4.3 Biogeoclimatic Units of the North Half of the Prince Rupert Forest Region

This section describes the biogeoclimatic units in the north half of the PRFR. Because of its remoteness, the north half of the region has not been studied in the same detail as the south half. Although the district is vast and ecologically diverse, few subzones and variants have been described so far. This situation is certain to change as the area receives further study.

The north half of the PRFR is 14 037 591 ha in size, and represents 56% of the entire region. It ranges from small areas of coastal forest to extensive areas of boreal forest and alpine tundra, extending north to the Yukon and Alaskan borders (Tables 4.8 and 4.9; Figure 4.13).

A large portion of the area is occupied by the Boreal White and Black Spruce zone (BWBS). This zone covers the lowland and montane areas east of the Coast Range. It is characterized by a northern continental climate, with long, very cold winters and a short growing season. Forest productivity is limited by the harsh climate of this boreal zone.

Above the BWBS is the Spruce – Willow – Birch zone (SWB), a subalpine zone characterized by an interior continental climate and covering the most extensive portions of the north half of the region. This zone is forested at lower elevations, mostly by subalpine fir and white spruce, but at higher elevations may be dominated by deciduous shrubs.

There is a small area of Sub-Boreal Spruce zone (SBS) in the north half of the region, occurring in the transition between the coast and interior along the low-elevation valleys of the Stikine and Caku rivers.

A unique subzone of the Interior Cedar – Hemlock zone occurs only in the north half of the region, and occurs along low to mid elevations in the central part of the Iskut and Stikine river valleys that slice through the Coast Mountains. It is neither typically coastal nor continental and is characterized by moist, moderately heavy snowpacks in the winter.

The Coastal Western Hemlock zone (CWH) occurs at low to mid elevations west of the ICH in the Coast Mountains. It is characterized by a maritime, humid (snowy) climate.

The Mountain Hemlock zone (MH) occurs above the CWH on the west slopes of the Coast Mountains. The Engelmann Spruce – Subalpine Fir zone (ESSF) lies above the ICH, SBS, and southernmost BWBS zones. The ESSF in this part of the region has the wettest and snowiest extremes of the zone and occurs in areas broadly transitional between the MH and the SWB zones. The Alpine Tundra zone (AT) covers the highest elevations throughout the north half of the PRFR.

TABLE 4.8. Environmental characteristics of all forested zones in the PRFR, north half

Biogeoclimatic zone	BWBS	SWB	SBS
Extent			
Area	2 479 000 ha	4 854 206 ha	163 278 ha
% of PRFR, north half	17.6%	34.6%	1.2%
Elevation range	300 - 1150 m	900 - 1700 m	100 - 800 m
Physiography			
Physiographic units	Stikine Plateau; Yukon Plateau; Liard Plain; Cassiar Mtns.; St. Elias Mtns.; northernmost Skeena Mtns.	Stikine Plateau; Yukon Plateau; Cassiar Mtns; Liard Plain; St. Elias Mtns.	Eastern valleys of Coast Mtns., Boundary Ranges; westernmost portions of Yukon and Stikine plateaus
Terrain	Flat to rolling plains and plateaus in the east; narrow mountain valleys in the west	Gently rolling plateaus to steep, heavily glaciated mountain slopes	Lower slopes and floors of major river valleys
Climate	Northern continental with frequent arctic airmasses; long, very cold winters and short, dry, quite warm summers	Northern interior subalpine, with frequent arctic airmasses; very long, cold winters and very short, cool summers	Continental, but with slight coastal influence; moister, with longer growing season and milder winters than BWBS
Soils			
Dominant soils	Brunisolic Gray Luvisols; Dystric Brunisols	Humo-Ferric Podzols; Eutric and Dystric Brunisols	Probably Humo-Ferric Podzols and Gray Luvisols
Humus forms	Hemimors; > 10 cm thick	Hemimors and Mormoders	Hemimors
Tree species[a]			
Major coniferous trees	Sw, Sb, Bl, Pl	Sw, Bl, Pl	Sxw, Bl, Pl, Sb
Major deciduous trees	At, Acb or Act, Ep	Willows, At, Acb	Act, Ep (At)

[a] Tree species codes are found in Appendix 3.

ICH	ESSF	CWH	MH
100 367 ha 0.7% 100 - 900 m	601 407 ha 4.3% 800 - 1500 m	175 670 ha 1.2% 0 - 450 m	220 680 ha 1.6% 400 - 1000 m
Eastern valleys of Coast Mtns., Boundary Ranges	Northernmost Skeena Mtns.; eastern slopes of Coast Mtns., Boundary Ranges	Coast Mtns., Boundary Ranges, St. Elias Mtns.	Coast Mtns., Boundary Ranges, St. Elias Mtns.
Lower slopes and floors of major river valleys	Gentle to steep, rocky mountain slopes	Steep, lower slopes and floors of heavily glaciated river valleys	Steep, heavily glaciated mountain slopes
Transitional; continental but moderated by strong coastal influences; cool, moist summers and cold, snowy winters	Interior subalpine; long, cold snowy winters and short, cool, rather wet summers	Submaritime; cool, moist summers and wet, very snowy winters; most valleys lie in rainshadow of the Coast Mtns. and are strongly influenced by nearby glaciers	Coastal subalpine; wet, snowy winters and short, cool, wet summers; strongly influenced by surrounding glaciers
Brunisolic Gray Luvisols; Dystric Brunisols	Ferro-Humic Podzols	Humo-Ferric Podzols	Ferro-Humic and Humo Ferric Podzols
Hemimors and Hemihumimors; > 10 cm thick	Hemihumimors; 5 - 15 cm thick	Hemimors and Mormoders	Humimors and Hemihumimors; 5 - 15 cm thick
Hw, Bl, Sx, Pl At, Act, Ep	Bl, Hm, Sxw, Hw --	Hw, Ss, Bl Act, Dr	Hm, Bl, Hw --

TABLE 4.9. Climatic characteristics of all forested zones in the PRFR, north half.

Biogeoclimatic zone		BWBS	SWB	SBS
Sources of climate data L/S/M[a]		2/4/1	1/0/0	
Name of reference station (RS)		Dease Lake	Cassiar	
Elevation of reference station		816 m	1078 m	
Precipitation				
Annual precipitation (mm)				
	range	327 – 461	--	--
	RS	406	700	--
Growing season precip. (mm)				
	range	142 – 223	--	--
	RS	221	275	--
Annual snowfall (cm)				
	range	135 – 205	--	--
	RS	205	295	--
Number of months with snowfall				
	range	9 – 11	--	
	RS	11	11	
Temperature				
Mean annual temp. (°C)				
	range	- 2.9 – 2.0	--	--
	RS	- 1.3	- 3.2	--
Mean temp. coldest month (°C)				
	range	- 26.4 to - 18.2	--	--
	RS	- 19.7	- 19.2	--
Extreme minimum temp. (°C)				
	range	- 52.8 to - 41.7	--	--
	RS	- 51.1	- 47.2	--
Mean temp. warmest month (°C)				
	range	12.0 – 15.6	--	--
	RS	12.5	11.2	--
Extreme maximum temp. (°C)				
	range	29.5 – 36.0	--	
	RS	33.9	29.4	--
Growing degree days >5°C				
	range	659 – 1226	--	--
	RS	748	534	--
Frost-free days				
	range	44 – 110	--	--
	RS	44	37	--

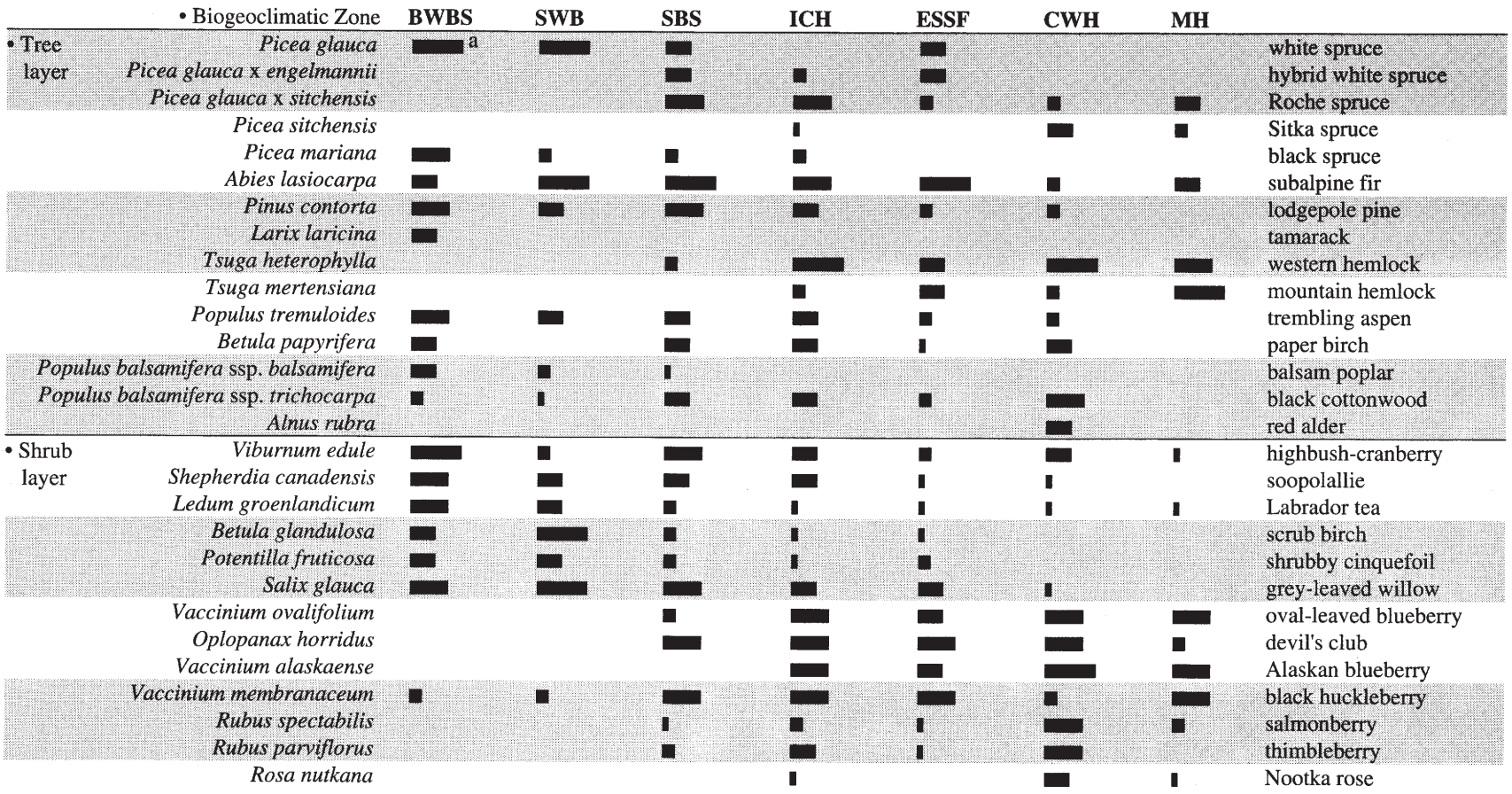
[a] Normalized climatic data L = long-term (Atmospheric Environment Services)
S = short-term (Atmospheric Environment Services)
M = short-term (B.C. Ministry of Environment).

Note: Not all climatic variables are available from short-term stations.

[b] Unnormalized short-term data.

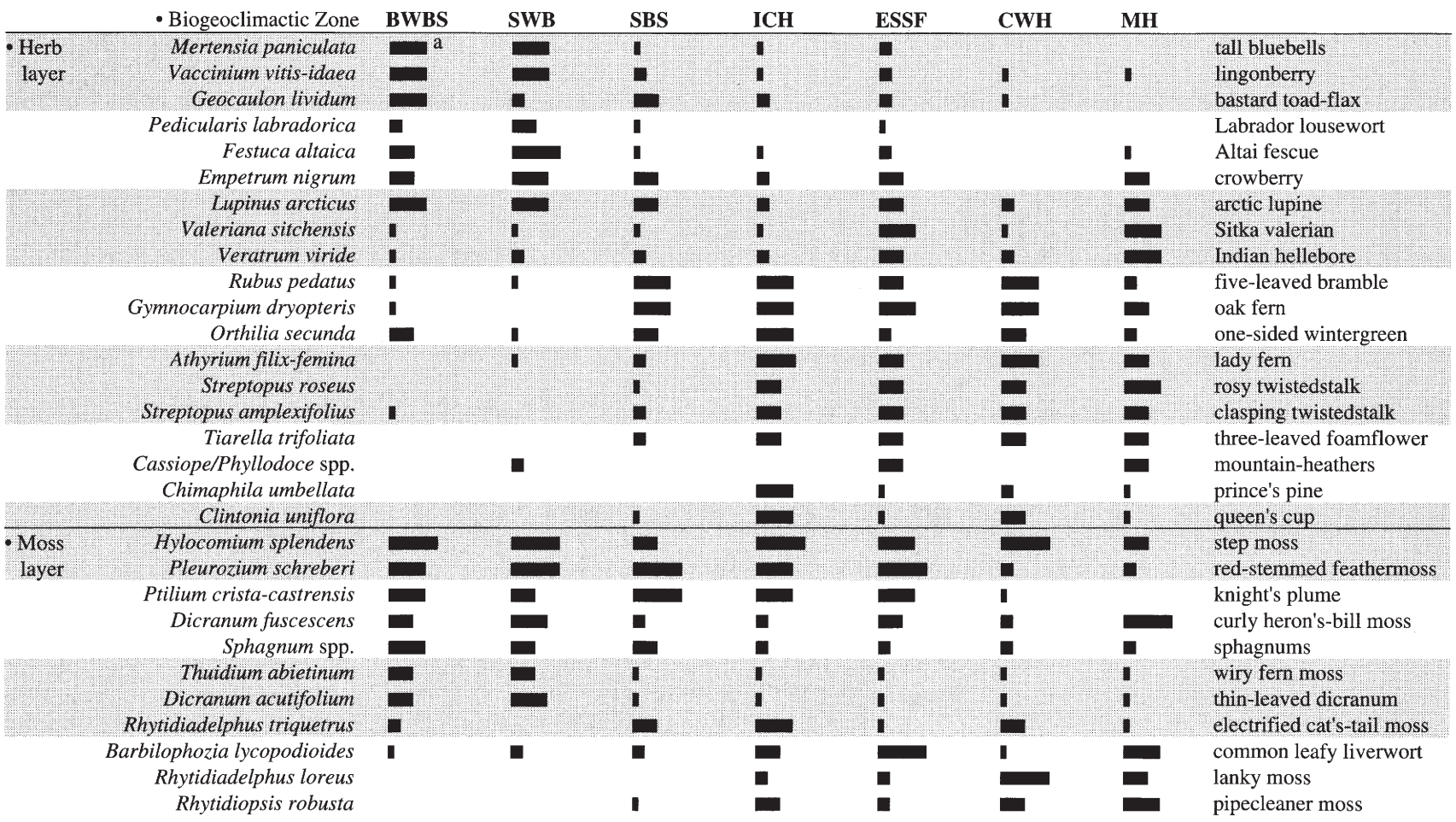
[c] This station probably located in AT zone.

ICH	ESSF	CWH	MH
-- Bob Quinn Lake[b] 457 m	-- Brucejack Lake[bc] 1376 m	-- Bronson Cr.[b] 110 m	-- Johnny Mountain[b] 1067 m
-- 620	-- --	-- --	-- 2420
-- 258	-- 318	-- 580	-- 757
-- 174	-- --	-- --	-- 1483
-- 9	-- 10	-- 8	-- 10
-- 3.0	-- -0.1	-- 5.0	-- 0.4
-- - 9.4	-- - 10.3	-- - 7.3	-- -8.6
-- - 37.0	-- - 36.0	-- - 28.0	-- - 29.5
-- 14.0	-- 9.5	-- 16.2	-- 9.8
-- 32.5	-- 23.0	-- 30.5	-- 23.5
-- 979	-- --	-- --	-- --
-- 158	-- --	-- --	-- --



[a] Bars indicate the relative abundance of plants across all site series within a biogeoclimatic unit. These bars are defined in Section 3.2.2, page 3•6.

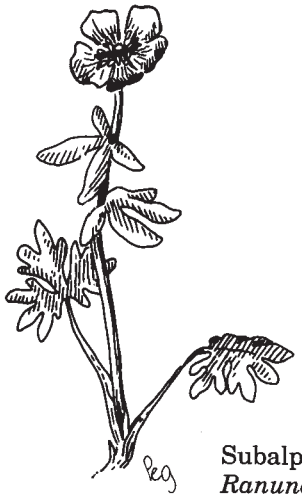
FIGURE 4.13. Vegetation table for all forested zones in the PRFR, north half.



[a] Bars indicate the relative abundance of plants across all site series within a biogeoclimatic unit. These bars are defined in Section 3.2.2, page 3•6.

FIGURE 4.13. (Continued)

Pink mountain-heather
Phyllodoce empetriformis



Subalpine buttercup
Ranunculus eschscholtzii

Partridgefoot
Luetkea pectinata

4.3.1 AT Alpine Tundra Zone

Location and Distribution: (Figure 4.3) The AT is the most extensive zone in the north half of the region, occupying 21.7% of the land area. It is widespread in the Coast, St. Elias, northern Skeena, and Cassiar mountains, and includes vast areas of the Stikine and Yukon plateaus as well. Most of this northern AT lies above the SWB, above elevations of 1000 - 1600 m. In the Coast Mountains, the AT occurs above the MH, above 900 - 1000 m.

Ecological Conditions: In general terms, the climate, vegetation, and soil of the northern AT is much like that of the alpine zone in the south half of the region. Northern krummholz is mostly mountain hemlock and subalpine fir in the coastal AT, and subalpine fir and white spruce in the interior AT. The dwarf evergreen and dwarf willow scrub types are much the same, but, in the north, two additional scrub types are widespread: dwarf evergreen mountain-heather – dominated communities, and erect, low, deciduous scrub dominated by scrub birch, willows, or Sitka alder. Grassy, Altai fescue - lichen tundra is very extensive, especially on high alpine plateaus and rolling ridges.

Permafrost and Turbic and Organic Cryosols are locally common at high latitudes or on north aspects where subsurface drainage is impeded.

Differentiating Features: Where the AT occurs above the SWB, the distinction between subalpine and alpine is not as straightforward as between the AT and the MH or ESSF. Upper parts of the SWB are virtually treeless, and are dominated by dense thickets of medium to tall (1 - 4 m high) deciduous shrubs (mainly scrub birch and/or willows). With increasing elevation, the stature of the shrub thickets declines. However, low scrub is still found in some parts of the alpine at lower elevations; a height criterion of 1 m or less is used to distinguish alpine scrub from SWB shrub communities.

Subzones: As in the south half of the region, there are two major divisions of AT: coastal and interior. The coastal AT is dominated by dwarf evergreen scrub (mainly mountain-heathers), whereas the interior AT zone has low deciduous scrub and tundra of dwarf willows, grasses, sedges, and lichens.

Tall bluebells
Mertensia paniculata

Scrub birch
Betula glandulosa

4.3.2 BWBS Boreal White and Black Spruce Zone

Location and Distribution: (Figure 4.14; Table 4.8) The BWBS is a lowland to montane zone, occurring north of roughly 57° N latitude and at elevations ranging from 100 to 1200 m. It occupies the lower elevations of the main valleys east of the Coast - St. Elias mountains. Major areas occur in the Dease-Kechika-Liard drainages, the middle Stikine and Taku drainages, around Atlin and Teslin lakes, and in the Tatshenshini drainage of the Haines Triangle. The largest expanse of BWBS in the PRFR covers the Liard Plain, centred on Lower Post. The BWBS represents 9.6% of the land area within the north half of the PRFR. All of the zone in the region lies within the Cassiar Forest District.

Climate: (Table 4.9) The northern continental climate, with its frequent outbreaks of arctic air masses, features long, very cold winters and short growing seasons. The prevailing poor tree growth in the BWBS reflects the adverse climate, especially the short vegetative season and cold soil temperatures. Most of the area has mean annual temperatures below freezing. The average temperature remains below 0° C for 5 to 7 months, and above 10° C for only 3 to 4 months (5 months at Telegraph Creek). However, mid-summer temperatures can be quite hot, and because of the long summer days, night-time cooling can be much less than further south. The ground freezes deeply for a large part of the year, and discontinuous permafrost may occur on some northern slopes and in peatlands. However, permafrost is much less extensive in the Cassiar Forest District than in the neighbouring Fort Nelson Lowland. Precipitation averages between 260 and 465 mm, with 35 - 55 % falling as snow.

Vegetation: (Figure 4.15) White spruce, black spruce, subalpine fir, lodgepole pine, trembling aspen, balsam poplar, and paper birch are the major tree species of the BWBS in the Cassiar Forest District. In general, there is more subalpine fir and less black spruce than in the BWBS northeast of the Rocky Mountains. Tamarack and Alaska paper birch are virtually restricted to the northeastern corner of the district, on the Liard Plain.

Forests predominate in the BWBS. Forest fires are frequent throughout, maintaining a variety of stand age classes and successional stages. “Climax” forest is dominated by white spruce, sometimes with subalpine fir and minor black spruce. Most older stands have at least a few trembling aspen and lodgepole pine remaining. Seral stands of lodgepole pine, trembling aspen, and mixed white spruce - aspen are common. With severe, repeated fires, forests give way to a persistent scrub of willow and aspen. Dry pine - lichen forest communities occur widely. Black spruce sphagnum wetlands are also common, but not extensive. Dry grassland and scrub vegetation is locally common on steep, south-facing slopes in the major valleys.

On more or less zonal sites, shrub and herb layers are poorly to moderately developed. Characteristic understory species include highbush-cranberry, prickly rose, soopolallie, bunchberry, twinflower, heart-leaved arnica, and

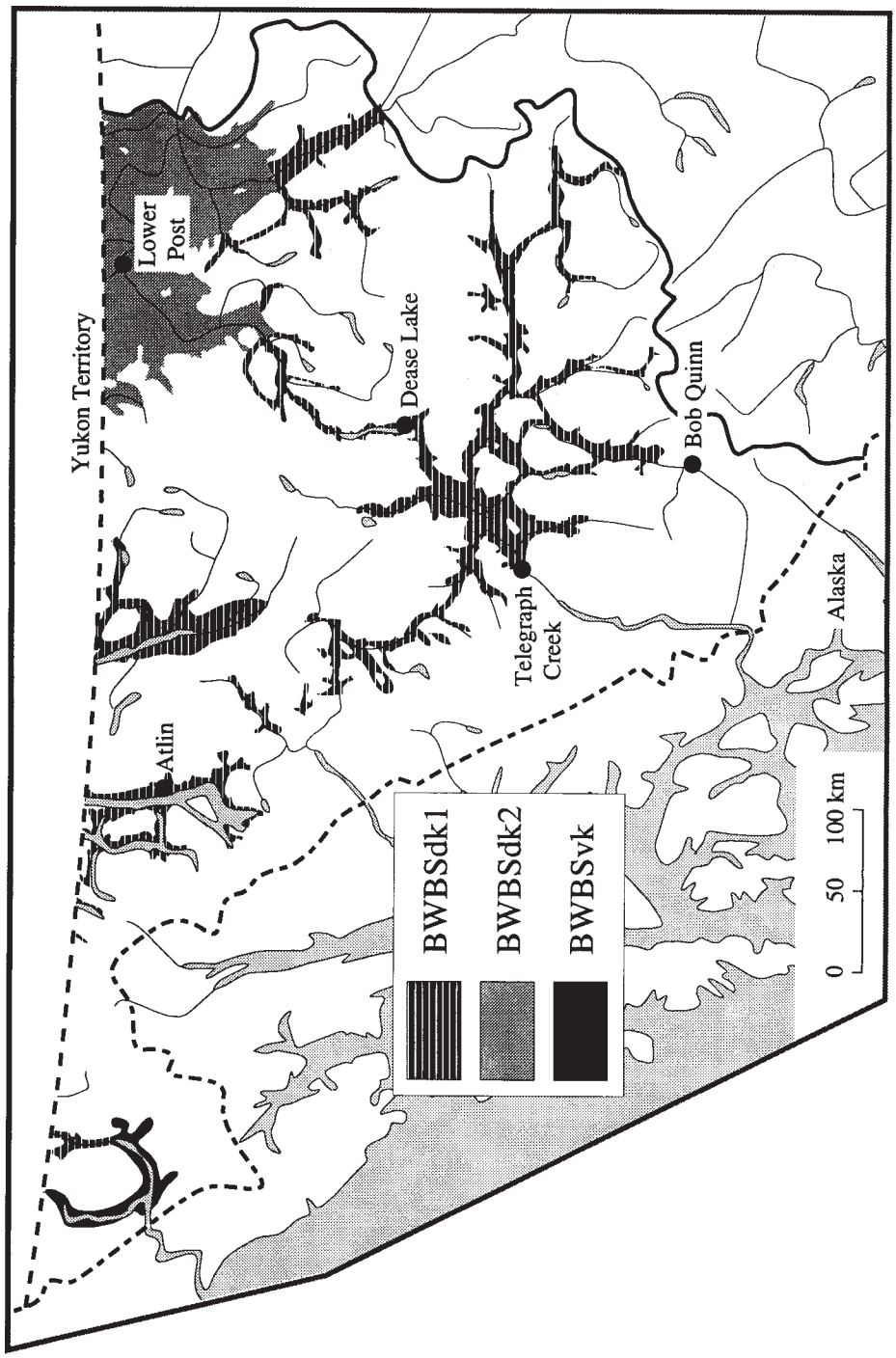


FIGURE 4.14. Distribution of BWBS subzones and variants in the PRFR, north half.

tall bluebells. Other common species include green alder, Labrador tea, lingonberry, Altai fescue, palmate coltsfoot, bastard toad-flax, and one-sided wintergreen. The moss layer is well developed and dominated by feathermosses, mainly step moss with lesser amounts of knight's plume and red-stemmed feathermoss. Freckled lichen is consistent but rarely abundant in the ground cover.

Soils: (Table 4.8) Zonal soils in the BWBS are dominantly Brunisolic Gray Luvisols in finer-textured morainal parent materials and Orthic Dystric Brunisols on coarser-textured morainal and fluvial materials. Hemimor humus forms predominate and are usually more than 10 cm thick. Organic horizons thicken as stands age, their canopies close, and deciduous trees drop out. Thickening of the insulating organic layers causes a progressive decline in soil temperature, and this consequently retards tree growth. Fire is the primary agent that breaks down these organic layers, releasing nutrients and revitalizing the ecosystem. However, if severe fires occur too frequently, site productivity will decline as nutrients are lost through volatilization and erosion. The most productive ecosystems in the zone occur on freely drained alluvial sites that rarely burn, but receive periodic flooding that retards humus build-up and provides an external source of soil nutrients. Such sites have Orthic, Gleyed, or Cumulic Regosols. Poorly drained soils (Gleysols and Organics) remain cold throughout the year, in some cases permanently frozen, and generally do not support forest vegetation.

Differentiating Features: The BWBS is distinguished by its patchwork of slow-growing forests, deciduous scrub, and wetlands of varying ages and successional stages. White spruce is dominant, in mixture with a variety of species including subalpine fir, black spruce, lodgepole pine, trembling aspen, paper birch, and balsam poplar. The BWBS can be differentiated from the SBS, ICH, and ESSF by the absence of Engelmann or Sitka spruce hybridization, black huckleberry, and devil's club, and by the greater abundance on zonal sites of black spruce, Labrador tea, and tall bluebells. The BWBS variant, which abuts the SBS on the Iskut, Taku, and Stikine rivers, lacks subalpine fir. From the ICH, the BWBS is also distinguished by a lack of western hemlock, oval-leaved blueberry, Alaskan blueberry, and false azalea. The transition between the BWBS and the SWB is gradual. It is usually around 900 - 1100 m elevation. The BWBS has less subalpine fir, a more continuous and productive forest cover, and more pine and deciduous trees than the SWB. Mature BWBS forests generally do not have much willow and scrub birch in the understory.

Subzones and Variants: (Figures 4.14 and 4.15; Table 4.10). The BWBS in the PRFR is represented by two Subzones. The drier, more extensive subzone has two variants:

BWBSdk - Dry Cool subzone

BWBSdk1 - Stikine variant
BWBSdk2 - Liard variant

BWBSvk - Very Wet Cool subzone

TABLE 4.10. Environmental characteristics of BWBS subzones and variants in the PRFR, north half

Subzone or variant	BWBSdk1	BWBSdk2
Extent		
Area	1 023 700 ha	1 396 743 ha
% of PRFR, north half	7.3%	9.9%
Elevation range	500 - 1050 m	350 - 1200 m
Distribution		
Physiographic regions	Stikine Plateau; Yukon Plateau; Cassiar Mtns.; St. Elias Mtns.; northernmost Skeena Mtns.	Liard Plain; Dease Plateau
Major drainages	Iskut R. upstream of Durham Cr.; Stikine R. upstream of Glenora; Tahltan, Tuya, and Tanzilla r.; Dease R. upstream of McDame; upper Inklin and Sheslay r.; Teslin Lake; Atlin Lake; upper Tatshenshini R.	Dease R. downstream of McDame; lower Blue and Little Rancheria r.; lower Kechika and Rabbit r.; main Liard R. valley
Climate		
	Montane climate with slight coastal influence. Drier, warmer in winter with less snow; and drier and slightly cooler in summer than the dk2. Highly variable due to temperature inversions, chinook winds, rainshadows, and N/S aspect differences.	More continental than dk1, with colder winters and colder soils. A warmer, moister growing season with more growing degree days than the dk1. Less variable than dk1 because of flat terrain.
Soils		
Zonal soils	Orthic Dystric and Eutric Brunisols; Brunisolic Gray Luvisols	Brunisolic Gray Luvisols; Orthic Dystric Brunisols
Humus forms	Hemimors	Hemimors
Vegetation[a]		
Major tree species	Sw, Pl, At, (Bl, Sb, Acb, Ep)	Sx, At, Sb, Pl, (Acb, Ep, Bl, Lt)
Zonal site association	Sw - Knight's plume - Step moss	Sw - Knight's plume - Step moss

[a] Tree species codes are found in Appendix 3.

BWBSvk

58 557 ha
0.4 %
100 - 600 m

St. Elias Mtns.; Alsek Ranges

Lower Tatshenshini R. below confluence with O'Connor R.; middle Alsek R. below Range Cr.

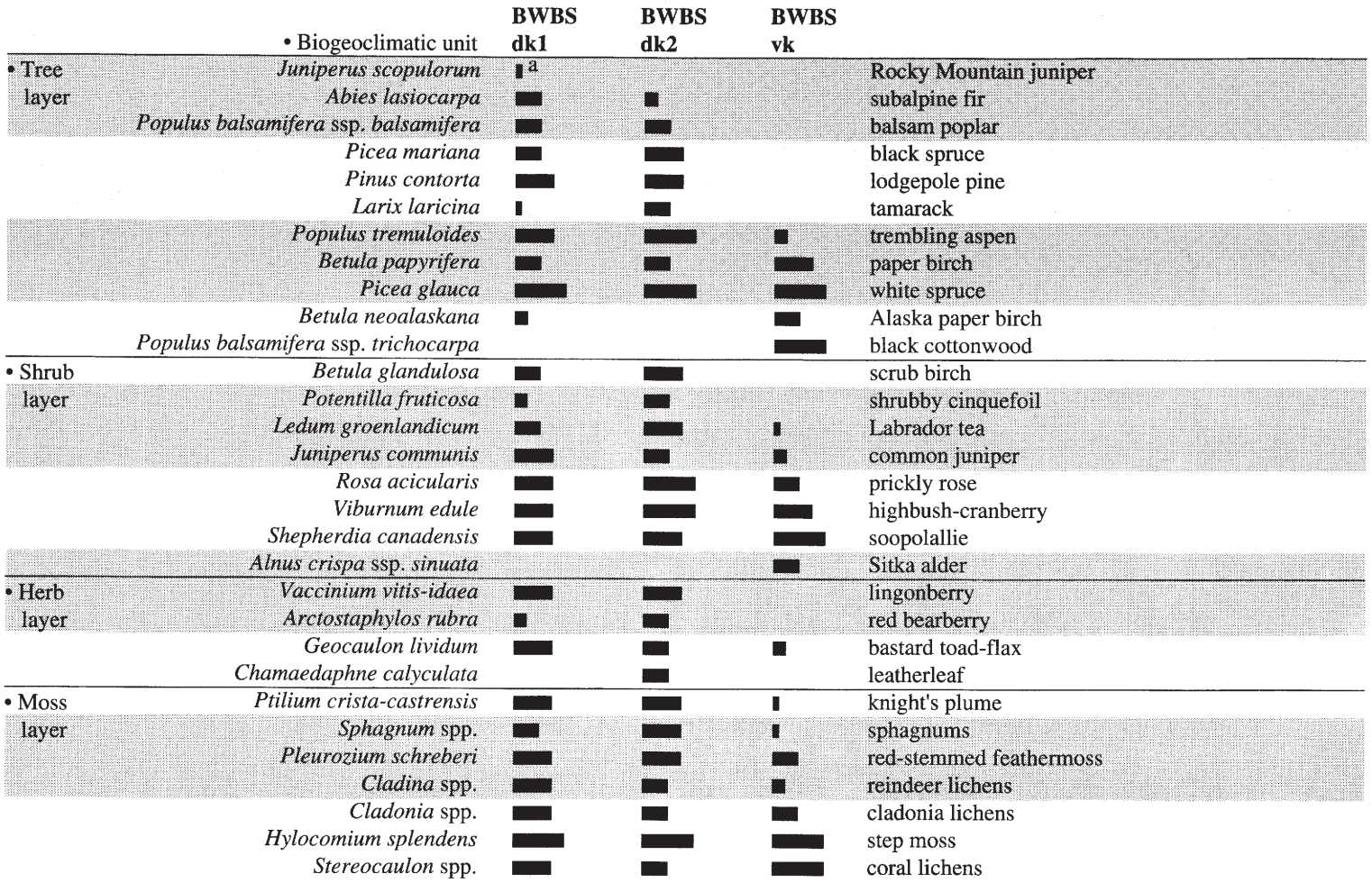
Montane climate with strong gradients; dominantly interior type but with coastal influence. Relatively wet (very snowy), very windy, subject to cold air ponding, chinooks, and outflow winds.

Melanic, Sombric, and Dystric Brunisols

Mormoders

Act, Sw, Ep, (At)

Sw - Red swamp currant - Step moss



• Biogeoclimatic unit		BWBS dk1	BWBS dk2	BWBS vk	
• Tree layer	*Juniperus scopulorum*	▮ [a]			Rocky Mountain juniper
	Abies lasiocarpa	▬	▪		subalpine fir
	Populus balsamifera ssp. *balsamifera*	▬	▬		balsam poplar
	Picea mariana	▬	▬		black spruce
	Pinus contorta	▬	▬		lodgepole pine
	Larix laricina	▮	▬		tamarack
	Populus tremuloides	▬	▬	▪	trembling aspen
	Betula papyrifera	▬	▬	▬	paper birch
	Picea glauca	▬	▬	▬	white spruce
	Betula neoalaskana	▪		▬	Alaska paper birch
	Populus balsamifera ssp. *trichocarpa*			▬	black cottonwood
• Shrub layer	*Betula glandulosa*	▬	▬		scrub birch
	Potentilla fruticosa	▪	▬		shrubby cinquefoil
	Ledum groenlandicum	▬	▬	▮	Labrador tea
	Juniperus communis	▬	▬	▪	common juniper
	Rosa acicularis	▬	▬	▬	prickly rose
	Viburnum edule	▬	▬	▬	highbush-cranberry
	Shepherdia canadensis	▬	▬	▬	soopolallie
	Alnus crispa ssp. *sinuata*			▬	Sitka alder
• Herb layer	*Vaccinium vitis-idaea*	▬	▬		lingonberry
	Arctostaphylos rubra	▪	▬		red bearberry
	Geocaulon lividum	▬	▬	▪	bastard toad-flax
	Chamaedaphne calyculata		▬		leatherleaf
• Moss layer	*Ptilium crista-castrensis*	▬	▬	▮	knight's plume
	Sphagnum spp.	▬	▬	▮	sphagnums
	Pleurozium schreberi	▬	▬	▬	red-stemmed feathermoss
	Cladina spp.	▬	▬	▪	reindeer lichens
	Cladonia spp.	▬	▬	▬	cladonia lichens
	Hylocomium splendens	▬	▬	▬	step moss
	Stereocaulon spp.	▬	▬	▬	coral lichens

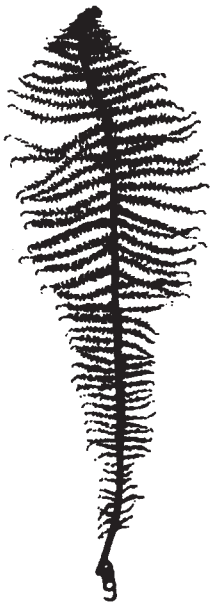
[a] Bars indicate the relative abundance of plants across all site series within a biogeoclimatic unit. These bars are defined in Section 3.2.2, page 3•6.

FIGURE 4.15. Vegetation table for BWBS subzones and variants in the PRFR, north half.

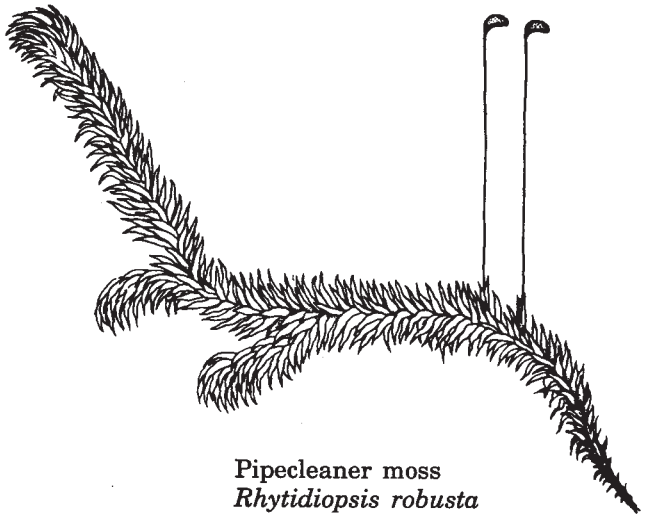
The **BWBSdk** is drier and cooler than other BWBS Subzones and has notably less precipitation during the growing season, making it less productive for tree growth and agriculture. Distinguishing species for the Subzone include soopolallie and bastard toad-flax, both of which are common on zonal sites. The **BWBSdk1** occurs within mountainous terrain and experiences many of the peculiarities of mountain climates (temperature inversions, chinook winds, local rainshadow, pronounced aspect differences). In general, it is drier and warmer in winter with less snow, and drier and slightly cooler during the growing season than the **BWBSdk2**. Climatic climax ecosystems appear to be dominantly white spruce forests. Subalpine fir is more common and black spruce is less common than in the BWBSdk2. Tamarack is virtually absent. The BWBSdk2 occupies the flat to gently rolling landscape of the Liard Plain and Dease Plateau. It has a more continental climate with colder winters (colder soils) than the BWBSdk1, but also receives more precipitation because it is out of the rainshadow of the mountains. Zonal ecosystems are usually mixed conifer and deciduous stands; black spruce communities on organic soils are abundant and most bogs have permafrost. Tamarack and leatherleaf are two typical wetland species.

The **BWBSvk** is an unusual boreal Subzone that occurs in British Columbia only in the western part (Alsek Ranges) of the Tatshenshini Alsek area, also known as the Haines Triangle. This far northwestern corner of British Columbia lies between the Coast Mountains to the east and the higher, wetter, more heavily glaciated Icefield and Fairweather ranges to the west. The valley of the lower Alsek River provides the only low-elevation breach in the windward front of the massive St. Elias Mountains, so weather spawned in the North Pacific is funnelled up the Alsek and Tatshenshini rivers. The climate of the BWBSvk appears to be a dominantly interior but transitional type, with strong gradients. It is drier than that of the coastal belt (which occurs further west in Alaska), but wetter and considerably snowier than that of the BWBSdk in the Tatshenshini Basin to the east. Heavy snowpacks and strong winds are key environmental features.

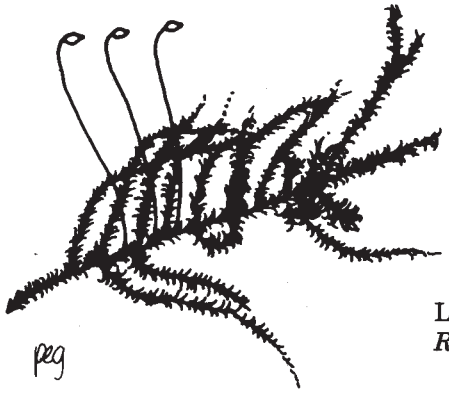
Reconnaissance-level sampling indicates that zonal forests in the BWBSvk are a mixedwood type, with white spruce, black cottonwood, and paper birch the most abundant tree species. The open stands have a well-developed understory of shrubs (willows, Sitka alder, mountain alder, soopolallie, highbush-cranberry, and red swamp currant) and herbs. Soils are Brunisols developed in loess (aeolian deposits), and, interestingly, they show no evidence of fire. Trembling aspen is uncommon, and lodgepole pine and subalpine fir are absent, as are western hemlock, Sitka spruce, and red alder. Notable is the abundance of black cottonwood. It forms extensive stands (with very minor white spruce), over an alder understory on many of the recent fluvial landforms. Very recent sandy-gravelly river deposits develop a characteristic cover dominated by yellow mountain-avens, rock mosses, and coral lichens. Newly exposed glacial till tends to be covered by shrub thickets of Sitka alder and willows rather than by trees. Wetlands are uncommon, and are mostly riparian backswamps and marshes.



Knight's plume
Ptilium crista-castrensis



Pipecleaner moss
Rhytidiopsis robusta



Lanky moss
Rhytidiadelphus loreus

4.3.3 CWH Coastal Western Hemlock Zone

Location and Distribution: (Figure 4.16; Table 4.8). The CWH occurs at low to middle elevations mostly west of the crest of the Coast Mountains. There is not much CWH in the north half of the PRFR (1.2%). The most significant areas of the zone occur along the lower stretches of the Unuk, Iskut - Stikine, Whiting, and Uaku drainages, along with some pockets in the eastern Haines Triangle. The CWH occupies elevations from near sea level to 300 - 450 m.

Climate: (Table 4.9) This northern portion of the CWH lies inland of the Alaska Panhandle, where it has no contact with the ocean. It is characterized by a submaritime, humid (snowy) climate. Stewart is the closest long-term, Canadian climate station, but comparisons with data from Alaskan stations such as Juneau and Wrangell and a short-term station at Bronson Creek indicate that it has a representative climate for the zone. Mean annual temperature at Stewart is 5.1° C. Average temperature is above 10° C for 4 months of the year and below 0° C for 3 months. Mean annual precipitation is 1843 mm; mean annual snowfall is 532 cm. The summer is cool and moist, fall is very wet, and winter is cool and has heavy, wet snowfalls. Local climate in the northern CWH is very strongly affected by cold air from the massive surrounding icefields that extend in many places to the valley floor.

Vegetation: (Figure 4.13) The CWH in the Cassiar Forest District differs from the southern CWH in that two key species, amabilis fir and western redcedar, are absent. Yellow-cedar is also absent. Most of the zone is covered by closed forests dominated by western hemlock and containing variable amounts of Sitka spruce. Sitka spruce is most abundant on alluvial terraces bordering the broad, braided riverbeds. Black cottonwood forms extensive stands on floodplains that occupy much of the valley bottoms along these braided rivers. Red alder and occasionally paper birch also occur in the alluvial forests. Subalpine fir is fairly common as a minor component of many stands, whereas dry, seral lodgepole pine stands are uncommon. Wetlands are uncommon in this zone, but when present are primarily riparian types.

On zonal ecosystems, Alaskan blueberry is the characteristic dominant shrub. Oval-leaved blueberry, false azalea, and devil's club are also frequent. Typical herbs include five-leaved bramble, bunchberry, oak fern, and one-sided wintergreen. Lanky moss, pipecleaner moss, step moss, knight's plume, and cedar-shake liverwort are also characteristic. Because of the snowy climate and concave, glacial valley profiles, devil's-club ecosystems are probably more widespread than zonal ecosystems. In addition to devil's club, these moister, richer ecosystems include thimbleberry, black gooseberry, oak fern, spiny wood fern, lady fern, rosy twistedstalk, clasping twistedstalk, three-leaved foamflower, leafy mosses, and ragged mosses. Red-osier dogwood, salmonberry, thimbleberry, highbush-cranberry, and stink currant typically join devil's club in alluvial forests.

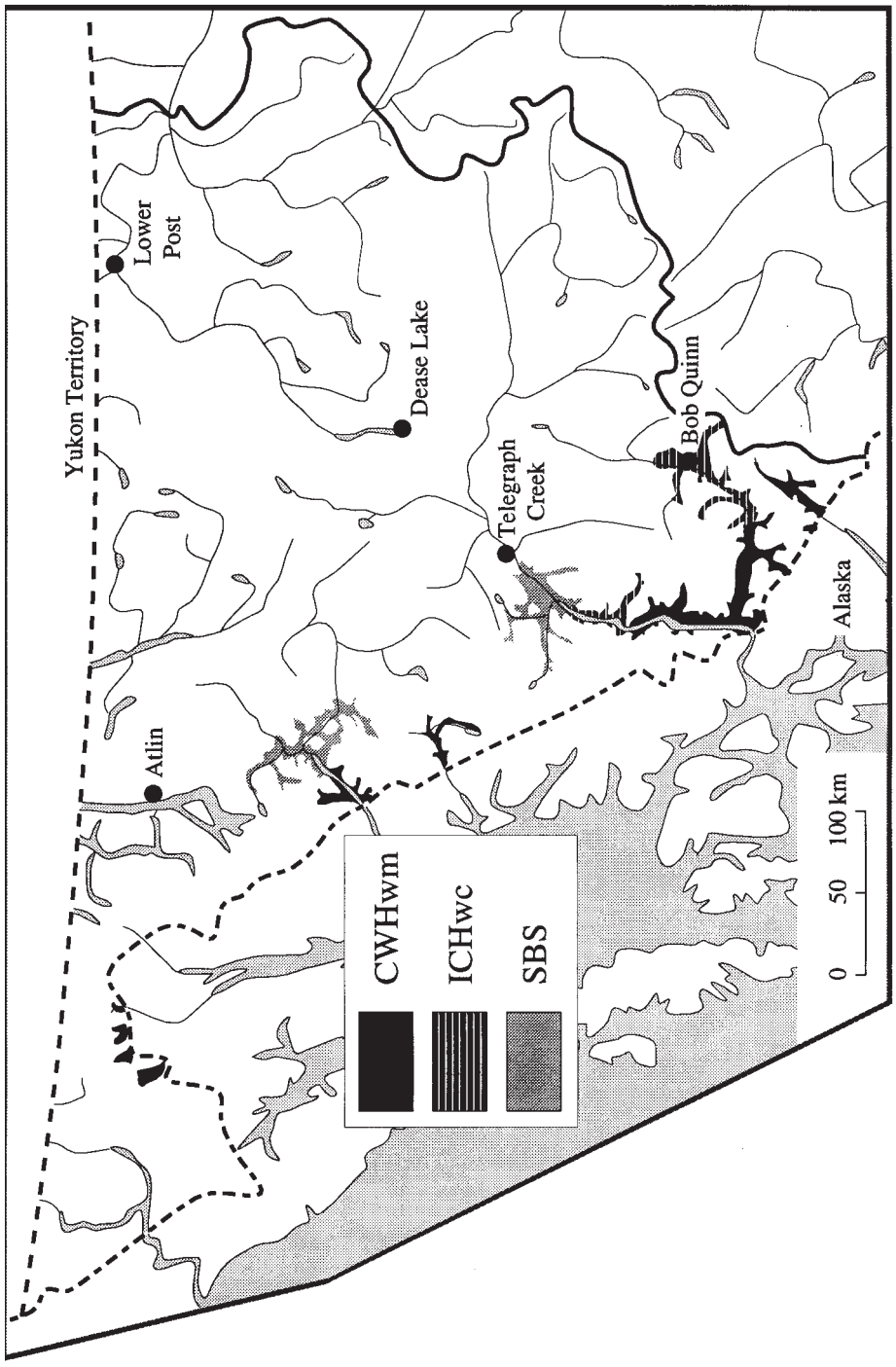


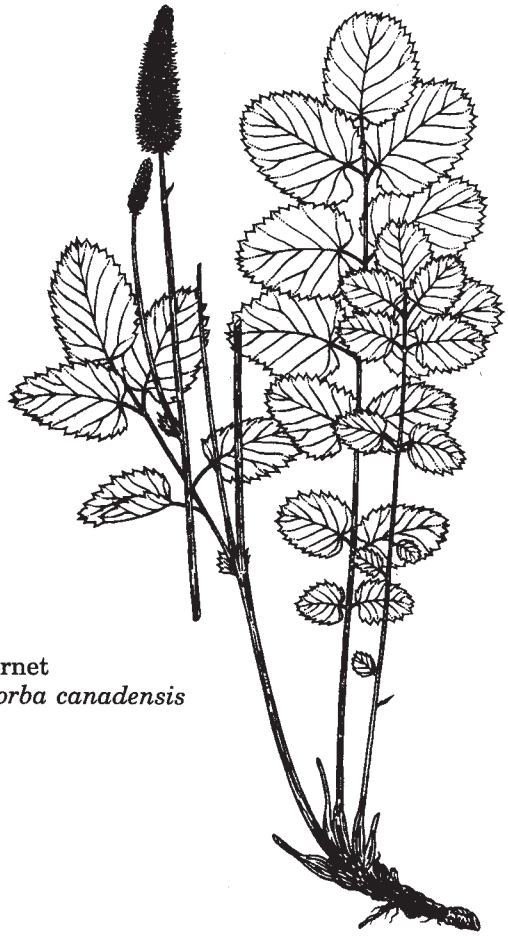
FIGURE 4.16. Distribution of CWH, ICH, and SBS zones in the PRFR, north half.

Soils: (Table 4.8) The moderately well-drained soils of zonal ecosystems in the northern CWH typically are Humo-Ferric Podzols with Hemimor and Mormoder humus forms. This characteristic soil profile covers even the driest ridges and shallow soils over bedrock. A distinctive feature of this northern CWH is the dominant effect of ongoing glacial, fluvial, and colluvial (avalanche and landslide) activity on soil formation. Thus, much of the zone in this area has very young soils (Regosols or Brunisols) that have had little opportunity to develop since being deposited. The short growing season and cool climate also slow the rate of biological and chemical activity. These soils are often coarse textured (gravels and sands) and may be deficient in nitrogen until they are colonized by nitrogen-fixing plants such as alder.

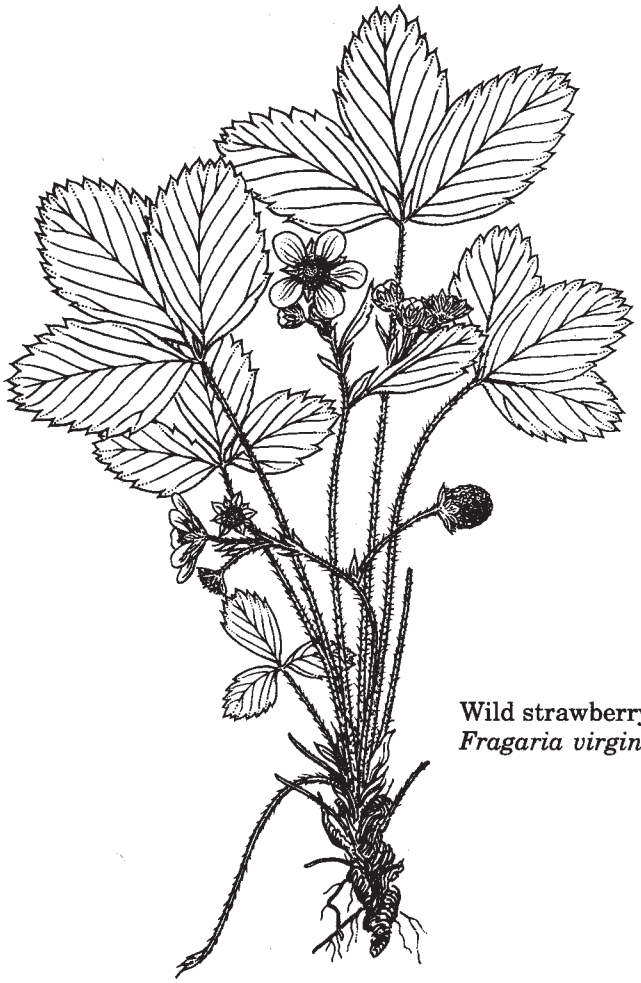
Differentiating Features: The CWH can be distinguished from the MH zone, which lies above it in elevation, by the pre-eminence of western hemlock over mountain hemlock, especially in regeneration. It can be distinguished from the neighbouring ICH zone by the presence of red alder, the dominance of lanky moss, and the relative lack of subalpine fir, black huckleberry, and knight's plume on zonal sites. The CWH can be readily distinguished from bordering areas of the SBS and BWBS because these two zones lack western hemlock, oval-leaved blueberry, Alaskan blueberry, and lanky moss.

Subzones: The CWH of the Cassiar Forest District belongs to the **Wet Maritime subzone** (**CWHwm**). Although the Cassiar portion of the CWHwm likely represents a separate northern variant of this subzone, we lack the data to formally recognize and describe this variant.

Oak fern
Gymnocarpium dryopteris



Sitka burnet
Sanguisorba canadensis



Wild strawberry
Fragaria virginiana

4.3.4 ESSF Engelmann Spruce – Subalpine Fir Zone

Location and Distribution: (Figure 4.17; Table 4.8) The ESSF is the subalpine forest and parkland zone lying above the ICH and SBS and southernmost BWBS zones in the north half of the PRFR. It occupies the eastern slopes of the Coast Mountains in the Taku, Stikine, and Iskut drainages and the northern Skeena Mountains in the area between Burrage Creek and the upper Klappan River. The ESSF ranges in elevation from approximately 600 - 800 m to 1250 - 1500 m and represents 4.3% of the land area in the north half of the PRFR.

Climate: (Table 4.9) The ESSF in the Cassiar Forest District is at the wettest and snowiest extremes of the zone in British Columbia, occurring as it does in areas broadly transitional between true coastal subalpine (MH zone) and the more continental SWB zone to the east. The heavy snowpack tends to shorten the already limited growing season. Moisture deficits are unlikely, except perhaps in the driest, easternmost portions of the zone. Unfortunately there is no long-term climate station in or near the ESSF of the study area.

Vegetation: (Figure 4.13) Lower elevations of the zone are continuously forested (except where dissected by avalanche tracks) by subalpine fir with minor white or hybrid spruce. Lodgepole pine and trembling aspen occasionally occur as seral species after fire. Western hemlock and sometimes mountain hemlock are minor species in subalpine forests. Mountain hemlock may be abundant at upper elevations of the zone, especially in subalpine parkland. Understory shrubs are typically members of the heather family, such as black huckleberry, oval-leaved blueberry, and false azalea.

Continuous forest gives way at higher elevations to subalpine parkland in which tree clumps occur in a mosaic with open areas of heath (typified by mountain-heathers, crowberry, dwarf blueberry, black huckleberry, and partridgefoot) and wet meadow (Sitka valerian, Indian hellebore, arrow-leaved groundsel, and arctic lupine). Snow avalanche tracks are very common and have distinctive vegetation dominated by Sitka alder.

Soils: (Table 4.8) Ferro-Humic Podzols are the typical zonal soils in the ESSF of the Cassiar Forest District. Both mineral soils and organic layers have an abundance of dark brown humified organic matter, reflecting cool and continuously moist soil conditions. Soils with imperfect or restricted drainage (gleyed subgroups and Gleysols) are very common in this zone in lower and toe slope positions, but true wetlands are relatively rare. Dry ecosystems are restricted to sites with shallow soils or organic accumulations over bedrock.

Differentiating Features: The ESSF in the Cassiar Forest District differs from the major subalpine zone, the SWB, in having understory layers dominated by shrubs in the heather family, rather than by willows and scrub birch, and subalpine fir is more abundant. Wetlands are much less abundant in the ESSF than in the SWB, and black spruce is absent.

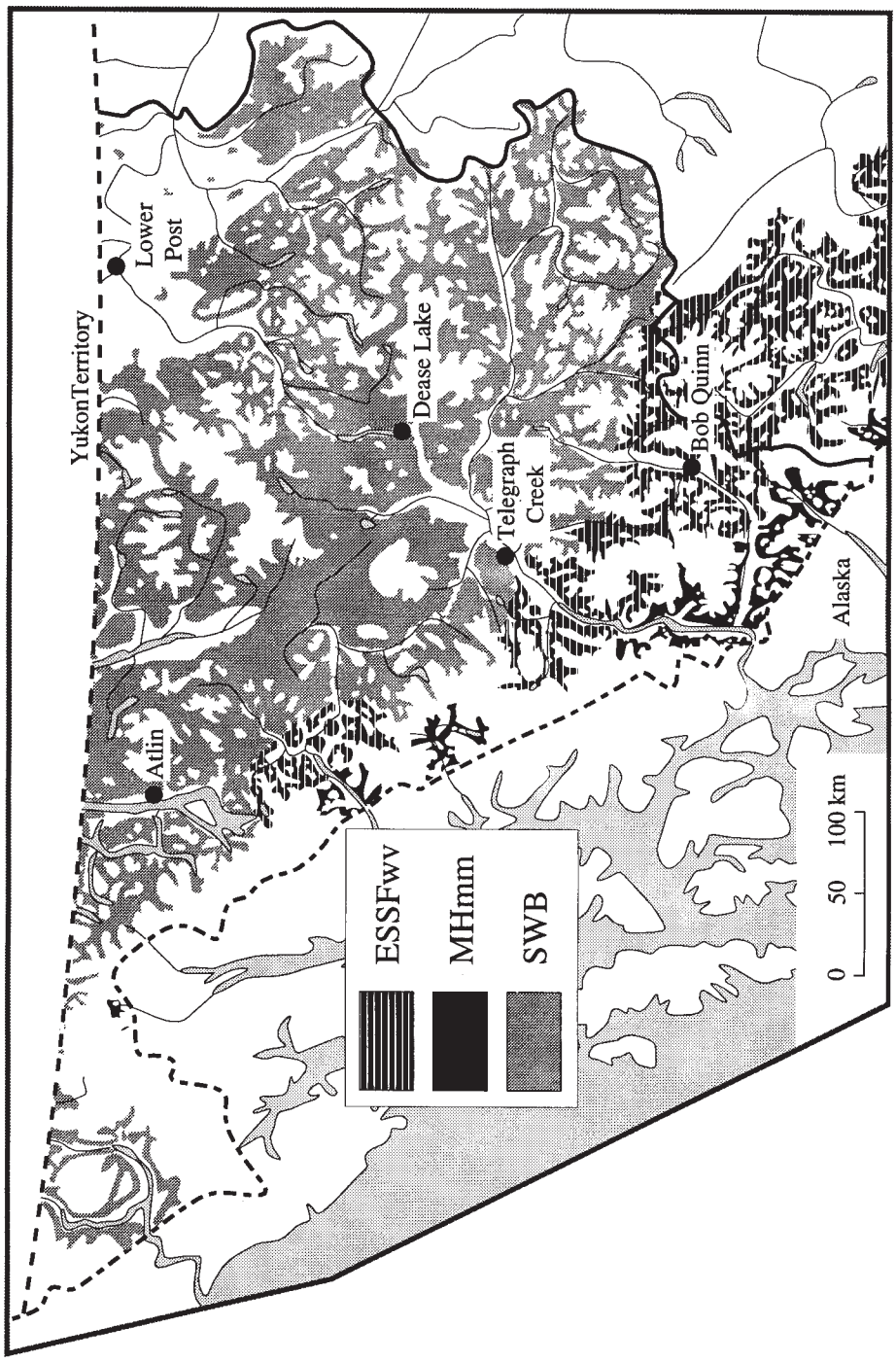
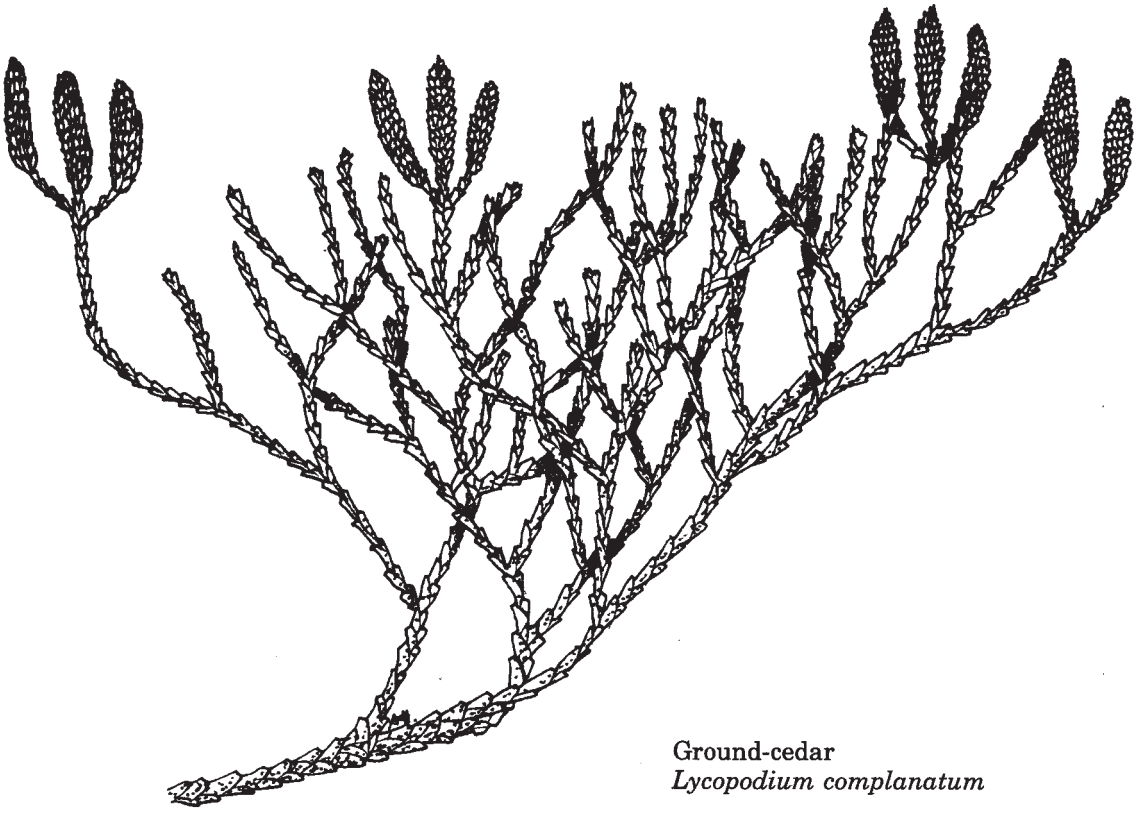


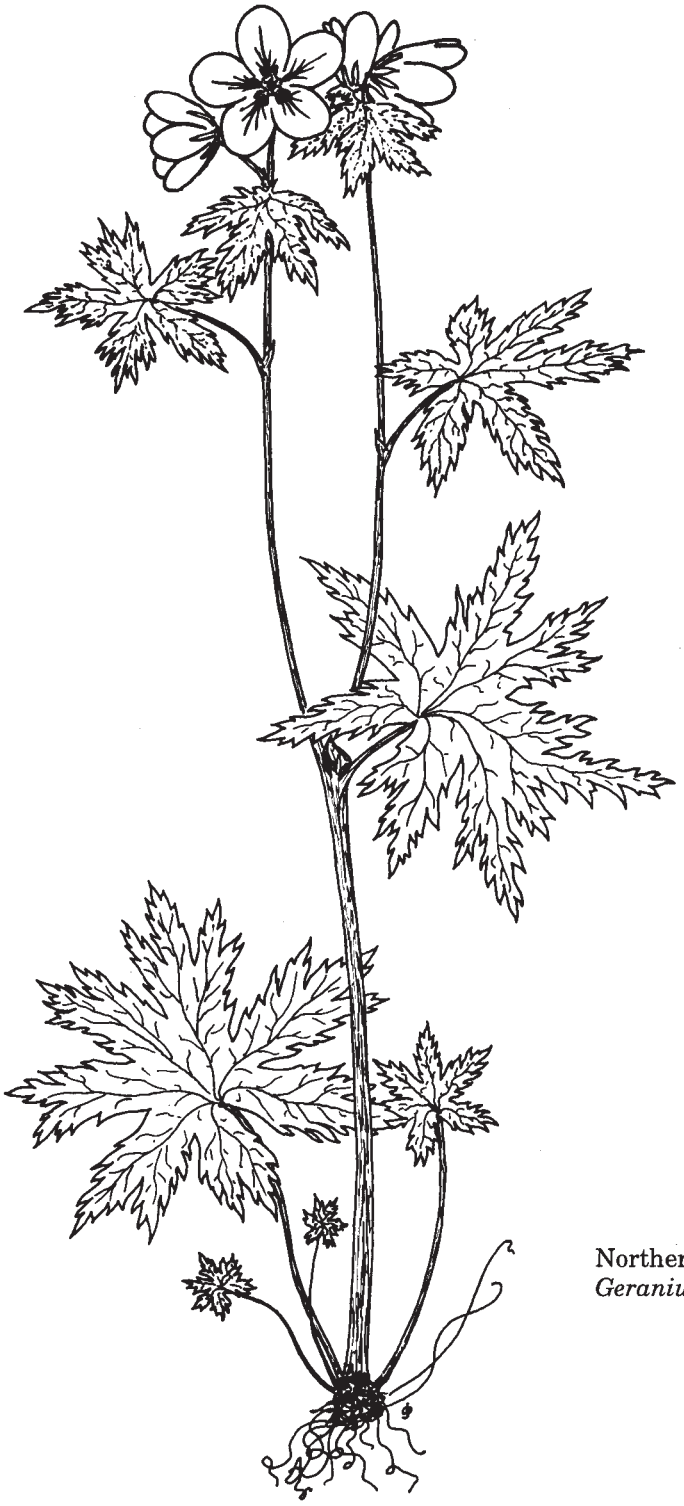
FIGURE 4.17. Distribution of ESSF, MH, and SWB zones in the PRFR, north half.

Devil's club is a typical ESSF species that is absent from the SWB. Where the ESSF overlies the ICH, the two zones can be differentiated by the relative abundance of western hemlock: in the ICH, western hemlock is the dominant species on zonal sites; in the ESSF, subalpine fir and mountain hemlock are more abundant than western hemlock. The differences between the ESSF and contiguous SBS are fairly subtle. The transition to ESSF is marked by a gradual shift in a dominance from hybrid spruce to subalpine fir, an increased dominance of shrubs in the heather family in the forest understory, and the appearance of subalpine herbs and dwarf shrubs in small forest openings.

Subzones: All but a tiny fragment of the ESSF in the Cassiar Forest District is classified as **ESSFwv** (Wet, Very Cold Forested subzone), and above it is the **ESSFwvp** (Wet Very Cold Parkland subzone). The headwaters of the Spatsizi River at Tahtsadle Creek are within the **ESSFmc** and **mcp** (Moist Cold Forested and Parkland subzones). No variants of these subzones have been identified. For information on how to distinguish these subzones, refer to the southern ESSF (Section 4.2.3; Table 4.5 and Figure 4.7).



Ground-cedar
Lycopodium complanatum



Northern geranium
Geranium erianthum

4.3.5 ICH Interior Cedar – Hemlock Zone

Location and Distribution: (Figure 4.16; Table 4.8) The ICH in the Cassiar Forest District occupies low to medium elevations (100 - 900 m) in the central part of the Iskut and Stikine river valleys, east of the crest of the Coast Mountains. Along the Iskut, the ICH extends from the lower Ningunsaw River and Durham-Ball creeks downstream to Snippaker Creek and is bordered to the east by the BWBS and to the west by the CWH. Along the Stikine River, the ICH starts just south of Dokdaon Creek and extends to the mouth of the Scud River, lying between the SBS and the CWH. The ICH represents 0.7% of the land area in the north half of the PRFR.

Climate: (Table 4.9) The climate of this portion of the ICH is neither typically coastal, nor interior or continental. It is less continental than that of the adjacent BWBS or SBS, but more continental than that of the adjacent CWH. The climate is moist and evidently somewhat milder than the ICHvc in the Kalum Forest District. Snowpacks are moist and moderately heavy, but not nearly as heavy as in the Meziadin - Bell-Irving area. During the winter, continental arctic air masses are more frequent in the ICS than in the true coastal climate of the CWH. There is no long-term climatic station in or near the area.

Vegetation: (Figure 4.13) Western hemlock is the climatic climax species in the ICH of the Cassiar Forest District and forms extensive old growth. Western redcedar and amabilis fir are absent. Subalpine fir and Roche spruce sometimes occur in mature forest on zonal sites; both species are abundant on moist, rich sites and in areas of cold air drainage or ponding. Black cottonwood, along with the Roche spruce, form floodplain forests. Lodgepole pine, aspen, and paper birch are scattered, forming seral forests in burned-over areas, especially in the vicinity of Bob Quinn Lake.

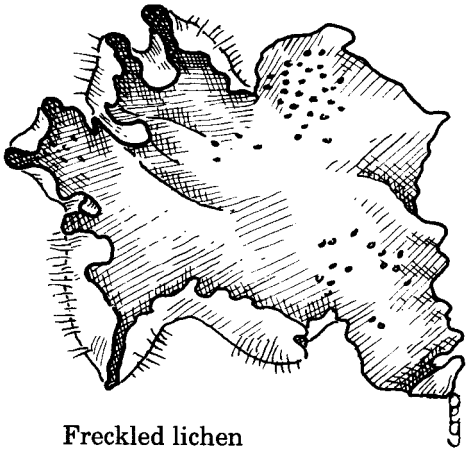
This ICH subzone has a well-developed shrub layer on zonal sites dominated by Alaskan blueberry, oval-leaved blueberry, black huckleberry, false azalea, and scattered devil's club. Herbs are also abundant, and characteristically include bunchberry, one-sided wintergreen, queen's cup, five-leaved bramble, oak fern, spiny wood fern, and prince's pine. Step moss, red-stemmed feathermoss, and knight's plume dominate the ground cover. Electrified cat's-tail moss and common leafy liverwort are common but not abundant. Dry forest ecosystems are uncommon, except on the Iskut lava beds. They usually contain lodgepole pine and have few shrubs or herbs and a thick moss carpet. At the other end of the moisture spectrum, moist, rich devil's club ecosystems are common and widespread. In addition to devil's club, these ecosystems have an abundance of ferns (oak fern, spiny wood fern, and lady fern) and other herbs (twistedstalks and three-leaved foamflower). Ragged and leafy mosses dominate the patchy moss layer.

Soils: (Table 4.8) Zonal soils in the ICH of the Cassiar Forest District are moderately well-drained Humo-Ferric Podzols with Hemimor or Mormoder humus forms occurring mainly on morainal parent materials. Drier forest

ecosystems are found primarily on shallow soils over bedrock, on steep, rocky colluvial slopes, and on the lava in the Iskut Canyon area. Here the soils are poorly developed Humo-Ferric Podzols or Brunisols with shallow, poorly decomposed Hemimor humus forms. The moister ecosystems occur widely on parent materials that are affected by seepage or fluvial action. These soils commonly show some mottling or gleying, dark brown mineral horizons near the surface, and organic layers with more advanced humus decomposition than on zonal sites. There are few wetlands with true Organic soils in this ICH.

Differentiating Characteristics: The ICH can be distinguished from the adjacent CWH by the scarcity of lanky moss (the characteristic dominant moss of the CWH) and by the absence of red alder on disturbed sites. Subalpine fir, black huckleberry, knight's plume, and electrified cat's-tail moss are characteristic ICH species that are much less common in the CWH. The ICH can be distinguished from the SBS and BWBS by the presence of western hemlock, oval-leaved blueberry, and Alaskan blueberry. The ESSF and MH zones lying above the ICH have more subalpine fir or mountain hemlock than western hemlock on zonal ecosystems.

Subzones and Variants: All of the ICH in the Cassiar Forest District is within a single subzone, the **ICHwc - Wet Cold subzone**. The ICHwc does not occur outside the Cassiar District. This subzone is compared in more detail with other ICH subzones/variants in Table 4.6 and Figure 4.9.



Freckled lichen
Peltigera aphthosa

4.3.6 MH Mountain Hemlock Zone

Location and Distribution: (Figure 4.17; Table 4.8) The MH is the subalpine forest and parkland zone lying above the CWH on the west slope of the Coast Ranges. The massive icefields and rugged topography of the Boundary Ranges of the Coast Mountains limit the extent of the MH in the Cassiar Forest District. In the Haines Triangle, the MH is mostly absent because there is no significant development of forest above the valley floor. In total, the MH represents 1.6% of the land area within the north half of the PRFR. The elevation range of the MH is typically from about 400 to 1100 m, but this varies greatly depending on the extent and proximity of glacial ice and other topographic factors.

Climate: (Table 4.9) The coastal subalpine climate is characterized by short, cool summers and long, cool, wet winters with heavy snow cover for several months. The deep winter snowpack is slow to disappear, and a short vegetative season is the result. Unfortunately, there are no long-term climate stations in the MH of the study area. The short-term station at Johnny Mountain averaged 1483 cm of snow over two years. As in the CWH, the MH climate is profoundly affected by strong winds and cold air from nearby ice sheets.

Vegetation: (Figure 4.13) At the lower elevations of the MH, the typically dense subalpine forest is dominated by mountain hemlock and varying but still significant amounts of western hemlock. Spruce (Sitka and Roche) and subalpine fir are common, especially along creeks. Yellow-cedar may occur near the British Columbia - Alaska border above the Stikine River, but otherwise it is not a significant species. Upper forest elevations of the MH are dominated by mountain hemlock and subalpine fir. With increasing elevation, the forest thins out into parkland with trees in isolated clumps and irregular, small patches, and along ridge crests where earlier snowmelt occurs. The tree clumps form a mosaic with subalpine heath, meadow, and fen vegetation.

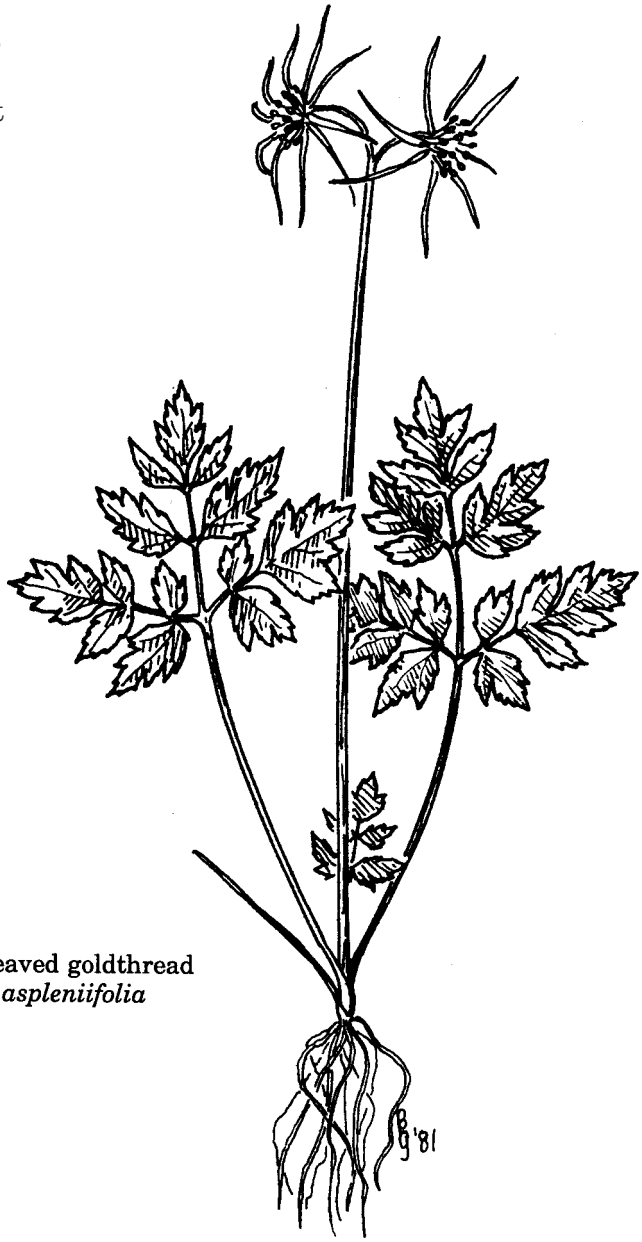
Predominance of shrubs of the heather family is a characteristic feature of the MH zone. In continuous forest, oval-leaved blueberry, Alaskan blueberry, black huckleberry, copperbush, and false azalea may be dominants, and, in parkland, pink, yellow, white, Alaskan, and club-moss mountain-heathers may join the list. Subalpine herbs are much less abundant than in the ESSF. Other characteristic floristic features of climax MH forests are the dominance of heron's-bill mosses, mountain leafy liverwort, pipecleaner moss, and red-stemmed feathermoss, and the abundant regeneration of mountain hemlock.

Soils: (Table 4.8) Characteristic soil processes in the MH are the accumulation of acidic, snow-compacted organic matter on the forest floor, mycelial Mor humus formation, gleying (many soils are moist to saturated throughout the year), leaching, eluviation, and illuviation. Podzols and Folisols are the predominant soils. The low temperature and high moisture content of most soils promote slow litter decomposition. Thus,

they often have a high content of organic matter. Tree roots are largely confined to the forest floor, indicating the essential role of the humus layers in nutrient cycling and tree growth.

Differentiating Features: In brief, the MH is distinguished from the CWH and ICH that lie below it by having more mountain hemlock than western hemlock in the canopy and in the regeneration. In the ESSF zone, subalpine fir is more abundant than either mountain hemlock or western hemlock.

Subzones: The MH zone in northern British Columbia has not been differentiated into subzones due to lack of data. It is most similar to the MHmm2 (Section 4.2.5, Table 4.5 and Figure 4.7), but is colder and lacks amabilis fir.



Fern-leaved goldthread
Coptis aspleniifolia

4.3.7 SBS Sub-Boreal Spruce Zone

Location and Distribution: (Figure 4.16; Table 4.8) There is only a small area of SBS in the north half of the PRFR (1.2%) and it is very poorly studied. This northern SBS lies in the coast/interior transition along the low-elevation valleys of the Stikine and Taku rivers and their tributaries. In the Stikine drainage, the SBS is bordered to the west by the ICH zone and to the east by the BWBS, and it extends from Glenora downstream to Dokdaon Creek. It includes most of the Chutine and Barrington river valleys. In the Taku, the SBS occupies a 30-km wide band between the CWH and the BWBS, including most of the Sloko, Nakonawe, King Salmon, and Sutlahine valleys and the lower half of the Inklin River. In elevation, the SBS ranges from approximately 100 m to 800 - 900 m. In drainages with extensive glaciation and heavy snow (e.g., the Chutine), however, the SBS gives way to the ESSF at elevations as low as 250 - 300 m.

Climate: A broad coast/interior transition exists in the Taku and Stikine river valleys because coastal weather systems are able to penetrate up these low-elevation river valleys, losing their warmth and moisture gradually. No climatic data exist for this zone, but topographic and vegetative characteristics suggest that it has a longer growing season, a greater accumulation of growing degree days, warmer soils, and significantly more moisture than the neighbouring BWBS. The increased moisture appears to increase the extent of hygric (seepage) sites rather than increasing the extent of poorly drained sites with cold soils as in the BWBS.

Vegetation: (Figure 4.13) Dominant tree species in the SBS of the Cassiar Forest District are hybrid spruce (apparently Roche spruce), subalpine fir, black cottonwood (not balsam poplar), paper birch, and, less commonly, lodgepole pine and trembling aspen. Understory dominants include black huckleberry, bunchberry, five-leaved bramble, step moss, knight's plume, and red-stemmed feathermoss. A characteristic feature of the SBS is the abundance of devil's club, a species that is uncommon in the BWBS.

Differentiating Features: The SBS of the Cassiar Forest District has abrupt boundaries with the adjacent CWH or ICH to the west, in which western hemlock is present, and with the BWBS to the east, in which white spruce is dominant. The ESSF, which lies above the SBS, is a less productive zone with more snow and a shorter growing season. The transition to ESSF is not abrupt, and is marked by a gradual shift in dominance from hybrid spruce to subalpine fir, an increased dominance of shrubs in the heather family in the forest understory, and the appearance of subalpine herbs and dwarf shrubs in small forest openings.

Subzones: For the time being, it appears that these low-elevation transitional forests in the Stikine and Taku most closely resemble the SBSmc of the south half of the PRFR. For additional details, refer to Section 4.2.7, Table 4.7 and Figure 4.12. With further classification work, it may become necessary to designate a new subzone of the SBS in the Cassier Forest District.

Bluejoint
Calamagrostis canadensis

Nodding wood-reed
Cinna latifolia

4.3.8 SWB Spruce – Willow – Birch Zone

Location and Distribution: (Figure 4.17; Table 4.8) The SWB is the subalpine zone found in northern British Columbia, above most of the BWBS. It includes a vast area of mid- to high-elevation plateaus and mountain slopes within the Cassiar Mountains, the St. Elias Mountains and much of the Stikine and Yukon plateaus. The SWB encompasses 34.6% of the total land area in the north half of the PRFR. Elevations of the SWB range between 1000 and 1600 m in the southern part of the zone; and between 600 - 900 and 1400 m in the north.

Climate: (Table 4.9) The climate of the SWB is evidently an interior subalpine type, although long-term climatic data are available from only one station in the PRFR at Cassiar. The mean annual temperature at Cassiar is -3° C. Temperature averages above 10° C for just 1 month of the year, and below 0° C for 7 months. Mean annual precipitation is 760 mm, with 60% falling as snow. Winters are long and cold, and summers are brief and cool, with frequent cloud cover and very long days. Moist Pacific air from the west frequently causes sudden, often violent, local storms during the summer. A more stable air mass usually prevails in the winter, but cold spells may be broken by chinook winds.

Vegetation: (Figure 4.13) Lower elevations of the SWB are forested, mainly by white spruce and subalpine fir. A general pattern apparent in many valleys is of intermittent to closed forest cover of white spruce, plus variable amounts of lodgepole pine, aspen, and black spruce on valley bottoms and lower slopes. Higher on the slopes, subalpine fir dominates. Balsam poplar is uncommon, and Engelmann spruce, paper birch, and tamarack are absent from the SWB. It appears that wildfires have been less frequent and extensive in the SWB than in the adjacent BWBS.

Zonal sites in the forested SWB have a well-developed shrub layer dominated by grey-leaved willow and scrub birch, together with other willow species, shrubby cinquefoil, and soopolallie. The herb layer typically includes crowberry, twinflower, lingonberry, dwarf blueberry, Altai fescue, fireweed, arctic lupine, and tall bluebells. The moss layer is dominated by red-stemmed feathermoss and step moss (knight's plume is a minor species). Thin-leaved dicranum and juniper haircap moss are common, and lichens are usually abundant (grey reindeer lichen, green reindeer lichen, orange-foot lichen, *Cladonia gonecha*, *C. gracilis*, freckled lichen, *Peltigera malacea*, and green kidney lichen).

Upper elevations of the SWB are dominated by 1 - 4 m tall deciduous shrubs, mainly scrub birch and several willows (grey-leaved willow, Barclays willow, tea-leaved willow, Barratt's willow, and woolly willow). Groves of stunted aspen and balsam poplar occur at timberline on some steep south slopes. It is thought that the long summer days and short, warm, frostless nights of the SWB favour dominance of deciduous shrubs. In some high, wide valleys subject to massive cold air ponding, a mosaic of

shrubs, fens, and Altai fescue grassland occupies the valley floor, a skirt of conifers occurs on lower slopes, and shrubs again dominate above the conifers.

Soils: (Table 4.8) Soil development in the SWB is generally not far advanced because of recent glaciation and the cold climate. The processes of frost shattering, solifluction, nivation, and cryoturbation, as well as colluviation and snow avalanching, are all active. Zonal soils in the SWB are Humo-Ferric Podzols or Brunisols, depending on the amount of precipitation (Brunisols are more common in areas of lower rainfall). Depending on the acidity of the parent material, both Eutric (high pH) and Dystric (low pH) Brunisols can occur. On fine-textured parent materials, Gray Luvisols are also found. Gleyed Regosols, Humic Gleysols, and shallow Organics occur beneath the wet willow thickets and wetland vegetation found in many of the valley floors. Cryosols (soils with permafrost) exist in high, wide valleys subject to cold air ponding, especially in finer-textured parent materials above 1200 - 1400 m elevation. Elsewhere in the SWB, permafrost is sporadic, occurring in pockets, mainly on north slopes.

Differentiating Features: The SWB could be confused with higher elevations of the BWBS zone, or with the ESSF where the two zones meet along the southern and western margins of the Cassiar Forest District. The SWB has less productive, more intermittent forests, more subalpine fir, fewer deciduous and pine trees, and more willow-birch scrub than does the BWBS. Understory vegetation in the SWB is dominated by willows and scrub birch, while the ESSF understory is dominated by shrubs of the heather family (black huckleberry, oval-leaved blueberry, and false azalea).

Subzones and Variants: Several subzones of the SWB have been tentatively identified, but none of these have yet been mapped or described sufficiently for inclusion in this guide. However, the Tatshenshini-Alsek area has a distinctive SWB, which is tentatively called the SWBvk, or very wet cool subzone. This very snowy subzone is primarily non-forested, although it has scattered open stands of white spruce and black cottonwood, both of which (but more commonly cottonwood) form timberline, such as it is. The dominant vegetation is dense shrubby thickets of medium to tall shrubs, especially Sitka alder and willows (variable, Barclay's and Alaska willows). There is very little scrub birch, in contrast to the rest of the SWB. Moist, lush meadows are common and widespread, including a distinctive fireweed - red raspberry - cow parsnip association that appears to persist without fire.