Spruce-Fir Habitat Types of the Rocky Mountains North of the Oldman River

by

R. T. Ogilvie

Discussion of Environmental Classification

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The study of environmental-vegetation relationships and the defining of environmental-vegetation units, has been in progress for over 50 years. The close relationship between environment and vegetation has been firmly established. It has also been well established that carefully conducted ecological work will yield classifications of sound and consistent environmental-vegetation units. This has been established from much work done in North America and work covering almost the entire continent of Europe. Such work has provided us with an intimate understanding of our vegetation and the environment which determines it. The environmental units are also important for carrying out further ecological investigations on different habitat conditions. These units provide an excellent basis for the laying out of field trials and the conducting of experiments.

The question arises whether such environmental categories have a practical use; whether they may be used in such fields as forest management, forest inventory, growth studies, regeneration work, and silviculture. I believe that in those fields where there is a clear-cut relationship between environment and the problem under study, these environmental units are very useful. Environmental units can provide a sound basis for such things as regeneration, planting, and other silviculture work. For assessing potential productivity of land, an environmental classification is valuable. Growth is largely determined by environment; if you can assess the environmental conditions of a piece of land, you can determine the potentiality of that land for growth. However, there are complications in dealing with actual growth and productivity. The growth of a stand is a function of environment, plus competition and stand history. Over a period of 300 years a great number of "chance" events affect a spruce stand. The "chance" events which affect one 300-year old stand will be entirely different from those which affect other stands. Thus all site classifications, regardless of technique used, are only capable of evaluating potential growth. They will not produce a series of site types each with a distinct and constant productivity rating, because no site classification is able to embrace the variability caused by excessive competition and stand history.

What are the short-comings of such ecological classification? First, it is time-consuming to carry out the initial classification of a region. It is necessary for the investigator to have a thorough knowledge of the geography, geomorphology, soils, climate, flora, fauna, and phytogeography of the study area, as well as to be trained in ecology. Much of this is obtained by lengthy field experience. Once the classification has been done, it requires training and experience on the part of the user for it to be applied in the field. It is necessary that the user have an adequate knowledge of the soils and plants of the area in order to properly identify the habitat types in the field. Once this knowledge is obtained, typing can proceed as rapidly as the field man

can examine the vegetation and soil and take mental note of the physical features of the stand.

I should like to summarize what I have said about the value of environmental classification.

1. It provides us with an understanding of our vegetation and its environment.

2. It provides us with environmental units which may be used as a basis for carrying out further research.

3. It provides us with land units which may be used in practical work such as planting, regeneration, and other silviculture work.

4. It provides us with land units of potential forest productivity.

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Picea / Equisetum Association — River Flat Horsetail

Along the major rivers there is flat terrain formed from material which has been deposited by the river. Much of the material is medium fine textured: silts and fine sands. Near the river where the water table is relatively high, the soils are immature, gloyed, fine alluvial soils, with an A - C horizon sequence. Mottling from gleisation occurs high in the profile, at around 9 inches, and lime occurs throughout the C horizon.

A_{00} + A_0 0-2" litter from needles, horsetails and mosses; very sparse mycelium. pH 7.4 (7.05-7.65)

A_0 (+ C) 2-6" intermixed, decomposed organic matter and mineral material; granular; loam; lime. pH 7.75 (7.7-7.95)

C 6-9" brown-gray, slight red mottling; massive to granular; loamy sand to loam; lime. pH 8.0 (7.95-8.1)

9" gray, mottled with red; strong seepage; massive; loamy sand to loam; lime; fine, river-deposited parent material. pH 8.0 (7.85-8.2)

The tree layer is composed of Picea glauca, and a small amount of Populus balsamifera.

The sparse shrub layer consists of mainly: Lonicera involucrata, Salix spp. (S. barclayi, S. pseudomonticola), Rubus pubsecens, Viburnum edule, and Cornus stolonifera.

A dense growth of Equisetum arvense and E. pratense covers the ground in the herb layer. Other typical herbs are: Carex vaginata, C. concinna, Petasites frigidus var palmatus, Equisetum scirpoides, Osmorhiza chilensis. and Mitella nuda.

The bryophyte and lichen layer consists typically of: Mnium affine, Mnium spp., Brachythecium sp., and Timmia austriaca.

Spruce growth is good in this type. The trees tend to be shallowly rooted, and exposed parts of the stands are susceptible to windthrow. The moistness of this habitat protects the stands of this type from fires, and lodgepole pine rarely occurs in this type.

Picea / Sphagnum - Ledum Association Peat Moss - Labrador Tea

Elsewhere along the broad river flats there are areas where fine clay material has been deposited. Drainage is impeded, and excessive stagnant water gives rise to bog vegetation. Peat from Sphagnum and Carex material accumulates to a depth of at least 4 feet to form Bog Soils. The peat material is highly basic at the surface, becomes more acid with depth, and is underlain by calcareous clay.

Deeper Bog Profile

0-7" living Sphagnum.	pH 7.65
8-11" peat.	7.7
15" free water.	
20-22" peat.	pH 5.8
30-32" peat.	5.55
43-45" peat.	6.0

Shallower Peat Profile

0-4" peat.	pH 6.6
17-20" peat.	6.35
22" free water.	

22-24" clay loam with organic matter. pH 7.2

32-35" clay; blue with red mottling, lime. 8.2

The tree layer is composed of small, narrow-crowned Picea glauca, suggesting the physiognomy of black spruce muskeg. Pinus contorta is sometimes present.

There is a well-developed shrub layer consisting typically of: Ledum groenlandicum, Betula glandulosa, Salix candida, and S. myrtillifolia. Beneath this, are the low, procumbent shrub species: Empetrum nigrum, Vaccinium vitis-idaea, V. oxycoccus, and Rubus pubescens.

The herb layer is dominated by Carex aquatilis, C. leptalea, C. vaginata, as well as Equisetum scirpoides, E. variegatum and E. arvense. Other typical species are: Juncus balticus, Eriophorum viridi-carinatum, Glyceria striata, and Pedicularis groenlandica.

The abundant moss layer consists of: Sphagnum spp. Aulacomnium palustre, Camptothecium nitens, and Polytrichum juniperinum on the summits of the dry peat tussocks.

This type is not abundant in the mountain region as a whole; however, locally along the Bow River it is common. Peat habitats also occur in Jasper National Park, but those are occupied by Picea mariana communities.

Less developed variants of this type occur, having a shallower peat layer and sometimes indications of occasional flooding: the peat is overlain by a band of silt and further peat is formed above. Correlated with these profile differences are a reduction in Sphagnum spp., and an increase in Equisetum arvense and Carex spp.

Spruce growth is very poor in this type. Rooting is shallow, windthrow is common, and stocking is sparse. The ground beneath the peat frequently remains frozen late in the year.

Picea / Arctostaphylos uva-ursi Association — Bearberry

Well away from the river on older, coarse gravel and sand deposits, the soils are more mature. There is some development of an acid, leached A_2 horizon and of a B horizon.

$A_{00} + A_0$ 0-3/4" sparse, dry litter from needles and Arctostaphylos leaves; mycelium absent or very sparse. pH 7.1 (6.75-7.55)

(A_1) 3/4-1½" patchy occurrence, or absent, dark brown-black, melanised; granular; lime. pH 7.8 (7.5-8.0)

A_2		patchy occurrence, ca. ¼" thick; light gray, single grain. pH 6.4 (5.85-6.75)
B_{Ca}	2-10"	red brown to yellow brown; weak blocky gravel and stones, loamy sand to loam; lime. pH 7.8 (7.15-8.35)
C_{Ca}	12"	gray brown; massive, coarse alluvial material with abundant stones, gravel and sand; lime. pH 8.1 (7.7-8.6)

This type occurs at elevations between 4200 and 4700 feet. Picea glauca makes up the tree layer.

There is a well-developed shrub layer composed typically of: Shepherdia canadensis, Juniperus communis, Potentilla fruticosa, Rosa acicularis, and occasionally Symphoricarpos albus. Beneath this is the low, prostrate shrub layer dominated by Arctostaphylos uva-ursi, with Juniperus horizontalis.

The herb layer consists typically of: Elymus innovatus, Carex concinna, C. eburnea, Anemone multifida, Viola adunca, Campanula rotundifolia, Gentianella amarella, Pyrola virens, and Fragaria virginiana var. glauca.

The bryophyte and lichen layer is rather impoverished, with some occurrence of: Drepanocladus uncinatus, Dendroalsia abietina, Brachythecium sp., Tortula ruralis, Polytrichum piliferum, Peltigera canina, and Cladonia spp.

Spruce growth is fair; the stocking is generally sparse. Because of the coarseness of the soil material the soil is excessively drained and droughty. The dryness of this habitat renders the forest stands susceptible to fires, and much of this type is now occupied by Pinus contorta.

Picea - Abies / Calamagrostis rubescens Association — Pinegrass

This association occurs on the medium-textured materials along the valley bottom, and extending up the south-facing valley slopes. Although moisture conditions are favourable for growth, the ground vegetation is highly inflammable and this type is very susceptible to fires. Most of the stands of this type are lodgepole pine.

The soils are podzolic, with a leached A_2 horizon above a brown B horizon.

A_{00} + A_0	0-1"	litter from pine needles and grass foliage; sparse mycelium; charcoal. pH 5.3 (4.75-6.2)

A_2	1-3"	yellow gray, single grain, sandy loam, loose and soft. pH 6.0 (4.95-6.9)
A_3	3-6",	or absent. Yellow gray; sandy loam to sandy clay loam; granular. pH 6.8 (6.3-7.25)
B_1	6-9",	or absent. Yellow brown; sandy loam to sandy clay loam; weak blocky to granular. pH 6.9 (6.05-7.7)
B_{2Ca}	9-20"	brown; gravelly, sandy clay loam to loam; blocky; compact. pH 7.5 (7.0-7.9)
B_{3Ca}	20-24",	or absent. Gray brown; gravelly, sandy clay loam; weak blocky to massive. pH 8.0 (7.7-8.3)
C_{Ca}	24"	yellow gray; gravelly, sandy loam to loam; massive. pH 8.15 (7.9-8.6)

The tree layer consists of Pinus contorta, Picea glauca, Abies lasiocarpa, and occasionally some Populus tremuloides.

The shrub layer is well developed, consisting typically of: Shepherdia canadensis, Arctostaphylos uva-ursi, Rosa acicularis, Juniperus communis, and Spiraea lucida, and often Vaccinium caespitosum and V. scoparium.

The herb layer is very abundant, consisting mainly of: Calamagrostis rubescens, Elymus innovatus, Aster conspicuus, Linnaea borealis var. americana, Fragaria virginiana var. glauca, Pyrola virens, Hedysarum sulphurescens, Arnica cordifolia, Carex concinna, Castilleja hispada, Aster ciliolatus, Achillea millefolium var. lanulosa, and Gentianella amarella ssp. acuta.

The bryophyte and lichen layer is only moderately developed, with mainly: Brachythecium spp., Drepanocladus uncinatus, Dicranum rugosum, Pleurozium schreberi, Hylocomium splendens, Polytrichum juniperinum, Cladonia spp., and Peltigera aphthosa.

Growth of lodgepole pine is fair in this type.

There are two variations of the Calamagrostis type. The Calamagrostis - Cladonia community has very abundant Cladonia spp.; the soil is coarser and stonier, and there are abundant stones at the surface.

The Calamagrostis - Vaccinium community has abundant Vaccinium caespitosum and often V. scoparium; the soil profile has a more acid humus horizon, and there is a more pronounced ashy A_2.

Picea - Abies / Hylocomium splendens - Cornus canadensis Association *

Feather Moss

Moving up out of the valley bottoms on to the lower valley slopes, from 4500 to 5500 feet elevation, on north to east aspects, the precipitation begins to increase, and the soils are more podzolised. There is an acid mat of moss and needle material, an ashy, leached A_2 horizon, and a well-developed B horizon.

$A_{00} + A_0$	0-3"	decomposing moss and needles; abundant mycelium pH 4.9 (3.9-6.7)
A_2	3-4"	bleached, ashy gray, single grain; sandy loam. pH 4.5 (3.7-4.9)
B_1	4-5"	variable; yellow brown to gray brown; granular to weak blocky; sandy loam to sandy clay loam. pH 6.5 (5.1-7.7)
B_2	5-20"	yellow red to red brown; blocky; gravelly, sandy loam to clay loam. pH 6.7 (5.0-7.9)
C	20"	coarse, stony glacial and glacial-fluvial material; gravelly to extremely gravelly, loamy sand to clay loam; lime. pH 7.3 (5.6-8.15)

The tree layer is composed of Picea glauca, the hybrid P. glauca X P. engelmannii, and Abies lasiocarpa.

A sparse shrub layer consists mainly of: Rosa acicularis, Lonicera involucrata, and occasionally Ribes lacustre, Juniperus communis, and Alnus crispa var. sinuata.

The herb layer is moderately developed, composed typically of: Cornus candensis, Linnaea borealis var. americana, Pyrola secunda, Elymus innovatus; as well as: Arnica cordifolia, Stenanthium occidentale, Pyrola asarifolia var. purpurea, and P. uniflora.

The striking feature of this association is the continuous carpet formed by the predominant bryophyte and lichen layer. The typical species consist of: Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis, Peltigera aphthosa, and Cladonia spp.; as well as: Mnium spp., Dicranum fuscescens, and Timmia austriaca.

Spruce growth is good in this type; spruce regeneration may tend to be excessive and cause overstocking and suppression.

Lodgepole pine stands are abundant in this type. The main features of difference between the spruce-fir stands and the pine stands are: in the pine stands there is a great increase in the shrub and herb layers, a rather thinner humus horizon, and a less bleached and less acid A_2 horizon.

Picea - Abies / Menziesia ferruginea - Lycopodium annotinum Association
False Azalea

On the middle and upper valley slopes, from 5500 to 6300 feet elevation, the mountain spruce-fir forest reaches its maximum development. Moisture conditions are favourable throughout the growing season, there is deep snow accumulation, and the soils are strongly podzolised. There is a deep acid layer of organic matter, a broad, ashy A_2 horizon, and a well developed, reddish, acid B horizon.

$A_{00} + A_0$	0-4"	decomposing litter from needles and mosses; mycelium very abundant. pH 4.3 (3.7-5.15)
A_2	4-6½"	bleached, ashy gray; platy to single grain; sandy loam. pH 3.9 (3.5-4.3)
B_1	7-10"	brown red; granular to weak blocky; soft, loose consistency; gravelly, sandy loam to sandy clay loam. pH 4.9 (4.25-5.45)
B_2	10-20"	yellow brown; blocky to weak blocky; gravelly to very gravelly, sandy loam. pH 5.4 (4.8-6.8)
C upper	20-24"	gray brown; massive; no lime; frequent cementation; very gravelly to extremely gravelly, sandy loam. pH 6.5 (5.4-7.7)
lower	24"	yellow gray; massive; lime; frequent cementation; stony, very gravelly to extremely gravelly, sandy loam. pH 7.5 (5.5-8.1)

The tree layer consists of the hybrid Picea engelmannii X P. glauca, Picea engelmannii, and Abies lasiocarpa.

The tall shrub layer is dense, composed of Menziesia ferruginea, with a small amount of Rhododendron albiflorum, Lonicera involucrata, and Ledum groenlandicum. Below this, the low shrub layer is composed of: Vaccinium scoparium, Vaccinium myrtillus, and some V. membranaceum.

The herb layer is very sparse, consisting mainly of: Lycopodium annotinum, Linnaea borealis var. americana, Arnica cordifolia and A. latifolia, Cornus canadensis, Pyrola secunda, and Elymus innovatus.

The very abundant bryophyte and lichen layer consists of: Pleurozium schreberi, Hylocomium splendens, Ptilium crista-castrensis, Peltigera aphthosa, Dicranum fuscescens, and liverworts.

Spruce growth is good in this type.

Stands of the Menziesia - Lycopodium type are less susceptible to fires and are infrequently burned. Lodgepole pine stands of this type are

rare. Their soils have a shallower and less acid humus horizon: pH 4.4 (3.7-5.0), the A_2 is less acid: pH 4.75 (4.3-5.7) and is frequently a yellowish or reddish gray, rather than the typical bleached ashy gray. The shrub layer is similar to the spruce-fir stands of this type, except for an increased abundance of Juniperus communis. The herb layer is more abundant than under spruce-fir stands of this type, with a greater amount of Epilobium angustifolium and Pyrola virens. Growth of lodgepole pine is very poor.

Picea - Abies / Ledum groenlandicum - Empetrum nigrum Association
Seepage Labrador Tea-Crowberry

Along the valley slopes there are localised places where groundwater comes closer to the soil surface and seepage occurs. The soil is gleyed-podzolic, with a bleached A_2 horizon, but with mottling in the lower B and C horizons.

The vegetation of this association shows relationships to the communities which adjoin it. This association might be considered as "seepage variants" of the Vaccinium, Menziesia - Lycopodium, and Hylocomium-Cornus associations, but it has a degree of distinction in the greater abundance of Ledum groenlandicum, Empetrum nigrum, Equisetum scirpoides, E. Variegatum, Pedicularis bracteosa, and Senecio triangularis.

Picea - Abies / Vaccinium scoparium Association — Grouseberry

This type occurs at the highest elevations, from 6400 feet to near timberline. There is very deep snow accumulation, an extremely short growing season with suboptimal temperatures, and frozen soil late in the year. The stands have a distinctive physiognomy: low, ericaceous shrubs and gray Cladonia tufts cover the floor beneath the narrow-crowned trees. Towards timberline the forest becomes discontinuous, with meadows and heaths interspersed between the stands of trees.

The soils are podzolic, but because of the lower temperatures the degree of podzolisation is less than at lower elevations such as in the Menziesia - Lycopodium type. The soil profile has a narrow humus horizon, an ashy A_2, and an acid B.

$A_{00} + A_0$	0-2"	decomposing needle and moss litter; very sparse to sparse mycelium. pH 4.7 (3.8-5.65)
A_2	2-3½"	ashy gray, single grain to platy; sandy loam to loam. pH 4.5 (3.9-5.25)
B_1	4-6"	variable. yellow red to red brown; weak blocky; gravelly, sandy loam to loam. pH 4.8 (4.2-5.5)

B_2	6-16"	yellow brown to red brown; weak blocky; gravelly, sandy loam to sandy clay loam. pH 5.4 (4.5-6.45)
C	16	variable; yellow gray; massive; frequently cemented; gravelly to extremely gravelly, sand to sandy clay loam; the upper part of this horizon tends to be acid, and varies to basic and calcareous in the lower part. pH 6.8 (4.85-8.2)

The tree layer consists of Picea engelmannii, Abies lasiocarpa, and occasional Larix lyallii and Pinus albicaulis.

The low shrub layer is well developed, composed manily of: Vaccinium scoparium, Phyllodoce glanduliflora, P. empetriformis, Empetrum nigrum, Cassiope mertensiana, C. tetragona, and Salix vestita.

The herb layer is very sparse: Arnica latifolia, Pedicularis bracteosa, Valeriana sitchensis, Sibbaldia procumbens, Potentilla diversifolia, Antennaria neglecta, and Pyrola secunda.

The bryophyte and lichen layer is very abundant, with: Cladonia spp., Peltigera aphthosa, liverworts, Dicranum fuscescens, Pleurozium schreberi, and Hylocomium splendens.

Spruce growth in this type is poor. Lodgepole pine may occur as scattered individuals in the stands.

Picea - Abies / Equisetum Association — Upper Streamside Horsetail

Along tributary streams at higher elevations there are conditions resembling the river flat Equisetum type of the valley bottom. The stream-laid materials are relatively fine: stratified sand, silt, and some gravel. The water table is high and the soil profile is an immature gleysolic with an A - C horizon sequence.

$A_{00} + A_0$	0-1"	decomposing needle and moss litter; mycelium very sparse. pH 6.5 (5.7-7.65)
A_1	2-6"	variable, organic matter + mineral material; granular structure. pH 6.0 (5.4-6.4)
C	6-12"	moist; gray brown; stratified, sand to loam. pH 7.2 (5.9-7.85)
C_G	12"	brown gray; mottling; seepage, wet; stratified, sandy loam to clay loam. pH 6.9 (5.25-7.9)

The tree layer consists of the hybrid Picea glauca X P. engelmannii, and Abies lasiocarpa.

The shrub layer is moderately developed, consisting mainly of: Lonicera involucrata, Rosa acicularis, Ribes lacustre, Salix spp., and Rubus pubescens.

The abundant herb layer is dominated by Equisetum arvense and E. pratense. Other typical species are: Equisetum scirpoides, Mitella nuda, Cornus canadensis, Linnaea borealis var. americana, Epilobium angustifolium, Carex spp., Pyrola secunda, Fragaria virginiana var. glauca, Petasites frigidus var. palmatus, and Osmorhiza chilensis.

The bryophyte and lichen layer is abundant, composed typically of: Timmia austriaca, Mnium affine, Hylocomium splendens, Peltigera canina, Ptilium crista-castrensis, and Pleurozium schreberi.

This association is a spruce-fir type; lodgepole pine occurs only rarely. Spruce growth is excellent in this type.