A FIELD GUIDE TO FOREST SITE IDENTIFICATION AND INTERPRETATION FOR THE CARIBOO FOREST REGION

O. A. Steen and R. A. Coupé

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Chapter 1 through 4

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PART 2

[1] Subsection numbers are the same as for the equivalent biogeoclimatic unit in Section 6. Missing subsections indicate biogeoclimatic units for which silviculture considerations have not yet been prepared.

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1 INTRODUCTION

Objectives and Scope

This guide presents site identification and interpretation information for forest ecosystems of the Cariboo Forest Region. Site identification is based on the biogeoclimatic ecosystem classification (BEC) initially developed by V.J. Krajina and his students at the University of British Columbia and subsequently revised by the B.C. Ministry of Forests.

The objectives of the classification are:

- to provide a framework for organizing ecological information and management experience about ecosystems;
- to promote a better understanding of forest ecosystems and their interrelationships;
- to provide resource managers with a common "language" to describe forest sites; and
- to improve the user's ability to prescribe and monitor site-specific treatments.

FIGURE 1 Location of the Cariboo Forest Region.

This guide results from the recently completed provincial correlation of the BEC system. It replaces “A Field Guide for the Identification and Interpretation of Ecosystems of the Cariboo Forest Region” (Research Section, Cariboo Forest Region 1982). Correlations between classification units used in this guide and those used in the previous guide for the Cariboo Forest Region are presented in Appendix 1.

This guide has two principal goals:

- to assist users in describing and identifying forest ecosystems; and
- to provide management interpretations to assist users in preparing stand-level forest management prescriptions.

  This guide describes only forested site units. Grassland, non-forested wetland, alpine tundra, and other non-forested sites of the Cariboo Forest Region will be described separately in other guides. In addition, the ecosystem descriptions apply primarily to coniferous forests, since deciduous forests have not been sufficiently well studied to be included.

Other Sources of Information

This guide is to be used in conjunction with the map of “Biogeoclimatic Units of the Cariboo Forest Region” available from the Research Section, Cariboo Forest Region in Williams Lake. More complete descriptions of the BEC system can be found in Pojar *et al.* (1987), MacKinnon *et al.* (1992), and Meidinger and Pojar (1991). For a more detailed discussion of ecosystem description methods, refer to Luttmerding *et al.* (1990). References for the identification of most of the common plants in the Cariboo Forest Region are MacKinnon *et al.* (1992) for northern parts of the Region and Parish *et al.* (1996) for southern parts of the Region. Other sources of information on silviculture systems and practices are included in Section 7.1.

Guide Contents and Limitations

This guide consists of seven principal sections plus appendices. Section 2 provides an overview of the BEC system. Section 3 outlines procedures for describing forest sites and identifying biogeoclimatic and site units. It is basically a "how-to" section. Section 4 provides a brief overview of the environment of the Cariboo Forest Region including physiography and major climate patterns. Section 5 describes the biogeoclimatic units (zones, subzones, and variants) of the Cariboo Forest Region including their distinguishing features. Section 6 describes the forested site units of each biogeoclimatic unit for which a site classification has been completed. It includes keys to site unit identification, edatopic grids, and vegetation and environment summaries. Section 7 summarizes silviculture considerations for site units. It includes ecologically adapted tree species, principal site factors limiting forest regeneration, shrub and herbaceous vegetation potential, and a summary of principles and current experience regarding successful silviculture practices. The appendices include several tools to aid site description and identification, including guides to identification of soil moisture regime, soil nutrient regime, soil texture class, common rock types, and soil humus form.

In this guide we have synthesized the knowledge and experience gained during nearly 20 years of forest ecosystem sampling, monitoring of management practices, and research in the Cariboo Forest Region.

Some biogeoclimatic units have not been sufficiently well sampled to develop a forest site classification. These occur mostly in the Coast Mountains where there has been relatively little timber harvesting history.

No guide to ecosystems can encompass all of the complexity and diversity of forest ecosystems that occur on the landscape. Although the described site units include most of the common ecosystems found throughout the distribution of the biogeoclimatic units, users are certain to encounter sites that do not appear to "fit" any site unit description. In these cases, a description of the site, soils, and vegetation features of the site and an understanding of the effects of these features on management options can assist in formulating an ecologically sound management prescription. It is important to recognize that the intent of this guide is to provide information to help users to classify sites and develop management prescriptions.

Format of the Guide

This guide has been structured and paginated to readily allow updates of individual sections and to allow users to modify the guide to suit their specific needs. Each section or subsection has its own numbering sequence and all pages have headers on the upper left and right indicating the section topic. Each biogeoclimatic unit has the same subsection number in sections 6 and 7.

Training

We have assumed that users of this guide have completed a BEC training course offered by a Ministry of Forests Regional Research Section, in which basic concepts and methods of ecosystem description and assessment are introduced. For information on training courses, contact the Research Manager, Cariboo Forest Region.

2 BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION (BEC) SYSTEM

This section briefly describes the principal concepts of the biogeoclimatic ecosystem classification (BEC) system. For a more complete description of the BEC system, refer to Pojar *et al*. (1987) or Pojar and Meidinger (1991).

Ecosystems

The BEC system classifies and organizes information about ecosystems. Ecosystems are interacting complexes of living organisms and their physical/chemical environment. For purposes of the BEC system, ecosystems are defined as portions of the physical landscape and the living systems that are on and in it. Complex interactions occur among the organisms within an ecosystem as well as between the organisms and their physical/chemical environment. In practical application, an ecosystem in the BEC system is identified and characterized by a plant community and its associated topography, soil, and climate. That is, it is an area of relatively uniform vegetation on relatively uniform topography and soils. Although other living organisms and other physical/chemical components of the ecosystem are not explicitly used to identify the ecosystem, it is assumed that they are relatively uniform within an area of uniform vegetation, topography, and soils.

Boundaries between ecosystems may be abrupt but more commonly are gradual due to the gradual change in physical and biological features across the landscape. As a result, most ecosystems include some variation in biological and physical features.

Synopsis of BEC system

The BEC system groups ecosystems at three levels of integration: regional, local, and chronological. At the regional level, vegetation, soils, and topography are used to infer the regional climate and to identify geographic areas that have relatively uniform climate. These geographic areas are termed biogeoclimatic units. At the local level, segments of the landscape are classified into site units that have relatively uniform vegetation, soils, and topography. Several site units are distributed within each biogeoclimatic unit, according to differences in topography, soils, and vegetation. At the chronological level of integration, ecosystems are classified and organized according to their successional relationships on a particular site.

To arrive at the three levels of integration, the BEC system integrates four classifications: vegetation, climatic (zonal), site, and seral. Vegetation classification is the most important step in the development of the ecosystem classification. However, the climatic and site classifications are the principal classifications used in application of the BEC system.

Vegetation Classification

The vegetation classification groups floristically similar plant communities into vegetation units using an approach similar to that of Braun-Blanquet (see Mueller-Dombois and Ellenberg 1974; Pojar *et al*. 1987). The principal vegetation unit is the plant association. Since late seral or climax vegetation is considered to be the best integrator of the combined influence of the many environmental factors affecting the ecosystem, and since it is a readily visible and measurable feature, the vegetation classification is integral to development of the other classifications. It is used to develop the site, climatic, and seral classifications, although it is generally not used in the field to identify climatic or site units. That is, the vegetation classification is used to develop the site classification, but once the site classification is developed, the site units are identified by a combination of site features and vegetation.

Climatic (Zonal) Classification

Concepts

The climatic or zonal classification uses vegetation, soils, and topography to infer the regional climate of a geographic area. It identifies areas (termed biogeoclimatic units) that have a relatively uniform climate (inferred from vegetation, soils, and topography), and classifies these areas in terms of their inferred climate. As used here, climate refers to the regional climate that influences ecosystems over an extended period of time and is usually expressed as statistics derived from normals of precipitation and temperature.

The geographic extent of biogeoclimatic units (areas of relatively uniform climate) in the BEC system is inferred from the distribution of climax and late-seral plant communities on zonal sites. Zonal sites are those where the influence of the prevailing climate on the vegetation is believed to be least modified by the local topography or the physical/chemical properties of the soil. They have intermediate soil moisture and nutrient regimes and the following additional characteristics:

- slope position mid in mountainous terrain and mid to upper in subdued terrain;
- slope position, gradient, aspect, and location do not result in strong modification of the climate (e.g., frost pockets, steep south or north aspects, snowdrift areas);
- slope gradients gentle to moderate (5–30%); generally 5–15% in dry climates but may be up to 50% in wet climates;
- soils have a) moderately deep to deep (>50 cm) rooting zone, without a strongly restricting horizon, b) loamy texture with coarse fragment content <50% by volume, and c) free drainage.

Other ecosystems (edaphic and topoedaphic ecosystems) within a regional climate are influenced more strongly by local topography and physical and chemical properties of soil parent materials. Therefore they do not provide as clear a reflection of the regional climate. For example, wet toe slopes and depressions have similar vegetation in different climates.

Biogeoclimatic subzones are the basic unit of the climatic classification. Subzones are grouped into biogeoclimatic zones to create more generalized units, and subdivided into biogeoclimatic variants to create more specific or climatically homogeneous units.

Biogeoclimatic subzones are sequences of related ecosystems that are distributed within a geographic area of vegetationally inferred, uniform regional climate. In practice, this may be thought of as a geographic area within which the same vegetation unit (plant association) occurs on zonal sites. A subzone boundary occurs when a different plant association occurs on zonal sites. The zonal site plant association is used to characterize the subzone. For example, in the Interior Douglas-fir Very Dry Warm (IDFxw) subzone found in the southern part of the Cariboo Forest Region, zonal sites are occupied by the *Fd - Juniper - Bluebunch wheatgrass* plant association, while at higher elevations in the

Interior Douglas-fir Dry Cool (IDFdk) subzone, zonal sites are occupied by the *FdPl - Pinegrass - Feathermoss* plant association.

Biogeoclimatic subzones with similar climatic characteristics and vegetation on zonal sites are grouped into biogeoclimatic zones. A zone includes geographic areas with broadly uniform climate and patterns of vegetation and soil development. It typically has consistent climax tree species on zonal sites. Distinguishing features of specific biogeoclimatic zones in the Cariboo Forest Region are described in Section 5.

Subzones may include significant climatic variation marked by small changes in the vegetation on zonal sites and differences in the vegetation on non-zonal sites. In these cases, the subzone may be subdivided into biogeoclimatic variants. Variants are generally recognized for areas that are slightly drier, wetter, snowier, warmer, or colder than that considered typical for the subzone. These climatic differences result in corresponding differences in vegetation, soil, and ecosystem productivity, although the changes in the vegetation are not sufficient to define a new plant association. Differences in vegetation are often changes in the proportion and vigour of certain plant species or variations in successional development or the overall sequence of vegetation over the landscape.

Naming Biogeoclimatic Units

Biogeoclimatic zones are typically named after one or more dominant climax tree species occurring on zonal sites, often in combination with a geographic or climatic modifier. For example, the Interior Cedar–Hemlock Zone and Coastal Western Hemlock Zone both have western hemlock as a climax species on zonal sites but occur in different climates and geographic areas. Biogeoclimatic zone names are often referred to by a two- to four-letter acronym. For example, the Interior Cedar–Hemlock Zone is referred to as the ICH Zone and the Montane Spruce Zone is referred to as the MS Zone.

Biogeoclimatic subzones are named according to their relative climate within the zone: whether their climate is drier or wetter, colder or warmer, or more or less continental (in the case of coastal zones) than the climate of other subzones within the zone. The first part of the subzone name describes the relative precipitation and the second part describes either the relative temperature (Interior zones) or relative continentality (Coastal zones). These names are usually abbreviated by a letter code as shown in Table 1.

TABLE 1 Subzone name codes

First Part Relative Precipitation		Second Part Relative Temperature or Continentality	
Name	Code	Name	Code
very dry	x	hot	h
dry	d	warm	w
moist	m	mild	m
wet	w	cool	k
very wet	v	cold	c
		very cold	v
		hypermaritime	h
		maritime	m
		submaritime	s

Biogeoclimatic variants are given geographic names reflecting their relative location or distribution within the subzone. For example, the Interior Douglas-fir Dry Cool Subzone (IDFdk) has four variants: Thompson Variant, Cascade Variant, Fraser Variant, and Chilcotin Variant. Variant names are given number codes, which in most cases reflect their geographic distribution within the subzone from south to north.

The coding convention for Interior biogeoclimatic units is as follows (using the Interior Douglas-fir Dry Cool Subzone, Fraser Variant):

Zone	Subzone	Variant
IDF	**dk**	**3**
	moisture temperature	

Site Classification

Concepts

Within each biogeoclimatic subzone or variant, a recurring pattern of sites reflects the variation in soil and physiographic properties. These sites are classified into site units according to their potential to produce similar climax vegetation units (plant associations or subassociations). It is assumed that sites with similar plant communities have similar environmental properties, particularly soil moisture, soil nutrient, and site temperature regimes. Site units can be identified by their environmental characteristics or by their climax vegetation unit (plant association or subassociations) if the climax or near-climax vegetation is present. It is important to note that a particular site unit can support a variety of plant communities of different successional stages, but it has the potential to have only one climax or near-climax plant community.

Three site units are formally recognized in the BEC site classification: site association, site series, and site type. A fourth unit, the site phase, is also used in this guide.

The **site association** is the basic unit of site classification and includes all sites capable of producing the same climax plant community regardless of which biogeoclimatic unit they occur in. Thus a site association is a group of related ecosystems that are physically and biologically similar enough that they would have similar vegetation at climax. Although a site association occurs on ecologically equivalent sites, it may occupy different positions on a scale of relative moisture and nutrients in different biogeoclimatic subzones. For example, the *Sxw - Oak fern* site association occurs in both the SBSmw and SBSwk subzones. In the SBSwk it occurs on zonal sites, while in the slightly drier climate of the SBSmw it is restricted to sites wetter than zonal sites.

Site series are subdivisions of site associations and include all sites within a biogeoclimatic subzone that are capable of producing the same climax vegetation unit (plant association). Site series is the most commonly used category in the site classification. It is approximately equivalent to the "ecosystem association" used in previous draft ecological field guides for the Cariboo Forest Region.

Site type represents the most detailed level in the site unit classification. Site types are subdivisions of site series that are distinguished by edaphic differences that are considered significant to management of the site. However, since the site type classification system is not yet fully developed, it is not used in this guide. Refer to Pojar *et al.* (1991a) for a more detailed discussion of site types.

Site phase, although not a formal unit in the site classification system, is used in this guide in place of the site type, to allow better site differentiation for forest management considerations. Site phases are conceptually very similar to site types and are intended for use only until the site type classification is completed provincially. As with site types, site phases are used to differentiate sites belonging to the same site series but with site or soil properties that may differ sufficiently to affect management implications. The site or soil differences have the same net effect on vegetation. For example, sites with shallow soils over bedrock and with coarse gravelly soils may have the same climax vegetation unit but different management implications. The use of site phases allows more consistent prediction of ecosystem response to management treatments.

Naming and Numbering of Site Units

Forested site associations are named using one or two tree species, followed by one or two understory plant species present in the climax or late seral vegetation unit (plant association) on which they are based. While the species chosen for naming the site association are often abundant in the climax vegetation, less common but characteristic species are sometimes used to ensure that the site unit has a unique name within the provincial classification.

Site series names use the same names as the site associations to which they belong, preceded by the appropriate biogeoclimatic subzone or variant name (or code). For example, the *ICHwk2/ CwHw - Oak fern* (or *ICHwk2/01*) represents the zonal site series in the ICHwk2. Zonal site units are always numbered 01. Non-zonal forested site series are numbered from 02 to 29 sequentially in order of increasing moisture regime and secondarily in order of increasing nutrient regime. For example, in the SBPSdc the driest unit is coded SBPSdc/02, while the wettest unit is coded as SBPSdc/08.

Site phases are named according to their differentiating criteria and given a single, non-connotative lowercase letter code after the site series number. For example *SBPSdc/02a* denotes the typic (deep soil) phase, while *SBPSdc/02b* denotes the shallow soil phase.

Seral Classification

The seral (often termed successional) classification in BEC is an integration of site and vegetation classifications with structural stage development. Very little classification of seral ecosystems has occurred using the BEC system and no seral ecosystems are presented in this guide. Hamilton (1988) presents a proposed approach to classifying seral ecosystems.

3 PROCEDURES FOR SITE DESCRIPTION AND IDENTIFICATION

This section summarizes procedures for describing and identifying site units in the Cariboo Forest Region. More comprehensive and detailed procedures and terminology for describing sites, soils, and vegetation are presented in Luttmerding *et al*. (1990).

Site identification involves two major steps. The first is to identify the biogeoclimatic subzone and variant and the second is to identify the site unit. These are accomplished through field assessment of site, soil, and vegetation characteristics and comparison of these characteristics with information presented in this guide and on biogeoclimatic maps. In order to simplify the identification process, especially for those new to an area, several aids to site description and identification are presented in this guide. These include guides to identifying site characteristics such as soil moisture and nutrient regimes, maps, summaries of vegetation and site characteristics, edatopic grids, keys to site units, and descriptions of biogeoclimatic and site units. As forest managers become more familiar with the ecosystems in their area, they will likely become less dependent on these aids for ecosystem description and identification.

Due to the importance of correct site description and identification to subsequent decisions regarding forest management practices, it is essential that site description data be collected as carefully and accurately as possible.

Identifying Biogeoclimatic Units

A preliminary identification of the biogeoclimatic subzone and variant of a specific site can be made by locating the site on a map of biogeoclimatic units of the Cariboo Forest Region. A 1:500 000 scale version of this map is available from the Cariboo Forest Region office (Research Section) in Williams Lake. A provincial biogeoclimatic map is available in digital format. The biogeoclimatic map of the Cariboo Forest Region is based on the best currently available information at the time of publication and is updated periodically. However, it must be recognized that map unit boundaries will likely require some minor modifications as additional detailed information is collected. Therefore, the map should not be relied on completely for biogeoclimatic unit identification, especially for sites near currently mapped boundaries.

The preliminary map-based identification of biogeoclimatic unit should be confirmed in the field. To do this most effectively, the user should examine zonal sites or other sites with medium (mesic) moisture regime and medium nutrient regime on gentle to moderate slopes. Elevation, tree species composition (canopy and regeneration layers), and principal shrub and herbaceous species should be noted and compared to the descriptions of biogeoclimatic zones and subzones in Section 5—"Biogeoclimatic Units of the Cariboo Forest Region." The user should also refer to the Site Unit Section (Section 6) for a list of vegetation attributes used to distinguish a particular biogeoclimatic subzone or variant from others with which it shares a border. This is particularly useful if the site is near a boundary between two or more biogeoclimatic units. A list of distinguishing vegetation attributes is included in each biogeoclimatic subzone or variant subsection of Section 6.

If the site of interest is located in a transition between two subzones or variants, or if doubt remains even after attempting field verification, then the site units for both possible subzones should be identified. The descriptions and interpretations for both subzones should be compared, and any interpretations and prescriptions should reflect the transitional nature of the site. Ecologists in the Cariboo Forest Region office in Williams Lake may be able to provide assistance in identifying biogeoclimatic subzones and variants in difficult, transitional areas.

Describing and Identifying Site Units

Site unit identification requires:

1) accurate description (determination and recording) of site, soil, and vegetation characteristics; and
2) use of the various aids and descriptive materials in this guide to determine the site unit that best matches these characteristics.

It should not be expected that sites will perfectly match all details in the description of a site unit in this guide. Sites that are classified within a site unit represent a population cluster around a central concept. The site should reasonably match the concept and principal features of a site unit but may not perfectly match all the details of the site unit description. It is important to note that the classification presented in this guide was developed primarily from climax or late-seral forests. Differences in vegetation composition and cover should be expected when dealing with earlier seral stages.

Although the classifications and descriptions of site units in this guide represent most of the variability expected to be encountered in the forests of any particular subzone or variant, there are still likely to be some forest ecosystems that do not appear to fit any described site unit reasonably well. This may be due to the fact that the ecosystem is located in a geographically transitional area between two or more biogeoclimatic subzones or variants, so that the site reflects the transitional climate. In this case, the descriptions and interpretations for both subzones should be compared, and any interpretations and prescriptions should reflect the transitional nature of the site. Secondly, a "poor fit" may be due to the fact that the plot from which data were collected is in a transitional location between two site units or overlaps two site units. In this case, the plot might be relocated to more accurately represent the typical ecosystems within the area of interest. Thirdly, a "poor fit" may be due to the fact that a new ecosystem has been encountered that has not yet been described for the subzone or variant. If this is thought to be the case, it should be brought to the attention of a regional ecologist in the Cariboo Forest Region office.

Describing Sites

Identifying site units requires careful observation and accurate description of site, soil, and vegetation features. The following steps are recommended.

Step 1. Select Sample Area. Locate an area of at least .04 ha (400 m^2) that is relatively homogeneous in vegetation composition, topography, and soil drainage and is representative of the ecosystem to be classified. The area should not include pronounced differences in site, soil, or vegetation that may indicate a second site unit.

Step 2. Determine and Record Site and Soil Features. Determine and record the site and soil features that are important for site identification and interpretation. Site features should represent the entire sample area. Soil features should be recorded in a soil pit dug to a depth of at least 50 cm and located in a representative microsite of the sample area. Microsites with atypical surface organic materials, soil drainage, or microtopography should be avoided.

Table 2 lists some of the most important site and soil attributes that should be described and the aids presented in this guide for describing these attributes.

TABLE 2 Important site and soil features for identifying site units

Feature	Definition and Description Aids
elevation (m)	from topographic map or altimeter
slope gradient (%)	average inclination from bottom to top of the sample area; from clinometer
slope aspect (degrees)	predominant direction (azimuth) that the slope of the sample area is facing; note if aspect of sample area differs from that of larger slope; from compass
mesoslope position	relative position of sample area within a moisture catchment area; see Figure 2 below and definitions in Appendix 4

TABLE 2 (continued)

Feature	Definition and Description Aids
soil texture	classes of percent sand, silt, and clay; especially record the predominant texture in the rooting zone; see Appendix 9
soil coarse fragment content (%)	% by volume of mineral fragments greater than 2 mm in diameter, including gravel, cobbles, and stones
surficial materials class	mode of deposition of soil parent materials; see Appendix 7
soil depth to impermeable layer (cm)	average depth from top of mineral soil to bedrock or other impermeable layer
depth to seepage water, water table, or gleying	depth at which water is seeping out of soil pit wall or where soils are mottled (orange splotches) or gleyed (colour of soil matrix dull olive to dull grey)
humus form	humus form order of the surface soil organic layers; see Appendix 12

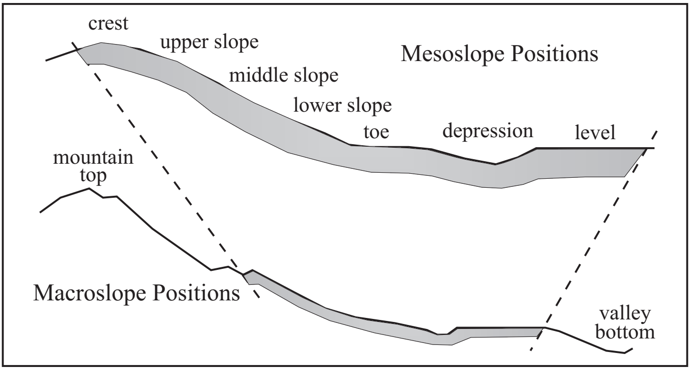

FIGURE 2 Mesoslope position diagram.

Step 3. Determine and Record Vegetation Features. Identify and record the percent ground cover of as many of the plant species as possible in each of the following vegetation layers:

- **dominant/codominant trees:** tallest trees and trees forming the main forest canopy;
- **intermediate or suppressed trees:** trees >10 m tall but below the main forest canopy;
- **tall shrubs:** woody plants 2–10 m tall; includes tree species;
- **low shrubs:** woody plants <2 m tall, except dwarf shrubs; includes tree species;
- **herbaceous species and dwarf shrubs:** non-woody species (forbs, grasses, sedges, rushes, etc.) and dwarf shrubs (woody and semi-woody species that are largely lying decumbent on the surface and seldom > 10 cm tall);
- **mosses and lichens:** all mosses, liverworts, lichens, and tree species germinants.

Estimating percent ground cover of the foliage of a plant species is a skill that improves with practice. Percent ground cover may be thought of as the percent of the ground surface that would be in the shadow of a plant species if a light source were directly overhead. In practice it is often helpful for reference to identify an area that is 1% of the plot, and also to determine the percentage of the plot that a given object such as a clipboard covers. For example, in a .04 ha plot, 1% of the plot is a 2 x 2 m area. Appendix 14 contains comparison charts for visual estimation of percent cover.

A list of common plant names (and their corresponding scientific names) used in this guide is presented in Appendix 13. Common names of plants largely follow Douglas *et al.* (1989, 1990, 1991, 1993) for vascular species and Meidinger (1987) for non-vascular species. Scientific names follow Douglas *et al.* (1989, 1990, 1991, 1993) for vascular plants, Ireland *et al.* (1987) for mosses, Stotler and Crandall-Stotler (1977) for liverworts, and Noble *et al.* (1987) for lichens. The Cariboo Forest Region office maintains a plant herbarium to assist in identifying unknown specimens. It includes collections of nearly all plant species known to occur within the Cariboo Forest Region.

Step 4. Determine Relative Soil Moisture and Soil Nutrient Regime. Relative soil moisture and soil nutrient regimes can be derived from the site and soils information collected above. Appendix 4 presents a guide to identification of soil moisture regime, while Appendix 6 presents a guide to identification of soil nutrient regime.

Identifying Site Units

Once the site, soil, and vegetation information has been recorded for an ecosystem and the soil moisture and nutrient regimes have been determined, the site series can be identified. Several tools are provided in Section 6 to assist the identification. These include a brief narrative description of each of the forested site series, dichotomous keys to site unit identification, edatopic grids, idealized landscape profiles showing the relative distribution of site series, tables summarizing site features of each site series, and a vegetation table showing the abundance of selected plant species in each site series.

The following procedure is recommended for identifying site units.

Step 1 Once the subzone/variant has been identified and the important site, soil, and vegetation features have be identified and recorded, turn to the "Key to Site Units" in the appropriate subzone and variant subsection of Section 6. Work through the key, selecting the best alternative of the two choices at each step of the key until arriving at a site series name. This should be considered a tentative identification.

Step 2 Verify the tentative site series identification from Step 1 by comparing the attributes recorded for the ecosystem with those in the site features summary table to ensure that site attributes are within the range normally found in the site series. The site series narrative descriptions, edatopic grid, vegetation table, and landscape profile for the subzone should also be compared with the recorded ecosystem attributes as a further confirmation of correct identification. If the ecosystem attributes recorded for the site generally match those described for the site series, then the site series has been correctly identified. Minor variation between the characteristics described in the guide and those recorded for the site can be anticipated.

Step 3 If there is significant disagreement between the attributes recorded for the ecosystem and those described for the site series identified in Step 1, then the user should check that the site attributes were recorded correctly and the correct choices were made in the dichotomous key. If after re-evaluation a satifactory match is still not present between the site characteristics and the descriptions in this guide, contact a regional ecologist in the Cariboo Forest Region office.

Identifying Seral Units

Field foresters, wildlife managers, and others are increasingly working with non-climax or seral ecosystems as more of the landscape is managed. Although the site unit keys and other aids to site unit identification were designed primarily for use in mature forests, most seral ecosystems can also be identified with these aids. Accurate site and soils information is usually sufficient to tentatively identify most site units even in early seral stages. However, the vegetation features used in the keys and other aids cannot be reliably used to confirm the identification. In a small number of cases, site series identification in the site unit keys relies almost entirely on vegetation. In these cases, other aids such as the summary table of site features, edatopic grid, and narrative description should be given greater emphasis than the keys to site units. Remnant mature vegetation found on the site or in an adjacent mature stand may also be used to assist in the vegetation assessment required for the keys.

4 ENVIRONMENT OF THE CARIBOO FOREST REGION

The Cariboo Forest Region is an area of about 8.21 million ha in the central Interior of British Columbia. It extends from about 51°00' to nearly 52°30' north latitude and from about 120°30' to nearly 125°45' west longitude. Western portions of the Region are within about 100 km of the main coastline of the Pacific Ocean but are separated from it by the high Coast Mountains. A location map is included in Section 1.

Physiography

The Cariboo Forest Region landscape is predominantly a plateau between two mountain systems (Figure 3). The plateau is part of the Interior Plateau of British Columbia (Holland 1976), a level to gently rolling landscape with incised river valleys and uplands locally rising above the general surface. Elevations of the plateau are predominantly 900–1500 m, rising to over 2000 m on local uplands. On the western side of the plateau, the landscape rises abruptly onto leeward slopes of the Coast Mountains. Peaks in this moderately to highly dissected landscape rise to elevations of 2700 to nearly 4000 m, with several peaks in the 3000–3300 m range. On its eastern side, the plateau landscape rises gradually through a broad transition to the Columbia Mountains. The landscape becomes increasingly dissected as it rises towards the Columbia Mountains, where elevations of summits are generally 2400–3600 m.

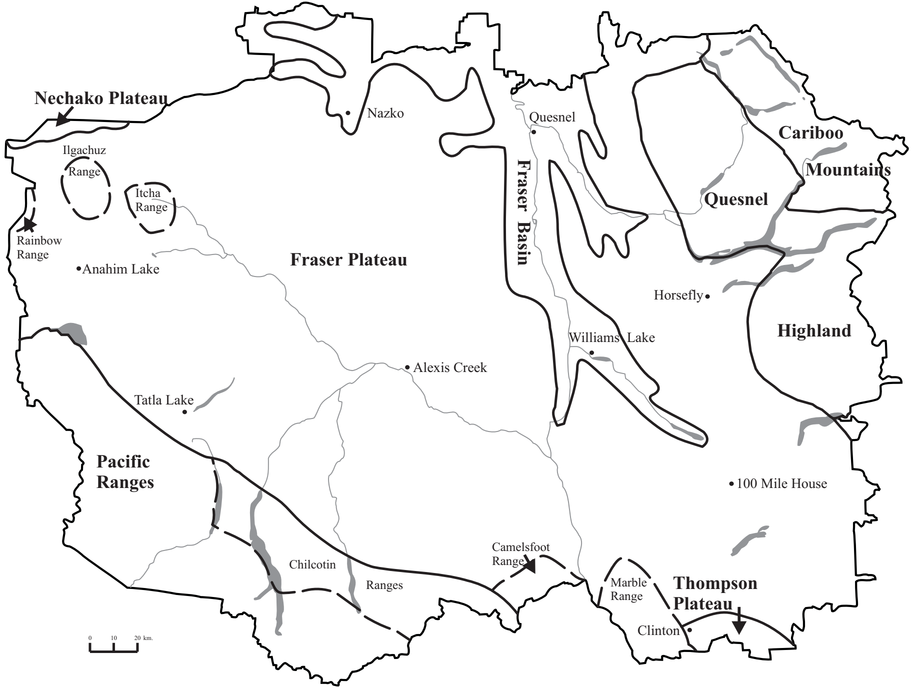

FIGURE 3 Physiographic subdivisions of the Cariboo Forest Region.

The Interior Plateau, Coast Mountains, and Columbia Mountains are further subdivided into smaller, more uniform physiographic subdivisions (Holland 1976). The Interior Plateau is represented in the Cariboo Forest Region primarily by the Fraser Plateau, Fraser Basin, and Quesnel Highland, with very small areas of the Nechako Plateau and Thompson Plateau. The Fraser Plateau covers the majority of the Cariboo Forest Region (Figure 3) and is predominantly a level to gently rolling landscape with elevations of 900–1500 m. It is underlain primarily by flat-lying to gently dipping olivine basalt bedrock, which in most areas is covered by a mantle of medium- to coarse-textured glacial till. In some areas the till is shaped by glaciers into drumlins. The Rainbow, Ilgachuz, Itcha, Camelsfoot, and Marble ranges are weakly dissected uplands that locally rise above the general plateau surface to elevations of 1500–2500 m.

The Fraser Basin occurs primarily to the north of the Cariboo Forest Region where it is a low-relief, low-lying plain covered by glacial till and glacial lake deposits. The till is frequently drumlinized. The Fraser Basin extends into the Cariboo Forest Region along the valleys of the lower Blackwater (West Road) River and the Fraser River north of the confluence with the Chilcotin River. In this area, the plateau surface is deeply incised by the river valleys.

The Quesnel Highland is a broad transition, about 50 km wide, from the Fraser Plateau to the Cariboo Mountains (part of the Columbia Mountains) on the east side of the Interior Plateau (Figure 3). The upland areas within this highland are remnants of a highly dissected plateau of moderate relief (Holland 1976). These remnants rise gradually from about 1500 m on the west to nearly 2300 m on the east near the Cariboo Mountains. This area is underlain primarily by folded schistose rocks with infolds of volcanic and sedimentary rocks (Holland 1976). Summits are mostly rounded because they were covered by Pleistocene glaciers, but cirques have developed since deglaciation on northern sides, resulting in a sharpening of summits.

The Nechako Plateau includes a very small area of the Cariboo Forest Region north of the Ilgachuz Range (Figure 3). The Thompson Plateau includes a very small area in the southeastern portion of the Cariboo Forest Region, east of Clinton (Figure 3).

The Coast Mountains is represented in the Cariboo Forest Region by the Pacific Ranges, including the Chilcotin Ranges, a physiographic subdivision of the Pacific Ranges (Figure 3). The Pacific Ranges is a highly dissected landscape, which includes the highest peaks of the Coast Mountains. Summit elevations are commonly 3000–3300 m and rise to approximately 4000 m on Mount Waddington. Except in the Chilcotin Ranges, the mountains are essentially granitic with icefields and extensive evidence of ice erosion. The high peaks are sculptured by cirque glaciers. The Homathko and Klinaklini rivers drain from the Fraser Plateau through the Coast Mountains to inlets of the Pacific Ocean. As a result, the valleys of these mountains are influenced by mild coastal air. The Chilcotin Ranges lie along the eastern edge of the Pacific Ranges (Figure 3). The mountains in this area are composed largely of non-granitic rocks and are characterized by lower, rounded summits and gently dipping areas of undissected upland (Holland 1976).

The Columbia Mountains are represented in the Cariboo Forest Region by the Cariboo Mountains, which occur from Bowron Lakes Provincial Park south to the area between the North and East Arms of Quesnel Lake. In total it occupies a small proportion of the Region. The Cariboo Mountains are composed of folded sedimentary and metamorphosed sedimentary rocks in which the principal rock type is quartzite, although some limestone is also present (Holland 1976). They have been intensely glaciated. Elevations of summits within the Cariboo Forest Region are mostly 2400–2700 m but, further eastward, elevations rise to nearly 3600 m.

The history of mountain uplift and Quaternary glaciation in British Columbia is summarized by Ryder (1978).

Climate

The climate of the Cariboo Forest Region is largely determined by physiographic features and their effects on principal air masses. The Region is affected by three principal air masses: warm, moist Pacific air from the west; cold, dry Arctic air from the north; and warm, dry Great Basin air from the south.

Since the Cariboo Forest Region is in the lee of the Coast Mountains, the moist Pacific air does not have a major effect on the climate of the Region (Annas and Coupé 1979). Western portions of the Fraser

Plateau, which are strongly affected by the Coast Mountains rainshadow, are among the driest parts of the Region. Total annual precipitation near Tatla Lake is only 338 mm. Elevations in this part of the Fraser Plateau are generally above 1300 m and, as a result, growing seasons are short and summers cool. Intense radiation cooling resulting from clear skies and low humidity results in frequent summer frost (Steen and DeMarchi 1991). In the northern part of the Region, the effects of the Coast Mountains are less intense, probably due in part to the fact that the Coast Mountains are lower and less extensive north of 52° latitude (Annas and Coupé 1979). In addition, interactions between the Pacific and Arctic air masses are more frequent and, as a result, annual precipitation in northwestern areas is generally greater than 450 mm.

As the Pacific air moves eastward across the Fraser Plateau, humidity and precipitation increase slightly. Mean annual precipitation at Williams Lake is 413 mm and at Horsefly is 564 mm. Further eastward, the westerly flow of air rises over the Quesnel Highland and eventually the Cariboo Mountains. As it does, precipitation increases quickly. Average precipitation at relatively low elevations near Bosk Lake, Doreen Creek, and Big Slide Mountain is 736, 861, and 987 mm, respectively, while at higher elevations on Boss Mountain it is 1177 mm. Elevations of the eastern Fraser Plateau and bottoms of major valleys in the Quesnel Highland are generally below 1100 m and, as a result, temperatures are warmer than on the higher plateau in the western parts of the Fraser Plateau. In addition, the higher humidity and cloud cover results in less radiation cooling during the summer, and frosts are less frequent. At high elevations of the Quesnel Highland, growing seasons are very short and summers are cool.

During summer months, the westerly flow of Pacific air is diminished by the large Pacific high-pressure centre (Schaefer 1978). Much of the precipitation during the summer is the result of numerous convective storms.

The Arctic air mass is well north of the Cariboo Forest Region during most of the summer but affects the climate during the winter months, resulting in periods of very cold temperatures. However, the Rocky Mountains shield the Cariboo Forest Region as well as most other parts of central and southern British Columbia from the full effects of the cold

Arctic air (Schaefer 1978). As a result, the Cariboo Forest Region does not experience the same degree and duration of cold as the Great Plains east of the Rocky Mountains. High snowfall events often occur when the cold Arctic air invades the region and interacts with the moister Pacific air. Northern parts of the Cariboo Forest Region are more affected by Arctic air incursions than are southern portions and, as a result, the northern areas experience colder, snowier winters and cooler summers. For example, mean annual temperature at Ashcroft (elevation 305 m) is 8.7°C, while at Quesnel (elevation 488 m) it is 5.0°C.

Warm Great Basin air has relatively little effect on the climate of the Cariboo Forest Region except in the Fraser River valley south of the Chilcotin River confluence. During the summer, hot, dry air can penetrate the Region from the south, resulting in high daytime temperatures and clear skies. Incursions of this air mass are limited by the Cascade and Coast mountains, the relatively high elevations of the Fraser Plateau, and the narrowness of the Fraser River valley.

Mean temperature and precipitation data for the biogeoclimatic subzones of the Cariboo Forest Region are presented in Section 5.

Vegetation and Soils

Major vegetation patterns in the Cariboo Forest Region reflect the patterns of climate, topography, and surficial geological materials. On the dry, cold leeward slopes of the Coast Mountains and the western and southwestern portions of the Fraser Plateau, lodgepole pine forests dominate the landscape and are generally the climax forest type. These forests are relatively open, and trees are slow growing and relatively small, often less than 20 m tall at maturity. In northwestern parts of the Cariboo Forest Region where precipitation is somewhat higher, spruce is more frequent in the pine forests. Spruce forests also become more frequent at higher elevations and on moist sites adjacent to wetlands. In the Chilcotin River valley and the valley and plateau adjacent to the Fraser River where elevations become lower and summer temperatures are higher, Douglas-fir forests are well represented on the landscape, usually in mixtures with lodgepole pine forests. In these dry climates, Douglas-fir is the climax tree species on most sites. Further eastward, as precipitation increases, the Douglas-fir forests become seral to spruce forests, which become increasingly common. Still further eastward in the Quesnel Highland where precipitation is high, the forest contains a rich assemblage of tree species and tree growth rates are high. Climax forests at low elevations south of the Cariboo River are most often dominated by western redcedar or western hemlock, while at high elevations and north of the Cariboo River, climax forests are dominated by spruce (hybrid white spruce or Engelmann spruce) and subalpine fir. Douglas-fir and lodgepole pine are common seral tree species. Small deciduous forests occur throughout most of the Fraser Plateau and Quesnel Highland, but are most common and extensive in the Fraser Basin physiographic unit in northern parts of the Region and on southeastern parts of the Fraser Plateau, south of Canim Lake. Grasslands, often with sagebrush, dominate the landscape on slopes of the Fraser River valley south of the confluence with the Chilcotin River.

Soil parent materials in the Cariboo Forest Region are predominantly glacial till of medium to coarse texture. The till materials were generally transported only relatively short distances by Pleistocene glaciers and, as a result, the composition of the till often reflects the local bedrock. Coarse-textured tills are especially common on the western Fraser Plateau where they were derived from granitic rocks of the Coast Mountains. Colluviated till occurs on steep slopes in the mountains. Glaciofluvial deposits, forming outwash plains, terraces, and eskers occur locally, especially in valley bottoms. Lacustrine deposits occur locally, especially in the Fraser Basin physiographic unit. Deep organic deposits have a small extent and are very localized.

Soil development reflects the climate, vegetation, and surficial geological materials. Dystric Brunisols are the most common soil type in the dry lodgepole pine forests of the western Fraser Plateau and adjacent slopes of the Coast Mountains. At higher elevations, Humo-Ferric Podzols have developed in some deep, coarse-textured materials. Eastward towards the Fraser River valley, Brunisolic Gray Luvisols are also common but they are often weakly developed. Further east across the Fraser River, where climax forests are dominated by Douglas-fir, Orthic Gray Luvisols are most common and are well developed. Closer to the Quesnel Highland, as precipitation increases and spruce become more common, these soils are replaced by Brunisolic Gray Luvisols as the most common soil subgroup. In the still wetter climates of the Quesnel

Highland, Dystric Brunisols and Humo-Ferric Podzols are common. The Podzols are most common at higher elevations. Chernozems are the principal soil order in the dry grasslands of the Fraser River valley. Throughout the region, Gleysols occur in poorly drained, wet mineral materials. Organic soils are common in wet depressions but are generally localized and not extensive.

Principal soils and soil-forming factors on British Columbia landscapes pertinent to the Cariboo Forest Region are summarized by Valentine and Dawson (1978), Jungen and Lewis (1978), and Wittneben and Lacelle (1978).