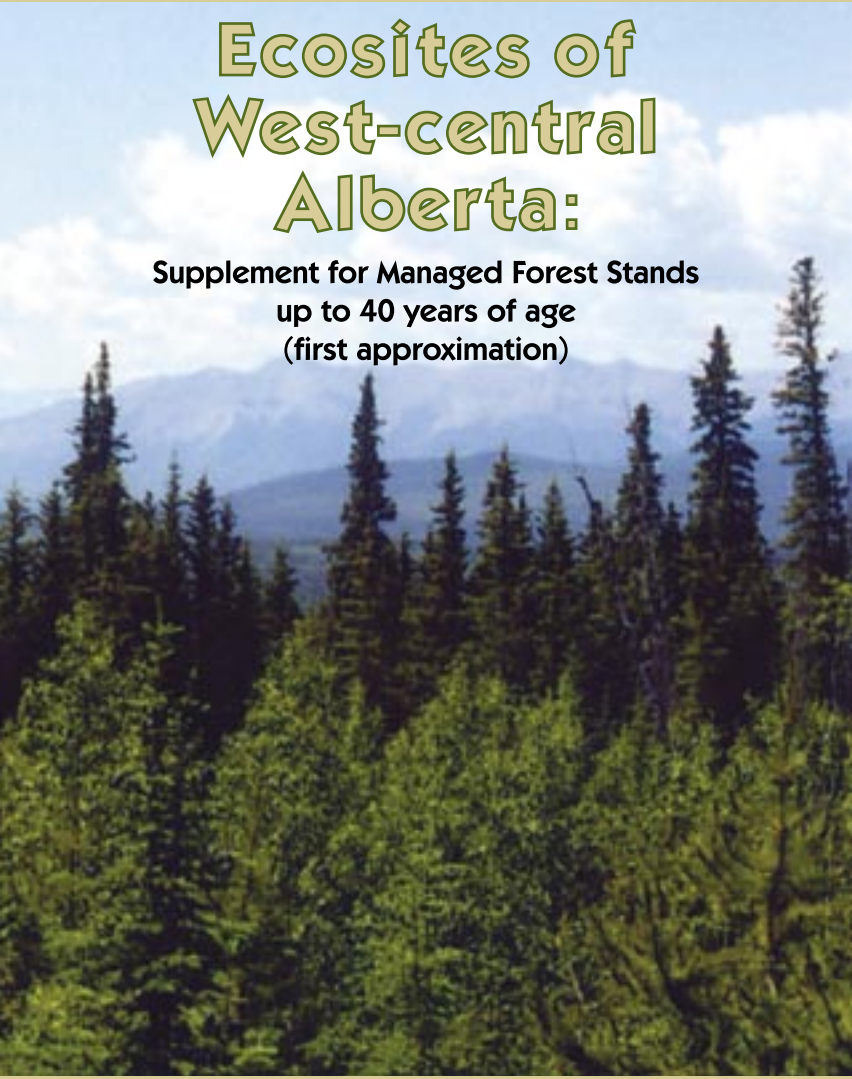
Field Guide to

Ecosites of West-central Alberta:

Supplement for Managed Forest Stands up to 40 years of age (first approximation)



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FIELD GUIDE TO ECOSITES OF WEST-CENTRAL ALBERTA: SUPPLEMENT FOR MANAGED FOREST STANDS UP TO 40 YEARS OF AGE (FIRST APPROXIMATION)

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SPECIAL REPORT 15

Canadian Forest Service, Northern Forestry Centre
2005

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Catalogue No. Fo29-34/15-2005E
ISBN 0-660-19424-4
ISSN 1188-7419

This publication is available at no charge from:
Natural Resources Canada
Canadian Forest Service
Northern Forestry Centre
5320-122 Street
Edmonton, Alberta T6H 3S5

A microfiche edition of this publication may be purchased from:
Micromedia Proquest
20 Victoria Street
Toronto, Ontario M5C 2N8

TTY: 613-996-4397 (Teletype for the hearing-impaired)
ATS: 613-996-4397 (appareil de télécommunication pour sourds)

Library and Archives Canada Cataloguing in Publication

Corns, I. G. W. (Ian George William)

Field guide to ecosites of west-central Alberta: Supplement for managed forest stands up to 40 years of age (first approximation)

(Special report, ISSN 1188-7419 ; no. 15)
Includes an abstract in French.
Includes bibliographical references.
ISBN 0-660-19424-4
Cat. no. Fo29-34/15-2005E

1. Forest site quality – Alberta -- Handbooks, manuals, etc.
2. Forest ecology – Alberta.
3. Vegetation dynamics – Alberta.
4. Forest health – Alberta.
5. Trees – Growth – Alberta.
5. Plant succession.

I. Downing, David J.
II. Little, T. I. (Todd Ian)
III. Northern Forestry Centre (Canada)
IV. Special report (Northern Forestry Centre (Canada) ; no. 15.
V. Title.

QH541.5F6C67 2005 577.3'097123 C2005-980048-8

DEDICATION

In memory of

Ian George William Corns and Dave Presslee

Dr. Ian Corns contributed significantly to the development of ecological site classification in Alberta, the development of forest management interpretations, and the evaluation of forest soils and site productivity, including the impact of forestry equipment. Among his accomplishments are several Alberta ecological classification guides and numerous journal publications, book chapters, and conference proceedings, which attest to his experience and to his role in the evolution of forestry in Alberta.

Mr. Dave Presslee was a visionary with an uncommon understanding of landscape and stand-level issues and had a well-grounded knowledge of silviculture, ecology, and human nature. Dave championed the use of ecological frameworks for forest management decision making and sought opportunities to advance our understanding of ecological processes as they apply to the successful regeneration of forests after disturbance. The wisdom he shared with us will continue to be a source of inspiration.

Ian and Dave shared a central role in the chronosequence project that provided the basic data for this field guide. Ian directed the project until illness made it impossible for him to fulfill this role, and he continued to provide scientific advice until his death. Dave supported the project by contributing both his expertise and financial and in-kind corporate assistance through Weldwood of Canada Limited (Hinton Division).

ABSTRACT

Corns, I.G.W.; Downing, D.J.; Little, T.I. 2005. *Field guide to ecosites of west-central Alberta: supplement for managed stands up to 40 years of age (first approximation).* Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta. Spec. Rep. 15.

This report augments the classification system presented in the *Field guide to ecosites of west-central Alberta*. Summaries of vegetation and site data are provided for up to four age classes (5, 10, 20–35, and 35+ years) for seven ecosites in the Lower Foothills Natural Subregion, six ecosites in the Upper Foothills Natural Subregion, and two ecosites in the Subalpine Natural Subregion. Classification keys are included to assist in the identification of ecosites and age classes. Successional and growth trends are presented in tabular and graphic formats. Biodiversity measures comparing diversity within and between subregions are presented. Forest health data are also presented for selected ecosites and age classes in the Lower and Upper Foothills Natural Subregions. Because of field data limitations, not all ecosites are represented, and within each ecosite, not all age classes are represented.

Keywords: ecological classification, natural subregion, ecosite, field guide, west-central Alberta, managed forest, succession, top height growth, biodiversity, moisture regime, nutrient regime, forest pests, forest diseases

RÉSUMÉ

Ce rapport vient prolonger le système de classification présenté dans le *Field guide to ecosites of west-central Alberta*. Des résumés des données concernant la végétation et les conditions locales sont fournis pour un maximum de quatre classes d'âge (5, 10, 20–35 et plus de 35 ans) et pour sept écosites de la sous-région naturelle des Lower Foothills, six écosites de la sous-région naturelle des Upper Foothills et deux écosites de la sous-région naturelle subalpine. Les clés utilisées pour la classification sont incluses pour aider à l'identification des écosites et des classes d'âges. Les modes de succession et de croissance sont présentés sous forme de tableaux et de graphiques. Nous présentons également des données sur la biodiversité, permettant de comparer le niveau de diversité des différentes sous-régions. Des données sur la santé des forêts sont également présentées pour quelques écosites et classes d'âges choisis dans les sous-régions des Lower et des Upper Foothills. Des limitations concernant les données sur le terrain font que certains écosites et certaines classes d'âge n'ont pu être représentés.

Mots clés : classification écologique, sous-région naturelle, écosite, guide de terrain, Centre-Ouest de l'Alberta, forêt gérée, succession, hauteur dominante, croissance, biodiversité, régime d'humidité, régime des nutrients, ravageurs forestiers, maladies forestières

ACKNOWLEDGMENTS

We thank the many individuals and agencies who contributed their expertise and assistance throughout this project. Ron Hall (Northern Forestry Centre, Canadian Forest Service) took over project management when Ian Corns became ill. Dr. Hall was responsible for guiding the project through to its completion, conducting reviews, managing resources, and providing many useful suggestions that significantly improved the quality of this field guide. Lynn Bergeron (Weldwood of Canada Limited [Hinton Division]) assumed the role left vacant by Dave Presslee and provided considerable support in terms of both securing project funding and providing insightful reviews of the results at various stages. Dr. Wayne Strong (Faculty of Environmental Design, University of Calgary) reviewed several drafts of the manuscript and contributed greatly to its content and quality.

The collection of data for this project was accomplished through the cooperative efforts of the Canadian Forest Service, Weldwood of Canada Limited (Hinton Division), the Foothills Model Forest, and Geographic Dynamics Corporation, and through contributions from numerous other members of the forest industry, including WestFraser Timber Co. (Blue Ridge Lumber Inc. and Slave Lake Pulp), Sunpine Forest Products, Weyerhaeuser Alberta (Grande Prairie, Grand Cache, Edson, and Drayton Valley), Alberta Newsprint Company, Millar Western Industries, and Ainsworth Lumber Co. Ltd.

The following individuals and agencies are also due our sincere thanks for their assistance during various stages of this project:

- staff of the Foothills Model Forest, for administrative services;
- Marcie Dubois (formerly of the Canadian Forest Service) and her field assistants, for coordinating fieldwork between 1998 and 2000;
- Doug Allan (Canadian Forest Service), for his technical expertise and experience in site classification;
- Yonghe Wang (Canadian Forest Service), for his expertise in the role of statistical advisor, for generating statistical results for interpretation, and for reviewing the first draft of this field guide;
- Leonie Nadeau (Northern Alberta Institute of Technology), for reviewing the first draft of this field guide;
- Eric Arsenault (Canadian Forest Service), for helping to develop the maps for the guide;

- the reviewers, including Peter Achuff (Parks Canada), Harry Archibald (Government of Alberta), Ken Baldwin (Canadian Forest Service, Ontario), René Belland (University of Alberta, Devonian Botanic Garden), Clinton Broeksma (Timberline Forest Inventory Consultants), Joyce Gould (University of Alberta), Grant Klappstein (Government of Alberta), Ellen Macdonald (University of Alberta), and Richard Sims (EBA Engineering Consultants);
- Colin Myrholm (Canadian Forest Service), for conducting the forest health survey work and compiling the forest health summary tables;
- Peggy Robinson for performing a substantive scientific editorial review of the manuscript;
- Brenda Laishley and Susan Mayer (Northern Forestry Centre, Canadian Forest Service), for final editing and manuscript preparation.

We also acknowledge the many Timberline field workers who contributed their insights gained through several thousand kilometers of transect work from 1994 through 2003 across the Weldwood Forest Management Agreement areas.

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STRUCTURE OF THE SUPPLEMENTAL FIELD GUIDE

This guide has 12 sections. Section 1 provides background information and defines the purpose of this supplemental field guide. Sections 2 and 3 provide information on the area of applicability for the guide and the methods used to collect and analyze plot data. Section 4 summarizes approaches that might be useful in assigning a managed stand to a particular ecosite. Section 5 explains the site and vegetation summary sheets used in Sections 6 through 8 to describe the ecosites.

Sections 6 through 8 summarize the findings for selected ecosites on managed stands within the Lower Foothills, Upper Foothills, and Subalpine Natural Subregions, respectively. Each of these sections includes a subregion-level summary of characteristics for all sampled ecosites, as follows:

- an overview of the subregion, including an edatopic (moisture–nutrient) grid showing the ecosites that are described for the subregion and those that are not;
- a summary of top height growth for lodgepole pine within a given subregion by ecosite and age class; and
- a one-to-two-page key to ecosite identification of managed forests that incorporates readily available site and vegetation information.

The subregion summary is followed by a four-page summary of site characteristics and successional trends for each assessed ecosite.

Section 9 presents a graphic summary of species richness and dominance concentration information by ecosite, age class, and subregion. In Section 10, the findings of insect and disease surveys conducted by Canadian Forest Service investigators in the Upper and Lower Foothills Subregions for age classes 5, 10, and 20–35 years are tabulated and briefly discussed. Cited references are listed in Section 11, and all plant species named in the guide are listed in Section 12.

1.0 INTRODUCTION AND PURPOSE OF SUPPLEMENTAL FIELD GUIDE

1.1 Background

Timber harvesting has significantly altered stand composition and structure on forested landscapes in west-central Alberta over the past 50 years. As a result, there is an increasing proportion of young, postharvest stands interspersed with fire-origin mature stands throughout this region. Postharvest successional trends during the first few decades after harvesting have not been well documented at the broad landscape level, particularly in terms of successional patterns and their relationship to underlying site characteristics.

The *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) was developed to classify fire-origin unharvested stands that are typically over 40 years of age. The 1996 field guide documented vegetation–environment relationships at four levels:

1. natural subregions, defined by the integration of regional vegetation, climate, soils, and geology (Alberta Environmental Protection 1994b);
2. ecosites, subdivisions of natural subregions with similar environments defined by moisture, nutrient availability, and the interaction of biotic elements;
3. ecosite phases, subdivisions of ecosites defined by the dominant species in the canopy; and
4. plant community types, subdivisions of ecosite phases defined by understory composition and abundance.

Successional patterns that characterized transitions from midseral stages to late seral stages were briefly discussed at the ecosite level in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996). Where postharvest succession was discussed, anticipated trends based on field observations of young to midseral communities were provided. There was a need for more specific information on postharvest trends linked to site conditions for young forest stands up to 40 years of age. These stands are referred to as "managed forests" or "managed stands" in this field guide, to distinguish them from stands having natural origins (e.g., fire, avalanche, insects, or disease).

Shortly after the publication of the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), Weldwood of Canada Limited (Hinton Division) and the Canadian Forest Service worked together on the

planning and execution of a project to fill this knowledge gap. Three years of data collection, covering an area from Grande Prairie south to Rocky Mountain House and northeast to Slave Lake, commenced in 1998. The objective was to gather information that would reveal successional trends in postharvest areas and to link these trends to moisture, nutrient, and climatic conditions. This information was to be incorporated within a framework that was already familiar to foresters and biologists. An ecosite-based approach to sampling and data presentation was therefore undertaken, similar to that provided in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).

1.2 Content of supplemental field guide

This supplemental field guide is a companion to the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996). It is best suited to users familiar with the 1996 field guide who need both a means of classifying managed cutblocks to the ecosite level and a summary of observed vegetative trends for various age classes. It augments the 1996 field guide for west-central Alberta by providing information for classifying and interpreting selected young, postharvest ecosite types outside the range of previously described stand ages, and it covers the same geographic area. It should be regarded as a first approximation of ecosite chronosequences in west-central Alberta that can be augmented by additional field survey information.

Specifically, this supplemental guide

- provides a framework based on current site characteristics and both current and past vegetation characteristics to help users identify many young, postharvest forest sites to the ecosite level within the Lower Foothills, Upper Foothills, and Subalpine Natural Subregions of west-central Alberta;
- presents a general description of the expected physical site characteristics in each managed forest type;
- provides a tabular presentation of successional trends in managed stands of different ages for selected ecosites by species and species group (trees, shrubs, forbs, graminoids, nonvascular plants), enabling comparisons between age classes;
- summarizes height growth trends for major tree species by ecosite and subregion for up to four postharvest time periods;
- presents information on plant species richness and dominance concentration for ecosites within managed stands less than 40 years old in the Lower and Upper

Foothills and Subalpine Natural Subregions; and
- summarizes forest health issues for managed stands in selected ecosites within the Lower and Upper Foothills Natural Subregions.

The supplemental guide should prove useful for classifying landscape units such as harvest blocks to one or more ecosites and age classes using readily observable site and stand characteristics that are defined by moisture, nutrient, and climatic conditions. For cutblocks for which ecosite and relative age have been determined, the guide provides insights into vegetation trends over time that are primarily due to site characteristics, the growth and development of crop trees, and competitive species. A summary of plant species richness and dominance concentration, defined in Section 3.2.4, provides a basis for comparing biodiversity among different ecosite age classes and between ecosites and subregions (Section 9).

The supplemental guide has a format similar to that of the 1996 *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) in terms of the sequence of presented information. However, it differs in the following ways:

- It assumes familiarity with the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) and the identification of site and vegetation characteristics. As such, the keys to ecosite identification in the current field guide focus on basic site characteristics for assigning all or part of a block to an ecosite. Current vegetation is not as significant a component in the classification keys as it was in the 1996 west-central field guide (see fourth point in this list).
- It presents information on only 15 of the 44 possible ecosites in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996). Wetland, meadow, and grassland ecosites are not discussed, although they may be included in harvested blocks. Information on upland forested ecosites and their associated vegetation is presented only where two or more age classes occur within an ecosite and each age class contains three or more plots.
- It does not include the Montane Natural Subregion because only one of three ecosites in that subregion had sufficient plots for analysis. These plots were older than 25 years and were located in a small area just west of Hinton and therefore were not considered representative of the subregion.
- It does not present information on ecosite phases or

community types. Early successional plant communities, whether postburn or postharvest, may follow any of a variety of trajectories, depending on the degree and type of disturbance, the availability of propagules, the competitive ability of postdisturbance survivors, and short-term changes to surface site conditions due to removal of tree cover. Organizing the array of possible early postdisturbance plant communities into a community-based classification paralleling the 1996 field guide would be difficult, requiring more intensive collection of both site and treatment data than was possible for this project. Even if such data collection had been possible, a community-based classification scheme might have limited utility for postharvest sites, because site treatments affect biotic responses in a variety of ways. In this supplemental guide, information about average vegetation composition is presented for those ecosite–age combinations with sufficient data to provide insights into general vegetation changes through time.

- Ecosites are not named according to commonly associated species for the same reasons that ecosite phase and community type information are not presented. Ecosites represent a range of moisture and nutrient conditions within a subregion that together influence the development of plant communities.
- This guide presents ecosite identification keys and sampling guidelines in a less structured manner than those given in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), on the assumption that users of the supplemental guide will be familiar with the basic site assessment techniques used in the 1996 guide. Site characteristics that may be useful for determining the most likely ecosite for a homogenous area within a harvest block are incorporated into each classification key.
- This guide includes neither an introduction to the rationale behind ecosystem classification nor background information on ecological characteristics of the area to which the guide applies. This information is provided in Sections 1.0 and 2.0 of the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).
- It does not include information on soil type classification, interpretations, plant recognition, a glossary of terms, or keys to the ecological variables. This information is provided in Sections 11.0 through 16.0 of the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).

2.0 AREA OF APPLICABILITY AND PLOT DISTRIBUTION

The 338 plots used to compile this supplemental guide were distributed within eight Forest Management Agreement (FMA) areas (Table 1).

Table 1. Distribution of plots within eight Forest Management Agreement areas

Company	Number (and %) of plots	
Weldwood of Canada Limited (Hinton Division)	232	(69)
Blue Ridge Lumber (WestFraser Timber)	41	(12)
Weyerhaeuser Alberta (Grande Cache, Grande Prairie, Drayton Valley)	32	(9)
Alberta Newsprint Company (Whitecourt), Millar Western Industries (Whitecourt), Slave Lake Pulp (WestFraser Timber)	33	(10)
Total	338	(100)

In total, 147 plots (44% of total) were established in the Lower Foothills Subregion, 147 plots (44% of total) in the Upper Foothills Subregion, and 44 plots (13% of total) in the Subalpine Subregion. Plots in the Weldwood FMA accounted for 80% of all Upper Foothills Subregion plots, 77% of Subalpine Subregion plots, and 54% of Lower Foothills Subregion plots. Plots in the Blue Ridge Lumber FMA accounted for 20% of Lower Foothills Subregion plots and 8% of Upper Foothills Subregion plots. Plots in the Weyerhaeuser Grande Cache FMA constituted the remaining 23% of Subalpine Subregion plots. Plots in the Weyerhaeuser (Drayton Valley and Grande Prairie), Alberta Newsprint Co., Slave Lake Pulp, and Millar Western Industries FMAs accounted for the remaining 26% of plots in the Lower Foothills Subregion and 12% of plots in the Upper Foothills Subregion.

Given the plot distribution, this supplemental guide is best suited for use within the Lower and Upper Foothills and Subalpine Subregions from Rocky Mountain House north to Grande Prairie and the Swan Hills (Figure 1).

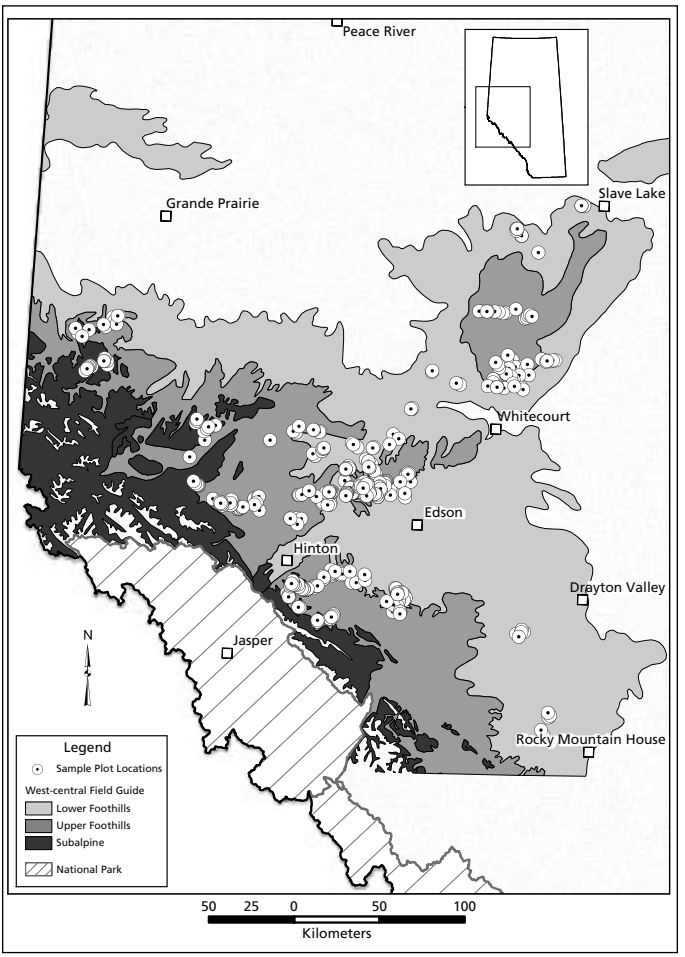


Figure 1. Distribution of sample plots within area of applicability.

3.0 METHODS

3.1 Data collection

Plot data were collected from 1998 to 2000 on a subset of harvested blocks within several FMA areas. The sample design and plot locations were determined by the Canadian Forest Service, and 485 sample plots were established. Each plot was approximately 500 m^2 in size based on nominal dimensions of 22.4 m x 22.4 m. Information about landscape characteristics (e.g., slope, aspect, elevation, slope position), ecological attributes (e.g., moisture, nutrients), soil attributes, vegetation composition, and tree growth characteristics was collected at each plot. The formats for data collection generally followed the specifications in the *Ecological land survey site description manual* (Alberta Environmental Protection 1994a). At each plot, representative photographs of the understory vegetation, the stand, and the soil profile were taken. Site treatment information was obtained either directly from observations made at the site or indirectly from information provided by various forestry companies. Most plant species codes were standardized according to the *Alberta plants and fungi — master species list and species group checklists* (Alberta Environmental Protection 1993). Other references (Douglas et al. 1998; Douglas et al. 1999–2002; Flora of North America Editorial Committee 1993–2000) were used for recent changes to vascular plant nomenclature.

Plots were assigned to ecosites by a two-step process. First, site evidence (e.g., slope, aspect, slope position, soil drainage, presence or absence of soil mottling) was used to determine the relative moisture and nutrient status at the plot. Then, this information was used to place the plot on the edatopic grid and assign the ecosite that best matched its position. The reference ecosites for this assignment were those presented in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996); for example, if the moisture and nutrient regime at a plot was judged to be average for the subregion (average moisture, medium nutrient status), the plot would typically be assigned to ecosite e in the Lower and Upper Foothills Subregions or ecosite d in the Subalpine Subregion.

Plots were assigned to one of four age classes (defined subjectively by the center point of the age class [e.g., age class 5 centers on 5-year-old blocks] and a more or less even age range on either side of the center point [e.g., age class 5 includes blocks 3 to 7 years old]) according to the number of years that had elapsed between the block harvest year and the plot sampling year (Table 2). The age range indicates the span of

years covered by the age class. No blocks were sampled in age ranges 13–17 and 33–37 years. The 5- and 10-year age classes were established so that relatively rapid early-successional changes in vegetation could be tracked; the other two age classes were broader, so that a reasonable number of plots would be available for analysis.

Of the 485 plots sampled, a total of 338 plots were used to compile the managed stand guide. Plots that occurred within nonmerchantable ecosites (bogs, fens, meadows), in the Boreal Mixedwood and Montane Natural Subregions, and in areas covered by the *Field guide to ecosites of southwestern Alberta* (Archibald et al. 1996) were not used. Plots collected in the Boreal Mixedwood Natural Subregion are not relevant to the area of applicability discussed above, nor are plots collected within the area covered by the southwestern field guide; as well, there were too few plots in either of these areas for meaningful analysis.

Table 2. Assignment of age classes to plots according to plot establishment year and block harvest year

		Block harvest year		
Age class	Age range (years)	For plots established in 1998	For plots established in 1999	For plots established in 2000
5	3–7	1991–1995	1992–1996	1993–1997
10	8–12	1986–1990	1987–1991	1988–1992
20–35	18–32	1966–1980	1967–1981	1968–1982
35+	38–42	1956–1960	1957–1961	1958–1962

3.2 Data analysis

3.2.1 Site and soil characteristics

The proportional occurrences of site and soil attributes (slope and aspect combinations, topographic position, moisture and nutrient regimes, effective soil texture, drainage, and depth to mottles) were calculated for each ecosite by aggregating all plots belonging to all age classes, whether or not these classes had a sufficiently large plot population to analyze vegetation trends. This process was followed under the reasonable assumptions that moisture and nutrient availability at a site will be a function of physical site attributes and that their interaction will not change substantially in response to early successional changes. (In this context, it may be that stand development contributes to changes

in understory microenvironments, e.g., reduced insolation as a result of canopy closure and subsequent changes in understory composition.) Statistics (mean and standard error of the mean) were calculated by age class for organic matter thickness, as block age and successional stage may affect this attribute.

3.2.2 Site treatment information

The proportion of plots that were affected by a given site treatment was calculated for each ecosite. Proportions were divided into two arbitrary groups (pre-1990 and post-1990) approximately coinciding with changes to the provincial regeneration standards in March 1991 (Alberta Environment 2000), which might have brought about modifications to silvicultural tactics.

3.2.3 Vegetation data

Average cover percentages and standard errors were calculated for species occurring in one or more eligible age classes within a given ecosite (where eligible age classes were those with at least three plots); as well, the percentage of plots (frequency) in which each species occurred was calculated. These three statistics together give a relative measure of species importance. Species occurring in at least 60% of sampled plots in any of the eligible age classes were selected for tabulation in the vegetation data summaries. Species were sorted for tabular presentation, generally by descending frequency and then by descending cover class within the 5-year age class, so that subsequent successional changes in species composition could be compared. The sort order for the 5-year age class was determined subjectively by examining both the average cover and frequency.

Statistics for height data of dominant or codominant ("top") trees were similarly calculated by age class. A minimum sample size of three trees was required.

3.2.4 Biodiversity measures: species richness and dominance concentration

The species richness statistic provides an indication of the total number of species in an individual stand or community type. For each age class and ecosite, the mean number of species in all species groups and the dominance concentration (D_w) were calculated. D_w is a relatively new diversity measure (Strong 2003) that assesses the degree of unevenness among plant species, based on abundance values such as percent cover. This measure can be applied to either community types or individual

stands. The D_w calculation method determines the variability among species based on standardized abundance and richness (i.e., number of species) values, and the concept of perfect evenness (i.e., all species with equal abundance). Because of this numeric design, D_w is not affected by total abundance and differences in species richness, which is not the situation for other commonly used measures such as the Simpson or Berger–Parker indices. D_w values range between 0 and 1. Values near 0 indicate that there was a very high degree of similarity among species (i.e., high degree of species evenness, or occurrence with nearly the same abundance), whereas D_w values near 1 represent a very large proportion of abundance concentrated within a few members of a sample. When dominance concentration and richness are used together, they provide a basis for comparing the diversity of different communities. Dominance concentration can also provide clues to changing plant community structure in response to natural or human-induced changes.

3.2.5 Forest health survey

The same plots established for soil and vegetation measurements within the Upper and Lower Foothills Natural Subregions were used in the forest health survey. At least three plots from each age class – ecosite combination were visited. It was occasionally necessary to modify the plot boundaries to survey a suitable number of trees; plot dimensions were recorded so that stand density could be estimated, and plots were dropped from the analysis if sufficient trees could not be sampled entirely within the age class – ecosite type.

At each plot, a minimum of 250 living or recently dead (<1 year) trees were assessed. Long-dead (>1 year) trees were also recorded, but these were not assessed or included in the summaries. Each tree (>50 cm in height) was classified as healthy, declining, dead (<1 year), or long dead (>1 year). If recently dead, the butt was examined for Warren root collar weevil or *Armillaria* root disease; otherwise, impact due to pests was assessed nondestructively.

All trees were assessed for cankers, galls, needle casts, blister rusts, terminal weevils, defoliators, and any other evident damage or deformity. The signs and symptoms of insects, diseases, and other damaging agents were recorded. Species were identified with reference to Hiratsuka et al. (1995).

4.0 USING THIS FIELD GUIDE

The information summaries for selected ecosites in this guide provide a benchmark against which field observations can be compared, to infer the most likely ecosite(s) within a harvest block. Field observations can also be used to help determine the most likely age class to which the harvest block (or portion of the block) belongs. Once the block has been classified as to ecosite and age class, the guide provides a summary of vegetation trends that can be expected at future stages in stand development. This information may be useful when planning stand-tending, habitat modification, or other management practices within the geographic area of applicability (see Section 2.0).

It is assumed that users of this guide are familiar with the basic elements of field sampling required to assess a site and assign the most probable ecosite, as outlined in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996). The objective of field sampling depends, in part, on management goals. Typical applications such as cutblock assessments for silvicultural prescriptions or wildlife habitat surveys require a block-level assessment of the factors that control and influence plant growth and development. The primary factors of interest for ecosite classification are soil moisture and nutrient characteristics, as influenced by landscapes, local and regional climate, and pre-existing stand conditions.

Summary tables and charts that may be useful in assessing site attributes, such as humus form, field soil texture classification, drainage class, slope position, moisture regime, and nutrient regime are provided in Appendix 1 of the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996, pp. 16-1 to 16-14).

4.1 Determining the ecosite

The most reliable primary source of information for a managed block is a properly conducted and documented preharvest assessment in combination with harvest information. The next best source of information is an ecological land classification for the area showing predicted or actual ecosites encountered in the harvest block area. A third source of information is a forest inventory that predates the harvest, whereby photo-interpreted stand composition, height, and density may be useful attributes in determining the most likely ecosite.

If adequate primary data are not available to adequately assess the ecosite and age class of a block, lay out a transect across the block and

collect the following information:

- To evaluate preharvest soil conditions on disturbed sites, look for areas that have not been affected by site treatment and dig a shallow pit; dig a soil pit close to a large stump, if possible, as harvesting or site treatment equipment may not have affected the area immediately adjacent to the stump. From the pit, determine organic thickness, depth to mottles, effective texture, and drainage.
- Conduct a general survey of vegetation. Look for remnant stands within the block that could indicate the vegetation before harvesting (and observe whether these remnant patches are representative of the general terrain, since some will have been left unharvested because of operational constraints, such as riparian areas, wetlands, or extremely steep local slopes); walk through adjacent unharvested stands on similar landscape positions, and examine what happens to species composition on microsites (e.g., concave and convex slopes, upper versus lower slopes, and different slope aspects). Single indicator species such as bracted honeysuckle may not be particularly valuable; the occurrence of a number of species together is more reliable (e.g., bracted honeysuckle, cow parsnip, and meadow horsetail occurring together are more likely indicative of richer sites than the singular occurrence of any of these species). Species with greater abundance are also more reliable indicators than minor species in the boreal forest (Strong et al. 1991).
- Small undisturbed areas can provide useful information for determining both local site conditions and the most likely subregion. For example, shaded areas in remnant stands in the Upper Foothills Natural Subregion can provide habitats for subregion indicators such as dwarf bramble and tall bilberry. For subregion determinations, it is also useful to walk through adjacent natural stands and consult the most current natural subregion maps (e.g., Alberta Environmental Protection 1994b).
- Pre-existing forest vegetation provides a long-term record of site conditions. Note the size, pattern, and species distribution of cut stumps; note the ring size of outer rings and develop a local understanding of tree growth as indicated by the relative size of outer rings. Inner ring widths are not reliable indicators of site growth potential, and trees that form part of the main canopy on poor sites (e.g., lodgepole pine) will have early growth increments

that are quite similar to those of trees on good sites in the first few decades. Generally, a poor to average site is indicated where the outer growth rings on a stump at least 15 cm in diameter are less than 1 mm wide and are difficult to see individually. If outer rings are easy to see individually and are greater than about 1 mm wide on stumps at least 15 cm in diameter, an average to rich site is more likely. In the first few years after harvesting, some idea of stand tree composition may be derived by examining logging debris, for example, noting the presence of black spruce cones. The distribution of stumps might also provide helpful clues; for example, a population of larger (15–40 cm) coniferous stumps interspersed with smaller stumps might point toward the prior presence of a lodgepole pine – black spruce stand, which is generally associated with relatively poor nutrient conditions. Associated remnant vegetation indicators might include black spruce and lodgepole pine cones in logging debris.

- Make an educated guess as to whether the site has become wetter since harvest; local hydrogeologic conditions and a reduction in transpiration may both contribute to rises in the water table after cutting. Conversely, a clearcut site may appear quite dry during the first few decades after harvest because of exposure of the soil surface to direct sun. Make a reasonable estimate of moisture and nutrient conditions when canopy closure occurs at about 40–60 years (sooner on sites dominated by deciduous trees). Hydrogeology maps may be of some assistance here and may indicate the possible influence of local or regional flow regimes.
- Apply the information collected to the appropriate key for the appropriate subregion in Section 6.0, 7.0, or 8.0. Choose the ecosite that appears to be the best fit, given the available evidence; review the site description and confirm that your deduction is reasonable.

It might be necessary to make more than one ecosite call, particularly on large blocks that cover a range of terrain conditions.

4.2 Determining the age class

For ease of comparing block observations with the information presented in this guide, it will be helpful to assign the block being assessed to the same age classes used herein, as shown in Table 3.

Table 3. Relationship between age class and block age

Block age[a] (year)	Age class
0–7	5
8–15	10
16–35	20–35
>35	35+

[a]Block age = year of sampling – block harvest year.

The most reliable primary information for assigning age class to a block is the block age as presented in harvest records. Another source of primary information may be found in forest inventory attribute lists for block areas; look for stand origin years in combination with attributes indicating anthropogenic disturbance.

If primary information is not readily available, then site features may be used to establish an approximate age for the block. Table 4 summarizes several features that are potentially useful for this purpose. It is not advisable to use these features without corroborating block records if the aim of block surveys is to examine the relationship between stand characteristics and block age, because of the possibility of circular reasoning.

Table 4. Stand and site attributes for estimating age class of a block

Attribute	Age class			
	5 years (age range 0–7 years)	10 years (age range 8–15 years)	20–35 years (age range 16–35 years)	35+ years (age >35 years)
Stump and debris weathering and decomposition	Stumps appear fresh-cut to slightly discolored; shovel blade will not penetrate stump surface more than 1–2 cm when firmly struck; outer rings are discernible even if thin; origin of slash (cones, bark, branches) is still easily identifiable to species	Stumps have weathered to a gray cut surface; shovel blade will not penetrate inner stump surface more than 1–2 cm when firmly struck, but outer edges may be softer; outer rings are usually discernible; slash debris has decomposed, but generally enough evidence remains for species identification	Stumps have weathered significantly; can be penetrated easily by a shovel blade; stumps and down woody debris often provide habitat for ants and food for bears; outer rings on stumps usually indistinguishable; down woody debris usually bark-free[a]	Stumps may be moss-covered and may be colonized by plants; stumps and down woody debris in contact with the ground are mostly decomposed; rings generally not countable
Understory plant species composition	Generally low cover; some species such as marsh reed grass may dominate on wet, rich sites; often a mix of annual or biennial and perennial species	Alder and willow may increase, especially in the Lower Foothills; annual and biennial species have disappeared	Plant species composition has stabilized; on average to poor sites, common Labrador tea and feathermosses generally increase	Understory plant species composition resembles that of the comparable ecosite and phase in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996)
Tree heights (lodgepole pine, average to rich site)	0.5–1.5 m	1–3 m (Lower, Upper Foothills) 1–2 m (Subalpine)	5–9 m (Lower Foothills) 4–8 m (Upper Foothills) 4–5 m (Subalpine)	13–15 m (Lower Foothills) 10–15 m (Upper Foothills) 10 m (Subalpine)
Tree cover (>5 m)	0%	0–3%	5–40%	10–40+%

[a]Farr, D.R.; Spytz, C.P.; Mercer, E.G. 2000. Structure of forest stands disturbed by wildfire and logging in the Rocky Mountain Foothills. Foothills Model Forest, Hinton, AB. Unpubl. Draft Rep. Authors observed that very few down woody debris pieces in logged coniferous stands between 23 and 27 years old had any bark present.

5.0 HOW TO READ THE SITE AND VEGETATION SUMMARY SHEETS

5.1 About the summary sheets

Four summary sheets are provided for each ecosite. The first describes the ecological reference conditions for an ecosite and a brief written summary of the age class characteristics. The second presents chart summaries of vegetation and tree height growth attributes. The third is a tabulation of biophysical conditions. The fourth is a tabulation of vegetation characteristics across age classes within the ecosite.

Biophysical variables such as slope position, aspect, and moisture regime are used to describe ecosite attributes across the age classes. Many of these biophysical variables also contain a superscript number that describes proportional occurrence within the ecosite as a decile (percentile, rounded upward to the nearest 10%). The aspect [slope class] variables from the Upper Foothills e ecosite are used to illustrate this scheme:

Variable: **Aspect [Slope class %]:** level [0–2]^4, all directions [2–5]^4, south [6–9]^1, west [10–15]^1

Interpretation: About 40% of the sample plots occurred on level areas (0–2% slope), 40% on very gentle (2–5%) slopes with no particular direction, 10% on gentle (6–9%) southerly slopes, and 10% on moderate (10–15%) westerly slopes.

Other variables describe ecosite attributes within an age class. Typically, these are presented as average values followed by the standard error in the site and vegetation summary tables.

5.2 Element of chance

The summary sheets (and classification keys) are based on vegetation, site, and soil attributes that are inherently variable. This may create inconsistencies between what is observed and what is reported in the keys or summary sheets for a given ecosite. When using the keys and summary sheets, consider the site that is to be classified, the sampling intensity indicated in the guide, and the area of applicability. As a very general rule, about 60% of the time, the vegetation and site data collected at a plot might be expected to match reasonably well with one of the described ecosites; about 20% of the time, the data might match well to

two ecosites; and for the remaining 20% of the time, an educated guess will be required. The more uncertain calls will likely be those for sites where there has been a significant change in the moisture regime as a result of harvesting (e.g., exposure to direct insolation or a rise in the water table).

5.3 Description of summary sheets

Sections 5.3.1 through 5.3.4 provide details on each of the ecosite summary sheets. The number in brackets (e.g., [1]) in the descriptive text refers to the number–arrow combination on the example summary sheet (Figures 2 and 3).

5.3.1 Ecosite summary sheet

The identification banner of the ecosite summary sheet (see Figure 2 for an example) shows the ecosite code [1] and the total number of plots sampled for the ecosite [2]. A short description of the ecosite [3] and a summary of typical vegetation conditions associated with each age class [4], along with the number of plots sampled in each age class, are provided below the identification banner.

5.3.2 Chart summary sheet

Two charts appear on the chart summary sheet (example not shown). The upper chart shows the average total cover for various species groups in age classes with at least three plots. The lower chart shows average top heights for one or more tree species in age classes with at least three height measurements per species.

5.3.3 Biophysical summary sheet

Various plot attributes are summarized on this sheet (Figure 3). The identification banner at the top of the sheet shows the subregion and ecosite code [1] and the number of plots summarized [2]. The ecosite is shaded on the edatopic grid [3], and the ellipse shows the approximate range of moisture and nutrient conditions. The moisture-nutrient regime summary shows the observed range of moisture and nutrient conditions. Topographic position, aspect [slope class %], effective texture, drainage and depth to mottles are organized according to value categories (e.g., highest to lowest topographic position, finest to coarsest effective texture). Potentially competitive species [4] are those known to be important competitors within a silvicultural context and that were observed to occur with significant cover in plots. Species diversity [5] includes a count of the common species (species richness) and a measure

of evenness (dominance index or dominance concentration); these measures are explained in Section 3.2.4. The site treatments component [6] provides a decile count of treatments before 1990 and after 1990; the label "no data" means that no treatments were indicated. Common conifer conditions [7] summarizes the insect, disease, and damage agents for stands in the 5, 10, and 20–35 year age classes in the Lower and Upper Foothills Subregions that affected about 20% or more of sampled trees.

5.3.4 Vegetation data summary sheet

The vegetation data summary sheet (example not shown) presents characteristic species by layer. Generally, these are listed in order of descending frequency, but they may also be listed in order of descending average cover. The statistics presented (average, standard error) are described in Section 3.2.3.

1 → e

n = 37 ← 2

The Lower Foothills e ecosite is modal for the subregion and occurs mainly in association with moderately fine-textured, well- to moderately well-drained soils on level to gentle slopes. Sites are typically mesic with medium nutrient status. ← 3

AGE CLASS 5 (8 SAMPLE PLOTS)

- Trembling aspen, lodgepole pine, and white spruce are between 0.5 m and 2 m tall, with low cover (<10%). ← 4
- Prickly rose and wild red raspberry are common shrubs; common fireweed and wild strawberry are common forbs.
- Hairy wild rye and marsh reed grass are present, with variable cover.

AGE CLASS 10 (15 SAMPLE PLOTS)

- Trembling aspen, lodgepole pine, and white spruce are between 1.5 m and 4 m tall; cover is still relatively low.
- Green alder occurs on the majority of sites, with variable cover, depending in part on pre-existing stand conditions and in part on site treatment. It can be a significant competitor on some e ecosites.
- Common fireweed is common; marsh reed grass may increase significantly.

AGE CLASS 20–35 (13 SAMPLE PLOTS)

- Lodgepole pine and trembling aspen have grown into the main tree canopy; lodgepole pine height is 7–9 m, trembling aspen is dominant, and stands tend to be open trembling aspen – lodgepole pine mixtures. Trembling aspen can be a competitor if softwood production is the objective.
- Green alder may occur on some sites but is probably not a competitive species in this age class. White spruce has not yet grown into the tree layer but has increased in cover from the previous age class.
- Bunchberry, common fireweed, and marsh reed grass are dominant herbs.
- Feathermoss cover is significant (>10%).

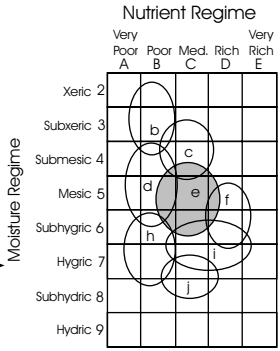
AGE CLASS 35+ (1 SAMPLE PLOT)

- The sample size is too small to discuss cover trends.
- From the trends in previous age classes, it might be expected that trembling aspen, lodgepole pine, and white spruce height and cover would continue to increase. Stands at age 30–40 years likely resemble those described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) for the Lower Foothills e3 mixedwood phase.

Figure 2. Example of an ecosite summary sheet.

1 → LF e

n = 37 ← 2



3 →

Site Characteristics

Moisture–Nutrient Regime: mesic–medium[8], subhygric–medium[1], submesic–medium[1]

Topographic Position: crest[1], upper[2], middle[4], lower[2], level[1]

Aspect [Slope class %]: level [0–2][4], all directions [2–5][4], all directions [>5][2]

Soil Characteristics

Effective Texture: SiCL[3], SIC[1], SCL[1], CL[2], SL[2], S[1]

Drainage: well[4], mod. well[5], imperfect[1]

Organic Thickness (average [SE], cm):

5 years:	7 [1]
10 years:	6 [1]
20–35 years:	7 [1]
35+ years:	no data

Depth to Mottles (range, cm): (0–10)[1], (>80)[9]

4 → ## Potentially Competitive Species

marsh reed grass, green alder (may be higher on sites with significant disturbance)

5 → ## Species Diversity

(species richness [dominance index])

5 years:	22 [0.31]
10 years:	20 [0.36]
20–35 years:	21 [0.34]
35+ years:	no data

6 → ## Site Treatments

Post-1990:	no data[6], no prep.[2], Donaren mounder[2]
Pre-1990:	no data[5], no prep.[5]

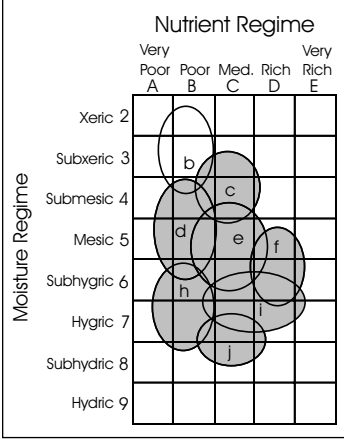
7 → ## Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	frost damage (spruce)
20–35 years:	needle rusts (spruce)
35+ years:	no data

Figure 3. Example of a biophysical summary sheet.

6.0 MANAGED FOREST ECOSITE – AGE CLASS SUMMARIES: LOWER FOOTHILLS SUBREGION

Seven Lower Foothills ecosites associated with managed forests less than about 40 years old are described in this section. The classification key provides a general framework for determining the moisture and nutrient regime and assigning the ecosite, as indicated by relative position on an edatopic grid (Figure 4). This framework is based on site and soil characteristics, observable remnants of preharvest stands, and early successional vegetation. Guidelines that might assist in estimating relative block age are given in Section 4.0 of this field guide, and the first two pages of each ecosite summary outline the major trends in each age class in written and graphic formats. Section 5.0 of this field guide explains the site and vegetation summary tables that are provided on the third and fourth pages of each ecosite summary. Figure 5, which follows the classification key, compares lodgepole pine top height by age class and ecosite within the subregion.



Ecosite	Moisture–nutrient regime
b	Subxeric–poor (not described in this guide)
c	Submesic–medium
d	Mesic–poor
e	Mesic–medium
f	Subhygric–rich
h	Subhygric–poor
i	Hygric–medium/rich
j	Hygric–medium

Figure 4. Edatopic grid for forested ecosites in the Lower Foothills Natural Subregion. Described ecosites are shaded.

6.1 Site-based key to managed forest ecosites of the Lower Foothills Subregion

1a Xeric to submesic sites ranging from a poor to medium nutrient regime on moderate to strong slopes with southerly and westerly aspects on crest to middle slope positions, or on level areas with coarse-textured soils; soils rapidly to well drained; slopes often convex and shedding moisture; common bearberry and hairy wild rye.

1a1 Stumps comprise a mixture of lodgepole pine and black spruce; stumps small (larger ones usually <40 cm diameter); inner and outer rings narrow; common bearberry dominant; steep, exposed slopes.....**Ecosite b**
(not described in this field guide)

1a2 Stumps primarily lodgepole pine or trembling aspen; larger ones may exceed 40 cm in diameter; outer rings discernible on unweathered stumps; hairy wild rye dominant; slopes moderate to strong..... **Ecosite c**

1b Sites submesic or moister.....**Key lead 2a**

2a Submesic to mesic sites typically on level to gentle slopes (all aspects and slope positions) with fine- to coarse-textured soils, well to moderately well drained.

2a1 Stumps comprise a mixture of lodgepole pine and black spruce; stumps small (larger ones usually <40 cm diameter); outer rings on unweathered stumps difficult to see clearly (<1–2 mm); natural pine regeneration usually good; common Labrador tea usually abundant on older blocks.....**Ecosite d**

2a2 Stumps are lodgepole pine or trembling aspen; black spruce stumps, if any, scattered; stumps average (larger ones >25 cm diameter); outer growth rings readily discernible on unweathered stumps; trembling aspen regeneration often good; marsh reed grass may be dominant ..... **Ecosite e**

2b Subhygric to hygric sites, typically on middle to lower slope positions; soils usually fine-textured, with prominent mottling common in upper 25 cm of soil profile, moderately well to poorly drained.

2b1 Stumps comprise a mixture of black spruce and lodgepole pine; stumps small (larger ones usually <25 cm diameter); outer rings on larger unweathered stumps difficult to see clearly (<1–2 mm); common Labrador tea, tufted moss, and poor-fen sphagnum common.....**Ecosite h**

2b2 Stumps larger and may include white spruce, black spruce, and lodgepole pine; outer growth rings usually readily discernible on unweathered stumps; marsh reed grass may be dominant .....**Key lead 3a**

3a Sites receiving significant nutrient inputs as evidenced by plant species, tree growth (large stump size, large trees in adjacent stands), and site position (seepage channels, fluvial influences).

3a1 Moderately well to imperfectly drained soils; raspberry, ferns, currants, bracted honeysuckle, horsetail often present; lodgepole pine sparse, scattered white spruce often the main tree on naturally regenerated sites ..... **Ecosite f**

3a2 Imperfectly to poorly drained soils; lower slope to depressional positions, often along stream channels or on fluvial terraces; may be very large stumps (white spruce) and residual balsam poplar; marsh reed grass dominant; natural white spruce and lodgepole pine regeneration typically low..... **Ecosite i**

3b Sites hygric and not nutrient rich; may occur adjacent to fens or creeks; stumps smaller than those in ecosites f and i; may include a mix of black and white spruce ..... **Ecosite j**

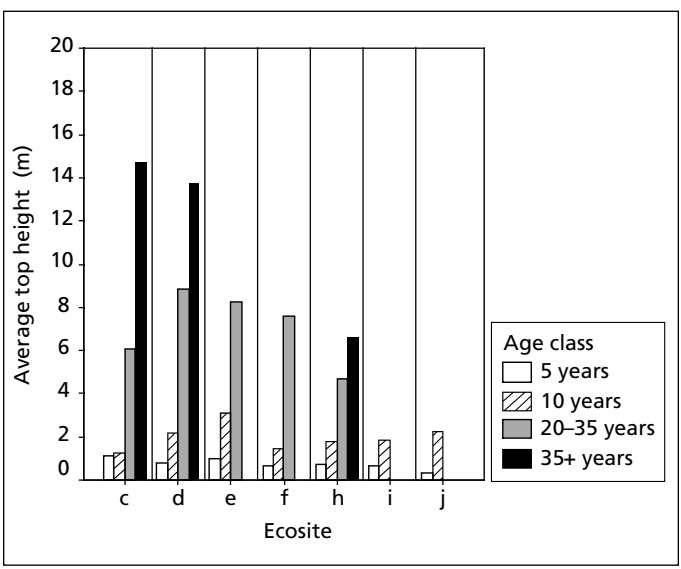


Figure 5. Average top height of lodgepole pine by ecosite and age class, Lower Foothills Natural Subregion.

c

n = 15

The Lower Foothills c ecosite occurs on level to southerly slopes, typically in upper to middle slope positions. Soils range from coarse- to fine-textured and are rapidly to well drained. Sites belonging to this ecosite are submesic and have a medium nutrient supply. Managed sites classified as Lower Foothills c ecosites tend to be somewhat drier on average than forested sites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), probably because of increased insolation and wind exposure in harvested blocks.

AGE CLASS 5 (6 SAMPLE PLOTS)

- Lodgepole pine height averages just over 1 m. Trembling aspen and lodgepole pine occur with very low cover (<5%) in the shrub layer.
- Common bearberry, common blueberry, and prickly rose are common shrubs.
- Hairy wild rye is the dominant grass, occurring with 15–20% cover on average.

AGE CLASS 10 (2 SAMPLE PLOTS)

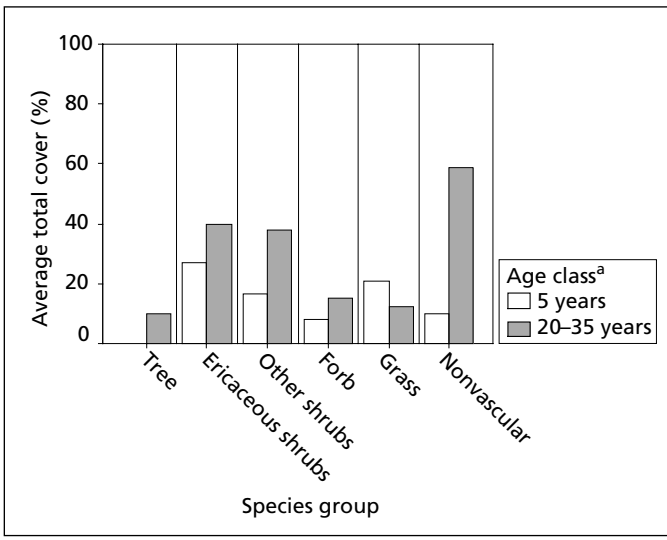
- Average lodgepole pine height remains just over 1 m.
- There are insufficient data to comment on specific vegetation trends; however, it may be expected that average lodgepole pine cover would increase to about 10%, while total feathermoss cover would increase to about 20%.

AGE CLASS 20–35 (6 SAMPLE PLOTS)

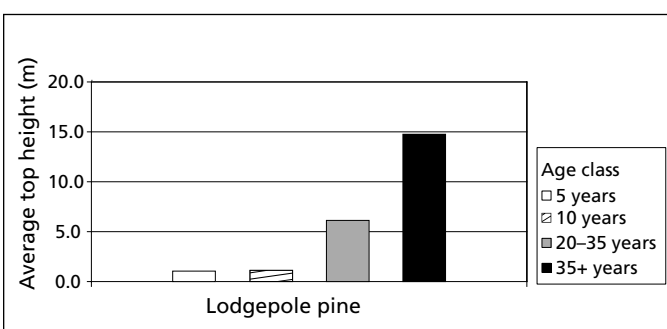
- Lodgepole pine has grown into the main tree canopy; average pine height is about 5.5–6.5 m, and average pine cover across the tree and shrub layers is about 20–30%.
- Common bearberry, common blueberry, and bog cranberry are the dominant shrubs; shrub cover totals about 60%, not including lodgepole pine.
- Hairy wild rye is the dominant grass (average cover 10–15%).
- Feathermoss cover is significant (average 40–55%).

AGE CLASS 35+ (1 SAMPLE PLOT)

- The sample size is too small to discuss cover trends.
- From the trends in previous age classes, it is expected that lodgepole pine height and cover would continue to increase. Stands at age 30–40 years will likely resemble those described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) for lodgepole pine or lodgepole pine–trembling aspen phases.



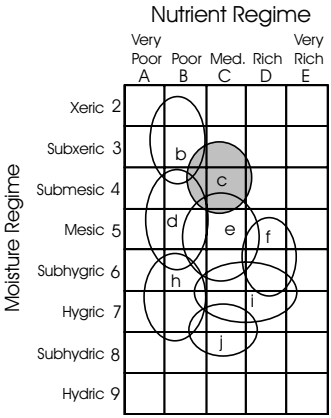
Cover trends by age class and species group, Lower Foothills ecosite
[a]Note: Insufficient data for age classes 10 and 35+.



Average top height by age class, Lower Foothills ecosite c

LF c

n = 15



Site Characteristics

Moisture–Nutrient Regime: subxeric–medium[2], submesic–medium[7], submesic–poor[1]
Topographic Position: crest[3], upper[3], middle[2], lower[1], toe[1]
Aspect [Slope class %]: south [10–15][3], south [16–30][2], level [<2][5]

Soil Characteristics

Effective Texture: SiCL[2], CL[2], SL[1], LS[3], S[2]
Drainage: rapid[3], well[5], mod. well[2]

Organic Thickness (Average [SE], cm):

5 years:	4 [0]
10 years:	insufficient data
20–35 years:	4 [1]
35+ years:	insufficient data

Depth to Mottles (range, cm):
(>80)[10]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	24 [0.39]
10 years:	insufficient data
20–35 years:	27 [0.50]
35+ years:	insufficient data

Site Treatments

Post-1990:	no data[5], no prep.[5]
Pre-1990:	no data[10]

Common Conifer Conditions

5 years:	*Armillaria* (pine), frost damage (spruce)
10 years:	*Armillaria* (pine)
20–35 years:	needle casts, *Armillaria* (pine)
35+ years:	no data

Summary: Vegetation data, ecosite c, Lower Foothills Subregion

LF

		Age class (number of plots)											
		5 years (n = 6)			10 years (n = 2)			20–35 years (n = 6)			35+ years (n = 1)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (> 5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	Insufficient data			9	[6.3]	83	Insufficient data		
Shrub (< 5 m)	Common bearberry (*Arctostaphylos uva-ursi*)	14	[7.1]	67				18	[5.8]	100			
	Common blueberry (*Vaccinium myrtilloides*)	7	[3.0]	83				8	[3.0]	100			
	Prickly rose (*Rosa acicularis*)	6	[3.1]	83				3	[1.0]	100			
	Trembling aspen (*Populus tremuloides*)	4	[2.4]	67				4	[2.2]	50			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	4	[1.6]	50				20	[6.3]	100			
	Bog cranberry (*Vaccinium vitis-idaea*)	3	[1.0]	100				12	[3.4]	100			
	Common Labrador tea (*Ledum groenlandicum*)	3	[1.5]	83				1	[0.8]	50			
	Twin-flower (*Linnaea borealis*)	2	[0.4]	83				7	[2.8]	83			
	Canada buffalo-berry (*Shepherdia canadensis*)	1	[0.7]	50				3	[1.0]	83			
	Dwarf bilberry (*Vaccinium caespitosum*)	1	[0.5]	50				1	[0.4]	50			
Forb	Bunchberry (*Cornus canadensis*)	2	[0.3]	100				3	[2.4]	50			
	Wild strawberry (*Fragaria virginiana*)	2	[1.0]	50				3	[0.8]	100			
	Harebell (*Campanula rotundifolia*)	1	[0.3]	50				1	[0.2]	83			
	Common fireweed (*Epilobium angustifolium*)	1	[0.3]	67				1	[0.3]	83			
	Wild lily-of-the-valley (*Maianthemum canadense*)	1	[0.3]	67				1	[0.2]	100			
	Northern bedstraw (*Galium boreale*)	1	[0.5]	50				2	[0.3]	100			
Grass	Hairy wild rye (*Leymus innovatus*)	18	[4.3]	100				13	[4.2]	100			
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	4	[2.5]	50				17	[4.4]	83			
	Stair-step moss (*Hylocomium splendens*)	2	[1.3]	50				33	[6.3]	100			
Tree height data (m)[a]		Average ht	[SE]	*N*	Average ht	[SE]	*N*	Average ht	[SE]	*N*	Average ht	[SE]	*N*
Lodgepole pine (*Pinus contorta* var. *latifolia*)		1.1	[0.1]	17	1.2	[0.3]	8	6.1	[0.3]	21	14.7	[0.1]	4

[a]*N* = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

d	n = 17

The Lower Foothills d ecosite occurs on level to moderate slopes with no preferred aspect. Soils range from coarse- to fine-textured and are usually well to moderately well drained. Sites are mainly submesic and nutrient poor, in contrast to the natural-stand d ecosites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), which typically have mesic moisture regimes. The drier conditions observed in young managed stands may be a consequence of greater exposure to sun and wind. Lodgepole pine height growth in early successional stages is good relative to other ecosites, but the rapid growth rates in early managed stands may not accurately reflect pine growth in stands greater than 40 years of age.

AGE CLASS 5 YEARS (4 SAMPLE PLOTS)

- Average lodgepole pine height is just under 1 m. Trembling aspen and lodgepole pine occur with very low (<5%) cover in the shrub layer.
- Willow, common Labrador tea, and common blueberry cover totals 15–20%.
- Common fireweed is the most common herb species (5–15%).
- Marsh reed grass cover is between 10% and 20%.

AGE CLASS 10 YEARS (8 SAMPLE PLOTS)

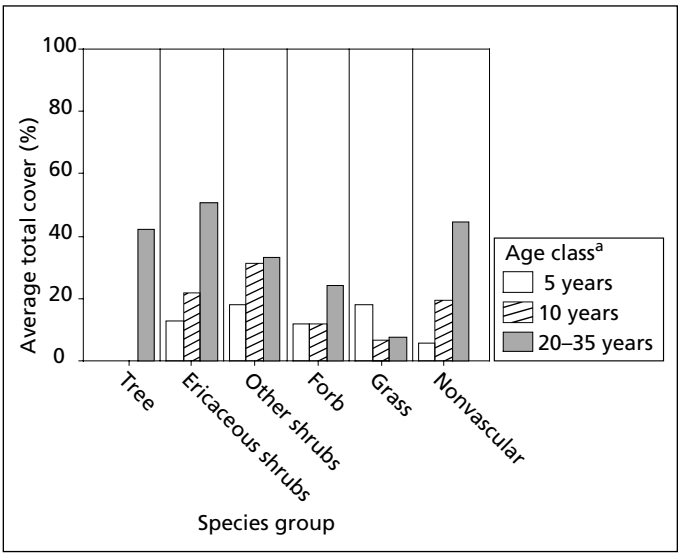
- Average lodgepole pine height is 2–2.5 m. Lodgepole pine and trembling aspen occur with about 15–25% cover in the shrub layer.
- Common Labrador tea cover has increased slightly, and general shrub cover is slightly higher than for age class 5.
- Total forb and marsh reed grass cover have declined slightly.
- Feathermosses are beginning to appear on many sites (<10% cover).

AGE CLASS 20–35 YEARS (3 SAMPLE PLOTS)

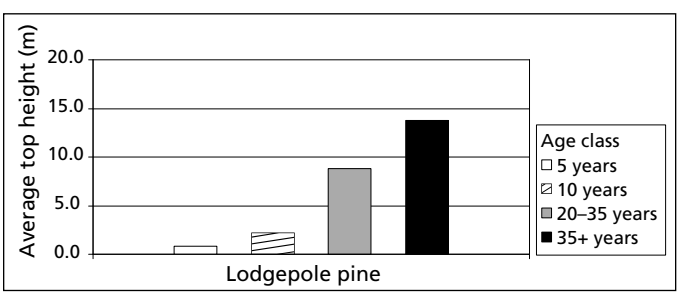
- Lodgepole pine has grown markedly in both height (8–9 m on average) and cover (40–50% in the tree and shrub layers).
- Common Labrador tea is the dominant shrub at 25–40% cover; common blueberry and green alder may also occur, with 5–15% cover.
- Hairy wild rye occurs with <10% cover.
- Feathermoss cover is significant (average 20–40% cover).

AGE CLASS 35+ YEARS (2 SAMPLE PLOTS)

- The sample size is too small to discuss cover trends.
- Average lodgepole pine height increases to 12–14 m.
- Stands resemble d ecosites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) at about 30 years of age.



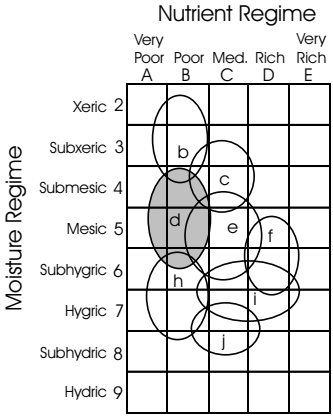
Cover trends by age class and species group, Lower Foothills ecosite d
[a]Note: Insufficient data for age class 35+.



Average top height by age class, Lower Foothills ecosite d

LF d

n = 17



Site Characteristics

Moisture–Nutrient Regime: submesic–poor[5], submesic–medium[3], mesic–medium[1], mesic–poor[1]

Topographic Position: crest[1], upper[4], middle[3], lower[1], level[1]

Aspect [Slope class %]: level [0–2][3], all directions [2–5][4], all directions [6–9][3]

Soil Characteristics

Effective Texture: SiCL[4], CL[2], L[2], SL[2]

Drainage: well[4], mod. well[5], imperfect[1]

Organic Thickness (Average [SE], cm):

5 years:	5 [1]
10 years:	5 [1]
20–35 years:	7 [2]
35+ years:	insufficient data

Depth to Mottles (range, cm):
(26–50)[2], (>80)[8]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	16 [0.31]
10 years:	25 [0.28]
20–35 years:	21 [0.38]
35+ years:	no data

Site Treatments

Post-1990:	no data[8], no prep.[2]
Pre-1990:	no data[10]

Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	frost damage (spruce)
20–35 years:	needle casts, *Armillaria* (pine)
35+ years:	no data

Summary: Vegetation data, Ecosite d, Lower Foothills Subregion

LF

		Age class (number of plots)											
		5 years (n = 4)			10 years (n = 8)			20–35 years (n = 3)			35+ years (n = 2)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	41	[5.2]	100	Insufficient data		
	Trembling aspen (*Populus tremuloides*)	–	–	–	–	–	–	1	[0.7]	67			
Shrub (<5 m)	Willow (*Salix* spp.)	6	[2.7]	75	4	[3.0]	50	3	[0.6]	100			
	Common Labrador tea (*Ledum groenlandicum*)	5	[1.9]	100	10	[2.7]	100	34	[10.2]	100			
	Trembling aspen (*Populus tremuloides*)	4	[1.9]	75	6	[3.6]	75	2	[0.3]	100			
	Common blueberry (*Vaccinium myrtilloides*)	4	[1.1]	100	6	[1.2]	100	13	[10.1]	100			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	3	[0.8]	100	11	[3.7]	88	10	[4.2]	100			
	Prickly rose (*Rosa acicularis*)	3	[0.5]	100	3	[0.6]	88	4	[3.0]	100			
	Bog cranberry (*Vaccinium vitis-idaea*)	2	[0.9]	100	4	[1.8]	100	4	[1.3]	100			
	Common bearberry (*Arctostaphylos uva-ursi*)	1	[0.4]	75	2	[1.2]	75	–	–	–			
	Black spruce (*Picea mariana*)	–	–	–	1	[0.4]	50	2	[1.2]	67			
	Canada buffalo-berry (*Shepherdia canadensis*)	–	–	–	–	–	–	2	[1.5]	67			
	Green alder (*Alnus viridis*)	–	–	–	–	–	–	7	[6.5]	67			
Forb	Common fireweed (*Epilobium angustifolium*)	10	[4.7]	100	5	[1.3]	100	11	[4.8]	100			
	Bunchberry (*Cornus canadensis*)	2	[0.9]	100	4	[1.0]	100	9	[3.5]	100			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	–	–	–	1	[0.5]	50	4	[2.0]	100			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	15	[5.4]	100	2	[1.1]	50	–	–	–			
	Hairy wild rye (*Leymus innovatus*)	3	[1.3]	75	3	[1.5]	88	8	[4.1]	100			
Nonvascular	Common hair-cap (*Polytrichum commune*)	6	[0.5]	100	5	[1.9]	63	10	[6.0]	100			
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	–	–	–	7	[6.4]	67			
	Reindeer lichen (*Cladina mitis*)	–	–	–	–	–	–	3	[2.2]	67			
	Schreber's moss (*Pleurozium schreberi*)	–	–	–	5	[2.3]	88	16	[7.4]	100			
	Stair-step moss (*Hylocomium splendens*)	–	–	–	5	[2.8]	50	4	[3.2]	67			
	Studded leather lichen (*Peltigera aphthosa*)	–	–	–	–	–	–	5	[2.7]	100			

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.8	[0.1]	8	2.2	[0.1]	32	8.8	[0.8]	8	13.7	[0.3]	7

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

e	n = 37

The Lower Foothills e ecosite is modal for the subregion and occurs mainly in association with moderately fine-textured, well- to moderately well-drained soils on level to gentle slopes. Sites are typically mesic with medium nutrient status.

Age class 5 (8 sample plots)

- Trembling aspen, lodgepole pine, and white spruce are between 0.5 m and 2 m tall, with low cover (<10%).
- Prickly rose and wild red raspberry are common shrubs; common fireweed and wild strawberry are common forbs.
- Hairy wild rye and marsh reed grass are present, with variable cover.

Age class 10 (15 sample plots)

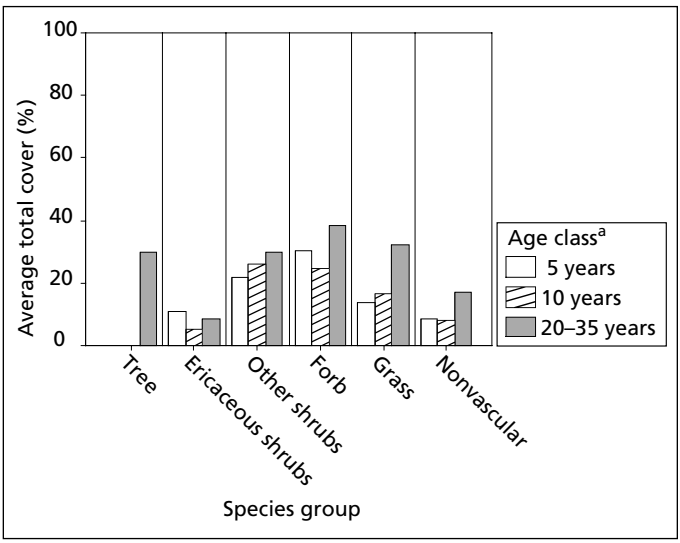
- Trembling aspen, lodgepole pine, and white spruce are between 1.5 m and 4 m tall; cover is still relatively low.
- Green alder occurs on the majority of sites, with variable cover, depending in part on pre-existing stand conditions and in part on site treatment. It can be a significant competitor on some e ecosites.
- Common fireweed is common; marsh reed grass may increase significantly.

Age class 20–35 (13 sample plots)

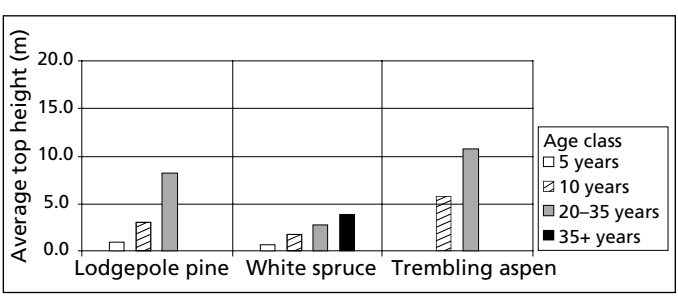
- Lodgepole pine and trembling aspen have grown into the main tree canopy; lodgepole pine height is 7–9 m, trembling aspen is dominant, and stands tend to be open trembling aspen – lodgepole pine mixtures. Trembling aspen can be a competitor if softwood production is the objective.
- Green alder may occur on some sites, but is probably not a competitive species in this age class. White spruce has not yet grown into the tree layer but has increased in cover from the previous age class.
- Bunchberry, common fireweed, and marsh reed grass are dominant herbs.
- Feathermoss cover is significant (>10%).

Age class 35+ (1 sample plot)

- The sample size is too small to discuss cover trends.
- From the trends in previous age classes, it might be expected that trembling aspen, lodgepole pine, and white spruce height and cover would continue to increase. Stands at age 30–40 years likely resemble those described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) for the Lower Foothills e3 mixedwood phase.



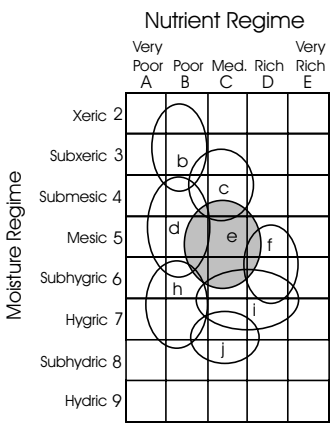
Cover trends by age class and species group, Lower Foothills ecosite e
[a]Note: Insufficient data for age class 35+.



Average top height by age class, Lower Foothills ecosite e

LF e

n = 37



Site Characteristics

Moisture–Nutrient Regime: mesic–medium[8], subhygric–medium[1], submesic–medium[1]
Topographic Position: crest[1], upper[2], middle[4], lower[2], level[1]
Aspect [Slope class %]: level [0–2][4], all directions [2–5][4], all directions [>5][2]

Soil Characteristics

Effective Texture: SiCL[3], SIC[1], SCL[1], CL[2], SL[2], S[1]
Drainage: well[4], mod. well[5], imperfect[1]

Organic Thickness (Average [SE], cm):

5 years:	7 [1]
10 years:	6 [1]
20–35 years:	7 [1]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[1], (>80)[9]

Potentially Competitive Species

marsh reed grass, green alder (may be higher on sites with significant disturbance)

Species Diversity

(species richness [dominance index])

5 years:	22 [0.31]
10 years:	20 [0.36]
20–35 years:	21 [0.34]
35+ years:	no data

Site Treatments

Post-1990:	no data[6], no prep.[2], Donaren mounder[2]
Pre-1990:	no data[5], no prep.[5]

Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	frost damage (spruce)
20–35 years:	needle rusts (spruce)
35+ years:	no data

Summary: Vegetation data, Ecosite e, Lower Foothills Subregion

LF

		Age class (number of plots)											
		5 years (n = 8)			10 years (n = 15)			20–35 years (n = 13)			35+ years (n = 1)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Trembling aspen (*Populus tremuloides*)	–	–	–	–	–	–	22	[5.9]	77			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	8	[2.0]	54			
Shrub (<5 m)	Prickly rose (*Rosa acicularis*)	4	[1.1]	100	2	[0.6]	67	4	[1.2]	85			
	Twin-flower (*Linnaea borealis*)	2	[0.4]	100	2	[0.6]	73	3	[0.7]	85			
	Trembling aspen (*Populus tremuloides*)	5	[2.3]	75	6	[2.9]	67	6	[1.8]	69			
	Wild red raspberry (*Rubus idaeus*)	5	[1.3]	75	3	[0.7]	80	–	–	–			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	4	[2.2]	63	6	[2.5]	53	3	[2.0]	62			
	Common blueberry (*Vaccinium myrtilloides*)	1	[0.6]	63	2	[0.7]	67	9	[4.7]	62			
	White spruce (*Picea glauca*)	1	[0.4]	63	1	[0.4]	67	7	[3.0]	77			
	Common Labrador tea (*Ledum groenlandicum*)	8	[6.2]	50	–	–	–	–	[0.0]	–			
	Bog cranberry (*Vaccinium vitis-idaea*)	1	[0.5]	50	3	[1.4]	80	–	[0.0]	–			
	Bracted honeysuckle (*Lonicera involucrata*)	–	–	–	–	–	–	2	[0.9]	54			
	Green alder (*Alnus viridis*)	–	–	–	6	[1.9]	73	–	–	–	Insufficient data		
	Low-bush cranberry (*Viburnum edule*)	–	–	–	–	–	–	4	[1.2]	69			
Forb	Common fireweed (*Epilobium angustifolium*)	11	[2.9]	100	13	[3.4]	100	10	[3.3]	85			
	Bunchberry (*Cornus canadensis*)	4	[1.9]	88	5	[1.4]	100	10	[3.6]	85			
	Wild strawberry (*Fragaria virginiana*)	10	[4.3]	75	1	[0.4]	60	1	[0.2]	77			
	Lindley's aster (*Aster ciliolatus*)	2	[1.2]	63	1	[0.6]	53	5	[2.6]	77			
	Dewberry (*Rubus pubescens*)	–	–	–	2	[0.7]	60	5	[1.9]	77			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	–	–	–	1	[0.2]	60	3	[1.1]	85			
Grass	Hairy wild rye (*Leymus innovatus*)	8	[3.4]	63	–	–	–	–	–	–			
	Marsh reed grass (*Calamagrostis canadensis*)	5	[3.7]	50	17	[5.6]	93	32	[8.4]	92			
Nonvascular	Common hair-cap (*Polytrichum commune*)	6	[4.3]	63	5	[2.7]	53	–		–			
	Schreber's moss (*Pleurozium schreberi*)	2	[1.0]	63	3	[1.3]	73	13	[6.2]	85			
	Knight's plume moss (*Ptilium crista-castrensis*)	1	[0.8]	50	–	–	–	4	[1.6]	62			

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.1]	23	3.1	[0.2]	36	8.2	[0.6]	29	Insufficient data		
White spruce (*Picea glauca*)	0.7	[0.1]	8	1.7	[0.2]	10	2.8	[0.1]	12	3.9	[0.9]	4
Trembling aspen (*Populus tremuloides*)	No data			5.7	[0.8]	7	10.7	[0.6]	31	Insufficient data		

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

f	n = 30

The Lower Foothills f ecosite occurs mainly on middle to lower slope positions and in level areas. Soils are typically fine-textured and moderately well to imperfectly drained. These sites often receive seepage during part or all of the growing season and are relatively moist and nutrient-rich. Marsh reed grass and nonericaceous shrubs can provide significant competition on some sites, which may partly explain the lower early-seral average height growth and foliar cover of lodgepole pine on this ecosite relative to c, d, and e ecosites. White spruce height growth is somewhat better on f than on e ecosites.

AGE CLASS 5 YEARS (4 SAMPLE PLOTS)

- Average lodgepole pine height is 0.4–0.6 m; average white spruce height is approximately 1 m.
- Prickly rose, white spruce, and wild red raspberry are common shrubs. Bracted honeysuckle indicates richer conditions.
- Ferns may occur with low cover, and indicate richer sites.
- Marsh reed grass occurs with 30–50% cover, up to 70% on some sites.

AGE CLASS 10 YEARS (16 SAMPLE PLOTS)

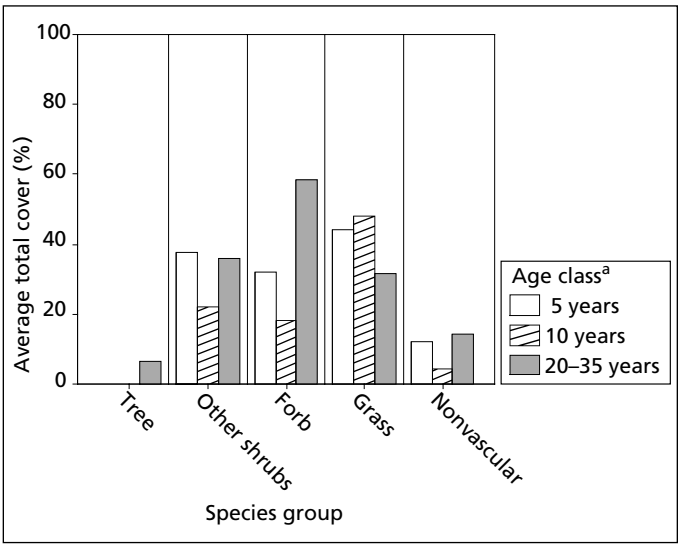
- Average lodgepole pine height is 1–1.5 m; average white spruce height is 2–2.5 m.
- Total shrub cover has decreased somewhat, but wild red raspberry, prickly rose, and bracted honeysuckle remain the main species.
- Forb cover is somewhat lower.
- Average marsh reed grass cover has decreased slightly but may exceed 80% on some sites.

AGE CLASS 20–35 YEARS (10 SAMPLE PLOTS)

- Average lodgepole pine height is 7–8 m; average white spruce height is 5–6 m; lodgepole pine occurs with low cover in the tree canopy. White spruce likely does not appear in the tree layer on the vegetation summary sheets because height data were collected outside the vegetation plot.
- White spruce and bracted honeysuckle are dominant species in the shrub layer.
- Typical f site forb indicators such as ferns and tall lungwort occur with higher cover.
- Feathermosses and common hair-cap have low cover.

AGE CLASS 35+ YEARS (0 SAMPLE PLOTS)

- There are no data upon which to base a discussion of trends.
- Based on field observations of stands 40–50 years old on the Weldwood FMA, stands in this age class can probably be classified according to the appropriate phase in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).
- Green alder seems to be a more important component of fire-origin stands than of harvested stands, but this may depend on the harvesting season and degree of site disturbance.

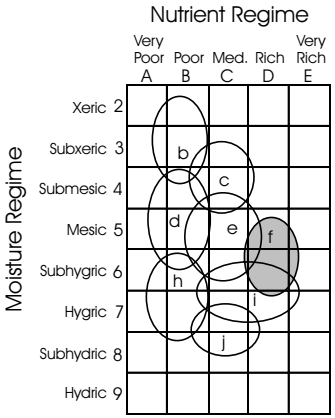


Cover trends by age class and species group, Lower Foothills ecosite f
[a]Note: No data for age class 35+.

Average top height by age class, Lower Foothills ecosite f

LF f

n = 30



Site Characteristics

Moisture–Nutrient Regime: subhygric–rich[5], mesic–rich[3], hygric–rich[1], subhygric–medium[1]
Topographic Position: middle[4], lower[2], toe[1], level[2], depression[1]
Aspect [Slope class %]: level [0–2][4], all directions [2–5][3], all directions [>5][3]

Soil Characteristics

Effective Texture: SiC[3], SiCL[3], SC[2], CL[1], C[1]
Drainage: well[1], mod. well[2], imperfect[7]

Organic Thickness (Average [SE], cm):

5 years:	7 [2]
10 years:	14 [4]
20–35 years:	6 [1]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[2], (11–25)[4], (26–50)[2], (>80)[2]

Potentially Competitive Species

marsh reed grass, wild red raspberry

Species Diversity

(species richness [dominance index])

5 years:	26 [0.43]
10 years:	24 [0.54]
20–35 years:	32 [0.38]
35+ years:	no data

Site Treatments

Post-1990:	no data[5], no prep.[4], power disk trencher[1]
Pre-1990:	no data[8], no prep.[1], Donaren mounder[1]

Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	frost damage (spruce)
20–35 years:	no significant conditions noted
35+ years:	no data

Summary: Vegetation data, ecosite f, Lower Foothills Subregion

LF

		Age class (number of plots)											
		5 years (n = 4)			10 years (n = 16)			20–35 years (n = 10)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	3	[1.1]	70			
	Trembling aspen (*Populus tremuloides*)	–	–	–	–	–	–	3	[1.2]	50			
Shrub (<5 m)	Wild red raspberry (*Rubus idaeus*)	15	[13.5]	75	4	[1.3]	94	3	[0.7]	90			
	White spruce (*Picea glauca*)	6	[4.7]	75	1	[0.4]	69	9	[3.4]	80			
	Prickly rose (*Rosa acicularis*)	6	[1.7]	100	3	[0.7]	81	3	[0.9]	90			
	Bracted honeysuckle (*Lonicera involucrata*)	3	[1.0]	75	3	[0.8]	81	10	[3.1]	90			
	White birch (*Betula papyrifera*)	–	–	–	6	[3.0]	50	4	[1.9]	60			
	Trembling aspen (*Populus tremuloides*)	2	[1.7]	50	3	[1.4]	75	–	–	–			
	Twin-flower (*Linnaea borealis*)	2	[0.5]	100	1	[0.2]	69	1	[0.6]	70			
	Wild red currant (*Ribes triste*)	1	[0.0]	100	1	[0.2]	69	–	–	–			
	Northern gooseberry (*Ribes oxyacanthoides*)	1	[0.4]	75	–	–	–	1	[0.4]	70			
Forb	Common fireweed (*Epilobium angustifolium*)	7	[2.6]	100	7	[2.9]	94	14	[4.0]	90			
	Dewberry (*Rubus pubescens*)	7	[2.9]	100	1	[0.4]	81	5	[1.7]	80			
	Wild strawberry (*Fragaria virginiana*)	5	[3.7]	75	–	–	–	–	–	–	No data		
	Bishop's-cap (*Mitella nuda*)	5	[2.8]	100	1	[0.9]	56	3	[1.1]	90			
	Tall lungwort (*Mertensia paniculata*)	2	[1.1]	75	1	[0.4]	63	4	[0.9]	90			
	Lindley's aster (*Aster ciliolatus*)	2	[0.6]	75	1	[0.3]	63	2	[0.5]	80			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	1	[0.3]	100	1	[0.3]	81	3	[0.8]	80			
	Bunchberry (*Cornus canadensis*)	1	[0.5]	75	1	[0.3]	88	9	[2.7]	90			
	Oak fern (*Gymnocarpium dryopteris*)	–	–	–	–	–	–	5	[2.5]	60			
	Broad spinulose shield fern (*Dryopteris assimilis*)	–	–	–	–	–	–	6	[5.5]	60			
	Woodland horsetail (*Equisetum sylvaticum*)	1	[0.4]	75	2	[1.2]	88	3	[1.1]	80			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	42	[11.6]	100	48	[8.6]	100	32	[7.9]	100			
Nonvascular	Stair-step moss (*Hylocomium splendens*)	6	[3.5]	50	2	[0.7]	63	1	[0.4]	50			
	Schreber's moss (*Pleurozium schreberi*)	5	[2.6]	50	1	[0.4]	56	5	[1.8]	90			
	Common hair-cap (*Polytrichum commune*)	–	–	–	–	–	–	7	[4.3]	90			
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	1	[0.2]	50	1	[0.6]	70			

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.6	[0.1]	4	1.4	[0.2]	13	7.6	[0.5]	19	No data		
White spruce (*Picea glauca*)	1	[0.2]	11	2.2	[0.4]	8	5.5	[0.4]	12	No data		

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size)
Dashes indicate there were no field plot samples on which to base an assessment..

h	n = 18

The Lower Foothills h ecosite occurs mainly on lower slope positions, in level areas, and in depressions. Soils are typically fine-textured and imperfectly to poorly drained; mottling is common in the upper 25 cm. These ecosites are associated with soils of poor nutrient status and are subhygric to hygric. Cold, wet soils probably contribute to relatively slow height growth for lodgepole pine and white spruce.

Age class 5 years (7 sample plots)

- Lodgepole pine and white spruce average 0.5–0.8 m tall, with low cover (<5%) in the shrub layer.
- Common Labrador tea and other ericaceous shrubs are dominant.
- Forb and grass cover are low.

Age class 10 years (6 sample plots)

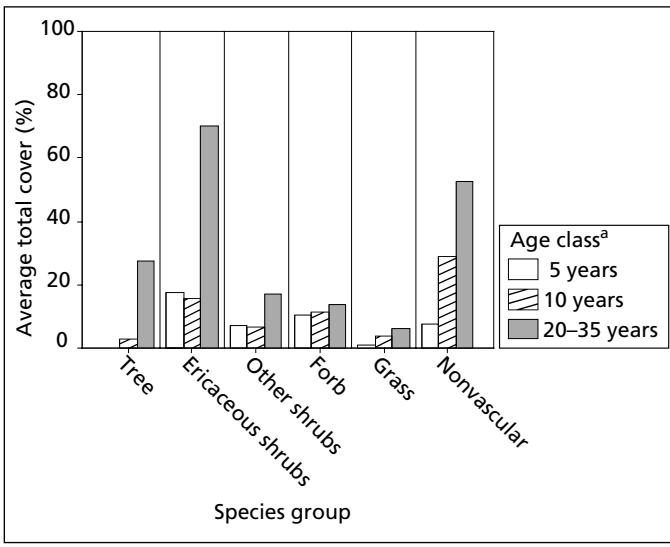
- Average lodgepole pine height is 1.5–2 m; average white spruce height is 1–1.5 m. Lodgepole pine occurs with low cover (<5%) in the tree layer.
- Shrub, forb, and grass cover are similar to the 5-year age class.
- Mosses typical of wet, average to poor nutrient sites (poor-fen sphagnum, tufted moss) and feathermosses average about 30% cover.

Age class 20–35 years (4 sample plots)

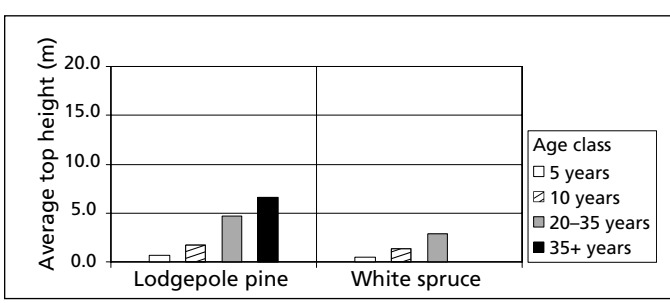
- Average lodgepole pine height is 4.5–5 m; average white spruce height is 2.5–3.5 m. Lodgepole pine occurs in the tree layer with low average cover. The high standard error indicates the influence of one plot with 80% cover.
- Common Labrador tea and other ericaceous shrubs average 70% cover.
- Moss species composition is similar to the 10-year class but has increased to about 50% cover.

Age class 35+ years (1 sample plot)

- The sample size is too small to discuss cover trends. Average top height for pine is 6–7 m, based on a very small sample.
- By age 30–40 years, managed-stand h ecosites resemble natural-stand h ecosites, as described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996). Unlike in the natural-stand h plots, green alder was not a significant component of any managed-stand plot.



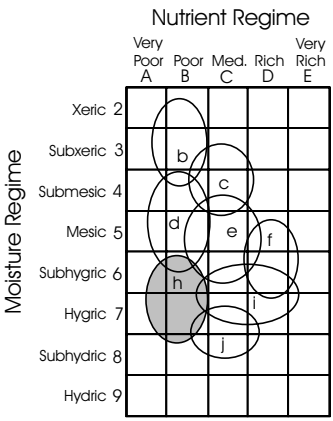
Cover trends by age class and species group, Lower Foothills ecosite h
[a]Note: Insufficient data for age class 35+.



Average top height by age class, Lower Foothills ecosite h

LF h

n = 18



Site Characteristics

Moisture–Nutrient Regime: subhygric–medium[3], subhygric–poor[4], hygric–poor[2], hygric–medium[1]
Topographic Position: middle[2], lower[2], toe[2], level[2], depression[2]
Aspect [Slope class %]: level [0–2][8], all directions [2–5][2]

Soil Characteristics

Effective Texture: SiC[2], SiCL[4], CL[2], SCL[1], L[1]
Drainage: imperfect[7], poor[3]

Organic Thickness (Average [SE], cm):

5 years:	9 [3]
10 years:	13 [5]
20–35 years:	16 [3]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[5], (11–25)[3], (26–50)[2]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	18 [0.33]
10 years:	21 [0.25]
20–35 years:	27 [0.46]
35+ years:	insufficient data

Site Treatments

Post-1990:	no data[6], no prep.[2], Donaren mounder[2]
Pre-1990:	no data[6], no prep.[4]

Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	no significant conditions noted
20–35 years:	frost damage (spruce), needle casts (pine)
35+ years:	no data

Summary: Vegetation data, ecosite h, Lower Foothills Subregion

LF

		Age class (number of plots)											
		5 years (n = 7)			10 years (n = 6)			20–35 years (n = 4)			35+ years (n = 1)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	3	[2.0]	50	22	[19.6]	50	Insufficient data		
	Trembling aspen (*Populus tremuloides*)	–	–	–	–	–	–	5	[3.5]	50			
Shrub (<5 m)	Common Labrador tea (*Ledum groenlandicum*)	13	[5.9]	86	12	[1.6]	100	37	[16.8]	100			
	Common blueberry (*Vaccinium myrtilloides*)	3	[1.0]	100	2	[1.2]	67	27	[9.2]	100			
	Prickly rose (*Rosa acicularis*)	2	[1.0]	57	1	[1.0]	50	1	[0.3]	100			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	2	[0.8]	71	–	–	–	2	[1.4]	50			
	Bog cranberry (*Vaccinium vitis-idaea*)	1	[0.2]	100	2	[0.6]	83	6	[3.1]	100			
	Twin-flower (*Linnaea borealis*)	1	[0.4]	71	2	[1.3]	50	1	[0.3]	100			
	Willow (*Salix* spp.)	1	[0.4]	57	–	–	–	5	[3.0]	50			
	Wild red raspberry (*Rubus idaeus*)	1	[0.3]	57	2	[0.8]	83	1	[0.7]	50			
Forb	Common fireweed (*Epilobium angustifolium*)	5	[2.5]	86	3	[1.7]	83	3	[1.4]	100			
	Woodland horsetail (*Equisetum sylvaticum*)	3	[2.1]	71	2	[0.8]	100	1	[0.1]	100			
	Bunchberry (*Cornus canadensis*)	2	[0.5]	100	3	[1.0]	67	4	[2.1]	100			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	1	[0.2]	57	2	[1.3]	50	3	[1.1]	75			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	–	–	–	4	[2.4]	50	5	[2.9]	50			
Nonvascular	Common hair-cap (*Polytrichum commune*)	3	[1.0]	71	–	–	–	9	[8.7]	50			
	Slender hair-cap (*Polytrichum strictum*)	2	[0.9]	57	4	[1.9]	83	3	[1.0]	75			
	Knight's plume moss (*Ptilium crista-castrensis*)	1	[0.4]	86	2	[1.3]	50	2	[0.9]	75			
	Schreber's moss (*Pleurozium schreberi*)	1	[0.4]	57	2	[1.2]	50	16	[5.9]	100			
	Stair-step moss (*Hylocomium splendens*)	1	[0.3]	57	5	[3.2]	67	1	[0.7]	50			
	Poor-fen sphagnum (*Sphagnum angustifolium*)	–	–	–	4	[2.7]	83	7	[4.4]	75			
	Tufted moss (*Aulacomnium palustre*)	–	–	–	10	[9.0]	50	15	[13.3]	50			

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.7	[0.1]	20	1.8	[0.2]	17	4.7	[0.4]	12	6.6	[0.8]	3
White spruce (*Picea glauca*)	0.5	[0.0]	5	1.3	[0.3]	3	2.8	[0.5]	3	Insufficient data		

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

i	n = 14

The Lower Foothills i ecosite occurs mainly on lower slope positions, in level areas, and in depressions. Soils are typically fine-textured and imperfectly to poorly drained; mottling is common in the upper 25 cm. These sites are subhygric to hygric and have a medium to rich nutrient status; they may receive nutrients through flooding or seepage, as indicated by the presence of bracted honeysuckle, bristly black currant, and marsh reed grass. Cold, wet soils probably contribute to relatively slow average height growth for lodgepole pine.

AGE CLASS 5 YEARS (3 SAMPLE PLOTS)

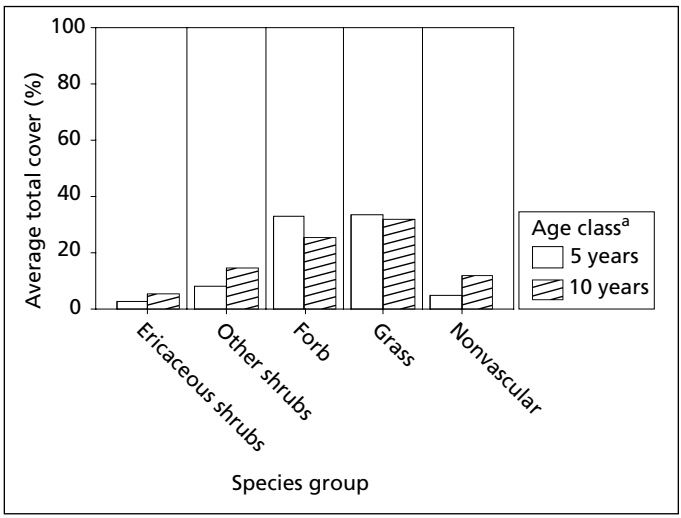
- Average lodgepole pine height is 0.5–1 m, with very low cover in the shrub layer (<5%).
- Total average shrub cover is less than 10%.
- Forb cover averages 20–30% and is highly variable.
- Marsh reed grass cover ranges from 0% to 30%.
- Mosses occur with low cover (<10%).

AGE CLASS 10 YEARS (10 SAMPLE PLOTS)

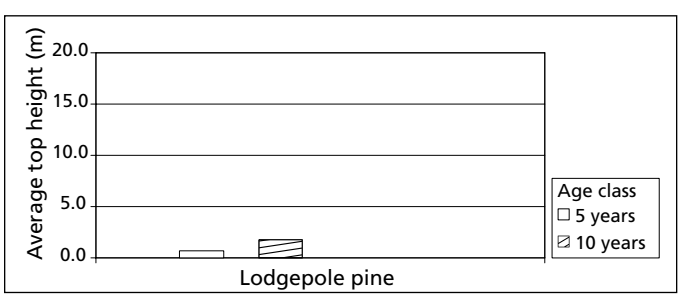
- Average lodgepole pine height is 1.5–2 m, with very low cover in the shrub layer (<5%).
- Forb and shrub cover is similar to that of the 5-year age class.
- Marsh reed grass cover can be significant and may exceed 50% on some sites.
- Moss cover averages 10–15%.

AGE CLASS 20–35 YEARS (1 SAMPLE PLOT) AND AGE CLASS 35+ YEARS (0 SAMPLE PLOTS)

- The sample size is too small to discuss cover trends.
  Managed i ecosites have a high water table; removal of the forest cover may cause the water table to rise locally through reduced transpiration, and site preparation techniques that create warmer, drier microsites may be necessary to encourage tree growth.
- Succession toward the natural i site vegetation is likely to be slow and may proceed toward the poor or rich fen (l or m ecosite) if the water table rises significantly.



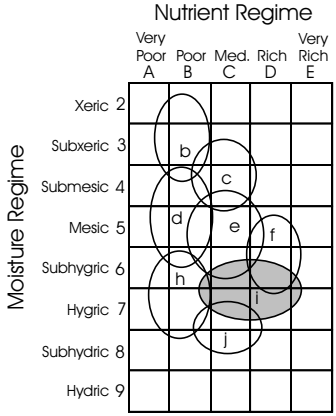
Cover trends by age class and species group, Lower Foothills ecosite i
[a]Note: Insufficient data for age class 20–35; no data for age class 35+.



Average top height by age class, Lower Foothills ecosite i

LF i

n = 14



Site Characteristics

Moisture–Nutrient Regime: subhygric–rich[1], subhygric–medium[4], hygric–rich[4], hygric–medium[1]
Topographic Position: lower[2], toe[4], level[2], depression[2]
Aspect [Slope class %]: level [0–2][7], all directions [2–5][3]

Soil Characteristics

Effective Texture: SiC[3], SiCL[5], CL[1], SCL[1]
Drainage: imperfect[5], poor[4], very poor[1]

Organic Thickness (Average [SE], cm):

5 years:	17 [9]
10 years:	14 [3]
20–35 years:	insufficient data
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[4], (11–25)[4], (26–50)[2]

Potentially Competitive Species

marsh reed grass

Species Diversity

(species richness [dominance index])

5 years:	19 [0.43]
10 years:	32 [0.40]
20–35 years:	insufficient data
35+ years:	no data

Site Treatments

Post-1990:	no data[6], no prep.[3], Bracke mounder[1]
Pre-1990:	insufficient data

Common Conifer Conditions

5 years:	no data
10 years:	frost damage (spruce, balsam fir)
20–35 years:	no data
35+ years:	no data

Summary: Vegetation data, ecosite i, Lower Foothills Subregion[a]

LF

		Age class (number of plots)											
		5 years (n = 3)			10 years (n = 10)			20–35 years (n = 1)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	None	–	–	–	–	–	–						
Shrub (<5 m)	Prickly rose (*Rosa acicularis*)	2	[0.7]	100	1	[0.3]	70						
	Twin-flower (*Linnaea borealis*)	2	[0.5]	100	1	[0.4]	60						
	Bracted honeysuckle (*Lonicera involucrata*)	1	[0.9]	67	3	[0.8]	80						
	Common Labrador tea (*Ledum groenlandicum*)	1	[0.9]	67	3	[1.2]	80						
	Beaked willow (*Salix bebbiana*)	1	[0.9]	67	2	[0.6]	60						
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.9]	67	2	[1.3]	60						
	Bristly black currant (*Ribes lacustre*)	1	[0.7]	67	–	–	–						
	Bog cranberry (*Vaccinium vitis-idaea*)	1	[0.3]	100	2	[0.6]	90						
	Wild red raspberry (*Rubus idaeus*)	–	–	–	2	[0.4]	90						
Forb	Wild strawberry (*Fragaria virginiana*)	16	[12.1]	100	2	[0.8]	60						
	Lindley's aster (*Aster ciliolatus*)	7	[1.7]	100	4	[0.9]	100						
	Common yarrow (*Achillea millefolium*)	4	[1.9]	100	1	[0.2]	90	Insufficient data			No data		
	Common fireweed (*Epilobium angustifolium*)	3	[1.5]	100	6	[0.8]	100						
	Common dandelion (*Taraxacum officinale*)	2	[0.9]	67	1	[0.4]	80						
	Bunchberry (*Cornus canadensis*)	1	[0.9]	67	2	[0.5]	80						
	Bishop's-cap (*Mitella nuda*)	–	–	–	2	[1.2]	70						
	Dewberry (*Rubus pubescens*)	–	–	–	2	[0.5]	70						
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	–	–	–	1	[0.3]	100						
Grass	Marsh reed grass (*Calamagrostis canadensis*)	16	[9.2]	67	31	[9.3]	90						
Nonvascular	Tufted moss (*Aulacomnium palustre*)	4	[3.2]	67	3	[0.7]	80						
	Schreber's moss (*Pleurozium schreberi*)	1	[0.9]	67	2	[0.6]	90						
	Common hair-cap (*Polytrichum commune*)	–	–	–	5	[3.2]	60						
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	1	[0.3]	80						
	Stair-step moss (*Hylocomium splendens*)	–	–	–	1	[0.4]	70						

Tree height data (m)[b]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.7	[0.1]	8	1.8	[0.1]	30	Insufficient data			No data		

[a]Plot sampling for the 5-year age class was undertaken mainly near Hinton. Plot sampling for the 10-year age class occurred in both the Hinton and Swan Hills areas, which are geographically separated; differences in plant community development may be partly due to location.
[b]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

j	n = 16

The Lower Foothills j ecosite occurs mainly on lower slope positions, in level areas, and in depressions. Soils are typically fine-textured and imperfectly to poorly drained; mottling is common in the upper 25 cm. These sites are typically hygric and are medium in nutrient status. Cold, wet soils probably contribute to relatively slow height growth for lodgepole pine.

Age class 5 years (6 sample plots)

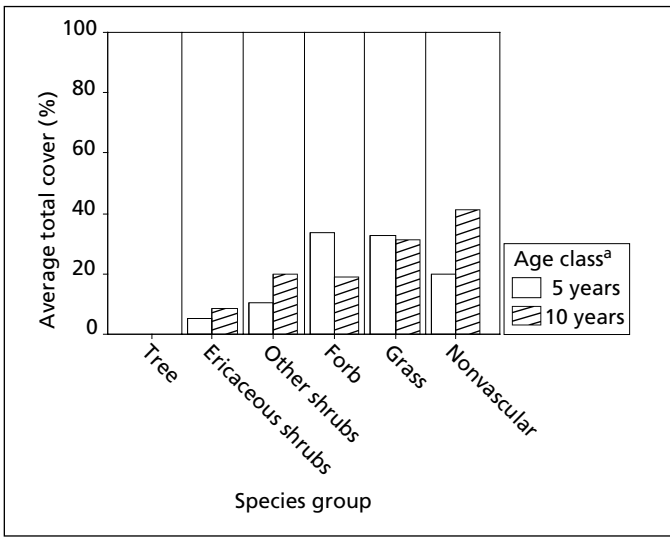
- Average lodgepole pine height is 0.2–0.5 m, with very low cover of pine and white spruce in the shrub layer (<5%).
- Total average shrub cover is less than 15%.
- Forb cover averages 20–30%; horsetails are common.
- Average marsh reed grass cover is about 20%, but is highly variable.
- Feathermosses and tufted moss occur with 10–15% cover.

Age class 10 years (8 sample plots)

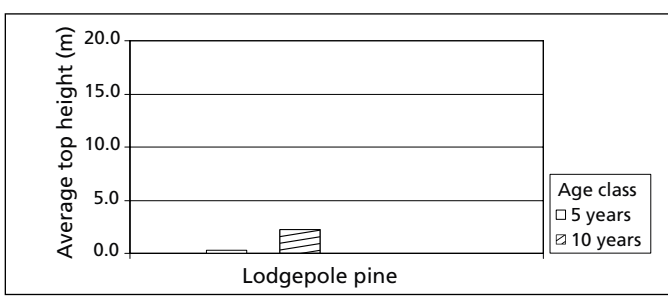
- Average lodgepole pine height is 2–2.5 m, with very low cover of lodgepole pine, black spruce, and white spruce in the shrub layer.
- Forb and shrub cover is similar to that of the 5-year age class.
- Marsh reed grass cover can be significant and may exceed 60% cover on some sites.
- Feathermoss, tufted moss, and hair-cap moss cover averages 30–40%.

Age class 20–35 years (2 sample plots) and age class 35+ years (0 sample plots)

- The sample size is too small to discuss cover trends.
- Managed j ecosites have a high water table; removal of the forest cover may cause the water table to rise locally through reduced transpiration, and site preparation techniques that create warmer, drier microsites may be necessary to encourage tree growth.
- Succession toward the natural j site vegetation is likely to be slow and may proceed toward the poor or rich fen (l or m ecosite) if the water table rises significantly.



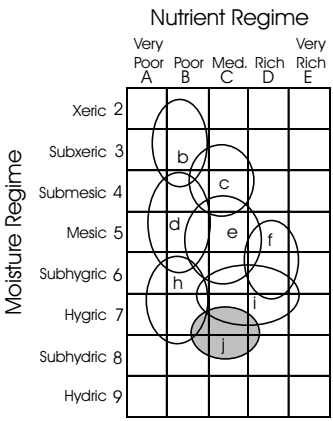
Cover trends by age class and species group, Lower Foothills ecosite j
[a]Note: Insufficient data for age class 20–35; no data for age class 35+.



Average top height by age class, Lower Foothills ecosite j

LF j

n = 16



Site Characteristics

Moisture–Nutrient Regime: subhygric–medium[1], subhygric–rich[1], hygric–medium[6], hygric–rich[1], hygric–poor[1]
Topographic Position: lower[2], toe[3], level[3], depression[2]
Aspect [Slope class %]: level [0–2][7], all directions [2–5][2], all directions [6–9][1]

Soil Characteristics

Effective Texture: C[1], SiC[5], SiCL[4]
Drainage: imperfect[4], poor[6]

Organic Thickness (Average [SE], cm):

5 years:	24 [7]
10 years:	11 [2]
20–35 years:	insufficient data
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[5], (11–25)[1], (26–50)[1], (51–79)[3]

Potentially Competitive Species

marsh reed grass

Species Diversity

(species richness [dominance index])

5 years:	34 [0.33]
10 years:	33 [0.43]
20–35 years:	insufficient data
35+ years:	no data

Site Treatments

Post-1990:	no data[7], no prep.[2], excavator mounder[1]
Pre-1990:	no data[10]

Common Conifer Conditions

5 years:	frost damage (spruce)
10 years:	frost damage (spruce)
20–35 years:	no data
35+ years:	no data

Summary: Vegetation data, ecosite j, Lower Foothills Subregion

LF

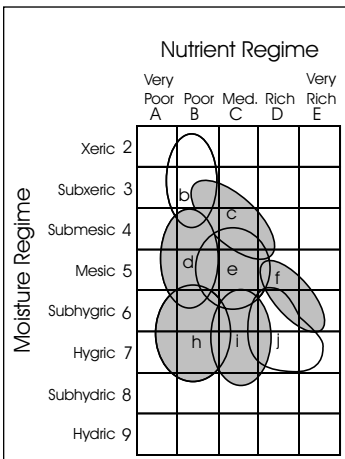
		Age class (number of plots)											
		5 years (n = 6)			10 years (n = 8)			20–35 years (n = 2)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	None	–	–	–	–	–	–						
Shrub (<5 m)	Willow (*Salix* spp.)	4	[2.4]	67	–	–	–						
	Bog cranberry (*Vaccinium vitis-idaea*)	3	[1.5]	83	2	[1.0]	75						
	Prickly rose (*Rosa acicularis*)	2	[1.1]	67	2	[0.7]	75						
	Common Labrador tea (*Ledum groenlandicum*)	2	[0.7]	100	6	[1.6]	100						
	White spruce (*Picea glauca*)	1	[0.8]	50	2	[0.6]	88						
	Black spruce (*Picea mariana*)	1	[0.4]	67	1	[0.3]	50						
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.3]	50	2	[1.1]	88						
	Twin-flower (*Linnaea borealis*)	1	[0.3]	50	2	[0.8]	75						
	Wild red raspberry (*Rubus idaeus*)	1	[0.3]	50	6	[2.5]	88						
	Bracted honeysuckle (*Lonicera involucrata*)	–	–	–	2	[0.6]	75						
Forb	Common fireweed (*Epilobium angustifolium*)	4	[1.3]	100	5	[2.2]	100						
	Common yarrow (*Achillea millefolium*)	3	[2.4]	50	1	[0.4]	63	Insufficient data			No data		
	Woodland horsetail (*Equisetum sylvaticum*)	3	[1.8]	50	4	[1.8]	88						
	Common horsetail (*Equisetum arvense*)	3	[1.5]	67	–	–	–						
	Meadow horsetail (*Equisetum pratense*)	7	[4.1]	50	1	[0.6]	50						
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	2	[0.7]	67	1	[0.3]	100						
	Bishop's-cap (*Mitella nuda*)	2	[0.8]	67	1	[0.4]	50						
	Lindley's aster (*Aster ciliolatus*)	1	[0.6]	83	1	[0.5]	50						
	Bunchberry (*Cornus canadensis*)	1	[0.8]	50	4	[1.2]	100						
Grass	Sedges (*Carex* spp.)	14	[8.2]	67	–	–	–						
	Marsh reed grass (*Calamagrostis canadensis*)	9	[4.5]	83	29	[11.2]	88						
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	7	[3.9]	67	12	[5.2]	88						
	Tufted moss (*Aulacomnium palustre*)	4	[2.4]	50	8	[3.6]	63						
	Common hair-cap (*Polytrichum commune*)	2	[1.6]	50	7	[4.9]	75						

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.3	[0.0]	5	2.2	[0.2]	13	Insufficient data			No data		

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

7.0 MANAGED FOREST ECOSITE – AGE CLASS SUMMARIES: UPPER FOOTHILLS SUBREGION

Six Upper Foothills ecosites associated with managed forests less than about 40 years old are described in this section. The classification key provides a general framework for determining the moisture and nutrient regime and assigning the ecosite, as indicated by relative position on an edatopic grid (Figure 6). This framework is based on site and soil characteristics, observable remnants of preharvest stands, and early successional vegetation. Guidelines that might assist in estimating relative block age are given in Section 4.0 of this field guide, and the first two pages of each ecosite summary outline the major trends in each age class in written and graphic formats. Section 5.0 of this field guide explains the site and vegetation summary tables that are provided on the third and fourth pages of each ecosite summary. Figure 7, which follows the classification key, compares lodgepole pine top height by age class and ecosite within the subregion.



Ecosite	Moisture–nutrient regime
b	Subxeric–poor (not described in this guide)
c	Submesic–medium
d	Mesic–poor
e	Mesic–medium
f	Subhygric–rich
h	Hygric–poor
i	Hygric–medium
j	Hygric–rich (not described in this guide)

Figure 6. Edatopic grid for forested ecosites in the Upper Foothills Natural Subregion. Described ecosites are shaded.

7.1 Site-based key to managed forest ecosites of the Upper Foothills Subregion

1a Xeric to subxeric, generally nutrient-poor sites on moderate to extreme slopes with southerly and westerly aspects on crest to middle slope positions, or on level areas with coarse-textured soils; soils rapidly to well drained; slopes often convex and shedding moisture; common bearberry and hairy wild rye common.

1a1 Stumps comprise a mixture of lodgepole pine and black spruce; stumps small (larger ones usually <30 cm diameter); inner and outer rings compressed; common bearberry dominant; steep, exposed slopes ..... **Ecosite b**
(not described in this field guide)

1a2 Stumps comprise a mixture of lodgepole pine; stumps average (larger ones >30 cm diameter); outer rings discernible on unweathered stumps; hairy wild rye common, low species richness ..... **Ecosite c**

1b Sites submesic or moister ..... **Key lead 2a**

2a Submesic to mesic sites typically on level to gentle slopes (all aspects and slope positions) with fine- to coarse-textured soils, well to moderately well drained.

2a1 Stumps comprise a mixture of lodgepole pine and black spruce; stumps small (larger ones usually <30 cm diameter); outer rings on unweathered stumps difficult to see clearly (<1–2 mm); natural pine regeneration usually good; common Labrador tea and feathermosses usually abundant on older blocks ..... **Ecosite d**

2a2 Fine to medium-textured soils, generally middle to upper slope positions with some lateral water flow; stumps are lodgepole pine or white spruce; black spruce stumps, if any, widely scattered; stumps average (larger ones >25 cm diameter); outer growth rings readily discernible on unweathered stumps; lodgepole pine, white spruce, and balsam or subalpine fir regeneration good ..... **Ecosite e**

2b Subhygric to hygric sites, typically on middle to lower slope positions; soils usually fine-textured, with prominent mottling common in upper 25 cm of soil profile, moderately well to poorly drained.

2b1 Stumps comprise a mixture of black spruce and lodgepole pine; stumps small (larger ones usually <25 cm diameter); outer rings on larger unweathered stumps difficult to see clearly (<1–2 mm); common Labrador tea and hair-cap mosses common ..... **Ecosite h**

2b2 Stumps larger and may include white spruce, black spruce, and lodgepole pine; outer growth rings usually readily discernible on unweathered stumps ..... **Key lead 3a**

3a Sites receiving significant nutrient inputs as evidenced by plant species, tree growth (large stump size, adjacent stands), and site position (seepage channels, fluvial influences).

3a1 Moderately well to imperfectly drained soils; currants, bracted honeysuckle, tall lungwort, cow parsnip often present; marsh reed grass may be dominant; older naturally regenerated blocks may have an open overstory of lodgepole pine, balsam or alpine fir, trembling aspen, and white spruce..... **Ecosite f**

3a2 Imperfectly to poorly drained soils; lower slope to depressional positions, often along stream channels or on fluvial terraces..... **Ecosite j**

(not described in this field guide)

3b Sites hygric and not nutrient rich; may occur adjacent to fens or creeks; stumps smaller than those in ecosites f and i; may include a mix of black and white spruce; marsh reed grass may be dominant; common Labrador tea, poor-fen sphagnum, golden moss, bracted honeysuckle present with low cover..... **Ecosite i**

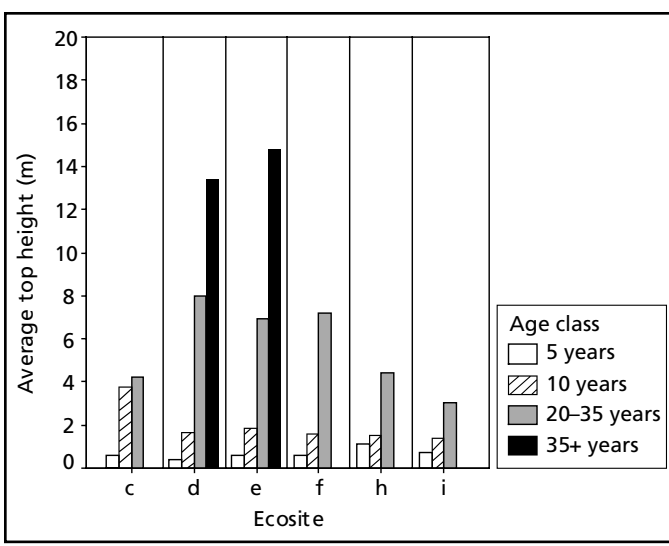


Figure 7. Average top height of lodgepole pine by ecosite and age class, Upper Foothills Natural Subregion.

c	n = 12

The Upper Foothills c ecosite occurs on level to southerly, moderate to extremely inclined slopes, typically in upper to middle slope positions. Soils range from coarse- to fine-textured, and are well drained. Sites belonging to this ecosite are submesic and poor to medium in nutrient status; c ecosites that occur on young managed stands tend to be somewhat drier on average than forested sites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), probably because of increased insolation and wind exposure.

Age class 5 years (5 sample plots)

- Lodgepole pine height averages about 0.5 m.
- Common bearberry occurs with very low cover.
- Forb cover and diversity is very low, and there are no species occurring in more than 60% of plots.
- Hairy wild rye averages 10–15% cover.
- Nonvascular plants were not observed in sample plots.

Age class 10 years (2 sample plots)

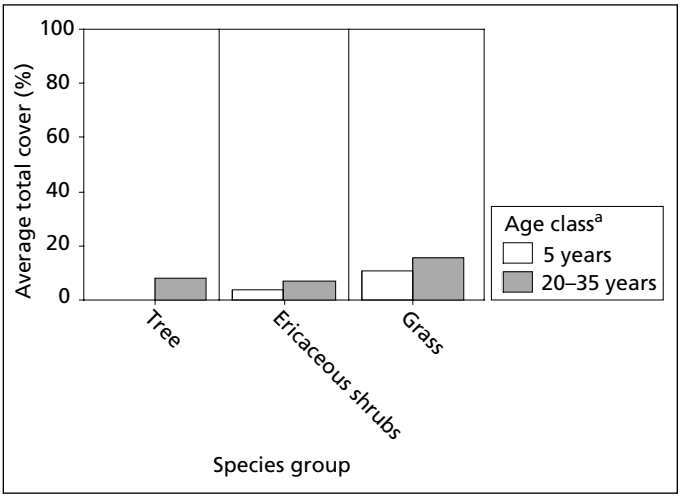
- Lodgepole pine height averages 3–4 m.
- There are insufficient data to comment on specific vegetation trends; however, there are probably few changes from the 5-year to the 10-year age class, judging from available data for the 20–35 year age class.

Age class 20–35 years (5 sample plots)

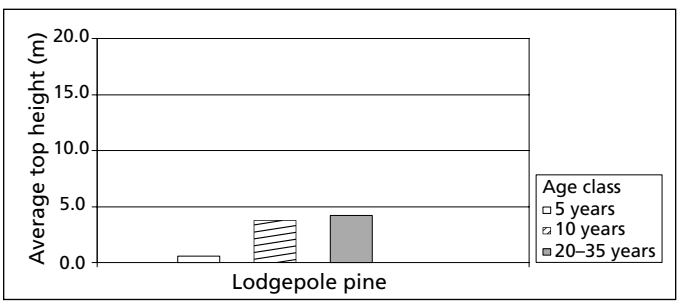
- Lodgepole pine height averages 4–5 m and occurs in the tree layer with low cover (<10%).
- Common bearberry and dwarf bilberry occur in the shrub layer with very low cover. Forb cover and diversity are very low.
- Hairy wild rye occurs with 10–20% cover.
- Nonvascular cover is extremely low.

Age class 35+ years (0 sample plots)

- There are no data upon which to base a discussion of trends.
- Drying conditions and relatively poor nutrient supplies probably contribute to the low diversity and cover in younger age classes, and this trend might be expected to continue in older c ecosite stands.



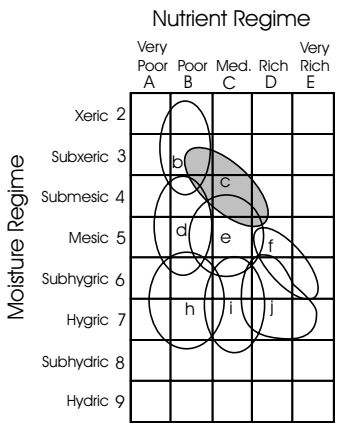
Cover trends by age class and species group, Upper Foothills ecosite c
[a]Note: Insufficient data for age class; no data for age classes 10 and 35+. See comment in vegetation summary table.



Average top height by age class, Upper Foothills ecosite c

UF c

n = 12



Site Characteristics

Moisture–Nutrient Regime: subxeric–medium[2], submesic–medium[2], submesic–poor[6]
Topographic Position: crest[2], upper[6], middle[2]
Aspect [Slope class %]: level [0–2][2], south [16–30][3], south [30–45][1], west [30–45][2], south [46–70][2]

Soil Characteristics

Effective Texture: SiC[1], SiCL[4], CL[1], SiL[2], SiS[1], S[1]
Drainage: rapid[2], well[8]

Organic Thickness (Average [SE], cm):

5 years:	4 [0]
10 years:	insufficient data
20–35 years:	6 [1]
35+ years:	no data

Depth to Mottles (range, cm): (>80)[10]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	2 [0.23]
10 years:	insufficient data
20–35 years:	4 [0.27]
35+ years:	no data

Site Treatments

Post-1990:	no data[2], no prep.[4], Bracke scalp[3], chain drag[1]
Pre-1990:	no data[4], ripper plow [2], Bracke scalp[2], chain drag[2]

Common Conifer Conditions

5 years:	no significant conditions
10 years:	insufficient data
20–35 years:	needle casts, western gall rust (pine)
35+ years:	no data

Summary: Vegetation data, ecosite c, Upper Foothills Subregion[a]

UF

		Age class (number of plots)											
		5 years (n = 5)			10 years (n = 2)			20–35 years (n = 5)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	Insufficient data			8	[2.6]	100	No data		
Shrub (<5 m)	Common bearberry (*Arctostaphylos uva-ursi*)	4	[2.0]	60				5	[3.4]	60			
	Dwarf bilberry (*Vaccinium caespitosum*)	–	–	–				2	[0.8]	80			
Forb	No species occurring in >50% of plots	–	–	–				–	–	–			
Grass	Hairy wild rye (*Leymus innovatus*)	11	[4.3]	80				16	[4.2]	100			
Nonvascular	No species occurring in >50% of plots	–	–	–				–	–	–			

Tree height data (m)[b]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.6	[0.1]	20	3.7	[0.9]	6	4.2	[0.2]	19	No data		

[a]Most of the plots representing this ecosite were established close together in one Weldwood compartment, and they may not be typical of the ecosite across the area of applicability of this field guide.
[b]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

d	n = 21

The Upper Foothills d ecosite occurs on various slopes and aspects. Soils range from coarse- to fine-textured and are usually well to moderately well drained. Sites are mainly submesic and nutrient-poor, in contrast to the natural-stand d ecosites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996), which typically have a mesic moisture regime. The drier conditions observed in young managed stands may be a consequence of exposure to sun and wind. Lodgepole pine height growth in early successional stages is comparable to that observed on more nutrient-rich e ecosites, but the rapid growth rates in early managed stands may not accurately reflect pine growth in stands greater than 40 years of age.

AGE CLASS 5 YEARS (9 SAMPLE PLOTS)

- Average lodgepole pine height is about 0.5 m.
- Common blueberry, common Labrador tea, and dwarf bilberry cover is less than 10%.
- Bunchberry and common fireweed occur with very low cover.
- Hairy wild rye and marsh reed grass cover is very low.

AGE CLASS 10 YEARS (3 SAMPLE PLOTS)

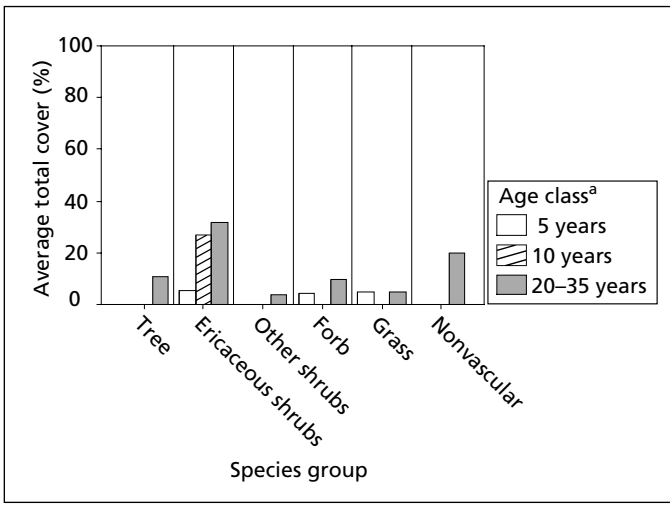
- Average lodgepole pine height is 1.5–2 m.
- Common Labrador tea cover has increased.
- Forbs and grasses both occur with very low cover.
- The three plots representing this age class are geographically separated from those representing the other age classes, and the trends may not be representative of the entire area of interest.

AGE CLASS 20–35 YEARS (8 SAMPLE PLOTS)

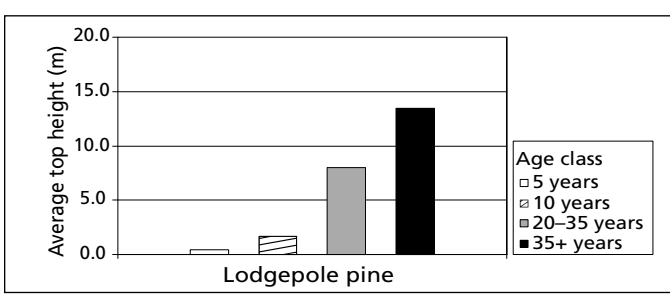
- Average lodgepole pine height is 8–9 m, and it is a constant species with 10–15% cover in the tree layer.
- Common Labrador tea, bog cranberry, and twin-flower are the dominant shrubs, totalling about 30% cover.
- Bunchberry, common fireweed, and palmate-leaved coltsfoot occur with low total cover.
- Hairy wild rye and marsh reed grass cover is low.
- Feathermoss cover is 10-15%.

AGE CLASS 35+ YEARS (1 SAMPLE PLOT)

- The sample size is too small to discuss trends.
- Average lodgepole pine height increases to 12–14 m.
- Stands resemble d ecosites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) at about 30 years of age.



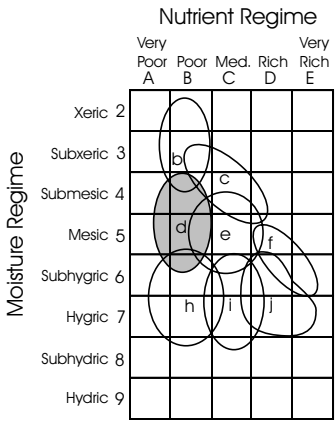
Cover trends by age class and species group, Upper Foothills ecosite d
[a]Note: Insufficient data for age class 35+. See comment in vegetation summary table.



Average top height by age class, Upper Foothills ecosite d

UF d

n = 21



Site Characteristics

Moisture–Nutrient Regime: submesic–medium[4], submesic–poor[4], mesic–medium[1], mesic–poor[1]
Topographic Position: upper[3], middle[4], lower[3]
Aspect [Slope class %]: level [0–2][1], south [2–5][3], east [2–5][1], west [2–5][1], south [6–9][2], south [10–15][1], north [15–30][1]

Soil Characteristics

Effective Texture: SiC[1], SiCL[3], CL[1], L[1], SiL[3], LS[1]
Drainage: well[6], mod. well[3], imperfect[1]

Organic Thickness (Average [SE], cm):

5 years:	5 [1]
10 years:	10 [1]
20–35 years:	5 [0]
35+ years:	insufficient data

Depth to Mottles (range, cm):
(26–50)[1], (>80)[9]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	7 [0.14]
10 years:	1 [0]
20–35 years:	14 [0.38]
35+ years:	

Site Treatments

Post-1990:	no data[2], no prep.[3], chain drag[3], Donaren mounder[2]
Pre-1990:	no data[5], no prep.[5]

Common Conifer Conditions

5 years:	stem deformity (black spruce)
10 years:	no significant conditions
20–35 years:	western gall rust (pine)
35+ years:	no data

Summary: Vegetation data, ecosite d, Upper Foothills Subregion

UF

		Age class (number of plots)											
		5 years (n = 9)			10 years (n = 3)[a]			20–35 years (n = 8)			35+ years (n = 1)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	11	[3.6]	88	Insufficient data		
Shrub (<5 m)	Common blueberry (*Vaccinium myrtilloides*)	3	[0.8]	78	–	–	–	–	–	–			
	Common Labrador tea (*Ledum groenlandicum*)	2	[0.3]	100	27	[8.8]	100	21	[9.8]	100			
	Dwarf bilberry (*Vaccinium caespitosum*)	1	[0.3]	78	–	–	–	–	–	–			
	Common bearberry (*Arctostaphylos uva-ursi*)	–	–	–	–	–	–	2	[0.7]	63			
	Bog cranberry (*Vaccinium vitis-idaea*)	–	–	–	–	–	–	9	[3.7]	100			
	Twin-flower (*Linnaea borealis*)	–	–	–	–	–	–	4	[2.5]	88			
Forb	Bunchberry (*Cornus canadensis*)	1	[0.5]	100	–	–	–	6	[3.3]	88			
	Common fireweed (*Epilobium angustifolium*)	3	[0.9]	100	–	–	–	2	[0.6]	88			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	–	–	–	–	–	–	2	[0.9]	75			
Grass	Hairy wild rye (*Leymus innovatus*)	2	[0.9]	78	–	–	–	3	[1.9]	63			
	Marsh reed grass (*Calamagrostis canadensis*)	2	[1.1]	67	–	–	–	2	[1.2]	88			
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	–	–	–	–	–	–	13	[5.0]	88			
	Studded leather lichen (*Peltigera aphthosa*)	–	–	–	–	–	–	4	[2.1]	88			
	Common hair-cap (*Polytrichum commune*)	–	–	–	–	–	–	2	[1.0]	63			
	Juniper hair-cap (*Polytrichum juniperinum*)	–	–	–	–	–	–	1	[0.7]	63			

Tree height data (m)[b]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.4	[0.0]	28	1.7	[0.2]	10	8	[0.7]	26	13.4	[0.4]	4

[a]The three plots representing age class 10 are geographically widely separated. This likely contributes to the low species diversity (different species in each of three plots, and only common Labrador tea occurred in two or more plots.
[b]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

e	n = 44

The Upper Foothills e ecosite is modal for the subregion and occurs mainly in association with moderately fine- to medium-textured, well- to moderately well-drained soils on level to gentle slopes. Sites are usually mesic and have medium nutrient status.

AGE CLASS 5 YEARS (15 SAMPLE PLOTS)

- Lodgepole pine and white spruce are between 0.5 m and 1 m tall, with very low cover (<2%).
- Common Labrador tea and prickly rose average less than 5% cover.
- Common fireweed and bunchberry average less than 5% cover.
- Hairy wild rye and marsh reed grass are present, with variable cover. Marsh reed grass may become locally competitive on some sites, particularly if disturbed.

AGE CLASS 10 YEARS (10 SAMPLE PLOTS)

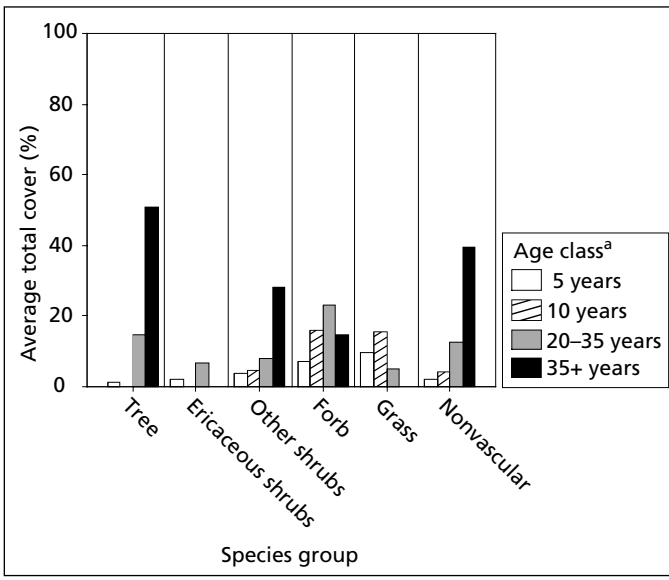
- Lodgepole pine and white spruce are between 0.5 m and 1 m tall, with very low cover (<2%).
- Shrub cover is very low (<5%).
- Common fireweed, bunchberry, and dewberry are common forbs.
- Marsh reed grass may increase locally in response to mechanical disturbance (e.g., Donaren mounder).

AGE CLASS 20–35 YEARS (16 SAMPLE PLOTS)

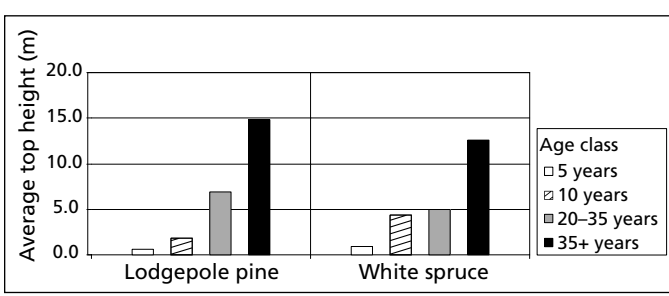
- Lodgepole pine and white spruce have grown into the main tree canopy; average pine height is 6.5–7 m, and average spruce height is 4.5–5.5 m.
- Common Labrador tea and twin-flower are common shrubs.
- Common fireweed, bunchberry, and palmate-leaved coltsfoot are common forbs.
- Average marsh reed grass cover is lower than in the 10-year age class.
- Feathermosses are common.

AGE CLASS 35+ YEARS (3 SAMPLE PLOTS)

- Average canopy closure of lodgepole pine, white spruce, and subalpine fir is about 40–50%. Lodgepole pine height averages 14.5–15 m; average white spruce height is 11–14 m.
- Common Labrador tea and twin-flower are likely still dominant in many plots; the apparent disappearance of common Labrador tea from the species list is likely a function of plot location (all three plots were in the same Weldwood compartment).
- Feathermoss cover averages 40–50%.
- Stand understories at age 30–40 years likely resemble those described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996) for the Upper Foothills e ecosite.



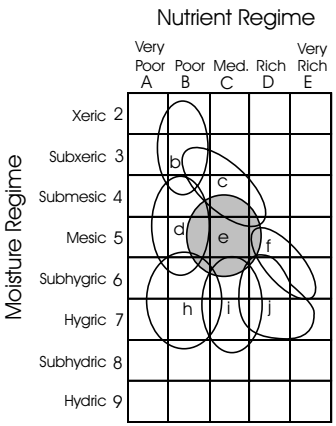
Cover trends by age class and species group, Upper Foothills ecosite e



Average top height by age class, Upper Foothills ecosite e

UF e

n = 44



Site Characteristics

Moisture–Nutrient Regime: mesic–medium[8], submesic–medium[2]
Topographic Position: crest[1], upper[3], middle[5], lower[1]
Aspect [Slope class %]: level [0–2][4], all directions [2–5][4], south [6–9][1], west [10–15][1]

Soil Characteristics

Effective Texture: SiCL[5], SiL[5]
Drainage: well[3], mod. well[6], imperfect[1]

Organic Thickness (Average [SE], cm):

5 years:	7 [1]
10 years:	9 [1]
20–35 years:	8 [1]
35+ years:	12 [1]

Depth to Mottles (range, cm):
(26–50)[1], (>80)[9]

Potentially Competitive Species

marsh reed grass (may increase with site disturbance)

Species Diversity

(species richness [dominance index])

5 years:	11 [0.25]
10 years:	13 [0.41]
20–35 years:	15 [0.30]
35+ years:	9 [0.23]

Site Treatments

Post-1990:	no data[5], chain drag[2], Donaren mounder[2], ripper plow[1]
Pre-1990:	no data[4], no prep.[6]

Common Conifer Conditions

5 years:	no significant conditions
10 years:	no significant conditions
20–35 years:	western gall rust (pine), *Atropellis* canker (pine)
35+ years:	no data

Summary: Vegetation data, ecosite e, Upper Foothills Subregion

UF

Layer	Common (scientific) name	Age class (number of plots)											
		5 years (n = 15)			10 years (n = 10)			20–35 years (n = 16)			35+ years (n = 3)		
		Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.5]	80	–	–	–	11	[4.1]	81	32	[13.0]	100
	Subalpine fir (*Abies bifolia*)	–	–	–	–	–	–	–	–	–	10	[6.2]	100
	White spruce (*Picea glauca*)	–	–	–	–	–	–	3	[1.1]	69	9	[7.9]	67
Shrub (<5 m)	Common Labrador tea (*Ledum groenlandicum*)	2	[1.3]	73	–	–	–	7	[3.2]	69	–	–	–
	Prickly rose (*Rosa acicularis*)	2	[0.8]	100	–	–	–	1	[0.4]	63	–	–	–
	Twin-flower (*Linnaea borealis*)	2	[0.4]	100	2	[0.9]	70	3	[0.9]	88	28	[16.4]	100
Forb	Common fireweed (*Epilobium angustifolium*)	4	[1.0]	100	7	[3.0]	100	13	[5.1]	100	–	–	–
	Bunchberry (*Cornus canadensis*)	2	[0.9]	100	4	[0.7]	100	6	[2.2]	100	11	[3.8]	100
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	1	[0.4]	80	1	[0.4]	60	2	[0.5]	81	–	–	–
	Dewberry (*Rubus pubescens*)	–	–	–	2	[0.7]	60	–	–	–	4	[1.9]	100
	Heart-leaved arnica (*Arnica cordifolia*)	–	–	–	1	[0.7]	60	2	[0.8]	75	–	–	–
Grass	Marsh reed grass (*Calamagrostis canadensis*)	8	[3.2]	60	15	[5.2]	90	5	[2.2]	88	–	–	–
	Hairy wild rye (*Leymus innovatus*)	2	[0.5]	60	–	–	–	–	–	–	–	–	–
Nonvascular	Common hair-cap (*Polytrichum commune*)	1	[0.4]	73	2	[0.5]	80	–	–	–	–	–	–
	Juniper hair-cap (*Polytrichum juniperinum*)	1	[0.5]	60	–	–	–	–	–	–	–	–	–
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	1	[0.7]	80	4	[2.2]	75	11	[1.9]	100
	Schreber's moss (*Pleurozium schreberi*)	–	–	–	1	[0.5]	70	6	[2.2]	88	15	[4.7]	100
	Stair-step moss (*Hylocomium splendens*)	–	–	–	–	–	–	3	[1.1]	69	13	[8.5]	100

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.6	[0.1]	46	1.8	[0.1]	21	6.9	[0.3]	37	14.8	[0.2]	12
White spruce (*Picea glauca*)	0.9	[0.1]	6	4.3	[1.3]	18	5	[0.4]	27	12.6	[2.2]	9

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

f	n = 33

The Upper Foothills f ecosite occurs mainly on middle to lower slope positions, with no apparent preference for aspect. Soils are typically fine-textured and moderately well to poorly drained. These sites often receive seepage during part or all of the growing season and are relatively moist and nutrient-rich. Marsh reed grass can provide significant competition on some sites.

Age class 5 years (10 sample plots)

- Average lodgepole pine and white spruce height is 0.5–0.7 m.
- Bracted honeysuckle, prickly rose, and wild red raspberry are the most common shrubs, occurring with low cover (<10%).
- Forb cover is low; common fireweed is the most common forb.
- Marsh reed grass occurs with about 10% cover on average.

Age class 10 years (8 sample plots)

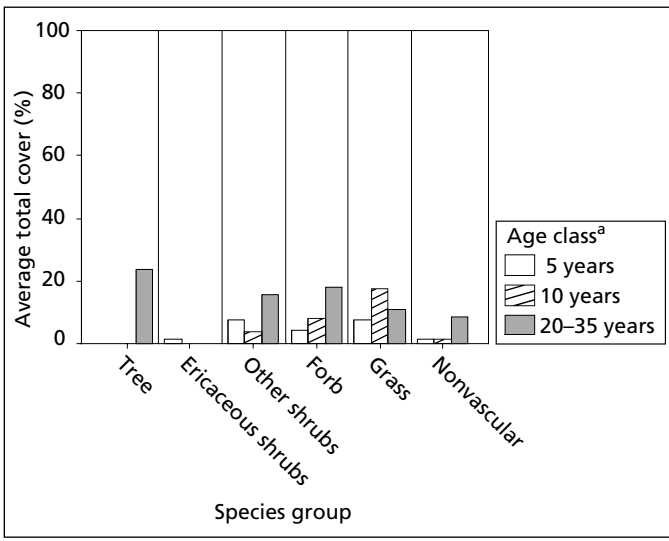
- Average lodgepole pine height is about 1.5 m; average white spruce height is about 1–1.5 m.
- Shrub and forb cover is similar to that in the 5-year age class.
- Average marsh reed grass cover is somewhat higher (15–20%) relative to age class 5, and may reach 50% or more on some sites, possibly in response to disturbance.

Age class 20–35 years (15 sample plots)

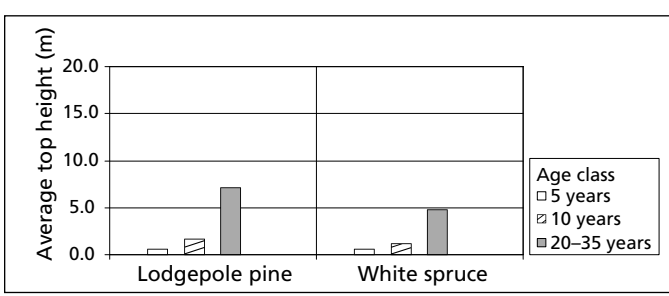
- Average lodgepole pine height is 7–8 m; average white spruce height is 4.5–5.5 m; average tree canopy cover is 20–25% and includes lodgepole pine, trembling aspen, white spruce, and balsam or subalpine fir.
- Shrub cover averages 15–20%, and green alder may be a significant component on some sites.
- Typical f site forb indicators such as oak fern, tall lungwort, and cow parsnip are common.
- Marsh reed grass cover averages 10–15%.
- Feathermosses are common, with low cover (<10%).

Age class 35+ years (0 sample plots)

- There are no data upon which to base a discussion of trends.
- Based on field observations of stands 40–50 years old in the Weldwood FMA, stands in this age class can probably be classified with reference to the appropriate phase in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).



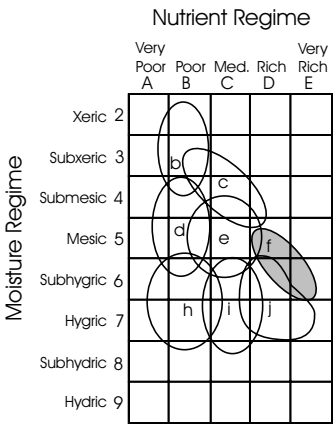
Cover trends by age class and species group, Upper Foothills ecosite f
[a]Note: No data for age class 35+.



Average top height by age class, Upper Foothills ecosite f

UF f

n = 33



Site Characteristics

Moisture–Nutrient Regime: subhygric–rich[4], mesic–rich[4], subhygric–medium[1], hygric–medium[1]

Topographic Position: upper[2], middle[3], lower[3], toe[2]

Aspect [Slope class %]: level [0–2][3], south [2–5][1], north [6–9][1], south [6–9][1], north [10–15][1], west [10–15][1], north [16–30][1], west [16–30][1]

Soil Characteristics

Effective Texture: SiC[2], SiCL[3], CL[1], SC[1], SCL[1], L[1], SiL[1]

Drainage: well[1], mod. well[4], imperfect[3], poor[2]

Organic Thickness (Average [SE], cm):

5 years:	10 [2]
10 years:	8 [1]
20–35 years:	9 [1]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[3], (26–50)[1], (51–79)[1], (>80)[5]

Potentially Competitive Species

marsh reed grass (may increase with site disturbance)

Species Diversity

(species richness [dominance index])

5 years:	9 [0.30]
10 years:	8 [0.44]
20–35 years:	24 [0.31]
35+ years:	no data

Site Treatments

Post-1990:	no data[4], ripper plow[3], excavator mounder[2], Donaren mounder[1]
Pre-1990:	no data[7], no prep.[3]

Common Conifer Conditions

5 years:	no significant conditions
10 years:	no significant conditions
20–35 years:	no significant conditions
35+ years:	no data

Summary: Vegetation data, ecosite f, Upper Foothills Subregion

UF

		Age class (number of plots)											
		5 years (n = 10)			10 years (n = 8)			20–35 years (n = 15)			35+ years (n =0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Trembling aspen (*Populus tremuloides*)	–	–	–	–	–	–	8	[3.8]	73	No data		
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	8	[2.1]	80			
	Balsam fir (*Abies balsamea*)	–	–	–	–	–	–	5	[2.1]	87			
	White spruce (*Picea glauca*)	–	–	–	–	–	–	3	[1.0]	60			
Shrub (<5 m)	Bracted honeysuckle (*Lonicera involucrata*)	3	[0.7]	100	2	[0.6]	88	2	[1.6]	60			
	Prickly rose (*Rosa acicularis*)	2	[0.5]	90	2	[0.8]	100	1	[0.6]	73			
	Wild red raspberry (*Rubus idaeus*)	2	[0.6]	90	–	–	–	1	[0.3]	67			
	Twin-flower (*Linnaea borealis*)	1	[0.3]	90	–	–	–	1	[0.4]	80			
	Bristly black currant (*Ribes lacustre*)	–	–	–	–	–	–	1	[0.1]	87			
	Green alder (*Alnus viridis*)	–	–	–	–	–	–	6	[3.3]	60			
	Low-bush cranberry (*Viburnum edule*)	–	–	–	–	–	–	3	[1.3]	67			
Forb	Common fireweed (*Epilobium angustifolium*)	3	[0.6]	100	3	[0.9]	100	2	[0.5]	100			
	Tall lungwort (*Mertensia paniculata*)	1	[0.3]	100	2	[0.7]	100	2	[0.6]	87			
	Bunchberry (*Cornus canadensis*)	–	–	–	–	–	–	3	[1.0]	100			
	Cow parsnip (*Heracleum maximum*)	–	–	–	–	–	–	1	[0.5]	80			
	Dewberry (*Rubus pubescens*)	–	–	–	2	[0.9]	75	2	[0.5]	87			
	Dwarf bramble (*Rubus pedatus*)	–	–	–	–	–	–	1	[0.5]	60			
	Heart-leaved arnica (*Arnica cordifolia*)	–	–	–	–	–	–	1	[0.3]	80			
	Oak fern (*Gymnocarpium dryopteris*)	–	–	–	–	–	–	4	[2.8]	60			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	–	–	–	1	[0.5]	88	2	[0.4]	100			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	8	[1.8]	90	17	[6.3]	88	11	[3.7]	100			
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	1	[0.6]	70	–	–	–	4	[1.5]	100			
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	1	[0.6]	75	3	[1.8]	87			

Tree height data (m)[a]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	0.6	[0.1]	14	1.6	[0.1]	12	7.2	[0.5]	34	No data		
White spruce (*Picea glauca*)	0.6	[0.1]	21	1.2	[0.1]	14	4.8	[0.3]	27	No data		

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

h	n = 15

The Upper Foothills h ecosite occurs mainly on middle to lower slope positions, in level areas, and in depressions. Soils are typically fine-textured and imperfectly to very poorly drained; mottling is common in the upper 10 cm. These sites occur on nutrient-poor substrates and are subhygric to hygric. Cold, wet soils probably contribute to relatively slow height growth for lodgepole pine and black spruce.

Age class 5 years (4 sample plots)

- Lodgepole pine and black spruce average 1–2 m in height, with low cover (<5%) in the shrub layer.
- Common Labrador tea and other ericaceous shrubs are dominant, but their cover is highly variable (10–45%).
- Average forb and grass cover is very low (<5%).
- Hair-cap mosses are common, with low cover (<10%).

Age class 10 years (7 sample plots)

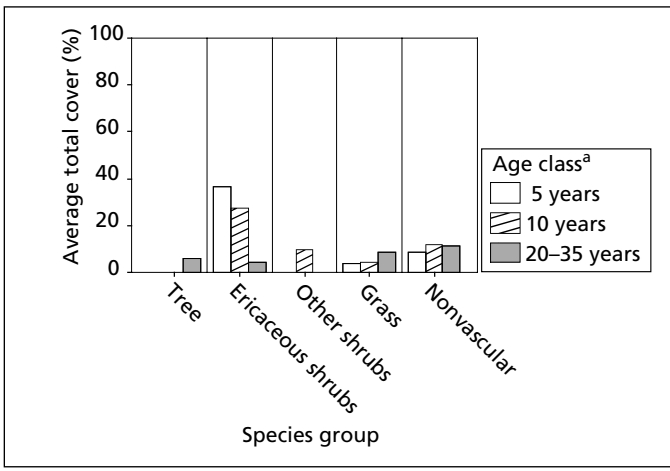
- Average lodgepole pine height is 1.3–1.7 m; average black spruce height is 1–3 m.
- See note at bottom of vegetation summary for explanation of differences between this age class and the 5-year and 20–35 year age classes.

Age class 20–35 years (4 sample plots)

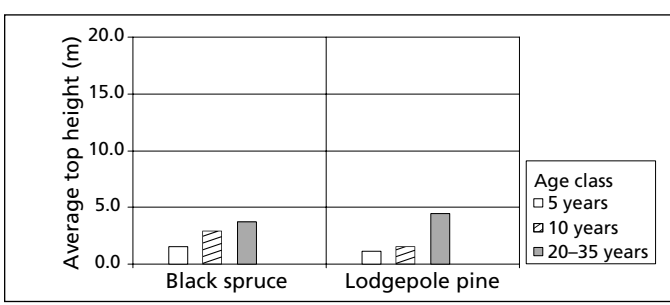
- Average lodgepole pine height is 4–5 m; average black spruce height is 3–5 m. Lodgepole pine occurs in the tree layer with low cover.
- Average shrub cover has declined significantly from the 5-year age class value; this may be partly a consequence of plot location.
- Hair-cap mosses and feathermosses are common.

Age class 35+ years (0 sample plots)

- There are no data upon which to base a discussion of trends.
- By age 40–50 years, managed-stand h ecosites are expected to resemble natural-stand h ecosites described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).



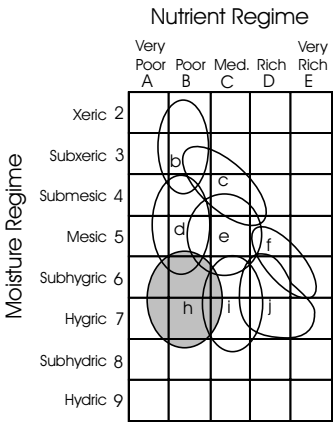
Cover trends by age class and species group, Upper Foothills ecosite h
[a]Note: No data for age class 35+. See comment in vegetation summary table.



Average top height by age class, Upper Foothills ecosite h

UF h

n = 15



Site Characteristics

Moisture–Nutrient Regime: subhygric–poor[4], hygric–poor[3], hygric–medium[2], subhydric–poor[1]
Topographic Position: middle[3], lower[4], toe[2], level[1]
Aspect [Slope class %]: level [0–2][6], all directions [2–5][4]

Soil Characteristics

Effective Texture: SiC[3], SiCL[4], SCL[1], CL[1], SL[1]
Drainage: imperfect[7], poor[2], very poor[1]

Organic Thickness (Average [SE], cm):

5 years:	11 [4]
10 years:	8 [1]
20–35 years:	10 [3]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[5], (11–25)[2], (26–50)[3]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	4 [0.35]
10 years:	9 [0.33]
20–35 years:	5 [0.16]
35+ years:	no data

Site Treatments

Post-1990:	no data[4], no prep.[3], Bracke scalp[1], excavator mounder[1], chain drag[1]
Pre-1990:	no data[8], no prep.[2]

Common Conifer Conditions

5 years:	winter damage (spruce)
10 years:	no significant conditions
20–35 years:	no significant conditions
35+ years:	no data

Summary: Vegetation data, ecosite h, Upper Foothills Subregion

UF

		Age class (number of plots)											
		5 years (n = 4)			10 years (n = 7)[a]			20–35 years (n = 4)			35+ years (n =0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	6	[1.9]	75	No data		
Shrub (<5 m)	Common Labrador tea (*Ledum groenlandicum*)	29	[14.4]	100	20	[10.6]	71	5	[1.9]	100			
	Common blueberry (*Vaccinium myrtilloides*)	8	[3.0]	100	–	–	–	–	–	–			
	Black spruce (*Picea mariana*)	–	–	–	2	[1.2]	71	–	–	–			
	Bog cranberry (*Vaccinium vitis-idaea*)	–	–	–	7	[5.1]	86	–	–	–			
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	5	[2.8]	71	–	–	–			
	Twin-flower (*Linnaea borealis*)	–	–	–	3	[1.4]	71	–	–	–			
Forb	No species occurring in >50% of plots	–	–	–	–	–	–	–	–	–			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	4	[1.2]	100	4	[1.9]	86	9	[4.8]	100			
Nonvascular	Common hair-cap (*Polytrichum commune*)	9	[3.6]	100	–	–	–	–	–	–			
	Juniper hair-cap (*Polytrichum juniperinum*)	–	–	–	–	–	–	8	[4.3]	100			
	Schreber's moss (*Pleurozium schreberi*)	–	–	–	8	[6.2]	86	3	[1.2]	100			

Tree height data (m)[b]	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)	1.1	[0.3]	7	1.5	[0.2]	22	4.4	[0.5]	13	No data		
Black spruce (*Picea mariana*)	1.6	[0.7]	9	2.9	[0.5]	4	3.8	[1.0]	6	No data		

[a]Plot sampling for age class 10 was undertaken in areas geographically separated from those for age classes 5 and 20–35. This is probably the reason for the occurrence of some species in age class 10 that are not present in the other age classes.
[b]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

i	n = 22

The Upper Foothills i ecosite occurs on middle to lower slope positions, in level areas, and in depressions. Soils are typically fine-textured and imperfectly to very poorly drained; mottling is common in the upper 10–25 cm. These sites are typically hygric and have a medium nutrient status. Cold, wet soils probably contribute to relatively slow average height growth for lodgepole pine.

Age class 5 years (14 sample plots)

- Average lodgepole pine height is 0.5–1 m, with very low cover of pine in the tree layer (1%).
- Total average shrub cover is less than 10%.
- Forb cover averages 5–10%.
- Marsh reed grass cover averages 5–10%, with higher values on some sites.
- Hair-cap mosses and poor-fen sphagnum occur with 10–20% average cover.

Age class 10 years (4 sample plots)

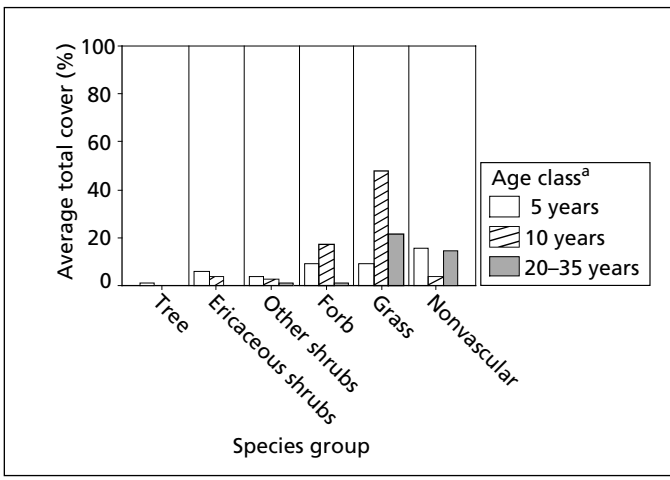
- Average lodgepole pine height is about 1.5 m, with very low cover of pine, black spruce, and white spruce in the shrub layer.
- Average forb and shrub cover is similar to that of the 5-year age class. See comment at bottom of vegetation summary table.
- Marsh reed grass cover is generally less than 20% but can exceed 60% on some sites.

Age class 20–35 years (4 sample plots)

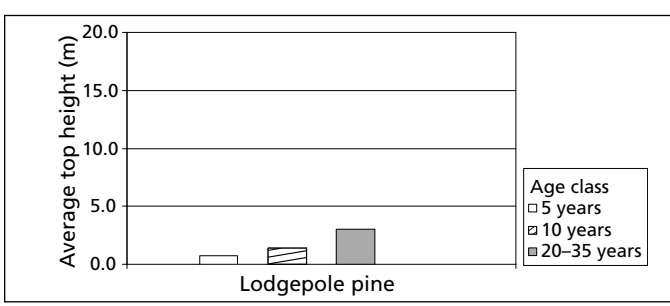
- Average lodgepole pine height is 2.5–3.5 m (sample size was only 4 trees).
- See comment at bottom of vegetation summary table.

Age class 35+ years (0 sample plots)

- There are no data upon which to base a discussion of cover or tree growth trends.
- Succession toward the natural i site vegetation is likely to be slow and may proceed toward the poor or rich fen (l or m ecosite) if the water table rises significantly.



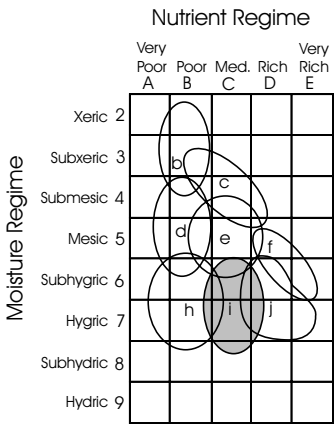
Cover trends by age class and species group, Upper Foothills ecosite i
[a]Note: No data for age class 35+. See comment in vegetation summary table.



Average top height by age class, Upper Foothills ecosite i

UF i

n = 22



Site Characteristics

Moisture–Nutrient Regime: subhygric–medium[4], hygric–medium[5], hygric–rich[1]

Topographic Position: middle[2], toe[2], level[3], depression[3]

Aspect [Slope class %]: level [0–2][6], all directions [2–5][3], all directions [6–9][1]

Soil Characteristics

Effective Texture: SiC[3], SiCL[2], CL[2], SC[3]

Drainage: mod. well[1], imperfect[4], poor[4], very poor[1]

Organic Thickness (Average [SE], cm):

5 years:	13 [2]
10 years:	8 [1]
20–35 years:	23 [7]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[4], (11–25)[2], (26–50)[1], (>80)[3]

Potentially Competitive Species

marsh reed grass

Species Diversity

(species richness [dominance index])

5 years:	15 [0.37]
10 years:	12 [0.36]
20–35 years:	5 [0.39]
35+ years:	no data

Site Treatments

Post-1990:	no data[2], Donaren mounder[2], Bracke scalp[1], chain drag[1], ripper plow[1], no prep.[1], excavator mounder[2]
Pre-1990:	no data[5], Donaren mounder[3], ripper plow[2]

Common Conifer Conditions

5 years:	no significant conditions
10 years:	no significant conditions
20–35 years:	no significant conditions
35+ years:	no data

Summary: Vegetation data, ecosite i, Upper Foothills Subregion[a]

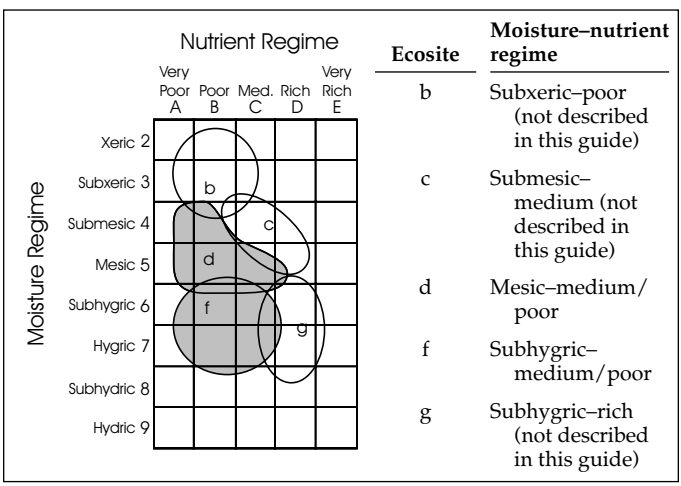
UF

		Age class (number of plots)											
		5 years (n = 14)			10 years (n = 4)			20–35 years (n = 4)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.4]	64	–	–	–	–	–	–	No data		
Shrub (<5 m)	Common Labrador tea (*Ledum groenlandicum*)	5	[2.2]	93	4	[2.2]	75	–	–	–			
	Twin-flower (*Linnaea borealis*)	3	[1.1]	86	–	–	–	–	–	–			
	Bog cranberry (*Vaccinium vitis-idaea*)	1	[0.7]	86	–	–	–	–	–	–			
	Wild red raspberry (*Rubus idaeus*)	1	[0.2]	71	–	–	–	–	–	–			
	Prickly rose (*Rosa acicularis*)	1	[0.2]	64	–	–	–	–	–	–			
	Bracted honeysuckle (*Lonicera involucrata*)	–	–	–	3	[1.8]	75	1	[0.4]	75			
Forb	Common fireweed (*Epilobium angustifolium*)	2	[0.4]	93	4	[1.8]	100	–	–	–			
	Bunchberry (*Cornus canadensis*)	2	[0.5]	93	–	–	–	–	–	–			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	2	[0.5]	79	–	–	–	–	–	–			
	Woodland horsetail (*Equisetum sylvaticum*)	3	[1.4]	64	–	–	–	–	–	–			
	Tall lungwort (*Mertensia paniculata*)	1	[0.2]	64	2	[1.1]	75	1	[0.4]	100			
	Bishop's-cap (*Mitella nuda*)	–	–	–	3	[1.7]	75	–	–	–			
	Lindley's aster (*Aster ciliolatus*)	–	–	–	3	[1.8]	75	–	–	–			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	9	[4.0]	93	24	[18.9]	75	22	[9.8]	100			
	Hairy wild rye (*Leymus innovatus*)	–	–	–	16	[13.1]	75	–	–	–			
Nonvascular	Common hair-cap (*Polytrichum commune*)	7	[3.7]	71	–	–	–	–	–	–			
	Schreber's moss (*Pleurozium schreberi*)	1	[0.6]	71	–	–	–	–	–	–			
	Poor-fen sphagnum (*Sphagnum angustifolium*)	7	[3.1]	64	–	–	–	–	–	–			
	Golden moss (*Tomenthypnum nitens*)	–	–	–	–	–	–	6	[4.7]	75			
Tree height data (m)[b]		Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)		0.7	[0.1]	42	1.4	[0.1]	12	3.1	[0.3]	4	No data		

[a]Plot sampling for age class 5 was undertaken across the whole area of applicability, plot sampling for age class 10 was undertaken primarily in the Grande Cache area, and plot sampling for age class 20–35 occurred in the Weldwood area. Differences in plant community development may be partly due to location.
[b]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

8.0 MANAGED FOREST ECOSITE – AGE CLASS SUMMARIES: SUBALPINE SUBREGION

Two Subalpine ecosites associated with managed forests less than about 40 years old are described in this section. The classification key provides a general framework for determining the moisture and nutrient regime and assigning the ecosite, as indicated by relative position on an edatopic grid (Figure 8). This framework is based on site and soil characteristics, observable remnants of preharvest stands, and early successional vegetation. Guidelines that might assist in estimating relative block age are given in Section 4.0 of this field guide, and the first two pages of each ecosite summary outline the major trends in each age class in written and graphic formats. Section 5.0 of this field guide explains the site and vegetation summary tables that are provided on the third and fourth pages of each ecosite summary. Figure 9, which follows the classification key, compares lodgepole pine top height by age class and ecosite within the subregion.



Ecosite	Moisture–nutrient regime
b	Subxeric–poor (not described in this guide)
c	Submesic–medium (not described in this guide)
d	Mesic–medium/poor
f	Subhygric–medium/poor
g	Subhygric–rich (not described in this guide)

Figure 8. Edatopic grid for forested ecosites in the Subalpine Natural Subregion. Described ecosites are shaded.

8.1 Site-based key to managed forest ecosites of the Subalpine Subregion

1a Xeric to subxeric, generally nutrient-poor sites on moderate to extreme slopes with southerly and westerly aspects on crest to middle slope positions, or on level areas with coarse-textured soils; soils rapidly to well drained; slopes often convex and shedding moisture; common bearberry and hairy wild rye common.

1a1 Common bearberry dominant; steep, exposed slopes ..... **Ecosite b**
(not described in this field guide)

1a2 Hairy wild rye dominant ..... **Ecosite c**
(not described in this field guide)

1b Sites submesic or moister ..... **Key lead 2a**

2a Submesic to mesic sites, typically on upper to middle slopes with fine- to medium-textured soils, well to moderately well drained; common Labrador tea, bog cranberry, lodgepole pine common in shrub layer; good natural lodgepole pine regeneration and good stand development, often with abundant feathermosses, in older (>30 year) blocks ..... **Ecosite d**

2b Subhygric to hygric sites, usually on level to gentle slopes; soils usually fine-textured, with distinct to prominent mottling common in upper 25 cm of soil profile, moderately well to poorly drained; marsh reed grass common and locally abundant ..... **Ecosite f**

2c Sites receiving significant nutrient inputs as evidenced by plant species, tree growth (large stump size, large trees in adjacent stands), and site position (seepage channels, fluvial influences); marsh reed grass common and locally abundant; willows, tall lungwort, and tufted moss occur ..... **Ecosite g**
(not described in this field guide)

Figure 9. Average top height of lodgepole pine by ecosite and age class, Subalpine Natural Subregion.

d	n = 37

The Subalpine d ecosite is the modal site for this subregion. It occurs on all slope positions and aspects; moderate to very strong slopes are typical. Soils are fine- to medium-textured and well to moderately well drained. The d ecosites are moderately moist, and nutrient status ranges from medium to poor. Initial lodgepole pine height growth is comparable to that of the Upper Foothills e site; however, growth rates appear to slow relative to Upper Foothills e sites beyond about 30 years. This could be attributed to the shorter growing seasons in the Subalpine Subregion.

AGE CLASS 5 YEARS (7 SAMPLE PLOTS)

- Average lodgepole pine height is 0.7–1.0 m; pine occurs with very low cover in the shrub layer.
- Common Labrador tea and bog cranberry are the most common shrubs; shrub cover averages 15–20%.
- Average forb and grass cover is very low.

AGE CLASS 10 YEARS (14 SAMPLE PLOTS)

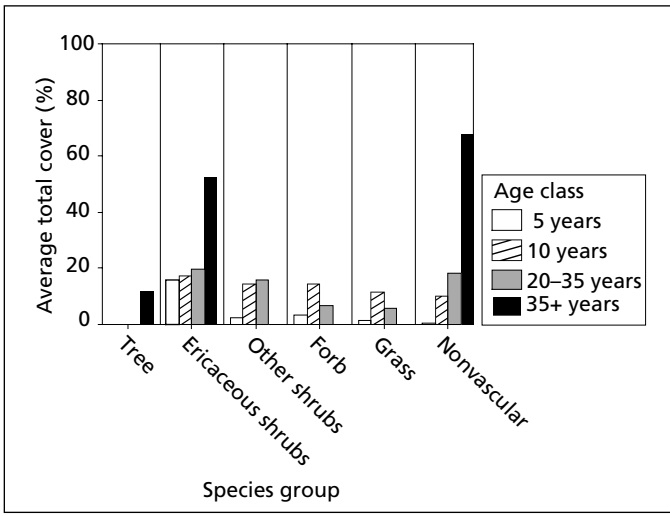
- Average lodgepole pine height is 1.5–2 m, and pine cover in the shrub layer is 10–15%.
- Common Labrador tea and bog cranberry are the most common shrubs; cover of ericaceous shrubs remains at an average of 15–20%.
- Common fireweed and marsh reed grass cover together average 15–25%.

AGE CLASS 20–35 YEARS (13 SAMPLE PLOTS)

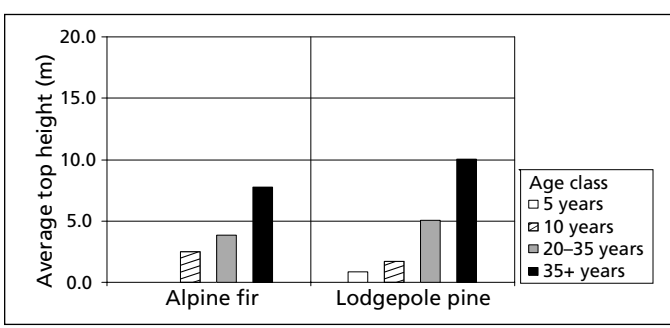
- Average lodgepole pine height is about 5 m, and pine cover in the shrub layer is 10–15%.
- Common Labrador tea and bog cranberry are the most common shrubs; cover of ericaceous shrubs remains at an average of 15–20%.
- Common fireweed and marsh reed grass cover together average 5–15%.
- Feathermoss cover averages 5–15%.

AGE CLASS 35+ YEARS (3 SAMPLE PLOTS)

- Average lodgepole pine height is 10–10.5 m; the pine shrub component has now grown into the tree layer.
- Common Labrador tea and bog cranberry remain the most common shrubs; cover of ericaceous shrubs is 40–50%.
- Forbs and grasses are present, with very low cover.
- Feathermoss cover averages 60–70%.
- Managed-stand d ecosites that have reached 30–40 years are similar to those described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).



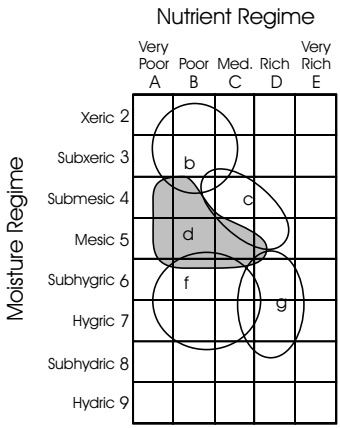
Cover trends by age class and species group, Subalpine ecosite d



Average top height by age class, Subalpine ecosite d

SA d

n = 37



Site Characteristics

Moisture–Nutrient Regime: mesic–medium[4], mesic–poor[4], submesic–poor[2]
Topographic Position: upper[4], middle[4], lower[2]
Aspect [Slope class %]: level [0–2][1], north [6–9][1], west [6–9][1], north [10–15][1], west [10–15][1], all directions [16–45][5]

Soil Characteristics

Effective Texture: C[1], SiC[1], SiCL[3], CL[1], L[1], SiL[3]
Drainage: rapid[1], well[6], mod. well[3]

Organic Thickness (Average [SE], cm):

5 years:	7 [1]
10 years:	7 [1]
20–35 years:	6 [1]
35+ years:	11 [2]

Depth to Mottles (range, cm):
(51–79)[1], (>80)[9]

Potentially Competitive Species

none

Species Diversity

(species richness [dominance index])

5 years:	8 [0.43]
10 years:	18 [0.48]
20–35 years:	18 [0.48]
35+ years:	7 [0.34]

Site Treatments

Post-1990:	no data[5], no prep.[5]
Pre-1990:	no data[5], no prep.[5]

Common Conifer Conditions

5 years:	no data
10 years:	no data
20–35 years:	no data
35+ years:	no data

Summary: Vegetation data, ecosite d, Subalpine Subregion

SA

Layer	Common (scientific) name	Age class (number of plots)											
		5 years (n = 7)			10 years (n = 14)			20–35 years (n = 13)			35+ years (n = 3)		
		Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	–	–	–	–	–	–	–	–	–	12	[9.3]	67
Shrub (<5 m)	Common Labrador tea (*Ledum groenlandicum*)	12	[7.2]	86	11	[4.4]	79	15	[5.7]	85	37	[3.3]	100
	Bog cranberry (*Vaccinium vitis-idaea*)	4	[2.7]	100	5	[2.2]	100	2	[1.0]	85	9	[5.7]	100
	Lodgepole pine (*Pinus contorta* var. *latifolia*)	2	[0.6]	100	11	[2.5]	100	10	[3.0]	100	–	–	–
	Twin-flower (*Linnaea borealis*)	1	[0.3]	71	3	[0.9]	93	2	[1.5]	85	–	–	–
	Tall bilberry (*Vaccinium membranaceum*)	–	–	–	1	[0.3]	100	1	[0.2]	62	–	–	–
Forb	Common fireweed (*Epilobium angustifolium*)	2	[1.0]	71	10	[3.1]	100	5	[2.1]	100	–	–	–
	Bunchberry (*Cornus canadensis*)	1	[0.3]	86	2	[0.7]	100	2	[0.5]	100	–	–	–
Grass	Marsh reed grass (*Calamagrostis canadensis*)	1	[0.5]	100	11	[3.4]	86	6	[3.0]	85	–	–	–
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	1	[0.3]	71	1	[0.2]	93	14	[5.9]	92	46	[12.7]	100
	Juniper hair-cap (*Polytrichum juniperinum*)	–	–	–	7	[5.0]	79	2	[1.1]	85	–	–	–
	Knight's plume moss (*Ptilium crista-castrensis*)	–	–	–	–	–	–	1	[0.4]	77	7	[6.4]	100
	Stair-step moss (*Hylocomium splendens*)	–	–	–	–	–	–	–	–	–	15	[2.9]	100
Tree height data (m)[a]		Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N	Average ht	[SE]	N
Lodgepole pine (*Pinus contorta* var. *latifolia*)		0.8	[0.1]	26	1.7	[0.1]	52	5.1	[0.2]	39	10.1	[0.2]	6
Subalpine fir (*Abies bifolia*)		Insufficient data			2.5	[0.4]	4	3.8	[0.3]	14	7.7	[1.3]	5

[a]N = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

f

n = 7

The Subalpine f ecosite occurs on all slope positions and aspects; moderate to strong slopes are typical. Soils are fine- to medium-textured and moderately well to poorly drained. The f ecosites are moist to very moist, and medium to poor nutrient status was observed at sample plots.

Age class 5 years (3 sample plots)

- Lodgepole pine height averages about 1 m; it occurs with very low cover (1%) in the shrub layer.
- Forbs occur with low cover; marsh reed grass cover is highly variable and can exceed 60% on some sites.

Age class 10 years (0 sample plots)

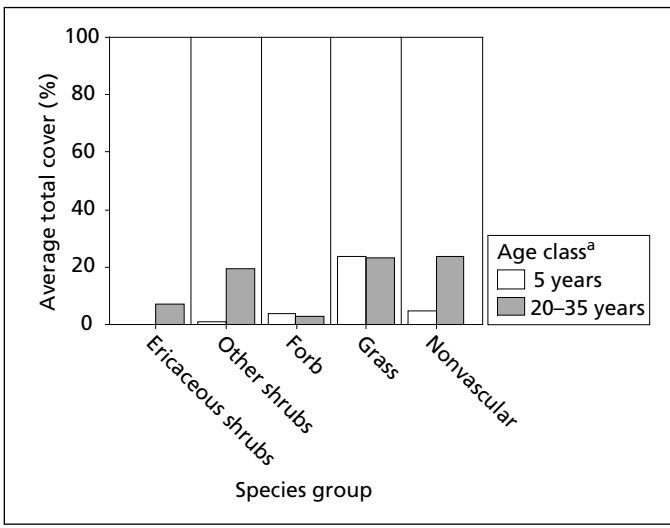
- There are no data upon which to base a discussion of trends.
- Vegetation is probably similar to that reported for the 5-year age class.

Age class 20–35 years (4 sample plots)

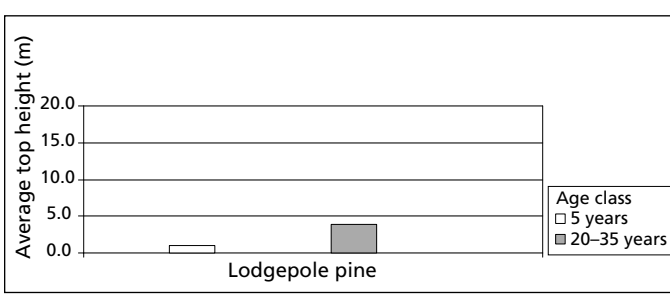
- Lodgepole pine height averages 3.5–4.5 m; it occurs with low cover (5–10%) in the shrub layer.
- Black spruce, bog cranberry, and dwarf birch occur with low cover in the shrub layer.
- Marsh reed grass cover is highly variable and can exceed 60% on some sites.
- Feathermosses, hair-cap mosses, and tufted moss occur with 15–25% cover.

Age class 35+ years (0 sample plots)

- There are no data upon which to base a discussion of trends.
- It is likely that at about 40 years, lodgepole pine grows into the tree layer, and the understory develops species composition and structure characteristic of natural-stand f ecosites, as described in the *Field guide to ecosites of west-central Alberta* (Beckingham et al. 1996).



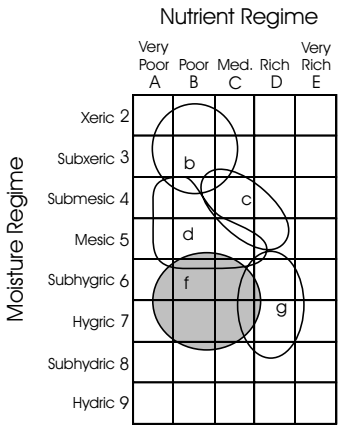
Cover trends by age class and species group, Subalpine ecosite f
[a]Note: No data for age classes 10 and 35+.



Average top height by age class, Subalpine ecosite f

SA f

n = 7



Site Characteristics

Moisture–Nutrient Regime: mesic–poor[4], subhygric–poor[4], subhygric–medium[1], hygric–medium[1]
Topographic Position: upper[3], lower[3], toe[1], level[3]
Aspect [Slope class %]: level [0–2][3], east [2–5][4], south [2–5][2], north [16–30][1]

Soil Characteristics

Effective Texture: C[1], SiC[3], SiCL[3], CL[1], SiL[2]
Drainage: well[1], mod. well[4], imperfect[3], poor[2]

Organic Thickness (Average [SE], cm):

5 years:	9 [2]
10 years:	no data
20–35 years:	9 [1]
35+ years:	no data

Depth to Mottles (range, cm):
(0–10)[4], (26–50)[2], (>80)[4]

Potentially Competitive Species

marsh reed grass

Species Diversity

(species richness [dominance index])

5 years:	6 [0.54]
10 years:	no data
20–35 years:	17 [0.38]
35+ years:	no data

Site Treatments

Post-1990:	no data[7], no prep.[3]
Pre-1990:	no prep.[10]

Common Conifer Conditions

5 years:	no data
10 years:	no data
20–35 years:	no data
35+ years:	no data

Summary: Vegetation data, ecosite f, Subalpine Subregion

SA

		Age class (number of plots)											
		5 years (n = 3)			10 years (n = 0)			20–35 years (n = 4)			35+ years (n = 0)		
Layer	Common (scientific) name	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots	Average cover %	[SE]	% of plots
Tree (>5 m)	None	–	–	–	No data			–	–	–	No data		
Shrub (<5 m)	Lodgepole pine (*Pinus contorta* var. *latifolia*)	1	[0.4]	100				8	[4.4]	100			
	Black spruce (*Picea mariana*)	–	–	–				1	[0.7]	75			
	Bog cranberry (*Vaccinium vitis-idaea*)	–	–	–				1	[0.4]	75			
	Dwarf birch (*Betula glandulosa*)	–	–	–				2	[0.8]	75			
Forb	Common fireweed (*Epilobium angustifolium*)	2	[0.7]	100				3	[1.2]	100			
	Palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*)	2	[1.6]	67				–	–	–			
Grass	Marsh reed grass (*Calamagrostis canadensis*)	24	[20.8]	100				22	[16.1]	100			
	Small-flowered wood rush (*Luzula parviflora*)	–	–	–				1	[0.9]	75			
Nonvascular	Schreber's moss (*Pleurozium schreberi*)	1	[0.8]	100				6	[4.8]	100			
	Juniper hair-cap (*Polytrichum juniperinum*)	4	[3.3]	67				7	[6.0]	50			
	Tufted moss (*Aulacomnium palustre*)	–	–	–				6	[4.7]	75			
	Studded leather lichen (*Peltigera aphthosa*)	–	–	–				1	[0.6]	100			
	Stair-step moss (*Hylocomium splendens*)	–	–	–				1	[0.4]	75			
Tree height data (m)[a]		Average ht	[SE]	*N*	Average ht	[SE]	*N*	Average ht	[SE]	*N*	Average ht	[SE]	*N*
Lodgepole pine (*Pinus contorta* var. *latifolia*)		1	[0.2]	12	No data			3.9	[0.4]	12	No data		

[a]*N* = number of sample trees. Note: SE = standard error of the mean (square root of variance divided by sample size).
Dashes indicate there were no field plot samples on which to base an assessment.

9.0 BIODIVERSITY MEASURES: SPECIES RICHNESS AND DOMINANCE CONCENTRATION

Species richness and dominance concentration are explained in Section 3.2.4. Bar charts indicating species richness and dominance concentration for each subregion and sampled ecosite – age class combination are presented in Figures 10–12. Several general trends are evident from the bar charts.

9.1 Lower Foothills Natural Subregion

- Species richness is generally higher than in the Upper Foothills or Subalpine subregions, with between 15 and 25 vascular and nonvascular species occurring in many ecosite – age class groups. Overall species richness is greatest on the wetter, richer f, i, and j ecosites.
- Higher dominance concentration values (greater than about 0.35), indicating a higher relative abundance of a few species, are due to a variety of factors:
  - high cover of lodgepole pine, common bearberry, bog cranberry, and hairy wild rye on c ecosites
  - high cover of common Labrador tea on d and h ecosites in the 20–35 year age class
  - high cover of marsh reed grass on f, i, and j ecosites in all sampled age classes.

9.2 Upper Foothills Natural Subregion

- Between 7 and 15 vascular and nonvascular species occur in many ecosite – age class groups. Vascular plant species richness is greatest on e and f ecosites. Very low species richness in age class 10 within the d ecosite may be an artifact of sampling distribution (see comment on vegetation summary sheet). Low species richness in age class 5 within the c ecosite may be partly due to dry site conditions on exposed mineral soils.
- Higher dominance concentration values (greater than about 0.35), indicating a higher relative abundance of a few species, are due to two main factors:
  - high cover of common Labrador tea, lodgepole pine, and various mosses on d ecosites in the 20–35 year age class and h ecosites in the 5- and 10-year age classes

- high cover of marsh reed grass on e and f ecosites in the 10-year age class and i ecosites in the 10-year and 20–35 year age classes.

9.3 Subalpine Natural Subregion

- Species diversity is comparable to that of the Upper Foothills Subregion.
- Higher dominance concentration values (greater than about 0.35), indicating a higher relative abundance of a few species, are due to two main factors:
  - high cover of common Labrador tea, lodgepole pine, and various mosses on d ecosites in all age classes
  - high cover of marsh reed grass and mosses on f ecosites in all sampled age classes.

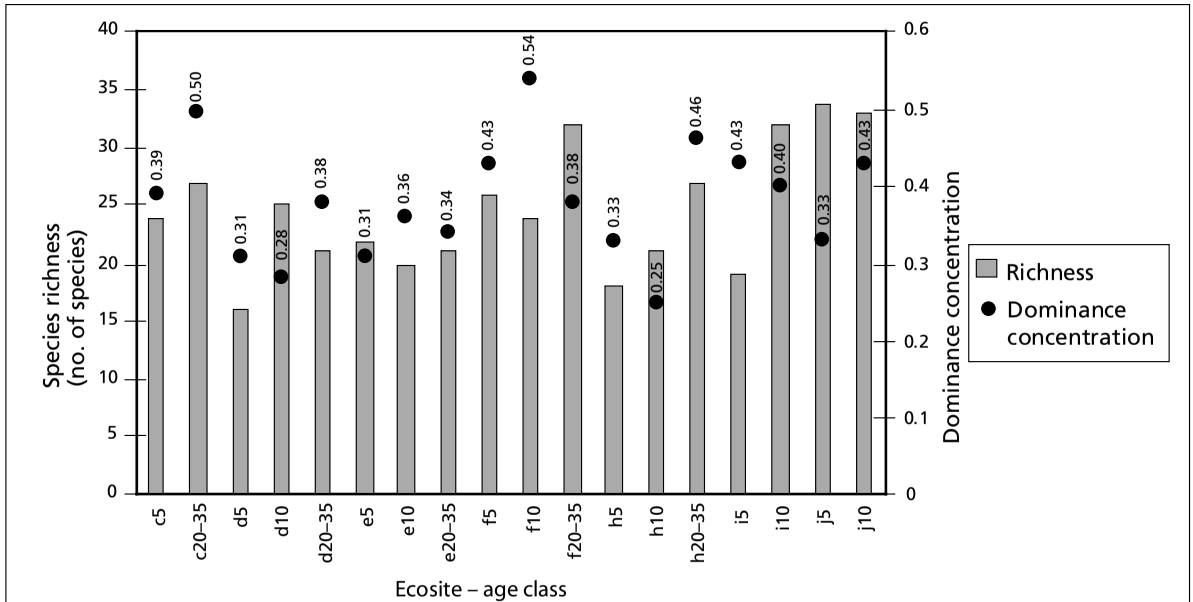


Figure 10. Plant species diversity summary for Lower Foothills Natural Subregion. For each bar label, the lower case letter indicates the ecosite and the number (or numbers) represent the age class. Note: there were insufficient plots in some ecosite – age classes for biodiversity measurements.

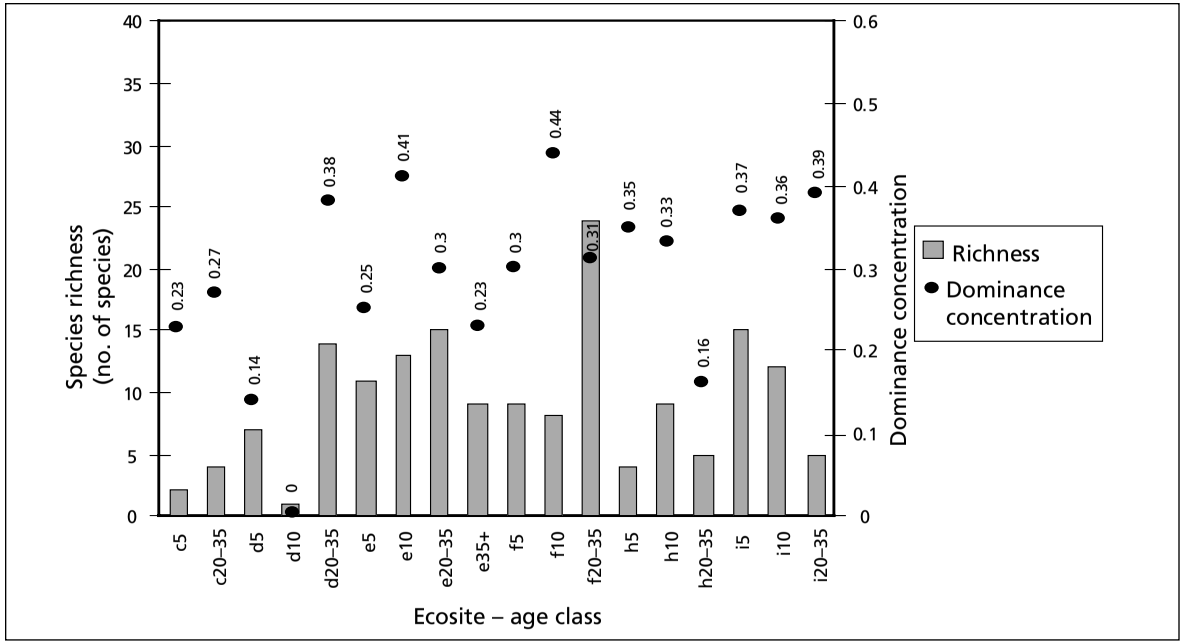


Figure 11. Plant species diversity summary for Upper Foothills Natural Subregion. For each bar label, the lower case letter indicates the ecosite and the number (or numbers) represent the age class. Note: there were insufficient plots in some ecosite – age classes for biodiversity measurements.

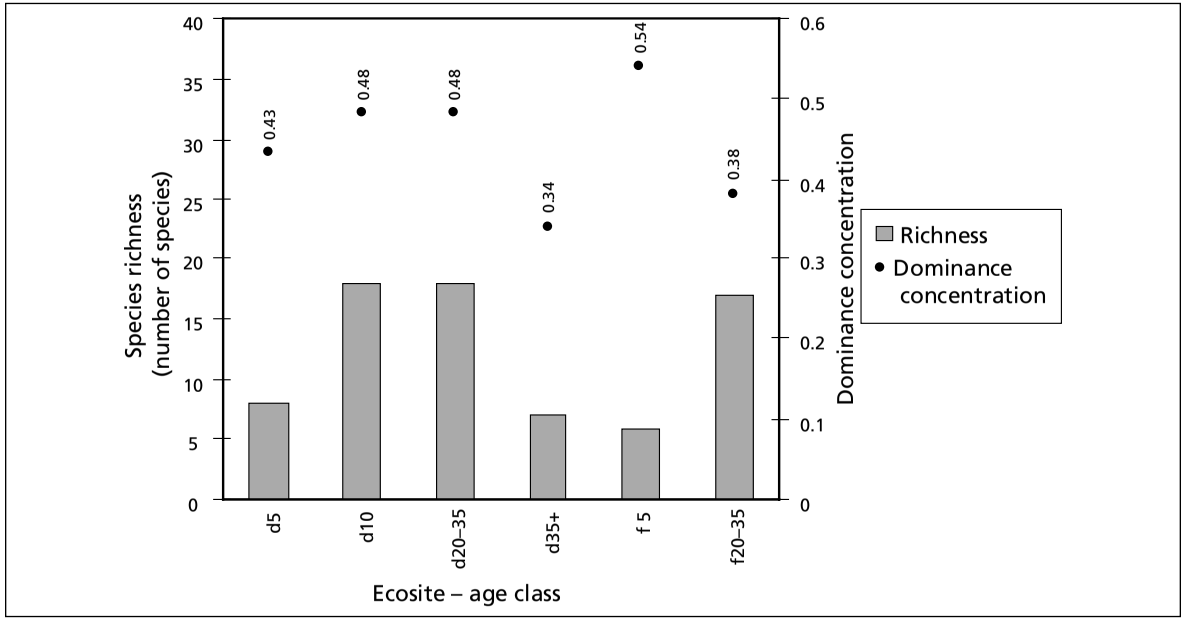


Figure 12. Plant species diversity summary for Subalpine Natural Subregion. For each bar label, the lower case letter indicates the ecosite and the number (or numbers) represent the age class. Note: there were insufficient plots in some ecosite – age classes for biodiversity measurements.

10.0 SUMMARY OF FOREST HEALTH DATA

Tables 5–17 summarize information on various disease, insect, and damage agents and their symptoms observed on certain tree species within Upper and Lower Foothills Natural Subregion ecosite – age class types. The sample size is the number of trees that were sampled for all plots in an ecosite – age class type. Overall tree health is presented as the percentage of trees recorded as healthy. For each agent, the number in each cell is a percentage (rounded to the nearest whole number) indicating the proportion of sampled trees that were affected. The percent values for a given tree species in an ecosite – age class may sum to more than 100, because some sampled trees had more than one condition. All agents with values of >0.5% in one or more cells for a given tree species are reported.

Damaging agents were recorded on the basis of evident external signs and symptoms. For some agents, such as stem decays, external indicators are not always present, and these were likely underrepresented in this survey. The occurrence of agents with a known high potential for damage causing significant annual losses, either through stem mortality or volume loss, are shaded in gray.

Foliar disease (including frost damage) and insect-caused defoliation were the most commonly reported types of damage across regions, site types, and tree species. Impacts from these types of damage are usually minimal, though repeated years of defoliation will eventually affect tree vigor and growth.

Armillaria root disease (ARD) appeared to be the primary cause of tree mortality in both the Upper and Lower Foothills Subregions, with 36% of all recent (within 1 year) tree deaths attributed to this disease. Although ARD does occur in both subregions, it was encountered more frequently in the Lower Foothills. Moderately dry to moderately moist site types (ecosites c, d, and e) in both subregions had the highest incidence of ARD-caused mortality, with the disease rarely being reported on moist to wet site types (ecosites f, h, i, and j) in both subregions. Because only mortality from ARD was recorded, the actual incidence and impact of the disease on sites where it occurs would be higher than is evident from the data.

Human damage reported in these tables was primarily a result of stand-tending activities.

The following subregional and species-specific trends are evident from the tabular information.

Lower Foothills Natural Subregion, trembling aspen

- Leaf and twig blights were the most common damage agents.
- Mortality could not be attributed to any one agent (human stand-tending activities excepted).
- Insect-caused defoliation was prevalent.
- Hypoxylon canker caused some mortality, especially within e ecosites, age classes 20–35 and 35+.
- Some mortality was due to ARD on drier ecosites (ecosites c, d, and e).

Lower Foothills Natural Subregion, lodgepole pine

- ARD was the leading cause of mortality, accounting for over 50% of all recent lodgepole pine mortality.
- Needle casts and other foliar diseases were prevalent in the 20–35 year age class across site types, and close to 50% of trees in this age class were affected.
- Western gall rust occurred at low but steady levels across most ecosites and occurred on 15–20% of trees in age class 35+.
- Pitch blister moth had an incidence of about 10% on many ecosites in the 10-year age class, but not in other age classes.

Lower Foothills Natural Subregion, white spruce

- ARD was found on ecosite e only but accounted for almost all (>80%) of observed white spruce mortality. See also previous comments on ARD.
- A high incidence of frost damage was reported, especially on younger trees in the 5- and 10-year age classes.

Upper Foothills Natural Subregion, trembling aspen

- Leaf and twig blights were the most common damage agents.
- Mortality could not be attributed to any one agent (human stand-tending activities excepted).
- Almost no insect-caused defoliation was observed.
- Hypoxylon canker was not encountered, and ARD was rarely encountered.

Upper Foothills Natural Subregion, lodgepole pine

- ARD was the leading cause of mortality, accounting for over 50% of all recent lodgepole pine mortality.
- Needle casts and other foliar diseases occurred at much lower levels than in the Lower Foothills Subregion, with the exception of ecosite type c, where over 50% of trees in the 20–35 year age class were affected.
- Levels of Western gall rust reached up to 50% on c, d, and e ecosites by age class 35+, but were less than 15% on ecosites f, h, and i.
- *Atropellis* canker had a significant impact on tree health on Upper Foothills e ecosites in the 20–35 year age class, as it occurred with 25% cover, but it was not found at high levels on any other site type.
- Incidence of pitch blister moth was low.

Upper Foothills Natural Subregion, white spruce

- ARD was found mainly on ecosites c, d, and e and accounted for about 45% of white spruce mortality.
- Although there was less frost damage reported for white spruce in the Upper Foothills than in the Lower Foothills, harsher winter conditions adversely affected tree health.

Table 5. Summary of disease, insect, and damage agents affecting trembling aspen, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																					
Agent[b]	c5	c10	c20–35	c35+	d5	d10	d20–35	d35+	e5	e10	e20–35	e35+	f5	f10	f20–35	h5	h10	h20–35	h35+	i10	j5	j10
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1
Sample size	333	221	271	188	161	387	90	313	508	284	1227	109	454	438	54	58	57	128	35	8	12	10
Trees recorded as healthy (%)	100	100	92	81	100	97	97	90	99	100	85	38	91	99	91	97	96	92	71	100	100	100
Leaf and twig blight	53	6	61	25	79	9	18	45	48	15	15	21	4	8	30	5	2	15	11	0	50	10
Insect defoliators	46	0	45	0	55	10	38	0	16	10	49	0	6	0	46	19	2	18	0	0	67	0
Other crown or apex damage	4	3	16	22	2	8	4	15	8	9	10	19	11	1	19	5	0	9	23	0	0	0
Browse	10	0	0	5	0	1	0	0	2	10	2	0	29	1	7	5	14	11	6	13	0	10
Other stem deformity/damage	0	0	1	10	0	0	0	4	0	0	14	0	0	0	0	2	0	1	11	13	0	0
Insect galls (branch or stem)	1	11	0	1	2	6	1	2	2	4	0	1	12	0	0	9	0	2	0	0	0	0
Human damage	0	0	0	0	0	0	0	0	0	0	2	55	0	0	2	0	0	1	0	0	0	0
Other bark damage	0	0	3	1	0	1	1	0	0	0	4	0	3	0	0	0	2	0	3	0	0	0
Hypoxylon canker	0	0	1	0	0	0	0	0	0	0	4	2	0	0	2	0	0	0	0	0	0	0
Stem decays	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Other stem cankers or galls	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	1	0	0	0	0
Armillaria root disease[c]	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Other foliar insects	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	2	1	0	0	0	10
Aphids	0	0	1	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0
Other foliar damage or symptoms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	0
Hail damage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 6. Summary of disease, insect, and damage agents affecting white birch, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																						
Agent[b]	c5	c10	c20–35	c35+	d5	d10	d20–35	d35+	e5	e10	e20–35	e35+	f5	f10	f20–35	h5	h10	h20–35	h35+	i10	j5	j10	
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1	
Sample size	0	3	0	0	0	2	0	0	0	53	37	0	6	68	276	241	243	64	0	0	0	0	
Trees recorded as healthy (%)	–[c]	100	–	–	–	100	–	–	–	100	95	–	100	100	93	99	98	58	–	–	–	–	
Insect defoliators	–	0	–	–	–	0	–	–	–	0	11	–	83	0	4	93	7	2	–	–	–	–	
Browse	–	0	–	–	–	50	–	–	–	8	11	–	0	3	14	5	6	2	–	–	–	–	
Other crown or apex damage	–	0	–	–	–	0	–	–	–	0	5	–	0	0	7	4	0	42	–	–	–	–	
Human damage	–	0	–	–	–	0	–	–	–	0	0	–	0	0	4	0	0	41	–	–	–	–	
Other foliar damage or symptoms	–	0	–	–	–	0	–	–	–	0	0	–	0	0	1	0	2	0	–	–	–	–	
Other bark damage	–	0	–	–	–	50	–	–	–	0	8	–	0	0	0	0	0	0	–	–	–	–	
Other stem damage	–	0	–	–	–	0	–	–	–	0	3	–	0	0	0	0	0	0	–	–	–	–	
Armillaria root disease[d]	–	0	–	–	–	0	–	–	–	0	3	–	0	0	0	0	0	0	–	–	–	–	

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Dashes indicate no birch were present on sampled sites.
[d]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 7. Summary of disease, insect, and damage agents affecting balsam fir, and subalpine fir, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																						
			c20–35			d20–35				e20–35				f20–35			h20–35						
Agent	c5	c10		c35+	d5	d10		d35+	e5	e10		e35+	f5	f10		h5	h10		h35+	i10	j5	j10	
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1	
Sample size	0	0	0	0	0	1	1	0	0	0	0	3	41	1	58	16	1	13	0	194	0	233	
Trees recorded as healthy (%)	–[b]	–	–	–	–	100	100	–	–	–	–	100	100	100	100	88	100	100	–	98	–	100	
Frost damage	–	–	–	–	–	100	0	–	–	–	–	0	56	0	9	31	0	23	–	86	–	42	
Hail damage	–	–	–	–	–	0	0	–	–	–	–	0	0	0	34	0	0	77	–	0	–	0	
Other stem deformity/damage	–	–	–	–	–	0	0	–	–	–	–	0	7	0	0	0	0	0	–	8	–	2	
Other crown or apex damage	–	–	–	–	–	0	0	–	–	–	–	0	0	0	2	13	0	0	–	3	–	6	
Other bark damage	–	–	–	–	–	0	0	–	–	–	–	0	0	0	0	19	0	0	–	5	–	3	
Aphids	–	–	–	–	–	0	0	–	–	–	–	0	0	0	0	0	0	0	–	0	–	4	
Other foliar damage or symptoms	–	–	–	–	–	0	0	–	–	–	–	0	0	0	0	19	100	0	–	0	–	2	

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Dashes indicate no balsam fir or subalpine fir were present on sampled sites.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 8. Summary of disease, insect, and damage agents affecting balsam poplar, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																					
Agent[b]	c5	c10	c20–35	c35+	d5	d10	d20–35	d35+	e5	e10	e20–35	e35+	f5	f10	f20–35	h5	h10	h20–35	h35+	i10	j5	j10
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1
Sample size	22	0	5	2	41	31	1	0	10	5	202	5	55	82	243	1	9	63	74	1	20	29
Trees recorded as healthy (%)	100	–[c]	100	100	100	100	100	–	100	100	96	60	100	100	98	100	100	100	93	100	100	97
Insect defoliators	64	–	40	0	20	6	0	–	0	0	29	0	7	0	19	0	0	86	0	0	85	0
Leaf and twig blight	23	–	0	0	0	0	0	–	10	0	19	0	2	0	17	0	0	46	0	0	55	0
Browse	9	–	0	0	0	0	0	–	0	0	1	0	2	0	2	0	0	13	4	0	0	0
Other crown and apex damage	0	–	0	0	0	0	0	–	0	0	1	0	9	0	5	0	0	3	1	0	0	0
Other stem cankers and galls	0	–	0	0	0	0	0	–	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Other bark damage	0	–	0	0	0	0	0	–	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Human damage	0	–	0	0	0	0	0	–	0	0	0	40	0	0	1	0	0	0	0	0	0	0
Other stem deformity/damage	0	–	0	0	0	0	0	–	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Frost damage	0	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Aphids	0	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	11	0	0	0	0	0
Armillaria root disease[d]	0	–	0	0	0	0	0	–	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Insect galls (branch or stem)	0	–	0	0	0	0	0	–	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Hail damage	0	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0	2	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Dashes indicate no balsam poplar were present on sampled site.
[d]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 9. Summary of disease, insect, and damage agents affecting lodgepole pine, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																					
			c20–			d20–				e20–				f20–			h20–					
Agent[b]	c5	c10	35	c35+	d5	d10	35	d35+	e5	e10	35	e35+	f5	f10	35	h5	h10	35	h35+	i10	j5	j10
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1
Sample size	431	302	759	75	495	693	602	137	398	725	335	60	48	487	51	105	310	133	26	15	120	18
Trees recorded as healthy (%)	98	95	92	99	100	97	86	91	100	96	93	88	100	99	96	100	100	97	96	100	100	100
Needle casts and other foliar diseases	15	3	68	0	9	6	45	1	0	13	3	0	0	0	43	0	0	45	0	7	13	0
Western gall rust	1	5	14	16	0	9	7	15	1	6	16	17	2	2	10	0	7	6	23	7	0	0
Pitch blister moth	2	4	2	0	1	12	2	1	1	15	2	3	0	7	2	0	3	2	0	0	0	0
Other stem deformity/damage	3	1	1	4	2	1	1	6	5	2	3	5	0	3	6	1	1	6	8	0	3	6
Armillaria root disease[c]	2	5	4	0	0	1	2	0	0	4	1	3	0	1	0	0	0	0	0	0	0	0
Human damage	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other crown or apex damage	1	0	1	0	2	0	1	1	1	0	1	0	0	1	2	1	0	1	0	0	0	0
Browse	0	0	1	0	0	0	0	10	1	1	1	7	0	0	0	0	0	2	4	0	0	0
Hail damage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0	0
Other bark damage	0	0	1	1	0	2	1	0	0	0	3	2	0	0	2	0	0	0	4	0	0	0
Aphids	0	0	0	0	0	0	0	0	1	0	0	0	2	5	0	0	2	0	0	0	0	0
Blister rusts	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Warren root collar weevil[c]	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0
Atropellis canker of pine	0	0	0	0	0	0	1	0	0	0	2	0	0	0	4	0	0	1	0	0	0	0
Other foliar damage or symptoms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	2	11
Frost damage	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Warren root collar weevil and Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to these agents; their actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 10. Summary of disease, insect, and damage agents affecting black spruce, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																						
Agent[b]	c5	c10	c20–35	c35+	d5	d10	d20–35	d35+	e5	e10	e20–35	e35+	f5	f10	f20–35	h5	h10	h20–35	h35+	i10	j5	j10
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1
Sample size	0	8	1	15	20	43	47	92	1	3	320	52	1	79	7	9	61	285	98	0	14	5
Trees recorded as healthy (%)	–[c]	75	100	100	100	100	100	97	100	100	99	98	100	100	100	100	100	100	100	–	100	100
Frost damage	–	0	0	0	0	2	0	0	0	0	0	0	0	4	0	11	2	23	0	–	21	0
Needle, shoot, and broom rusts	–	13	0	7	0	0	36	8	0	0	1	8	0	0	0	0	0	6	7	–	0	0
Needle casts and other foliar diseases	–	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	–	0	0
Adelgid galls	–	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	0	0	–	0	0
Insect galls (branch or stem)	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	–	7	0
Other stem deformity/damage	–	0	0	0	5	0	0	0	0	0	1	2	100	3	0	0	3	2	2	–	7	0
Hail damage	–	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0	4	0	–	0	0
Other foliar damage or symptoms	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	43	0
Armillaria root disease[d]	–	25	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	–	0	0
Other bark damage	–	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	–	14	0
Aphids	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	–	0	0
Other crown or apex damage	–	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	–	7	0
Other stem cankers or galls	–	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	–	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Dashes indicate no black spruce were present on sampled sites.
[d]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 11. Summary of disease, insect, and damage agents affecting white spruce, Lower Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																					
			c20–				d20–				e20–				f20–			h20–				
Agent[b]	c5	c10	35	c35+	d5	d10	35	d35+	e5	e10	35	e35+	f5	f10	35	h5	h10	35	h35+	i10	j5	j10
No. of plots surveyed	3	2	4	1	3	4	3	2	4	4	9	1	3	5	5	3	3	3	1	1	3	1
Sample size	10	4	46	1	132	14	62	1	130	165	280	46	246	108	761	203	109	110	10	69	233	52
Trees recorded as healthy (%)	100	100	100	100	100	100	100	100	91	98	98	98	100	100	91	100	100	100	100	100	99	100
Frost damage	70	25	11	0	83	86	3	0	55	36	13	0	45	30	11	89	25	75	0	67	96	46
Hail damage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	86	0	0	0	0
Needle, shoot, and broom rusts	0	0	0	100	5	0	50	0	45	0	4	96	0	0	0	0	0	0	80	0	0	0
Needle casts and other foliar diseases	0	0	0	0	0	0	0	0	0	0	53	0	0	0	0	0	0	0	0	0	0	0
Other foliar damage or symptoms	0	0	0	0	0	0	0	0	1	1	0	0	0	1	16	0	1	0	0	1	1	4
Adelgid galls	0	25	0	0	0	0	3	0	0	0	4	2	0	0	8	0	0	9	0	1	0	0
Other crown or apex damage	0	25	2	0	2	0	3	0	8	0	0	0	0	0	0	0	0	0	0	0	18	2
Other stem deformity/damage	0	25	0	0	1	0	5	0	5	1	3	2	2	0	2	0	0	0	0	1	5	0
Insect galls (branch or stem)	0	0	26	0	0	0	2	0	1	1	2	0	0	0	3	0	0	0	0	0	0	0
Aphids	0	0	0	0	0	0	0	0	2	1	3	0	0	0	1	0	0	4	0	4	0	2
Armillaria root disease[c]	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0
Other bark damage	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insect defoliators	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Human damage	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Browse	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 12. Summary of disease, insect, and damage agents affecting trembling aspen, Upper Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																		
Agent[b]	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	2	74	16	54	9	114	22	14	40	262	371	77	399	38	131	76	87	23	29
Trees recorded as healthy (%)	100	97	100	96	100	99	100	100	100	93	100	100	84	100	98	96	100	96	86
Leaf and twig blight	0	23	25	0	33	14	0	29	18	54	81	35	5	8	76	49	99	48	48
Browse	50	1	0	0	11	3	18	0	35	6	18	34	5	0	1	7	0	26	17
Other crown or apex damage	0	11	0	6	0	8	0	0	5	6	1	1	13	16	11	3	15	30	10
Human damage	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	3	0	0	0
Insect galls (branch or stem)	0	0	0	2	0	4	0	0	5	3	1	3	0	5	2	5	1	0	0
Other bark damage	0	0	0	4	0	1	0	0	0	3	0	0	2	0	0	5	5	0	0
Stem decays	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Other stem deformity/damage	0	0	6	0	0	1	0	0	0	1	0	1	2	3	0	1	0	0	0
Insect defoliators	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Armillaria root disease[c]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Other foliar insects	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 13. Summary of disease, insect, and damage agents affecting balsam fir, and subalpine fir, Upper Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																		
Agent[b]	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	38	1	48	240	153	68	8	29	158	143	13	157	182	3	9	1	249	169	80
Trees recorded as healthy (%)	89	100	94	98	100	100	100	100	100	99	92	97	99	100	100	100	97	99	100
Other crown or apex damage	13	0	0	5	5	3	0	31	13	1	0	16	3	0	0	0	14	20	10
Other stem deformity/damage	11	0	0	13	8	0	0	24	7	3	15	7	5	0	11	0	10	12	11
Frost damage	32	0	46	0	0	0	0	0	0	0	85	0	1	0	0	0	0	0	18
Other bark damage	8	0	2	2	1	0	0	34	1	0	8	1	1	0	0	0	4	2	0
Needle, shoot, broom rusts	0	0	0	0	1	51	0	0	0	0	0	0	0	0	0	0	0	0	0
Other foliar damage/ symptoms	0	0	4	0	0	0	0	0	0	8	0	1	0	0	0	0	0	1	1
Browse	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0
Needle casts and other foliar diseases	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0
Armillaria root disease[c]	3	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Warren root collar weevil[c]	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Other stem- or bark-damaging insects	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Warren root collar weevil and Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to these agents; their actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 14. Summary of disease, insect, and damage agents affecting balsam poplar, Upper Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																			
Agent[b]	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	5	13	14	8	2	19	4	81	30	155	204	178	193	0	4	0	0	14	34
Trees recorded as healthy (%)	100	100	100	100	100	100	100	95	100	96	100	99	56	–[c]	100	–	–	100	100
Human damage	0	0	0	0	0	0	0	0	0	0	0	0	53	–	0	–	–	0	0
Browse	0	0	0	0	0	0	50	0	13	13	21	2	2	–	25	–	–	0	0
Other crown or apex damage	0	15	0	0	0	0	0	1	0	3	1	0	1	–	0	–	–	0	0
Other stem deformity/damage	0	0	0	0	0	0	0	1	0	1	0	0	3	–	0	–	–	0	0
Leaf and twig blight	0	0	0	0	0	0	0	0	0	5	0	0	0	–	0	–	–	0	0
Other bark damage	0	0	0	0	0	0	0	1	0	2	0	0	0	–	0	–	–	0	0
Armillaria root disease[d]	0	0	0	0	0	0	0	1	0	1	0	0	0	–	0	–	–	0	0
Other stem- or bark-damaging insects	0	0	0	0	0	0	0	0	0	0	0	1	0	–	0	–	–	0	0
Other stem cankers or galls	0	0	0	0	0	0	0	0	0	1	0	0	0	–	0	–	–	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Dashes indicate no balsam poplar were present on sampled sites.
[d]Assessment of Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to this agent; its actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 15. Summary of disease, insect, and damage agents affecting lodgepole pine, Upper Foothills Natural Subregion

Agent[b]	Ecosite – age class[a]; % of trees affected																			
	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	776	316	601	173	571	714	140	330	560	692	269	271	437	574	533	729	404	416	81
Trees recorded as healthy (%)	98	93	96	100	99	94	91	93	98	89	100	97	95	99	99	99	100	100	95
Western gall rust	2	9	37	1	3	27	47	1	2	50	2	1	14	7	8	14	1	2	4
Needle casts and other foliar diseases	7	8	56	0	2	6	0	0	0	16	0	0	11	1	0	14	0	0	2
Other stem deformity/damage	2	0	2	3	2	2	4	7	2	8	0	6	12	8	2	1	0	4	6
Other crown or apex damage	2	2	1	3	3	2	0	3	6	0	3	1	1	3	5	1	1	12	2
Other bark damage	0	0	0	3	0	3	0	5	0	11	0	0	3	2	0	6	0	0	0
Atropellis canker of pine	0	0	0	0	0	0	4	1	0	25	0	0	1	0	0	0	0	0	0
Browse	0	0	0	0	0	2	6	0	0	5	0	1	2	0	0	1	0	0	20
Armillaria root disease[c]	1	5	1	0	0	1	4	2	1	1	0	1	0	0	0	0	0	0	0
Blister rusts	1	6	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Pitch blister moth	0	2	1	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	0
Other foliar damage/ symptoms	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	6
Warren root collar weevil[c]	0	0	0	0	1	0	1	3	1	0	0	1	0	0	0	0	0	0	0
Aphids	0	0	0	0	1	0	0	0	1	0	2	1	0	0	0	0	0	1	0
Terminal weevils	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Frost damage	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Winter damage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Assessment of Warren root collar weevil and Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to these agents; their actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 16. Summary of disease, insect, and damage agents affecting black spruce, Upper Foothills Natural Subregion

	Ecosite – age class[a]; % of trees affected																		
Agent	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	0	0	25	20	154	332	20	226	10	41	4	2	231	131	258	454	44	89	303
Trees recorded as healthy (%)	–[b]	–	100	90	98	100	100	99	100	95	100	100	99	97	100	100	100	100	100
Other stem deformity/damage	–	–	0	70	8	8	0	10	0	5	0	0	4	17	24	3	0	30	10
Other crown or apex damage	–	–	0	0	2	0	0	1	0	2	0	0	0	0	0	1	0	12	14
Needle, shoot, broom rusts	–	–	0	0	0	1	0	2	0	0	0	0	0	5	0	2	0	0	0
Other bark damage	–	–	0	10	2	0	0	1	0	0	0	0	0	5	1	0	0	0	0
Frost damage	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Adelgid galls	–	–	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
Browse	–	–	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
Other foliar damage/ symptoms	–	–	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0
Aphids	–	–	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Dashes indicate no black spruce were present on sampled sites.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

Table 17. Summary of disease, insect, and damage agents affecting white spruce, Upper Foothills Natural Subregion

Agent[b]	Ecosite – age class[a]; % of trees affected																			
	c5	c10	c20–35	d5	d10	d20–35	d35+	e5	e10	e20–35	f5	f10	f20–35	h5	h10	h20–35	i5	i10	i20–35
No. of plots surveyed	3	2	3	3	3	5	1	3	3	6	4	3	6	3	3	3	3	3	2
Sample size	17	120	52	295	5	225	81	198	8	288	87	147	223	77	33	0	2	114	37
Trees recorded as healthy (%)	100	93	100	79	100	99	95	95	100	99	100	99	100	81	100	–[c]	100	100	100
Winter damage	0	0	0	61	0	0	0	24	0	0	0	0	0	71	0	–	0	0	0
Needle, shoot, broom rusts	0	0	0	0	0	60	59	0	0	3	0	0	0	0	0	–	0	0	0
Other crown or apex damage	6	1	0	4	0	1	6	3	0	0	5	3	3	0	21	–	50	11	5
Frost damage	29	23	27	0	0	0	0	0	0	0	1	0	2	0	0	–	0	2	5
Other stem deformity/damage	12	1	0	3	0	1	0	2	0	1	1	1	3	4	3	–	0	5	5
Adelgid galls	6	2	0	0	0	9	12	0	0	2	0	0	1	0	0	–	0	0	14
Browse	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	–	0	0	3
Needle casts and other foliar diseases	0	0	0	0	0	0	0	0	0	7	0	0	1	0	0	–	0	0	0
Armillaria root disease[d]	0	8	0	0	0	0	1	1	0	1	0	0	0	0	0	–	0	0	0
Other bark damage	12	0	0	1	0	0	0	2	0	0	0	0	0	0	0	–	0	0	0
Other foliar damage/ symptoms	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	–	0	0	0
Aphids	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	–	0	0	0
Warren root collar weevil[d]	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	–	0	0	0
Terminal weevils	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	–	0	0	0

[a]For each column, the lowercase letter indicates the ecosite, and the number (or numbers) represent the age class.
[b]Gray shading indicates agents with a known high potential for damage causing significant annual losses.
[c]Dashes indicate no white spruce were present on sampled sites.
[d]Assessment of Warren root collar weevil and Armillaria root disease was carried out only on dead trees. The data indicate that an annual mortality rate could be ascribed to these agents; their actual incidence is expected to be higher.
Note: some ecosite – age classes are not represented in the table because representative sites in the field may not have been sampled or were not available.

11.0 LITERATURE CITED

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12.0 PLANT NAMES

Vascular plant nomenclature follows Moss (1983); names marked with an asterisk have been updated as noted in Flora of North America (Flora of North America Editorial Committee 1993–2000) and Douglas et al. (1998, 1999–2002). Nonvascular plant nomenclature, specifically for mosses, follows Ireland et al. (1987) and Schofield (1992).

Abies balsamea (L.) Mill . . . . . balsam fir
Abies bifolia A. Murr*. . . . . subalpine fir
Achillea millefolium L. . . . . .common yarrow
Alnus viridis (Vill.) Lam .& DC.* . . . . . green alder
Arctostaphylos uva-ursi (L.) Spreng. . . . . common bearberry
Arnica cordifolia Hook. . . . . heart-leaved arnica
Aster ciliolatus Lindl. . . . . Lindley's aster
Aulacomnium palustre (Hedw.) Schwaegr. . . . . .tufted moss
balsam fir . . . . . .***Abies balsamea*** (L.) Mill
balsam poplar . . . . . .***Populus balsamifera*** L.
beaked willow . . . . . ***Salix bebbiana*** Sarg.
Betula glandulosa Michx.. . . . . bog birch
bishop's-cap . . . . . ***Mitella nuda*** L.
bog birch . . . . . ***Betula glandulosa*** Michx.
bog cranberry . . . . . ***Vaccinium vitis-idaea*** L.
black spruce . . . . . ***Picea mariana*** (Mill.) BSP.
bracted honeysuckle . . . . . .***Lonicera involucrata*** (Richards.) Banks
bristly black currant. . . . . ***Ribes lacustre*** (Pers.) Poir.
broad spinulose shield fern . . . . . ***Dryopteris assimilis*** S. Walker
bunchberry . . . . . ***Cornus canadensis*** L.
Calamagrostis canadensis (Michx.) Beauv. . . . . marsh reed grass
Campanula rotundifolia L.. . . . . harebell
Canada buffalo-berry . . . . . ***Shepherdia canadensis*** (L.) Nutt.
Carex spp. . . . . sedges
Cladina mitis (Sandst.) Hale & W. Culb. . . . . reindeer lichen
common bearberry. . . . . .***Arctostaphylos uva-ursi*** (L.) Spreng.
common blueberry. . . . . ***Vaccinium myrtilloides*** Michx.
common dandelion . . . . . .***Taraxacum officinale*** Weber
common fireweed. . . . . .***Epilobium angustifolium*** L.
common hair-cap . . . . . .***Polytrichum commune*** Hedw.

common horsetail. . . . . ***Equisetum arvense*** L.
common Labrador tea . . . . . ***Ledum groenlandicum*** Oeder
common yarrow . . . . . ***Achillea millefolium*** L.
Cornus canadensis L.. . . . . bunchberry
cow parsnip. . . . . ***Heracleum maximum*** Bartr.*
dewberry . . . . . ***Rubus pubescens*** Raf.
Dryopteris assimilis S. Walker . . . . . broad spinulose shield fern
dwarf bilberry. . . . . ***Vaccinium caespitosum*** Michx.
dwarf bramble . . . . . ***Rubus pedatus*** J.E. Smith
Epilobium angustifolium L.. . . . . common fireweed
Equisetum arvense L.. . . . . common horsetail
Equisetum pratense Ehrh.. . . . . meadow horsetail
Equisetum sylvaticum L. . . . . woodland horsetail
Fragaria virginiana Duchesne . . . . . wild strawberry
Galium boreale L.. . . . . northern bedstraw
golden moss . . . . . ***Tomenthypnum nitens*** (Hedw.) Loeske
green alder. . . . . ***Alnus viridis*** (Vill.) Lam. & DC.*
Gymnocarpium dryopteris (L.) Newm. . . . . oak fern
hairy wild rye . . . . . ***Leymus innovatus*** (Beal) Pilger*
harebell . . . . . ***Campanula rotundifolia*** L.
heart-leaved arnica . . . . . ***Arnica cordifolia*** Hook.
Heracleum maximum Bartr.* . . . . . cow parsnip
Hylocomium splendens (Hedw.) B.S.G. . . stair-step moss (feathermoss)
juniper hair-cap . . . . . ***Polytrichum juniperinum*** Hedw.
knight's plume moss (feathermoss) . . . . . ***Ptilium crista-castrensis*** (Hedw.) De Not.
Ledum groenlandicum Oeder . . . . . common Labrador tea
Leymus innovatus (Beal) Pilger* . . . . . hairy wild rye
Lindley's aster. . . . . ***Aster ciliolatus*** Lindl.
Linnaea borealis L. . . . . twin-flower
lodgepole pine . . . . . ***Pinus contorta*** Dougl. *ex* Loudon var. ***latifolia*** Engelm.
Lonicera involucrata (Richards.) Banks . . . . . bracted honeysuckle
low-bush cranberry . . . . . ***Viburnum edule*** (Michx.) Raf.
Luzula parviflora (Ehrh.) Desv. . . . . small-flowered wood-rush
Maianthemum canadense Desf.. . . . . wild lily-of-the-valley
marsh reed grass . . . . . ***Calamagrostis canadensis*** (Michx.) Beauv.

meadow horsetail. . . . . ***Equisetum pratense*** Ehrh.

Mertensia paniculata (Ait.) G. Don. . . . . tall lungwort

Mitella nuda L.. . . . . bishop's-cap

northern bedstraw . . . . . ***Galium boreale*** L.

northern gooseberry . . . . . ***Ribes oxyacanthoides*** L.

oak fern . . . . . ***Gymnocarpium dryopteris*** (L.) Newm.

palmate-leaved coltsfoot . . . . . ***Petasites frigidus*** var. ***palmatus*** (Ait.) Cronq.*

Peltigera aphthosa (L.) Willd. . . . . studded leather lichen

Petasites frigidus var. palmatus (Ait.) Cronq.* . . . . . palmate-leaved coltsfoot

Picea glauca (Moench) Voss. . . . . white spruce

Picea mariana (Mill.) BSP. . . . . black spruce

Pinus contorta Dougl. *ex* Loudon var. ***latifolia*** Engelm. . . . . lodgepole pine

Pleurozium schreberi (Brid.) Mitt. . . . . Schreber's moss (feathermoss)

Polytrichum commune Hedw. . . . . common hair-cap

Polytrichum juniperinum Hedw.. . . . . juniper hair-cap

Polytrichum strictum Brid. . . . . slender hair-cap

poor-fen sphagnum . . . . . ***Sphagnum angustifolium*** (C. Jens. *ex* Russ.) C. Jens. *in* Tolf

Populus balsamifera L. . . . . balsam poplar

Populus tremuloides Michx.. . . . . trembling aspen

prickly rose . . . . . ***Rosa acicularis*** Lindl.

Ptilium crista-castrensis (Hedw.) De Not. . . . . knight's plume moss (feathermoss)

reindeer lichen . . . . . ***Cladina mitis*** (Sandst.) Hale & W. Culb.

Ribes lacustre (Pers.) Poir. . . . . bristly black currant

Ribes oxyacanthoides L.. . . . . northern gooseberry

Ribes triste Pall. . . . . wild red currant

Rosa acicularis Lindl. . . . . prickly rose

Rubus idaeus L. . . . . wild red raspberry

Rubus pedatus J.E. Smith . . . . . dwarf bramble

Rubus pubescens Raf.. . . . . dewberry

Salix spp.. . . . . willows

Salix bebbiana Sarg. . . . . beaked willow

Schreber's moss (feathermoss). . . . . ***Pleurozium schreberi*** (Brid.) Mitt.

sedges. . . . . ***Carex*** spp.

Shepherdia canadensis (L.) Nutt. . . . . Canada buffalo-berry
slender hair-cap . . . . . ***Polytrichum strictum*** Brid.
small-flowered wood-rush . . . . . ***Luzula parviflora*** (Ehrh.) Desv.
Sphagnum angustifolium (C. Jens. *ex* Russ.) C. Jens. *in* Tolf . . . . poor-fen sphagnum
stair-step moss (feathermoss) . . . ***Hylocomium splendens*** (Hedw.) B.S.G.
studded leather lichen . . . . . Peltigera aphthosa (L.) Willd.
subalpine fir . . . . . ***Abies bifolia*** A. Murr*
tall bilberry . . . . . ***Vaccinium membranaceum*** Dougl. *ex* Hook.
tall lungwort . . . . . ***Mertensia paniculata*** (Ait.) G. Don.
Taraxacum officinale Weber . . . . . common dandelion
Tomenthypnum nitens (Hedw.) Loeske . . . . . golden moss
trembling aspen . . . . . ***Populus tremuloides*** Michx.
tufted moss . . . . . ***Aulacomnium palustre*** (Hedw.) Schwaegr.
twin-flower . . . . . ***Linnaea borealis*** L.
Vaccinium caespitosum Michx. . . . . dwarf bilberry
Vaccinium membranaceum Dougl. ex Hook. . . . . tall bilberry
Vaccinium myrtilloides Michx. . . . . common blueberry
Vaccinium vitis-idaea L. . . . . bog cranberry
Viburnum edule (Michx.) Raf. . . . . low-bush cranberry
white spruce . . . . . ***Picea glauca*** (Moench) Voss
wild lily-of-the-valley . . . . . ***Maianthemum canadense*** Desf.
wild red currant . . . . . ***Ribes triste*** Pall.
wild red raspberry . . . . . ***Rubus idaeus*** L.
wild strawberry . . . . . ***Fragaria virginiana*** Duchesne
willows . . . . . ***Salix*** spp.
woodland horsetail . . . . . ***Equisetum sylvaticum*** L.

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