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Coniferous Forest Habitat Types of Northern Utah

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Donald L. Anderson (Bureau of Land Management) authored parts of the preliminary northwestern Utah classification and was responsible for much of the plant identification. In addition, many other Utah State University undergraduate forestry students served as valuable field or office assistants.

RESEARCH SUMMARY

A habitat type classification is presented for the coniferous forests of northern Utah and adjacent areas of Idaho and Wyoming. The classification and descriptions are based on data from about 1,100 sample stands covering 6 years of reconnaissance sampling. The habitat type concept, a hierarchical system of land classification, is based on potential natural vegetation of forest sites. A total of 8 climax series, 36 habitat types, and 24 phases of habitat types were identified. A diagnostic key is provided for field identification of the habitat types based on the indicator species used in the development of the classification.

In addition to a site classification, mature coniferous forest communities are described and tables provided to portray ecological distributions of all species. Potential productivity for timber, physical site characteristics, climatic characteristics, and surface soil characteristics are also described for each type. Preliminary implications affecting natural resource management and general successional dynamics for both tree and undergrowth species are discussed.

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INTRODUCTION

Forest vegetation, and the sites that support it, are complex entities in themselves. Vegetation also reflects, however, the environmental regime under which it has developed to the present, and will develop in the immediate future. Thus, some system of resource classification is fundamental to sound, intelligent management of both the forest vegetation and other site resources.

Pfister and others (1977) have briefly reviewed some of the classification systems that have been employed. They state that forest managers and researchers usually find special classifications inadequate for general use. For example, a cover-type classification often encompasses great variability in forest conditions and, in addition, provides little information on successional trends or past disturbance. A "physical-site" classification, on the other hand, has little relationship to forest vegetation, even though the site environment substantially influences vegetation. The need for an integrated classification system is clear. And as these authors have further noted, such a system must also provide a base for improving communications, management interpretations, and research applications.

The habitat type approach to forest site classification is such a system. Developed by Rexford Daubenmire (1952) for forests of northern Idaho and adjacent Washington, with subsequent modification (Daubenmire and Daubenmire 1968), it has proven to be useful for management and research applications (Layser 1974; Pfister 1976). Thus, in 1971, the habitat type classification system was selected for development and application in Montana (Pfister and others 1977). As part of a program to extend such classifications throughout western North America, the classification of Utah forest sites was begun in 1975 as a cooperative research effort between the Department of Forestry and Outdoor Recreation of Utah State University, and the Intermountain Forest and Range Experiment Station and the Intermountain Region of the Forest Service, U.S. Department of Agriculture. This report constitutes the subsequent classification of the conifer-dominated lands of northern Utah. It is based on a combination and secondary analysis of data from (1) northwestern Utah preliminary classification (Henderson and others 1976), (2) Uinta Mountains preliminary classification (Henderson and others 1977), and (3) Utah subalpine forest classification (Pfister 1972).

OBJECTIVES AND SCOPE

As a part of a broad regional classification program, the objectives of the northern Utah study correspond to those outlined by Pfister and others (1977):

1. Development of a classification for conifer-dominated forest lands based on potential vegetation.
2. Description of the general geographic, physiographic, climatic, and edaphic features of each type.
3. Description of the mature forest communities (late seral) as well as the potential climax communities (associations) characteristic of each type.
4. Presentation of information on successional development, timber productivity potential, and other biological observations of importance to forest land managers.

To provide a continuity between the classifications of specific areas, our terminology corresponds largely to that of Steele and others (1981). Reference to the glossary included in that publication as appendix G (p. 137-138) is encouraged. Also, their format of organization and presentation has been followed.

The area of study includes the forested lands of northern Utah and adjacent Idaho (fig. 1). As such, the classification encompasses parts of five National Forests, as well as proximate public and private lands. Some lands supporting certain plant communities were not included. Expressly excluded were riparian sites dominated by *Populus angustifolia*, *Betula occidentalis*, *Acer negundo*, or *Salix*; various woodlands such as *Acer grandidentatum*, *Quercus gambelii*, *Juniperus osteosperma*, *J. scopulorum*, *Pinus edulis*, or *P. monophylla*; and *Populus tremuloides* lands of uncertain successional status. This classification therefore includes the forested lands that are potentially capable of supporting at least a 25 percent canopy cover of conifers, excluding woodland species.

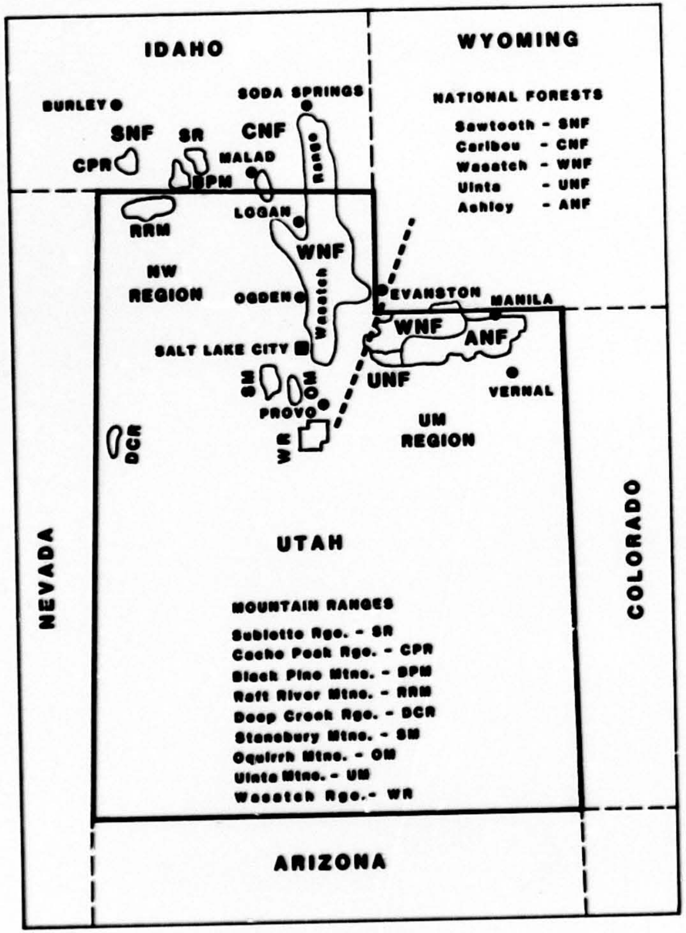

Figure 1.—Distribution of sampled National Forests and mountain ranges in the northern Utah study area. Heavy dashed line delineates northwestern and northeastern (Uinta Mountain) regions, as referenced in the habitat type discussions.

METHODS

Plot Sampling

Mature to near-climax stands were sampled with temporary plots in an attempt to represent the full range of environmental conditions and late successional stages for forested sites throughout northern Utah and adjacent Idaho. Sampling was conducted over three summers. The methodology of the study essentially followed that of Pfister and others (1977), as recently discussed in further detail by Pfister and Arno (1980).

Stands were selected for sampling by first inspecting forest conditions along a traveled transect (usually a road or trail), generally following an elevational gradient. The identification of potential stands was based on the overstory, undergrowth, substrate, and environmental characteristics, and also the relationships to both adjacent stands and the study area as a whole. Plots were then objectively located in the most representative and homogeneous parts of the most mature stands of the area. Ecotones, exceptionally dense clumps, openings, rock outcrops, and seeps were purposefully avoided. Recently disturbed sites were also avoided, but this was not always possible because of the intensive use that has occurred throughout much of the study area.

The use of random or systematic systems for stand selection was rejected. Such methods are inefficient, generating many stands that either are not mature, which is necessary for classifying habitat types, or that represent ecotone conditions. Random selection systems also tend to oversample abundant communities and undersample scarcer ones.

Three distinct types of plots were used for sampling: "survey," "reconnaissance," and "detailed research" or "Daubenmire" (after Henderson and West 1977). All data were recorded on specially designed cards. In addition, extensive photography was employed, which proved to be valuable during data analysis. Survey plots were circular. During 1975, a 375-m^2 plot (about one-tenth acre) was used, with a centered 50-m^2 subplot for tree regeneration. After 1975, a 500-m^2 plot (about one-eighth acre) and 100-m^2 subplot were adopted in order to provide a better representation of overstory conditions. In exceptionally dense stands of *Pinus contorta*, however, a 250-m^2 plot (50-m^2 subplot) was substituted to reduce data collection time.

The less intensive reconnaissance plot was chiefly used in 1977 for verifying the classification and for supplemental sampling. Reconnaissance plots were similar to the survey plots, except that plot boundaries (encompassing about the same area) were estimated, not measured, and less data were collected. One investigator can lay out and collect the data on a reconnaissance plot in about 20 minutes, versus 45 minutes to 2 hours for the survey plot, or 2 to 4 hours for the detailed research plot (Henderson 1979).

The detailed research plot was employed to provide both training and recurrent calibration of cover estimates. This plot was derived from Daubenmire (1959; see also Daubenmire and Daubenmire 1968). The cover of each undergrowth species was estimated independently, using 50 to 100 systematically placed 0.1-m^2 quadrats, recorded by six cover classes. Cover of a species was calculated as the mean of the cover class midpoints for all quadrats. Plot configuration and area matched that of the survey plots—circular, with quadrats placed along four radii. The accuracy and efficiency of this plot with respect to the other types of plots has been discussed by Henderson (1979).

For all types of plots, undergrowth data consisted of the canopy coverage of each vascular plant species ocularly estimated to the nearest percentage, from 1 to 10 percent, and to the nearest 5 percent thereafter. When present with less than 0.5 percent cover, a species was recorded as a trace and assigned a value of 0.3 for computational purposes. In addition, a species that was absent in a plot but represented in the immediate stand was noted as a "+" and ignored in computations unless the stand was exceptionally depauperate.

Unknown species were collected for subsequent identification. Mosses were treated collectively. Cover of minor species was not recorded for reconnaissance plots.

Overstory data included the canopy coverage of each tree species, estimated by three breast-height-diameter classes (using the procedure for undergrowth): less than 4 inches; 4 to 12 inches; and greater than 12 inches (less than 10 cm; 10 to 30 cm; and greater than 30 cm). For survey and detailed survey plots, a stand table was recorded by 4-inch (10-cm) diameter classes for basal area determination; and established seedlings 0.5 to 4.5 feet in height (15 to 137 cm) were counted on the regeneration subplot. On each reconnaissance plot, basal area for each species was estimated with a 10-factor prism; established seedlings were noted but not counted. These data were used extensively in assessing successional trends.

Whenever possible, the age and height of at least one relatively free-growing individual for each species were determined to provide an estimate of timber productivity. Only one tree was usually measured for each reconnaissance plot.

Physical site characteristics were determined for each plot. These included elevation, aspect (azimuth), slope (percentage), and a qualitative position and configuration. Survey and detailed research plots were referenced to conspicuous landmarks for possible revisitation during the study, and all plots were located on USGS topographic quadrangles when these were available.

Soil characteristics were determined largely on site. These included parent material composition, texture of the upper 10 inches (25 cm) of surface soil, litter depth (in cm); charcoal presence, and the relative presence of coarse fragments (collectively referred to as "gravel" throughout the descriptions). In addition, the percentage of area in bare soil and exposed rock (material greater than 3 inches in diameter) was estimated for survey and detailed research plots, using the coverage procedure for vegetation. A sample of the upper 20 cm of soil was collected. Bedrock and surficial geology were determined whenever possible from geological maps on other published studies (Atwood 1909; Bradley 1964; Kinney 1955; Stokes 1962; Stokes and Madsen 1961; Williams 1946).

Notes were made on stand and fire history and the relationship of the sampled stand to adjacent stands as well as on wildlife and domestic livestock use, forest diseases and pests, and general management implications.

During the summer of 1975, a total of 445 plots were sampled in the Wasatch, Caribou, and Sawtooth National Forests of northwestern Utah and adjacent Idaho (fig. 1). This was done by three two-person teams. In 1975, 256 plots were sampled in the Uinta Mountains, Utah, and Wyoming by two two-person teams. This work covered the Ashley and Wasatch National Forests and an adjacent section of the Uinta National Forest. During the summer of 1977, 292 reconnaissance plots were sampled throughout northern Utah by three individuals for classification verification or for supplemental sampling where data were scant. In addition, about 10 survey plots in 1979, 25 plots in 1980, and 11 plots in 1981 were taken for the latter purpose.

In 1975 and 1977, the higher forested mountain ranges of the Great Basin area were visited. These included the Deep Creek Range and Oquirrh, Raft River, and Stansbury Mountains of Utah; and the Black Pine Mountains, Sublette Range, and Cache Peak Range (including the Albion Mountains) of Idaho. Sampling was generally more intensive in the more northern mountain ranges where accessibility was better. All of these areas, except the Deep Creek Range, are represented in the data by 47 plots.

In addition, 84 plots sampled by Pfister (1972) in northern Utah were used for verification and then incorporated into the data base. Thus, the classification has been developed from about 1,120 plots. The distribution of sample stands is presented by National Forest and State or geographic region in appendix A.

Office Procedures

The development of this habitat type classification follows in general the data analysis procedures discussed in detail by Pfister and Arno (1980). The classification was developed through a series of successive approximations and revisions. Its general chronological development is outlined as follows:

1. Subjective first groupings were made following each field season (1975 and 1976). These were based on habitat types reported from adjacent studies (see below) and from observations made during sampling. Possible new habitat types were briefly described.
2. Following the identification of voucher collections, all data were prepared for computer processing. Computer programs were developed by the senior author for specific analysis throughout the course of the study.
3. Synthesis tables (Mueller-Dombois and Ellenberg 1974) were computer generated for the stands of each series, that is, all stands having the same projected climax tree species. Such tables allow visual comparisons of data between stands. The initial stand arrangement was based on the first groupings. These tables were studied in detail to identify general similarities of vegetal composition. Species showing consistent differential distributions were noted. A series of new tables were then created by rearranging similar stands. From these, possible indicator species were identified. The final stand arrangement provided the formal basis for the series, habitat types, and phases.
4. Characteristic vegetational parameters for the habitat types and phases were identified and briefly described. From these, a key to the habitat types was constructed. When the key was then applied to all stands, several problems were identified, which resulted in slight revisions of the classifications.
5. Summary tables were computer generated for constancy and average cover of important species for each habitat type and phase (appendix C).
6. Computer-generated summaries of geographic locations, physical site parameters, soils, etc., were inspected to insure that specific environmental patterns could be related to each habitat type and phase. This process also identified a few new situations, which were mainly phases. These summaries provided the basis for appendix D.
7. Terminology for the types was correlated wherever possible to that of previous studies (Daubenmire and Daubenmire 1968; Pfister 1972; Wirsing and Alexander 1975; Hoffman and Alexander 1976; Pfister and others 1977; Steele and others 1979, 1981) and to express the interrelationships as clearly as possible.
8. The preliminary classifications (1976, 1977) which included descriptions of the types were distributed, presented at training sessions, and put into use. Evaluations by the users were solicited. Reported problems sometimes revealed geographic areas or portions of the classifications that required additional sampling.
9. The preliminary classifications including data from subsequent sampling were combined in this report. This process identified several significant problem areas in the preliminary classifications. Thus, the entire analysis process was repeated to yield the final classification. Specific classification changes have been noted in the habitat type descriptions. Several of these were based on the treatment of eastern Idaho and western Wyoming by Steele and others (1983). Yet other changes reflected significant departures from both that treatment and the preliminary classifications of northern Utah. Finally, approximately 3 percent of the sample stands (excluding *Populus tremuloides* communities) did not fit the final classification. Most of these were evidently ecotones, early-seral stands, or unusual forest communities; some stands were woodland communities; and a few stands may represent habitat types that are poorly represented in this area.
10. For the final classification more phases were identified, particularly for situations that correspond to descriptions from adjacent studies as well as from ongoing work in southern Utah. A phase may represent a broad transition (usually occupying significant landscape) between two adjacent types—for example, ABLA/BERE h.t., RIMO phase. (Because of frequent reference to habitat type names, abbreviations are used for convenience throughout this report; these are shown in table 1.) A phase may also represent a difference of species dominance in a third layer (the habitat type is defined by dominants or indicator species in two layers), such as the PIPO/FEID h.t., ARPA and ARTR phases.

Table 1.—Northern Utah forest habitat types

Abbreviation	Habitat types and phases: Scientific names	Habitat types and phases: Common names
	***Pinus flexilis* Climax Series**	
PIFL/CELE h.t.	*Pinus flexilis/Cercocarpus ledifolius* h.t.	limber pine/curlleaf mountain-mahogany
PIFL/BERE h.t.	*Pinus flexilis/Berberis repens* h.t.	limber pine/Oregongrape
	***Pinus ponderosa* Climax Series**	
PIPO/CAGE h.t.	*Pinus ponderosa/Carex geyeri* h.t.	ponderosa pine/elk sedge
PIPO/FEID h.t.	*Pinus ponderosa/Festuca idahoensis* h.t.	ponderosa pine/Idaho fescue
-ARPA phase	-*Arctostaphylos patula* phase	-greenleaf manzanita phase
-ARTR phase	-*Artemisia tridentata* phase	-big sagebrush phase
-FEID phase	-*Festuca idahoensis* phase	-Idaho fescue phase
	***Pseudotsuga menziesii* Climax Series**	
PSME/PHMA h.t.	*Pseudotsuga menziesii/Physocarpus malvaceus* h.t.	Douglas-fir/ninebark
-PAMY phase	-*Pachistima myrsinites* phase	-myrtle pachistima phase
PSME/ACGL h.t.	*Pseudotsuga menziesii/Acer glabrum* h.t.	Douglas-fir/mountain maple
PSME/OSCH h.t.	*Pseudotsuga menziesii/Osmorhiza chilensis* h.t.	Douglas-fir/mountain sweetroot
-PAMY phase	-*Pachistima myrsinites* phase	-myrtle pachistima phase
PSME/CARU h.t.	*Pseudotsuga menziesii/Calamagrostis rubescens* h.t.	Douglas-fir/pinegrass
PSME/CELE h.t.	*Pseudotsuga menziesii/Cercocarpus ledifolius* h.t.	Douglas-fir/curlleaf mountain-mahogany
PSME/BERE h.t.	*Pseudotsuga menziesii/Berberis repens* h.t.	Douglas-fir/Oregongrape
-CAGE phase	-*Carex geyeri* phase	-elk sedge phase
-JUCO phase	-*Juniperus communis* phase	-common juniper phase
-SYOR phase	-*Symphoricarpos oreophilus* phase	-mountain snowberry phase
-BERE phase	-*Berberis repens* phase	-Oregongrape phase
PSME/SYOR h.t.	*Pseudotsuga menziesii/Symphoricarpos oreophilus* h.t.	Douglas-fir/mountain snowberry
	***Picea pungens* Climax Series**	
PIPU/AGSP h.t.	*Picea pungens/Agropyron spicatum* h.t.	blue spruce/bluebunch wheatgrass
PIPU/BERE h.t.	*Picea pungens/Berberis repens* h.t.	blue spruce/Oregongrape
	***Abies concolor* Climax Series**	
ABCO/PHMA h.t.	*Abies concolor/Physocarpus malvaceus* h.t.	white fir/ninebark
ABCO/OSCH h.t.	*Abies concolor/Osmorhiza chilensis* h.t.	white fir/mountain sweetroot
ABCO/BERE h.t.	*Abies concolor/Berberis repens* h.t.	white fir/Oregongrape
-SYOR phase	-*Symphoricarpos oreophilus* phase	-mountain snowberry phase
-BERE phase	-*Berberis repens* phase	-Oregongrape phase
	***Picea engelmannii* Climax Series**	
PIEN/EQAR h.t.	*Picea engelmannii/Equisetum arvense* h.t.	Engelmann spruce/common horsetail
PIEN/CALE h.t.	*Picea engelmannii/Caltha leptosepala*	Engelmann spruce/elkslip marshmarigold
PIEN/VACA h.t.	*Picea engelmannii/Vaccinium caespitosum* h.t.	Engelmann spruce/dwarf blueberry
PIEN/VASC h.t.	*Picea engelmannii/Vaccinium scoparium* h.t.	Engelmann spruce/grouse whortleberry

(con.)

In other cases, a phase may distinguish geographic subdivisions of types that have wide distributions—for example, PSME/ACGL h.t., PAMY phase.

11. Additional analytic methods were employed during the final classification revision. Several index-of-similarity matrices were computer generated for particularly difficult groups of stands. Initially, "Sorenson's k' index" (Dick-Peddie and Moir 1970) and, later, the "Bray-Curtis index" (Mueller-Dombois and Ellenberg 1974) were used, with the species' percentage of cover as attributes. Cluster analysis dendrograms were also created from the similarity matrices through the use of the general purpose program, CLUSTAR (Marshall and Romesburg 1977), along with UPGMA clustering linkage (Unweighted Pair Group Method). Both of these analyses provided general insight for the problem areas.

Table 1.—(con.)

Abbreviation	Habitat types and phases: Scientific names	Common names
	***Abies lasiocarpa* Climax Series**	
ABLA/CACA h.t.	*Abies lasiocarpa/Calamagrostis canadensis* h.t.	subalpine fir/bluejoint reedgrass
ABLA/STAM h.t.	*Abies lasiocarpa/Streptopus amplexifolius* h.t.	subalpine fir/claspleaf twisted-stalk
ABLA/ACRU h.t.	*Abies lasiocarpa/Actaea rubra* h.t.	subalpine fir/baneberry
ABLA/PHMA h.t.	*Abies lasiocarpa/Physocarpus malvaceus* h.t.	subalpine fir/ninebark
ABLA/ACGL h.t.	*Abies lasiocarpa/Acer glabrum* h.t.	subalpine fir/mountain maple
ABLA/VACA h.t.	*Abies lasiocarpa/Vaccinium caespitosum* h.t.	subalpine fir/dwarf blueberry
ABLA/VAGL h.t.	*Abies lasiocarpa/Vaccinium globulare* h.t.	subalpine fir/blue huckleberry
ABLA/VASC h.t.	*Abies lasiocarpa/Vaccinium scoparium* h.t.	subalpine fir/grouse whortleberry
-ARLA phase	-*Arnica latifolia* phase	-broadleaf arnica phase
-CAGE phase	-*Carex geyeri* phase	-elk sedge phase
-VASC phase	-*Vaccinium scoparium* phase	-grouse whortleberry phase
ABLA/CARU h.t.	*Abies lasiocarpa/Calamagrostis rubescens* h.t.	subalpine fir/pinegrass
ABLA/PERA h.t.	*Abies lasiocarpa/Pedicularis racemosa* h.t.	subalpine fir/sickletop pedicularis
-PSME phase	-*Pseudotsuga menziesii* phase	-Douglas-fir phase
-PERA phase	-*Pedicularis racemosa* phase	-sickletop pedicularis phase
ABLA/BERE h.t.	*Abies lasiocarpa/Berberis repens* h.t.	subalpine fir/Oregongrape
-PIFL phase	-*Pinus flexilis* phase	-limber pine phase
-RIMO phase	-*Ribes montigenum* phase	-mountain gooseberry phase
-CAGE phase	-*Carex geyeri* phase	-elk sedge phase
-JUCO phase	-*Juniperus communis* phase	-common juniper phase
-PSME phase	-*Pseudotsuga menziesii* phase	-Douglas-fir phase
-BERE phase	-*Berberis repens* phase	-Oregongrape phase
ABLA/RIMO h.t.	*Abies lasiocarpa/Ribes montigenum* h.t.	subalpine fir/mountain gooseberry
-THFE phase	-*Thalictrum fendleri* phase	-Fendler meadowrue phase
-PICO phase	-*Pinus contorta* phase	-lodgepole pine phase
-TRSP phase	-*Trisetum spicatum* phase	-spike trisetum phase
-RIMO phase	-*Ribes montigenum* phase	-mountain gooseberry phase
ABLA/OSCH h.t.	*Abies lasiocarpa/Osmorhiza chilensis* h.t.	subalpine fir/mountain sweetroot
ABLA/JUCO h.t.	*Abies lasiocarpa/Juniperus communis* h.t.	subalpine fir/common juniper
	***Pinus contorta* Climax Series**	
PICO/CACA c.t.[1]	*Pinus contorta/Calamagrostis canadensis* c.t.	lodgepole pine/bluejoint reedgrass
PICO/VACA c.t.	*Pinus contorta/Vaccinium caespitosum* c.t.	lodgepole pine/dwarf blueberry
PICO/VASC c.t.	*Pinus contorta/Vaccinium scoparium* c.t.	lodgepole pine/grouse whortleberry
PICO/JUCO c.t.	*Pinus contorta/Juniperus communis* c.t.	lodgepole pine/common juniper
PICO/ARUV h.t.	*Pinus contorta/Arctostaphylos uva-ursi* h.t.	lodgepole pine/bearberry
PICO/BERE c.t.	*Pinus contorta/Berberis repens* c.t.	lodgepole pine/Oregongrape
PICO/CARO h.t.	*Pinus contorta/Carex rossii* h.t.	lodgepole pine/Ross sedge

Total number of habitat types = 36

Total number of habitat type, phase, and *Pinus contorta* community type categories = 67

[1]Community type.

Because percentage of cover was used as the importance value for these indices, "common" species having high cover values throughout portions of a series often tended to confound relationships evident in the synthesis tables and field observations. Thus the indices consistently yielded community type or cover type groupings rather than habitat type groupings. Consequently, various transformations were applied to the data of which a square-root transformation of cover consistently yielded groups most closely related to the groups formed by the synthesis table approach. Pfister and Arno (1980) overcame this problem by using cover class codes instead of percentage of cover.

12. A generalized description was prepared for each defined habitat type, based on the final summary tables. This included geographic distribution, physical environment features, key features of vegetation, descriptions of phases and the basis for their separation, relationships to frequently adjacent types, general implications for management, and relationships to other types reported in the literature.

13. This classification provides the foundation for developing "site-specific" considerations useful for management or for future research. For example, consider the appraisal of timber productivity, which immediately follows. An understanding of the environmental and vegetative features of each habitat type can help the user answer many pressing management questions. Some of the more obvious relationships have been stressed in the descriptions. Undoubtedly more will become known as the system is used.

Timber Productivity

Timber productivity was one of the key management considerations for which data were collected in the northern Utah study. Our methods of analysis followed those of Pfister and others (1977).

For each plot, one dominant or codominant tree of each species was selected for age and height measurement, wherever possible. Trees were rejected for further analysis if increment cores exhibited diameter-growth suppression during any 10-year period. The trees used, then, represent the productivity of relatively free-growing trees from natural stands.

Pfister and others (1977) outlined the special procedures and considerations for determining site index from age-height data. For curves based on total age, the number of years to reach breast height must be determined. Species for which site index curves are not available require the use of a substitute curve. In addition, each curve has a range of basic age-height data from which it was derived. Trees having values not included within these ranges were rejected for site index analysis. Criteria used to determine total age and the sources of site index and yield capability curves are summarized in table 2.

Lynch's (1958) *Pinus ponderosa* curve was used to determine *Pseudotsuga* site index rather than Brickell's (1968) curve because the latter does not have yield capability relationship.

Although we had to determine total age (introducing a possible error), the *Pinus ponderosa* curve was used to determine *Abies concolor* and *Pinus flexilis* site index. This use also facilitated a more direct comparison with *Pseudotsuga*, which is the most common associate of these species. Alexander's (1967) *Picea engelmannii* curve also appeared to reflect rather reasonably *Abies concolor* site index, but it poorly represented *Pinus flexilis*.

Alexander's (1967) curve for *Picea engelmannii* was used for this species instead of Brickell's (1966) curve because a yield capability relationship was available and total age determination was not necessary. This curve was also used for *Abies lasiocarpa* and *Picea pungens* site index.

Alexander's curve (1966) was used for *Pinus contorta*; however, individual values were not corrected for effects from excessive crown competition. Thus, some site index and yield capability values may be arbitrarily low.

Table 2.—Criteria and sources for determining site index and estimating yield capability

Species	Estimated years to obtain breast height	Source of site curve[1]	Yield capability (all trees - fig. 2)
PIPO	15	Lynch 1958	Brickell 1970
PSME	15	----------used PIPO curves----------	
ABCO	15	----------used PIPO curves----------	
PIFL	20	----------used PIPO curves----------	
PICO	10	Alexander 1966	Pfister and others 1977[2]
PIEN	([3])	Alexander 1967	Pfister and others 1977[4]
PIPU	([3])	----------used PIEN curves----------	
ABLA	([3])	----------used PIEN curves----------	

[1]A FORTRAN computer program was written for site-index determination and yield capability estimation. Site-index algorithms of Brickell (1970) were used for the PIPO and PICO curves, and that of Clendenen (1977) for the PIEN curve. Algorithms are based on the sources shown and additionally convert 100-year base age curves to 50-year base age.

[2]A *Larix occidentalis* curve for all trees (0.5 inch) was used for PICO. This curve was developed from data in Schmidt and others (1976) by Pfister and others (1977), who explain, "Brickell's (1970) curves for PICO and LAOC (trees larger than 5.0 inches) were nearly identical . . . . The LAOC curve for all trees appears to be as accurate as any available for estimating PICO yield capability for all trees."

[3]Curve based on breast-height age was used.

[4]The curve used was derived by R. D. Pfister from yield data of Alexander and others (1975). It is described in Pfister and others (1977, p. 128-129).

The site index data (base age 50 years) have been summarized by species within habitat type (appendixes E-1 and E-2). Because of regional differences in habitat type occurrence and apparent regional differences in productivity for some habitat types, all timber productivity data were summarized separately for the northwestern region and the Uinta Mountains. The mean site index was calculated whenever three or more values were available; with five or more values, a 95-percent confidence interval for estimating the true population mean was calculated. The same procedure was used for summarizing basal areas of sample stands.

Site index alone can be used to compare differences in site productivity. A more useful assessment, however, is that of net estimated yield capability (cubic-foot production). Pfister and others (1977) further explain yield capability:

> Until managed-stand yield tables are completed, the best approach is to use natural-stand yield tables for assessing yield capability. As stated by Brickell (1970), "Yield capability as used by Forest Survey, is defined as mean annual increment of growing stock attainable in fully stocked natural stands at the age of culmination of mean annual increment." (In other words, yield capability = maximum mean annual increment attainable in fully stocked natural stands.)

The curves used to determine yield capability from site index are presented in figure 2; sources of the relationships are discussed in table 2. All yield capability values (cubic feet/acre/year) are based on all trees (0.5 inches d.b.h.).

A computer program was developed for the graphic and statistical analyses of the yield capability estimates. The procedures employed were essentially those of Pfister and others (1977):

1. Yield capability was estimated for each site tree according to the criteria presented in table 2. These estimates were plotted within each category (habitat type or phase, by region) for a visual display of data distribution.

2. Mean yield capability based on all site trees in each category was calculated. Cutoffs were established to approximate 90 percent of the range of our data. Values were combined and new means and cutoffs were determined for instances where regional data were scant.

3. For habitat types (or phases) where stockability appeared to limit productivity, a stockability factor was developed. Basal area data for plots in these categories were compared to Meyer's (1938) basal area data for fully stocked "normal" stands, following the approach of MacLean and Bolsinger (1973). From these calculations and additional observations, an average mean stockability factor was determined for several categories and yield capability based on each site tree was multiplied by the respective plot factor (the ratio of basal areas) to determine the adjusted yield capability. Cutoffs were established to approximate 90 percent of the range of data.

Our current best estimates of yield capability are presented by region in appendix E-3 and E-4 for cubic

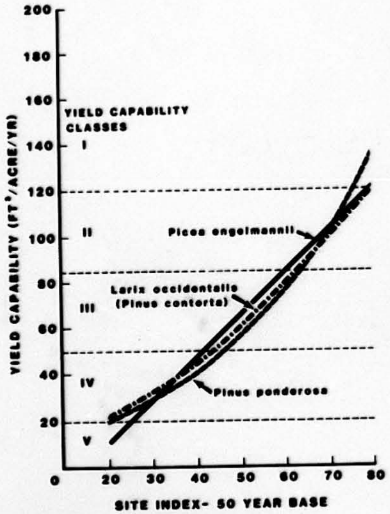

Figure 2.—Yield capability of fully stocked natural stands in relation to site index (adapted from Pfister and others 1977).

feet/acre/year. Forest Survey classes and terminology for cubic-foot production are employed in the habitat type descriptions under the productivity/management section. These are (in cubic feet/acre/year): less than 20, very low; 20-50, low; 50-85, moderate; 85-120, high; and greater than 120, very high.

As Daubenmire (1976) emphasized, natural vegetation serves as a convenient indicator of productivity over large areas of land. Productivity within habitat types (appendix E), however, often varies substantially. The following section explains this variation and tells how to reduce it:

1. Site index curves were used to obtain productivity estimates from yield tables. Different height-growth patterns undoubtedly occur on different sites just as they have been shown to vary with habitat type (Daubenmire 1961); data to account for this variation are not available, however.

2. Yield tables and site curves have not been developed for all species or growth regions. Extrapolation is therefore necessary and tenuous at times; for instance, when we use use Lynch's curve for several different montane species (table 2).

3. Yields of mixed stands can be estimated by several individual species yield tables, and a range in yield capability was common in individual stands. In addition,

intraspecies differences were present in individual stands. Productivity estimates often varied appreciably between individuals of *Abies lasiocarpa* and, to a lesser extent, *Picea engelmannii*. The trees were of about the same height but of a different age, yet all met the non-suppressed criterion. Typically, the older, more open-grown individual had an estimated value that was considerably less than an individual developing under conditions of partial shade (a developmental process which has been reviewed and modeled by Sperger [1980]). In most instances, only the older trees are represented in appendix E.

4. Some variation in productivity can be expected within a natural classification system, such as habitat types. The habitat type classification is based on abilities of species to reproduce and mature under competition, not on their rates of growth. The correlation between competitive strategies and productivity is imperfect at best. For example, in the ABLA/OSCH h.t., mature trees may draw on deeper soil moisture and achieve greater growth rates relative to the growth rates of immature trees, which may be limited by surface drought.

5. It has been suggested that productivity estimates could be improved by incorporating classifications of soils, topography, or climate. We have shown a major difference in productivity by separating the northwestern region and the Uinta Mountains data (appendix E). Differences in regional productivity have also been shown for Montana by Pfister and others (1977) through a separation of data from the east side and west side of the Continental Divide, as well as by Steele and others (1981, 1983) both through a regional treatment of Idaho and in relation to habitat types that are common to Montana. Differences in productivity within a habitat type due to topography, soils, or parent materials are also apparent in local areas. If more accurate estimates of species productivity are needed locally, sites could be stratified, for example, by parent materials such as quartzite vs. other materials for the Uinta Mountains. Because of the limitations of existing site index curves and yield tables, however, more precise estimates of productivity for large areas will not be possible until measuring techniques are improved.

6. Natural-stand yield capability by habitat type could be estimated more precisely by direct measurements of volume growth, rather than by using site index to enter a yield table based on averages. This would require analysis of existing timber inventory plots representing maximum growth potential or new field measurements.

7. Recent growth models (Stage 1973, 1975) utilize growth coefficients based on habitat types. These add a new dimension to yield prediction, provide the basis for developing managed-stand yield tables, and should improve our knowledge of productivity within and between habitat types.

Taxonomic Considerations

Unfortunately, a complete, up-to-date flora for the study area was not available during the field sampling; this caused a great deal of frustration. Many identifications, then, were based on floristic treatments of the surrounding areas (Davis 1952; Harrington 1954; Hitchcock and Cronquist 1973).

More than a thousand voucher collections of plants were made in the course of this study. Most were identified to species. Several specimens were identified or verified by Leila Shultz or Arthur Holmgren of the Intermountain Herbarium, Utah State University, Logan. About 200 of the better specimens have been deposited in this institution. Also, Mont E. Lewis (Forest Service, retired) identified several *Carex* specimens.

Sampling methodology required that field identification be made on material in vegetative, sterile, or less than optimal condition for taxonomic separation. This prevented the positive identification of some closely related species, primarily some graminoids, several of the composite complex, some penstemons, and many weedy species; in such cases, specimens were grouped under the most prevalent taxon for the region.

A few species presented special taxonomic problems. The descriptions provided in Hitchcock and others (1955-69) can be consulted for a precise separation of these and for general identification of the more common species mentioned in the descriptions.

The *Vaccinium globulare-V. membranaceum* complex is especially notable. The complex within the study area has been treated both as *V. globulare* and as *V. membranaceum* by various authors. The name *V. globulare* was adopted for type designation and description because all specimens collected in this study—from southeastern Idaho, extreme northern Utah, the western Uintas, and central Utah as well—correspond much closer to *V. globulare* material from Idaho than to *V. membranaceum* material from Washington and Oregon.

Vaccinium scoparium and *V. myrtillus* are difficult taxonomically, often intergrading in nearby States. Although Pfister (1972) listed *V. myrtillus* from the Uinta Mountains, all of our material corresponds to *V. scoparium*. Therefore, the *V. myrtillus* of Pfister's stands has been grouped under *V. scoparium*.

Separating *Osmorhiza chilensis* and *O. depauperata* is practically impossible without fruits. In *O. chilensis*, the fruit is rather strongly concavely narrowed at the summit, whereas in *O. depauperata* it is convexly narrowed (more rounded). Although *O. depauperata* is found mainly at mid-to-high elevations, both species often occur together on many sites within the study area. These species have been treated as ecologically similar in such situations.

Vegetatively, *Arnica latifolia* and *A. cordifolia* are quite similar; the cauline leaves of *A. latifolia*, however, tend to be largest toward the middle of the stem, being sessile or petiolate as well as rarely cordate; thus, its stems appear to be more leafy than those of *A. cordifolia*. The latter usually has its largest leaves at the base and longer petioles throughout. *A. latifolia* is usually restricted in occurrence to higher elevations and moist sites typically supporting *Picea engelmannii*. *A. cordifolia* is widespread and can occur on much drier sites.

SYNECOLOGICAL PERSPECTIVE AND TERMINOLOGY

The following two sections of discussion are quoted directly from Pfister and others (1977, p. 9-11).

Definition and Explanation of Habitat Type

All land areas potentially capable of producing similarplant communities at climax may be classified as the same habitat type (Daubenmire 1968). The climax plant community, because it is the end result of plant succession, reflects the most meaningful integration of the environmental factors affecting vegetation. Thus, each habitat type represents a relatively narrow segment of environmental variation and delineates a certain potential for vegetative development. One habitat type may support a variety of disturbance-induced, or seral, plant communities, but the vegetative succession will ultimately produce similar plant communities at climax throughout the type.

The climax community type, or association, provides a logical name for the habitat type—for example, *Pseudotsuga menziesii /Calamagrostis rubescens*. The first part of this name is based on the climax tree species, which is usually the most shade-tolerant tree adapted to the site. We call this level of classification the series and it encompasses all habitat types having the same dominant tree at climax. The second part of the habitat type name is based on the dominant or characteristic undergrowth species in the climax community type.

Use of climax community types to name habitat types does not imply that we have an abundance of climax vegetation in the present landscape. Actually, most vegetation in the landscape reflects some form of disturbance and various changes of succession towards climax. Nor do climax community type names imply that management is for climax vegetation; in fact, seral species are frequently preferred for timber and wildlife browse production. Furthermore, this method does not require the presence of a climax stand to identify the habitat type. It can be identified during most intermediate stages of succession by comparing the relative reproductive success of the tree species present with known successional trends and by observing the existing undergrowth vegetation. Successional trends toward climax usually appear to progress more rapidly in the undergrowth than in the tree layer. In very early stages of secondary succession, the habitat type can be identified by comparing the site with similar adjacent ones having mature stands.

Not all units of land will fit neatly into the habitat type system. As in most biological classifications, intergrades, or transitional areas will be encountered.

However, these situations occupy a small percentage of land and need not greatly detract from the utility of a habitat type classification.

The main advantage of habitat types in forest management is that they provide a permanent and ecologically based system of land stratification. Each habitat type encompasses a certain amount of environmental variation, but the variation within a habitat type should be less than that between types. In addition, habitat types provide a classification of climax plant communities. Plant succession should be generally predictable for each habitat type, and similar responses to management treatments can be expected on units of land within the same type.

Although transitional areas or ecotones between habitat types can be interpreted as being broad or narrow, our approach was to interpret them as narrowly as possible. In this way, more of the land surface is definable to habitat type and less is in ecotonal categories that may be impractical for use in resource management.

In discussing the relationship of a habitat type to certain environmental features, we have followed the polyclimax concept of Tansley (1935). Thus, a **climatic climax** develops on deep loamy soils of gently undulating relief; an **edaphic climax** differs from the climatic climax due to extreme soil condition such as coarse texture or poor drainage; and a **topographic climax** reflects compensating effects of topography on microclime. The **topoedaphic climax** is a convenient way to designate deviation from a climatic climax due to combined effects of edaphic and topographic features. Some habitat types reflect only one type of climax, but the majority of them occur in two or more of the above categories in response to interaction of environmental factors.

Habitat Types Versus Continuum Philosophy

A vigorous debate has been carried on for many years by ecologists who study plant communities—i.e., phytosociologists. Although several philosophies have been developed to interpret plant-community organization, two of them are often the center of debate: (1) the advocates of typal communities argue that distinct vegetation types develop at climax and are repeated over the landscape where environmental conditions are similar; (2) continuum advocates argue that even at climax, vegetation, like environmental conditions, varies continuously over the landscape (Daubenmire 1966; Cottam and McIntosh 1966; Vogl 1966). Some of those who accept the typal communities philosophy may view habitat type classification much the same as they view the taxonomic classification of the plant kingdom. Continuum advocates may regard habitat type classifications as an attempt to make categories by drawing fine lines at intervals along a complex vegetational continuum. Collier and others (1973) presented these contrasting philosophies and advocated an intermediate viewpoint.

While this debate may be of interest academically, it need not preoccupy natural resource managers and field biologists who need a logical, ecologically-based classification with which to work. We have proceeded under the philosophy that if a "continuum" does exist, then we would subdivide it into classes. Our primary objective has remained to develop a logical classification that reflects the natural patterns found on the landscape. Local conditions that deviate from this classification can still be described in terms of how they differ from the nearest typal description.

THE PHYSICAL SETTING

General Study Area

The physiography of the study area is generally characterized by several high, discontinuous mountain ranges of linear configuration that rise above surrounding valley and basin areas (fig. 1). The lowlands support many small communities and are mainly devoted to livestock production and other agricultural industries. Several large population centers are situated along the Wasatch Front. Thus, the nearby mountains are intensively utilized for forage, wood, recreation, and the paramount resource, water.

The study area has been considered part of two physiographic provinces (Fenneman 1931). The area to the east of Salt Lake City is a part of the Middle Rocky Mountain province. As such, it includes the most prominent features, the Uinta Mountains and the entire Wasatch Range, of which the Bear River Range, an eastern spur, extends some 50 miles into Idaho. The Basin and Range province encompasses the area immediately to the west of the Wasatch Range, including the smaller ranges to the west of Malad, Idaho. This is also the basic geographic separation for climatological descriptions of the study area (Brown 1960).

Floristically, Cronquist and others (1972) have considered the study area as the Uinta Mountains, the Wasatch Mountains, and the Great Basin "floristic divisions." Each division exhibits many distinct topographic, geologic, and climatic dissimilarities in addition to floristic ones. Indeed, the Uintas are more "Rocky Mountain" in all of these characters than is the Wasatch, a range that is more similar to those in the Great Basin (Cronquist and others 1972). As Cottam (1930) stated, "the Uinta Mountains represent Utah's only claim to a typical Northern Rocky Mountain Flora." This is reflected prominently in the associations of vegetation in each respective area and therefore, their prevalent habitat types.

Because of these differences, the Uinta Mountains are largely treated throughout the discussion as a separate region of the study area. The smaller, islandlike ranges of the Great Basin are fairly similar to the western front of the Wasatch Range. The Great Basin and Wasatch Ranges, therefore, are collectively referred to as the "northwestern region."

Topography and Geology

The Wasatch Range trends north-south from near Soda Springs, Idaho, through north-central Utah to its terminus near Nephi; a distance of some 220 miles (355 km) (Cronquist and others 1972). Approximately two-thirds of the range lies within the study area (fig. 1).

Structurally, the Wasatch Range consists of a thrust-faulted and folded syncline that has been uplifted by block faulting. Uplift has been more active along the western edge, or front. Consequently, the western edge tends to be the summit of the Wasatch Range proper, as well as that of the Bear River Range. Rising above a series of western valley systems lying about 4,000 to 4,500 feet (1 220 to 1 370 m) elevation, summits attain nearly 10,000 feet (3 050 m) elevation in the north and nearly 12,000 feet (3 660 m) elevation in the south. Limited alpine vegetation occurs in the latter area.

The western edge is characterized by steep faces (facets) and ridges as well as deep, V-shaped westerly trending canyon systems, of which only the Weber and Provo Rivers cut across the range. The Bear River section, somewhat broader than the rest of the range, includes fairly extensive upland topography. Its eastern flank, dissected by smaller streams, slopes gently to the Bear Lake-Bear River valleys at about 6,000 feet (1 830 m) elevation.

The surface geologic formations are varied and oftentimes complex. Near Logan, Utah, early Paleozoic rocks (quartzite-sandstone-shales of marine origin as well as dolomite and limestone) form the canyon sides. At higher elevations, limestones and calcareous sandstones of carboniferous deposition are also common. Precambrian quartzite is quite common in Idaho as well as near Willard, Utah. Between Ogden and Salt Lake City, the narrow Wasatch Front consists mostly of complex Precambrian schist and gneiss. The southernmost portion of the Wasatch Range within the study area and that near Logan are geologically similar. Precambrian quartzite and argillite, and various Paleozoic and Mesozoic sedimentary rocks (both calcareous and noncalcareous) are represented.

Additionally, two other formations are especially noteworthy. First, intrusive Tertiary granitoid rocks occur in the Little Cottonwood Canyon area. Second, the Wasatch conglomerate is widespread from the Idaho-Utah border through the central and eastern flank areas of the Wasatch Range to northeast of Salt Lake City. Terrain is typically gentle to rolling uplands. This formation is comprised of quartzite and shale fragments and is of early Tertiary deposition (Williams 1946). It has been mapped by Stokes (1962), and Stokes and Madsen (1961) as the Knight conglomerate and occurs in the northwestern Uinta Mountains.

In topography and geology the ranges of the Great Basin are similar to the Wasatch Range—with the possible exception of the Raft River Mountains. This minor range is geologically similar to the Uinta Mountains: an east-west orientation of some 25 miles (40 km), a core of Precambrian quartzite-schist-calcareous rocks, and local intrusions of Precambrian granitoids. Younger sedimentary rocks overlie its northwestern and eastern flanks.

Glaciation has occurred locally along the western crest of the Wasatch Range and in the Stansbury Mountains, leaving small cirques and drift as evidence (for example, at Tony Grove Lake near Logan). Glaciation has been most extensive southeast of Salt Lake City. There, glaciers formed typically large U-shaped canyons, with the glacier in Little Cottonwood Canyon extending downward to about 6,000 feet (1 830 m) elevation (Atwood 1909).

For Utah, the Uintas are almost an anomaly. Cronquist and others (1972, p. 152) have characterized the range as follows:

> The Uinta Mountains form an extensive east-west oriented anticlinal plateau, which for 100 miles rises above 9,000 feet elevation (55 miles of which is above 11,000 feet). The highest elevation is on Kings Peak at 13,498 feet.

These authors further note:

> The total area above timberline in the Uintas exceeds that of all the rest of the Intermountain Region combined. The extensive rolling hills of alpine country provide an environment for the development of a flora somewhat similar to that of the Arctic Region.

The central core of the anticline consists of Precambrian rocks. These are chiefly quartzite. Overlying sedimentary strata comprise the flanks. These include mainly Mississippian limestones and weakly calcareous sandstones (Kinney 1955) within the forested zones. Interbedded shales are locally common throughout both the core and flank areas. Several younger formations are especially significant, also.

The Duchesne formation, which was deposited during the late Eocene and which consists of fluvial sandstones of weathered quartzite as well as some mudstone, is represented chiefly west of the Whiterocks River. The quartziferous-dominated Browns Park formation of late Miocene or early Pliocene deposition occurs mainly east of the Uinta River. It forms gentle, locally extensive surfaces (Bradley 1964; Stokes and Madsen 1961).

Along the north-central flank, only limestones remain chiefly exposed. These occur as prominent, but discontinuous, moderate to steeply dipping sections that attain elevations of about 10,000 feet (3 050 m). Elsewhere, isolated evidence of late Oligocene or early Miocene pedimentation, which occurred in an arid or semiarid climatic regime, remains as the "Gilbert Peak surface" (Bradley 1964). Shallow bedrock is mainly associated with its upper extent, whereas the lower, more gentle extent is covered by an aggregated cobbly veneer of quartzite material. This extends well into the nonforested zone in Wyoming, which occurs below about 8,800 feet (2 680 m) elevation, and grades into the underlying Eocene-age shales of the Green River Basin.

The topography of the Uinta Mountains, then, is largely dominated by the above features. In addition, that of the more western and central areas has also been shaped by the extensive glaciation of recent time. There, several glaciers extended well into the surrounding basins. Those of the south slope cut very deep canyon systems, whereas those of the north slope were less pronounced in this respect. Throughout, the higher elevations are characterized by cirques and narrow ridges, which form a scalloped crest, and large, drift-covered basins. Additionally, extensive interbasin, plateaulike surfaces remain in most areas. The largely unglaciated lower reaches of the southwestern and eastern Uintas are characterized by deep, V-shaped canyon topography similar to that of the Wasatch Range.

Contrasting plant communities often develop at the contact of calcareous and noncalcareous substrates throughout northern Utah and adjacent Idaho. Various situations have become apparent in the course of this study. These are discussed under the appropriate series and habitat types. Many instances are quite similar to those which have been noted for Montana (Pfister and others 1977), central Idaho through western Wyoming (Steele and others 1981, 1983), and north-central Wyoming (Hoffman and Alexander 1976). Pfister and others (1977, p.12) have also listed several, more local studies of such communities in and around Montana. But for the Uinta Mountains in general and for *Pinus contorta* and *Pseudotsuga menziesii* there in particular, Despain's (1973) study of the Big Horn Mountains, Wyo., is especially significant in this respect.

The Wasatch conglomerate is unique in its effect on plant communities. For example, much of this surface formation occurs well within the temperature range of *Pseudotsuga*, yet *Pseudotsuga* is not widely associated with this substrate. Instead, persistent *Populus tremuloides* communities of fire origin as well as various nonforest communities dominate these sites. Whether this pattern represents an intolerance of *Pseudotsuga* to the soils or is related to past disturbance is uncertain. (On the other hand, some of the most productive sites for *Picea engelmannii* are associated with the highest occurrence of Wasatch conglomerates: the ABLA/PERA h.t., PERA phase.)

Soils

The forested soils of northern Utah are diverse because of the typically steep mountain topography and in some areas recent glaciation. Many soils are rather gravelly and well drained; others are rocky and shallow. Yet others are fairly deep and well developed, occupying toe-slope positions or gentle to rolling terrain. A few are seasonally moist, such as those associated with streamside terraces or seasonally high water tables.

Wilson and others (1975) have compiled the major soil associations of Utah, following the nomenclature of **Soil Taxonomy** (USDA Soil Conservation Service 1975). In general, the forest soils of northern Utah are represented by three broad soil groups, which are largely based on temperature and moisture regimen:

1. Group A.—Soils of the middle-to-high elevations that are cold (cryic temperature regime) and moist in parts throughout the summer. These occur typically throughout the upper montane and subalpine climax series. Two associations are represented. The Argic Cryoborolls-Pachic Cryoborolls-Cryic Paleborolls Association (-1) is found throughout the northwestern region as well as in the westernmost Uinta Mountains, whereas the Typic Cryorthents-Typic Cryochrepts-Mollic Cryoboralfs Association (-4) occurs throughout the central and eastern Uintas.
2. Group B.—Soils of the lower-to-middle elevations that are usually moist in some parts during the summer (ustic moisture regime). These are restricted to the southern and northeastern Uinta Mountains. The Lithic Argiborolls-Rock Outcrop-Typic Argiborolls Association (-9) is mainly represented .
3. Group F.—Soils of the lower-to-middle elevations that are usually dry during the summer (xeric moisture regime). These are restricted to the northwestern region. The two most widely represented associations are the Lithic Haploxerolls-Typic Haploxerolls Association (-24) and the Pachic Argixerolls-Typic Argixerolls-Calcic Argixerolls Association (-25).

The authors discuss the general depth, textural, and pH characteristics of these soil associations. In addition, Lawton (1979) studied several environmental parameters of selected habitat types east of Logan, Utah, and identified several soils in these associations.

Climate and Microclimate

The climate of Utah is determined largely by elevation, latitude, and the principal storm patterns that track oceanic moisture into the State (Brown 1960). Given the rather narrow latitude encompassed by the study area (about 2°), climatic uniformity would be expected. Actually, the climates of the two regions are distinctly different, largely because of moisture patterns. This is expressed in their respective vegetation—and their habitat types.

Climatological data from stations that record both temperature and precipitation are presented in appendix D-2. In addition, precipitation data from two stations in the Uinta Mountains are presented. Although only a few stations are situated within the forested zone, the others allow general comparisons within northern Utah.

Temperature is influenced most strongly by elevation. Generally for Utah, mean annual temperature decreases about 3° F (1.7° C) for each 1,000-foot (305-m) increase in altitude, and decreases approximately 1.5° to 2.0° F (0.8° to 1.1° C) for each 1° increase in latitude (Brown 1960). Temperature and microclimate, however, can be greatly modified by slope exposure or cold air drainage or accumulation.

Two additional influences on temperature are locally present during the winter months. First, strong temperature inversions, ranging from 500 to 1,500 feet (150 to 455 m) in depth, develop in surrounding valleys as a result of down-slope cold air drainage and valley accumulation. Thus, temperatures of lower mountain slopes situated above the inversion layers can average between 9° and 18° F (5° to 10° C) higher than valley bottoms (Wilson and others 1975). Second, both the Great Salt Lake and Provo Lake have a mediating effect on the temperatures of nearby mountains (Brown 1960); these lakes also increase local precipitation by increasing the moisture content of the westerly storm systems.

The effect of latitude on temperature has special significance within the study area. *Abies concolor* has its northernmost Rocky Mountain location near Logan, Utah. As a viable climax, however, *A. concolor* essentially terminates much farther south in the vicinity of Ogden. Some possible temperature-latitude relationships that might influence species distribution are discussed under the *A. concolor* series.

The influx of oceanic moisture follows two general patterns. Throughout the winter and spring, the principal storm track flows westerly from the Pacific. Much of the moisture in this flow is lost in the Sierra Nevada area prior to reaching Utah. This flow is largely absent during the summer months, which creates an extended dry period, with the exception of local thunderstorms.

The second pattern is associated with moisture-laden air flowing into southeastern Utah from the Gulf of Mexico during the spring and summer months. This pattern usually penetrates only to the southern Uinta Mountains. There orographic storms regularly develop. For example, mean precipitation for the period of May to August is about 10 percent higher for the Uinta stations than for the Wasatch Range stations (appendix D-2). The occurrence of *Pinus ponderosa* (within its temperature limits) could reflect the distribution of this early growing season rainfall through the lower eastern Uintas to the northeastern area. Farther west, the high crest creates a rain shadow condition in local areas of the north-central slopes. There, *Pinus contorta* is frequently the indicated climax. Both of these vegetation patterns are discussed in more detail under each respective series.

Wind patterns also significantly influence vegetation. Windspeed usually varies with elevation and local topography, with upper slopes and ridgetops being most windy. Windspeed averages 15 to 20 miles per hour (24 to 32 km/h) at higher elevations, and about half of these values at lower elevations. Winds up to 90 miles per hour (145 km/h) accompany cold fronts, intense thunderstorms, and regional air movements (Wilson and others 1975). As Pfister (1972) has pointed out, the physiological stress induced by wind substantially reduces the effects of increased precipitation at higher elevations. Additionally, wind reduces snowpack accumulation on particularly exposed sites through wind erosion and sublimination. This is especially apparent where *Pinus flexilis* occurs; there, winter soil temperatures are also substantially lower (usually freezing) because of an absence of an insulating snowpack.

THE HABITAT TYPE CLASSIFICATION

A total of 36 habitat types are defined for northern Utah and adjacent Idaho. This large number of habitat types reflects the geologic and climatic relationships of the area to both the Great Basin and the Rocky Mountain system. In addition, the more common habitat types are divided into phases to further stratify the forested landscape.

The entire classification is listed in table 1 for convenient reference. Only scientific names are used in the text to prevent the confusion that might result from common names. However, common names of the categories are included in table 1, under each habitat type description heading, and in the checklist, appendix F. Frequent reference to type names requires the use of abbreviations; all follow a standard four-letter code, which consists of the first two letters of the genus and the first two letters of the species. Initially this code may be confusing, but it is easily mastered.

The classification is presented in the following order:

1. Key to the habitat types (fig. 3).—The first step in the correct identification of the habitat type is to become familiar with the instructions for the use of the key. The identification of the potential climax series, the habitat type, and finally the phase follows.
2. Series description.—This provides a general overview for each series and the habitat types. It usually includes a discussion of characteristics common to most of the habitat types within the series.
3. Habitat type description.—This information summarizes the geographic range, environmental features, vegetation, phases, and general management implications.

The series are discussed in an order that generally corresponds to an increasing moisture gradient and an increasing altitudinal gradient. Of course, not all series are encountered in any given location of the study area; the westernmost Uinta Mountains are the most diverse in this respect.

Under each series habitat types are presented in the order of their position in the key. Typically, the position of an indicator species in the key also reflects its relative ecological amplitude—species appearing first tend to have more restricted requirements and are on more moist sites than those appearing later. The order of habitat types usually reflects the relative extent of the type across the landscape, except that most of the last few types listed are minor in occurrence. Until the user gains experience with the classification, the identification of particularly awkward sites can be aided by this knowledge of indicator amplitudes and of the relative dryness of a site.

The extent of the habitat types is indicated by relative terms. "Incidental" types occur as isolated extensions of types that reportedly are more common in other areas, such as ABLA/STAM. "Local," or "minor," habitat types are either prevalent in specific locations within the study area (for example, ABLA/CARU) or widespread in occurrence but do not occupy extensive area throughout a region or the entire study area (ABLA/CACA). "Major" habitat types are both widely distributed and extensive (PSME/BERE, ABLA/BERE and ABLA/VASC).

Figure 3.—Key to climax series, habitat types, and phases.

READ THESE INSTRUCTIONS FIRST!

1. Use this key for stands with a mature tree canopy that are not severely disturbed by grazing, logging, forest fire, etc. (If the stand is severely disturbed or in an early successional stage, the habitat type can best be determined by extrapolating from the nearest mature stand occupying a similar site.)
2. Accurately identify and record canopy coverages for all indicator species (appendix F). Canopy coverage is the nearest percentage of cover, from 1 to 10 percent and the nearest 5 percent thereafter. If a species is present with a 0.5 percent cover and is not obviously restricted to atypical microsites, record a "T" for trace.
3. Check plot data in the field to verify that the plot is representative of the stand as a whole. If not, take another plot.
4. Identify the correct potential climax tree species in the Series key. (Generally, a tree species is considered reproducing successfully if 10 or more individuals per acre [25 per hectare] occupy or will occupy the site.)
5. Within the appropriate series, key to HABITAT TYPE by following the key literally. Determine the phase by matching the stand conditions with the phase descriptions for the type. (The first phase description that fits the stand is the correct one.)
6. If you have difficulty deciding between types, refer to constancy and coverage data (appendix C-1) and the habitat type descriptions.
7. In stands where undergrowth is obviously depauperate (unusually sparse) because of dense shading or litter accumulations, reduce the critical key coverage levels from 1 percent to "present" and 5 percent to 1 percent.
8. Remember, the key is NOT the classification! Validate the determination made using the key by checking the written description.

Key to Climax Series

(DO NOT PROCEED UNTIL YOU HAVE READ THE INSTRUCTIONS!)

1. *Abies lasiocarpa* present and reproducing successfully	*Abies lasiocarpa* Series (Item H)
1. *Abies lasiocarpa* not the indicated species	2
2. *Abies concolor* present and reproducing successfully	*Abies concolor* Series (Item E)
2. *Abies concolor* not the indicated climax	3
3. *Picea engelmannii* present and reproducing successfully	*Picea engelmannii* Series (Item F)
3. *Picea engelmannii* not the indicated climax	4
4. *Picea pungens* present and reproducing successfully	*Picea pungens* Series (Item D)
4. *Picea pungens* not the indicated climax	5
5. *Pinus flexilis* a successfully reproducing dominant, often sharing that status with *Pseudotsuga*	*Pinus flexilis* Series (Item A)
5. *Pinus flexilis* absent or clearly seral	6
6. *Pseudotsuga menziesii* present and usually reproducing successfully	*Pseudotsuga menziesii* Series (Item C)
6. *Pseudotsuga menziesii* not the indicated climax	7
7. *Pinus ponderosa* present and reproducing successfully	*Pinus ponderosa* Series (Item B)
7. *Pinus ponderosa* not the indicated climax	8
8. Pure *Pinus contorta* stands with little evidence as to potential climax	*Pinus contorta* Series (Item G)
8. *Pinus contorta* absent; *Populus tremuloides* present	*Populus tremuloides* Series (Unclassified)

(con.)

Figure 3.—(con.)

A. Key to *Pinus flexilis* Habitat Types

1. *Cercocarpus ledifolius* at least 5% cover (and persistent)	*Pinus flexilis/Cercocarpus ledifolius* h.t. (p. 20)
1. *C. ledifolius* less than 5% cover or clearly seral	2
2. *Berberis repens* at least 1% cover.	*Pinus flexilis/Berberis repens* h.t. (p. 21)
2. *B. repens* less than 1% cover; *Leucopoa kingii* present	*Pinus flexilis/Leucopoa kingii* h.t. (p. 20)

B. Key to *Pinus ponderosa* Habitat Types

1. *Carex geyeri* at least 5% cover	*Pinus ponderosa/Carex geyeri* h.t. (p. 22)
1. Not as above; *Festuca idahoensis* or *F. ovina* present	*Pinus ponderosa/Festuca idahoensis* h.t. (p. 22)
a. *Arcostaphylos patula* at least 5% cover	*Arctostaphylos patula* phase
b. *Artemisia tridentata* at least 5% cover	*Artemisia tridentata* phase
c. Not as above	*Festuca idahoensis* phase

C. Key to *Pseudotsuga menziesii* Habitat Types

1. *Physocarpus malvaceus* at least 5% cover	*Pseudotsuga menziesii/Physocarpus malvaceus* h.t. (p. 25)
1. *P. malvaceus* less than 5% cover	2
2. *Acer glabrum* at least 5% cover	*Pseudotsuga menziesii/Acer glabrum* h.t. (p. 26)
2. *A. glabrum* less than 5% cover	3
3. *Osmorhiza chilensis* or *O. depauperata* at least 5% cover either separately or collectively	*Pseudotsuga menziesii/Osmorhiza chilensis* h.t. (p. 26)
3. *O. chilensis* or *O. depauperata* less than 5% cover	4
4. *Calamagrostis rubescens* at least 5% cover	*Pseudotsuga menziesii/Calamagrostis rubescens* h.t. (p. 27)
4. *C. rubescens* less than 5% cover	5
5. *Cercocarpus ledifolius* at least 5% cover	*Pseudotsuga menziesii/Cercocarpus ledifolius* h.t. (p. 27)
5. *C. ledifolius* less than 5% cover	6
6. *Berberis repens* or *Pachistima myrsinites* at least 1% cover	*Pseudotsuga menziesii/Berberis repens* h.t. (p. 28)
a. *Carex geyeri* at least 5% cover	*Carex geyeri* phase
b. *Juniperus communis* at least 5% cover	*Juniperus communis* phase
c. *Symphoricarpos oreophilus* at least 5% cover and *Leucopoa kingii* usually present, stands isolated or never achieving closed canopies	*Symphoricarpos oreophilus* phase
d. Not as above	*Berberis repens* phase
6. *B. repens* and *P. myrsinites* less than 1% cover; *Symphoricarpos oreophilus* present (and usually greater than 5% cover)	*Pseudotsuga menziesii/Symphoricarpos oreophilus* h.t. (p. 30)

(con.)

Figure 3.—(con.)

D. Key to *Picea pungens* Habitat Types

1. *Equisetum arvense* at least 5% cover	*Picea engelmannii/Equisetum arvense* h.t. (p. 36)
1. *E. arvense* less than 5% cover	2
2. *Agropyron spicatum* at least 1% cover	*Picea pungens/Agropyron spicatum* h.t. (p. 32)
2. *A. spicatum* less than 1% cover; *Berberis repens* or *Juniperus communis* present	*Picea pungens/Berberis repens* h.t. (p. 32)

E. Key to *Abies concolor* Habitat Types

1. *Physocarpus malvaceus* at least 10% cover	*Abies concolor/Physocarpus malvaceus* h.t. (p. 34)
1. *P. malvaceus* less than 10% cover	2
2. *Osmorhiza chilensis* at least 10% cover (or riparian tree species present)	*Abies concolor/Osmorhiza chilensis* h.t. (p. 34)
2. Not as above; *Berberis repens* or *Pachistima myrsinites* present	*Abies concolor/Berberis repens* h.t. (p. 34)
a. *Symphoricarpos oreophilus* at least 5% cover or stands isolated or never achieving closed canopy	*Symphoricarpos oreophilus* phase
b. Not as above	*Berberis repens* phase

F. Key to *Picea engelmannii* Habitat Types

1. *Equisetum arvense* at least 5% cover	*Picea engelmannii/Equisetum arvense* h.t. (p. 36)
1. *E. arvense* less than 5% cover	2
2. *Calamagrostis canadensis* at least 5% cover	*Abies lasiocarpa/Calamagrostis canadensis* h.t. (p. 40)
2. *C. canadensis* less than 5% cover	3
3. *Caltha leptosepala* at least 1% cover	*Picea engelmannii/Caltha leptosepala* h.t. (p. 37)
3. *C. leptosepala* less than 1% cover	4
4. *Vaccinium caespitosum* at least 1% cover	*Picea engelmannii/Vaccinium caespitosum* h.t. (p. 37)
4. *V. caespitosum* less than 1% cover	5
5. *Vaccinium scoparium* at least 5% cover	*Picea engelmannii/Vaccinium scoparium* h.t. (p. 38)
5. *Vaccinium scoparium* less than 5% cover	6
6. *Ribes montigenum* present	*Abies lasiocarpa/Ribes montigenum* h.t. (p. 51)
6. *R. montigenum* absent; *Juniperus communis* the major undergrowth species	*Abies lasiocarpa/Juniperus communis* h.t. (p. 54)

(con.)

Figure 3.—(con.)

G. Key to *Pinus contorta* Communities

1. *Calamagrostis canadensis* at least 5% cover	*Pinus contorta/Calamagrostis canadensis* c.t. (p. 56)
1. *C. canadensis* less than 5% cover	2
2. *Vaccinium caespitosum* at least 1% cover	*Pinus contorta/Vaccinium caespitosum* c.t. (p. 56)
2. *V. caespitosum* less than 1% cover.	3
3. *Vaccinium scoparium* at least 5% cover	*Pinus contorta/Vaccinium scoparium* h.t. (p. 57)
3. *V. scoparium* less than 5% cover	4
4. *Calamagrostis rubescens* at least 5% cover	*Abies lasiocarpa/Calamagrostis rubescens* h.t. (p. 45)
4. *C. rubescens* less than 5% cover	5
5. Stands of the south-central Uintas; *Juniperus communis* (or *Arctostaphylos patula*) the dominant undergrowth	*Pinus contorta/Juniperus communis* h.t. (p. 58)
5. Not as above	6
6. *Arctostaphylos uva-ursi* at least 1% cover	*Pinus contorta/Arctostaphylos uva-ursi* h.t. (p. 58)
6. *A. uva-ursi* less than 1%	7
7. *Berberis repens* or *Pachistima myrsinites* present	*Pinus contorta/Berberis repens* c.t. (p. 59)
7. *B. repens* and *P. myrsinites* absent	*Pinus contorta/Carex rossii* h.t. (p. 60)

H. Key to *Abies lasiocarpa* Habitat Types

1. *Equisetum arvense* at least 5% cover	*Picea engelmannii/Equisetum arvense* h.t. (p. 36)
1. *E. arvense* less than 5% cover	2
2. *Calamagrostis canadensis* at least 5% cover	*Abies lasiocarpa/Calamagrostis canadensis* h.t. (p. 40)
2. *C. canadensis* less than 5% cover	3
3. *Streptopus amplexifolius* or *Senecio triangularis* at least 5% cover either separately or collectively	*Abies lasiocarpa/Streptopus amplexifolius* h.t. (p. 41)
3. Not as above	4
4. *Caltha leptosepala* at least 1% cover	*Picea engelmannii/Caltha leptosepala* h.t. (p. 37)
4. *C. leptosepala* less than 1% cover	5
5. *Actaea rubra* at least 5% cover	*Abies lasiocarpa/Actaea rubra* h.t. (p. 41)
5. *A. rubra* less than 5% cover	6
6. *Physocarpus malvaceus* at least 5% cover	*Abies lasiocarpa/Physocarpus malvaceus* h.t. (p. 41)
6. *P. malvaceus* less than 5% cover	7
7. *Acer glabrum* or *Sorbus scopulina* at least 5% cover either separately or collectively	*Abies lasiocarpa/Acer glabrum* h.t. (p. 42)
7. Not as above	8
8. *Vaccinium caespitosum* at least 1% cover	*Abies lasiocarpa/Vaccinium caespitosum* h.t. (p. 42)
8. *V.caespitosum* less than 1% cover	9

(con.)

9. *Vaccinium globulare* at least 5%	*Abies lasiocarpa/Vaccinium globulare* h.t. (p. 43)
9. *V. globulare* less than 5% cover	10
10. *Vaccinium scoparium* at least 5% cover	*Abies lasiocarpa/Vaccinium scoparium* h.t. (p. 44)
a. *Arnica latifolia* at least 1% cover	*Arnica latifolia* phase
b. *Carex geyeri* at least 5% cover	*Carex geyeri* phase
c. Not as above	*Vaccinium scoparium* phase
10. *V. scoparium* less than 5% cover	11
11. *Calamagrostis rubescens* at least 5% cover	*Abies lasiocarpa/Calamagrostis rubescens* h.t. (p. 45)
11. *C. rubescens* less than 5% cover	12
12. *Pedicularis racemosa* at least 1% cover and *Ribes montigenum* or *Pinus flexilis* absent	*Abies lasiocarpa/Pedicularis racemosa* h.t. (p. 46)
a. *Pseudotsuga menziesii* present	*Pseudotsuga menziesii* phase
b. Not as above	*Pedicularis racemosa* phase
12. Not as above	13
13. *Berberis repens* or *Pachistima myrsinites* present	*Abies lasiocarpa/Berberis repens* h.t. (p. 47)
a. *Pinus flexilis* a dominant overstory component	*Pinus flexilis* phase
b. *Ribes montigenum* present	*Ribes montigenum* phase
c. *Carex geyeri* at least 5% cover	*Carex geyeri* phase
d. *Juniperus communis* at least 5% cover	*Juniperus communis* phase
e. *Pseudotsuga menziesii* present	*Pseudotsuga menziesii* phase
f. Not as above	*Berberis repens* phase
13. Not as above	14
14. *Ribes montigenum* present	*Abies lasiocapra/Ribes montigenum* h.t. (p. 51)
a. *Trisetum spicatum* present; stands of the upper timber-line zone	*Trisetum spicatum* phase
b. *Pinus contorta* a major over-story component; stands of the south-central Uinta Mountains	*Pinus contorta* phase
c. *Thalictrum fendleri* present	*Thalictrum fendleri* phase
d. Not as above	*Ribes montigenum* phase
14. *R. montigenum* absent	15
15. *Osmorhiza chilensis* or *O. depauperata* at least 1% Cover either separately or collectively	*Abies lasiocarpa/Osmorhiza chilensis* h.t. (p. 53)
15. Not as above; *Juniperus communis* the major Undergrowth species	*Abies lasiocarpa/Juniperus communis* h.t. (p. 54)

Pinus flexilis Series

Distribution.—This series has a limited distribution in northwestern Utah and adjacent Idaho, occurring principally in the northern Wasatch Range. Stands are found on all aspects but normally occupy south- to west-facing slopes or ridgetops of about 7,000 feet (2 135 m) to above 8,700 feet (2 650 m) elevation. These exposures represent some of the most adverse environments for tree growth within the *Abies lasiocarpa* and upper *Pseudotsuga menziesii* zones. In this respect, the *Pinus flexilis* series represents a topographic or edaphic climax.

Vegetation.—In northwestern Utah, stands of this series do not usually have *Pinus flexilis* as the only tree species present: more often *Pseudotsuga* is a climax associate. Normally *Pinus flexilis* is a successfully reproducing dominant with no indication of being replaced at climax. Stands have trees that occur either singly or in scattered groups. Recent evidence indicates that *Pinus flexilis* establishment throughout much of this series is the result of abandoned seed caches of the Clark's nutcracker (Lanner and Vander Wall 1980).

Undergrowth is typically shrubby. Principal species include *Symphoricarpos oreophilus*, *Berberis repens*, and various Asteraceae and bunchgrasses, species which are also commonly representative of adjacent, drier nonforest communities (Ream 1964). In addition, where *Cercocarpus ledifolius* is persistent, undergrowth is often impenetrably dense. Adjacent, more moderate exposures are the PSME/CELE or PSME/BERE h.t.'s.

Soils/climate.—This series occurs on calcareous and shaley-quartziferous substrates, which are often considerably exposed at the surface (appendix D). Soils are correspondingly shallow and gravelly, and surface textures range from sandy loam to clayey. Loose surface rock and bare soil are also typically present. Erosion of fine particles is usually evident. Litter accumulation is often intermittent and shallow; litter depth for the series averages 0.6 inches (1.6 cm).

Exposures are droughty, relatively warm (but with high diurnal and seasonal temperature differences) and subject to year-long dessicating winds. In addition to accelerating evapotranspiration, these winds substantially reduce snowpack accumulation. Soils commonly freeze and have low moisture-holding capacity. Lack of soil moisture is somewhat ameliorated, however, by the fractured bedrock which provides a deeper rooting medium. (Climatological data are unavailable.)

Fire history.—Evidence of past fires is scant. Light surface fires likely occurred, but their effect on undergrowth was probably inconsequential.

Productivity/management.—This series is important watershed cover and also provides cover and browse for deer in the summer, particularly where *Cercocarpus* is vigorous and accessible. Livestock use the type primarily for shade wherever the more open stands are near forage areas. *Pinus flexilis* seeds, which are relatively large, supply a critical food source for small mammals and birds.

Timber productivity is very low to low (appendix E). This is attributed to sporadic regeneration, stockability limitations, and poor growth.

Other studies.—*Pinus flexilis* habitat types have been described in Montana by Pfister and others (1977); central Idaho by Steele and others (1981); eastern Idaho and western Wyoming by Steele and others (1983); and southeastern Wyoming by Wirsing and Alexander (1975).

Other various *Pinus flexilis* habitats have been described in the Bighorn Mountains of Wyoming (Despain 1973); New Mexico, Colorado and southeastern Wyoming (Peet 1978); and Utah (Ellison 1954; Pfister 1972; Ream 1964).

The *Pinus flexilis/Leucopoa kingii* h.t. (*Hesperochola kingii*), described by Steele and others (1983) and Wirsing and Alexander (1975), may be present in northwestern Utah. Specific considerations are discussed for the PIFL/CELE and PIFL/BERE h.t.'s.

PINUS FLEXILIS/CERCOCARPUS LEDIFOLIUS H.T.(PIFL/CELE; LIMBER PINE/CURLLEAF MAHOGANY)

Distribution.—This habitat type occurs mainly in the northern Wasatch Range. The most common exposures are southerly to westerly upper slopes and ridgetops between about 7,000 and 8,700 feet (2 135 and 2 650 m) elevation.

Vegetation.—*Pinus flexilis* is the indicated climax, usually with *Pseudotsuga* as a climax associate. Normally, old-growth stands are open (fig. 4).

Figure 4. *Pinus flexilis/Cercocarpus ledifolius* h.t. on a gentle southeasterly slope toward the north end of the Bear River Range on the Wasatch-Cache National Forest (7,300 feet [2 230 m] elevation). *Artemisia tridentata* and *C. ledifolius* are prominent shrubs among the scattered *P. flexilis*; the herb layer is dominated by the grasses *Leucopoa kingii* and *Stipa lettermannii*.

Undergrowth is characterized by persistent *Cercocarpus* constituting variable but conspicuous cover. Other shrubs are *Artemisia tridentata*, *Berberis repens*, *Chrysothamnus viscidiflorus*, *Pachistima myrsinites*, and *Symphoricarpos oreophilus*. Common herbaceous species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Comandra pallida*, *Eriogonum* spp., *Lomatium nuttallii*, *Agropyron spicatum*, *A. trachycaulum*, *Leucopoa kingii*, and *Stipa lettermannii*.

Soils.—Soils are as described for the series.

Productivity/management.—The habitat type is primarily valued as deer summer range and watershed protection. Timber productivity is low (appendix E). Nevertheless, *Pinus* can attain massive diameters of 40+ inches (100+ cm) and exceed 500 years age, but heights are considerably less than those for *Pseudotsuga*.

A deviation in the site-index analysis should be noted. For this habitat type only, average site index represents values obtained mainly from old-growth trees (computed at 200 years age). These estimates appear to be reasonable because other sample trees in the same stand meeting the age criterion have values slightly below those of the old-growth trees.

Other studies.—PIFL/CELE was described in east-central Idaho by Steele and others (1981). It was also noted in eastern Idaho (Steele and others 1983).

The ridgetop sites located on the eastern flank of the Wasatch Range near Paris, Idaho, are physionomically similar to the PIFL/LEKI h.t., described by Steele and others (1983) and Wirsing and Alexander (1975). Undergrowth, however, has persistent *Cercocarpus* but is otherwise more steppelike, including abundant *Artemisia tripartita*. Such sites are common only to this locality and probably reflect a regional transition between the PIFL/LEKI and PIFL/CELE h.t.'s.

PINUS FLEXILIS/BERBERIS REPENS H.T. (PIFL/BERE; LIMBER PINE/OREGONGRAPE)

Distribution.—PIFL/BERE is a rather uncommon habitat type that occurs in the northern Wasatch Range in the vicinity of Logan, Utah. It occurs on steep, southerly slopes and ridgetops near 7,000 feet (2 135 m) elevation, and at lower elevations (to 6,500 feet [1 982 m]) on northerly exposures.

Vegetation.—*Pinus flexilis* is the indicated climax, and *Pseudotsuga* is often a climax codominant. *Juniperus scopulorum* is locally a minor seral associate.

Undergrowth is shrubby, being dominated by *Berberis repens*, *Pachistima myrsinites*, *Prunus virginiana*, and *Symphoricarpos oreophilus*. Herbaceous species include *Comandra pallida*, *Mertensia oblongifolia*, *Senecio integerrimus*, *Viola purpurea*, *Agropyron spicatum*, *A. trachycaulum*, *Leucopoa kingii*, and occasionally *Elymus cinereus* as well.

Soils.—Soils are as described for the series, although they are somewhat more protected from environmental fluctuations. Also, bare soil is less than that of the PIFL/CELE h.t. and litter is somewhat more uniform.

Productivity/management.—Principal uses are as deer summer range and watershed cover. Timber productivity is very low to low (appendix E) because of stockability limitations. Site index, however, appears to be significantly higher than that in the PIFL/CELE h.t., particularly for *Pseudotsuga*.

Other studies.—The PIFL/BERE h.t. has not been identified previously in the literature. Undergrowth is somewhat similar compositionally to that of the PIFL/HEKI h.t. of eastern Idaho and western Wyoming (Steele and others 1983), but undergrowth structure and site exposures are not physiognomically similar.

Pinus ponderosa Series

Distribution.—Sites having *P. ponderosa* as the indicated climax occur primarily in the eastern and southern Uinta Mountains.[1] There, the series occupies warm and dry exposures through a rather narrow altitudinal belt: this is summarized in table 3. Generally, soils are well drained and sandy. The series is seldom found on clayey soils or those derived from limestone. Topography is typically gentle in the northeastern area where the series occurs between about 7,100 and 8,400 feet (2 165 and 2 560 m) elevation. In the southern areas, however, the series occurs on steeper topography between about 8,100 and 8,900 feet (2 470 and 2 715 m) elevation.

Climatic factors strongly influence the distribution of the series. Its geographic extent is generally associated with the prevailing patterns of greatest early growing season precipitation. On droughty soils, minimum season temperatures influence the upper elevation limits of this series.

P. ponderosa is also found in the western Uintas, particularly near Kamas, Utah, and in very isolated locations in the Wasatch Range as well. This species sometimes appears to be seral in these areas. A few of these stands are experimental plantations that date in origin from 1913 to 1920 (Baker and Korstian 1931).

The *Pinus contorta* series, and locally the *Pseudotsuga* and *Picea pungens* series, are adjacent to or above this series on the more moist or colder exposures, or on limestone substrates. The *P. ponderosa* series is normally bounded at the warmer and drier extent by various shrub, grassland, or woodland communities.

Vegetation.—The structure of mature stands varies from rather open to locally dense. Likewise, age structure ranges from all-aged to irregular even-aged groups or completely even-aged stands. *Pinus contorta* and *Populus tremuloides* are the most significant seral associates (appendix B).

Graminoids are normally conspicuous in the undergrowth, and various shrub species are dominant in certain parts of the series. Physiognomically, undergrowth of the PIPO/CAGE h.t. is similar to *Carex geyeri*-dominated undergrowths of the other series. Undergrowth of the FEID phase of the PIPO/FEID h.t., however, is altogether unique in northern Utah; it is an open forest-grassland.

Soils/climate.—This series is generally associated with quartzite parent materials, except in the southern area where it is also associated with sandstone (appendix D). The well-drained, gravelly soils are shallow when over bedrock, but deeper when developed from various depositional features. The latter soils are more common in the

[1]Sites must be additionally capable of supporting mature stands that have an aggregate overstory canopy coverage of at least 25 percent, excluding woodland species (*Pinus edulis*, *Juniperus*, and *Quercus gambelii*). Note that woodlands having *P. ponderosa* as a component are unclassified.

lower southern areas. Most surface soils are sandy loams or loams. Exposed surface rock is greater in the south, but normally bare soil is absent throughout. Litter depth is fairly uniform.

No weather stations exist within the series. Data from Flaming Gorge, however, located below the series in a *Pinus-Juniperus* woodland community, are presented in appendix D-2.

Fire history.—Fires were undoubtedly frequent in the past. Large *P. ponderosa* are resistant to surface fires, but fire will kill or damage seedlings and smaller trees. Destructive crown fires sometimes occur in dense stands of young trees. Thus, fire locally shapes stands and, conversely, stand structure can influence significantly burning patterns and intensity.

Fire effects do not long persist in undergrowth that is principally herbaceous. But where chaparral-like undergrowth occurs, as in the PIPO/FEID h.t., ARPA phase, fire can greatly affect local composition and structure for some time. Different shrub species react differently to fire. For instance, ecotypes of *Purshia tridentata* may be killed outright by light surface fires, but usually reseed easily. *Arctostaphylos* regenerates readily following a necessary seed scarification by fire and may also resprout from surviving root crowns, as it does in parts of Oregon (Franklin and Dyrness 1973). Frequent fires, then, would tend to result in the development of a dense, shrubby undergrowth that would persist under conditions of less than maximum overstory density.

Productivity/management.—Timber productivity ranges from very low to low (appendix B). This is largely because of stockability limitations. PIPO/CAGE is generally the most productive habitat type of the series.

Opportunities for timber management are generally good for the more moderate sites. Throughout the *P. ponderosa* series, however, relatively intense competition from undergrowth vegetation as well as relatively unfavorable soil moisture conditions greatly retard seedling establishment; this is further compounded by infrequent seed production. But when all factors are favorable, especially summer precipitation, *P. ponderosa* readily regenerates. As Wellner and Ryker (1973) suggest, the multitude of stand conditions present in the series usually provide several viable strategies for natural regeneration: methods include selection, shelterwood, and small clearcuts. Some site preparation might be necessary for all. Also, artificial regeneration may be successful on the better sites.

Where sites are less brushy, this series provides good forage for domestic livestock. Deer use for browse and as cover is moderate.

Other studies.—Various *Pinus ponderosa* habitat types have been described from the Northern Rocky Mountains (Daubenmire and Daubenmire 1968; Hoffman and Alexander 1976; McLean 1970; Pfister and others 1977; Steele and others 1981; Thilenius 1972; Wirsing and Alexander 1975). In addition, Franklin and Dyrness (1973) have summarized the *P. ponderosa* communities of the Northwestern United States, many of which have *P. ponderosa* as the indicated climax.

PINUS PONDEROSA/CAREX GEYERI H.T. (PIPO/CAGE; PONDEROSA PINE/ELKSEDGE)

Distribution.—This habitat type, the most moist in the series, is apparently restricted in distribution to the northeastern Uinta Mountains where it occupies gentle slopes. Elevational range and exposures are summarized in table 3.

Vegetation.—*Pinus ponderosa* is the indicated climax. *Pseudotsuga menziesii* is accidental. Normally canopies are moderately dense and stands are even-aged or are comprised of groups of different ages.

Undergrowth is characterized by a prominent ground cover of *Carex geyeri*. Other species common in the type include *Amelanchier alnifolia, Berberis repens, Pachistima myrsinites, Symphoricarpos oreophilus, Antennaria* spp., and *Poa nervosa*. Herbaceous species are normally inconspicuous, however.

Cooler adjacent sites are generally occupied by the PSME/BERE h.t., CAGE phase, or *Pinus contorta* communities. The latter communities also occupy nearby sites having shallower soils or those with greater gravel content. In addition, *Arctostaphylos uva-ursi* is occasionally abundant, reflecting a transition to the drier and perhaps more frost-prone PICO/ARUV h.t.

Soils.—Our sample stands are associated with some of the deeper, more developed montane soils encountered in the northeastern Uinta Mountains. Substrates are quartzite (appendix D). Soil surface textures are sandy loam or loamy, and normally gravel is present. Surface rock and bare soil are typically absent. Litter depth averages 1.8 inches (2.9 cm).

Productivity/management.—Timber productivity is low (appendix E). Average sample site index is the highest in the series, but stockability limitations reduce productivity. Even-aged management of *Pinus* by shelterwoods or small clearcuts appears to be the most feasible option for most sites. Also, site preparation may be necessary to reduce early competition from *C. geyeri*.

Deer use for cover is moderate. Domestic livestock use is low. Overstory manipulation should increase forage production, resulting in increased ungulate use.

Other studies.—The PIPO/CAGE h.t. was first described by Wirsing and Alexander (1975) in the Medicine Bow National Forest of southeastern Wyoming. It was most extensive in the Laramie Peak area but was absent from the Sierra Madre area, the area closest to the Uinta Mountains. This habitat type has not been described in other studies.

PINUS PONDEROSA/FESTUCA IDAHOENSIS H.T. (PIPO/FEID; PONDEROSA PINE/IDAHO FESCUE)

Distribution.—This is the most common habitat type in this series, occurring in the northeastern and south-central areas of the Uinta Mountains. In general, exposures are warm and dry, and elevations range from 7,100 to 8,400 (2 165 to 2 560 m) in the northeast and from 8,100 to 8,900 feet (2 470 to 2 715 m) in the south-central area. Three phases are recognized; a more detailed summarization of elevation and exposure by phase and area of occurrence is presented in table 3.

Table 3.—Distribution of the PIPO/CAGE h.t. and phases of the PIPO/FEID h.t. in different geographic areas of the Uinta Mountains

Habitat type	Northeastern		South-central	
	Elevation range	Exposure	Elevation range	Exposure
	Feet (m)		*Feet (m)*	
PIPO/CAGE	7,200-8,300 (2 195-2 530)	NW-SE	None	
PIPO/FEID-ARPA	None		8,100-8,900 (2 470-2 715)	W,NE-S
PIPO/FEID-ARTR	7,500-8,300 (2 285-2 530)	W-N,SE	8,300 (2 530)	SE
PIPO/FEID-FEID	7,100-8,400 (2 165-2 560)	NW-SE	8,200-8,600 (2 500-2 620)	E-S-W

Vegetation.—*Pinus ponderosa* is the indicated climax; on some sites it is also the only tree species present. *Pseudotsuga* is accidental. The seral species *Pinus contorta, Populus tremuloides*, and *Juniperus scopulorum* differ in importance and distribution by phase (appendix B). Stand structure varies from very open to rather dense, and from all-aged to even-aged.

Depending on the phase, the undergrowth ranges from densely brushy to depauperate. *Festuca idahoensis* and/or *F. ovina* generally dominate the herbaceous component (fig. 5), although *Poa fendleriana* sometimes dominates in the south-central area. Other common graminoids are *Carex rossii* and *Sitanion hystrix*. Shrub species usually encountered throughout the type include *Amelanchier alnifolia, Artemisia tridentata vaseyana, Berberis repens*, and *Juniperus communis*. The more droughty sites also have *Amelanchier utahensis* and *Cercocarpus montanus*, the latter being more local in occurrence. Forb composition is generally diverse, but the species are usually inconspicuous; *Antennaria* spp. and *Heterotheca villosa* are notable exceptions.

***Arctostaphylos patula* (ARPA) phase.**—This warm, dry phase was found only in the south-central area where some sites occupy the highest elevations of the series (table 3). Topography is variable but includes primarily gentle terrain, and steep northeasterly slopes and ridgetops.

Pinus contorta and *Populus* are the principal seral associates. Each has a local distribution but only the latter is of major importance.

Undergrowth is normally brushy. It is usually dominated by the typal shrub *A. patula, Purshia tridentata*, and *Symphoricarpos oreophilus*. Common herbs include *Arenaria congesta* and *Sedum lanceolatum*.

Adjacent warmer sites often support shrub communities dominated by *A. patula* and *Amelanchier*. Cooler nearby sites are generally occupied by the FEID phase of this h.t. or the PICO/JUCO c.t.

***Artemisia tridentata* (ARTR) phase.**—This phase occurs mostly in the northeast area. It occupies gentle, sloping tablelands and ridges, and generally lies immediately above *Artemisia*/graminoid communities, which are common to this area. Overall, exposures tend to be more westerly than those of the FEID phase.

Figure 5. *Pinus ponderosa/Festuca idahoensis* h.t. on the eastern end of the Uinta Mountains (7,700 feet [2 360 m] elevation), Ashley National Forest. The undergrowth consists of an abundance of *F. idahoensis*, and widely scattered *Artemisia tridentata* and *Purshia tridentata*.

Pinus ponderosa occurs in groups or as scattered individuals. *Juniperus scopulorum* is a local, minor seral species. Canopies are more closed wherever *P. contorta* and *Populus* occur as important components.

Undergrowth is variable, but generally shrubby and characterized by *Artemisia tridentata vaseyana*. This species has its greatest abundance in this phase, as does *Festuca idahoensis* on some sites. *Purshia* and *Symphoricarpos* are usually present in addition to the typal species.

***Festuca idahoensis* (FEID) phase.**—This phase is common in both areas of the Uinta Mountains.

In the northeast it is locally extensive above 7,800 feet (2 375 m) elevation, occupying gentle tablelands or slopes that generally have more easterly exposures than the drier ARTR phase. Most often adjacent nonforest sites support shrub/bunchgrass communities.

Pinus contorta and *Populus* are local, minor seral associates in this area. Undergrowth varies from moderately dense in cover to depauperate. It is dominated by graminoids of which *Festuca* and *Poa nervosa* are the most common; the other typal species are usually subordinate.

The FEID phase in the south-central area occurs in a narrow belt 8,200 to 8,600 feet (2 500 to 2 620 m) elevation, occupying moderate to steep hillslopes and ridges. Exposures tend to be more southerly than those of the ARPA phase.

Juniperus scopulorum is occasionally present with *Pinus ponderosa*, and canopies are somewhat more closed than those of the other phases. Undergrowth tends to be more brushy with less diversity of species; typically, *Poa fendleriana* is the dominant member of the typal species.

Soils.—Sampled stands primarily have sandstone or quartzite parent materials (appendix D), and occupy a variety of broad regolith types. South-central stands are associated with glacial outwash, ground moraine, alluvium, and residual bedrock, whereas the northeast stands are found only on residual bedrock. Surface soil textures are sandy loam to loamy, and gravel is typically present in considerable amounts. Surface rock varies in amount, ranging from absent to very considerable; the south-central stands are more rocky. Little if any bare soil is present in the type. Litter depth is greatest in the south-central stands, where it averages 1.5 inches (3.9 cm) for both the ARPA and FEID phases.

The ARTR and FEID phases on the northeastern area have average litter depths of 0.9 and 0.7 inches (2.4 and 1.7 cm) respectively. The average depth for the habitat type is 1.1 inches (2.9 cm).

Productivity/management.—Timber productivity is low to very low (appendix E). Sample site index, stockability limitations, regeneration difficulties, and brush competition hazards resulting from overstory manipulation are variable. Usually only the more productive or more protected sites in the FEID phase offer fair timber management opportunities.

Deer use is light to moderate. Overstory manipulation appears to increase use, particularly where brush development occurs. Sheep and cattle utilize this habitat type for forage; PIPO/FEID is one of the most important forest habitat types in the Uinta Mountains for livestock.

Other studies.—PIPO/FEID h.t.'s similar to the FEID phase were described for Montana (Pfister and others 1977), eastern Washington, northern Idaho (Daubenmire and Daubenmire 1968), central Idaho (Steele and others 1981), and north-central Wyoming (Hoffman and Alexander 1976). The ARPA and ARTR phases have not been previously reported in those areas. Dealy (1971), however, described a seral *Pinus ponderosa/Arctostaphylos patula/Festuca idahoensis* community that occupies residual soils within the *Abies concolor* zone of south-central Oregon. The ARPA and ARTR phases should be considered regional variants that are not closely related to PIPO/FEID h.t. of the Rocky Mountains.

Pseudotsuga menziesii Series

Distribution.—Throughout much of northwestern Utah and adjacent Idaho, *Pseudotsuga* is the indicated climax of low to moderate elevations. This broad elevational belt ranges from below 5,000 feet (1 525 m) to 8,000 feet (2 440 m), and locally up to about 8,800 feet (2 680 m). In general, the lower exposures are very protected, steep, northerly canyon slopes. Some of these locally reflect lower treeline, if woodland species are excluded. *Pseudotsuga* grows on southerly or westerly exposures at the highest elevations.

Nearby warmer or drier exposures at low to moderate elevations are occupied by *Acer grandidentatum* or occasionally *Juniperus* woodlands. Shrub-dominated communities (all of which are briefly described by Ream 1964) may border *Pseudotsuga* elsewhere. The *Pinus flexilis* series may be adjacent, but only at moderate elevations. The *Abies lasiocarpa* series occupies adjacent, cooler or more mesic sites and also bounds the series at higher elevations. South of Ogden, Utah, *Abies concolor* largely replaces *Pseudotsuga* as the indicated climax in this elevational zone.

In the Uinta Mountains, the *Pseudotsuga* series has a more limited distribution, largely because it is somewhat restricted to the various (but chiefly calcareous-dominated) sedimentary substrates that flank the central quartzite core. Thus, it is very local except in the eastern and southern areas. There, it occupies moderate to steep slopes between 7,000 and 9,600 feet (2 135 and 2 925 m) elevation. With the exception of local occurrences in the northeastern area, these sites do not represent lower treeline.

This series is bordered on drier or lower sites by the *Pinus contorta* and occasionally the *Pinus ponderosa* series or, in the northeastern area, shrub communities. More moist exposures contain the *Picea pungens* series or at higher elevations, the *Abies lasiocarpa* series.

Vegetation.—Stands vary from very open on exposed sites, as scattered trees or groups, to rather dense on more moderate exposures. Several seral associates are present in the series (appendix B), but *Pseudotsuga* is usually the principal pioneer species as well as the indicated climax. At lower elevations in the northwestern region, *Acer grandidentatum* is also very important, as is *Pinus ponderosa* in the Uintas. *Populus tremuloides* and *Pinus contorta* are important seral constituents at higher elevations, although the latter is largely absent from northwestern Utah. *Pseudotsuga* is clearly the most shade tolerant of the conifer associates; in the absence of major disturbance, such as an intense surface fire, it is conceivably the only conifer within the zone that can successfully reproduce in the shade of the overstory canopy.

Although variable, the undergrowth is predominantly brushy, especially in the low elevation habitat types. Occasionally, however, undergrowth has a chiefly herbaceous nature, as in the case of the OSCH phase of the PSME/OSCH h.t. Undergrowth is depauperate only in stands of the PSME/BERE h.t., BERE phase that have dense canopies.

Soils/climate.—Even though a variety of parent materials are associated with this series (appendix D-1), most are wholly or at least weakly calcareous, or include shale. The *Pseudotsuga* series is infrequently associated with the Wasatch conglomerate; where this formation occurs within the environmental compass of climax *Pseudotsuga*, persistent *Populus tremuloides* communities are frequently found.

Normally the soils, derived from moderately deep colluvium or shallow, jointed bedrock, are gravelly and well drained. Surface soil textures encompass all textural classes, but most are loamy or finer. Considerable rock is frequently exposed. Bare soil is generally absent unless sites are intensely utilized by livestock. Litter varies from intermittently shallow to uniformly deep.

Climatic data from the Utah State University weather station, located at the mouth of Logan Canyon about 300 feet (100 m) in altitude below the occurrence of the *Pseudotsuga* series, are shown in appendix D-2.

Fire history.—In the northwestern region, all but the most inaccessible stands are second-growth (about 90 to 120 years old), having been cut and subsequently burned during the settlement of the surrounding valley areas (Bird 1964). The natural fire frequency, therefore, is largely conjecture. Most stands in the Uinta Mountains, however, are old-growth and appear to be of fire origin. Undoubtedly, light surface fires have been frequent historically, as indicated by multiple fire scars on older trees and by numerous, layered charcoal fragments that are typically encountered in most surface soils and duff. In both regions, the effect on vegetation in general and undergrowth in particular is probably only transitory, most likely producing a flush of shrub and herbaceous growth (Lyon 1971; Lyon and Stickney 1976).

Productivity/management.—Timber productivity ranges from very low to high (appendix E). Although stockability limitations are present with some habitat types or phases, productivity for lower elevation types is generally comparable to that of the more moderate portion of the *Abies lasiocarpa* series. Opportunities for timber management are generally good in the moderate part of the Uinta *Pseudotsuga* series. Parts of the PSME/BERE h.t. provide excellent timber management possibilities in the northwestern region. Several pertinent considerations are associated with regenerative activities; these are discussed for each habitat type. In general, natural regeneration is best secured with shelterwood techniques. Dwarf mistletoe (*Arceuthobium douglasii*) is very localized in northern Utah and is currently not a major problem, probably because of past logging.

Nontimber values such as watershed protection, wildlife habitat, esthetic considerations, and diverse recreational opportunities are important throughout the series. During favorable weather and snow conditions, the lower brushy habitat types provide alternate big game wintering areas to the usual *Juniperus* woodlands.

PSEUDOTSUGA MENZIESII/PHYSOCARPUS MALVACEUS H.T.(PSME/PHMA; DOUGLAS-FIR/NINEBARK)

Distribution.—PSME/PHMA is the major low-elevation habitat type in this series in northwestern Utah and adjacent Idaho. It occupies steep to very steep protected exposures, typically northwest- to northeast-facing, lower and middle slopes, between about 5,000 and 7,000 feet (1 520 to 2 130 m) elevation.

Vegetation.—*Pseudotsuga* is the indicated climax. *Acer grandidentatum* is the most common seral tree. Rarely *Pinus contorta* is a major seral component in southeastern Idaho.

Undergrowth is brushy and best characterized as consisting of several distinct structural components or layers. *Physocarpus*, typically dense, is the dominant shrub (fig. 6). This is overtopped by patchy *Amelanchier alnifolia* and several other tall shrubs that vary by phase. *Berberis repens*, *Pachistima myrsinites*, *Rosa woodsii*, and *Symphoricarpos oreophilus* constitute a lower shrub component. *Arnica cordifolia* is often the most conspicuous herbaceous species; others that occur throughout the type include *Cystopteris fragilis*, *Fragaria vesca*, *Mitella stauropetala*, *Smilacina racemosa*, and, locally, *Carex geyeri*. Ground moss is occasionally notable, and *Osmorhiza chilensis* is frequently abundant on toe-slope sites reflecting greater moisture and deeper soil material.

Figure 6. *Pseudotsuga menziesii/Physocarpus malvaceus* h.t. on a steep northerly exposure in Blacksmith Fork drainage east of Logan, Utah (6,300 feet [1 920 m] elevation). The dense shrub layer of *P. malvaceus* contains substantial amounts of *Pachistima myrsinites* and an herb undergrowth of primarily *Carex geyeri*.

Adjacent warmer exposures contain *Acer grandidentatum*, *Physocarpus*, *Prunus*, or *Symphoricarpos-Artemisia tridentata* shrub communities. Cooler or more rocky sites are often the PSME/BERE h.t. PRVI phase.

Soils.—Stands in northern Utah and adjacent Idaho normally occur on very stony colluvium. Parent materials are calcareous or quartziferous (appendix D). Soil surface textures are mainly loamy or finer. Within the type some surface rock is typical; bare soil is generally absent. Litter depth averages 7.5 cm overall.

Productivity/management.—Timber productivity is low to moderate (appendix E). Although productivity may be moderate, timber management opportunities are very limited because of the typical steepness of sites and difficult hardwood and brush control associated with overstory manipulation. Shelterwood techniques are often the most reliable regeneration strategy.

This habitat type is an important part of deer winter range in this area. In addition, many sites have considerable esthetic and watershed cover values. Domestic livestock use is nominal.

Other studies.—The PSME/PHMA h.t. occurs throughout the Northern Rocky Mountains. It has been described from eastern Washington, northern Idaho (Daubenmire and Daubenmire 1968), Montana (Pfister and others 1977), central Idaho (Steele and others 1983). Hoffman and Alexander (1976) and Moir and Ludwig (1979) have described a similar habitat type, PSME/*Physocarpus monogynus*, from north-central Wyoming and northern New Mexico.

Steele and others (1983) have broadly classified this habitat type in southern Idaho and western Wyoming as the PAMY phase to geographically differentiate it from the PSME/PHMA h.t. of central Idaho.

PSEUDOTSUGA MENZIESII/ACER GLABRUM H.T. (PSME/ACGL; DOUGLAS-FIR/MOUNTAIN MAPLE)

Distribution.—PSME/ACGL is a relatively cool and moist habitat type in this series. It occurs locally throughout northwestern Utah and adjacent Idaho at 5,800 to 7,500 feet (1 770 to 2 285 m), and infrequently in the Uinta Mountains above 7,700 feet (2 350 m) elevation. It is generally associated with the cold air drainage features common to middle and lower slopes, such as ravines or stream bottoms. These slopes are usually very steep and north- to northeast-facing.

Adjacent habitat types include the relatively warmer PSME/OSCH and PSME/PHMA h.t.'s or the drier PSME/BERE h.t. Cooler bordering sites are most often ABLA/ACGL or ABLA/ACRU h.t.'s.

Vegetation.—*Pseudotsuga* is the indicated climax and most often is the major component of seral stands. Many minor seral species occur locally (appendix B), of which *Populus tremuloides* is the most common.

Undergrowth generally has several canopy components (fig. 7). The prominent high-shrub layer typically includes *Acer glabrum*, *Amelanchier alnifolia*, and *Prunus virginiana*, whereas *Berberis repens*, *Pachistima myrsinites*, and *Symphoricarpos oreophilus* comprise a lower, less conspicuous one. Herbaceous vegetation is diverse: the most common species are *Arnica cordifolia*, *Disporum trachycarpum*, *Fragaria vesca*, *Mitella stauropetala*, *Osmorhiza* spp., and *Smilacina racemosa*. In addition, *Carex geyeri* and *Calamagrostis rubescens* may be locally abundant.

Soils.—These stands are associated with mixed calcareous or quartziferous substrates (appendix D). Soil surface textures range from sandy loam to clayey. Considerable amounts of coarse fragments are often present in the profile. Some stands have a great amount of surface rock but exposed soil is generally absent. The litter averages 2.2 inches (5.5 cm) in depth, with an observed maximum of 8.7 inches (22 cm).

Productivity/management.—Timber productivity is low to high (appendix E). This habitat type includes some of the highest observed values in the series, although the average site index is slightly lower than that of the PSME/PHMA and PSME/OSCH h.t.'s. Management opporunities for timber, however, are generally restricted in northern Utah by steepness of slope and limited extent of the habitat type. Where opportunities exist, the shelterwood method should provide some control over subsequent brush development. Scarification may also be necessary where rhizomatous graminoids are present.

Use of this habitat type by domestic livestock is very low. Deer use is moderate.

Other studies.—We consider this habitat type to correspond to the PAMY phase as described by Steele and others (1983) for the PSME/ACGL h.t. of eastern Idaho and western Wyoming. As such, this phase serves as a geographical distinction from the ACGL and SYOR phases of central Idaho (Steele and others 1981).

Figure 7. *Pseudotsuga menziesii/Acer glabrum* h.t. on a moderately steep northeastern exposure (7,000 feet [2 130 m] elevation) in the Raft River Mountains. The moderately dense shrub undergrowth of *A. glabrum*, *Amelanchier alnifolia*, *Pachistima myrsinites*, and *Ribes viscosissimum* is underlain by substantial cover of *Calamagrostis rubescens* and *Arnica cordifolia*.

PSEUDOTSUGA MENZIESII/OSMORHIZA CHILENSIS H.T. (PSME/OSCH; DOUGLAS-FIR/MOUNTAIN SWEETROOT)

Distribution.—This relatively warm, moist habitat type occurs locally in northwestern Utah and adjacent Idaho, but principally in the northern Wasatch Range (fig. 8). It usually occupies moderate to steep lower to middle

Figure 8. *Pseudotsuga menziesii/Osmorhiza chilensis* h.t. on a moderate northerly exposure at the north end of the Bear River Range, Wasatch-Cache National Forest at an elevation of 6,800 feet (2 070 m). The undergrowth consists primarily of the herbaceous *Arnica cordifolia* and *Thalictrum fendleri*.

slopes between 5,400 and 7,400 feet (1 646 and 2 256 m) with northwest- to northeast-facing exposures. Sites are normally fairly protected.

Vegetation.—*Pseudotsuga* is the indicated climax. *Acer grandidentatum* and *Populus tremuloides* are locally major seral associates. *Pinus contorta* is occasionally a seral associate in Idaho.

Undergrowth is diverse. Common species include the indicator *Osmorhiza chilensis* (or *O. depauperata* at higher elevations) and *Amelanchier alnifolia*, *Berberis repens*, *Symphoricarpos oreophilus*, *Smilacina racemosa*, and *Thalictrum fendleri*. Sites that receive regular livestock use normally have an abundance of weedy species. Interestingly, *Circea alpina* was only encountered in the *Pseudotsuga* series in this habitat type.

Acer, *Prunus*, and other shrub communities occupy nearby warmer and drier sites. Drier forested sites, typically upslope, are normally the PSME/BERE h.t.

Soils.—This habitat type occur almost exclusively on colluvium. Various parent materials are represented (appendix D). Subsurface coarse fragments are usually present, and surface soil textures range from loamy to clayey. Surface rock is generally absent. Bare soil is occasionally present. The average litter depth of the habitat type is 2.4 inches (6.2 cm).

Productivity/management.—Timber productivity is moderate to high (appendix E). This type has the highest overall sampled site index, productivity, and basal area increment and development of the northern Utah *Pseudotsuga* h.t.'s. These values appreciably reflect the overall moderate environment of the type and in particular the moistness of the colluvial soils. Opportunities for intensive timber management, however, are limited because of the scarcity of the habitat type.

A shelterwood best reflects the *Pseudotsuga* regeneration patterns observed in mature stands. Also, this method provides some additional site protection from potential hardwood and brush development. In this series, pocket gopher activity appears to be greatest in this habitat type, perhaps because of the typical lushness of herbaceous vegetation and conducive soil factors, as well as the close proximity of meadow areas.

Both deer and domestic livestock utilize the habitat type for cover and limited forage.

Other studies.—This type has also been described in central Idaho (Steele and others 1981), and eastern Idaho (Steele and others 1983).

PSEUDOTSUGA MENZIESII/CALAMAGROSTIS RUBESCENS H.T. (PSME/CARU; DOUGLAS-FIR/PINEGRASS)

Distribution.—We sampled this habitat type on a steep cool-dry exposure at 6,440 feet (1 963 m) elevation in the extreme northwestern extension of the Wasatch Range near Malad, Idaho. Isolated occurrences are to be expected in northwestern Utah and the westernmost Uintas, which would probably represent the southernmost extent of the habitat type. The PSME/CARU h.t. is apparently absent from the eastern Uinta Mountains because *Abies lasiocarpa* is the most probable indicated climax of sites having a dense *Calamagrostis* undergrowth component.

The PSME/CARU h.t. in southeastern Idaho and adjacent Wyoming is recognized as the PAMY phase and is described in detail by Steele and others (1983).

Vegetation.—*Pseudotsuga* is the indicated climax. It is the only conifer present in the stand. Elsewhere in Idaho, *Pinus contorta* is an important seral species. *Calamagrostis rubescens* conspicuously dominates the undergrowth. Small amounts of *Pachistima myrsinites*, *Prunus virginiana*, and *Symphoricarpos oreophilus* are present, with small amounts of various herbs.

Soils.—Our example of this habitat type has quartziferous and calcareous parent materials and a clayey surface soil. Surface rock and bare soil are absent. The litter is 2.0 inches (5.0 cm).

Productivity/management.—Steele and others (1983) report timber productivity to be low to moderate. Our stand has moderate productivity and an above average site index.

Other studies.—Similar habitat types are found throughout the Northern Rocky Mountains. In addition to eastern Idaho and western Wyoming, it has been described from central Idaho (Steele and others 1981), Montana (Pfister and others 1977), northern Idaho, eastern Washington (Daubenmire and Daubenmire 1968), Alberta (Ogilvie 1962), British Columbia (McLean 1970), and eastern Oregon (Hall 1973).

PSEUDOTSUGA MENZIESII/CERCOCARPUS LEDIFOLIUS H.T. (PSME/CELE; DOUGLAS-FIR/CURLLEAF MOUNTAIN-MAHOGANY)

Distribution.—This minor habitat type is found principally in the Wasatch Range in areas adjacent to the Utah-Idaho border. It also occurs in the Stansbury Mountains. PSME/CELE occupies a variety of dry, very exposed slopes from about 6,300 feet (1 920 m) elevation on northerly aspects, to 8,000 feet (2 440 m) on southerly exposures. Sites are subject to year-round winds and intense isolation, which contribute to desiccation as well as reduced snowpack and snow retention. These factors, in conjunction with the typically shallow, rocky soils, make the environment the most severe of the *Pseudotsuga* series.

Vegetation.—*Pseudotsuga* is the indicated climax. Trees occur as scattered individuals or in groups. *Juniperus scopulorum* and *Pinus flexilis* are minor seral species. The PIFL/CELE h.t. occurs where *Pinus* rather than *Pseudotsuga* is a reproducing dominant.

Undergrowth is dominated by *Cercocarpus ledifolius*, which is very persistent in old-growth stands (fig. 9).[2] Many other shrubs are present, including *Amelanchier*, *Artemisia tridentata*, *Berberis repens*, *Prunus virginiana*, *Symphoricarpos oreophilus*, and occasionally *Ceanothus velutinus*. The herbaceous component is diverse, the most common species being *Achillea millefolium*, *Balsamorhiza sagittata*, *Crepis acuminata*, *Stellaria jamesiana*, *Agropyron spicatum*, *A. trachycaulum*, and *Leucopoa kingii*. These species reflect often the adjacent mixed-shrub, *Cercocarpus*, or grass communities where moisture stress inhibits tree growth. The PSME/BERE h.t. often occurs nearby on more protected sites.

Soils.—This type occurs primarily on calcareous parent materials (appendix D). Soils are shallow and very gravelly, and have the broadest range of surface textures in the series. Surface rock and bare soil range from absent to considerable. The average litter depth is 1.7 inches (4.2 cm).

Figure 9. *Pseudotsuga menziesii/Cercocarpus ledifolius* h.t. in the northern portion of the Wasatch Range on a steep northwesterly exposure at 6,300 feet (1 920 m) elevation. The predominently shrubby undergrowth is dominated by *C. ledifolius*, *Symphoricarpos oreophilus*, and *Amelanchier alnifolia*.

Productivity/management.—Timber productivity is very low (appendix E) and stockability limitations are present. Some sites which are adjacent to the PSME/BERE h.t., however, have moderate productivity. Although forage is generally good, many stands are inaccessible to livestock because of the denseness of *Cercocarpus* and other shrubs. Other values, particularly deer habitat and watershed cover, are of much greater importance.

Other studies.—The PSME/CELE habitat type was recognized in central Idaho (Steele and others 1981) and eastern Idaho and western Wyoming (Steele and others 1983).

PSEUDOTSUGA MENZIESII/BERBERIS REPENS H.T.(PSME/BERE; DOUGLAS-FIR/OREGONGRAPE)

Distribution.—With four phases, this is the most common habitat type in the *Pseudotsuga* series. It is represented by 66 sample stands. Table 4 summarizes the range of environment conditions by phase and geographic region.

In northwestern Utah and adjacent Idaho, PSME/BERE occupies relatively warm and dry forested sites through a 3,500-foot (1 067-m) range of elevation, from 5,400 to nearly 9,000 feet (1 067 to 2 743 m). The type occurs on all exposures at higher elevations, but only on northerly exposures at low elevations. It commonly occupies moderate to very steep middle to upper slopes.

This habitat type is generally more mesic in the Uinta Mountains than elsewhere in Utah. In the Uintas it occurs on all aspects and elevations from 7,200 to 9,600 feet (2 195 to 2 926 m). Its presence on slopes and lower elevation exposures here are similar to those of northwestern Utah.

Vegetation.—*Pseudotsuga* is the indicated climax. Many seral species are associated with this habitat type (appendix B), but in many stands *Pseudotsuga* is the only conifer present, particularly in northwestern Utah. There, *Acer grandidentatum* is the most notable major seral species of low elevation stands. In the Uinta Mountains, *Pinus contorta*, *P. ponderosa*, and *Populus tremuloides* are the major seral associates, each having local distributions.

Undergrowth generally is diverse, varying from very brushy to depauperate (fig. 10). These conditions are reflected by the phases. Many species are common only to certain phases or to parts of phases (appendix C), corresponding to an altitudinal gradient in general. In addition to the joint indicators *Berberis repens* and *Pachistima myrsinites*, the species *Amelanchier alnifolia*, *Symphoricarpos oreophilus*, and *Poa nervosa* occur throughout the type.

***Carex geyeri* (CAGE) phase.**—This phase occurs infrequently in northwestern Utah and adjacent Idaho. The normally steep exposures appear to include the same temperature regime as sites without *C. geyeri* but probably have different edaphic conditions. In addition to the typal species, undergrowth notably includes *Salix scouleriana*, *Aster engelmannii*, and *Thalictrum fendleri*.

The CAGE phase is more common, but local, in the Uinta Mountains. It apparently is restricted to sandstone and quartzite substrates. Exposures are warm and dry, and moderate to very steep. Undergrowth is usually characterized by abundant coverage of *Carex*. In addition to the species that occur throughout the type, *Juniperus communis* is common, and *Arctostaphylos uva-ursi* and *Astragalus miser* are locally abundant. Where *Pinus ponderosa* is a major seral associate, nearby warmer and drier sites are the PIPO/CAGE h.t.; elsewhere adjacent habitat types are variable.

***Juniperus communis* (JUCO) phase.**—This cool, dry phase is apparently restricted to the central and eastern Uinta Mountains where it is associated with the sedimentary formations that flank the central quartzite core of the range. (It is also to be expected on the Uinta National Forest portion of the southwestern Uinta Mountains, and possibly at the higher elevations of the Wasatch Range where *Juniperus* occurs very infrequently.) In the northeast this phase frequently occupies all exposures in a narrow altitudinal band at the upper elevations of the sedimentary formations; on the other hand, exposures are mostly protected in the southern area. Topography is steep to very steep.

Pinus contorta and *Populus tremuloides* are important seral associates in southern areas, but *Pseudotsuga* is usually the only tree in northeastern stands. Undergrowth is typically brushy, with *Juniperus* as the dominant species. The herbaceous component is normally depauperate, having *Galium boreale* and *Carex rossii* as the most common species. On some sites, however, *Astragalus miser* is conspicuous.

Nearby warmer and drier exposures are the PICO/BERE c.t. principally in the southern area and PSME/SYOR h.t., which is usually lower in the northeastern areas. The slightly more mesic PIPU/BERE h.t. is sometimes adjacent in the southeastern area. In the northeast nearby cooler or more mesic sites are the BERE phase or the ABLA/BERE h.t.

***Symphoricarpos oreophilus* (SYOR) phase.**—This phase is common in the northern Wasatch Range of Utah. In the Uinta Mountains, where it is infrequent, sites reflect exposures intermediate to those of the PSME/SYOR h.t. and the JUCO and BERE phases of the PSME/BERE h.t.

The SYOR phase in northwestern Utah occupies some of the warmest and driest forested sites. These are very steep at lower 6,000-foot (1 829-m) elevations. Between 7,000 and 9,000 feet (2 134 to 2 743 m), the typical midslope to ridgetop topography is moderate to very steep.

Stands are either isolated or are open, with scattered trees that never achieve complete canopy closure; stands with dense canopies are usually in the BERE phase. *Pseudotsuga* is the dominant conifer. *Abies lasiocarpa* is accidental. Undergrowth is usually brushy and dominated by *Symphoricarpos* and *Leucopoa kingii*. Normally, lower elevation sites have abundant cover of *Arnica cordifolia* as well.

Adjacent, more mesic exposures are the BERE phase of this habitat type or the ABLA/BERE h.t. Drier sites are *Symphoricarpos*-dominated communities.

[2]Low elevation stands of the PSME/BERE h.t. in early to mid-successional stages occasionally have abundant *Cercocarpus*. In such circumstances, this species is considered seral.

Table 4.—Distribution of PSME/BERE h.t. in northern Utah by phase and region

Phase	Northwestern Utah[1]		Uinta Mountains	
	Elevation range	Exposure	Elevation range	Exposure
	Feet (m)		*Feet (m)*	
CAGE	6,600-8,100 (2 012-2 469)	N-NE	7,500-9,200 (2 286-2 804)	NE,S
JUCO	—		8,100-9,600 (2 469-2 926)	All
SYOR	6,000-8,800 (1 829-2 682)	All	8,300-9,200 (2 530-2 804)	All
BERE	5,400-8,000 (1 646-2 438)	NW-NE	7,300-9,600 (2 225-2 926)	All

[1]Includes adjacent Idaho.

Figure 10. *Pseudotsuga menziesii/Berberis repens* h.t. on a steep northwest exposure (6,400 feet [1 950 m] elevation) in the Bear River Range, Wasatch-Cache National Forest. The sparse undergrowth consists of a mix of low shrubs and herbs.

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Berberis repens (BERE) phase.—This is the commonest phase in the habitat type. In northwestern Utah and adjacent Idaho, elevations for the habitat type range from 5,400 to 7,500 feet (1 646 to 2 286 m), but most sites occur above 6,000 feet (1 829 m). Topography is variable, ranging from moderate to very steep. Exposures are relatively warm and dry but are normally more moderate than those of the other phases.

Pseudotsuga is usually the only tree present, but some lower stands have, in addition, a nominal coverage of *Juniperus scopulorum*. Undergrowth is variable. Sites at the lower elevations have many species in common with the PSME/PHMA h.t. Higher sites are normally depauperate except for the typal shrubs.

Nearby habitat types at lower elevations include the more mesic PSME/PHMA, the cool-moist PSME/ACGL, or the very warm and dry SYOR phase. At higher elevations adjacent habitat types are the warm-moist PSME/OSCH, or the cool-moist PSME/ACGL or ABLA/ACGL h.t.'s; cool and dry sites are ABLA/BERE; warmer sites are the SYOR phase (particularly near forest fringes); and very warm and dry sites are frequently PSME/CELE h.t. or nonforest vegetation.

In the Uinta Mountains, the BERE phase is common only in the northeastern area. The moderate to very steep exposures are normally the most mesic of the Uinta *Pseudotsuga* series. Substrates include sedimentary materials, chiefly limestone, and occasionally quartzite.

Pinus contorta is a major seral associate of most stands. Undergrowth is typically depauperate. *Berberis* is often the most abundant species, with small coverages of *Juniperus communis* and the other typal species being additionally present.

In the Uinta Mountains, adjacent sites include the warmer PICO/BERE c.t., the higher cool-dry JUCO phase, or the cooler and more moist ABLA/BERE h.t. Nonforest communities frequently abut this phase.

Soils.—Our stands occur on sedimentary and quartzite substrates (appendix D). Surface soil textures, which range from sandy loam to clayey, reflect this variety of parent materials. Soils are typically shallow and most have considerable coarse fragments. Overall, the soils of stands in the Uinta Mountains are coarser textured. Surface rock is variable but bare soil is generally absent. The average duff depth for the type is 4.5 cm; the range of the average phase values is 3.3 cm (JUCO) to 5.5 cm (BERE).

Productivity/management.—Productivity is very low to moderate (appendix E). Overall, productivity values for this habitat type are the lowest for the types having management possibilities in this series. The highest productivity for the type occurs in the CAGE phase. The SYOR and JUCO phases have the lowest because of low site index in combination with stockability limitations. The BERE phase has the greatest range of productivity values and the highest site index (64 feet) of the PSME/BERE stands sampled. Overall, the average productivity and site index of Uinta Mountain stands is lower than that of the northwestern stands. It is also noteworthy that this habitat type has the vast majority of the old-growth stands in the *Pseudotsuga* series.

Opportunities for timber management are generally good for all phases except the SYOR, wherever slope or other factors are not restrictive. *Pseudotsuga* is the only conifer available for management in northwestern Utah. In the Uinta Mountains, *Pinus contorta* or *P. ponderosa* may present additional opportunities in some stands. With overstory manipulation, many sites in both areas are subject to excessive brush competition and insolation. This suggests the use of a shelterwood for securing natural regeneration. Small clearcuts with planting also appear to be satisfactory on the better, more moist sites. Where *Carex geyeri* is present, scarification may be necessary.

Lower elevation sites in northwestern Utah are an important part of deer winter range. Other sites appear to receive variable summer use by deer and elk, mainly for cover. Domestic livestock may make heavy use of this habitat type for shade when grazing areas are nearby.

Other studies.—This habitat type was described for central Idaho by Steele and others (1981). The type and phases are recognized as occurring throughout southern Idaho as well as in scattered locations of western Wyoming (Steele and others 1983). The PSME/BERE h.t. has also been described from the Bighorn Mountains of Wyoming by Hoffman and Alexander (1976).

PSEUDOTSUGA MENZIESII/SYMPHORICARPOS OREOPHILUS H.T. (PSME/SYOR; DOUGLAS-FIR/MOUNTAIN SNOWBERRY)

Distribution.—Although this habitat type occurs locally throughout the Uintas, it is common only in the northeastern area. It is rarely encountered in northwestern Utah and adjacent Idaho. The type occupies ridges and moderate to steep middle and upper slopes. Exposures are relatively warm and dry; it is found at elevations ranging from 7,000 to 9,600 feet (2 134 to 2 926 m).

Vegetation.—*Pseudotsuga* is the indicated climax, and the undergrowth is characterized by *Symphoricarpos*. Several seral species are locally present (appendix B), of which *Populus tremuloides* and, at lower elevations, *Pinus ponderosa* are the most notable. In general, stands are the most open of the Uinta *Pseudotsuga* series.

Undergrowth is variable but normally brushy, being dominated by *Symphoricarpos* and, on some sites, *Juniperus communis* or *Artemisia tridentata vaseyana*. The herbaceous component is typically depauperate with *Carex rossii* and *Leucopoa kingii* as the most common species.

In many locations this type borders lower, warmer, and drier *Symphoricarpos-Artemisia* communities. Adjacent cooler sites are the PSME/BERE h.t., BERE phase, or wherever *Juniperus* is a major undergrowth component, the JUCO phase.

Soils.—Our stands have a variety of substrates (appendix D). Soils are gravelly, and surface textures range from sandy loam to clayey. The type has moderate surface rock but little bare soil. The average litter depth is 4.4 cm.

Productivity/management.—Productivity is very low to low (appendix E) because of low site index in combination with stockability limitations. Management opportunities are limited to the protected, better sites. Regeneration strategies should follow natural patterns, like shelterwood; larger clearcuts will be difficult to regenerate because of brush competition and excessive insolation and droughty conditions.

Deer use this type moderately and mainly for cover. Domestic livestock use is principally for shade, and is high wherever grazing areas are nearby. This habitat type is also important watershed cover at higher elevations.

Other studies.—The PSME/SYOR habitat type has been described from southwestern Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and eastern Idaho and western Wyoming (Steele and others 1983). Reed (1976) recognized the PSME/SYOR habitat type as a much broader concept in the Wind River Range, Wyo.

Where *Juniperus* is a major undergrowth component, the type is somewhat similar to the PSME/JUCO habitat types of the above authors (excluding Reed).

Picea pungens Series

Distribution.—Stands with *Picea pungens* as a component are locally common throughout the Uinta Mountains. Such stands also occur occasionally in the canyons near and to the south of Salt Lake City. *Picea pungens* is more abundant and important throughout southern Utah.

Stands in northern Utah where *P. pungens* is the indicated climax occur mainly in the southeastern and northern Uinta Mountains at elevations between about 7,800 and 8,800 feet (2 375 and 2 680 m). Sites range from warm, dry, steep, southerly slopes or ridgetops to relatively mesic canyonsides to very wet streamsides. This series probably reflects a topographic and edaphic climax, as suggested by Pfister (1972). These three site conditions for *P. pungens* also occur in the southwest (Moir and Ludwig 1979; Pearson 1931).

In the southeastern Uinta Mountains the series is bordered by the warmer and drier *Juniperus* woodland, *Populus tremuloides* series, or shrub communities which are dominated by *Artemisia* spp. and *Symphoricarpos oreophilus*, with a variety of herbaceous species (Cronquist and others 1972). The *Pinus contorta* series usually borders it in the northern Uintas.

Stands where *P. pungens* is a major dominant also occur on the northern slope of the Uinta Mountains on private lands, which were not sampled. Most of these stands occupy streamside terraces or other related landforms, and are usually at the lowest elevations at which conifers are encountered. Undergrowth of several observed wet sites was dominated by species of *Salix*, *Carex*, and *Equisetum*. In contrast, near Robertson, Wyo., a relatively warm site having deep clayey alluvial sediments and very dry surface soils was observed on the Blacks Fork River. Undergrowth was dominated by *Arctostaphylos uva-ursi*, *Juniperus communis*, and *Potentilla fructicosa*.

Of special consideration are the streamside sites within the montane zone throughout northern Utah that have *P. pungens* as a major climax associate. These sites are uncommon and were not sampled but include great variation in undergrowth. Sites such as terraces where *Equisetum arvense* is a major component are included in the *Picea engelmannii*/EQAR h.t., after Steele and others' (1983) treatment for this situation in eastern Idaho and western Wyoming. Other riparian sites are unclassified.

Vegetation.—In the Uinta Mountains, it appears that *Picea pungens* has an intermediate shade tolerance, as suggested by Daniel and others (1979). Stand structure analysis shows that it is significantly less tolerant than *Abies lasiocarpa* and *Picea engelmannii*. We believe that in this area it is slightly more tolerant than *Pseudotsuga*, although a reverse relationship is indicated in eastern Arizona by Jones (1974). Other common associates (appendix B) are clearly less tolerant.

Perhaps of more significance, however, when considering this species' competitive relationship with *Pseudotsuga*, is its apparent adaptation to warmer temperature regimes, especially very dry sites with calcareous substrates. In this sense, *P. pungens* usually has a distinct competitive advantage over *Pseudotsuga*. When cooler and moister sites are considered, or those that have weakly calcareous or noncalcareous substrates such as sandstone, this relationship is sometimes less discernible and care must be taken to place a particularly questionable stand in the appropriate series. In general, the more productive of these sites, as measured by site index, are usually the *P. pungens* series. Often, however, the tolerance relationship is directly apparent. In some stands that exceed 300 years of age for example, stand structure is somewhat similar to that of old-growth *Picea engelmannii-Abies lasiocarpa* stands; *Pseudotsuga* is dominant in the upper canopy and *P. pungens* is reproducing in the lower.

Excluding wet sites, undergrowth reflects a bimodal range of environmental conditions. Warm-dry extremes are characterized by *Agropyron spicatum* and a host of other species. More moist sites normally have brushy undergrowth dominated by *Berberis repens*, *Juniperus communis*, or *Pachistima myrsinites*; *Arnica cordifolia*, *Galium boreale*, and *Thalictrum fendleri* are present also.

Soils.—A variety of parent materials are associated with this series (appendix D). These are principally limestone or mixtures of various sedimentary materials of which many are weakly calcareous (Kinney 1955). Quartzite is only common as a predominant parent material in the northern area where it is usually associated with glacial or alluvial depositions.

Soils are gravelly. Surface textures range from loamy to clayey. Exposed bedrock, surface rock, and bare soil are most abundant, with the drier sites in the series where litter accumulation is also least. Average litter depth for the series is 0.9 inches (2.4 cm).

Fire history.—Charcoal fragments are present mainly in the more mesic part of the series, but an overall past fire history and its influence on vegetation is not clear. Light surface fires probably have had little long-term effect on undergrowth. Nevertheless, this type of fire may have greatly influenced overstory composition by destroying *Picea pungens*. If such is the case, then larger individuals of *Pseudotsuga* would survive, and seral stands would be maintained.

Productivity/management.—Timber productivity is low to moderate (appendix E). *Picea pungens* is the most productive species but it is presently not extensively utilized; *Pseudotsuga* and *Pinus contorta* are the principal management species.

Deer use for cover and browse is moderate and livestock use is locally important where adjacent forage is also available. This series also provides watershed protection.

Other studies.—*Picea pungens* habitats have been described throughout the central and southern Rocky Mountains, from Utah (Kerr and Henderson 1979; Pfister 1972; Ream 1964), Arizona and New Mexico (Moir and Ludwig 1979), New Mexico and Colorado (Peet 1978), and western Wyoming (Steele and others 1983).

PICEA PUNGENS/AGROPYRON SPICATUM H.T. (PIPU/AGSP; BLUE SPRUCE/BLUEBUNCH WHEATGRASS)

Distribution.—This warm, dry habitat type is locally common in the southeastern Uinta Mountains. It occupies moderate to steep slopes or ridgetops between 7,800 and 8,800 feet (2 375 and 2 680 m) elevation. Exposures are overall southerly, ranging from east- to west-facing.

Vegetation.—*Picea pungens* is the indicated climax. *Abies lasiocarpa* is accidental. *Pseudotsuga* is a major seral component, as are *Pinus ponderosa* and *Populus tremuloides* in local situations. *Juniperus scopulorum* and *Pinus flexilis* are minor seral associates also having local distributions. Stands are open and rarely achieve complete canopy closure.

Undergrowth is variable, ranging from sparse to brushy. It reflects the xeric nature of this habitat type as exemplified by *Agropyron spicatum, Arenaria congesta, Linum kingii*, and *Oryzopsis hymenoides*. Dominant shrubs are *Berberis repens, Juniperus communis, Pachistima myrsinites*, and *Symphoricarpos oreophilus*. *Carex rossii* is also common. The use of *A. spicatum* as an indicator species does not imply an overall grassland physiognomy.

Warmer and drier sites are *Juniperus* woodland or nonforest communities. Adjacent, more mesic habitat types include PIPU/BERE, PSME/BERE, and ABLA/BERE.

Soils.—The soils of our stands are associated exclusively with calcareous substrates. Soils are very gravelly. Surface textures range from gravelly loams to gravelly clays. Surface rock is often considerable (occasionally including exposed bedrock) and some bare soil is present. Litter accumulation is usually intermittent, averaging 0.4 inches (1.0 cm) in depth. Erosion is often very noticeable.

Productivity/management.—Watershed cover is the most important management consideration. Deer and livestock use may be important in some situations.

Although *Picea* and *Pseudotsuga* site-index values are moderate, timber productivity is very low to low because of stockability limitations (appendix E).

Erosion hazards are present throughout much of the habitat type.

Other studies.—PIPU/AGSP habitat type has not been previously mentioned in other studies.

PICEA PUNGENS/BERBERIS REPENS H.T. (PIPU/BERE; BLUE SPRUCE/OREGONGRAPE)

Distribution.—PIPU/BERE, the more moderate habitat type of the series, occurs locally in the southeastern Uinta Mountains. It is also infrequently encountered in the northern area of this range. This habitat type occupies protected exposures at elevations of 8,000 to 8,800 feet (2 440 to 2 680 m). Slopes range from gentle to very steep.

Vegetation.—*Picea pungens* is the indicated climax. When present, *Pseudotsuga* is usually a persistent seral species. *Populus tremuloides* and *Pinus contorta* are other major seral associates.

Undergrowth is typically shrubby. In addition to the joint indicator species *Berberis* and *Juniperus communis*, normally present are *Acer glabrum, Pachistima myrsinites, Rosa* spp., and *Symphoricarpos oreophilus*. Especially noteworthy is the presence of *Ceanothus velutinus* and *Shepherdia canadensis*, which suggest the incidence of fire. Although diverse, the herbaceous component is generally depauperate, except when *Astragalus miser* or *Carex geyeri* are abundant. The most common herbs include *Anemone multifida, Arnica cordifolia, Galium boreale, Thalictrum fendleri*, and *Carex rossii*.

In the southeastern area, drier sites are nonforest communities or the POTR/CAGE or PIPU/AGSP h.t.'s. Normally the PICO/BERE c.t. is adjacent in the northern area. Nearby cooler habitat types are PSME/BERE or ABLA/BERE.

Soils.—The PIPU/BERE h.t. is associated with a greater diversity of dominant parent materials than PIPU/AGSP (appendix D). These include quartzite, limestone, and other weakly calcareous or noncalcareous sedimentary rocks. Surface textures range from sandy loam to clayey, and most soils are gravelly. Normally little surface rock and bare soil are present. The average litter depth is 1.3 inches (3.4 cm).

Productivity/management.—Timber productivity is low to moderate (appendix E). The site index values of *Picea pungens* have little variability. Although only two of the sampled *Pseudotsuga* trees were acceptable for site-index determination, the *Pseudotsuga* site index appears to be higher in this type than in the PIPU/AGSP h.t.

Small clearcuts and shelterwood cuts appear to be acceptable for regeneration of *Picea* and *Pseudotsuga*, respectively.

Deer and elk use the type moderately for cover. Only local livestock use occurs.

Other studies.—This habitat type was first noted in Utah by Pfister (1972), and subsequently by Kerr and Henderson (1979). Moir and Ludwig (1979) have described a similar habitat type (PIPU-PSME h.t., JUCO phase) from northern New Mexico.

Abies concolor Series

Distribution/climate.—Within the northern Utah study area, the *Abies concolor* series occurs throughout the higher mountain ranges of the northwestern region, roughly south of the vicinity of Ogden, Utah (latitude 41°15'). It is also found locally in the southwestern to westernmost Uinta Mountains. The series increases in

importance through southern Utah. In general, it occupies most all montane forest sites between the elevations of about 5,000 feet (1 525 m), lower timberline, and 8,000 feet (2 440 m). The series is strikingly similar in most all respects to the *Pseudotsuga menziesii* series.

North of 41°51' latitude, *Abies concolor* has an increasingly sporadic occurrence; its northernmost Rocky Mountain location is in Cottonwood Creek east of Logan, Utah. Within this tension zone, *Pseudotsuga menziesii* appears to replace *A. concolor* as the indicated climax of montane forest sites. Here, a combination of two factors seems to most strongly influence the population dynamics, and thus the distribution, of *A. concolor*.

The first factor is a critical, limiting minimum temperature that develops within this area as a result of increasing latitude. (The same limitation appears to affect *Quercus gambelii*, which also terminates in the same general area.) Based on the climatological maps provided in Brown (1960), this threshold may hypothetically correspond to a mean maximum January temperature of about 30° to 32° F (-1° to 0° C) occurring within the lower altitudinal (moisture) limits of *A. concolor*. Aside from temperature, fairly similar conditions of both substrates and precipitation occur throughout the Utah portion of the Wasatch Range, although the Great Salt Lake and Provo Lake apparently contribute to a slight increase in precipitation (appendix D-2). Thus while seedlings of *A. concolor* are commonly encountered, successful establishment would occur only during a series of the most favorable years having winters of above average temperature. While the Uinta Mountains are located south of Ogden in latitude, this same January temperature pattern occurs eastward because of the cold surrounding basins.

The second factor is that several rodents prefer to feed on the cambial tissue of *A. concolor* rather than that of *Pseudotsuga*. Hayward (1945), in a study of the Mt. Timpanogos area in the southern Wasatch Range, noted the near-complete destruction of scattered *A. concolor*, which had developed under the protective cover of *Populus tremuloides*. Given the normally episodic establishment of this species in the northernmost extent of its range, such activity could have a marked impact on population dynamics. For example, several stands of *Pseudotsuga*, as well as *Populus*, which included small populations of *A. concolor*, were located during 1972 to 1976. Typically, these included a representation of small- to medium-sized saplings. By 1977, almost all of the *A. concolor* had been destroyed by porcupines. In addition, the upper crowns of larger, widely located trees exhibited a periodic stripping of thinner bark. These feeding patterns appear to be opportunistic. In this area, many porcupines migrate from their valley and foothill wintering areas through the montane zone to their summering areas at higher elevations. Also, constant destruction of the leaders of the smaller trees by feeding mice, generally occurring at the level of snowpack accumulation, results in very "bushy," stunted individuals. Mice probably also destroy a great portion of each year's new seedlings.

Clearly, the combination of temperature constraints and rodent pressure serves to limit the success of *A. concolor* within the tension zone. With the exception of isolated sites, *Pseudotsuga* is the indicated climax within the tension zone and *A. concolor* is probably an accidental species. This relationship merits more study.

Vegetation.—*Abies concolor* usually reproduces abundantly throughout the series under conditions of dense shade, but it is an aggressive pioneer species as well. Overstory conditions are variable. On exposed, principally lower elevation sites *A. concolor* occurs either as widely spaced single trees or in scattered groups, between which brush or woodland species, chiefly *Acer grandidentatum* and *Quercus gambelii*, , are abundant.[3] *Pseudotsuga* and occasionally *Populus tremuloides* are dominant seral associates on more moderate exposures. On these sites canopies are normally more closed, often densely so. In addition, *Populus angustifolia* or *Acer negundo* is sometimes represented on sites close to streams.

Overall, undergrowth is similar to that of the *Pseudotsuga menziesii* series.

Soils.—Soils are derived from a variety of parent materials that include calcareous and noncalcareous sedimentary, complex metamorphics, granitic and quartzite rocks (appendix D). Additionally, most soils are associated with colluvium or rather shallow bedrock. A few stands occupy glacial-related features at the lower reaches of some canyons near Salt Lake City. Soils are gravelly and most are fairly well drained. All textural classes are represented in the surface soils in the series. The depth of litter and the amount of exposed rock are quite variable, but bare soil is generally absent.

Weather data from Cottonwood Weir Station, which is located lower than the series, and from Timpanogos Cave, which reflects the climate of a woodland site across-canyon from the ABCO/BERE h.t., BERE phase, are presented in appendix D-2.

Fire history.—Natural fire frequency prior to the influence of settlers is uncertain. In general, its effect on undergrowth was probably temporary and, in general, similar to that which is suggested for the *Pseudotsuga menziesii* series. Fire probably had a more significant effect on the overstory because *Abies concolor* is less fire resistant than *Pseudotsuga*. Thus, frequent light surface fires probably maintained rather open stands of large, persistent *Pseudotsuga*, and perhaps a few old *Abies* as well. In addition, *Abies* stands in local areas could be completely destroyed because their branching habit favors crowning out of surface fires.

As is the case for the *Pseudotsuga menziesii* series, many stands in the *A. concolor* series were logged and subsequently burned during the late 1800's. A review of various historical documents relating to that period indicates that *A. concolor* was just as scarce north of Ogden then as now.

Productivity/management.—Timber productivity ranges from very low to very high. The ABCO/OSCH h.t. includes some of the highest observed sample site index values of the montane zone of northwestern Utah.

[3]Such sites, however, must be capable of supporting at least 25 percent canopy cover of *Abies*, including any *Pseudotsuga*. Sites supporting less than 25 percent canopy cover of these conifers are considered as the ABCO-QUGA woodland series.

Timber management is generally limited, however, largely because other values are paramount. Timber guidelines are similar overall to those which are discussed for the *Pseudotsuga* series. Regeneration of *Abies concolor* is usually accomplished best through shelterwoods.

The series provides a multitude of nontimber benefits: deer habitat, watershed protection, and a diverse range of recreational opportunities.

Other studies.—Various *Abies concolor* habitats have been discussed for Oregon by Franklin and Dyrness (1973), who provide a summary of many studies, and for New Mexico and Colorado by Peet (1978).

Abies concolor h.t.'s have been described from central and southern Utah (Pfister 1972), and Arizona and New Mexico (Moir and Ludwig 1979). *Abies concolor/Acer glabrum* and *Abies concolor/Cercocarpus ledifolius* are unsampled habitat types that are expected to be common in the southern Wasatch Range and that possibly occur in the study area near Salt Lake City.

ABIES CONCOLOR/PHYSOCARPUS MALVACEUS H.T. (ABCO/PHMA; WHITE FIR/NINEBARK)

Distribution.—This habitat type is common in the southern Wasatch Range and Stansbury Mountains. It occupies relatively warm sites that most closely resemble those of the PSME/PHMA h.t. Slopes range from moderate to very steep.

Vegetation.—*Abies concolor* is the indicated climax. The shrubby undergrowth is dominated by typically dense *Physocarpus*. Species which occur throughout the type are *Amelanchier alnifolia, Pachistima myrsinites,* and *Prunus virginiana*. In addition, *Carex geyeri* is locally abundant. The presence of herbaceous species varies (appendix C), as does that of seral overstory associates (appendix B).

Pseudotsuga is usually a major seral associate, and stands are fairly closed. Occasionally *Acer* and *Quercus* are represented but they are persistent in the largest canopy openings only. In addition to the typal species, undergrowth includes *Symphoricarpos oreophilus, Mitella stauropetala,* and *Smilacina racemosa* as the most common species of the many that occur. Nearby drier forested sites are typically the ABLA/BERE h.t. Cooler, more mesic exposures at higher elevations are the ABLA/ACRU, ABLA/PHMA, or ABLA/ACGL h.t.'s.

Soils.—The soils of our sample stands are derived primarily from shaley quartzite (appendix D). In general, soils are gravelly with surface texture loamy to clayey. Surface rocks are usually absent. Litter depth averages 6.8 cm.

Productivity/management.—In general, timber productivity is high. This habitat type is important for deer, especially as winter range. Watershed protection and esthetic values are also high.

Other studies.—This habitat has not been previously mentioned.

ABIES CONCOLOR/OSMORHIZA CHILENSIS H.T. (ABCO/OSCH; WHITE FIR/MOUNTAIN SWEETROOT)

Distribution.—This minor, moist habitat type occurs throughout the geographical extent of the series, with the exception of the Uinta Mountains. Overall, ABCO/OSCH is fairly similar to the PSME/OSCH h.t. Exposures are northerly, steep to very steep lower and midslopes. Sites otherwise are protected and principally occupy streamsides or benches. Elevations are between about 5,400 and 7,000 feet (1 645 and 2 135 m).

Vegetation.—*Abies concolor* is the indicated climax. Normally *Pseudotsuga* is a major seral associate, and *Populus angustifolia* and *Acer negundo* are associated with streamside sites.

Undergrowth is usually brushy. Common shrubs include *Amelanchier alnifolia, Pachistima myrsinites, Prunus virginiana,* and, when the drier ABCO/PHMA h.t. is proximate, minor amounts of *Physocarpus malvaceus*. *Osmorhiza chilensis* is usually the most notable herbaceous species (appendix C).

Soils.—The soils of our stands are derived from a variety of substrates (appendix D). Surface textures are variable, ranging from loamy sands to clayey, and most soils are gravelly but relatively moist. Considerable surface rock but little bare soil is typically present. Litter depth averages 1.9 inches (4.8 cm).

Productivity/management.—Timber productivity is high to very high, which is highest for the series (appendix E). Timber management opportunities, however, are restricted because of the limited extent and nature of the sites. In this respect, maintenance of water quality is usually a paramount concern.

Other studies.—This habitat type has not been mentioned previously.

ABIES CONCOLOR/BERBERIS REPENS H.T. (ABCO/BERE; WHITE FIR/OREGONGRAPE)

Distribution.—This habitat type, with two recognized phases, occurs throughout the geographical extent of the series. Elevations range from about 5,700 feet (1 735 m) to over 8,000 feet (2 440 m). Exposures are north-facing or otherwise protected, and slopes are gentle to extremely steep. The habitat type is similar in most all respects to the PSME/BERE h.t.

Vegetation.—*Abies concolor* is the indicated climax. Seral associates vary in occurrence by phase.

Undergrowth is typically brushy (fig. 11). Common species include the joint indicators *Berberis* and *Pachistima myrsinites*, as well as *Symphoricarpos oreophilus, Thalictrum fendleri,* and minor amounts of *Osmorhiza chilensis*. Where the ABCO/PHMA h.t. is nearby on somewhat more mesic sites, small amounts of *Physocarpus malvaceus* are also present. Other more mesic habitat types include ABCO/OSCH and the cooler ABLA/BERE. Warmer and drier sites most frequently support woodland or nonforest communities; also the PSME/BERE h.t. is occasionally adjacent.

Figure 11. *Abies concolor/Berberis repens* h.t. on a moderately steep northeast exposure (8,400 feet [2 560 m] elevation) in the western part of the Uinta Mountains near Kamas, Utah. The low, brushy undergrowth consists primarily of *Symphoricarpos oreophilus* and *B. repens.*

***Symphoricarpos oreophilus* (SYOR) phase.**—This phase occupies the warmest and driest exposures and is especially common in the western mountain ranges. Usually *Abies* does not achieve a closed canopy. *Acer grandidentatum* and *Quercus gambelii* are locally important seral associates which are sometimes persistent in the larger canopy openings. Undergrowth is characterized by normally dense *Symphoricarpos* or the presence of persistent *Cercocarpus ledifolius*. In addition to the typal species, *Prunus virginiana* is often present at the lower elevations and *Ceanothus velutinus* at the higher elevations.

***Berberis repens* (BERE) phase.**—The more mesic BERE phase is commonest in the Wasatch Range and southwestern Uinta Mountains. Stand structure is more closed. *Pseudotsuga* is the principal seral associate; occasionally *Populus tremuloides* is present as a seral species. Undergrowth additions are *Amelanchier alnifolia, Aster engelmannii, Stellaria jamesiana,* and sometimes *Carex geyeri*.

Soils.—Our stands have soils that are derived from a variety of substrates (appendix D). Soils are gravelly, and surface soils vary from sandy loams to rather clayey. Normally little surface rock is present, and bare soil is generally absent. The SYOR phase has an average litter depth of 1.0 inches (2.5 cm); that of the BERE phase is 1.4 inches (3.5 cm).

Productivity/management.—Timber productivity is very low, with stockability limitations in the SYOR phase, and low in the BERE phase (appendix E). Very local timber management opportunities exist where other use considerations are not predominant. Shelterwoods best reflect observed patterns of regeneration. Moderate deer use occurs throughout the type.

Other studies.—The ABCO/BERE h.t. has been briefly described from central Utah by Pfister (1972).

Picea engelmannii Series

Distribution.—This series occurs most commonly throughout the more central and eastern Uinta Mountains. It also occupies some of the moistest sites in the Salt Lake City area of the Wasatch Range as well as in the westernmost Uintas. Although most all sites occur within the altitudinal range of *Abies lasiocarpa*, exposures are either too cold or too dry for *Abies*. In general, all aspects are represented and elevations range from about 9,000 feet (2 745 m) to over 11,000 feet (3 350 m) at timberline.

Vegetation/fire history.—*Picea engelmannii* is often very long-lived, frequently attaining ages of greater than 400 years. Fire is an important perturbation: although more frequent at lower elevations, its effect may be more severe at higher elevations where stand establishment can be quite prolonged. Very wet sites often have *Abies lasiocarpa* represented as a climax associate. Several old-growth structural trends are encountered on drier sites. There, reproduction occurs mainly on mineral soil created by upturned root masses, and *Abies* is accidental. For the series, undergrowth varies from a rather diverse assemblage of moist-site species to undergrowth dominated by cold-site species, especially *Vaccinium*.

Below about 10,600 feet (3 230 m) elevation, *Pinus contorta* is usually a major seral associate. *Pinus*, however, can be quite persistent. Where it is persistent, *Picea* usually occurs as scattered individuals, and subsequent *Picea* reproduction is quite sporadic, primarily reflecting the droughty seedbed conditions. *Populus tremuloides* is sometimes an additional seral associate at lower elevations.

Old-growth stands occupying sites above the occurrence of *Pinus* are comprised of largely all-aged *Picea*. Stands vary from fairly continuous to isolated groups of trees, or copses, that are surrounded by meadow communities. Within the timberline zone, stands are similar in most respects to those of the TRSP phase of the ABLA/RIMO h.t.

Pfister (1972) recognized a *Picea engelmannii/Ribes montigenum* h.t., which occurs above the cold limits (about 10,800 feet [3 290 m]) of *Abies lasiocarpa* in southern Utah. One old-growth PIEN/RIMO community was sampled in the southeastern Uintas near 10,900 feet (3 320 m) elevation. Although *Abies* was not represented in the stand, it was nearby on the same substrate, and the site appeared to be sufficiently warm for this species. This stand was placed in the ABLA/RIMO h.t., TRSP phase. Also, several mature stands of *Picea engelmannii/Juniperus communis* communities were sampled in the south-central Uintas. These appeared to have occupied the ABLA/JUCO h.t. and were placed in that group. It is expected that similar correspondences will occur for other stands of either situation. Probably the pure *Picea engelmannii* stands of the northwestern region will also represent the *Abies lasiocarpa* series, with the possible exception of the Deep Creek Range where a major PIEN/RIMO h.t. appears to be present and where *A. lasiocarpa* was not encountered.

Soils.—Soils are derived predominantly from quartziferous materials (appendix D). Most are quite gravelly and typically shallow. Surface soils vary from fairly well-drained sandy loams to very clayey for the moistest sites. Exposed rock ranges from absent or only slight to considerable; it is most common on slopes and at high elevations. Bare soil is normally absent. Litter accumulation is somewhat greater than that of the comparable *Abies lasiocarpa* h.t.'s.

Productivity/management.—Timber productivity is generally low throughout the series (appendix E). The adverse regeneration conditions of high-elevation sites within the series have been discussed by Roe and others (1970). Where environmental factors and growth rates are acceptable, small clearcuts for *Pinus contorta* appear to be the best natural regeneration strategy (guidelines for this species are discussed under the *P. contorta* series, Management section). If *Picea* is desired, partial shade and mineral soil are usually necessary.

The most important values of the series are summer elk habitat (Winn 1976), watershed cover, and wilderness considerations. Use by sheep for shaded bedgrounds is most extensive at the higher elevations wherever open grazing areas are nearby.

Other studies.—Various, mostly dissimilar *Picea engelmannii* h.t.'s have been described from Montana (Pfister and others 1977) and central Idaho (Steele and others 1981). In general, these occupy very cool sites between the *Abies lasiocarpa* and *Pseudotsuga menziesii* series. The *P. engelmannii* series of western Wyoming (Steele and others 1983), as well as the Big Horn Mountains, Wyo. (Hoffman and Alexander 1976), is more similar to that of northern Utah. In addition, one habitat type has been recognized from northern New Mexico (Moir and Ludwig 1979) and, as noted, from southern Utah (Pfister 1972).

PICEA ENGELMANNII/EQUISETUM ARVENSE H.T. (PIEN/EQAR; ENGELMANN SPRUCE/COMMON HORSETAIL)

Distribution.—This minor habitat type occurs in the central Wasatch Range in the vicinity of Salt Lake City, and in isolated locations of the Uinta Mountains. Elevations are near 9,000 feet (2 745 m). The PIEN/EQAR h.t. normally occupies moist to wet streamside terraces that are relatively cool for the area but warm for the series (fig. 12).

Vegetation.—*Picea engelmannii* is the indicated climax. *Pinus contorta* is a minor seral associate in the Uinta Mountains. Normally *Abies lasiocarpa* is a climax associate; however, we concur with Pfister and others (1977) and Steele and others (1983) in the placement of such sites in the *Picea engelmannii* series in that *Picea* appears to have a greater competitive advantage under these very wet environmental conditions. Although *Picea pungens* was not encountered as a climax dominant under such conditions, it can be expected to occur in northern Utah. When present, such sites should be placed in the PIEN/EQAR h.t. for management considerations.

Undergrowth is normally characterized by abundant *Equisetum arvense* and a variable assortment of moist-

Figure 12. Picea engelmannii/Equisetum arvense h.t. is a somewhat unusual type that occurs in the central portion of the Wasatch Range on moist streamside terraces. This stand occurs at 8,750 feet (2 670 m) elevation east of Kamas, Utah. It has an herbaceous undergrowth dominated by *Calamagrostis canadensis*, various species of *Carex*, *E. arvense*, and *Veratrum californicum*.

site forbs, such as *Aconitum columbianum*, *Pyrola asarifolia*, *Saxifraga odontoloma*, *Senecio triangularis*, species of *Carex* including *C. disperma*, and *Salix*. In addition, in the Uinta Mountains *Calamagrostis canadensis* is characteristically present. *Erigeron peregrinus*, *Pyrola secunda*, *Smilacina stellata*, *Bromus ciliatus*, *Elymus glaucus*, and species of *Lonicera*, *Arnica*, and *Geranium* commonly occupy drier microsites. *Ribes montigenum*, *Sambucus racemosa*, *Aster engelmannii*, *Osmorhiza depauperata*, *Rudbeckia occidentalis*, and *Veratrum californicum* are locally abundant.

In northwestern Utah, the ABLA/BERE h.t., RIMO phase, is often found upslope of the PIEN/EQAR h.t. In the Uinta Mountains, the ABLA/CACA h.t. is sometimes proximate. Similarly the ABLA/VACA or ABLA/VASC h.t.'s are found on better drained sites. Adjacent, wetter sites everywhere normally support *Salix/Carex* communities which usually contain an *Equisetum* component.

Soils.—The substrates of our stands are predominantly alluvium of variable composition, but chiefly granitic or quartziferous (appendix D). Surface soils are normally very moist and locally range in texture from sandy loam to mucky-clays; gravel occurrence is equally variable. Surface rock is sometimes present but bare soil is usually absent. Litter depth averages 2.5 inches (6.5 cm).

Productivity/management.—Timber productivity is low in the Uintas and moderate in the Wasatch Range (appendix E). Sites are extremely fragile. Thus, the principal value of the type is as streamside cover and wildlife habitat.

Other studies.—The PIEN/EQAR h.t. has been described from Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and eastern Idaho, western Wyoming (Steele and others 1983).

PICEA ENGELMANNII/CALTHA LEPTOSEPALA H.T. (PIEN/CALE; ENGELMANN SPRUCE/ELKSLIP MARSHMARIGOLD)

Distribution.—This very local habitat type occurs principally in the southern and western Uinta Mountains. The gentle slopes are cool to cold, often with seasonably high water tables. Elevations range from near 10,000 feet (3 050 m) to over 10,900 feet (3 320 m).

Vegetation.—*Picea engelmannii* is the indicated climax. *Pinus contorta* is locally a major seral associate. Although *Abies lasiocarpa* is sometimes present, individual trees are normally stunted and only occupy drier microsites.

Undergrowth is predominantly herbaceous. In addition to the indicator *Caltha leptosepala*, other common moist- or cold-site species are *Arnica* spp., *Pedicularis bracteosa*, *P. groenlandica*, *Polygonum bistortoides*, *Potentilla* spp., *Sibbaldia procumbens*, *Trifolium* spp., *Carex atrata*, *C. scirpoidea*, *Deschampsia caespitosa*, *Luzula spicata*, *Phleum alpinum*, and occasionally *Veronica wormskjoldii*, *Festuca ovina*, and *Poa alpina*. Species often represented on drier microsites include *Antennaria microphylla*, *Erigeron peregrinus*, *Danthonia intermedia*, *Poa nervosa* and *Trisetum spicatum*. The only common shrubs are *Vaccinium caespitosum* and *V. scoparium*; these also reflect the proximate, drier PIEN/VACA, PIEN/VASC, and ABLA/VASC h.t.'s.

Soils.—Our stands have quartzite or Duchesne sandstone substrates (appendix D). Surface soils are moist and have loamy to clayey textures and local gravel. Subsurface clay-dominated horizons are also usually present. Some surface rock, but little or no bare soil, is present. Litter averages 1.3 inches (3.4 cm) in depth.

Productivity/management.—Timber productivity is low and growth rates are poor (appendix E). For the most part, overstory manipulation usually results in raised water tables and an intensification of insolation and frost heaving, which impedes regeneration. Cattle use is local and particularly intensive near recent stand openings or where grazing areas are nearby.

Other studies.—Steele and others (1983) described this habitat type for western Wyoming.

PICEA ENGLEMANNII/VACCINIUM CAESPITOSUM H.T. (PIEN/VACA; ENGELMANN SPRUCE/DWARF BLUEBERRY)

Distribution.—The PIEN/VACA h.t. occurs throughout the central and eastern Uinta Mountains. Elevations are between 9,600 and 11,100 feet (2 925 and 3 385 m), and occasionally as low as 9,300 feet (2 835 m) on northerly exposures. It is similar to the ABLA/VACA h.t. insofar as sites are dominated by cold air drainage or accumulation. Accordingly, the normally gentle terrain includes such features as basins, benches, ridge slopes, and plateaulike surfaces.

Vegetation.—*Picea engelmannii* is the indicated climax. Below 10,600 feet (3 230 m), *Pinus contorta* is usually a major seral associate. Sometimes it is persistent. *Populus tremuloides* is locally an important seral component at lower elevations only.

Vaccinium caespitosum characterizes a rather diverse undergrowth (fig. 13). At higher elevations, several other cold-site species are fairly common, such as *Lewisia pygmaea*, *Polygonum bistortoides*, *Potentilla* spp., *Sibbaldia procumbens*, *Trifolium* spp., *Deschampsia caespitosum*, *Luzula spicata*, *Poa alpina*, and particularly near timberline, *Geum rossii*, *Carex albo-nigra*, and *Carex scirpoidea*. Occurring throughout the type are *Juniperus communis*, *Ribes montigenum*, *Achillea millefolium*, *Antennaria* spp., *Arnica cordifolia*, *Epilobium angustifolium*, *Erigeron peregrinus*, *Fragaria virginiana*, *Sedum lanceolatum*, *Carex rossii*, *Poa nervosa*, and *Trisetum spicatum*. In addition, *Vaccinium scoparium* is often abundant, reflecting the warmer, proximate PIEN/VASC h.t. Normally, a variety of non-forest communities are adjacent at higher elevations (which are described by Lewis 1970).

Figure 13. Picea engelmannii/Vaccinium caespitosum h.t. on gentle topography at high elevations (10,050 feet [3 060 m]) in the eastern Uintas, Ashley National Forest. The undergrowth in this stand is dominated by a mixture of *V. caespitosum* and *Vaccinium scoparium*.

Soils.—Our stands have parent materials that are mainly quartziferous, chiefly quartzite (appendix D). Surface soil textures range from sandy loam to clayey, generally the latter, and gravel is typically present. Surface rock varies from absent to considerable. Bare soil is generally absent. Litter depth averages 1.2 inches (3.1 cm).

Productivity/management.—The principal use of this type is as wildlife habitat for elk as well as a variety of smaller vertebrates (Winn 1976).

Timber productivity is low (appendix E). Management is more feasible where *Pinus contorta* is a major stand component. There, small clearcuts are often the best natural regeneration strategy. In many locations, however, severe frost-pocket conditions may result from such activities, with excessive seedling mortality and stunted initial growth.

Other studies.—This habitat type has been described from Montana by Pfister and others (1977).

PICEA ENGELMANNII/VACCINIUM SCOPARIUM H.T. (PIEN/VASC: ENGELMANN SPRUCE/GROUSE WHORTLEBERRY)

Distribution.—This habitat type is common throughout the central and eastern Uinta Mountains. Elevations range from about 9,600 feet (2 925 m) to 11,200 feet (3 415 m) at timberline. Exposures are typically very cool and dry to moist. As such, the PIEN/VASC h.t. occupies a variety of gentle to moderately steep terrain that encompasses drainage bottoms through middle to upper slopes, as well as broad plateaulike surfaces.

Vegetation.—*Picea engelmannii* is the indicated climax. *Pinus contorta*, which is often persistent, is a major seral associate below 10,600 feet (3 230 m) elevation.

Undergrowth usually consists of a striking cover of *Vaccinium scoparium*. Common species include *Juniperus communis* as well as small amounts of *Ribes montigenum*, *Achillea millefolium*, *Arnica cordifolia*, *Erigeron peregrinus*, *Potentilla* spp., *Carex rossii*, *Poa nervosa*, and *Trisetum spicatum*. *Antennaria* spp., *Polemonium pulcherrimum*, *Sibbaldia procumbens*, and *Sedum lanceolatum* are more local in occurrence. Colder proximate sites are usually the PIEN/VACA h.t. Warmer habitat types are typically the PICO/VASC h.t. at lower elevations in the north-central area and the ABLA/VASC h.t. elsewhere. The ABLA/RIMO h.t., TRSP phase, typically occurs at higher elevations.

Soils.—In general, the soils of our stands are similar overall to those of the PIEN/VACA h.t. Litter depth, however, is less (1.0 inches [2.6 cm]) and the surface soils are generally coarser, being predominantly gravelly sandy loams.

Productivity/management.—Timber productivity is low (appendix E). Resource management opportunities and considerations are generally similar to those of the PIEN/VACA h.t., but frost-related damage appears to be less critical.

Other studies.—The PIEN/VASC h.t. has been described from western Wyoming (Steele and others 1983) and north-central Wyoming (Hoffman and Alexander 1976). In addition, a somewhat similar *Picea engelmannii/Vaccinium scoparium/Polemonium delicatum* h.t. has been recognized in northern New Mexico by Moir and Ludwig (1979).

Abies lasiocarpa Series

Distribution.—The *Abies lasiocarpa* series occurs throughout the higher mountain ranges of northern Utah and adjacent Idaho (appendix A). In the northwestern region, it occupies all but the warmest of forested exposures above 7,500 to 8,000 feet (2 285 to 2 440 m) elevation. This represents, for example, about 2,500 vertical feet (760 m) in the northern Wasatch Range. Near Salt Lake City it forms the timberline forests to about 10,500 feet (3 200 m) elevation. The series occasionally extends downward to about 6,000 feet (3 200 m) on protected, generally northerly slopes. Topography is typified by both moderate to very steep slopes and gentle uplands. Normally the warmer *Pseudotsuga menziesii* series occurs below. The *Pseudotsuga* series may also occupy the warmest exposures or the driest sites having shallow bedrock within the *A. lasiocarpa* series, except where it may be replaced by the *Abies concolor* series of the southern areas. Persistent shrub communities are also sometimes adjacent on warmer exposures (described by Ream 1964).

The *Abies lasiocarpa* series is represented by extensive forests throughout most of the Uinta Mountains from between about 8,000 and 9,000 feet (2 440 and 2 745 m) elevation to treeline, which is at about 11,000 feet (3 355 m). As such, it occupies all exposures, including steeper canyon and ridge slopes except the driest or exceptionally coldest. The *Abies lasiocarpa* series is often conspicuously absent within the rain shadow area of the north-central Uintas where it is replaced by the *Pinus contorta* or the *Picea engelmannii* series on most all of these dry and cold exposures. Throughout the Uintas, the *A. lasiocarpa* series is also found at lower elevations on especially moist or cool sites within the warmer *Picea pungens* and *Pseudotsuga* series (which generally occupy calcareous-dominated substrates) and the *P. contorta* series, to a lower limit of about 7,500 feet (2 285 m).

Vegetation.—*Abies lasiocarpa* is the indicated climax. A variety of stand conditions are encountered throughout the series, as could be expected given its environmental extent. Pfister (1972) discussed the general structural, successional, and compositional trends of the series, and identified specific patterns that are associated with environmental extremes and more modal conditions. Briefly summarized, these represent three major points:

1. For unfavorable sites, normal succession progresses relatively more slowly, with seral species tending to create the dominant stand aspect.
2. Old-growth stands occupying unfavorable sites tend to be more open; conversely, those of more favorable sites are more closed, being often densely so.
3. Seral associates growing in smaller canopy openings resulting from minor mortality such as windthrow, biological agents, or light fires tend to contribute more significantly to the dominant stand aspect on unfavorable sites than on favorable sites.

The overstory vegetation patterns on the most unfavorable sites are particularly characteristic of specific habitat types or phases, and are discussed where most applicable: for instance, timberline forest conditions with the ABLA/RIMO h.t., TRSP phase.

Nearly all northern Utah tree species are represented as seral associates in the series (appendix B). Of the major species, *Pseudotsuga menziesii* is most important on the warmer exposures in the northwestern region; *Pinus contorta* on similar sites in the Uinta region. Likewise, *Populus tremuloides* occurs throughout the northern Utah area. *Picea engelmannii* is normally associated with cooler exposures. Following major disturbance such as fire, these species are the dominant components of seral stands, although *Abies* is also a major pioneer species on especially mesic exposures.

Typically, late seral stands occupying the more moderate exposures develop a distinct, sometimes very dense component of *Abies* that often includes layered stems. This component normally approaches an all-aged condition. *Abies* mortality can be extensive, however. This is generally attributed to various decay fungi, and principally the root rot *Fomes annosus* (Nelson 1963).

Two old-growth conditions are especially noteworthy. First, whenever *Picea* is initally a major stand component, the old-growth aspect is dominated by this species. These *Picea* are long lived, 300+ years, and typically large, 40 inches (100 cm) d.b.h. and 100 feet (30 m) high. The understory component of the stand is often dominated by *Abies*, with little representation of *Picea*, except where mineral soil has been bared by upturned root systems. This old-growth aspect is particularly evident in the ABLA/PERA h.t. (PERA phase), the ABLA/RIMO h.t. (THFE phase), and the ABLA/VASC h.t. (ARLA phase). In the above instances, it appears that *Picea* is a long-lived dominant that some authors consider coclimax. The relative inability of *Picea* to establish on its own litter, as demonstrated by Daniel and Schmidt (1972), suggests the use of the *Abies* climax name for this condition.

The second old-growth condition occurs with lower sites in the Uinta Mountains. There, old-growth stands are frequently dominated by *Pinus contorta* and have only a minor *Abies* component. Thus, some stands may be sought at the *Pinus contorta* series. Even though replacement by shade-tolerant species is slow, its progression should be fairly obvious (see also the *Pinus contorta* series). Such circumstances are perhaps better attributed primarily to unfavorable, droughty seedbed conditions for seedling establishment rather than entirely to the presumably frequent incidence of natural surface fires. Although fire will often destroy shade-tolerant associates, it also creates optimum seedbed conditions for these associates.

Soils/climate.—Soils of the *Abies lasiocarpa* series are derived from a variety of substrates (appendix D-1). In general, surface soil textures range from loamy to clayey in the northwestern region, and from sandy loam to loamy in the Uintas. Many surface soils are gravelly and well drained, although those of the ABLA/CACA and ABLA/STAM h.t.'s are seasonally moist and typically clayey. Exposed rock and bare soil are most common in habitat types that are associated with shallow bedrock and with sites near timberline. Litter depth varies, ranging from an average depth of about 2.0 inches (5.0 cm) on the lower, mesic habitat types to about 0.8 inches (2.0 cm) on the higher types.

The most characteristic features of the climate of the *Abies lasiocarpa* series are the overall cool temperatures, frequent summer frosts, and deep snowpack accumulation and lengthy retention (Lawton 1979), all of which create a short growing season. The climatic data from two stations presented in appendix D-2 reflect these conditions.

Fire history.—As noted by Pfister and others (1977), lightning-caused fires in the lower elevation, drier habitat types tend to be more frequent and less harmful than in the moister types. The extent of burning at higher elevations, however, is often restricted by terrain, natural fuel breaks, and moister and cooler burning conditions.

The extensive logging that occurred throughout the Wasatch Range during the late 1800's and the fires that followed had a marked influence on some current stand conditions. Their effect is most apparent in the middle elevation habitat types of the *Abies* series. For example, in the vicinity of Franklin Basin east of Logan, extensive areas were logged for all but the smallest material. Afterward, fires swept through much of the area, destroying residual stems and new regeneration as well as unlogged stands. This was followed by a period of intensive livestock grazing, apparently mostly sheep, which resulted in significant soil loss and compaction and even yet more fires. Many essentially pure stands of *Populus tremuloides* resulted. In many of these, conifers, mainly *A. lasiocarpa*, have only recently become established. This is particularly evident on the less protected exposures of the ABLA/OSCH and ABLA/BERE h.t.'s, where *Pseudotsuga* would normally have been a principal seral associate (as indicated by large, charred stumps and from Bird 1964), and succession to conifer dominance probably would have been fairly rapid. This is not to be interpreted that all stands dominated by *Populus* are clearly seral stages of *A. lasiocarpa* h.t.'s.

Productivity/management.—Within the series, timber productivity is highest in the mesic, midelevation habitat types of northwestern Utah and adjacent Idaho. Upper-moderate to high yield capability occurs in parts of the ABLA/ACRU, ABLA/PERA, the PSME and BERE phases of the ABLA/BERE, and the THFE phase of the ABLA/RIMO h.t.'s (appendix E). Basal area development is also good in these types. With the exception of *Pseudotsuga* in the ABLA/ACRU h.t., either *Picea engelmannii* or *Abies lasiocarpa* is the fastest growing species, as measured by average sample site index. Elsewhere, productivity ranges from low to moderate, and *P. engelmannii* or *Pinus contorta* is the most productive species. In some instances, such as the ABLA/OSCH h.t., dominance by *Populus* normally tends to reduce overall coniferous productivity.

The northwestern region offers good timber management opportunities on the more gentle portions of the above types, as with the ABLA/VAGL and ABLA/ACGL h.t.'s in Idaho. This series includes most of the old-growth stands of this region. In the Uinta Mountains most of the lower part of the series offers good management opportunities, primarily for *Pinus contorta*. Timber management opportunities for other northern Utah types in the series are poorer because of low productivity, adverse regeneration conditions or brush development following overstory manipulation, or conflicting use considerations.

Silvicultural strategies and considerations for regeneration have been discussed in general for the series by Alexander (1974) and Pfister (1972), for *P. contorta* by Lotan (1975a), for *Pseudotsuga* by Ryker (1975), and for *P. engelmannii* by Roe and others (1970). Mineral soil appears to be a prerequisite for good regeneration for all species (Daniel and Schmidt 1972). Furthermore, specific site preparation measures may be necessary to control rhizomatous graminoids or brush, and windthrow is often a special problem (Alexander 1974). Schimpf and others (1980) have provided a current review of autecological studies relating to the natural regeneration of these species.

Pinus contorta is normally the easiest species to regenerate by both natural and artificial means. Because its cone habit is largely nonserotinous throughout northern Utah, small patch or strip clearcuts are generally best. The more shade-tolerant species are best regenerated under conditions of partial shade. Various shelterwood measures most typically reflect the majority of observed natural stand patterns, particularly for *Pseudotsuga*. These also serve to suppress subsequent *Populus* development. *Populus*, however, may be especially desirable for wildlife forage (Patten and Jones 1977) or as a "nurse" cover for conifer establishment especially when diseased old-growth necessitates clearcutting. Selection methods are sometimes possible for *P. engelmannii*. Smaller patch or strip clearcuts are feasible for all of these species but usually on more protected exposures only; even so, planting is often necessary but is not always successful. Roe and others (1970) discussed the various factors that are potentially troublesome with clearcutting, especially for *P. engelmannii* at higher elevations. These include seedling mortality from direct insolation, moisture stress, frost heaving, cold injury, and damage by vertebrates. The development of competition from *Carex rossii* appears to be especially critical in larger clearcuts.

Shade-tolerant species are the hosts for several diseases, most of which are only local problems and, in general, only affect vigor and growth. The most conspicuous of these are broom rusts (*Stellaria* is an alternate host); if this disease is particularly severe in a stand, clearcutting may be the only available regeneration strategy. Root rots (primarily *Fomes annosus*) and stem decay fungi are very important because of mortality and merchantability losses.

The *Abies lasiocarpa* series provides significant nontimber benefits throughout northern Utah. Esthetic considerations are very important because of the fairly intense, seasonal recreational activities, such as skiing in the Wasatch Range and wilderness values in the higher Uinta Mountains. Watershed protection values are high, and opportunities for water quality and yield management are often major considerations. Seral stands provide summer range and forage for big game and domestic livestock on the more gentle sites. Additionally, the series is habitat for a multitude of other wildlife (Collins and others 1978; Deschamp and others 1979; Winn 1976).

ABIES LASIOCARPA/CALAMAGROSTIS CANADENSIS H.T. (ABLA/CACA; SUBALPINE FIR/BLUEJOINT REEDGRASS)

Distribution.—This habitat type, which is always associated with seasonally moist or saturated surface soils, is found locally throughout the Uinta Mountains. Elevations range from about 7,700 feet (2 350 m) along northerly stream courses, to near 10,000 feet (3 050 m). Exposures are gentle and include alluvial terraces as well as benchlands, ridges, and other related glacial and fluvial terrain. The ABLA/CACA h.t. also might be encountered at the higher elevations of the Wasatch Range in the vicinity of Salt Lake City.

Vegetation.—*Abies lasiocarpa* is the indicated climax. The dominant components of most seral stands are *Pinus contorta* and, locally, *Populus tremuloides*. *Picea engelmannii* is a persistent seral associate on particularly wet sites. *Picea pungens* is occasionally present as a minor associate at lower elevations. *Abies* and *P. engelmannii* are sometimes only poorly represented as stunted or very slow-growing individuals in old-growth stands of persistent *Pinus contorta*. These prolonged seral conditions typically occur with sites that are not too wet; they are discussed separately as the PICO/CACA c.t.

Although the undergrowth assemblage is diverse, *Calamagrostis* usually dominates the swardlike herbaceous component. On seeps or very moist streamside sites at lower elevations the undergrowth can include *Alnus tenuifolia*, *Pyrola asarifolia*, or *Cinna latifolia*, whereas *Caltha leptosepala*, *Polygonum bistortoides*, *Carex atrata*, *Deschampsia caespitosa*, *Luzula parviflora*, *Phleum alpina*, or *Poa reflexa* can be represented at higher elevations. Herbs, which occur commonly throughout the type on drier microsites, include *Achillea millefolium*, *Arnica cordifolia*, *Fragaria virginiana*, *Galium boreale*, *Geranium richardsonii*, *Bromus ciliatus*, *Trisetum spicatum*, as well as species of *Erigeron*, *Osmorhiza*, and *Potentilla*. Similar in occurrence are the shrubs *Juniperus communis*, *Lonicera involucrata*, *Ribes montigenum*, *Berberis repens*, *Vaccinium caespitosum*, or *V. scoparium*. The latter three species typically reflect the most common adjacent *Abies lasiocarpa* h.t.'s. Especially noteworthy are *Linnaea borealis*, a species that is sometimes abundant on cool microsites at lower elevations, and minor amounts of *Equisetum arvense*, which indicates the proximate PIEN/EQAR h.t.

Soils.—Our stands have quartzite as an exclusive soil parent material (appendix D). Permanently wet sites (seeps) have mucky surface soils below a typically thick organic layer. Better drained sites have a loamy surface soil texture, and often gravel. High water table conditions are probably associated with argillic horizons, as is the case for the PICO/CACA c.t. Surface rock and bare soil are usually absent. Litter averages 1.2 inches (3.0 cm) in depth, excluding humus.

Productivity/management.—Timber productivity is low (appendix E). Timber activities should be limited to drier sites. On wet sites, overstory manipulation generally results in windthrow, equipment problems, and raised water tables where regeneration success is very sporadic.

The ABLA/CACA h.t. is an important habitat segment for big game (Winn 1976). Domestic livestock use is locally variable.

Other studies.—The ABLA/CACA h.t. has been described for Montana by Pfister and others (1977); central Idaho by Steele and others (1981); and in eastern Idaho and western Wyoming by Steele and others (1983). These authors have also recognized a *Vaccinium caespitosum* phase which generally reflects a cooler temperature regime of lower elevations. Five of our 13 sample stands, including the PICO/CACA c.t., might be considered to represent such a phase. The remaining stands would then comprise a CACA phase.

ABIES LASIOCARPA/STREPTOPUS AMPLEXIFOLIUS H.T. (ABLA/STAM; SUBALPINE FIR/CLASPLEAF TWISTED-STALK)

Distribution.—ABLA/STAM is an incidental habitat type in northern Utah that occupies very moist slopes and alluvial terraces. It can be expected to occur very locally at midelevations of the *Abies lasiocarpa* series in the Uinta Mountains and possibly in the Wasatch Range near Salt Lake City. Elevations appear to be higher than the more common ABLA/CACA and PIEN/EQAR h.t.'s.

Vegetation.—*Abies lasiocarpa* is the indicated climax. Apparently *Picea engelmannii* is a persistent seral dominant and *Pinus contorta* is a minor seral associate occurring only on drier microsites.

Undergrowth is typified by a diverse assemblage of moist-site herbs, such as the joint indicators *Streptopus* and *Senecio triangularis*. The latter is more abundant in open, seral stands. Others include *Arnica latifolia*, *Mertensia ciliata*, *Osmorhiza depauperata*, *Saxifraga odontoloma*, *Bromus ciliatus*, and *Luzula parviflora*. Drier microsites contain *Ribes montigenum*, *Vaccinium scoparium*, *Pyrola secunda*, and *Carex rossii*. Proximate, drier sites are usually the ABLA/VASC h.t.

Soils.—Our sample stands have quartzite parent material. The surface textures are clayey and include considerable organic matter. Some coarse fragments are typically present, both in the shallow soil and on the surface. Litter depth averages 2.9 inches (7.3 cm) but is quite variable.

Productivity/management.—Timber productivity appears to be moderate, but timber management opportunities are extremely limited because of the moistness and rarity of the habitat type.

Other studies.—The ABLA/STAM h.t. is common in central Idaho, where it is described in greater detail by Steele and others (1981). It also extends into western Wyoming (Steele and others 1983).

ABIES LASIOCARPA/ACTAEA RUBRA H.T. (ABLA/ACRU; SUBALPINE FIR/BANEBERRY)

Distribution.—This habitat type is locally common in the canyons of the Wasatch Range of Utah and Idaho, and northward (Steele and others 1983). It is infrequently encountered elsewhere in northern Utah. Typically, sites are very moist northerly exposures on lower and middle slope positions. Steepness ranges from moderate to very steep, and elevations are between about 6,000 and 7,000 feet (1 830 and 2 135 m).

Vegetation.—*Abies lasiocarpa* is the indicated climax. The primary seral dominant is *Pseudotsuga* and locally, at higher elevations, *Picea engelmannii* and *Populus tremuloides*. *Abies* develops fairly rapidly although large *Pseudotsuga* tend to dominate the old-growth aspect.

Undergrowth is usually brushy, with a lush herbaceous component. Shrubs include *Amelanchier alnifolia*, *Berberis repens*, *Pachistima myrsinites*, *Prunus virginiana*, *Symphoricarpos oreophilus*, and, at lower elevations, *Physocarpus malvaceus*. In addition to *Actaea* common herbs are *Agastache urticifolia*, *Aquilegia coerulea*, *Arnica cordifolia*, *Aster engelmannii*, *Clematis columbiana*, *Disporum trachycarpum*, *Fragaria vesca*, *Mitella stauropetala*, *Thalictrum fendleri*, and species of *Galium*, *Lathyrus*, and *Osmorhiza*. *Carex geyeri* may also be present.

Drier, adjacent habitat types are most often ABLA/PHMA, ABLA/ACGL, ABLA/BERE, and on much warmer exposures at higher elevations, ABLA/OSCH. When ABLA/ACRU occurs within the upper zones of the *Abies concolor* and *Pseudotsuga menziesii* series, proximate sites are the respective habitat types of these series.

Soils.—Typically, soils are deep and moist. In our stands parent materials are quartziferous or sometimes calcareous (appendix D). Surface soils range from loamy to clayey, and some gravel is generally present. Surface rock and bare soil are usually absent. Litter depth averages 2.0 inches (5.1 cm). A few soils appeared to be unstable and might present engineering problems.

Productivity/management.—Timber productivity is moderate to high, representing one of the highest average values of the series (appendix E). Nevertheless, timber management has limited potential because the type is scarce and other uses conflict, especially esthetics. Whenever timber management is feasible, *Pseudotsuga*, the most productive species, might be favored by heavy shelterwood cuts.

The ABLA/ACRU h.t. provides important deer habitat and watershed protection.

Other studies.—Steele and others (1983) described this habitat type from eastern Idaho and western Wyoming. Cooper's (1975) *Abies lasiocarpa/Galium triflorum* h.t. appears to fall into our ABLA/ACRU h.t. In Montana, the ABLA/GATR h.t., which is described by Pfister and others (1977), is similar in some respects to the ABLA/ACRU h.t. of northern Utah.

ABIES LASIOCARPA/PHYSOCARPUS MALVACEUS H.T. (ABLA/PHMA; SUBALPINE FIR/NINEBARK)

Distribution.—This warm, fairly moist habitat type occurs throughout the Wasatch Range of Utah and Idaho, but it is most common toward the southern portion. It is infrequent elsewhere, except in the extreme northwestern Uinta Mountains near the Weber River. The ABLA/PHMA h.t. occupies northerly, lower to middle canyon slopes that are moderate to very steep. Elevations are between about 6,600 and 7,800 feet (2 010 and 2 375 m).

Vegetation.—*Abies lasiocarpa* is the indicated climax. Seral stands are usually dominated by *Pseudotsuga*, which rapidly develops a closed canopy. Locally, *Abies concolor* and *Picea engelmannii* are additional major seral associates. *Populus tremuloides* and *Acer grandidentatum* are minor seral associates that are also local in distribution. Old-growth stands appear fairly similar to those of the ABLA/ACRU h.t.

The shrubby undergrowth is characterized by a normally dense *Physocarpus* layer. Other common shrubs include *Amelanchier alnifolia*, *Berberis repens*, *Pachistima myrsinites*, *Rosa* spp., and *Symphoricarpos oreophilus*. Cooler sites may also have *Acer glabrum* or *Sorbus scopulina*. The herbaceous component typically includes *Aquilegia coerulea*, *Aster engelmannii*, *Clematis columbiana*, *Fragaria vesca*, *Mitella stauropetala*, *Osmorhiza* spp., *Pyrola secunda*, *Thalictrum fendleri*, *Viola adunca*, and, when the ABLA/ACRU h.t. is adjacent on moister sites, minor amounts of *Actaea rubra*.

Nearby warmer habitat types include ABCO/PHMA and PSME/PHMA or, if markedly drier, the ABLA/BERE, ABCO/BERE and PSME/BERE h.t.'s. Cooler exposures are typically the ABLA/ACGL h.t.

Soils.—Parent materials are usually diverse, reflecting the colluvial landforms that this habitat type principally occupies. Quartziferous fragments are often a major component (appendix D). Gravel is normally present, sometimes in considerable volume. Surface soils range from loamy to clayey in texture. Surface rock and bare soil are usually absent. Litter averages 1.5 inches (3.8 cm).

Productivity/management.—Timber productivity is moderate (appendix E). Management options and considerations are essentially similar to those of the ABLA/ACRU h.t., with the exception of problems created by the generally steeper slopes and the much greater probability of excessive brush development following overstory removal.

Other studies.—Steele and others (1983) have described this habitat type from eastern Idaho and western Wyoming.

ABIES LASIOCARPA/ACER GLABRUM H.T. (ABLA/ACGL; SUBALPINE FIR/MOUNTAIN MAPLE)

Distribution.—This cool, fairly moist habitat type is found principally in the Wasatch Range of northern Utah and adjacent Idaho. Like the PSME/ACGL h.t., topographic features of the ABLA/ACGL h.t. provide rapid drainage of cold air. Typically, the sites are moderate to very steep northerly canyon slopes. Westerly exposures also occur but are usually associated with streamsides or ravines. Elevations range from 6,500 feet (1 980 m) to 8,000 feet (2 440 m); however, the habitat type also extends downward locally to about 5,900 feet (1 800 m).

The ABLA/ACGL h.t. is very rare in the Uinta Mountains. It was sampled in a canyon bottom at 8,200 feet (2 500 m) elevation in the northeastern area as well as at 9,500 feet (2 895 m) occupying a steep midslope in the south-central area.

Vegetation.—*Abies lasiocarpa* is the indicated climax. Of the many seral associates which are represented with the type (appendix B), *Pinus contorta* and *Populus tremuloides* occur locally with *Pseudotsuga*, the principal seral dominant. Minor components include *Acer grandidentatum*, *Picea engelmannii*, and *Populus angustifolia*; these are generally associated with lower, higher, or streamside-proximate sites, respectively.

Undergrowth is normally quite shrubby. Tall members include *Amelanchier alnifolia*, *Acer glabrum*, and *Sorbus scopulina*; the latter has been adopted as a coindicator with *Acer* to correspond with the treatment of the type by Steele and others (1983). Low shrub components include *Berberis repens*, *Pachistima myrsinites*, *Rosa* spp., and *Symphoricarpos oreophilus*. The undergrowth also includes a relatively rich herbaceous assemblage; commonly represented are *Aquilegia coerulea*, *Arnica cordifolia*, *Aster engelmannii*, *Fragaria vesca*, *Goodyera oblongifolia*, *Mitella stauropetala*, *Osmorhiza* spp., *Pyrola secunda*, *Silene menziesii*, *Thalictrum fendleri*, and *Carex rossii*. Also, *Rubus parviflorus* and *Calamagrostis rubescens* are locally abundant.

Because the ABLA/ACGL h.t. is relatively cool and moist for the lower *Abies lasiocarpa* series, a variety of habitat types are adjacent. The warmer of these include ABLA/PHMA, ABCO/PHMA, PSME/ACGL, and PSME/PHMA, as well as the moister ABLA/ACRU. Drier sites are ABLA/BERE, ABCO/BERE, or PSME/BERE. In Idaho, the ABLA/VAGL and drier ABLA/CARU h.t.'s are typically located upslope.

Soils.—Although the soils of our stands are associated with a variety of substrates, quartziferous-dominated materials are the most common (appendix D). The gravelly surface soils also vary, but finer textures predominate. Surface rock and bare soil are generally absent. Litter averages 2.2 inches (5.5 cm) in depth.

Productivity/management.—Timber productivity is moderate (appendix E). Management guidelines are similar to those of the ABLA/ACRU h.t., but slopes are usually quite steep. Opportunities for timber management are generally better in the Idaho areas.

Other studies.—Steele and others (1983) recognize this habitat type in eastern Idaho and western Wyoming as the *Pachistima myrsinites* phase. This serves as a geographical distinction from the *Acer glabrum* phase of central Idaho (Steele and others 1981).

ABIES LASIOCARPA/VACCINIUM CAESPITOSUM H.T. (ABLA/VACA; SUBALPINE FIR/DWARF BLUEBERRY)

Distribution.—In northern Utah, the ABLA/VACA h.t. is apparently restricted to the Uinta Mountains. Elevations range from about 8,600 to 10,000 feet (2 620 to 3 050 m). The type occurs especially on terrain conducive to accumulating cold air. Topography varies, typically encompassing canyon benches and steep slopes, plateaulike surfaces, and adjacent upper slope areas, as well as the undulate terrain of glacial till.

Vegetation.—*Abies lasiocarpa* is the indicated climax. The dominant component of most seral stands is *Pinus contorta*, but *Picea engelmannii* and *Populus tremuloides* are often important seral associates. *Pseudotsuga*, a minor seral species, is restricted to canyon slopes. As is the case with the other subalpine habitat types where *Pinus contorta* can be a persistent seral species, *Abies lasiocarpa* and *Picea engelmannii* are sometimes present only as stunted or very slow-growing individuals.

Undergrowth typically includes small amounts of *Achillea millefolium*, *Arnica cordifolia*, *Epilobium angustifolium*, *Fragaria virginiana*, *Galium boreale*, *Potentilla* spp., *Pyrola secunda*, *Stellaria jamesiana*, *Bromus ciliatus*, *Carex rossii*, *Poa nervosa*, and *Trisetum spicatum*. In addition, *Carex geyeri* is sometimes abundant at lower and *Sibbaldia procumbens* at higher elevations. The most common shrubs are *Juniperus communis*, *Vaccinium scoparium*, *Ribes montigenum*, and at lower elevations, *Berberis repens* or *Pachistima myrsinites*. All of these species reflect warmer, proximate habitat types.

Normally *Vaccinium caespitosum* is represented with sufficient coverage to clearly delineate a site as the ABLA/VACA h.t. In especially depauperate undergrowths or at lower elevations, however, this species occurs mainly as isolated stems. Nevertheless, in many of these instances its presence generally reflects an influence of cold air; any such sites, therefore, should be considered as an ABLA/VACA h.t.

Soils.—Our stands have soil parent materials that are either wholly quartzite or predominantly quartziferous (appendix D). Surface soils range from sandy loams to clay loams but are mainly coarse-textured. Gravel content and surface rock are often considerable but bare soil is normally absent. Average litter depth is 1.3 inches (3.2 cm).

Productivity/management.—Timber productivity is low (appendix E). Seedling growth is poor and reflects the exceptionally frosty environment. Because of this, *Pinus contorta* is the best species for management, and is the easiest to regenerate.

Wildlife and livestock use is local; sites adjacent to meadows are particularly critical for cover.

Other studies.—In Montana, the ABLA/VACA h.t. has been described by Pfister and others (1977). Kerr and Henderson (1979) described an ABLA/VACA h.t. from central Utah that is overall similar to our stands containing *Berberis* or *Pachistima*.

ABIES LASIOCARPA/VACCINIUM GLOBULARE H.T. (ABLA/VAGL; SUBALPINE FIR/BLUE HUCKLEBERRY)

Distribution.—The ABLA/VAGL h.t. occurs infrequently in the northernmost Wasatch Range and westernmost Uinta Mountains (appendix A). It increases in extent northward through southeastern Idaho and adjacent Wyoming where it is recognized by Steele and others (1983). Kerr and Henderson (1979) described an *Abies lasiocarpa/Vaccinium membranaceum* h.t. from central Utah which corresponds to our ABLA/VAGL h.t.

ABLA/VAGL h.t. occupies a variety of cool and moderately moist, typically north-facing exposures between about 7,200 feet (2 195 m) and 8,800 feet (2 680 m) elevation. Slopes range from gentle to very steep, but are most typically moderate in steepness.

Vegetation.—*Abies lasiocarpa* is the indicated climax. Most seral stands are dominated by *Picea engelmannii*, with *Pinus contorta* or *Pseudotsuga* as an additional seral associate. Most are also distinctly even-aged in appearance, being of fire origin. *Abies* develops rather slowly on some sites.

Undergrowth is characterized by abundant cover of *Vaccinium*, which for the northern Utah area is unique in appearance (fig. 14). Other common shrubs are *Pachistima myrsinites*, *Sorbus scopulina*, and *Ribes montigenum*. *Arnica latifolia* and *Pedicularis racemosa* are usually the most abundant herbs; others include *Aquilegia coerulea*, *Arnica cordifolia*, *Aster engelmannii*, *Osmorhiza* spp., *Pyrola secunda*, and *Carex rossii*.

The ABLA/VAGL h.t. gradually disappears from the southeastern Idaho landscape southward through northern Utah. Topographically, it appears to be replaced by the ABLA/PERA h.t. and the RIMO phase of the

Figure 14. *Abies lasiocarpa/Vaccinium globulare* h.t. on a gentle northerly exposure toward the north end of the Bear River Range on the Wasatch-Cache National Forest (8,100 feet [2 470 m] elevation). The abundance of *V. globulare* in the undergrowth is typical of this type.

ABLA/BERE h.t.; these generally encompass the more moist and cooler portions of the ABLA/VAGL landscape.

Soils.—The soils of our stands are almost exclusively associated with quartzite or other quartziferous-dominant parent materials (appendix D). Surface soils are expected to be the most acidic of the lower *Abies lasiocarpa* h.t.'s. Where calcareous-dominated substrates are close by, the transition from ABLA/VAGL to ABLA/BERE is often striking. The predominant surface soil texture is clayey; soils are normally gravelly. Little surface rock and bare soil are present, although occasionally a considerable amount of rock is encountered. Litter depth averages 1.9 inches (4.8 cm).

Productivity/management.—Timber productivity is mostly moderate (appendix E). Opportunities for timber management are generally good in Idaho wherever slopes are not too steep. Management alternatives include *Pinus contorta*, *Pseudotsuga*, or *Picea engelmannii*. Natural regeneration strategies vary from shelterwoods to small clearcuts, depending on the present and desired composition. Planting might be very successful on the warmer, protected sites.

Wildlife use is light to moderate. Of special significance is *Vaccinium* fruit production; this provides a unique resource for both wildlife and local residents alike. Silvicultural treatments that increase direct sunlight appear to enhance berry production. Also, *Vaccinium* density might be increased by light surface fires (Miller 1977).

Other studies.—In Montana, the ABLA/VAGL h.t. has been described by Pfister and others (1977); it is most common in the south-central and southwestern sections of the State. Steele and others (1983) have recognized two phases of ABLA/VAGL in eastern Idaho and western Wyoming. The cooler and higher phase is characterized by at least 25 percent cover of *Vaccinium* *scoparium*. Some sites in the Uinta Mountains may correspond to this phase. The other phase, *Pachistima myrsinites*, serves as a geographical distinction from the VAGL phase of central Idaho (Steele and others 1981).

ABIES LASIOCARPA/VACCINIUM SCOPARIUM H.T. (ABLA/VASC; SUBALPINE FIR/GROUSE WHORTLEBERRY)

Distribution.—The ABLA/VASC h.t. occurs throughout most of the Uinta Mountains. Elevations range from about 9,000 feet (2 745 m) to just below 11,000 feet (3 355 m) near treeline. The relatively cool to cold exposures are variable in moistness; these conditions are reflected by the three recognized phases. In general, the type encompasses the extensive plateaulike surfaces and basin and ridge slopes which so characterize the central massif. ABLA/VASC is the most ubiquitous habitat type of the upper Uintas, but it is relatively uncommon in the north-central area. There, it normally occupies only the most moderate sites within the rain shadow area, being largely replaced by the PIEN/VASC h.t. on cooler exposures and the PICO/VASC h.t. on warmer exposures.

The ABLA/VASC h.t. was not found in northwestern Utah. In Idaho, it was sampled from only a few isolated locations in the Wasatch Range (Copenhagen Basin). There, exposures were gentle, northeasterly slopes near 8,500 feet (2 590 m) elevation, with quartzite substrates.

Vegetation.—*Abies lasiocarpa* is the indicated climax. Two extreme overstory conditions are commonly encountered with old-growth stands. Whenever *Picea engelmannii* is initially a major seral component, it tends to dominate the overall old-growth aspect, with an often dense *Abies* understory of layered stems. Such conditions are especially evident at the higher, timberline extent of the VASC phase, or the most moist portions of the ARLA phase. Elsewhere in the Uintas, *Pinus contorta* is the primary seral associate. On particularly warm-dry sites, *Pinus* can be the dominant aspect of old-growth stands; sometimes shade-tolerant species such as *Picea* have only poor representation and a slow rate of placement. *Populus tremuloides* is nominally represented at lower elevations.

A sweeping high carpet of *V. scoparium* typifies the undergrowth (fig. 15). Small amounts of *Achillea millefolium*, *Epilobium angustifolium*, *Hieracium* spp., *Carex rossii*, *Poa nervosa*, *Trisetum spicatum*, and the conspicuous *Arnica cordifolia* are represented throughout the type. *Vaccinium caespitosum* and either *Pachistima myrsinites* or *Berberis repens* are often present also, reflecting their presence in adjacent habitat types.

***Arnica latifolia* (ARLA) phase.**—This phase, typically the moistest, is chiefly absent from the southern Uinta Mountains. Elevations range from 9,000 feet (2 745 m) to near 10,600 feet (3 230 m). Exposures are northwest- to northeast-facing, moderate lower slopes or occasionally undulate surfaces. Sites otherwise are very protected.

Normally *P. engelmannii* is the dominant component of late seral stands. Undergrowth is generally dominated by *V. scoparium*. In addition to the typal species and an often abundant cover of *A. latifolia*, other common herbs include *Hieracium gracilis*, *Pedicularis racemosa*, *Pyrola*

Figure 15. *Abies lasiocarpa/Vaccinium scoparium* h.t. in Copenhagen Basin in the northern portion of the Bear River Range, at an elevation of 8,600 feet (2 620 m). The low-shrub and herbaceous undergrowth consists of a considerable mixture of species of which *V. scoparium* is dominant.

secunda, and species of *Erigeron* and *Osmorhiza*. Also, *Carex geyeri* is occasionally present on the warmer exposures. The presence of *Ribes montigenum* sometimes reflects the adjacent, drier RIMO phase of the ABLA/BERE h.t.

***Carex geyeri* (CAGE) phase.**—The CAGE phase occurs in the western and occasionally in the eastern areas. Relatively warm and dry, it typically occupies gentle, northeasterly to southerly slopes that are typically well drained. Elevations are between 8,700 and 10,100 feet (2 650 and 3 080 m).

Principal seral associates are *P. contorta* and, to a lesser extent, *Carex* component. In addition to the typal species, *Juniperus communis*, *Hieracium*
typal species, *Juniperus communis*, *Hieracium albiflorum*, *Osmorhiza* spp., *Pedicularis racemosa*, *Pyrola secunda*, *Stellaria jamesiana*, and *Elymus glaucus* are commonly represented. *Calamagrostis rubescens* is also sometimes abundant in the eastern area. Most warmer exposures are the CAGE phase of the ABLA/BERE h.t., whereas cooler sites are generally the VASC phase.

***Vaccinium scoparium* (VASC) phase.**—This phase occurs throughout the Uinta Mountains and often forms the moderately moist timberline forests. Exposures, elevations, and undergrowth characteristics are typical of the type, although the average coverage of *V. scoparium* is somewhat less than that of the other phases. Seral associates are *P. contorta* and *P. engelmannii*, the former being absent from the highest elevations and the latter from the lowest elevations of the phase. Undergrowth often includes *Ribes montigenum* and *Juniperus communis*. These species commonly reflect proximate habitat types: at the higher elevations the more exposed, drier TRSP phase of the ABLA/RIMO h.t.; and at the lower elevations in the southern area, the much warmer and drier ABLA/JUCO h.t. Elsewhere, the ABLA/BERE h.t. occupies the warmer exposures.

Soils.—Our stands are almost exclusively associated with quartziferous-dominated substrates (appendix D). These are derived primarily from quartzite, although sandstone, conglomerate, or shale- or limestone-quartzite sources are also encountered. In general, substrates are shallow residuals or glacier-related in origin. Most soils contain considerable gravel. Surface soils range from sandy loams to clays. Exposed rock varies from absent to very considerable and bare soil is usually absent. The average litter depth ranges from 0.7 inches (1.9 cm) in the CAGE phase to 1.3 inches (3.2 cm) in the ARLA phase.

Productivity/management.—Timber productivity is low to moderate (appendix E). While the VASC and ARLA phases include the highest associated values, the CAGE phase has the highest average productivity. Opportunities for timber management are generally good except on most high-elevation sites and sometimes the moistest sites of the ARLA phase where growth rates are slow. Usually, *Pinus contorta* is the principal timber species, with small clearcuts yielding adequate regeneration. Partial shade and mineral soil are normally required for *Picea engelmannii* regeneration. Special site preparation measures may be necessary in the CAGE phase to reduce competition from this rhizomatous sedge.

Recent studies have shown that big game use of such coniferous forest types varies locally. Working in the southeastern area, Collins and others (1978) observed that elk used the type primarily as cover for travel and resting. Also, the *Vaccinium* browse, herbs, and late-season mushrooms provided alternative forage to preferred feeding habitats such as wet meadows and recent clearcuts. Similar use by deer was observed in the same area by Deschamp and others (1979), except that forbs (*Arnica cordifolia* in particular) contributed more to their diet. Winn (1976), working in the north-central area, identified somewhat similar ungulate presence as well as that of a multitude of avian and mammal species. Domestic livestock use is typically local.

Water yield is an especially important resource; this habitat type is more amenable than others to silvicultural activities intended to improve water yields (Leaf 1975).

Other studies.—ABLA/VASC h.t.'s are encountered throughout the Rocky Mountains: from British Columbia (McLean 1970), western Washington, and northern Idaho (Daubenmire and Daubenmire 1968) through north-central Wyoming (Hoffman and Alexander 1976), and southward to northern New Mexico (Moir and Ludwig 1979). The ABLA/VASC h.t. of the Uinta Mountains was initially described by Pfister (1972), who also discussed the type in relation to elevational distribution. In addition, Reed (1976) recognized a broader concept of the type, which includes our PIEN/VASC h.t.

The VASC phase occurs throughout the above areas, but the ARLA and CAGE phases have not been previously mentioned. The environment of the ARLA phase, however, appears to be quite similar to that of the *Thalictrum occidentale* phase in Montana described by Pfister and others (1977). The *Calamagrostis rubescens* (CARU) phase recognized in Montana (Pfister and others 1977) and in Idaho and western Wyoming (Steele and others 1981, 1983; Cooper 1975) is somewhat similar to our CAGE phase. In these areas, *Carex geyeri* is often a codominant undergrowth member in drier situations of the CARU phase. In the eastern Uintas, the CAGE phase sometimes includes *C. rubescens* as a major component. Also, *C. geyeri* occurs in the lower part of the ABLA/VASC h.t. of southern Wyoming (Wirsing and Alexander 1975).

ABIES LASIOCARPA/CALAMAGROSTIS RUBESCENS H.T. (ABLA/CARU; SUBALPINE FIR/PINEGRASS)

Distribution.—ABLA/CARU, a relatively cool-dry habitat type, is found locally in southeastern Idaho, southward through the eastern flank of the Wasatch Range (the Bear River Range) to the vicinity of Logan, Utah. In this area, it primarily occupies west- to east-facing canyon ridge slopes of gentle to moderate relief at elevations between about 6,900 and 7,600 feet (2 105 and 2 315 m). The ABLA/CARU h.t. is also locally extensive in the easternmost Uinta Mountains. Here it occurs on gentle lower slopes and benches at all exposures from 8,000 feet (2 440 m) to 8,500 feet (2 590 m), or occasionally broad ridgetops to 9,000 feet elevation (2 745 m). *C. rubescens* occurs sporadically through the westernmost Uinta Mountains; it has been observed in the South Fork of the Provo River and Current Creek drainages.

Vegetation.—*Abies lasiocarpa* is the indicated climax. *Pinus contorta* is a major seral dominant, as is more locally *Pseudotsuga*. Usually *Populus tremuloides* is a minor seral associate.

Throughout northern Utah, stands are occasionally encountered within the *Abies lasiocarpa* zone where *A. lasiocarpa* is only poorly represented or absent, and *P. contorta* is the principal or only tree present. *Abies lasiocarpa* is clearly the indicated climax on such sites in northwestern Utah and adjacent Idaho. The successional dynamics of such stands in the Uintas are more questionable; all evidence suggests, however, that *Abies* is also the indicated climax. The three sample stands having these conditions have therefore been included in this series; it is expected that other PICO/CARU communities will also correspond to the *A. lasiocarpa* series.

Undergrowth appearance is strikingly swardlike; it is normally dominated by abundant *Calamagrostis*, and sometimes *Carex geyeri* as well. Other common but minor species include *Amelanchier alnifolia*, *Berberis repens*, *Pachistima myrsinites*, *Rosa nutkana*, *Arnica cordifolia*, *Hieracium albiflorum*, *Osmorhiza* spp., *Viola adunca*, *Carex rossii*, *Poa nervosa*, and *Juniperus communis* (Uinta Mountains). The ABLA/BERE h.t. is most frequently adjacent, particularly where substrates are predominantly calcareous or where soils are more shallow and perhaps more gravelly.

Soils.—The soils of our stands are derived from either quartzite substrates or other quartziferous-dominated materials (appendix D). Surface soil textures range from loamy to clayey; normally some gravel is present in the profile. Exposed rock and soil are generally absent. Litter depth averages 1.2 inches (3.1 cm).

Productivity/management.—Timber productivity ranges from low to moderate, but chiefly the latter (appendix E). Opportunities for timber management are generally good although not especially extensive. *Pinus contorta* is the principal management species; when present, *Pseudotsuga* presents additional management possibilities. Regeneration by small clearcuts, or clearcutting with planting, is usually adequate for *Pinus*, but partial shade should enhance *Pseudotsuga* regeneration. In addition, special site preparation measures may be necessary because of the rhizomatous nature of *Calamagrostis* and *Carex geyeri*.

Wildlife and livestock use is light to moderate.

Other studies.—The ABLA/CARU h.t. has been described from Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and eastern Idaho—western Wyoming (Steele and others 1983). Northern Utah is apparently the southernmost extent of the habitat type.

Steele and others (1983) have recognized two phases: the *Pachistima myrsinites* phase, where *Pseudotsuga* and shrub species are more common, and the *C. rubescens* phase, which has *Pinus contorta* as the major seral associate and less conspicuous shrubs. Both phases are probably present in northern Utah even though not formally described.

ABIES LASIOCARPA/PEDICULARIS RACEMOSA H.T. (ABLA/PERA; SUBALPINE FIR/SICKLETOP PEDICULARIS)

Distribution.—Represented by two phases and a total of 66 sample stands, this cool, moist habitat type is quite common at higher elevations in the Wasatch Range of northern Utah and adjacent Idaho, generally between 7,000 and 8,800 feet (2 135 and 2 680 m). This area represents the geographic center of the type. It occasionally is found in the westernmost Uinta Mountains between 8,200 and 9,600 feet (2 500 and 2 925 m) elevation on northerly, gentle to moderately steep exposures.

Within the study area, the lower part of the ABLA/PERA h.t. encompasses landscapes similar to that of the ABLA/VAGL h.t.; a type that is largely absent in Utah but common farther north (Steele and others 1983). The upper part of the ABLA/PERE h.t. is fairly similar to the landscape of the ABLA/VASC h.t., which is also common to the north as well as to the east in the Uintas.

Vegetation.—*Abies lasiocarpa* is the indicated climax. *Picea engelmannii*, *Pinus contorta*, and *Populus tremuloides* occur as associates locally throughout both phases. *Pseudotsuga* is used as a phasal indicator.

Undergrowth varies by phase. In addition to *Pedicularis*, which is often abundant, *Pachistima myrsinites*, *Arnica cordifolia*, *Aster engelmannii*, *Fragaria vesca* (or *F. virginiana*), *Geranium viscosissimum*, *Hieracium albiflorum*, *Osmorhiza* spp., *Pyrola secunda*, *Stellaria jamesiana*, *Carex rossii*, and *Poa nervosa* are usually present (fig. 16). Although less frequent, *Ceanothus velutinus*, *Shepherdia canadensis*, *Arnica latifolia*, and *Lathyrus lanszwertii* are nevertheless conspicuous when present.

Figure 16. *Abies lasiocarpa/Pedicularis racemosa* h.t. is a prominent in the Wasatch Range. This stand occurs on a moderate southwesterly exposure at an elevation of 7,200 feet (2 200 m), with *P. racemosa*, *Symphoricarpos oreophilus*, *Arnica cordifolia*, and *Thalictrum fendleri* prominent in the undergrowth.

***Pseudotsuga menziesii* (PSME) phase.**—Although this relatively warm and dry phase occurs throughout the range of the type, it is most common in southeastern Idaho. The PSME phase is delineated by the presence or potential presence of *Pseudotsuga* as evidenced by the occurrence of the local environmental range of *Pseudotsuga*, including its geological material limitations (see Soils section). Typically, elevations are between 7,000 and 8,800 feet (2 135 and 2 680 m) and exposures are northwest- to east-facing. Where sites are protected, however, the phase is encountered at elevations as low as 6,000 feet (1 830 m), or more westerly and southerly exposures. The predominant terrain is moderate to steep, middle and upper slopes.

In addition to the other seral associates, *Pseudotsuga* is normally a major component of seral stands. It often persists as fairly massive individuals in old-growth stands, but it only occasionally establishes in the larger canopy openings. Successional development is similar to that of the ABLA/BERE h.t., PSME phase, although it normally progresses more rapidly, particularly through a *Populus* sere.

Undergrowth is more shrubby in this phase. In addition to *Pachistima*, it usually includes the shrubs *Amelanchier alnifolia*, *Berberis repens*, *Rosa* spp., and *Symphoricarpos oreophilus*. *Aquilegia coerulea* and *Thalictrum fendleri* are often represented with the typal herbs, and *Carex geyeri* is sometimes abundant at lower elevations.

***Pedicularis racemosa* (PERA) phase.**—The widespread PERA phase represents the cooler and moister extent of the type. Elevations range from 7,300 feet (2 225 m) to 8,700 feet (2 650 m), but reach up to about 9,600 feet (2 925 m) in the southern Wasatch and Uintas. Most slopes are gentle to moderate on northwest- to southeast-facing uplands and broad ridges. As with the PSME phase, however, the PERA phase occurs on other exposures on protected sites. Undergrowth is as described for the type.

When present, *Pinus contorta* and *Picea engelmannii* are important seral species. *Picea* is especially pronounced on the most moderate, gentle sites where, as long-lived, large individuals, it typically dominates old-growth stands. *Populus* is less common in this phase; however, on some gentle sites it is an important pioneer species providing a "nurse" cover for subsequent conifer establishment (Daniel and others 1979). Normally short-lived, *Populus* can persist as suckers in smaller canopy openings of old-growth stands. Throughout the phase, the development of a typically dense *Abies* component normally progresses more rapidly than in the PSME phase. Occasionally, *Abies* is the only stand component. Stand structure and developmental processes have been discussed recently by Schimpf and others (1980).

Soils/climate.—For both phases, our stands have surface soils that are predominantly loamy to clayey in texture (appendix D-1). Gravel is often present, and the amount of exposed rock and soil vary considerably. The average litter depth is less in the PSME phase (1.7 inches [4.3 cm]) than in the PERA phase (2.4 inches [6.2 cm]), and averages 2.1 inches (5.3 cm).

The associated geology of the ABLA/PERA h.t. is especially noteworthy. Although a variety of parent materials are represented (appendix D-1), quartzite and other quartziferous and shaley materials predominate; wholly calcareous materials occur infrequently. A few sites occupy glacier-related features. This type, and especially the PERA phase, is largely associated with the quartzite-shaley Wasatch Conglomerate (the Knight formation), a major high- to midelevational formation in the Wasatch Range of northern Utah. Conversely, *Pseudotsuga*, as a major stand component, is encountered less frequently with this formation.

Weather data of the College Forest Station (appendix D-2), situated in an adjacent meadow area, reflects the relative climate of a moderate site in the PERA phase.

Productivity/management.—The ABLA/PERA h.t. generally presents some of the best opportunities for timber management in the northwestern region. The moderate to high productivity in both phases (appendix E) and generally excellent terrain conditions, particularly in the PERA phase, contribute to this. In addition, all species often have massive dimensions in old-growth stands; some trees are the largest we encountered in northern Utah and adjacent Idaho. Regeneration measures range from those creating conditions of partial shade and mineral soil for the more shade-tolerant species, to clearcutting and planting for *Pinus contorta*. Nevertheless, adverse seedling environments for all species might result from clearcutting. Fir broom rust is sometimes particularly troublesome. Bark beetles are also a problem in the Uintas.

The ABLA/PERA h.t. is important summer range for big game. Sheep occasionally use the PERA phase. Seral stands are used more for forage.

Other studies.—Steele and others (1983) have described this habitat type in eastern Idaho and western Wyoming, although their treatment is conceptually narrower. ABLA/PERA has not been mentioned elsewhere.

The ABLA/PERA h.t. is recognized as a much broader concept than that which was previously described (Henderson and others 1976). As such, it includes the more mesic portions of several preliminary types, largely ABLA/*Lathyrus leucanthus*, ABLA/*Arnica latifolia*, ABLA/BERE, and ABLA/OSCH. It excludes, however, exposed sites where *Pinus flexilis* is a dominant stand component or cooler sites where *Ribes montigenum* is present. These sites are now classified as the PIFL phase of the ABLA/BERE h.t., or the RIMO phase of the ABLA/RIMO h.t.

ABIES LASIOCARPA/BERBERIS REPENS H.T. (ABLA/BERE; SUBALPINE FIR/OREGONGRAPE)

Distribution.—ABLA/BERE is the most ubiquitous habitat type of northern Utah and adjacent Idaho (fig. 17). With six phases, it is represented by a total of 214 sample stands (appendix A). ABLA/BERE was first described throughout Utah by Pfister (1972), who recognized only three phases.

Throughout the area, the ABLA/BERE h.t. occupies the relatively cooler and drier exposures of the series. The soils of this type are relatively well drained, and sometimes quite shallow and rocky. Elevations range from about 6,100 to 9,900 feet (1 860 to 3 020 m) in the northwestern region, and from about 7,700 to 10,300 feet (2 345 to 3 140 m) in the Uinta Mountains. Topography is variable, but gentle or undulate terrain and moderate to steep slopes predominate. In a sense the ABLA/BERE h.t. can be considered to be the nucleus of the forested landscape in northern Utah and adjacent Idaho.

Each of the six phases reflects rather specific regimes of the overall environmental span of the habitat type;

Figure 17. The *Abies lasiocarpa/Berberis repens* h.t. is the most widespread coniferous forest type in northern Utah. This stand representing the *Ribes montigenum* phase occurs on a gentle easterly exposure at 9,000 feet (2 740 m) elevation on the Wasatch-Cache National Forest; *B. repens* and widely dispersed clumps of *R. montigenum* typify the depauperate undergrowth.

each is also characterized by certain geologic relationships and management considerations. Table 5 summarizes elevational ranges and exposures by phase in the geographic regions. Site characteristics and pertinent aspects of the associated diverse geology (appendix D) are discussed more specifically under the phase descriptions.

The more south-central areas of the Uinta Mountains, roughly between the Duchesne and Whiterock Rivers, present a special situation. There, sites that are particularly exposed are best considered as the ABLA/JUCO h.t. Such sites typically occupy southerly, steep ridges and slopes, and have exceptionally well-drained soils. In addition, most are associated with the Duchesne formation, a fluvial sandstone consisting of quartzite fragments. This applies especially to stands that are dominated by *Pinus contorta* where replacement by *Abies* is indicated, but is exceptionally slow; these situations are treated as the PICO/JUCO c.t. Thus, only the most moderate sites in the south-central Uinta Mountains are classified as the ABLA/BERE h.t., and then usually as the PSME phase.

Vegetation.—*Abies lasiocarpa* is the indicated climax. It also is sometimes a major pioneer species, especially on the more favorable sites. Typically, late seral stands on favorable sites have a distinct multistoried component of *Abies*; frequently the lower branches of the *Abies* are layered. The structural and successional patterns within the type are essentially as described for the series. Many seral species are associated with the habitat type (appendix B). The occurrence and significance of the major seral associates are discussed for each phase, particularly with respect to the stand conditions.

Several shrubs characterize the typical undergrowth, of which the low, evergreen *Berberis* and *Pachistima* *myrsinites* are the most indicative. In general, *Berberis* is commonly encountered with the somewhat warmer or drier sites within the type; *Pachistima* has its greatest representation on the slightly cooler exposures. *Symphoricarpos oreophilus* and *Rosa nutkana* (or at lower elevations, *R. woodsii*) are also found throughout the type, as is *Juniperus communis* in the Uintas. Although *Pachistima* has a high constancy overall, Pfister (1972) did not use it to name the type ". . . because of possible confusion with a northern Idaho *Abies lasiocarpa/Pachistima myrsinites* h.t. which is very different floristically (Daubenmire and Daubenmire 1968)."

Although a multitude of herbs are encountered in the habitat type, including many weedy, accidental species, most are only casual in occurrence (appendix C). In general, species diversity is greatest on the most unfavorable exposures and on the moistest sites. Seral stands of *Populus tremuloides* or stands disturbed by livestock have particularly high diversity. On the other hand, seral stands with especially dense canopies and deep duff are usually quite depauperate. Some of the more common undergrowth members include *Achillea millefolium*, *Aquilegia coerulea*, *Arnica cordifolia*, *Pyrola secunda*, *Stellaria jamesiana*, *Thalictrum fendleri*, and *Carex rossii*. In the northwestern region, *Aster engelmannii* and *Osmorhiza* spp. are usually present also. Species of *Lathyrus* are locally abundant throughout.

***Pinus flexilis* (PIFL) phase.**—This phase, where *P. flexilis* is a major associate that persists in late seral stands, occurs throughout the northwestern region but is most common in the Wasatch Range of Utah and Idaho. It is also encountered in the geologically complex westernmost Uinta Mountains. But stands in the more eastern Uintas that meet the phasal criterion are typically isolated, local situations within the JUCO phase, such as limestone outcrops along ridge slopes.

Table 5.—Distribution of ABLA/BERE h.t. in northern Utah by phase and geographic region

Phase	Northwestern Utah[1]		Uinta Mountains	
	Elevation range	Exposure	Elevation range	Exposure
	Feet (m)		*Feet (m)*	
PIFL	7,200-9,500+ (2 195-2 895)	SW-N,E	near 10,000 (3 050)	SW-W
RIMO	6,600-9,900 (2 010-3 020)	W-NE-S	8,500-10,100 (2 590-3 080)	W-NE-S
CAGE	6,800-7,700 (2 075-2 345)	W-NE	7,700-9,100 (2 345-2 775)	W-NE-S
JUCO	—		8,300-10,000 (2 530-3 050)	ALL
PSME	6,100-8,800 (1 860-2 680)	ALL	7,700-10,300 (2 345-3 140)	W-NE-S
BERE	6,900-8,600 (2 105-2 620)	ALL	7,800-9,900 (2 375-3 020)	W-N-SE

[1]Includes adjacent Idaho.

Exposures are the most severe of the *Abies lasiocarpa* series (table 5), such as westerly slopes, ridgetops, and isolated knolls of high-elevation sink-basin topography. Substrates are shallow and rocky, calcareous or mixed quartziferous materials, which are often exposed at the surface. Snowpack retention is relatively short, and available soil moisture is low. Furthermore, constant wind augments physiological stress.

Stands occur as isolated groups of trees on particularly severe exposures. Elsewhere stands are somewhat more closed. Typically present are several fairly massive, long-lived *Pinus flexilis*. *Pseudotsuga* is usually present, except in the Uintas on noncalcareous substrates. More local components are variable (appendix B). Of these, *Picea engelmannii*, like *Abies* on extreme sites, slowly establishes on protected microsites near tree bases. A fairly typical, rather lengthy process of stand establishment in a burn area of the Raft River Mountains of Utah that corresponds to this phase has been recently described by Lanner and Vander Wall (1980), which identifies the role of the Clark's nutcracker in *P. flexilis* regeneration.

Undergrowth is generally compositionally diverse and often includes a few especially well-represented species (appendix C). In addition to the typal species, it usually reflects both that of nearby *Symphoricarpos*-dominated shrub communities as well as that of other phases or habitat types of more protected downslope or leeward exposures. At higher elevations, *Ribes montigenum* and *Juniperus* are especially prevalent. The presence of *Shepherdia canadensis* and *Ribes cereum* suggests a rather frequent incidence of light surface fires.

***Ribes montigenum* (RIMO) phase.**—As the coolest part of the habitat type, the RIMO phase represents the broad transition or intergrade between the ABLA/BERE and the yet cooler ABLA/RIMO h.t. (Pfister 1972). It is fairly common throughout northern Utah and adjacent Idaho (appendix A). It principally occupies gentle to moderate terrain above 8,000 feet (2 440 m) elevation, or, in the Uintas, above about 9,200 feet (2 805 m) elevation. It also occurs on lower sites that are particularly cool, such as steep, northerly slopes. Substrates vary widely (appendix D).

The principal seral associates are *Picea engelmannii* and, in the northwestern region, *Pseudotsuga*, which is mainly associated with calcareous-dominated substrates and lower elevations. *Populus*, common in the Uinta Mountains, is a major early seral species of easterly or southerly exposures throughout both regions. *Pinus contorta* is infrequent. Stand conditions are fairly similar overall to the THFE and RIMO phases of the ABLA/RIMO h.t. Normal successional development is rather similar to the PIFL and BERE phases, except that *Picea* has its greatest significance here. Interestingly, layered *Abies* was encountered infrequently in our sample stands; no explanation is apparent.

Undergrowth varies from rather depauperate to rather luxuriant. *Arnica latifolia*, *Pedicularis racemosa*, and *Lathyrus* often contribute substantially to the undergrowth. For the most part, *Ribes* occurs as widely scattered clumps near the base of trees. Several additional species are noteworthy in the Uintas: *Astragalus miser*,[4] *Erigeron* spp., *Lupinus argenteus*, *Agropyron trachycaulum*, *Trisetum spicatum*, and with recent fire, *Shepherdia canadensis*.

Adjacent cooler habitat types include ABLA/RIMO, ABLA/VACA, and ABLA/VASC. Nearby warmer sites vary and range from the ABLA/PERA h.t. to other phases of ABLA/BERE, and nonforest communities.

***Carex geyeri* (CAGE) phase.**—This phase, however, is common only in the northwestern and southeastern Uinta Mountains. It occupies relatively warm and dry, well-drained, gentle to moderately steep slopes, which reflect the lower extent of the *Abies lasiocarpa* series in these areas (table 5). In the southeastern area, stands of the PICO/BERE c.t. that are dominated by *Carex geyeri* are frequently nearby indicating yet drier conditions. The warmer PSME/BERE h.t., CAGE phase, may also occur nearby. Proximate cooler sites are typically the JUCO phase or occasionally the ABLA/VASC h.t., CAGE phase. Parent materials are diverse (appendix D).

Pinus contorta and *Populus* are the principal seral associates; *Picea pungens* and *Pseudotsuga* are regional associates. Normal succession is prolonged at the dry extent of the phase where *Picea engelmannii* is normally absent. Undergrowth is characterized by a typically abundant cover of *Carex*. *Juniperus communis*, *Astragalus miser*, *Galium boreale*, *Viola adunca*, and *Bromus ciliatus* are sometimes present with the typal species.

The CAGE phase is only rarely encountered in northwestern Utah and adjacent Idaho, where it occupies steep lower slopes (table 5). For management purposes these sites could be considered the PSME phase.

***Juniperus communis* (JUCO) phase.**—The JUCO phase is found locally through the northern, southeastern, and southwesternmost Uinta Mountains. It occupies gentle to moderate slopes and benches (table 5). Exposures appear to be influenced by cold air drainage, but are intermediate in dryness as indicated by a minor representation of *Carex geyeri*. More moist nearby sites are the BERE phase or, on even cooler sites, the RIMO phase.

The *Abies* component is usually fairly well developed in late seral stands. *Pinus contorta* and *Populus* are the principal seral associates, as is *Picea pungens* locally. *Juniperus*-dominated stands of the PICO/BERE c.t. are often nearby on drier exposures. As a minor species, *Pseudotsuga* is generally associated with calcareous-dominated substrates, where yet warmer exposures are sometimes the PSME/BERE h.t., JUCO phase.

Undergrowth aspect is typically one of patches of *Juniperus* and *Symphoricarpos*. *Galium boreale*, *Bromus ciliatus*, *Trisetum spicatum*, and species of *Antennaria*, *Erigeron*, *Geranium*, and *Potentilla* are often present along with the typal species.

***Pseudotsuga menziesii* (PSME) phase.**—This phase is delineated by the occurrence of *Pseudotsuga*.

As the most common component of the forested landscape of the northwestern region (appendix A), the PSME phase is principally associated with the drier portions of lower subalpine slope areas. These sites are relatively warm or have shallow or seasonally dry soil conditions; most are moderate to steep. Although the phase has a rather broad distribution of exposures (table 5), the majority of sites are west- to northeast-facing and between about 7,000 and 8,200 feet (2 135 and 2 500 m) elevation. Parent materials are chiefly calcareous, although other kinds are also represented; the Wasatch Conglomerate, however, is notably uncommon. Most of the more moderate adjacent sites are the PSME phase of the ABLA/PERA h.t., or in Idaho the ABLA/VAGL h.t., particularly with changes to quartzite-dominated substrates.

The PSME phase is neither very common nor locally extensive in the Uinta Mountains. Where it does occur, it reflects the occurrence of calcareous substrates (limestone and calcareous sandstones) within the temperature range of *Pseudotsuga*. It occupies moderate to steep lower canyon sides and ridge faces, and occurs on generally west-facing slopes at lower elevations and east- to south-facing slopes at higher elevations. Adjacent sites are usually the warmer PSME/BERE h.t. or the cooler JUCO phase.

Pseudotsuga is normally the principal seral species and often establishes beneath canopy openings. It often dominates late seral stands, especially on less favorable sites where succession is slower. *Picea engelmannii* is primarily a minor seral associate at higher elevations of the phase. *Pinus contorta* and *Populus* have fairly high constancy in this phase in the Uintas. *Populus* is particularly significant on lower sites in the northwestern region: with major disturbance, *Populus* often perpetuates repletely and can dominate stands for quite some time.

Undergrowth is similar to that described for the type. In addition to the typal species, *Amelanchier alnifolia*, *Fragaria vesca*, *Geranium viscosissimum*, and *Mitella stauropetala* are frequently present in the northwestern region, whereas small coverages of *Galium boreale* and *Phacelia sericea* are common in the Uinta Mountains.

***Berberis repens* (BERE) phase.**—This relatively cool, moist phase occurs throughout the northwestern region. It is especially common in the Utah portion of the Wasatch Range. Exposures are chiefly moderate to steep midslopes (table 5). Parent materials are predominantly quartziferous and include the Wasatch Conglomerate. Adjacent, warmer sites are usually the ABLA/OSCH h.t. and nonforest communities, or the PSME phase where the substrate becomes calcareous. Nearby cooler exposures are the RIMO phase or, when moister, the PERA phase of the ABLA/PERA h.t.

The phase is found in the Uintas mostly in the more northwestern and the southeastern areas above 9,000 feet (2 745 m) elevation where the substrates are mainly quartzite. It locally occupies variable but overall gentle terrain (table 5). In the westernmost Uintas, elevations tend to be lower (around 8,000 feet [2 440 m]) and exposures east-facing, moderate lower slopes. Adjacent cooler exposures are the RIMO and JUCO phases, or the ABLA/VASC h.t. Warmer exposures are usually the CAGE phase and nonforest communities, and occasionally the PICO/BERE c.t.

Major seral associates are *Populus tremuloides* in the northwestern region and *Pinus contorta* in the Uintas. *Picea engelmannii* is local throughout the phase but is of major importance only in the northwestern region, where *Abies concolor* is also sometimes represented.

Undergrowth is normally dominated by the typal species. Small amounts of *Hieracium albiflorum* as well as species of *Fragaria* and *Geranium* occur locally with *Amelanchier alnifolia* (northwestern region) and *Antennaria microphylla* (Uintas).

Soils/climate.—Our northwestern stands have soils that are derived from diverse substrates; those of the Uinta Mountains are derived primarily from quartzite substrates (appendix D). Soils are often very gravelly, or shallow and rocky; some others are quite deep. Surface textures range from loamy to clayey in the northwestern region. In the Uintas, however, they are chiefly sandy loams or loams. Other surface characteristics also vary regionally within phases, although surface rock and bare soil are often absent or only slight in amount. Considerable rock is often present in the RIMO, PIFL, and Uinta PSME phases, as is bare soil in the latter two of these. Litter is generally shallower in the Uintas than in the northwestern area.

Weather data of Silver Lake Brighton (appendix D-2) reflects the relative climate of a moderate site in the RIMO phase.

Productivity/management.—Timber productivity varies between the phases (appendix E). Basically, production in the PIFL phase is low because of stand structure. Productivity is largely low to moderate throughout the Uintas and in the entire RIMO phase. The PSME and BERE phases in the northwestern region have primarily moderate to high productivity. In general, *Picea engelmannii* is the most productive species, judging from average sample site index.

With the exception of the PIFL phase, timber management opportunities are generally good wherever exposures are not too severe or other use considerations do not conflict. Management activities are sometimes limited by shallow soils or rockiness. Regeneration measures in the northwestern region on the more moderate sites are similar to those for the ABLA/PERA h.t. In the Uintas, stands having *Pinus contorta* as a major seral associate can usually be regenerated by clearcutting. Elsewhere throughout the northern Utah area, site protection usually is critical, often necessitating the use of a shelterwood. Also, planting is usually quite difficult except on the best sites; special site preparation measures may be required to reduce competition in the CAGE phase.

The ABLA/BERE h.t. is important for watershed protection. It also provides a major part of big game summer range. *Populus* may locally present special opportunities for improvement of big game browse. Domestic livestock use is moderate in seral stands.

Other studies.—The ABLA/BERE h.t. was first described by Pfister (1972). His preliminary treatment for northern Utah was much broader than ours in that it included essentially all of our lower *Abies lasiocarpa* h.t.'s as well as the ABLA/PERA, ABLA/OSCH and part of the ABLA/VAGL h.t.'s. Pfister also utilized

[4]Although *A. miser* was not identified in the stands sampled in Idaho, it is known to occur there.

Symphoricarpos and *Rosa nutkana* as additional indicators for the habitat type; we found that the presence of either *Berberis* or *Pachistima* is adequate in northern Utah. The use of only these two species has also eliminated a potential identification problem for the ABLA/OSCH h.t. where *Symphoricarpos* has a high constancy and *Rosa* is occasionally present.

We have expanded Pfister's (1972) three phases to six with the addition of the PIFL, CAGE, and JUCO phases. While we essentially agree with his treatment of the RIMO phase, a major departure exists with his ABLA and BERE phases. The BERE phase was delineated by the presence of *Picea engelmannii*. The PSME phase, delineated similarly by *Pseudotsuga*, has been adopted in order to facilitate a closer correspondence to the treatment of the more moist ABLA/PERA h.t., the other major type of northwestern Utah and adjacent Idaho. This treatment should serve as a more useful ecological, or zonal, differentiation, especially in view of the associated management implications. Thus, the ABLA phase has been dropped. The BERE phase remains the modal phase, as considered by Pfister, although in a somewhat different context.

An ABLA/BERE h.t. with a CAGE phase is recognized in southeastern Idaho and western Wyoming by Steele and others (1983). There, the type is delineated by the criteria that either *Berberis* or *Pachistima* must be present with at least 1 percent and 5 percent cover, respectively. Our treatment is much broader than theirs, and possibly includes some of their other types as extensions into northern Utah. Their *Abies lasiocarpa/Arnica cordifolia* and *Abies lasiocarpa/Carex rossii* h.t.'s, the most probable extensions, do not appear to be fully analogous to possible northern Utah situations, all of which exhibit a closer conceptual correspondence to the nuclear ABLA/BERE h.t. Thus, the broader approach has been adopted.

ABIES LASIOCARPA/RIBES MONTIGENUM H.T. (ABLA/RIMO; SUBALPINE FIR/MOUNTAIN GOOSEBERRY)

Distribution.—The ABLA/RIMO h.t. is very common throughout the higher elevations of northern Utah and adjacent Idaho (appendix A). Sites are cool and relatively moist in the northwestern region as well as in some areas of the westernmost Uinta Mountains. It generally occurs above 7,000 feet (2 410 m) in the northwestern region and above 9,000 feet (2 745 m) in the western Uintas. Throughout most of the Uintas the habitat type reflects cool or cold and relatively dry exposures. Much of the type occurs above 10,500 feet (3 200 m) encompassing the drier portion of the extensive timberline zone; ABLA/RIMO also extends downward to near 10,000 feet (3 050 m) in the south-central Uintas.

The ABLA/RIMO h.t. was originally described from throughout Utah by Pfister (1972). He recognized three phases, of which the THFE and RIMO are present in northern Utah. Two new phases, TRSP and PICO, are identified for the Uintas. Specific site characteristics are discussed for each phase (appendix D).

Vegetation.—In general, each phase exhibits rather distinct structural and successional overstory characteristics. Some stands are comprised wholly of *Abies lasiocarpa*, the indicated climax. More often, however, *Picea engelmannii* is a major associate that is frequently long-lived and persistent. The seral associates *Pinus contorta*, *Pseudotsuga menziesii*, and *Populus tremuloides* are represented at lower elevations only.

Ribes montigenum, which occurs in sunlit patches at the base of trees, and particularly among layered stems, best typifies the undergrowth. Undergrowth conditions are rather uniform, especially when each phase is considered separately. The undergrowth ranges from depauperate to luxuriantly herbaceous.

***Trisetum spicatum* (TRSP) phase.**—This phase represents most of the ABLA/RIMO h.t. in the Uinta Mountains. It occupies the most exposed sites of the upper timberline zone, that is the upper slopes to ridgetops and plateaulike surfaces from about 10,500 feet (3 200 m) to over 11,200 feet (3 415 m) elevation. These exposures are cool, dry, and windswept. Strong insolation during the day and rapid nocturnal cooling result in wide daily ranges of temperature. Soils are derived principally from quartzite and are typically shallow and rocky. In addition, some are subject to freeze-thaw activity at the higher elevations, and include gentle felsenmeer ground and some limited talus. More protected, moderate sites are usually the VASC phase of the ABLA/VASC h.t., whereas yet colder sites are the PIEN/VASC or PIEN/VACA h.t.'s.

Because of the exposed sites, stand structure is invariably open throughout the phase. It usually forms the timberline zone and is chiefly composed of isolated groups of trees, or copses, that are surrounded by meadow communities. Tree growth form changes with increasing elevation from fairly large but slow-growing trees, through smaller and very slow growing, to the final point at tree line of "flagged" growth forms. Above these elevations growth becomes prostrate; this is the krummholz area of the timberline zone. Upper timberline is generally considered to coincide with a mean July temperature of less than 50° F (10° C) (Pfister and others 1977).

Picea engelmannii is a persistent species in most all of the phase. The lower branches of *Abies, and Picea* to a lesser extent, often tend to layer. Stand establishment is very slow following a major disturbance such as fire. Initial establishment is spotty, with new trees establishing outward under the protection of older established stems. *Abies* can be especially dense in older stands under large *Picea*.

Undergrowth composition is variable, largely because of the local occurrence of many meadow and alpine species. Species dispersion is fairly uniform, however, in that it typically follows two distinct patterns. In general, many species common to the moister nearby habitat types are encountered in minor amounts, with *Ribes* under the protective cover of tree crowns and layered stems. These include *Aquilegia coerulea*, *Arnica cordifolia*, *A. latifolia*, *Erigeron peregrinus*, *Mertensia ciliata*, *Pedicularis racemosa*, *Polemonium pulcherrimum*, *Pyrola secunda*, *Carex rossii*, *Trisetum spicatum*, *Vaccinium caespitosum*, and *V. scoparium*. Between the groups of trees are such forbs as *Achillea millefolium*,

Antennaria spp. (chiefly *A. microphylla*), *Arenaria* spp., low species of *Erigeron*, *Geum rossii*, *Ivesia gordonnii*, *Penstemon whippleanus*, *Sedum lanceolatum*, *Sibbaldia procumbens*, and *Solidago spathulata*; and the graminoids *Carex rossii*, *Festuca ovina*, *Luzula spicata*, *Trisetum spicatum*, and several species of *Poa* (primarily *P. alpina*, *P. canbyi*, *P. cusickii*, and *P. nervosa*). Many of these species are important components of nearby meadow communities, which are discussed by Lewis (1970).

While *Trisetum spicatum* is used to name the phase, the associated stand structure of these exposed sites is also characteristic. This phase may best reflect the largely unsampled timberline zone forests near Salt Lake City, as well as those of the more western mountain ranges.

***Pinus contorta* (PICO) phase.**—This phase occurs only in the south-central Uinta Mountains near 10,300 feet (3 140 m) elevation roughly between the Duchesne and White Rock Rivers. It occupies drier, gentle to moderately steep slopes and ridges. The well-drained soils are derived from Duchesne sandstone and occasionally quartzite. The PICO phase is typically bounded by the warmer and drier ABLA/JUCO h.t., the more moist ABLA/VASC h.t., VASC phase, and the TRSP phase at higher elevations. *Pinus contorta* and *Picea engelmannii* are the major seral associates. Stands are fairly open. Undergrowth is very similar to higher elevation stands of the ABLA/JUCO h.t., with the addition of widely scattered patches of *Ribes*.

***Thalictrum fendleri* (THFE) phase.**—The THFE phase reflects the most mesic extent of the habitat type. Although it occurs throughout the northwestern region, sampled between 7,900 and 9,600 feet (2 410 and 2 925 m) elevation, this phase is most common in the Wasatch Range of Utah. It is also found in the westernmost Uinta Mountains near 9,600 feet (2 925 m). Exposures are chiefly northwest- to southeast-facing on gentle to moderate slopes. Soils are derived from a variety of materials, including metamorphic, sedimentary (calcareous and noncalcareous), and granitic rocks. Surface soils under canopies usually remain moist through the growing season but rapidly become droughty in open conditions.

Old-growth stands are normally fairly closed and develop a rather dense *Abies* component. When present, *Picea engelmannii* is often a long-lived associate that can attain large dimensions. *Populus tremuloides* is occasionally a major pioneer species on warmer exposures.

The undergrowth is typically the most luxuriant of the high-elevation habitat types. In addition to *Thalictrum* and often abundant *Ribes*, it is characterized by *Aquilegia coerulea*, *Aster engelmannii*, *Osmorhiza chilensis*, *O. depauperata*, and *Stellaria jamesiana*; all of which are very common throughout the phase. More local but nevertheless significant in representation are *Aconitum columbianum*, *Arnica cordifolia*, *A. latifolia*, *Erigeron peregrinus*, *E. speciosus*, *Mertensia ciliata*, *Pedicularis racemosa*, *Polemonium foliosissimum*, *P. pulcherrimum*, *Senecio serra*, *Valeriana occidentalis*, and species of *Geranium* and *Lathyrus*. *Symphoricarpos oreophilus* and *Sambucus racemosa* are the only other shrubs that occur rather constantly, as do the graminoids *Bromus* spp., *Carex rossii*, *Elymus glaucus*, and *Poa nervosa*.

***Ribes montigenum* (RIMO) phase.**—This phase occupies northerly upland slopes that are gentle to very steep and rather cold. Sample stands in the northwestern region range in elevation from 7,900 feet (2 410 m) to 9,500 feet (2 895 m); those in the northwestern Uintas are near 10,000 feet (3 050 m). The phase most likely extends much higher in both regions. Substrates are similar to those of the THFE phase, but the soils appear to be better drained, and hence become more droughty earlier in the growing season. The ABLA/VAME h.t. is sometimes nearby, as are types and phases proximate to the THFE phase.

Overstories are similar to the THFE phase, except that stands tend to be more open. Undergrowth varies from very depauperate, with *Pyrola secunda*, *Carex rossii*, moss, and widely scattered *Ribes*, to rather richly herbaceous, with many of the same species that are common to the THFE phase, especially *Arnica latifolia*.

Soils.—As noted for each phase, our stands have soils that are derived from a variety of substrates (appendix D). Some soils are also glacier-related in origin. Surface soils are predominantly sandy loams or loams in the PICO and TRSP phases; textures are more variable in the THFE and RIMO phases, ranging from sandy loam to clayey. Most soils are gravelly, and some are quite shallow. In general, the more open phases have greater amounts of surface rock and bare soil; litter depth is greatest in the THFE and RIMO phases.

Productivity/management.—Timber productivity is essentially low in the TRSP phase, low to moderate in the PICO and RIMO phases, and moderate to high in the THFE phase (appendix E). Timber management opportunities generally are fair only in the THFE phase. *P. engelmannii* is the primary management species. Regeneration is difficult, as Pfister (1973) emphasized:

> Maintenance of a forest cover is essential for natural regeneration, so establishment of *Picea* requires either a selection or shelterwood system. If clearcut, these stands regenerate extremely slowly because the environmental extremes delay natural seedling establishment and make the probabilities of planting success extremely low.

In addition, most advanced reproduction is suppressed *Abies*, so final removal cuts may result in an unproductive stand.

Domestic livestock use is very local, except for much of the TRSP phase where sheep use is periodically high. The habitat type provides cover for big game and watershed protection. Also, esthetics and recreation are usually important considerations—this habitat type is the site of most ski areas in the Wasatch Range.

Other studies.—An ABLA/RIMO h.t. has been described without phases from southern Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and in eastern Idaho and western Wyoming (Steele and others 1983). *Ribes montigenum* is also a major undergrowth component of the *Abies lasiocarpa/Senecio sanguisorboides* h.t. of central New Mexico (Moir and Ludwig 1979).

The preliminary OSCH and ANMI phases presented in Henderson and others (1977) are generally equivalent to the THFE and the PICO or TRSP phases, respectively.

ABIES LASIOCARPA/OSMORHIZA CHILENSIS H.T. (ABLA/OSCH; SUBALPINE FIR/MOUNTAIN SWEETROOT)

Distribution.—The ABLA/OSCH h.t. is found locally in the northwestern region, but is most common in the Bear River Range. It occupies relatively warm exposures and all aspects at elevations of between about 7,000 and 8,800 feet (2 135 and 2 680 m). ABLA/OSCH is associated primarily with the deeper, ostensibly moister depositional soils of moderately steep, lower-to-middle ridge slopes. This habitat type is also to be expected in the extreme western Uinta Mountains and perhaps through the southern Wasatch Range as well.

Vegetation.—*Abies lasiocarpa* is the indicated climax. *Populus tremuloides* is the major component of seral stands, and *Picea engelmannii* is uncommon. *Pseudotsuga* is usually absent; if present in substantial amounts, the site should be considered to be the ABLA/BERE h.t., with the *Berberis* and/or *Pachistima* absent because of past severe disturbance.

The typical sere begins with a "nurse" cover of *Populus*. Conifer establishment is normally cyclic and spotty except on the most protected sites. Our data show, for example, that the difference in breast-height ages between *Populus* and conifers generally ranges from 10 to 20 years on more protected, northerly exposures, and up to 40 to 50 years or even 80+ years on southerly exposures. Conifer stem density follows a similar pattern. The factors controlling this differential rate of conifer establishment are unclear, but several possibilities have become apparent during this study.

Speculatively, the shade provided by *Populus* ameliorates the physiological stress of new seedlings, particularly on the drier exposures. Soil water in the upper soil profile is rapidly depleted by *Populus* and the typically lush undergrowth vegetation. This serves to limit conifer establishment to the most favorable periods of climatic conditions. Once the conifer roots penetrate the deeper and more moist soil profile, growth rapidly improves. Development to a state of virtual dominance by *Abies* progresses very slowly on unfavorable exposures.

Major site disturbances are fairly common. The significance of fire as a factor for the continual maintenance of *Populus* stands by stimulating suckering, as well as that of major aspen mortality due to various biological agents including large mammals, has been well documented (Krebill 1972; Loope and Gruell 1973; Gruell and Loope 1974; Schier 1975; Hinds 1976). The particularly destructive effect of heavy foraging by deer and livestock on *Populus* regeneration has been addressed by Smith and others (1972) and Mueggler and Bartos (1977). Much of the upper elevation forest land of the Bear River Range burned during the intensive logging and sheep grazing activities of the early 1900's. This created many new *Populus* stands, particularly in this habitat type. Sheep grazing probably also created trampled and compacted soil conditions poor for early conifer establishment, augmenting further the effect of unfavorable exposures.

Two other disturbances are perhaps locally significant in *Populus* maintenance, especially in decadent stands. First, heavy snows may break up foliated canopies. Second, severe winds may "level" stands. With regard to the latter, many ABLA/OSCH sites occupy east-west oriented, flanking ridges and slopes that are downslope from major ridge systems. Such situations are normally not subject to continuous wind (Alexander 1974); but because of this, the infrequent severe winds of short duration would be especially destructive. All of these disturbances except fire would at least temporarily release recently established conifers. Any significant, subsequent *Populus* development would temporarily retard conifer establishment through reinitiated competition.

Undergrowth is principally herbaceous and often includes many weedy species. In addition to the joint indicators *Osmorhiza chilensis* and *O. depauperata*, the most frequently encountered forbs include *Achillea millefolium, Agastache urticifolia, Aquilegia coerulea, Aster engelmannii, Senecio serra*, and *Thalictrum fendleri*. Various graminoids are common, such as *Elymus glaucus* and species of *Agropyron, Bromus, Carex*, and *Poa*. On sites that have been disturbed by livestock, *Lathyrus* spp., *Rudbeckia occidentalis*, and *Stellaria jamesiana* are often abundant. The most significant shrubs are *Symphoricarpos oreophilus* and *Sambucus racemosa*.

Adjacent, warmer sites are usually *Populus*-dominated stands having essentially similar undergrowths. *Symphoricarpos* becomes increasingly important on drier sites, many of which appear to be "stable" *Populus/Symphoricarpos* communities, in the sense of Mueggler (1976). Nonforest communities are sometimes adjacent. Nearby, more mesic habitat types include ABLA/BERE and ABLA/PERA.

Soils.—Our stands are associated primarily with mixed quartziferous substrates (appendix D). Of the latter, the Wasatch Conglomerate and glacial till are especially noteworthy. Surface textures are mainly loamy to clayey. Small gravel fragments are often abundant in the usually deep profile, but exposed rock is nominal. Bare soil is absent or scarce, unless livestock use is high. Litter depth averages 0.9 inches (2.3 cm).

Productivity/management.—The ABLA/OSCH h.t. provides abundant forage for both domestic livestock and big game. Opportunities for improving game forage by maintaining *Populus* are typically very good (Patten and Jones 1976; Schier and Smith 1979). Pocket gopher activity is usually conspicuous, perhaps also influencing conifer establishment.

Although yield capability is moderate to high (appendix E), actual conifer productivity is quite low because of the preponderance of *Populus* and slow successional development.

Other studies.—Steele and others (1981, 1983) have recognized an ABLA/OSCH h.t. from the southern Sawtooth National Forest of Idaho, and eastern Idaho and western Wyoming. Their treatment is conceptually much broader than ours for northern Utah. It largely corresponds to our ABLA/BERE h.t., and to a lesser extent our ABLA/PERA h.t.

The present treatment of ABLA/OSCH represents a much narrower concept than that which was originally described in Henderson and others (1976). The cooler or drier portions of their type are presently classified in the ABLA/PERA, ABLA/BERE, or ABLA/RIMO h.t.'s.

ABIES LASIOCARPA/JUNIPERUS COMMUNIS H.T. (ABLA/JUCO; SUBALPINE FIR/COMMON JUNIPER)

Distribution.—The ABLA/JUCO h.t. is found only in the south-central Uinta Mountains, roughly between the Duchesne and Whiterocks Rivers, where it is fairly common. Relatively warm and dry, it embraces moderate to very steep ridge and canyon slopes as well as gentle upland surfaces. Elevations are between about 8,700 and 10,500 feet (2 650 and 3 200 m). These sites are typically the most droughty of the *Abies lasiocarpa* series.

Vegetation.—*Abies lasiocarpa* usually is the indicated climax. *Picea engelmannii*, *Pinus contorta*, and locally *Pseudotsuga menziesii* are seral dominants. *Populus tremuloides* is occasionally a minor seral associate. Stands are fairly open, and replacement progresses rather slowly.

Dense to scattered *Juniperus* accents a rather scant undergrowth, which reflects greatly the dryness of sites. Of the herbs having the highest constancy, *Lupinus argenteus* usually has the greatest abundance. Other, relatively inconspicuous members include *Antennaria microphylla*, *Arnica cordifolia*, *Epilobium angustifolium*, *Fragaria virginiana*, *Solidago* spp., *Carex rossii*, *Poa nervosa*, and *Trisetum spicatum*. *Shepherdia canadensis* is occasionally abundant, emphasizing the importance of fire in the type. Minor amounts of *Vaccinium caespitosum* or *V. scoparium* are sometimes present on upland sites; these reflect the proximate, more mesic ABLA/VACA or ABLA/VASC h.t.'s. More xeric slopes are normally the PICO/JUCO c.t.

Soils.—The soils of our stands are derived predominantly from the fluvial sandstone of the Duchesne formation (appendix D). Surface soils are gravelly sandy loams that are typically well drained. Generally, surface rock is present in moderate to considerable amounts, but there is very little exposed soil. Litter averages 1.1 inches (2.9 cm) in depth.

Productivity/management.—Timber productivity is low (appendix E). Because sites are particularly droughty and often steep, opportunities for timber management are few. Forage production is light and wildlife use varies.

Other studies.—An ABLA/JUCO h.t. has been described from Montana and Idaho (Pfister and others 1977; Steele and others 1981, 1983), as well as northern Arizona and New Mexico (Moir and Ludwig 1979). In addition, parts of our ABLA/JUCO h.t. appear to be very similar to the *Abies lasiocarpa/Arnica cordifolia* h.t. of eastern Idaho and western Wyoming described by Steele and others (1983).

Pinus contorta Series

Distribution.—The lands that comprise this series support essentially pure stands of *Pinus contorta*, and lack sufficient evidence that another species is the potential climax (Pfister and others 1977). This series occurs in Utah only in the Uinta Mountains. (*Pinus contorta* stands of the northern Wasatch Range should be considered as seral communities of various *Abies lasiocarpa* h.t.'s).

The *P. contorta* series throughout most of the Uintas occupies an elevational belt about 1,500 feet (455 m) in width. In some locations, and most notably in the north-central and northeastern areas, the series is actually a separate zone having *Pinus* as the indicated climax. Varying in altitude, the belt has a minimum lower occurrence at about 7,600 feet (2 315 m) in the western and northeastern areas, and a maximum upper one at about 10,300 feet (3 140 m) in the north-central area. The topography encompassed by the series ranges from gentle or undulate terrain to very steep canyon and ridge slopes; these conditions are typical of the northern and southern Uintas, respectively. Exposures are relatively warm and usually quite droughty with well-drained or shallow soils. On the other hand, some sites have seasonally moist soils, such as those of the PICO/CACA c.t. Environmentally, then, this series reflects or borders on the cold, upper portion of the *Pinus ponderosa* series, the dry portion of the *Pseudotsuga menziesii* series, or the warm, dry portions of the *Abies lasiocarpa* and *Picea engelmannii* series.

Vegetation.—The various factors that may be responsible for complete or near-complete dominance by *P. contorta* are discussed under each type.

The *P. contorta* sample stands were initially grouped by community type for the analysis. Usually, the successional role of *P. contorta*, as defined by Pfister and Daubenmire (1975), was readily discernible for any given stand. Groups or individual stands where the species had a generally "dominant seral" role were placed in the appropriate climax series and habitat type. These included all stands of the northwestern region. Two additional situations, though not specifically sampled, were anticipated and have been included in the *Picea engelmannii* series key.

The remaining groups forming the series had *P. contorta* represented as at least a "persistent seral" species. Of these groups, two had definitive conditions to the extent that *P. contorta* was the indicated climax, not because of any direct, interspecific competitive relationships, but rather because of the severity of the sites. These were designated as habitat types. For purpose of discussion, these were not separated from the community type group. The remaining five groups had more variable conditions and were maintained as community types (c.t.'s). About one-half of these stands had sufficient representation of other conifers (*Abies lasiocarpa*, *Picea engelmannii*, or occasionally *Pseudotsuga*) and also corresponding site characteristics to indicate that they were persistent seral communities of various habitat types of other series.

Identifying the habitat type of some sites may be particularly difficult in the field, especially those with exceptionally dense stands. Proper placement often can be determined by the investigator through an examination of nearby, more open or older stands occupying similar sites.

Soils.—Soils are derived almost exclusively from quartzite or other quartziferous materials (appendix D). In general, they vary from shallow, when over fractured quartzite bedrock, to rather deep, when associated with various depositional features or certain geologic surface formations. With the exception of some especially moist, clayey soils that occur most notably with the PICO/CACA c.t., soils are typically gravelly and well-drained and have sandy loam or loam surface textures. Many are very droughty. The amount of exposed rock varies, but bare soil is generally absent. Litter usually averages about 1.2 inches (3.0 cm) in depth.

Productivity/management.—Although timber productivity is low throughout the series (appendix E), opportunities for intensive timber management are generally good. The values shown in appendix E may be low because site-index values were not corrected for excessive crown competition. *Pinus contorta* is almost invariably the only conifer having management possibilities. With the exception of the more xeric sites where shelterwood techniques are perhaps more applicable, *Pinus* usually regenerates well with clearcutting and minimal mineral soil preparation (Tackle 1956); in fact, overstocked conditions often occur. Planting, while feasible, ordinarily is not necessary. General silvicultural guidelines have been discussed by Lotan (1975a) and by Alexander (1974), who also considered windthrow hazard, an often critical concern in the Uintas. Three other pertinent regeneration and management considerations for this area are overstocking, the predominant cone habit, and various pest problems. These concerns are present throughout the study area.

Too much regeneration is especially undesirable because at excessive densities *Pinus* is particularly susceptible to early suppression of height and diameter growth. This is perhaps a greater problem with the "better" sites (Alexander 1974). Dense stands of the PICO/CACA c.t. near East Park Reservoir were associated with seasonally moist soil conditions attributed to the presence of an argillic horizon (personal communication with Dennis Austin, Utah Division of Wildlife Resources, Logan). Management for this problem is best considered during the regenerative period. Observations of recent thinning plots on the PICO/CARO h.t., in which acceptable numbers of *Pinus* seedlings became established under various thinning regimes, indicate that shelterwood cuttings might substantially alleviate overstocking on local areas. In the same area, overcrowding was less on recent clearcuts that had received heavy cattle use. Several of these had been additionally seeded to forage species, perhaps further increasing regeneration-vegetation competition and reducing stocking. Minimum levels of site preparation also may be useful in certain instances.

The predominant cone serotiny habit of *Pinus* is especially important because it largely determines the appropriate site and slash preparation measures for regeneration (Lotan 1975a). As a part of a broad regional study to identify general serotiny patterns of the species, Lotan (1975b) sampled several *Pinus* stands in the northern and eastern Uinta Mountains. He found that the percentage of serotinous cones of his sample stands in the Uintas was rather uniform within stands but quite variable between stands. The predominant cone habit was that of nonserotiny. In the Ashley National Forest samples, he also found that an increase in serotiny was correlated with increasing elevation (r^2 = 0.468). We also observed these general relationships; furthermore, we observed that the predominant cone habit throughout northern Utah appeared to be nonserotinous. In most situations, therefore, sufficient seed should be present in adjacent stands to regenerate clearcuts. And as a general rule, Lotan (1975b) suggested a maximum cutting width of about 200 feet (60 m) to insure adequate seed dispersal.

In northern Utah, *Pinus* is affected by several diseases and pests. Currently, the most serious problem is dwarf mistletoe (*Arceuthobium americanum*). This parasite is responsible for a significant reduction of potential growth and mortality (Hutchinson and others 1965). Local partial-cutting practices ("high-grading" or "tie-hacking") prior to 1900 in infected stands of the more western, northern areas directly resulted in an intensification of today's problem. For example, Hutchison and others (1965) reported that 55 percent of the *P. contorta* cover type in those areas had at least a 10 percent infection rate. To facilitate a tentative identification of distributional relationships, the presence of dwarf mistletoe was included as part of our plot examination in the Uintas. Infected trees were noted on 25 plots at elevations of between 8,600 and 10,300 feet (2 620 and 3 140 m). Of the 10 types having observed infections, the most frequent were the PICO/ARUV h.t., the ABLA/VASC h.t., CAGE and VASC phases, and the PICO/VACA c.t. Others were the PICO/VASC and PICO/BERE c.t.'s and the ABLA/CACA, ABLA/VACA, ABLA/BERE (CAGE phase), PIEN/VACA, and PIEN/VASC h.t.'s. Interestingly, dwarf mistletoe was rarely observed in the southwestern and south-central areas.

Throughout northern Utah, comandra blister rust (*Cronartium commandrae*) and western gall rust (*Endocronartium harknessii*) are locally responsible for reduced vigor and growth as well as direct, but more limited mortality. Various root and stem decays are even more harmful; these pathogens often account for appreciable losses in merchantability and mortality in old-growth stands (Krebill 1975).

Insects and animals can also cause considerable damage. Past epidemics of the mountain pine beetle (*Dendroctonus ponderosae*) resulted in extensive mortality throughout much of the northern area (Hutchinson and others 1965). Currently, damage is localized; eruptions of the pest can certainly occur in the future.

however. The most significant mammal pests are pocket gophers and porcupines; the latter are especially harmful in managed stands in the Wasatch Range (Daniel and Barnes 1959).

Nontimber values of the *Pinus contorta* series are diverse. Utilization by various wildlife species has been studied locally by Collins and others (1978), Deschamp and others (1979), and Winn (1976). The effect of management activities on water yield and quality is an important consideration throughout. Domestic livestock use is associated with sites where forage areas are proximate.

Other studies.—Various, often similar *Pinus contorta* community types have been described from Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and eastern Idaho, western Wyoming (Cooper 1975, Steele and others 1983).

Pfister and Daubenmire (1975) listed the current references to plant communities in the northwestern United States which refer to *P. contorta* as climax. Several specific situations are particularly noteworthy. Cooper (1975) and Pfister and others (1977) recognized a *Pinus contorta/Purshia tridentata* h.t. in southwestern Montana. In central Idaho, a *Pinus contorta/Festuca idahoensis* h.t. has been described by Steele and others (1981). Hoffman and Alexander (1976) and Reed (1976) recognized a total of three PICO habitat types in Wyoming. Also, Moir (1969) discussed a zone in the Colorado Front Range where *P. contorta* is either a prolonged seral species or climax. This zone is similar in several respects to the *P. contorta* series of the Uinta Mountains, as is the climax zone of the Bighorn Mountains, Wyoming (Despain 1973).

PINUS CONTORTA/CALAMAGROSTIS CANADENSIS C.T. (PICO/CACA; LODGEPOLE PINE/BLUEJOINT REEDGRASS)

Distribution.—This community type occurs locally in the northern Uinta Mountains and eastward through the southeastern area. Elevations range from about 8,800 feet to 9,800 feet (2 680 to 2 985 m). Most sites occupy gentle slopes that are relatively cool and generally dry. Usually, surface soils are seasonally moist, a condition that apparently results from a local drainage-impeding soil structure (such as an argillic horizon).

Vegetation.—*Populus tremuloides* is occasionally a minor seral species. All sample stands had evidence of past fire occurrence, and only two were older than 150 years of total age. Scattered, stunted reproduction of other conifer species was represented in six stands.

For our sample stands, then, it appears that *Abies lasiocarpa* is the indicated climax and that *Pinus* is a persistent seral species. *Picea engelmannii* is locally present as a seral associate. Sites are somewhat drier than, but generally as cool as, the ABLA/CACA h.t. The possible role of fire in removing on-site, shade-tolerant seed sources is more pronounced in the PICO/CACA c.t. than elsewhere in the series. This is because many adjacent drier sites are the PICO/VACA or PICO/VASC h.t.'s that are normally without any representation of other conifers.

Calamagrostis creates the dominant aspect of the undergrowth, although *Vaccinium caespitosum* is sometimes also abundant, reflecting the relative coolness of a site. The other common shrubs and herbs (appendix C) represent a rather intermediate floristic transition between the wetter ABLA/CACA h.t. and the drier ABLA/VACA or PICO/VACA types.

Soils.—The moist soils of our stands are derived from a variety of quartziferous parent materials (appendix D) and are associated mainly with glacial, alluvial, or other depositional features. Textures range from sandy loam to clayey. Gravel content varies. Exposed soil and rock are generally absent or only slight, although the latter is sometimes present in moderate amounts. Litter averages 1.2 inches (3.0 cm) in depth.

Productivity/management.—Although timber productivity is low to moderate (appendix E), it is generally good, compared to the series as a whole. Clearcutting should provide adequate regeneration of *Pinus* even though some soils may become temporarily waterlogged. Although dense, stagnated stands do occur, diameter growth and thinning from natural competition was exceptionally good in the majority of our sample stands; frost-heaving has perhaps served to thin seedlings during stand establishment.

The PICO/CACA c.t. provides cover and forage for big game species (Winn 1976). Cattle use is also locally high.

Other studies.—PICO/CACA communities occur in Montana (Pfister and others 1977), central Idaho (Steele and others 1981), and northwestern Wyoming and adjacent Idaho (Cooper 1975; Steele and others 1983). These authors, however, did not describe a PICO/CACA c.t.; rather, they considered all stand conditions directly with the ABLA/CACA h.t.

PINUS CONTORTA/VACCINIUM CAESPITOSUM C.T. (PICO/VACA; LODGEPOLE PINE/DWARF HUCKLEBERRY)

Distribution.—Although it is found throughout the Uinta Mountains, the PICO/VACA c.t. is commonest in the northern and eastern areas. It characteristically occupies topography subject to cold air accumulation. Such sites include meadow edges, gentle terrain having depressions, and occasionally steeper slopes. Elevations are between 8,300 feet (2 530 m) and about 10,000 feet (3 050 m). A notable exception is found in the western area where the type occurs on some steep, south-facing sites near 7,700 feet (2 345 m) elevation that have moist substrates.

Vegetation.—*Populus tremuloides* is a local, minor seral species. Other conifers were absent in many of our sample stands and replacement by shade-tolerant species appeared to be particularly prolonged.

Six stands probably best represented the ABLA/VACA h.t. These had minor amounts of *Abies* and occurred outside the north-central area between 8,300 and 9,700 feet (2 530 and 2 955 m) elevation. This also appeared to be the case for three rather unusually brushy, species-rich stands near 7,700 feet (2 345 m) in the western area, even though *Abies* was absent. Small amounts of *Picea engelmannii* were present in five

higher stands at 9,700 to 10,300 feet (2 955 to 3 050 m) elevation; because the stands were relatively old—more than 150 years—it is uncertain whether they represent persistent seral communities of the PIEN/VACA h.t. or situations of a *P. contorta* climax. Of the 14 remaining stands that lacked other conifers, about eight that occupied relatively dry sites likely reflected a PICO/VACA h.t.: for instance, sites where *Arctostaphylos uva-ursi* was present and the PICO/ARUV h.t. was adjacent.

In addition to *V. caespitosum* and *Juniperus communis*, undergrowth often includes other shrubs that are indicative of nearby, warmer habitat or community types, such as *A. uva-ursi, Berberis repens, Pachistima myrsinites*, or *V. scoparium*. Many herbaceous species are also represented, the most common of which are *Antennaria* spp., *Arnica cordifolia, Fragaria virginiana, Carex rossii, Poa nervosa*, and *Trisetum spicatum*. Furthermore, *Polygonum bistortoides* is a characteristic undergrowth species of sites adjacent to meadow edges.

Soils.—Substrates are dominated by quartzite or other quartziferous materials (appendix D), which are often glacial till. Surface soils range from gravelly sandy loams to moist clays. Bare soil is usually absent, and exposed rock varies from absent to considerable. The average litter depth is 1.2 inches (3.0 cm).

Productivity/management.—Timber productivity is low to moderate (appendix E). *Pinus contorta* usually regenerates well with clearcutting. Following this practice, however, some gentle sites may become temporarily waterlogged. Other uses vary, but habitat values for elk predominate in many areas (Winn 1976).

Other studies.—The PICO/VACA c.t. has been described from Montana by Pfister and others (1977), and from central Idaho by Steele and others (1981). These authors have treated most all of their sample stands as successional communities occupying other habitat types.

Franklin and Dyrness (1973) listed *Pinus contorta/Vaccinium uliginosum* communities from central Oregon that may be related to the moister stands of our PICO/VACA. These communities had *V. caespitosum* as a characteristic component. Also, two of Moir's (1969) "subalpine" stands in the Colorado Front Range included *V. caespitosum* as an undergrowth member. These stands occur at the higher elevations of a zone where *P. contorta* is either a prolonged seral species or climax.

PINUS CONTORTA/VACCINIUM SCOPARIUM C.T. (PICO/VASC; LODGEPOLE PINE/GROUSE WHORTLEBERRY)

Distribution.—PICO/VASC is found throughout the northern and eastern Uinta Mountains between about 8,500 and 10,000 feet (2 590 and 3 050 m) elevation. It occupies gentle upland surfaces and gentle to moderately steep ridge-slopes. In relation to the series as a whole, exposures are relatively cool but dry.

Vegetation.—PICO/VASC communities sampled in the more central areas of the southern Uintas were always recognizable as seral communities of either the PIEN/VASC h.t. or the VASC phase of the ABLA/VASC h.t.; thus, they have been included in those types. Most all of the other stands considered under this category occupied relatively droughty exposures.

Six of our sample stands occupied very dry exposures between about 9,300 and 10,000 feet (2 835 and 3 050 m) elevation, of which four were over 150 years old and two were over 200 years. Five of these six stands also had very widely scattered *Picea engelmannii* of about the same stand age, and some stunted but otherwise similar *Abies lasiocarpa*; the other stand was entirely *Pinus* in composition. Three younger stands also had similar representation of these shade-tolerant conifers.

In terms of a general stand establishment model for the higher elevations, these conditions suggest that most *Picea*, and probably most *Abies*, becomes established with *Pinus*, probably throughout the latter's rather prolonged period of stand establishment. Once the stand develops an extensive, shallow root system and duff further accumulates, however, the seedbed becomes too droughty for any appreciable subsequent establishment of *Picea* or *Abies*. Limiting amounts of critical mineral nutrients may also impede establishment. From a management standpoint, then, sites such as these are probably best considered a *Pinus contorta* climax, with other conifers occurring as accidentals. For the Uintas, both of the above factors are probably more significant than the occurrence of presumably frequent, natural surface fires in curtailing *Picea* and *Abies* regeneration.

Of the nine remaining younger stands, four pure *Pinus* stands occupied very droughty sites at about 9,100 feet (2 775 m) elevation. These sites most certainly represented a PICO/VASC h.t., regardless of stand ages. Stunted *Abies* was present in the other, more mesic samples that occurred near 8,900 feet (2 715 m). Some of these possibly reflected the same stand establishment conditions noted for the higher elevation stands having *Picea*. One eastern stand that had an abundant cover of *Calamagrostis rubescens* was clearly seral to *Abies*.

Usually *V. scoparium* conspicuously dominates the undergrowth. With exceptionally droughty sites, however, this coverage is sometimes very patchy. Some of the more common herbs include *Achillea millefolium, Antennaria microphylla, Arnica cordifolia, Epilobium angustifolium, Lupinus argenteus, Carex rossii, Poa nervosa*, and *Trisetum spicatum*. Several shrubs are often represented, such as *Juniperus communis, Berberis repens, Pachistima myrsinites*, or *V. caespitosum*; the latter three species often reflect nearby habitat or community types.

Soils.—The soils of our sample stands are generally similar to those described for the PICO/VACA c.t. (appendix D). The major exception is that the surface soils are most always gravelly and drier. Litter averages 1.1 inches (2.9 cm) in depth.

Productivity/management.—Timber productivity is low (appendix E). Regeneration is usually successful on small clearcuts, although stand establishment may be prolonged on drier sites. Natural thinning appears to occur readily in most stands.

Nontimber uses are similar to those described for the ABLA/VASC h.t.

Other studies.—Hoffman and Alexander (1976) recognize a PICO/VASC h.t. from the Bighorn Mountains, Wyo. This type is similar in many respects to the drier extent of our stands designated as a *P. contorta* climax. The PICO/VASC c.t. has been described from Montana (Pfister and others 1979), central Idaho (Steele and others 1981), and eastern Idaho, western Wyoming (Steele and others 1983). In Montana, Idaho, and Wyoming, the community type normally occupies the ABLA/VASC h.t., although these authors recognize certain droughty conditions where *P. contorta* may be climax.

PINUS CONTORTA/JUNIPERUS COMMUNIS C.T. (PICO/JUCO; LODGEPOLE PINE/COMMON JUNIPER)

Distribution.—The PICO/JUCO c.t. occurs only in the south-central Uinta Mountains. There, it is found primarily between the Whiterocks River and eastern Duchesne River drainages. It occupies most all southerly, moderately steep to very steep ridge and canyon slopes (east- and west-facing). Elevations are between about 8,400 and 10,000 feet (2 560 and 3 050 m). These exposures are warm and soils are extremely well drained, being some of the driest within that area.

Vegetation.—This community type occurs within the normal altitudinal distribution of *Abies lasiocarpa* or *Pseudotsuga menziesii*; the ABLA/JUCO or PSME/BERE h.t.'s are usually nearby on the more protected exposures. All of our sample stands occupied burn areas that were between 80 and 120 years old. In addition, one two-storied stand included several residual trees of about 250 years of age. Stands were normally quite dense; *Populus tremuloides* was a local pioneer species that had been rapidly shaded out. Eight of the 14 stands had minor representation of *Abies*, *Pseudotsuga*, or *Picea engelmannii*. Replacement by these species appears to be exceptionally slow.

Undergrowth also exhibits the influence of fire. In addition to *Juniperus*, several "fire" shrubs are locally present, such as *Arctostaphylos patula*, *Amelanchier alnifolia*, *Rosa* spp., and *Salix scouleriana*. The herbaceous component is typically depauperate. The most frequently encountered species include *Aster glaucodes*, *Epilobium angustifolium*, *Bromus ciliatus*, *Carex rossii*, and species of *Festuca* and *Poa*.

Small amounts of *Berberis repens* and occasionally *Pachistima myrsinites* are encountered in the undergrowth, which suggests that these sites might be a part of the PICO/BERE c.t. With the exception of a few instances, however, the undergrowth and typical topography are more representative overall of the ABLA/JUCO h.t.—a type where these two species are apparently absent. These communities, then, are treated separately from the PICO/BERE c.t., which is elsewhere more similar to the ABLA/BERE h.t. Although the successional status of *Pinus* for the most part is uncertain primarily because of stand ages, *Pinus* can be considered a persistent seral species. Most lower elevation seral stands may best reflect the PSME/BERE h.t., and higher seral stands may represent the ABLA/JUCO h.t. Stands of the very warm and well-drained droughtiest sites might well be a PICO/JUCO h.t.

Soils.—The soils of our stands are chiefly derived from either sandstone of the Duchesne formation, or from Uinta quartzite (appendix D). Stands occupying other substrates, especially calcareous materials, are most likely another habitat type such as PSME/BERE. Surface soils are usually gravelly sandy loams or gravelly loams. Generally considerable rock is exposed, but little or no bare soil. Litter averages 1.1 inches (2.7 cm) in depth.

Productivity/management.—Timber productivity is low to moderate (appendix E). Opportunities for timber management are nominal in most instances because of slope steepness. Wildlife use is mainly as cover.

Other studies.—Steele and others (1981) have described a PICO/JUCO c.t. from central Idaho, which occurs locally eastward through Idaho to adjacent Wyoming (Steele and others 1983). It has been considered to occupy the ABLA/JUCO h.t. or occasionally the PSME/JUCO h.t. In Montana, PICO/JUCO communities have been considered part of the PSME/JUCO h.t.

PINUS CONTORTA/ARCTOSTAPHYLOS UVA-URSI H.T. (PICO/ARUV; LODGEPOLE PINE/BEARBERRY)

Distribution.—This very warm and dry habitat type occurs principally in the northern Uinta Mountains, and is most extensive in the northeastern area. It occurs on gentle upland terrain as well as ridgetops and steeper slopes. Elevations range from 8,200 feet (2 500 m) to 9,500 feet (2 895 m). In the southern Uintas, *A. uva-ursi* usually reflects extreme soil drainage conditions.

Vegetation.—The structure of our sample stands varied from rather dense to more often moderately open. In the latter instance, five stands were more than 200 years old; an additional nine were older than 150 years. *Pinus contorta*, which had a predominantly nonserotinous cone habit, was intermittently self-replacing. Seedling establishment in self-replacing stands possibly coincided with periods of favorable soil moisture that followed a light surface fire of the prior growing season, a situation where seedbed conditions would have been optimal.

Populus tremuloides is a minor seral associate, with local distribution. As accidental species, *Abies lasiocarpa* and *Pseudotsuga menziesii* are normally restricted in occurrence to the moistest microsites.

Patches of *Arctostaphylos*, which often occurs at the base of trees, characterize the undergrowth. Other common species include *Berberis repens*, *Juniperus communis*, *Antennaria* spp., *Arnica cordifolia*, *Astragalus miser*, *Epilobium angustifolium*, *Lupinus argenteus*, *Sedum lanceolatum*, *Solidago spathulata*, *Carex rossii*, and *Poa nervosa*.

Nearby more moderate exposures are usually other *P. contorta* habitat types or, with a transition to calcareous parent materials, the PSME/SYOR h.t. or the JUCO phase of the PSME/BERE h.t. The *P. ponderosa* series is sometimes adjacent at lower elevations in the northeastern area where temperatures are sufficiently warm for this species.

Soils.—The droughty well-drained or shallow soils of our stands are derived almost exclusively from quartzite materials (appendix D). Gravelly sandy loam is the predominant surface soil. Usually, little bare soil but occasionally considerable rock is exposed. Litter is sometimes intermittent, averaging 1.1 inches (2.7 cm) in depth.

Productivity/management.—Timber productivity is the lowest of the series (appendix E). Regeneration by clearcutting is sometimes difficult on poorer sites. Shelterwood techniques may successfully regenerate some poor sites, although dwarf mistletoe infection is often severe.

Deer frequently utilize this habitat type. Cattle use is common wherever forage areas are nearby.

Other studies.—Pfister (1972) briefly described the PICO/ARUV h.t. in the Uinta Mountains. A similar habitat type has been recognized from the Bighorn Mountains, Wyo., by Hoffman and Alexander (1976) and Despain (1973).

Moir (1969) discussed "montane" stands in the Colorado Front Range, which bear striking topographic and floristic similarities to our stands. Franklin and Dyrness (1973) summarize the climax PICO/ARUV communities from various locations in southwestern Washington and northwestern Oregon. A climax PICO/ARUV community also occurs in the pumice region of central Oregon, although it is environmentally unlike the conditions of the Uinta Mountains because of seasonally moist soils (Youngberg and Dahms 1970).

PINUS CONTORTA/BERBERIS REPENS C.T. (PICO/BERE; LODGEPOLE PINE/OREGONGRAPE)

Distribution.—The PICO/BERE c.t. occurs throughout the more north-central and eastern Uinta Mountains (fig. 18). Elevations are between about 7,700 and 10,000 feet (2 345 and 3 050 m). Terrain is fairly similar to that of the PICO/ARUV h.t., although exposures are usually more moderate, being southerly in the more western and southeastern areas but shifting to more northerly in the northeastern area. Many stands of the south-central Uintas with *Berberis* or *Pachistima* should be considered as the much warmer and drier PICO/JUCO c.t.

Vegetation.—*Populus tremuloides* is often a major seral associate. Most of our sample stands appeared to be distinctly even-aged. Several exhibited early stagnation and some were also very dense. All stands occupied recent burns, with only two being older than 150 years total age. It was evident that stand establishment took considerable time on the more droughty sites.

Only two stands were sampled in the westernmost Uinta Mountains. One stand apparently reflected the driest extent of the PSME/BERE h.t., CAGE phase, occupying a gentle southwesterly slope at 8,700 feet (2 650 m) elevation. The other, occupying a steep southwest-facing slope at 8,400 feet (2 560 m) elevation, was unique in several respects. *Abies lasiocarpa* and *Abies concolor* were represented by a few seedlings and saplings, and the undergrowth was dominated strikingly by *Arctostaphylos patula*. Elsewhere, only four stands had minor amounts of *A. lasiocarpa*; these occurred between 7,700 and 9,900 feet (2 345 and 3 020 m) elevation. The remaining 14 stands were comprised entirely of *Pinus* (excluding *Populus*).

Figure 18. *Pinus contorta/Berberis repens* community type near Poison Mountain at 9,840 feet (3 000 m) elevation on the north slope of the Uinta Mountains. The sparse undergrowth is dominated by *Astragalus miser*, *B. repens*, and *Poa nevadensis*.

Five stands with abundant *Carex geyeri* in the eastern Uintas occupied sites fairly similar to those of the ABLA/BERE h.t., CAGE phase. The other stands occupied sites that are fairly similar to the JUCO and BERE phases of ABLA/BERE h.t. It appears, however, that many stands of the northern Uintas potentially reflect a PICO/BERE h.t. regardless of stand ages. As such, these stands would represent a part of the climax *Pinus contorta* zone occurring throughout that area, the major component of which is the drier and frequently adjacent PICO/ARUV h.t.

The evergreen shrubs *Berberis*, *Pachistima myrsinites*, and *Juniperus communis* normally characterize a rather sparse undergrowth except when *Carex geyeri* is abundant. Elsewhere, the most conspicuous herbs are *Antennaria microphylla*, *Arnica cordifolia*, *Astragalus miser*, *Lupinus argenteus*, *Poa nervosa*, and *Carex rossii*. Also, *Vaccinium caespitosum* is occasionally represented in minor amounts, typically reflecting the nearby, cooler PICO/VACA c.t.

Soils.—Our stands have soils that are derived predominantly from quartziferous materials (appendix D). Those of the northern Uintas are quite gravelly and mainly associated with either well-drained till deposits or shallow bedrock. The latter condition is fairly common, with sites occurring on the "Gilbert Peak surface" and similar landforms. All stands of the southeastern Uintas are associated with the Browns Park formation where soils are fairly deep and ostensibly more moist. In general, surface soils are sandy loams. The amount of exposed rock varies, but bare soil is generally absent. Litter averages 1.3 inches (3.2 cm) in depth.

Productivity/management.—Timber productivity is low (appendix E). Clearcuts normally regenerate readily on more mesic exposures. Where regeneration is expected to be profuse, minimum site preparation might help reduce excessive densities. Bark beetle infestations can be especially destructive.

Local ungulate and livestock use is varied throughout the Uintas. Seral stands having *Populus* as a major component are especially important for moose in the north-central area (Winn 1976).

Other studies.—The PICO/BERE c.t. has not been previously described. Steele and others (1983) consider somewhat similar communities to occupy a conceptually narrower ABLA/BERE h.t. Also, a few of our stands are similar overall to their *Pinus contorta/Arnica cordifolia* c.t. of eastern Idaho and western Wyoming.

PINUS CONTORTA/CAREX ROSSII H.T. (PICO/CARO; LODGEPOLE PINE/ROSS SEDGE)

Distribution.—The PICO/CARO h.t. is restricted to the north-central Uinta Mountains where it occurs at elevations of about 9,000 feet (2 745 m) to 9,700 feet (2 955 m). The type occupies the distinctive "Gilbert Peak surface" (Bradley 1964), a broad, gently north-sloping upland terrain, as well as several undifferentiated depositional features (Stokes and Madsen 1961). In comparison to the series as a whole, these sites are relatively intermediate in temperature, moistness, and soil drainage. As such, they apparently reflect a transition between the PICO/BERE and PICO/VACA community types.

Vegetation.—The overstory of all sample stands was entirely *Pinus contorta*. Several stands were dense and stagnated, and only one was open and older than 200 years. Judged solely on the basis of the sample stands, the successional status of *Pinus* was uncertain. Nevertheless, additional observations of typical stand conditions within the immediate area helped identify the climax status of *Pinus* on these sites.

Specifically, *Abies lasiocarpa* and *Picea engelmannii* were usually absent in these areas; when present, however, all age classes including reproduction were restricted to favorable microsites, primarily the better drained slopes. Also, corresponding situations having either of these species as the indicated climax were not identified from either the Uintas or from northern Utah. Consequently these sites probably best reflect a *Pinus contorta* climax, a status that is further supported by the apparent predominant interaction of the prevailing "rain shadow" growing season precipitation patterns and edaphic factors.

Populus tremuloides is normally absent in this habitat type. The sparse undergrowth consists of scattered herbs, the most frequent of which are *Antennaria microphylla, Arnica cordifolia, Astragalus miser, Fragaria virginiana, Geranium* spp., *Lupinus argenteus, Carex rossii, Poa nervosa, Sitanion hystrix*, and *Trisetum spicatum*. Small amounts of the shrubs *Juniperus communis* and *Rosa* spp. are sometimes present as well.

Soils.—The soils of our stands are derived almost exclusively from quartzite materials (appendix D). Soil drainage and depth to bedrock varies locally. In general, surface soils are gravelly sandy loams or gravelly loams, and some rock and bare soil are exposed. Litter averages 1.0 inches (2.5 cm).

Productivity/management.—Timber productivity is low to moderate (appendix E). For the Uinta Mountains as a whole, however, this type presents some of the best, locally extensive opportunities for timber management. Following clearcutting, excessive regeneration of *Pinus* and early stand stagnation are common; normally, some stocking control is necessary. (Because of the effect of excessive density on *Pinus* height growth in our unmanaged sampled stands, some productivity estimates may be artificially low for this type in particular.)

Wildlife habitat values are moderate (Winn 1976). Cattle use is greatest near recent clearcuts.

Other studies.—Steele and others (1983) have recognized a PICO/CARO c.t. from western Wyoming as a seral community type of the high elevation *Pinus albicaulis/Carex rossii* h.t.

The PICO/CARO c.t. is an anomaly insofar as an expected, corresponding ABLA/CARO h.t. has not been identified from the immediate area or from northern Utah. Although an ABLA/CARO h.t. has been recognized in the southern Sawtooth National Forest in Idaho (Steele and others 1981), the correspondence between these types is apparently one of type-name only.

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APPENDIX A. NUMBER OF SAMPLE STANDS BY HABITAT TYPE OR PHASE AND NATIONAL FOREST VICINITY IN NORTHERN UTAH AND ADJACENT IDAHO AND WYOMING

SI = Sawtooth National Forest, Idaho
C = Caribou National Forest, Idaho
SU = Sawtooth National Forest, Utah
WW = Wasatch and Uinta National Forests, NW Utah
U = Uinta National Forest, Idaho NE Utah
WE = Wasatch National Forest, NE Utah, and adjacent Wyoming
A = Ashley National Forest (and Uintah and Ouray Reservation)

Habitat type, phase	National Forest vicinity							
	SI	C	SU	WW	U	WE	A	Total
***Pinus flexilis* series**								
PIFL/CELE	.	3	.	4	.	.	.	7
PIFL/BERE	.	.	.	5	.	.	.	5
								12
***Pinus ponderosa* series**								
PIPO/CAGE	.	.	.	.	.	.	8	8
PIPO/FEID, ARPA	.	.	.	.	.	.	8	8
/FEID, ARTR	.	.	.	.	.	.	6	6
/FEID, FEID	.	.	.	.	.	.	15	15
								37
***Pseudotsuga menziesii* series**								
PSME/PHMA	2	3	.	37	2	.	.	44
PSME/ACGL	2	6	.	7	.	.	2	17
PSME/OSCH	4	8	.	15	.	.	.	27
PSME/CELE	.	3	.	7	.	.	.	10
PSME/CARU	.	1	.	.	.	.	.	1
PSME/SYOR	.	.	.	.	.	1	6	7
PSME/BERE, CAGE	.	1	.	5	2	1	4	13
/BERE, JUCO	.	.	.	.	.	3	8	11
/BERE, SYOR	.	1	.	10	.	.	.	11
/BERE, BERE	.	10	1	17	.	2	9	39
								180
***Picea pungens* series**								
PIPU/AGSP	.	.	.	.	.	.	7	7
PIPU/BERE	.	.	.	.	.	2	7	9
								16
***Abies concolor* series**								
ABCO/PHMA	.	.	.	8	.	.	.	8
ABCO/OSCH	.	.	.	5	.	.	.	5
ABCO/BERE, SYOR	.	.	.	7	.	1	.	8
/BERE, BERE	.	.	.	10	.	1	2	13
								34
***Picea engelmannii* series**								
PIEN/EQAR	.	.	.	2	1	3	.	6
PIEN/CALE	.	.	.	.	.	1	4	5
PIEN/VACA	.	.	.	.	.	3	11	14
PIEN/VASC	.	.	.	.	.	10	7	17
								42

(con.)

APPENDIX A. (con.)

Habitat type, phase	National Forest vicinity							
	SI	C	SU	WW	U	WE	A	Total
Abies lasiocarpa series								
ABLA/CACA	.	.	.	.	.	1	4	5
ABLA/STAM	.	.	.	.	.	2	1	3
ABLA/ACRU	.	1	.	9	1	.	.	11
ABLA/PHMA	.	.	.	9	1	.	.	10
ABLA/ACGL	.	12	.	8	.	.	2	22
ABLA/VACA	.	.	.	.	2	4	6	12
ABLA/VAGL	.	18	.	6	2	2	.	28
ABLA/VASC, ARLA	.	3	.	.	1	18	6	28
/VASC, CAGE	.	.	.	.	.	8	1	9
/VASC, VASC	.	.	.	.	1	9	37	47
ABLA/CARU	1	4	1	5	.	.	6	17
ABLA/PERA, PSME	.	18	.	10	2	2	.	32
/PERA, PERA	.	9	.	20	4	1	.	34
ABLA/BERE, PIFL	.	7	.	8	.	4	.	19
/BERE, RIMO	.	16	3	16	8	5	10	58
/BERE, CAGE	.	1	.	2	1	5	8	17
/BERE, JUCO	.	.	.	.	.	5	10	15
/BERE, PSME	2	6	2	51	3	1	8	73
/BERE, BERE	.	2	1	18	1	6	4	32
ABLA/RIMO, TRSP	.	.	.	1	.	4	13	18
/RIMO, PICO	.	.	.	.	.	.	8	8
/RIMO, THFE	.	3	.	15	8	2	1	29
/RIMO, RIMO	3	6	.	10	.	3	.	22
ABLA/OSCH	.	.	.	12	.	.	.	12
ABLA/JUCO	.	.	.	.	.	.	12	12
								573
Pinus contorta series[1]								
PICO/CACA c.t.	.	.	.	.	.	5	4	9
PICO/VACA c.t.	.	.	.	.	.	16	13	29
PICO/VASC c.t.	.	.	.	.	.	11	7	18
PICO/JUCO c.t.	.	.	.	.	.	.	14	14
PICO/ARUV h.t.	.	.	.	.	.	11	13	24
PICO/BERE c.t.	.	.	.	.	.	8	12	20
PICO/CARO h.t.	.	.	.	.	.	8	.	8
								122
Unclassified stands								
Populus tremuloides[2]	.	3	.	34	1	4	16	58
Other (ecotonal or unusual communities)	.	5	1	20	4	8	4	42
Total number of plots	14	150	9	393	45	181	324	1,116

[1]c.t. = community type; h.t. = habitat type.
[2]Cover type with several *P. tremuloides* community types represented.

APPENDIX B. DISTRIBUTION OF MAJOR TREE SPECIES IN NORTHERN UTAH HABITAT TYPES SHOWING THEIR DYNAMIC STATUS AS INTERPRETED FROM SAMPLE STAND DATA

C = major climax species
S = major seral species
() = in certain areas of type
c = minor climax species
s = minor seral species
a = accidental

HABITAT TYPE, PHASE	MAJOR TREE SPECIES											
	JUSC	PIFL	PIPO	PSME	PIPU	ABCO	PICO	PIEN	ABLA	POTR	ACGR	QUGA
PIFL/CELE	.	C	.	c	.	.	.	.	.	.	.	.
PIFL/BERE	(s)	C	.	c	.	.	.	.	.	.	.	.
PIPO/CAGE	.	.	C	a	.	.	(s)	.	.	(s)	.	.
PIPO/FEID, ARPA	.	.	C	a	.	.	(s)	.	.	(S)	.	.
/FEID, ARTR	s	.	C	a	.	.	(S)	.	.	(S)	.	.
/FEID, FEID	(s)	.	C	a	.	.	(s)	.	.	(s)	.	.
PSME/PHMA	(s)	.	.	C	.	a	(s)	.	a	(s)	(s)	.
PSME/ACGL	(s)	(s)	.	C	.	a	(s)	.	a	(s)	(s)	.
PSME/CELE	(s)	(s)	.	C	.	.	.	.	.	.	(s)	.
PSME/OSCH	(s)	.	.	C	.	.	(S)	.	a	(S)	(S)	.
PSME/BERE, CAGE	.	.	(S)	C	.	a	(s)	.	a	(s)	(s)	(s)
/BERE, JUCO	.	(s)	(S)	C	.	.	(S)	.	a	(S)	.	.
/BERE, SYOR	.	(s)	.	C	.	.	.	.	a	.	.	.
/BERE, BERE	(s)	(s)	(S)	C	a	a	(S)	.	.	(s)	(S)	.
PSME/SYOR	(s)	(s)	(s)	C	.	.	(S)	.	.	(s)	.	.
PIPU/AGSP	s	(s)	(s)	(S)	C	.	(s)	.	a	s	.	.
PIPU/BERE	.	.	.	S	C	.	(S)	.	a	S	.	.
ABCO/PHMA	(s)	.	.	S	.	C	.	.	a	(s)	(S)	(s)
ABCO/OSCH	.	.	.	S	.	C	.	(s)	a	(S)	(S)	.
ABCO/BERE, SYOR	(s)	(s)	.	(S)	.	C	.	.	.	.	(S)	(S)
/BERE, BERE	(s)	.	.	S	.	C	(s)	.	a	(s)	(S)	.
PIEN/EQAR	.	.	.	.	(c)	.	(S)	C	c	.	.	.
PIEN/CALE	.	.	.	.	.	.	(S)	C	(c)	.	.	.
PIEN/VACA	.	.	.	.	.	.	(S)	C	a	(S)	.	.
PIEN/VASC	.	.	.	a	.	.	(S)	C	a	.	.	.
ABLA/CACA	.	.	.	.	(s)	.	S	c	C	(S)	.	.
ABLA/STAM	.	.	.	.	.	.	s	c	C	.	.	.
ABLA/ACRU	.	.	.	(S)	(s)	(s)	.	(S)	C	(S)	(s)	.
ABLA/PHMA	.	.	.	S	.	(S)	.	(S)	C	(s)	(s)	.
ABLA/ACGL	.	(s)	.	S	.	(s)	(S)	(S)	C	(S)	(s)	.
ABLA/VACA	.	.	.	(s)	.	.	S	S	C	(s)	.	.
ABLA/VAGL	.	(s)	.	(s)	.	.	(S)	S	C	(S)	.	.
ABLA/VASC, ARLA	.	.	.	.	.	.	(S)	c	C	.	.	.
/VASC, CAGE	.	.	.	.	.	.	S	S	C	.	.	.
/VASC, VASC	.	.	.	(s)	.	.	S	S	C	(s)	.	.
ABLA/CARU	.	.	.	(S)	.	.	S	.	C	(s)	.	.
ABLA/PERA, PSME	.	.	.	S	.	.	(S)	S	C	(S)	.	.
/PERA, PERA	.	.	.	.	.	.	(S)	(c)	C	(S)	.	.
ABLA/BERE, PIFL	.	c	.	S	.	.	(s)	(S)	C	(s)	(s)	.
/BERE, RIMO	.	(s)	.	(S)	(s)	.	(S)	S	C	(S)	.	.
/BERE, CAGE	.	.	.	(S)	(S)	.	(S)	(S)	C	S	.	.
/BERE, JUCO	.	.	.	(S)	(S)	.	S	(s)	C	S	.	.
/BERE, PSME	.	.	.	S	(S)	(S)	(S)	(S)	C	(S)	(s)	.
/BERE, BERE	.	.	.	.	.	(s)	S	(S)	C	S	.	.
ABLA/RIMO, TRSP	.	.	.	.	.	.	(s)	c	C	.	.	.
/RIMO, PICO	.	.	.	.	.	.	S	S	C	(S)	.	.
/RIMO, THFE	.	.	.	(s)	.	.	(S)	S	C	(S)	.	.
/RIMO, RIMO	.	.	.	(S)	.	.	.	S	C	(s)	.	.
ABLA/OSCH	.	.	.	.	.	.	.	(s)	C	S	.	.
ABLA/JUCO	.	.	.	(S)	.	.	S	S	C	(s)	.	.

APPENDIX C-1. CONSTANCY AND AVERAGE CANOPY COVER (THE LATTER IN PARENTHESES) OF IMPORTANT PLANTS IN NORTHERN UTAH CONIFEROUS FOREST HABITAT TYPES AND PHASES (SEE BELOW FOR CODES)

	PINUS FLEXILIS SERIES		PINUS PONDEROSA SERIES				PSEUDOTSUGA MENZIESII SERIES			
	CELE h.t.	BERE h.t.	CAGE h.t.	FEID h.t. ARPA phase	FEID h.t. ARTR phase	FEID h.t. FEID phase	PHMA h.t.	ACGL h.t.	CELE h.t.	OSCH h.t.
Number of Stands	7	5	8	8	6	15	44	17	10	27
TREES										
Abies concolor	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	1(4)	(0)	(0)
Abies lasiocarpa	(0)	2(+)	(0)	1(+)	(0)	(0)	+(1)	2(1)	(0)	1(+)
Picea engelmannii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)
Picea pungens	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pinus contorta	(0)	(0)	4(8)	5(4)	2(17)	3(5)	+(12)	2(1)	(0)	+(25)
Pinus flexilis	10(16)	10(25)	(0)	(0)	(0)	(0)	(0)	1(8)	2(3)	(0)
Pinus ponderosa	(0)	(0)	10(48)	10(37)	10(34)	10(37)	(0)	(0)	(0)	(0)
Pseudotsuga menziesii	9(8)	8(7)	1(2)	5(+)	2(2)	1(+)	10(71)	10(74)	10(27)	10(67)
Juniperus scopulorum	1(+)	6(5)	(0)	(0)	7(1)	3(1)	3(3)	2(1)	5(2)	2(2)
Populus tremuloides	(0)	(0)	5(7)	6(16)	2(38)	3(4)	2(5)	3(8)	(0)	4(17)
Acer grandidentatum	(0)	(0)	(0)	(0)	(0)	(0)	5(10)	2(11)	1(11)	4(17)
Quercus gambelii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SHRUBS AND SUBSHRUBS										
Acer glabrum	(0)	2(1)	(0)	(0)	(0)	(0)	4(15)	10(15)	(0)	1(3)
Amelanchier alnifolia	4(1)	10(1)	9(10)	10(2)	8(1)	5(1)	8(11)	9(8)	9(4)	9(9)
Arctostaphylos patula	(0)	(0)	(0)	10(14)	2(+)	2(1)	(0)	(0)	(0)	(0)
Arctostaphylos uva-ursi	(0)	(0)	5(9)	4(1)	3(4)	1(1)	(0)	1(+)	(0)	(0)
Artemisia tridentata	10(4)	9(5)	4(+)	5(1)	10(14)	7(1)	+(+)	(0)	8(1)	(0)
Berberis repens	10(4)	10(3)	9(3)	6(1)	7(1)	7(1)	8(3)	10(2)	9(6)	6(4)
Ceanothus velutinus	4(1)	6(1)	1(+)	(0)	(0)	(0)	+(+)	(0)	6(4)	(0)
Cercocarpus ledifolius	10(15)	4(+)	(0)	(0)	(0)	1(+)	1(1)	1(+)	10(37)	+(+)
Cercocarpus montanus	(0)	2(+)	(0)	4(3)	5(3)	4(1)	+(+)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	7(1)	5(1)	(0)	(0)	2(1)	1(+)	+(+)	(0)	5(1)	(0)
Clematis columbiana	(0)	(0)	(0)	(0)	(0)	(0)	3(2)	2(2)	(0)	7(10)
Clematis pseudoalpina	(0)	2(+)	(0)	(0)	(0)	(0)	+(1)	2(2)	(0)	+(1)
Juniperus communis	(0)	(0)	6(2)	10(2)	5(2)	5(2)	+(1)	1(19)	(0)	(0)
Lonicera involucrata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	(0)	+(2)
Lonicera utahensis	(0)	(0)	(0)	(0)	(0)	(0)	+(1)	1(1)	(0)	1(1)
Pachistima myrsinites	7(4)	10(3)	8(1)	(0)	2(+)	1(+)	9(6)	9(8)	9(10)	6(3)
Physocarpus malvaceus	(0)	(0)	(0)	(0)	(0)	(0)	10(62)	2(2)	(0)	2(2)
Prunus virginiana	3(6)	10(8)	1(+)	(0)	(0)	(0)	7(12)	8(5)	7(7)	6(20)
Purshia tridentata	1(4)	2(+)	1(+)	9(1)	7(2)	5(1)	(0)	(0)	(0)	(0)
Ribes cereum	(0)	2(2)	(0)	1(+)	3(+)	1(1)	+(2)	2(1)	(0)	+(1)
Ribes montigenum	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)
Ribes viscosissimum	(0)	(0)	(0)	(0)	(0)	(0)	1(2)	3(2)	(0)	3(1)
Rosa nutkana	1(+)	2(+)	6(1)	1(1)	3(1)	1(+)	+(2)	1(+)	(0)	+(2)
Rosa woodsii	(0)	2(+)	1(1)	1(+)	3(2)	1(+)	6(2)	6(2)	5(2)	5(3)
Rubus parviflorus	(0)	(0)	(0)	(0)	(0)	(0)	1(5)	2(2)	(0)	1(2)
Sambucus cerulea	(0)	(0)	(0)	(0)	(0)	1(+)	+(+)	1(+)	(0)	1(1)
Sambucus racemosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Shepherdia canadensis	1(1)	(0)	(0)	3(1)	(0)	(0)	1(1)	2(1)	(0)	(0)
Sorbus scopulina	(0)	(0)	(0)	(0)	(0)	(0)	1(2)	3(8)	(0)	1(1)
Symphoricarpos oreophilus	10(3)	10(2)	8(9)	9(1)	8(1)	4(2)	8(5)	9(6)	10(10)	7(6)
Vaccinium caespitosum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Vaccinium globulare	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Vaccinium scoparium	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
GRAMINOIDS										
Agropyron spicatum	6(2)	6(1)	(0)	4(1)	5(1)	3(3)	(0)	(0)	5(9)	+(+)
Agropyron trachycaulum	6(2)	6(7)	1(1)	(0)	2(+)	(0)	1(+)	1(+)	6(2)	1(5)
Bromus anomalus	(0)	4(+)	(0)	(0)	(0)	(0)	+(+)	1(+)	1(+)	(0)
Bromus carinatus	(0)	2(+)	(0)	(0)	(0)	(0)	2(10)	2(1)	5(2)	4(9)
Bromus ciliatus	(0)	(0)	1(1)	4(+)	(0)	(0)	+(1)	1(1)	(0)	(0)
Calamagrostis canadensis	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)
Calamagrostis rubescens	(0)	(0)	(0)	(0)	(0)	(0)	+(6)	2(20)	(0)	4(1)
Carex geyeri	(0)	(0)	10(54)	(0)	(0)	1(3)	4(8)	3(6)	(0)	3(21)
Carex rossii	1(+)	2(1)	4(1)	10(1)	5(1)	7(2)	+(+)	2(1)	1(+)	1(1)
Deschampsia cespitosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Elymus glaucus	(0)	(0)	1(+)	(0)	(0)	(0)	3(2)	4(6)	1(+)	6(16)
Festuca idahoensis	1(+)	(0)	5(1)	10(4)	8(19)	9(4)	+(+)	(0)	2(+)	(0)
Festuca ovina	(0)	(0)	3(+)	(0)	2(1)	1(9)	(0)	1(1)	(0)	(0)
Leucopoa kingii	7(4)	10(3)	1(1)	(0)	3(3)	1(4)	+(5)	2(1)	8(3)	+(+)
Luzula spicata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Poa fendleriana	1(6)	(0)	1(+)	9(3)	3(4)	5(4)	+(2)	1(+)	(0)	(0)
Poa nervosa	4(1)	2(1)	8(1)	(0)	3(6)	4(2)	4(2)	4(1)	4(4)	3(15)
Sitanion hystrix	3(1)	(0)	4(+)	5(+)	8(2)	5(1)	(0)	(0)	(0)	(0)
Trisetum spicatum	(0)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)	+(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX C-1 (con.)

	PINUS FLEXILIS SERIES		PINUS PONDEROSA SERIES				PSEUDOTSUGA MENZIESII SERIES			
	CELE h.t.	BERE h.t.	CAGE h.t.	FEID h.t. ARPA phase	FEID h.t. ARTR phase	FEID h.t. FEID phase	PHMA h.t.	ACGL h.t.	CELE h.t.	OSCH h.t.
Number of Stands	7	5	8	8	6	15	44	17	10	27
FORBS AND FERN ALLIES										
Achillea millefolium	4(1)	6(+)	8(1)	1(+)	7(1)	3(+)	2(+)	2(1)	7(+)	4(1)
Aconitum columbianum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Actaea rubra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(2)	(0)	1(6)
Antennaria microphylla	(0)	(0)	9(+)	8(1)	10(+)	7(+)	(0)	(0)	(0)	(0)
Antennaria parvifolia	(0)	(0)	1(+)	3(1)	(0)	1(1)	(0)	1(+)	(0)	(0)
Aquilegia coerulea	(0)	(0)	(0)	(0)	2(+)	(0)	(0)	1(3)	(0)	1(1)
Arnica cordifolia	(0)	(0)	1(+)	(0)	2(1)	(0)	8(17)	5(8)	4(3)	6(13)
Arnica latifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Aster engelmannii	1(1)	2(1)	(0)	(0)	(0)	(0)	4(2)	5(1)	3(2)	2(1)
Aster glaucodes	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	2(+)	(0)
Aster perelegans	1(+)	6(1)	(0)	(0)	(0)	(0)	+(2)	1(1)	3(1)	1(1)
Astragalus miser	(0)	(0)	(0)	(0)	3(1)	(0)	(0)	(0)	(0)	(0)
Balsamorhiza sagittata	9(2)	2(3)	3(+)	(0)	(0)	(0)	(0)	(0)	6(5)	(0)
Caltha leptosepala	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Castilleja linariaefolia	3(+)	6(+)	3(+)	4(+)	(0)	(0)	+(+)	1(+)	(0)	(0)
Castilleja miniata	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Delphinium occidentale	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)
Disporum trachycarpum	(0)	(0)	(0)	(0)	(0)	(0)	6(2)	6(1)	1(+)	4(1)
Epilobium angustifolium	(0)	(0)	(0)	1(+)	(0)	(0)	1(+)	2(+)	(0)	1(+)
Equisetum arvense	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron peregrinus	(0)	(0)	1(+)	4(1)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron speciosus	1(+)	2(+)	(0)	(0)	2(+)	2(+)	+(+)	2(+)	4(1)	+(+)
Fragaria vesca	(0)	(0)	(0)	(0)	(0)	(0)	5(3)	7(2)	1(1)	4(4)
Fragaria virginiana	(0)	(0)	3(+)	(0)	(0)	(0)	+(1)	1(+)	(0)	1(1)
Frasera speciosa	(0)	(0)	(0)	3(+)	(0)	(0)	1(+)	3(1)	1(+)	+(+)
Galium boreale	(0)	(0)	6(+)	(0)	2(+)	1(+)	(0)	1(+)	(0)	3(2)
Geranium richardsonii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)	(0)	(0)
Geranium viscosissimum	1(+)	4(1)	(0)	(0)	(0)	(0)	1(+)	2(+)	2(1)	4(1)
Haplopappus parryi	(0)	(0)	(0)	(0)	(0)	1(+)	(0)	1(+)	(0)	(0)
Hieracium albiflorum	(0)	(0)	1(+)	(0)	(0)	1(+)	+(1)	3(+)	(0)	1(1)
Hieracium gracile	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lathyrus lanszwertii	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	(0)	(0)	2(20)
Lathyrus pauciflorus	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	(0)	(0)	+(+)
Ligusticum filicinum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)
Lomatium nuttallii	4(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	4(1)	(0)
Lupinus argenteus	(0)	(0)	1(+)	(0)	2(+)	(0)	(0)	(0)	(0)	(0)
Mertensia ciliata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella pentandra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella stauropetala	(0)	(0)	(0)	(0)	(0)	(0)	7(2)	6(2)	(0)	6(+)
Osmorhiza chilensis	(0)	2(+)	(0)	(0)	(0)	(0)	5(2)	6(5)	2(1)	9(10)
Osmorhiza depauperata	(0)	(0)	1(+)	(0)	(0)	(0)	+(2)	1(1)	(0)	2(12)
Pedicularis racemosa	1(+)	(0)	(0)	(0)	(0)	(0)	+(+)	1(3)	(0)	(0)
Penstemon whippleanus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polemonium foliosissimum	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	1(+)	1(1)
Polemonium pulcherrimum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polygonum bistortoides	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Potentilla glandulosa	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	1(+)	(0)	+(1)
Potentilla gracilis	(0)	(0)	(2)	(0)	(0)	(0)	(0)	1(2)	(0)	(0)
Pyrola asarifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pyrola secunda	(0)	(0)	(0)	(0)	(0)	(0)	+(3)	2(1)	(0)	1(+)
Saxifraga odontoloma	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sedum lanceolatum	(0)	(0)	(0)	8(+)	3(+)	1(+)	+(1)	(0)	(0)	(0)
Senecio serra	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	2(+)	(0)	3(1)
Senecio streptanthifolius	3(+)	(0)	(0)	(0)	2(+)	(0)	+(+)	1(+)	2(+)	+(+)
Senecio triangularis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sibbaldia procumbens	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Silene menziesii	(0)	2(+)	(0)	(0)	(0)	(0)	4(2)	5(1)	1(1)	5(1)
Smilacina racemosa	(0)	2(+)	(0)	(0)	(0)	(0)	8(+)	9(3)	3(1)	6(3)
Smilacina stellata	(0)	2(1)	(0)	1(1)	(0)	(0)	+(2)	2(1)	(0)	1(10)
Solidago spathulata	(0)	(0)	(0)	3(+)	2(+)	1(+)	(0)	1(+)	(0)	(0)
Stellaria jamesiana	(0)	(0)	4(2)	(0)	3(1)	1(+)	5(1)	2(+)	6(4)	6(2)
Streptopus amplexifolius	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Thalictrum fendleri	3(2)	4(2)	1(+)	(0)	2(+)	(0)	2(2)	6(5)	3(1)	7(2)
Viola adunca	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	6(1)	1(+)	4(1)
Viola nuttallii	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)
Viola purpurea	(0)	4(+)	(0)	(0)	(0)	(0)	+(+)	(0)	4(+)	(0)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX C-1 (con.)

	PSEUDOTSUGA MENZIESII SERIES (cont.)					PICEA PUNGENS SERIES		ABIES CONCOLOR SERIES	
	BERE h.t.				SYOR h.t.	AGSP h.t.	BERE h.t.	PHMA h.t.	OBCH h.t.
	CAGE phase	JUCO phase	SYOR phase	BERE phase					
Number of Stands	13	11	11	39	7	7	9	8	5
TREES									
Abies concolor	1(1)	(0)	(0)	4(4)	(0)	(0)	(0)	10(50)	10(51)
Abies lasiocarpa	2(1)	2(1)	2(2)	(0)	(0)	1(+)	3(1)	1(1)	2(+)
Picea engelmannii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	2(1)
Picea pungens	(0)	(0)	(0)	+(+)	(0)	10(15)	10(34)	(0)	(0)
Pinus contorta	1(5)	4(22)	(0)	1(29)	1(16)	3(1)	4(46)	(0)	(0)
Pinus flexilis	(0)	2(6)	4(9)	1(4)	3(2)	6(4)	1(+)	(0)	(0)
Pinus ponderosa	2(26)	2(12)	(0)	1(17)	3(4)	6(9)	1(1)	(0)	(0)
Pseudotsuga menziesii	10(65)	10(48)	10(45)	10(69)	10(54)	10(28)	6(28)	10(33)	8(17)
Juniperus scopulorum	1(+)	2(+)	(0)	4(3)	3(2)	7(3)	1(+)	1(3)	(0)
Populus tremuloides	2(6)	5(26)	(0)	3(7)	4(5)	7(6)	9(18)	3(5)	2(47)
Acer grandidentatum	2(4)	(0)	(0)	3(22)	(0)	(0)	(0)	4(27)	4(10)
Quercus gambelii	2(11)	(0)	(0)	+(+)	(0)	(0)	(0)	3(12)	(0)
SHRUBS AND SUBSHRUBS									
Acer glabrum	2(2)	2(3)	(0)	3(1)	(0)	1(+)	4(2)	1(3)	4(13)
Amelanchier alnifolia	7(3)	7(1)	5(2)	7(4)	3(1)	4(1)	3(+)	9(14)	8(13)
Arctostaphylos patula	(0)	3(4)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)
Arctostaphylos uva-ursi	2(5)	2(3)	(0)	1(1)	(0)	(0)	1(10)	(0)	(0)
Artemisia tridentata	1(8)	3(1)	8(2)	1(1)	7(1)	6(+)	(0)	(0)	(0)
Berberis repens	10(5)	9(7)	5(4)	10(3)	(0)	10(3)	8(2)	10(2)	8(1)
Ceanothus velutinus	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Cercocarpus ledifolius	1(5)	(0)	2(3)	2(3)	(0)	(0)	(0)	1(+)	(0)
Cercocarpus montanus	(0)	(0)	(0)	(0)	1(1)	1(1)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	2(3)	(0)	2(1)	1(1)	3(2)	1(+)	(0)	3(2)	2(1)
Clematis columbiana	2(3)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)
Clematis pseudoalpina	(0)	1(3)	(0)	1(2)	(0)	(0)	(0)	(0)	(0)
Juniperus communis	4(2)	10(14)	(0)	2(2)	9(10)	10(15)	10(13)	(0)	(0)
Lonicera involucrata	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	1(1)	2(2)
Lonicera utahensis	1(+)	(0)	1(2)	(0)	(0)	(0)	(0)	(0)	2(1)
Pachistima myrsinites	5(6)	5(1)	8(2)	8(6)	(0)	7(2)	7(4)	9(17)	8(13)
Physocarpus malvaceus	2(4)	(0)	(0)	+(2)	(0)	(0)	(0)	10(39)	6(7)
Prunus virginiana	2(7)	(0)	4(+)	4(17)	1(2)	(0)	(0)	6(5)	6(5)
Purshia tridentata	1(+)	(0)	1(2)	+(15)	(0)	(0)	(0)	(0)	(0)
Ribes cereum	2(4)	2(1)	(0)	2(1)	4(2)	1(+)	(0)	(0)	(0)
Ribes montigenum	1(1)	2(1)	5(15)	(0)	1(2)	(0)	(0)	(0)	(0)
Ribes viscosissimum	3(+)	(0)	1(+)	+(1)	1(+)	(0)	1(+)	(0)	4(1)
Rosa nutkana	3(1)	(0)	3(1)	1(1)	3(+)	(0)	7(1)	1(+)	(0)
Rosa woodsii	3(1)	3(+)	(0)	5(1)	1(2)	1(+)	2(2)	4(2)	(0)
Rubus parviflorus	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	4(1)
Sambucus cerulea	2(+)	(0)	(0)	+(1)	(0)	(0)	(0)	1(+)	(0)
Sambucus racemosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)	(0)
Shepherdia canadensis	(0)	3(1)	(0)	+(+)	(0)	3(+)	6(+)	(0)	(0)
Sorbus scopulina	1(2)	(0)	(0)	1(3)	(0)	(0)	(0)	3(2)	2(5)
Symphoricarpos oreophilus	9(12)	9(8)	10(11)	9(3)	10(12)	10(2)	7(5)	10(4)	4(13)
Vaccinium caespitosum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Vaccinium globulare	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Vaccinium scoparium	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
GRAMINOIDS									
Agropyron spicatum	3(14)	2(1)	1(4)	1(2)	3(5)	10(4)	(0)	(0)	(0)
Agropyron trachycaulum	4(2)	3(2)	5(2)	3(+)	4(2)	1(1)	6(1)	(0)	2(1)
Bromus anomalus	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)
Bromus carinatus	2(1)	(0)	4(2)	2(1)	(0)	(0)	(0)	1(+)	2(1)
Bromus ciliatus	1(+)	5(1)	(0)	+(+)	1(+)	(0)	2(1)	1(+)	(0)
Calamagrostis canadensis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Calamagrostis rubescens	(0)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)
Carex geyeri	10(23)	1(4)	(0)	2(1)	1(25)	(0)	7(21)	6(14)	2(1)
Carex rossii	2(4)	8(1)	1(+)	3(1)	7(1)	7(1)	6(1)	4(3)	2(+)
Deschampsia cespitosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Elymus glaucus	2(2)	(0)	2(+)	3(1)	(0)	(0)	(0)	3(1)	6(2)
Festuca idahoensis	(0)	2(1)	(0)	1(1)	4(1)	1(+)	(0)	(0)	(0)
Festuca ovina	1(1)	2(+)	(0)	+(2)	1(1)	(0)	(0)	(0)	(0)
Leucopoa kingii	2(10)	2(+)	9(3)	3(1)	6(1)	(0)	(0)	(0)	(0)
Luzula spicata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Poa fendleriana	1(+)	5(1)	1(4)	2(1)	3(1)	3(+)	2(1)	(0)	(0)
Poa nervosa	5(6)	3(1)	6(6)	5(2)	4(1)	1(+)	2(1)	(0)	(0)
Sitanion hystrix	1(+)	2(1)	1(+)	1(+)	3(+)	(0)	1(+)	(0)	(0)
Trisetum spicatum	(0)	1(+)	(0)	(0)	(0)	3(+)	3(1)	(0)	2(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX C-1 (con.)

	PSEUDOTSUGA MENZIESII SERIES (cont.)					PICEA PUNGENS SERIES		ABIES CONCOLOR SERIES	
	BERE h.t.				SYOR h.t.	AGSP h.t.	BERE h.t.	PHMA h.t.	OBCH h.t.
	CAGE phase	JUCO phase	SYOR phase	BERE phase					
Number of Stands	13	11	11	39	7	7	9	8	5
FORBS AND FERN ALLIES									
Achillea millefolium	2(+)	4(1)	4(+)	2(+)	3(+)	3(+)	4(1)	3(+)	(0)
Aconitum columbianum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Actaea rubra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	2(+)
Antennaria microphylla	2(+)	3(1)	(0)	1(+)	6(+)	(0)	1(+)	(0)	(0)
Antennaria parvifolia	(0)	2(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Aquilegia caerulea	1(+)	2(+)	2(3)	1(+)	1(+)	(0)	6(1)	(0)	2(1)
Arnica cordifolia	2(2)	2(2)	(0)	6(7)	(0)	(0)	4(+)	1(+)	(0)
Arnica latifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Aster engelmannii	2(3)	(0)	4(2)	3(1)	(0)	(0)	(0)	6(1)	2(1)
Aster glaucodes	(0)	2(+)	1(2)	2(+)	(0)	(0)	1(+)	(0)	(0)
Aster perelegans	4(2)	(0)	3(1)	2(+)	(0)	(0)	(0)	(0)	(0)
Astragalus miser	1(10)	4(15)	(0)	1(2)	3(1)	(0)	4(9)	(0)	(0)
Balsamorhiza sagittata	1(3)	(0)	5(1)	1(+)	(0)	(0)	(0)	(0)	(0)
Caltha leptosepala	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Castilleja linariaefolia	1(+)	2(+)	1(+)	+(+)	3(+)	(0)	3(1)	1(+)	(0)
Castilleja miniata	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)
Delphinium occidentale	1(1)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	2(+)
Disporum trachycarpum	2(1)	(0)	(0)	3(1)	(0)	(0)	(0)	4(1)	2(+)
Epilobium angustifolium	2(+)	(0)	(0)	1(+)	(0)	(0)	(0)	1(1)	2(+)
Equisetum arvense	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron peregrinus	1(+)	(0)	1(1)	(0)	(0)	(0)	3(1)	(0)	(0)
Erigeron speciosus	1(+)	4(2)	3(3)	2(1)	(0)	(0)	(0)	1(+)	(0)
Fragaria vesca	3(1)	(0)	1(+)	4(1)	(0)	(0)	(0)	3(+)	2(+)
Fragaria virginiana	2(2)	4(1)	(0)	1(1)	3(1)	1(+)	4(1)	(0)	(0)
Frasera speciosa	2(1)	3(1)	1(+)	2(+)	(0)	4(1)	6(1)	(0)	(0)
Galium boreale	2(1)	5(1)	(0)	2(+)	1(+)	4(+)	8(1)	(0)	(0)
Geranium richardsonii	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	(0)	(0)
Geranium viscosissimum	(0)	(0)	2(1)	2(+)	1(1)	(0)	1(2)	1(2)	(0)
Haplopappus parryi	(0)	1(7)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hieracium albiflorum	(0)	(0)	(0)	+(+)	1(+)	(0)	1(+)	(0)	2(+)
Hieracium gracile	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lathyrus lanszwertii	1(2)	(0)	2(2)	+(2)	(0)	(0)	(0)	4(1)	2(1)
Lathyrus pauciflorus	1(+)	(0)	1(3)	(0)	(0)	(0)	(0)	1(+)	(0)
Ligusticum filicinum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lomatium nuttallii	(0)	(0)	4(2)	(0)	(0)	(0)	(0)	(0)	(0)
Lupinus argenteus	1(+)	2(1)	(0)	(0)	(0)	(0)	4(2)	(0)	(0)
Mertensia ciliata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella pentandra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella stauropetala	2(2)	(0)	2(1)	2(1)	(0)	(0)	(0)	8(1)	2(2)
Osmorhiza chilensis	1(1)	(0)	1(7)	5(1)	(0)	(0)	1(+)	8(1)	8(11)
Osmorhiza depauperata	(0)	(0)	(0)	1(1)	1(+)	(0)	2(+)	(0)	(0)
Pedicularis racemosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Penstemon whippleanus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polemonium foliosissimum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polemonium pulcherrimum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polygonum bistortoides	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Potentilla glandulosa	1(+)	(0)	2(1)	(0)	(0)	(0)	1(+)	3(+)	(0)
Potentilla gracilis	(0)	(0)	(0)	+(+)	(0)	(0)	2(+)	(0)	(0)
Pyrola asarifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pyrola secunda	(0)	2(+)	(0)	+(1)	(0)	(0)	4(1)	1(+)	2(1)
Saxifraga odontoloma	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sedum lanceolatum	(0)	2(+)	(0)	1(+)	1(+)	(0)	(0)	(0)	(0)
Senecio serra	(0)	(0)	1(1)	+(+)	(0)	(0)	(0)	(0)	(0)
Senecio streptanthifolius	(0)	2(1)	7(+)	1(+)	(0)	1(+)	2(1)	3(2)	2(1)
Senecio triangularis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sibbaldia procumbens	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Silene menziesii	1(+)	(0)	1(+)	4(1)	(0)	(0)	(0)	5(+)	2(+)
Smilacina racemosa	4(1)	(0)	2(+)	5(3)	(0)	(0)	(0)	6(1)	4(1)
Smilacina stellata	(0)	3(+)	(0)	1(1)	(0)	3(+)	3(1)	(0)	(0)
Solidago spathulata	(0)	4(1)	(0)	(0)	3(1)	(0)	1(2)	(0)	(0)
Stellaria jamesiana	5(3)	1(4)	8(2)	4(4)	1(+)	(0)	3(1)	1(+)	2(5)
Streptopus amplexifolius	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Thalictrum fendleri	6(1)	4(2)	3(1)	3(2)	4(1)	4(+)	8(1)	1(20)	2(1)
Viola adunca	2(1)	(0)	1(+)	4(2)	(0)	(0)	2(1)	(0)	4(1)
Viola nuttallii	1(+)	(0)	(0)	1(1)	(0)	(0)	(0)	1(+)	(0)
Viola purpurea	(0)	(0)	1(+)	1(1)	(0)	(0)	(0)	(0)	(0)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

	ABIES CONCOLOR SERIES (cont.)		PICEA ENGELMANNII SERIES				ABIES LASIOCARPA SERIES		
	BERE h.t.		EGAR h.t.	CALE h.t.	VACA h.t.	VASC h.t.	CACA h.t.	STAM h.t.	ACRU h.t.
	SYOR phase	BERE phase							
Number of Stands	8	13	6	5	14	17	5	3	11
TREES									
Abies concolor	10(42)	10(35)	(0)	(0)	(0)	(0)	(0)	(0)	1(9)
Abies lasiocarpa	(0)	2(1)	8(29)	6(6)	1(2)	2(1)	10(7)	10(29)	10(53)
Picea engelmannii	(0)	(0)	10(33)	10(43)	10(34)	10(32)	8(21)	10(63)	4(31)
Picea pungens	(0)	(0)	(0)	(0)	(0)	(0)	2(3)	(0)	1(4)
Pinus contorta	(0)	1(9)	5(14)	6(48)	6(53)	6(50)	10(29)	10(4)	(0)
Pinus flexilis	1(7)	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pinus ponderosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pseudotsuga menziesii	4(10)	9(45)	(0)	(0)	(0)	1(2)	(0)	(0)	6(40)
Juniperus scopulorum	4(1)	2(4)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Populus tremuloides	(0)	5(6)	2(+)	(0)	1(40)	(0)	4(41)	(0)	5(23)
Acer grandidentatum	4(28)	2(21)	(0)	(0)	(0)	(0)	(0)	(0)	5(5)
Quercus gambelii	5(12)	2(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SHRUBS AND SUBSHRUBS									
Acer glabrum	(0)	3(5)	(0)	(0)	(0)	(0)	(0)	(0)	5(5)
Amelanchier alnifolia	4(8)	6(3)	(0)	(0)	(0)	(0)	2(3)	(0)	5(4)
Arctostaphylos patula	(0)	1(4)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Arctostaphylos uva-ursi	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	(0)	(0)
Artemisia tridentata	1(+)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Berberis repens	9(15)	10(3)	(0)	(0)	(0)	(0)	2(2)	(0)	5(1)
Ceanothus velutinus	1(25)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Cercocarpus ledifolius	5(9)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Cercocarpus montanus	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Clematis columbiana	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	(0)	5(3)
Clematis pseudoalpina	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Juniperus communis	(0)	2(4)	3(+)	(0)	5(2)	5(5)	4(1)	(0)	(0)
Lonicera involucrata	(0)	(0)	8(2)	(0)	(0)	(0)	6(1)	3(2)	1(1)
Lonicera utahensis	(0)	2(1)	2(+)	(0)	(0)	(0)	(0)	3(+)	5(5)
Pachistima myrsinites	9(4)	7(7)	2(1)	(0)	1(1)	(0)	4(2)	3(+)	6(3)
Physocarpus malvaceus	1(8)	4(3)	(0)	(0)	(0)	(0)	(0)	(0)	4(13)
Prunus virginiana	6(12)	2(2)	(0)	(0)	(0)	(0)	(0)	(0)	5(4)
Purshia tridentata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Ribes cereum	3(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)
Ribes montigenum	(0)	(0)	2(15)	4(+)	6(1)	5(1)	4(2)	3(2)	3(13)
Ribes viscosissimum	(0)	2(1)	(0)	(0)	(0)	1(+)	(0)	(0)	2(3)
Rosa nutkana	3(1)	2(2)	(0)	(0)	1(+)	(0)	4(2)	3(+)	4(2)
Rosa woodsii	4(1)	4(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Rubus parviflorus	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	3(+)	4(1)
Sambucus cerulea	3(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sambucus racemosa	(0)	1(+)	2(15)	(0)	(0)	(0)	(0)	(0)	2(1)
Shepherdia canadensis	(0)	1(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sorbus scopulina	1(2)	(0)	(0)	(0)	(0)	(0)	(0)	3(+)	5(1)
Symphoricarpos oreophilus	9(20)	10(7)	(0)	(0)	(0)	(0)	2(+)	(0)	8(4)
Vaccinium caespitosum	(0)	(0)	3(3)	6(4)	10(8)	1(+)	6(1)	(0)	(0)
Vaccinium globulare	(0)	(0)	(0)	(0)	(0)	(0)	(0)	3(+)	(0)
Vaccinium scoparium	(0)	(0)	3(6)	8(34)	8(36)	10(39)	8(6)	10(13)	(0)
GRAMINOIDS									
Agropyron spicatum	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Agropyron trachycaulum	1(+)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Bromus anomalus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(2)
Bromus carinatus	5(1)	2(+)	(0)	(0)	(0)	(0)	(0)	(0)	3(2)
Bromus ciliatus	(0)	2(1)	7(1)	(0)	1(1)	1(1)	6(9)	3(3)	2(+)
Calamagrostis canadensis	(0)	(0)	8(16)	(0)	(0)	1(+)	10(41)	7(2)	(0)
Calamagrostis rubescens	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Carex geyeri	1(+)	5(11)	2(1)	(0)	2(2)	(0)	4(1)	3(1)	1(1)
Carex rossii	(0)	1(+)	(0)	4(1)	9(1)	8(2)	2(1)	10(1)	3(1)
Deschampsia cespitosa	(0)	(0)	2(2)	8(47)	2(22)	(0)	4(23)	(0)	(0)
Elymus glaucus	3(8)	1(2)	5(3)	(0)	(0)	(0)	6(4)	7(3)	3(3)
Festuca idahoensis	1(+)	(0)	(0)	(0)	1(+)	(0)	(0)	(0)	(0)
Festuca ovina	(0)	(0)	(0)	4(2)	4(2)	1(15)	(0)	(0)	(0)
Leucopoa kingii	3(+)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Luzula spicata	(0)	(0)	(0)	8(+)	4(1)	1(+)	2(+)	(0)	(0)
Poa fendleriana	1(+)	(0)	(0)	(0)	1(+)	(0)	(0)	(0)	(0)
Poa nervosa	1(+)	1(1)	(0)	6(1)	6(1)	8(1)	6(1)	7(1)	(0)
Sitanion hystrix	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Trisetum spicatum	(0)	(0)	3(+)	10(1)	7(2)	6(+)	10(1)	7(+)	(0)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

	ABIES CONCOLOR SERIES (cont.)		PICEA ENGELMANNII SERIES				ABIES LASIOCARPA SERIES		
	BERE h.t.		EGAR h.t.	CALE h.t.	VACA h.t.	VASC h.t.	CACA h.t.	STAM h.t.	ACRU h.t.
	SYOR phase	BERE phase							
Number of Stands	8	13	6	5	14	17	5	3	11
FORBS AND FERN ALLIES									
Achillea millefolium	3(+)	2(+)	3(2)	6(6)	7(1)	7(+)	6(1)	7(+)	(0)
Aconitum columbianum	(0)	(0)	7(7)	(0)	(0)	(0)	4(1)	3(+)	(0)
Actaea rubra	(0)	(0)	(0)	(0)	(0)	(0)	2(1)	3(1)	10(12)
Antennaria microphylla	(0)	(0)	(0)	10(6)	6(+)	2(3)	(0)	(0)	(0)
Antennaria parvifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Aquilegia caerulea	(0)	1(+)	2(2)	(0)	1(+)	2(+)	2(1)	7(+)	5(3)
Arnica cordifolia	(0)	2(2)	3(1)	2(15)	4(2)	6(1)	10(1)	7(2)	6(5)
Arnica latifolia	(0)	(0)	2(3)	4(1)	1(1)	2(1)	(0)	7(12)	(0)
Aster engelmannii	4(1)	4(2)	3(19)	(0)	1(+)	(0)	(0)	3(+)	5(4)
Aster glaucodes	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Aster perelegans	3(+)	2(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Astragalus miser	(0)	(0)	(0)	(0)	(0)	1(1)	(0)	(0)	(0)
Balsamorhiza sagittata	4(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Caltha leptosepala	(0)	(0)	2(50)	10(5)	(0)	(0)	4(23)	3(25)	(0)
Castilleja linariaefolia	(0)	1(+)	2(+)	(0)	1(+)	(0)	(0)	(0)	(0)
Castilleja miniata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	3(+)	(0)
Delphinium occidentale	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)
Disporum trachycarpum	(0)	2(2)	(0)	(0)	(0)	(0)	2(+)	(0)	5(1)
Epilobium angustifolium	(0)	(0)	7(1)	(0)	4(+)	2(+)	2(+)	10(+)	2(2)
Equisetum arvense	(0)	(0)	10(34)	(0)	(0)	(0)	4(1)	3(+)	(0)
Erigeron peregrinus	(0)	(0)	5(4)	8(6)	6(1)	6(1)	8(4)	10(2)	1(+)
Erigeron speciosus	5(2)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Fragaria vesca	(0)	2(1)	(0)	(0)	(0)	(0)	2(1)	(0)	5(2)
Fragaria virginiana	(0)	(0)	7(1)	2(1)	4(1)	2(+)	10(1)	3(2)	1(+)
Frasera speciosa	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	2(+)
Galium boreale	1(+)	2(+)	2(1)	(0)	3(1)	(0)	10(2)	3(3)	1(10)
Geranium richardsonii	(0)	(0)	8(8)	(0)	3(+)	1(+)	8(4)	3(+)	(0)
Geranium viscosissimum	1(+)	1(+)	2(10)	2(3)	1(+)	1(10)	(0)	(0)	2(+)
Haplopappus parryi	(0)	(0)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)
Hieracium albiflorum	(0)	(0)	2(+)	(0)	(0)	(0)	(0)	(0)	1(+)
Hieracium gracile	(0)	(0)	(0)	2(1)	1(1)	1(+)	(0)	3(+)	(0)
Lathyrus lanszwertii	3(+)	2(3)	3(5)	(0)	(0)	(0)	(0)	(0)	5(6)
Lathyrus pauciflorus	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)
Ligusticum filicinum	(0)	(0)	2(1)	(0)	(0)	(0)	2(+)	7(+)	(0)
Lomatium nuttallii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lupinus argenteus	(0)	(0)	(0)	(0)	2(2)	2(1)	(0)	(0)	(0)
Mertensia ciliata	(0)	1(+)	2(+)	2(+)	(0)	(0)	4(+)	10(7)	(0)
Mitella pentandra	(0)	(0)	5(2)	(0)	(0)	(0)	(0)	7(2)	(0)
Mitella stauropetala	(0)	2(1)	2(5)	(0)	(0)	(0)	(0)	3(3)	8(5)
Osmorhiza chilensis	5(3)	5(1)	(0)	(0)	(0)	(0)	2(8)	3(2)	7(4)
Osmorhiza depauperata	(0)	(0)	5(5)	2(2)	1(1)	1(+)	8(2)	7(5)	3(11)
Pedicularis racemosa	(0)	(0)	2(+)	4(1)	1(1)	1(+)	(0)	3(1)	3(5)
Penstemon whippleanus	(0)	(0)	(0)	(0)	(0)	2(+)	(0)	(0)	(0)
Polemonium foliosissimum	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	4(+)
Polemonium pulcherrimum	(0)	(0)	(0)	(0)	1(+)	2(+)	2(2)	3(+)	(0)
Polygonum bistortoides	(0)	(0)	2(+)	10(2)	4(2)	1(1)	4(2)	(0)	(0)
Potentilla glandulosa	(0)	1(+)	(0)	(0)	1(+)	1(+)	(0)	(0)	1(+)
Potentilla gracilis	(0)	(0)	(0)	6(1)	(0)	2(+)	6(+)	(0)	(0)
Pyrola asarifolia	(0)	(0)	7(10)	(0)	(0)	(0)	4(8)	3(2)	(0)
Pyrola secunda	(0)	1(+)	5(2)	(0)	1(+)	1(+)	4(3)	7(1)	5(3)
Saxifraga odontoloma	(0)	(0)	3(6)	(0)	(0)	(0)	(0)	7(1)	(0)
Sedum lanceolatum	1(+)	2(+)	(0)	(0)	4(+)	4(+)	(0)	(0)	(0)
Senecio serra	1(+)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	3(1)
Senecio streptanthifolius	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Senecio triangularis	(0)	(0)	7(8)	(0)	(0)	(0)	4(1)	10(11)	(0)
Sibbaldia procumbens	(0)	(0)	(0)	8(3)	4(4)	4(1)	(0)	(0)	(0)
Silene menziesii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	4(1)
Smilacina racemosa	5(+)	3(+)	(0)	(0)	(0)	(0)	(0)	(0)	3(1)
Smilacina stellata	(0)	1(1)	8(2)	(0)	(0)	(0)	4(1)	3(2)	3(1)
Solidago spathulata	(0)	(0)	(0)	(0)	3(+)	1(2)	(0)	(0)	(0)
Stellaria jamesiana	6(2)	6(1)	(0)	6(+)	1(+)	(0)	4(+)	(0)	4(1)
Streptopus amplexifolius	(0)	(0)	5(1)	(0)	(0)	(0)	2(6)	10(5)	(0)
Thalictrum fendleri	5(2)	5(1)	5(1)	(0)	(0)	(0)	4(2)	3(1)	8(3)
Viola adunca	1(+)	4(+)	2(+)	(0)	1(+)	(0)	4(+)	(0)	4(1)
Viola nuttallii	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Viola purpurea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX C-1 (con.)

	ABIES LASIOCARPA SERIES (cont.)									
	PHMA h.t.	ACGL h.t.	VACA h.t.	VAGL h.t.	VASC h.t.			CARU h.t.	PERA h.t.	
					ARLA phase	CAGE phase	VASC phase		PSME phase	PERA phase
Number of Stands	10	22	12	28	28	9	47	17	32	34
TREES										
Abies concolor	2(19)	+(5)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Abies lasiocarpa	10(32)	10(38)	10(22)	10(29)	10(45)	10(38)	10(18)	9(14)	10(34)	10(34)
Picea engelmannii	5(20)	2(13)	8(30)	8(43)	10(35)	9(19)	9(36)	1(1)	6(25)	6(28)
Picea pungens	(0)	(0)	(0)	+(1)	(0)	(0)	(0)	(0)	(0)	(0)
Pinus contorta	1(+)	1(31)	8(47)	4(34)	6(19)	10(33)	8(45)	9(56)	4(27)	7(47)
Pinus flexilis	(0)	+(3)	(0)	+(5)	(0)	(0)	(0)	(0)	(0)	(0)
Pinus ponderosa	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pseudotsuga menziesii	9(47)	8(34)	2(6)	4(10)	(0)	(0)	+(5)	5(33)	10(26)	(0)
Juniperus scopulorum	(0)	(0)	(0)	+(2)	(0)	(0)	(0)	(0)	(0)	(0)
Populus tremuloides	3(4)	3(23)	3(10)	1(21)	(0)	1(+)	1(3)	6(6)	4(21)	3(7)
Acer grandidentatum	2(2)	3(3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Quercus gambelii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SHRUBS AND SUBSHRUBS										
Acer glabrum	4(12)	6(17)	1(1)	(0)	(0)	(0)	(0)	1(+)	+(1)	(0)
Amelanchier alnifolia	10(12)	7(4)	2(+)	3(3)	(0)	1(+)	(0)	6(3)	5(2)	3(1)
Arctostaphylos patula	(0)	(0)	(0)	+(2)	(0)	(0)	(0)	(0)	(0)	(0)
Arctostaphylos uva-ursi	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Artemisia tridentata	(0)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)
Berberis repens	8(2)	7(2)	2(1)	2(4)	+(2)	2(+)	1(1)	6(1)	6(2)	1(1)
Ceanothus velutinus	1(10)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(12)	+(4)
Cercocarpus ledifolius	1(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Cercocarpus montanus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Clematis columbiana	5(12)	1(3)	(0)	(0)	(0)	(0)	(0)	(0)	1(3)	(0)
Clematis pseudoalpina	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)
Juniperus communis	(0)	1(3)	8(3)	+(15)	2(1)	3(6)	4(6)	3(1)	(0)	(0)
Lonicera involucrata	3(+)	1(1)	2(+)	2(2)	1(1)	(0)	(0)	1(+)	2(2)	+(+)
Lonicera utahensis	5(5)	3(4)	1(2)	3(2)	1(1)	(0)	+(+)	1(5)	3(1)	2(1)
Pachistima myrsinites	10(13)	9(8)	5(1)	8(2)	5(2)	8(3)	3(1)	8(2)	9(4)	8(2)
Physocarpus malvaceus	10(40)	1(2)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)
Prunus virginiana	2(1)	3(4)	(0)	(0)	(0)	(0)	(0)	1(+)	1(7)	+(1)
Purshia tridentata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Ribes cereum	(0)	+(10)	(0)	(0)	(0)	(0)	(0)	1(+)	(0)	(0)
Ribes montigenum	(0)	+(+)	5(5)	4(3)	6(2)	1(1)	4(2)	(0)	(0)	(0)
Ribes viscosissimum	2(6)	3(1)	(0)	3(1)	+(+)	(0)	+(+)	1(+)	4(1)	2(+)
Rosa nutkana	8(1)	5(2)	3(+)	2(1)	1(1)	2(+)	2(1)	7(1)	6(1)	3(1)
Rosa woodsii	(0)	3(1)	(0)	(0)	(0)	(0)	+(+)	1(+)	2(+)	(0)
Rubus parviflorus	5(6)	4(22)	2(+)	4(1)	+(1)	3(+)	(0)	1(1)	3(4)	+(+)
Sambucus cerulea	(0)	+(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sambucus racemosa	(0)	1(1)	1(+)	1(1)	1(+)	(0)	+(1)	(0)	1(+)	1(31)
Shepherdia canadensis	2(8)	1(1)	2(2)	4(5)	+(+)	(0)	1(1)	2(+)	2(6)	2(3)
Sorbus scopulina	6(12)	8(13)	(0)	6(1)	+(+)	(0)	(0)	1(2)	4(1)	1(1)
Symphoricarpos oreophilus	8(5)	6(4)	2(1)	1(10)	(0)	1(+)	(0)	4(1)	8(3)	3(+)
Vaccinium caespitosum	(0)	(0)	9(3)	(0)	+(+)	1(+)	+(+)	1(+)	(0)	(0)
Vaccinium globulare	(0)	(0)	1(2)	10(42)	+(1)	(0)	(0)	(0)	1(+)	1(2)
Vaccinium scoparium	(0)	(0)	7(18)	1(5)	10(48)	10(37)	10(37)	1(+)	1(+)	+(2)
GRAMINOIDS										
Agropyron spicatum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Agropyron trachycaulum	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	2(2)	1(+)	1(1)
Bromus anomalus	(0)	1(1)	1(2)	(0)	(0)	(0)	(0)	(0)	+(1)	(0)
Bromus carinatus	1(+)	2(2)	(0)	+(+)	(0)	(0)	+(+)	1(2)	3(1)	1(+)
Bromus ciliatus	3(+)	1(2)	5(2)	1(+)	3(1)	3(1)	1(1)	3(+)	1(1)	1(+)
Calamagrostis canadensis	(0)	(0)	2(+)	(0)	+(1)	(0)	+(+)	(0)	(0)	(0)
Calamagrostis rubescens	(0)	1(23)	(0)	+(+)	(0)	1(25)	(0)	10(33)	+(2)	+(+)
Carex geyeri	3(3)	2(3)	2(23)	1(7)	3(6)	10(20)	1(1)	5(4)	2(8)	+(1)
Carex rossii	(0)	4(2)	7(1)	7(1)	8(1)	7(1)	9(2)	5(1)	6(1)	10(2)
Deschampsia cespitosa	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Elymus glaucus	(0)	3(1)	1(3)	2(2)	3(1)	6(+)	+(+)	2(2)	3(1)	1(+)
Festuca idahoensis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Festuca ovina	(0)	(0)	3(1)	(0)	(0)	(0)	3(1)	(0)	(0)	(0)
Leucopoa kingii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(1)	(0)
Luzula spicata	(0)	(0)	(0)	(0)	1(+)	(0)	1(+)	(0)	(0)	(0)
Poa fendleriana	(0)	(0)	1(+)	(0)	1(1)	1(+)	1(1)	(0)	(0)	(0)
Poa nervosa	1(1)	1(1)	5(1)	2(1)	6(1)	9(2)	6(1)	6(+)	3(2)	4(1)
Sitanion hystrix	(0)	(0)	1(+)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)
Trisetum spicatum	(0)	1(+)	8(1)	1(+)	7(+)	7(1)	5(1)	1(+)	2(+)	2(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX C-1 (con.)

	ABIES LASIOCARPA SERIES (cont.)									
	PHMA h.t.	ACGL h.t.	VACA h.t.	VAGL h.t.	VASC h.t.			CARU h.t.	PERA h.t.	
					ARLA phase	CAGE phase	VASC phase		PSME phase	PERA phase
Number of Stands	10	22	12	28	28	9	47	17	32	34
FORBS AND FERN ALLIES										
Achillea millefolium	1(+)	+(+)	5(3)	2(1)	5(1)	4(4)	5(2)	2(+)	2(1)	4(2)
Aconitum columbianum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Actaea rubra	4(1)	1(1)	(0)	+(+)	(0)	(0)	(0)	(0)	1(1)	(0)
Antennaria microphylla	(0)	+(+)	3(+)	1(1)	3(1)	7(1)	3(1)	1(1)	+(+)	+(+)
Antennaria parvifolia	(0)	+(+)	(0)	(0)	(0)	(0)	1(2)	(0)	(0)	(0)
Aquilegia coerulea	4(1)	5(+)	3(1)	6(1)	1(+)	2(1)	1(1)	1(+)	5(1)	3(1)
Arnica cordifolia	5(4)	7(4)	5(5)	7(3)	6(4)	9(3)	8(3)	9(4)	9(5)	6(4)
Arnica latifolia	(0)	1(2)	3(6)	6(16)	10(9)	2(+)	1(+)	(0)	1(4)	1(9)
Aster engelmannii	8(1)	7(1)	1(2)	6(2)	4(1)	4(1)	+(+)	2(+)	8(2)	6(2)
Aster glaucodes	1(+)	+(+)	1(+)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)
Aster perelegans	(0)	+(+)	(0)	+(15)	(0)	(0)	(0)	1(+)	(0)	(0)
Astragalus miser	(0)	(0)	(0)	(0)	(0)	1(+)	+(+)	1(+)	(0)	(0)
Balsamorhiza sagittata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)
Caltha leptosepala	(0)	(0)	(0)	(0)	1(+)	(0)	+(2)	(0)	(0)	(0)
Castilleja linariaefolia	(0)	(0)	1(+)	+(+)	1(+)	(0)	(0)	1(+)	+(+)	+(+)
Castilleja miniata	(0)	(0)	(0)	(0)	1(+)	(0)	+(+)	(0)	(0)	(0)
Delphinium occidentale	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Disporum trachycarpum	4(+)	4(1)	(0)	+(+)	(0)	(0)	(0)	1(1)	+(+)	(0)
Epilobium angustifolium	3(1)	1(+)	6(1)	3(1)	6(1)	6(1)	4(1)	1(+)	2(1)	1(1)
Equisetum arvense	(0)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron peregrinus	(0)	(0)	3(2)	4(1)	6(2)	1(+)	2(1)	2(1)	1(+)	2(1)
Erigeron speciosus	(0)	(0)	1(+)	1(1)	1(2)	1(2)	(0)	(0)	1(2)	(0)
Fragaria vesca	8(1)	5(1)	(0)	3(1)	(0)	2(2)	(0)	3(1)	4(2)	3(+)
Fragaria virginiana	(0)	+(+)	6(2)	+(4)	3(1)	1(+)	5(1)	3(+)	2(1)	1(1)
Frasera speciosa	2(+)	1(+)	(0)	1(+)	(0)	(0)	(0)	1(+)	1(+)	1(1)
Galium boreale	(0)	+(1)	4(1)	1(8)	+(1)	3(5)	1(4)	3(+)	+(+)	+(5)
Geranium richardsonii	(0)	2(+)	3(6)	1(+)	2(1)	1(15)	2(1)	2(1)	1(1)	1(+)
Geranium viscosissimum	3(1)	1(+)	3(1)	3(+)	1(3)	2(+)	1(1)	2(+)	4(+)	5(1)
Haplopappus parryi	(0)	(0)	(0)	(0)	+(5)	(0)	2(2)	(0)	(0)	(0)
Hieracium albiflorum	1(+)	3(+)	2(+)	3(1)	1(1)	3(1)	1(1)	7(1)	3(1)	4(2)
Hieracium gracile	(0)	(0)	(0)	(0)	4(1)	3(+)	2(1)	(0)	(0)	(0)
Lathyrus lanszwertii	2(1)	1(4)	2(1)	+(+)	+(+)	2(19)	+(4)	(0)	2(19)	3(21)
Lathyrus pauciflorus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(1)	+(1)
Ligusticum filicinum	(0)	(0)	1(2)	3(1)	3(1)	(0)	(0)	(0)	1(1)	1(3)
Lomatium nuttallii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lupinus argenteus	(0)	(0)	4(1)	(0)	1(2)	(0)	2(2)	(0)	(0)	(0)
Mertensia ciliata	1(+)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)
Mitella pentandra	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Mitella stauropetala	9(3)	7(1)	2(2)	4(1)	1(1)	1(+)	(0)	2(+)	3(1)	1(1)
Osmorhiza chilensis	7(1)	8(7)	1(+)	5(2)	1(1)	(0)	(0)	4(1)	7(2)	6(1)
Osmorhiza depauperata	1(1)	1(4)	3(6)	5(3)	4(2)	3(6)	1(1)	6(1)	2(3)	4(2)
Pedicularis racemosa	1(1)	3(1)	3(2)	9(7)	8(4)	7(2)	2(3)	1(5)	10(4)	10(6)
Penstemon whippleanus	(0)	(0)	(0)	+(+)	2(+)	1(+)	1(+)	(0)	(0)	(0)
Polemonium foliosissimum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)
Polemonium pulcherrimum	(0)	(0)	1(+)	(0)	1(2)	(0)	2(1)	(0)	(0)	(0)
Polygonum bistortoides	(0)	(0)	2(1)	(0)	1(+)	(0)	2(1)	(0)	(0)	+(2)
Potentilla glandulosa	(0)	+(+)	(0)	1(1)	+(+)	(0)	(0)	(0)	1(1)	2(+)
Potentilla gracilis	(0)	(0)	4(1)	+(+)	+(+)	2(1)	1(+)	1(1)	+(+)	1(1)
Pyrola asarifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pyrola secunda	8(1)	6(2)	7(4)	9(1)	5(2)	3(2)	2(1)	4(1)	7(1)	5(1)
Saxifraga odontoloma	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sedum lanceolatum	(0)	(0)	(0)	(0)	1(+)	2(1)	1(1)	(0)	(0)	+(+)
Senecio serra	(0)	2(+)	(0)	(0)	(0)	(0)	(0)	1(+)	1(+)	+(+)
Senecio streptanthifolius	(0)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	1(+)
Senecio triangularis	(0)	(0)	(0)	(0)	+(1)	(0)	(0)	(0)	(0)	(0)
Sibbaldia procumbens	(0)	(0)	1(15)	(0)	+(+)	1(+)	1(1)	(0)	(0)	(0)
Silene menziesii	1(+)	5(1)	(0)	1(1)	(0)	(0)	(0)	2(2)	2(+)	1(1)
Smilacina racemosa	3(1)	4(+)	1(+)	(0)	(0)	(0)	+(+)	(0)	1(2)	(0)
Smilacina stellata	1(+)	1(1)	(0)	+(2)	(0)	(0)	(0)	1(+)	(0)	+(2)
Solidago spathulata	(0)	(0)	1(2)	(0)	1(+)	(0)	2(1)	1(+)	(0)	(0)
Stellaria jamesiana	(0)	3(1)	4(1)	3(3)	3(1)	9(1)	3(1)	4(1)	5(2)	6(2)
Streptopus amplexifolius	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Thalictrum fendleri	7(1)	8(4)	3(1)	5(1)	+(2)	1(2)	(0)	5(+)	7(4)	3(1)
Viola adunca	7(1)	3(+)	2(1)	1(1)	+(+)	2(+)	+(+)	5(1)	3(1)	2(1)
Viola nuttallii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	1(1)
Viola purpurea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

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	ABIES LASIOCARPA SERIES (cont.)									
	DERE h.t.						RIMO h.t.			
	PIFL phase	RIMO phase	CAGE phase	JUCO phase	PSME phase	DERE phase	TRSP phase	PICO phase	THFE phase	RIMO phase
Number of Stands	19	58	17	15	73	32	18	8	29	22
TREES										
Abies concolor	(0)	(0)	(0)	(0)	1(43)	+(17)	(0)	(0)	(0)	(0)
Abies lasiocarpa	10(17)	10(42)	9(36)	9(27)	10(34)	10(35)	9(25)	9(9)	10(56)	10(34)
Picea engelmannii	4(10)	8(35)	3(30)	3(5)	3(20)	5(25)	8(25)	10(22)	7(38)	7(32)
Picea pungens	(0)	+(13)	1(41)	3(33)	+(39)	(0)	(0)	(0)	(0)	(0)
Pinus contorta	2(8)	2(14)	6(34)	9(39)	3(40)	7(40)	1(4)	10(17)	+(24)	(0)
Pinus flexilis	10(19)	1(3)	1(2)	1(2)	1(2)	(0)	(0)	(0)	1(2)	+(3)
Pinus ponderosa	(0)	(0)	1(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pseudotsuga menziesii	8(34)	4(41)	5(31)	5(19)	10(31)	(0)	(0)	(0)	2(8)	2(35)
Juniperus scopulorum	(0)	(0)	1(3)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Populus tremuloides	1(3)	3(10)	10(18)	8(18)	6(15)	8(20)	1(1)	3(44)	3(28)	1(3)
Acer grandidentatum	1(5)	(0)	1(1)	(0)	1(21)	(0)	(0)	(0)	(0)	(0)
Quercus gambelii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SHRUBS AND SUBSHRUBS										
Acer glabrum	(0)	1(1)	(0)	1(2)	+(1)	+(2)	(0)	(0)	(0)	(0)
Amelanchier alnifolia	3(2)	1(1)	4(2)	2(1)	5(5)	4(3)	(0)	(0)	(0)	1(+)
Arctostaphylos patula	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Arctostaphylos uva-ursi	(0)	(0)	1(+)	3(1)	(0)	+(+)	(0)	(0)	(0)	(0)
Artemisia tridentata	3(1)	1(2)	1(1)	1(+)	+(1)	1(1)	(0)	(0)	(0)	+(+)
Berberis repens	5(3)	3(1)	8(4)	7(2)	7(3)	4(1)	(0)	(0)	(0)	(0)
Ceanothus velutinus	1(3)	+(+)	1(1)	(0)	+(1)	1(+)	(0)	(0)	(0)	(0)
Cercocarpus ledifolius	1(3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Cercocarpus montanus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	(0)	(0)	(0)	1(+)	+(+)	+(1)	[illegible]	(0)	(0)	(0)
Clematis columbiana	(0)	(0)	1(+)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)
Clematis pseudoalpina	(0)	+(13)	(0)	1(2)	1(2)	1(+)	(0)	(0)	(0)	(0)
Juniperus communis	3(11)	1(7)	5(14)	10(14)	1(2)	1(2)	1(3)	4(2)	(0)	(0)
Lonicera involucrata	(0)	+(2)	(0)	1(1)	1(1)	(0)	(0)	(0)	1(1)	(0)
Lonicera utahensis	1(1)	4(2)	(0)	(0)	2(2)	1(1)	(0)	(0)	2(2)	1(3)
Pachistima myrsinites	8(5)	10(4)	7(4)	6(4)	9(9)	9(3)	(0)	(0)	(0)	(0)
Physocarpus malvaceus	(0)	(0)	(0)	(0)	+(1)	(0)	(0)	(0)	(0)	(0)
Prunus virginiana	2(14)	+(3)	2(15)	1(+)	2(7)	1(3)	(0)	(0)	(0)	(0)
Purshia tridentata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Ribes cereum	2(4)	+(5)	1(2)	1(+)	+(1)	(0)	(0)	(0)	(0)	(0)
Ribes montigenum	4(7)	9(6)	(0)	(0)	(0)	(0)	9(2)	10(1)	10(18)	10(11)
Ribes viscosissimum	1(+)	1(1)	(0)	2(+)	2(2)	1(1)	(0)	(0)	+(+)	+(+)
Rosa nutkana	4(1)	3(1)	7(2)	7(5)	5(1)	5(1)	(0)	(0)	(0)	1(1)
Rosa woodsii	2(1)	1(1)	1(+)	1(2)	1(1)	1(1)	(0)	(0)	(0)	(0)
Rubus parviflorus	1(+)	1(1)	(0)	1(+)	1(1)	1(+)	(0)	(0)	(0)	(0)
Sambucus cerulea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)
Sambucus racemosa	1(+)	2(2)	(0)	(0)	+(1)	1(10)	1(+)	(0)	5(4)	1(2)
Shepherdia canadensis	4(3)	1(3)	1(1)	4(5)	2(3)	1(2)	(0)	(0)	(0)	(0)
Sorbus scopulina	3(+)	1(1)	(0)	1(+)	2(1)	1(1)	(0)	(0)	2(+)	1(+)
Symphoricarpos oreophilus	9(7)	5(2)	7(5)	5(3)	8(5)	6(8)	(0)	(0)	4(+)	4(2)
Vaccinium caespitosum	(0)	(0)	(0)	1(+)	(0)	(0)	2(+)	1(+)	(0)	(0)
Vaccinium globulare	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(3)
Vaccinium scoparium	(0)	1(4)	(0)	1(2)	+(+)	1(2)	5(1)	3(1)	(0)	1(3)
GRAMINOIDS										
Agropyron spicatum	1(+)	(0)	(0)	(0)	+(4)	(0)	(0)	(0)	(0)	(0)
Agropyron trachycaulum	4(1)	1(6)	2(2)	3(1)	2(3)	2(3)	2(+)	1(5)	1(+)	+(+)
Bromus anomalus	1(1)	(0)	1(2)	(0)	+(7)	+(+)	(0)	(0)	(0)	(0)
Bromus carinatus	3(1)	2(1)	1(3)	(0)	2(1)	1(1)	(0)	(0)	3(2)	2(+)
Bromus ciliatus	(0)	1(3)	4(1)	6(1)	1(1)	1(1)	1(+)	3(+)	1(5)	(0)
Calamagrostis canadensis	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Calamagrostis rubescens	(0)	1(1)	1(1)	(0)	1(1)	+(+)	(0)	(0)	(0)	(0)
Carex geyeri	1(+)	2(6)	10(23)	4(1)	2(1)	3(1)	(0)	(0)	1(2)	1(1)
Carex rossii	3(+)	5(1)	1(2)	7(3)	5(1)	7(2)	6(1)	10(1)	4(3)	5(+)
Deschampsia cespitosa	(0)	(0)	(0)	1(+)	(0)	(0)	2(5)	(0)	(0)	(0)
Elymus glaucus	1(+)	1(2)	2(2)	1(+)	2(2)	2(4)	(0)	(0)	2(4)	(0)
Festuca idahoensis	(0)	(0)	(0)	(0)	+(+)	+(+)	(0)	(0)	+(+)	(0)
Festuca ovina	(0)	1(1)	(0)	3(1)	+(2)	(0)	6(1)	5(1)	(0)	+(+)
Leucopoa kingii	5(2)	1(4)	(0)	1(+)	+(+)	(0)	(0)	(0)	(0)	1(+)
Luzula spicata	(0)	(0)	(0)	(0)	(0)	(0)	3(+)	(0)	(0)	+(+)
Poa fendleriana	(0)	+(5)	1(3)	(0)	(0)	(0)	2(+)	(0)	(0)	(0)
Poa nervosa	4(1)	3(1)	4(3)	7(1)	2(1)	5(3)	7(2)	10(1)	2(7)	3(1)
Sitanion hystrix	1(+)	(0)	1(+)	1(2)	(0)	+(2)	1(+)	1(+)	(0)	(0)
Trisetum spicatum	1(+)	2(1)	2(1)	5(3)	1(1)	3(1)	10(1)	10(1)	1(1)	1(1)

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4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

	ABIES LASIOCARPA SERIES (cont.)									
	DERE h.t.						RIMO h.t.			
	PIFL phase	RIMO phase	CAGE phase	JUCO phase	PSME phase	DERE phase	TRSP phase	PICO phase	THFE phase	RIMO phase
Number of stands	19	58	17	15	73	32	18	8	29	22
FORBS AND FERN ALLIES										
Achillea millefolium	7(1)	3(3)	4(3)	7(2)	1(1)	4(1)	6(1)	9(1)	4(1)	4(1)
Aconitum columbianum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(10)	(0)
Actaea rubra	(0)	+(1)	(0)	(0)	+(1)	+(2)	(0)	(0)	+(4)	(0)
Antennaria microphylla	1(1)	+(+)	2(1)	5(1)	+(+)	1(+)	6(+)	8(+)	(0)	(0)
Antennaria parvifolia	(0)	+(+)	1(+)	2(1)	(0)	(0)	(0)	(0)	[illegible]	(0)
Aquilegia caerulea	3(+)	6(2)	6(3)	5(1)	4(2)	3(2)	4(1)	1(1)	6(3)	8(1)
Arnica cordifolia	4(3)	7(5)	6(5)	6(6)	6(5)	6(2)	2(+)	4(1)	3(3)	3(6)
Arnica latifolia	(0)	3(7)	(0)	(0)	(0)	(0)	3(1)	1(+)	1(5)	4(12)
Aster engelmannii	4(2)	4(4)	1(1)	(0)	5(1)	4(2)	(0)	(0)	5(3)	6(1)
Aster glaucodes	2(1)	+(+)	1(+)	1(+)	+(1)	(0)	(0)	(0)	(0)	(0)
Aster perelegans	2(1)	(0)	1(5)	(0)	1(1)	+(2)	(0)	(0)	(0)	(0)
Astragalus miser	1(+)	1(6)	4(2)	6(7)	+(1)	+(+)	(0)	(0)	(0)	(0)
Balsamorhiza sagittata	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Caltha leptosepala	(0)	+(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(+)
Castilleja linariaefolia	(0)	+(+)	(0)	1(5)	(0)	+(+)	(0)	(0)	(0)	1(1)
Castilleja miniata	1(+)	(0)	(0)	1(+)	+(+)	(0)	(0)	(0)	+(2)	(0)
Delphinium occidentale	(0)	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	1(+)	1(1)
Disporum trachycarpum	(0)	+(+)	1(+)	(0)	1(1)	+(+)	(0)	(0)	(0)	(0)
Epilobium angustifolium	1(+)	2(2)	2(+)	4(1)	1(1)	1(1)	1(+)	3(+)	2(1)	2(1)
Equisetum arvense	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron peregrinus	1(1)	2(1)	1(+)	4(2)	(0)	+(+)	3(1)	1(3)	1(2)	4(1)
Erigeron speciosus	4(1)	1(9)	2(1)	2(6)	1(1)	2(1)	(0)	(0)	1(1)	1(2)
Fragaria vesca	1(3)	2(2)	2(2)	(0)	3(2)	4(1)	(0)	1(+)	1(+)	(0)
Fragaria virginiana	(0)	1(1)	6(2)	3(2)	1(1)	1(1)	2(1)	8(1)	+(1)	(0)
Frasera speciosa	4(1)	2(1)	2(1)	4(1)	2(1)	1(1)	1(+)	(0)	1(1)	3(+)
Galium boreale	1(1)	1(1)	7(1)	5(4)	2(+)	2(+)	(0)	(0)	+(2)	1(+)
Geranium richardsonii	(0)	1(6)	2(1)	3(5)	+(+)	2(1)	(0)	1(3)	+(2)	+(+)
Geranium viscosissimum	6(1)	3(2)	3(1)	3(1)	3(1)	3(1)	(0)	1(1)	2(9)	3(1)
Haplopappus parryi	(0)	1(+)	1(1)	1(+)	+(1)	1(2)	1(+)	(0)	1(9)	(0)
Hieracium albiflorum	(0)	1(+)	2(+)	(0)	1(1)	4(1)	1(+)	(0)	+(+)	1(+)
Hieracium gracile	(0)	(0)	(0)	1(+)	(0)	(0)	1(+)	(0)	(0)	(0)
Lathyrus lanszwertii	2(3)	2(6)	2(12)	1(20)	2(7)	2(1)	(0)	(0)	4(17)	3(20)
Lathyrus pauciflorus	(0)	+(2)	1(2)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)
Ligusticum filicinum	1(2)	2(+)	(0)	(0)	+(+)	(0)	(0)	(0)	2(1)	4(+)
Lomatium nuttallii	4(7)	+(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)
Lupinus argenteus	1(1)	1(4)	1(+)	3(5)	+(1)	+(+)	1(2)	10(7)	1(1)	1(1)
Mertensia ciliata	1(+)	1(1)	(0)	(0)	+(+)	(0)	3(+)	(0)	3(4)	3(2)
Mitella pentandra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella stauropetala	1(+)	2(1)	2(2)	(0)	3(2)	1(1)	(0)	(0)	3(1)	2(2)
Osmorhiza chilensis	4(1)	4(1)	3(4)	1(1)	6(3)	3(1)	1(+)	1(+)	4(3)	6(6)
Osmorhiza depauperata	2(2)	3(7)	4(2)	2(1)	2(2)	4(1)	1(+)	3(+)	4(8)	3(2)
Pedicularis racemosa	3(3)	4(6)	(0)	1(+)	(0)	+(+)	2(1)	(0)	2(5)	5(4)
Penstemon whippleanus	1(+)	1(+)	(0)	1(+)	(0)	(0)	4(+)	1(+)	(0)	(0)
Polemonium foliosissimum	(0)	1(+)	1(+)	(0)	+(+)	+(2)	(0)	(0)	2(1)	+(+)
Polemonium pulcherrimum	(0)	(0)	(0)	(0)	+(15)	(0)	3(1)	(0)	1(4)	[illegible]
Polygonum bistortoides	(0)	+(1)	(0)	1(1)	(0)	(0)	1(+)	(0)	(0)	(0)
Potentilla glandulosa	1(+)	2(+)	(0)	1(+)	1(+)	(0)	(0)	(0)	2(1)	3(1)
Potentilla gracilis	(0)	+(+)	2(1)	4(1)	+(+)	+(2)	2(+)	8(+)	+(+)	+(+)
Pyrola asarifolia	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pyrola secunda	1(1)	6(2)	4(3)	5(3)	4(2)	5(1)	2(1)	1(+)	2(4)	3(1)
Saxifraga odontoloma	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	+(1)	(0)
Sedum lanceolatum	2(+)	(0)	(0)	1(+)	+(+)	1(+)	4(+)	6(+)	+(+)	(0)
Senecio serra	(0)	+(+)	1(1)	(0)	1(1)	2(1)	(0)	(0)	1(8)	1(1)
Senecio streptanthifolius	3(+)	2(+)	1(1)	1(+)	1(+)	1(1)	1(+)	(0)	1(+)	1(+)
Senecio triangularis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sibbaldia procumbens	(0)	(0)	(0)	(0)	(0)	(0)	5(+)	1(+)	(0)	(0)
Silene menziesii	2(1)	1(+)	1(2)	(0)	2(1)	1(1)	(0)	(0)	1(1)	(0)
Smilacina racemosa	1(+)	+(1)	1(2)	(0)	2(1)	(0)	(0)	(0)	1(+)	+(+)
Smilacina stellata	2(1)	+(1)	4(2)	3(+)	1(1)	+(+)	(0)	1(+)	(0)	(0)
Solidago spathulata	1(1)	1(1)	1(1)	4(1)	+(2)	2(+)	5(1)	8(1)	+(1)	+(2)
Stellaria jamesiana	6(1)	4(2)	5(2)	4(3)	5(1)	5(1)	2(1)	1(+)	7(2)	8(3)
Streptopus amplexifolius	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Thalictrum fendleri	6(5)	6(2)	7(7)	5(4)	7(2)	6(1)	(0)	(0)	10(4)	(0)
Viola adunca	1(1)	1(1)	5(1)	2(1)	4(1)	3(1)	(0)	(0)	2(4)	1(2)
Viola nuttallii	1(2)	1(1)	1(1)	(0)	1(+)	1(1)	(0)	(0)	2(3)	1(2)
Viola purpurea	1(2)	1(1)	(0)	(0)	+(1)	1(1)	(0)	(0)	(0)	+(2)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%,
4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

	ABIES LASIOCARPA SERIES (cont.)		PINUS CONTORTA SERIES						
	OSCH h.t.	JUCO h.t.	CACA c.t.	VACA c.t.	VASC c.t.	JUCO c.t.	ARUV h.t.	BERE c.t.	CARO h.t.
Number of Stands	12	12	9	29	18	14	24	20	8
TREES									
Abies concolor	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	(0)
Abies lasiocarpa	10(25)	8(12)	4(+)	2(1)	6(1)	4(1)	1(1)	3(+)	(0)
Picea engelmannii	2(8)	9(12)	3(1)	2(1)	4(1)	2(1)	(0)	(0)	(0)
Picea pungens	(0)	(0)	1(+)	+(1)	1(+)	(0)	(0)	(0)	(0)
Pinus contorta	(0)	10(30)	10(67)	10(67)	10(63)	10(69)	10(56)	10(61)	10(67)
Pinus flexilis	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)
Pinus ponderosa	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)
Pseudotsuga menziesii	(0)	1(30)	(0)	(0)	(0)	2(1)	+(+)	1(2)	(0)
Juniperus scopulorum	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	1(+)	(0)
Populus tremuloides	10(63)	6(6)	2(11)	3(8)	4(15)	6(5)	5(6)	6(7)	(0)
Acer grandidentatum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Quercus gambelii	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SHRUBS AND SUBSHRUBS									
Acer glabrum	(0)	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Amelanchier alnifolia	1(6)	2(1)	(0)	1(5)	1(+)	4(+)	1(+)	3(1)	(0)
Arctostaphylos patula	(0)	(0)	(0)	+(+)	(0)	4(8)	(0)	1(30)	(0)
Arctostaphylos uva-ursi	(0)	(0)	1(+)	3(4)	(0)	2(+)	10(6)	2(+)	(0)
Artemisia tridentata	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Berberis repens	(0)	(0)	(0)	3(2)	4(1)	7(1)	7(1)	9(1)	(0)
Ceanothus velutinus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(2)	(0)
Cercocarpus ledifolius	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Cercocarpus montanus	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Chrysothamnus viscidiflorus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Clematis columbiana	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Clematis pseudoalpina	(0)	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Juniperus communis	(0)	8(3)	6(1)	10(3)	7(1)	7(2)	8(4)	9(5)	6(1)
Lonicera involucrata	(0)	1(+)	(0)	1(1)	1(+)	(0)	(0)	(0)	(0)
Lonicera utahensis	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pachistima myrsinites	(0)	(0)	2(1)	3(5)	6(1)	4(+)	2(1)	4(+)	(0)
Physocarpus malvaceus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Prunus virginiana	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1(1)	(0)
Purshia tridentata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Ribes cereum	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)
Ribes montigenum	(0)	(0)	2(1)	1(3)	2(1)	(0)	+(+)	(0)	3(+)
Ribes viscosissimum	1(1)	(0)	(0)	1(+)	1(+)	2(+)	2(+)	1(+)	(0)
Rosa nutkana	1(+)	2(2)	6(1)	3(2)	3(1)	3(1)	3(1)	5(1)	3(1)
Rosa woodsii	(0)	(0)	(0)	1(1)	1(+)	1(+)	2(1)	2(+)	(0)
Rubus parviflorus	1(1)	(0)	(0)	+(50)	1(+)	1(+)	(0)	1(+)	(0)
Sambucus cerulea	(0)	(0)	(0)	(0)	(0)	(0)	+(+)	(0)	(0)
Sambucus racemosa	3(3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Shepherdia canadensis	(0)	1(30)	(0)	3(3)	3(1)	1(1)	3(+)	2(+)	(0)
Sorbus scopulina	1(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Symphoricarpos oreophilus	6(14)	1(+)	1(1)	1(+)	(0)	3(+)	1(+)	2(+)	(0)
Vaccinium caespitosum	(0)	3(+)	7(8)	10(7)	1(+)	(0)	1(+)	2(+)	3(+)
Vaccinium globulare	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Vaccinium scoparium	(0)	4(2)	6(1)	5(5)	10(35)	1(+)	+(+)	(0)	1(+)
GRAMINOIDS									
Agropyron spicatum	(0)	(0)	(0)	(0)	(0)	1(+)	(0)	(0)	(0)
Agropyron trachycaulum	3(5)	(0)	1(+)	+(+)	(0)	(0)	(0)	(0)	3(+)
Bromus anomalus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Bromus carinatus	7(6)	(0)	(0)	+(+)	(0)	(0)	(0)	1(+)	(0)
Bromus ciliatus	(0)	3(+)	2(6)	2(1)	2(+)	6(+)	+(1)	3(+)	(0)
Calamagrostis canadensis	(0)	(0)	10(32)	3(1)	1(+)	(0)	(0)	(0)	1(+)
Calamagrostis rubescens	(0)	(0)	(0)	(0)	1(70)	(0)	(0)	(0)	(0)
Carex geyeri	1(+)	(0)	1(+)	2(2)	3(2)	(0)	1(7)	7(19)	(0)
Carex rossii	3(1)	9(1)	3(1)	8(1)	6(1)	9(+)	7(1)	6(1)	10(+)
Deschampsia caespitosa	(0)	(0)	2(7)	1(5)	(0)	(0)	(0)	(0)	(0)
Elymus glaucus	6(7)	(0)	1(15)	2(12)	(0)	(0)	(0)	(0)	(0)
Festuca idahoensis	1(2)	1(+)	(0)	2(4)	(0)	3(1)	1(1)	(0)	(0)
Festuca ovina	(0)	3(1)	1(1)	3(+)	2(+)	1(1)	3(2)	1(+)	(0)
Leucopoa kingii	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Luzula spicata	(0)	(0)	2(+)	3(+)	1(+)	(0)	(0)	(0)	(0)
Poa fendleriana	(0)	(0)	(0)	+(+)	(0)	1(1)	1(1)	(0)	(0)
Poa nervosa	3(2)	9(2)	6(2)	8(2)	6(1)	4(1)	7(2)	9(1)	9(3)
Sitanion hystrix	(0)	3(+)	1(+)	2(1)	(0)	1(+)	2(+)	1(+)	4(+)
Trisetum spicatum	1(+)	9(1)	8(1)	8(1)	6(+)	2(+)	4(1)	5(1)	5(+)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

	ABIES LASIOCARPA SERIES (cont.)		PINUS CONTORTA SERIES						
	OSCH h.t.	JUCO h.t.	CACA c.t.	VACA c.t.	VASC c.t.	JUCO c.t.	ARUV h.t.	BERE c.t.	CARO h.t.
Number of Stands	12	12	9	29	18	14	24	20	8
FORBS AND FERN ALLIES									
Achillea millefolium	6(1)	3(1)	10(1)	6(1)	4(+)	1(1)	2(1)	5(+)	5(1)
Aconitum columbianum	(0)	(0)	(0)	+(2)	(0)	(0)	(0)	(0)	(0)
Actaea rubra	2(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Antennaria microphylla	(0)	8(+)	7(+)	7(1)	5(+)	3(+)	5(1)	7(1)	6(+)
Antennaria parvifolia	(0)	(0)	(0)	1(1)	(0)	(0)	1(+)	(0)	(0)
Aquilegia caerulea	5(1)	1(+)	1(+)	3(1)	1(+)	1(3)	1(2)	2(+)	(0)
Arnica cordifolia	3(1)	4(1)	7(3)	8(2)	8(2)	3(2)	5(3)	5(1)	9(1)
Arnica latifolia	(0)	(0)	(0)	(0)	(0)	1(+)	(0)	(0)	(0)
Aster engelmannii	6(3)	(0)	(0)	+(+)	(0)	(0)	(0)	1(+)	(0)
Aster glaucodes	(0)	(0)	(0)	+(+)	(0)	4(1)	2(1)	1(1)	(0)
Aster perelegans	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Astragalus miser	(0)	(0)	(0)	1(+)	(0)	(0)	5(3)	4(6)	5(11)
Balsamorhiza sagittata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Caltha leptosepala	(0)	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)
Castilleja linariaefolia	(0)	(0)	1(+)	1(1)	1(+)	(0)	1(+)	1(+)	(0)
Castilleja miniata	(0)	(0)	1(1)	+(+)	(0)	(0)	(0)	1(+)	(0)
Delphinium occidentale	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Disporum trachycarpum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Epilobium angustifolium	1(+)	5(+)	4(+)	5(+)	4(+)	4(+)	4(+)	3(+)	8(+)
Equisetum arvense	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Erigeron peregrinus	(0)	2(1)	4(2)	3(2)	1(2)	1(2)	(0)	3(1)	1(+)
Erigeron speciosus	2(2)	(0)	(0)	1(9)	(0)	(0)	(0)	1(+)	(0)
Fragaria vesca	3(1)	(0)	(0)	+(+)	(0)	(0)	+(+)	(0)	(0)
Fragaria virginiana	(0)	7(1)	10(3)	9(1)	5(1)	1(+)	2(+)	4(1)	8(+)
Frasera speciosa	1(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Galium boreale	(0)	(0)	8(1)	4(2)	2(1)	1(+)	1(1)	4(+)	1(+)
Geranium richardsonii	(0)	(0)	4(2)	3(4)	1(1)	1(1)	(0)	2(1)	1(+)
Geranium viscosissimum	3(2)	1(+)	4(1)	2(2)	2(+)	1(25)	2(1)	3(+)	3(+)
Haplopappus parryi	(0)	1(2)	(0)	+(2)	(0)	1(30)	(0)	(0)	(0)
Hieracium albiflorum	(0)	(0)	(0)	2(1)	3(+)	1(+)	2(+)	2(1)	(0)
Hieracium gracile	(0)	(0)	1(+)	1(+)	2(+)	(0)	(0)	(0)	(0)
Lathyrus lanszwertii	7(27)	(0)	(0)	1(1)	1(4)	(0)	+(2)	1(2)	(0)
Lathyrus pauciflorus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Ligusticum filicinum	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Lomatium nuttallii	1(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lupinus argenteus	(0)	6(2)	4(+)	2(1)	4(1)	3(5)	3(6)	4(3)	8(1)
Mertensia ciliata	(0)	(0)	1(1)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella pentandra	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mitella stauropetala	2(+)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Osmorhiza chilensis	9(5)	1(+)	2(+)	1(2)	2(+)	1(+)	(0)	1(+)	(0)
Osmorhiza depauperata	1(4)	(0)	3(+)	4(+)	2(+)	1(+)	+(+)	3(+)	1(+)
Pedicularis racemosa	(0)	(0)	1(+)	(0)	1(1)	(0)	(0)	(0)	(0)
Penstemon whippleanus	(0)	3(+)	1(+)	1(+)	1(+)	(0)	+(+)	(0)	(0)
Polemonium foliosissimum	2(2)	(0)	(0)	(C)	(0)	(0)	(0)	(0)	(0)
Polemonium pulcherrimum	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Polygonum bistortoides	(0)	1(+)	3(+)	2(1)	(0)	(0)	(0)	(0)	(0)
Potentilla glandulosa	1(1)	(0)	1(+)	+(+)	(0)	(0)	(0)	1(+)	(0)
Potentilla gracilis	(0)	3(+)	6(+)	3(+)	2(+)	(0)	+(1)	3(+)	5(+)
Pyrola asarifolia	(0)	(0)	(0)	+(3)	(0)	(0)	(0)	(0)	(0)
Pyrola secunda	(0)	2(3)	1(1)	3(1)	3(1)	1(+)	2(+)	3(+)	1(+)
Saxifraga odontoloma	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sedum lanceolatum	(0)	5(+)	(0)	3(+)	2(+)	1(+)	5(+)	2(+)	8(+)
Senecio serra	4(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Senecio streptanthifolius	(0)	(0)	(0)	+(+)	(0)	(0)	1(+)	2(+)	(0)
Senecio triangularis	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sibbaldia procumbens	(0)	(0)	2(3)	2(+)	1(+)	(0)	(0)	(0)	(0)
Silene menziesii	1(1)	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)
Smilacina racemosa	1(+)	(0)	(0)	1(+)	(0)	(0)	(0)	(0)	(0)
Smilacina stellata	(0)	(0)	(0)	1(1)	(0)	1(1)	(0)	1(+)	(0)
Solidago spathulata	(0)	6(1)	6(5)	3(1)	2(+)	1(+)	4(1)	2(2)	6(1)
Stellaria jamesiana	7(5)	1(2)	1(+)	3(1)	2(+)	1(+)	1(+)	5(1)	(0)
Streptopus amplexifolius	(0)	(0)	(0)	+(+)	(0)	(0)	(0)	(0)	(0)
Thalictrum fendleri	8(3)	1(+)	2(+)	2(1)	1(+)	(0)	1(+)	2(+)	3(+)
Viola adunca	(0)	(0)	3(1)	3(1)	1(+)	(0)	(0)	1(+)	1(+)
Viola nuttallii	3(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Viola purpurea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

(+) = COVER <0.5% CODE TO CONSTANCY VALUES: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%

APPENDIX D-1. GENERAL LANDFORM AND SOIL CHARACTERISTICS (upper 20 cm) OF NORTHERN UTAH HABITAT TYPES AND PHASES

	PIFL SERIES	PINUS PONDEROSA SERIES					PSEUDOTSUGA MENZIESII SERIES								
	CELE h.t.	BERE h.t.	CAGE h.t.	FEID h.t. ARPA phase	FEID h.t. ARTR phase	FEID h.t. FEID phase	PHMA h.t.	ACGL h.t.	CELE h.t.	OSCH h.t.	BERE h.t. CAGE phase	BERE h.t. JUCO phase	BERE h.t. SYOR phase	BERE h.t. BERE phase	SYOR h.t.
Number of Stands	7	5	8	8	6	15	44	17	10	27	13	11	11	39	7
COARSE FRAGMENT COMPOSITION (in percent occurrence)															
SEDIMENTARY															
Limestone, dolomite	43	20	--	--	--	--	23	24	57	37	23	27	18	29	29
Sandstone	--	--	--	--	--	7	2	12	--	4	--	--	--	--	--
Tufaceous sandstone 1/	--	--	12	--	--	--	--	--	--	--	--	9	--	--	--
Sandstone-mudstone 2/	--	--	--	38	17	33	5	--	--	--	15	27	--	--	14
Shale	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--
Conglomerate 3/	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mixed clacareous 4/	14	80	--	--	--	--	51	35	43	26	31	28	46	40	29
METAMORPHIC															
Quartzite	43	--	88	62	83	60	14	29	--	33	31	9	36	22	14
Quartzite-argillite	--	--	--	--	--	--	5	--	--	--	--	--	--	3	14
Schist-quartzite	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--
Schist-gneiss	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
IGNEOUS															
Granitoid rocks	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Andesitic pyroclastics	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Number of observations	7	5	8	8	6	15	43	17	7	27	13	11	11	37	7
REGOLITH (in percent occurrence)															
RESIDUAL ORDER 5/															
Mineral Class	--	--	100	38	100	93	--	--	--	--	33	36	100	34	71
Freeze-Thaw Class	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DEPOSITIONAL ORDER															
Colluvium Class	100	--	--	12	--	--	100	100	--	100	67	55	--	58	29
Alluvium Class	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--
Drift Class	--	--	--	50	--	7	--	--	--	--	--	--	--	8	--
Number of observations	1	0	8	8	6	15	2	2	0	1	9	11	1	12	7
GROUND SURFACE															
SURFACE ROCK EXPOSED (mean %)	13	13	0	20	5	50	3	6	9	0	11	7	11	5	12
BARE SOIL EXPOSED (mean %)	3	1	0	2	0	0	1	1	5	1	2	0	1	1	1
DUFF DEPTH (mean cm)	1.0	1.7	2.9	3.9	2.4	2.6	7.1	5.5	3.4	6.2	4.0	3.1	3.2	5.0	4.1
Number of observations 6/	4/7	5/5	3/8	6/8	4/6	3/15	44/44	17/17	10/10	25/27	11/12	8/11	10/11	33/39	3/7
UPPER SOIL (in percent occurrence)															
COARSE FRAGMENT PRESENCE															
None significantly noted	--	--	12	--	--	--	10	--	--	33	--	--	--	--	--
Gravelly (<3" in shape)	33	100	12	--	17	--	18	56	100	50	11	9	27	36	14
Cobbly (3-8" in shape)	--	--	-	--	17	--	--	11	--	--	11	--	--	9	--
Stony (>8" in shape)	33	--	13	--	--	--	62	22	--	17	11	--	46	14	--
Gravelly-cobbly	--	--	--	--	32	--	5	--	--	--	33	27	--	9	43
Gravelly-stony	--	--	--	--	17	7	--	--	--	--	--	9	9	5	14
Cobbly-stony	--	--	13	38	--	--	--	--	--	--	--	--	--	18	--
Gravelly-cobbly-stony	34	--	50	62	17	93	5	11	--	--	34	55	18	9	29
Number of observations	6	4	8	8	6	15	21	9	5	12	9	11	11	22	7
TEXTURAL CLASS															
Sand	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--
Loamy sand & sandy loam	14	40	75	75	67	60	2	24	20	7	15	18	--	16	29
Loam	72	--	12	25	33	40	24	18	20	30	54	46	27	14	29
Silt loam & silt	--	--	--	--	--	--	22	24	10	19	23	--	18	27	--
Silty clay loam & clay loam	14	60	12	--	--	--	52	34	40	44	8	36	55	43	42
Number of observations	7	5	8	8	6	15	42	17	10	27	13	11	11	37	7

(cont.)

1/ Browns Park formation of southern and eastern Uinta Mountains (= Tbp)
2/ Duschense River formation of southern Uinta Mountains (= Tdr)
3/ Wasatch and Knight conglomerates, comprised principally of quartziferous and shaly fragments (= Tw and Tk)
4/ Limestone and dolomite fragments in part, locally with others of sandstone, shale, quartzite, or argillite
5/ Adapted from DeGraff and others 1977
6/ Number of observations for exposed rock-soil and duff depth, respectively

	PIPU SERIES	ABIES CONCOLOR SERIES				PICEA ENGELMANNII SERIES				ABIES LASIOCARPA SERIES					
	ABSP h.t.	BERE h.t.	PHMA h.t.	OSCH h.t.	BERE h.t. SYOR phase	BERE h.t. BERE phase	EQAR h.t.	CALE h.t.	VACA h.t.	VASC h.t.	CACA h.t.	STAM h.t.	ACRU h.t.	PHMA h.t.	ACGL h.t.
Number of Stands	7	9	8	5	8	13	6	5	14	17	5	3	11	10	22
COARSE FRAGMENT COMPOSITION (in percent occurrence)															
SEDIMENTARY															
Limestone, dolomite	86	22	--	--	12	38	--	--	--	--	--	--	27	10	10
Sandstone	--	--	12	--	--	--	--	--	--	--	--	--	--	20	--
Tufaceous sandstone 1/	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
Sandstone-mudstone 2/	--	--	--	--	--	--	--	40	7	--	--	--	--	--	5
Shale	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5
Conglomerate 3/	--	--	--	--	--	--	17	--	--	--	--	--	--	--	5
Mixed clacareous 4/	14	56	38	20	25	23	--	--	--	--	--	--	36	30	28
METAMORPHIC															
Quartzite	--	22	--	20	38	24	50	60	79	88	100	100	28	--	37
Quartzite-argillite	--	--	38	--	--	15	--	--	--	12	--	--	9	30	--
Schist-quartzite	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Schist-gneiss	--	--	--	20	12	--	--	--	--	--	--	--	--	--	5
IGNEOUS															
Granitoid rocks	--	--	12	40	13	--	17	--	--	--	--	--	--	10	5
Andesitic pyroclastics	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--
Number of observations	7	9	8	5	8	13	6	5	14	17	5	3	11	10	21
REGOLITH (in percent occurrence)															
RESIDUAL ORDER 5/															
Mineral Class	71	34	--	--	17	--	--	60	29	12	--	--	17	--	33
Freeze-Thaw Class	--	--	--	--	--	--	--	--	14	6	--	--	--	--	--
DEPOSITIONAL ORDER															
Colluvium Class	29	44	50	--	50	78	33	--	--	--	40	--	--	20	33
Alluvium Class	--	--	--	33	--	11	33	--	--	--	40	100	--	--	--
Drift Class	--	22	50	67	33	11	34	40	57	82	20	--	83	80	21
Number of observations	7	9	2	3	6	9	6	5	14	17	5	3	6	5	3
GROUND SURFACE															
SURFACE ROCK EXPOSED (mean %)	48	1	4	31	18	8	1	3	10	10	0	7	2	4	2
BARE SOIL EXPOSED (mean %)	2	0	1	1	3	2	0	0	0	0	0	1	2	1	1
DUFF DEPTH (mean cm)	1.0	3.4	5.0	3.9	2.5	3.5	6.4	3.4	3.1	2.6	3.0	7.3	5.1	3.8	5.5
Number of observations 6/	4/7	6/9	6/8	4/5	5/8	8/13	5/6	3/5	9/14	5/17	2/5	3/3	10/11	9/10	20/22
UPPER SOIL (in percent occurrence)															
COARSE FRAGMENT PRESENCE															
None significantly noted	--	22	--	--	--	--	32	--	--	--	60	67	--	--	11
Gravelly (<3" in shape)	57	22	33	33	32	31	17	--	--	6	--	--	100	50	34
Cobbly (3-8" in shape)	--	11	17	33	17	--	--	20	21	--	--	--	--	--	11
Stony (>8" in shape)	--	--	17	--	17	8	--	20	--	12	--	--	--	--	22
Gravelly-cobbly	29	34	--	34	17	30	--	--	--	6	20	--	--	--	--
Gravelly-stony	14	11	--	--	--	8	17	--	--	--	--	--	--	--	--
Cobbly-stony	--	--	--	--	--	--	17	--	29	24	--	--	--	--	--
Gravelly-cobbly-stony	--	--	33	--	17	23	17	60	50	52	20	33	--	50	22
Number of observations	7	9	6	3	6	13	6	5	14	17	5	3	6	4	9
TEXTURAL CLASS															
Sand	--	--	--	--	--	--	--	--	--	6	--	--	--	--	4
Loamy sand & sandy loam	--	22	--	40	38	23	17	--	14	53	20	33	--	--	18
Loam	71	11	75	40	25	31	33	60	36	35	40	--	27	40	14
Silt loam & silt	--	11	12	--	12	--	--	--	--	--	--	--	9	--	14
Silty clay loam & clay loam	29	56	13	20	25	46	50	40	50	6	40	67	64	60	50
Number of observations	7	9	8	5	8	13	6	5	14	17	5	3	11	10	22

(cont.)

1/ Browns Park formation of southern and eastern Uinta Mountains (= Tbp)
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4/ Limestone and dolomite fragments in part, locally with others of sandstone, shale, quartzite, or argillite
5/ Adapted from DeGraff and others 1977
6/ Number of observations for exposed rock-soil and duff depth, respectively

APPENDIX D-1 (con.)

	ABIES LASIOCARPA SERIES (cont.)													
	VACA h.t.	VAGL h.t.	VASC h.t.			CARU h.t.	PERA	PERA	BERE h.t.					
			ARLA phase	CAGE phase	VASC phase		PSME phase	PERA phase	PIFL phase	RIMO phase	CAGE phase	JUCO phase	PSME phase	BERE phase
Number of Stands	12	28	28	9	47	17	32	34	19	58	17	15	73	32
COARSE FRAGMENT COMPOSITION (in percent occurrence)														
SEDIMENTARY														
Limestone, dolomite	--	--	--	--	--	--	6	3	18	23	6	7	23	--
Sandstone	8	4	--	--	2	--	--	3	--	5	12	7	7	--
Tufaceous sandstone 1/	17	--	--	--	2	6	--	--	--	--	6	13	--	--
Sandstone-mudstone 2/	8	--	--	--	9	--	--	--	--	--	--	--	1	3
Shale	--	--	--	--	--	6	--	--	--	--	--	--	--	--
Conglomerate 3/	--	21	7	--	2	29	16	58	24	9	--	--	9	31
Mixed clacareous 4/	--	4	--	--	2	--	16	3	12	18	29	13	42	19
METAMORPHIC														
Quartzite	50	67	82	100	81	53	52	24	40	21	41	60	13	32
Quartzite-argillite	--	--	7	--	2	--	4	3	6	2	6	--	--	3
Schist-quartzite	--	--	--	--	--	6	--	--	--	5	--	--	1	3
Schist-gneiss	--	--	--	--	--	--	--	--	--	--	--	--	3	3
IGNEOUS														
Granitoid rocks	--	--	--	--	--	--	--	--	--	7	--	--	1	3
Andesitic pyroclastics	17	4	4	--	--	--	6	6	--	7	--	--	--	3
Number of observations	12	24	28	9	47	17	31	33	17	57	17	15	68	32
REGOLITH (in percent occurrence)														
RESIDUAL ORDER 5/														
Mineral Class	60	--	27	--	67	67	14	80	66	65	66	54	34	33
Freeze-Thaw Class	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DEPOSITIONAL ORDER														
Colluvium Class	10	40	5	17	9	33	29	20	17	23	17	8	22	7
Alluvium Class	--	--	--	--	--	--	--	--	--	--	--	8	--	--
Drift Class	30	60	68	83	24	--	57	--	17	12	17	30	44	60
Number of observations	10	5	22	6	45	6	7	5	6	26	12	13	18	15
GROUND SURFACE														
SURFACE ROCK EXPOSED (mean %)	12	6	10	17	15	1	2	2	10	9	6	9	3	4
BARE SOIL EXPOSED (mean %)	1	1	1	2	2	0	0	2	3	1	1	2	1	1
DUFF DEPTH (mean cm)	3.2	4.6	3.2	1.9	2.6	3.1	4.3	6.2	4.4	3.7	3.2	3.2	3.2	3.2
Number of observations 6/	9/12	26/28	24/27	8/9	29/47	7/17	26/31	25/34	12/17	48/58	12/16	9/15	52/72	16/32
UPPER SOIL (in percent occurrence)														
COARSE FRAGMENT PRESENCE														
None significantly noted	--	--	--	--	--	9	--	7	--	8	13	--	17	6
Gravelly (<3" in shape)	42	40	25	67	26	46	70	60	13	50	74	36	28	56
Cobbly (3-8" in shape)	--	7	4	--	2	9	--	--	--	3	13	7	9	6
Stony (>8" in shape)	--	33	4	--	7	9	15	13	40	8	7	7	26	--
Gravelly-cobbly	16	--	30	22	4	--	--	20	13	15	13	14	6	12
Gravelly-stony	--	--	4	--	--	9	--	--	--	3	13	--	3	--
Cobbly-stony	--	7	8	--	2	--	--	--	--	--	--	--	--	--
Gravelly-cobbly-stony	42	13	25	11	59	18	15	--	34	12	7	36	11	20
Number of observations	12	15	24	9	46	11	13	15	15	38	15	14	35	16
TEXTURAL CLASS														
Sand	8	4	7	22	4	--	--	--	--	2	--	--	1	3
Loamy sand & sandy loam	25	--	21	33	45	18	6	15	22	14	18	46	11	28
Loam	33	14	43	11	21	41	25	30	22	40	35	40	29	44
Silt loam & silt	17	18	4	34	19	--	--	9	12	4	12	7	1	6
Silty clay loam & clay loam	17	64	25	--	11	41	69	46	44	40	35	7	58	19
Number of observations	12	28	28	9	47	17	32	33	18	58	17	15	70	32

(cont.)

1/ Browns Park formation of southern and eastern Uinta Mountains (= Tbp)
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3/ Wasatch and Knight conglomerates, comprised principally of quartziferous and shaly fragments (= Tw and Tk)
4/ Limestone and dolomite fragments in part, locally with others of sandstone, shale, quartzite, or argillite
5/ Adapted from DeGraff and others 1977
6/ Number of observations for exposed rock-soil and duff depth, respectively

APPENDIX D-1 (con.)

	ABIES LASIOCARPA SERIES (cont.)						PINUS CONTORTA SERIES						
	RIMO h.t.				OSCH h.t.	JUCO h.t.	CACA c.t.	VACA c.t.	VASC c.t.	JUCO c.t.	ARUV h.t.	BERE c.t.	CARO h.t.
	TRSP phase	PICO phase	THFE phase	RIMO phase									
Number of Stands	10	8	29	22	12	12	9	29	18	14	24	20	8
COARSE FRAGMENT COMPOSITION (in percent occurrence)													
SEDIMENTARY													
Limestone, dolomite	--	--	11	21	17	--	--	--	--	--	--	--	--
Sandstone	--	--	14	--	--	--	--	--	--	7	--	5	--
Tufaceous sandstone 1/	--	--	--	--	--	--	22	21	22	--	--	35	--
Sandstone-mudstone 2/	11	100	--	--	--	75	--	--	--	43	--	--	--
Shale	--	--	--	--	--	--	--	--	--	--	--	--	--
Conglomerate 3/	--	--	11	26	50	--	--	--	--	--	--	--	--
Mixed clacareous 4/	--	--	18	22	25	--	--	--	6	--	--	--	--
METAMORPHIC													
Quartzite	89	--	20	26	--	25	78	79	72	29	96	60	100
Quartzite-argillite	--	--	4	--	--	--	--	--	--	21	4	--	--
Schist-quartzite	--	--	--	--	--	--	--	--	--	--	--	--	--
Schist-gneiss	--	--	7	--	8	--	--	--	--	--	--	--	--
IGNEOUS													
Granitoid rocks	--	--	4	5	--	--	--	--	--	--	--	--	--
Andesitic pyroclastics	--	--	11	--	--	--	--	--	--	--	--	--	--
Number of observations	10	8	28	19	12	12	9	29	18	14	24	20	8
REGOLITH (in percent occurrence)													
RESIDUAL ORDER 5/													
Mineral Class	50	100	44	50	--	84	56	41	41	50	50	75	75
Freeze-Thaw Class	28	--	--	--	--	--	--	--	--	--	--	--	--
DEPOSITIONAL ORDER													
Colluvium Class	--	--	6	--	--	8	11	--	6	29	--	5	--
Alluvium Class	--	--	--	--	--	--	11	--	--	7	--	--	--
Drift Class	22	--	50	50	100	8	22	59	53	14	50	20	25
Number of observations	10	8	18	4	2	12	9	29	17	14	24	20	8
GROUND SURFACE													
SURFACE ROCK EXPOSED (mean %)	43	0	2	2	0	16	1	5	12	29	9	5	3
BARE SOIL EXPOSED (mean %)	15	0	0	0	2	3	0	0	0	1	1	0	1
DUFF DEPTH (mean cm)	1.2	1.4	3.6	3.9	2.3	2.9	3.0	3.0	2.9	2.7	2.7	3.2	2.5
Number of observations 6/	6/10	0/8	22/28	17/22	8/12	4/12	6/9	24/29	14/17	7/14	16/24	13/20	3/8
UPPER SOIL (in percent occurrence)													
COARSE FRAGMENT PRESENCE													
None significantly noted	--	--	14	8	--	--	38	7	--	7	--	--	--
Gravelly (<3" in shape)	6	12	62	38	80	8	25	7	19	--	22	10	25
Cobbly (3-8" in shape)	--	--	--	23	--	--	12	4	6	--	--	30	--
Stony (>8" in shape)	--	--	--	--	20	--	12	11	6	--	4	5	--
Gravelly-cobbly	--	--	5	23	--	--	--	34	19	7	9	25	--
Gravelly-stony	--	--	--	--	--	--	--	--	6	--	22	--	50
Cobbly-stony	--	--	--	--	--	--	--	11	12	--	--	10	12
Gravelly-cobbly-stony	94	88	19	8	--	92	13	26	32	86	43	20	13
Number of observations	10	8	21	13	5	12	8	27	16	14	23	20	8
TEXTURAL CLASS													
Sand	6	--	4	--	--	8	--	--	11	--	8	--	--
Loamy sand & sandy loam	56	62	14	9	17	92	11	52	56	93	71	70	62
Loam	32	38	39	22	33	--	56	31	16	--	17	25	38
Silt loam & silt	--	--	18	5	8	--	--	3	6	--	--	--	--
Silty clay loam & clay loam	6	--	25	64	42	--	33	14	11	7	4	5	--
Number of observations	10	8	28	22	12	12	9	29	18	14	24	20	8

1/ Browns Park formation of southern and eastern Uinta Mountains (= Tbp)
2/ Duschense River formation of southern Uinta Mountains (= Tdr)
3/ Wasatch and Knight conglomerates, comprised principally of quartziferous and shaly fragments (= Tw and Tk)
4/ Limestone and dolomite fragments in part, locally with others of sandstone, shale, quartzite, or argillite
5/ Adapted from DeGraff and others 1977
6/ Number of observations for exposed rock-soil and duff depth, respectively

APPENDIX D-2. CLIMATIC PARAMETERS FOR STATIONS WITHIN OR PROXIMATE TO HABITAT TYPES OF SERIES IN NORTHERN UTAH (FROM U.S. WEATHER SERVICE RECORDS UNLESS NOTED) (~ =APPROXIMATELY; ND = NO DATA)

Geographic location and station	Estimated habitat types and phase or position to nearest adjacent climax series	Mean monthly temperature July	Mean monthly temperature Jan.	Average number of frosts (32°F-0°C) June-August	Mean annual precipitation	Mean May-Aug. precipitation	Mean annual snowfall	Longitude/latitude	Elevation	Record period
		°F(°C)	°F(°C)		Inches (mm)	Inches (mm)	Inches (mm)		Feet (meters)	
NORTHERN WASATCH										
Utah State University	below PSME series	73(23)	40(4)	0	18.3 (465)	4.2 (107)	74 (1 880)	111°49'/41°44'	4,780 (1 457)	1971-76
College Forest[1]	ABLA/PERA-PERA	58(15)	14(−10)	ND	40.1 (1 019)	5.3 (135)	ND	111°30'/41°52'	8,500 (2 591)	1971-76
CENTRAL WASATCH										
Cottonwood Weir	below ABCO series	80(27)	33(~1)	0	21.7 (551)	5.4 (137)	86 (2 184)	111°47'/40°27'	4,961 (1 512)	1951-60
Timpanogos Cave	ABCO/BERE-BERE[2]	73(23)	29(−2)	0	22.1 (561)	5.8 (147)	112 (2 845)	111°43'/40°27'	5,523 (1 683)	1951-60
Silver Lake Brighton	ABLA/BERE-RIMO	58(15)	19(−8)	10	41.7 (1 059)	8.4 (213)	410 (10 414)	111°35'/40°36'	8,700 (2 652)	1951-60
NORTHEASTERN UINTAS										
Flaming Gorge	below PIPO series[3]	68(20)	21(−6)	1	12.4 (315)	5.0 (127)	46 (1 168)	109°25'/40°56'	6,270 (1 911)	1957-75
SOUTH-CENTRAL UINTAS										
Elkhorn R.S.	below POTR series[4]	ND	ND	ND	12.0 (305)	4.1 (104)	69 (1 753)	109°57'/40°33'	6,850 (2 088)	1951-56
Moon Lake	PSME/BERE-JUCO	60(16)	17(−8)	11	19.0 (483)	7.0 (178)	ND	110°30'/40°34'	8,150 (2 484)	1951-60

[1]Data from Lomas 1977.
[2]Station is situated above canyon bottom in *Quercus gambelii-Acer grandidentatum* woodland with scattered *Abies concolor* stems; exposure is southerly lower slope and is directly across canyon from ABCO/BERE h.t., BERE phase, occupying steep northerly slope.
[3]Station is situated in *Pinus edulis-Juniperus osteosperma* woodland.
[4]Station is situated near lower treeline comprised solely of *Populus tremuloides*.

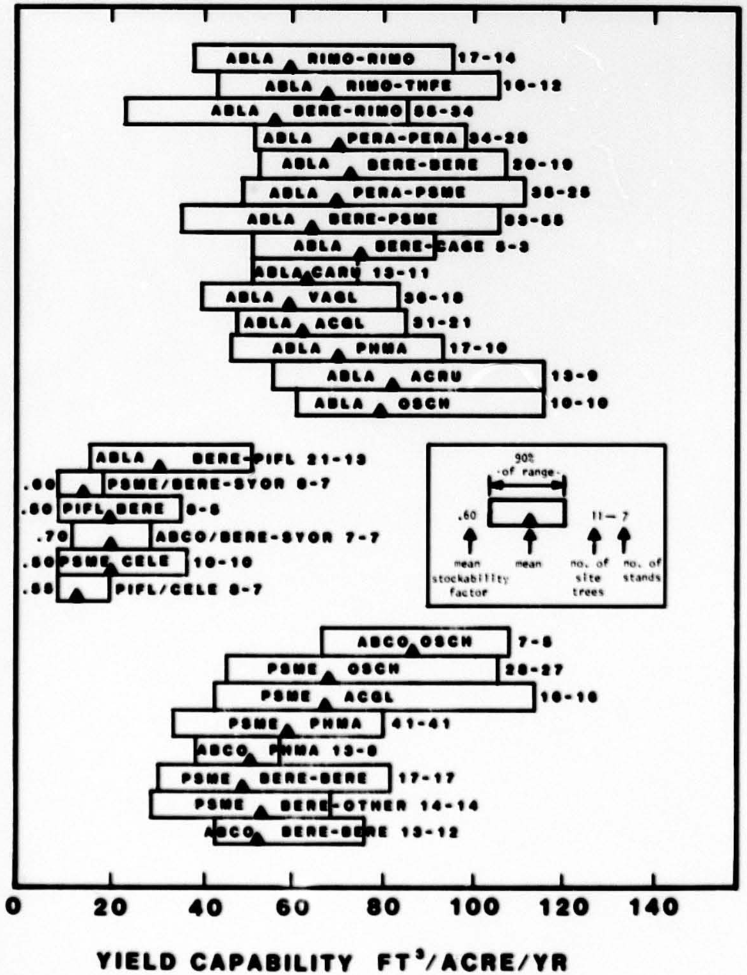
APPENDIX E-1. MEAN BASAL AREAS AND 50-YEAR SITE INDEXES (IN FEET) FOR NORTHWESTERN UTAH SAMPLE STAND DATA BY HABITAT TYPE

Habitat type	Basal area (ft²/acre)	Site index by species PIFL	PSME	ABCO	PICO	PIEN	ABLA
PIFL/CELE	83 ± 56	16 ± ?	21 ± 4	.	.	.	.
PIFL/BERE	78 ± 43	31 ± ?	39 ± ?	.	.	.	.
PSME/CELE	90 ± 69	.	27 ± 6	.	.	.	.
PSME/PHMA	140 ± 19	.	49 ± 3	.	.	.	.
PSME/ACGL	174 ± 47	.	53 ± 6	.	.	.	.
PSME/OSCH, PRVI	149 ± 23	.	52 ± 4	.	.	.	.
PSME/OSCH, OSCH	182 ± 41	.	54 ± 6	.	.	.	.
PSME/BERE, BERE	176 ± 37	.	42 ± 5	.	.	.	.
PSME/BERE, SYOR	199 ± 85	.	26 ± 6	.	.	.	.
PSME/BERE, other	134 ± 31	.	46 ± 5	.	.	.	.
ABCO/PHMA	194 ± 37	.	44 ± 5	44 ± 5	.	.	.
ABCO/OSCH	244 ± 56	.	63 ± ?	62 ± ?	.	.	.
ABCO/BERE, SYOR	126 ± 54	.	.	27 ± 3	.	.	.
ABCO/BERE, BERE	186 ± 35	.	46 ± 5	38 ± ?	.	.	.
ABLA/ACRU	203 ± 55	.	63 ± ?	.	.	61 ± ?	55 ± 12
ABLA/PHMA	152 ± 35	.	50 ± 7	.	.	58 ± ?	56 ± 16
ABLA/ACGL	189 ± 40	.	51 ± 4	.	.	.	47 ± 5
ABLA/VAGL	208 ± 35	.	46 ± 8	.	46 ± 3	49 ± 5	45 ± 8
ABLA/CARU	193 ± 40	.	49 ± ?	.	51 ± 3	.	.
ABLA/PERA, PSME	234 ± 37	.	54 ± 6	.	45 ± 4	54 ± 4	56 ± 7
ABLA/PERA, PERA	207 ± 20	.	.	.	51 ± 3	56 ± 6	51 ± 6
ABLA/BERE, PIFL	195 ± 63	21 ± 6	36 ± 4	.	.	36 ± ?	31 ± 9
ABLA/BERE, RIMO	228 ± 34	.	46 ± 6	.	47 ± ?	46 ± 5	43 ± 6
ABLA/BERE, CAGE	208 ± ?	.	56 ± ?	.	.	.	.
ABLA/BERE, PSME	196 ± 18	.	48 ± 3	.	48 ± 4	58 ± 8	51 ± 4
ABLA/BERE, BERE	197 ± 45	.	.	.	50 ± 5	61 ± 9	54 ± 12
ABLA/RIMO, THFE	196 ± 52	.	.	.	.	58 ± 19	49 ± 12
ABLA/RIMO, RIMO	206 ± 47	.	43 ± ?	.	.	49 ± 8	47 ± 11
ABLA/OSCH	183 ± 35	.	.	.	.	.	54 ± 9

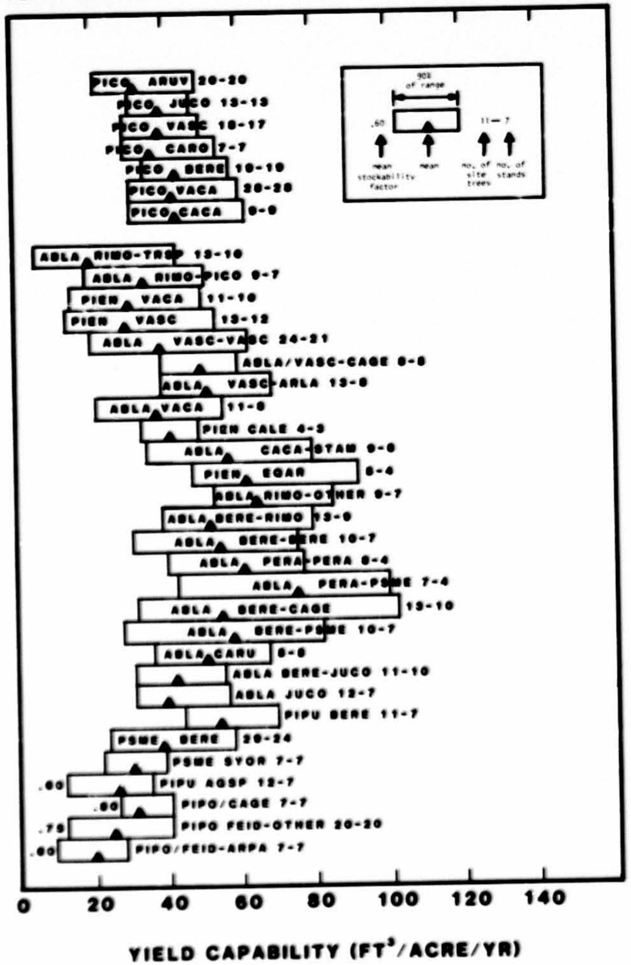
APPENDIX E-2. MEAN BASAL AREAS AND 50-YEAR SITE INDEXES (IN FEET) FOR UINTA MOUNTAINS SAMPLE STAND DATA BY HABITAT TYPE

Habitat type	Basal area (ft²/acre)	Site index by species					
		PIPO	PSME	PIPU	PICO	PIEN	ABLA
PIPO/CAGE	140 ± 37	39 ± 5	.	.	.	.	.
PIPO/FEID, ARPA	100 ± 30	31 ± 4	.	.	.	.	.
PIPO/FEID, other	117 ± 20	34 ± 3	.	.	.	.	.
PSME/BERE	156 ± 22	44 ± ?	34 ± 4	.	41 ± ?	.	.
PSME/SYOR	160 ± 37	.	30 ± 4	.	.	.	.
PIPU/AGSP	97 ± 32	.	36 ± 3	40 ± 5	.	.	.
PIPU/BERE	166 ± 36	.	.	46 ± 3	43 ± ?	.	.
PIEN/EQAR	202 ± 109	.	.	.	41 ± ?	52 ± ?	.
PIEN/CALE	173 ± ?	.	.	.	32 ± ?	38 ± ?	.
PIEN/VACA	162 ± 38	.	.	.	36 ± 4	25 ± 9	.
PIEN/VASC	178 ± 39	.	.	.	32 ± 6	25 ± 10	.
ABLA/CACA - STAM	227 ± 69	.	.	.	44 ± ?	45 ± ?	.
ABLA/VACA	170 ± 34	.	.	.	34 ± 4	34 ± ?	.
ABLA/VASC, ARLA	182 ± 30	.	.	.	40 ± ?	40 ± 6	45 ± ?
ABLA/VASC, CAGE	141 ± 41	.	.	.	43 ± 7	.	.
ABLA/VASC, VASC	159 ± 16	.	.	.	35 ± 4	35 ± 14	33 ± ?
ABLA/CARU	157 ± 63	.	.	.	43 ± 9	.	.
ABLA/PERA, PSME	170 ± ?	.	46 ± ?	.	.	64 ± ?	.
ABLA/PERA, PERA	201 ± ?	.	.	.	43 ± ?	48 ± ?	.
ABLA/BERE, RIMO	170 ± 51	.	.	.	.	41 ± 10	43 ± 7
ABLA/BERE, CAGE	173 ± 24	.	.	.	40 ± 7	.	61 ± ?
ABLA/BERE, JUCO	160 ± 33	.	.	.	37 ± 5	.	.
ABLA/BERE, PSME	166 ± 27	.	.	.	44 ± ?	.	48 ± ?
ABLA/BERE, BERE	159 ± 47	.	.	.	39 ± 10	.	53 ± ?
ABLA/JUCO	136 ± 44	.	.	.	37 ± 6	.	34 ± ?
ABLA/RIMO, TRSP	111 ± 41	.	.	.	.	25 ± 9	22 ± ?
/RIMO, PICO	158 ± 31	.	.	.	41 ± ?	31 ± 8	.
/RIMO, other	213 ± 39	.	.	.	.	49 ± 7	.
PIPC/CACA	144 ± 35	.	.	.	37 ± 7	.	.
PIPO/VACA	177 ± 21	.	.	.	36 ± 3	.	.
PICO/VASC	183 ± 28	.	.	.	34 ± 3	.	.
PICO/JUCO	158 ± 27	.	.	.	35 ± 3	.	.
PICO/ARUV	146 ± 18	.	.	.	30 ± 3	.	.
PICO/BERE	167 ± 29	.	.	.	37 ± 3	.	.
PICO/CARO	193 ± 43	.	.	.	33 ± 6	.	.

APPENDIX E-3. ESTIMATED YIELD CAPABILITIES OF UINTA MOUNTAINS HABITAT TYPES BASED ON SITE INDEX AND STOCKABILITY FACTORS (CUBIC FEET/ACRE/YEAR)



APPENDIX E-4. ESTIMATED YIELD CAPABILITIES OF UINTAH MOUNTAINS HABITAT TYPES BASED ON SITE INDEX AND STOCKABILITY FACTORS (CUBIC FEET/ACRE/YEAR)



APPENDIX F. NORTHERN UTAH HABITAT TYPE FIELD FORM

NAME

DATE

INSTRUCTIONS: Estimate each species coverage to the nearest 1% when < 10% or to the nearest 5% when > 10%. Use trace (T) when < .5%. Estimate trees (> 4 inches d.b.h.) and regen. (0-4 inches d.b.h.) separately, (e.g. 35/10). Landform and parent material notes are also useful.

Plot No.				
Meridian				
T				
R				
S				
Elevation				
Aspect				
% Slope				
Topography				
Config.				

POSITION CODES

1-Ridge
2-Upper slope
3-Midslope
4-Lower slope
5-Bench/flat
6-Stream bottom

CONFIGURATION CODES

1-Convex (dry)
2-Straight
3-Concave (wet)
4-Undulate

	Scientific name	Abbrev.	Common name	CANOPY COVERAGE (%)			
TREES							
1.	Abies concolor	ABCO	white fir	/	/	/	
2.	Abies lasiocarpa	ABLA	subalpine fir	/	/	/	
3.	Picea engelmannii	PIEN	Engelmann spruce	/	/	/	
4.	Picea pungens	PIPU	Blue spruce	/	/	/	
5.	Pinus contorta	PICO	lodgepole pine	/	/	/	
6.	Pinus flexilis	PIFL	limber pine	/	/	/	
7.	Pinus ponderosa	PIPO	ponderosa pine	/	/	/	
8.	Pseudotsuga menziesii	PSME	Douglas-fir	/	/	/	
9.	Populus tremuloides	POTR	quaking aspen	/	/	/	
10.	Quercus gambelii	QUGA	Gambel oak	/	/	/	
SHRUBS AND SUBSHRUBS							
1.	Acer glabrum	ACGL	mountain maple				
2.	Arctostaphylos patula	ARPA	greenleaf manzanita				
3.	Arctostaphylos uva-ursi	ARUV	bearberry				
4.	Artemisia tridentata	ARTR	big sagebrush				
5.	Berberis repens	BERE	Oregongrape				
6.	Cercocarpus ledifolius	CELE	Curlleaf mountain-mahogany				
7.	Juniperus communis	JUCO	common juniper				
8.	Pachistima myrsinites	PAMY	myrtle pachistima				
9.	Physocarpus malvaceus	PHMA	ninebark				
10.	Prunus virginiana	PRVI	chokecherry				
11.	Ribes montiginum	RIMO	mountain gooseberry				
12.	Sorbus scopulina	SOSC	mountain-ash				
13.	Symphoricarpos oreophilus	SYOR	mountain snowberry				
14.	Vaccinium caespitosum	VACA	dwarf blueberry				
15.	Vaccinium globulare	VAGL	blue huckleberry				
16.	Vaccinium membranaceum	VAME	big whortleberry				
17.	Vaccinium scoparium	VASC	grouse whortleberry				
GRAMINOIDS							
1.	Agropyron spicatum	AGSP	bluebunch wheatgrass				
2.	Calamagrostis canadensis	CACA	bluejoint reedgrass				
3.	Calamagrostis rubescens	CARU	pinegrass				
4.	Carex geyeri	CAGE	elk sedge				
5.	Carex rossii	CARO	Ross sedge				
6.	Festuca idahoensis (+ ovina)	FEID	Idaho fescue				
7.	Leucopoa kingii	LEKI	spike-fescue				
8.	Trisetum spicatum	TRSP	spike trisetum				
FORBS AND FERN ALLIES							
1.	Actaea rubra	ACRU	baneberry				
2.	Arnica cordifolia	ARCO	heartleaf arnica				
3.	Arnica latifolia	ARLA	broadleaf arnica				
4.	Caltha leptosepala	CALE	elkslip marshmarigold				
5.	Equisetum arvense	EQAR	common horsetail				
6.	Osmorhiza chilensis (+ depauperata)	OSCH	mountain sweetroot				
7.	Pedicularis racemosa	PERA	sickletop pedicularis				
8.	Senecio triangularis	SETR	arrowleaf groundsel				
9.	Streptopus amplexifolius	STAM	claspleaf twisted-stalk				
10.	Thalictrum fendleri	THFE	Fendler meadowrue				

SERIES ______

HABITAT TYPE ______

PHASE ______

U.S. GOVERNMENT PRINTING OFFICE: 1984-0-776-032/10,503

Mauk, Ronald L.; Henderson, Jan A. Coniferous forest habitat types of northern Utah. General Technical Report INT-170. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984. 89 p.

A land classification system based upon potential natural vegetation is presented for the coniferous forests of northern Utah. The classification and descriptions are based on reconnaissance data from over 1,000 stands. A total of 8 climax series and 38 habitat types are described. A diagnostic key, utilizing conspicuous indicator species, provides for field identification of the types.

KEYWORDS: forest vegetation, Utah, habitat types, plant communities, forest ecology, forest management, classification

The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

The Intermountain Station includes the States of Montana, Idaho, Utah, Nevada, and western Wyoming. About 231 million acres, or 85 percent, of the land area in the Station territory are classified as forest and rangeland. These lands include grasslands, deserts, shrublands, alpine areas, and well-stocked forests. They supply fiber for forest industries; minerals for energy and industrial development; and water for domestic and industrial consumption. They also provide recreation opportunities for millions of visitors each year.

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