A Guide to the Interior Cedar - Hemlock Zone, Northwestern Transitional Subzone (ICHg), in the Prince Rupert Forest Region, British Columbia
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A Guide to the Interior Cedar - Hemlock Zone, Northwestern Transitional Subzone (ICHg), in the Prince Rupert Forest Region, British Columbia

by
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1 INTRODUCTION

The British Columbia Ministry of Forests is currently developing an ecosystem classification of the forest and range land of the province. Our classification is based, with some modifications, on the biogeoclimatic system developed over the past 30 years by Dr. V.J. Krajina and his students at the University of British Columbia. The system incorporates primarily climate, soil, and vegetation data. The resulting biogeoclimatic classification provides a framework for forest and range management, as well as for scientific research.

This guide briefly outlines the principles and methods of the classification system, stressing the two primary areas of emphasis within the classification, the biogeoclimatic (zones, subzones, variants) and the ecosystematic (ecosystem associations and their phases and variations). We summarize the environmental characteristics of the Northwestern transitional subzone of the Interior Cedar - Hemlock Zone (ICHg) and its five variants: ICHg1 - Upper Nass Basin variant; ICHg2 - Lower Nass Basin variant; ICHg3 - Hazelton variant; ICHg4 - Meziadin - Bell-Irving variant; and ICHg5 - Iskut - Stikine variant. The classification of the subzone at the ecosystematic level is then presented in detail.

An ecological classification can serve several purposes, depending on the needs and viewpoints of the users of the classification. The B.C. Ministry of Forests intends its classification to provide a context for scientific research and resource management, and to be used as a reference for scientists and resource managers responsible for maintaining or enhancing supplies of timber, forage, wildlife habitat, recreation, and water quantity and quality. All resources can be related to our ecosystem classification, but timber has priority within this ministry. Because of this priority, and also because of insufficient knowledge of other resources, we have developed primarily silvicultural interpretations, which are presented in the final section of the report. Use these prescriptions as a guide; they are not intended to be final or to be used in "cookbook" fashion. With time and increasing knowledge, we will amplify and modify the interpretations as required.
The area covered by this guide encompasses most of the lowland and mid-elevation forests of the western part of the Kispiox Timber Supply Area (TSA), and much of the northern Kalum TSA (see Figs. 1 and 5). Originally the study was to cover the now obsolete Skeena Public Sustained Yield Unit, but we extended the boundaries both to the north and the south.

We have included, in the pocket on the inside back cover, a map at 1:500 000 of the ICHg in the Prince Rupert Forest Region. Ultimately a map of all biogeoclimatic zones, subzones, and variants will be produced at a scale of 1:500 000 for the area covered by this report. The map will be similar to that produced by Klinka et al. (1979). Unfortunately we do not yet know enough of the study area (map sheets 93 NW, 103 NE, and 104 SE), especially at higher elevations, to make such a detailed map.

"A Guide to Some Common Plants of the Skeena Area, British Columbia" has been prepared (Coupé et al. 1982), and is designed to be used in conjunction with this guide to classification and interpretation. We have also produced a companion report entitled "A Guide to the Coastal Western Hemlock Zone, Northern Drier Maritime Subzone (CWHf) in the Prince Rupert Forest Region, British Columbia" (Haeussler et al. 1982). The CWHf guide is organized along the same lines as the ICHg guide, as both have evolved from the same original research project.
FIGURE 1. Timber Supply Areas of the Prince Rupert Forest Region, British Columbia.
2 OBJECTIVES

The goal of the ecosystem classification program is the improvement of forest management in British Columbia. The overall objective of the program is to provide resource managers with some of the information needed to meet the goal, by developing a "permanent", land-based, ecological classification to organize our knowledge of ecosystems and to serve as a framework within which to manage resources. In other words, the classification program aims to both organize and apply our knowledge of the structure, function, and relationships of forest and range ecosystems.

More specifically, this guide has five objectives:

1. Characterization, description, and mapping of the Interior Cedar-Hemlock Biogeoclimatic Zone, Northwestern transitional subzone (ICHg), in the Prince Rupert Forest Region;
2. Characterization and description of forest ecosystems in the ICHg;
3. Provision of aids in the identification of biogeoclimatic and ecosystematic units in the ICHg;
4. Development of preliminary silvicultural and forest management interpretations and recommendations relating to the ecosystem units of the ICHg;
5. Promotion of the concept of the ecosystem as the fundamental unit of forest management.
3 PRINCIPLES AND PHILOSOPHY

Numerous authors working in many different scientific fields have analysed and described the philosophy and methods of taxonomic classification. Some summaries pertinent to ecosystem classification are by Cline (1949), Whittaker (1962), Sokal (1974), Soil Survey Staff (1975), Bailey et al. (1978), Davis and Henderson (1978), and Pfister and Arno (1980). The biogeoclimatic system used by the Ministry of Forests is a classification of ecosystems (also called biogeocoenoses). It is being developed as a multi-level hierarchy with two primary sections or areas of emphasis: ecosystem or biogeocoenotic levels of integration, and biogeoclimatic or zonal levels (Fig. 2). Each section has several hierarchical taxonomic categories, as explained below in Sections 3.4 and 3.5.

3.1 Ecosystem

Ecosystem is the term used for the sum total of vegetation, animals, and physical environment in whatever size segment of the world is chosen for study (Fosberg 1967). Ecosystems are interacting complexes of living organisms (plants, fungi, bacteria, animals) and the physical environment (soil, air, water, bedrock) immediately affecting them. The ecosystem, as defined by Tansley (1935), has long served as the fundamental conceptual and functional unit of ecology. However, Tansley's concept of ecosystem is too broad to easily integrate into a formal classification. Therefore, Krajina (1960) proposed that Sukachev's biogeocoenose (Sukachev and Dylis 1964) for practical purposes best represents a basic ecosystem. A biogeocoenose is a special case of the ecosystem, but the two terms are used here interchangeably. Hence, for our purposes a terrestrial ecosystem (biogeocoenose) is a unit or portion of the landscape and the life on and in it. It is a landscape segment relatively uniform in the composition, structure, and properties of both the biotic and abiotic environments and in their interactions.
FIGURE 2.  Schematic relations between zonal and ecosystem levels of classification.  AT = Alpine Tundra Zone; ESSFx and ESSFxp = hypothetical forested and parkland subzones, respectively, of the Engelmann Spruce - Subalpine Fir Zone; ICHx = a hypothetical subzone of the Interior Cedar - Hemlock Zone.
Numerous organisms such as fungi, earthworms, bacteria, insects, birds, and mammals are as much a part of the forest ecosystem as are trees, shrubs, herbs, and mosses. Furthermore, within the ecosystem there is a complex and dynamic set of relationships among these organisms and between them and their physical environment. However, for simplicity, the classification system deals primarily with two components of the ecosystem: vegetation and soil. The model of ecosystem function is that of Major (1951): vegetation and soils are products of climate, organisms, topography, parent material, and time. Plants and soil, considered simultaneously, integrate all ecosystem components and reflect ecosystem functioning. They are easy to observe and assess, and are considered to be the most convenient and suitable ecosystem features upon which to base the classification.

Thus, an ecosystem may be practically characterized by a "plant community" (a volume of relatively uniform vegetation) and the "soil polypedon" (a volume of relatively uniform soil) upon which the plant community occurs. An ecosystem has geographical bounds; its size is determined by the extent of the plant community and the associated soil polypedon. The latter boundaries may be abrupt, but more commonly they are gradual. As a result, an individual ecosystem usually contains some variation in biotic and abiotic characteristics.

3.2 Zonal Ecosystem

Climate is the fundamental determinant of the nature of terrestrial ecosystems. A classification of ecosystems should attempt to group related ecosystems influenced by the same mesoclimate. However, climate data are scant or lacking in some areas and climatic analysis alone will not produce an ecosystem classification. A reliable functional link between climate and ecosystems is needed. The concept of the zonal or climatic climax ecosystem provides this link.

The zonal ecosystem is that which best reflects the mesoclimate or regional climate of an area. The integrated influence of climate on the vegetation, soil, and other ecosystem components is most strongly
expressed in those ecosystems least influenced by local relief or by physical and chemical properties of soil parent materials. Such ecosystems generally occur on gentle to moderate (5-35%) slopes, in positions that neither receive nor shed an excess of water and nutrients. They have normal exposure to solar energy (heat and light) and wind, and are not affected by localized cold air drainage. Zonal ecosystems have intermediate soil textures (broadly loamy), medium or mesic moisture regimes, and medium or mesotrophic nutrient regimes. Soils usually are moderately pervious, deep (greater than 50 cm), and without root-restricting layers within the rooting zone. Hence, the biogeochemical cycles and energy exchange pathways of zonal ecosystems are more or less independent of local relief and soil parent material, and are in equilibrium with the regional climate.

Other ecosystems in a given area are influenced more strongly by local physiography and the physical and chemical properties of soil parent materials. They may be drier, wetter, richer, or poorer than zonal ecosystems, and they do not provide as clear a reflection of the regional climate.

Zonal ecosystems are characteristic of the regional climate that dominates their development. Hence, they are used to characterize biogeoclimatic units, which represent broad geographical areas of similar mesoclimate. The distribution of zonal ecosystems also determines the geographical extent of the biogeoclimatic units. Thus the concept of the zonal ecosystem links the ecosystematic and biogeoclimatic levels of classification (a zonal ecosystem labelled as "1", is indicated in Fig. 2).

3.3 Climax and Succession

3.3.1 Climax

The term "climax" in ecology refers to a condition of dynamic equilibrium, a steady state rather than a static

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1Mesic and mesotrophic are qualitative, relative terms that represent different actual conditions in different zones (e.g., a mesic ecosystem in the Interior Cedar - Hemlock Zone is quantitatively wetter than a mesic ecosystem in the Sub-Boreal Spruce Zone). However, in all zones mesic and mesotrophic designate "average" or medium moisture and nutrient conditions, intermediate between the existing extremes of each zone.
endpoint. The species populations of a climax ecosystem should be in steady state, with a balance between recruitment and death of individuals. Similarly, overall ecosystem functions or attributes, such as productivity, biomass, soil organic matter, energy and nutrient budgets, should be in balance (Whittaker 1975). Hence, a climax ecosystem is, in theory, a stable, permanent occupant of the landscape -- self-perpetuating unless disturbed by outside forces or modifying factors. The living components of a climax ecosystem are in equilibrium with the prevailing factors of the physical environment and the member species are in dynamic balance with one another.

In climax vegetation the species of plants are self-maintaining. Tree species of a climax forest are present as seedlings, saplings, and subcanopy and canopy trees. Similarly, climax shrubs, herbs, mosses, liverworts, and lichens are present in all stages from seedling or sporeling to maturity. In zonal forest ecosystems, only tree species that tolerate shade and intermediate moisture and nutrient conditions regenerate continually under the forest canopy.

3.3.2 Types of climax

Climatic climax ecosystems reflect the development potential of the prevailing regional climate. Other types of climax ecosystems occur where certain environmental factors have a greater influence on ecosystem development than does the regional climate. An edaphic climax differs from the climatic climax due to extreme soil or substrate conditions such as very coarse texture, high base saturation, or poor drainage. A topographic climax reflects compensating effects of topography on local climate (e.g., such as occur on a steep south slope). A topoedaphic climax occurs as a result of the combined influence of soil and topography (e.g., shallow, stony soil on a steep south slope). A fire climax may result from recurrent wildfire.
3.3.3 Succession

According to what has been termed the traditional view of succession (Drury and Nisbet 1973), ecosystems arrive at climax through a process of change called ecological succession, the progressive development of ecosystems through time. Sequential series of successional stages are called seres. There are several recognizable seral or successional stages in ecosystem development from, for example, an original bare surface to a mature forest. In theory, succession ends in a mature, climax ecosystem of relatively stable species composition and steady-state function, adapted to its environment and essentially permanent if undisturbed (Daubenmire 1968; Odum 1969; Whittaker 1975).

3.3.4 Climax and succession in the ICHg

The concepts of climax and succession have generated considerable controversy (for example, see Whittaker 1953; McIntosh 1967; Langford and Buell 1969; Drury and Nisbet 1973), much of it revolving around definitions, distinguishing criteria, structural and functional attributes, and the reality of both the climax state and the successional process. It would be inappropriate to discuss the controversy in this report, but it should be pointed out that we are following the traditional view of climax and succession in our ecosystem classification and, although many ecologists dispute this view, it provides useful insights and part of the philosophical basis of our treatment of the ecosystems of the ICHg.

Many ecosystems throughout North America and the world exist in successional states with little likelihood of ever attaining theoretical climax, because of the pervasive and persistent effects of disturbance. However, in northwestern North America, many forest ecosystems escape large-scale catastrophic destruction by fire, wind, and other agents (Parminter 1983; Brady
and Hanley 1984). Succession may continue over centuries (Harris and Farr 1974; Waring and Franklin 1979; Henderson 1982), and large tracts of old forest occur throughout the region, including the ICHg. These forests can be termed old (most exceed 200 years in age), old-growth (in the sense of Franklin et al. 1981), uneven- or multi-aged, climax, decadent, over-mature, steady state, or dynamic equilibrium, depending on one's perspective. In any case, such forests (mostly Tsuga heterophylla\textsuperscript{2} - dominated) occur in the ICHg, and they dominate the landscape of much of the study area.

This is not to say that climax forests are unchangeable or that all stands in similar environments are identical. Minor edaphic and climatic differences; differences in stand history in terms of past insect attacks, disease, windthrow, mass movements, fire, etc.; and chance factors all contribute to differences within a stand and from stand to stand on similar sites (Whittaker 1953). Fire, insects, and disease have all played major roles in the ICHg.

Although overall the ICHg is dominated by climax forests of western hemlock (Tsuga heterophylla) with lesser amounts of western red-cedar (Thuja plicata), subalpine fir (Abies lasiocarpa), and hybrid spruce (Picea glauca x sitchensis ?x engelmannii), there are extensive areas, especially at low elevations along the major rivers, dominated by seral ecosystems. Seral stands of trembling aspen (Populus tremuloides), paper birch (Betul apapyrifera), and lodgepole pine (Pinus contorta) are widespread as a result of natural and human-caused fire and land clearing. When such seral ecosystems are relatively old, yet remain distinct in form and function from climax (and we have sufficient samples), we have classified them into seral ecosystem associations, acknowledging that there is little likelihood they will ever reach theoretical climax.

\textsuperscript{2}Botanical nomenclature follows Coupé et al. (1982).
Sometimes, however, forests occur that theoretically are seral stages of a western hemlock climax, but are dominated by species such as subalpine fir and hybrid spruce that are moderately shade-tolerant. These stands appear capable of self-maintenance for at least several hundred years, and satisfy at least some of the criteria for climax. They probably owe their persistence to a localized sub-boreal type of climate that prevails because of cold air ponding on valley floors near the boundary between the Sub-Boreal Spruce Zone and the ICHg. We have treated such ecosystems as subassociations of the climax ecosystem association.

3.3.5 Potential climax and succession

British Columbia foresters will increasingly deal with seral ecosystems in the future, as older climax or near-climax stands are logged and replaced with young seral stands. Many of our management interpretations and recommendations are based on the expectation that if a disturbed (logged) forest is left alone it will gradually return to its natural state according to traditional successional theory. Whether this actually happens or not is uncertain, but nevertheless is largely an academic question because industrial forestry will maintain most productive ecosystems in seral states, probably less than 100 years old. Because our system classifies potential climax ecosystems, the classification will not become obsolete when managed seral forests prevail, if logging-related disturbance is not excessive. The potential and limitations of a logged-over site remain similar to what was set out by the classification and interpretation of the original or potential climax ecosystem. Successional trends toward the climax can usually be identified even in young stands. We can still recognize, describe, and integrate the seral ecosystem into our classification, and can still make
interpretations and predictions about the seral ecosystem
throughout its succession towards harvestable age. Ecosystem
classification thus provides a more or less permanent and
ecologically-based system of land classification, with immediate
and continuing application to management activities. In this
report, we treat seral stages either as seral ecosystem
associations or as ecosystem variations. With sufficient study,
successional stages and pathways (which depend on stand history)
could be described within each ecosystem unit, much as Arno (1982)
and Steele (1984) have done within habitat types in Montana and
Idaho. If more detail on seral ecosystems was required, a
parallel classification, resulting in a greater array of seral
ecosystem associations, could also be constructed.

3.4 Ecosystem Levels of Classification
Classification at ecosystematic (or biogeocoenotic) levels
involves small areas relatively homogeneous in vegetation, soils, and
implicitly in patterns of nutrient and energy dynamics, whereas
classification at biogeoclimatic levels involves broad geographical areas
of similar climate.

In this report, we use the ecosystematic categories of ecosystem
association, subassociation, type, and seral ecosystem association.
Phases and variations of ecosystem associations and subassociations are
also recognized and used, although the phase and the variation are not
formal categories in the classification. We will go into some detail in
defining ecosystematic units, as they represent the levels of the
classification within which most of the users of this report will be
working.

3.4.1 Ecosystem type
An individual ecosystem consists of a plant community plus
the soil polypedon upon which the community occurs. In the
Interior Cedar - Hemlock Zone (ICH), the landscape is covered by
numerous ecosystems of varying size, spread out over hill and valley. Most are forested; some are grassy, brushy, boggy, or have been recently cut or burned. Often the different ecosystems form a complex mosaic over the land, but their distribution is not random or helter-skelter. Similar plant communities recur in similar habitats, as do similar soil polypedons. The classification groups similar plant communities into "plant associations", and similar soil polypedons (in terms of humus form, horizons, texture, reaction [pH], parent materials, rooting depth, and coarse fragments) into "soil families". We define an "ecosystem type" as all ecosystems (land areas plus their biota) capable of producing vegetation belonging to the same climax plant association on soil of a single soil family. Although we have used the ecosystem type in constructing the classification, we do not define individual types in this report.

3.4.2 Ecosystem association

We then define the "ecosystem association" as all ecosystems capable of producing vegetation belonging to the same plant association at climax. Thus an ecosystem association is a group of related ecosystems physically and biologically similar enough that they have or would have similar vegetation at climax. The ecosystem association is similar to the habitat type of Daubenmire (1968) and Pfister et al. (1977).

We use the climax (or, where necessary, the advanced seral) condition to characterize ecosystem associations because we think that, as the culmination of ecological succession, the climax association best reflects the integration of environmental factors. One ecosystem association may include a variety of disturbance-induced, or seral, ecosystems, but succession will ultimately result in similar plant communities at climax throughout the association. Use of the climax plant association to name ecosystem associations does not imply that climax vegetation dominates the present landscape. Although overall the subzone is still dominated by
-15-

old-growth, climax forest, many ecosystems in the ICHg (especially in the ICHg3 or Hazelton variant) reflect some form of disturbance and are in various stages of succession towards climax.

At this level of the classification we use the vegetation to define the taxon of ecosystem association. Although such an approach risks over-simplification, its utility validates it to some extent, as vegetation may be readily observed and described. Furthermore, plants integrate and reflect all other ecosystematic factors (climate, nutrient and water levels, time, etc.); vegetation is a product as well as a part of the environment.

For these reasons, and for brevity and familiarity, we label the ecosystem association with the name of the climax plant association. For example, in the ICHg1, there is the Tsuga heterophylla - (Vaccinium spp.) - Hylocomium splendens - Pleurozium schreberi - Ptilium crista-castrensis or "Zonal hemlock - moss" ecosystem association. Ideally, the name for this ecosystem unit would incorporate factors of physiography and soils, but that would be impractical, because an ecosystem association often occurs over a wide range of soil and landform characteristics. However, the occurrence of the same climax plant association over the range of site characteristics is an expression of the similar moisture and nutrient regimes shared by these sites. Thus the Zonal hemlock - moss ecosystem association signifies that group of ecosystems that occur 1) on moderately well to well-drained soils ranging from shallow to deep Podzols, Brunisols, and Folisols with Hemimor humus forms; 2) on landforms ranging from morainal and colluvial blankets and veneers to organic (LFH) veneers over bedrock; and 3) on middle to lower, gentle to moderately steep slopes; all share more or less mesic and mesotrophic (intermediate for the subzone) moisture and nutrient regimes and supporting climax vegetation characterized by the Tsuga - (Vaccinium spp.) - Hylocomium - Pleurozium - Ptilium plant association. Providing the classification is adequately

\[^3\text{Humus form (forest floor) terminology after Klinka et al. (1981).}\]
described, explained, and understood, a relatively simple name can convey a great deal of useful information about individual ecosystems in the field.

3.4.3 Ecosystem subassociation

The goal of our classification is to describe adequately the natural variation of the forests of British Columbia, and to classify this variation in a way that is not only scientifically accurate and defensible, but is as simple as possible and also allows and encourages practical applications. Classification at the ecosystem association level accounts for and describes the major variation in species composition and moisture/nutrient regimes within a given biogeoclimatic subzone or variant. Among the climax ecosystems making up associations, however, there often occurs recognizable variation in the relative abundance of one or more species that appears to reflect environmental differences, and is worthy of a place in the classification. We have defined a taxonomic sub-division of the ecosystem association, the "ecosystem subassociation", to describe these differences in species composition that appear to reflect trends in local climatic, edaphic or very long-term successional factors, but which are not considered significant or distinct enough (based on present data) to warrant the recognition of a distinct ecosystem association.

For example, in the ICHg3 variant two subassociations of the zonal hemlock - moss ecosystem association (ICHg3/01) are recognized based on the relative dominance of western hemlock and western redcedar versus subalpine fir and hybrid spruce in the overstory. The Hemlock - (cedar) subassociation (ICHg3/01.1) is dominated by western hemlock and to a lesser extent by western redcedar, with infrequent subalpine fir and hybrid spruce. Conversely the Subalpine fir - spruce subassociation (ICHg3/01.2) is dominated by subalpine fir and hybrid spruce, and apparently represents "pseudoclimax" stands that will maintain themselves (because most regeneration is subalpine fir and hybrid spruce rather than western hemlock and
redcedar) for at least 100 years. Even though they are the most shade-tolerant species in the variant, it appears that hemlock and cedar will very slowly gain ascendancy, because a localized sub-boreal-like climate prevails in certain valley-bottom parts of the ICHg3 (e.g., vicinity of Kispiox, Moricetown, Trout Creek valley). It seems that in these transitional areas close to the boundary between the ICHg and the Sub-Boreal Spruce Zone, reproduction of shade-tolerant trees is sensitive to relatively slight variations in local climate, with the consequence that climax ecosystems may be dominated either by hemlock and cedar, or subalpine fir and spruce. With more study, these areas of cold-air ponding could perhaps be delimited as biogeoclimatic phases of the ICHg3.

3.4.4 Seral ecosystem association

The category of seral ecosystem association was created to accommodate disclimax ecosystems. A disclimax exists when an apparently seral (non-climax) community, dominated by shade-intolerant species, is perpetuated by continuous or intermittent disturbance. Disclimax ecosystems are widespread in the ICHg, particularly in the Hazelton region where stands of lodgepole pine, trembling aspen, paper birch, hybrid spruce, and subalpine fir have been established and maintained by fire for such long periods of time that they have altered the nature of the soil and virtually excluded western hemlock from many areas.

It is true that a shade-tolerant, hemlock-dominated climax would eventually develop if natural fires, beetle infestations, and other forms of disturbance were prevented. However, long-term lack of disturbance would be an artificial condition, and spruce and subalpine fir would still be dominant tree species for several generations before giving way to hemlock and cedar.

It would be unrealistic to impose a classification based solely on shade-tolerant climax ecosystems on a subzone like the ICHg, where a significant portion of both managed and unmanaged stands will not
even approach a climax condition within a reasonable time. Seral ecosystem associations have significantly different vegetation and physical site properties from climax ecosystem associations and thus create different opportunities and problems for forest managers.

3.4.5 Ecosystem association phase

Sometimes the ecosystem association, which is a fundamental theoretical unit in the classification, may also be the operational unit upon which to base silvicultural and other management decisions. However, in many cases the ecosystem association must be subdivided into more operationally significant units. This is especially true of those widespread ecosystem associations that encompass quite a range of habitat conditions.

The "ecosystem association phase" (or ecosystem phase for short) is used for better site differentiation and identification. The "ecosystem phase" is basically a functional subdivision of the ecosystem association and recognizes some edaphic property or attribute that may be useful or significant to the users of the classification. For example, the ICHg3/09 or Spruce - pine - shrub seral ecosystem association has two phases, coarse textured and fine textured, in recognition of two general particle-size classes that are correlated with differences in ecosystem moisture, nutrients, and tree growth. Delimitation of the two phases gives more meaning to silvicultural interpretations of the widespread seral associations. Other ecosystem phases might be based on slope classes, aspect, soil climate, bedrock type, or some other useful feature of the soil or landform. The ecosystem phase thus reflects variation contained within ecosystem associations, and allows differentiation of recognizable and repeatable subunits of the ecosystem association for management, silvicultural, or purely descriptive purposes.

3.4.6 Ecosystem association variation

We use the "ecosystem association variation" (or "ecosystem variation" for short) to accommodate slight vegetative deviations
from the central concept of the ecosystem association, or to describe some widespread successional stages of the climax association. In part because our classification relies on climax ecosystems, this type of variability does not yet have a place in the formal classification. However, it is important to recognize and describe such variation in species composition, so as to aid in the identification and interpretation of ecosystems in the field.

The *Vaccinium* variation of the ICHgl/01 is an example of a vegetative deviation from the central concept of the ecosystem association. The *Vaccinium* variation is more or less identical to typical ICHgl/01, except for the presence of a characteristic, well-developed, *Vaccinium*-dominated shrub layer.

Seral ecosystems are common in the ICHg. We use variations to label and describe seral stands that already bear a strong relationship to the climax stand into which they will (it appears) eventually develop. Such stands can usually be easily assigned to the appropriate climax ecosystem association.

However, when seral stands are relatively old (greater than 100 years in age) but have not yet attained or even approached theoretical climax, we recognize seral ecosystem associations rather than variations. It appears that such stands will very probably never reach climax in the prevailing disturbance regime, in which the average return period of major disturbance is less than 100 years. For example, it appears that flooding occurs frequently enough to maintain cottonwood ecosystems as long as there is an active floodplain, so they are grouped in a seral ecosystem association rather than as a variation of a (theoretical climax) spruce floodplain association.

3.5 Biogeoclimatic Levels of Classification

The biogeoclimatic area of emphasis provides higher categories in the taxonomic hierarchy to accommodate further generalization of ecosystem units, based mainly on climatic relationships. Classification,
characterization, and mapping of biogeoclimatic units are the major activities carried out at these levels. Biogeoclimatic units or categories commonly used by the Ministry of Forests are the zone, subzone, and variant. In addition, phases are recognized and used, but the phase is not a formal category in the classification.

3.5.1 Biogeoclimatic subzone

A distinct climatic climax or zonal ecosystem association characterizes a "subzone". A subzone thus consists of unique sequences of geographically related ecosystems in which climatic climax ecosystems are members of the same zonal ecosystem association. Such sequences are influenced by one type of regional climate. Subzones are the basic units of biogeoclimatic classification, and are the first to be recognized in the classification process. Note that the two sections of the classification are linked through the fundamental relationship between the zonal ecosystem association and the subzone.

This report deals primarily with one subzone of the Interior Cedar - Hemlock Zone, the ICHg or Northwestern transitional subzone.

3.5.2 Biogeoclimatic variant

Subzones also contain considerable variation, for which we have provided the biogeoclimatic category of "variant". Variants reflect further differences in regional climate, and are generally recognized for areas that are drier, wetter, snowier, warmer, or colder than other areas in the subzone. These climatic differences result in corresponding differences in vegetation, soil, and ecosystem productivity. The differences in vegetation may be expressed as changes in the proportion and vigour of certain plant species, or differences in successional development or in the overall pattern of vegetation over the landscape. Differences in soils may be confined to the variation in intensity of certain soil-forming processes and not be markedly expressed in morphological features. Thus, variants are characterized by a distinct zonal ecosystem association plus a supplementary combination of environmental factors.
In this report on the Northwestern transitional subzone, we have recognized five distinct biogeoclimatic variants, designated ICHg1,2,3,4, and 5. Characteristic features of and differences among the variants are described in detail in Section 6.

3.5.3 Biogeoclimatic phase

The "biogeoclimatic phase" accommodates variation, resulting from local relief, in the regional climate of subzones and variants. Phases are useful in designating significant, extensive areas of ecosystems that are, for topographic or topoedaphic reasons, atypical for the regional climate. Examples might be extensive areas of grassland occurring only on steep, south slopes in an otherwise forested subzone; enclaves of apparently coastal forest on moist, northeastern slopes in an interior subzone (e.g., ICHgla or Amabilis fir phase); or valley-bottom, frost-pocket areas in mountainous terrain (as occur in the ICHg3). The biogeoclimatic phase relates to local climate and hence is not a formal category in the classification, but phases can be identified and mapped for management or descriptive purposes.

The only biogeoclimatic phase we describe in this report is the ICHgla or Amabilis fir phase. However, other areas with atypical local climate certainly exist within the subzone and may be recognized as special phases when we have more data to describe them.

3.5.4 Biogeoclimatic zone

We group subzones with affinities in climatic characteristics and zonal ecosystems into zones. We define a biogeoclimatic zone as a large geographic area with a broadly homogeneous mesoclimate. Consequently a zone has characteristic webs of energy flow and nutrient cycling, and typical patterns of vegetation and soil. We characterize zones by closely related, zonal ecosystem associations. Zones also have characteristic, prevailing soil-forming processes, and one or more typical, major, climax species of tree, shrub, herb,
and/or moss. Zones are usually named by one or more of the dominant shade-tolerant tree species (the Alpine Tundra Zone is a self-explanatory exception) capable of self-regeneration in zonal ecosystems; a geographical modifier is often added to the name.
4 METHODS

Field procedures of the Ministry of Forests' classification program follow those outlined in detail in the manual by Walmsley et al. (1980). Analytic and synthetic methods have been described by Klinka et al. (1977), and are similar to those of Krajina and his students (e.g., Brooke et al. 1970; Wall and Krajina 1973; Kojima and Krajina 1975). However it seems that our methods are still not well understood and need further explanation.

4.1 Plot Sampling

Field sampling is stratified on the basis of biogeoclimatic units and ecological moisture and nutrient regimes. Based on reconnaissance and other available information, tentative biogeoclimatic units are often delineated prior to plot selection. An edatopic grid (Fig. 3) is used as an aid to stratification within each biogeoclimatic unit. We try to sample five or more plots representing each of the possible combinations of moisture and nutrients. Intensity of sampling varies according to the areal extent of the ecosystem, its apparent diversity, and its importance for forestry or range management. Sampling intensity also depends on available access, and on the nature and scale of the project.

We sample selectively. Sample plots are located in habitats that are as uniform as possible; heterogeneous, transitional, or disturbed sites are avoided. To date, most sampling has been confined to climax or near-climax ecosystems. Plots are located so as to represent particular combinations of moisture and nutrients (see Tables 1 and 2). Slope position, indicator plant species, relative tree growth, soil texture, seepage, and base status of parent materials, among other things, are used as clues to moisture and nutrient regimes. The professional judgement of experienced fieldworkers in selecting representative ecosystems is an important part of our approach.

The smallest unit of sampling in ecosystem studies is the "sample plot" (also termed 'sample plot' by Mueller-Dombois and Ellenberg

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### ECOLOGICAL NUTRIENT REGIME

<table>
<thead>
<tr>
<th>ECOLOGICAL MOISTURE REGIME</th>
<th>OLIGOTROPHIC</th>
<th>SUBMESOTROPHIC</th>
<th>MESOTROPHIC</th>
<th>PERMESOTROPHIC</th>
<th>SUBEUTROPHIC TO EUTROPHIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY XERIC</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XERIC</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBXERIC</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBMESIC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MESIC</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBHYGRIC</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYGRIC</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBHYDRIC</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 3.** Edatopic grid of ecological moisture and nutrient regimes.
### TABLE 1. Ecological moisture regime classes

<table>
<thead>
<tr>
<th>Moisture regime</th>
<th>Description</th>
<th>Primary water source</th>
<th>Slope position</th>
<th>Texture</th>
<th>Drainage</th>
<th>Depth to impermeable layer</th>
<th>Surface humus depth</th>
<th>Available water stor. cap.</th>
<th>Slope gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY XERIC</td>
<td>Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after ppt.</td>
<td>precipitation</td>
<td>ridge crests (gravely-s)</td>
<td>very coarse</td>
<td>rapidly</td>
<td>very shallow (&lt; 0.5 m)</td>
<td>very</td>
<td>extremely low</td>
<td>very steep (especially on south aspects)</td>
</tr>
<tr>
<td>XERIC</td>
<td>Water removed very rapidly in relation to supply; soil is moist for brief periods following ppt.</td>
<td>precipitation shedding</td>
<td>abundant coarse fragments</td>
<td>rapid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBXERIC</td>
<td>Water removed rapidly in relation to supply; soil is moist for short periods following ppt.</td>
<td>precipitation</td>
<td>upper slopes mod. coarse</td>
<td>rapid to</td>
<td></td>
<td>shallow</td>
<td>shallow</td>
<td>steep</td>
<td>very low</td>
</tr>
<tr>
<td>SUBMESIC</td>
<td>Water removed slowly in relation to supply; water available for moderate short periods following ppt.</td>
<td>precipitation shedding (LS-SL) mod. coarse fragments</td>
<td>mid-slope normal to rolling to flat</td>
<td>moderately</td>
<td>moderately</td>
<td>good</td>
<td>moderately</td>
<td>deep</td>
<td>deep</td>
</tr>
<tr>
<td>MESIC</td>
<td>Water removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year. Available soil moisture reflects climatic inputs</td>
<td>precipitation</td>
<td>moderately to fine (L-SL)</td>
<td>good</td>
<td>moderately</td>
<td>deep</td>
<td>moderately</td>
<td>moderate</td>
<td></td>
</tr>
<tr>
<td>SUBHYDRIC</td>
<td>Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm.</td>
<td>precipitation and seepage</td>
<td>lower slopes variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slight</td>
</tr>
<tr>
<td>HYDRIC</td>
<td>Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying</td>
<td>seepage</td>
<td>lower slopes variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBHYDRIC</td>
<td>Water removed slowly enough to keep the water table at or near the surface for most of the year; gleved mineral or organic soils; permanent seepage less than 30 cm below the surface.</td>
<td>seepage or permanent water table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDRIC</td>
<td>Water removed so slowly that the water table is at or above the soil surface all year; gleved mineral or organic soils.</td>
<td>permanent water table depressions</td>
<td>variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*From Waring et al. (1980).*
TABLE 2. Ecological nutrient regime characteristics

<table>
<thead>
<tr>
<th></th>
<th>Oligotrophic A</th>
<th>Submesotrophic B</th>
<th>Mesotrophic C</th>
<th>Permesotrophic D</th>
<th>Eutrophic E</th>
<th>Hypereutrophic F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>very poor nutritional status, very small supply of available nutrients</td>
<td>poor nutritional status, low supply of available nutrients</td>
<td>medium nutritional status, medium supply of available nutrients</td>
<td>rich nutritional status, plentiful supply of available nutrients</td>
<td>very rich nutritional status, abundant supply of nutrients</td>
<td>saline nutritional status, excess salt accumulations</td>
</tr>
<tr>
<td><strong>BEDROCK SOURCE</strong></td>
<td>granite</td>
<td>granodiorite</td>
<td>diorite</td>
<td>gabbro</td>
<td>peridotite</td>
<td>dunite- serpentine</td>
</tr>
<tr>
<td></td>
<td>rhyolite</td>
<td>dacite</td>
<td>andesite</td>
<td>basalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>quartzite</td>
<td>quartz gneiss</td>
<td>garnet schist</td>
<td>biotite schist</td>
<td>slate</td>
<td>phyllite- marble</td>
</tr>
<tr>
<td></td>
<td>quartz sandstone</td>
<td>conglomerate</td>
<td>graywacke</td>
<td>argillite. shale-dolomite</td>
<td>limestone</td>
<td>gyspsy- halite</td>
</tr>
<tr>
<td><strong>TEXTURE</strong></td>
<td>very coarse</td>
<td>coarse</td>
<td>medium</td>
<td>fine</td>
<td>very fine</td>
<td>variable</td>
</tr>
<tr>
<td><strong>ORGANIC MATTER CONTENT</strong></td>
<td>low</td>
<td>moderate</td>
<td>high</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HUMUS FORM</strong></td>
<td>acid mors</td>
<td>mors and moder</td>
<td>moder</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SOIL REACTION</strong></td>
<td>extremely acid to</td>
<td>medium acid to</td>
<td>slightly acid to</td>
<td>moderately to</td>
<td>mildy alkaline</td>
<td>strongly alkaline</td>
</tr>
<tr>
<td></td>
<td>medium acid</td>
<td>neutral</td>
<td>mildly alkaline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CATION EXCHANGE CAPACITY</strong></td>
<td>low</td>
<td>moderate</td>
<td>high</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BASE SATURATION</strong></td>
<td>low</td>
<td>moderate</td>
<td>high</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C/N RATIO</strong></td>
<td>high</td>
<td>moderate</td>
<td>low</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 From Walmsley et al. (1980). Note that the presence of nutrient-rich seepage waters may compensate for other factors to create eutrophic conditions.
(1974) for vegetation sampling, and termed 'pedon' by Soil Survey Staff (1975) for soil sampling. Plot size in forest stands is usually 400-500 m²; plot shape is variable but usually square or rectangular. At each site, the standardized provincial site, soil, humus form, vegetation, and mensuration data sheets are completed, according to the procedures in Walmsley et al. (1980).

4.2 Analysis

The information collected from the sample plots must be analysed and integrated into a usable classification. To accomplish this we code vegetation and selected soil, physical, and mensurational data for tabulation by a computer program developed by Klinka and Phelps (Klinka et al. 1977⁵). The program sorts, organizes, and presents these data; it does not perform any classification. This procedure aids in the traditional Braun-Blanquet method of classification by tabular analysis (see Mueller-Dombois and Ellenberg 1974), mainly by reducing manual procedures and transcription errors.

The program produces environment, vegetation, and vegetation summary tables. The classifier specifies the tentative ecosystem units, relying to a large extent on personal knowledge and judgement. The program summarizes environment and vegetation data according to the specified units. The summary vegetation table then presents species presence (frequency of occurrence in sample plots) and mean species significance (an estimate of both cover and abundance) for all plant species in all differentiated units. Successive rearrangements can be easily made.

The classifier generally groups plots by tentative biogeoclimatic unit and by estimated moisture/nutrient regime. The vegetation tables list species by stratum or layer (trees, shrubs, herbs, etc.) in order of presence and mean percent cover for each ecosystem unit. Plots or groups of plots that are floristically different may be separated or moved to another group. Plots that appear similar in moisture and nutrient regime

⁵Ibid.
are experimentally merged. Through this process of computer-assisted, experimental grouping, rearrangement, and refining of groups, the ecosystem associations are defined (cf. Poore 1962). Ecosystem associations may then be subdivided into subassociations, types, variations, or phases, often on the basis of edaphic factors as summarized by the environment tables. The degree of lumping or splitting among ecosystem units is largely a matter of personal judgement or, in the case of phases, of operational significance.

Zonal ecosystem associations characterize individual subzones. Subzones which are more similar to each other than they are to any other subzones are then grouped into biogeoclimatic zones. This last taxonomic decision has to date been largely subjective, based on the classifiers' concepts of mesoclimate, zonal ecosystem associations, allowable variation within a zone, and the precedent of Krajina (1965, 1973, 1979).

The Ministry of Forests has so far done little mathematical treatment of the data collected and summarized by the ecosystem classification program. However, there are plans for using ordination and other numerical techniques in the near future.

4.3 Mapping

Biogeoclimatic mapping begins with a review of available ecosystem classifications within or near the mapping area. Biogeoclimatic units are characterized and summarized in synopsis form. A draft map, based on physiography and the extrapolation of elevational limits, may be prepared. Field mapping is done along selected transects by ground and air survey. The ground survey includes brief descriptions (rapid reconnaissance) of vegetation and soils; special attention is paid to zonal ecosystems. Boundaries drawn in the field are based on the type and occurrence of zonal ecosystems, floristic combinations, and the distribution of azonal, edaphic climax ecosystems. Final boundaries are drawn after fieldwork and data analysis have been completed. Boundaries outside transects are extrapolated on the basis of elevation and physiography.
5 GENERAL CHARACTERISTICS OF THE SUBZONE

5.1 Geographic Description

The Interior Cedar – Hemlock Biogeoclimatic Zone (ICH) in the Prince Rupert Forest Region consists of one subzone, the ICHg or Northwestern transitional subzone. Other subzones of the ICH are located in the "Interior wet belt" of southeastern British Columbia.

The ICHg lies just east of the Coast Mountains in the drainages of the Skeena, Nass, Iskut, and Stikine rivers. It encompasses most of the Nass Basin physiographic subdivision and adjacent parts of the Skeena and Hazelton Mountains (Holland 1976). Valley floors and lower to mid-mountain slopes ranging in elevation from 100 m to 1000 m are included within the ICHg. To the west, the ICHg is bounded by subzones of the Coastal Western Hemlock Zone (CWH); to the east it borders on the Sub-Boreal Spruce Zone (SBS). The Engelmann Spruce – Subalpine Fir Zone (ESSF) lies at subalpine elevations above the ICHg. Figures 4 and 5 show the location of the ICHg in the Prince Rupert Forest Region.

5.2 Climate (Wilson and Marsh 1975; Environment Canada 1980)

The climate of the ICHg (see Fig. 6) is intermediate between the cool, wet, more equable conditions of the North Coast and the drier, more extreme conditions of the Interior Plateau. In west central British Columbia, weather systems generally originate off the Pacific Coast and move inland. As warm, moisture-laden, coastal air masses rise over the Coast Mountains they are abruptly cooled and deposit most of the moisture on the windward (west-facing) mountain slopes. By the time these air masses reach the interior or leeward side of the mountains, they are quite dry and susceptible to cooling or warming by the land surface. Where wide valleys such as the Skeena and the Nass cut through the Coast ranges the warm humid air is able to penetrate much further inland, losing its warmth

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FIGURE 4. Base map of central part of the Prince Rupert Forest Region.
FIGURE 5. The Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg), in the Prince Rupert Forest Region.
Table 6. Climatic conditions for the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg).

<table>
<thead>
<tr>
<th>Station</th>
<th>Location</th>
<th>Duration (years)</th>
<th>Mean Annual Temperature</th>
<th>Mean Annual Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hazelton</td>
<td>(314 m)</td>
<td>(20-24)</td>
<td>4.4°C</td>
<td>535.3 mm</td>
</tr>
</tbody>
</table>

Temperature (°C) and Precipitation (mm) vs. Month:

- J: -13.9°C
- A: -45.0°C
- F: 22.5°C
- I: 36.1°C

Key:
- a: Station
- b: Height above sea level (metres)
- c: Duration (years) of observations
- d: Mean annual temperature
- e: Mean annual precipitation
- f: Mean daily minimum temperature of the coldest month
- g: Lowest temperature recorded
- h: Mean daily maximum temperature of the warmest month
- i: Highest temperature recorded
- k: Curve (dotted) of mean monthly temperature
- l: Curve of mean monthly precipitation
- n: Months with mean daily minimum temperature less than 0°C (black)
- o: Months with absolute temperature less than 0°C (frosts occur; black plus cross-hatching)
- p: Mean duration (days) of frost free period
- q: Index of continentality = [1.7(mean temp. July - mean temp. January) - 20.4] / (sine degrees latitude)

Figure 6. Representative climatic diagram for the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg).
and moisture gradually. This phenomenon results in the wide band of transitional climate that characterizes the ICHg.

Summarized briefly, the climate of the ICHg is warm and moist in summer, cool and wet in fall, and cold in winter. Average annual precipitation ranges from 500 to 1200 mm. Snowfall varies from moderately light to very heavy depending on location, and snowpacks last from 4 to 7 months. The ground is generally frozen throughout the winter and breakup occurs between early March and late May.

There is considerable climatic variation within the ICHg. Most of this variation can be attributed to four factors: longitude, latitude, elevation, and local topography. A strong climatic gradient exists from west to east across the ICHg. Western sections have a predominantly coastal-transitional climate, while eastern sections show dominantly continental or sub-boreal climatic influences. Precipitation, number of frost-free days, and winter temperatures all decrease significantly from west to east, while summer-time temperatures increase.

The ICHg has a latitudinal range extending from 54°40′ N on the Skeena River to 57°30′ N on the Stikine River. Within this range there is considerable variation in temperature, precipitation, and length of growing season.

Elevation profoundly influences local climate. In general, high elevation mountain slopes are cooler, more humid, and receive more snow than low elevation valley bottoms. However, because cold air drains downslope, creating temperature inversions, the greatest temperature extremes and heaviest frosts are often experienced on the valley floor, while mid-mountain slopes have a more equitable climate.

Local topographic features play a very important role in determining local climate. For example, rain-shadow areas that receive unusually low amounts of precipitation are often found on the leeward side of mountain barriers such as at Hazelton and Kitwanga. Sheltered middle elevation valleys like Boulder Creek in the Rocher de Boulé Range can be unusually wet and mild. Large lakes also can have a moderating influence on climate along the lakeshore.
5.3 Vegetation (Runka 1972; Haeussler 1980)

The transitional nature of the ICHg climate is reflected in the vegetation of the subzone, which combines elements of both coastal and interior flora. Climax forests are dominated by western hemlock, which occurs together with subalpine fir, hybrid spruce, and western redcedar.

Fire has had a major influence on the development of many plant communities in the subzone. Seral (nonclimax) stands composed of lodgepole pine, trembling aspen, paper birch, spruce, and subalpine fir dominate lower elevations in many parts of the ICHg. Even older stands, approaching climax, usually contain remnant individuals of the seral community. Except in sheltered locations such as middle elevation valleys and some north-facing slopes, it is difficult to find a climax stand in the ICHg that has not been disturbed by fire within the past few centuries.

Specific vegetation features that characterize the ICHg and can be used to distinguish it from neighboring biogeoclimatic zones and subzones are listed in Table 3.

5.4 Geology (Holland 1976; Hutchison et al. 1979; Souther et al. 1979; Tipper et al. 1979).

There are three major physiographic regions within the ICHg subzone in which geology and surficial materials can be defined. These are the Nass Basin, Hazelton Mountains, and Skeena Mountains. All of these regions lie east of the Coast Mountains and north of the Nechako Plateau. However, part of the ICHg5 (the northwestern-most variant) occurs in the Boundary Ranges of the Coast Mountains.

Over most of the ICHg, relatively fine-grained volcanic and sedimentary rocks dominate the geology. Such rocks are readily fractured through chemical and physical weathering when compared to the massive plutonic bedrock types of the Coast Mountains that underlie much of the CWHf subzone.

The Nass Basin occupies much of the central part of the ICHg subzone, particularly the ICHg1 and ICHg4 variants. The geology of the Nass Basin includes mainly thick deposits of sedimentary and volcanic rocks. Shale,
TABLE 3.

Synopsis of vegetation characteristics of the 10Cg and adjacent biogeoclimatic zones and subzones

| Key: **** widespread and dominant  
| *** widespread  
| ** common  
| * uncommon  
| + rare  
| - absent |

<table>
<thead>
<tr>
<th>VEGETATION CHARACTERISTICS</th>
<th>BIOGEOClimATIC ZONES AND SUBZONES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10Cg Interior Cedar - Hemlock Zone, Northwestern transitional subzone</td>
</tr>
<tr>
<td>Climax tree species</td>
<td></td>
</tr>
<tr>
<td>western hemlock (<em>Tsuga heterophylla</em>)</td>
<td>****(southern sections)</td>
</tr>
<tr>
<td>western redcedar (<em>Thuja plicata</em>)</td>
<td>***</td>
</tr>
<tr>
<td>amabilis fir (<em>Picea amabilis</em>)</td>
<td>***</td>
</tr>
<tr>
<td>subalpine fir (<em>Picea lasiocarpa</em>)</td>
<td>+</td>
</tr>
<tr>
<td>mountain hemlock (<em>Tsuga mertensiana</em>)</td>
<td></td>
</tr>
<tr>
<td>Spruce hybridization</td>
<td>Interior and Sitka spruce characteristics (<em>Picea glauca x Sitchensis</em> <em>Engelmannii</em>)</td>
</tr>
<tr>
<td>Seral tree species</td>
<td></td>
</tr>
<tr>
<td>red alder (<em>Alnus rubra</em>)</td>
<td></td>
</tr>
<tr>
<td>lodgepole pine (<em>Pinus contorta</em>)</td>
<td></td>
</tr>
<tr>
<td>trembling aspen (<em>Populus tremuloides</em>)</td>
<td></td>
</tr>
<tr>
<td>paper birch (<em>Betula papyrifera</em>)</td>
<td></td>
</tr>
<tr>
<td>black cottonwood (<em>Populus balsamifera ssp. trichocarpa</em>)</td>
<td></td>
</tr>
<tr>
<td>Other tree species</td>
<td></td>
</tr>
<tr>
<td>black spruce (<em>Picea mariana</em>)</td>
<td></td>
</tr>
<tr>
<td>Rocky Mountain Juniper (<em>Juniperus scopulorum</em>)</td>
<td></td>
</tr>
</tbody>
</table>

- **(southern sections only) - **(southern sections only)

- **(mainly low elevations) ***(*)
- **(mainly low elevations) ***
- **(mainly low elevations) **
- **(mainly low elevations) **
- **(mainly low elevations) **
<table>
<thead>
<tr>
<th>Key:</th>
</tr>
</thead>
<tbody>
<tr>
<td>**** widespread and dominant</td>
</tr>
<tr>
<td>*** widespread</td>
</tr>
<tr>
<td>** common</td>
</tr>
<tr>
<td>* uncommon</td>
</tr>
<tr>
<td>+ rare</td>
</tr>
<tr>
<td>- absent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VEGETATION CHARACTERISTICS</th>
<th>BIOGEOCLIMATIC ZONES AND SUBZONES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IDg Interior Cedar - Hemlock Zone, Northwestern transitional subzone</td>
</tr>
<tr>
<td>Climax shrub and herb species</td>
<td></td>
</tr>
<tr>
<td>salmonberry (Rubus spectabilis)</td>
<td>*(northern and western sections only)</td>
</tr>
<tr>
<td>skunk cabbage (Lysichiton americanus)</td>
<td>*(western sections)</td>
</tr>
<tr>
<td>red huckleberry (Gaylussacia baccata)</td>
<td>*</td>
</tr>
<tr>
<td>Alaskan blueberry (V. alaskaense)</td>
<td>*(northern and western sections)</td>
</tr>
<tr>
<td>oval-leaved blueberry (V. ovalifolium)</td>
<td>**(*)</td>
</tr>
<tr>
<td>black huckleberry (V. membranacea)</td>
<td>***</td>
</tr>
<tr>
<td>Sitka valerian (Valeriana sitchensis)</td>
<td>+</td>
</tr>
<tr>
<td>arrowleafed groundsel (Senecio triangularis)</td>
<td>+</td>
</tr>
<tr>
<td>Indian hellebore (Veratrum viride)</td>
<td>+</td>
</tr>
<tr>
<td>mountain sage (Artemisia arctica)</td>
<td>-</td>
</tr>
<tr>
<td>pink mountain-heather (Phyllodoce empetriformis)</td>
<td>-</td>
</tr>
<tr>
<td>white mountain-heather (Cassiope mertensiana)</td>
<td>-</td>
</tr>
</tbody>
</table>

| Seral shrub and herb species |                                                   |                                                   |                                                   |                                                   |
| hazelnut (Corylus cornuta) | ***(southern sections) | - | - | - |
| meadow rose (Rosa rubiera) | ** | *** | - | - |
| goat's-beard (Bunias dioica) | *(*) | *** | - | - |
| bracken (Pteridium aquilinum) | ** | *** | + | + |
| prickly rose (Rosa acicularis) | ***(especially in southern sections) | *** | *** | *** |
| eucalyptus (Shepherdia canadensis) | *** | * | *** | **(*) |
| purple sage (Lathyrus nevadensis) | *** | * | *** | - |
| trailing raspberry (Rubus pubescens) | *** | * | *** | **(*) |
| dwarf blueberry (Vaccinium caespitosum) | *** | * | *** | **(*) |
| ricegrasses (Oryzopsis asperifolia, O. pungens) | *** | * | *** | - |

| Mosses and liverworts |                                                   |                                                   |                                                   |                                                   |
| Rhytidophyllum luzonicum | * | **** | - | + |
| Plagiochila pellioiloides | *(*) | **** | - | + |
| Scapania bolanderi | * | *** | - | - |
| Hylocomium lanuginosum | * | *** | - | - |
| Rhytidophyllum triquetrus | ***(*) | ** | **(*) | + |
| Pellaea cristata-castrensis | *** | * | *** | ** |
| Atriplex sibirica | * | *** | **(*) | *(*) |
| Myrtillus sp. | *** | **** | **(*) | *(*) |
| Rhytidophyllum robusta | **(*) | **** | **(*) | *(*) |
argillite, siltstone, greywacke, and mafic volcanic rocks are common throughout sections of the basin. Recent lava flows have occurred near Aiyansh. Ropy lava surfaces, flow breccia, and collapse features provide evidence of this flow which originated from the head of the Tseax River.

The Skeena Mountains, which form much of the eastern sections of the ICHg, have a complex bedrock geology consisting of extensively folded sedimentary and metasedimentary rocks. Rocks found within these ranges include fine to medium grained argillite, shale, and dark greywacke with some minor inclusions of granites. Argillite formations are relatively easily erodible and contain more bedrock-folding features than the more resistant, peak-forming greywacke deposits (Holland 1976).

The Nass, Kispiox, and Bulkley Ranges occur within the Hazelton Mountains physiographic region. The Hazelton Mountains lie east of the coastal granitic intrusions and are underlain largely by sedimentary and volcanic rocks that may contain isolated stocks and small batholiths of granitic rock. The Bulkley and Kispiox ranges have regularly occurring central cores of granite that may weather to produce coarser textured surficial deposits. Rock types dominating the Hazelton Mountains include those of the Hazelton Group; mainly andesitic to rhyolitic breccias, sandstone, shale, and conglomerate.

5.5 Surficial Materials (Runka 1972; Ryder 1978).

As in most areas of British Columbia, the surficial materials that have formed soils in the ICHg were deposited during and since the Fraser glaciation, the most recent glaciation of the province. There are five types of surficial materials found within the study area: morainal (glacial till), glaciofluvial, fluvial, colluvial, and organic materials.

Where surficial materials are derived largely from bedrock (i.e., glacial till, colluvium), the minerological composition and texture of the soil is closely related to the type of parent bedrock and its susceptibility to weathering. In deposits of unconsolidated sediments (glaciofluvial, fluvial), soil texture is determined primarily by the extent of water action upon deposition, and the weathering processes that follow. See the glossary for detailed definitions of surficial materials and landforms.
5.5.1  Glacial till

Glacial till refers to a heterogeneous mixture of sand, silt, and clay that has been deposited directly by glaciers. Such morainal deposits are the dominant soil parent materials of the Nass Basin, where numerous lake basins and drumlin-like landforms remain as evidence of glacial activity. Morainal blankets (greater than 1 m thick) and veneers (less than 1 m thick) also make up a major portion of surficial materials on level to moderately sloping surfaces that lie between valley floors and the bedrock and colluvial slopes of the higher elevations of the Hazelton and Skeena mountains. Soils derived from morainal deposits are mainly of fine to medium texture, which is largely a function of the fine-grained volcanic and sedimentary bedrock that prevails in the ICHg. Surficial materials arising from morainal deposits are usually moderately well to well-drained.

5.5.2  Glacial outwash (glaciofluvial)

Glaciofluvial deposits are loose, often well-drained materials (sands, gravels) that were deposited by meltwater either in contact with glacier ice or beyond the ice margin as outwash. Outwash plains and terraces are commonly found in the ICHg subzone on lower slopes adjacent to rivers.

5.5.3  Fluvial

Fluvial deposits include both recent (active) and older (inactive) sediments, and occur in valley floors wherever rivers and streams occur. Major fluvial deposits of the ICHg occur along the Nass, Skeena, Bulkley, Kispiox, Cranberry, Kitwanga, Bell-Irving, Iskut, and Stikine rivers. Less extensive fluvial deposits can be found adjacent to numerous small streams. Coarse sands are often deposited in steep mountainous areas, whereas finer textured sands and silts are more common on floodplains that have been laid down by
low gradient rivers (e.g., Skeena). Fluvial terraces, floodplains, and fans are fluvial landforms that can be found. Drainage within fluvial materials is generally good, but is strongly dependent on the depth of water table.

5.5.4 Colluvial

Colluvial materials represent deposits of loose, angular fragments that occur in any range of particle sizes from clay to large blocks of fractured bedrock. Colluvial deposits are the products of mass wastage and have reached their present position through gravity-induced movement. Rockslides and slumping are two common examples of colluvial activity within the ICHg. Colluvial deposition increases as the slope increases, particularly within numerous areas of the Skeena and Hazelton mountains. Colluviated till is also common in these mountains. Relatively weak bedrock structure (porous, folded), steep slopes, and extensive freezing and thawing action within much of the mountainous area of the ICHg promote failures and gravity-induced movement. Colluvial materials are usually well-drained, as a consequence of poor sorting of materials upon deposition and the high coarse fragment (greater than 2 mm diameter) content.

5.5.5 Organic

Organic deposits commonly develop on very gentle slopes or in isolated depressions throughout the ICHg. Bogs and fens represent two types of poorly to very poorly drained organic deposits, and are particularly common in the ICHg3. Organic layers develop on poorly drained sites where the rate of accumulation of plant matter exceeds the rate of decay.

On some of the steeper slopes of the Hazelton and Skeena mountains, thin organic layers (Folisols) may develop over bedrock. These deposits are generally well-drained in comparison to the peat of bogs, fens, and swamps.
5.6 Soils (Runka 1972)

The soils of the ICHg subzone are composed mainly of mineral materials, most of which were deposited during glaciation. Luvisols and Podzols occur often on sloping valley sides where glacial till has been deposited. Brunisols and Podzols are common soils found on the steepest mountain slopes, where colluvial deposits occur. Podzols and Regosols can be found on alluvial sites in the valley bottoms. Weathering of predominantly volcanic and sedimentary bedrock within the ICHg results in the formation of loamy or finer textured soils. Rainfall generally increases with elevation, thus leaching increases and affects profile development. The soil environment is strongly affected by seasonal temperature differences among the variants.
6 GENERAL CHARACTERISTICS OF THE VARIANTS

Within the ICHg there is considerable climatic variation. This variation corresponds primarily to differences in longitude, latitude, elevation, and surrounding topography within the subzone. The climatic variation is strongly reflected in vegetation characteristics such as the distribution of tree species within the subzone, and patterns of plant communities in the landscape. In order to recognize this variation, we have subdivided the ICHg subzone into five distinct biogeoclimatic variants:

ICHg1: Upper Nass Basin variant
ICHg2: Lower Nass Basin variant
ICHg3: Hazelton variant
ICHg4: Meziadin-Bell-Irving variant
ICHg5: Iskut-Stikine variant.

Figure 7 is a map of the ICHg showing the distribution of its variants. A description of each of the biogeoclimatic variants follows. General characteristics of the variants are summarized in Table 4. In Figure 8, profile diagrams show the elevational sequence or stratification of the variants on typical mountain slopes in the Nass and Skeena drainages.

6.1 ICHg1 - Upper Nass Basin Variant
6.1.1 Geographic description

The ICHg1 or Upper Nass Basin variant covers the undulating terrain that extends roughly north and east of Cranberry junction. Major drainages in the east include the Skeena River above Cutoff Mountain, the lower reaches of Shedín Creek and Babine River, and the Kispox River north of its junction with the Sweetin River. Major portions of the Nass River drainages are included: the upper Nass below Damdochax Creek to the mouth of the Bell-Irving River, and again from Meziadin River to the Cranberry River. A tongue of ICHg1 extends southwest on the north side of the Nass, including the lower Kinskuch River. In the southeastern portion of the subzone, a mid-elevational belt of ICHg1 extends above the ICHg2 from approximately 750 to 1100 m elevation.
FIGURE 7. Biogeoclimatic variants of the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg).
<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>ID4g1 (upper Nass Basin (subalpine fir) variant)</th>
<th>ID4g2 (lower Nass Basin (cedar) variant)</th>
<th>ID4g3 (Hazelton (aspen) variant)</th>
<th>ID4g4 (Meziadin - Bell-Irving (snowy) variant)</th>
<th>ID4g5 (iskut - Stikine variant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation range</td>
<td>(150) 300 - 950 (1100) in Nass Basin; (600) 750 - 950 (1100) in southeast.</td>
<td>100 - 600 Nass Valley; 450 (600) - 750 (900) Skeena valley.</td>
<td>150 - 450 (600).</td>
<td>240 - 1000.</td>
<td>150 - 900</td>
</tr>
<tr>
<td>Climate</td>
<td>cool, moist; longest and most severe winters, moderately heavy moist or dry snow; minor summer drought.</td>
<td>mild, moist with moist snow in Nass valley; harsher in southeastern Skeena-Bulkley valleys. Intermediate between gl and g3 variants; moderate snowfall.</td>
<td>winters relatively dry, cold with light, dry snowpack; short frost-free period, cold air ponding. Summers warm, relatively dry, hottest summer drought. Shortest temperatures in subzone. Significant summer drought.</td>
<td>very heavy snowpack (3-6m). Winters generally wetter, less severe than ID4g1. Summers cool, moist. Little or no summer drought.</td>
<td>cool, moist; winters wet with moderately heavy, moist snow. Summers cool, moist; little or no summer drought.</td>
</tr>
<tr>
<td>Vegetation:</td>
<td>HW*, BI, (SX); (Ba in Ba phase) Cw absent.</td>
<td>HW, CW, (BI, SX, PL). HW, CW.</td>
<td>SX, PL, BI, AT, EP.</td>
<td>BI, HW, SX; Cw absent.</td>
<td>HW, BI, SX, ACT; Cw absent.</td>
</tr>
<tr>
<td>Major tree species</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seral stands</td>
<td>only extensive in southern sections; dominantly BI, BI, SX.</td>
<td>frequent in Nass Valley, less common elsewhere; BI, SX, BI, AT, EP.</td>
<td>widespread and dominant. Extensive stands of AT - EP - hazelnut and other shrubs. Also BI, SX, BI, and ACT.</td>
<td>uncommon; mostly BI; PI rare; AT on a few south-facing slopes.</td>
<td>uncommon except on floodplains; PI, ACT, EP, AT.</td>
</tr>
<tr>
<td>CHARACTERISTICS</td>
<td>IOg1 upper Nass Basin (subalpine fir) variant</td>
<td>IOg2 lower Nass Basin (cedar) variant</td>
<td>IOg3 Hazelton (aspen) variant</td>
<td>IOg4 Meziadin - Bell-Irving (snowy) variant</td>
<td>IOg5 Iskut - Stikine variant</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------</td>
<td>--------------------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Vegetation (cont’d): (sub)association</td>
<td>Hw - (B1) - (Vaccinium ovalifolium, V. alaskanae, V. membranaceum) - Hymenoxys pedatus - Pleuroziun schreberi</td>
<td>Hw - (Ow, Bl, Sx) - (Chimaphila umbellata, Clintonia uniflora) - Hymenoxys pedatus - Ptillium crista-castrensis - Pleuroziun schreberi - Rhytidolephus trigretus</td>
<td>Hw - (Ow, Bl, Sx) - (Chimaphila umbellata, Clintonia uniflora) - Hymenoxys pedatus - Ptillium crista-castrensis - Pleuroziun schreberi - Rhytidolephus trigretus</td>
<td>Hw - Bl - (Sx) - Vaccinium alaskanae - V. ovalifolium - V. membranaceum - Cornus canadensis - Hymenoxys pedatus - Ptillium crista-castrensis</td>
<td>Hw - Bl - (Sx) - Vaccinium alaskanae - V. ovalifolium - V. membranaceum - Cornus canadensis - Hymenoxys pedatus - Ptillium crista-castrensis</td>
</tr>
<tr>
<td>miscellaneous notes (Ba phase: Hw - Ba - Vaccinium ovalifolium)</td>
<td></td>
<td></td>
<td>(extensive moss carpets may cover even moister (sub)alpine sites especially in southeastern sections)</td>
<td>(extensive areas of sub-alpine to hygroic B1 - Sx - Oplognax horticus - Gymnocarpium dryopteris - Nyssum spp.)</td>
<td>(extensive Sx - Bl - (Hw) - Oplognax horticus - Gymnocarpium dryopteris - Nyssum spp.)</td>
</tr>
<tr>
<td>understory vegetation features</td>
<td>Vaccinium alaskanae present; V. ovalifolium and Rubus pedatus abundant.</td>
<td>Vaccinium alaskanae, Rubus pedatus lacking; Vaccinium ovalifolium scattered on zonal sites.</td>
<td>Vaccinium alaskanae, V. ovalifolium, Rubus pedatus lacking on zonal sites.</td>
<td>Vaccinium alaskanae, V. ovalifolium, Rubus pedatus abundant.</td>
<td>Vaccinium alaskanae, V. ovalifolium, Rubus pedatus abundant.</td>
</tr>
<tr>
<td>Landforms: lower elevations: (valley floors)</td>
<td>Fluvial terraces and morainal blankets.</td>
<td>Fluvial terraces and glaciofluvial outwash; minor morainal blankets.</td>
<td>Extensive fluvial terraces and active floodplains; organic deposits.</td>
<td>Fluvial terraces and morainal blankets.</td>
<td>Extensive fluvial terraces and active floodplains; morainal blankets.</td>
</tr>
<tr>
<td>middle to upper elevations:</td>
<td>Morainal and/or colluvial veneers and blankets (Ba phase: colluvial veneers and blanket).</td>
<td>Morainal and/or colluvial veneers and blankets.</td>
<td>Morainal vaneers and colluvial vaneers on steepest slopes.</td>
<td>Morainal vaneers and colluvial vaneers on steepest slopes.</td>
<td>Morainal vaneers and colluvial vaneers on steepest slopes.</td>
</tr>
</tbody>
</table>

*Tree species symbols as in Appendix 2.
FIGURE 8 a and b. Representative valley profiles showing distribution of biogeoclimatic units in the study area.
FIGURE 8 c and d. Representative valley profiles showing distribution of biogeoclimatic units in the study area.
6.1.2 Climate

Very little climatic information is available for the ICHg1 because the area is virtually unsettled. We do know that precipitation tends to be higher than in the more southerly ICHg2 and g3 variants and that snowpacks are both deeper and of longer duration. In the ICHg1, winters are cold with mainly dry snow and summers are cool and moist. The growing season is considerably shorter than in the g2, g3, and perhaps the g5 variants.

6.1.3 Vegetation

Because climatic data are so limited, we rely mainly on vegetation characteristics to delineate the biogeoclimatic variants. The primary criterion used to distinguish the ICHg1 from adjacent g2 and g3 variants is the absence of western redcedar. Presumably the ICHg1 is too cold (especially in winter) and has too short a growing season for this species. The upper Nass Basin variant is also referred to as the subalpine fir variant because subalpine fir is the main associate of western hemlock in upland forest, and often dominates stands on low-lying, wetter sites. Amabilis fir is scattered in the southwestern portions of the variant, but is under severe climatic stress on most sites and grows very poorly.

Seral (non-climax) stands are not extensive except in low elevation southern portions of the variant, adjacent to the ICHg3. Lodgepole pine is the dominant seral species but trembling aspen and paper birch are also common, especially on south-facing slopes.

6.1.4 Soils

Hummocky glacial till deposits of the Nass Basin cover most of the ICHg1 landscape. Because sedimentary bedrock dominates a large

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7The soil descriptions and comparisons within the variants of the ICHg are based only on soil types with a moderate (mesic) supply of nutrients and moisture.
proportion of this variant, a wide variety of mineral textures result from glacial activity and bedrock weathering. Predominant soils developing on morainal blankets are Orthic Humo-Ferric Podzols (containing reddish brown to yellowish red Bf horizons) with coarse loamy soil textures. Leached, whitish, surface mineral horizons are generally thin or lacking in these Podzols. Orthic Dystric Brunisols (acidic, with a brown Bm horizon) and Podzols are common on the dry, steep, colluvial slopes. Where bedrock knobs occur, shallow soils such as Lithic Folisols (thin organic layers over bedrock) or thin Podzols are found. These soils are rapidly drained and their nutrient status strongly depends on the type of parent bedrock.

The major humus forms found in the ICHgl are acidic OrthoHemimors, in which fungal decomposition occurs. Organic materials formed on zonal soils range in thickness from 5-14 cm, with depth generally increasing with available moisture.

6.1.5 Amabilis fir phase (ICHglα)

On northeastern slopes and in small sheltered valleys of the Rocher de Boule and Kispiox Ranges, and between approximately 750 and 1100 m elevation, there exist enclaves of a seemingly coastal forest of western hemlock and amabilis fir. We describe these forests as the Amabilis fir phase of the ICHgl variant (ICHglα). The trees in the Amabilis fir phase often reach coastal dimensions (amabilis fir and spruce 45-50 m in height are not uncommon), and typically coastal understory species such as salmonberry (Rubus spectabilis) and Rhytidiadelphus loreus are present. Soils are frequently Ferro-Humic Podzols and humus layers are unusually thick. In general, the ICHglα bears a very strong resemblance to higher elevation forests of the Coastal Western Hemlock biogeoclimatic zone.

The ICHglα consists of old-growth stands that show no signs of past fire for many generations. The phase occurs in areas of unusually humid local climate. It seems probable that during the summer cloudbanks often land directly over or in the ICHglα elevational band, producing above-average precipitation and humidity
and cool temperatures. During the winter, the ICHgla is above the ceiling of the cold inversion layer that often develops in the valley bottom. The vigorous growth of amabilis fir may also reflect heavy snowfalls that begin early in fall, thus insulating the soil from winter frost.

6.2 ICHg2 – Lower Nass Basin Variant

6.2.1 Geographic description

The ICHg2, Lower Nass Basin or cedar variant is found in the Nass River valley from Cranberry junction to the Tseax River valley, near Aiyansh. In the Nass drainage it ranges from the valley floor to an elevation of approximately 600 m. In the Skeena drainage, the ICHg2 occurs as a mid-elevation belt above the Hazelton (ICHg3) variant. The ICHg2 belt begins anywhere between 450 and 600 m in elevation and extends upslope to between 750 and 900 m. A discontinuous belt of ICHg1 is found above the g2 in eastern sections of the subzone.

6.2.2 Climate

The western sections of the variant are moist and cool. They receive moderate amounts of moist snow in the winter and total annual precipitation can exceed 1000 mm. In eastern sections, continental climatic influences are stronger. Summer temperatures are probably warmer than in the Nass valley but winters are colder. Snowpacks are moderately light and annual precipitation probably does not exceed 700-800 mm. In general, the ICHg2 climate is intermediate between that of the ICHg1 and g3 variants.

6.2.3 Vegetation

Climax forests in the ICHg2 are dominated by western hemlock and western redcedar together with lesser amounts of subalpine fir and spruce. Amabilis fir is generally absent from the variant. Seral stands are quite common at lower elevations in the ICHg2, particularly in the Nass valley. However, for the most part, they do
not seem as firmly established as the extensive seral stands in the ICHg3; a successional trend towards hemlock and cedar is generally apparent. Most mature hemlock - cedar stands contain a few overmature individuals of lodgepole pine, paper birch, or trembling aspen, indicating a relatively recent fire origin.

Understory layers of hemlock-dominated stands are characterized by a thick carpet of feather moss. In some colder, eastern sections of the variant this acidic moss and humus layer seems to take over even the wetter habitats, virtually excluding other understory plants. In contrast, in stands with a heavy component of cedar or some deciduous species the growth of feather mosses is held back and herbs are quite abundant.

6.2.4 Soils

There is an increasing trend in the ICHg2 toward the development of fine textured Luvisols, especially in the Kispiox and Hazelton areas. B horizons of massive to blocky structure and clayey texture are characteristic of Brunisolic Gray Luvisols. A loamy, brown-coloured surface mineral horizon (Bm) commonly overlies the clay-rich Bt horizon, and supports abundant rooting. "Clay skins" (shiny coatings on coarse fragments, ped surfaces, and/or within pores) provide evidence of clay movement in these fine textured Luvisols. Compacted subsurface layers may restrict rooting in the fine textured soils. Coarser textured Podzols that do not restrict root penetration are very common in the Nass Valley. Relatively high volumes of coarse fragments occur in soils located on steep colluvial slopes, and on morainal veneers of middle to upper elevations.

Forest-floor organic materials are similar in form and depth to the humus forms of the ICHg1.

6.3 ICHg3 - Hazelton Variant

6.3.1 Geographic description

The ICHg3, Hazelton variant is centred on the valley floor of
the Skeena River between Tenas Hill and Legate Creek. Arms of the ICHg3 extend up major tributaries of the Skeena including the Bulkley River below Trout Creek, the Kispiox River below Sweetin River, and the Kitwanga, Kitseguecla, and Suskwa River valleys. From the valley bottoms, the ICHg3 extends upslope to between 450 and 600 m in elevation.

West of Cedarvale the ICHg3 borders at its upper elevations on the Northern drier maritime subzone of the Coastal Western Hemlock Zone (CWHf). To the east, it is bounded at upper elevations by the ICHg2.

6.3.2 Climate

The climate of the ICHg3 is fairly well-documented because climatic stations have been established at several valley bottom locations within the variant for many years. Of the five ICHg variants, the Hazelton variant clearly has the most favourable climate for settlement and agriculture.

Total annual precipitation ranges from over 725 mm annually west of Cedarvale to below 480 mm annually near Hazelton. Much of the variant seems to be within the rain-shadow of surrounding mountains. Summers are warmer and sunnier in the ICHg3 than anywhere else in the subzone, and significant periods of drought are quite common. During the winter, the ICHg3 is relatively dry and receives little snow (113 cm on average at New Hazelton). Temperatures are often very cold because cold air drains into the valley bottoms and sets up temperature inversions that may persist for several weeks. A very short frost-free period is also characteristic of the ICHg3 climate.

Because of its position in the bottoms of major river valleys, the ICHg3 is often affected by surges of warm, moist air from the Coast or of cold dry air from the Interior. It is therefore subject to greater climatic fluctuations than other variants of the ICHg.
6.3.3 Vegetation

The vegetation of the Hazelton variant reflects the influence of frequent natural fire and widespread human disturbance. The ICHg3 is also referred to as the aspen variant because of the extensive seral stands of trembling aspen and paper birch that have established themselves as a result of the fires and land clearing. These deciduous stands have dense shrub and herb layers and little or no moss on the forest floor. Hazelnut (*Corylus cornuta*) is very characteristic of the Hazelton variant; it is a dominant shrub within the variant and is rare or absent outside the ICHg3.

Lodgepole pine, spruce, and subalpine fir are the dominant coniferous tree species. In many areas of the ICHg3, stands bear a strong resemblance to those found in the Sub-Boreal Spruce Zone (SBS) because subalpine fir and spruce are the dominant species reproducing under the tree canopy.

Western hemlock and western redcedar are the true climatic climax tree species in the ICHg3 but their distribution is restricted. Small patches are scattered throughout the landscape and larger stands occur mainly on north-facing slopes and at the higher elevations, where disturbance has been less severe and climatic stress is less pronounced. Both hemlock and cedar seem to be stressed by conditions in the ICHg3; they are highly susceptible to decay and establish themselves slowly under stands of shade-intolerant tree species. Much of the cedar in the ICHg was removed from older stands during past selective logging.

There are few floristic criteria that can be used to distinguish climax stands of the ICHg3 from those of ICHg2 where the two variants occur one above the other on a mountain slope. Elevation and the relative abundance of successional stands are the two major criteria used to differentiate the variants in such areas.

6.3.4 Soils

The ICHg3 occupies primarily the valley floors, where coarse textured Podzols dominate, particularly on inactive glaciofluvial and
fluvial landforms. On morainal deposits, weak Luvisols as well as Podzols may occur on lower slopes and in side valleys. Compacted subsurface clay horizons may restrict rooting in some fine textured soils. In the shallowest soils, the bedrock and surface organic materials may strongly influence the nutrient status of the site.

Humus forms are dominantly Mors (Orthineminors) ranging from 5-12 cm in depth under mature climax forests. Fungal decomposition predominates, although the ICHg3 has a greater abundance of deciduous trees that usually provide a favourable environment (less acidic litter) for insect (zoogenous) decomposition. Zoogenous activity generally results in increased rates of humus decomposition and the production of organic-rich mineral layers (Ah).

6.4 ICHg4 - Meziadin - Bell-Irving Variant

We have completed only preliminary studies of the ICHg4, or Meziadin - Bell-Irving variant, and are therefore unable to characterize this variant in detail. We hope to complete the classification of ecosystem units soon so that they may be added to revisions of this publication. In the meantime, we suggest that you refer guardedly to the descriptions and guidelines presented for the ICHg1 when working in the g4 variant. Keep in mind that the ICHg4 has a distinct and unique set of characteristics that must be taken into account in management decisions.

6.4.1 Geographic description

The Meziadin - Bell-Irving variant of the ICHg extends from the White River and Niska Lakes area north along the Bell-Irving River to Ningunsaw Pass. It does not appear to extend east of the junction of the Nass and Bell-Irving Rivers, nor into the main Nass Valley south of Meziadin lake. The ICHg4 ranges in elevation from 240 m at Meziadin Lake to approximately 900-1000 m on some mountain slopes.

6.4.2 Climate

We refer to the ICHg4 as the snowy variant because of the very large amounts of moist snow it receives. Normal maximum snow-
packs are estimated at between 2.5 and 5 m in depth, well over twice as deep as at equivalent elevations in the ICHgl.

During most of the year, the ICHg4 is cool and moist. It is usually slightly cooler in summer and milder in winter than adjacent parts of the ICHgl. It is estimated that the ICHg4 receives between 800 and 2000 mm of precipitation annually, which is high relative to most other parts of the subzone. Much of this precipitation falls as snow, but effective summer moisture is high and soils rarely dry out because of the cool temperatures and the large amount of runoff available from melting snow. Because of its northerly latitude and short snow-free period (May-October), the ICHg4 has a short growing season relative to more southerly sections of the ICHg.

6.4.3 Vegetation

The effects of heavy snowloads are very apparent in patterns of vegetation found in the ICHg4. Western hemlock is the dominant tree species on mesic or zonal sites, but the occurrence of these well-drained upland sites is limited. A major portion of the landscape is occupied by poorly drained, low-lying sites or slopes receiving abundant seepage. Such sites are dominated by subalpine fir together with spruce, and contain very little hemlock. Subalpine fir grows exceptionally well in the ICHg4 and often reaches record size. It is obviously the tree species best adapted to growing conditions in the g4 variant. In association with the subalpine fir are understory layers dominated by devil's club (Oplopanax horridus) and oak fern (Gymnocarpium dryopteris) that seem to extend from valley bottom to ridge top.

Western redcedar is absent from the ICHg4, while amabilis fir is common only in the Niska Lakes area at the southern end of the variant. Mountain hemlock, a species well-adapted to heavy snow conditions, is found at unusually low elevations in the ICHg4.

Fire seems to have had little influence on the development of vegetation in this variant. There are stands of trembling aspen on a
few south-facing slopes but, in general, seral stands are of minor occurrence and subalpine fir is the most frequent pioneer tree. Lodgepole pine is especially uncommon; it seems to be poorly adapted to the ICHg4 climate.

Avalanches are the major disturbance factor in the ICHg4. Broad swaths of Sitka alder (*Alnus viridis* ssp. *sinuata*) and other pioneer species extend from upper mountain slopes into the valley bottoms and are a prominent visual feature of the ICHg4.

6.4.4 Soils

Due to limited sampling within the ICHg4 variant, detailed knowledge of soil chemistry, surficial materials, and other soil features is lacking.

Organic layers are often compact-matted due to the heavy snow loads. Fungal decomposition is prominent, as signified by abundant white and yellow mycelia within decomposing layers. Acidic humus forms (*Mors*) and underlying Podzols are dominant.

Coarse textured Podzols with reddish brown mineral horizons (*Bf*) extend to depths greater than 30 cm. These horizons may be overlain by a leached, whitish coloured surface horizon (*Ae*), 3 to 6 cm in depth, which usually indicates a well-drained soil.

6.5 ICHg5 - Iskut - Stikine Variant

The ICHg5 (or Iskut - Stikine variant) is, like the ICHg4, little sampled and poorly known. The ICHg5 seems most similar to the ICHgl and, until we do more work in this remote, northern variant, can be usefully studied and interpreted in the context of existing knowledge about the ICHgl.

6.5.1 Geographic description

The Iskut - Stikine variant of the ICHg occupies low to medium elevations (150 to 900 m) in the central part of the Iskut and Stikine River valleys, east of the crest of the Coast Mountains. In
the Iskut drainage, the ICHg5 extends from the lower Ningunsaw River and Durham-Ball creeks downstream to Snippaker Creek. The variant occurs in the Stikine drainage from Dokdaon Creek to just below the Scud River.

6.5.2 Climate

The ICHg5 is the most northerly variant of the subzone, but because of generally lower elevation and fairly close communication with coastal areas, has a moist climate that is evidently milder than that of the ICHg3 and g4 and probably also the eastern sections of the g1. Snowpacks are moist and moderately heavy, but not nearly as heavy as in the Meziadin - Bell-Irving variant. Because of its proximity to boreal regions, the ICHg5 probably experiences more frequent or severe outbreaks of Continental Arctic air masses in winter than other ICH variants, except perhaps the ICHg3.

6.5.3 Ecological features

Western hemlock is the climatic climax species of the ICHg5 and forms extensive, old-growth, often "decadent" stands; western redcedar is absent. Subalpine fir and hybrid Sitka x white 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 hybrid spruce, forms floodplain forests. Lodgepole pine, aspen, and paper birch are scattered, forming seral forest in burned-over areas, especially in the vicinity of Bob Quinn Lake.

The Western hemlock - Vaccinium spp. - Hylocomium splendens - Pleurozium schreberi association represents climatic climax vegetation. Western hemlock dominates the zonal forests, and is sometimes joined by subalpine fir and hybrid spruce. Subalpine fir and spruce, however, do not persist to a great extent in old stands. They seem to die at an earlier age than hemlock, and also regenerate in climax stands primarily in openings or gaps. Typical shrubs
include blueberries and huckleberries (*Vaccinium alaskaense*, *V. ovalifolium*, *V. membranaceum*), and false azalea (*Menziesia ferruginea*). Characteristic herbs are bunchberry (*Cornus canadensis*), one-sided wintergreen (*Orthilia secunda*), queen's cup (*Clintonia uniflora*), five-leaved bramble (*Rubus pedatus*), and prince's pine (*Chimaphila umbellata*). *Hylocomium splendens*, *Pleurozium schreberi*, and *Ptilium crista-castrensis* dominate the ground cover. *Rhytidiadelphus triquetrus* and *Barbilophozia lycopodioides* are common but usually not abundant. *R. loreus* is relatively uncommon.

Zonal ecosystems typically have moderately well-drained Humo-Ferric Podzols with Hemimor or Mormoder humus forms.

Drier forest ecosystems are uncommon in the ICHg5. They occur mostly on shallow soils over bedrock (e.g., in the vicinity of the Iskut Canyon) or on steep, rocky colluvial slopes. Mature stands on dry sites are usually a mixture of lodgepole pine, western hemlock, subalpine fir, and hybrid Sitka spruce, whereas earlier seral stands may be dominated by pine, aspen, and paper birch.

Moist rich Devil's club ecosystems are common and widespread. They usually occupy lower slopes or stable alluvial terraces. Hybrid Sitka spruce and subalpine fir of excellent growth dominate the canopy, while poorly growing western hemlock often forms a subcanopy or may be abundant as regeneration. Devil's club dominates the shrub layers. Oak fern, spiny wood fern (*Dryopteris assimilis*), twistedstalks (*Streptopus* spp.), three-leaved foamflower (*Tiarella trifoliata*), and five-leaved bramble are characteristic herbs. *Brachythecium* spp. and *Mnium* spp. dominate the patchy moss layer.
7 ECOSYSTEM UNITS OF THE ICHg

7.1 Introduction and Definitions

In this section, we outline the classification of ecosystem units in the ICHg. The ecosystem units are grouped into subsections according to the biogeoclimatic variant in which they are found. On the first page of each subsection is a list of the ecosystem units found in the variant. On subsequent pages, each ecosystem unit is described in detail so that it can be easily identified in the field.

The description for each ecosystem association consists of three pages: a general page, including a schematic representation of the association and line drawings of typical plants; a vegetation page; and a soils page. Descriptions of ecosystem phases and variations are often less detailed. Most of the information included in the ecosystem descriptions is self-explanatory, but some of the terms and symbols may require further explanation.

7.1.1 General description page

**Ecological Moisture Regime:** refers to the relative amount of moisture available for plant growth. The modal moisture regime of the ecosystem unit is indicated here, rather than the entire range of moisture conditions associated with the unit (the range is depicted on the edatopic grid). For a synopsis of the moisture regime classes, refer to Table 1.

**Ecological Nutrient Regime:** refers to the relative amount of nutrients available for plant growth. Again, the modal nutrient regime is indicated here. For a synopsis of the nutrient regime classes, refer to Table 2.

**Edatopic Grid Position:** the small grid indicates Ecological Moisture Regime (0-7) on its vertical axis and Ecological Nutrient Regime (A-E) on its horizontal axis. The shaded area on the grid indicates the range of moisture and nutrient conditions under which the ecosystem unit develops. Enlarged versions of the grid, properly labelled, appear in Figures 10, 11, 12, and 13.

**Distribution:** gives a general idea of how common the ecosystem unit is and where it occurs within the variant.
Physiographic Features: summarizes typical or common site characteristics and indicates where in the landscape one may expect to find the ecosystem unit.

7.1.2 Vegetation page

The vegetation page lists the most common or most important plant species in the ecosystem unit, and comments on relevant features of the plants. Each species is listed by a common name and by its scientific (Latin) name. Scientific and most common names correspond with those used in the publication "A Guide to Some Common Plants of the Skeena Area, British Columbia" (Coupé et al. 1982), which is designed to be used in conjunction with this guide. Occasionally, when a plant species immediately follows another belonging to the same genus, the name of the genus is abbreviated (e.g., Vaccinium ovalifolium, V. alaskaense). A complete list of plant species appears in Appendix 1.

The plants are listed according to strata or layers which are defined as follows:

Trees: woody plant exceeding 10 m in height. In extreme habitats, such as bogs, tree species are often stunted and less than 10 m tall. However, we still list them in the tree layer and comment on their reduced height. Note that the tree species listed represent those found in mature climax or at least advanced successional stands (unless otherwise indicated). Young stands may have a very different species composition.

Shrubs: woody plants between approximately 30 cm and 10 m in height. Note that once a species has been recorded in the tree layer, we do not list it again in the shrub layer, even if seedlings and saplings below 10 m are present. In some cases, however, we do comment on the importance of advance regeneration in the shrub layer.

Herbs: all herbaceous (non-woody) plants, including ferns, plus all trailing woody plants and dwarf shrubs that do not normally exceed 30 cm in height. For example, the dwarf shrub kinnikinnick (Arctostaphylos uva-ursi) is always included in the herb layer because of its low growth habit.
Moss layer: includes mosses, liverworts, and lichens growing on the forest floor. Note that unless otherwise indicated in the comments, we do not include species growing on decaying wood or on living plants. We do not list common names for most species in this layer. However, the term feather moss is used to refer collectively to the three mosses Pleurozium schreberi, Hylocomium splendens, and Ptilium crista-castrensis; leafy mosses are all species belonging to the genus Mnium (also known as Rhizomnium or Plagiomnium). Peat moss refers to Sphagnum mosses.

Within each layer, the species are listed more or less in order of importance, although the order varies from site to site in the field. The list does not include all species found in an ecosystem unit, just those that are most common or most important in terms of cover or indicator value. Cover refers to the abundance or percentage of ground surface occupied by the plant. Indicator value refers to how much a plant can tell you about the growing conditions on the site. Some plants, like bunchberry (Cornus canadensis) are poor indicators because they will grow almost anywhere. Other plants, such as enchanter's nightshade (Circaea alpina) are very choosy about their habitat requirements and therefore are good indicators of site conditions such as moisture, nutrients, light, and climate. Where possible we have tried to specify the indicator value of a species.

Species enclosed in square brackets [ ] either have low cover, or are not consistently present. They are always less important than species without brackets.

The abbreviation "sp." after the name of a plant genus (e.g., Viola sp.) refers to a single, unknown species, while "spp." refers to several unnamed species belonging to the genus (e.g., Sphagnum spp.). Occasionally we recognize subdivisions of a species, called subspecies. These are abbreviated "ssp." (e.g., Alnus viridis ssp. sinuata).
7.1.3 Soils page

The soils page attempts to summarize those soil features that aid in classification and identification of the ecosystem unit. In many cases, soil profiles described within an ecosystem association are extremely variable. Similarities between soil features such as texture, colour, volume of coarse fragments, and depth of organic layers may aid in the identification of an ecosystem unit. The use of statements regarding nutritional status or texture of a horizon should not be taken as definite, owing to a lack of chemical or physical lab analysis of these soils. A brief description of the soil page format follows:

SOILS: includes a paragraph summarizing the basic morphological features of the soil pedon, such as colour, texture, and depth of humus. These are the features that would appear most obvious to an observer looking into the soil pit.

Soil Classification: classifies the most common soils within each ecosystem unit, based on Canadian Soil Survey Committee, Subcommittee on Soil Classification (1978).

Humus Form Classification: refers to the classification of surface organic materials and is based on Klinka et al. (1981).

Schematic Profile: presents a simplified diagram of a "typical soil profile" within an ecosystem unit. Horizon designations and a brief description of important or dominating horizons are also given. The most important morphological features of the horizons such as colour, texture, structure, abundance of roots, presence or absence of mottling, and acidity may be mentioned. Parentheses around a horizon designation, e.g., (Bm), are used either (1) to suggest the horizon may occur, but is not the most common; or (2) in cases where two profiles are described. Parentheses around horizons correspond to the soil name in parentheses below the profile. Colour names used in profile descriptions come from the Munsell Colour Chart. For a breakdown of sand (S), silt (Si), and clay (C) into textural classes, refer to the textural triangle in Figure 9.

Average pH: mineral horizons - refers to the weighted average of pH values within the upper 50 cm of the mineral soil (or less if lithic contact occurs).
Average pH: organic horizons - refers to the weighted average of pH values for organic horizons (L,F,H) above the mineral surface, or to a maximum depth of 50 cm for non-freely drained organic soils (Ofr, Om, Oh).

Key Characteristics: this includes, in point form, some features that may help to identify soils of a particular ecosystem unit from other units. This section focuses on some of the key features that occur in most profiles within a particular unit.

A brief concluding section (Comments) may follow.
Soil texture classes. Percentages of clay and sand in the main textural classes of soil; the remainder of each class is silt.

FIGURE 9. Soil textural triangle. Subdivision of the triangle into coarse and fine textured sections corresponds with family particle-size classes (Canada Soil Survey Committee 1978: Fig. 36), whereby relatively coarse textured soils have sandy or coarse-loamy family particle sizes, and everything else is relatively fine textured.
7.2 Classification of Ecosystem Units of the ICHgl: Upper Nass Basin Variant

/01 Zonal hemlock - moss ecosystem association
  /01(1) Vaccinium variation
/02 Pine - lichen ecosystem association
/03 Dry hemlock - moss ecosystem association
/04 Devil's club - oak fern - feather moss ecosystem association
/05 Devil's club - fern - leafy moss ecosystem association
/06 Horsetail - (skunk cabbage) swamp ecosystem association

Seral ecosystem association:
/07 Floodplain cottonwood seral ecosystem association

Seral variations:

7.2.1 ICHglA: Upper Nass Basin Variant: Amabilis Fir Phase

/01 Zonal hemlock - amabilis fir - (Vaccinium) - moss ecosystem association
/02 Dry hemlock - moss ecosystem association
/03 Devil's club - oak fern ecosystem association
/04 Devil's club - lady fern - oak fern ecosystem association
FIGURE 10. Edatopic grid of ecological moisture and nutrient regimes - ICHgl.
FIGURE 11. Tree species silhouettes used in the slope diagrams.