm (1954-1969) considered the taxon not to be markedly different from S. apocarpum. Consequently, they treated it as only a subspecies or variety of the latter. On the other hand, Deguchi (1978) argued strongly that S. confertum differs significantly from S. apocarpum in terms of size, habit and exothecial cell morphology. Deguchi (in. litt., 1980) suggested, however, that S. confertum might be conspecific with S. dupretii, which rarely produces hairpoints, even on perichaetial leaves. S. dupretii appears to be a compact, muticous and miniature counterpart of the S. alpicola as S. confertum is to S. apocarpum. Furthermore,
half of the exothecial cells of _S. confertum_ are transversely elongate or short rectangular as correctly observed by Deguchi (1978), whereas those of _S. dupretii_ and _S. apocarpum_ are mostly vertically elongate and rectangular. Lawton's key (1971) to the two species based on the thickness of the leaf margins and the criptoseness of peristome teeth appear to be unreliable. A few specimens of _S. dupretii_ that I have dissected show clearly bistratose margin in the upper half of the leaf, the same as in _S. confertum_. The Kootenay population of _S. confertum_, like the Japanese counterparts, is from rocky summit of a high mountain. The few eastern North American populations, on the contrary, are from low or subalpine elevations (Crum, 1976).

The present collection of _S. confertum_ is new to the Selkirk and Purcell Mountains. The species is equally rare in Washington, Idaho, Montana and other parts of the continents. Equally rare in Europe, Japan, Asia and Africa.
Schistidium dupretii (Ther.) Tan, comb. nov. Map 82.

Easionym: Grimmia dupretii Ther., Bryologist 10: 63. 1907.

Synonym: Grimmia alpicola var. dupretii (Ther.) Crum

This species is very similar in morphology to S. atrichum. The two species may well be conspecific with S. atrichum being the earlier available name. Within the province, S. dupretii and S. atrichum are rarely collected and accurately determined. See S. atrichum for more taxonomic comments.

Crum (1976) reduced the present taxon to a variety of S. alpicola. Morphologically, the two species are rather alike, but the highly reduced size and the compact cushion habit of S. dupretii, plus the alpine habitat, appear to be sufficient grounds for a clear separation of it from S. alpicola. In eastern North America, the species is reported from much lower elevations but on calcareous rocks (Crum, 1976).

A rare North American broadly endemic species (Jones in Grout, 1933; Flowers, 1973).

Representative specimens seen: Idaho Lookout Tower, New Denver (UBC B-6317); Fred Laing Ridge, Mica Dam vicinity (UBC B-6318); Zincton (UBC E-6319).

Grimmia alpicola var. rivularis (Brid.) Wahlendb.

This is a common species on periodically wet boulders or outcrops in or beside water courses. *S. rivulare* is essentially a montane species, becoming uncommon at lowlands. It has been treated as a variety or form of *S. alpicola*. The best distinguishing character is the irregularly serrulate or denticulate leaf apices of *S. rivulare*. Deguchi (1978) tabulated many differences between *S. rivulare* and *S. alpicola*.

Known also from Europe, Asia, Japan and many states and provinces of North America.

Representative specimens seen: Cayuse Creek Falls (UBC B-6320); Rosebery (UBC B-6321); Kokanee Glacier Park (UBC B-6322).
This is a pretty, slender, reddish brown species of *Schistidium* with shortly piliferous perichaetial leaves and immersed capsules. *S. strictum* is a common plant in the study area on cr along shaded or exposed rocky shores of creeks and streams. The papillae of the costa near the leaf apex easily distinguish *S. strictum* from *S. apccarpum*.

The correct species epithet should be *strictum* (published in 1804) and not *gracilis* (1812) as used by Deguchi (1978). The combination used for the taxon in Smith (1978), *S. strictum* (Turn.) Loeske, is, according to Deguchi (1978), a nom. inval. in syn., and that the correct authority for the binomial is *S. strictum* (Turn.) Loeske *ex* Mart.

Also a common boreal species in the northern hemisphere.

Representative specimens seen: Beatrice Creek, Slocan Lake (UEC B-6323); Erie Lake, near Salmo (UEC E-6324); Pend' Oreille River gorge (UEC B-6325).
**Scouleria** Hook. in Drumm.

This is a small genus of semi-aquatic mosses. Of the five species in the genus, two are found in Siberia, one in South America and two are endemic to western North America. The two endemic western North American species are both recorded from the study area. Both are found attached to wet outcrops and boulders in fast flowing streams.

1. Leaf margins mainly unistratose, occasionally with bistratose streaks; peristome present. **S. aquatica**

2. Leaf margins 3 to multi-stratose; peristome absent. **S. marginata**

S. nevii C. Muell. (isotype at CANM !)

S. muelleri Kindb. in Macoun (isotype at CANM !)

The species is a common and variable epilithic species in rapidly flowing streams and on river banks. Submerged populations are particularly luxuriant. Common in the study area at all elevations. Sporophytes common.

Macoun's collections (CANM) of S. nevii and S. muelleri from the study area were studied and confirmed to be conspecific with the present taxon.

Recently, Edwards (1979) reported on the strong similarity of the nature of peristome teeth between species of Scouleria and Seligeria.

A west coast North American endemic known from Alaska to California.

Representative specimens seen: Rosebery (CANM 133470); Glacier National Park (UEC B-6295); Kokanee Glacier Park (UBC B-6296).
1895. Map 83.

This is a distinct species resembling S. aquatica in general habit, but the leaves are more stiff and less crisped, owing, perhaps, to the thicker leaf margins. Only one population is known in the entire study area. Specimens (Tan & Ensing 77-2041) came from Boundary Creek near the Canadian-American International Boundary.

Also known from Washington, Oregon, California, and Idaho. First report of the species for Canada.

FAMILY FUNARIACEAE

The family is represented by six genera in North America, four in British Columbia and three in the study area. It is characterized mainly by gametophytic features. The leaves are single costate with large, rhomboid-hexagonal, thin-walled laminal cells. Capsules vary from cleistocarpous to stegocarpous, radially symmetrical to strongly asymmetric. Without the sporophyte, specimens can be confused readily with
members of the Family Splachnaceae.

1. Capsules cleistocarpous .......... *Physcomitrella patens*

1. Capsules stegocarpous ...............2

2. Capsules with well-developed peristome teeth, theca asymmetrically curved and striate ...... *Funaria hygrometrica*

2. Capsules without peristome teeth or only rudimentarily developed, theca erect, symmetrical and smooth

................................. *Entosthodon fascicularis*
Entosthodon Schwaegr.

This is an ill-defined genus segregated from *Funaria* on the basis of erect capsules with either reduced peristome teeth or none. Other bryologists like Chen (1963) and Smith (1978) preferred to combine it with *Funaria*. It appears that the new evidence derived from the study of the detailed spore morphology under the scanning electron microscope done by Hirohama (1978b) supports the separation of the two genera. Such is also the opinion of Mr. A. Fife of the University of Michigan who is presently revising the family for North America (pers. comm., 1979).

Only one species has been reported from the southern half of the Vancouver Island in the province. The same species is collected recently from the southern border of the study area.
Entosthodon fascicularis (Hedw.) C. Muell., Syn. 1: 120. 1848.

E. leibergii Britt.

The only collection from the study area (UBC B-4324) was made from the margin of Hawkins Creek, south of Yahk Park. The capsules show clearly the lack of peristomes.

Known also from Washington and Idaho; also from Europe.

Funaria Hedw.

There are three species of Funaria presently reported from British Columbia. Only the weedy species, F. hygrometrica, is present in the study area.

The genus has been defined traditionally to include species of Entosthodon, hence, an estimation of the total species around the world is difficult, depending on one's generic concept. It is, however, treated here in the strict
Funaria hygrometrica Hedw., Spec. Musc. 172. 1801.

Like Ceratodon purpureus, the present species is a very common weedy moss in all human settlements, along disturbed roadbanks and fallow lands. It is common in nearly every camp site visited in the study area. Its preference for soil with high ash and mineral content is apparent by the many populations seen growing on burned-over sites. The tiny rosettes of leaves are inconspicuous, but the sporophytes when produced are distinctive. The length of setae has been observed to be highly variable (from 1 to 7 cm long).

A cosmopolitan species.

Representative specimens seen: mouth of Gold River near Mt. Sir Sandford (UBC B-4325); Wycliffe Regional Park (UBC B-4326); Balfour, Kootenay Lake (UBC E-4328).
Physcomitrella B. S. G.

Revised by Tan (1979), Physcomitrella is a genus of one species with four geographical subspecies. Only P. patens subsp. patens is known to the study area and the province.

Physcomitrella patens (Hedw.) B. S. G. subspecies patens,


The discovery of the present taxon (UEC B-4329) in the study area has been reported by Tan (1978) as new to western North America. The leaves are variable in shape and size (Tan, 1978), but the cleistocarpous capsules are diagnostic. Recently, specimens collected by Dr. Icngton from the campus of the University of Manitoba at Winnipeg has been confirmed to be also P. patens subsp. patens. It is probably widely scattered across the whole North American continent like all the other weedy and pioneering species of many disturbed sites. The small and inconspicuous size of only a few mm tall must have prevented frequently its discovery in the field.
It is a widespread species in the north temperate region, although not reported yet from China.

FAMILY SPLACHNACEAE

This is a family of eight genera occurring in general on substrata rich in nitrogen in many wetlands or creek banks in high northern latitudes. A total of three genera are recorded for the study area. *Voitia nivalis* Hornsch. which has been collected a few times from alpine elevations in the Albertan section of the Rocky Mountains is included in the key to the genera for purposes of future reference.

The family is characterized by a funarioid gametophyte, but the capsule with a single row of peristome teeth is unique in structure and detailed ornamentation, and is very different from that seen in the Funariaceae. The highly enlarged and colored hypophysis of the capsule which is present in many taxa, and the dispersal of spores by flies and other coprophilous insects are additional interesting features of the family.

The family is rather poorly represented in the study area when compared with their frequency in the Canadian Rockies.
Possibly, the topography of the study area, which consists of steep slopes and narrow valleys, does not favor the development of extensive, flat wetlands needed to attract large numbers of herbivores, including caribou and moose. Consequently, the much preferred animal dung substratum is uncommon in the study area.

1. Leaves long subulate .................. 2

1. Leaves round to cymose, acute, at most acuminate

2. Leaf margins irregularly and strongly serrate; hypophysis of the capsules swollen and larger than the width of the urn proper ......................... Splachnum

2. Leaf margins entire or regularly serrulate towards the apex; hypophysis not differentiated or nearly approximating the width of the urn .................... 3

3. Capsules cleistocarpous, with no differentiation of operculum and hypophysis ............... (Voitia)

3. Capsules stegocarpous, with operculum and hypophysis
4. Hypophysis smaller than the width of the urn

...........................Tetraplodon

4. Hypophysis swollen, larger than the width of the urn

...........................Tayloria

...........................Splachnum

Splachnum Hedw.

This is an essentially coprophilous genus of 10 species in high northern latitudes. A few species, such as S. luteum, develop a brightly colored and enlarged hypophysis that gives the plants the common name "umbrella mosses". Five species occur in the province and scattered mainly in the northern part, with only two species reported here for the study area.
1. Leaf margins strongly and irregularly serrate in the upper half; attenuate leaf apex 2-4 times as long as wide; hypophysis usually at least twice the width of the urn

.............................................S. ampullaceum

1. Leaf margins only weakly serrulate near the apex; attenuate leaf apex 1-2 times as long as wide; hypophysis slightly larger than the width of the urn ... S. sphaericum


This species is rare in the Pacific Northwest (Lawton, 1971). In British Columbia, it occurs on dung in peatlands on the Queen Charlotte Islands and along the coastal mountains southward. My collection from the Purcell Wilderness Conservancy (UBC B-4829) is not only new to the study area, but also the second inland population for the province (Map 77). The collection is sterile, but the strongly serrate leaf margin and the long and slenderly acuminate leaf apex are not matched by any other species of the family in the area (Crum et al., 1972). When produced, the capsule with enlarged hypophysis nearly twice the width of the urn provides a useful diagnostic
character (Noguchi, 1974b).

1974b). Known also from Alaska, Alberta, a few localities in eastern North America, Europe, Siberia, Japan, and Southeast Asia.


S. ovatum Hedw.

This is rather common, although only sporadically and widely scattered in the province. The capsules are frequently produced and show a slightly enlarged, dark brown hypophysis and eight pairs of reflexed and tightly appressed peristome teeth. It has been collected from the following localities in the study area: Bugaboo Glacier Park (UBC B-4830); Glacier National Park (with several perigonal buds, UBC B-4831); and Nelson district (Nelson Forestry Herbarium).

Known also from Asia, Europe and other parts of North America. It is probably more of a continental species than the previous one.
Tayloria Hcck.

This is a large genus of about 65 species of worldwide distribution. At least six species are already known to the province, three of which occur in the study area. Among the members of the family, the genus appears to be the least affected by the percentage of the nitrogen in the substratum. Populations frequently grow also on rotten logs and soil with litter, not necessarily directly on dung.

Frisvoll's (1978a) key and description to the species of the genus in Norway has proven useful with Kootenay specimens.

1. Leaves obtuse to rounded, entire or with only short and blunt marginal teeth ...................... T. lingulata

1. Leaves acute to acuminate, serrate to serrulate

.......................................................... 2

2. Peristome teeth erect or recurved, in pairs of eight or sixteen ................................. T. serrata

2. Peristome teeth strongly reflexed, divided into 32 coiled
This species is rare in the study area, known from two localities: Echo Lake at the Spillimacheen River near Parson (UBC B-4924) and Roger's Pass, Glacier National Park (CANM 138945). The leaves are entire with a blunt to round apex. The taxon is easily distinguished from other species of *Tayloria* in the area except *T. froelichiana* which has similar entire leaf margins. Compared with the latter, *T. lingulata* commonly has a longer and flexuose seta (3-4 cm high), a very constricted hypophysis in dry condition, 16 erect teeth not borne in conspicuous pairs and smaller spores (approximately 20-25 μm in diameter). There exists a Macoun collection (Canadian Musci 42) at CANM collected from "Selkirk Range" which has capsules without a contracted hypophysis, and the columella is included, like that observed in *T. froelichiana*, but the length of the seta, the size of the spores and the
peristome teeth are like *T. lingulata*.

*T. lingulata* grows on peaty soil on the banks of lakes or creeks. It is uncommon and widely scattered in the province, as well as across the northern boreal zone. It appears to have no altitudinal restriction in its distribution in the study area.


In the study area, this is the most common and widespread member of the family. The obovate leaves with serrate margins cluster around a short stem. The erect capsule borne on a long seta has a well-differentiated, narrower hypophysis. It is most common at subalpine elevations in the study area. Without sporophytes, specimens are difficult to interpret. It is randomly distributed in the study area where the appropriate substratum is present.

A common circumboreal species.

Representative specimens seen: Silverton (UBC B-4825); Glacier National Park (UEC B-4826); headwaters of Columbia
The discovery of the present species from Glacier National Park (UBC E-4828) is a new addition to the moss flora of the study area. Previous determinations of UBC Herbarium collections are doubtful because the specimens do not show convincingly the taxonomic characters described in the literature. The species has been collected from the Canadian Rockies, Alaska, and rarely from Washington State. In fact, Lawton (1971) did not include a discussion of present taxon in her treatment owing to the lack of good collections from her area of study.

My collection from Glacier National Park bears several capsules with reflexed, coiled and reddish brown peristome teeth that surround the exserted columella. The leaves have serrulate margins and a shortly acute to obtuse apex which distinguishes it from *T. acuminata* Hornsch., as explained by Crum (1955). The exothecial cells also show clearly the uneven thickening of the cell walls so characteristic of
T. splachnoides (Crum, 1955). The other locality in the province reported by Crum (1955) for the species is Chilliwack (Macoun ccll., July 9, 1901, specimen at CANM, not seen).

A circumboreal species of high latitudes with a few disjunct populations at high elevations in Mexico.

_Tetraplodon_ B. S. G.

This is another coprophilous genus of the northern hemisphere. It has a total of 13 species with four taxa occurring in the province, only two of which were collected from the study area. All local species share similar habitats of dung, animal remains and regurgitation pellets of carnivores. In British Columbia, the genus is more strongly represented in the northern part than the southern half of the province.

Recently, Frisvoll (1978) discussed the morphological variations of many species of _Tetraplodon_ common to the province and Norway. At the same time, he also reported a few populations of hybrid _Tetraplodon_ from Norway.
1. Leaves with serrulate margins towards the apex; seta short, less than 5 mm long ............................T. angustatus

1. Leaves nearly entire; seta long, more than 6 mm long

......................................................T. mnioides


The compact tufts of the present species, growing on excrement in wetlands is striking. The short seta quickly distinguishes it from T. mnioides. Only two populations are known from the study area: Purcell Wilderness Conservancy (UBC B-4833) and New Denver area, MacFadden (V C3604). Nearby, specimens have been collected from the adjacent Kootenay National Park, Mt. Robson Provincial Park, Wells Gray Provincial Park and Vernon areas.

A circumboreal species.
**Tetraplodon mnioides** (Sw. ex Hedw.) Bruch & Schimp., Bryol.


This is a much more common species than *T. angustatus*, both in the study area and the entire province. The long setae with the clearly exerted capsules are characteristic. The capsules also have a well-differentiated hypophysis narrower than the width of the urn. The total range of distribution of the present species in the study area is New Denver (UBC B-4835), Purcell Wilderness Conservancy (UBC B-4836) and Spillimacheen River basin near Parson (UBC B-4834).

A circumboreal species.

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**FAMILY SCHISTOSTEGACEAE**

A monotypic family with one genus and one species. It is characterized by persistent protonema that glows in the dark or reflects light through its many lens-like protonemal cells. The common name, "luminous moss", aptly describes this feature.
Schistostega Mohr


F. osmundacea Mohr

The gametophyte which is feather-like in morphology and orientation, combined with the luminous protonemal cells is unique for the present species. The species is frequently encountered in the study area in a very distinctive habitat at subalpine elevation: on humid earth clinging to shaded and overturned rootstumps near a body of water inside the forest. Interestingly, Schofield (1976) observed it to be rare in the coast and infrequent in other parts of the interior of the province. Crum (1976) also reported it to be rare in many states in eastern North America. None of the many Kootenay populations discovered were from moist walls of caves as reported from other parts of the world (Kanda, 1971). Sporophytes are frequent.

A detailed ecological investigation of the species in Japan was reported by Kanda (1971) and an interesting account on the protonemal gemmae has been published by Edwards (1978).
Also a widely scattered north temperate species.

Representative specimens examined: junction of Oke and Teepee Creeks (UEC E-4274); St. Mary Alpine Park vicinity (UEC B-4275); Revelstoke National Park (UEC E-4276).

FAMILY ERYACEAE

The Family Eryaceae is currently becoming a more natural grouping after many attempts to circumscribe it since the time of Hedwig (Dixon, 1924; Andrews in Grout, 1935; Ochi, 1959). The family appears to be most closely related to the Family Mniaceae. At present, Dr. H. Ochi of Tottori University in Japan is probably the most knowledgeable authority on the family. He is revising taxonomically the family on a worldwide basis. His most recent treatment submerges most of the genera of the family under a broadly conceived genus Eryum with several subgenera. His many taxonomic papers are important sources of information in understanding this group of mosses that long have challenged the effort of many bryologists.

I recognize, contrary to Ochi's most recent opinion, six separate genera from the study area: Ancmobryum, Eryum,
Leptobryum, Pohlia, Flagoiobryum, and Koellia.

I would like to acknowledge here the kind help of Dr. Ochi in naming my difficult Bryum collections.

1. Leaves, including those of the perichaetium, mostly linear-lanceolate to setaceous ...............Leptobryum

1. Leaves, except those of the perichaetium of Pohlia (section Mniobryum), not lanceolate-linear, never setaceous ..............................................2

2. Plants slender and julaceous, leaves imbricate ......................................................3

2. Plants not slender and julaceous, leaves divergent ......................................................6

3. Capsules curved, asymmetrical and cernuous, neck distinct; outer peristome teeth shorter than the inner ones .........................................................Flagoiobryum zierii

3. Capsules not asymmetrical; outer peristome teeth equal or longer than the inner peristome ..............4
4. Leaves unbordered, margin entire, apical leaf cells elongate-vermicular, wall thick ........ *Anomobryum filiforme*

4. Leaves otherwise .......................5

5. Leaves usually bordered with elongate cells very different from the laminal cells; if unbordered, then the leaf cells short (3-4:1 or shorter); costa percurrent to excurrent ........................................... *Eryum*

5. Leaves not bordered; leaf cells mostly longer (5:1 or longer); costa never excurrent ........ *Pohlia*

6. Plants large, more than 1 cm high; leaf areolation lax, laminal cells thin-walled, exceeding 100 μm in length; capsules cylindric with short neck ....... *Roellia*

6. Plants smaller, less than 1 cm high; if larger, then laminal cells not exceeding 100 μm in length; capsules shortly cvoid, pyriform to short cylindric with long neck .........................................................7

7. Leaf cells short, 3-4:1 or shorter; leaf margins mostly entire, rarely serrulate at apex, with clearly differentiated border cells; costa percurrent to excurrent ........................................... *Eryum*
7. Leaf cells long, 5:1 or longer; leaf margins commonly serrulate at apex, marginal cells not differentiated; costa never excurrent .................. Pohlia

Ancrobryum Schimp.

A genus treated by Dixon (1924) as a section of Bryum, and by Andrews in Grout (1935) and Lawton (1971) as part of Pohlia. I am inclined to follow Nyholm (1954-1969) and Smith (1978) in accepting it as a separate genus. This is also consistent with my acceptance of the other genera of the Family Bryaceae. The taxon shows both bryoid and pohlioid features which in combination, would seem to preclude it from being placed in either Bryum or Pohlia. In addition, it has its own peculiar habit and combination of characters which make the taxon easy to identify in the field. It is thus probably best to accord the taxon its own generic rank. A genus of 65 species with only one representative in the province.
Anomobryum filiforme (Dicks.,) Solms-Laub. var. concinnatum (Spruce) Weis., Bryol. Brit. 246. 1855.

A. concinnatum Lindb.

A. julaceum (Sm.) Schimp.

Pohlia filiformis (Dicks.) Andrews

A rare plant in the area under study, A. filiforme var. concinnatum was collected twice. Both collections were from wet, calcareous cliff faces close to waterfalls in the Purcell Mountains at low elevations. Nyholm (1954-1969) remarked that the taxon is a strongly variable biological entity in terms of the size and form of the leaves, and the leaf costae. However, the julaceous, glossy white plants are distinctive in the field. Microscopically, the elongate to vermiciform thick-walled apical laminal cells are not found among the species of Pohlia and Bryum. Var. concinnatum differs from var. filiforme in having narrowly elongate (not vermiciform) upper laminal cells with thinner cell walls.

A nearly cosmopolitan species, although locally quite rare.

Specimens examined: Tan & Ensing 77-1755, Bugaboo Falls, Bugaboo Glacier Provincial Park (UBC E-6326); Tan & Teng 78-
347

1033, Bear Creek Falls, Glacier National Park. (BC B-6327).

Bryum Hedw.

Among the genera of Bryaceae, the distinction between
Bryum and Pohlia is sometimes not clear. Typical members of
Bryum, however, can be separated from Pohlia with ease by the
predominantly shorter laminal cells (3-4:1), differentiated
leaf margins and excurrent costae.

A genus of nearly 1000 species, the taxonomy of Bryaceae
in many areas of the world is still in confusion. The species
concepts that I follow in this treatment are derived in part
Taxonomic decisions were made occasionally out of convenience.
Consequently, the treatment for the genus offered here is far
from natural and satisfactory. It represents only my best
effort in dealing with the hundreds of Bryum specimens
collected from the interior Columbian mountains.

The most serious problem in the genus is the inconsistency
of species definition among different authorities. A quick
comparison of recent regional floras and monographs easily
confirms this observation. To complicate the situation, an excessive number of names of microspecies have been published. Possibly, these microspecies represent only ecomorphological variations of the polymorphic species concerned. Podpera's *Bryum* monograph (1942-1973) is a conspicuous example of how unruly the myriads of species and infraspecies epithets have become. To solve the problems, future monographers would need to work out all species on a worldwide basis, supporting their studies with transplantation experiments and extensive field studies of the natural variation within populations of each taxon.

Species of *Bryum* traditionally have been delineated on a combination of leaf and peristome characters. Thus, collections without sporophytes are sometimes impossible to name. There are many sterile *Bryum* collections from the province in the UBC herbarium that remain unidentified. With only a limited number of reliably identified specimens, the distribution of species in the province, even the very common ones, is unclear in most cases.

The key to the species presented here is based, as far as is possible, on gametophytic characters because the fruiting structures of many *Bryaceae* are not frequently collected. Also, the distribution notes provided for the various taxa are to be taken with reservation.

Dixon (1924) discussed eloquently the difficulties and
problems inherent in the taxonomy of *Bryum*. His suggestions about the examination and interpretation of *Bryum* capsules are helpful and should be consulted by all students studying these mosses.

The key is intentionally artificial. In a few couplets, peristome and sexuality must be carefully studied before a confident decision can be made. In addition, rhizoidal gemmae are ignored in the key characters if possible. These asexual reproductive structures were rarely seen in the nearly 300 packets of Kootenay *Eryum* that I examined. The red versus green color of the leaf costae also is not emphasized in the key. This feature appears to reflect the maturation of the plants, and is subject to environmental modification. On the other hand, a few species do consistently develop a wine red color (as in *Bryum miniatum* and *E. muehlenbeckii*). Such observations are given under the particular species where appropriate.

Tan & Ensing 77-1036 from the Idaho Lookout Tower near New Denver (7000 ft) and Tan & Ensing 77-754, 77-681 from Kokanee Glacier Park, above 6000 ft, are green plants with concave and short acute leaves and red brown costa. The laminal cells are short, rectangular, thin-walled and the marginal cells weakly differentiated. Dr. H. Ochi determined both specimens as *E. calcphyllum*. Typical specimens of *E. calophyllum* (see Map 89) are best determined by the peculiar series of tiny openings on the base of exostome teeth of mature capsules (see Nyholm’s Fig. 112, p. 222, 1954-1969). Gametophytically, the taxon is
similar to *B. muehlenbeckii* and *B. turbinatum*. As all my collections from the study area are sterile, their identity, to a certain extent, remains doubtful; otherwise, the collections will be the first report for the taxon from British Columbia.

*B. calophyllum* is an arctic-alpine species. Using the key presented above, specimens of *B. calophyllum* will key to *B. turbinatum* or *B. muehlenbeckii*. A rare to sporadically scattered species in the northern hemisphere, *E. calophyllum* has been reported also from California, Alberta, and Alaska. The best material of it from North America that I have seen is a collection of G. Brassard from Ellesmere Island (UBC).

Dr. Nyholm also identified two specimens among my collections as *Bryum alpinum* With. (Tan & Ensing 77-812 from Kokanee Glacier Park and Tan & Teng 78-639 from Gimli Peak vicinity, Valhalla Range). Both specimens have the typically reddish colored, concave and denticulate leaves of *B. alpinum* but the laminal cells are thin-walled, short and broad (less than 5:1) unlike the thick-walled and elongate laminal cells of European *B. alpinum*. I am, therefore, reluctant to include *E. alpinum* in the key to the species of *Bryum*.

Lastly, there is one collection in MacFadden Herbarium (no. 4863) determined as *Pohlia tozeri* (Grev.) Del. The specimen came from Slccan Lake and consists of sterile and young plants of a *Pryum* species,
1. Mature gametophytes small and slender, not more than 1 cm tall ........................................................................2

1. Mature gametophytes larger, more than 1 cm tall .........................................................................................5

2. Leaves silvery whitish green ..........B. argenteum

2. Leaves not silvery green ..................3

3. Leaves acuminate to acute ..............B. bicolor sensu lato

3. Leaf apices obtuse to nearly rounded ..4

4. Leaves ovate to lanceolate, upper laminal cells elongate to vermiciform .................................B. blindii

4. Leaves broadly ovate to orbicular, upper laminal cells broadly rhomboidal to rectangular ......B. cyclophyllum

5. Leaves distantly arranged, strongly contorted when dry, broadly and long decurrent at base ....B. weigelii

5. Leaves closely arranged on the stem, spirally twisted or imbricate when dry, narrowly or not decurrent at base ........................................................................................................6
6. Leaf apex obtuse to broadly acute, never long acuminate; costa ending before apex or at most percurrent

7. Leaf apex strongly acute to long acuminate; costa percurrent to excurrent

8. Leaf cells narrowly elongate, vermiform at times, with incrassate walls; margins plane or slightly recurved at leaf base. *B. miniatum*

9. Leaf cells broadly elongate to rhomboidal, lax, with thin walls, at times weakly pitted; margins recurved on both sides almost to apex. *B. muehlenbeckii*

10. Costa of the upper and perichaetial leaves percurrent, sometimes weakly excurrent

11. Leaf marginal cells gradually becoming elongate, not abruptly differentiated from the laminal cells

12. Leaf marginal cells abruptly becoming elongate to linear, abruptly differentiated from the laminal cells
10. Stems not covered thickly with red to dark red rhizoids; leaf cells lax, more than 20 µm wide, thin-walled, broadly elongate, rectangular, rhomboidal to a few hexagonal; leaf margins slightly reflexed or plane; capsules turbinate, short with indistinct neck ...............B. turbinatum

10. Stems usually covered with abundant reddish rhizoids; leaf cells narrower, less than 20 µm wide, with thick walls, at times pitted near the base of the leaf; margins recurved at least on one side; capsules ellipsoid, with distinct neck ........................................B. pseudotriquetrum

11. Plants shortly caespitose, stems to about 1 cm high or less; leaves ovate to lanceolate, imbricate when dry; laminal cells long, 6-7:1; filamentous propagules not present ........................................B. caespiticium

11. Plants tufted, not caespitose, stems more than 1 cm tall; upper and perichaetial leaves mostly obvate, twisted when dry; laminal cells shorter (4-5:1); filamentous propagules frequently present on sterile stems ....B. capillare, sensu lato

12. Leaf margins at least bistratose to multistratose in part ........................................13
12. Leaf margins unistratose throughout .........................................................15

13. Dioicous; inner peristome with appendiculate cilia ..................................................14

13. Aucoicous; inner peristome with rudimentary cilia ...................................................... B. uliginosum

14. Dry capsules often bent downward and then curving upward; exothecial cells long and narrow (42-85 x 14-24 um); spores small, 14-19 um in diameter .......................B. mesesioides

14. Dry capsules bent downward only or nodding; exothecial cells shorter and broader (23-38 x 28-52 um); spores larger, 19-28 um ......................................................B. pallens

15. Plants large, stems to 4 cm tall, covered with abundant reddish rhizoids; leaves not noticeably decurrent; costa percurrent to a few slightly excurrent; laminal cells often pitted at base ..............................B. pseudotriquetrum

15. Plants smaller, stems not covered with conspicuous reddish rhizoids; leaves not or weakly decurrent at base; costa mostly long excurrent; laminal cells not pitted at base .................................................................16

16. Upper and perichaetial leaves mostly obovate; filamentous
propagules present .................. E. capillare, sensu lato

16. Upper and perichaetial leaves not obovate; filamentous propagules not known .................. 17

17. Exostome with transverse lamellae joined together by vertical and oblique band-like structures; endostome with 1-2 or rudimentary cilia or lacking ....... E. algovicum var. rutheanum (= E. angustirete)

17. Exostome with lamellae not joined together by vertical and oblique bands; endostome with well developed cilia

................................................. E. pallescens

(including

B. creberrimum)

Bryum angustirrete Kindb. ex Macoun

One collection (Tan 76-325) from Yark Creek Park just north of Sicamous was named by Dr. H. Ochi as the present taxon. The collection site, although outside of the study area, is near Revelstoke and the widespread distribution of the species in the boreal zone suggests that the taxon is probably not uncommon in the Columbian Mountain Ranges. When fully mature, this species is distinctive in having mesh-like excostomial teeth organization (see Fig. 452 on p. 157 of Crum, 1976). Also, Tan & Teng 78-1278 from the headwater of Lyle Creek, ca. 1825 m, along the New Denver-Kaslo Hwy. has been so determined by Dr. Ochi. The peristome, however, does not exhibit the characteristic mesh-like ornamentation.

A circumboreal species of sandy or gravelly wet, disturbed sites. Widely scattered in eastern and Arctic North America.

A very distinct species, *B. argenteum* with its silvery white coloration seems to inhabit only sites in or near human settlement. It is frequently collected and seen in parking lots and gardens.

A cosmopolitan taxon. In natural habitats, it is found on exposed rock faces with soil cover.

Representative specimens seen: Syringa Provincial Park (UBC B-6337); Cranbrook (UEC B-6338); Edgewater on Hwy 95 (UBC B-6339).

**Bryum bicolor** Sm., Fl. Brit. 3: 1355. 1804.

The species has recently been split into several microspecies based on bulbil characters. For the refinement of the species concept, consult Smith & Whitehouse (1978). Since I could not find bulbils in the few collections of *B. bicolor* from the study area, I have decided to treat the species in a broad sense following Nyholm (1954-1969). The species is to be
found on moist ground along roadsides, ditch banks and grassy slopes at low elevations. Often, it is found mixed with other species of *Bryum*. Morphologically, the species is easy to recognize even in the field by its minute gametophytes and the dark red, ovoid to turbinate capsule. The other species in the area that might be confused with it is *Bryum blindii*. The latter, however, has elongate apical laminal cells.

Judging from the UEC herbarium collections, the species appears to be mainly a coastal species with populations scattered more frequently in the southern part of the interior wet belt of the province. Reported also from Alaska, Alberta, Washington, Colorado, California, Japan, New Zealand, Australia, and Europe.

Representative collections seen: Albert Canyon Hotspring (UBC B-6340); Crawford Bay, Kootenay Lake (UBC B-6341); Cayuse Falls area, Deer Park (UEC B-6342).


Known only from two localities, the species is rare in the province. Since the taxon is reported to be a calcicole, its
rarity coincides with the rarity of calcareous rocks in the study area. Tan & Ensing 77-1673 from a wet, anonymous creek bank by the Jumbo Creek logging road leading to the Toby Creek settlement in the Purcell Wilderness Conservancy area is a well-developed material for this taxon. The thick, dark red short capsules are attractive. For the difference between this species and B. licolor, see comments under the latter name. The other known locality of B. blindii is Six Mile Creek, Selkirk Mountains (Macoun's Canadian Musci 72, CANM !).

The taxon is perhaps equally rare outside the province. Specimens at UEC show its presence in Yukon, Ontario, New Brunswick and Europe. The California collection determined by D. H. Norris at UEC is doubtful.

**Bryum caespiticium** Hedw., Spec. Musc. 180. 1801.

**Bryum microcephalum** Kindt. ex Maccun

**Bryum cligocladon** C. M. & Kindt.

**Bryum synoico-caespiticium** C. Muell. & Kindb.

A common open wasteland species, **Bryum caespiticium**
inhabits drier, silty roadbanks and slopes. The short, caespitose colonies with long excurrent costae are distinctive among *Eryum* species in similar habitats. Other gametophytic characters, including laminal cell size and thickness of cell walls are highly variable. Luxuriant specimens collected from moist sites can be mistaken for *E. pallescens*. However, *E. caespiticum* is dicoccus whereas *E. pallescens* is said to be autoicus. *E. pallescens* also has a well differentiated leaf margin consisting of elongate cells. Suspected hybrids between *E. caespiticum* and other taxa have been reported to occur occasionally in Europe (Nyholm, 1954-1969; Smith, 1978).

The type materials of the three synonyms listed above were studied (CANM !) and were identical in details with the present taxon, as suggested by Andrews in Grout (1935).

More widespread in the southern part of the study area, it perhaps reflects the lower annual precipitation in the area.

Representative specimens seen: New Denver (UEC E-6343); Blazed Creek (UEC E-6344); Erie Lake (UEC E-6346).
**Bryum capillare** Hedw., Spec. Musc. 182. 1801.

When well developed, *B. capillare* is distinctive in its comally tufted, obovate upper perichaetial leaves. The leaves sometimes are broadly ovate in shape. When dry, the leaves become spirally twisted around the stem similar to *B. pseudotriquetrum*. The latter, however, is a much taller plant with the stem matted with reddish brown rhizoids. *B. capillare* inhabits mesic sites whereas *B. pseudotriquetrum* grows best in wet sites, such as margins of bodies of water and rock outcrops and earth near waterfalls. In addition, *B. capillare*, compared to *B. pseudotriquetrum*, has a markedly differentiated leaf margin, long excurrent leaf costa and laminal cells that are shorter and broader with thin walls. Nyholm (1954-1969) noted that the species varies considerably according to habitats. In open, drier places, tufts can become shorter, and cushion-like, the leaves more strongly concave, and the laminal cells furnished with pitted walls.

Recently, Syed (1973) divided the species into many microspecies based on the leaf morphology and the presence of propagules. Nearly all collections from the study area yield filamentous and papillose propagules in leaf axils, and following Syed's key, they would be named *B. subelegans* Kindb. I have not seen enough annotated specimens of Syed's microspecies and would prefer to treat the species in a broad
sense following tradition.

*B. capillare* is uncommon in the study area. Possibly, many populations were mistaken in the field for the common *B. pseudotriguetrum*.

A cosmopolitan species.

Representative specimens seen: Jackson Basin (UBC B-6350); New Denver (UBC B-6351); Whatshan Lake (UBC B-6352).


*Bryum tortifolium* Fr. E. S. G.

*Bryum cryophilum* C. Mart.

An alpine species in the study area, *Bryum cyclophyllum* is distinctive in having broadly ovate leaves with blunt to round apices. The two collections from the area (Tan & Ensing 77-733A, Lemmon Creek Trail to Sapphire Lakes, Kokanee Glacier Provincial Park, and Tan & Teng 78-639, alpine wet meadow, Wolfs Peaks and Gimli Peak vicinity, Valhalla Mountain Range)
are both sterile. The plants are small, reddish and match in every detail the description given in Nyholm (1954-1969). The collections, although smaller in size, are closer in morphology and habitat to E. cryophilum which is interpreted by many bryologists as a separate arctic-alpine species. From E. cyclophyllum, the collections differ only in habitat and the reddish tufts. Ochi (1959) showed convincingly in a series of photos that the Japanese and European materials of the two taxa intergrade completely. His recommendation to combine the two taxa is thus supported by my collections from this region. I suspect that the species sensu lato is probably present in most of the alpine sites and mountain peaks in the Columbian Mountains. A parallel case in the genus Fohlia is E. obtusifolia. Both taxa are unmistakable even when dealing only with gametophytic materials.

A widely scattered species in the northern hemisphere occurring in wet sites from subalpine to alpine elevations. In British Columbia, additional populations have been collected from mile 340 Alaskan Hwy (Worley 5898, UBC), Sheep Lick Mountain, Spatsizi (Krajina, s. n., 13 July, 1975, UBC) and Teresa Island, Atlin Lake (Buttrick 28, UBC).

One of the many confusing species of Kindberg, B. meesioides has been relegated to the synonymy of B. pallens for many years, and only recently revived by Ireland (1977). The long, upwardly bending capsules in dry state is striking and easy to observe in the field. For more differences between the species and B. pallens, see Ireland (1977). B. meesioides is a western North American endemic.

The ecology of B. meesioides in Kootenay, is the same as that of B. pallens. Both taxa prefer disturbed roadbanks, open forest margins and wastelands. Its distribution in the province is unclear because many of the specimens at UBC are still filed under B. pallens.

Representative specimens seen: Goldstream River Basin (UBC B-6347); New Denver (UBC B-6348); Cayuse Creek area (UBC B-6349).
Map 90.

E. atwateriae C. Muell.

A beautiful wine red species, the obtuse, concave to cucullate leaf apices with narrowly elongate, thick-walled laminal cells are good diagnostic characters for the taxon. Several collections at the UBC Herbarium from the study area have been confused with E. muehlenbeckii. The latter has acute leaf apices, thinner laminal cell walls, and most importantly, recurved margins which are not seen in E. miniatum. The leaves are also never cucullate. The alar region of E. miniatum consists of large, swollen, brownish, thin-walled cells, a rare phenomenon in the genus Bryum. The only other species in the province that develops similar alar cells, although to a lesser extent, is E. muehlenbeckii.

A common coastal species, E. miniatum is extremely rare in the study area, known from only very wet sites around Slocan Lake (Map 90). MacFadden's collections distributed under the synonym B. atwateriae C. Muell. came from Six Mile Creek (UBC B-6588), near Silverton (CANM 143838) and also the New Denver area (UBC B-6587). I have tried for three summers (1976-1978) to relocate the populations but with no success. The
localities, unfortunately, have been extensively logged since the beginning of the century.

Widespread in western North America west of the Rocky Mountains, but reappearing in Great Lakes area, Newfoundland, and the Faeroe Islands. It has been reported from Missouri.


*Eryum rubicundum* C. M. & Kindb. (isotype at CANM !)

Like *E. miniatum*, the present taxon is also wine-red in color and is often confused with it. The best character to separate the two species are the width of the median laminal cells (12-25 um in *B. muehlenbeckii* and 5-10 um in *B. miniatum*) and also the leaf margins (recurved nearly to apex in *B. muehlenbeckii* and plane to slightly reflexed only at the base in *B. miniatum*).

*B. muehlenbeckii*, like *B. miniatum*, is rare in the study area, known only from Kokanee Glacier Provincial Park (Tan & Ensing 77-812; Tan & Ensing 77-1114) and Glacier National Park
Macoun's Canadian Musci 390 and 519 as *E. rubicundum*. It seems equally uncommon from the rest of the province.

Scattered across the continent growing on wet rocks, and creek margins, it is also reported from Europe and Asia.


This species is most often confused with *E. meesioides* and *E. uliginosum*. Among my many collections of brya from the study area with bistratose margins, only one population is definitely dicous which I determined as *E. pallens* (Tan & Ensing 77-1691, Toby Creek drainage, Purcell Wilderness Conservancy area). Earlier, the species was collected by MacFadden from New Denver (Musci Acrocarpi Boreali-Americani et Europaei 605) and by Macoun from Beaver Creek, Selkirk Range (Canadian Musci 71). Autoicous populations are *E. uliginosum*. For differences between the taxon and *E. meesioides*, see comments under the latter name.

The habitat for *E. pallens* is damp or wet soil. Its distribution in the province is not well understood. Flowers (1973) reported the species to be widely distributed in Arctic
and Subarctic areas of North America and extending southwards occasionally to New York, Michigan, Montana, Washington, Nevada, and Colorado. Also in Europe, China, Japan, Greenland and South America.


E. cirratum Hoppe & Hornsch.
E. lonchocaulon C. Muell.
E. revelstokense Kindb.
E. columbico-caespiticium Kindb.
E. haematophyllum Kindb.
E. creberrimum Tayl.

A common species in the area, E. pallescens (including E. creberrimum Tayl.) is characterized by leaves with well differentiated unistratose leaf margins, short and long, thick-walled, pitted or not pitted, laminal cells and long excurrent costa. The plants form dense tufts or cushions. Depauperate specimens can be mistaken for E. caespiticium. The latter,
however, is dioicous. *B. pallescens* is very similar to *B. creberrimum* in morphology. Traditionally, the two taxa are separated by their sexuality (*B. pallescens* is autoicous while *B. creberrimum* is syncicous). Smith (1978) recently discovered that *B. pallescens* can also be syncicous. He therefore resorted to other characters, such as the spore size and the nature of perforation of the inner peristome teeth, in separating the two taxa (Smith, 1973, 1978). Both characters, in my experience, are unreliable as far as the local collections are concerned. In fact, Smith (1978) admitted on p. 409 that plants with intermediate spore size occur. The gametophyte of *B. pallescens*, he added, is variable, and some forms are indistinguishable from *B. creberrimum*. I therefore treat the latter as a synonym of *B. pallescens* which is the earlier name. My judgement on the problem must be considered tentative as I was unable to study the type specimens. Nevertheless, I did have the opportunity to study the type materials of the other names listed above as synonyms (CANM !).

*B. pallescens* sensu lato is widespread in the northern hemisphere.

Representative materials examined: Champion Lake Provincial Park (UBC E-6353); Fairmont Hotspring (UBC B-6354); Revelstoke (CANM 14323 as *P. columbia-caespiticum*); Slocan (CANM 143230 as *P. lynchocaulon*).

Bryum bimum Schreb.

Bryum crassirameum Ren. & Card.

Bryum pseudotriguetrum as defined here, can be distinguished in most cases by the combination of the following characters: large plant body matted with dark red rhizoids nearly up to the shoot tip, spirally twisted leaves with decurrent leaf bases (not as broad and long as the decurrent leaf base of P. weigelii), pitted basal laminal cells, percurrent to shortly and weakly excurrent leaf costa, and a wet habitat. Sexuality could be dicicous or synoicous as in the var. bimum. I do not recognize the varieties, because the species, like many others growing in wet habitats, tends to be variable. Intermediate specimens among the various varieties are common as mentioned by Lawton (1971).

Atypical forms may be confused with P. capillare, B. pallescens (including B. creberrimum), P. turbinatum, P. weigelii, and even P. caespiticium. See further comments under each of the species names.

Smith (1978) recognized several segregate species of
B. pseudotriguetrum and his treatment should be consulted for a refinement of the taxonomy of the species involved.

This is the most common species of Bryum in the area (Map 92). It is also widespread and common in the northern hemisphere.

A nearly cosmopolitan species.

Representative specimens seen: Long Arrow Lake, on way to Bugaboo Glacier (UBC E-6355); Fry Creek Canyon (UBC B-6356); Champion Lake Provincial Park (UBC E-6357).

Bryum turbinatum (Hedw.) Turn., Musc. Hist. 126. 1804.

Bryum schleicheri var. latifolium (Schwaegr.) Schimp.

A rather problematic species, E. turbinatum is difficult to circumscribe in words. It has a combination of many features, each of which when fully developed may characterize a different Bryum species. The best way to identify the species is to run through the key. A species of wet habitat, E. turbinatum is variable, paralleling the case of Pohlia.
**wahlenbergii** with which it can be sometimes confused.

*B. turbinatum*, when collected with capsules is more possible to determine than when sterile. The capsules are short and thick, or turbinate, hence the species epithet. Species that are likely to be confused with it and grow in similar wet sites are *B. weigelii* and *E. pseudctriquetrum*. From *B. weigelii*, it is separated by the narrowly and short decurrent leaf bases. From *E. pseudctriquetrum*, the species differs in the lack of both matted rhizcids on the stems and the pitted basal laminal cells.

*B. schleicheri* var. *latifolium* is treated here as a synonym of *B. turbinatum* following the opinion of Andrews in Grout (1935), Dixon (1924) and Ochi (1959). Smith (1978), on the other hand, preferred to accept it as a separate species apart from *B. turbinatum*. Typical plants of the var. *latifolium* are large and tumid with lax and more concave leaves. Capsules are turbinate like those in *E. turbinatum*. This form is found around the Sandci area, near New Denver (MacFadden collections dated June 6, 1926 and July 2, 1925), Kokanee Glacier Provincial Park (Tan & Ensing 77-792; 77-766) and Roger's Pass, Glacier National Park (Macoun's Canadian Musci 685, CANM).

Typical forms of *B. turbinatum* are very much smaller and more slender in habit than the var. *latifolium* which has appressed to slightly contorted leaves when dry. The typical variety is uncommon in the area. In addition, extremely
slender forms with the leaves distantly arranged like those in *B. weigeli* have also been collected.

A widespread taxon in both northern and southern hemispheres.

Representative specimens seen: Lemon Creek, near Kokanee Glacier Provincial Park (UEC E-6358); Jackson Basin (UBC B-6359 as var. *latifoliurn*); Bugaboo Glacier Provincial Park (UBC B-6360).


This species is difficult to determine. Like *B. pallens*, it develops bistratose to multistratose leaf borders and also excurrent costa. But unlike the former, *B. uliginosum* is autoicous and bears capsule with only rudimentary cilia.

The species is uncommon to rare in dampish sites in the study area. Its rare occurrence may have been a case of undercollection owing to the inconspicuous features of the species in the field.
A widespread northern temperate taxon.

Representative specimens seen: Plumbcb Creek (UBC B-6581); Blue Lake, near Canal Flats (UBC B-6582).


*Bryum lat-decurrens* C. Muell. & Kindb. (isotype at CANM !)

*Bryum duvalii* Vcit.

This is a wet habitat species with distinctly broad and long decurrent leaf bases that reach down to the next leaf lower on the stem. *B. weigellii* is easy to identify even when dry. The specimens are lax and slender with soft and contorted leaves. Occasionally, stouter plants can be confused with small forms of *B. pseudotriquetrum* and *B. turbinatum*. For the differences, see comments under the latter two names. No sporophytes have been seen from collections made from the study area.
Common in wet habitats in the northern hemisphere.

Representative specimens seen: Idaho Lookout Tower, Sandon (UBC B-6361); Bugaboo Glacier Provincial Park (UBC B-6362); Revelstoke (CANM 144953).

leptobryum (B. S. G.) Wils.

A cosmopolitan genus of 5 species, only L. pyriforme is reported from North America.


Map 93.

Like Bryum argenteum, L. pyriforme is a widespread weedy species in disturbed places like roadsides, forest margins, ditch banks, landslide slopes, and burnt areas. I have seen populations growing in flower pots at the Cominco Garden in
Kimberley City. It is best identified by the pear-shaped shining capsules coupled with the long, setaceous leaves with broad costae.

Representative specimens seen: Boundary Lake (UBC B-6328); along Big Bend Hwy, north of Golden (UBC B-6329); Large Erie Lake (UBC E-6330).

**Plagio Bryum Lind.**

A genus of seven species in the north and south temperate zones, *P. zierii* is the only species reported from the province.

Like Ancmohryum filiform, the silvery, julaceous plant of the present taxon is remarkably distinctive in the field. When present, the peculiar shape of the asymmetrically long-necked capsules add to its distinctiveness. The other species of the genus, P. demissum (Hook.) Lindb. has excurrent costae and recurved margins in the upper leaves. It has already been reported from alpine areas of the neighboring Canadian Rocky Mountains in Alberta. Its eventual discovery can be expected in the Columbia Mountains and northern British Columbia.

Plagiothryum zierii is rare to uncommon in the study area. The species prefers humid to wet cliff crevices near the spray of waterfalls. The largest population of the species in the area was found at Silvertip Falls, 4 miles north of Revelstoke. An extensive population with abundant capsules covered the damp cliff face near the waterfalls. Regrettably, this population will be totally submerged after the construction of the controversial Revelstoke Dam is completed. In nature, sterile plants may be difficult to distinguish from A. filiforme. The latter, however, is in general more slender in habit, and lacks the reddish tinge underneath the silvery green color of the leaves. Leaf cells between the two taxa are very different. In the province, Schofield (1976) has remarked that P. zierii
is found in British Columbia throughout the mountains at higher elevations.

Also a widespread north temperate taxon.

Representative specimens seen: Purcell Wilderness Conservancy (UEC B-6334); Silvertip Falls, 4 miles north of Revelstoke (UEC B-6335); Sutherland Falls, Blanket Creek Park (UEC B-6336).

Pohlia Hedw.

This is a cosmopolitan genus of about 155 species. In contrast to Bryum, Pohlia is characterized by elongate laminal cells, absence of a marginal leaf border and by a leaf costa which is never excurrent. In 1968(a), Schofield listed 18 species for British Columbia, of which a few names probably will have to be reduced to synonymy. The presence of at least 12 species in the two mountain ranges investigated have now been confirmed by my study.

The identification of the species of Pohlia is no less troublesome than Bryum. Thus far, the best up-to-date key to the species of Pohlia in the northern hemisphere is the one
prepared by Smith (1978), where gametophytic, sporophytic and asexual bulbil characters are taken into consideration. Nyholm's key to the Pohlia species in Scandinavia is also useful.

Mr. Jon Shaw, who is studying the species of North American Pohlia at the University of Alberta, has stated (in lit, 1978), that he has collected Pohlia rothii (Correns ex Limpr.) Broth. and Pohlia cardotii (Ren. ex Ren. & Card.) Broth. from Southeastern British Columbia, but I have not seen the collections. On the other hand, Pohlia vexans (Limpr.) H. Lindb. and Pohlia columbica Kindb. were both reported from Glacier National Park area by Macoun & Kindberg (1892). All specimens so named at CANM are misdetermined. One specimen at CANM (MacFadden 4214) which was determined as P. pulchella in actuality is a P. vexans. I am reporting elsewhere the confusion of the identities centered around the members of the Section Mniochyum in British Columbia which includes P. columbica and P. vexans (Tan et al., 1980b). Interestingly, Pohlia lescuriana which was thought to be an eastern North American species is shown to be present in the study area, on the Queen Charlotte Islands of British Columbia and Olympic Mountains National Park in Washington State.

Dr. E. Nyholm of Stockholm, Sweden, determined one of my collections (Tan & Teng 78-342) as P. longicolla. The specimen is comparable to typical plant material of P. longicolla except for the very much reduced size and the sexuality being
dioicous. This Kootenay collection appears to me to be only a depauperate form of *P. cruda*. *P. longicolla* has been collected from the Rocky Mountains in Alberta and Montana (Lawton, 1971). Its occurrence in the study area still awaits confirmation.

Mr. J. Shaw also kindly identified several of my Kootenay collections (Tan & Ensing 77-1883, 77-733B; Tan & Teng 78-596A and 78-363A) as *Pohlia bolanderi* Lesq. The specimens are all sterile although quite distinctive in gross morphology. The plants form tufts and impart a metallic dark green color. Leaves are imbricate with long laminal cells. The species is common in alpine wet meadow sites in Kootenay. Andrews in Grout (1935) did not consider the taxon to be sufficiently distinctive to warrant species recognition, and Shaw has informed me that his determination is still tentative. Thus, I have not included the species in my treatment of *Pohlia*. Specimens of *P. bolanderi*, however, would key to *P. cruda* in the treatment here.

Furthermore, the genus *Mniobryum* Limpr. is not recognized and is accepted here as a section of *Pohlia*, following the tradition and the opinions of contemporary authorities like Ochi (1959), Nyholm (1954-1969) and Smith (1978). The Section *Mniobryum* differs from *Pohlia* proper quite significantly in the shape and size of the capsule and the exothecial cell morphology which, in the final analysis, may be worthy of a generic rank.

Rank.
I thank Dr. H. Ochi and Mr. J. Shaw for their taxonomic opinions on my problematic specimens.

The key to the species presented below is modified from Smith (1978).

1. Plants with axillary gemmae or bulbils 2

1. Plants without axillary bulbils ........5

2. Bulbils numerous, more than 6 in each leaf axil

.................................3

2. Bulbils few, 1-6 per leaf axil ..........4

3. Bulbils elongate to thread-like, twisted, without basal stalk

.................................P. proligera

3. Bulbils globose, not twisted, with a short basal stalk

.................................P. camptotrichela

4. Bulbils small, 200-400 μm, ovoid, yellowish becoming black when dry; leaf primordia mostly apical in position

.................................P. filum
4. Bulbils larger, 400-1000 um, ellipsoid, reddish brown when dry; leaf primordia extending to the middle of the body or lower ........................................P. drummondii

5. Leaf base clearly decurrent ............6

5. Leaf base not or slightly decurrent ...8

6. Plants light green to whitish green; stomates cryptoporous ..................................................P. wahlenbergii

6. Plants greenish to yellow or reddish green; stomates phaneroporous .................................7

7. Leaf base broad and long decurrent; median laminal cells rhomboidal, 12-16 um wide .................P. ludwigii

7. Leaf base narrow or short decurrent; median leaf cells elongate, 10-12 um wide ..................P. drummondii

8. Plants glaucous green with metallic sheen; upper leaves much larger (3-5 mm) than the lower ones; apical laminal cells elongate to linear; dioicous, paricous or synoicous .................................................................P. cruda

8. Plants without this combination of characters ...............................................................9
9. Middle leaf cells hexagonal, short elongate or rhomboidal, lax in arrangement, 15-40 um wide ......P. wahlenbergii

9. Middle leaf cells long and narrow, 6-14 um wide

.................................................................10

10. Paricccus or autcicous .......................11

10. Dioicous ..................................................13

11. Capsules long and narrow, with neck nearly as long as the urn .................................................P. elongata

11. Capsules ellipsoid to pyriform, neck much shorter than the urn .........................................................12

12. Leaves plane, ovate-lanceolate, apices acute, common in disturbed sites at all elevations ......P. nutans

12. Leaves mostly concave, ovate, apices obtuse to broadly acute; restricted to high alpine elevations, rare

.................................................................P. obtusifolia

13. Capsules small, less than 1.5 mm long, ovoid to funnel shaped .........................................................14

13. Capsules larger, more than 1.5 mm long, oblong-ovoid to
Pyriform .................. P. drummondii complex
(=P. annotina aggregate)

14. Stomates cryptporous .............. 15

14. Stomates emergent .................. 16

15. Peristome teeth reddish brown ........ P. wahlenbergii

15. Peristome teeth yellow to light yellow brown

........................................ P. vexans

16. Plants yellow greenish; peristome teeth yellow; exothecial cells not ccllenchymatous, annulus present

........................................ P. lescuriana

16. Plants reddish; peristome teeth chocolate brown; exothecial cells ccllenchymatous, annulus absent

........................................ P. atropurpurea

Mniobryum atropurpureum Hag.
Webera atropurpurea C. Jens.

A small distinct species, Pohlia atropurpurea is easily identified by the small, ovoid capsules with chocolate brown peristome teeth. A few specimens have been confused in the past with Pohlia wahlenbergii and P. columbica. Unlike P. wahlenbergii, P. atropurpurea has phaneroporous or emergent stomates. The dark brown color of the peristome teeth will separate it from P. columbica.

Inhabiting stream banks and gravelly roadsides, P. atropurpurea is fairly common in the province. Though scattered across the province, the species is more common on the west coast than in the eastern part of the continent. It is also reported from northern Europe and Siberia.

MacFadden's collections from Silverton (April 25, 1925), Burton City (May 31, 1927) and New Denver (March 20, 1926) were distributed under the name Pohlia carnea (L.) Lindb. The specimens are P. atropurpurea. P. carnea is largely an European species reported also from a few localities in

Representative specimens seen: Slccan (UBC B-6363); Silverton (UBC E-6364); Glacier National Park (CANN 141492).


A segregate species of the Pohlia annotina complex, Pohlia camptotrichela can be identified only with certainty in the presence of bulbils. Only one collection has been so named by Mr. J. Shaw, that is, Tan & Ensing 77-866 from "Pseudo-Shannon" Creek, Valhalla Mountain Range, north of New Denver. Smith's Flora (1978) should be consulted for differences in the bulbil structure among the members of this complex.

Its distribution in the study area as well as in the entire province will not be clear until the complex is studied in the light of bulbil morphology recently proposed by Lewis & Smith (1978). Outside North America, the species is known from Great Britain, Ireland, and continental Europe.
**Pohlia cruda** (Hedw.) Lindb., Musci Scand. 18. 1879.

A common forest species of shaded sites, populations are extremely variable in morphology. Typical populations in favorable habitats are easy to recognize in the field owing to the opalescent pale green color. The dioicous sexuality will further confirm the identity. However, there are populations that are paricous or synoicous. Other specimens which develop deep green color can be difficult to determine and can be confused with **P. nutans**. Crum (1976) noted that **P. cruda**, unlike **P. nutans**, has long to linear upper laminal cells. In general, **P. cruda** also develops linear marginal leaf cells which are much longer than the laminal cells. The same is not true in **P. nutans**.

**P. cruda** is a cosmopolitan species. Its local distribution in the study area parallels that of **P. nutans** and **Ceratodon purpureus**.

Representative specimens seen: Enterprise Creek, Slocan Lake (UBC E-6365); Blazed Creek (UEC E-6366); Champion Lake Provincial Park (UEC E-6367); Meachen Lake, near Kimberley (UBC E-6368).

P. commutata Lindb.
P. gracilis (B. S. G.) Lindb.
P. drummondii var. gracilis (E. S. G.) Podp.

Weterea polymorphoides Kindb.

A variable and difficult species, *P. drummondii* can be identified with confidence only on the characters of the bulbils. The gametophyte is variable, and many varietal names have entered the literature. This species, together with *P. rothii* (Correns ex Limpr.) Broth., *F. filum* (Schimp.) Mart., *P. bulbifera* (Warnst.) Warnst., *P. camptotrachela* (Ren. & Card.) Broth. and *P. muyldermansii* Wilcz. & Demar, form the notorious *P. annotina* complex. Recently, Lewis and Smith (1977; 1978) studied the complex in agar cultures and concluded that all the membered taxa are good and distinct species, each with distinctive bulbil structure. In the study area, typical plants of *P. drummondii* are tall or slender with leaves which are imbricate even when wet. This form superficially approximates *Anomobryum filiforme* (Licks.) Husn., whose leaf areolation, however, is very different from *P. drummondii*. The leaves of *F. drummondii* have a narrow decurrent base as noted
by Lawton (1971), and the stomates are phaneroporous, a character which separates it from *P. wahlenbergii*. The leaf cells of *P. drummondii* are usually elongate, like those of *P. nutans* (Hedw.) Lindb. and *P. cruda* (Hedw.) Lindb. From *P. filum* and other members of the *P. annotina* complex. The taxon is distinguished by bulbil characters as shown in the key to the species.

A widespread north temperate to boreal species, *P. drummondii* is common in open, disturbed sites. Because of the general lack of distinctiveness of the *P. annotina* complex in the field, *P. drummondii* can be easily overlooked and mistaken for the more common species of *Pohlia* and *Bryum*. Its distribution in the area under study is probably wider than that shown in Map 94.

Representative specimens seen: Silverton (UBC B-6369); Glacier National Park (UEC B-6370); Mica Dam area (UBC B-6371).
*Pohlia elongata* Hedw., Spec. Musc. 171. 1801.

_Webera acuminata_ Schimp.

A distinct species, *P. elongata* is best recognized by its long capsules, the neck of which is nearly as long as the urn, coupled by the paricicous or autoicous sexuality.

Known only from four localities, *P. elongata* seems to be rare in the study area. Its occurrence in the province is equally rare and unclear. In North America, Andrews in Grout (1935) reported it as being not common. My collections (Tan & Eising 77-1957, Tan & Teng 78-746 from Sutherland Falls, west shore of Upper Arrow Lake, ca 30 km south of Revelstoke on Hwy 23; Tan & Eising 77-1836 from Glacier National Park; Tan & Scagel 79-573 from Goldstream River, floodplain, north of Revelstoke) came from rock covered with thick humus mixed with sand, a habitat similar to that reported by Nyholm (1954-1969) for the Scandinavian populations. One collection (MacFadden coll, dated June 5, 1926) which came from Three Forks on the New Denver-Kaslo Hwy, consists mostly of *P. wahlenbergii* with only one plant bearing the long capsule characteristic of *P. elongata*.

Macoun's Canadian Musci nos. 419 and 512 named *Webera*
acuminata are good specimens of *P. elongata*. Both specimens came from Glacier National Park.

For variations within the species, see comments by Nyholm (1954-1969) and Smith (1978).


The species is described by Nyholm (1954-1969) to be of large, soft and reddish plants forming tufts in mountains. My specimens (determined by Dr. Ochi) are small, green and soft plants collected at low elevation from a shaded rocky face near the city of Trail. The materials show clearly long decurrent leaf base. However, I am not convinced that the materials (Tan 76-1339, Tan & Ensing 77-14 and 77-16) were correctly identified. Nyholm cautioned against confusing the taxon with *P. drummondi*. If Dr. Ochi is correct in his determination, the collections are one addition to the other two localities reported for British Columbia. Elsewhere, *Pohlia ludwigii* is known from Washington, Colorado, Eastern North America, Europe, and Japan. The species appears to be locally abundant in subalpine late snow areas in the Coast and Northern Cascade
Mountains.


A highly variable species, *P. nutans* is best identified by the presence of a pair of antheridia in the axils of perichaetial leaves, plus the elongate, nodding capsules with short neck. The alpine populations usually become dwarf in growth and may defy positive determination. For the differences between this species and *P. cruda*, see comment under the latter name.

Also a cosmopolitan species. Widely scattered and locally abundant in the study area.

Representative specimens seen: Champion Lakes Provincial Park (UBC B-6372); Trail (UBC B-6373); Glacier National Park (UBC B-6374).

E. cucullata (Schwaegr.) B. S. G.

A species of high alpine elevations, E. obtusifolia is distinguished by its obtuse and concave leaves of the middle and upper part of the stem. The parccicus sexuality is also diagnostic. Caution should be taken not to confuse this taxon with the alpine forms of P. nutans which have acute to acuminate leaves and longer and narrower laminal cells.

Tan & Teng 78-1223 from 7000 ft at St. Mary Alpine Park is the most characteristic specimen of the species I have seen. The population bore abundant sporophytes, and each antheridium occurred singly in its own perigonial tract which extended nearly halfway down the stem. I also collected the species from most of the other alpine areas visited (see Map 96).

Smith (1978) and Lawton (1971) both commented on the rare occurrence of this taxon in their local areas of study. My collections are the first report for British Columbia. I have also seen specimens from Mt. Rainier, Washington. Andrews in Grout (1939) mentioned one collection from Mt. Dana, California; and Lawton (1971) reported it from Montana and
Colorado. *P. obtusifolia* appears to be confined essentially to the western Cordilleran region. It should be sought in Yukon, NW Territories and Alaska. Also known from Japan, Europe, Greenland and Central Asia.

Representative specimens seen: St. Mary Alpine Lakes (UBC B-6375); Glacier National Park (UBC E-6376); Kokanee Glacier Provincial Park (UBC E-6777).


**Pohlia annotina** (Hedw.) Lindb. var. *decipiens* Loeske

This is the most distinctive member of the so-called *Pohlia proligera-annotina* complex. The bulbils which are elongate to long, and twisted are usually abundant on sterile stems. Smith (1978) recently reduced *P. annotina* var. *decipiens* to a synonym of *P. proligera* arguing that the bulbils produced by the two species intergrade. On the other hand, Crum (1976) contended that there was no difficulty in distinguishing the bulbils of the two. I concur with Smith.
P. proligera is rather common in the study area. Its distribution in the province is not clear at present because the many specimens may have been filed under the other binomials of this aggregate. A circumboreal species of high latitudes.

The MacFadden collection from Bear Lake, 25 June, 1926, which was distributed as P. annotina Schwaegr. should be placed here. Macoun's Canadian Mosses 129 & 452 from a ditch and springy place at Revelstoke distributed under the name Microbryum albicans are P. proligera (CANM!).

Representative specimens seen: Mouth of Gold River, north of Golden (UBC B-6378); Enterprise Creek, Slocan Lake (UBC B-6379); Bugaboo Glacier Provincial Park (UBC B-6380).
Pohlia lescuriana (Sull.) Andrews in Grout, Moss Flora N. Am. 2: 201. 1935.

Webcera pulchella (Hedw.) Fuernr.

An uncommon to rare species in eastern North America, P. lescuriana is reported here for the first time from western North America. A few specimens from other parts of British Columbia were also discovered in UFC and CANM. These were all misidentified as P. vexans.

P. lescuriana has distinctive superficial stomates and a revoluble annulus, which characters are absent in P. vexans. From P. wahlenbergii, it is separated by its yellow peristome teeth and superficial stomates and from P. atropurpurea, also by its yellow exostome.

The only collection from the Kootenay area is MacFadden 18795 from the Nakimu Caves, Glacier National Park dated July 25, 1941. No habitat information was supplied by the collector. Elsewhere, the species is an inhabitant of damp roadside ditches, banks and also creek margins. A widely scattered circumpolar species.

The name P. lescuriana takes precedence over P. pulchella (Hedw.) Lindb. which is an illegitimate homonym, as explained

A somewhat rare to uncommon species in Western North America, it was collected only once by MacFadden from New Denver (CANM 141429) and was misdetermined as Pohlia pulchella. The stomates are distinctly immersed and the peristome teeth are yellowish in color. Possibly, there are a few more populations of present species in the study area awaiting discovery. Superficially, the species closely resembles P. lescuriana (=P. pulchella), especially in the field. See the latter name for more comments.

Known also from Europe and Asia.
**Pohlia wahlenbergii** (Web. & Mohr) Andrews in Grout, Moss Flora N. Am. 2: 203. 1935

**Pohlia albicans** (Wahlenb.) Lindb.

**Mniobryum wahlenbergii** (Web. & Mohr) Jenn.

**Weberea albicans** (Wahlenb.) Schimp.

A common species in the study area, the large form of **Pohlia wahlenbergii**, even when sterile, is quite distinctive in its loosely tufted habit. Individual plants are pale green and bear distantly positioned ovate to lanceolate leaves. The leaves become twisted near the apex when dry. Male plants produce attractive bulbiform perigonia. The short capsules at the end of long setae add to the species' distinctiveness. This species, however, has a wide ecological amplitude and produces many variant forms as a result of diverse environmental influences. The typically broad, rectangular, thin-walled laminal cells are sometimes narrower and longer with thicker cell walls. The variation can be mistaken for other members of the Section *Mniobryum*, most frequently *P. atropurpurea* and *P. columbica*. From the latter, *P. wahlenbergii* differs in possessing brownish peristome teeth and not or slightly collenchymatous exothecial cells. Tan et al. (1980b) recently discussed in detail the use of
sporophytic differences in defining this species from its related taxa. See also comments under *P. atropurpurea* for the differences between the two taxa.

A common species of wet sites, *P. wahlenbergii* is a cosmopolitan taxon.

The MacFadden collection 4214 determined as *Webera pulchella* is dioicous, with plane leaf margins and cryptoporous stoma. It is a small form of *P. wahlenbergii*. Likewise, the MacFadden collection dated June 5, 1926 bearing the name *Webera columbica* is also *P. wahlenbergii*.

Representative specimens seen: New Denver gorge (UBC B-6381); Enterprise Creek (UBC B-6382); Fend' Oreille River (UBC B-6383).

*Roellia* Kindb.

A distinct monotypic genus that resembles members of the Family Mniaceae in gross appearance, but the leaf areolation and sporophyte are definitely bryoid. The single species, *Roellia roelli*, is a western North American endemic.

Eryum sandbergii Hclz.

The largest of the Family Eryaceae in western North America, R. roellii is common in the mesic coniferous forested sites at subalpine elevations in the Selkirk and Purcell Mountains and is frequently encountered with sporophytes. The long cylindric capsules that measure more than 5 mm long and the long seta are striking for the species among the members of the Family Eryaceae. Its taxonomic position in the family has been discussed by Crum (1967) who argued in favor of the recognition of a separate genus, Roelli, with one species. For complete synonymy, consult Crum (1967).

Representative specimens seen: Kokanee Glacier park (UBC B-6331); Dipper Lake area, Kimberley (UBC F-6332); Champion Lakes Provincial Park (UEC B-6333).
I follow Koponen (1968) in accepting four genera of the Family Mniaceae as present in my area of study.

The genus Cyrtcmnium was first proposed in 1957 by K. Holmen. The differences between this taxon and Mnium from which it was segregated were discussed in Eryologist 60: 135-138, 1957. Of the two species of Cyrtcmnium known today from the province, C. hymenophyloides (Hub.) Kop. is the one more likely to be present in the southeastern mountains of Kootenays because it has been discovered from nearby Jasper National Park (Canadian Rocky Mountains). Secondly, C. hymenophyloides has a more southern distribution than C. hymenophyllum (B. S. G.) Holmen which is a high arctic species of wetland habitats (Koponen, 1974). The genus is, therefore, included in the key to the local genera although no collections were made from the Selkirk and Purcell Mountains.

1. Plants dendroid .................................. Leucolepis

1. Plants not dendroid ............................. 2
2. Leaf margins unistratose throughout ...3

2. Leaf margins at least partially or wholly bi- to multistratose ..................5

3. Leaf margin serrate, singly toothed ...Plagiomnium

3. Leaf margin entire ..................4

4. Stomata of the capsules cryptoporous; gametophytes with some reddish color ....................Rhizomnium

4. Stomata of the capsules phaneroporcorus; gametophytes never with reddish color ...................(Crytomnium)

5. Leaf margin entire ..................Rhizomnium

5. Leaf margin serrate, usually doubly toothed

.................................Mnium
Leucolepis Lindb.

This is a distinctive monotypic genus endemic to western North America.

Leucolepis menziesii (Rock.) Steere in Koch, Leafl. West.


The large, dendroid habit of this species is unmistakable. The laminal cells of the stem leaves are at times fusiform and elongate, quite unlike those seen in the rest of the family. It is very common in the coastal regions, becoming uncommon in the interior wet humid forests of the Columbian Mountains, being confined apparently to the wetter Selkirk Range (Map 101).

Representative specimens seen: St. Leen Creek Hotspring (UBC B-6569); Gray Creeks, Kootenay Lake (UBC E-6570); Beatrice Lake, Valhalla (UBC E-6571).
The name *Mnium* is a nomen conservandum. The original concept used by Hedwig in 1801 was too inclusive and heterogeneous. In recognition of the evidence derived from morphology, chromosomes and spore characters (Lowry, 1948; Koponen, 1968; Scrsa & Koponen, 1973), I have decided to follow the generic revision proposed by Koponen (1968). The genus in strict sense consists of only mnioid plants having at least partially bi- to multistratose leaf border with double teeth or serration.

*Mnium* has about 12 known species (Smith, 1978), most of which are northern hemisphere taxa. The habitat of *Mnium* species is essentially in shaded woodland sites at various elevations. There are six species of *Mnium* known today from British Columbia, all of which are in the study area.

1. Blue postmortem colour present in the cell sap of specimens revived in water or KCH solution; leaf costa ending well below the apex; leaf margin nearly entire, at times weakly toothed .................................. *M. blyttii*
1. No blue colour present in the cell sap; leaf costa clearly percurrent to excurrent; leaf margin markedly toothed

2. Laminal cells mostly elongate to rectangular, marginal cells not clearly differentiated from the laminal cells; leaf margin serrate to serrulate along the upper half of the leaf only

2. Laminal cells mostly hexagonal, round or quadrate, rarely rectangular; leaf marginal cells elongate, clearly differentiated from the rest of the laminal cells; leaf margin serrate to leaf base

3. Leaf marginal teeth small and blunt, sometimes rudimentary

3. Leaf marginal teeth long and sharp

4. Plants synoicous; peristome teeth dark brown; leaf costa lacking dorsal teeth or with only few small ones

4. Plants dioicous; peristome teeth yellow; leaf costa with distinct dorsal teeth

5. Laminal cells small, less than 17 \( \mu m \) wide, thick-walled;
cells beside the costa and leaf margins of nearly equal size; calcicole .......................... M. thomsonii

5. Laminal cells larger, more than 17 μm wide, thin-walled; cells near the costa clearly larger than those near the leaf margins; not calcicole .......................... M. lycopodioides

*Mnium arizonicum* Amann, Rev. Bryol. 52: 23. 1925.

Only one collection is known from the study area. The specimens were collected by G. Hazelwood from the top of a mountain between Mt. Icencclast and Mountain Creek in Glacier National Park at 2760 m (UBC). The species, however, has been known for many years from the nearby Canadian Rockies in Alberta, and it is reported to be common in Idaho, Utah, Colorado, Nevada, Wyoming, and Arizona. The Hazelwood collection is also the first specimen seen from the province. No habitat information was provided on the label of the packet. Elsewhere, *M. arizonicum* grows on rather dry soil and humus in rock crevices, along creek banks, and on fallen logs at high elevation (upper subalpine). Recently, Schofield (pers. comm., 1980) collected it from a few localities in the dry
Okanagan region of this province.

The species is easy to recognize. It has a weakly differentiated leaf border and a weak serration as well. The small size of the plants and the rhomboidal to elongate, pitted laminal cells aligned in neat, diagonal rows from the costa to leaf margin are additional diagnostic characters. The only species that may be mistaken for it are *M. blyttii* and *M. stellare*. Both have, however, a positive blue postmortem colour appearing in the cell sap when the specimen is soaked in water or KOH solution.

A North American endemic, *M. arizonicum* is also known from the NW territories (Koponen, 1974).


*M. blyttii* is probably best determined by the blue colour which appears in the cell sap of dry plants soaked in water or KOH solution. The short costa which ends well below the leaf apex is equally uncommon in the genus, and the illustrations (plate 85, fig. 4) in *Flowers* (1973) are excellent. Specimens of *M. blyttii* with weakly developed to rudimentary marginal
teeth, are hard to distinguish from *Cyrtomnium hymenophyllum*. One has to rely then on the blue postmortem colour test. In addition, in *C. hymenophyllum*, the leaf marginal cells are usually broadly rectangular to shortly elongate, whereas in *M. blyttii*, they are slenderly elongate. The rhizoids of *Cyrtomnium* are in general much more strongly and coarsely papillose than their counterparts in *M. blyttii* when seen under the light compound microscope.

*M. blyttii* grows in wet sedge meadows and is sometimes very abundant near timberline, though occasionally populations extend down to 910 m elevation (cf. M. Bell, s. n., Aug. 25th, 1958, Stevens Pass, near Arrow Park, UBC). Outside the study area, it is known from Alaska, Yukon, NW territories, Washington, Colorado, Montana, north and central Europe, Siberia, Japan, Greenland. Koponen (1974) and Nyholm (1954-1969) agreed that the taxon is an arctic and hemiarctic plant. In the more southern latitudes, it is found only at alpine and upper subalpine zones, preferring calcareous soil (Map 98).

Representative specimens seen: Headwaters of Lyle Creek (UBC B-6544); Kokanee Glacier Park (UBC E-6545); Meadow Mountain Alpine Recreation Park (UBC B-6546); Glacier National Park (UBC B-6547).

According to Koponen (1974), *M. lycopodioides*, *s. str.*, is a temperate east Asiatic and central European species. The taxa described from North America and lumped into the present species are: *M. crthorrhynchum* var. *tenellum* Bruch & Schimp., *M. macounii* Kindb., *M. pseudolycopodioides* C. Muell. & Kindb., and *M. umbratile* Mitt. The relationship among these constituent species is unclear, and *M. lycopodioides* is hereby accepted in its broad sense.

The species differs from *M. thomsonii* in the characters listed in the key, and it is more widespread in the study area than *M. thomsonii*. The explanation is that *M. thomsonii*, being a strict calcicole, is restricted in distribution by the lack of extensive limey cutcrepso in the Selkirk and Purcell Mountain Ranges.

As observed, *M. lycopodioides* grows on the forest floor, tree bases, rock faces and cliff crevices. Outside British Columbia, *M. lycopodioides* is scattered through all provinces and states. Widespread in Europe and Asia, it is basically a northern boreal species.

Representative specimens seen: Kokanee Glacier Park (UBC B-6548); Purcell Wilderness Conservancy (UBC B-6549); Beatrice
Lake, Valhalla Range (UEC E-6550).


This species is distinctive in its synoicous sexuality and smooth costa without dorsal teeth. Smith (1978) maintained that there are dioicous populations of *M. marginatum* in Great Britain and Ireland.

Throughout the province, the species is rather uncommon. *M. marginatum* prefers shaded creek banks at lower elevation. Fruiting specimens have been collected from the study area and are monosetose. It is known also from Alaska, Yukon, Washington, Montana, and Idaho. Koponen (1974) stated that the species has a wide distribution across Canada, except Prince Edward Is. and Saskatchewan.

Representative specimens seen: Curtis Creek, near Salmo (UBC B-6551); Rosebery (UBC B-6552); Champion Lakes Park (UBC E-6553).

A widespread species in the southern boreal zone, *M. spinulosum* is the most common species of the genus in the study area. It commonly produces sporophytes owing to its synoicous sexuality. Its dark brown peristome teeth, slightly twisted and shiny green leaves (when dry), strong marginal teeth and nearly excurrent costa without dorsal teeth are all good diagnostic characters. Koponen (1974) maintained that the British Columbian plants are usually larger and more frequently polysetose than those from central and eastern Canada. Found also in Alaska, Oregon, Washington, eastern North America. Circumboreal.

Representative specimens seen: Kokanee Glacier Park (UBC B-6536); Nakusp (UBC B-6537), Mt. Revelstoke National Park (UBC B-6538); Kinbasket Lake (UBC E-6539).

Mnium crthorrhynchum C. Muell. auct. non Brid.

The species is most closely related to M. lycopodioides and can best be distinguished from it by the laminal cells near the leaf costa and those near the leaf margin which are nearly equal in size. The laminal cells of M. thomsonii are in general smaller in size and have thicker cell walls when compared to M. lycopodioides. Corner thickening of laminal cells has been employed by many bryologists (Koponen, 1974; Nyholm, 1954-1965; Lawton, 1971) in distinguishing the two taxa. Specimens of M. thomsonii from the study area may or may not exhibit the "collenchymatous" laminal cells. Hence, I consider this character to be unreliable. In habitat, M. thomsonii is more discriminating and grows only on calcareous substrata.

A circumpolar species, ranging from Greenland to Alaska, south to California, New Mexico and Arizona.

Representative specimens seen: Golden (UBC B-6540); Wilson Lake vicinity (UEC E-6541); Purcell Wilderness Conservancy (UBC B-6542); Coffee Creek, Kootenay Lake (UBC E-6543).
As proposed by Koponen (1968), the genus consists of mnioid plants that have a unistratose border with teeth in a single row. The genus is cosmopolitan in distribution with approximately 20 species. In 1968, Schofield listed 9 species of *Plagicmnium* for the province, eight of which are present in the study area.

North American plants labelled as *Mnium affine* are either *P. drummondii* (Eruch & Schimp.) Kop. or *P. medium* (B. S. G.) Kop. True *P. affine* is said to be Eurasian in distribution with possible occurrence in northern Africa (Koponen, 1971a).

The key to the species of *Plagicmnium* in the study area presented below is modified after Koponen (1974).

1. Plants calcicolous; stolon present, strongly complanate, tightly attached to the substratum; leaf apices emarginate to obtuse, occasionally apiculate; operculum rostrate

................................. *P. rostratum sensu stricto*
1. Plants not strictly calcicolous; stolons absent or if present, not attached firmly to the substratum, not strongly complanate; leaf apices acute to cuspidate, never emarginate; operculum not rostrate ........2

2. Leaves serrate or serrulate from apex nearly to base ...........................................3

2. Leaves serrate or serrulate from apex to middle, never to base ...........................................7

3. Plagiotropic stolons absent; leaf costa in section without stereids ...............................P. venustum

3. Plagiotropic stolons present; leaf costae in section with bands of stereids ......................4

4. Leaves slightly or not decurrent; laminal cells mostly in elongate rows; marginal teeth short and blunt, becoming rudimentary toward leaf base ...........P. ellipticum

4. Leaves strongly or broadly decurrent; laminal cells mostly polygonal, or if elongate, marginal teeth long and well developed, rarely short .................5

5. Synoicous; laminal cells with weak corner thickenings, those near margin clearly smaller than those near the costa
5. Dioicous; laminal cells with strong and distinct corner thickenings, those near the margin slightly smaller or equal in size with those near the costa .......6

6. Leaf marginal teeth long, with blunt tips, mostly 2-3 (4) cells; laminal cells clearly elongate; monosetose

.........................P. ciliare

6. Leaf marginal teeth shorter, but with sharp tips, mostly 1-2(3) cells; laminal cells mostly isodiametric to polygonal; polysetose .......................P. insigne

7. Leaves twisted when dry; laminal cells with thick walls, showing distinct corner thickening; monosetose

..........................P. cuspidatum

7. Leaves not twisted when dry; laminal cells with thin walls, no corner thickening; polysetose .......P. drummondii

Mnium ciliare (C. Muell.) Schimp.

Koponen (1971a) reported this species from Revelstoke based on Macoun's collection made in 1880. I have been unable to locate the Macoun specimens, nor did I recollect the species from the same area. *P. ciliare* is often confused with specimens of *P. medium* that have well developed teeth consisting mostly of only 2 cells. *P. ciliare*, on the other hand, very often has leaf marginal teeth consisting of 3-4 cells. Specimens of *P. drummondii* have also been misidentified as *P. ciliare*. The lack of marginal teeth toward the lower half of the leaves should help reveal the identity of *P. drummondii*.

*P. ciliare* has a strong eastern distribution in North America with disjunct extensions in British Columbia and Alberta. In the province, the species seems to be confined to the vicinity of the Canadian Rockies and the south eastern ranges of the Columbia Mountains.

Mnium cuspidatum Hedw.

There is only one collection of this species known from the study area. The specimen (UBC E-6554) was collected by MacFadden in June, 1926 from an old ledge at the head of Slocan Lake. The species is distinctive in its marginal serration reaching only halfway down the leaf, and the corner thickenings of laminal cells. In addition, the much twisted leaves (when dry) and the small plant size, 2-3 cm tall, are good diagnostic characters that help to separate the species from the closely related P. drummondii.

It is reported to be widespread in U. S. and Canada. It is, however, very rare in the study area. Lawton (1971) remarked that the species is rare in the Pacific Northwest. Also found in Europe and Asia.

Sexuality of the species is monoecious, with sporadic populations of dioecious plants (Koponen, 1974).

Mniium drummondii Fruch & Schimp.

A common eastern North America species, *P. drummondii* has a more northern distribution in British Columbia. The species, however, is common, especially in the areas north of Revelstoke and Golden. For more comments of its taxonomic characters, see *P. cuspidatum*. Specimens have been collected in the study area from low elevations to subalpine and from a wide range of substrata and sites: decaying logs, wet ground, creek banks, and in open and closed forests. Also reported from Washington, Montana, Alaska, and Alberta. Reported from Europe and Siberia.

Crum (1976) remarked that the species is best recognized by the clustered sporophytes, scarcely contorted leaves (when dry) and the larger, more regularly hexagonal laminal cells, with no corner thickenings, when compared to *P. cuspidatum*.

Representative specimens seen: Revelstoke (UBC B-6555); Revelstoke area (UBC E-6556); Nakusp area (UBC B-6557).
1971.

Mnium rugicum Laur.

Plagiomnium rugicum (Laur.) Kcp.

Plagiomnium ellipticum differs from all other species of the genus in the study area by the absence of decurrent leaf bases, and by having smaller or shorter leaf marginal teeth mostly one cell in length (Koponen, 1974). From P. rostratum, fertile material can be separated by the conic (and not rostrate) operculum. Sterile specimens of P. ellipticum can be determined by the more elongate laminal cells, and by the cuspidate to mucronate leaf apices which are never emarginate as in P. rostratum. The loosely attached plagiotropic stolon is also diagnostic of P. ellipticum. The habitat preference of the species seem to be wet boggy sites and swampy meadows, or by lake margins. A boreal species in both northern and southern hemisphere. In North America, it is present in most of the provinces and states.

One MacFadden collection from Silvertown, June 21, 1928 exhibits a polysetose condition of the sporophytes (MACF).

The few specimens collected from the study area are:
Tan & Ensing 77-155, forming mat in wet swampy area, Champion Lakes Provincial Park (UBC B-6559); Tan & Teng 78-993, on marshy ground, roadside calcareous swamp, Glacier National Park (UBC E-6559); and Tan & Teng 78-1069, in marshy area in Spillimacheen Mountain Range (Purcell Mts.), 3 miles west of Parson (UBC B-6560).


Mnium insigne Mitt.

This common endemic species of the North American Pacific Northwest coast is a rarity in the study area. Only two collections were seen, although several localities are reported from Idaho and Montana. When well developed, it is very distinct and easy to identify. Its large size, long and broad decurrent leaves and polysety are noticeable even to the naked eye. The only other species that can be confused with it is P. medium. Nevertheless, P. insigne is dicocious and P. medium is monocious. For the differences in sterile material, consult
Koponen (p. 335, 1971).

The species share similar ecological preferences both in the interior wet belt and the coastal zone: that of mesic to moist woodlands.

Collections seen from the study area are: Tan & Teng 78-265, in disturbed secondary forest by Earrett Creek, north of Ymir, 3500 ft; Revelstoke area, Downie Ck, Krajina, s. n., 1954; and Goldstream Basin, in mature western Hemlock forest, Tan & Scagel 79-539.

Several other specimens from Kootenay at the UBC Herbarium so named are either P. medium or P. drummondii.

Mniium medium F. S. G.

This is the most common species of the genus in the study area. The shape and size of laminal cells appear to be variable, ranging from isodiametric, hexagonal to elongate, or a mixture of all shapes, but never arranged in clear rows. As such, the taxon is often confused with other species, most especially P. insigne. For differences of the present species and P. insigne and P. ciliare, see comments under these species. The overall tomentose fertile shoots and relatively more elongate laminal cells in P. medium aid in most cases in separating it from the related taxa.

In the study area, P. medium was collected from a variety of moist to wet substrata: logs, rock faces, creek margins and forest floor. It is most abundant at lower subalpine elevations. Perhaps, it replaces P. insigne in the interior wet belt zone. Across the North American continent, its distribution essentially shows an east-west disjunction with no records from the intervening prairie zone. Also found in Europe, Asia, Japan and Greenland.
A specimen collected by MacFadden from Slocan, Kootenay on June 6, 1923 and distributed as *Mnium affine* is *P. medium*.


*Mnium rostratum* Schrad.

The species has a sporadic distribution in the west coast, and the pattern is reflected in the study area. The plants seem to prefer very wet sites in calcareous regions, and it is, thus, limited in its range of distribution. A total of four populations are known from the Kootenay region: Tan & Ensing 77-486, on wet rock, near "Scleropodium Falls" at the mouth of Tulip Creek, west of Syringa Creek Park, Lower Arrow Lake; Tan & Ensing 77-1202, on wet rock, Fry Creek Canyon Recreation Area, near Johnson Landing settlement, east shore of Kootenay Lake; Deer Park area (CAKM 146320); and Revelstoke area (CANM 146316). All specimens have no sporophytes. It is known also from Alaska, Washington, Oregon, Idaho, Montana and the eastern part of the continent. Andrews in Grout (1935, vol. II)
remarked that the species is essentially subtropical in
distribution, more common in the southern states of U. S. He
further added that although the species is the only member of
the family to attain a nearly worldwide distribution, yet
specimens are not common anywhere or at least not often
encountered.


Mnium venustum Mitt.

Like P. insigne, the species is another Pacific Northwest
endemic element. It is the most distinct species in the genus
in the study area and can be identified quickly in the field.
When dry, the leaves are strongly twisted owing perhaps to the
lack of stereids in the leaf costae. The lack of stolons is
equally characteristic. Koponen (1974) described the stomatal
cells on the capsules as visibly manillose, a feature unique in
the genus. The marginal teeth of the leaf of P. venustum are
long (2-3 cells) and sharply pointed, unlike those of
P. ciliare which are long (2-4 cells) but blunt at the tips.

The occurrence of *P. venustum* in the province is restricted to the southern part of the Coast Mountains and the Columbian mountains, though the species does reappear locally on the Queen Charlotte Islands (Schofield, 1976). In the study area, populations of *P. venustum* are consistently collected from wet soil or humus on rock and cliff faces along creeks or lake margins. It is fairly common in the area (Map 99).

Representative specimens seen: Three Forks (UBC B-6564); Ainsworth Hot Springs (UBC B-6565); Fry Creek Canyon (UBC B-6566).

**Rhizomnium** (Broth.) Kop.

This is a genus of about 10 species in the northern hemisphere. *Rhizomnium*, as redefined by Koponen in 1968, is characterized by at least partially bi- to multi-stratose and entire leaf margins. Exceptions are *R. gracile* Kop. and *R. andrewsianum* (Steere) Kop. whose leaf borders are unistratose. Rhizoids on the stems are of two kinds: macronemata and micronemata, and are reported to have taxonomic significance (Koponen, 1968). The macronemata are the large, profusely branching rhizcids originating from the area
surrounding the bud structures, whereas the micronemata are the slender rhizoids scattered over the surface of the stem. In general, the rhizoids are most abundant on specimens growing in wet habitats. As taxonomic characters, the nature of rhizoids should be used with caution.

Schofield (1968a) listed five species for the province. Since then, Koponen (1974) has added R. magnifolium and R. gracile, and removed R. andrewsianum as a high arctic species known only from Yukon and NW Territories. Thus, there are now 6 species of Rhizomnium known from the province, all of which were collected from the study area.

For distributional information of the genus on a worldwide basis, consult Koponen (1974).

1. Micronemata present on the main stem ...
2. Micronemata absent or confined only to the basal part of the main stem 

1. Micronemata present on the main stem ..2

2. Plants usually large, leaves up to 10 mm long; costa percurrent or ending just below the apex; capsules ovoid to ellipsoid, peristome teeth yellow .... R. magnifolium

2. Plants smaller, leaves not more than 7 mm long; costa rarely percurrent, usually disappearing 5 cells below the apex; capsules nearly globose, peristome teeth brown

...............................3
3. Leaves small, approximately 4 mm long; leaf border unistratose throughout; dioicous ........R. gracile

3. Leaves larger, approximately 6 mm long, leaf border bistratose at base; synoicous ........R. pseudopunctatum

4. Leaves not contorted when dry, border weak especially near apex; costa not reaching the apex; operculum short conic ..................................................R. nudum

4. Leaves contorted when dry, border strong throughout; costa often percurrent; operculum rostrate to conic ..........................................................5

5. Laminal cells mostly isodiametric to polygonal, cell walls pitted with distinctly developed corner thickenings ............................................R. glabrescens

5. Laminal cells elongate, not pitted, cell walls equally thickened ........................................R. punctatum

Mnium glabrescens Kindb.

A distinct western North American endemic species, R. glabrescens is reported to be widely distributed in the southern half and coastal regions of the province (Schofield, 1976). It is, however, very rare in the study area. At present, only two collections are known: TAN 76-358, inside a mature forest, near Revelstoke and R. Fell, s. n., June 30, 1959, in a dense immature forest, Eurtcn, Fast Kootenay. Both collections differ slightly from the coast populations in that the corner or angular thickenings of the laminal cells are not strongly developed.


The small plant size, together with the leaves which are
only approximately 3 mm long, and the unistratose leaf margins are distinctive features for the species. As presently known, the species has a northern distribution in the province, around Dease Lake area, Alaska–EC border and Moose Lake, Yellowhead Pass. The Kckanee Glacier Provincial Park population (Tan & Teng 78-352, along creek margin, open site, trail to Sunset Lake vicinity) not only is a new record for the study area, it is also the southernmost population in British Columbia for the taxon.

*R. gracile* has a wide range of distribution in boreal North America.


*R. punctatum* var. *elatum* (Schimp.) Kop.
*R. perssonii* Kop.
*Mnium magnifolium* Horik.

The large mature leaves measuring up to 10 mm in length coupled with the densely micrchnematous stem are characteristic
features of the species. However, there are populations that produce smaller leaves, and can be mistaken for
*R. pseudopunctatum* (cf. Tan & Teng 78-985 collected from Mt. Sir Sanford vicinity, north of Golden). The uncertainty of identification can be resolved by seeking leaves with percurrent costae in *R. magnifolium*. On the other hand, some populations of *R. magnifolium* produce new, erect, secondary stems devoid of micronemata, and specimens can be confused with *R. glabrescens*. These two taxa, however, differ drastically in the shape of the laminal cells that form the apical border. As first noted by Smith (1978), the border cells at the leaf apex of *R. magnifolium* are rectangular in shape with truncate end walls, whereas in *R. glabrescens*, the end wall is prosenchymatous (cf. Koponen, 1974, figs. 56 & 57).

Herbarium specimens at UBC, identified as *Mnium punctatum* var. *elatum* Schimp. and collected by MacFadden from Rosebery road to New Denver, from Glacier National Park and Ten Mile Creek, Slocan Lake, are all *R. magnifolium* fide Koponen's determination.

In the study area, it is the most common and abundant species in the genus. It grows mostly in habitats with running water such as creek banks, but also in seepy woodlands, pond margins and lake shores. Present also in *Sphagnum* fens at subalpine elevations.

The species appears to have east-west disjunctive centers of distribution in North America. Circumboreal.
Representative specimens seen: Revelstoke area (UBC B-6525); Nakusp Hotspring Park (UBC E-6526); Fishermaiden Lake (UBC B-6527); Kckanee Glacier Park (UBC E-6528).


 Mnium nudum Britt. & Williams

The broadly elliptic to nearly circular, shiny dark green leaves, which are not contorted when dry, plus the naked stems, are good diagnostic characters to use in identifying the species. It is rather widespread and abundant locally, growing on a variety of substrata such as logs, humus cover, cliff, stream banks, wet bogs, and in meadows. It is distributed vertically at all elevations, and has been collected from above 2140 m near the permanent snow line. It is a good example of the so-called North Pacific elements (Koponen, 1971c). Outside the main range of distribution in western North America, it is also known from Japan.

Representative specimens seen: Ainsworth Hotspring (UBC B-

Mnium subglobosum E. S. G.

Often confused with small forms of *R. magnifolium*, *Rhizomnium pseudopunctatum* is identifiable by the distinctly pitted leaf cells, the shorter non-percurrent leaf costa, the basally bistratose leaf margins, the globose capsules, the brown peristome teeth and, above all, the synoicous sexuality.

The MacFadden collection from Jackson Basin, Sandon dated June 28, 1926 and labelled as *Mnium subglobosum* is *Rhizomnium pseudopunctatum*.

In the study area, the species is common on the eastern side of the Purcell Mountain Range and the nearby Canadian Rockies, a distribution possibly related to the more basic substrate. Outside the province, it is widespread across the
continent. Also known from Europe, Asia, Greenland and Taiwan.

Representative specimens seen: Jackson Basin (UBC B-6533); Purcell Wilderness Conservancy (UBC E-6534); Stagleap Park (UBC B-6535).


*Mnium punctatum* Hedw.

As clarified by Koponen (1974), *R. punctatum* is closest to *R. glabrescens*. Both have naked stems. The apical border cells of the leaf and the percurrent costal condition of the two species are also similar. However, *R. punctatum* differs from the latter in having clearly elongate laminal cells that are without distinct corner thickenings.

*R. punctatum* is rare in the province, and all records elsewhere in northwestern North America should be accepted only after counterchecking the identity of the specimens. Many bryologists in the past have included *R. magnifolium* in the present taxon, hence, the confusion that ensued. Koponen
(1974) suggested that the North American populations of *R. punctatum* belong to subsp. *chlorophyllosum* (Kindb.) Kop. and are different from the European plants. *R. punctatum* is therefore mainly an eastern North American taxon with a disjunct distribution in British Columbia and Idaho State (Koponen, 1974).

In the study area, I have seen only one specimen from a wet rock, Hamil Creek Trail to Earl Grey Pass at Purcell Wilderness Conservancy (Tan & Teng 78-506). The populations mentioned by Koponen (1974) from Revelstoke area (Macoun 127) and Big Eddy of Columbia River (Taylor 5538) are in CANM, MICH and NY, and were not available for study.

Known also from Europe, Caucasus, Asia and Greenland.

**FAMILY AULACOMNIACEAE**

A family of two genera in the north and south temperate regions. Only *Aulacomnium* is known in North America.
Aulacccniuin Schwaegr.

This is a genus of eight species scattered in Europe, Asia, Africa, North and South America, and Oceania. Four species are known to the province, two of which are in the study area. *A. turgidum* Schwaegr. was reported from Slocan Lake and is based on a misidentification of *A. palustre* (CANM 418389).

1. Leaf apex strongly serrate, acute to short acuminate, basal laminal cells neither inflated nor colored; gemmae fusiform, forming a dense spherical mass at the apex of an attenuate shoot ..............................................*A. androgynum*

1. Leaf apex serrulate, slenderly acuminate, basal laminal cells swollen and often colcred; gemmae leaf-like, loosely scattered along the apical part of an attenuate shoot ..............................................*A. palustre*

This is very common on damp and decaying logs or moist rootstumps in all habitats in the study area. The globular mass of gemmae borne at the tip of an attenuate shoot is a useful field character for the species. Capsules are frequent. Populations are occasional on shaded wet banks of lakes and swamps.

Common in the province and across the continents of North America and Eurasia.

Representative specimens seen: Syringa Creek Park (UBC B-4333); Champion Lakes Provincial Park (UBC B-4334); Rosebery Campsite (UBC E-4335).


This is a widespread species, though less common than A. androgynum in the study area. At high elevations, especially around the margin of most alpine lakes, it is the
common species of the genus encountered. Plants of *A. palustre* are large (commonly 6-10 cm tall) and the stems are covered with reddish rhizoids. Under the microscope, the strongly trigonous laminal cells are distinctive. Although the two species of *Aulacomnium* have similar habitat preferences in the study area, *A. palustre* is more frequent on marshy or muddy ground than on decaying logs.

Also a circumboreal taxon in the northern hemisphere.

Representative specimens seen: Champion Lakes Provincial Park (UBC E-4330); Kackanee Glacier Park (UEC B-4331); Gray Creek, Kootenay Lake (UEC E-4332).

**FAMILY MEESIACEAE**

Meesiaceae is a family common to wetlands or wet sites in boreal zones. It consists of three genera with species in northern and southern hemispheres (Chen, 1968). All genera are represented in the province and in the study area. The family is most interesting in having very diverse gametophytic evolution but shares a common pyriform capsule that resembles a question mark borne on the seta.
1. Leaves strongly squarrose-recurved ....2

1. Leaves not strongly squarrose-recurved 3

2. Leaf cells mamilllose ......................Paludella

2. Leaf cells smooth .........................Meesia

3. Laminal cells thin-walled, parenchymatous

..............................................Amblyodon

3. Laminal cells thick-walled, not parenchymatous

..............................................Meesia

Amblyodon E. S. G.

A monotypic genus with a Funaria-like gametophyte and a Meesia-like sporophyte. The thin-walled laminal cells resemble a fine mesh under the 10X field magnifying lens. Smith (1978) contends that the cytological evidence clearly indicates the genus to belong in the Family Meesiaceae.
Amblyodon dealbatus (Hedw.) B. S. G. Bryol. Eur. 10.
1841.

A rare species in the province, it is equally rare in the study area. Collected twice from the swampy margin of Echo Lake near Parson on Hwy 55 (UBC B-4375) and Columbia Lake near the Dutch Creek Hoodoos (UBC B-4376). Both localities are in the calcareous soil area. The only other collection from the province at UBC is from Tokumm Creek, Kootenay National Park.

A widespread but locally always rare species in the northern hemisphere

This report is new to the study area.

Meesia Hedw.

This is a distinctive genus, easy to recognize by the shape of the capsules. It consists of 10 species throughout the world and three are reported for British Columbia. To date, only M. uliginosa is found in the study area. M. triquetra (Richt.) has been collected from Mt. Robson
Provincial Park, Wells Gray Provincial Park north of the study area, and Cusson Creek just west of the Lower Arrow Lake. Its presence in the study area is very likely. It is a peatland species, and if present in the study area, is probably rare since extensive development of bogs and fens is lacking in Selkirk and Purcell Mountains.

1. Plants tall, more than 50 mm; leaves squarrose, margins serrate above, not strongly recurved ...(M. triguetra)

1. Plants short, less than 30 mm; leaves not squarrose, margins entire or indistinctly serrulate at apex, strongly recurved ......................M. uliginosa

M. trichodes (L.) Spruce.

A fairly common species in calcareous sites of the study area (Map 103). It is often collected with Tomentypnum nitens. Schofield (1976) observed it to be more common in swampy and peatland areas in the northern half of the province, becoming local in mountains southward to the coast where it occurs on humid cliff shelves.

A circum northern temperate taxon.

Representative specimens seen: Lake of Hanging Glaciers (UBC B-4377); Glacier National Park (UEC E-4378); Purcell Wilderness Conservancy (UBC B-4379).
**Paludella** Brid.

A beautiful genus characterized by the tomentose stem and squarrose leaves. Principally circumpolar, it is a species of high latitudes in the northern hemisphere.


The species, thus far, is known in the study area from Glacier National Park (UEC B-4380). It forms extensive mats intermixed with *Tomentypnum nitens* and species of *Sphagnum* in a roadside fen approximately 2 miles east of Roger's Pass. Schofield (1976) reported it to be in calcareous swamps or fens throughout the interior of British Columbia extending to alpine elevations. Sporophytes not seen.

It is a widely scattered species in the northern parts of Europe, Asia, and North America (including Greenland). Wyoming is perhaps the southernmost boundary of its distribution in the North American continent.
FAMILY CATOSCOPICIACEAE

A monotypic family common to the continents north of the equator. The family affinity is uncertain (Smith, 1978).

*Catoscopium* Brid.

A monotypic genus restricted to calcareous sites.


The taxon is an attractive plant frequently encountered along the banks of pools and lakes, rarely creeks or streams, in most open, calcareous sites in the Columbia Trench (see Map 104). The subglobose, shining dark brown capsule with a
downwardly pointed mouth is usually produced in abundance. In British Columbia, the species forms dark green turfs in periodically wet, sunny calcareous sites, particularly in the northern and eastern parts (Schofield, 1976).

A circumpolar species in the northern hemisphere.

Representative specimens seen: Purcell Wilderness Conservancy (UEC B-4277); Glacier National Park (UBC B-4278); Jubilee Lockcut Mtn. near Parson (UEC E-4279).

FAMILY BARTRAMIACEAE

This is a cosmopolitan family of 10 genera distributed from the Tropics to the Arctic and Antarctic zones. Five genera have been recorded for Canada. All of them grow in the study area.

The family appears to be rather natural in phyletic grouping with similar gametophytic and sporophytic morphology. The spore morphology, on the other hand, reveals that Bartramia is of the general type and that of Philonectis being derived (Hirohama, 1977).
1. Plants with strongly imbricate leaves .2

1. Plants with erect-spreading, flexucse or crisped leaves ...........................................3

2. Stem covered with reddish rhizicids nearly to the apex; leaves not arranged in five rows; capsules erect, smooth, at most wrinkled .........................Anacolia

2. Stem not covered with reddish rhizicids; leaves arranged distinctly in four or five angular rows; capsules inclined and striate .........................Conostomum

3. Plants polyangular in cross section owing to the leaves arranged in four or five angular rows; peristome teeth united apically ......................Conostomum

3. Plants including the leaves round or triangular in cross section; peristome teeth free ...........4

4. Leaf cells with rows of cuticular thickenings that resemble papillae ..........................Plagiopus

4. Leaf cells truly papillose or mamillose, papillae not in rows ....................................5

5. Outer cortical cells of stem small and thick-walled; leaf
bases distinctly expanded, clasping \textit{Bartramia}

5. Outer cortical cells of stem inflated and thin-walled; leaf bases neither noticeably expanded, nor clasping

\textit{Philonotis}

\textit{Anacolia} Schimp.

The genus has been monographed by Flowers (1952). Seven species with a north-south distribution pattern in the eastern and western hemisphere are recognized. Only one is present in western North America from Alaska to California and inland to Idaho, Montana, and Wyoming.
*Anacolia menziesii* (Turn.) Par., *Index Eryol.* 27. 1894. Map 106.

A fairly common species in the Selkirk Range at low elevations (see Map 106), *A. menziesii*, with its stem bearing imbricate leaves and with long and fine leaf apices, is distinctive enough not to be confused with any other members of the family. Unlike the coastal populations, the Kootenay plants are confined to deeply shaded cliff faces or large boulders in areas facing the lakes or close to waterfalls. More frequent and common nearer to the coast.

A broadly west coast endemic species.

Representative specimens seen: near Nakusp (UBC B-3454); 2 miles north of Gray Creek, facing Kootenay Lake (UBC B-4355); New Denver (UBC B-4356).
Bartramia Hedw.

This is a large genus of approximately 150 species distributed in the Temperate and Subtropical zones, and restricted to high elevation in the Tropics. Four species are reported for British Columbia (Ireland et al, 1980). Only two species are documented here for the study area. *E. halleriana* Hedw. with the nearly immersed capsules has been collected from the adjacent Mt. Robson Provincial Park. Its future discovery in the study area is to be welcomed.

1. Leaves crisped ......................... *B. pomiformis*

1. Leaves straight, or only flexucse ..... *B. ithyphylla*

This is a fairly common species occurring locally on or in protected rock crevices from lower subalpine to alpine elevations. The erect-patent and straight leaves are diagnostic.

Bartramia subulata E. S. G. was reported by MacPadden (1926) from the southeastern part of the province. All her collections of B. subulata at UBC and CANM are actually B. ithyphylla. True B. subulata is a subtropical to tropical species in the New World.

A near cosmopolitan species.

Representative specimens seen: Purcell Wilderness Conservancy (UBC B-4357); waterfalls at Cayuse Creek, Lower Arrow Lake (UBC B-4358); Bugaboo Glacier Provincial Park (UBC E-4359); Kootenay Glacier Park (UBC B-4360).

Bartramia pumiformis Hedw., Spec. Musc. 164. 1801.
B. glaucoviridis C. M. & Kindb.

This is a common species in the study area. It is much more common than B. ithyphylla at low elevations. It grows on shaded cliffs, boulders and rarely on tree trunks. Sporophytes frequent.

Widespread in the province, as well as across Canada.

A near cosmopolitan taxon.

Representative specimens seen: Meachen Lake, near St. Mary Lake (UBC E-6574); Flanket Creek campground, Upper Arrow Lake (UBC E-6575); Revelstoke area (UBC E-6576).

Conostomum Sw. in Web. & Mohr

This is a predominantly southern hemisphere genus of 15 species with C. tetragonum being the only representative in the northern hemisphere.

C. tetragonum is frequent at alpine elevations in the study area (Map 108). Populations form tight, glaucous green clumps and cover the rock crevices or cliff faces. Other populations grow on ground among the heaths or on the north side of large boulders on open ridges. At Revelstoke National Park, plants that grow to 60 mm tall are common near Jade Lake.

A widespread circumboreal alpine taxon in the northern hemisphere.

Representative specimens seen: st. Mary alpine Park (UBC B-4361); Microwave Tower Trail, Mica Dam site (UBC B-4362); Bugaboo Glacier Park (UBC B-4363); Revelstoke National Park (UBC B-4364).
Philonotis Brid.

This is a problematic genus of most wetlands. Unfortunately, the sporophytes do not provide any useful taxonomic characters for species identification. Gametophytically all characters are highly variable. The genus has been studied on a regional basis such as Japan and adjacent islands by Cchi (1962, 1963) and North America by Zales (1973). Zales had employed the methods of experimental transplantation of natural populations in an attempt to understand the species concepts. It is mainly his proposed classification that I follow here. The work of Field (1963) in the use of vegetative characters to key the species of Philonotis in England is also consulted.

The genus is represented in British Columbia by four species (Zales, 1973; Ireland et al, 1980), all of which are in the study area. P. calcarea Schimp. as reported by MacFadden (1926) from southeastern British Columbia has been excluded by Crum et al (1973) from North America.
1. Leaf cells with centrally located papilla
   ..........................................................P. yezoana

1. Leaf cells with terminally located papilla
   ..........................................................2

2. Leaf cells papillose on both ends; leaf margins doubly serrulate
   ..........................................................P. fontana

2. Leaf cells papillose on the upper ends or apically; leaf margins singly serrulate, very rarely forming two teeth projected side by side ..........................3

3. Leaves ovate-lanceolate, apex acute to short acuminate; basal leaf cells thin-walled, often quadrate to short rectangular (less than 4:1) ..............P. marchica

3. Leaves narrowly lanceolate, apex long and narrowly acuminate; basal leaf cells thick-walled, mostly long rectangular (more than 5:1) .............P. capillaris
Philonotis capillaris Lindb, ex Hartm., Skand. Fl. 10: 40. 1871. Map 105

P. arnellii Husn.
P. racemii Lesq. et James
P. vancouveriensis Kindb.

This is an uncommon species in the study area (Map 105). It is mainly a coastal species with a few populations in the interior Kootenay of British Columbia and Idaho. Zales (1973) mapped the total distribution of the taxon in North America and indicated three localities in the study area. None of the three collections is at UBC although Zales listed a MacFadden collection dated June 9, 1927 from Slocan City at UBC. Nevertheless, specimens named by Dr. Zales as P. capillaris at CANM and Provincial Museum (V) were studied and confirmed. The specimens (CANM 150784 & 150787) are from Slocan City, Three Forks, and Revelstoke. I have collected recently another population at Ymir area (UBC B-4370).

For the taxonomic differences between the present taxon and P. marchica, see comments under the latter name. Smith (1978) in his flora of Great Britain used the name P. arnellii over the present binomial without explanation. P. arnellii is a later synonym published by Husnot in 1890.
The species has a disjunct distribution between the western North America and Europe to Asia Minor.

*Philonotis fontana* (Hedw.) Brid., Bryol. Univ. 2: 18. 1827.

*E. americana* Dism.

*E. tomentella* Mc1.

This is the most variable species of *Philonotis* in North America. Numerous varietal and form names have been produced, some of which had the type locality from the study area. For a complete synonymy, see Zales (1973).

Zales has reduced a significant number of names to synonyms of the present species after conducting transplanting experiments. His species concept calls for the recognition of three varieties with reportedly ecological and geographical segregations. Var. *fontana* is the very widespread taxon with more or less straight and pointed stem apex and not or weakly plicate leaves. Var. *americana* (Dism.) Flow. *ex* Crum is western in distribution in North America, and has a falcate or twisted stem apex and also strongly plicate leaves. Lastly,
var. *pumila* (Turn.) Brid. is an arctic-alpine form with short (nearly the size of average *Conostegium tetragonum*) and compactly tufted habit. With Kootenay collections of *Philonotis*, the only variety that appears distinct is the var. *pumila*. The correlation of morphological characters which differentiate var. *fontana* from var. *americana* is not as clear-cut as was described by Zales (1973). I have opted therefore not to maintain any varietal recognition for the populations in the Kootenay. Var. *pumila*, in my opinion, is probably an ecological form in response to the harsh conditions of alpine environment.

A widespread circumpolar taxon in the northern hemisphere.

Representative specimens seen: Albert Canyon Hotspring (UBC 4372 as var. *fontana*); Revelstoke National Park (UBC B-4373 as var. *americana*); Bugaboo Glacier Provincial Park (UBC B-4374 as var. *pumila*).
Philonotis marchica (Hedw.) Brid., Bryol. Univ. 2: 23. 1827.

P. muehlenbergii (Schwaegr.) Brid.

This species is rare in the southeastern part of British Columbia (Zales, 1973). The two populations known from the study area were located at the northernmost boundary of its range of distribution in North America. Outside the study area, the species has not been collected elsewhere in the province.

P. marchica resembles P. capillaris in many morphological details. Zales separated the two species by stating that the basal leaf cells of P. marchica are elongate (6-20:1) in more or less vertical rows while those of the latter are quadrate to rectangular (4:1) in less obvious vertical rows. Unfortunately, this difference is unreliable. Often, more elongate basal leaf cells may be observed in specimens of P. marchica. Therefore, the feature should not be taken as a primary diagnostic character. I agree with Smith (1974) that a more reliable feature in distinguishing the two taxa is the difference in the shape of the leaf apex. P. marchica tends to develop acute to shortly acuminate leaf apices, and the apices are soft-locking. On the other hand, those of P. capillaris are narrowly, long acuminate, and stiff-locking owing perhaps
to the more strongly excurrent costa. Perigonal leaves, if present, can also be useful taxonomically. Those of *P. capillaris* are only acute to short acuminate, never long acuminate as in *P. marchica*. This reversal of difference in the leaf apex of both the vegetative and perigonal leaves of the two taxa is rather interesting. In addition, I found that the basal leaf cells, especially near the leaf insertion, in the case of *P. marchica*, are thin-walled and often are swollen while those of *P. capillaris* have firm and thick walls.

*P. marchica* is common and widespread in eastern North America. It is also widespread in Europe, northern Africa and Asia. Iwatsuki (pers. comm., 1980) maintained that the Japanese report of *P. marchica* is doubtful.

Representative specimens seen: Nakusp Hotsspring area (UBC B-4368); Halcyon Hotsspring (UBC B-4369).

A very rare species common to the western North America and Japan with one disjunct population in Vermont. The present discovery of a population in the study area links up the inland population with another population reported from Montana. My collection (UBC B-4371) was made from a granitic rock in a shaded gorge at the Nakusp Hotspring site. The laminal cells, except the marginal ones, are clearly unipapillose. The single and centrally placed papilla on the leaf cell is unique among the species of Philonotis in the North Temperate, and deserves a species recognition as argued by Zales (1973).

The report is new to the Kootenay Interior of this province.
This is a genus of two species, one occurring in New Zealand and the other one widespread in the northern hemisphere.


*Bartramia oederi* Brid.

Populations of *P. oederi* often acquire thick mats of rhizoids on the stems and can be mistaken for *Anacolzia menziesii*. The latter, however, has leaves that are straight and tightly appressed to the stem whereas in *P. oederi*, the leaves are erect-spreading and flexuose. In addition, plants of *P. cederi* are usually darker green in color. Under the compound microscope, the triangular cross section of the stem and rows of papillae on the surface of leaf cells, like those in *Amphidium*, characterize the present species. In the study
area, *P. oederi* grows on protected or shaded cliff faces from low to subalpine elevations. I have not noted the species at alpine elevations, nor have I noted it to be restricted to calcareous substrata.

Representative specimens seen: Schroeder Creek, north of Kaslo (UBC B-4365); Rosebery (UBC E-4366); Revelstoke Area (UBC B-4367); Halcyon Hotspring (MacFadden 4338, MACF).

**FAMILY TIMMIACEAE**

This is a monotypic family characterized by gametophytes that are sometimes polytrichaceous in habit, laminal cells mamillose or papilllose only on the adaxial side and double peristomes whose 64 endostomial cilia are interconnected with appendages forming a net-like structure.
The genus has the characters of the family. Only two out of the total of 10 species of the genus are known in the study area and in the province.

1. Most of the upper leaf cells 10 µm wide or more
   ..............................................................2

1. Most of the upper leaf cells 9 µm wide or less
   ..............................................................3

2. Leaf costa strongly toothed or denticulate abaxially towards apex; cilia of endostome not appendiculate; dioicous
   .............................................................-T. austriaca

2. Leaf costa smooth or papillose abaxially towards apex, rarely denticulate (if present, tooth consisting of one cell); cilia of endostome appendiculate; autoicous
   .............................................................-T. megapolitana

3. Leaf costa strongly toothed or denticulate abaxially
towards apex; cilia cf endostome nct appendiculate; dioicous

\[ \text{\textit{T. austriaca}} \]

3. Leaf costa smooth or only papillose abaxially towards apex; cilia cf endostome appendiculate; autoicous

\[ \text{\textit{T. meqapolitana}} \]
\[ \text{var. tavarica} \]

**Timmia austriaca** Hedw., Spec. Musc. 176. 1801.

This is a common species on humic soil inside forest, or stream banks in mesic to hygric sites. Plants without sporophytes may be mistaken for a member of Polytrichaceae. The leaf, however, lacks lamellae.

The present species is often confused with **T. meqapolitana**. Most floras would recognize the specimens with approximately 10 μm wide leaf cells and a deep reddish orange leaf sheath as **T. austriaca**. Specimens with smaller leaf cells and a pale yellow to hyaline leaf sheath will key to **T. meqapolitana** and **T. bavarica**. These differences in the gametophytes are not constant and infrequently, various combinations of the supposedly diagnostic leaf characters
occur. I have therefore placed emphasis on the sporophytic difference, especially the endostomial cilia. Furthermore, my experience with the genus reveals that plants which possess the typical non-appendiculate cilia in the capsule tend to possess leaves in which the costa becomes strongly toothed at the back apically, whereas plants with T. megalolitana -type of appendiculate endostomial cilia usually have leaves with a smooth to only papillose costa. This leaf costal dissimilarity, therefore, is emphasized also in the key to the two species. In the absence of sporophytes, the toothed or papillose costa is a much more reliable feature to use than the color of the leaf sheath.

The total distribution of T. austriaca in North America was recently mapped by Miller and Ireland (1978) which shows the main centers of distribution in the Arctic circle and around British Columbia, Alberta, and Washington. It is rare and sporadic on the east coast. A circumboreal species.

Representative specimens seen: Purcell Wilderness Conservancy (UBC B-4386); Syringa Creek Park (UBC B 4387); Blazed Creek (UBC B-4388).
**Timmia megapolitana** Hedw., Spec. Musc. 176. 1801.

**T. tavarica** Hessl.

This is a more restricted species in the study area, perhaps owing to its stronger preference for basic substrates. My species concept for *T. megapolitana* applies to plants with smooth to papillose leaf costae at the back and appendiculate emdostomial cilia. See *T. austriaca* for further commentary.

*T. bavarica* is suggested by Lawton (1971) to be a variety of the present taxon. The two taxa differ in the size of leaf cells and the papillarity of the leaf sheath (See Nyholm, 1954-1969). I find the differences often not clearly defined among the Kootenay specimens. Until more constant and conspicuous characters are discovered to differentiate *T. bavarica* from *T. megapolitana*, I prefer to treat their differences at the varietal level. Most collections of *T. megapolitana* from the study area belong to the var. *bavarica*, with the var. *megapolitana* confined to the more basic sites along the Columbia Trench.

Within the province, the habitat of *T. megapolitana* is similar to that of *T. austriaca* except that the present species appears to have a stronger selection for basic substrata.
Largely a continental species, it rarely reaches the coast of British Columbia.

G. F. Brassard (1980) who is presently revising the genus believes that *T. megapolitana* var. typica is absent in western North America west of the Rockies, and that all specimens collected from the province belong to *T. megapolitana* var. *bavarica*.

Mainly a circumboreal taxon in the northern hemisphere.

Representative specimens seen: Cayuse Creek, Lower Arrow Lake (UBC E-4383); Thunder Hill Park Campsite (UBC E-4384); Ainsworth Hot Springs (UBC E-4385).

**FAMILY ORTHOTRICHACEAE**

This is a family of seven genera in North America, of which only *Orthotrichum*, *Amphidium*, and *Ulota* are present in the study area. The placement of *Amphidium* in the family is rather controversial and tentative. Many bryologists include it in the Family Dicranaceae. The evidence presented by Lewinsky (1976) argues for its inclusion in the Orthotrichaceae based mainly on the ontogeny of the thecal peristome-forming
layers in *Amphidium*. Since the genus *Amphidium* produces only gymnostomous capsules, the problem of its true affinities may never be solved. The gametophytic characters can be accommodated equally well in either the Dicranaceae or Orthotrichaceae. Perhaps, D. H. Vitt's proposal (in litt., 1979) to unite the *Amphidium* and *Rhabdoweisia* to form a separate family Rhabdoweisiaceae will be the ultimate solution. *Zygodon* is known to be distributed mainly in places of high humidity or precipitation, and its absence from the interior mountain systems of the province was predictable.

1. Leaves crispred when dry .................2

1. Leaves straight, appressed to twisted when dry, not crispred

...............Orthotrichum

2. Leaf base consisting of strongly differentiated rows of marginal cells with transverse cross-walls conspicuously thicker than longitudinal walls; calyptra mitrate; capsules with single or double peristome .........*Ulota*

2. Leaf base consisting of marginal cells not clearly different from the rest of the laminal cells; calyptra cucullate; peristome wanting ............*Amphidium*
Amphidium Schimp.

A genus of 12 species with a world-wide distribution, only three species are known from British Columbia (Schofield, 1968a). *Amphidium californicum* (Hampe ex. C. Muell.) Broth. is said to be confined to the drier, southwestern portion of the province with extended populations along the eastern slopes of Queen Charlotte Islands (Schofield, 1976). *Amphidium mcugeottii* (B. S. G.) Schimp., on the other hand, has a sporadic distribution from Alaska, coastal British Columbia, Washington to Idaho and Montana. The closest population to the study area that I knew of is Macoun’s Can. Musci 101 (CANM) collected from Eagle Pass, Kamloops District, ca. 70 km west of Revelstoke. The species is usually sterile and is probably undercollected. Consequently, its ecology and distribution are poorly documented. Its eventual discovery in the Columbian Mountains is to be expected. *A. lapponicum* (Hedw.) Schimp. is the only species presently known to occur in the study area.

A common species of both calcareous and acidic, shaded cliff faces and rock crevices, *A. lapponicum* tends to form compact to somewhat loose, dark green cushions. The taxon is particularly common in all canyons and gorges visited in the study area. The slightly emergent, gymnostomous, ribbed, and funnel-shaped capsules are particularly characteristic and are frequently encountered in nature.

The taxon differs from *A. mougeotii* in having leaf margins which are plane halfway or nearly to the base, more strongly papillose upper laminal cells, more or less uniform elongate basal cells with thinner walls, and shorter adaxial surface cells (5:1 or less) on the leaf costae. The other important diagnostic features of *A. mougeotii*, such as the exserted capsules and dioicous sexuality, are seldom observed in natural populations.

*A. lapponicum* is a circumboreal species.

Representative specimens seen: Coffee Creek, Slocan Lake (UBC B-6426); Three Forks (UBC E-6427); Champion Lakes Provincial Park (UBC E-6428).
Orthotrichum Hedw.

A world-wide genus of 200 saxicolous or corticolous species, Orthotrichum has been studied and revised on a regional basis many times (Venturi, 1887; Grout, 1946; Vitt, 1973c; Lewinsky, 1977a). Although the genus is well defined today, its species concepts remain far from stable. The taxonomic characters employed at the species level are derived to a large extent from the sporophytes, notably capsules and peristome, which for the genus are, unfortunately, variable. In nearly all species there exist populations that deviate from the norm of the species definition. This has made the construction of a workable key to the species very difficult. Species keys in most floras work only within the limited area of study.

The genus, like Encalypta, consists of some species with single, and others with double or no peristome. Recently, Lewinsky (1977b) in a series of SEM pictures of surface ornamentation of exostome teeth of representative species, demonstrated that the various ornamentation patterns can be grouped into major categories which may be given taxonomic meaning. Hinneri (1976), on the other hand, discusses the ecological variation which exists in some of the common northern boreal taxa. Both papers considerably enhance our understanding of the genus.
As a result of the present study, I have confirmed the presence of 11 species of *Orthotrichum* in the study area, out of the total of 14 taxa listed by Schofield (1968a) for British Columbia. The taxa that are presently unknown from the study area are either oceanic-coastal species like *O. pulchellum* Brunt. or more calcilclous species such as *O. hallii* Sull. & Lesq. In other words, the genus is represented in the study area by the predominantly widespread taxa. *O. lescurii* Aust. which is now considered to be a synonym of *O. strangulatum* F. Beauv., was reported by Macoun & Kindberg (1892) from Deer Park, Lower Arrow Lake. The specimen so named and deposited at CANM was examined, and is actually *O. cupulatum*. Thus, *O. strangulatum*, is eastern North American in distribution as noted by Vitt (1973c).

In preparing the present treatment, I have followed mainly Vitt's (1973c) revision, although the keys and illustrations provided by Nyholm (1954-1969) and Lawton (1971) have been consulted. Sexuality is given considerable emphasis in the key to the species. This should not cause serious problems in the determination of species since there are only two dioecious taxa in the entire genus, both of which are morphologically distinct. Furthermore, the perigonia when present, are close to the perichaetia, either below or on a modified short branch nearby. Asexual brood bodies are reported from several species. I have not been able to detect any among my Kootenay materials except in *O. obtusifolium*, hence, I have made no use
of this character in the key. Preperistome structure, which is characteristic of the genus, is generally ignored. This small supplemental peristomial structure outside the exostome, although a constant feature in some members of the section Rupestria, (e.g., C. rupestre) falls off with the operculum in many instances (Lewinsky, 1977a). Thus, its structure is often impossible to observe. The user is reminded here once more that in Orthotrichum, aberrant forms are frequent, and therefore, the statement of characters in the key holds true only for the majority of specimens collected.

The general ecology, infrageneric evolution, and phylogeny have been aptly summarized by Vitt (1971) and the conclusions need not be repeated here.

1. Plants dicicous ..........................2

1. Plants autoicous ..........................3

2. Plants large, leaves (3)4-6(9) mm long, lanceolate to linear-lanceolate, apices long acuminate

............................O. lyellii

2. Plants smaller, leaves 1-3 mm long, ovate to ovate-
lanceolate, apices obtuse to blunt ....G. obtusifolium

3. Stemates phanerocrous (superficial); basal leaf cells thick-walled, porous ..................4

3. Stemates cryptoporuous (immersed); basal leaf cells thin-walled, not pitted ..................7

4. When mature, exostome teeth erect to spreading, never revolute; endostome segments absent to rudimentary consisting of a single row of cells ....5

4. When mature, exostome teeth reflexed to revolute; endostome segments well developed, consisting of two rows of cells ........................................6

5. Calyptra sparsely hairy; capsules cylindric, usually longer than 2 mm, fully exserted ..........G. laevigatum

5. Calyptra densely hairy; capsules oblong, less than 2 mm, emergent to partially immersed inside the perichaetium ..............................................G. rupestre

6. Capsules smooth to weakly grooved only in the upper half ........................................G. speciosum

6. Capsules strongly grooved throughout the entire length
7. Exostome teeth reflexed or revolute in mature capsules; endostome segments well developed ......8

7. Exostome teeth erect to spreading; endostome segments absent or rudimentary ..............9

8. Upper laminal cells with low, conical simple papillae; calyptra naked; stamates slightly or at most 1/3 overarched or covered by the poorly differentiated subsidiary cells; cladautoicous ..........................0. pallens

8. Upper laminal cells with tall, conical and forked papillae; calyptra hairy; stamates 1/2 to 2/3 overarched or covered by the well differentiated subsidiary cells; gonicautoicous ..........................0. alpestre

9. Setae orange to pale brown in color; capsules cylindrical, fully exserted .........................0. anomalum

9. Setae green, dark green to brown; capsules ovoid to oblong, immersed or emergent .............10

10. Plants green, dark green to greenish brown; capsules with 16 grooves ..........................0. cupulatum
10. Plants glaucous brown; capsules with 8 grooves

..............................C. *pellucidum*

(=C. *jamesianum*)


A rare species in the study area, *C. affine* usually grows on the trunks and bases of deciduous trees near creeks. The plants are small and bear leaves which are erect-appressed and straight when dry. The strongly grooved cylindrical capsules, with their conspicuously revolute exostome teeth, are characteristic. At times, specimens may be mistaken for aberrant forms of *C. rupestre* which also possess endostome segments. The habitats, however, differ between the two species. The latter is consistently epilithic, at least in southern British Columbia. Nyholm (1954-1969) suggested that this taxon may be a hybrid between *C. fastigiatum* Bruch and *C. speciosum* Nees in Sturm. Based on the distribution map prepared by Vitt (1973c), the species is restricted to western North America, where it is scattered along the Cascade and Rocky Mountain Ranges. Elsewhere, it is known from Europe and Asia. Representative specimens seen: Kikomum Creek Park (UBC

A very rare species in the study area, *O. alpestre* was collected twice from only a single locality, i.e. the vicinity of Lake of Hanging Glacier and its main drainage stream, Horsethief Creek, in the Wilmer District, Purcell Mountains (MacFadden 4242 dated 18 July, 1928, determined by R. S. Williams as *O. cupulatum*, and Tan & Teng 78-1137). Both collections came from an exposed rock face. Vitt (1973c) reported it to occur on rocks as well as on trees. The species, in its gross morphology, closely resembles *O. affine* in having strongly grooved capsules with revolute exostome teeth. *O. affine*, however, has superficial stigmata. Furthermore, *O. alpestre* has leaves which are twice as large as those of *O. affine*. The leaves, moreover, are loosely appressed and more or less twisted when dry. The upper laminal cells of *O. alpestre* have sharp and branched papillae. The calyptra is densely hairy and strongly papillose. From *O. pallens*, it differs in having a hairy calyptra.
Widely scattered across the northern hemisphere, the species is bipolar disjunctive, and is known also from New Zealand. In North America, the distribution map prepared by Vitt (1973c) shows that it is basically continental, concentrated in the western states and provinces, barely reaching the Pacific Coast. Also reported from Europe, Central Asia, Siberia, and Kashmir.

Orthotrichum anomalum Hedw., Spec. Musc. 162. 1801.

Although O. anomalum was collected only twice in the study area, it is reported (Vitt, 1973c) to be widespread across the continent. It grows on rocks, especially limestone, and rarely at tree bases. The species is at times difficult to distinguish from related species that have similarly exserted capsules such as O. speciosum. The latter, however, has superficial stomates. The most reliable feature separating it from O. cupulatum and O. pellucidum is the fully exserted, cylindrical capsules with 16 alternating long and short grooves. The reddish to orange seta may add to the distinctiveness of O. anomalum. Furthermore, the leaves of O. anomalum are always unistratose.
My own collection (Ian & Ensing 77-1553B) so named by Dr. D. Vitt, is from Kikcum Creek Park, on the east side of Koocanusa Lake in the dry Ponderosa pine and Douglas fir forest community. The other collection from the study area as indicated in the distribution map in Vitt (1973c) is probably from the area of Lake of Hanging Glacier. I have not been able to locate the collection nor is it mentioned in the text by Vitt. In the same publication, Vitt maintained that eastward, the species is found only north of the line of maximum glaciation and becomes sporadic in the arctic zone. From his map, it is possible to suggest that the taxon survived during the last glaciation south of glacial boundary in midwestern United States, and that the populations then migrated northward and eastward after the retreat of the ice. Thus, the species is possibly still in the process of colonizing the drier side of the Purcell Mountains. Given time, additional populations may be expected in the study area.

Known also from several localities across the Eurasian continent.

Vitt (1973c) reported this species to be most common in the drier area of Ponderosa Pine forests and on dry rock faces. There are two populations known from the study area: Deer Park by the shore of Lower Arrow Lake (CANM 151) and Lake of Hanging Glacier (VC3620). The first locality falls within the eastward extension of Ponderosa Pine community in Southern British Columbia. The second locality represents the northernmost population of the species in Western North America. The species may be present also in the Ponderosa Pine forest in the vicinity of Kikomum Creek Park and Koocanusa Lake. The urceolate, 16 grooved and immersed capsules are distinctive. Care must be taken not to confuse O. cupulatum with O. pellucidum which has a glaucous brownish sheen reminiscent of the coloration of the gametophyte of Tortula ruralis.

Canadian Musci 565 distributed by Macoun under the name of O. sturmii is a misidentification. The specimen at CANM 151 is O. cupulatum and also came from Deer Park area.

O. macounii Aust.
O. laevigatum fo. macounii (Aust.) Lawton & Vitt.
O. lonchothecium C. M. & Kindb. ex Macoun & Kindb.
O. roellii Vent.

O. laevigatum is a variable saxicclous species occurring sporadically in the study area (Map 114), where it appears to be more common in the Selkirk Mountains. Average plants are sometimes up to 40 mm tall with lanceolate to oblong leaves. The fully exserted cylindrical, smooth capsules are distinctive among the local species. The neck of the capsule shows a twist to the right. The peristome is single and often consists of 16 erect to spreading exostome teeth. Occasionally, there are aberrant grooved capsules with 8 endostome segments. These can be mistaken for O. pylaisii Brid. The latter, however, has 8 reflexed to revolute exostome teeth, and is not known from the study area. Depauperate specimen of O. laevigatum with a shorter seta may resemble O. rupestre. The two can be segregated on the basis of hairiness of the calyptra (see key couplet 5).

Canadian Musci 176 from Revelstoke distributed by Macoun
under the name *C. laevigatum* is probably a case of mispacketing. The specimen at CANM is *C. obtusifolium*.

Forma *macounii* has narrower and more acuminate leaf apices and the laminal cells have simple papillae. It has been collected from Kaslo, Deer Park at Lower Arrow Lake and Ainsworth Hotspring Resort. The distinction between the forma *macounii* and the typical form is not always clear, at least in the Kootenay populations. In addition, the forma *macounii* has no distinctive distribution pattern in the Kootenay area. In the Yukon, Alaska, and the NW Territories, Witt (1973c) noted that most populations would belong to the forma *macounii*.

*O. laevigatum* is common south of the boreal zone and is reported to be rare in Europe.

Representative specimens seen: Idaho Lookout Tower, Sandon (UEC B-6431); Champion Lakes Provincial Park (UBC B-6432); Kaslo (UEC E-6433).

A common west coast species in the wet, lowland coastal forests, O. lyellii is reported here as new to the interior Columbia Mountains. The collection (Tan 76-898D) is from a maple tree in a shaded humid forest along a creek behind the Ainsworth Hotspring Resort. Specimens are characteristically large with linear lanceolate and long acuminate leaves. Neither sporophyte nor brood bodies were collected.

Also known from Europe and North Africa.


Map 115.

A rather common species in the study area. O. obtusifolium is one of the few species of the genus that can be identified with ease in the field. The small clumps of populations with broad and obtuse leaves on tree trunks immediately reveal its identity. The host trees for the species in the study area are mainly Pseudotsuga trichocarpa, the
common trees along creek or lake margin at low elevations.

Common also in the boreal forests elsewhere in North America and Eurasia.

Representative specimens seen: Rosebery (UBC B-6434); Erie Creek, near Salmo (UBC E-6435); Revelstoke (UBC E-6436).

Orthotrichum pallens Bruch ex Brid., Brycl. Univ. 1: 188.

1827. Map 113.

_Or_ _thotrichum pallens_ is a small species on the trunk and branches of conifers and deciduous trees including _Picea, Abies, Alnus_ and _Populus_. It is best distinguished by its strongly grooved, cylindric, immersed capsules, as well as by the naked calyptra that is smooth or slightly papillose on the plications. The 8 exostome teeth are either erect or reflexed, and the endostome segments vary from 16 to 8 to none. _C. affine_, which also has naked calyptrae, may be confused with the present species. However, _C. pallens_ is cryptoporous. From _C. obtusifolium_, it is separated by its autoicous sexuality and by the leaf apices being acute to narrowly cuneate, never rounded and broadly obtuse.

The species has been collected from widely separated localities within the study area: Tan & Ensing 77-1963, on a
*Populus* tree trunk at the cutlet of Alki Creek, west of Kimberly City en route to St. Mary Lake; Tan & Scagel 79-561 and 79-585, on the trunks of dead alder and spruce, in an open floodplain, Goldstream River, north of Revelstoke; Tan & Teng 78-1027 from twigs of *Picea*, Beaver Creek valley, Glacier National Park. The last mentioned collection had been determined by H. A. Crum as *O. stellatum* Brid., which is an eastern North American species according to Vitt (1973c). The same collection (Tan & Teng 78-1027), kindly determined by D. H. Vitt as *O. pallens*, has only 8 endostome segments, and its exostome teeth have a finely papillose basal surface ornamentation, unlike the more typical striate to coarsely papillose pattern of *O. pallens*. The other known locality of *O. pallens* in the province, is the Lyall collection from Pack River, northern British Columbia (specimen at NY, not seen).

Both the small size of *O. pallens* (the stem being 1-5 mm tall including the capsules) and the branch-epiphytic habitat have possibly led to this taxon being overlooked in the field. This may account also for the few collections known from the boreal zone across Canada (see Map 42 for *O. pallens* in Vitt, 1973c). Southward in the U. S., the species is restricted to high elevations in conifer forests (Vitt, 1973c). Known also from Europe.

Macoun's collection at CANM from a poplar tree on an island in the Columbia River at Revelstoke, May 8, 1890 and labelled *O. brachytrichum*, is actually *O. pallens*. 

C. jamesianum Sull.

The taxcn is very distinct in its glaucous to chalky brown color caused by the sharp and forked papillae on the laminal cells. The 16 erect to spreading exostome teeth (without endostome segments) and the 8-grooved capsule are equally diagnostic. C. pellucidum is a widely distributed endemic species in western North America with outlying populations in Greenland. In 1971, Lawton reduced C. jamesianum to a variety of C. cupulatum. I concur with Vitt (1973c) and Lewinsky (1977c) in accepting it as a good species. Recently, Lewinsky (1977c) discovered that the type specimen of C. pellucidum Lindb., which is an earlier name, is conspecific with C. jamesianum. I have not seen any specimens of C. pellucidum from Greenland, but judging from the beautiful illustration provided by Lewinsky (1977c), the two appear to differ quite significantly in the leaf papillosity. This feature, of course, is variable in C. jamesianum. I have not yet seen any specimen determined as C. jamesianum that possesses the smooth or slightly papillose leaf cells of C. pellucidum. Perhaps the Greenland populations with smooth leaf cells should be treated
as a variety distinct from the typical form which develops strongly papillose laminal cells. The same species recently has been reported by Lewinsky (pers. comm., 1980) from Sweden, the first record for Europe.

*O. jamesianum* is rather rare in the study area having been collected only once from the Horsethief Creek logging road in the Purcell Mountain (Tan & Teng 78-1154).


*O. macfaddenae* Williams (CANM !)

The present taxon is strictly epilithic in the study area. The size of the plants is variable, often becoming slender and bushy, and resembling *Grimmia alpicola*. The leaf areolation, however, differs sharply between the two genera. Capsules of *O. rupestre* are globose, ovoid to oblong, never cylindrical, distinctly grooved, and immersed to emergent. The peristome is commonly single, rarely double. Excstome teeth are 16, erect or reflexed. Although each of the diagnostic features
described for the species may vary, yet the more or less constant combination of the sporophyte characters, plus the rock habitat, enable one to identify the taxon accurately in most instances. *O. rupestris* has a main center of distribution in the temperate zone of western North America, becoming less common northward. Another center of a few populations around the Great Lakes area has been reported recently by Vitt (1974). It is nearly as common in the study area as is *O. speciosum*. Also reported from Europe, Canary Islands, northern and eastern Africa, and Central Asia. Vitt (1973c) maintains that its presence in the southern hemisphere and Japan is doubtful.

The type of *O. macfaddene* from Rosebery at CANM was studied and found to be within the range of variation for *O. rupestris*.

Representative specimens seen: Kokanee Glacier Provincial Park (UBC E-6437); Horsethief Creek (UEC E-6438); Halcyon Hotspring (UEC E-6439).
Orthotrichum speciosum Nees in Sturm., Deutsch. Pl. 2: 5. 1819.

This is the most common species in the study area. In southern British Columbia, O. speciosum grows on rock and tree trunks. The morphology is highly variable. The plants can be tall or short, while the capsules can be smooth or grooved, and fully emergent to immersed. Fortunately, the 8 revolute exostome teeth with well developed, stout endostome segments, and superficial stomates are constant features. From the aberrant form of O. rupestre with slender endostome segments, O. speciosum is distinguished by the stout endostome segments consisting of two rows of cells (at least near base).

Vitt (1973c) treats the populations of O. speciosum with smooth, exserted capsules as var. elegans. This variety has an eastern North American distribution whereas the var. speciosum with grooved capsules is more common west of the continental divide. The study area (which is within the area of distributional overlap between the two varieties) yields many populations that produce both smooth and grooved capsules, even on the same plant. Consequently, I believe that it is unrealistic to recognize varieties among the Kootenay specimens. In Europe, Nyholm (1954-1969) held var. elegans to be only a poorly developed O. speciosum.
A circumboreal taxon.

North American Musci Perfecti 99 issued by Grout under the name of *C. sordidum* Sull. & Lesq., which was collected from the study area, is *C. speciosum*. Similarly misidentified are specimens collected from New Denver named *C. affine* (MacPadden collections 3970 & 16989).

Representative specimens seen: Kokanee Glacier Park (UBC E-6440); Silvertown (UEC E-6441); St. Mary Lake area (UBC B-6442).

*Ulota* Mohr in Brid.

*Ulota* is a large temperate genus of about 65 species. It is represented in the province by only six taxa. *Ulota curvifolia* is the only record of the genus in the study area. The rest of the species are restricted to the more humid coastal regions.

Essentially a low arctic-alpine or northern montane species, *U. curvifolia* was collected by MacFadden once from the study area from a large boulder covered with humus in the woods at Mt. Sir Donald trail, Glacier National Park on 29 July, 1941 (UBC, CANM!). Both specimens were sterile and devoid of any gemmae. They were determined by Grout as *U. obtusiuscula* C. Muell. & Kindt. - a taxon which is today interpreted to be a coastal species absent east of the Cascade Mountains (Schofield, 1976). *U. curvifolia* is distinguished from the latter by the well-developed, tall, sharp and forked papillae on the upper laminal cells and also by the epilithic habitat. *U. obtusiuscula* is a lowland epiphytic species. The MacFadden collection is the first record of the taxon from the Kootenay. Elsewhere, the taxon has been reported from Wells Gray Provincial Park, the Cariboo River, Hector, the Rocky Mountains, the Yukon, Alaska, Lake Huron, Newfoundland, Labrador, Greenland, and Europe.
FAMILY FONTINALACEAE

This is mainly an aquatic moss family in the north temperate area. The family was monographed by Welch (1960) and includes the genera Fontinalis, Dichelyma, and Brachelyma Schimp. ex Card. Brachelyma is the only genus not found in British Columbia. The submerged habit and the trellis-like endostome are important characters of the family.

1. Leaves unicostrate and falcate ........ Dichelyma

1. Leaves ecostate and never falcate .... Fontinalis

Dichelyma Myr.

The genus consists of five species with three species in the study area. Both D. falcatum and D. pallescens are new records for the province, and D. pallescens is reported here as
new to western North America.

1. Leaf costa long excurrent, leaves very strongly falcate-secund, circinate .......................D. uncinatum

1. Leaf costa slightly excurrent to percurrent, leaves not very strongly falcate ......................2

2. Leaf apices sub obtuse to obtuse, costa percurrent ..............................................D. pallescens

2. Leaf apices subulate or acuminate, costa slightly excurrent .........................................D. falcatum


This is the most common species of the genus in the study area. Populations are submerged in swampy pools or at lake
margins at all elevations. The leaves can be falcate-secund like *D. uncinatum*, but the slightly excurrent costa will distinguish it from *D. uncinatum* which is a more common species in the wet coastal regions. Uncommon in the study area as well as in the province.

A broad circumboreal species.

Representative specimens seen: Fishermaiden Lake, Silverton Creek (UBC E-4470); Yahk Provincial Park (UBC B-4471); St. Mary Alpine Park at 7000 ft (UBC B-4472); Kokanee Glacier Park (UBC E-4473).


This is the largest species of the genus in the area. Mature plants up to 6 cm long were observed to form extensive mats on the bottom of a dried up lake, Dipper Lake, near Kimberley City (UBC E-4474). The immediate vegetation cover surrounding the lake is a mixture of Lodgepole pines and juniper groves. The leaves, which are obtuse to broadly acute at the apex, quickly identify the species. Duplicates of the
collection were confirmed by Drs. R. R. Ireland and W. R. Buck.

Considered an endemic species widely distributed in eastern North America until the present discovery.

*Dichelyma uncinatum* Mitt., Journ. Linn. Soc. 8: 44. 1865.

Occasionally this species is difficult to separate from *D. falcatum*. Lawton (1971) treated it as a variety of the latter. The two taxa differ in the degree of excurrency of leaf costa and the degree of falcation of the leaves. Only one collection from the study area has strong falcate-secund leaves with long excurrent costa (UBC B-4475) and was named *D. uncinatum*. The specimens were collected from a fallen branch lying beside the margin of Moyie Lake near Cranbrook. The present taxon is widespread as an epiphyte on lower trunks and shrubs in periodically flooded area on the Coast (Schofield, 1976).

A North American species.
Fontinalis (Dill.) Hedw.

This is a genus of about 20 to 40 species depending on one's taxonomic philosophy. The genus is north temperate in its distribution. There are three species in the study area. *F. howellii* Ren. & Card. is accepted as a synonym of *F. antipyretica*. *F. novae-angliae* Sull. was erroneously reported by Macoun & Kindberg (1892) from Deer Park, Lower Arrow Lake. The specimens at CANM are *F. antipyretica*.

1. Leaves keeled, conspicuously three-ranked towards the stem apex ........................................... 2

1. Leaves not keeled, either concave or plane, not neatly ranked near the stem apex ........... *F. hypnoides*

2. Leaves more or less appressed, making the leafy shoots markedly triquetrous at the end of branches, mainly oblong-lanceolate, acute; perichaetial leaves abruptly apiculate to acuminate ........................................... *F. neo-mexicana*

2. Leaves more widely erect-spread, making the leafy shoots
more or less terete at the end of branches, mainly ovate or broadly lanceolate, obtuse; perichaetial leaves broadly ovate ...................... F. antipyretica

sensu lato

Fontinalis antipyretica Hedw., Spec. Musc. 298. 1801.

F. howellii Ren. & Card.
F. kindbergii Ren. & Card.
F. chrysophylla Card.

Like other aquatic mosses, F. antipyretica is extremely variable in the size and shape of leaves. The only species in the study area that may be confused with it is F. neo-mexicana. The latter, in general, has the stem width narrower, approximately 2 mm wide when dry. This is because of the appressed habit of the leaves. On the other hand, leaves of the present species remain erect-spreading even when dry and the stem measures approximately 4 mm wide. See also the key to the species for more technical differences between the two species.
F. howellii is characterized by Welch (1960) as having "leaves with keels or median lines predominantly straight above basal curve". This is in contrast to the condition in *F. antipyretica* as having "leaves with keels or median lines predominantly curved above the basal curve". I cannot visualize this difference and have been unable to interpret the distinctiveness of *F. howellii*. Nor can I discern any constant dissimilarities between specimens at UBC labelled by Dr. W. Welch as *F. howellii* and *F. antipyretica*. With the degree of variability observed within many populations of the present taxon collected from the study area and elsewhere in the province, the recognition of the different varieties at the moment appears to serve no purpose. It could also be that the broad concept of *F. antipyretica* adopted here actually consists of a couple of truly distinct taxa that await future critical clarification and redescription. Schofield (pers. comm., 1980) observed that some populations, probably *F. howellii*, are always detached in the natural aquatic environment, while those of *F. antipyretica* are always attached to the substratum. In the study area, *F. antipyretica* is at times seen partly submerged in swampy lake margins and wet forest depressions where skunk cabbage is common. When in clear running water, plants can grow to several feet long covering a distance of one mile of the stream bottom. Other common mosses associated are species *Calliergon* and *Drepanocladius*. It is widespread in the province.
A widespread circumtoreal species.

Representative specimens seen: Fry Creek Canyon (UBC B-4476); Balfour, Kootenay Lakeshore (UBC E-4477); Revelstoke National Park (UEC E-4478).


A beautiful western North American endemic species, __F. neo-mexicana__ is less widespread than __F. antipyretica__ in the study area (see Map). At times, the species resembles depauperate specimens of __F. antipyretica__.

Reported from Alaska down the Pacific coast to California, New Mexico, Wyoming, to Mexico and Argentina (Welch, 1960).

Specimens seen: Beatrice Lake (UBC E-4479); White Creek near St. Mary Alpine Park (UBC B-4480); Teepee Creek, Purcell Range (UBC E-4481).
**Fontinalis hypnoides** Hartm., Skand. Fl. ed. 4: 434. 1843.

This is a distinctive species that is rare in the study area and in the rest of the province. The concave to plane leaves without a dorsal keel or fold are unmistakable. Collected from only two localities in the Kootenay Region: Slocan Lake, mouth of Bonanza Creek (UEC E-4482); and Albert Canyon Hotpspring area (UBC B-4483). I agree with Crum (1976) that the var. *duriae* Schimp.) Husn. differs so insignificantly from the typical variety that it is not worth recognition.

A widespread circumboreal species in Europe, Asia, and North America, reaching Brazil, south of the Equator.

**FAMILY CLIMACIACEAE**

A monotypic family of dendroid mosses. Widespread in both northern and southern hemispheres.
Only two of the four species of *Climacium* are known to North America. The populations in the western Canada belong to *C. dendroides* (Eird, 1964).

*Climacium dendroides* (Hedw.) Web. & Mohr, Nat. Reise Schwed. 96. 1804.

*C. dendroides* is widespread in nearly all kinds of wetlands in the study area. Populations appear to be more luxuriant in eutrophic swampy and mucky habitats and often form a miniature "forest cover" in the area. The dendroid habit, when well-developed, is distinctive. Depauperate specimens, however, can be confused with *Pleuronema schreberi* that normally invades the more mesic habitats. The single costa and the serrate leaf apex can help in identifying difficult specimens of *C. dendroides*. The presence of paraphyllia is also distinctive.

Nyholm (1954-1969) has placed this genus in the Family
Hypnaceae without elaborating on her justification.

The total distribution of the present species in North America has been mapped by Horton and Vitt (1976). Known also from Europe, Asia, and New Zealand. A bipolar disjunct species.

Representative specimens seen: Large Erie Lake, near Salmo (UBC B-4320); Champion Lakes Provincial Park (UBC B-4321); Fishermaiden Lake, Silverton (UBC E-4322); Lang Lake, Templeton Creek road (UBC E-4323).

**FAMILY HEDWIGIACEAE**

This is a family of six genera adapted mostly to dry, sunny habitats. Two genera are described for the province, only *Hedwigia* is recorded for the study area.
Hedwigia P. Beauv.

A genus of two species depending on whether or not Hedwigidiun B. S. G. is accepted as a genus separated from Hedwigia. Only H. ciliata occurs in the study area.

Hedwigia ciliata (Hedw.) P. Beauv., Prod. 15. 1805.

This is a species common to dry, exposed faces of siliceous rock outcrops in the southern half of the study area at low elevations. Populations often grow together with Racemitiun canescens, R. fasciculare, species of Grimmia and Polytrichum piliferum. Superficially, the species can be mistaken for Racemitiun brevipes. The immersed capsule subtended by perichaetial tracts with long marginal hairs is diagnostic. Furthermore, the laminal cells of the two genera are different in morphology, and Hedwigia has ecastate leaves while Racemitiun has unicostate leaves.

It occurs throughout the province, more frequently encountered in the drier interior.
A near cosmopolitan species.

Representative specimens seen: Gray Creek (UBC B-4381); mouth of Evans Creek, Slccan Lake (UBC F-4382); Revelstoke (CANM 1588669).

**FAMILY LEUCODONTACEAE**

The family has about 10 genera, mostly epiphytic on trees, a few epilithic, in the temperate zones. *Antitrichia* is the only genus known in the study area.

*Antitrichia* Brid.

A genus of about 6 species in Europe, Asia, Africa, and America, *Antitrichia* is distinctive in having a single costa, often with short supplementary costae, oblong to fusiform laminal cells and a well-differentiated and broad region of alar cells consisting of quadratc to horizontally rectangular.
cells. Two species were listed by Schofield (1968a) for British Columbia. Both are in the study area.

1. Branches slender, with strongly imbricate leaves when dry, more or less 1 mm wide; costa without short, supplementary costae ................................... A. californica

1. Branches coarse, with leaves somewhat divergent when dry, more or less 2 mm wide; with supplementary costae ................................... A. curtipendula


The key characters outlined above should be sufficient to distinguish the two species of *Antitrichia* in the study area. In addition, the laminal cells of *A. curtipendula* are strongly pitted whereas in *A. californica*, they are at most only weakly pitted. The dimension of the capsules, long thought to be a good taxonomic character by Grout (1928-1940) and Lawton
(1971), is not as reliable as the gametophytic characters. All collections of *Antitrichia* from the study area were sterile.

Populations of *A. californica* in Kootenay Mountains appear to be confined to the wetter parts of the southern Selkirk Range (Map 18). All, except one (Tan & Ensing 77-944), were found on trunks of deciduous tree species such as *Populus* and *Pyrus*. Superficially, specimens of *A. californica* resemble *Homalotheicum fulgescens*. Along the humid coastal region, *A. californica* is much more common locally.

The species has been reported from most states and provinces of western North America, including Colorado. Also known from western Europe.

Representative specimens seen: Cahill Lake, Slocan Lake area (UBC B-4342); Duck Lake, Creston area (UBC B-4343); Sandon (UEC E-4344).


This is a rare and large species of *Antitrichia* in the study area. The luxuriant mats that grow on rock and cliff faces resemble populations of slender *Phytidiadelphus*
triguetrus. One population (Tan & Ensing 78-697) was observed to be festooning a tree trunk near a deep gorge, a condition often seen with coastal populations.

The taxon is more common and abundant in humid sites in the coastal part of western North America than inland. It becomes less common in the east coast of the continent. In the study area, it is more widely scattered than *A. californica*. Known also from Europe and Asia.

Representative specimens seen: Nakusp Hotsping (UBC E-4345); Slocan Park (UBC E-4346); Gray Creek (UBC E-4347); Revelstoke (CANM 161094).

**FAMILY NECKERACEAE**

This is a family of at least twelve genera principally tropical in distribution. The component genera remain controversial. Smith (1978) segregated Family Thamniaceae from Neckeraceae on the basis of differences in leaf cell morphology and peristome. In view of my limited outlook acquired through the study of only a few common genera in the north temperate zone, I prefer to accept only one family with four genera. *Porotrichum* (Brid.) Hamp. has been reported (MacFadden, 1926).
to occur in the southeastern part of the province. The report is actually based on a specimen of *Thamnobryum* which historically has been confused with *Porotrichum* (cf. Grout, 1928-1940; Wagner, 1951).

1. Plants dendroid; leaves strongly concave and plicate
   
   ........................................... *Thamnobryum*

2. Plants complanate, not dendroid; leaves plane or weakly concave
   
   ........................................... 2

3. Middle laminal cells quadrate, hexagonal to short rectangular, never more than 3:1
   
   ........................................... *Thamnobryum*

4. Middle laminal cells longer, at least 3-4:1
   
   ........................................... 3

5. Leaves conspicuously undulate
   
   ........................................... 4

6. Leaves not conspicuously undulate
   
   ........................................... 5

7. Stems with paraphyllia; leaves unicostate
   
   ........................................... *Metaneckera*
4. Stems without paraphyllia; leaves ecostate or with costa short and double ------------------------Neckera

5. Leaves asymmetric, spathulate, curved, widest above the middle, apex broadly rounded and evenly serrulate ---------------------------Homalia

5. Leaves symmetrical, elong-lanceolate, not curved, apex acute to obtuse, strongly and irregularly serrate ---------------------------(Porotrichum bigelovii)

Homalia (Brid.) E. S. G.

A tropical genus of 25 species with one species present in the northern temperate zone.
44-45. 1850.

H. macounii C. M. & Kindb. (isotype at CANM!)

The species is known from two of Macoun's collections made from the Columbia River above Revelstoke (CANM 198110 & 198113 and a MacFadden collection (V C3309) from the Nakusp-Edgewood Highway. The locality information supplied by Macoun is vague, typical of his tendency to list only the district name instead of the exact collection site.

When present, plants cover the base of tree trunks with their thin and flat, green leaves. Its habitat elsewhere is in humid and periodically flooded areas such as swampy banks along the river. It has been collected also from shaded boulder faces and cliffs (Schofield, 1976). Within the province, it is widespread, but never common, along the coast and is rare in the interior mountains.

A circumboreal species.
Keckera Hedw.

This is a genus of worldwide distribution with about 120 species. The complanate and undulate leaves arranged on both sides of the creeping or hanging secondary stems are characteristic. Two species are known to British Columbia, only one of which is reported here.


The long acuminate leaf apices with sharp and recurved marginal teeth easily distinguish this species from *N. pennata* which is present in the coast and also the interior mountains north of the study area.

The three populations from the study area came from a humid conifer tree trunk at Crawford Bay, Kootenay Lake (UBC B-4403); damp maple tree trunk at Ainsworth Hotspring (UBC B-4404); and New Denver (CANM 232067).

First published report east of the Cascade Mountains in British Columbia.
A west coast endemic species.

**Metaneckera** Steere

A monotypic genus of western North America and the Mediterranean.


**Neckeradelphus menziesii** (Hock.) Steere

**Neckera menziesii** Hock, *in* Drumm.

A common moss on tree trunks in the coastal area, the species grows on both tree trunks and shaded rock outcrops in the study area. The numerous flagelliform tranchlets are characteristic of the taxon, and probably serve as asexual propagules when broken off.

*M. menziesii* is common in the study area. Its reports
from Siberia, China, and Japan are doubted by Dr. W. B. Schofield (pers. comm., 1980). Asiatic specimens have now been named as Neckera polyclada by Noguchi (pers. comm., 1980).

Representative specimens seen: Arrow Park ferry landing (UBC B-4405); east side of Trout Lake (UBC B-4406); Coffee Creek logging road, Kootenay Lake (UBC E-4407).

*Thamnobryum* Nieuwpl.

This is a largely tropical genus of about 40 species with only a few reaching the northern boreal zone. Only one species occurs in British Columbia. In the past, the genus has been called *Thamnium* E. S. G., which is a hoc, illeg. (Wagner, 1951).

\textit{T. leibergii} (Britt.) Nieuwl.

\textit{Porotrichum neckeroides} (Hook.) Williams

This is a somewhat dendroid, semi-mat forming plant growing on wet to moist rocks. It is probably not a calcicole. When fully developed, the concave and plicate leaves of the secondary stems cannot be mistaken for those of any other members of the family. Nevertheless, a few populations of dwarf plants can achieve a complanate habit. This form has been mistaken for \textit{Porotrichum bigelovii} (Sull.) Kindb. True \textit{Porotrichum bigelovii} has longer middle laminal cells, thinner cell walls and the marginal teeth are more strongly, irregularly developed and larger in size, consisting mostly of two to four cells. On the other hand, the middle laminal cells of \textit{T. neckeroides} are short and oblong, mostly isodiamic, sometimes quadrate to short-hexagonal, and the apical marginal teeth consist of mostly one to two cell protrusions. Thus far, all collections of \textit{P. bigelovii} from the interior portion of the province at UBC have proven to be \textit{Thamnobryum neckeroides}. Good specimens of \textit{Porotrichum bigelovii}, however, have been collected from Idaho. Thus, its occurrence in the study area
is possible.

The species is another west coast endemic taxon.

Representative specimens seen: Boat Encampment (near Mica Creek) (UBC B-4408); mouth of Lait Creek, Kootenay Lake (UBC B-4409); Kokanee Glacier Park (UBC B-4410).

FAMILY HCOKERIACEAE

A family of six genera in North America, one genus is represented in British Columbia (Welch, 1962). The family is principally tropical to subtropical in distribution (Welch, 1968; 1970).

Hcokeria Sm.

A tropical genus, Hcokeria is represented in the north temperate zone by two widespread species, one of which has been rarely collected from the study area.
**Hookeria lucens** (Hedw.) Sm., Trans. Linn. Soc. Lond. 9: 275. 1808.

**Pterygophyllum lucens** (Hedw.) Brid.

This is a beautifully distinctive species growing on humus underlying overturned rootstumps and bases of tree trunks near stream banks. My own collection (UEC E-4319) was collected at the mouth of Beatrice Creek which drains into the Slocan Lake. Earlier, Macoun collected it from peels close to the Columbia River at Revelstoke (CANM 164899 and 164900). The same locality was explored in an unsuccessful effort to relocate the populations. The immediate ecology around Revelstoke area has changed drastically through years as a result of logging activities and subsequent urbanization. Conifer forests which enhanced the persistence of many mosses on both sides of the Columbia River have long been replaced by stands of *Populus* inundated periodically by the river water controlled by Mica Dam. If encountered in the field, the whitish green color and complanate habit of the plants is striking, and under the magnifying lens, the lax and short rhomboidal leaf cells are apparent.

The species is more common in the wet, coastal region, and is rare inland. It is, together with *H. acutifolia*, the
northernmost species of the family in North America. Also known from Europe and Asia Minor.

FAMILY THELIACEAE

I have chosen conservatively to follow Brotherus (1924-1925) and Chen (1978) in defining the family in a strict sense to include only three genera: Thelia Sull., Myurella and Fauliella Besch. Only Myurella is represented in the province.

As Crum (1976) correctly pointed out, the Family Theliaceae is arbitrarily defined and is unsatisfactory as a phyletic group. It is related to Family Fabroniaceae, Leskeaceae, and distantly, to the Family Thuidiaceae. The division of this group of related families is based to a large extent on gametophytic differences. Consequently, many of the important family features overlap. On the other hand, the proposals of Grout (1928-1940) and Crum (1976) to include all the four families mentioned here under a single broad Family Leskeaceae with several subfamilies, does not resolve the issue of the natural phyletic grouping of the various families.
Myurella B. S. G.

Myurella is a genus of slender, julaceous, glaucous green pleurocarps mosses. The laminal cells are oblong to short fusiform, similar to those of Fabronia and Lescuraea, but are papillose. The leaves are concave and alar cells are not well-differentiated. Capsules are erect, peristome teeth double, and the inner peristome is usually reduced. Three species are now known to the province, only one of which is recorded for the study area.

M. sitirica (C. Muell.) Reim. which differs from M. julacea in having more strongly dentate leaf margins and centrally placed, unipapillose laminal cells, has been rarely collected from high elevations along the Canadian Rockies and northern British Columbia. It is possible that the species is present in the northern portion of the study area.
**Myurella julacea** (Schwaegr.) E. S. G., Bryol. Fur. fasc. 52-54. 1853.

This is a rare moss on shaded, humid to wet, calcareous rocks often within the spray of waterfalls. The plants are tiny and string-like. Even in the few Kootenay populations collected, the variability in terms of denticulate leaf margins and the weakly papillose laminal cells is apparent. It is collected sporadically from many parts of the province. A widespread North Temperate species.

Representative specimens seen: Silvertip Falls, 4 miles north of Revelstoke (with *Flagiobryum zierii*, UBC B-4348); Jumbo Creek (UBC B-4349); 5 miles east of Revelstoke (UBC B-4350).

**FAMILY FABRONIACEAE**

This is a family of very slender, pleurocarpous mosses and consists of eight genera principally distributed in the Tropics and Subtropics (Euck & Crum, 1978). In British Columbia, three genera were reported by Schofield (1968a), only *Fabronia* has
been collected from the study area.

**Fabronia** Raddi

A genus of 95 species, mostly tropical in distribution, *Fabronia* is represented in British Columbia by a single species.


1808.

This is a very distinctive and slenderly julaceous moss that occurs on rock in the study area. The long hairpoints as well as the "cilia" along the leaf margins impart a whitish cast to the plant. The only population known from the study area came from Deer Park at the Lower Arrow Lake. Specimens were collected in abundance by Macoun in 1890 and were segregated into five collection numbers. All the five packets deposited at CANM were studied. The labels indicate the
habitat as "in crevices of steep rocks". Mixed with the species of *Fabronia* are *Homalotheceum nevadense* and juvenile individuals of *Tortula* sp. The exact locality is now submerged.

The species is also very rare in the southwestern part of the province. The other known localities are on or near Sumas Mountain.

Grout (1928-1940) suggested that the species should be treated as a subspecies *Fabronia ciliaris* (Brid.) Brid., an opinion with which most bryologists disagree.

A widely scattered species in Europe, Middle East, East Asia, Northern Africa and America.

**FAMILY LESKEACEAE**

The family Leskeaceae is sometimes united with the Family Thuidiaceae (Crum, 1976). The controversy over the distinction between the two families and the bases of their familial separation are discussed by Noguchi (1973) and Crum (1976). I prefer to treat the two families separately. The Family Leskeaceae is distinguished from the rest of the pleurocarpous
mosses by the short, fusiform to elliptic and thick-walled laminal cells. The well differentiated alar regions consist of quadrates to horizontally rectangular cells not extending up along the leaf margins. Other important features of the family are the presence of foliose paraphyllia on the stems, non-papilllose paraphyllial cells, and either neckeroid or hypnoid capsules. This difference in having erect or inclined capsules within the family has led Crum (1976) to reassign genera with hypnoid capsules (i.e., Pseudoleskea and Pseudoleskeella) to the Family Thuidiaceae.

The genus Pseudoleskea (B. S. G.) Lesq. et James as discussed thoroughly by Koch (1955), is not recognized in the present treatment. This is in agreement with the taxonomic philosophy of Lawton (1957) and Noguchi (1972). Similarly, the genus Leskeaella (Limpr.) Lcesk. is combined with Pseudoleskeella Kindb. as suggested by Nyholm (1954-1969) and Smith (1978). Thus, the family is represented in the study area by four genera, namely, Leskea, Pseudolekeaella, Lescuraea, and Pterigynandrum.

Recently, Pterigynandrum which was included traditionally in the Family Leskeaceae has been suggested by Chen (1978) to be transferred to the Family Entodontaceae.
1. Leaf costa single ..........................2

1. Leaf costa absent or double ............5

2. Plants without paraphyllia on stems ...(Pseudoleskeella nervosa)

2. Plants with paraphyllia on stems ......3

3. Plants on tree trunk or branches ......4

3. Plants on rock ..............................Lescuraea

4. Plants minute and slender, stem width (including the leaves) less than 1 mm; laminal cells with centrally located, single papilla; capsules long cylindric, erect to slightly inclined ..........................Leskea polycarpa

4. Plants larger and coarser, stem width (including the leaves) more than 1 mm; laminal cells with terminally projected (rarely centrally located) papilla or smooth; capsules ovoid to short oblong, mostly inclined ..........................Lescuraea

5. Branches distinctly julaceous; stems with paraphyllia; laminal cells strongly papillose on the abaxial surface ..........................Pterigynandrum
filiforme

5. Branches not julaceous; paraphyllia absent on stem; laminal cells mostly smooth, rarely weakly papillose

.................................Pseudoleskeella
tectorum
Lescuraea B. S. G.

A genus of about 10 arctic or high elevation species in the northern hemisphere. As treated here, the taxon includes Pseudoleskea B. S. G. which is characterized by inclined capsules with perfect, hypnaceous peristomes. The difference in the orientation of the capsule and the peristomial structure should not be overstressed to divide an otherwise seemingly homogenous genus (in terms of gametophytic features) into two genera, i.e., Lescuraea, and Pseudoleskea. Furthermore, examination of many collections of Lescuraea radicosa reveals that both erect, semi-inclined and inclined capsules are present.

In 1968(a), Schofield listed 8 species and three varieties for the province. Of these, five are presently known from the interior mountain systems. Lescuraea sayiana (De Not.) Lawton, as noted by Lawton (1957), is a difficult species. Its characteristics are intermediate between L. radicosa and L. incurvata. The key characters defined for the three taxa (Lawton, 1971) are rather vague and appear to be quantitative in difference. I am convinced that past collections of L. sayiana from the Kootenay area are all L. radicosa. To date, I have seen no convincing collection of L. sayiana from the province.

In addition, all previous reports of L. atricha (Kindb.)
Lawt. and *L. baileyi* (Best & Grout) Lawt. from the interior of British Columbia have proven to be misidentifications, and these taxa are essentially coastal mountain species, not reaching the southeastern part of the province.

In general, *Lescuraea* is especially well represented west of the Rocky Mountains with many varieties described for the various species.

All problematic specimens of *Lescuraea* collected from the study area were kindly annotated by Dr. Lawton.

1. Leaf cells with centrally located, large papillae
   
   .............................. *L. patens*

1. Leaf cells smooth, or with papillae formed at the ends of the cells
   
   .............................. 2

2. Basal leaf cells long, 30-35 um ...... *L. saxicola*

2. Basal leaf cells short, less than 25 um long, sometimes mixed with a few longer cells
   
   ............... 3

3. Leaves lanceolate, long acuminate; epiphytic on trunks and branches, rarely on rock and ground ...... *L. stenophylla*
3. Leaves ovate, short acuminate, often abruptly narrowed into a short acumen; on rocks and ground, infrequently on trees

4. Median leaf cells isodiametric to short rectangular-elongate (mostly 1-2:1), cell walls thick, if longer, the cell walls conspicuously incrassate, sometimes pitted and often intermixed with irregularly shaped, short and angular cells .............................................. L. incurvata

4. Median leaf cells longer (mostly 2-4:1), cell walls thin to moderately thick, never incrassate and pitted

......................................................... L. radicosa

Pseudcleskea oligoclada Kindb.
Pseudcleskea atrovirens sensu E. S. G.
Lescuraea incurvata var. gigantea Lawt.
Lescuraea incurvata var. tenuiretis (Culmann) Lawt.
Pseudcleskea falicuspis C. M. & Kindb.

This species is similar to L. radicosa in habit, ecology, and distribution pattern and is difficult to distinguish from the latter. See comment under L. radicosa.

Representative specimens seen: Ymir Creek (UBC B-6384); Champion Lakes Provincial Park (UBC E-6385); Blazed Creek (UBC B-6386).

Pseudoleskea radicosa Kindb.
Pseudoleskea rigescens (Wils.) Lindb.
Pseudoleskea howei Koch
Pseudoleskea denudata Kindb.
Pseudoleskea radicosa var. compacta Best
Pseudoleskea rallida Best

This species is, by far, the most common and widely distributed species of Lescuraea in the study area. It is also the most difficult and confusing species to identify. Lescuraea radicosa was redefined by Lawton in 1957 to differ from L. incurvata in having longer median laminal cells with thinner walls. The concept has since been followed by others, though often one finds very few characters to separate the two taxa with confidence (Persson, 1954; Noguchi, 1973). Both taxa are extremely variable in their leaf morphology. My experience is that some leaves with mostly long median laminal cells, and others with short median leaf cells, can be found on the same plant. Furthermore, I have studied carefully many specimens determined by Lawton (UCR) as L. incurvata and L. radicosa, and found her determinations to be inconsistent with the size
measurements of the leaf cells she has set for the two species (Lawton, 1957). In the field, the two species are often found growing intermixed with no obvious differences in ecology or substrate preferences. In view of the fact that the many varieties described form intermediates which nicely link up the two species, I feel that they should be united into a single, highly polymorphic species with the name *L. incurvata* as the older available species name. However, as I have not studied the type specimens of either of the species or their many infraspecific taxa, I am obliged to accept provisionally the two species. My present species concepts of the two follow mainly those of Flowers (1973) and Nyholm (1954-1969), wherein the two species are arbitrarily separated on an artificially defined dimension of median laminal cells, long (2-4:1) versus short (1-2:1), regardless of the thickness and porosity of cell walls.

*L. radicosa* is a widespread species in the mountains in British Columbia and elsewhere in the northern temperate region.

Representative specimens seen: Kokanee Glacier Park (UBC B-6387); Wilmer (UBC E-6388 as var. *compacta*); St. Mary Lake (UBC B-6389).

Pseudoleskea patens Limpr.
Lesquiteuxia atrovirens Braith.
Pseudoleskea atrovirens B. & G.

This species is easy to identify since the laminal cells have a centrally located large papilla. It grows mainly on rocks and ground in alpine heathlands. It is scattered across the province and the study area (Map 122), also widely distributed in Europe, Asia, and North America.

Representative specimens seen: Glacier National Park (UBC B-6390); Sandon (UBC B-6391); Sheep Creek, near Salmo (UBC B-6392).
A high elevation rock species, *L. saxicola* is distinctive in having a glossy greenish brown color and long basal leaf cells. It is very rare in the province, only three localities being known. My collection, Tan & Teng 78-484, came from an open, alpine meadow (2080 m), Meadow Mountain Alpine Recreation Park, north of Kootenay Lake. The other two collections, MacFadden s. n., July 23, 1928, was from the Lake of Hanging Glacier, and Macoun s. n., August 13, 1890 was from Hector Mountain. This last specimen is the type of *Pseudoleskea striata* Bent and is at NYBG.

Uncommon and only sporadically collected in Europe and North America at high elevations and high northern latitudes.


Pseudoleskea stenophylla Ren. & Card. ex Roell
Pseudoleskea rigescens Lindb. sensu Sharp
Lescuraea imperfecta C. M. & Kindt.

This species forms loosely spreading, green to yellow green mats covering the branches of living and dead deciduous trees and shrubs. L. stenophylla is easy to identify in the field by its long and gradually acuminate leaf apices. Common in the study area where suitable host tree species and sufficient atmospheric moisture are present.

A western North American and Japanese species.

Representative specimens seen: Grizzly Creek area, Little Slocan Lake (UBC B-6393); Stagleap Park (UEC B-6394); Glacier National Park (CANM 167232).
Leskea Hedw.

Leskea is mainly a northern hemisphere genus. Smith (1978) estimated it to have about 75 species distributed across Europe, Asia, and North America. Leskea polycarpa Hedw. is the only species found in the study area.


The species is distinct in its slightly secund and lanceolate leaves with the laminal cells having a single centrally placed papilla. The elongate tc cylindric, nearly erect capsules are also distinctive. Occasionally, depauperate forms can be confused with Lescuraea patens (Lindb.) Arn. et Jens. The latter, however, is best separated from the former by its short and inclined capsules, with the perichaetal leaves weakly ccstate.

Leskea polycarpa prefers open, humid sites such as the base of tree trunks and root stumps by the streams or lake
margins. Its occurrence in the area is probably more common than is shown in the distribution map (Map 123). Only four collections are known at present: Tan 76-572, on trunk of Alder, Duck Lake, Creston area; MacFadden 3899, at base of Poplar trees, Nelson; MacFadden 637, on willow tree, New Denver, 1926; and MacFadden 430, on willow tree, Edgewood, 1927.

Var. paludosa (Hedw.) Schimp. which is characterized by broadly ovate and shortly pointed leaves was reported from Nelson based on a Macoun collection dated July 30, 1890. The variety is, according to Lawton (1971), not worth maintaining because many specimens are intermediate in character expressions.

Pseudoleskeella Kindb.

This is an arctic or alpine genus of 8 species. Only one taxon, Pseudoleskeella tectorum (Funck) Kindb., is presently recorded for the study area.

Pseudoleskeella nervosa (Brid.) Nyholm was mentioned in Macoun & Kindberg's Catalogue of Canadian Plants (1892) as having been collected from the Kootenay, but I was unable to
locate the specimen on which this report was based. The species was not mentioned as occurring in British Columbia by Lawton (1971), even though it was reported from Alaska, Alberta, Washington, Montana, and Idaho. At present, there are two good collections of *P. nervosa* in the UBC Herbarium. Both are Schofield's collections made from northern British Columbia. It is possible that the species is present in the study area but awaits discovery.


Map 123.

A variable species collected only twice in the past by MacFadden. Both collections are from mountains: MacFadden 3998 from a bluff face along the Horsethief Creek below the Lake of Hanging Glacier, Wilmer district (V); and MacFadden 19708 from a mountain stream bank, near Golden. The species, although rare locally, is widely and sporadically scattered across the North American continent, and is often collected from calcareous rocks. The remarks of Nyholm (1954-1969) and Lawton (1971) on the variation of the species are useful. Recently,
Lewinsky (1974) mapped the world distribution of the present taxon indicating a discontinuous distribution across the continents in the northern hemisphere.

Pterigynandrum Hedw.

This is a genus of about four species distributed through Europe, Asia, North Africa, North and Central America and Macronesia. The genus is mainly saxicolous or occasionally epiphytic on tree trunks and branches.

Pterigynandrum filiforme Hedw., Spec. Musc. 81. 1801.

A distinctly julaceous and filiform species growing frequently on shaded rock faces, Pterigynandrum filiforme is fairly easy to recognize in the field. The species seems to be more common in the southern half of the study area which
supports the interior Douglas fir forests than in the wet hemlock forests to the north.

Because of its variability, many poorly defined varieties such as var. parillosum (C. M. & Kindb.) Ther., var. minus Lesq. & James and var. decipiens (Web. & Mohr) Limpr. have been described, all of which I do not recognize.

Crum (1953) reported propagulae for the species. I also noted them in a few of the Kootenay collections, notably, Schofield & Jamieson 58983 from Goat Creek, Zincton summit (UBC).

Representative specimens seen: Gray Creek, Kootenay Lake (UBC B-6395); Fred Laing Ridge, Mica Dam (UBC E-6396); mouth of Evans Creek (UBC B-6397); Kokanee Glacier Park (UBC B-6398).

FAMILY THUIDIACEAE

This is a family of about 19 genera distributed mainly in subtropical to tropical regions. Crum (1976) proposed to include in the present family Pseudoleskeella and Myurella and at the same time to transfer Anomodon, Harpohymenium and Herpetineurn to the Family Leskeaceae. The family as treatment here, however, follows that of Watanabe (1972) and
Chen (1978) which actually is modified from the system proposed by Fleischer (1915-1922) and Brotherus (1924-1925). Genera of the present family are closely related to the Leskeaceae, but differ in having a more or less pinnately branching habit, profuse development of stem paraphyllia in most taxa, long basal laminal cells adjacent to the leaf costa, pleuropapillose leaf cells and perfect, hypnaceous peristome teeth.

Five genera occur in British Columbia. All have been collected from the study area.

1. Leaves with double costa or none ..........Heterocladium

1. Leaves with single costa .................2

2. Plants pinnately branched; laminal cells with one large, centrally located, conical papilla .......Abietinella

2. Plants irregularly or twice to thrice pinnately branched; if once-pinnately branched, then laminal cells smooth or apical laminal cells with two to three papillae, or with one terminally located, small, simple or stellate papilla

..................................................3
3. Paraphyllial cells smooth ...............4

3. Paraphyllial cells papillose ...............5

4. Paraphyllia abundant on stem and the base of stem leaves
..........................................................Helodium

4. Paraphyllia few or wanting ...............Claopodium

5. Paraphyllia abundant, highly branched and uniseriate
..........................................................Thuidium

5. Paraphyllia few to wanting; if present, simple and scale-like ...............Claopodium

Abietinella C. Muell.

This is a weak genus segregated from Thuidium. The genus differs from Thuidium in having an unipinnately branching habit and leaf cells with a single large papilla. The average plant size is usually twice as large as the species of Thuidium in the region. Three species are described for the genus, only
one is present in the study area and the province as well.


**Thuidium abietinum** (Hedw.) B. S. G.

This is a common and large moss in dry, open, humic ground of conifer forests at low to subalpine elevations, particularly over basic substrata. It is more common in the eastern flank of the Purcell Mountain Range facing the Columbia Trench and the Canadian Rockies. Its counterpart in similar humic forest floors in wet to moist sites is *Ptilium cristat-castrensis*. Sporophytes are only occasionally collected.

The only species that is likely to confused with the present taxon is *Helodium flandowii* which is an inhabitant of wet and boggy habitats. *A. abietina* is rare in the wet coastal mountains.

A common species in temperate countries. Broadly circumboreal in distribution.

Representative specimens seen: Canal Flats (UBC B-4804);
New Denver (UBC E-4805); Fairmont Hot Spring (UBC B-4806).

**Claopodium** (Lesq. & James) Ren. & Card.

This is a worldwide genus of eight species as revised by Noguchi (1964). He noted that the genus has a secondary center of speciation in western North America, particularly along the coast. Four species are now known from British Columbia with one species, *C. bolanderi* Eest, being restricted in North America to the Pacific Northwest, including the Aleutian Islands, and is the only species present in the study area. Earlier reports of *C. crispifolium* (Hock.) Ren. et Card. from the interior Kootenay Region are based on misdetermined specimens of *C. bolanderi*. The former species differs from *C. bolanderi* in having most of the leaf cells with a single papilla.

This is a tiny or slender plant with crisped, piliferous leaves. Like Abietinella abietina, it frequents mesic to dry, calcareous sites, growing either on humic forest floor mixed with Heterocladium proccurrens or at the base of tree trunks. Occasionally, it covers shaded cliff faces. It is common in the province.

Western North American endemic.

Representative specimens seen: Trcut Lake (UBC B-4807); Boswell, Kootenay Lake (UBC B-4808); Nakusp (UBC B-4809).

Helodium Warrst.

Helodium is a small genus of wetland habitats with five species described from the north temperate zone. Only one species is known to occur in the province and the study area.

This is a species in bogs and fens, as well as in waterlogged swamps and margins of lakes. It is uncommon in the study area, possibly because of the few extensive fen formations in the Selkirk and Purcell Mountains. The smooth paraphyllia that form felts on the stems and also at the base of leaves and leaf costa are diagnostic features. The large pinnately branched habit can be mistaken superficially for Abietinella abietina but the two species occupy different habitats. A few collections at MacFadden Herbarium have been misidentified as H. paludosum (Sull.) Aust. which is an eastern North American and east Asian species. The latter species has longer leaf cells (5-6:1) and weakly papillose middle laminal cells.

A northern circumpolar species.

Representative specimens seen: Old Rosebery road, Slocan Lake (CANM 170244); Horsethief Creek area (UBC B-4810); Glacier National Park (UEC E-4811); New Denver, MacFadden s. n. (V C3312).
This is a genus of eight species distributed in Eurasia and North America, Macronesia and Brazil. It is distinctive among the genera of the Family Thuidiaceae in having a double costa. There are three species of *Heterocladium* reported by Schofield (1968a) from British Columbia, all of which have been collected from the study area.

1. Branch leaves complanately arranged, squarrose-reflexed when dry; stems and stem leaf cells smooth

   ...................................................... *H. procurrens*

1. Branch leaves not complanately arranged, appressed to imbricate when dry; stems and stem leaf cells frequently papillose ...........................................2

2. Basal leaf cells unipapillose; stem leaves erect-spreading to slightly squarrose when dry ........ *H. dimorphum*

2. Basal leaf cells pluripapillose; stem leaves appressed when dry, rarely erect-spreading ............ *H. macounii*

H. squarrosum (Voit) Lindb.

This is a rare species in the interior Kootenay Region. It is primarily a species of rock outcrops in open forests in semi-arid climate or well-drained sites in the Fraser Canyon and coastal region (Schofield, 1976), with a few scattered inland populations along the southern border of the province to Cristina Lake (UBC E-4812) and Kookanusa Lake areas (UBC B-4813). Both inland populations reported here are found inside the Ponderosa pine-Lodgepole pine forests. Earlier reports of the species from other areas in the wet interior are actually H. procurrens. The western North American specimens of H. dimorphum do not match their European counterparts in the degree of squarrosity of stem leaves. Thus, the species can easily be mistaken for H. macounii which has only appressed to weakly erect-spreading stem leaves and pluripapillosa laminal cells.

Although locally rare, the species is nonetheless widely scattered across Europe, Asia and North America, including Greenland.

A slender and somewhat julaceous species, H. macounii is uncommon in the study area on shaded rock outcrops. The appressed stem and branch leaves are distinctive, and under the microscope, with the aid of Hoyer's clearing solution, the two to four tiny papillae on each of the leaf cells are useful diagnostic characters. The species appears to be concentrated mainly in the wetter parts of the area under study (Map 128). New to the study area.

A western North American endemic.

Representative specimens seen: Balfour (UBC B-4814); Airy Creek (UBC B-4815); Sutherland Falls, south of Revelstoke (UBC B-4816).

Heterocladium procurrens (Mitt.) Jaeg., Ber. S. Gall.

H. hemoeopterum C. M. & Kind. (isotype at CANM!)
This is the most common and most distinctive species of the genus in the province. It is the only species of the genus that has a complanate habit with both stem and branch leaves squarrose-reflexed in habit. The leaf cells of *H. procurrens* are smooth, another unusual feature of the species.

*H. procurrens* grows abundantly on forest floors at all elevations in the wetter parts of the study area (see Map 126). Occasionally, it is observed to form mats which cover cliff faces and creek banks. It is frequently associated with *Claopodium iclanderi* in the study area.

Within the province, it is also widespread in the coast mountains (Schofield, 1976).

A western North American endemic.

Representative specimens seen: Ainsworth Hotspring (UBC B-4817); Cayuse Falls, near Deer Park (UEC E-4818); Champion Lakes Provincial Park (UEC B-4819); 11 miles north of Revelstoke (UBC E-4820).
This is a large genus of about 160 species of temperate and subtropical zones. The plants are commonly multi-pinnately branched, resembling a feather. Aside from possessing abundant stem paraphyllia whose cells are strongly papillose, the genus is also known to develop a strong dimorphism between the stem and branch leaves. Two species occur in British Columbia, with only one species, *Thuidium recognitum*, found in the study area.


A common species in the study area, *T. recognitum* is present in most seepy sites, damp forest floor and along the bank of wetlands in calcareous areas. Hence, it is very common along the Columbia Trench (see Map 127) whose substrata are rather basic from the influence of the alluvial substrata derived from the Canadian Rockies. It often occurs with *Tomentypnum nitens* and *Mesia uliginosa*. The plants are usually two or three times pinnately branched, resembling a
miniature of *Hylocomium splendens* in its branching pattern. All Kootenay materials belong to the var. *recognitum* which differs from the var. *radicans* Kindb. (=*T. philibertii* Limpr.) in having paraphyllia with papillae protruded from the ends of the cells, and stem leaves with only acuminate apices.

A circumboreal species in the northern hemisphere.

Specimens examined: Glacier National Park (UEC E-4821); Eox Canyon, east of Revelstoke (UBC E-4822); Cartwright Lake, south of Bugaboo Glacier Park (UBC E-4823).

**FAMILY AMBLYSTEGIACEAE**

The family is characteristic of wet habitats. It is most closely related to the Brachytheciaceae, differing from it in having cylindric, arcuate capsules with a yellow brown peristome, instead of shorter and ovoid capsules with a reddish brown peristome.

Members of the Family Amblystegiaceae are highly variable in morphology. Bryologists are divided in opinions on the disposition of the family. In fact, generic characters are so diverse that it has become almost impossible to generalize the
family characters. The only binding feature seems to be their common preference for wet to aquatic habitats. As stated by Smith (1978), it remains to be proven that the family represents a truly natural congregation of related genera.

Kanda (1975-1976) recently revised the family based on Japanese collections. In his monograph, he gave a succinct review of the history and taxonomic problems inherent in the family. His generic concepts, nevertheless, appear to be narrow and often based on a few minor and unstable characters. On the other hand, Nyholm's (1954-1969) and Smith's (1978) treatments of the genus *Amblystegium* are, in my opinion, too inclusive. I chose to follow Schofield (1968a) and Crum (1976) in accepting the following genera for the study area: *Amblystegium, Campylium, Calliergon, Calliergidium, Cratoneuron, Drepanocladus, Hygroamblystegium, Hygrohypnum, Leptodictyum, Platydictya*, and *Scorpidium*. Disagreeing with Lawtcn (1971) and Kanda (1975-1976), I exclude *Pleuroziun* from the family Amblystegiaceaee on the basis of morphological and habitat differences. Buck (1979) shared the same view and suggested that *Pleuroziun* be returned to the family Hylocomiaceaee.

1. Costa single ................................2

1. Costa double or none ......................12
2. Alar cells thin-walled, strongly enlarged to inflated

........................................3

2. Alar cells thick-walled, either undifferentiated or not strongly enlarged, or inflated ........7

3. Paraphyllia present, few to numerous . . . Cratoneuron

3. Paraphyllia absent ......................4

4. Leaf apices blunt, narrowly rounded . . . Calliergon

4. Leaf apices acute to acuminate ..........5

5. Leaves distinctly falcate-secund when dry

........................................6

5. Leaves not distinctly falcate-secund when dry

........................................Calliergidium

6. Leaves broadly ovate, oblong to ovate-oblong; apices acute, acuminate or obtuse .................. Hygrohypnum

6. Leaves broadly or narrowly lanceolate; apices long and slenderly acuminate ................. Prepanocladus

7. Leaves strongly erect-spread ing to squarrose, usually
abruptly acuminate from an ovate base; apices channeled

......................................................Campylium

7. Leaves imbricate to erect-patent, gradually acuminate;
apices flat or cucullate ...............8

8. Middle laminal cells short, rhomboidal to fusiform, mostly
2-3:1 ......................................................9

8. Middle laminal cells longer, oblong to linear, mostly more
than 4:1 ......................................................10

9. Costa strong, percurrent to excurrent .Hygroamblystegium

9. Costa weak, disappearing halfway from the apex

......................................................Amblystegium

10. Leaves broadly ovate, oblong to ovate-lanceolate

......................................................Hygrohypnum

10. Leaves long lanceolate ...............11

11. Most leaves appressed, strongly falcate-secund

......................................................Drepanoclados

11. Most leaves erect-patent, rarely falcate, sometimes the
blades twisted, especially when dry ....Leptodictyum
12. Alar cells abruptly enlarged or strongly inflated

13. Leaves strongly erect-spreading or squarrose; apices abruptly narrowed from an ovate base, distinctly channeled

Campylium

14. Plants tufted, not firmly attached to the substratum; ascending, lower portion often partly submerged; leaf apices narrowly rounded, at times cucullate

Calliergonella

14. Plants matted, firmly attached to the substratum, prostrate, nearly entirely bathed in running water; apices various, never narrowly rounded and cucullate

Hygrohypnum

15. Plants large, coarse, often more than 50 mm long and purplish in color; leaves imbricate, 2-4 mm long, falcate and somewhat rugose when dry

Scorpidium
15. Plants rarely more than 30 mm long, never purplish; leaves usually less than 2 mm long, never rugose

16. Leaves orbicular, broadly ovate, imbricate when wet, often concave; apices shortly acute, obtuse to broadly rounded

.............Hygrohypnum.............

16. Leaves ovate-lanceolate to narrowly lanceolate, neither imbricate nor concave when wet; apices acuminate

.............Campylium.............

17. Leaves strongly erect-spreading or squarrose; apices abruptly narrowed from an ovate base to channeled and acuminate acumen; capsules arcuate to horizontal

.............Campylium.............

17. Leaves appressed to erect-patent, never squarrose with reflexed and channeled leaf apices; leaf acumen flat; capsules erect to slightly inclined .....Platydictya
Amblystegium B. S. G.

The genus *Amblystegium* illustrates the changing concept of a moss genus which has resulted from our increased knowledge about the mosses. The name *Amblystegium* was originally proposed by Bruch, Schimper and Guembel in *Bryologia Europaea* in 1853 (see Cheney, 1897). It included a heterogeneous array of pleurocarpous mosses in wet habitats. Subsequent efforts were directed to define the genus in a more natural way by excluding unrelated species and erecting new genera to accommodate them. Among these many segregated genera are: *Campylium*, *Prepanocladus*, *Hygroamblystegium*, *Hygrohypnum*, *Homomallium*, *Leptodictyum*, *Platydictya*, *Rhynchostegiella*, and *Sciaronium*. A few, including *Homomallium* and *Rhynchostegiella*, have been transferred to different families. Thus, the genus *Amblystegium* has become increasingly restrictive in definition today, consisting probably of 15 species throughout the world.

The genus as defined here is characterized by small, mat-forming pleurocarpous plants with short laminal cells (less than 4:1) and a short single costa reaching only halfway up the leaf. The capsules are typically hypnaceous. Since the placement of several species in *Amblystegium* is still far from satisfactory, a few modern bryologists, notably Nyholm (1954-1969) and Smith (1978), have preferred to adopt the old and more inclusive generic concept.
Amblystegium varium (Hedw.) Lindb. was reported by Macoun & Kindberg (1892) from Pend O'Reille River based on Lyall's collection. No such specimen could be traced at CANM. This species differs from the very common Amblystegium serpens in having a longer costa that vanishes into the acumen of the leaf. It is best considered a species of Hygroamblystegium. Conard (1959) observed that the costa in the perichaetal leaves of Amblystegium varium, like other species of Hygroamblystegium, is stout and excurrent, while that of Amblystegium is thin, pale and not so markedly percurrent. A. varium (=Hygroamblystegium varium) has been reported from adjacent areas, notably Banff and Jasper National Parks. Its discovery in the study area is likely.

Thus, only one species and one variety are recorded for the study area.
**Amblystegium serpens** (Hedw.) B. S. G., Bryol. Eur. 6: 53. 1853.

**A. juratzkanum** Schimp.

This is a tiny plant that often covers damp, decaying tree trunks, root-stumps and logs; it also is in rock crevices at mesic to wet sites at various elevations. The species is rather easy to recognize after an initial acquaintance. The only moss likely to be confused with it is the rare *Leptodictyum trichopodium*. See *L. trichopodium* for more comments.

Plants with larger, more or less spreading leaves, sometimes falcate and more elongate to rectangular alar cells are often recognized as var. **juratzkanum** (Schimp.) Rau et Herv., following the taxonomic opinion of Nyholm (1954-1969) and Crum (1976).

Widespread in all suitable habitats in both hemispheres. In the study area, *A. serpens* is frequently associated with *Platydictya jungermannicidae* and species of *Plagiothecium*, less often with species of *Hyppnum* and *Furhynchium pulchellum*.

Representative specimens seen: Schroeder creek, Kootenay Lake (UBC B-6443); Kikomum Creek Park (UBC B-6444); Cody Caves
Provincial Park (UBC E-6445).

Calliergidium (Ren.) Grout

This is a small genus of three species whose morphology is intermediate between Drepanocladus and Calliergon. From Drepanocladus, it is distinguished by its shortly lanceolate and nearly straight leaves, and from Calliergon, by its acuminate apices. Formerly treated as a species of Drepanocladus in many floras, Calliergidium pseudostramineum is the only taxon of the genus known to British Columbia.


Drepanocladus pseudostramineum C. Muell.
Calliergidium pseudostramineum always resembles Drepanoclados in the field. Its correct identity can be determined only with microscopic examination. It is possible to misinterpret this species with the aberrant form of Drepanoclados aduncus showing non-falcate leaves. Occasionally, it strongly resembles slender forms of Brachythecium rivulare which always have some serrulation along the leaf margins.

Three collections are known from the area: Tan & Teng 78-469, along sedgy bank of a creek in a wet, open, alpine meadow, Meadow Mountain Alpine Recreation Area, Selkirk Mountain; Tan & Teng 78-245A, on the bottom of a pool in a subalpine forest near Whitewater Ski Mountain Lodge, Nelson and Tan & Teng 78-1235, on wet and partly saturated pool margin at Totem Lake, St. Mary Alpine Park, 7400 ft.

According to Schcfield (1968a), the species is not rare in Coast Mountains. However, its distribution within the province is poorly understood. Reported as rare in Alaska, Yukon, Washington, Eastern North America, and Europe.

Recently, Kanda (1975-1976) interpreted the species as a form of Drepanoclados fluitans, a judgement that appears to be unsound.
Calliergon (Sull.) Kindb.

A genus of wet habitats, Calliergon is rather easy to recognize both macroscopically and microscopically. The ascending tufts with blunt tips are distinctive. Both the early revision of Wynne (1945) and the recent one by Karczmarz (1971) have been consulted for information on the habitat and geographical distribution of the various species. The genus is presently credited with 15 species (Smith, 1978), of which three are known from the study area. Calliergon sarmentosum (Wahlenb.) Kindb. was reported by MacFadden (1926) from the south eastern section of the province. I did not have the opportunity to study this MacFadden's collection to confirm its presence in the study area. Judging from the collections deposited at UBC, C. sarmentosum is a northern and high elevation species, found only in glacier-fed pools and ledges in snow-melt streams in the southern limit of its range. Care should be taken not to confuse it with the similar purplish Scorpidium scorpidioides. Within the province, it is known presently from the Coast and insular mountains, and the Stikine and Cassiar regions.
1. Plants mostly without lateral branches; leaves closely imbricate; costa percurrent .............C. stramineum

1. Plants with many lateral branches; leaves distant, erect, except near stem apex; costa shorter, extending 2/3 the length of the leaf ..................2

2. Plants sparsely and irregularly branched; alar cells gradually enlarged and inflated ........C. cordifolium

2. Plants profusely and pinnately branched; alar cells abruptly inflated ......................C. giganteum


A widely distributed species in the study area and the province as well, this species is common in the shallow water in fens, marsh and pools from low elevations to subalpine elevations. Plants are either submerged or emergent.

A circumpolar species.
Representative specimens seen: Moyie Lake Park (UBC B-6495); Purcell Wilderness Conservancy (UBC B-6496).


In her revision of the genus *Calliergon*, Wynne (1945) suggested that *C. giganteum* was an aquatic phase of *C. cordifolium*, a conclusion with which I disagree. The two can usually be distinguished without any difficulty. *C. giganteum* is large and much branched. The abruptly inflated alar cells are highly diagnostic. The plants infrequently develop a golden brown hue when emergent. In the study area, *C. giganteum* is less common than *C. cordifolium* (Maps 132 & 135), and restricted to more mucky water in quiet pools or roadside ditches. The species at times forms large mats that cover the bottom of the water bodies.

Widespread in the province and elsewhere in North America. Circumpolar.

Representative specimens seen: Horsethief Creek (UBC B-6488); Canal Flats (UBC E-6489); New Denver (UBC E-6490);
Calliergon stramineum (Brid.) Kindt., Canad. Rec. Soc. 6: 72. 1894.

_C. stramineum_ is the most slender of the three species found in the study area. Plants consist of individual strands of unbranched stems usually intermixed with _Sphagnum_ and other hygrophilic mosses in fens and bogs. The species very rarely forms dense mats. Microscopically, the leaf apices of _C. stramineum_ possess an area consisting of a group of 4-6 differentiated, thin-walled, polygonal cells that eventually produce radicles. Crum (1976) observed similar radicle formation in Michigan specimens of _Calliergidium pseudostramineum_.

A circumpolar species.

Representative specimens seen: Kokanee Glacier Park (UBC B-6492); Cayuse Creek (UBC B-6493); Mica Dam area (UBC B-6494).
Calliergonella Loeske

A monotypic genus that resembles Calliergon but possesses a short, double costa. The outer cortical cells (hyalodermis) of the stem are inflated, a feature not seen in Calliergon. Kanda (1975-1976) considered the genus to be anomalous in the family Amblystegiaceae, and suggested that further studies are needed to elucidate its family disposition.

Calliergonella cuspidata (Hedw.) Loeske, Hedwigia 50: 248.
1911. Map 131.

This species shares to a large extent the habitats of Calliergon. It is rather widespread in southwestern British Columbia where it often becomes weedy along the ditches and invades lawns and gardens. But inland, the species is uncommon. Only three populations were discovered in the study area, all were collected from places away from human settlements. My collection, tan & Teng 78-716, was submerged partly in a puddle on the way to Kimble Lake following the
Kuskanax River, about 2 miles past the Nakusp Hotspring Resorts. It is in the same locality where the first interior population of Plagiothecium undulatum was collected. On the other hand, Tan 76-388B came from a wet cliff face of an nameless waterfall near roadside picnic tables south of Galena Bay on Hwy 23, Upper Arrow Lake. The third collection, Brayshaw, s. n., which is deposited at the Provincial Museum in Victoria, came from 2 miles W of Salmo.

Since the species has become so widespread in and around human settlements in the coast, it is possible that the two populations in the study area are similarly the results of inadvertent human introduction.

Crum (1976) believes that the species is a calcicole. A nearly cosmopolitan species with southern hemisphere populations reported from New Zealand and Argentina.

Campylium (Sull.) Mitt.

My generic concept of Campylium follows that of Crum (1976) and Smith (1978) which includes also Campyliadelphus (Kindb.) Kanda and Campylophyllum (Schimp.) Fleisch. The genus
*Campylium* is characterized by strongly erect-spreading to squarrose leaves whose apices are acuminate and channeled. The costa can be single, double or none. This feature, however, is highly variable among the species. Frequently, double costate leaves are observed in individual plants that typically have a single costa, such as *C. polygamum*. The reverse is equally true. The double costate species, like *C. stellatum*, occasionally develop leaves with a single costa. Thus, the nature of the costa appears not to be a reliable basis on which to separate the genera *Campylophyllum* and *Campyliadelphus* from *Campylium* (see Kanda, 1975-1976). I also cannot follow the argument put forward by Andrews (1957) for transferring *C. hispidulum*, *C. sommerfeltii*, and *C. halleri* to the Family Hypnaceae.

*Campylium* is a worldwide genus of about 30 species (Smith, 1978). Schofield (1968a) has reported seven from the province. Later, *C. adscendens* (Lindb.) Ferss. was transferred to *Herzogiella* Broth. by Iwatsuki and Schofield (1973). Recently, Schofield collected good material of *C. calcareum* Crundw. & Nyholm from Ainsworth Hotspring area, and I have identified also *C. radicale* (P. Beauv.) Grout from Macoun's herbarium at CANM. Both are new to the province. *C. hispidulum* and *C. sommerfeltii* are accepted here as two distinct species following Crundwell and Nyholm (1962b). A total of 8 species are therefore known from the area under study.
1. Costa single, extending half the length in most leaves ........................................2

1. Costa double or absent in most leaves .4

2. Alar cells enlarged and inflated, forming excavated auricles ..................................C. polygamum

2. Alar cells not inflated, at most slightly enlarged, never forming excavated auricles ........3

3. Leaf cells oblong to linear, more than 5:1; alar cells usually thick-walled; dioicous ........C. chrysophyllum

3. Leaf cells mostly oblong to short rhomboidal, not more than 6:1; alar cells usually thin-walled; autoicous ..........................................C. radicale

4. Plants usually large (leaves more than 1.5 mm long), gradually acuminate; alar cells mostly rectangular to oblong, enlarged to inflated, forming distinct auricles ..................................................C. stellatum

4. Plants slender (leaves often less than 1 mm long), more or less abruptly acuminate; alar cells quadratae to short rectangular, only occasionally enlarged, never forming excavated auricles .......................5
5. Plants forming dense mats, golden brown; leaves strongly squarrose and crowded with the clasping leaf bases overlapping; rhizoids papillose ..........C. halleri

5. Plants forming loose mats, yellowish green; leaves erect-spread, distant; rhizoids smooth ....6

6. Stem leaves mostly broadly ovate; median leaf cells shorter than 5:1; channeled acumen short, equal or twice the length of the broad ovate base .................7

6. Stem leaves mostly ovate lanceolate; median leaf cells longer than 6:1; channeled acumen long, more than twice the length of the ovate base ..............C. sommerfeltii

7. Alar cells numerous, mostly quadrate to short hexagonal, never enlarged; on calcareous rocks ....C. calcareum

7. Alar cells few, a mixture of quadrate and rectangular cells, sometimes slightly enlarged; not a strict calcicole .................................................C. hispidulum

The species was separated by Crundwell and Nyholm (1962) from the C. hispidulum- sommerfeltii complex and was characterized by having many well differentiated quadrate alar cells. It is also believed to be restricted to calcareous and limey outcrops within its range in Europe.

Schofield and Jamieson 58931, collected from the shaded face of a boulder (calcareous?) on a slope 3 miles south of Ainsworth Hotspring has leaves with alar cells that compare very well with the authentic material from Europe. This collection, confirmed by A. C. Crundwell, is the first report of the species for North America.

Campyliaadelphus chrysophyllum (Brid.) Kanda

*C. chrysophyllum* is a distinct and widely distributed species. The overall size of average specimens is nearly half that of *C. polygamum*, the other unicostate species that it might be confused with. In its general morphology and color, the present species parallels *C. stellatum*, but the double or single costa should quickly separate the two. A MacFadden collection from Burton City dated June 1, 1927 (CANM) and determined as *C. hispidulum* belongs here. Leaves of *C. chrysophyllum* are not consistently unicostate. Care should be taken not to confuse such specimens with the predominantly bicostate specimens of *C. stellatum*, *C. hispidulum*, and *C. sommerfeltii*. Smith's comments (1978) on the variation of the number of leaf costae in *C. chrysophyllum* is most elucidating and should be read when determining difficult specimens of *Campylium*.

Locally abundant when present, the species grows over wet ground, rock, cliff faces, stream tanks and also over wet grassy wastelands, mostly at lower elevations. Within British Columbia, it appears to be uncommon if the present collections
at UBC Herbarium are a reliable indication of the local distribution.

A nearly cosmopolitan species.

Representative specimens seen: Jinsmith Lake Park, by Kiakho Lake (UBC B-6452); Hamil Creek Trail, Purcell Wilderness Conservancy (UBC B-6453); Wilson Lake, Rosebery (UBC B-6454).

Campylium halleri (Hedw.) Lindb*, Musci Scand. 38. 1879.
Maps 134 & 136.

Campylophyllum halleri (Hedw.) Fleisch.

A relatively uncommon species in the area. The crowded and strongly squarrose leaves with golden brown tinge are remarkably distinctive. Among the many species of Campylium, C. halleri closely resembles a miniature Rhytidiadelphus squarrosus. All the local collections came from shaded, damp basic rocks from low to subalpine elevations (see Map 134).

Widespread in all the northern temperate zones.
Representative specimens seen: Purcell Wilderness Conservancy (UBC B-6455); Schroeder Creek, Kootenay Lake (UBC B-6456).


Campylium hispidulum var. cordatum Grout

Nomenclaturally and taxonomically, C. hispidulum has been confused consistently with C. sommerfeltii and C. calcareum. Many eminent bryologists have attempted to solve the problem without much success (Grout, 1928-1940; Jones & Warburg, 1956; Andrews, 1957). The most recent effort to clarify the taxonomic confusion was that of Crundwell and Nyholm (1962) and it is their taxonomic disposition that I follow.

The species that is most likely to be confused with C. hispidulum is, doubtless, C. stellatum var. protensum which is, nonetheless, twice the size of C. hispidulum. The median leaf cells of C. stellatum are elongate to linear. Its alar regions are somewhat excavated and its alar cells enlarged.
The same distinction holds true between *C. stellatum* var. *protensum* and *C. sommerfeltii*.

According to Crundwell and Nyholm (1962b), *C. hispidulum* differs from *C. sommerfeltii* in having broader and more ovate stem leaves, shorter and channeled leaf acumens, more serrulate leaf margins, stronger and terminally papillose laminal cells that are shorter than (3)4:1, and alar cells more or less uniformly short rectangular. These many differences often are not clearly exhibited in North American specimens. Careful examination is required in order to see them. In habitat, there appears to be no difference between the two based mainly on the label information on herbarium specimens. Both grow on logs, rocks, marshy ground and stream banks. *C. hispidulum*, which was long thought to be an eastern North American species, is uncommon in western North America. All reports in literature should be checked in the light of the new findings published by Crundwell and Nyholm (1962b). *C. hispidulum* has been collected only twice within the study area: Tan & Ensing 77-395b, on logs, along Deer Creek, Deer Park area and Tan & Ensing 77-1354, Salmo (UBC). Duplicate specimens were confirmed by Dr. Nyholm. Its rarity in the local sites probably reflects the obscure habit and slender size. Its distribution within the province is not well understood.

A circumboreal species and locally always rare.

Campyliadelphus polygamus (B. S. G.) Kanda

*C. polygamum* is a difficult species to describe and identify. In habit, it sometimes resembles *Leptodictyum riparium*, and, indeed, is often confused with it. Most specimens of *C. polygamum*, however, develop well differentiated and often excavate alar regions, a feature not shared by *L. riparium*. Well-developed plants of *C. polygamum* also exhibit a channeled leaf acumen. In addition, the single, long costa in *C. polygamum* is occasionally branched and simulates a double costate condition, whereas in *L. riparium*, the leaves are persistently unicostate. For additional differences between the two, consult Kanda (1975-1976).

Although nearly cosmopolitan (absent in the tropics) in its geographical distribution, *C. polygamum* has been collected from only seven localities in the Kootenay area (see Map 140). It seems to prefer marshy substrata beside lakes and ponds. Individual plants may climb up the base of tree trunks or logs in extremely wet sites. At Champion Lakes Provincial Park, it grows intermixed with *L. riparium* in many sites.
Representative specimens seen: Echo Lake vicinity, Revelstoke (UBC B-6457); Lardeau River (UBC B-6458); Champion Lakes Provincial Park (UBC B-6459).

Campylium radicale (P. Beauv.) Grout, Moss Fl. N. Am. 3: 84. 1931.

Hypnum decursivalum C. Muell. & Kindb. (isotype at CANM !)
Amblystegium saxatile Schimp.

C. radicale is a slender plant forming loose, soft and light green mats on humic or mucky soil and swamp margins. The arcuate capsule is borne on a long and flexuose seta. The small size approximates that of C. hispidulum and C. sommerfelti, but the single costa of C. radicale is sufficient to identify the species. The leaves of C. radicale are rather distantly arranged along branches, and the laminal cells are oblong to rectangular. Crundwell and Nyholm (1964) provided the best illustration for the taxon although these authors placed it in Amblystegium.
It is very rare (?) in the study area and the province as a whole. Thus far, the species is known only from a single locality, Albert Canyon on Hwy 1 midway between Revelstoke and Glacier National Parks (Macoun’s Canadian Musci 514, which is, incidentally, also the isotype of *Hypnum decursivalum*).

Crundwell and Nyholm (1964) remarked that the species is widespread in Europe and North America, but is nowhere common. Crum (1976) suggests that the species is probably overlooked in many places within its range because of its inconspicuousness.

A new record for the province.

*Campylium sommerfeltii* (Myr.) Bryhn, Explor. p. 61. 1893.

*Campylium hispidulum* var. *sommerfeltii* (Myr.) Lindb.

Like *C. hispidulum*, the present species is a minute and slender pleurocarpous moss difficult to spot in the field and troublesome to identify in the laboratory. It was treated by Grout (1928-1940) and Andrews (1957) as a variety of *C. hispidulum*. However, the channeled acumen of *C. sommerfeltii* is at least twice the length of the ovate basal
part of the leaf and its laminal cells are longer than those of C. hispidulum. Furthermore, the alar cells of C. sommerfeltii consist of a mixture of quadrate, rectangular and oblong cells, some of which occasionally even become enlarged and thin-walled. Under this circumstance, it becomes almost impossible to distinguish it from C. stellatum var. protensum.

C. sommerfeltii is widespread in the northern hemisphere but locally rare. In North America, C. sommerfeltii is more common in the western states and provinces than in the east coast. An African report of the species has already been dismissed as a misidentification by Crundwell and Nyholm (1962b).

Representative specimens seen: Ainsworth Hotspring (UBC B-6585); Nakusp Hotspring (UBC B-6586).

*Campyliadelphus stellatus* (Hedw.) Kanda

*C. stellatum* is a common, variable species in most wet sites in the study area. Typical populations form dense masses of prostrate to tufted, greenish yellow plants with stiff leaf apices. The alar regions tend to become excavate, with the cells strongly inflated and pigmented. There exists a form called var. *protensum* (Brid.) Bryhn, that is half the size of the typical form and the alar cells are enlarged, but not inflated. The alar regions are at most only slightly excavated. This variety has been misidentified consistently in many herbarium specimens as *C. sommerfeltii* or *C. hispidulum*. The last two species are more slender and only half the plant size of var. *protensum*, in addition to other morphological differences. Smith (1978) observed that var. *protensum* in Great Britain grows in drier habitats and is a marked calcicole. Kanda (1975-1976) preferred to treat var. *protensum* as a distinct species apart from *C. stellatum*. He further reported that the inner perichaetal leaves of *C. stellatum* always possess a single costa reaching 2/3 the length of the lamina, although the vegetative leaves are mostly bicostate.
This, in my opinion, supports a close and natural relationship between the unicostate and bicostate species of *Campylium*.

Widespread in the northern hemisphere.

Representative specimens seen: Purcell Wilderness Conservancy (UBC B-6460); Champion Lakes Provincial Park (UBC B-6461); Kooteney Glacier Provincial Park (UBC B-6462); Canal Flats (UBC B-6463).

**Cratoneuron** (Sull.) Spruce

This is a worldwide genus of about 19 species, best characterized by the presence of stem paraphyllia, strongly inflated alar cells, stout and nearly excurrent costa and rhomboidal to short rectangular laminal cells. Two species are known from the study area, as well as from the province.

1. Stem paraphyllia abundant; stem leaves strongly plicate;
laminal cells slightly to conspicuously papillose near cell ends ........................................... C. commutatum

1. Stem paraphyllia few to none; stem leaves not plicate, at most wrinkled; laminal cells smooth .... C. filicinum

Cratoneuron commutatum (Hedw.) Roth, Hedwigia 38: 6. 1899.
Map 142.

Cratoneuron decipiens (De Not.) Loeske

Cratoneuron williamsii Grout

The species is common along spring-fed lake and stream margins, and over seepy cliffs, especially on calcareous substrata. Cratoneuron commutatum is highly variable. Smith (1978) recognized at least four varieties among the British specimens. These, Nyholm (1954-1969) accepted only as forms. I have studied many collections of C. commutatum and have been unable to find any reliable features to separate C. decipiens and C. williamsii from C. commutatum. They seem to be best treated as extreme ends of a morphological continuum. Stem
leaves of *C. commutatum* range from cordate to ovate-lanceolate, and from nearly straight to falcate. Laminal cells show different degrees of papillosity. Probably, the only constant taxonomic character is the presence of abundant stem paraphyllia. Flowers (1973) also expressed doubts as to the distinctiveness of *C. decipiens* and *C. williamsii* as separate from *C. commutatum*. A third species, *C. falcatum* Brid., was added by him to the list of synonymy for the present taxon.

A nearly cosmopolitan species.

Representative specimens seen: Glacier National Park (UBC B-6468); Kintasket Lake (UBC B-6469); Horsethief Creek area (UBC B-6470).


*C. filicinum* is similar to *C. commutatum* in ecology, but in terms of distribution, the former is much more widespread (see Map 143). It is also a highly variable taxon. Specimens without inflated alar cells (only enlarged) and with nearly glabrous stem surfaces without paraphyllia are extremely
difficult to name. Often, such specimens are determined as *Drepanocladus aduncus* or species of *Hygroamblystegium*. Under the circumstances, the only feasible solution is to search for a few leaves that may still show the inflated or semi-inflated alar cells. The typical form of *C. filicinum*, on the other hand, is easy to recognize even with a 10x hand lens. A good illustration of its typical branching pattern can be found in Schofield (1969b). Often the stout costa and the uniformly short rhomboidal leaf cells can be used to distinguish it from *D. aduncus*.

A cosmopolitan species.

Representative specimens seen: Balfour, Kootenay Lake (UBC B-6464); Trout Lake (UBC B-6465); Slocan (UBC E-6466); Albert Canyon Hotspring on Hwy 1 (UBC b-6467).

**Drepanocladus** (C. M.) Roth

A broad concept of the genus *Drepanocladus* is preferred which includes the genus proper, *Limprichtia* Loeske, *Warnstroemia* Loeske and *Sanionia* Loeske, but excludes *Loeskypnum* Paul.
In the case of *Sanionia*, the arguments of Kanda (1975-1976) for a separate generic status are convincing. Nevertheless, the only species in the study area, *Sanionia uncinata* (Hedw.) Loeske, is so variable within its range that I strongly suspect that the supposedly diagnostic characters of the genus will survive the rigorous tests of experimental morphology and critical cultivation studies.

The genus *Drepanoclados sensu lato* in North America was revised by Wynne in 1944. Although much has been learned about the genus from her study and the subsequent publications (1944a, 1944b, 1944c, 1944d), her taxonomic judgements are over generally based. Already, *D. vernicosus* (Lindb.) Warnst. has been suggested to be a *Scorpidium* by Tuomikoski et al. (1973). In addition, they (1973) suggested the recognition of *Loeskypnum*, *Limprichtia*, *Warnstorfia*, and *Sanionia* as distinct genera. I consider the genus *Drepanoclados sensu lato* to remain poorly understood. Any hasty attempt to redefine the genus under the guise of "naturalness" is premature. More studies like those of Lodge (1959) are needed to understand the phenotypic and genotypic variation over its range of distribution.

A total of 8 species is now known from the province (Schofield, 1968a), six of which are in the study area. The total number of species of the genus depends much on one's generic concept and can range from 4 to 35 species in the temperate zones.
D. brevifolius (Lindb.) Warnst., which has not been reported for British Columbia, is likely to be found in the study area. It is not uncommon in Yukon, NW Territories and the Albertan section of the Rocky Mountains. The taxon is best characterized by its poorly differentiated alar regions whose cells are thick-walled and pitted, and intergrade with the rest of the pitted basal laminal cells.

A few statements made by Wynne (1944b) on the phytogeography of the genus remain valid today and are worth repeating here. D. aduncus and D. uncinatus are the two most variable species, and in terms of their distribution, are also the most widespread and abundant. The variability, therefore, reflects their strong adaptability to various changes in the environmental parameters. Others, like D. revolvens, show less variability in morphology and physiology, and greater restriction in their range of distribution which, in the case of D. revolvens, is confined to northern boreal wetlands.

Above all, the genus is widespread in wet and aquatic habitats in both the northern and southern hemispheres, and noticeably absent in most parts of the Tropics.

The help of Dr. E. Nyholm in determining the many difficult specimens of Drepanocladus is hereby acknowledged.
1. Stem hyalodermis present, outer cortical cells inflated

2. Stem hyalodermis absent or poorly differentiated, outer cortical cells not inflated

2. Stem leaves strongly plicate; alar regions decurrent and often with one to three inflated cells forming a small auricle; plants green to yellow, never purplish

\[ \text{D. uncinatus} \]

2. Stem leaves not strongly plicate, somewhat wrinkled; alar regions neither decurrent nor auriculate; plants usually purplish in color (green in the var. intermedius)

\[ \text{D. revolvens} \]

3. Stem leaves plicate; alar cells poorly differentiated, never enlarged or inflated

\[ \text{D. vernicosus} \]

3. Stem leaves smooth, wrinkled or weakly plicate; the pleats, if present, not reaching the entire length of the leaf; alar cells variously enlarged or inflated

4. Leaf apices mostly entire, rarely provided with minute teeth

\[ \text{D. aduncus} \]

4. Leaf apices clearly serrulate, even in the upper and
younger leaves .......................... 5

5. Leaf costa reaching 3/4 the length of the leaf, plano-convex in cross-sectional view; inflated alar cells not reaching the costa, not auriculate ..... D. fluitans

5. Leaf costa longer, nearly percurrent to slightly excurrent, biconvex in cross-sectional view; inflated alar cells many, forming conspicuous auricles and reaching the costa

................................. D. exannulatus


This is an extremely variable and often difficult species to interpret. It is likely that the myriad forms and varieties indicate a species complex that requires re-evaluation with new tools of systematic investigation. Specimens can be seen with various degrees of alar cell inflation. A few specimens even exhibit a suggestion of serrulation near the leaf apex.

I include here within the species var. polycarpus (Bland.) Warnst., characterized by shorter, oblong to hexagonal lower
leaf cells together with inflated alar cells reaching the costa; var. kneiffii (B. S. G.) Warnst. with more or less remotely spaced and straight leaves; and var. capillifolius (Warnst.) Riehm. with excurrent costa and several enlarged alar cells. The three varieties, like all other minor forms, are not clearly defined, even in the literature. Without studying type specimens and with only the limited experience in the study of Kootenay specimens, I lack a clear understanding of the subspecific taxa. In many cases, efforts to name collections at the varietal level have led to frustration. I therefore adopt a very broad concept for the species.

As defined here, this species is the most common Drepanocladus, next to D. uncinatus, in the study area. Frequently collected from lake margins, swampy shores, aquatic depressions, creek banks, and other hygric sites at low elevations. It is widespread and common in the northern hemisphere.

Representative specimens seen: Jimsmith Lake Park (UBC B-6471); 9 mi W of Kaslo (UBC B-6472); Slocan (UBC B-6473).

This species is very similar to D. fluitans, and is often confused with it. Lodge (1959) conducted studies on the effect of various cultivation treatments (such as submerged versus emerged condition, different concentrations of salts in the solution, and light intensity) on the morphology of these two species of Drepanocladius in Britain. The results have significant taxonomic implications. It was observed that, among the many taxonomic characters employed in separating the two equally variable taxa, only the morphology of alar cells remains stable under all treatments. Phenotypically, alar cells in D. exannulatus form a distinct auricle and the cells are strongly inflated, and the differentiated area reaches the leaf costa. On the other hand, alar cells of D. fluitans are generally somewhat enlarged, not strongly inflated, and do not form distinct auricles reaching the leaf costa. Nyholm (1954-1969) observed that in Scandinavian countries, D. exannulatus is more common in basic pools or lakes whereas D. fluitans is more frequent in acid water of poor fens and pools. Such a preference in terms of pH of the water was not noted in the Kootenay populations of the two taxa. In British Columbia, both taxa are collected from all elevations. Both are common also in the entire northern hemisphere.
Representative specimens seen: Parson area on Hwy 95 (UBC B-6474); St. Mary Alpine Park (UBC B-6475); Kokanee Glacier (UBC B-6476).


Like *D. exannulatus*, *D. fluitans* can also be notoriously variable, and no attempt is given here to determine the validity of the numerous available infraspecific taxa. See *D. exannulatus* for more taxonomic comments concerning the two species.

*D. fluitans* is less common than *D. exannulatus* in terms of local distribution in the study area. Wynne (1944b) also noted it to be less common than *D. exannulatus* in Western North America.

Representative specimens seen: Beatrice Lake, Valhalla Mountain Range (UBC B-6477); mouth of Gold River (UBC B-6478); Dewar Creek, near St. Mary Alpine Park (UBC B-6479).

The species is represented mainly by its variety intermedius (Lindb.) Wils. in the study area. It is rare in the Selkirk and Purcell Mountains: MacFadden 4397 from New Denver; Tan & Teng 78-1174 from Whitetail Lake along Findlay Creek in Purcell Mountains; Vitt 22410 from Golden and MacFadden 3958 from the Lake of Hanging Glacier, Wilmer district.

The typical variety of D. revolvens is fairly conspicuous by its large size and purplish coloration. It is known to date only from Lake of Hanging Glacier based on a collection of MacFadden (MACF). Var. intermedius develops only green coloration. From the other Drepanoclados species, D. revolvens can be easily identified by its well developed stem hyalodermis. From D. uncinatus, it is distinguished by the purplish color, the smooth to slightly wrinkled stem leaves as well as its different habitat. Autoicous and purplish populations, typical of D. revolvens, also have been collected from the adjacent Rocky Mountains and the area immediately north of the Columbia River basin.

D. revolvens inhabits mucky to muddy lake shores and wet margins of pools, being totally submerged in shallow water.
Common in the North Temperate zone.

Representative specimens seen (var. *intermedius*): New Denver (UBC B-6485); Whitetail Lake, near Canal Flats area (UBC B-6486); Golden area (UBC B-6487).


*Sanicnia uncinata* (Hedw.) Loeske

Extremely common in the study area, *D. uncinatus* presumably also possesses a wide range of ecological tolerance. It is the only species of *Drepanocladus* that invades mesic to seemingly dry habitats. The species, in humid environments, can become epiphytic on trunks or branches and cover decaying logs and rocks within mature forests. It is easy to distinguish by its extremely falcate-secund and strongly pitted leaves with slender apices. The variety *symmetricus* (Ren. & Card.) Grout with its erect, cylindrical capsules is uncommon in the study area. Most populations produce typically arcuate
to inclined capsules. See *D. revolvens* for additional taxonomic comments.

A nearly cosmopolitan species.

Representative specimens seen: Kokanee Glacier Park (UBC B-6480); Kikomum Creek Park (UBC B-6481); Champion Lakes Provincial Park (UBC B-6482); Nakusp Hotspring Resort (UBC B-6483).


This is a somewhat large species of *Drepanoclados*, averaging larger than the size of most *D. uncinatus*, with strongly falcate leaves that are plicate but without alar differentiation. Laminal cells are homogeneously vermicular to linear excepting the very basal row of cells. Only three collections were seen from the study area: MacFadden 4397, Schofield & Jamieson 58978B from New Denver and RA Keller, s. n., Summer, 1979. The latter specimen came from the floodplain of Columbia River in the vicinity of Spillimacheen.
drainage in the Columbia Trench. Smith (1978) remarked that in Great Britain, the species is found in bogs, fens, and marshes, rarely by streams. Depauperate specimens are easily mistaken for *D. uncinatus* which has, however, strongly inflated hyalodermal cells around the stem periphery, and also leaves with small, auriculate alar regions. Scattered across the province and other parts of North America, it is also circumboreal.

Recently, Crum (1976) offered a controversial and new taxonomic interpretation by stating that *D. vernicosus* might only be an expression of *D. revolvens* var. *intermedius*. In my opinion, the two are certainly similar in gross morphology but differ significantly in the stem anatomy. *D. vernicosus* lacks the stem hyalodermis and central strand that are present in *D. revolvens* var. *intermedius*.

In Japan, Kanda (1975-1976) reported both species as rare, from the wet soil at high elevations. This does not accord with the typical habitats where they generally grow in the study area.
**Hygroamblystegium** Loeske

A small genus of 15 species segregated out of *Amblystegium* on the basis of having a stout and excurrent costa. Crum (1976) fittingly described the genus as "a large edition of *Amblystegium* with notably stout costa". Two species of *Hygroamblystegium* are reported here and a third species, *H. varium*, possibly awaits discovery.

1. Costa terete, very stout at base, in section consisting of 5-8 layers of homogeneous cells, shortly excurrent in a stout mucro ......................*H. noterophilum*

1. Costa not terete, less stout at base, in section consisting of 3-5 layers of cells, percurrent ......*H. tenax*

H. fluviatile (Hedw.) Loeske

A rare species in the study area, H. tenax has been collected from only two localities. Both populations were attached to rocks along a stream margin and submerged: Tan & Teng 78-586, headwaters of Lyle Creek on New Denver and Kaslo' Hwy., above 6000 ft; MacFadden's collection, s. n., dated September, 1926, head of Slocan Lake at Rosebery. The strong costa is an unmistakable generic character while a cross section of the costa will reveal the species identity.

A few specimens named H. irriquum (Hook. et Wils.) Loeske at CANM were available for study and proved to be small forms of Cratoneuron filicinum.

Widespread in the northern hemisphere, though locally uncommon, also reported from Mexico.
Hygroamblystegium noterophilum (Sull. & Lesq. ex Sull.)


This is a large and coarse, submerged species in which often only the blackish costae persist on the older portions of the stems. See the key for the differences between the two species of the genus.

Known at present from only two localities: Tan & Ensing 77-1564, on rock, submerged in a nameless creek near the mouth of Plumbob Creek, 5 mi NW of Kikomum Creek Park; Tan & Ensing 77-1977A, on exposed rocky bank of Kootenay Lake, Ainsworth Hotspring.

This is the first report for the province. Distributed also in eastern North America and Chile but absent from Europe and Asia.
Hygrohypnum Lindb.

Another difficult and variable genus of wet habitats, Hygrohypnum, like Campylium, consists of single- and double-costate species. Within one species, the number of costae often varies. This has led to the creation of many unnecessary binomials.

The genus Hygrohypnum has been recently monographed on a worldwide basis by D. W. Jamieson (1976) whose results have reduced drastically the species number from 39 to 16. The monographer concluded that it is very difficult to give a concise generic definition for Hygrohypnum, and that the most important uniting feature for all the species is the peculiar habitat where they are collected: that of wet rocks and boulders in running water. Basically, Hygrohypnum is a northern hemisphere genus. The genus has 11 species in the province, 9 of which are in the study area. I have followed mainly the species concepts of Jamieson (1976) for the genus and the key to the species presented below is also modified after the unpublished key of his Ph. D. dissertation. Furthermore, the help of Dr. D. W. Jamieson in determining several puzzling specimens of Kootenay Hygrohypnum is hereby acknowledged.
1. Hyalodermis present in stem cross-sectional view                       \[ \text{H. ochraceum} \]

1. Hyalodermis absent                                                  \[2\]

2. Marginal leaf cells linear, mostly longer than 60 um                \[ \text{H. bestii} \]

2. Marginal leaf cells short to elongate, less than 60 um              \[3\]

3. Leaves mostly orbicular or broadly ovate in outline               \[4\]

3. Leaves oblong to lanceolate, oblong ovate, never orbicular         \[7\]

4. Costa single, strong                                              \[ \text{H. smithii} \]

4. Costa mostly double, none or short with one arm longer than the other \[5\]

5. Leaves mostly concave, apices acute to acuminate; alar cells poorly or not differentiated \[ \text{H. molle} \]

5. Leaves plane to ruffled or at most slightly concave, apices obtuse to broadly rounded; alar cells plainly differentiated
6. Alar cells thin-walled, gradually enlarged, rectangular to oblong, rarely inflated; leaf apices often minutely toothed; inner perichaetial leaves papillose on the abaxial surface near apex ............................. H. alpinum

6. Alar cells thick-walled, abruptly differentiated from the rest of the basal laminal cells, quadrate to rectangular, enlarged to inflated, often colored; leaf apices entire or only weakly toothed; inner perichaetial leaves smooth ........................................ H. duriusculum

7. Alar cells markedly differentiated, quadrate to rectangular, thick-walled, occasionally inflated and thin-walled ........................................... H. luridum

7. Alar cells poorly or not differentiated, never inflated .................................................. 8

8. Leaf apices abruptly acuminate, forming slender acumen ........................................... H. styriacum

8. Leaf apices shortly acute, at times obtuse ................................................................. H. norvegicum
Hygrohypnum alpinum (Lindb.) Loeske, Hedwigia 43: 194. 1904.

H. alpinum, like its closest ally, H. duriusculum, inhabits rocks that are submerged or emergent in swiftly flowing mountain streams. The two taxa are difficult to separate. Jamieson (1976) suggested that plants of H. alpinum are more ascending in habit and softer to touch. Also, the leaves of H. alpinum, when dry, tend to display a ruffled appearance whereas those of H. duriusculum are mainly plano-concave. All these features I find unreliable. The only character that I can trust with Kootenay specimens is the difference in the alar differentiation (see key description). However, in dealing with difficult specimens it takes careful study and previous experience in examining authentic specimens of the two to be able to make a sound taxonomic judgement using the alar difference.

The geographical distribution map prepared by Jamieson (1976) indicates that the taxon has a disjunct distribution between Western North America and Western Europe.

H. molle var. bestii (Ren. et Bryhn) Hab.

This is one of the few Hygrohypnum species in the study area that is stiff or rough to touch when dry. The species is best recognized by the broadly ovate leaves with very long marginal cells.

In the study area, populations of H. bestii are firmly attached to rocks and are submerged in cold, clear, and running water in mountains. Layers of silt usually coat the leaf axils and stem surface, giving the whole plant a dirty and gritty appearance.

Common in the Selkirk and Purcell Mountains, it is a North American broadly endemic species with the main center of distribution in western North America. It is new to the study area.

Representative specimens examined: Silverton (CANM 175281); Goldstream River (UBC B-6583); Glacier National Park (UBC B-6584).
Hygrohypnum duriusculum (DeNot.) Jamieson, Taxon 29: 151.

H. dilatatum (Wils.) Loeske

Jamieson (1976) observed that H. duriusculum and H. alpinum in western North America produce densely foliose rhizomatous and stoloniferous stems bearing numerous short, erect or ascending branches, a feature which is uncommon to rare in other species in the genus. In habit, H. duriusculum is coarse and rigid to touch when dry, even after removing all the silt. See H. alpinum for comments of morphological differences between the two.

The species is widespread in the temperate zone. The confinement of H. duriusculum to the Selkirk Mountain Range (see Map 147) is apparently an artifact of collections when comparison is made with its world wide distribution map prepared by Jamieson (1976).

The present combination of the binomial for H. duriusculum has priority over H. dilatatum as discussed by Jamieson (1980).

Representative specimens seen: Beaton, Trout Lake (UBC B-6498); New Denver area (UBC B-6499); Kokanee Glacier Park (UBC B-6500).
**Hygrohypnum luridum** (Hedw.) Jenn., Man. Mosses West Pennsylv. 287. 1913.

**H. palustre** (Hedw.) Loeske

**Hypnum pseudo-montanum** Kindb. *in* Macoun

**Hypnum columbico-palustre** C. Muell. & Kindb. *in* Macoun

This is a common species in diverse wet sites. It is extremely variable in morphology. Almost all the vegetative characters such as the costa number and length, laminal cells, alar cells, and leaf outline vary from population to population, a situation reminiscent of **Dichodontium pellucidum**. Specimens with very short double costa and strongly enlarged and colored alar cells are likely to be misdetermined as **Callicladium haldanianum** (Grev.) Crum, a widespread eastern North America species not yet recorded from the study area. The latter, however, is a hypnaceous taxon with the alar regions more markedly colored and inflated, and the overall habit is dissimilar to **H. luridum**. A consultation of illustrations of the variability of the species prepared by Jamieson (1976) is extremely useful.

A fairly widespread circum-North Temperate species.

Representative specimens examined: Deer Park area (CANM
Hygrohypnum molle (Hedw.) Loeske, Moosfl. Harz. 320. 1903.

_H. molle_ is another common species of the genus that produces broadly ovate to sometimes orbicular leaves. The leaves of the present taxon, however, are more concave than those of _H. alpinum_ or _H. duriusculum_. The alar cells are also poorly differentiated in _H. molle_. For further taxonomic comments concerning the dissimilarities among the three taxa with equally broadly ovate leaf shape, Jamieson (1976) should be consulted.

Like _H. alpinum_, _H. molle_ exhibits an interesting western North America and western Europe disjunctive distribution pattern.

Representative specimens seen: Joseph Creek, near Cranbrook (UBC B-6504); Tye settlement, west bank of Kootenay Lake (UBC B-6505); Sheep Creek, near Salmo (UBC B-6506).
Hygrohypnum norvegicum (Schimp.) Amann., Fl. Mouss. Swisse 1: 188. 1912.

The discovery of this small, disjunct population of Hygrohypnum norvegicum from the Porcupine Creek in Salmo by D. W. Jamieson (coll. 5598 at UBC) is most surprising and significant. The locality is a thousand miles south of its normally circumarctic range.

H. norvegicum is uncommon to rare in most parts of the Arctic. Collections are too few at UBC Herbarium to permit comment on its morphological variation.

Hygrohypnum ochraceum (Turn. ex Wil.) Loeske, Moosfl. Harz. 321. 1903.

By virtue of its well developed stem hyalodermis, Hygrohypnum ochraceum is the easiest species to identify in the genus. Similarly, the distinct layer of stem outer cortical cells has led Jamieson to question the validity of including the species in the genus Hygrohypnum.
H. ochraceum is the most common species of the genus at all elevations in the study area. It is equally widespread outside of the province. It is circumboreal, although absent in the continental dry belts.

Representative specimens seen: Glacier National Park (UBC B-6507); Whitewater Ski Mountain Lodge, near Nelson (UBC B-6508); Zincton (UBC B-6509); Kokanee Glacier Park (UBC B-6510).


H. arcticum (Schm.) Loeske

H. smithii forms very stiff, coarse and loosely interwoven tufts on irrigated rocks in mountain streams or creeks. The broadly ovate leaves, coupled with the single and strong costa, are highly diagnostic. In a few leaves, nevertheless, the base of the costa may become branched, thereby displaying a false double-costate condition. H. smithii, like Hygroamblestegium noterophilum, often has only the costae left behind in the old portion of the stems. The two species, however, are very
different in the leaf areolation and should not be confused.

It is uncommon in the study area and the province as well (see Map 149), *H. smithii* generally appears to be a high elevation species. Present also around the St. Lawrence Gulf area in eastern Canada, Greenland and western Europe.

Representative specimens examined: Lake of Hanging Glacier (CANM 175934); Kokanee Glacier Park (UBC E-6511); Revelstoke National Park (UBC E-6512).


The species is best identified by the rather abruptly acuminate leaf apices and poorly defined alar regions. The leaf costa can be single or double. It is locally uncommon. Jamieson (1976) showed its disjunct pattern of distribution between western North America and western Europe.

Representative specimens seen: Idaho Lookout Tower, Sandon area (UBC E-6513); Kokanee Glacier Park (UBC B-6514); Jackson Basin (UBC B-6515).
Leptodictyum (Schimp.) Warnst.

The genus is, admittedly, vague in delineation. Perhaps, it is best united with Amblystegium as was done by Nyholm (1954-1969) and Smith (1978). I am retaining the genus since one of the common species present in many still water pools in the study area is L. riparium. It is rather large in size and distinctive in overall gametophytic morphology. The species suggests only a remote relationship with the rest of Amblystegium. Yet, when one studies all the species of Leptodictyum on a worldwide basis, the distinction between the genus and Amblystegium becomes untenable. Presently, the best summary of the generic differences between Amblystegium and Leptodictyum is that presented by Kanda (1975-1976). As is, Leptodictyum has oblong (4:1) to linear leaf cells, a more or less entire leaf margin and filamentous pseudoparaphyllia.

In the study area, L. trichopodium often produces leaves with short oblong to rectangular laminal cells. Such a depauperate specimen is likely to be determined as Amblystegium.

Leptodictyum also has well spaced and widely spreading leaves that are somewhat complanate in orientation along the main stem. The leaf apices, moreover, are not channeled and reflexed as in the case of Campylium.
Only two species are accepted for the entire study area.

1. Median leaf cells short, rhomboid to oblong, 25-45 μm long

L. trichopodium

1. Median leaf cells longer, linear, more than 50 μm in length

L. riparium


Amblystegium riparium (Hedw.) B. S. G.

L. riparium is a highly variable species in the study area. The laminal cells are long and linear with the alar cells only imperceptibly differentiated from the rest of the basal laminal cells. This feature is useful in differentiating the species from the superficially similar Campylium polyganum
In addition, the leaf apices of *L. riparium* are not channeled. The leaf costa is consistently single and long, and is never tranched at the base to simulate the double costa feature seen in *C. polyganum*.

In the Kootenay, *L. riparium* is common and abundant in mucky water and in still pools and marshes or roadside ditches with high organic content. Rarely is it found in fast running water of mountain streams and glacier fed creeks.

A nearly cosmopolitan species.

Representative specimens seen: Purcell Wilderness Conservancy (UBC B-6449); Salmo (UBC B-6450); Sasquatch Lake, Lemon Creek Trail, Kckanee Glacier Park (UBC B-6451).

**Amblystegium trichopodium** Schultz

**Amblystegium kochii** B. S. G.

There are two collections from the southeastern part of the province correctly named *L. trichopodium* var. *kochii* at CANM. Both are MacFadden's collections. Collection 3407 came from a rock at the head of Slocan Lake at Rosebery and is an **Amblystegium serpens**. A third collection, MacFadden 7469, is from Sandon. In addition, I also collected the species from Gray Creek area, Kootenay Lake (UBC B-6568).

*L. trichopodium* can be mistaken readily for **Amblystegium serpens** whose plant size is only half of that of the former. Also, the leaves of *L. trichopodium* are more broadly ovate and the margin more entire. The leaf apex of *L. trichopodium* often narrows conspicuously into a short acuminate tip from the broad ovate base whereas in *A. serpens*, the acumen gradually becomes long acuminate. The dimensions of the laminal cells in *L. trichopodium* are unreliably variable. I made no attempt to distinguish the var. *kochii* from the typical form which differs in the shape of leaves and length of costa, because there are only a few specimens of doubtful determination of the

The above mentioned collections are the second and third known localities of the species in British Columbia. Earlier, Porsild and Crum (1961) had reported it from Liard Hotspring. Elsewhere, it is known from Alberta, Washington, Oregon, Idaho, and eastern North America. It is also present in Europe and Asia.

Platydictya Berk.

This is a small genus of 10 species found in Europe, Asia, and North America. It is closest to Amblystegium in leaf areolation but differs in the narrowly lanceolate leaf outline and the double and short costae. In addition, the stem of Platydictya does not develop a central strand as in Amblystegium. Habitat preference, however, is the same for the two genera. Consequently, it is included in the present family, instead of the family Hypnaceae as suggested by Crum (1976). Only one species is known from the entire province.

Amblystegiella jungermannioides (Brid.) Giac.
Amblystegiella sprucei (Bruch) Loeske

This is a common and widespread species in the study area. It grows on nearly all kinds of damp objects in nature, from trunk bases, decayed logs to seepy cliff, rock crevices and stream banks. Often found associated with Amblystegium serpens, P. jungermannioides is, of course, smaller than A. serpens which it matches in habit. Leaves of P. jungermannioides are also narrowly lanceolate, more strongly serrulate at the base, and doubly costate to ecostate.

The problem regarding the type specimens of P. jungermannioides has been resolved by Isoviita (1979), and a lectotype was chosen by him.

A circumpolar northern hemisphere species.

Representative specimens seen: Ainsworth Hotspring (UYBC B-6446); Idaho Lookout Towel, Sandon (UBC B-6447); Poplar Creek, N of Lardeau (UBC B-6448).
Scorpidium (Schimp.) Limpr.

This is a genus of only three species. Specimens are commonly tumid and robust with a strong purplish color. I cannot see the validity of transferring Drepanocladius vernicosus (Mitt.) Warnst. to the present genus as proposed by Tuomikoski et al. (1973). Only Scorpidium scorpioides is present in the study area. In 1892, Macoun reported Hypnum (Scorpidium) turgescens Th. Jens. from a small brook in Roger's Pass, Selkirk Mountains. The specimen at CANM (175279) is a Hygrohypnum bestii. Based on the collections at UBC and literature, S. turgescens (Th. Jens.) Loeske is a calcicole and has a more northern circumboreal distribution with only a few disjunct populations in the Rocky Mountain Range that borders the provinces of Alberta and British Columbia. Its presence in the study area is unlikely or extremely rare.

This is a relatively common and always locally abundant taxon in the rich, calcareous fens and swamps in the Columbia Trench (Map 148). Populations are frequently mud encrusted, slippery when wet and submerged in shallow water. When dry, the surface of the leaves becomes wrinkled and the purplish color is more apparent. Smith (1978) reported that the taxon can grow also in acidic habitats in Great Britain.

One of the MacFadden collections from Taylor Falls (New Denver?) dated October, 1925 is correctly named Scorpidium scorpioides. The exact locality of Taylor Falls in the Kootenay region is not clear and is unlikely to be in New Denver. Furthermore, the species, which is a calcicole, is not likely to be in New Denver area, which lacks calcareous substrata.

A circumboreal species.

Representative specimens examined: Lake of Hanging Glacier (CANM 231486); Glacier National Park (UBC B-6517); Canal Flats area (UBC B-6518).
FAMILY BRACHYTHECIACEAE

A large pleurocarpous family characterized by a stem without paraphyllia, leaves with a single costa, elongate to linear leaf cells, differentiated alar cells and capsules with double peristomes.

The last attempt to redefine the family in a natural way was done by Robinson in 1962. Wigh (1974), on the other hand, discussed the relationship between the family Brachytheciaceae and some other pleurocarpous families.

Schofield (1968a) has accepted 12 genera for British Columbia: Trachybryum, Tomentypnum, Hemantheeium, Brachythecium, Bryhnia, Cirripilium, Scleropodium, Rhynchossteugium, Isothecium, Rhynchossteugilla, and Eurychnium (including Stokesiella). Of these, I have recorded 8 for the study area.

Isothecium is the only genus that causes difficulty in the family delimitation. The leaf cells are commonly short elongate to rhomboidal, while the alar cells are dense and mostly transversely elongate forming a large triangular alar region at leaf basal angles. The phenetic justification for retaining the genus in the family Brachytheciaceae is the morphology of Isothecium stoloniferum (Hook.) Brid. whose alar cells, like those seen in many Brachythecium, are quadrate to
rectangular. Since *Isothecium stoloniferum* is the only species of the genus present in the study area, I have included the genus in the family, following the traditional treatments of Grout (1928-1940), Robinson (1962), Takaki (1955-56), and Lawton (1971). Otherwise, I believe that the genus, in consideration of all its included species, is better placed in the family Lembophyllaceae following Fleischer (1915-22), Brotherus (1924-25), and Crosby and Magill (1979).

1. Leaves strongly plicate .................2

1. Leaves weakly plicate, wrinkled to smooth ........................................4

2. Median leaf cells linear to vermiform (>6:1) ........................................3

2. Median leaf cells shorter, elongate to rhomboidal (<6:1) .........................Brachythecium

3. Stems erect to ascending, conspicuously tomentose nearly to the shoot apex; alar regions scarcely differentiated ......................................................Tomentypnum
3. Stems prostrate, creeping or branches sometimes tufted, not conspicuously tomentose; alar regions clearly differentiated ................................................. Homalothecium

4. Branches julaceous; leaves distinctly concave, median laminal cells vermiciform ............... Scleropodium

4. Plants without the above combination of characters ......................................................... 5

5. Plants strongly serrulate to base; opercula long rostrate .................................................. 6

5. Leaves entire or serrulate only apically or weakly serrulate at base; opercula conic to apiculate .......................................................... 7

6. Leaves heterophyllous; stem leaves broadly deltoid, strongly squarrose, long acuminate; apical laminal cells of branch leaves long to elongate, similar to the median laminal cells ............................. Stokesiella

6. Leaves not heterophyllous; stem leaves not broadly deltoid, erect-spreading as in branch leaves, apices acute to obtuse; apical laminal cells of branch leaves shortly elongate to rhomboid-hexagonal, very different from the median laminal cells ................................. Eurhynchium
7. Plants small and slender, leaves not more than 1.5 mm long, narrowly lanceolate, plane; leaf marginal serration with paired teeth at base; costa strongly percurrent

.......................................................... *Rhynchoptegiella compacta*

7. Plants larger, leaves mostly more than 2 mm long, broadly ovate to lanceolate, slightly to strongly concave; leaf margins entire, or if serrulate, lacking paired teeth at the leaf base; costa ending midway or rarely percurrent

.......................................................... 8

8. Plants often with flagelliform branches; leaves clearly serrulate in the upper half and entire or slightly serrulate at base; alar cells numerous, mostly quadrate, thick-walled

.......................................................... *Isothecium*

8. Plants never with flagelliform branches; leaves entire or serrulate throughout, or only serrulate at base; alar cells not thick-walled, if so, then not numerous

.......................................................... *Brachytheicum*
Brachythecium B. S. G.

A large and cosmopolitan genus of about 300 species. The genus is easy to recognize among the many unicostate, pleurocarpous mosses, but the species are, in many cases, unsatisfactorily defined.

The species concept of Brachythecium is traditionally based on a combination of leaf and peristome characters with greater emphasis on gametophytic features. Within the genus, the degree of morphological variation over a wide geographical area has not been carefully documented. None of the taxonomic features presently employed in defining the species seem to be stable in their phenotypic expression. Even the few distinctive species (such as Brachythecium collinum, B. albicans and B. hyalotaracetum) have individuals that are intermediate or atypical in morphology and defy accurate species determination. Since Brachythecium is often collected without sporophytes, I have tried to construct the key to the species by emphasizing gametophytic characters such as length of the costa, plicateness and concavity of stem leaf, size of laminal cells, and alar differences. My experience has shown that the alar characters and seta papillosity are the two least variable taxonomic features. Though sexuality is another constant character, it is sometimes difficult to determine this feature in the often intertangled stems of Brachythecium. The presence of many species complexes in the genus, i. e.
B. *rivulare*- *rutabulum*, B. *aspermum*- *frigidum* and B. *salebrosum*- *campestre*, further attests to the taxonomic difficulty inherent in the genus and suggests the enormous effort needed to resolve the enigma. The situation also seem to suggest that the genus is in a process of explosive speciation in North America, where the species diversity appears to reach its peak in the western North America, resulting in the existence of many locally widespread endemic species.

Lawton in 1971 treated 20 species of *Brachythecium* for the Pacific Northwest. Earlier Schofield (1968a) accepted 22 taxa for British Columbia. The difference in the species number is mainly the result of different species concepts adopted by the two workers. It is my belief that a broader species concept will work better and more satisfactorily in a variable and poorly understood genus. Thus, a total of 18 species are recognized for the study area.

*B. acutum* (Mitt) Sull. is treated here as a synonym of *B. salebrosum*, and *B. lamprochryseum* C. Muell. & Kindb. as a synonym of *B. frigidum*. *B. curtum* (Lindb.) Limpr. is interpreted as a distinct variety of *B. starkei*. *B. acuminatum* (Hedw.) Aust. and *B. oxycladon* (Brid.) Jaeg. & Sauerb. have been reported from southeastern British Columbia by Macoun & Kindberg (1892) and MacFadden (1926). Specimens at MacFadden Herbarium (MACF) were studied and proved to be either *B. albicans* or *B. salebrosum*. *B. oxycladon* is suggested by
Crum (1976) to be an eastern North American species. Likewise, *B. glaciale* B. S. G. and *B. glareosum* (Spruc.) B. S. G., which were reported from the study area, have already been excluded by Crum et al. (1973) from the checklist of North American mosses.

Robinson (1962), in his generic revision of North American Brachytheciaceae, had accepted and amended Grout's genus, *Chamberlainia*, as segregated from *Brachythecium*. As originally proposed, *Chamberlainia* differed from *Brachythecium* in having an erect capsule with rudimentary or no cilia in the endostome. Robinson expanded the generic concept to include all species that have strongly plicate stem leaves with numerous quadrate alar cells. This division of the genus is unnatural because there are several species that are intermediate in character combinations, including *B. asperrum* and *B. frigidum*. Furthermore, in many populations of *Chamberlainia*, there are always a few capsules that are curved. I follow, therefore, Nyholm (1954-1965), Crum (1976), and Smith (1978) in accepting an inclusive generic concept for *Brachythecium*. Recently, Wigh (1974) reviewed the evidence of chromosome number which supports the naturalness of various sections within the genus *Brachythecium*. 
1. Costa mainly percurrent, ending in the acuminate leaf apex ...........................................2

1. Costa shorter, extending halfway up the length of the leaf ................................................4

2. Leaves weakly decurrent; seta rough above, smooth below ............................................B. populeum

2. Leaves strongly decurrent; seta rough throughout ..............................................................3

3. Leaf margins often recurved at the base of the leaf, at least on one side; alar cells quadrate to short rectangular, not much differentiated from the rest of the basal laminal cells ........................................B. reflexum

3. Leaf margins plane or slightly recurved only at base of leaf; alar cells quadrate to short rectangular, different from the elongate basal laminal cells ..B. starkei var. pacificum

4. Plants hypnoid in habit; leaves strongly falcate and plicate ..............................................5

4. Plants not hypnoid in habit; leaves erect-spreading, not strongly falcate, plicate or smooth ....6
5. Plants more or less pinnately branched; seta very rough; autoicous ........................................B. leiibergii

5. Plants irregularly branched; seta smooth; dioicous ..................................................B. erythrorrhizon

6. Leaves, including branch leaves, clearly plicate, wet or dry ...........................................7

6. Leaves, including branch leaves, smooth, at most wrinkled or lightly plicate .........................13

7. Seta rough throughout ...............................8

7. Seta smooth throughout or at least smooth near the lower half ...........................................10

8. Stem leaves more or less deltod-lanceolate with distinct auriculate alar region; basal leaf margins distinctly serrulate; dioicous .................................9

8. Stem leaves mostly ovate-lanceolate, very rarely with discernible auricles; basal leaf margins entire to weakly serrulate; autoicous ..............................B. rutabulum

9. Plants tufted; leaves imbricate, strongly plicate from base to apex; alar cells enlarged, mostly rectangular to oblong
9. Plants in mats; leaves erect-spreading, moderately plicate, plicae not reaching the entire leaf length; alar cells not enlarged, mostly short rectangular to polygonal .......................... B. asperllum

10. Plants coarsely tumid and strongly julaceous, in tufts; leaves strongly plicate; in wet places, arctic-alpine species ........................................ B. turgidum

10. Plants mat-forming, branches complanate to slightly julaceous; leaves moderately to weakly plicate; on moist, rotten logs, and humus covered forest floor, not arctic-alpine ........................................ 11

11. Plants yellowish to dark green, branches more or less complanate; autoicous ....................... 12

11. Plants whitish green, branches slightly julaceous; dioicous ........................................ B albicans

12. Leaf margins entire to weakly serrulate in the upper half; seta smooth throughout .................. B. salebrosum

12. Leaf margins strongly serrulate in the upper half; seta minutely roughened, becoming smooth near the lower half
B. campestre

13. Plants julaceous; leaves appressed to imbricate wet or dry

13. Plants somewhat to markedly complanate, never julaceous; leaves erect-spreading when wet

14. Plants with short julaceous branches, forming compact mats on moist ground or humus-covered rock faces; branch leaves up to 1 mm long; leaves broadly ovate to suborbicular

14. Plants with long and slender branches, forming loose mats or tufts along stream banks and rock outcrops; branch leaves mostly longer than 1 mm; leaves lanceolate to oblong-ovate, never suborbicular

15. Leaves strongly decurrent

15. Leaves not strongly decurrent; decurrent base narrow, 2-3 cells wide and reaching only halfway to the leaf below

16. Plants whitish green, on forest floor; leaves lanceolate with long slender apex, not concave; alar cells thin-walled
to thick-walled, not pitted ............ B. albicans

16. Plants yellowish to brownish green, on wet rock outcrops along streams or creeks or waterfalls; leaves oblong-ovate, strongly concave, apices abruptly acuminate; alar cells thick-walled, frequently pitted ........ B. plumosum

17. Leaves longly and broadly decurrent; decurrent leaf bases at least 3 cells in breadth and reaching the insertion of the leaf below ...................... 18

17. Leaves moderately to slightly decurrent, or none; decurrent base at most 3 cells in breadth and not reaching the leaf below ...................... 20

18. Alar regions auriculate and concave; alar cells rectangular to oblong, enlarged to inflated, mostly thin-walled ...................... 19

18. Alar regions not auriculate, not concave; alar cells mostly quadrate, thick-walled, never oblong and inflated ...................... B. starkei
   (including
   B. holzingeri
   Grout)

19. Plants with few short lateral branches, sometimes somewhat
dendroid; stem leaves broadly oblong ovate, concave, abruptly acute or shortly acuminate; inflated cells confined to alar regions .................... B. *rivulare*

19. Plants profusely branched; stem leaves triangular-ovate, flat, gradually long acuminate; inflated alar cells reaching the costa ............................ B. *nelsonii*

20. Leaves deltoid-ovate; leaf bases distinctly auriculate, serrulate .......................... B. *asperrimum*

20. Leaves oblong-ovate to lanceolate; leaf bases not auriculate, mostly entire .............. 21

21. Plants large and more or less complanate, at least 4 mm wide including the leaves, with greenish sheen; stem leaves concave, abruptly apiculate; branch leaves closely inserted, somewhat imbricate .................... B. *hyalotapetum*

21. Plants small and not complanate, only 2 mm wide including leaves, not glossy; stem leaves not concave, long acuminate; branch leaves often distant, erect-spreading, twisted in various directions .................... B. *velutinum*
1853.

A common species on xeric to mesic, humic forest floors and sloping rocky outcrops throughout the province. Brachythecium albicans appears to have a wide tolerance for drought, and is more common in drier sites in the study area. The whitish green color of the plants and the loosely imbricate stem leaves with long and slender leaf apices are diagnostic in the field. Smith (1978) described the habit of the species as "string-like" and claimed it to be a calcifuge in Great Britain. The only species of Brachythecium that it may be confused with is the atypically slender form of B. salebrosum. The latter, however, is autoicous and has more plicate stem leaves. Grout (1928-1940) utilized the entire leaf margin of branch leaves to distinguish problematic specimens of B. albicans. I have found this character to be totally unreliable.

A widespread, nearly cosmopolitan species.

Representative specimens seen: Sutherland's Falls, south of Revelstoke (UBC B-6221); Champion Lakes Provincial Park (UBC B-6222); Jinsmith Lake Park by Kiakho Lake (UBC B-6223).
Brachythecium asperrimum (Mitt.) Sull., Icon. Musc. Suppl. 100. 1874. Map 150.

B. gemmascens C. Muell. & Kindb.

In the study area, B. asperrimum is a loosely matted species in wet sites. It resembles a depauperate and branched form of B. frigidum. The two species, however, differ in several aspects. Employing methods of numerical taxonomy, Hoisington (1979) recently documented the discrete differences between the two and her work should be consulted for more information. She further asserted that B. asperrimum is a coastal species. Examination of past and recent collections made from the Kootenay area proves that this is not true. I have found at least three collections of B. asperrimum that match the emended species concept proposed by Hoisington (1979). It is truly rare in the interior mountain systems being replaced mostly by B. frigidum. The most important difference between the two taxa lies in their alar differentiation. See B. frigidum for further comments.

Schofield (1976) stated that in general, B. asperrimum is epiphytic on trees and shrubs. In the study area, I have observed them to be growing in wet depressions and on moist humic ground.
Collections of *B. asperissimum* from the study area are: Tan & Teng 78-541, along Hamil Creek in Purcell Wilderness Conservancy; MacFadden 16960, Halcyon Hot Springs, Arrow Lake; Macoun's Canadian Musci 111 from Revelstoke, 12th May, 1890, labelled as isotype of *B. gemmascens*. All collections came from decaying logs.

A western North American endemic species.


*B. campestre* is, according to Grout (1928-1940), doubtfully distinct from *B. salebrosum*. There is only one collection from the study area, i.e., Tan & Ensing 77-1346 from the Purcell Mountains, that compares well with European and eastern North American specimens. The specimen has a strange combination of characters. Its alar cells are more like those of *B. rutabulum* while the plicateness of the stem leaves approach *B. salebrosum*. The seta is only weakly roughened and becomes smooth at the lower half. Doubtless, the species, if my interpretation is correct, stands between *B. rutabulum* and *B. salebrosum* in morphology. It is best
identified by carefully following the key to the species provided by Flowers (1973) and Nyholm (1954-1969). In addition, the strongly serrate and much shortened upper marginal cells of the branch leaves are diagnostic for B. campestre.

The taxon has been reported a few times from the northern and southeastern parts of the province. However, examination of the few UBC herbarium specimens showed that they are actually either B. salebrosum or B. rutabulum. Also reported from Alberta, Idaho, Montana, and Utah and eastern North America. Its local ecology is not clear as it is known only from a single locality. Probably, it parallels B. salebrosum in ecological preference. More common in the eastern part of the continent. Known also from Europe, Siberia, India, Japan, and northern Africa.


This is a small and compactly matted species. Unlike B. velutinum of similar size, the branches of B. collinum are more or less julaceous and the leaves are strongly concave and
imbricate. The taxon is infrequent on exposed ground at high elevations in the study area. Schofield (1976) reported it to be extremely local west of the Cascade Mountains, but widespread east of this mountain range (see Map 151). Sporophytes frequent. Flowers (1973) offers an interesting discussion on its various ecomorphs. Locally it is common at Kokanee Glacier Park.

Widely scattered across the North American continent, but more common in the west. Also reported from Greenland, Europe, north and central Asia and Japan.

Representative specimens seen: Kokanee Glacier Park (UBC E-6224); Bugaboo Glacier Provincial Park (UBC B-6225); Idaho Lookout Tower, New Denver (UBC B-6226).


**B. harpidioides** C. Muell. & Kindb. *fide* Grout (1928).

The taxon is a problematic species of *Brachythecium* in the study area. It is intermediate between *B. leibergii* and
B. starkei. From B. leibergii, it is best determined by the slender main stem with few branches irregularly arranged, the dioicous condition and the smooth seta. From B. starkei, it differs in the narrow and shorter decurrent leaf bases and strongly falcate stem leaves. It is best identified by becoming familiar with the morphology of B. leibergii and B. starkei first, and then following carefully an elimination process in interpreting the key statements.

B. harpidioides C. Muell. & Kindb. has its type locality at Revelstoke. No specimen was seen at CANM. Judging from the original description in Macoun & Kindberg's Catalogue of Canadian Plants (1892) vol. 6: 194 which states "... tufts compact, soft, whitish green....stem intricate, irregularly branching or pinnate....leaves arcuate, not auricled, plicate, decurrent.... alar cells subquadrate, dioicous, capsules not found....plants like B. albicans ....", I totally agree with Grout (1928-1940) in considering it to be B. erythrorrhizon.

The species is not common in the study area or in the rest of the province. It is more common on the west coast, rare in eastern North America and equally sporadic from various places in Europe, Great Britain, and Siberia.

Flowers (1973) presents a fine illustration of B. erythrorrhizon.

Representative specimens seen: Jacksbn Basin (UBC B-6228); Syringa Creek Provincial Park (UBC B-6227).

B. lamprochryseum (C. Muell.) Jaeg.

B. washingtonianum Eaton in Grout

A common large and tufted species on wet stream margins or creek outcrops (Map 153). It is most closely related to B. asperrimum, sharing the same deltoid-lanceolate stem leaves with clearly auriculate and serrulate leaf bases. The stem leaves of B. frigidum are strongly plicate and the alar cells are mostly oblong to rectangular and enlarged. In addition, like B. asperrimum, B. frigidum develops a row of enlarged, thin-walled basal laminal cells that join the leaves to the stem. Similar features are also present in other hygrophilic species including B. rivulare, B. rutabulum, and B. nelsonii.

MacFadden 18609 from Glacier National Park and 3532 from Slocan Lake which were named B. rivulare appear to belong here.

A widespread western North American endemic.

Representative specimens seen: Glacier National Park (UBC B-6229); Kokanee Glacier Park (UBC B-6230); Champion Lake Provincial Park (UBC B-6231).
Brachythecium hyalotapetum Hig. & Hig., Bryologist 61: 339. 1958.

E. rutabulum var. flavescens (Brid.) B. S. G.

A large and complanate species, B. hyalotapetum was described in 1958 by Higinbotham & Higinbotham as a species separate from B. rutabulum. It differs from B. rutabulum in developing small, quadrate alar cells and more pronounced decurrent leaf bases. It is best identified by its somewhat complanate habit, concave stem leaves with abruptly acute apices and decurrent leaf bases which are recurved. Occasionally the whole alar region may become slightly auriculate, but the alar cells have not been observed to become inflated as in B. rivulare or B. nelsonii. For more comments on its taxonomy and synonymy, consult Higinbotham and Higinbotham (1958).

B. hyalotapetum is fairly common in the coniferous forests of the interior mountains in mesic sites to wet sites at subalpine elevation. Schofield (1976) reported it to be infrequent west of the Cascade Mountains. The same ecology is probably preferred by the species throughout its range in western North America. A western North American endemic.
Representative specimens seen: Blazed Creek, W of Creston (UBC B-6232); Boat Encampment, N of Golden (UBC B-6233); Slocan (UBC B-6234).


This species superficially resembles *Hypnum* with pinnately arranged lateral branches and strongly falcate leaves. The single costa quickly reveals its generic position. The broadly lanceolate stem leaves, which are strongly to moderately plicate, distinguish it from *B. velutinum*. In addition, the branch leaves of *B. velutinum* are distantly arranged and twisted in all directions, never falcate in one direction as in *B. leibergii*. The other species that has somewhat falcate stem leaves is *B. erythrorhizum*. It differs from *B. leibergii* in developing a long main stem with irregularly arranged lateral branches. It also has a smooth seta and is dioicous.

*B. leibergii* is rather common in the study area on logs, tree stumps as well as on humic forest floor from low
elevations to subalpine. Occasionally, it grows on steep granitic rock faces near waterfalls.

A western North American endemic.

Representative specimens seen: Kokanee Creek Provincial Park (UBC B-6235); Wilson Lake, Nakusp (UBC B-6236); Champion Lakes Provincial Park (UBC B-6237).

Brachythecium nelsonii Grout, Bryologist 5: 76. 1902.

B. nelsonii is difficult to differentiate from some forms of B. rivulare. The stem leaves of B. nelsonii are more narrowly lanceolate with gradually acuminate leaf apices whereas in B. rivulare, the leaves are mostly broadly ovate-lanceolate and abruptly short acuminate. The inflated cells of B. nelsonii reach across the leaf base to the costa. The habit of B. nelsonii is more slender, straggling-looking and mat-forming. The original illustration prepared by Grout in Bryologist (1902) vol. 5: 75 is excellent. This taxon appears to be derived from the more widespread and more variable B. rivulare as contended by Hoisington (1979).

In the study area, B. nelsonii grows on damp, decaying
logs and moist forest floors in association with skunk cabbage. Flowers (1973) observed that in Utah and the neighboring states, *E. nelsonii* prefers shaded places at high elevations. Such an elevational preference was not observed in the study area. Grout (1928) reported it to be very common in the American Rocky Mountains in Colorado State. A western North American endemic species.

MacFadden collections 3533 and 3535 from Fishermaiden Lake above Silverton, Jackson Basin and Sandon are all *E. nelsonii* and not *E. rivulare* as originally determined.

Representative specimens seen: Stagleap Park vicinity (UBC B-6238); Blazed Creek (UBC B-368); Purcell Wilderness Conservancy (UBC B-6239).
1853. Map 154.

B. flagellare (Hedw.) Jenn.

Hypnum semiasperum C. M. & Kindb. (isotype at CANM !)

A species of semi-aquatic to wet habitats, B. plumosum is not rare in suitable environments in interior mountain systems, especially along the Selkirk Mountain Range (Map 154). Its absence in the Purcell Mountains may not be significant. The species usually forms brownish to golden green mats over splashed outcrops and boulders along the banks of streams, creeks, cascades, and lakes, and also wet cliff faces near waterfalls. Essentially a prostrate plant, the many creeping branches develop ascending and tufted secondary branches which are very characteristic. The quadrate, thick-walled and often pitted alar cells are dependable microscopic characters. Takaki (1955-1956) reported it to be highly variable in Japan. The Kootenay populations seem fairly uniform in characters and do not pose a problem in its determination.

A cosmopolitan species with populations extending into the Tropics.

Representative specimens seen: W of Revelstoke (UBC B-

B. nanopes C. M. & Kindb. (isotype at CANM !)

A small and slender to filiform Brachythecium, readily identified by its nearly percurrent costa, and partially papillose seta. It is rare in the study area, known only from three sites: Tan & Ensing 77-307 from a nameless waterfall at the upper reaches of Cayuse Creek, Deer Park, Arrow Lake; MacFadden collection from Apex, New Denver, April 2, 1926; and Macoun's Canadian Musci 548 from Revelstoke dated May 19, 1890. Its apparent rarity may be simply an oversight by collectors, resulting from its slender and indistinctive habit in nature. Surprisingly, the taxon is common and highly variable in Japan and adjacent areas. Takaki (1955-1956) described four varieties and tabulated, in addition, the differences between B. populeum and E. plumosum. Fortunately, B. populeum is not
difficult to distinguish from *B. plumosum* in the study area.

Occasionally, *B. populeum* may resemble *B. reflexum*. The laminal cells of *B. reflexum*, however, are short rectangular to short oblong-hexagonal. The stem leaves are cordate-ovate and the seta rough throughout.

Scattered across North America and Eurasia.

*Brachythecium reflexum* (Starke ex Web. & Mohr) B. S. G.,


*B. reflexum* resembles *B. populeum* in its filiform habit and its long nearly percurrent costa, but unlike the latter, *B. reflexum* has more ovate stem leaves, shorter laminal cells, strong decurrent leaf bases and rough seta.

Schofield (1976) observed that it forms loose mats on boulders and up the base of tree trunks in subalpine mountains throughout the southern half of the province. In the study area, it is of interest to note that *B. reflexum* and *B. starkei* are both present in the two localities where *B. starkei* var. *pacificum* was collected. The variety *pacificum* has a slender habit and long costa like that of *B. reflexum* but the
very strong broad, decurrent leaf base and long median laminal cells are like those of B. starkei. Renauld and Cardot treated the taxon as a variety of B. reflexum. I follow Lawton (1971) in accepting it as a variety of B. starkei. Perhaps, Grout (1928-1940) was correct in recognizing it as a distinct species of hybrid origin. It is possible to suggest, that the putative parents are B. reflexum and B. starkei. If such a judgement is to be followed, the correct name for the species is B. bestii Grout.

B. reflexum is common in North America, Europe, Asia, Japan, and Greenland.

Representative specimens seen: Glacier National Park (UBC B-6243); Kokanee Glacier Park (UBC B-6244); Zincton (UBC B-6245).


This is an extremely variable species of wet habitats. Easily recognized, the typical form has strongly concave stem leaves with a shortly acute to obtuse leaf apex, short oblong apical laminal cells and large inflated alar cells.
Nevertheless, there exist many forms that acquire a longer acuminate leaf apex, and less inflated alar cells and are difficult to distinguish from B. nelsonii and B. rutabulum. The submerged form can become long and tufted in habit with few inflated alar cells and even without well delimited alar regions. This form intergrades with E. rutabulum and is almost impossible to distinguish from it. Under the circumstances, it becomes a subjective judgement of the taxonomist who then depends much on his previous acquaintance with the variability of B. rivulare and E. rutabulum.

Dr. K. Wigh (1975) did some experiments on the morphological plasticity of B. rivulare and B. rutabulum. His tabulation of the morphological dissimilarities of the two taxa is elucidating, and should be consulted.

A widespread species in the northern half of the hemisphere. Because of its extreme variability, no infraspecific taxa appear worthy of recognition.

Representative specimens seen: Jackson Basin (UBC B-6246); Kokanee Glacier Park (UBC B-6247); Rosebery (UBC B-6248).
**Brachythecium rutabulum** (Hedw.) B. S. G., Bryol. Eur. 6: 15. 1853.

**E. cavernosum** Kindb. (isotype at CANM !)

**B. columbico-rutabulum** Kindb. in Macoun (isotype at CANM !)

Stem leaves of **B. rutabulum** in the study area can be rounded ovate, concave or flat, plicate or wrinkled to smooth, imbricate to slightly spreading. The species is extremely variable. The alar cells, however, are rather constant, oblong to rectangular, enlarged but not inflated, and thin-walled (Wigh, 1975). The alar regions are, unlike **B. rivulare**, not concave and auriculate. The rough seta, when present, adds another useful character. The taxon seems to be more common in the wetter Selkirk Mountains than the Purcell Range.

Higinbotham and Higinbotham (1958) concluded that **B. rutabulum** did not occur in the Pacific Northwest. The conclusion was made after they re-determined many of the misidentified specimens of **B. rutabulum** as their new species, **E. hyalotapetum**. The many recent collections of **B. rutabulum** in the North American Pacific Northwest have contradicted, of course, the validity of the statement. **B. rutabulum** is actually a rather widespread species in the northern hemisphere
with distant populations in Hawaii, Tasmania, New Zealand, and South America.

*B. cavernosum* Kindb. was treated as a doubtful species by Grout (1928-1940). There is one collection of Brinkman so named at CANM. The collection came from Glacier Provincial Park and is a *B. rutabulum*.

The isotype of *B. cumbico-rutabulum* Kindb. in Macoun at CANM was also studied. The alar region is not auriculate at all and the name should not be considered a synonym of *B. asperrimum* as suggested by Grout (1928-1940). It is *E. rutabulum*.

MacFadden 3526 (CANM) from Lemon Creek, Slocan Lake was incorrectly determined as *B. plumosum*. It is a *B. rutabulum*.

Representative specimens seen: Slocan (UBC B-6250); Trail (UBC B-6251); Salmon (UBC B-6252).

E. flexicaule Ren. & Card.
E. acutum (Mitt.) Sull. fide Robinson (1962)
Rhynchostegium revelstokense Kindb. fide Britton, in sched.

B. salebrosum is either an extremely inclusive species or a highly variable taxon. It is distinguished in the literature and annotated herbarium specimens by plicate, lanceolate stem leaves with acuminate apices, mostly quadrate alar cells and smooth setae. The species intergrades into B. campestre, B. calcareum Kindb. and B. acuminatum (Hedw.) Aust. forming a species complex. The species complex at present is badly in need of a revision in order to understand and clarify the concepts of the species involved. Until then, I am treating B. salebrosum in a broad sense.

B. acutum differs from B. salebrosum in having more narrow and gradually tapering lanceolate stem leaves with leaf apex more filiform. Robinson (1962) has suggested that it is conspecific with B. salebrosum. The few specimens so named by Grout at UBC and CANM were examined. B. acutum superficially resembles B. salebrosum in having plicate leaves and a smooth
seta. The alar cells, on the other hand, are more rectangular and lax, like those of *B. rutabulum*. As I have not studied the type of *B. acutum*, no definite opinion can be offered here. Other collections of MacFadden and Macoun named *B. glareosum* B. S. G. proved to be either *B. salebrosum* or *B. albicans*.

*Rhynchostegium revelstokenese* was described by Kindberg (1897) in Bryol. N. Am. & Eur. 67 based on a specimen from the type locality at Revelstoke. The specimen at CANM was studied. Earlier, Dr. E. Britton had annotated the specimen to be *B. acutum*, a determination which I tentatively accepted, because the specimen compares well with the original description and illustration of *B. acutum* in Sullivant's Icones Muscorum Supplement (1874).

Representative specimens seen: Balfour, Kootenay Lake (UBC B-6253); Lake Lillian, Invermere (UEC B-6254); Deer Park area (UBC B-6255).

B. laxirete Kindb.
B. erythrorrhizoides Macoun, nom. nud. in sched.
B. pacificum (Ren. & Card.) Grout
B. curtum (Lindb.) Limpr.
Hypnum oedipodium Mitt. fide Grout (1928)

B. starkei is one of the most variable moss species. The few reliable taxonomic features of the species seem to be the broadly and longly decurrent leaf bases, quadrate alar cells and the rough seta. Most European tryologists have maintained the taxon as separate from B. curtum. On the other hand, Crum (1976) believed that all North American specimens can be properly referred to B. curtum. The two taxa differ in a few minor details: B. starkei is more complanate, has shorter middle laminal cells (40-80 um) and is smaller in size. None of these differences, however, hold true with the many populations of B. starkei-curtum seen from the study area and other parts of the province. I have received specimens determined by Dr. E. Nyholm as typical for the two taxa. Specimens with complanate-patent leaves, in most cases, can be separated with ease from the more terete form with more or less
imbricate branch leaves. It is this terete form that I call B. starkei var. curtum (Lindb.) Warnst. following Grout (1928-1940). The ecology of the two varieties does not seem to differ as far as my limited field experience could determine.

Var. pacificum has a long, almost percurrent costa. The variety is rare in the study area having been collected mainly from the areas around Zincton, Jackson Basin and Sandon (MacFadden 3531 and 3528, CANM) and Asulkan Glacier Valley, Glacier National Park (Brinkman, s. n., July 14, 1908 named as B. erythrorrhizoides by Macoun). See also B. reflexum for more comments on the var. pacificum. Incidentally, the name B. erythrorrhizoides was never validly published by Macoun and is a nomen nudum.

Canadian Musci 61 named B. oedipodium Mitt. at CANM is a mixture of B. starkei and B. rutabulum. The basionym Hypnum oedipodium Mitt. was pointed out by Grout (1928-1940) to be a synonym of B. starkei (including B. curtum). The new combination B. oedipodium was made by Kindberg in Macoun & Kindberg's Catalogue of Canadian Plants 6: 197 (1892) and was erroneously attributed to Mitten by Macoun.

Another specimen at CANM labelled as the isotype of B. laxirete, n. sp., from Asulkan Valley, Glacier National Park was also studied. The collection was made by Brinkman and was found to have a broad decurrent leaf base. It therefore fits into my concept of B. starkei var. curtum. Grout (1928-
1940), however, treated the name as synonymous with
E. *rutabulum*.

**E. holzingeri** (Grout) Grout has a confusing nomenclatural
history (Grout, 1901, 1922). The taxon was originally compared
to *B. collinum*. The long and broad decurrent leaf base,
however, allies it with *E. starkei*. It differs from the
latter by the leaves being more lanceolate, leaf apices more
acuminate and the seta only weakly roughened. All of these
characters unfortunately, are quite variable in *B. starkei*.
Perhaps, the species should be treated as only a slender form
of *B. starkei*. It is, for this reason, that MacFadden
collection 4387 from Sandon which was originally determined by
Dr. A. J. Grout as *E. holzingeri* is included in the
discussion here.

Representative specimens seen: Glacier National Park (UBC
B-6256); Meadow Mountain Alpine Recreation Park (UBC B-6257);
Revelstoke National Park (UBC B-6258).

An extremely rare species in the study area. The only collection (Tan & Teng 78-1093) came from a wet cliff face near a nameless waterfall at 1815 m elevation at Bugaboo Glacier Provincial Park. The leaves are strongly plicate and the alar cells are mostly quadrate, very unlike those of **B. rutabulum** and **B. frigidum**. Unlike **B. salebrosum**, the plants are yellowish to golden green in color and are tufted and julaceous. Poorly developed **B. turgidum** becomes difficult to distinguish from luxuriant forms of **B. salebrosum**.

A common species at high latitudes of circumpolar regions. Southward, the species is more or less restricted to wet places at alpine elevations. Its distribution pattern in the province is not clear, being in general more common in the northern part of the province.

A small creeping species that forms silky green mats on humic forest floors. It is found closely associated with B. starkei in coniferous forests at lower elevations. The erect-spreading branch leaves may at times become falcate-secund and may be confused with B. leibergii. The latter, however, is very pinnately branched and hypnoid in gross appearance. From B. starkei, the species can be identified by the more slender and filiform habit and the absence of a broad and long decurrent leaf base. From B. reflexum and B. populeum, by its shorter costa reaching only halfway the length of the leaves.

A fairly common woodland species in the northern hemisphere.

Representative specimens seen: Trcut Lake (UBC B-6259); Nakusp (UBC B-6260); Deer Creek area (UBC B-6261).
Eurhynchium B. S. G.

The generic name alludes to the long rostrate beak, a very distinct feature if specimens are collected with sporophytes. Fruiting populations, however, are infrequent. Sterile specimens are best identified by the strong leaf marginal serrulation and blunt leaf apex. The smooth seta and the undifferentiated stem leaves will distinguish it from Stokesiella. Eurhynchium consists of 80 species in the world, only two species and one variety are listed for the study area. Eurhynchium riparioides is sometimes placed in the genus Platypnidiunm Fleisch. and in the Family Amblystegiaceae on the basis of its aquatic habitat. I agree with Crum (1976) that E. riparioides has a close relationship with E. pulchellum and E. hians (Hedw.) Sande-Lac.; thus, it is properly included in the genus.

1. Plants aquatic, on wet stones near watercourses; leaves broadly ovate to orbicular ...............E. riparioides

1. Plants terrestrial, usually on humic forest floors; leaves ovate to lanceolate ...............E. pulchellum

E. fallax (Ren. & Card.) Grout
E. substrigosum Kindb. in Macoun
E. diversifolium (Schleich.) E. S. G.
E. strigosum (Web. et Mohr) B. S. G.

A very common species of forest floor in the Kootenay Mountains. Frequently it is found associated with Brachythecium starkei, B. velutinum, and Plagiothecium laetum. The blunt to obtuse leaf apices and distinctly serrulate leaf margins are clues to the species determination.

Schofield (1976) stated that the species is particularly common on calcareous substrata from sea level to subalpine elevations throughout the province, although becoming infrequent along the coast.

E. pulchellum is a variable species, especially in size. As a result, many of the variations have been accorded species rank. Only two distinct varieties are recognized:
var. barnesii (Ren. & Card.) Crum, Steere and Anderson which is an unusually large form with somewhat plicate leaves and var. praecox (Hedw.) Dix. which has julaceous branches with
imbricate-appressed leaves. Kootenay populations of var. barnesii differ from the typical variety in only a few characters that are probably environmentally modifiable. However, in the coastal region, the var. barnesii is observed by Schofield (pers. comm., 1980) to be distinct in habit and larger in size even when growing intermixed with the typical form. It is, perhaps, best accepted as separate species.

Var. praecox, according to Nyholm (1954-1969), is a lowland form in dry habitats and var. diversifolium (B. S. G.) C. Jens., also a julaceous form, is a mountain and boreal form. Grout (1928-1940) reported that the var. diversifolium differs from var. praecox in being more slender in habit and with branch leaves having more quadrate alar cells. These differences, unfortunately, appear not to be constant even in an individual plant. I doubt very much the usefulness of recognizing two varieties among the julaceous specimens. At any rate, var. praecox is an earlier name if the two varieties are to be merged. Kootenay's collections of E. pulchellum with julaceous branches all had been called var. diversifolium by MacFadden and Grout (UBC, CANM).

Both var. barnesii and var. praecox are rare in the study area, being known only from two localities each at low elevation around the Slocan Lake vicinity in Selkirk Mountains, and Deer Park at Lower Arrow Lake and Fry Creek Canyon at Kootenay Lake.
E. pulchellum is equally common elsewhere in the northern hemisphere.

Representative specimens seen: Gray Creek (UBC B-6262); Syringa Creek (UEC B-6263); St. Mary Alpine Park (UBC B-6265).


Platyhypnidium riparioides (Hedw.) Dix.
Rhynchostegium riparioides (Hedw.) Card.

An easily distinguished taxon on rocks and boulders associated with fast flowing water. The nearly orbicular leaves with broadly obtuse to rounded apex are diagnostic. Alar cells vary from scarcely differentiated to rectangular and enlarged. Alar regions, when developed, are excavated.

Populations of North American E. riparioides, especially from the northwestern states and provinces, differ somewhat from their counterparts in Europe in having broader and orbicular leaves with a nearly rounded apex (Lawton, 1971).
The cross-section of stems reveal further that a few cortical cells acquire various patterns of additional wall thickenings on their end walls. These pitted cortical cells are, interestingly, not apparent in any European and Central Asian specimens but present in Japanese materials. Recognizing these morpho-anatomical dissimilarities, it is possible that the Japanese and North American plants of *E. riparioides* should be treated as a distinct variety of *E. riparioides*. Pitted cells have been reported in gametophytes of other pleurocarpous mosses such as *Hylocomium splendens* and *Thuidium delicatulum* (Finocchio, 1967).

*E. riparioides* is widespread in the northern hemisphere.

Representative specimens seen: Salisbury Creek, Kootenay Lake (UBC B-6266); Evans Creek, Slocan Lake (UBC B-6267); Halcyon Hotspring (UBC B-6268).

*Homalothecium* B. S. G.

This genus is close to *Brachythecium* and shares with it several characters such as plicate leaves, single costa and differentiated alar cells. However, the strongly plicate
leaves, the longer, almost linear, laminal cells, and the strongly auriculate alar regions, add up to the distinctiveness of the genus Homalothecium. Campothecium B. S. G. has been interpreted to be a weak segregate genus by many contemporary bryologists. It differs from Homalothecium in having erect capsules and the resultant reduction of inner peristome. I agree that Campothecium should be combined with the present genus. On the other hand, Tomentypnum is a distinct taxon and should be recognized apart from Homalothecium.

The generic revision done by Lawton (1965) listed five species for the province, three of which are recorded from the study area. Homalothecium pinnatifidum (Sull. & Lesq.) Lawton was reported by MacFadden (1926) from the study area based on a misidentified specimen. The specimens at CANM and MACF are H. aeneum. All the three species of Homalothecium found in the study area are endemics to western North America.
1. Capsules erect to slightly bent .......2

2. Secondary stems long and creeping, with many short, lateral branches strongly incurved when dry; usually on rocks and ground ........................................H. nevadense

2. Secondary stems not well developed, not creeping, lateral branches long, straight, ascending or only slightly inrolled when dry; usually on trees ..............H. fulgescens

3. Branches straight, fuzzy in appearance; branch leaves with stiff filiform apex, occasionally long acuminate; common on tree ..................................................H. fulgescens

3. Branches slightly incurved, not fuzzy in appearance; branch leaves with many obtuse to broadly acute apices, infrequently acuminate; common on rocks and ground ..........................................................H. aeneum

Camptothecium dolosum Ren. & Card.

This is a coarse and glossy species with only weakly inrolled lateral branches, commonly growing on rock. This species prefers more basic substrata (Lawton, 1965). The apices of branch leaves are variable, but they are frequently obtuse, an important criterion in separating the species from H. nevadense and H. fulgescens which have long acuminate leaf apices. The more compactly appressed leaves on the branches can help in distinguishing this species from H. fulgescens. H. pinnatifidum, which has been confused with it, has many regularly and pinnately arranged, short, lateral branches.

H. aeneum has a similar distribution range to that of H. nevadense in the Pacific Northwest (Lawton, 1965) which is rare west of Coastal and Cascade Mountains, and more common inland.

Representative specimens seen: Pend' Oreille River (UBC B-6269); Slocan Park (UBC B-6270); Gray Creek (UBC B-6271).

This is the only species of Homalothecium growing on tree trunks in the study area. Other species were observed to be epilithic. *H. fulgescens* is uncommon in the Kootenay area but is common in the coast where it is usually epiphytic on trunks of deciduous trees (Schofield, 1976). Branch leaves of *H. fulgescens* are more stiff and more distantly arranged than those of *H. aeneum*, resulting in a fuzzy appearance which is a good diagnostic feature. Lawton (1965) observed that the capsules infrequently can become erect or slightly curved. Indeed, when immature, the capsules are normally erect to suberect. She further showed the species to be different from the European *H. lutescens* (Hedw.) Robins. in many details. Old collections from the Kootenay mountains determined as Campthothecium lutescens at UBC and CANM usually prove to be present species.

*H. fulgescens* is common from southeast Alaska to northern California, rare west of the Cascades, and becomes less frequent in southern Alberta, Idaho and Montana.

Representative specimens seen: Slocan Park (UBC B-6272); Lardeau (UBC B-6273); Revelstoke area (UBC B-6274).

H. sericeoides C. Muell. & Kindb. (isotype at CANM !)

When in "fruit", H. nevadense is a distinctive species with unmistakably erect, cylindric capsules. Many sterile specimens are difficult to distinguish from H. aeneum. H. nevadense, in general, is nearly half the size of H. aeneum and has many strongly coiled or incurved lateral branches when dry. Lawton (1965) added that the branch leaves of H. nevadense have, in many cases, narrower leaf apices and long leaf cells at the apex.

The local distribution (Map 160) shows that the species is confined to the Selkirk Mountain Range. Its absence in the drier and more basic substrata of the Purcell Mountains is difficult to understand.

H. nevadense ranges from southern California to southern British Columbia and becomes rarer near the coast. Present also in Utah and Nevada.

Representative specimens seen: Galena Bay (UBC B-6275); Sanca Creek, near Boswell (UBC B-6276); Halcyon Hotspring (UBC B-6277).
Isothecium Brid.

The inclusion of *Isothecium* in the Family Brachytheciaceae has always been controversial. *Isothecium stoloniferum* (Hook.) Brid. is the only species found in the study area.


Map 162.

An extremely variable species that locally becomes uncommon as an epiphyte and on rocks and boulders in the interior mountains. Only one collection, Tan 76-944, from Kookanee Spring Resort at Crawford's Bay, was collected from the trunk and branches of *Thuja plicata*. The species is a common epiphyte in the wet coastal forests of this province. The long, slender, sometimes flagelliform branches with leaf margins strongly serrate only in the upper half and the numerous short thick-walled quadrate alar cells are distinctive features. Since the species is infrequent, little variation was observed in the gross morphology among the Kootenay
populations.

A western North American endemic.

Representative specimens seen: Revelstoke area (UBC B-6278); Porcupine Creek area, near Ymir (UBC B-6279); St. Leon Creek, Upper Arrow Lake (UBC B-6281).

**Rhynchostegiella** (B. S. G.) Limpr.

The genus is sometimes united with **Rhynchostegium** B. S. G. from which it differs in having an apiculate operculum and not complanate lanceolate leaves. A genus of 50 species throughout the world, only **R. compacta** is collected from the study area.

A pretty small, more or less compact moss growing on ground in the mountains. The narrowly lanceolate leaves with weak double teeth restricted to the leaf base is unusual, revealing at once its identity. It is not frequent in the study area (Map 158). Populations elsewhere have been observed to produce brood bodies at the back of the leaf apices, a feature which has not been seen in Kootenay specimens.

Crum (1976) described its ecology in eastern North America to be on wet calcareous cliffs or on bark at the base of trees in wet woods. Also found in Europe, Asia, Japan, and Mexico.

Morphologically, R. compacta is rather dissimilar to the other species of the genus (Robinson, 1976). Smith (1978) transferred the species to Amblystegium, a taxonomic judgement worthy of reconsideration. Robinson (1976), on the other hand, proposed a new and monotypic genus, Conardia, to accommodate it.

Representative specimens seen: Lake Lillian (UBC B-6288); Dutch Creek Hoodoos, Columbia Lake (UBC E-6289); Thunder Hill Park (UBC B-6290).
Robinson (1962) remarked that the genus is a small, poorly defined group of perhaps unrelated species. There are three species of *Scleropodium* known from British Columbia (Schofield, 1968a), two of which are reported here. Both taxa have distinctly concave leaves with an abruptly pointed apex, a single, strong, nearly subpercurrent costa with short, lateral branches and median leaf cells that are elongate-flexuose with blunt ends.

The following key to the species of *Scleropodium* in the study area is modified from Lawton (1967)

1. Plants aquatic to semi-aquatic or in wet habitats, large, branches more than 1.5 mm in width, strongly tumid; leaf apices obtuse to rounded; capsules strongly arcuate or inclined ..................*S. obtusifolium*

1. Plants terrestrial or epiphytic, not aquatic, smaller, branches less than 1.5 mm in width, moderately julaceous; leaf apices mostly acute to shortly acuminate; capsules slightly inclined to nearly erect ......*S. caespitans*
Scleropodium obtusifolium (Mitt.) Kindb. in Macoun, Cat. Canad. Pl. 6: 202. 1892.

A rather common species on splashed outcrops of fast flowing streams and creeks and also on wet cliff faces flanking the waterfalls. *S. obtusifolium* is striking in its tumid gross morphology and the wet habitat. The only species that might possibly be confused with it is *S. tourettei* (Erid.) L. Koch, which is not found in the Kootenay region. Schofield (1976) reported *S. tourettei* from the vicinity of Vancouver Island and Q. Charlotte Islands.

*S. obtusifolium* is a western North American endemic.

Representative specimens seen: Pend' Oreille River (UBC B-6282); Gwilliam Creek (UBC 6283); Deer Park area (UBC B-6284).


A very rare species in the study area. Collections Schofield & Tan 60746 and Tan 76-488 from Slocan Park vicinity,
in fact, are the first reports of the taxon from the Kootenay Region. *S. caespitans* resembles a miniature or slender form of *S. obtusifolium*, nearly half the overall dimension. Leaf apexes of *S. caespitans* are generally acute to shortly acuminate whereas that of *S. obtusifolium* are apiculate or obtuse. The habitats of the two also differ significantly.

*S. caespitans* inhabits dry cliff faces and sometimes up the bases of trees (Schofield, 1976). The species has disjunct populations in England and Europe outside of western North America.

**Stokesiella** (Kindb.) Robins.

This genus consists of a group of distinct species that have been placed by different authorities in *Eurhynchium* or *Bryhnia*. The stem leaves, which are divaricate, are unlike the branch leaves. They are broadly deltoid, abruptly acuminate and broadly decurrent. The plants are frondose and creeping or mat-forming in the field. Following Crum et al. (1973), I accept two species for the study area: *Stokesiella oregana* and *S. praelonga*. 
1. Plants clearly pinnately branched ..... *S. oregana*

1. Plants irregularly or more than once-pinnately branched

................................. *S. praelonga*

*Stokesiella praelonga* (Hedw.) Robins., Bryologist 70: 39.
1967.

*Furhynchium stokesii* (Turn) B. S. G.

The species is distinct from *S. oregana* only when at its fullest morphological development. The smaller size and the irregularly arranged lateral branches suffice, in many cases, to identify the taxon. Nevertheless, a few populations (e.g., Tan 76-5340 from Gray Creek area) are intermediate in habit and are difficult to interpret. Showing also similar ecological preference, the two species, perhaps, should be combined and given only subspecies or varietal ranks as already suggested by many bryologists. In the study area, *S. praelonga* is much more common than *Stokesiella oregana* on moist humic grounds, swampy sites, on logs, up on tree bases and even on boulders in the
shade. Both species are extremely common and well-developed in wet coastal forests. *Stokesiella oregana* is considered to be a western North American endemic while *S. praelonga* is a common species in Europe, Asia, and western North America.

Representative specimens seen: Coffee Creek Road (UBC B-6294); Broadwater (UBC B-6293); Ainsworth Hotspring (UBC B-6567).


*Eurhynchium oreganum* (Sull.) Jaeg.

See *S. praelonga* for comments.

Representative specimens seen: Airy Creek, Slocan Park (UBC B-6291); Ainsworth Hotspring area (UBC B-6292).
Tomentypnum Lceske

This is a distinct genus characterized by erect or ascending, frondose stems with abundant, conspicuous reddish rhizoids up to the stem apex. The rhizoids are usually abundant on the lower part of the costa. The strongly plicate leaves with linear laminal cells nearly uniform to the leaf base and the scarcely differentiated alar cells contribute to the distinctiveness of the genus. The smooth seta will aid in distinguishing it from Homalothecium. Only one species is recorded for the study area: T. nitens.


Homalothecium nitens (Hedw.) Robins.

The species is frequent in wet, calcareous sites, including peaty margins of Sphagnum fens, swamps and lake shores. It is very common along the eastern flank of the
Purcell Mountain Range (Map 161). Schofield (1976) observed it to be rare in the coastal and insular areas, but frequent in the northern and eastern parts of the province.

Though Nyholm (1954-1969) reported that some populations of *Tomentypnum nitens* in high mountains in Europe are devoid of tomentum, similar glabrous plants have not been observed in the study area.

The same ecology is reported for *T. nitens* elsewhere in the province. There is a specimen at UBC collected by MacFadden from New Denver, Slocan Lake. New Denver vicinity has been botanized by me for three summers from 1976-79 and no calcareous habitats had been noted, nor has *T. nitens* been found there. The collection may represent an extinct population or the locality information on the label is erroneous.

Recently, Crundwell (1979) has cited the presence of abundant rhizoids on the stem and leaf costa as a peculiarity supporting the segregation of the genus *Tomentypnum* from *Homalothecium*.
FAMILY ENTODONTACEAE

The family is mainly tropical in its distribution and is characterized gametophytically by double costa, short and oblong laminal cells, strongly developed and broadly triangular alar regions; and sporophytically, by erect capsules with double peristomes. The sporophytic characters have been critically assessed by Buck (1979) in his revisionary study of the family. The differences between the hypnoid type of peristomes and the entodontaceous type is described and emphasized by Buck. Orthothecium E. S. G. and Pleurozium Mitt., the only two members of the family in the traditional sense, following Brotherus (1924-1925), were suggested by Buck (1979) to be excluded from the present family. Orthothecium is suggested to belong in the Family Hypnaceae and Pleurozium, in the Family Hylocomiaceae.

Orthothecium is represented in the province by two species, with O. chryseum being the only species collected from the study area. The gametophytic features of O. chryseum are very different from other entodontaceous taxa. I therefore agree with Buck (1979) to exclude the taxon from the present family, but I have reservations about its transfer to the Family Hypnaceae. Considering the fact that the taxonomic viewpoints of Dr. W. R. Buck have not been presented fully in print, I am keeping the genus in the family until a fuller
understanding is available of all species of Orthothecium throughout the world.

Orthothecium B. S. G.

This is a genus of about ten species occurring mostly on soil at high elevations.

Orthothecium chryseum (Schwaegr. ex Schultes) B. S. G.,


This is a large and imbricate-leafed moss forming abundant and ascending yellow green or golden brown tufts. Superficially, it may resemble Brachythecium turgidium or B. frigidum. However, the plicate leaves, linear leaf cells, the lack of a single costa and the erect capsule are useful characters in identifying it. The species is rare on many humid cliffs at high elevations or deep gorges in the local
area. Schofield (1976) observed it to be infrequent near the Coast, becoming frequent in the interior and northern parts of the province (Map 152).

Nyholm (1954-1969) classified the taxon as an arctic-alpine plant in the northern hemisphere. In China, Chen (1978) reported it as a calcicole.

Representative specimens studied: Glacier National Park (UBC B-4351); Jumbo Creek (UBC B-4352); Horsethief Creek, Wilmer (UBC B-4353).

FAMILY PLAGIOTHECIACEAE

The family has been studied and revised by Iwatsuki (1970), Ireland (1969), and Lewinsky (1979). I have followed, in general, their taxonomic opinions except on the placement of Isopterygium and Herzogiella, which I include in the Family Hypnaceae following the system proposed by Schofield (1968a), Crum (1976), and Ireland (pers. comm., 1980). The family Plagiotheciaceae is, therefore, treated here as a family with only one genus and it is, as Smith (1978) states, a poorly defined family closely related to the Family Hypnaceae.

The family, as defined here, is characterized by leaves
with well-developed decurrent bases, complanate habit, linear to oblong laminal cells with pointed cell ends and a perfect hypnaceous peristome.

I thank Dr. R. R. Ireland for his help in naming a few of my difficult *Plagiothecium* specimens.

*Plagiothecium* Bruch & Schimp.

This is a very distinct genus, yet, many species are often difficult to interpret. Students of the genus such as Iwatsuki (1970), Ireland (1969), and Lewinsky (1979) do not agree on the delineation of some species. I adopt a narrow species concept for the genus. My limited experience gained in the study of the genus as represented in the area has led me to accept the species treatment proposed by Ireland (1969) with a few reservations which are mentioned in the text where appropriate. The solution to the problematic species complex such as *P. curvifolium* - *laetum*, *P. denticulatum* - *ruthej* and *P. platyphyllum* - *succulentum* - *memorale* - *denticulatum* perhaps can only be achieved when a revision is made on a worldwide basis.
There are now a total of seven species known from the province, six of which are present in the study area.

The key to the species of the genus in the study area places emphasis on the morphology of the decurrent leaf base. This character is, I believe, far more reliable taxonomically than the shape and habit of the capsule. Their difference is best observed in situ on the stem or branches after the leaves have been removed.

1. Plants large (at least 4 mm long and 2 mm wide), whitish green; leaves strongly undulate .......... P. undulatum

1. Plants smaller and narrower in length and width; leaves smooth, wrinkled, but not undulate ..... 2

2. Leaves abruptly contracted into a long and piliferous hairpoint ........................................ P. piliferum

2. Leaves without piliferous hairpoints, apex acute to acuminate ........................................ 3

3. Leaves with broad, decurrent leaf bases consisting of at least two rows of enlarged, broadly rectangular, round to
oval cells .................................. *P. denticulatum*

3. Leaves with narrow decurrent leaf bases consisting of at most two rows of tapered elongate to long rectangular cells, very rarely oval in shape .............. 4

4. Terminal portion of the stem and branches clearly julaceous; leaves mostly symmetrical and strongly concave ................................................... *P. cavifolium*

4. Stem and branches complanate; leaves asymmetrical and plane, at most only weakly concave ....5

5. Leaves plane when dry, closely spaced; middle laminal cells long and narrow, less than 10 um wide .. *P. laetum*

5. Leaves shrinking when dry, frequently distantly spaced; middle laminal cells rhomboidal to short rectangular, more than 10 um wide ......................... *P. nemorale*

P. roseanum B. S. G.

A rare species in the study area, P. cavifolium was collected only twice locally. The two localities are: Glacier National Park (UBC B-4250, originally det. as P. denticulatum) and St. Mary Alpine Park vicinity (UBC B-4249).

Well-developed plants of P. cavifolium are distinctive in having strongly concave and symmetrical leaves arranged imbricately around the stem resulting in a somewhat julaceous habit. However, there are collections that display a semi-complanate and less julaceous habit and can be mistaken for P. denticulatum or P. succulentum. Normally, the branches of P. cavifolium show the julaceous habit even when leaves on the main stem are complanately oriented.

It grows on silty soil or humus overlying boulders and cliffs, or on forest floor. It is found throughout the province.

Ireland (1969) observed that the plants west of the Continental Divide grow in loose, prostrate mats and rarely form the dense and erect tufts that are so prevalent in eastern
North America. The two populations known from the study area corroborate his contention. The same author (Ireland, 1969) further commented that future study may show the two forms to be separable taxonomic entities.

**Plagiothecium denticulatum** (Hedw.) Bruch & Schimp., Bryol. Eur. 5: 190. 1851.

**P. ruthei** Limpr.

This is another common species of the genus in the study area. It is usually larger and darker green (stem 1.5 to 2 mm wide) when compared to **P. laetum** (less than 1.5 mm wide). Typical plants show clearly a broad and long decurrent leaf base consisting of 3-4 rows of swollen, broadly rectangular, round and oval cells. Ireland (1969) included in the present species a form that has a narrow decurrent leaf base like that of **P. laetum**, but has broader middle laminal cells (more than 10 um wide). I have accepted this broad species concept for **P. denticulatum** because of my lack of understanding of the variations exhibited by populations across the whole northern
hemisphere. Most European workers (Greene, 1957; Smith, 1978; Nyholm, 1954-1969; Lewinsky, 1979), nevertheless, would call the form in question P. succulentum (Wils.) Lindb. The relationship among P. denticulatum, P. succulentum, P. platyphyllum, and P. nemorale, in my opinion, are still not satisfactorily understood despite efforts of modern monographers. At their fullest morphological development, each of them is well-marked, but, unfortunately, many of their taxonomic features overlap causing problems in the correct identification.

P. denticulatum has a similar ecology to that of P. laetum, although locally less widespread.

Representative specimens seen: Columbia River, approximately 13 miles north of Revelstoke (UBC B-4244); Glacier National Park (UBC B-4242); Slocan (UBC B-4243).


This is a widespread and very common species on decaying logs, tree stumps, humid cliffs and forest floors in the study area. The very narrow leaf cells, less than 10 μm wide, and
the narrow decurrent leaf base of long and narrowly rectangular cells are diagnostic features. It is unlikely to be confused with any other species of *Plagiothecium* in the study area. Occasionally, it is difficult to distinguish it from a form of *P. denticulatum* that has similar narrow, decurrent leaf bases. Under the circumstances, the narrow leaf cells of *P. laetum* are useful in identifying the species. Laminal cells of *P. denticulatum* are broader, at least more than 10 um wide.

The European taxon, *P. curvifolium*, is very similar to the present species in having narrow and linear leaf cells. But the equally narrow decurrent leaf bases of the former show, at times, some oval to rounded-quadrate cells. Ireland (1969) considered it to be a synonym of *P. laetum* which most European workers do not agree (Greene, 1957; Smith, 1978; Nyholm, 1954-1969; Lewinsky, 1979). Nyholm (1954-1969) described *P. curvifolium* as an interesting taxon with a variation between *P. laetum* and *P. denticulatum* and suggested that the habit and shape of the capsules are useful taxonomic characters in distinguishing the three taxa. I have not seen any specimens from the study area that approximate the character combination of *P. curvifolium*. Its presence in North America, if indeed it is distinct apart from the variable and common *P. laetum*, still awaits confirmation.

Many collections of MacFadden (UBC and CANM) from the study area were named *P. sylvaticum* or *P. roseanum* which in reality are all *P. laetum*. 
Representative specimens examined: Deer Creek, Lower Arrow Lake (UBC B-4241); Airy Creek, near Slocan Park (UBC B-4238); Glacier National Park (UBC B-4239) and Wilson Lake (UBC B-4240).


\textit{P. sylvaticum} (Brid.) Bruch & Schimp. sensu European authors

A specimen (UBC B-4248) collected from the study area by the local forestry personnel at Nelson was submitted for identification. The leaves are shrunken when dry and are distantly spaced along the stem. Laminal cells are broadly rectangular to rhomboidal, measuring to approximately 15-20 \textmu m wide and 60-100 \textmu m long. The decurrent leaf base resembles that of \textit{P. laetum}. Indeed, the collection compares very well with the European and Japanese specimens of \textit{P. nemorale} at UBC. Dr. A. Crundwell, who examined the specimen wrote (in \textit{litt.}, 1980), "... the cells of \textit{P. nemorale} in Europe are
consistently wider than in your specimen... nor is your specimen a \textit{P. succulentum}.... I would like to believe that it is \textit{P. platyphyllum}, but I have not seen distinct rhizoidal initials at the leaf apex so characteristic of the latter taxon...."

Future effort should be directed in searching for better specimens of \textit{P. nemorale} in the study area. If my taxonomic judgement is correct, then the species is not only new to the province, but also new to North America.

Recently, Ireland \textit{(in litt., 1980)} agreed to my determination, but opined that \textit{P. nemorale} is probably not a good and valid species.

\textit{P. nemorale} is a widely scattered species in Eurasia. It is also a weakly differentiated species as far as the our understanding goes. Its relationship with \textit{P. platyphyllum} and \textit{P. denticulatum} needs further clarification.
Plagiothecium piliferum (Sw. ex Hartm.) Bruch & Schimp., Bryol.
Fur. 5: 186. 1851. Map 163.

P. trichophorum (Spruce) Vent. et Bott., auct. non Lesq.
et James.

The filiform, flexuose hairpoints and erect, cylindric
capsules make the present taxon easy to identify in the field
even with a hand lens. It is widespread in the study area,
probably ranking next to P. laetum and P. denticulum in its
frequency of occurrence.

Schofield (1976) described its ecology as growing on tree
trunks and cliff and boulder faces throughout the southern half
of the province from sea-level to subalpine levels. The
Kootenay populations confirm the above observation, except that
they are mainly epilithic. Smith (1978) stated that the
species is a shaded, acidic rock dweller in Great Britain and
is very rare locally.

A widespread species in the north temperate zone.

Representative specimens examined: Glacier National Park
(UBB B-4247); Slocan Park (UBC B-4246); Kokanee Glacier Park
(UBC B-4245).

Neckeropsis undulata (Hedw.) Kindb. ex Allen

The recent discovery of a population (UBC B-4237) at Nakusp Hotspring area is a significant extension of the local range of distribution of P. undulatum in the province (see Map 165). Previously known to be a coastal species, it is the most distinctive and also the largest species of the genus. The only known interior population forms extensive mats over a shaded humic forest floor very close to a deep gorge approximately 1 mile west of the Nakusp Hotspring Resort site. The surrounding forest of Thuja and Pseudotsuga shows no signs of serious human disturbance, except for a foot trail that goes over the ridge to a mountain lake. Nevertheless, proximity of the population to the famous tourist attraction has cast some doubts on the indigenous nature of this single local interior population.

Absent in eastern North America, the present species is reported also from Europe and Asia (Asia Minor and Siberia).
FAMILY HYPNACEAE

This is a large pleurcarpous family characterized by double-costate or ecostate leaves, elongate to linear laminal cells and differentiated alar cells. The peristome, which has been termed hypnaceous, is nearly always double with the exostome teeth strongly trabeculate and also cross-striolate below, and the endostome with high basal membrane and well-developed keeled segments and nodulose cilia.

Cilia.

I have followed Crum (1976), Schofield (1968a) and Ireland (pers. comm., 1980) in including Isopterygium and Herzogiella in the present family.

1. Lateral branches pinnately arranged forming many erect, triangular fronds; leaves strongly plicate

..............................................Ptilium

1. Lateral branches creeping, not frondose; leaves not strongly plicate .................2

2. Capsules erect and symmetrical, elongate to cylindric, inner peristome with rudimentary cilia or none; leaves
appressed, mostly straight, rarely falcate, never circinate

Pylaisiella

2. Capsules variously inclined, ovoid to cblong, peristome perfect; leaves not appressed, falcate-secund; flexuose or circinate

3

3. Leaves clearly falcate-secund; alar cells well-differentiated, quadrate to rectangular, enlarged or inflated; peristome teeth usually brownish in color

Hypnum

3. Leaves erect-spreading, somewhat flexuose, at most only falcate near branch apex; alar cells weakly differentiated, never enlarged or inflated; peristome teeth usually creamy white in color

4

4. Leaves entire; capsules smooth

Isopterygium

4. Leaves strongly serrulate; capsules usually grooved

Herzogiella
As explained by Iwatsuki (1970), species of this genus, previously known as Sharpiella Iwats., are better placed in Herzogiella. The two genera differ in the habit of the capsule: erect in Herzogiella and inclined in Sharpiella. This distinction, however, is not distinct nor constant.

It is a genus of 5 or 6 species concentrated mainly in the northern half of the hemisphere. Three species are known from the province (Schofield, 1968a, 1980c), and one from the study area.

**Sharpieella seligeri** (Brid.) Iwats.

Only two collections have been identified from the many specimens studied. The collections are: on decayed log, Nakusp Hotspring (UBC B-4231) and Fisher Creek, near Arrow Park (UBC B-4233). Specimens superficially resemble *Isopterygium*. Under the microscope, the distinctly serrate to serrulate leaf margins at least in the upper half quickly identify the genus.

Schofield observed (1976) the species to be rare on logs and over bracket fungi in coniferous forests. It is infrequent near the coast, becoming more common at subalpine areas of the interior mountains in the southern half of the province.

Locally, it is rare and is found between 600 to 680 m (2000 to 2200 feet) elevation. Outside the province, it is scattered across the continent. Known also from Europe, Asia and Japan.
Like **Bryum** and **Dicranum**, the genus **Hypnum** has undergone taxonomic "cleansing" processes several times to become what it is today. As defined here, the genus includes as its section **Breidleria** Loeske and **Pseudostereodon** (Broth.) Fleisch.

A cosmopolitan genus of some 200 species, many of which are widespread in the northern boreal zone. Schofield (1968a) listed 15 species for the province and I have found 9 species in the study area. Two additional ones, **H. hamulosum** B. S. G. and **H. procerrimum** Mcl., which are present in the adjacent Canadian Rocky Mountains (Schofield, 1956), are included in the key for future reference. A third species, **H. recurvatum** (Lindb. & Arn.) Kindb., which is said to be an inhabitant of dry, calcareous rocks in the province (Schofield, 1976) may also be discovered in the study area. **H. callichroum** has been reported in the literature from the study area. I failed to locate any collections so named at CANM, V and UBC. I consider the species as a near-coastal element in the province.

**Hypnum oakesii** Sull. which was reported from Revelstoke in Macoun & Kindberg (1892) is, according to Kindberg (in Macoun, 1892), a **Hylocomium pyrenaicum**. I have seen the collection at CANM (192697) and confirmed the above conclusion.

Lastly, the work of Schofield (1956) and Ando (1972a,
1972b, 1973, 1976) has been useful in providing information on
the distribution of the species of Hypnum not only in Canada
and Alaska, but also throughout the world.

1. Stems with cortical hyalodermis ..........2

1. Stems without cortical hyalodermis ....7

2. Alar cells strongly differentiated, enlarged or inflated

.........................................................3

2. Alar cells not or weakly differentiated, not enlarged

.........................................................5

3. Apices of upper or terminal leaves shortly acute, often
obtuse; leaves only slightly falcate ...H. pratense

3. Apices of upper leaves long and slenderly acuminate; leaves
strongly falcate-secund to circinate ...4

4. Plants regularly pinnate; leaves strongly circinate, apex
slenderly filiform, serrulate at tip or entire; capsules not
ribbed when dry .........................H. dieckii
4. Plants irregularly branched; leaves falcate-secund, apex gradually long acuminate, not filiform, always entire; capsules ribbed when dry ............... H. lindbergii

5. Plants clearly complanate in habit; leaf bases cordate, rounded to insertion; leaf apices acute or often obtuse ................................................................. H. pratense

5. Plants not complanate; leaf bases not rounded to insertion; leaf apices always long and slenderly acuminate ................................................................. 6

6. Plants small, leaves less than 1 mm long; branches irregularly arranged, forming tufts; capsules short, 1-2 mm long ................................................................. (H. hamullosum)

6. Plants larger, leaves more than 2 mm long; branching pinnate, forming mats; capsules long, 3-5 mm ................................................................. H. subimponens

7. Leaf margins distinctly serrate to serrulate from apex to the middle ............................................. H. pallescens

7. Leaf margins entire or only serrulate at the apex ................................................................. 8

8. Leaf margins revolute at least from the base to the middle
8. Leaf margins plane or recurved only at the base

H. revolutum

9. Leaves strongly circinate; capsules short, ovoid

H. circinale

9. Leaves falcate-secund; capsules not shortly ovoid or unknown

10

10. Leaves auriculate at base; alar cells few, irregular in shape, quadrate and short rectangular, never transversely elongate

H. procerrimum

10. Leaves not auriculate at base; alar cells numerous, mostly quadrate and transversely elongate

11

11. Leaves small, less than 1.5 mm in length, usually widest at the middle, abruptly acuminate; median laminal cells 4-6:1; pseudoparaphyllia broadly floccose to semi-circular, margin toothed

H. vaucheri

11. Leaves larger, more than 1.5 mm long, widest at base, and gradually narrowed to apex; median laminal cells 10-15:1; pseudoparaphyllia narrowly lanceolate to near filamentous, margin entire

H. cupressiforme

A beautiful western North American endemic species, H. circinale is unique, among the many local taxa of Hypnum, in acquiring a short, ovoid capsule. The regularly and pinnately branched and creeping habit that becomes appressed to the substratum adds to its distinctiveness. The species is common and often locally abundant in moist to wet, humid sites in the Selkirk Mountains, becoming sporadic only in the southern dry portion of the study area. The species grows with Orthodicranum strictum generally on rotten logs inside shaded forest. Nonetheless, it has been observed to form mats on rocks and boulders along the banks of rivers and creeks, and is sometimes epiphytic on tree trunks. The species is found from low to subalpine elevations.

Representative specimens examined: Revelstoke National Park (UBC B-4205); Slocan Lake (UBC B-4204); Mica Dam vicinity (UBC B-4203); Halcyon Hotspring (UBC B-4202).

This species is rare in the area of study, being known from two collections: on ground, Edgewater on Hwy 95 (UBC B-4207) and Kaslo-New Denver Hwy (UBC B-4206). The nearly straight leaf blade with recurved apex and numerous small alar cells are characteristic. Sterile, depauperate specimens are, at times, difficult to separate from H. vaucheri. Under the circumstances, the difference in the pseudoparaphyllia between the two species should prove helpful in the identification (see Watanabe and Ando, 1977). H. cupressiforme, which is common on maritime headlands, boulders and logs above high tide level throughout the coast (Schofield, 1976), is locally rare in the interior and appears to be restricted more to calcareous substrata, as is the case in the Canadian Rocky Mountains. The species is a variable one with many forms and varieties described. I have not attempted to treat the infraspecific taxa since the taxon is rare in the study area.

Widely scattered in North America, Europe and Asia.
In North America, this is a west coast species like *H. circinale*. Its total distribution is less widespread in the province than *H. circinale*. In the study area, *H. dieckii* is rare, being restricted to wet, deep gorges that are bathed in the mist or spray of nearby waterfalls. Two collections are known: Sutherland Falls, south of Revelstoke (UBC B-4209) and Fry Creek Canyon (UBC B-4210). Both populations are like the typical coast counterparts: matted, pinnately branched and golden brown in color. Also known from Japan.

Horikawa & Ando (1957) mapped the world distribution of the present species.
A fairly common species in the study area, *H. lindbergii* can be identified with ease in most cases by its inflated hyalodermal stem cells and thin-walled, enlarged to inflated alar cells. Occasionally the species can be confused with *H. dieckii* which has a longer and more slenderly falcate-secund leaf apex and more regularly, pinnately branched, and matted habit. In *H. dieckii*, however, the alar cells are usually accompanied by a few reddish pigmented cells, while in *H. lindbergii*, such cells are absent. Ecological tolerance of *H. lindbergii* seems wider than the former, especially in terms of moisture regime.

A common northern hemisphere species.

Representative specimens examined: Rosebery (UBC B-4211); Purcell Wilderness Conservancy (UBC B-4212); Bugaboo Glacier Park (UBC B-4213); Revelstoke (CAML 189503).


*H. reptile* Michx.

*H. pseudo-fastigiatum* C. Müll. & Kindb.
This is an uncommon species of *Hypnum* in the study area (see Map 169), yet fairly easy to determine by its serrulate leaf margins. It is the smallest *Hypnum* known from the study area, with the leaves averaging less than 1 mm long. *H. pallescens* is epiphytic on trunks of conifers in subalpine areas in coastal regions (Schofield, 1976). In the study area, it is both epiphytic and epilithic.

Uncommon also in the province and becoming more frequent in eastern North America. Known also from Europe and East Asia, although interestingly absent in Great Britain.

Lawton (1971) synonimized *H. pseudo-fastigiatum* with the present species. I have not seen any isotype of *H. pseudo-fastigiatum* at CANM, but judging from the original description in Macoun (1892), I accept Lawton's judgement.

Representative specimens examined: Revelstoke National Park (UBC B-4214); Beatrice Lake vicinity, Valhalla Range (UBC B-4215); Purcell Wilderness Conservancy (UEC B-4216).

A locally rare species, *H. pratense* is unique in developing a clearly complanate habit, resembling a species of *Plagiothecium*. The size of the plant is large, approaching the dimensions of *Plagiothecium undulatum*. The leaves are less falcate-secund than *H. lindbergii* which it sometimes resembles. It is interesting to note that the species has been collected only around the Slocan Lake area, by Macoun (UBC E-4219), MacFadden (UBC B-4220) and Tan (UBC B-4221). The habitat is the swampy or marshy margin of the lake.

*H. pratense* is also rare in the province as well as in other parts of North America. Crum (1976) reported it as a calcicole growing in open swampy areas and also a circumpolar species, becoming more common in arctic North America.


This is fairly common in the study area. Like *H. pallescens*, it is relatively small and equally distinctive in its revolute leaf margins. Ando (1973) describes it as a polymorphic species and provides excellent illustrations of the various habits the species might assume and treats these as several forms and varieties. I prefer to treat all the forms and varieties under a single broad taxon which is characterized by various degree of revolute leaf margins.

*H. revolutum* is a widespread northern hemisphere species common on calcareous and non-calcareous rocks, over humic forest floor, rotten logs and, rarely, trunk bases.

Representative specimens examined: Horsethief Creek, det. by Ando as var. *dolomiticum* (Milde) Moenk. (UBC B-4222); Lake Lillian, Invermere (UBC B-4223); Porcupine Creek, Ymir (UBC 4224).
1865.

This is the most common species of *Hypnum* in the study area. Populations grow mainly on tree trunks and rotten logs, and secondarily on rocks and river banks. Small plants may resemble *H. circinale*, but *H. subimponens* is never tightly attached to the substratum. The long and curved capsules also aid in differentiating it from *H. circinale*. In ecology, the present species has more tolerance to the dryness than *H. circinale*, consequently, it is more widespread than the latter species within the study area.


Representative specimens examined: New Denver (UBC B-4228); Radium Hotspring vicinity (UBC B-4229); Deer Park area (UBC B-4230); Slocan City (CANM 189298).

A rare species in the study area, *H. vaucheri* grows chiefly on calcareous rocks and appears to be restricted to the more basic substrata in the Columbia Trench. It is most likely to be confused with *H. cupressiforme*, but the difference in the morphology of pseudoparaphyllia should be sufficient to separate the two species. See *H. cupressiforme* for further comments. Ando (1976) has greatly clarified the species concept of the present taxon. Again, since few collections are available, I have not considered the numerous subspecific taxa proposed by Ando (1976).

A widespread species of north temperate continents.

Representative specimens examined: Lake of Hanging Glacier (UBC B-4227); Radium Hotspring vicinity (UBC B-4226); Edgewater on Hwy 95, det. as forma *tereticaulis* Ando (UBC B-4225).
**Isopterygium Mitt.**

A large, worldwide genus of nearly 260 species, most of which are tropical and subtropical in distribution. Schofield (1968a) listed three species for British Columbia, two of which are in the study area.

The genus differs mainly from *Plagiothecium* in not developing decurrent leaf bases. In addition, species of *Plagiothecium* have an outer layer of thin-walled stem cortical cells. This feature is absent in *Isopterygium*.

A new type species (*Hypnum tenerum* Sw. = *Isopterygium tenerum* (Sw.) Mitt.) has been recently chosen by Iwatsuki and Crosby (1979) to lectotypify the genus.

1. Plants complanate; leaves superficially distichous, serrulate at the apex; dioicous .........I. elegans

1. Plants not complanate; leaves arranged at least in three rows, margins entire; autoicous .........I. pulchellum

A beautiful dark green species true to the species epithet, *I. elegans* is uncommon and very local in the interior humid area. The complanate and superficially distichous arrangement of leaves are sufficient characters to identify this species from *I. pulchellum*. The Kootenay populations have been rarely observed to produce the fusiform propagula so common to the coastal populations. Consequently, I have not employed this feature in the species key.

All the Kootenay populations grow on shaded, moist rock outcrops, forming extensive mats. Smith (1978) contends that it is a calcifuge.

Widespread in the north temperate region.

**Flagiothecium pseudo-latebricolum** Kindb. in Macoun

A fairly common species in the study area often growing on decaying logs inside coniferous forests from low to subalpine elevations. Near waterfalls, the species can be found in protected rock crevices and misty boulders. Frequently, it is associated with **Plagiothecium denticulatum** and **P. laetum**.

The entire, narrowly ovate to lanceolate leaves without apparent costa and non-decurrent leaf bases are important features of the species. The MacFadden collection (CANM 190137 !) from Salmo and reported by her (1926) as **Plagiothecium striatellum** (Brid.) Lindb. is a **Isopterygium pulchellum**.

Widespread in the province and also in the whole northern hemisphere.

Representative specimens examined: Sutherland Falls, south of Revelstoke (UBC B-4234); Poplar Creek, north of Larderou (UBC B-4235); Meachen Creek, St. Mary Lake area (UBC B-4236).
**Ptilium De Not.**

This is a frondose genus of two species, one widespread in the boreal zone, and the other one endemic to the Caribbean Region.


This is a large, pinnately branched, bright yellow green moss, 40-120 mm tall. It grows in the wet to dry forest floor of coniferous forests in the study area. The plume-like habit and the plicate and strongly falcate-secund leaves are striking in appearance. Populations are most luxuriant in shaded and moist forest floors, where they often form extensive carpets. In drier sites, the species thrives with **Pleurozium schreberi**, **Dicranum polysetum**, and species of **Racemitrium**. Sporophytes are frequently encountered in the Kootenay mountains.

Common throughout the most parts of the province, except on the humid coast (Schofield, 1976).
A widespread northern hemisphere taxon.

Representative specimens examined: Glacier National Park (UBC B-4201); Kokanee Glacier Park (UBC E-4199); Little Slocan Lake (UBC E-4200).

_Pylaisiella_ Grout

_Pylaisiella_ is an epiphytic genus of about 40 species, mainly of northern hemisphere distribution. Only one species is recorded for the study area.

The name _Pylaisia_ Bruch & Schimp., according to Grout (1896), is a later homonym. Hence, I am using the name _Pylaisiella_ following Crum _et al._ (1973).

Pylaisia polyantha (Hedw.) B. S. G.

An epiphyte on the trunks of deciduous tree species such as *Populus tremuloides* and species of *Betula*, *P. polyantha* is easy to recognize in the field by its erect capsules. In the study area, all populations came from trees growing on rivers or lake margins near human settlements. Schofield (1976) reported that the species is common east of the Cascade Mountains and in the boreal forests, but absent from the coastal area.

Known also from eastern North America, Greenland, Europe, Siberia, India, China, and Japan.

Representative specimens examined: Kikomum Creek Park, Koocanusa Lake (UBC E-4198); St. Mary Lake’s margin (UBC B-4197); Revelstoke (UBC E-4196).
The status of the family has been debated since the time of Hedwig (1801). The problem was reviewed by Andrews (1954) and more recently by Noguchi (1972). Both presented their viewpoints about the family definition and made comparison with that of Brotherus (1924-1925) which is essentially the system accepted by Lawton (1971). I include herein Pleurozium, following the revisional study of Buck (1979) on the Family Entodontaceae, and remove Rhytidiopsis to the Family Hylocomiaceae following the arguments of Andrews (1954) and Noguchi (1972). Most European bryologists, nevertheless, treat the genera discussed here in a single, broadly conceived family including those placed under the Family Hylocomiaceae and Family Hypnaceae (Smith, 1978; Nyholm, 1954-1969).

Family Rhytidiaceae, as defined here, differs from the Family Hylocomiaceae mainly in lacking dense paraphyllial outgrowths on the stem and branches and in developing pseudoparaphyllia of the same kind.

Rhytidium rugosum (Hedw.) Kindb., the only species of the genus, is rather distinct by virtue of its rugose and somewhat imbricate to falcate leaves. The species is widely scattered in limestone areas in the province (see Schofield, 1976), including the Albertan section of the Rocky Mountains. It is
included in the key to the genera since its presence in the area seems probable.

1. Leaves strongly rugose; costa single and strong
   .................................................. *(Rhytidium)*

1. Leaves not rugose; costa double or none
   .................................................2

2. Leaves imbricate, concave, margin entire, apices apiculate to acute and costa wanting, rarely double and short
   .................................................. *Pleurozium*

2. Leaves erect-spreading to squarrose, plane, margin toothed, apex long acuminate, costa distinctly double, at least one arm longer ............................... *Rhytidia delphus*
**Fleurozium** Mitt.

A monotypic genus placed by Lawton (1971) in the Family Amblystegiaceae, a judgement not accepted by most bryologists. The genus is distinct, widespread and common in the northern boreal forests, and is also variable in morphology. Chromosome numbers have been counted to be $n=5$, 7 and 10, and the different aneuploid and polyploid populations in nature, possibly account for its observed wide ecological adaptability and morphological plasticity.


A widespread species of mesic to dry forest floor in boreal and interior coniferous forests, *Pleurozium schreberi* was reported by Schofield (1976) to be less frequent in the humid coastal forest, confined in most cases to exposed boulder talus and terraces. The reddish stem and concave leaves with short, apiculate apex are useful field characters. Plants can be erect and somewhat dendroid or more or less prostrate in growth
habit.

A widespread species in northern hemisphere.

Representative specimens seen: Gray Creek, Kootenay Lake (UBC B-4837); Creston area (UBC B-4838); Glacier National Park (UBC B-4839).

*Rhytidiadelphus* (Limpr.) Warnst.

This is mainly a north temperate genus of seven species plus one species from South America. The four species reported from British Columbia are all forest floor species in the shaded and open sites such as banks of streams and creeks. The name is certainly misleading because the genus is probably only distantly related to the single-costate genus *Rhytidium*. *Rhytidiadelphus subpinnatus* (Lindb.) Kcp. is treated here as an infraspecific taxon of *R. squarrosus* (Hedw.) Warnst.
1. Leaves plicate, not squarrose; alar cells little differentiated .............2

1. Leaves not plicate, strongly squarrose, especially near the apical ends of branches and stem; alar cells clearly differentiated, distinctively colored .. R. squarrosus

2. Plants large, 4-5 mm wide including the leaves on the stem; costa strong and double, reaching midway up the leaf; leaf cells usually terminally papillose ..... R. triquetrus

2. Plants smaller, approximately 2-3 mm wide; costa weak and double or occasionally none, not reaching halfway up the leaf length; leaf cells smooth ........ R. loreus


This is fairly common in the area, although not as abundant or common as in the coastal and insular regions. The plicate, patent and falcate-secund leaves are distinctive enough to identify it from the other local species of the
genus. Plants form carpets on logs, cliff shelves and creek banks in addition to the humic forest floor.

Wynne (1943) has showed that the species has a disjunct east-west distribution in North America.

A common North American, Europe, Asia, and Northern Africa.

Representative specimens seen: Revelstoke National Park (UBC B-4840); Wilson Lake, Nakusp area (UBC B-4841); Halcyon Hotspring (UBC B-4842).


R. calvescens (Lindb.) Warnst.

R. subpinnatus (Lindb.) Kop.

This is a variable species which may involve several taxa. It has strongly squarrose or reflexed branch leaves, and to a certain degree in some populations, also the stem leaves. In the study area, it prefers much wetter habitats than the other
species of the genus. Aside from invading the lawns in towns and cities, populations are most frequent along deeply shaded banks of creeks or streams in mountains.

Var. calvescens (Lindb.) Warnst. (=R. subpinnatus (Lindb.) Kop.) is accepted by most European bryologists as a distinct species separable from R. squarrosus (Nyholm, 1954-1969; Smith, 1978; Koponen, 1971b). In Europe, the two species are reportedly different in the degree of squarrosity of stem leaves, shape of leaves, branching pattern and habitat, as well as geographical distribution. Koponen (1971b) summarized these differences in a table. Nevertheless, all the differences mentioned, besides being only quantitative in nature, do not hold true with many Kootenay collections. Populations with various combinations of all these supposedly apparent differences exist and defy a definitive determination (Ahti and Fagersten, 1967). Further confusing the issue, Japanese and European herbarium specimens of R. subpinnatus, R. calvescens, when compared to the North American R. squarrosus, show different leaf shapes and branching patterns. It is true that in the study area as in the coastal region, populations invading the lawns in human settlements or in wet disturbed localities tend to become erect, less branched and with leaves strongly squarrose. Frequently lateral branches are also markedly tapered to the apex, giving the plants a highly distinctive habit. On the other hand, its counterparts in mature forest and undisturbed natural habitats tend to be
larger (twice the dimension), more branched and with apical leaves of the main stem and larger branches strongly squarrose. Nevertheless, intermediate forms exist and the two forms described can occur in the same habitat. I am not convinced, therefore, that the British Columbian specimens indicate two separate species with distinct habitat preference. Nor can I discount the degree of difference seen in the squarrosity of stem leaves. It is best, I believe, to treat *R. calvescens* at present at the varietal level until thorough and critical transplantation experiments have been carried out to determine which morphological characters are merely ecophenotypic in expression.

The var. *calvescens*, as described here, is the population which grows in disturbed habitats with more strongly squarrose stem and branch leaves and the var. *squarrosus* is the plant growing in less disturbed sites with only strongly squarrose branch leaves.

Both the var. *squarrosus* and var. *calvescens* are widespread taxa of northern boreal zones.

Representative specimens seen: Champion Lakes Provincial Park (UBC B-4843 as the var. *squarrosus*); Stagleap Park (UBC B-4844 as the var. *squarrosus*); Kokanee Glacier Park (UBC B-4845 as var. *calvescens*); Monk Creek vicinity (UBC B-4846 as the var. *calvescens*).

This is the largest species of the genus. The erect-spreading leaves with two strong costae are striking. It is unlikely to be confused with any other moss species inhabiting the forest floor.

Common in the study area as well as other parts of the North Temperate Zone.

Representative specimens seen: Arrow Park ferry landing (UBC B-4847); Champion Lakes Provincial Park (UBC B-4848); Kokanee Creek Provincial Park (UBC E-4849).

**FAMILY HYLOCOMIACEAE**

This is a small family of four genera characterized by the presence of abundant, branched or toothed paraphyllia and pseudoparaphyllia with several lateral outgrowths near the base.
Recently, *Rhytidiopsis* has been argued by Noguchi (1972) to be closer in relationship to *Hylocomium* than to *Rhytidium*. The evidence presented by him for the inclusion of *Rhytidiopsis* in the present family is derived from both the gametophyte and sporophyte.

The family is nearly worldwide in distribution.

1. Branches usually flattened; leaves imbricate, not falcate, either plicate or weakly rugose; laminal cells often papillose apically, occasionally smooth; alar cells not or only weakly differentiated .......................... *Hylocomium*

1. Branches not flattened; leaves erect-spreading, falcate, strongly plicate below and markedly rugose above; laminal cells smooth; alar cells well-differentiated .......................... *Rhytidiopsis*
Hylocomium B. S. G.

This is a small genus of 8 species in north and south temperate zones including the tropics. Hylocomiastrum Fleisch. ex Broth. is not recognized here as a separate genus.

Three species are reported for the study area and the province as well.

1. Plants irregularly, never bipinnately branched; leaf costa single ........................................H. pyrenaicum

2. Branches bi- or tripinnately branched; leaf costae double ........................................2

2. Branches profusely developed into frondose layers representing the annual growth; stem leaves concave, ovate-lanceolate with often papillose leaf cells and a contracted, long and twisted apex .................H. splendens

2. Branches more or less regularly pinnately arranged, not forming well-developed annual frondose layers; stem leaves plane, broadly ovate to deltoid with smooth leaf cells and a
gradually acuminate apex ..............*H. umbratum*

**Hylocomium pyrenaicum** (Spruce) Lindb., Musci Scand. 37. 1879.

The species is uncommon in the study area and seems to be confined to the northern half of the Selkirk and Purcell Mountains. Plants grow profusely on logs and the forest floor. Superficially, the irregular branching habit is reminiscent of the species of *Brachythecium* or even *Antitrichia curtipendula*, but the abundant paraphyllia will reveal its generic identity.

Schofield (1976) reported it to be rare in open habitats of subalpine areas near the Coast. Vitt (1973a) stated that it is not at all common in western North America.

A widely scattered species in northern and montane Europe, Asia, Japan, North America, Iceland, and Faroes.

Representative specimens seen: Glacier National Park (UBC B-4850); Burton, Trout Lake (UBC B-4852); Goldstream, north of Revelstoke (UEC B-4853).
Hylocomium splendens (Hedw.) B. S. G., Bryol. Eur. fasc. 
49-51. 1852. Map 175.

This is a frondose species that is not likely to be mistaken for any other species of mosses. The so-called "feather-like or step-like structure" represents annual growth of branches arranged on a single plane and often can become continuously attached to the previous year's growth in a series of five tiers. The species seems to have a wide ecological tolerance. It becomes slender and less branched in drier sites, but remains luxuriantly branched on shaded, moist cliff faces flanking deep gorges. Often, it covers acres of the floor of mature conifer forests with thick and deep mats.

A common and widespread North Temperate species.

Representative specimens seen: Slocan (UBC B-4854); Galena Bay area (UBC B-4855); Cayuse Creek, Deer Park area (UBC B-4856); Purcell Wilderness Conservancy (UBC B-4857).
Hylocomium umbratum (Hedw.) B. S. G., Bryol. Eur. 5: 175.
1852.

The present species resembles *Hylocomium splendens* in its profusely, pinnately branching habit. Nevertheless, *H. umbratum* appears to be more slender in overall habit and size, resembling depauperate form of *H. splendens*. In addition, the stem leaves which are broadly ovate and plane are different from that of *H. splendens*. It has been collected only twice from the study area but is probably more common, since plants can be easily mistaken for the very common taxon, *H. splendens*.

Schofield (1976) reported it to be widespread but local in the southeastern interior humid forests and very rare in the subalpine forest near the Coast.

It has a similar geographical distribution to that of the other species of the genus.

Representative specimens seen: Eagle River (UBC B-4858; B-4858).
Rhytidiopsis Broth.

This is a monotypic genus endemic to western North America.


True to its species epithet, the present species is large among the local mosses; yet untrue to its generic name, it is only distantly related to the genus Rhytidium. The two genera are at times confused among the many herbarium specimens studied. The latter has only rugose leaves whereas Rhytidiopsis has both plicate and rugose features on the same leaf. Habitat preference is like that of H. splendens and is often seen growing together with it especially in subalpine forests. It is very common in the study area.

Representative specimens seen: Champion Lakes Provincial Park (UBC B-4860); Nelson area (UBC E-4861); Zincton (UBC B-4862).
V. Discussion

A. Taxonomic problems

The results of the present investigation have expanded greatly our knowledge of mosses growing in the Selkirk and Purcell Mountains. 366 species distributed in 128 genera and 40 families are now confirmed and accepted based on the study of a large number of collections. Several distinct varieties such as Grimmia alpestris var. holzingeri, Desmatodon latifolius var. muticus, Racomitrium canescens var. strictum, Drepanocladius uncinatus var. symmetricus, Eryum turbinatun var. lanatum, Barbula revoluta var. obtusula, and others have been recognized. Conversely, for variable and poorly understood taxa such as Drepanocladius aduncus, Dichodontium pellucidum and Lescuracea radicosa, the many published varieties are not given recognition in the present treatment.

Often the taxonomic judgements of an individual are unavoidably influenced by his or her experience with the particular moss flora being studied. As such, I have come to accept Didymodon cylindricus and Didymodon vinealis as two distinguishable species, at least in the area of study. I have interpreted also that Dicranella pseudoralustris is a species distinct from Dicranella schreberiana, the name under which it
has been treated traditionally as a variety. Since these problematic species are mostly widely distributed in the northern boreal zone, it is not surprising that some of the diagnostic characters which hold true for the Kootenay populations may not be observable in other parts of the world. The keys and taxonomic comments included here apply only to the local moss populations studied. A final solution to these taxonomic controversies can be achieved only by undertaking monographic studies on a worldwide basis.

Critical evaluation has been done recently with a few large and unwieldy genera like Bryum and Pohlia in an attempt to produce better and more refined definitions of species (Syed, 1973; Smith, 1978). The results of these studies have not been applied to the identification of local moss specimens because of the lack of good reference materials properly annotated by the monographers. As more and more generic revisions are undertaken and completed in the future, there will be more species of Bryum, Pohlia and other genera reported from the area than are accepted presently by me.

There are still a number of taxonomic problems to be resolved. The limitation of the time allotted to the present investigation, the inaccessibility to herbarium collections housed in other continents as well as the difficulty met in tracing and borrowing of critical type specimens have all contributed to the open questions regarding the taxonomic status of Dicranum sulcatum - D. fuscescens, Polytrichum
longisetum - P. formosum, Tortula ruralis - T. intermedia - T. norvegica, Schistidium atrichum - S. dupretii and Lescuraea incurvata - L. radicosa. The nature of the problems differ from case to case and are discussed in the text where appropriate with the intention of calling attention to the problems and of offering some possible solutions.

Since the Selkirk and Purcell Mountains have not been carefully botanized by trained bryologists in the past, the present effort naturally yielded numerous new records for the two mountain ranges. All of these new records are emphasized in Chapter IV. In addition, there are several species discovered that represent new records for the province, for Canada, for western North America, and even for the North American continent. These are listed below:

1. New to the province - Campylium radicale, Hygroamblystegium noterophilum, Mnium arizonicum, and Pohlia obtusifolia.

2. New to Canada - Scouleria marginata.

3. New to western North America - Physcomitrella patens, Dichelyma pallescens, and Pohlia lescuriana.


Likewise, several species which were reported in the
literature from this region have been subsequently found to be based on misidentifications and should be excluded from the list of local moss species. Among these are *Aulacomnium turgidum*, *Dicranoweisia cirrata*, *Homalothecium pinnatifidum*, *Lescuraea taileyii*, *Pohlia columbica*, *Poretrichum bigelovii* and *Trematodon ambiguus*, to name only a few.

There are a few rare species, including *Plagiomnium ciliare* and *Scorpidium turgescens*, which were collected or reported only once by Macoun from southeastern British Columbia. Judging from their present distribution in North America, they are not likely to be present locally. Either the populations are extinct today following the destruction of the habitats or the collections were erroneously attributed to the study area by Macoun, a mistake commonly encountered in his collections. The case of *Pohlia columbica* is a good example of the latter situation (Tan et al., 1980b).

This floristic study also results in several new combinations. These are: *Didymodon cylindricus* (Taylor) Tan, *Racomitrium affine* var. *macounii* (Kindb.) Tan, *Schistidium atrichum* (C. Muell. & Kindb. ex Macoun & Kindb.) Tan, and *Schistidium dupretii* (Ther.) Tan.

The discovery of populations of *Andreaea blyttii*, *Arctoa fulvella*, *Bryum cyclophyllum*, *Campylium calcareum*, *Neckera douglasii*, *Philonotis yezoana*, *Plagiothecium undulatum*, *Tortula subulata*, *Tayloria splachnoides*, *Splachnum ampullaceum*,
Seligeria tristichoides, Tetrodontium repandum, Paraleucobryum enervec, Paludella squarrosa, Orthotrichum lyellii, Scouleria marginata, Pohlia lescuriana, Dichelyma pallescens, Lescuraea saxicola, Cynodontium jenneri, Enthostodon fascicularis, Pterygoneurum ovatum, P. subsessile, Aloina brevirostris, Alcina rigida, Hookeria lucens, and Physcomitrella patens in the study area represents meaningful extension of local range and provides interesting phytogeographical information.

In terms of the number of species, the largest genus in the area is Brachythecium (18 species), followed closely by Bryum (16 species), Pohlia (12 species), Orthotrichum (11 species), and Dicranella (10 species). It is interesting to note that all of these large genera are found commonly in exposed and disturbed habitats, and that many contain successfully widespread, almost weedy species.

Lastly, a possible weakness in the present investigation is the failure to collect the ephemeral species that may have germinated and died after a short season during the early spring and late fall. Despite this limitation, such an omission probably represents only an insignificant number of taxa, based on a comparison of the local moss flora with those of the neighboring areas.

B. Ecology and species association
The occurrence of bryophytes, like all other plant groups, depends on the interaction of the organisms and their environment. The many environmental factors are probably as diverse as the innate factors which govern the life processes of the organism. Hence, the presence of a species in a locality is the direct and complicated result of thousands of years of interaction between the physical surrounding and the population concerned. Restricted by their small size and the general lack of efficient adaptations to live on land, bryophytes mostly inhabit more protected and moist micro-niches. As such, they are sensitive to slight changes in the micro-environment although the effects of the change of macro-environment on them are less direct.

There are many physical environmental factors that affect the growth and development of plants. Among these, the availability of moisture and the edaphic conditions are probably the two most important factors that determine the local distributions of mosses (Barkman, 1958). It is, admittedly, in any ecological investigation, difficult to identify in a clear-cut manner as to which particular physical factor, such as light, temperature or moisture, is the critical or limiting factor under particular circumstances. All these factors often work in a complicated manner and may affect the plant either separately or in combination.

Numerous studies have attempted to interpret the definitive role played by the different abiotic factors in
promoting or suppressing the growth and development of mosses or moss communities. They are selectively listed below by the particular factor the papers dealt with: pH (Jeglum, 1971; Robinove & La Rue, 1929), water regime (Busby and Whitfield, 1977; Clausen, 1952; Johnson & Kokila, 1970; Meyer, 1942a; Patterson, 1964), light (Benson-Evans, 1961; Valanne, 1966), strong irradiation (Kinugawa & Otsuka, 1972a; Kinugawa et al., 1972b; Steere, 1970), phorophyte (Barkman, 1958; Culberson, 1955; Phillips, 1951) and inorganic substrata (Nagano, 1969, 1972; Shacklette, 1965). Needless to say, a sound understanding of the effects of these environmental factors on mosses is necessary to interpret correctly any observed phytogeographical patterns.

Despite the fact that bryophytes frequently constitute a significant portion of the world vegetation, ecological study, like all the other aspects of Bryology, lags behind its counterpart in the vascular plants. The recent progress in bryophyte ecology has been summarized by Streeter (1970) and more ably, by Watson (1974).

Most recent ecological studies have taken place in the polar to temperate zones because it is in these zones that bryophytes form conspicuous ground cover in the ecosystem. By and large, these studies deal quantitatively and qualitatively with the characterization of the different bryophytic communities using bryophytes as indicator species (Barkman, 1958; Bunce, 1967; Culberson, 1955; Gimingham &

Except for the field report (Utzig et al., 1978) prepared by the Nelson Forest District, Ministry of Forests wherein the bryophytes were treated as casual and unimportant elements of the local vegetation, no study of local moss communities has been conducted. In this regard, the adjacent areas in Washington and Idaho have been investigated (Coleman et al., 1956; Cooke, 1955; Hoffman & Kazmierski, 1969; Steele, 1978). The results of these studies agree well with my three-year observations on the ecology of the mosses in the area. Schofield (1976), thus far, provides the only comprehensive and up-to-date information concerning the ecology of British Columbian mosses.

Indeed, the occurrence of the moss species in this area is dictated by the presence of appropriate substratum and moisture. The elevational distribution, like the horizontal range, is equally determined to a large degree by these two factors. Since the species of trees present is in itself a direct response to the prevailing climatic and edaphic conditions of the area, the type of forest cover does not appear to dictate strongly that a definite group of mosses to grow under its canopy. Similar moss taxa have been collected
from similar microhabitats under the canopy of different types of forest, sometimes even at various elevations. Also, within the same biogeoclimatic zone, mosses inhabiting the somewhat open and marginal habitats such as stream banks or avalanche sites are very different from those growing across the shaded, moist and humic forest floor. Furthermore, the mountains in the Selkirk and Purcell Ranges are highly complex in structure and variable in physical factors and local vegetation. Consequently, it is a common experience to discover moss species in unexpected habitat and locality.

Below is presented in a general enumeration the more common or locally abundant mosses observed to be associated with specific habitat types in the Selkirk and Purcell region. The description of the habitat is given in very general terms to avoid misinterpretation. One should bear in mind that there are a few mosses that have wide ecological tolerance which enables them to appear and compete in two or three habitats. Except for the Interior Western Hemlock Zone, the detailed habitat classification such as rock, forest floor or tree trunk is not provided. Information on this matter can be obtained from Chapter IV under each species name.

I. In mature Interior Western Hemlock forest -

A. Shaded, moist and humic forest floor:
Prachythecium hyalotapetum    Fleurozium schreberi
B. leibergii    Pohlia nutans
Dicranum scoparium    Polytrichum commune
D. fuscescens    P. alpinum
Drepanocladius uncinatus    P. formosum
Furhynchium pulchellum    P. juniperinum
Heterocladium procurrens    Ptilium crista-castrensis
Hylocomium splendens    Rhytidium triquetrum
Mnium spinulosum    Rhytidipsis robusta
Plagicmnium medium    Sphagnum spp.

B. Shaded, acidic, permanent muddy depressions or semi-permanent seepy sites:

Prachythecium rivulare    Flagicmnium ellipticum
B. frigidum    Pohlia drummondii
B. rutabulum    Rhizcmnium magnifolium
Bryum pseudotriquetrum    R. nudum
B. wigelii    R. pseudopunctatum
Calliergon cordifolium    Rhytidiadelphus loreus
C. stramineum    R. squarrosus
Drepanocladius spp.    Sphagnum spp.
Fontinalis antipyretica
C. Shaded, humid and non-calcareous boulders or cliff faces:

- *Amphidium lapponicum*
- *Anacolia menziesii*
- *Bartramia romiformis*
- *Brachythecium leibergii*
- *Cladopodium bolanderi*
- *Dicranoweisia crispula*
- *Dicranum fuscescens*
- *D. scoparium*
- *Distichium capillaceum*
- *Dryptodon patens*
- *Grimmia torquata*
- *G. trichophylla*
- *Hemalothecium spp.*
- *Hylocomium splendens*
- * Isothecium stoloniferum*
- *Metaneckera menziesii*
- *Orthotrichum rupestre*
- *Plagiochila venustum*
- *Plagiochila oederi*
- *Fleurozium schreberi*
- *Pohlia cruda*
- *Fetigynandrium filiforme*
- *Rhytidiopsis robusta*

D. Open, drier and acidic boulders or disturbed grounds:

- *Brachythecium albicans*
- *Bryum caespiticium*
- *Dicranum polysetum*
- *D. scoparium*
- *Furhynchium pulchellum*
- *Grimmia montana*
- *Pohlia nutans*
- *Pohlia nutans*
- *Polytrichium juniperinum*
- *P. lyallii*
- *F. riliferum*
- *Racomitrium brevipes*
- *R. canescens*
Medwigia ciliata  Phytidiopsis robusta

Pleurczium schreberi

E. Shaded, humid, overturned roctstumps with soil cover:

Atrichum selwynii  P. nutans
Aulacomnium androgynum  Schistostega pennata
Fissidens bryoides  Timmia austriaca
Pohlia cruda

F. Shaded, decaying and moist logs or base of tree trunks:

Amblystegium serpens  H. subimponens
Aulacomnium androgynum  H. lindbergii
Brachythecium starkey  Isorterygium pulchellum
B. velutinum  Isotrichium stoloniferum
Buxbaumia viridis  Lescuraea stenophylla
B. piperi  Mnium spinulosum
Claopodium bolanderi  Onchophorus virens
Dicranum fuscesens  Orthodicranum strictum
D. scoparium  Flagiothecium denticulatum
Drepanocladus uncinatus  F. laetum
Isopterygium pulchellum  Tetraphis pellucida
**Hypnum circinale**

II. In Interior Douglas-fir, lodgepole pine and Ponderosa pine forests -

A. Shaded forest floor:
- Abietinella abietina
- Brachythecium salebrosum
- B. albicans
- Bryum caespiticium

B. Open sites or exposed boulders:
- Aloina brevirostris
- Brachythecium albicans
- Brachythecium salebrosum
- Bryum caespiticium
- Bryum pallescens
- Dicranum polysetum
- Furhynclium pulchellum
- Pohlia nutans
- Polytrichum juniperinum
- P. piliferum
- Pterygoneurum ovatum
- Pterigynandrum filiforme
- Racontrium brevipes
- R. canescens
- Tortula ruralis

III. In cool and humid Subalpine Engelmann-Subalpine Fir
forest -

A. Shaded forest floor:

- Aulacomnium palustre
- Brachythecium collinum
- Bryum spp.
- Dicranum fusescens
- D. pallidisetum
- D. scoparium
- Hylcomium splendens
- Hypnum lindbergii
- Hypnum rallecescens
- Kiaeria starkei
- Lescuraea radicosa
- L. patens
- Mnium spinulosum
- Oligotrichum aligerum
- Paraleucobryum longifolium
- Pleurozium schreberi
- Pohlia cruda
- P. nutans
- Foellia roellii
- Sphagnum spp.
- Tayloria serrata

B. Open parklands or exposed boulders:

- Andreaea rupestris
- Bratramia ithyphylia
- Brachythecium collinum
- Bryum spp.
- Dicranoweisia crisprula
- Dicranum fusescens
- Grimmia montana
- Lescuraea patens
- Oligotrichum aligerum
- Paraleucobryum longifolium
- Pohlia nutans
- Raconitrium affine
- R. heterostichum
- Tortula norvegica
Kiaeria starkei

IV. In alpine tundra, mostly on rocks or cliff faces -

Andreaea nivalis  Lescuraea saxicola
Bartramia ithyphylla L. patens
Bryum cyclophillum Mnium blyttii
Conostcmum tetragonum Pohlia obtusifolia
Desmatodon latifolius Polytrichum piliferum
Dichodontium olympicum P. sexangulare
Drepanoclados uncinatus Racemitrium canescens
Grimmia alpestris R. sudeticum
Kiaeria blyttii Weissia controversa
K. falcata

V. Open, disturbed roadsides or trail banks -

A. Low elevations:

Atrichum selwynii P. varia
Barbula convoluta Didymodon vinealis
B. unguiculata Pohlia nutans
Bryum argenteum Polytrichum juniperinum
B. bicolor
Ceratodon purpureus
Dicranella heteromalla

Tortula ruralis
Trichodon cylindricus
Leptobryum pyriforme

B. Subalpine elevations:

Buxbaumia aphylla
Ceratodon purpureus
Dicranum fuscescens
D. pallidisetum
Lescuraea radicosia
Kiaeria starkei

Clicotrichum aligerum
Fohlia nutans
Pogonatum urnigerum
Fleuroziurn schreberi
Tortula norvegica

VI. Steep, humid river gorges or canyons near waterfalls:

Bartramia pomiformis
Elindia acuta
Brachythecium plumosum
Bryum turbinatum
Campylium spp.
Cratoneuron filicinum
Ditrichum flexicaule
Dichodontium pellucidum

Myurella julacea
Orthothecium chryseum
Philonotis fontana
Plagiobryum zierii
Plagiopus oederi
Pohlia cruda
F. proligera
F. wahlenbergii
Didymodon cylindricus  Polytrichum commune
Encalypta ciliata  Facomitrium aciculare
E. procera  Bacomitrium aciculare
Fissidens adianthoides  R. aquaticum
Hylocomium splendens  Rhytidiodelphus spp.
Metaneckera menziesii  Scleropodium obtusifolium
Mnium lycopodioides  Timmia austriaca
M. thomsonii  Tortella tortuosa

VII. Lake shores or swampy margins -

A. Acidic substrata:

Amblystegium serpens  Climacium dendroides
Aulacomnium androgynum  Drepanocladus spp.
A. palustre  Leptodictyum riparium
Bryum pseudotrichetrum  Leucolepis menziesii
B. weigelii  Philonotis fontana
Calliergon spp.  Rhizomnium spp.
Campylium polygamum  Sphagnum spp.

B. Basic substrata:

Aongstroemia longipes  Drepanocladus spp.
**Campylium spp.**

**Catascopium nigritum**

**Cratoneuron filicinum**

**C. commutatum**

**Didymodon torpiceous**

**Melodium blandovii**

**Melesia uliginosa**

**Scorpidium scorpioides**

**Tomentypnum nitens**

C. Nitrogenous excreta: species of *Splachnum* and *Tetraplodon*

**VIII. Calcareous rock outcrops -**

**Abietinella abietina**

**Cratoneuron filicinum**

**Distichium capillaceum**

**Encalypta spp.**

**Eucladium verticillatum**

**Gymnostomum recurvirostre**

**Heterocladium procurrens**

**Metaneckera menziesii**

**Mnium thomsonii**

**Myurella julacea**

**Orthotrichum chryseum**

**Orthotrichum pellucidum**

**Seligeria spp.**

**Tortella spp.**

**IX. Boulders or rock outcrops in open, running streams or cascading creek bank -**
Blindia acuta
Cratoneuron spp.
Drepanocladus spp.
Eurhynchium riparioides
Fissidens spp.
Fontinalis spp.
Hygrohypnum spp.
Racomitrium aciculare
Schistidium rivulare
S. strictum
Scouleria aquatica

Epiphytic mosses are only moderately to poorly developed in this region in comparison with the moss flora of the coastal hemlock forest. The explanations are threefold: first, the local humidity at any time of the year is not as high as that recorded for the oceanic portion of the province; second, most of the trees in the region are conifers with acidic bark (Barkman, 1958), a substratum not favorable to the growth of epiphytes. Even in highly humid areas, the trunk of Thuja plicata whose bark is less acidic than most of the conifers, does not harbour a large epiphytic moss flora. Thirdly, the long period of frost and the severe winter are unfavorable to the growth of trunk epiphytes. Some of the locally common trunk epiphytes seen are Isothecium stoloniferum, Dicranum fuscescens, Orthodicranum strictum, Hydnum circinale, Metaneckera menziesii, Dicranum montanum, and Orthotrichum pallens. The deciduous, broad-leaved trees which frequently grow in alluvial habitats such as creek banks and lake margins have also a few epiphytic mosses that are different from those
observed on the tree trunks of conifers. These epiphytes are *Orthotrichum obtusifolium*, *Pylaisiella polyantha*, *Homalothecium fulgescens*, *Lescuraea stenophylla*, *Isothecium stoloniferum*, *Dicranum fuscescens*, and *Tortula latifolia*, depending on the ambient humidity conditions, relative texture and pH of the bark substratum.

As a response to the distribution of precipitation, mosses in the area that frequent hygric sites like *Pogonatum contortum*, *Isopterygium elegans*, *Orthodicranum montanum*, *Plagiothecium undulatum*, *Hookeria lucens* and *Homalia trichomanoides* concentrate more in the northern end of the two mountain ranges and gradually disappear in the southern half of Selkirk Mountain (see Maps 46, 101 & 173). Likewise, those that are thought to be drought resistant, including *Coscinodon calyptatus*, *Aloina* spp., *Tortula ruralis*, *Pterygoneurum* spp., *Phascum cuspidatum* and *Orthotrichum cupulatum* prefer the southern (drier and warmer) parts of the area of study as well as the rain-shadow side of the Purcell Mountains (see Maps 53 & 60).

Similarly, the Selkirk Mountains, whose parent rocks are mainly of acidic nature, support many acidophilous or pH neutral moss species including *Andreaea rupestris* and species of *Grimmia* and *Racomitrium*. Calcicolous species, on the other hand, have become restricted to the Purcell Mountain Range where the substrata are more frequently calcareous. Good examples of the latter group are *Catoscopium nigritum* (Map
The above generalizations are, doubtless, over-simplified. Local conditions in the Selkirk and Purcell Mountains vary so much that there will be many exceptions to any generalizations.

Along the upper tributary of the Columbia River near Spillimacheen, a series of ponds or pools adjacent to the river were found to harbour none of the calcicolous moss taxa common in the Columbia Trench. It was observed later that these bodies of water were flooded at least once a year by the rise of the water from the main river as a result of the seasonal rain and also from the regulation of the water by the series of dams constructed downstream. The flooding, obviously, has washed away the Ca and Al ion particles concentrated in the pools or ponds, thereby has lowered significantly the pH value of these water bodies.

Furthermore, logging and other human activities have brought radical threats, and at times irreparable changes, to the local moss flora. *Fabronia pusilla*, *Orthotrichum cupulatum*, *Ulota curvifolia*, *Homalia trichomanoides* and *Plagiomnium ciliare* have not been recollected since the first collections by Macoun or MacFadden. These populations may well be extinct today.

Another interesting case to analyze in this regard relates to the mosses collected by MacFadden around Halcyon Hotspring
during the early part of the 20th century. Table II contains an incomplete list of the moss species collected by MacFadden from the Halcyon Hotspring as based on her report of 1926 and the actual specimens I studied. It is possible that some of her collections listed in Table II were not made directly at the hotspring site, but from areas within the general vicinity. I visited the hotspring in 1976. At that time, the hotspring resort had been burned over and abandoned. The vicinity has been logged and is presently covered by patches of trees of lodgepole pine, Douglas fir, and grasses. The mosses that I collected from the hotspring site are also listed in Table II. The absence of a number of species common to the mesic or hygric sites such as Stokesiella praelonga, Campylium stellatum, Claopodium bolanderi, Plagiochrus oederi, Brachythecium frigidum, and Hypnum circinale in the locality today is indicative of the drastic change in the local ecology which has occurred through the decades as a result of indiscriminate logging and accidental forest fires. Presumably, these missing taxa have become extinct.

C. Regional distribution and phytogeographical affinity

The patterns of plant distribution in a broad region or across the globe have intrigued botanists and plant geographers
for centuries (Good, 1964). The different patterns observed in a study area could form the valid basis for the interpretation of the existing physical geography, plant ecology, and above all, the past history of the local flora.

Aside from the availability of a suitable environment for the establishment of surviving populations, the ability of mosses to reproduce, to disperse their diaspores, and to compete with other living organisms are three other important factors that determine the distribution pattern they acquire (Gemmell, 1950, 1955; Love, 1963; Schofield, 1974). There are some studies elucidating the sexual reproductive biology, asexual reproduction, spore dispersal and germination of mosses. These papers are recommended here to further one's understanding on the ecology and phytogeography of mosses (Benson-Evans, 1964; Bopp, 1968; Ccnard, 1946; During, 1979; Kanda & Nehira, 1976; Koponen & Nehira, 1972; La Rue, 1930; Longton, 1972; Meyer, 1941, 1942b; Miller & Ambrose, 1976; Shimamura, 1978; Zander, 1979a, 1979b).

In terms of distribution patterns, the moss flora of the Selkirk and Purcell Mountains has evolved, through thousands of years, its own characteristic features. To shed light on the affinity and the origin of this moss flora, an analysis of the patterns of distribution was made at the geographic level of the province, North America and the world.

It has been mentioned earlier in the discussion that
within the Kootenay region, the distribution of mosses follows closely the patterns of the distribution of the precipitation and also the nature of the substrata. Thus, the frequency and the abundance of certain groups of moss species in the northern wet subzone and southern moist to dry subzones of the Interior Western Hemlock Zone are significantly different. Likewise, the concentration of more acidophilous mosses in the Selkirk Mountains and the calcicclous taxa in the Purcell Mountains is equally a reflection of the differences in the existing substrata. The details have already been presented in the previous section and will not be repeated here.

At the provincial level, the moss species from the Selkirk and Purcell areas can be grouped into the following categories:

1. Common and widespread taxa (43.7%) -

Examples are *Amblystegium serpens*, *Amphidium lapponicum*, *Andreaea rupestris* (Map 11), *Aulacomnium androgynum*, *Barbula convoluta*, *Bartramia pomiformis*, *Blindia acuta*, *Brachythecium salebrosum*, *Bryoerythrophyllum recurvirostrum*, *Bryum argenteum*, *Ceratodon purpureus*, *Cladapodium bolanderi*, *Cratoneuron filicinum*, *Desmatodon latifolius*, *Dichodontium pellucidum*, *Dicranella grevilleana*, *Dicranum scoparium* (Map 42), *Distichium carillaceum*, *Ditrichum flexicaule*, *Drepanocladus aduncus*, *Encalypta ciliata*, *Fissidens bryoides*, *Funaria hygrometrica*, *Grimmia montana*, *Hygrohypnum...
luridum, Hylocomium splendens, Kiaeria starkei, Leptobryum pyriforme, Philonotis fontana, Plagiothecium laetum, Pleurozium schreberi, Pohlia nutans, Polytrichum juniperinum, Racemitrium canescens, Rhizomnium magnifolium, Scouleria aquatica, Tetraphis pellucida, Thuidium recognitum and others. To this group belong the weedy lowland species and the widespread montane species. Other species included here, although they may discriminate somewhat as to the pH and texture of the substratum, are, nevertheless, nearly always present where the preferred substrata are encountered.

2. Uncommon and widely scattered taxa (12%) -

Examples are Anomobryum filiforme, Aongstroemia longipes, Campylium sommerfeltii, Dicranum brevifolium, Dicranella cerviculata, Eucladium verticillatum, Herzogiella seligeri (Map 166), Kiaeria falcata (Map 44), Paraleucobryum longifolium (Map 47), Plagiothecium zierii, Pogonatum dentatum, Pohlia elongata, Rhynchostegiella compacta, Tayloria lingulata, Tayloria serrata, Tortella inclinata and others. Future collections will definitely alter the classification of many of the species included here. The remaining taxa will be those that have more restricted and widely spaced range owing perhaps to more exclusive
ecological requirement or narrower ecological tolerances.

3. Mainly inland or continental in distribution, widespread, and becoming rare to absent in the coastal region west of the Cascade Mountain Range (12.5%) –

Examples are *Abietinella abietina*, *Buxbaumia aphylla*, *Catascopium nigritum* (Map 104), *Dicranum polysetum* (Map 29), *Hypnum revolutum*, *Orthotrichum pallens*, *Plagionnium medium*, *Pseudeleskeella tectorum*, *Roellia roelli*, *Saelania glaucescens*, *Scorpidium scorpioides*, *Thuidium recognitum* and others. Many of the taxa mentioned here are widespread in the continental portion of North America.

4. Mainly coastal or oceanic in distribution, becoming rare inland, even in the interior wet belt (10.1%) –

Examples are *Antitrichia curtipendula*, *Bryum miniatum*, *Cynodontium jenneri*, *Dicranella rufescens*, *Heterocladium macounii*, *Hookeria lucens*, *Homalia trichomanoides*, *Hypnum cupressiforme*, *Isopterygium elegans*, *Neckera douglasii*, *Orthotrichum lyalli*, *Plagionnium insigne*, *Plagiothecium undulatum* (Map 165), *Pogonatum contortum*, *Rhizomnium glabrescens*, *Scleropodium caespitans* and others. A few of
the taxa included here have reached only the southern portion of the province. Others are circum-northern Pacific in distribution. The species can also be called the oceanic elements of the local moss flora.

5. Common to uncommon in southern British Columbia, becoming very infrequent to rare or absent in the northern half of the province (12%) -

Examples are Antitrichia californica, Barbula eustegia (Map 55), Coscinodon calytratus (Map 65), Dichodontium olympicum (Map 30), Dicranum pallidisetum, Ditrichum montanum, Dryptodon patens, Entostodon fascicularis, Eurhynchium riparicoides, Hygrohypnum molle, Hyphnum subimponens, Mnium arizonicum, Orthotrichum anomalum, Philonotis marchica, Plagiomnium venustum, Polytrichum lyallii, Seligeria donniana, Tortula subulata, and others. A few of them, such as Aloina brevirostris, Pterygoneurum ovatum, and Mnium arizonicum, are more widespread in the drier and temperate zone south of the study area. These taxa probably can be considered as members of the Madro-Tertiary flora which invaded the province after the last glaciation. Others, like Dicranum pallidisetum and Dichodontium olympicum, are widespread across a narrow zone bordering the southermost boundary of the past Cordilleran
ice sheet.

6. Common and widespread in northern British Columbia, becoming locally infrequent, rare or restricted to high mountains in the southern half of the province (5.5%) -

Examples are Brachythecium turgidum, Bryum cyclophyllum, Dicranum undulatum, Encalypta affinis, Hylocomium umbratum, Hypnum pratense, Orthotrichum pellucidum, Faludella squarrosa, Racemitrium lanuginosum, Rhizomnium gracile, Sphagnum riparium, Splachnum sphaericum (Map 84), Tetraplodon angustatus, Ulota curvifolia and others. The arctic-alpine taxa rightfully belong here.

7. Provincial distribution not clear owing to too few collections or confusing taxonomic status (4.2%) -

Examples are Amblyodon dealbatus, Bryum blindii, Didymodon rigidulus, Fontinalis hypnoides, Tetrodontium repandum, and others.

If the widespread taxa, common or uncommon (Categories 1 & 2) be discounted in the analysis, it is apparent that the
mosses of the area has a stronger representation of continental species (12.5%) than oceanic species (10.1%). Nonetheless, the difference in the percentage is not high enough to constitute two distinct floras. The situation is only indicative of the wet condition of the interior wet belt. In fact, the similarity of the moss flora between the study area and the coast region has increased significantly as a result of the present investigation. Species such as *Plagiothecium undulatum* and *Neckera*, common to the coastal hemlock forest, have been collected for the first time in the interior, and many more local populations of other common coastal species such as *Isopterygium elegans*, *Leucrolepis menziesii* and *Pogonatum contortum* have been discovered.

The moss flora of the region of study also shows a stronger southern affinity (12%) than northern affinity (5.5%).

If the whole continent of North America is taken into consideration, then the species of mosses described in Chapter IV can be placed in the following groups:

Species of northern boreal affinity ...............62.5%
Species of southern temperate affinity ............10.9%
Widespread boreal and temperate species
Or nearly circumpolar species .................... 9.0%
Western North American endemics ...............11.1%
Cordilleran disjunctive species .................. 4.5%
Species of uncertain affinity .................... 2.0%

The first group (boreal affinity) includes primarily Category 1 (widespread taxa), Category 2 (widely scattered taxa) and Category 6 (northern taxa) of the previous classification made at the provincial level. The second group (temperate affinity) is roughly the equivalent of Category 5 (southern taxa) of the previous classification.

There are 42 endemic species recorded from the study area (see Table III). Interested readers may referred to Schofield (1980a) for a complete listing of western North American endemic mosses that are in British Columbia. Many of them are confined to the west of the Cordilleran Mountain Ranges and most of them reappear in the interior wet belt (Schofield, 1980a).

The Cordilleran disjuncts need further comment here. The history of their discovery and the possible explanations have been reviewed by Schofield (1969). Many of them exhibit a widely broken circumboreal distribution, or in some cases, affinities with Asia. Others are Boreal American endemics. All of them, however, show a marked disjunction between western North America west of the Rocky Mountains and northeastern North America around the Great Lakes area, St. Lawrence Gulf and the maritime provinces of Canada.

Examples of Cordilleran disjuncts are Antitrichia
curtipendula, Barbula revoluta var. obtusula, Bryum miniatum, Dichelyma pallescens, and Grimmia tcrquata. More examples of Cordilleran disjunct are enumerated below under the section on discontinuous distribution.

Again the affinity of the moss flora of Selkirk and Purcell Mountains is obviously with the northern boreal zone (63.5%) with a rather high percentage of endemism (10.1%). Surprisingly, there were no high arctic species (north of Lat. 60 N) collected from the high peaks of the Selkirk and Purcell Mountains, although a number of them have found their way further south via the Rocky Mountain Ranges. The reason for their absence in the area studied may be attributed to the topography of broken mountain chains in the Columbia Mountains and the Cariboo Plateau. To date, only a few low arctic species sensu Vitt (1973a), such as Uloca curvifolia and Mnium, have been found in the area. In most cases, these taxa are grouped with the boreal taxa in the present classification because the boundary between the boreal zone and the low arctic zone is not conspicuously marked.

It is interesting to compare at this point, the moss flora of the study area with that of the adjacent areas: southern end of the Canadian Rockies (Bird, 1962, 1973; Bird & Ogilvie, 1964; Marsh, 1974; Vitt, 1973a, 1973b; Vitt & Horton, 1979), Montana (Harris & Harris, 1904; Hermann, 1969), Idaho (Britton, 1889, 1891; Holzinger, 1895; McCleary & Green, 1971), eastern Washington (Jones, 1929; Lawton, 1971; Lawton & Ireland, 1963)

There are quite a few species of the coastal elements that are present in Idaho and the northeastern portion of Washington but are not yet found in the study area. Examples are Pseudobraunia californica, Cladopodium crispifolium, Homalothecium nuttallii, Trachybryum megaptilum, Tripterocladium leucocladulum, Crumia latifolia, Ptychomitrium gardneri, Tortula princeps, Porotrichum bigelovii, Homalothecium pinnatifidum, Atrichum undulatum, Amphidium mougeotii, Dicranoweisia cirrata, and Ulota hutchinsiae. I was unable to check on the validity of the species determinations of all of these Idaho and Washington collections. Presumably, these taxa, if correctly identified, must have survived the last glaciation south of the boundary of the Cordilleran ice sheet, and have not successfully reinvaded the northern areas since. Given time and the persistence of the present climate, there is no reason to believe that future northward expansion of the range of these taxa is not likely to occur, provided that the vegetation in the wet and moist subzones of the Interior Western Hemlock Zone in southeastern part of the province is not destroyed.

On the other hand, the moss flora of the two mountain ranges investigated and that of the neighboring Rocky Mountains (including Waterton Lakes Provincial Park and Glacier National Park of Montana) show a marked difference in species
composition. Many locally common or rare species of the Selkirk and Purcell Mountain Ranges are absent in the Rocky Mountains. Examples are *Dicranella cerviculata*, *Ditrichum heteromalla*, *Entosthodon fascicularis*, *Pohlia vexans*, *Mnium arizonicum*, *Philonotis yezcana*, *P. marchica*, *Orthotrichum cupulatum*, *O. lyallii*, *Fontinalis neo-mexicana*, *Heterocladium macounii*, *Plagiothecium undulatum*, *Hygrohypnum norvegicum*, *Brachythecium asperrimum*, *B. leibergii*, *Hypnum pallescens*, *Tetrodontium repandum*, *Hookeria lucens*, *Antitrichia curtipendula*, *A. californica*, *Metaneckera menziesii*, *Anacolia menziesii*, and *Leucolepis menziesii*. Since many of these taxa belong to the oceanic floristic elements of the province, their eastward expansion may have been effectively blocked by the interior mountain ranges in addition to the prevailing drier and colder continental climate system.

It is equally true that there are numerous taxa widespread along the Rocky Mountains but are absent in the study area. Examples are *Cynodontium schistii*, *Dicranum groelandicum*, *D. elongatum*, *Grimmia heterophylla*, *Encalypta brevicolla*, *E. spathulata*, *E. mutica*, *Splachnum luteum*, *S. vasculosum*, *Tayloria froehlichiana*, *Bartramia halleriana*, *Mielinchoferia macrocarpa*, *Cinclidium stygium*, *Orthotrichum pumilum*, *Myurella tenerrima*, *Calliergon richardsonii*, *C. trifarium*, *Scorpidium turgescens*, *Cirriphyllum cirrosum*, *Aulacomnium turgidum*, *Hypnum procerrimum*, *H. bambergeri*, *Didymodon johansenii*, *D. nigrescens*, *Bryobrittonia longipes*, *Rhytidium rugosum*,
Voitia nivalis, and Oreas martiana. Most of the species enumerated are either calcicolous or true arctic-alpine members of the North American moss flora.

Granted that half of all the above mentioned taxa are actually present on both sides of the Columbia Trench and are only awaiting discovery, the number of taxa remaining that are not common to the Rocky Mountains and the Selkirk and Purcell Mountain Ranges would still be impressive. Truly, the Rocky Mountain Range is not only a continental divide, but also an effective floristic divide between eastern and western North American floras.

Possible explanations for this phenomenon are:

1. The Rocky Mountain Range offers extensive limey or calcareous rock outcrops for the development of a distinct and rich calcicolous moss flora not comparable with that found in the area of study whose main rock outcrops are mostly acidic;

2. The Rocky Mountain Range has its unique and long history of orogeny since the early Tertiary (Russell, 1954; Eistacher, 1977) compared to the more recent geologic history of the Selkirk and Purcell Mountains. Thus, the Rockies has had a longer time and greater chances to acquire a distinct flora (Leopold & Macginite, 1972);
3. The Rocky Mountain Range has a number of high peaks that were apparently not glaciated during the Pleistocene. In addition, recent evidence has showed the possible existence of an 'ice-free corridor' along the eastern foothill of the mountain range (White et al., 1979). These unglaciated areas, doubtless, have allowed many indigenous plants to migrate in a north-south direction or vice versa, or even to survive in situ throughout the ice age (Reeves, 1973; Packer & Vitt, 1974). Similar condition does not exist in the area under study.

The moss flora of Wells Gray Provincial Park, which is located north of the area across from the Columbia River, is rather similar to that of the northern portion of the two mountain ranges investigated. The few taxa that were collected by Ahti and Fagersten (1967) from Wells Gray Provincial Park which have not been reported from the Selkirk and Purcell Mountains are mainly the arctic-alpine species whose southernmost limit may be in the Wells Gray Provincial Park. These species are Dicranum spadiceum, D. angustum, Drepanocladus tundrace, Sphagnum ovatum, Meesia trifaria, and Tomentypnum falcifolium. It is interesting to note here that there are, in addition, several northern species of Sphagnum such as S. centrale and S. jensenii collected from the Wells Gray Provincial Park that are not known yet from my study area.
This, perhaps, is the result of the presence of numerous, extensive fens in the former park territory owing to the more gradual sloping terrain which is favorable for fens or bog development.

Based on the literature regarding the worldwide distribution, the moss flora of the Selkirk and Purcell Mountains can be divided into several phytogeographical elements under two broad categories: the continuous and the discontinuous distributions, as defined in a relative sense by Schofield (1969).

No known plant distribution today is truly continuous. The term continuous, as used here, indicates a wide and broad distribution across the northern or southern hemispheres. Taxa classified herewith do not necessarily possess a continuous range both latitudinally and longitudinally.

The designation of discontinuous distribution is used as a synonym for disjunctive distribution. In order to be called a disjunctive species, the distance between two close populations must exceed the average and normal range of dispersal of diaspores of the plant species involved (Cain, 1944). Discontinuity on land resulting from the absence of appropriate substratum, landform, and climate are not considered disjunctive.

Under the two main categories, several subcategories are accepted following the definitions of Schofield (1969). Since
many of the widespread boreal species have disjunctive populations in the southern hemisphere, the same species may be scored twice under two subcategories. Thus, the total percentage of all the subcategories does not come up to 100%.

The regional checklists and floristic works of Podpera (1954), Brotherus (1924-25), Iwatsuki and Noguchi (1973), Nyholm (1968), Schofield (1969, 1980a) and Smith (1978) have been useful in providing worldwide distribution information for many species. Furthermore, worldwide distribution maps of many species are to be found in Schofield (1972, 1980) and Steere (1978, 1979), as well as in the monographic works of Jamieson (1976), Karczmarz (1971) and others.

All species listed below are present in my study area.

A. Continuous Distribution

1. Nearly cosmopolitan, often with several outlying disjunctive taxa in both hemispheres (9.8%) - The cosmopolitan taxa are not necessary the locally abundant species. Examples are Amblystegium serpens, Bryum argenteum, B. capillare, Barbula unguiculata, Ceratodon purpureus, Brachythecium plumosum, B. rutabulum, Dicranella varia, D. heteromalla, Dicranum scoparium, Drepanoclados uncinatus, Funaria hygrometrica,
Gymnostomum recurvirostrum, Leptobryum pyriforme, Leptodictyum riparium, Plagiochilium rostratum, Pohlia nutans, Polytrichum juniperinum, and Weissia controversa.

2. Circumboreal (72.2%) - This subcategory includes the common and uncommon taxa whose distribution spans mainly across the boreal zone of the northern hemisphere. Some species may spread well into the polar as well as the northern boundary of the temperate zone (see Steere, 1979; Good, 1964). Many have also disjunctive populations in the southern hemisphere. Good examples are Polytrichum formosum, P. alpinum, Andreaea rupestris, Bryum turbinatum, Fissidens grandifrons, Hedwigia ciliata, Racemitrium cansecens, P. heterostichum, Sphagnum girgensohnii, S. russowii, Orthotrichum obtusifclium, Campylium stellatum, Grimmia trichophylla, Lescuraea radicosa, Herzogilla seligeri, Isopterygium pulchellum, Plagiothecium cavifolium, Brachythecium starkei, Tomentypnum nitens, Erythynchium pulchellum, Calliergon cordifolium, Drepanoclados fluitans, Hygrohypnum duriusculum, H. luridum, Platydictya jungermannioides, Distichium capillaceum, Pohlia atropurpurea, Mnium spinulosum, Dichodontium pellucidum, Timmia austriaca, Schistostega pennata, Kiaeria starkei, Orthodicranum montana, Ptilium crista-castrensis, Tetrathis sellucida, Catascopium nigritum, Tortella tortucsa, Tayloria serrata, Pleurozium schreberi,
**Heterocladium dimorphum** and **Rhytidiadelphus loreus**.

3. Arctic-alpine (1.6%) - This is a very small subcategory of mosses. As explained earlier, true high arctic-alpine species have not been found in the Selkirk and Purcell Mountains. Only a few low arctic-alpine species such as **Arctoa fulvella**, **Conostomum tetragonum**, **Tayloria splachnoides** and **Ulota curvifolia** have reached the high peaks of the area. Many of them are believed to be relics of Arcto-Tertiary flora that have survived in the many refugia in unglaciated portions of Alaska, Yukon and the Northwest Territories during the Pleistocene (Steere, 1979).

4. Circum alpine (3.5%) - Schofield defined this subcategory as a group of plants that are predominantly high montane or alpine in vertical distribution in the northern hemisphere, and not essentially widespread in the arctic circle. The species occasionally can descend to a much lower elevation in edaphically suitable sites associated with humid canyons and deep river gorges. Examples are **Brachythecium turgidum**, **Bryum cyclophyllum**, **Grimmia mollis**, **Hygrohypnum smithii**, **Oligotrichum hercynicum**, **Orthothecium chryseum**, **Pohlia obtusifolia** and **Polytrichum sexangulare**.

5. Boreal american endemics (2.7%) - Mosses which belong
here are usually widespread North American boreal species. Many of them, however, show a Cordilleran disjunctive pattern in western and eastern North America. Examples are Dichelyma pallescens, Hygrohypnum bestii, Mnium arizonicum, Roellia roellii and Schistidium dupretii.

B. Discontinuous Distributions

1. North Pacific or western North America-eastern Asia (2.0%) - Schofield (1969) suggested that populations in this subcategory probably survived during the Pleistocene glaciation south of the ice boundary on both sides of the Pacific Ocean and several have expanded since via the Aleutian chain, and not necessarily through the Bering land bridge. The following species belong to this subcategory: Hypnum dieckii, H. subimponens, Lescuraea stenophylla, Oligotrichum aligerum (also reported from the Pacific Coast of Mexico), C. parallellum and Pogonatum contortum.

2. Western North America-western Eurasia (including Asia Minor and part of North Africa near the Mediterranean Sea) (3.8%) - Taxa belonging here are Plagiothecium undulatum (Siberia?), Antitrichia californica,
Cynodontium jenneri, Fabronia pusilla, Hygrohypnum alpinum, H. styriacum, H. molle, Hockeria lucens, Metaneckera menziesii, Orthotrichum alpestre, O. lyellii, O. laevigatum, Plagiothecium piliferum and Tortula latifolia.

3. Western North America-western Eurasia-east Asia (1.6%) - Examples are Encalypta affinis, Herzogiella seligeri, Orthotrichum affine, O. rupestre, Paraleucobryum enerve and Tortula subulata.

4. Western North America-eastern North America-western Eurasia (2.7%) - Examples are Barbula revoluta var. obtusula, Bryum miniatum, Hygrohypnum smithii, Isopterygium elegans, Orthotrichum cupulatum, O. fellucidum, Philonotis capillaris, Pohlia vexans, Seligeria campylopora, and S. tristichoides.

5. Western North America-eastern North America-Eurasia (3.3%) - Examples are Andreaea blyttii, A. nivalis, Puxbaumia aphylla, B. viridis, Dryptodon patens, Kiaeria falcata, Oligotrechium hercynicum, Philonotis marchica, Seligeria recurvata, Tetroduntium repandum and Tortula norvegica. Species belonging here may easily become circum-boreal in status when future collections made in the intervening areas yield positive results.
6. Bipolar disjuncts (19.1%) - Species in western North America having bipolar disjuncts in the southern hemisphere have been painstakingly summarized by Schofield (1974). Many of them are actually widespread circumboreal taxa if only the northern hemisphere populations be considered. Schofield (1974) suggested that these bipolar disjunctive distributions either represent remnants of a much wider ancient worldwide distribution or are evidence of successful long distance dispersal of moss spores across the Tropics. A few of them, especially those found only in the disturbed sites in the southern hemisphere, probably were introduced accidentally into the localities by man (Schofield, 1974; van Zanten, 1978).

There are a total of 70 taxa present in my area which have disjunctive populations in the far distant southern hemisphere. A more complete list of these taxa belonging here can be found in Schofield (1974) and will not be repeated here. Among them, the following three species have relatively more striking disjunctive pattern of world distribution:

**Buxbaumia aphylla** (Western North America, eastern North America, Eurasia, Japan, and New Zealand);

**Plagiothecium denticulatum** (Western North America, eastern North America, central America, Eurasia, southern South America and Oceania);
Anti
trichia curtipendula (western North America, eastern North
America, western Eurasia, southern South Africa and
Patagonia).

As to how the moss diaspores manage to cross the Tropics,
to survive during the transportation, and to land in the
appropriate niche in the opposite hemisphere is not known, but
van Zanten (1976, 1978) has offered many interesting
experimental results which reveal a whole variety of possible
routes. Since most of these taxa are common and widespread in
the area, their disjunctive patterns elsewhere outside of the
northern hemisphere, in reality, provide no meaningful clues as
to the possible origin and migration history of the moss flora
in southeastern British Columbia.

It can therefore be concluded that the moss flora
discussed here constitutes primarily an important section of
the northern boreal vegetation. Nearly 80% of the local mosses
have boreal affinity, be they widespread or broadly endemic in
the continent. The remaining disjunctive taxa can be
interpreted as remnants of a much wider global distribution in
the geologic past which could also well be circum-boreal in
distribution in ancient time. Already, the little fossil and
subfossil evidence that accumulates in Europe, Asia, and North
America clearly supports the above postulate (Miller & Ambrose,
1976; Dickson, 1973).
D. Origin and evolution of the moss flora of Selkirk and Purcell Mountain Ranges

Since the time of Herzog (1926, 1932), phytogeographical studies of bryophytes have aimed at revealing the origin and evolution of regional floras, aside from deciphering the various patterns of distribution observed (Anderson & Zander, 1973; Crum, 1966, 1972; Godfrey, 1977; Iwatsuki, 1958, 1972; Robinson, 1972b; Schofield, 1965, 1969a, 1980a; Steere, 1976, 1979; Worley, 1972). In general and within the same region, the distribution of bryophytes (Crum, 1972; Schofield & Crum, 1972), particularly mosses, have been found to follow the same patterns as that of the flowering plants (Thorne, 1972). This is because in a particular locality and over a definite period of time, the local flora responds, either favorably or unfavorably, as a living unit to the selective forces of the physical surroundings. The different plant components, be they angiosperms, bryophytes or fungi, evolve together and adapt to the changing environment. Nevertheless, the different survival mechanisms acquired and perfected by the various plant groups will modify, to some extent, the overall general patterns of distribution. Being slow in speciation (Anderson, 1963; Khanna, 1964) and living in well-protected microniches, mosses can persist in a locality often long after the macro-environmental conditions have changed and the macrophytes have
died. Hence, their present distributions are considered to indicate in a more meaningful way the past physical conditions as well as the past vegetation that existed in an area (Anderson, 1963; Crum, 1972; Sharp, 1966).

Crum (1966) attributed the evolution of the Canadian moss flora to a series of chances resulted from its past climatic and geological history. Many factors, including the nature of sexual conditions and long distance dispersal, probably played an important role at one time in the possible evolution of Canadian moss flora.

With regard to the bryoflora of the Pacific Coast of North America, Crum (1966), Schofield (1965) and Steere (1969) were all equally impressed by the strong affinity between the coastal floras of western North America and east Asia, especially Japan. In addition, the large number of locally endemic genera and species is another unique feature of the western North American bryoflora.

The study area, which is more than 200 miles away from the Pacific coast, still harbours today a regional moss flora consisting of ca 10% endemic taxa which represent some 40.6% of the total 91 species endemic to western North America (Schofield, 1980b). In addition, 12.5% of the mosses in the area only barely reach the coastal mountains of the province. This is in contrast to 10% of the local mosses that are primarily oceanic in distribution. Likewise, there are more
mosses (12%) that are widespread south of the study area than those (5.5%) that are more common and widespread further north.

Based upon these floristic features and other known geologic facts, it is postulated that the entire western Cordilleran flora was probably very similar to that of Europe and Asia up until and during Cretaceous time (Crum, 1966). The land was believed to be low in relief and the climate warm and moist (Wolfe, 1975). It is likely that the widespread Asiatic elements in our flora arrived in the province during this period. The differentiation into humid, moist or arid regional floras could only start after the onset of the orogeny of west coast mountain systems toward the end of the Tertiary (Wolfe, 1969; Rouse & Mathews, 1979). A good share of the local moss flora at this geologic time probably was already circumboreal or northern in distribution (Crum, 1966). A large number of boreal taxa would have migrated across the north Pacific rim in both directions through the Bering Land bridge or the Aleutian Island chain during the cool period of the late Tertiary (Steere, 1969; Hopkins, 1967).

The Pleistocene glaciation, which started some two million years before present, disrupted this formerly continuous distribution of the evolving boreal flora in North America, causing the extinction of some species as well as the southern displacement of others. The evidence on hand today indicates that the area of southeastern British Columbia was covered entirely under the Cordilleran ice sheet except perhaps for
some high peaks that protruded above 8000 ft in elevation (McKee, 1972), and also maybe, the immediate vicinity of some active hotsprings.

There is no indication of the existence of nunutak-type refugia in the area based on the present day plant distribution, although the moss flora near or peripheral to the hotspring often yields an interesting assemblage of many strongly oceanic species such as *Pogonatum contortum*, *Isothecium stoloniferum*, *Isopterygium elegans*, *Plagiothecium undulatum*, *Leucolepis menziesii*, *Stokesiella praelonga*, *Metaneckera menziesii*, and *Antitrichia californica*. This assemblage is very characteristic of a high humid environment such as the coastal western hemlock forest. Two good representative localities to observe this phenomenon are the Nakusp and St. Leon Hotsprings.

It is also difficult, if not impossible, to speculate without more information, on the effect of the hot steam and boiling water flowing out of the hotspring on the covering ice sheet during the maximal Pleistocene glaciation. Very locally, an active hotspring might have created a small microhabitat close to the mouth of the spring to allow some populations of mosses to survive in situ. Steere (1969) noted the presence of a group of species of bryophytes around the hotsprings in Iceland that are normally out of their range farther south and also out of harmony with the prevailing climate. Are these the relics of the Tertiary flora or new arrivals by long distance
dispersal? Seddon (1971) suggested that lowland refugia may also exist between glacier tongues or the lobes of an irregular ice margin. Whether these types of refugia existed in the study area during the Pleistocene glaciation is difficult to determine. Presumably, the immediate vicinity of these types of refugia would be hostile to plant growths owing to the proximity to the expansive ice cap.

By the end of the Pleistocene, the open, wet and bare ground left behind by the retreating glaciers was quickly taken over and colonized by the more weedy boreal taxa of mosses and other plants which earlier were displaced to the south. The return of mosses was surely achieved hand in hand with the establishment of the vascular flora in a slow, stepwise migration (Crum, 1972). The more important source of migration into the study area is most likely from the unglaciated mountains and lowlands to the south. This is in line with the higher percentage of the moss species having the southern affinity than the northern affinity. The eastward expansion of the oceanic species into the interior mountain systems probably also took place simultaneously following in all probability the main route of the westerlies. Evidence for this can be seen from the present range of a few species such as Dichodontium olympicum (Map 30) and Dicranum pallidisetum. The more southern distribution of other species such as Barbula eustegia (Map 55) further supports the claim that the areas to the south of the study area were an important source of plant migration.
during the Holocene period.

The southward migration of moss taxa from the northern refugia in Yukon and NW Territories into the study area, either via the Rocky Mountain corridor or via the Columbian Mountain Ranges, appears to be minor. This is reflected by the fact that only 5.5% of the moss species have true northern arctic affinity. Supposedly, the northwest to southeast alignment of the Rocky Mountain Range which arches and shields over the northern end of the area under study, the deep valleys and broad river gorges caused by the bending of the Fraser and Columbia Rivers and the difference in the climates between the area and the Cariboo and Lillooet regions north and northwest of it effectively constitute natural barriers which have prevented large scale southward migration of northern species into the mountains of the Selkirk and Purcell ranges.

Similarly, westward expansion of moss species from the continental prairies was blocked by the height and physical conditions of the Rocky Mountains. This has resulted in the evolution of two rather distinct regional floras between the Rocky Mountains and the study area, an interesting phenomenon which was discussed earlier. The species that are common today to the southeastern part of the province and the prairies either reach their present distribution from a common southern origin or filter through the transversely disposed mountain passes which cut the various mountain chains.
Chance and long distance dispersal of moss spores into the study area must have occurred many times in the past (van Zanten, 1976). The present distribution of moss species such as *Phascum cuspidatum* and *Physcomitrella patens* which colonize mainly open, disturbed road cuts and fallow fields illustrates this.

A number of years ago, Crum (1966) observed the absence in the western Cordillera of many eastern American moss species, disjunct in Asia, that are Arcto-Tertiary in origin. He, therefore, suggested that it is logical to seek a more recent relationship of floristic exchange between Japan and western North America. Members of the North Pacific floristic elements, such as *Pogonatum contortum* and *Hypnum dieckii*, especially those that are strictly coastal species which do not have any inland populations, may have migrated into western North American coastal regions during the Pleistocene via the Aleutian Islands (Sharp, 1974; Schofield, 1969a) when the sea level had dropped several feet below the present level (Mathews, 1979).

Iwatsuki (1972) further reported that although most of the species disjunct in eastern Asia and eastern North America had originated from the temperate or tropical taxa, the members of the North Pacific elements have, instead, boreal or circumboreal origin. This statement clearly implies a more recent migration of the North Pacific elements into western North America. Lastly, the occurrence of disjunctive species
on two sides of the Pacific Ocean, instead of vicarious species, may also be interpreted to indicate a recent exchange of taxa between the two regions.

Needless to say, species such as Aloina rigida and Pterygoneurum subsessile which have a restricted distribution in the southern semi-arid and warm portion of the area covered by the Ponderosa pine-bunchgrass vegetation, are perhaps even more recent in migration from the south after the dessication of the interior portions of the province which took place behind the Cascade Mountains.

No flora on earth is forever static. As a result of constant changes in physical conditions, some members, especially the ill-adapted taxa, will become extinct as new ones arrive to fill the ecological niches. The local moss flora, with its present strong boreal affinity, will certainly change its phytogeographical affinity in the distant future in accordance with the changes of the environmental conditions. With the increased tempo of logging and mining activities proceeding in the Kootenay region and in the province, the first to disappear will be the hygrophilic species of mosses that need the shade and moisture provided by the forest canopy. The xerophilic taxa doubtless will thereafter expand their local range as is shown clearly in the case of the moss flora of Halcyon Hotspring.

It is urgent and imperative then to explore the area north
of Revelstoke and Golden which falls into the wet subzone of the Interior Western Hemlock biogeoclimatic zone. It is this end of the Selkirk Mountain that is least collected and where many more coastal and arctic-alpine species might be discovered. Future explorations of other botanically unexplored mountains and canyons in the area will yield additional new species records but the discoveries are unlikely to alter the strong boreal affinity of the moss flora of Selkirk and Purcell Mountain Ranges.

VI. Summary and Conclusion

The moss flora of the Selkirk and Purcell Mountain Ranges was studied and analyzed in an attempt to characterize this floristic group and compare it with the moss floras of the coastal western hemlock forest, as well as its neighboring regions. Initially, the area was chosen because of the close similarity of the mean annual precipitation and the same arboreal and non-arboreal plant species present in the interior wet belt and in the wet coastal western hemlock zone. A knowledge of the moss flora, therefore, is considered important in order to achieve a valid classification of the local vegetation zones for the multi-purposes of conservation,
recreation, forestry, park and wildlife management, agriculture and other land uses.

A total of nearly 6000 moss collections were examined and checked for accurate identification. These include ca 4000 personal collections that I gathered during the four summers from 1976-79. The many historical collections of Macoun (specimens at CANM) and MacPadden (specimens at MACP-Fullerton) were also studied. A total of 366 species distributed in 128 genera and 40 families was conservatively recognized to constitute the moss flora of the Selkirk and Purcell areas. The number is more than half the total moss species known to the entire province.

No species new to science was discovered. Presumably, this is because the area was thoroughly glaciated in the Pleistocene and that no local plant populations were able to survive in situ. The interval since glaciation is probably still too brief for segregation of unique taxa from the more common and widespread boreal taxa which reinvaded the newly opened and barren land. The slow process of speciation in mosses may have also contributed to the apparent lack of new species. The local moss flora consists of as high as 80% of mosses that are cf boreal distribution, many of them widespread in the northern hemisphere. As such, the taxonomic portion of the thesis should equally be useful in the study of mosses of other boreal states and provinces of United States and Canada.
It is important to remember that taxonomy in practice often has to compromise theoretical consideration of biological species and the convenience of naming a plant specimen. Consequently, it should not be surprising to see that infraspecific taxa are occasionally recognized in some genera but not in others. Isotypes of many taxa, mostly of the synonyms, were made available for study and their proper identifications were either confirmed or corrected.

The present study clarified several formerly confusing taxonomic concepts which revolved around species like *Dichodontium pellucidum* - *D. olympicum*, *Pohlia columbica*, *Barbula revoluta* var. *obtusula* and *Barbula eustegia* - *B. convoluta*. Many incorrect reports of species from the area investigated, which unfortunately are embedded in the literature, also have been exposed and deleted from the list of local mosses. The results have provided a better understanding of the phytogeography of the southeastern British Columbia and its relations to the floras of the neighboring regions.

The whole moss flora was analyzed further for its phytogeographical affinities. This analysis and comparison of species composition was made separately at various geographical scales: the province, the North American continent and the world. The results show convincingly that a large portion of the species belong to the northern boreal floristic elements or exhibit northern phytogeographical affinities. Among these various boreal taxa, more than twice the number are more
widespread south of the study area (12%) than north of it (5.5%). This is interpreted to indicate that the more important source of plant migrations into the local mountains after the retreat of the last ice sheet is probably from the mountains and lowlands of the southern unglaciated portion of the continent, especially the Columbia River gorge and valley in Washington and Oregon.

Since there exists no published studies dealing with the history of Holocene vegetation of Kootenay Region, postulation has been based on the studies of Holocene vegetational history in the adjacent Washington and Idaho, and the few studies of regional glacial geology.

It is postulated that the area of interest was largely covered by ice during the maximal Pleistocene glaciation. As soon as the ice started to retreat, there appeared first a tundra-like environment. Immediately the area was invaded by the widespread and weedy boreal plant taxa that earlier were displaced further to the south in latitude by the glaciers. This stage was quickly taken over by other coniferous tree species and their associated herbaceous and shrub species until the present vegetation cover was attained, depending, of course, on the local environmental conditions. Migration of Arctic species into the two mountain ranges was almost nil because of the barrier effects caused by the topography and orientation of the Cariboo and Rocky Mountain ranges immediately north and east of the Selkirk and Purcell
Mountains.

The Rocky Mountains with its extensive limey outcrops and an ice-free corridor at its eastern foothills during the Pleistocene became an important passageway for the north-south migration of plants before and after the Pleistocene. The possible explanations for the obvious lack of east-west migration or exchange of floras between the Rocky Mountains and the study area are also outlined and discussed.

Long distance dispersal of moss spores must have occurred many times in the geologic past and in the present. This is evident today by the erratic appearance of a few rather weedy mosses of open, disturbed habitats, e.g., Physcomitrella patens and Phascum cuspidatum.

Eastward expansion of oceanic species into the interior wet belt would have followed the main route of the westerlies which occurs often along the southern boundary of the province. The distributions of local endemic species, such as Dichodontium olympicum and Dicranum pallidisetum, support this claim.

There is a total of 42 western North American endemic species in the Kootenay regional moss flora. The number is roughly 11% of the total moss flora of the province. Furthermore, the percentage of species with continental distribution (12.5%) is slightly higher than those having a primarily oceanic distribution (10.1%). This is a reflection
of the stronger influence of the continental climate which prevails over the study area. It is also a strong indication of the similarity of the moss flora of the interior wet belt and that of the oceanic portion of the province.

Local differentiation of species distribution is also evident. The calcicloous species appear to concentrate along the eastern slope of the Purcell Range and also the Columbia Trench. Likewise, the more hygrophilic species tend to confine themselves to the northern half of the two mountain ranges, within the so-called wet subzone of the Interior Western Hemlock zone.

Although there is no distinct group of mosses observed locally to be associated with a biogeoclimatic zone at various localities and elevations, the definitive and simultaneous presence of a handful of moss species reveals, to some degree, the physical conditions prevailing, or the kind of specific micro habitat that they are in. These observations are discussed in Chapter V under the section on Ecology.

Often, the detailed description of the moss flora in a locality seems only of limited value since mosses are a small component of the overall vegetation. But such a study becomes essential and supplemental to the knowledge of other plant groups, especially the vascular flora, when one attempts to understand correctly the dynamics of the regional vegetation. The Selkirk and Purcell Mountains, with its natural wealth of
forests, mineral ores and hydroelectric power, is undergoing tremendous changes brought by man in the name of progress. It is necessary that a full and comprehensive knowledge of the presently existing flora be obtained before the whole array of indigenous plant species be altered, mutilated or lost forever.


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Nagano, I. 1969. Comparative studies of moss vegetation developing on the limestone, chert, and other rocks lying adjacent to each other in the Chichibu Mountain area, Central Japan. J. Hattori Bot. Lab. 32: 155-203.


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APPENDICES, TABLES AND MAPS
Map 1. The study area including the Selikirk and Purcell Mountain Ranges.

1. Foliated metamorphic rock (Cretaceous)

2. Intrusive igneous rock (Mesozoic)

3. Folded and faulted volcanic and sedimentary rocks (Mesozoic)

4. Folded sedimentary rock (Paleozoic or older)
Map 3. Soil map of the study area excluding the alpine tundra habitats (modified after Lord & Valentine, 1978).

1. Gray Luvisol
2. Eutric Brunisol
3. Humo-ferric Podzol
4. Dystric Brunisol
Map 3. Soil map of the study area excluding the alpine tundra habitats (modified after Lord & Valentine, 1978).
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Map 4b. Subzones of the biogeoclimatic zones of the study area (modified after Utzig et al., 1978).

1 wet subzone

2 dry subzone

3 moist subzone
Map 4b. Subzones of the biogeoclimatic zones of the study area (modified after Utzig et al., 1978).
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Map 37. Dicranella subulata.

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Map 54. *Desmatodon latifolius* (●) and *Desmatodon latifolius* var. *muticus* (○).
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Map 60. Distribution of Phascum cuspidatum in British Columbia.

Map 61. Distribution of Tortula latifolia in British Columbia.
Map 62. *Tortella fragilis*.

Map 63. *Tortella tortuosa*.
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Map 65. Distribution of *Coscinodon calyptratus* in British Columbia.
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Map 67. *Tortula subulata* (●) and *Weissia controversa* (○).
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Map 69. Grimmia mollis.

Map 70. Grimmia ovalis.

Map 71. Grimmia anodon.
Map 72. Grimmia alpestris.

Map 73. Grimmia montana.
Map 74. Grimmia trichophylla.

Map 75. Grimmia torquata.
Map 76. Distribution of *Racomitrium aquaticum* in British Columbia.

Map 77. Distribution of *Splachnum ampullaceum* in British Columbia.
Map 78. Racomitrium aciculare.

Map 79. Racomitrium fasciculare.
Map 80. Schistidium atrichum.

Map 81. Schistidium confertum.

Map 82. Schistidium dupretii.

Map 83. Scouleria marginata.
Map 84. Distribution of *Splachnum sphaericum* in British Columbia.

Map 85. Distribution of *Tetraplodon angustatus* in British Columbia.
Map 86. *Tayloria serrata*.

Map 87. *Schistostega pennata*. 
Map 90. Distribution of Bryum miniatum in British Columbia.

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Map 96. *Pohlia obtusifolia*.

Map 97. *Pohlia proligera*. 
Map 100. *Rhizomnium nudum*.

Map 101. *Leucolepis menziesii*. 
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Map 103. Distribution of *Neesia uliginosa* in British Columbia.
Map 104. Distribution of *Catascopium nigritum* in British Columbia.

Map 105. Distribution of *Philonotis capillaris* in British Columbia.
Map 106. *Anacolia menziesii*.

Map 107. *Bartramia ittyphylla*. 
Map 108. Conostomum tetragonum.

Map 110. *Orthotrichum affine*.

Map 111. *Orthotrichum alpestre*.

Map 112. *Orthotrichum cupulatum*.

Map 113. *Orthotrichum pallens*. 
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Map 121. *Thamnobryum neckeroides*. 
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Map 126. *Heterocladium procurrens*.

Map 127. *Thuidium recognitum*. 
Map 128. Distribution of Heterocladium macounii in British Columbia.

Map 129. Distribution of Helodium blandovii in British Columbia.
Map 130. Calliergidium pseudostramineum.

Map 131. Calliergonella cuspidata.

Map 132. Calliergon giganteum.

Map 133. Calliergon stramineum.
Map 134. Campylium halleri.

Map 135. Calliergon cordifolium.
Map 136. Distribution of *Campylium halleri* in British Columbia.

Map 137. Distribution of *Hygrohypnum styriacum* in British Columbia.
Map 140. *Campylium polygamum*.

Map 141. *Leptodictyum riparium*.
Map 142. *Cratoneuron commutatum*.

Map 143. *Cratoneuron filicinum*.
Map 144. *Drepanocladus exannulatus*.

Map 145. *Drepanocladus revolvens* var. *intermedius*.
Map 148. Scorpidium scorpioides.
Map 149. Distribution of *Hygrohypnum smithii* in British Columbia.

Map 150. Distribution of *Brachytheicum aspernimum* in British Columbia.
Map 151. Distribution of *Brachythecium collinum* in British Columbia.

Map 152. Distribution of *Orthothecium chryseum* in British Columbia.
Map 153. *Brachythecium frigidum*.

Map 154. *Brachythecium plumosum*.
Map 155. Brachythecium populeum.

Map 156. Brachythecium reflexum.

Map 158. *Rynchostegiella compacta*. 
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Map 165. Distribution of *Plagiothecium undulatum* in British Columbia.

Map 166. Distribution of *Herzogiella seligeri* in British Columbia.
Map 167. *Hypnum circinale*.

Map 168. *Hypnum cupressiforme* (•) and *Hypnum dieckii* (○).
Map 169. Hypnum pallescens.

Map 170. Hypnum pratense.

Map 171. Hypnum revolutum.

Map 172. Hypnum vaucheri.
Map 173. Isopterygium elegans.

Map 174. Pylaisiella polyantha.
Map 175. Distribution of Hylocomium splendens in British Columbia.

Map 176. Distribution of Ulota curvifolia in British Columbia.
Appendix 1. Checklist of mosses known from Mt. Revelstoke National Park
(specimens mostly at UBC and CANM).

Subclass Sphagnidae
Family Sphagnaceae
   Sphagnum capillifolium
   S. girgensohnii
   S. russowii
   S. warnstorfi

Subclass Andreaeidae
Family Andreaeaceae
   Andreaea blyttii
   A. nivalis
   A. rupestris

Subclass Tetraphidae
Family Tetraphidaceae
   Tetraphis geniculata
   T. pellucida

Subclass Buxbaumiidae
Family Buxbaumiaceae
   Buxbauma piperi
   B. viridis

Subclass Polytrichidae
Family Polytrichaceae
   Oligotrichum aligerum
   Pogonatum urnigerum
   Polytrichum alpinum
   P. commune
   P. formosum
   P. juniperinum
   P. lyallii
   P. piliferum
   P. sexangulare

Subclass Bryidae
Family Fissidentaceae
   Fissidens bryoides

Family Ditrichaceae
   Distichium capillaceum
   Ceratodon purpureus
   Ditrichum flexicaule
   D. heteromallum
   D. montanum
   D. pusillum
   Trichodon cylindrical

Family Seligeriaceae
   Blindia acuta

Family Dicranaceae
   Aongstroemia longipes
   Cynodontium jenneri
   Dichodontium pellucidum
   Dicranella crispa
   D. grevilleana
   Dicranoweisia crispa
   Dicranum acutifolium
   Dicranum fuscescens
   D. pallidisetum
   D. scoparium
   Kiaeria blyttii
   K. falcata
   K. starkei
   Orthodicranum strictum
   Oncophorus virens
   O. wahlenbergii
   Paraleucobryum longifolium

Family Encalyptaceae
   Encalypta ciliata
   E. procera

Family Pottiaceae
   Anoetangium aestivum
   Barbula convoluta
   B. unguiculata
   Desmatodon latifolius
   D. latifolius var. muticus
   Didymodon cylindrical
   D. vinealis
   Gymnostomum recurvirostrum
   Tortella fragilis
   Tortula norvegica
   T. ruralis

Family Grimmiaeae
   Dryoptodon patens
   Grimmia alpestris
   G. alpestris var. holzingeri
   G. mollis
   G. montana
   G. trichophylla
   Racomitrium aciculare
   R. brevipes
   R. canescens
   R. canescens var. strictum
   R. canescens var. ericoides
Subclass Bryidae
Family Grimmiiaceae
Racomitrium fasciculare
R. heterostichum
R. affine (=R. sudeticum)
Schistidium alpicola
S. apocarpum
S. strictum
S. rivulare
Scouleria aquatica
Family Funariaceae
Funaria hygrometrica
Family Splachnaceae
Tayloria serrata
Family Schistostegaceae
Schistostega pennata
Family Bryaceae
Bryum argenteum
B. bicolor
B. caespiticium
B. capillare
B. pallescens
B. pseudotriquetrum
B. turbinatum
B. weigelii
Pohlia atropurpurea
P. cruda
P. drummondii
P. nutans
P. proligerai
P. wahlenbergii
Roellia roellii
Leptobryum pyriforme
Family Mniaceae
Mnium blyttii
M. lycopodioides
M. spinulosum
Plagiomnium ciliare
P. drummondii
P. insigne
P. medium
P. rostratum
Rhizomnium glabrescens
R. nudum
R. pseudopunctatum
R. magnifolium
Family Aulacomniaceae
Aulacomnium androgynum
A. palustre
Family Bartramiaeqae
Anacololia menziesii
Bartramia iciphyphylla
B. pomiformis
Conostomum tetragonum
Philonotis fontana
P. capillaris
Plagioicus oederi
Family Timmiaceae
Timmta austriaca
T. megapolitana
Family Orthotrichaceae
Amphidium lapponicum
Orthotrichum laevigatum
O. pallens
O. obtusifolium
O. speciosum
Family Fontinalaceae
Fontinalis antipyretica
F. hypnoides
F. neo-mexicana
Family Climaeciaeae
Climacium dendroides
Family Hedwigiaeae
Hedwigia ciliata
Family Leucodontaceae
Antirrichia curtipendula
Family Neckeraeqae
Homalia trichomannoides
Metaneckera menziesii
Thamnobryum nekeroides
Family Hookeriaeqae
Hookeria lucens
Family Theliaceae
Myurella julacea
Family Leskeaeqae
Lescuraea incurvata
L. patens
L. radicosa
L. stenophylla
Pterigynandrum filiforme
Subclass Bryidae
Family Thuidiaceae
Claopodium bolanderi
Heterocladium macounii
H. procurrens
Thuidium recognitum

Family Amblystegiaceae
Amblystegium serpens
A. serpens var. juratzkanum
Calliergon cordifolium
C. giganteum
Campylium chrysophyllum
C. polygamum
C. stellatum
Cratoneuron commutatum
C. filicinum
Drepanocladium aduncus
D. fluitans
D. uncinatus
Hygrohypnum luridum
H. molle
H. smithii
Platydictya jungermannioides

Family Brachytheciaceae
Brachythecium albicans
B. asperrimum
B. frigidum
B. hyalotapetum
B. leibergii
B. plumosum
B. populeum
B. reflexum
B. rivulare
B. rutabulum
B. salebrosum
B. starkei
B. starkei var. curtum
B. velutinum
Eurhynchium pulchellum
Homalotheicum fulgescens
H. nevadense
Isothecium stoloniferum
Stokesiella praelonga
Tomentypnum nitens

Family Plagiotheciaceae
Plagiothecium denticulatum
P. laetum
P. piliferum

Family Hypnaceae
Hypnum circinale
H. lindbergii
H. pallescens
H. revolutum
Isotterygium pulchellum
I. elegans
Ptilium crista-castrensis
Pylaesiella polyantha

Family Rhytidiaceae
Pleuroziium schreberi
Rhytiadiophilus loreus
R. squarrosum
R. triquetrus

Family Hylocomiaceae
Hylocomium pyrenaicum
H. splendens
Rhytiadiopsis robusta
Appendix 2. Checklist of mosses known from Glacier National Park. (specimens mostly at UBC and CANM)

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<th>Family</th>
<th>Species</th>
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Subclass Bryidae
Family Pottiaceae
Didymodon vinealis
Gymnostomum recurvirostrum
Tortella tortuosa
Tortula norvegica
T. ruralis
Family Grimmiaaceae
Dryopteris patens
Grimmia alpestris
G. alpestris var. holzingeri
G. montana
G. ovalis
G. torquata
Racomitrium aciculare
R. affine
R. brevipes
R. canescens
R. canescens var. ericoides
R. canescens var. strictum
R. fasciculare
R. heterostichum
R. lanuginosum
Schistidium alpicola
S. apocarpum
S. atrichum
S. rivulare
S. strictum
Scouleria aquaticum
Family Funariaceae
Funaria hygrometrica
Family Splachnaceae
Splachnum sphaericum
Tayloria lingulata
T. serrata
T. splachnoides
Tetraplodon mnioides
Family Schistostegaceae
Schistostega pennata
Family Bryaceae
Anomobryum filiforme var. concinnatum
Bryum argenteum
B. capillare
B. muehlenbeckii
B. pallens
B. pallescens
Subclass Bryidae
Family Bryaceae
Bryum pseudotriquetrum
B. turbinatum
B. weigeli
Leptobryum pyriforme
Pohlia atrorubescens
P. cruda
P. drummondii
P. elongata
P. filum
P. lescuriana
P. nutans
P. obtusifolia
P. proligerum
P. vexans
P. wahlenbergii
Roellia roellii
Family Mniaceae
Mnium arizonicum
M. blyttii
M. lycopodioides
M. thomsonii
M. spinulosum
Plagiommium drummondii
P. insignis
P. medium
Rhizomnium glabrescens
R. nudum
R. magnifolium
R. pseudopunctatum
Family Aulacomnmiaceae
Aulacomnium androgynum
A. palustre
Family Meesiaceae
Melesia uliginosa
Paludella squarrosa
Family Catascopiaceae
Catascopium nigritum
Family Bartramiaceae
Bartramia ithyphylla
B. pomiformis
Conostomum tetragonum
Philonotis fontana
Plagiopus oederi
Family Timmiaeaceae
  Timmia austriaca
  T. megapolitana

Family Orthotrichaceae
  Amphidium lapponicum
  Orthotrichum laevigatum
  O. pallens
  O. obtusifolium
  O. speciosum
  Ulota curvifolia

Family Fontinalaceae
  Fontinalis antipyretica

Family Climaciaceae
  Climaciaceae
  Climacium dendroides

Family Hedwigiaceae
  Hedwigia ciliata

Family Neckeraeaceae
  Metaneckera menziesii

Family Theliaceae
  Myurella julacea

Family Leskeaceae
  Lescuraea incurvata
  L. patens
  L. radicosa
  L. stenophylla
  Pterigynandrum filiforme

Family Thuidiaceae
  Cladopodium bolanderi
  Helodium blandovii
  Heterocladium procurrens
  Thuidium recognitum

Family Amblystegiaceae
  Amblystegium serpens
  A. serpens var. juratzkanum
  Calliergon cordifolium
  C. giganteum
  C. stramineum
  Campylium chrysophyllum
  C. polygamum
  C. stellatum
  Cratoneuron commutatum
  C. filicinum
  Drepanoclados aduncus
  D. exannulatus

Subclass Bryidae
Family Amblystegiaceae
  Drepanoclados fluitans
  D. revolvens var. intermedius
  D. uncinitus
  Hygrohypnum alpinum
  H. bestii
  H. durisuculum
  H. luridum
  H. molle
  H. ochraceum
  H. smithii
  Platydictya jungermannioides
  Scopodium scorpioides

Family Brachytheciaceae
  Brachythecium albicans
  B. collinum
  B. frigidum
  B. hyalotapetum
  B. leibergii
  B. plumosum
  B. reflexum
  B. rivulare
  B. rutabulum
  B. salebrosum
  B. starkei
  B. starkei var. curtum
  B. velutinum
  Eurhynchium pulchellum
  Homalothecium fulgescens
  H. nevadense
  Rhynchostegiella compacta
  Stokesiella praelonga
  Tomentypnum nitens

Family Entodontaceae
  Orthothecium chryseum

Family Pliagiotheciaceae
  Plagiothecium cavifolium
  P. denticulatum
  P. laetum
  P. piliferum

Family Hypnaceae
  Hypnum circinale
  H. lindbergii
  H. pallescens
  H. revolutum
  Isopterygium elegans
Subclass Bryidae
Family Hypnaceae
  Isopterygium pulchellum
  Ptilium crista-castrensis
Family Rhytidiaceae
  Pleurozium schreberi
  Rhytidiadelphus squarrosus
  R. triquetrus
  R. loreus
Family Hylocomiaceae
  Hylocomium pyr enaicum
  H. splendens
  Rhytidiopsis robusta
Appendix 3. List of major collection sites (see Map 5) -

1. Vicinity of Waneta Dam on Hwy 22A, south of Trail, Selkirk Mountains, 49° 03'N  117° 35'W.

2. Slope behind the city hospital of Trail, Selkirk Mountains, 49° 10'N  117° 40'W.

3. Champion Lakes Provincial Park, ca 10 miles NW of Fruitvale on Hwy 3, Selkirk Mountains, 49° 08'N  117° 40'W.

4. Syringa Provincial Park at the south end of Lower Arrow Lake, Selkirk Mountains, 49° 22'N  117° 55'W.

5. Cayuse Creek drainage, Deer Park and Broadwater area, Lower Arrow Lake, ca 49° 27'N  118° 01'W.

6. Narrow gorge at the junction of Pend' Oreille River, Limpid Creek and Salmo River, S of Trail and Salmo, 49° 03'N  117° 15'W.

7. Large and Small Erie Lakes, near Salmo, Selkirk Mountains, 49° 15'N  117° 15'W.

8. Stagleap Regional Park on Hwy 3, E of Salmo, Selkirk Mountains, 49° 15'N  117° 03'W.

9. Sheep Creek and its tributaries, near Salmo, Selkirk Mountains, 49° 10'N  117° 05'W.

10. Boundary Lake, near Monk Creek, north of the international border, Selkirk Mountains, 49° 01'N  116° 56'W.

11. Vicinity of Cultus Creek and headwater of Blazed Creek in Nelson Range, Selkirk Mts., 49° 18'N  116° 55'W.

12. Whitewater Ski Mountain, south of Nelson, Selkirk Mountains, 49° 25'N  117° 13'W.

13. Little Slocan Lakes, behind Perry Ridge, near Slocan, Selkirk Mountains, 49° 38'N  117° 40'W.

14. Junction of Koch Creek and Grizzly Creek, Selkirk Mountains, 49° 40'N  117° 53'W.

15. Lemon Creek Trail (including Sasquatch Lake) to Kokanee Glacier Park, Selkirk Mountains, 49° 45'N  117° 25'W.

16. Slocan, south end of Slocan Lake on Hwy 6, Selkirk Mountains, 49° 46'N  117° 28'W.

17A. "0' Bara" Lake along the Hoder Creek Valley road, Valhalla Range, Selkirk Mountains, 49° 46'N  117° 35'W.

17B. Wolf Peaks and Gimli Peak, summit of Bannock Burn Creek Ridge, Valhalla Range, Selkirk Mountains, 49° 46'N  117° 35'W.

18. Beatrice Lake and Cahill Lake vicinity, Valhalla Range, Selkirk Mountains, 49° 50'N  117° 35'W.

19. Enterprise Creek Trail to Kokanee Glacier Park, Selkirk Mountains, 49° 53'N  117° 15'W.

20. Silverton Creek Trail (including Fishermaiden Lake) to Kokanee Glacier Park, Selkirk Mountains, 49° 50'N  117° 15'W.
21. Kokanee Creek Trail to Gibson Lake, Kokanee Glacier Park, Selkirk Mountains, 49° 40'N 117° 10'W.

22. Chief Slocan Cabin, Kokanee Glacier Park, Selkirk Mountains, 49° 46'N 117° 12'W.

23. Ainsworth Hotsprings and Cody Caves Provincial Park, W of Kootenay Lake, Selkirk Mountains, 49° 45'N 116° 55'W.

24. Woodbury Creek Trail to Sunset Lake, Kokanee Glacier Park, Selkirk Mountains, 49° 46'N 117° 04'W.

25. Keen Creek road to Joker Millsite Trail, Kokanee Glacier Park, Selkirk Mountains, 49° 50'N 117° 12'W.

26. Buchanan Lookout Tower, 7 miles W of Kaslo, Kootenay Lake, Selkirk Mountain, 49° 55'N 116° 55'W.

27. Jackson Basin, near Retallack on Hwy 31A, Selkirk Mountains, 50° 02'N 117° 08'W.

28. Idaho Lookout Tower, near Sandon and New Denver, Selkirk Mountains, 49° 58'N 117° 10'W.

29. Rosebery Park, east shore of Slocan Lake on Hwy 31, Selkirk Mountains, 50° 03'N 117° 25'W.

30. Shannon Lake along Shannon Creek, west side of Slocan Lake, Valhalla Range Selkirk Mountains, 50° 04'N 117° 35'W.

31. Box Lake and Summit Lake Park on New Denver-Nakusp Hwy 6, Selkirk Mountains, 50° 12'N 117° 40'W.

32. Wilson Lake vicinity on Fitzstubbs Creek road, Selkirk Mountains, 50° 20'N 117° 40'W.

33. Nakusp Hotsprings, resort by Kuskanax River, Selkirk Mountains, 50° 20'N 117° 40'W.

34. Small waterfall near Fauquier on Hwy 6, Lower Arrow Lake, Selkirk Mountains, 49° 50'N 118° 02'W.

35. Schroeder Creek gorge, 14 miles N of Kaslo by Hwy 31, Selkirk Mountains, 50° 04'N 116° 58'W.

36. Davis Creek Park at Lardeau, 50° 10'N 116° 57'W.

37. Meadow Mountain Forestry Alpine Recreation Park above 7000 ft., Selkirk Mountains, 50° 15'N 117° 08'W.

38. Poplar Creek drainage, N of Lardeau on Hwy 31, Selkirk Mountains, 50° 20'N 117° 16'W.

39. Glacier Creek drainage, E of Duncan Lake, Purcell Mountains, 50° 23'N 116° 50'W.

40. Vicinity of Trout Lake municipality, north end of Trout Lake on Hwy 31, Selkirk Mountains, 50° 40'N 117° 32'W.
41. Un-named hotspring, 1.5 miles E from the Upper Arrow Lake, along the St. Leon Creek road, Selkirk Mountains, 50° 28'N  117° 55'W.

42. Galena Bay, near Northeast Arm of Upper Arrow Lake, Selkirk Mountains, 50° 41'N  117° 52'W.

43. Sutherland Falls, Blanket Creek Campground on Hwy 23, west shore of Upper Arrow Lake, 50° 40'N  118° 01'W.

44. Echo Lake, 5 miles S of Revelstoke, by the Akolkolex River, Selkirk Mountains, 50° 50'N  118° 01'W.

45. Mt. Revelstoke National Park on Hwy 1, Selkirk Mountains, 51° 02'N  118° 04'W.

46. Silver Tip Falls, 4 miles N of Revelstoke on Hwy 23, Selkirk Mountains, 51° 03'N  118° 10'W.

47. Floodplain of Goldstream River, Selkirk Mountains, 51° 35'N  118° 05'W.

48. Microwave Tower vicinity (6200 ft.), Fred Laing Ridge, near Mica Dam site, Selkirk Mountains, 52° 02'N  118° 30'W.

49. Mouth of Gold River, west arm of MacNaughton Lake, Selkirk Mountains, 51° 04'N  117° 45'W.

50. Glacier National Park on Hwy 1, Selkirk and Purcell Mountains, 51° 20'N  117° 30'W.

51. Vicinity of Golden on Hwy 95 (93), Purcell Mountains, 51° 23'N  117° 00'W.

52. "Echo Lake" and vicinity of Bobbie Burns basin and Spillimacheen River basin, near Parson on Hwy 95, Purcell Mountains, 50° 58'N  116° 30'W.

53. Vicinity of Cartwright Lake, Lang Lake, Dunbar Lake and Templeton Lake, near Brisco on Hwy 95, Purcell Mountains, 50° 42'N  116° 30'W.

54. Bugaboo Creek road to Bugaboo Glacier Park, Purcell Mountains, 50° 45'N  116° 40'W.

55. Bugaboo Glacier Provincial Park (including Walter Lake and Cobalt Lake), Purcell Mountains, 50° 45'N  116° 42'W.

56. CANN campground at Edgewater on Hwy 95, Purcell Mountains, 50° 40'N  116° 06'W.

57. Dry Gulch Park on the west side of Hwy 95, near Radium Hotspring, Purcell Mountains, 50° 40'N  116° 02'W.

58. Horsethief Creek road to the Lake of Hanging Glaciers, Purcell Mountains, 50° 35'N  116° 37'W.

59. Lake Lillian, Invermere area, near Hwy 95, Purcell Mountains, 50° 30'N  116° 02'W.

60. Junction of Jumbo Creek and Toby Creek near the northeastern boundary of the Purcell Wilderness Conservancy, Purcell Mountains, 50° 23'N  116° 40'W.

61. Earl Grey Pass Trail, Purcell Wilderness Conservancy, Purcell Mountains, 50° 23'N  116° 32'W.
62. Hamil Creek Valley Trail to Earl Grey Pass, Purcell Wilderness Conservancy, Purcell Mountains, 50°17'N 116°55'W.
63. Fry Creek Canyon, near Johnson Landing, east side of Kootenay Lake, Purcell Mountains, 50°03'N 116°52'W.
64. Fairmont Hotspring on Hwy 95, east of Purcell Mountains, 50°22'N 115°50'W.
65. Dutch Creek road, Canal Flats on Hwy 95, Purcell Mountains, 50°10'N 115°48'W.
66. Whitetail Lake and Blue Lake, by the Findlay Creek road, near Canal Flats, Purcell Mountains, 50°15'N 116°01'W.
67. Skookumchuck Creek road going to St. Mary Alpine Park and Purcell Wilderness Conservancy, Purcell Mountains, 49°58'N 115°56'W.
68. Ta Ta Creek road by Hwy 95A, near Kimberley, Purcell Mountains, 49°48'N 115°45'W.
69. North Star Ski Mountain and Dipper Lake, Kimberley, Purcell Mountains, 49°40'N 116°01'W.
70. St. Mary Lake vicinity, west of Kimberley, Purcell Mountains, 49°40'N 116°12'W.
71. Parking lot vicinity of St. Mary Alpine Park near the end of White Creek road, Purcell Mountains, 49°50'N 116°14'W.
72. Lyall Lake and Totem Lake, St. Mary Alpine Park, above 6500 ft elev., Purcell Mountains, 49°50'N 116°22'W.
73. Lake near the headwater of Meachen Creek, S of Kimberley, Purcell Mountains, 49°30'N 116°35'W.
74. Cooper Lake, near the headwaters of Moyie River, S of Cranbrook, Purcell Mountains, 49°20'N 116°06'W.
75. Kiakho Lake and vicinity of Cranbrook on Hwy 95, Purcell Mountains, 49°30'N 115°45'W.
76. Moyie Lake Park on Hwy 95, S of Cranbrook, Purcell Mountains, 49°23'N 115°47'W.
77. Kikomum Creek Park, east side of Koocanusa Lake, east of Purcell Mountains, 49°12'N 115°12'W.
78. Plumbob Creek, west shore of Koocanusa Lake, Purcell Mountains, 49°17'N 115°22'W.
79. Tepee Creek road, S of Cranbrook, Purcell Mountains, 49°17'N 115°40'W.
80. Yahk Park at the junction of Hwy 95 and 3, near Kingsgate border custom, Purcell Mountains, 49°03'N 116°03'W.
81. Kootenay River marshes, Creston Valley Wildlife Center and Duck Lake Vicinity, near Creston, 49°10'N 116°40'W.
Table I. Climatic data of selected weather stations in the study area and British Columbia (1941-1970).

<table>
<thead>
<tr>
<th>Stations</th>
<th>Mean total annual precipitation (ml)</th>
<th>Number of days with frost</th>
<th>Number of days with precipitation</th>
<th>Mean daily temperature (° C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>Cranbrook</td>
<td>44</td>
<td>194</td>
<td>119</td>
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<td>Creston</td>
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<td>Deer Park</td>
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<td>Fauquier</td>
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<td>151</td>
<td>117</td>
<td>12.72</td>
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<td>Glacier</td>
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<td>200</td>
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<td>Golden</td>
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<td>Kaslo</td>
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<td>Kimberley</td>
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<td>196</td>
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<td>Lardeau</td>
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<td>Mica Dam</td>
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<td>Nelson</td>
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<td>Slocan</td>
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<td>Spillimacheen</td>
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<td>Waneta</td>
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<td>Haney</td>
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<td>80</td>
<td>149</td>
<td>13.17</td>
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<tr>
<td>Kelowna</td>
<td>30.5</td>
<td>137</td>
<td>105</td>
<td>13.94</td>
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</tbody>
</table>

Table II. Partial list of mosses collected from Halcyon Hotsprings.

<table>
<thead>
<tr>
<th>MacFadden's collections</th>
<th>Tan's collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphidium lapponicum</td>
<td>Bryum argenteum</td>
</tr>
<tr>
<td>Aulacomnium palustre</td>
<td>Bryum caespiticium</td>
</tr>
<tr>
<td>Brachythecium frigidum</td>
<td>Brachythecium albicans</td>
</tr>
<tr>
<td>B. rivulare</td>
<td>B. salebrosum</td>
</tr>
<tr>
<td>B. rutabulum</td>
<td>Ceratodon purpureus</td>
</tr>
<tr>
<td>B. salebrosum</td>
<td>Dicranum fusescens</td>
</tr>
<tr>
<td>Andreaea rupestris</td>
<td>Drepanoclados uncinatus</td>
</tr>
<tr>
<td>Campylium stellatum</td>
<td>Eurhynchium pulchellum</td>
</tr>
<tr>
<td>Claopodium bolanderi</td>
<td>Homalothecium nevadense</td>
</tr>
<tr>
<td>Dicranum scoparium</td>
<td>Funaria hygrometrica</td>
</tr>
<tr>
<td>Dicranoweisia crispula</td>
<td>Grimmia sp. (sterile)</td>
</tr>
<tr>
<td>Eurhynchium riparioides</td>
<td>Philonotis fontana</td>
</tr>
<tr>
<td>Grimmia ovalis</td>
<td>Tortula ruralis</td>
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<tr>
<td>G. torquata</td>
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<tr>
<td>G. trichophylla</td>
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<tr>
<td>Homalothecium aeneum</td>
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<tr>
<td>H. nevadense</td>
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<tr>
<td>Hypnum circinale</td>
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<tr>
<td>Kiaeria blyttii (?)</td>
<td></td>
</tr>
<tr>
<td>Orthotrichum speciosum</td>
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<tr>
<td>Plagiopus oederi</td>
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<tr>
<td>Stokesiella praelonga</td>
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</table>
Table III. Western North American endemic species present in the study area.

<table>
<thead>
<tr>
<th>Species</th>
<th>Species</th>
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<tbody>
<tr>
<td>Anacolia menziesii</td>
<td>Polytrichum lyallii</td>
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<td>Atrichum selwynii</td>
<td>Racamitrium brevipes</td>
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<td>Barbula eustegia</td>
<td>Rhizomnium glabrescens</td>
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<td>B. revoluta var. obtusula</td>
<td>Rhytiodyopsis robusta</td>
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<td>Brachythecium asperrimum</td>
<td>Roellia roellii</td>
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<tr>
<td>B. frigidum</td>
<td>Scleropodium obtusifolium</td>
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<tr>
<td>B. hyalotapetum</td>
<td>Scouleria aquatica</td>
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<tr>
<td>B. leibergii</td>
<td>S. marginata</td>
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<tr>
<td>Bryum meesioides</td>
<td>Stokesiella oregana</td>
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<tr>
<td>Buxbaumia piperi</td>
<td>Thamnobryum neckeroides</td>
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<tr>
<td>Claopodium bolanderi</td>
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<tr>
<td>Dichelyma uncinatum</td>
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<tr>
<td>Dichodontium olympicum</td>
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<tr>
<td>Dicranum pallidisetum</td>
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<tr>
<td>Ditrichum montanum</td>
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<tr>
<td>Eurhynchium pulchellum var. barnesii</td>
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<tr>
<td>Fontinalis neo-mexicana</td>
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<tr>
<td>Schistidium atrichum</td>
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<tr>
<td>Coscinodon calyptratus</td>
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<td>Heterocladium macounii</td>
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<td>Hypnum circinale</td>
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<td>Isothecium stoloniferum</td>
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<td>Leucolepis menziesii</td>
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<td>Leucursarea stenophylla</td>
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<td>Neckera douglasii</td>
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<td>Orthotrichum pellucidum</td>
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<td>Plagiomnium insigne</td>
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<td>P. venustum</td>
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