FIELD GUIDE
HABITAT CLASSIFICATION SYSTEM

For
UPPER PENINSULA OF MICHIGAN
AND NORTHEAST WISCONSIN

Developed By

COOPERATIVE RESEARCH ON FOREST SOILS
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INTRODUCTION

The Fieldguide of the Habitat Classification System for the Upper Peninsula of Michigan and Northeastern Wisconsin has been developed by CROFS (Cooperative Research on Forest Soils) for any individual or organization involved in land management decisions. Its primary purpose is to aid in delineating ecologically different land units in order to have the ability to predict response to management activities with greater accuracy than has been possible in the past. Although the approach has direct applicability to wildlife, visual management, fire management, etc., this guide is primarily oriented to timber management. The benefits of the system for timber management come from its ability to:

1. To predict site/successional relationships.
2. To identify whether poor quality in a stand is a result of site quality or stand history.
3. To match the most productive species (having economic importance) to site.
4. To determine the effort needed to maintain and/or convert to another stage of succession.
5. To identify areas that will provide the best opportunity for intensive management.
6. To provide ecologically sound silviculture systems for the various successional stages within each habitat type.

THE HABITAT TYPE CONCEPT

The habitat type concept has its roots in work done by European ecologists and their discovery that plants normally are found in predictable patterns or communities. These communities reflected differences in site and it was soon determined that the plant communities could be used as a measure of site. Rexford Daubenmire brought the basic concept to the western United States where it is now used as a viable management tool.

Daubenmire developed the system based on the following assumptions. A unit of vegetation can be recognized only if it appears homogenous. Each area of vegetation that is essentially homogenous in all layers and differs from contiguous vegetation types by either quantitative or qualitative characters is a ***STAND***. All climax[1] stands in which the dominants of corresponding layers of vegetation are essentially the same, (to the extent that any differences in composition are due to chance dissemination or to a transitory historic factor rather than to a fundamental dissimilarity in site potential), comprise one ***ASSOCIATION*** or (Habitat Type). It is recognized that no two stands in one association are ever identical, and that soil climate, and animals may differ from one stand to another so long as these factors compensate in a way that their ***ECOLOGIC SUMS*** produce plant groupings with a high degree of similarity. The stand is a concrete and objective reality. The association, on the other hand, is a subjective concept based on those characteristics at least potentially common to all the separate stands which represent it, and which serve to separate the group from all other stands.

Associations are normally grouped into broader ecological units that are dominated by one or two climax tree species. These groups of associations dominated by the same climax tree species are termed a SERIES and indicate similar ecological conditions for the various associations within the series.

The Habitat Type. The classification system is based on climax associations. An important advantage of centering classification on the more stable climax plant community is that it

[1]Climax refers to the stage in succession whereby the vegetative species are apparently self-regenerating in predictable patterns and have long been free of disturbance by fire, grazing, logging, etc.

draws together different successional communities[2] all leading to the same few stable climax types. Unless the site itself is changed in a way that changes the ecological sum, the same climax type will eventually develop if left undisturbed regardless of what type of disturbance caused retrogression in the first place. Hence the habitat (all factors making up the site potential) remains unchanged through retrogression and succession until it finally produces a stand of the same climax association existing before disturbance. Since each climax can normally regenerate itself repeatedly following destruction, and since its potential share of the landscape remains fixed, field ecology is simplified by focusing attention on the area belonging to each association which is usually occupied by seral stages representing it. All the area (sum of discrete units) that now supports, or within recent time has supported, and presumably is still capable of supporting, one association is called a ***HABITAT TYPE.***[3]

Nomenclature of climax associations (habitat types) is difficult. Normally those species that characterize the overstory and understory in a climax association (each of which may also participate individually in other associations) are used in the name. To avoid confusion, the international latinized names of the plants must always be used. However, for field use these names are usually abbreviated for simplicity sake.

Key Indicator Species. In practice habitat types are identified in successional stands by looking for those combinations of species that characterized the climax stands. Some of the climax species will not appear in early successional stages. However, there will normally be several that are found in about the same proportion, though in lower numbers, as they were found in the climax association. These species are referred to as ***KEY INDICATOR SPECIES.*** Although they may only make up a fraction of the total species composition present in an early successional stage, the key indicator species are normally present in sufficient quantities to allow the habitat to be identified.

Tree species make poor indicator species because of two important reasons. First, even though tree species are found in definite combinations in the climax associations, some species have wide ecological amplitudes and will quickly invade other habitat types as successional species upon disturbance. Red maple, sugar maple, red oak, balsam fir, white spruce, white pine, red pine, and jack pine are all climax dominants in certain associations but are also successional species on other habitat types. Second, tree species are long lived so the original climax combinations do not appear for many years, even centuries.

Understory plant species, although influenced by stand density, past history, and the composition of the forest, have generally more restricted ecological tolerance and are thus restricted in their ability to appear on other habitat types. In addition they have more consistent seed years, shorter life cycles, and more viable seed stored in the duff than do trees. All of these factors work to quickly re-establish many of the original groundflora climax species after a mejor disturbance. This relationship is not always perfect - even under 'normal' types of disturbance (light burning, blowdowns, logging) seed availability or other historic discontinuities may be such that reappearance of one of the key indicator species is delayed. This is especially important in very early successional stages such as pastures or brush fields or in very dense conifer plantations established on the old fields. However, in most forest situations the technique will work satisfactorily.

[2] A successional community (seral stage) is comprised of stands which are not self-regenerating and which eventually give way to other communities or stages.

[3] For further discussion on this concept refer to *Plant Communities - A Textbook of Plant Synecology* by Rexford Daubenmire, 1968, Harper & Row, Publishers.

LIMITATIONS AND ADVANTAGES OF THE SYSTEM

It must be clearly understood that habitat type classification is just that - it is a means of classifying ecologically homogenous units of land using phytosociological techniques. By itself it provides little utility to a land manager. However, since each habitat type is ecologically homogenous and is in some way different from all other habitat types, measurable differences in productivity or response to treatment should occur. It is these differences that provide the needed information for timber management decisions as outlined on page one.

It is imperative that the user understand that the initial effort in developing the habitat classification system was primarily in the delineation and identification of the habitat types themselves. The second phase in the development of the system - that of determining descriptive or interpretive information for each habitat type - is only just beginning. Consequently, much of the *DESCRIPTIVE INFORMATION CONTAINED IN THIS SECOND PRINTING OF THE FIELD GUIDE IS BASED ON VERY LIMITED DATA AND SHOULD BE USED WITH CAUTION.*

The descriptive information used in this field guide has (or will) come from several sources. Extensive sampling and observation have provided the bulk of the interpretive information utilized in the second printing of the field guide. The specific limitations on the use of the descriptive information is detailed in each section. Secondly, habitat types are being determined for previously established long term research study sites in the Upper Peninsula so that results from these projects can be utilized in refining descriptive material. Some of this work has been started, but much more will be necessary in the future. Finally, comprehensive research directed at answering specific habitat type/productivity/response questions has been started and some of these results are included in this printing. However, much more of this type of research will be needed in the future.

Although incomplete, it is the intent of this field guide to provide the land manager with information that can be utilized in his decision making process today. Because the descriptive information contained within the guide has to be obtained quickly by utilizing extensive sampling procedures or other published data, some information will be in error. Even though these errors are expected to be small, obvious ones can be found through normal field use. In other words, the user is involved in the validation process. This illustrates a strong point in the cooperative nature of the development of this field guide. Because the user also tests the descriptive information, costly, time consuming validation procedures are reduced. As a user, if you suspect an error in the descriptive information, you should contact the appropriate CROFS representative (presently Dr. Michael Coffman, Mr. Edward Alyanak, Dr. John Kotar, or Mr. Carl Trettin). One of these individuals will review your observations and appropriate corrections made.

Other weaknesses are also inherent in the procedure itself. The Habitat Type Classification System is not capable of providing all descriptive information needed by land managers. In its present form it yields little to no information concerning topographic or soil limitations. Therefore, information on operability, trafficability, certain productivity anomalies, etc; are at best only indirectly addressed using the habitat type system. However, research is presently underway to integrate this system with conventional soil classification techniques that will provide a more total ecological classification system. This approach should provide far more utility to the land manager than either approach by itself.

Finally, the habitat classification system does not replace the need for conventional forest inventories. Forest inventories are a description of what exists now - how much volume, what species composition, etc. The habitat type system defines the alternatives and addresses the questions "what is the expected productivity of the current stand on this site" and "what other alternatives exist for this site".

As mentioned previously, the Habitat Type system provides a framework for information concerning silviculture, growth, and yield. Work to date has concentrated on defining the framework. Your continued help is requested in validating or replacing the information in that framework.

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NOTES

USING THE HABITAT CLASSIFICATION KEY

The key is designed, like most keys of its type, to first look at the broader community characteristics of groundflora and soil relationships for a given site. These broadly similar ecological types are called Series Groups (droughty sand soils vs. mesic loamy soils, etc). The user first determines the Series group. Next, via a progression of decisions of alternate possibilities, a Series is selected. The Series is a group of habitat types having the same climax tree species (Pinus banksiana, Tsuga canadensis, Tsuga canadensis/Acer saccharum, etc). Finally, via a series of decisions involving which species combinations are found in the greatest abundance, the proper habitat type is determined. The key is cross referenced so that if the user chooses the incorrect path early in the key, he can still get to the appropriate habitat type.

The key has been totally restructured since the first printing. This allows the inclusions of new habitat types as they are added without the key becoming cumbersome. The current format of the key keeps the number of steps needed to arrive at a habitat type at a minimum. In actual use the key is still based on the *relative* coverage of the indicator species to each other. The actual percent cover of the indicator species varies depending on the amount and duration of past disturbance, and the density of the overstory canopy. For instance, severe disturbance on one of the maple dominated habitat types will allow successional groundflora and overstory species to invade (such as bracken fern, grasses, hawkweeds, etc. under aspen) which will completely dominate the key indicator species. Although only present in small numbers (compared to near climax situations), the relative proportion of the key indicator species *to each other* will remain approximately the same.

The presence of a species on any area of land depends upon the presence of a seed source and specific environmental (climatic) conditions at the time of seed availability. Consequently, some areas will not have all the indicator species normally associated with a habitat type.

Unless the disturbance is severe (such as numerous hot fires) the omission of a species from the site will not prevent the determination of its habitat type since the remaining group of species associated with the type can be used to make the proper identification. Experience indicates that about 20 percent of all areas investigated will be so badly disturbed that they cannot be typed. In these cases the identification of the habitat type may still be possible by using the vegetative information provided in Table 1 in Section 4 (Summary Tables) and the Habitat Type Descriptions in Section 6.

Included in the key is the broad texture/drainage class of the soils typically supporting specific habitat type groups. However, since the vegetation reflects the sum total of all environmental factors, a given habitat type can be found on texture/drainage classes other than the one given if there are compensating factors in the soil or slope position. For instance, a loam to sandy soil will support the Tsuga-Maianthemum-Vaccinium or even a Acer-Quercus-Vaccinium h.t.'s if it occurs as a thin cap over sand and gravel. Conversly, a fine sand can support the Acer-Tsuga-Dryopteris h.t. if there is a well developed fragipan within the soil. As additional soil/habitat information becomes available, more specific information and correlations will be given.

In Section 3 following the key is a list of scientific/common names for all indicator species used in the key. Color plates of most indicator species are included to aid in field identification. Line drawings are included for those species that color plates do not exist. All line drawings were provided courtesy of Cranbrook Institute of Science.

KEY TO CLIMAX SERIES, HABITAT TYPES, AND PHASES
(Revised, January 1983)

Read these instructions first:

1) Determine that you are in an area of the stand which is representative of the habitat as a whole. Look over an area about 300 m^2 in size (56 ft. x 56 ft.) and record the foliar coverage of all indicator species. Foliar coverage is the sum of the vertical projections of the general outline of all individuals of a given species.

2) Determine which group I, II or III the habitat best fits and procede with that group key to identify series.

3) Within the appropriate series, key to habitat type by literally following the key. Determine the phase, if applicable, by checking if the habitat fits phase requirements. (The first phase description that fits the habitat is the correct one). If the habitat does not fit any phase requirements describe it using the habitat type name only.

4) Remember, all decisions in the key are based on species coverage, NOT numbers or height of individuals.

5) If the stand being examined has been severely disturbed by logging, grazing, fire, or is a plantation, the habitat type can often best be determined from the nearest undisturbed stand occupying a similar site.

6) Definitions of some terms in the key:

Present - A few individuals within the *average* site condition will satisfy this requirement. Do not include individuals within unique microsite conditions (i.e. rotten logs, stumps, small wet areas, etc.)

Extremely Rare - Less than 1% coverage

Common - At least 5% coverage

Well Represented - At least 10% coverage

Impeded Drainage - Site shows EVIDENCE that surface water is present much of the year, but not all of the year; cradle-knoll often common with water in depressions. Water table (may be perched) usually within one foot of the surface.

Podzol (Podzolized) - A sandy or loamy sand soil having a leached $A_2(E)$ horizon that is often grayish in color, with an accumulation of clay, organics, and minerals (primarily iron with some aluminum) in the B horizon. In highly podzolized soils this accumulation of clays, organics, and iron often cements into an ortstein layer of discontinuous dark reddish brown plates in the B horizon. (Where used in this field guide the term podzol or podzolized refers to this process rather than to meeting the exact criteria for a spodosol).

7) Remember, the key is *NOT* the classification! Validate the determination made using the key by checking the written habitat type description.

KEY TO SERIES GROUP I

I. Habitat affected by drought during the growing season, with no evidence of impeded drainage. Soils usually sandy with minimal horizon development. Understory vegetation characterized by the presence of low sweet blueberry, canada blueberry, hairgrass, bearberry, trailing arbutus and/or wood betony.

1. Habitat extremely droughty; the sum of hairgrass, sedges, reindeer moss and bear berry > the sum of wild lily-of-the-valley and bracken fern ..... PINUS SERIES (A)

1 Habitat not as above ..... 2.

2. Low sweet blueberry > the sum of wild sarsaparilla, wood betony, twisted stalk, yellow beadlily, false solomon's seal, and spinulose shield fern; wood betony not common ..... ACER-QUERCUS SERIES (B)

2. Low sweet blueberry < the sum of the above species or wood betony common (canada blueberry usually > low sweet blueberry) ..... TSUGA SERIES (C)

KEY TO SERIES GROUP II

II. Habitat with favorable soil moisture throughout the growing season. If impeded drainage is evident it is localized. Soils usually loamy sand to clay loam with good to excellent moisture holding properties produced by finer textures, high organic content, and/or a semipermeable layer in the solum. Understory vegetation characterized by wild lily-of-the-valley, spinulose shield fern, smooth yellow violet, canadian white violet or downy yellow violet, sweet cicely and/or maple leaf viburnum.

1. Blueberries present; or the sum of maple leaf viburnum, witch hazel and pointed leaved tick trefoil > the sum of spinulose shield fern, sweet cicely, and smooth yellow violet, canadian white violet or downy yellow violet ..... 2.

1. Habitat understory vegetation not as above ..... 3.

2. Low sweet blueberry > the sum of wild sarsaparilla, wood betony, twisted stalk, yellow beadlily, false solomon's seal and spinulose shield fern; and wood betony not common. Or maple leaf viburnum, witch hazel and/or pointed leaved tick trefoil common ..... ACER-QUERCUS SERIES (B)

2. Low sweet blueberry < the sum of the above species; or wood betony common (canada blueberry usually > low sweet blueberry). Maple leaf viburnum, witch hazel and pointed leaved tick trefoil extremely rare or absent ..... 3.

3. Wild lily-of-the-valley > the sum of spinulose shield fern, sweet cicely, red berried elder and smooth yellow violet, canadian white violet or downy yellow violet ..... TSUGA SERIES (C)

3. Wild lily-of-the-valley < the sum of the species in 3 above ..... 4.

4. Spinulose shield fern at least twice as much coverage as the sum of sweet cicely, blue cohosh and smooth yellow violet, canadian white violet or downy yellow violet. Or partridge berry present on clay loam soils. ..... ACER-TSUGA SERIES (D)

4. Spinulose shield fern < twice as much coverage as the sum of the species in 4 above. Partridge berry extremely rare or absent, not a clay loam soil ..... ACER SERIES (E)

KEY TO SERIES GROUP III

III. Habitat with impeded drainage or excessive soil moisture throughout the growing season, or clay loam to claysoil with variable drainage. On mineral or organic soils with excessive soil moisture, if soil drying occurs it is limited to a short period in late summer. Group III understory vegetation is characterized by goldthread, bunchberry, common wood sorrel, palmate leaf sweet coltsfoot, spotted joe-pye weed, touch-me-not, partridge berry, sphagnum moss, naked miterwort, sedges, cinnamon fern and/or leatherleaf

1. Habitat on clay loam to clay texture soil. . . 2.

1. Habitat not as above ..... 4.

2. The sum of partridge berry and wild sarsaparilla > american fly honeysuckle; palmate leaf sweet coltsfoot, black snake root, spotted joe-pye weed/boneset, and touch-me-not must be absent or extremely rare ..... ACER-TSUGA SERIES (D)

2. Habitat not as above ..... 3.

3. Habitat with impeded drainage; spotted joe-pye weed/boneset, water hemlock, touch-me-not and/or dwarf enchanter's night shade common ..... FRAXINUS SERIES (G)*

3. Habitat understory vegetation not as in 3 above ..... TSUGA THUJA SERIES (F)*

4. The sum of sedges and mint > the sum of all other understory species present. Or touch-me-not and/or dwarf enchanter's nightshade common with sphagnum moss < 25% coverage ..... FRAXINUS SERIES (G)*

4. Habitat not as above ..... 5.

5. Habitat on mineral or shallow (<6") organic over mineral soil. The sum of goldthread, common wood sorrel, and bunchberry at least one half the sum of sphagnum moss[1], horsetail, cinnamon fern, marsh marigold, naked miterwort and twinflower ..... TSUGA SERIES (C)

5. Habitat with vegetation not as described in 5 above ..... 6.

6. The sum of goldthread, bunch berry, common wood sorrel, naked miterwort and twinflower > the sum of cinnamon fern, marsh marigold, leatherleaf, bog rosemary, and pale laurel ..... TSUGA-THUJA SERIES (F)*

6. Habitat not as above ..... PICEA SERIES (H)*

[1]Sphagnum moss. maybe replaced by other moss species when cedar overstory > 50%.

*Denotes series which contain habitat types that are not well defined and may be modified as more data is assimilated.

(A) KEY TO PINUS BANKSIANA-RESINOSA SERIES HABITAT TYPES

1. Hairgrass > sedges; spinulose shield fern usually absent	PINUS-VACCINIUM-DESCHAMPSIA Habitat Type
1. Hairgrass < sedges; spinulose shield fern often present	PINUS-VACCINIUM CAREX Habitat Type

(B) KEY TO ACER RUBRUM-QUERCUS RUBRA SERIES HABITAT TYPES

1. The sum of maple leaf viburnum, witch hazel and pointed leaved tick trefoil > the sum of low sweet blueberry and canada blueberry (habitat located in Wisconsin or near Michigan/Wisconsin border)	ACER-QUERCUS-VIBERNUM Habitat Type
1. Habitat understory vegetation not as in 1 above	2.
2. Trailing arbutus at least twice as much coverage as the sum of beaked hazel, wild sarsaparilla, and barren strawberry	QUERCUS-ACER-EPIGAEA Habitat Type
2. Trailing arbutus < twice the coverage of the species in 2 above	ACER-QUERCUS-VACCINIUM Habitat Type

(C) KEY TO TSUGA CANADENSIS SERIES HABITAT TYPE

1. Habitat must have evidence of impeded drainage; at least two of the following species present: goldthread, bunch berry, or common wood sorrel	TSUGA-MAIANTHEMUM-COPTIS Habitat Type
a) Blueberries common (Habitat usually located on lacustrine sand)	Vaccinium Phase
b) Spinulose shield fern > wild lily-of-the-valley; long beech fern, oak fern and/or hairy solomon's seal common	Dryopteris Phase
1. Habitat with no evidence of impeded drainage or understory vegetation not as in 1 above	2.
2. Canada blueberry, low sweet blueberry, and/or wood betony present	TSUGA-MAIANTHEUM-VACCINIUM Habitat Type
2. Canada blueberry, low sweet blueberry and/or wood betony absent or extremely rare	TSUGA-MAIANTHEMUM Habitat Type
a) Habitat on highly podzolized sand with good drainage; hairgrass present	Deschampsia Phase

(D) KEY TO ACER SACCHARUM-TSUGA CANADENSIS SERIES HABITAT TYPES

1. Habitat located on clay or clay loam soil; the sum of american fly honeysuckle and partridge berry > the sum of spinulose shield fern, sweet cicely, smooth yellow violet, canadian white violet, and downy yellow violet ..... TSUGA-ACER-MITCHELLA Habitat Type

   a) Habitat with localized impeded drainage; horsetail common..... Equisetum Phase

1. Habitat not as above..... ACER-TSUGA-DRYOPTERIS Habitat Type

   a) Habitat on highly podzolized sand with good drainage; hairgrass present; overstory often a conifer plantation ..... Deschampsia Phase

   b) Habitat type on highly podzolized sand with good drainage; lady fern, smooth yellow violet, canadian white violet, downy yellow violet, jack-in-the-pulpit, and/or rattlesnake fern absent or extremely rare ..... Dryopteris Phase

   c) Habitat with localized impeded drainage; the sum of touch-me-not and dwarf enchanter's nightshade > 5% coverage .... Circaea-Impatiens Phase

(E) KEY TO ACER SACCHARUM SERIES HABITAT TYPES

1. Habitat with apparent moisture and nutrient enrichment; blue cohosh common ..... ACER-OSMORIZA-CAULOPHYLLUM Habitat Type

1. Habitat not as above..... ACER-VIOLA-OSMORHIZA Habitat Type

   a) The sum of wild leek and maiden hair fern > 5% coverage ..... Adiantum Phase

   b) Habitat with localized impeded drainage; the sum of touch-me-not and dwarf enchanter's nightshade > 5% coverage .... Circaea Impatiens Phase

(F) KEY TO TSUGA CANADENSIS-THUJA OCCIDENTIALIS SERIES HABITAT TYPES

1. Habitat on clay soil with good surface drainage ..... 2.

1. Habitat on non-clay soil, often with excessive soil moisture ..... 3.

2. Habitat on well drained clay soil; palmate leaf sweet coltsfoot and/or black snakeroot absent ..... TSUGA-THUJA-LONICERA Habitat Type

2. Habitat on clay soil which may have localized impeded drainage; palmate leaf sweet coltsfoot, and/or black snakeroot present ..... TSUGA-THUJA-PETASITES Habitat Type

3. The sum of goldthread, bunch berry and common wood sorrel > the sum of naked miterwort, twin flower and fringed polygala ..... TSUGA-THUJA-SPHAGNUM Habitat Type

3. The sum of goldthread, bunch berry and common wood sorrel < the sum of naked miterwort, twinflower and fringed polygala ..... TSUGA-THUJA-MITELLA Habitat Type

(G) KEY TO FRAXINUS NIGRA SERIES HABITAT TYPES

1. Habitat on clay loam to clay soil; spotted joepye weed, boneset and/or water hemlock common ..... FRAXINUS-EUPATORIUM Habitat Type

1. Habitat not as above ..... 2.

2. The sum of sedges and mint > the sum of all other understory species present ..... FRAXINUS-MENTHA-CAREX Habitat Type

a) Habitat a floodplain with little or no overstory present ..... Carex Phase

2. Habitat not as above (often mineral soil, upland drainway) ..... FRAXINUS-IMPATIENS Habitat Type

a) Habitat usually having flowing water, marsh marigold common and sedges well represented ..... Caltha Phase

(H) KEY TO PICEA MARIANA SERIES HABITAT TYPE

1. Cinnamon fern > the sum of leatherleaf, bog rosemary and pale laurel ..... PICEA-OSMUNDA Habitat Type

1. Habitat typical non-productive acid bog; vegetation dominated by sphagnum moss; leatherleaf, bog rosemary and/or pale laurel well represented ..... PICEA-CHAMADAPHNE-SPHAGNUM Habitat Type

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Twinflower	Linnaea borealis	1-361	3-45
Twisted Stalk	Streptopus roseus	1- 53	3-46, 47
Violet, Canadian White	Viola canadensis	1-233	3-48
Violet, Downy Yellow	Viola pubescens	1-233	3-49
Violet, Smooth Yellow	Viola pensylvanica	1-235	3-50

COMMON NAME	SCIENTIFIC NAME	BK.-PG.	PLATE #
Water Hemlock	Cicuta maculata	1-259	3-51
Wild Leek	Allium tricoccum	1- 45	3-52
Wild Lily-of-the-Valley	Maianthemum canadense	1- 52	3-53
Wild Sarsaparilla	Aralia nudicaulis	1-247	3-54
Witch Hazel	Hamamelis virginiana	2-115	3-55
Wood Betony	Pedicularis canadensis	1-349	3-56
Wood Sorrel	Oxalis montana	1-213	3-57
Yellow Beadlily	Clintonia borealis	1- 48	3-58

List Prepared by Jim Ferris - March 1983

* * * * * *

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Voss, Edward G. 1972. Michigan Flora. First Edition. Cranbrook Institute of Science; Bloomfield Hills, Michigan. 488 pages. (Book No. 5).

BARREN STRAWBERRY
Waldsteinia fragarioides (Michx.) Tratt.

- Flowers yellow, leaves more obovate than strawberry or wood anemone.
- Usually found on sandy or clay soils following disturbance.

WILD STRAWBERRY

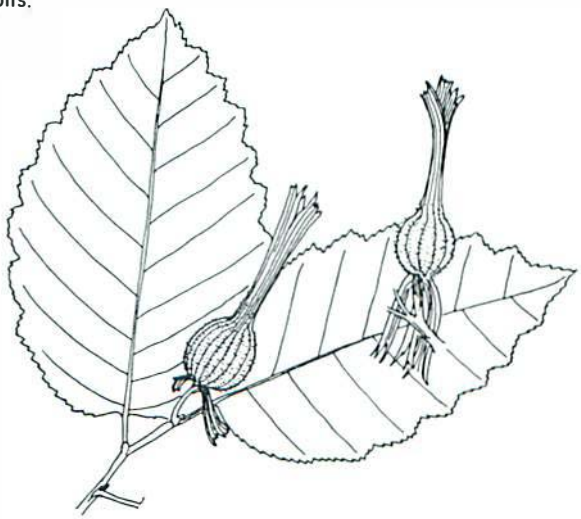
Fragaria virginiana Duchesne

- Leaves obovate, nearly lanceolate as distinguished from barren strawberry which has obovate, nearly orbicular leaves. Flowers are white for strawberry, yellow for barren strawberry.
- Found on nearly all upland sites after disturbance.

HAZEL (BEAKED HAZEL)

Corylus cornuta Marsh.

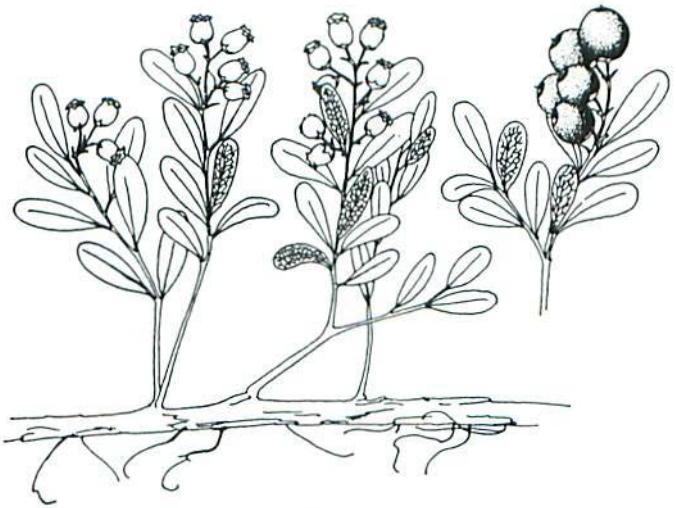
- Tall shrub up to 15 feet.
- Most common on fine sand or clay soils, but can be found on all upland soils.



BEARBERRY

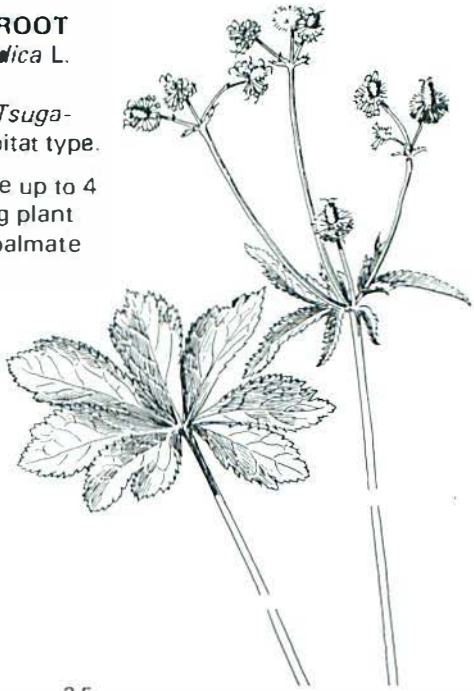
Arctostaphylos uva-ursi (L.) Spreng.

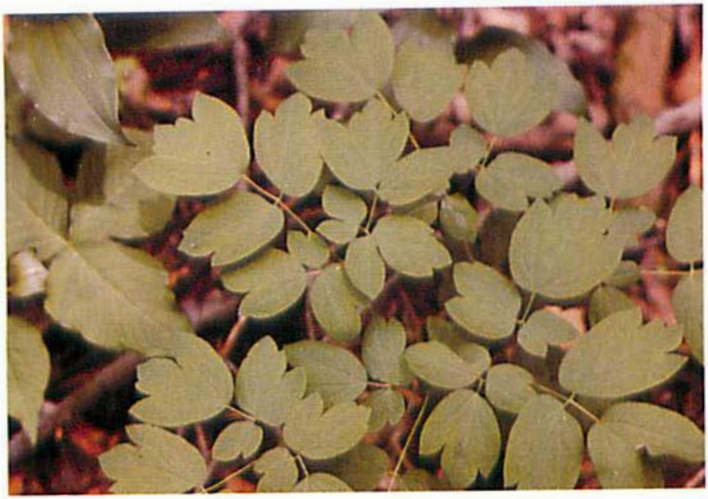
- Found on very dry sand plains.



BLACK SNAKEROOT
Sanicula marilandica L.

- Normally found on *Tsuga-Thuja-Petasites* habitat type.
- Fruiting plant will be up to 4 feet tall; non fruiting plant will consist of one palmate leaf.





BLUE COHOSH
Caulophyllum thalictroides (L.) Michx.

- Found on loam and silt loam soils.
- Indicates very good site.
- Begins to turn yellow in August, often hard to find in September.

CANADA BLUEBERRY

Vaccinium myrtilloides Michx.

- Twigs Pubescent
- Leaf margins entire
- Do not confuse this species with lowsweet blueberry and late low blueberry whose stem is glabrous and leaves are serrate.

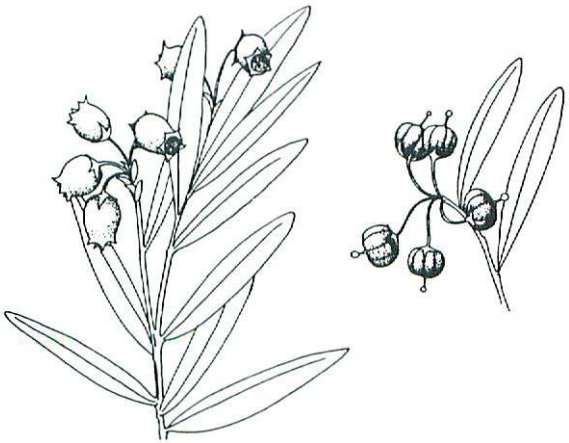
LOW SWEET BLUEBERRY

Vaccinium angustifolium (Ait.) Gray
Vaccinium pennsylvanicum Lam.

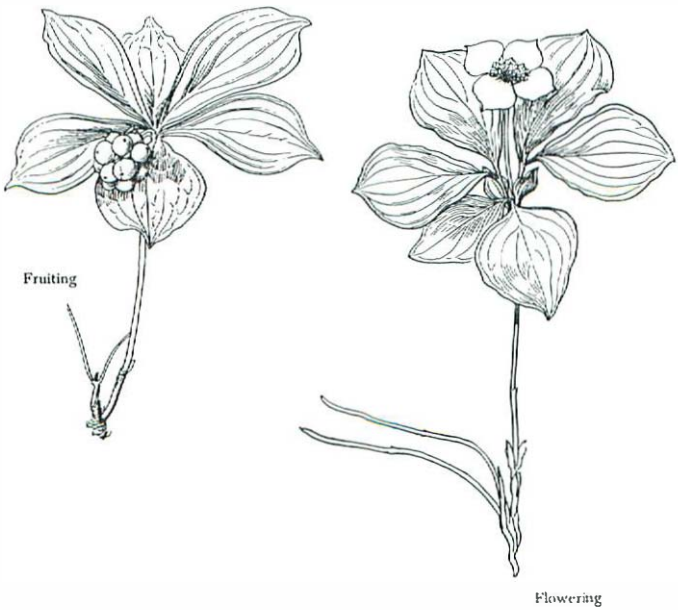
- Low shrub with glabrous green stems and leaves with finely serrate leaf margins as distinguished from canada blueberry which has pubescent stems and entire leaf margins.
- Difficult to distinguish from thin-leaved bilberry.
- Found on sandy soils.

BOG ROSEMARY
Andromeda glaucophylla Link.

- As name implies, found in bogs.



BUNCHBERRY
Cornus canadensis L.



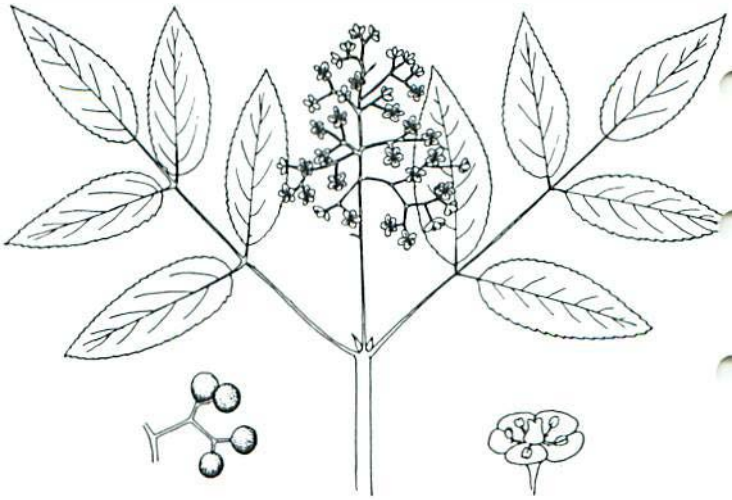
DWARF ENCHANTERS NIGHTSHADE

Circaea alpina L.

- Succulent in appearance.
- Found on rich somewhat poorly drained soils.

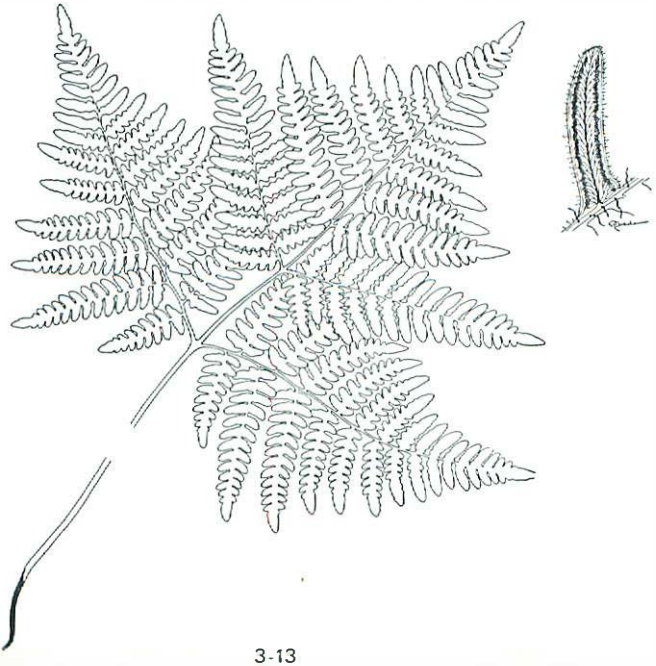
ELDERBERRY
Sambucus pubens Michx.

- Tall shrub up to 12 feet tall.
- Found on sandy loam to loam soils.



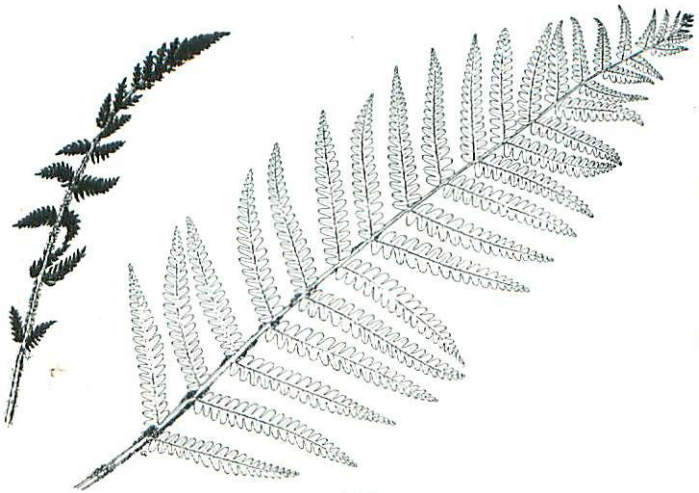
BRACKEN FERN

Pteridium aguilinum var. *latiusculum* (Brake)



CINNAMON FERN
Osmunda cinnamomea L.

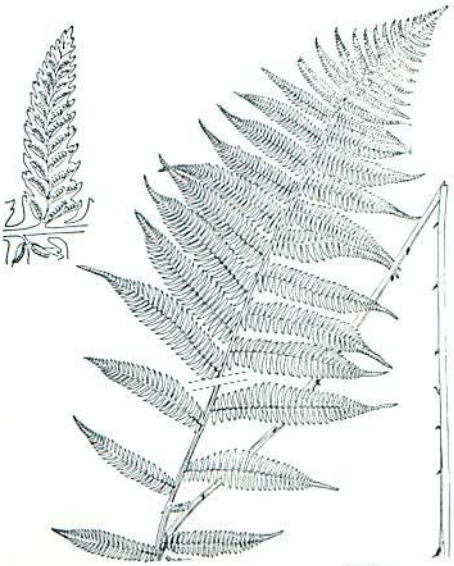
- Fertile fronds covered with rusty wool when young.
- Infertile fronds have tufts of tomentum at their bases.
- Found on poorly drained soils having standing water all summer.

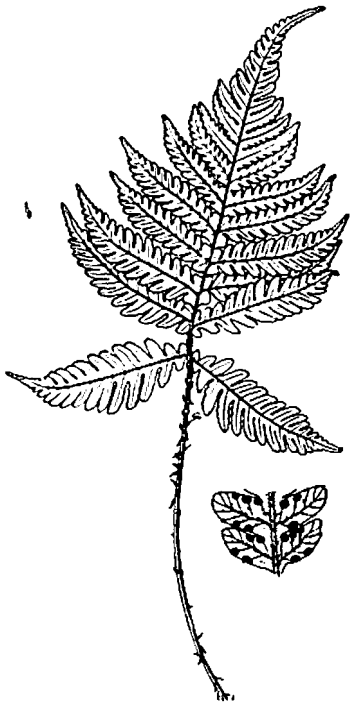


LADY FERN

Athyrium Felix-femina (L.) Roth

- Has the appearance of spinulose shield fern.
- All fronds die in winter, base of fronds scaly or nearly smooth with dark brown or reddish brown scales; as distinguished from spinulose shield fern which has some living fronds throughout the winter and has light brown scales at base of fronds.
- Found on moist sandy loam to silt loam soils.

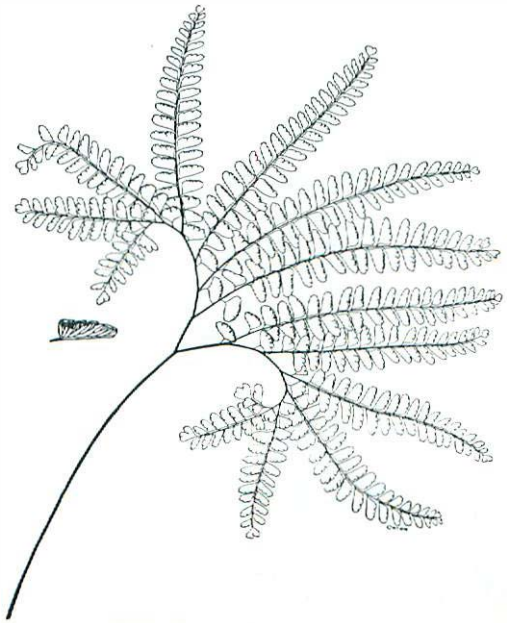




LONG BEECH FERN
Dryopteris phegopteris (L.) Christens.

- Much "heavier" in appearance than Oak Fern.

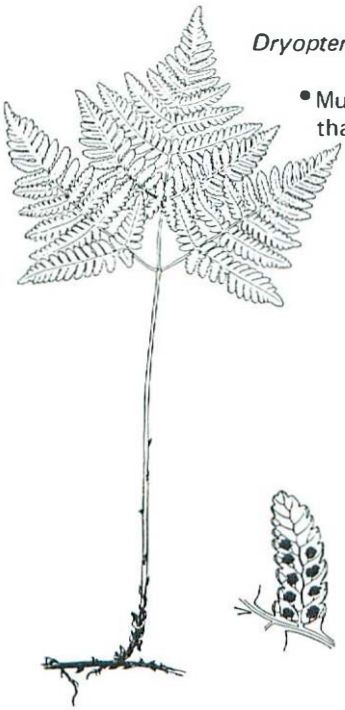
MAIDENHAIR FERN
Adiantum pedatum L.



OAK FERN

Dryopteris disjuncta (Ledeb.) C.V. Morton

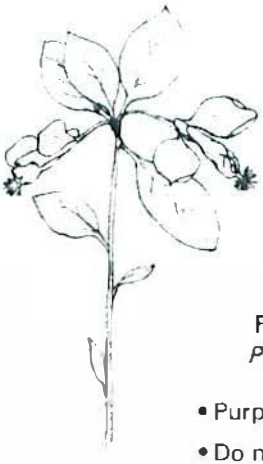
- Much more "delicate" in appearance than Long Beech Fern.



RATTLESNAKE FERN
Botrychium virginianum (L) SW.

SPINULOSE SHIELD FERN
Dryopteris spinulosa (O.F. Müll.) Watt.

- Scales on base of fronds are light brown as distinguished from lady fern which has dark brown or reddish brown scales.
- Some fronds remain alive during winter - they do not for lady fern.



FRINGED POLYGALA

Polygala paucifolia willd.

- Purple flower in the spring.
- Do not confuse this species with wood anemone in the color plate. Leaves of polygala are entire while those of wood anemone are sharply toothed.

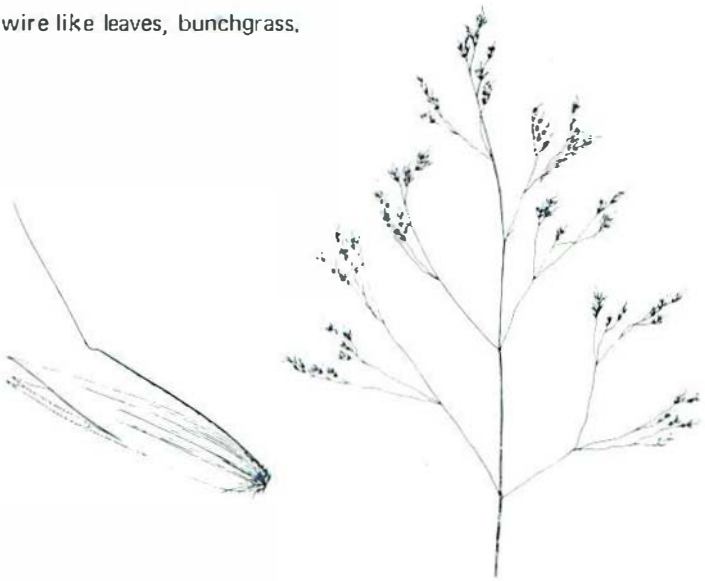
GOLD THREAD
Coptis groenlandica (Oeder) Fern.

- Has golden yellow threadlike rootstalk.
- Some similarity to barren strawberry except smaller and has white flower.
- Found on acid and somewhat poorly drained soils - *Tsuga-maianthemum-coptis* habitat type.

HAIR GRASS

Deschampsia flexuosa

- Fine, wire like leaves, bunchgrass.



AMERICAN FLY HONEYSUCKLE

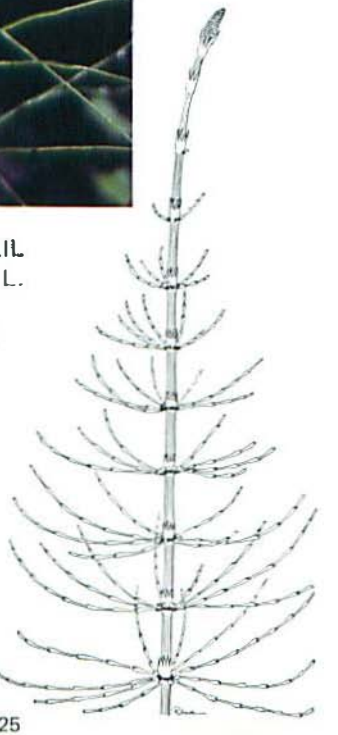
Lonicera canadensis Marsh

- Pubescent under leaves when young, nearly glabrous when mature.
- Typically spreading on *Tsuga-Thuja-Lonicera* and *Acer-Dryopteris-lonicera* habitat types. Upright on all other habitat types.

MARSH HORSETAIL

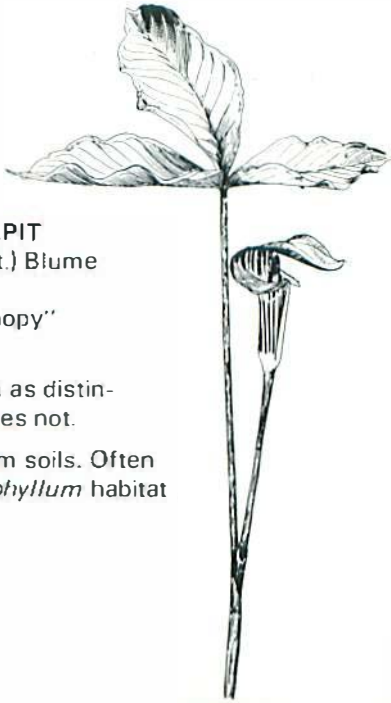
Equisetum palustre L.

- Found on poorly to somewhat poorly drained soils.



WATER HORSETAIL
Equisetium fluviatile

- Found on poorly drained soils.



JACK-IN-THE-PULPIT
Arisaema atrorubens (Ait.) Blume

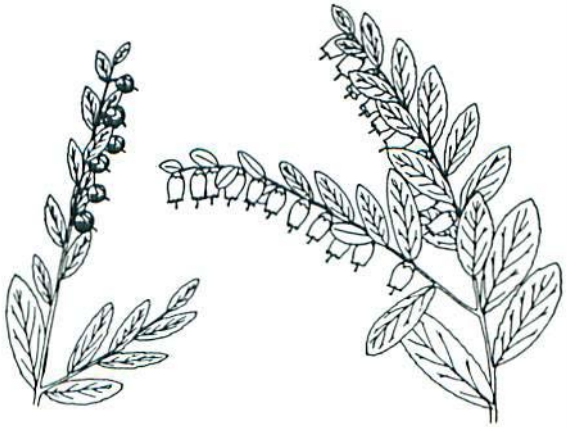
- Flower forms a "pulpit and canopy" appearance.
- Venation jointed at leaf margin as distinguished from trillium which does not.
- Found on most loam or silt loam soils. Often on the *Acer-Osmorhiza-Caulophyllum* habitat type.

JEWELWEED (SPOTTED TOUCH-ME-NOT)
Impatiens capensis Meerb.

- Succulent, quickly wilting, many branched up to 6 feet tall. Usually 1 foot tall.
- Found on somewhat poorly drained soils- *Fraxinus Impatiens* habitat type.

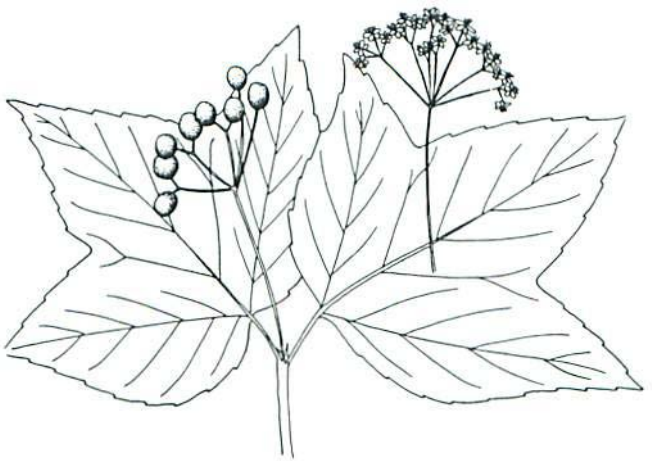
LEATHER LEAF
Chamaedaphne calyculata (L.) Moench.

- Found in Bogs.



MAPLELEAF VIBURNUM
Viburnum acerifolium L.

- Leaf has a maple shape.
- Tall shrub 3-6 feet tall.



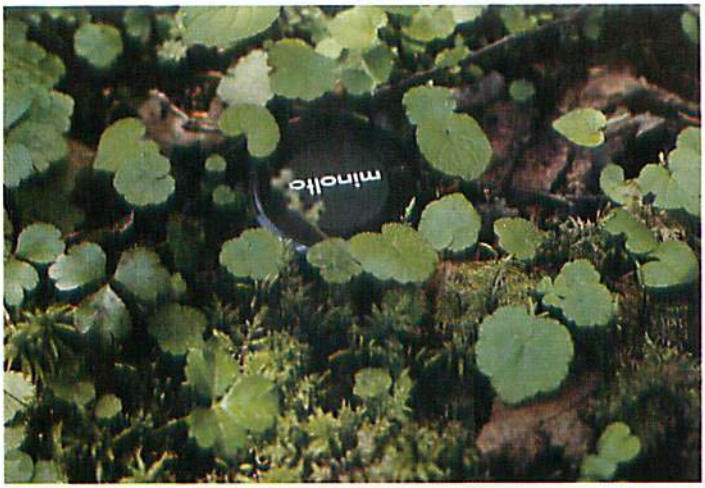
MARSH MARIGOLD
COWSLIP
Caltha palustris L.

- Found on poorly drained soils.

AMERICAN WILD MINT

Mentha arvensis L.

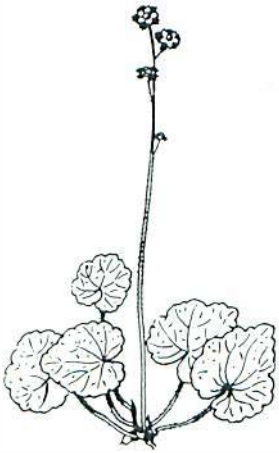
- Flowers lilac or pinkish, born in dense clusters in the leaf axils.



NAKED MITERWORT

Mitella nuda L.

- Scattered, stiff, short hairs on both sides of leaves.
- The naked miterwort in color plate is in the four to seven o'clock position on the camera lens cap.



PALE (BOG) LAUREL
Kalmia polifolia wang.

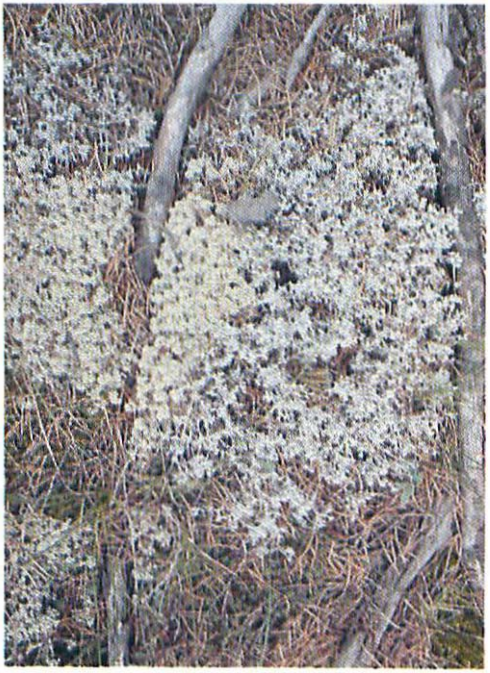
- As name implies, found in bogs.

PALMATE-LEAF SWEET COLTSFOOT

Petasites palmatus

- Found on damp clay soils.

PARTRIDGE-BERRY
Mitchella repens L.



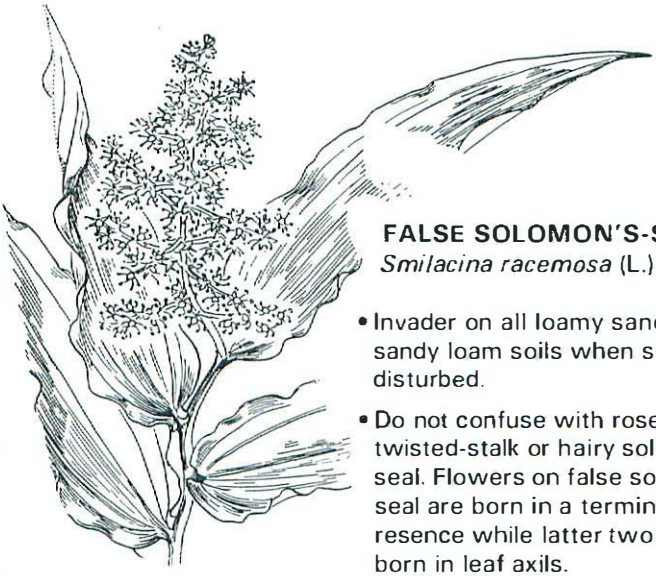
BLUE CLADONIA (left)
Cladonia mitis sandst.

REINDEER MOSS (right)
Cladonia rangiferina (L.) Wigg.

- Found on dry sand plains.
- Blue cladonia typically has a bluish green hue while reindeer moss is a ash gray.

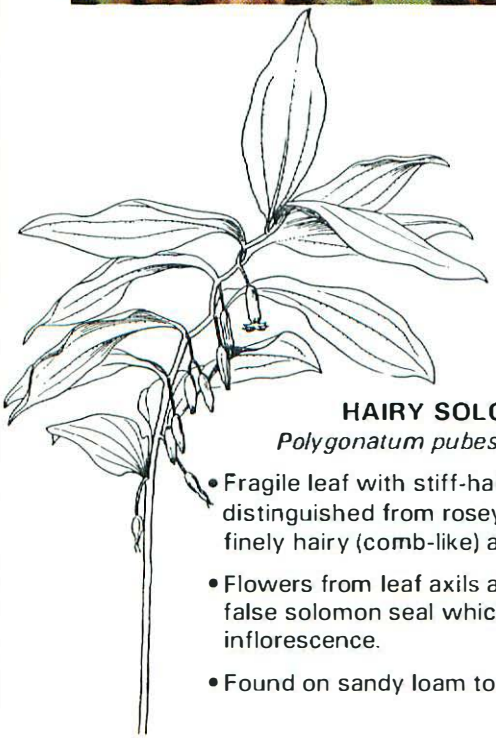
CAREX (SEDGE)
CAREX spp.

- Species undifferentiated at this time.
- Sedges can be separated from grasses by angular basal stems and three ranked leaves.



FALSE SOLOMON'S-SEAL
Smilacina racemosa (L.) Desf.

- Invader on all loamy sand to sandy loam soils when site disturbed.
- Do not confuse with rosey twisted-stalk or hairy solomon seal. Flowers on false solomon seal are born in a terminal inflorescence while latter two are born in leaf axils.



HAIRY SOLOMON SEAL

Polygonatum pubescens (Willd.) Pursh

- Fragile leaf with stiff-hair along veins beneath as distinguished from rosey twisted-stalk which is finely hairy (comb-like) along leaf margin.
- Flowers from leaf axils as distinguished from false solomon seal which flowers in a terminal inflorescence.
- Found on sandy loam to silt soils.

SPOTTED JOE-PYE WEED

Eupatorium purpureum L.

- Tall perennial up to six feet.
- Found on wet clays.

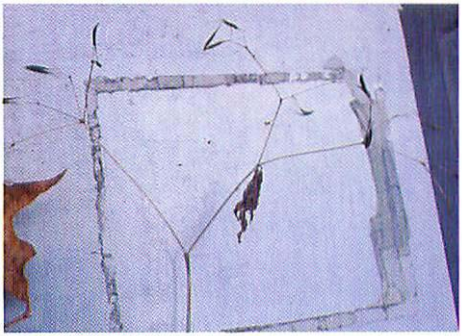
BONESET

Eupatorium perfoliatum L.

- Found on poorly drained clay soils.

SWEET CICELY (early spring)
Osmorhiza claytoni (Michx.) C.B. Clark

- Can be confused with white baneberry.
- Somewhat pubescent compound (3's to 5's) leaves.
- White flowers in spring.
- Found on sandy loam to silt loam soils on better sites.

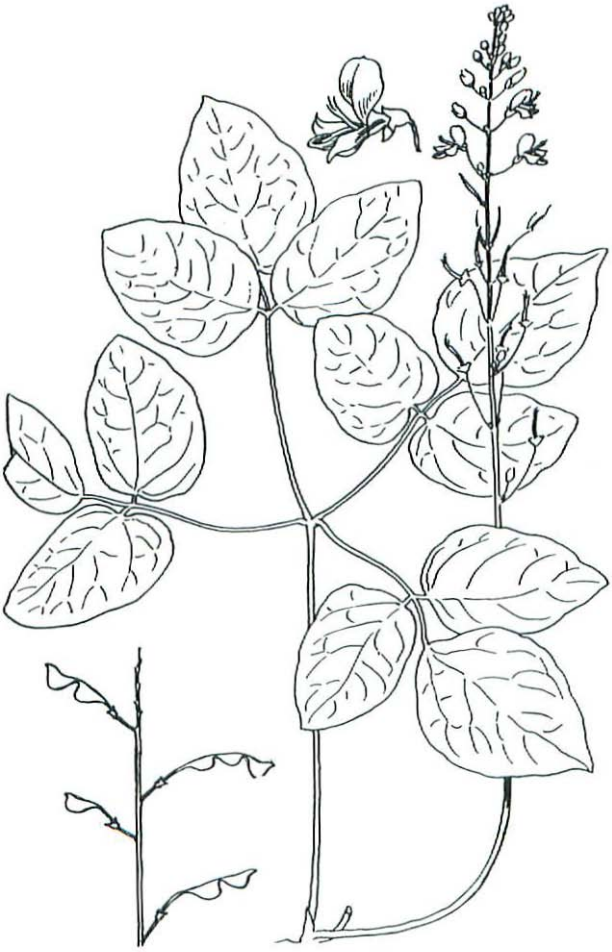


SWEET CICELY (late summer, early fall)

- Fruit linear, black, with slender ribs covered with stiff, upward-pointing appressed bristles that will cause seed, when mature, to catch on clothing.
- Mature plant dies in late summer, but new basal leaves develop that remain green throughout the winter and spring.

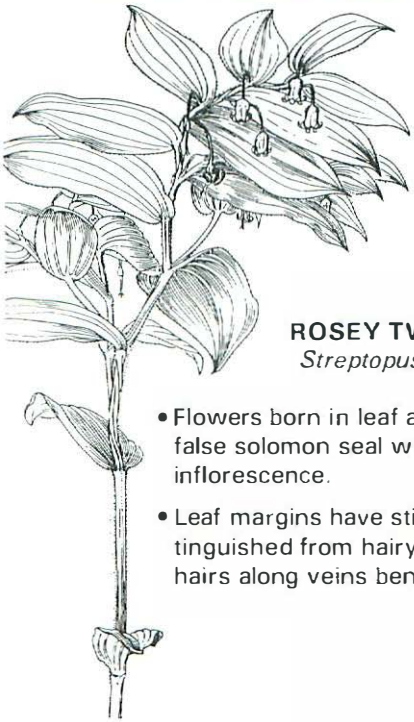
TRAILING ARBUTUS
Epigaea repens L.

- Prostrate plant.
- Found on dry sandy soils.



POINTED-LEAVED TICK TREFOIL
Desmodium glutinosum (Muhl) Wood

TWINFLOWER
Linnaea borealis L.



ROSEY TWISTED-STALK
Streptopus roseus Michx.

- Flowers born in leaf axils as distinguished from false solomon seal which are born in a terminal inflorescence.
- Leaf margins have stiff hairs (comb-like) as distinguished from hairy solomon-seal which have hairs along veins beneath leaf.

FALSE SOLOMON-SEAL (right)
Smilacena racemosa

ROSEY TWISTED-STALK (left)
Streptopus roseus

HAIRY SOLOMON'S SEAL (center)
Polygonatum pubescens

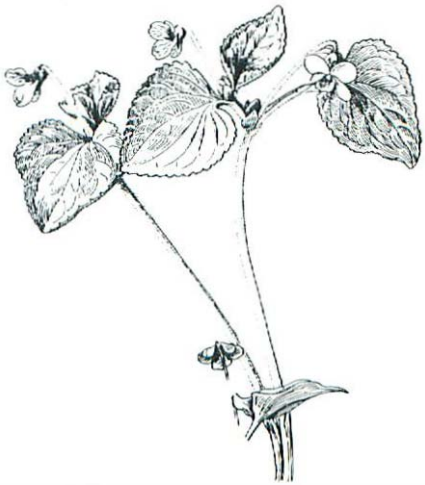
CANADIAN WHITE VIOLET

Viola canadensis L.

- Branched from the stem as with the two yellow violets, but with a white flower and more "delicate" in appearance.
- Leaves are more pointed than the two yellow violets.

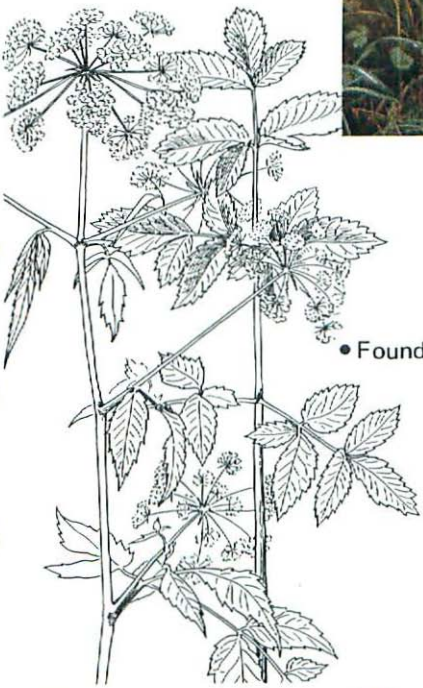
DOWNY VIOLET
Viola pubescens Ait.

- Downy stem, leaves, and seed capsule. Has no basal leaves.
- Should not be confused with smooth yellow violet whose stem and leaves are glabrous and has basal leaves.
- Found on loam, silt, and clay soils.



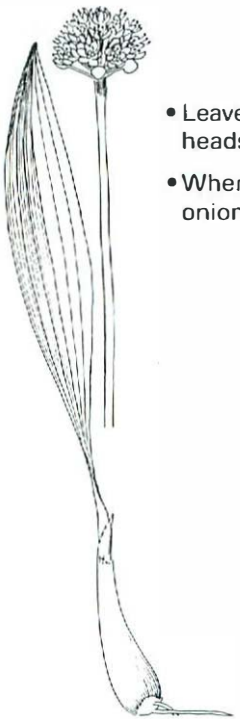
SMOOTH YELLOW VIOLET
Viola Pensylvanica Michx.

- Multi branched glabrous violet having basal leaves as distinguished from downy violet which is pubescent and does not have basal leaves.
- Similar to canada violet which has white flowers and is found on similar site.
- Found on sandy loam to clay soils.



WATER HEMLOCK
Cicuta maculata L.

- Found on wet, poorly drained soils.

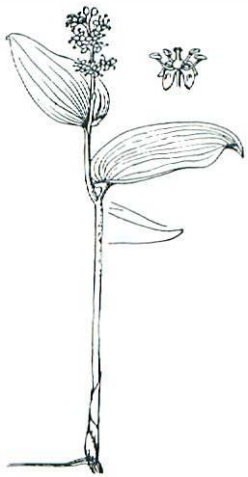


WILD LEEK
Allium tricoccum Ait.

- Leaves die and dissappear by mid-June but seed heads remain visible all summer.
- When leaves are crushed they emit a strong onion odor.

WILD LILY-OF-THE-VALLEY
Maianthemum canadense Desf.

- Single leaf when not fruiting, two leafs when fruiting.

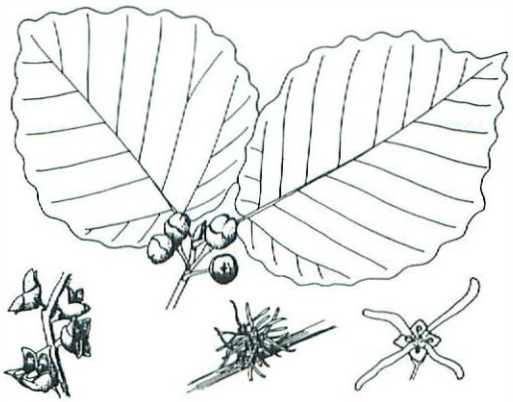


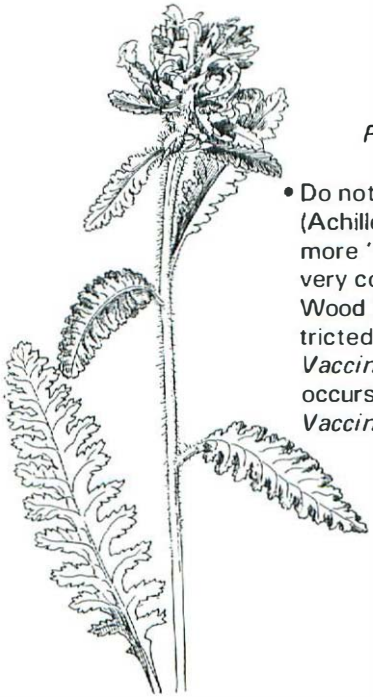
WILD SARSAPARILLA
Aralia nudicaulis L.

- Fruit born on a single stem from base of plant.

COMMON WITCH HAZEL
Hamamelis virginiana L.

- Tall shrub.
- Flowers in the fall.

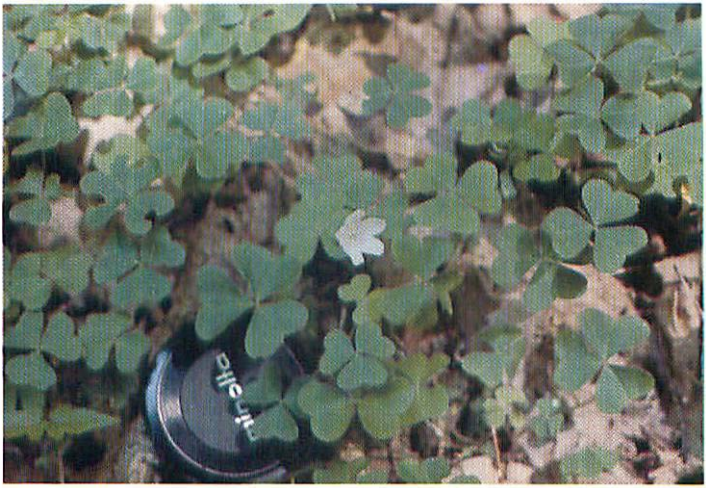




WOOD BETONY

Pedicularis canadensis L.

- Do not confuse with common yarrow (Achillea millefolium) which is much more "delicate" in appearance and is very common throughout the area. Wood betony is almost entirely restricted to the *Tsuga-Maianthemum-Vaccinium* habitat type. It rarely occurs on the *Acer-Quercus-Vaccinium* habitat types.



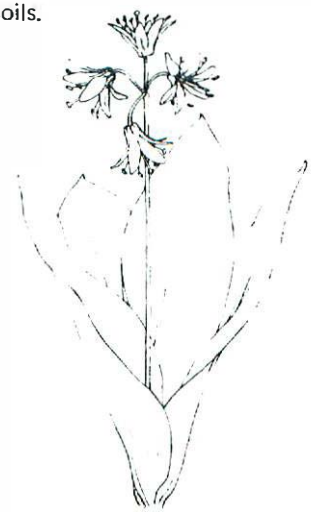
WOOD SORREL
Oxalis montana Raf.

- White flower in spring.
- Found on somewhat poorly to poorly drained soils.

YELLOW BEADLILY

Clintonia borealis (A.T.) Raf.

- Flowers yellow.
- Found on sandy loam to clay soils.



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SUCCESSIONAL RELATIONSHIPS BY HABITAT TYPE

Because the habitat type classification system is based on the climax association, *SUCCESSIONAL STAGES*[1] within a given habitat type can be identified and the *SERE*[2] for that habitat type determined. The successional relationships exhibited in the following schematic diagrams were developed by reviewing the range of forest cover types found on given habitat type and the direction of succession within each cover type/habitat type combination. This assumes that the habitat type remains unchanging and will always produce the same climax association if given sufficient time. The direction of succession was determined by noting the species of the smaller diameter classes within each cover type/habitat type combination. By correlating overstory/understory interactions with knowledge of light, moisture, and nutrient requirement of each species the basic successional relationships could be determined.

It should be noted that *THE PRECISE SUCCESSIONAL RELATIONSHIPS HAVE NOT BEEN FULLY DEVELOPED.* Field data used in classifying the habitat types were also used in developing the following schematic diagrams. Although the data was collected so that it could be used for determining successional relationships, there has been insufficient time to fully analyze this information. Since the schematic diagrams were developed using only tabular information for each stand, specific details of the diagrams could change with a more through examination of the data.

[1] Any floristically or structually distinctive segment of a sere is termed a successional or seral stage even though the transition from one stage to another is always part of a gradual process rather than an event.

[2] All temporary communities in the sequence of succession are collectively referred to as a sere (or chrono sequence).

By reviewing the schematic diagrams the user can determine probable seres and the rate of transition back to climax starting from a given cover type/habitat type combination. Since some cover types are found on several habitat types, the schematic diagrams (along with other descriptive information in this field guide) help to unravel the confusing data often resulting when stands are inventoried or treated by cover type alone. A given cover type may have a different successional pathway on one habitat type compared to another and therefore may react differently to the same treatment. Volume growth and other descriptive information will also be different.

In using the schematic diagrams there are certain factors of which the user must be aware. First, *THE INITIAL SERAL STAGE FOLLOWING DISTURBANCE IS A RESULT OF THE COMBINATION OF THE TYPE OF DISTURBANCE, TIME OF DISTURBANCE, AVAILABLE SEED SOURCE, AVAILABLE SEED, ABILITY OF THE SPECIES IN THE INITIAL STAND TO SPROUT OR SUCKER, AND CLIMATE JUST PRIOR TO, DURING, AND IMMEDIATELY FOLLOWING THE DISTURBANCE.* For instance, the typical climax stand on the *Tsuga-Maianthemum* Association (habitat type) is comprised of approximately 50 to 80% eastern hemlock, 15 to 40% sugar and red maple and the remainder of yellow birch and small amounts of basswood, ironwood, white spruce, balsam fir, northern red oak, white pine, and northern white cedar. Because eastern hemlock produces above normal seedcrops only every 3 to 7 years (grosbeaks, etc., consume most seed in average seed year) seed availability is low even though seed source is high. Furthermore, adequate germination and initial survival of a eastern hemlock will occur only when the above normal seed crops are followed by a warm moist spring and a cool wet summer. Finally,

adequate survival depends on several years of above normal precipitation. Since this combination occurs infrequently(possiblyevery 50 to 100 years) little hemlock regeneration exists under a hemlock stand. Conversely, maple consistently produces good seed crops, and the seed germinates and survives under 'normal' conditions. Therefore, there are usually 500-3000 maple seedlings under a hemlock stand. Although these seedlings only live 4 to 6 years before the dense shade kills them, there are always ample maple seedlings available. Similar relations also exist for the species occuring in lower numbers. (there are always a few yellow birch seedlings on rotting logs, etc.) If the old growth climax hemlock stand is clearcut an even aged stand of seed origin maple develops. The proportion of yellow birch and other species in the second growth stand depends on the exact conditions at the time of cutting, seed availability, and amount of advanced regeneration.

Conversely, if the same climax stand had been blown down a variable density stand of seed origin maple etc. would develop. If this second origin growth stand is later clearcut a stump sprout origin maple stand will probably result with a higher composition of balsam fir and white spruce (again depending on seed source, availability, etc.) If cut and burned a mixture of aspen, white birch, and spruce fir will result, again depending on the severity of the fire, seed source/availability, etc.

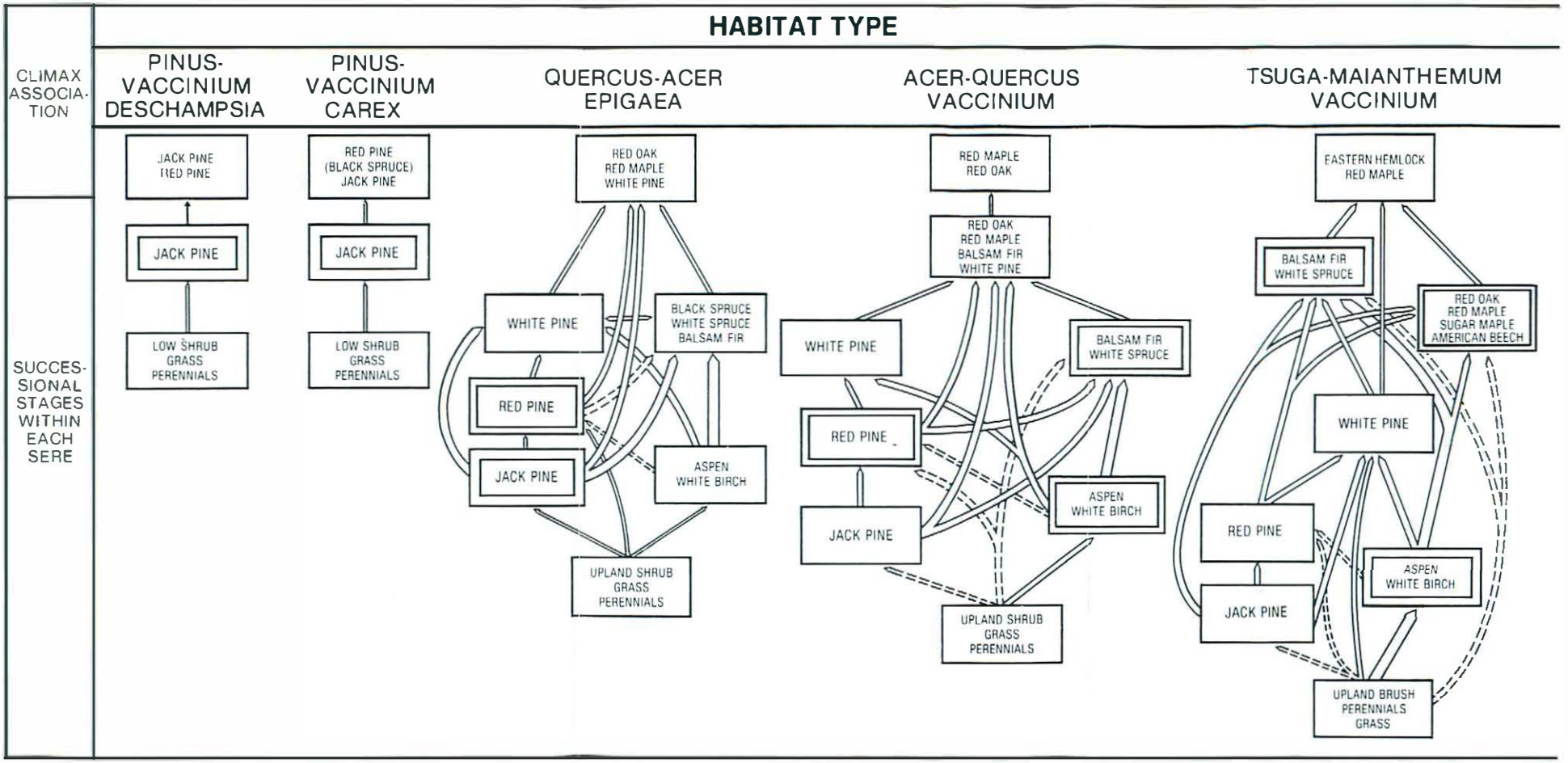
In addition, many of the same factors determine the successional pathway back to climax once retrogression has occurred. Aspen/birch on the *Tsuga-Maianthemum* habitat type will typically succeed to spruce/fir quickly. However, if the spruce/fir seed source does not exist, or conditions were more favorable to northern hardwoods, aspen will succeed directly to maple/yellow birch. This complexity in possibilities exists all the way back to climax with more shade tolerant/competitive species replacing less tolerant/competitive species.

The user should also be aware that each successional stage does not abruptly succeed to the next higher one as depicted on the schematic diagrams. Rather it is a continuous flow from one into another and species from lower seral stages can also be found in much higher stages. Additionally, species from one sere with a habitat type may also be found in another.

The purpose of this discussion is to show that succession is very complex and variable. It is not totally unpredictable however. *THE KEY IN EACH STEP OF RETROGRESSION OR SUCCESSION CENTERS AROUND TYPE OF DISTURBANCE, SEVERITY OF DISTURBANCE, AND SEED AVAILABILITY. THESE ARE FACTORS THE LAND MANAGER HAS SOME CONTROL OVER, AND WITH A PROPER UNDERSTANDING OF SPECIFIC SILVICULTURE PROCEDURES CAN EXERT VARYING CONTROL OVER RETROGRESSION AND SUCCESSION ON A SPECIFIC HABITAT TYPE.* Once these silviculture systems are fully developed, manpower, equipment, energy, costs, and returns associated with the silvicultural operations can be determined so that management alternatives can be evaluated.

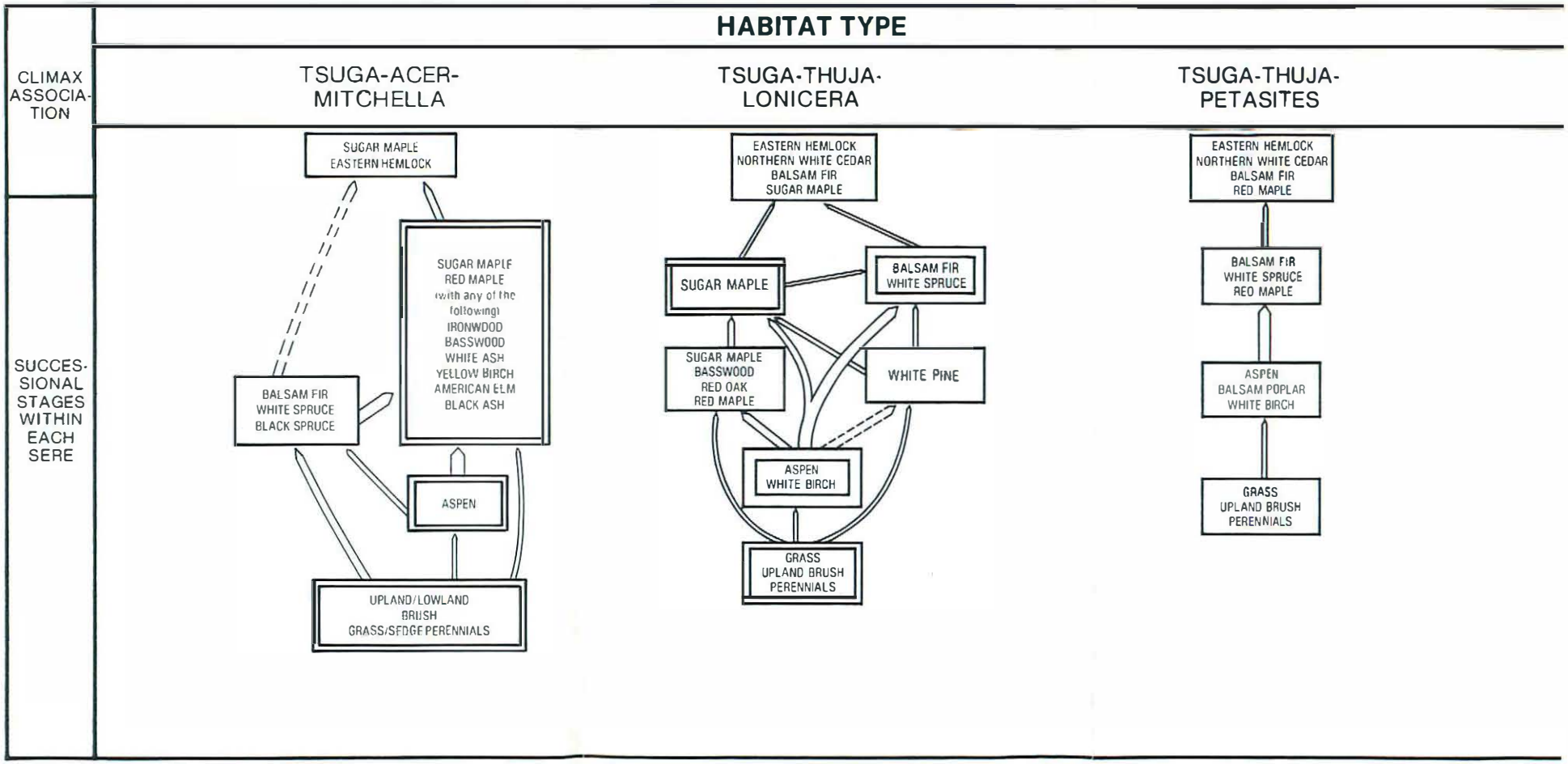
Finally, it should be noted that the climax associations depicted for sandy soils have not been observed in the field. Because of natural fire history, these habitat types normally do not succeed beyond the fire disclimax stage of pine. However, successional direction noted within advanced cover types for each of the habitat types suggest that the depicted climax associations represent what will happen naturally. Black spruce is listed as a climax species within the *Pinus-Vaccinium-Carex* habitat type because it was found in the understory of jack pine, red pine and aspen so frequently. Whether it is actually a climax component is uncertain. There is presently no literature available to support this conclusion.

SUCCESSIONAL STAGES OF PROBABLE SERES FOR EACH HABITAT TYPE COMMONLY FOUND ON SANDY SOILS



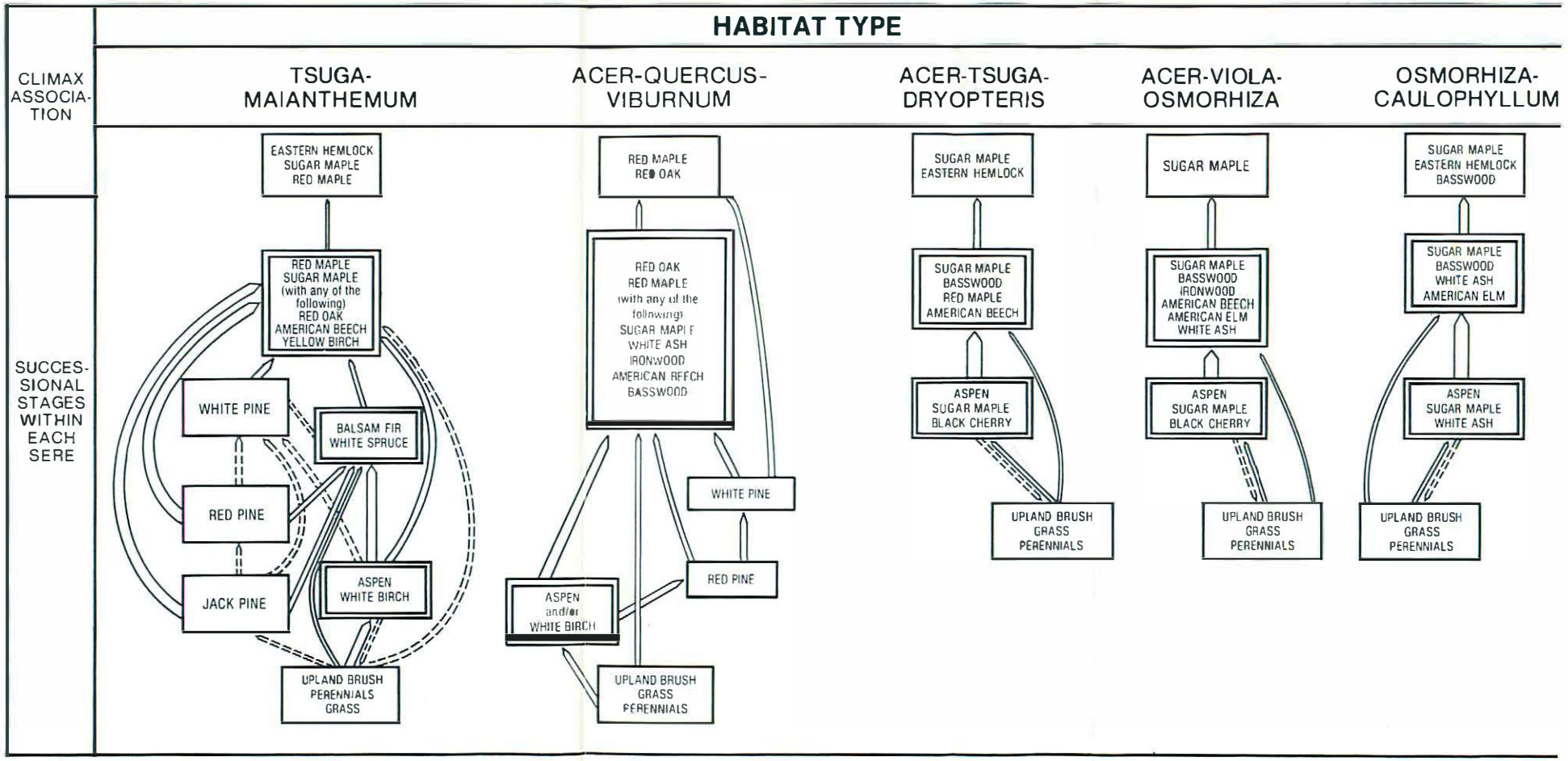
- The thicker the arrows, the faster the rate of succession from one stage to the next. Dashed arrows indicate possible, but improbable paths.
- Double-lined boxes represent the most common successional stages for that habitat type in the upper peninsula of Michigan. The wider the spacing between lines, the more common that successional stage.

SUCCESSIONAL STAGES OF PROBABLE SERES FOR EACH HABITAT TYPE COMMONLY FOUND ON SILT TO CLAY SOILS



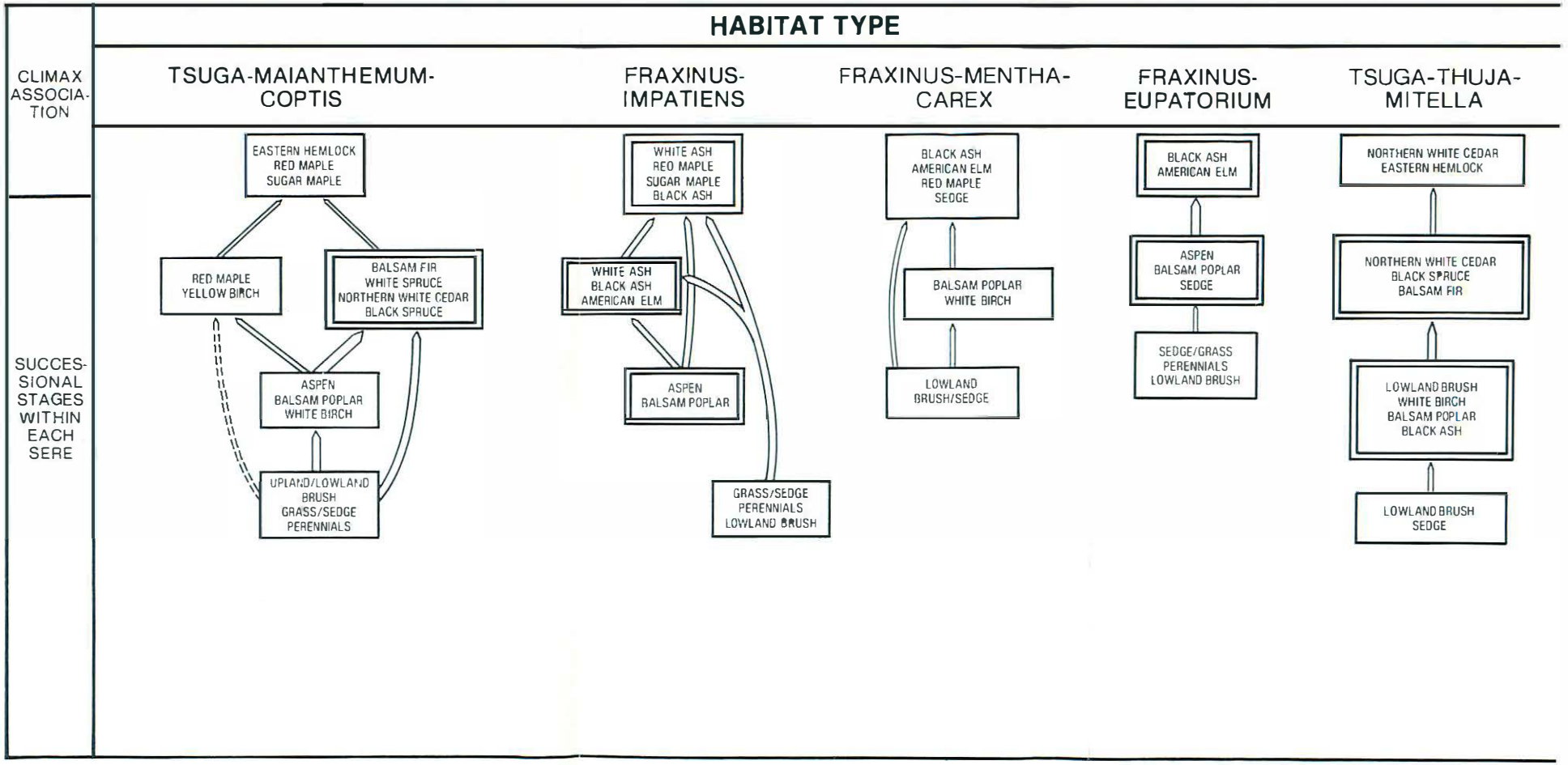
- The thicker the arrows, the faster the rate of succession from one stage to the next. Dashed arrows indicate possible, but improbable paths.
- Double-lined boxes represent the most common successional stages for that habitat type in the upper peninsula of Michigan. The wider the spacing between lines, the more common that successional stage.

SUCCESSIONAL STAGES OF PROBABLE SERES FOR EACH HABITAT TYPE COMMONLY FOUND ON LOAMY SOILS



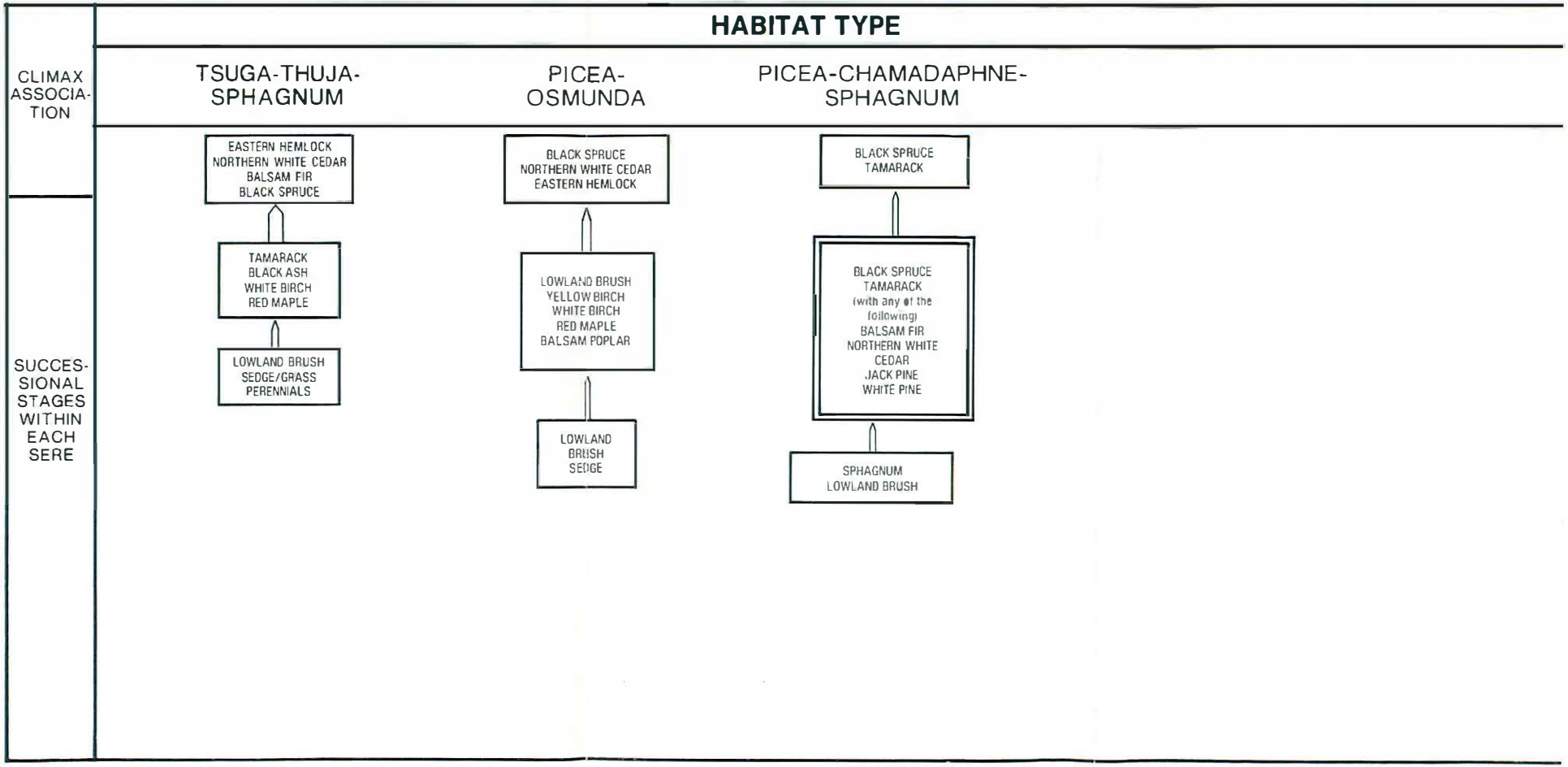
- The thicker the arrows, the faster the rate of succession from one stage to the next. Dashed arrows indicate possible, but improbable paths.
- Double-lined boxes represent the most common successional stages for that habitat type in the upper peninsula of Michigan. The wider the spacing between lines, the more common that successional stage.

SUCCESSIONAL STAGES OF PROBABLE SERES FOR EACH HABITAT TYPE COMMONLY FOUND ON SOILS HAVING IMPEDED DRAINAGE



- The thicker the arrows, the faster the rate of succession from one stage to the next. Dashed arrows indicate possible, but improbable paths.
- Double-lined boxes represent the most common successional stages for that habitat type in the upper peninsula of Michigan. The wider the spacing between lines, the more common that successional stage.

IMPEDED DRAINAGE CONT'D.



- The thicker the arrows, the faster the rate of succession from one stage to the next. Dashed arrows indicate possible, but improbable paths.
- Double-lined boxes represent the most common successional stages for that habitat type in the upper peninsula of Michigan. The wider the spacing between lines, the more common that successional stage.

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SUMMARY INFORMATION BY HABITAT TYPE AND SPECIES

Summary tables, site index, mean annual growth, and figures for vegetation distribution, site information, and periodic annual growth are included for easy comparision of each measure within all species habitat combination. Additional summary tables and figures using different measures will be included as they are developed. These tables and figures provide an easy reference for determining site potential for each species normally found as a successional stage within each habitat type. Additionally the tables and figures can be used to allow productivity comparisions between species within a habitat type, and between habitat types for the same species. Figures 5.11 and 5.12 are specifically for red pine which allow the user to evaluate plantation performance and to accurately predict long term (40 year) site index and volume growth.

There are restrictions as to the accuracy of this data and how it should be used. These restrictions will be discussed under the heading for each table or figure in this section.

GROUNDFLORA DISTRIBUTION (Table 5.1)

The data presented on groundflora comes from over 2500 sample plots within nearly all cover types found in the Upper Peninsula of Michigan and Northeastern Wisconsin. The bulk of the data comes from the Western half of the Upper Peninsula of Michigan, but sufficient sampling has been accomplished in Northeastern Wisconsin and the Eastern half of the Upper Peninsula of Michigan to show that the vegetative distribution is consistent within a habitat type across the Region. However, minor regional differences do occur, and since most of the data is from the Western U.P., the data will be most reliable for this area. If these deviations are found to be important for management interpretations they will be so noted in future printings.

Table 5.1 provides a variety of habitat characteristics that can be useful to the land manager in understanding or in identifying a specific habitat type. The table is divided up into the three groups used in the first separation of the habitat type key. The cover types and broad soil groups that are characteristically found on each habitat type are also given. For instance, both the Acer-Viola-Osmorhiza (AVO) and Tsuga-Maianthemum (TM) habitat types are found in Group II. The northern hardwood cover type can commonly be found on both. However, aspen is normally found on the AVO habitat type only as a mixed aspen/-hardwood type but it is commonly found as an aspen/birch type on the TM h.t. Spruce/fir is also a common cover type on the TM h.t. but not on the AVO h.t. Soils of the AVO h.t. are usually sandy loam to silt loam in texture, and because they are found on Group II usually have good drainage. Conversely, soils on the TM h.t. are usually a fine sand to loamy sand, or a sand that has well developed Bhir horizons. Other cover types and soil types can also be found on these habitat types but they are normally not as common as those listed.

Use of the table. A groundflora or shrub species listed in Table 5.1 for a specific habitat type means that species will be found on that habitat type *at least* 75 percent of the time. It can also be found on closely related habitat types for which it is not listed, but not as commonly. When it is found, it has an average coverage as noted in the table. This table can be of help to the user in two ways: 1) in understanding the full range of species that are commonly found (i.e. >75% of the time) on a habitat type, and 2) to aid in identifying highly disturbed habitat types that are difficult to identify using the key alone. For example, you may find two aspen stands in which the common indicator species are absent or confusing. In the example, sampling may have revealed that both stands have a site index of 60 feet (50 year basis) and both have greater than 25 percent coverage of bracken fern with some beaked hazelnut. The first stand also has some bedstraw, wild leek, bellworts, and occassional clumps

of maidenhair fern. Conversely, the second stand has none of the latter species but does have some cow wheat, sweet fern, large leaved aster, and wild sarsaparilla. By finding the relative positions of these species in this table it is apparent that the two stands are on widely different habitat types. The first stand is in Group II and is probably an ATD, AVO, or AOC h.t. while the second is in Group I and is probably a QAE, AQVac. or TMV habitat type. The first aspen stand should have a relatively high proportion of sugar maple mixed in the aspen, while the second stand has very little sugar maple, but may have some red maple or red oak. If the soils are known, the first will have sandy loam or silt loam texture, while the second will be a sand or a thin loamy cap over sand and gravel. By referring to the Habitat Type Descriptions (Section 6) it is highly probable that the first stand is on an AVO and the second an AQVac. habitat type. By inference the low site index of the first stand is probably the result of factors other than site potential. A serious error would have resulted if the user had assumed both stands to be on the same site simply because both had the same site index!

SITE INDEX (Table 5.2)

Data given on site index represents the range of one standard deviation from the mean where sufficient data has been taken to make such an estimate. Where insufficient data has been taken, these ranges were estimated and therefore will change somewhat as additional information is collected. The ranges represent data collected from dominant or codominant trees in normally stocked stands that met the exacting requirements of a site index tree: no evidence of past suppression or excessive growing room, no damage or tree abnormalities present, etc. Heights were taken with a clinometer at known distances, and ages with increment cores - visually in the lab under good light conditions.

Several difficulties were (and will be) encountered that reduce the reliability of these results. First, in northern hardwood stands, very few trees meet the exacting requirements to be considered a site tree. Standards were relaxed slightly to get some site trees, but it is unknown how much this affected site index. Second, although height measurements were taken as accurately as possible, tops of hardwood crowns are difficult to see and errors in determining the exact top of the tree occurred. Differences of 5 feet were noted (in 50 to 60 foot trees) when heights were determined from different vantage points. Much larger errors have been observed in height measures taken by 'typical' field foresters. Third, correct age determination is extremely difficult for some hardwood species. Differences of 3 to 10 years between age counts of the same core are not uncommon when attempted in the field. Although cores were taken into the lab (using binocular microscopes and good light) and several counts taken, some error is inevitable. These errors may have increased the variance more than may actually exist.

Errors are present in this data even though extreme caution was taken. Experience indicates that these errors are much larger when the 'typical' field forester determines site index in cruising or inventory work. While it has been noted that this data has greater variability within habitats than reported in the tables, the mean site index for species within each habitat type is usually with the range given in the table, and its coefficient of variation is less than 10%. For instance, in one inventory of over 150 observations, site index data for sugar maple within the three maple habitat types varied widely, but the mean for each habitat type was within the predicted range for the habitat type and the coefficient of variation ranged from 8 to 10%.

Besides common field errors, there are problems associated with the site

index concept. Several studies have shown that codominant hardwoods have faster height growth than adjacent dominant trees. In spite of the fact that in all other respects the trees are good site trees. Other species have the reverse relationship. A second major weakness of the conventional technique is the assumption that the shape of the harmonized height-growth curve is the same for all sites. Although this generalization gives good results in many instances, it does not hold for all soil conditions. Growth in a shallow soil condition may occur at one rate until the roots fully occupy the available soil then will grow at a slower rate. Conversly, a slow growth rate can occur in an 'infertile' soil until the roots penetrate an enriched zone, and will then grow faster. The use of standard curves assumes this does not occur. Although separating site index by habitat type will account for much of this variation, the technique will continue to be subject to this type of error until soil/land form relationships are incorporated into the system. Site index is a useful tool for foresters because it is supposed to indicate site potential or productivity. However, as figures 5.11 and 5.12 reveal, site index forred pine (and perhaps other species as well) does not necessarily reflect true site potential as previously believed. The degree of intensity and care in managing the stand (especially early in the life of the stand) is so important in the case of red pine that it totally masks the effect of site. As such, site index can be very misleading if used as a measure of site potential, although it will always be useful as a measure of current performance.

VOLUME GROWTH (Table 5.3)

The estimate of mean annual volume growth for a species within a habitat type represents the potential growth rather than actual gowth. It also assumes the stands are regulated and under relatively intensive management. *IT IS IMPORTANT THAT THESE QUALIFIERS BE CONSIDERED WHEN MAKING VOLUME GROWTH EVALUATIONS.* In making evaluations to maximize product goals and financial returns the total potential of the site must be considered; not what is being produced today. Forecast growth can always be reduced downward by applying reasonable reduction factors for less intensive management practices. Additionally, the data represent what can be produced under fully stocked conditions. Reduction factors will have to be applied if some acres are understocked, are taken out of production because of roads, etc., or are otherwise not growing to their full potential.

These summary tables allow easy comparison of productivity potential between species on a given habitat type and the same species between habitat types. In making decisions of the species or species mix on a given habitat type the product goals of your organization must be balanced with the cost of converting and/or maintaining that species or species mix, and its *VALUE GROWTH*. Very often the species having the best volume growth will not have the best value growth. Unfortunately, the conversion techniques to accelerate succession or retrogression for each habitat type are not fully known. When known, this information will be included in the field guide, so that costs can be computed. Additionally, management techniques to bring poorly stocked, poor quality second growth stands into a regulated condition is also unknown for each habitat type. However, considerable past research and recommendations have been made for general situations, and through a coordinated effort of the cooperators this information can be brought into guidelines within a short period of time. Scheduling and cost data would then be possible to compute by each user for his situation.

Most mean annual volume growth estimates presented in the summary table were collected using point sampling (BAF10) in well stocked even-aged stands of specific successional stages of each habitat type.

To be acceptable sample stands had to have at least 75% composition of the indicated tree species and show no evidence of growth reduction caused by poor stand treatment - natural or mancaused. Pulpwood merchantable top was set at 4 and 3 inches for hardwoods and conifers respectively, and sawtimber limits were 10.5 and 8 inches d.i.b. respectively. Age was determined in the site index procedure and mean annual growth determined for stands averaging more than 40 years of age.

Using mean annual growth data for stands ranging from 40 to approximately 90 years of age (most were 40 to 60 years old) has probably introduced error depending on the age at which culmination of periodic annual increment occurs for each species. As noted previously, research emphasis has been on developing the classification prodedure and not in collecting descriptive information such as volume growth. Consequently little time was devoted to such data collection and only 5 to 10 stands were sampled for each species/habitat type combination. Since the first printing additional sampling has been accomplished, especially on red pine and sugar maple, and this data has also been incorporated. However, further sampling is still needed. The habitat type classification system is supposed to predict ecologically similar response units which should reduce the variability in volume growth compared to previous experience. The fact that mean annual volume growth for each species/habitat combination sampled as of the second printing exhibits such a narrow range supports a tentative conclusion that these data are not far in error. Regardless, further validation and refinement utilizing additional sampling and CFI data is essential.

The most reliable information is for red pine and sugar maple within the *Tsuga-Maianthemum, Acer-Tsuga-Dryopteris,* and *Acer-Viola-Osmorhiza* habitat types. Specific habitat type related studies have been conducted on these species and CFI data have been utilized. Measured volume growth of a species on a particular habitat type having a specific site index has shown a good agreement with published yield tables in the "Managers Handbook for Red Pine (and Jack Pine) in the North Central States" (USDA General Technical Report, NC-33 and NC-32). Unevenaged volume growth is also available for sugar maple on these types. The least reliable data is for aspen on any of the habitat types. All aspen volume growth was extrapolated from "The Managers Handbook for Aspen in the North Central States" by Donald Perala (USDA General Technical Report NC-36). To be valid the extrapolation assumes the aspen yield tables by a similar site index class. However, until more direct studies are conducted, this data is the best available.

Perhaps the weakest area of this data lies in the assumption that the mean annual growth determined for unmanaged stands will be the same for well managed stands. Although it is well known and accepted that total fiber (or cubic foot volume) growth will not increase with management, the usable length of the average tree might increase as trees with forks and other poor form characteristics are removed from the stand. This would increase the merchantable volume growth of the stand, especially for sawtimber. Extreme care was taken in picking sample stands that had minimal tree form problems to minimize this problem.

As with any study involving prediction of volume growth, the utility of the predictions are only as good as the original data. As many sources of error have been eliminated as possible in obtaining the preliminary information. Certainly more data needs to be collected in the future. Perhaps the greatest benefit of this approach is that in the past site variation has been one of the greatest sources of error, and the hardest to identify. The habitat classification system will at last allow the manager to identify much of that source of variation.

HEIGHT GROWTH RELATIONSHIPS (Figures 5.1 - 5.10)

The height over age (Figures 5.1-5.5) and periodic annual height growth charts (Figures 5.6-5.10) by habitat type provide the user with information about the height growth relationships of different species on the same habitat type. this data is from detailed stem analysis on over 180 individual trees of various species growing on five habitat types. As such these should be considered as preliminary relationships. Additional data collection is required to finally define these relationships.

The accuracy of these figures is a function of the number of trees sampled to derive the relationship. Several species (such as European larch) have only three trees in the sample and the data should be used cautiously. Other species have a minimum of 12 trees in the sample within a habitat type and the data is more reliable. To assist the user the number of trees used in deriving the curve for a species within a habitat type is given in the legend.

Inferences made from these curves for aspen may be misleading. Several exceptionally good clones were sampled within the Acer-Tsuga-Dryopteris h.t. which tended to improve the average growth relationships for aspen on this habitat type. However, all of the better clones of aspen known to be on Acer-Viola-Osmorhiza h.t. had been clearcut prior to sampling and therefore could not be included in the data base. Consequently, the height growth curves for aspen on the AVO h.t. show poorer growth than that found for the ATD h.t. This is probably not real and user should use the aspen growth curves for the AVO and ATD h.t.'s with caution. Unfortunately, it is unlikely that much more information can be collected on aspen within the AVO habitat type because most stands are overmature or have already been clearcut.

Use in Developing Site Preparation Strategies. These curves are also useful for evaluating the type of competition likely from aspen or maple on newly planted red pine or European larch. For example, on the Tsuga-Maianthemum habitat type red pine height growth exceeds that of sugar maple by a significant amount after the second or third year, but does not exceed that of aspen height growth until around the tenth year of age (Figure 5.8). Where both competing species need to be controlled when planting red pine, a site preparation prescription that merely retards sugar maple growth for two to three years, but kills aspen will be required. The silvicultural prescriptions given for red pine within the Tsuga-Maianthemum h.t. in Section 6 should provide this balance. conversely, red pine height growth does not exceed that of sugar maple on the Acer-Viola-Osmorhiza h.t. until about six years of age, and aspen until approximately fifteen to twenty years of age (Figure 5.10). In fact red pine height growth may never exceed that of aspen suckering from better clones on the AVO h.t. Therefore, a site preparation prescription that either kills both aspen and sugar maple or retards their growth for many years is required. The silvicultural prescriptions for red pine within the Acer-Viola-Osmorhiza h.t. in Section 6 are much more intensive to reflect this increased need for control. Also, as can be seen in Figures 5.11 and 5.12, care must be taken to plant only the most vigorous red pine seedlings and, if grass is present, it must be controlled, especially on the AVO habitat type.

RED PINE PLANTATION GROWTH (Figure 5.11-5.12)

Recent research has revealed that site index and mean annual increment of 35 to 45 year old red pine plantations is highly correlated to early height growth of red pine within specific habitat types. Sufficient data now exists to incorporate this preliminary information in the field guide.

Stem analysis of seventy-five individual red pine trees growing on a variety of stands across five habitat types, show that within habitat types, both site index and mean annual increment of the plantations is highly correlated ($R^2 \geq .90$) to the number of

years it takes 21 dominant trees per acre to reach a height of 4.5 feet tall (Figures 5.11 and 5.12). In evaluating the probable cause of this relationship, it was found that the variation within a habitat type is probably not related directly to soil texture. The two fastest growing (highest site index) plantations occurred on the Acer-Viola-Osmorhiza habitat type. One of these plots occurred on a sandy loam soil and the other on a silt loam. Conversely, the poorest plantation (lowest site index) occurring on this habitat type also occurred on the same two soils. In reviewing existing plantation records the only factor that explained the variable growth within a habitat type was site preparation for grass control. Since most of these plantations were established on old fields or cutover areas having almost no brush or hardwood sprouting, brush competition was not a factor. Seedling vigor probably was also very important, but since true vigor could not be adequately evaluated 30 to 40 years ago when these plantations were established, vigor classification was of little use. In the case of site preparation however, there did appear to be a good cause/effect relationship. Plantations having no site preparation to control grass had the poorest site index and volume growth, while those reported to have good grass control at the time of planting had the highest site index and volume growth. Although this cause/effect relationship is merely an inference, the relationship is strong enough to suggest that control of grass[1] (and seedling vigor) is as important as control of brush in maximizing long term volume growth of red pine.

It is difficult to prove the importance of white grubs and grass competition on suppressing growth of red pine with this data alone. However, two of the plantations sampled were originally part of a site preparation study. Both were growing side by side and were on the Tsuga-Maianthemum-Vaccinium habitat type. The one receiving the better sod control grew over 1 foot per year by the second year, and was growing over 2 feet per year by the seventh year. Conversely, the adjacent plantation receiving only superficial sod control grew only slightly more than a half a foot per year until the eighth year, and did not start growing over 2 feet per year until the fourteenth year. It took the first plantation just over four years to reach breast height and now has a site index of 75 feet (50 year basis). The second plantation took over seven years to reach breast height and now has a site index of only 63. This tends to confirm the inferred conclusions made from the curves themselves.

As noted previously, site index for red pine (and probably other species as well) does not provide an accurate estimate of site potential. It does, however, provide an accurate estimate of current stand productivity. Existing published yield tables for red pine which are based on site index are therefore reliable. However, TO USE SITE INDEX OF AN EXISTING PLANTATION TO FORECAST YIELDS OF FUTURE ONES CAN RESULT IN VERY LARGE ERRORS, AND CAN LEAD TO INAPPROPRIATE MANAGEMENT DECISIONS.

Use of Curves. Land Managers will continue to use site index of existing red pine plantations to evaluate performance and to develop yield forecasts for these plantations. To properly estimate true potential of the site for red pine, however, it will be necessary to determine the habitat type. Once accomplished, actual versus potential can be compared, and the relative growth performance for the dollars expended in site preparation can be evaluated.

Performance of newly established red pine plantations can be evaluated using Figure 5.11 and 5.12. This is accomplished by determining the number of years since planting it takes about 20 DOMINANT TREES per acre within the plantation to reach a height of 4.5 feet. It should take no more than 4 years for these trees to attain this height on a TMV, TM, ATD, or AVO habitat type, or 5 years on an AQVac habitat type. If it takes longer than this there is probably insufficient grass control, improper storage or a poor planting job resulting in poor seedling vigor, or drought/environmental problems. By using the curves, future site index and volume growth of the plantation can be predicted, even though it may be only 5 to 10 years of age.

[1]White grubs may be as much of a factor in reducing the growth of pine when planted in grass as the grass competition itself.

TABLE 5.1 AVERAGE COVERAGE OF SPECIES WITH GREATER THAN 75% CONSTANCY, AND THEIR RELATIVE INDICATOR VALUE[1]

GROUP	GROUP I					GROUP II						GROUP III									
COMMON COVER TYPE	JACK PINE		ASPEN/BIRCH/OAK	RED PINE	W. PINE ASPEN/ BIRCH SPRUCE/ FIR	NORTHERN HARDWOODS		MIXED HARDWOODS AND ASPEN		ASPEN SPRUCE/ FIR		ASPEN/BIRCH SPRUCE/FIR WHITE PINE		BLK. ASH ASPEN	ASPEN/BIRCH/BAL. POPLAR HEMLOCK/CEDAR/BLACK SPRUCE		BRUSH/ SEDGE	ASH MAPLE	BLACK SPRUCE N. WHITE CEDAR	
						SPR./FIR ASPEN/ BIRCH						NORTHERN HARDWOODS	N. WHITE CEDAR	BALSAM POPLAR	SPRUCE/FIR	TAMARACK	BALSAM POPLAR			B. SPR. TAMARACK BOG SPECIES
GENERAL SOIL TYPES	POORLY DEVELOPED SAND		MODERATELY DEVELOPED SAND	VERY SHALLOW CAP OVER SAND AND GRAVEL		FINE TO LOAMY SAND	SANDY LOAM TO LOAM	HIGHLY DEVELOPED SANDS HAVING STRONG Bhir HORIZONS[1]	LOAM TO SILT LOAM	SILT LOAM ENRICHED LANDFORM POSITION	CLAY LOAM TO CLAY	GOOD SURFACE DRAINAGE	MODERATE SURFACE DRAINAGE	IMPEDED DRAINAGE	NORTHERN HARDWOODS	BLACK ASH	ASPEN B ASH/R MAPLE/ELM	BIRCH R MAPLE	EXCESSIVE WATER	
HABITAT TYPE	PVD	PVC	OAE	AQVac	TMV	TM	AQVib	ATD	AVO	AOC	TAM	TTL	TTP	FE	TMC	TTM	TTS	FMC	FI	PO	PCS
SPECIES												CLAYS			SANDS	ALL TEXTURES (HEAVIER)	ORGANIC (>6")	ORGANIC FLOOD PLAIN	LOAMS	ORGANIC	DEEP ORGANIC
1 HAIR GRASS	★★■	●▭				△□		△□													
2 SEDGE	●■	★★■																			
3 SWEET FERN	●▭	●□																			
4 LOWSWEET BLUEBERRY	●■	●■	●■	★★▭	★□																
5 REINDEER MOSS	★▭	●▭																			
6 TRAILING ARBUTUS	●□	●▭	★★□																		
7 BRACKEN FERN	●■	●■	●■	●■	●■	●■	●▭					●▭	●▭		●■						
8 CANADA BLUEBERRY	●□	●□	●▭	●▭	★★□										△□						●▭
9 PIN CHERRY	●□																				
10 COW WHEAT	●□	●□																			
11 SAND CHERRY		●□																			
12 JUNEBERRIES		●□	●□																		
13 WILD LILY-OF-THE-VALLEY		●□	●□	●▭	●▭	★★□			●□		●□	●□			★▭	●□	●▭				
14 WINTER GREEN		●▭	●▭	●▭																	
15 SPINULOSE SHIELD FERN		★□			★□			★★▭	●□	●▭	●□	●□		●□	△▭				●▭		
16 GRASSES			●▭	●▭		●■	●■					●▭	●■						●▭		
17 MOSSES			●▭													●■					
18 LARGE LEAVED ASTER				●▭	●■		●▭				●▭	●▭	●■								
19 BEAKED HAZELNUT				★★▭	★▭		●▭														
20 WILD SARSAPARILLA					★★▭	●□	●▭				●▭		●■								

21 YELLOW BEADLILY					★□						●□				●□						●□	
22 FALSE SOLOMONS SEAL					★□		●□															
23 TWISTED STALK					★□			●□	●□	●□	●□											
24 WOOD BETONY					★★⊟																	
25 SEDGES (MESIC SPECIES)						●⊟		●⊟	●⊟		●■	●⊟	●■	●■	●⊟	●■	●■	●■	★★■	●■	●⊟	●■
26 STARFLOWER						●□									●□	●□	●□				●□	
27 BEDSTRAW						●□			●□		●□								●□			
28 HAIRY SOLOMONS SEAL							●□	●□	●□	●□					△□							
29 LADY FERN								△□	●⊟	●⊟	●□									●⊟		
30 YELLOW/CANADA/DOWNY VIOLET								△□	★★□	★⊟		●□										
31 JACK IN-THE-PULPIT								△□	★□	★□												
32 RATTLESNAKE FERN								△⊟	★□	★□												
33 DWARF ENCHANTERS NIGHTSHADE								△□	△□											★★□		
34 JEWELWEED								△□	△□										●□	★★⊟		
35 MAPLE-LEAF VIBURNUM						★★□																
36 WOOD ANEMONE						●□																
37 CHOKE CHERRY						●□					●⊟											
38 TRILLIUMS						●□																
39 WITCH-HAZEL						★★⊟																
40 POINTED-LEAVED-TICK TREFOIL						★★⊟																
41 SWEET CICELY									★★⊟	●⊟												
42 ELDERBERRY									●□	●□										●□		
43 BLUE COHOSH									★□	★★⊟												
44 BLOODROOT									★□	●□												
45 BELLWORTS									★□													
46 WILD LEEK									△□	★□												
47 MAIDENHAIR FERN									△□	★□												
48 OSTRICH FERN										●⊟												
49 AMERICAN FLY HONEYSUCKLE										●□	★★⊟											
50 DEWBERRY										●□		●⊟	●⊟						●⊟	●□		
51 PARTRIDGE BERRY										★★□												
52 HORSETAILS										△□												
53 ST. JOHNSWORT											●□											
54 WILD STRAWBERRY												●⊟	●□									
55 BARREN STRAWBERRY												●■										
56 BUNCHBERRY												●⊟			★★⊟		●□				●□	
57 HORSETAILS												●□					★★⊟					
58 PALMATE LEAVED SWEET COLTSFOOT												★★⊟										
59 BLACK SNAKEROOT												★★□										
60 TALL RATTLESNAKE ROOT												★□										
61 MINTS (AMERICAN)													●□						★★■	●□		
62 TAG ALDER													●■						●■			
63 SPOTTED JOE-PYE WEED														★★⊟								
64 WATER HEMLOCK														★★□								
65 BONESET														★★□								
66 GOLDTHREAD															★★⊟		★□				●□	
67 WOOD SORREL															★★□		★□					
68 LONGBEECH FERN															△□							
69 OAK FERN															△□							
70 SPHAGNUM MOSS																★■	★★■				★■	★■
71 BLUEBERRIES																	★□					
72 NAKED MITERWORT																★★⊟						
73 TWINFLOWER																★★□						
74 FRINGED POLYGALA																★★□						
75 SENSITIVE FERN																			●□			
76 TUFTED LOOSESTRIFE																			●□			
77 MARSH MARIGOLD																				△□	●□	
78 CINNAMON FERN																					★★■	
79 CREEPING SNOWBERRY																					●□	●□
80 GOOSE BERRIES																					●□	
81 LABRADOR TEA																						●■
82 LEATHER LEAF																						★★■
83 CRANBERRY																						●⊟
84 BOG ROSEMARY																						★★⊟
85 BOG (PALE) LAUREL																						★★⊟
86 PITCHER PLANT																						●□
87 SUNDEW																						●□

INDICATOR SPECIES

49 American Fly Honeysuckle
55 Barren Strawberry
19 Beaked Hazelnut
27 Bedstraw
45 Bellworts
59 Black Snakeroot
44 Bloodroot
43 Blue Cohosh
71 Blueberries
85 Bog (Pale) Laurel
84 Bog Rosemary
65 Boneset
1 Bracken Fern
56 Bunchberry
6 Canada Blueberry
37 Choke Cherry
78 Cinnamon Fern
10 Cow Wheat
83 Cranberry
79 Creeping Snowberry
50 Dewberry
33 Dwarf Enchanter's Nightshade
42 Elderberry
22 False Solomon's Seal
74 Fringed Polygala
66 Goldthread
80 Goose Berries
16 Grasses
1 Hairgrass
28 Hairy Solomon's Seal
52 Horsetails
57 Horsetails
31 Jack-in-the-pulpit
34 Jewelweed
12 Juneberry
81 Labrador Tea
29 Lady Fern
18 Large-Leaved Aster
82 Leatherleaf
68 Longbeech Fern
4 Lowsweet Blueberry
47 Maidenhair Fern
35 Maple-leaf Viburnum
77 Marsh Marigold
61 Mints (American)
17 Mosses
72 Naked Miterwort
69 Oak Fern
46 Ostrich Fern
86 Palmate-leaved Sweet Coltsfoot
51 Partridge Berry
9 Pin Cherry
86 Pitcher Plant
40 Pointed-Leaved Tick Trefoil
5 Reindeer Moss
32 Rattlesnake Fern
11 Sand Cherry
25 Sedges (mesic species)
75 Sensitive Fern
70 Sphagnum Moss
15 Spinulose Shield Fern
63 Spotted Joe-pye Weed
53 St. Johns Wort
26 Starflower
87 Sundew
41 Sweet Cicely
3 Sweetfern
62 Tag Alder
60 Tall Rattlesnake Root
6 Trailing Arbutus
38 Trilliums
76 Tufted Loosestrife
73 Twinflower
23 Twisted Stalk
64 Water Hemlock
48 Wild Leek
13 Wild Lily-of-valley
20 Wild Sarsaparilla
54 Wild Strawberry
14 Wintergreen
39 Witch-Hazel
36 Wood Anemone
24 Wood Betony
67 Wood Sorrel
21 Yellow Beadlily
30 Yellow, Canada, Downy Violet

LEGEND

★★ - Primary Indicator
★ - Additional Indicator
△ - Private Indicator
● - Common Associate

□ - <5% Cover
⊟ - 5-15% Cover
■ - 15-25% Cover
□ - Phase Indicator, but less than 75% constancy for the habitat type.

[1] A 75% constancy means that species will be found 75% of the time on that specific habitat type. If a species occurs less than 75% of the time it will not be listed in this table unless it is a indicator species, even though it may occur on that type.
[2] The Acer-Quercus-Viburnum h.t. is not usually found on these sandy soils

TABLE 5.2
PRELIMINARY ESTIMATES
SITE INDEX[1] BY HABITAT TYPES

Habitat Type	Maple	Aspen	White Birch	White Ash/Elm	Red Oak	Bass-wood	Red Pine	Jack Pine	White Spruce	Bal-sam Fir	N. White Cedar	Black Spruce	Tam-arack
Pinus-Vaccinium-Deschampsia	——[5]	——	——	——	——	——	40-46[3]	50-56	——	——	——	——	——
Pinus-Vaccinium-Carex	——	——	——	——	——	——	45-53	55-60	N.D.	N.D.	——	——	——
Quercus-Acer-Epigaea	——	50-65	——	——	40-50	——	50-59[2]	56-64[2]	N.D.	N.D.	——	——	——
Acer-Quercus-Vaccinium	40-50[3]	55-75	N.D.[4]	——	50-60	——	64-68	67-75	40-55	N.D.	——	——	——
Tsuga-Maianthemum-Vaccinium	50-56	65-80	N.D.	——	63-68	——	72-78	73-78	50-62	N.D.	——	——	——
Tsuga-Maianthemum	54-61[2]	65-80	N.D.	——	68-73	——	78-82	75-80	55-66	N.D.	——	——	——
Acer-Quercus-Viburnum	61-73	73-82	——	67-73	64-70	N.D.	74-79	N.D.	N.D.	60-68	——	——	——
Acer-Tsuga-Dryopteris	60-65	70-80	N.D.	——	70-75	64-68	(78-82)[6]	——	N.D.	N.D.	——	——	——
Acer-Viola Osmorhiza	64-69	75-85	——	N.D.	N.D.	67-70	(78-82)	——	——	——	——	——	——
Acer-Osmorhiza-Caulophyllum	68-73	N.D.	N.D.	77-82	N.D.	70-75	——	——	——	——	——	——	——
Tsuga-Acer-Mitchella	45-53	58-68	N.D.	N.D.	N.D.	N.D.	——	——	N.D.	N.D.	——	——	——
Tsuga-Thuja-Lonicera	45-50	70-80	70-75	N.D.	N.D.	N.D.	55-60	N.D.	60-65	50-55	——	——	——
Tsuga-Thuja-Petasites	N.D.	48-60	——	——	——	——	——	——	44-54	42-49	——	——	——
Tsuga-Maianthemum-Coptis	45-57	N.D.	——	50-54	——	47-54	——	——	55-65	42-60	——	45-56	56-64
Fraxinus-Impatiens	51-57	——	——	——	——	——	——	——	——		N.D.	N.D.	N.D.
Tsuga-Thuja-Sphagnum	——	——	——	——	——	——	——	51-59	——	55-66	25-30	39-47	50-55
Fraxinus-Picea-Osmunda	——	——	——	——	——	——	——	——	——	——	——	N.D.	N.D.

[1]Site indexes are given in ranges that represent one standard deviation from the mean. Therefore, occasional site indices will be greater or less than the limits of the range given.

[2]Site indices that are underlined are the results of numerous observations and should be reliable.

[3]Site indices not underlined are based on only a few stands and may change slightly after more sampling.

[4]N.D. No or insufficient information is available to make an estimate.

[5]——Dashed lines indicate the species are not part of the successional pattern for that particular habitat type.

[6]()Site indices in parenthesis indicate the species is not part of the successional pattern for the habitat type but because of plantation work, the site indices are available.

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TABLE 5.3
PRELIMINARY ESTIMATES
MEAN ANNUAL VOLUME GROWTH BY HABITAT TYPE

PULPWOOD (Cu. Ft./Ac.)

Habitat Type	Hard/ Soft Maple	Aspen	White Birch	White Ash/Elm	Red Oak	Bass-wood	Red Pine	Jack Pine	White Spruce	Bal-sam Fir	N. White Cedar	Black Spruce	Tam-arack
Pinus-Vaccinium-Deschampsia	—[1]	—	—	—	—	—	—	(30-40)[2]	—	—	—	—	—
Pinus-Vaccinium-Carex	—	—	—	—	—	—	—	(40-50)	—	—	—	—	—
Quercus-Acer-Epigaea	—	N.D.[3]	—	—	N.D.	—	65-85	(50-70)	N.D.	—	—	N.D.	—
Acer-Quercus-Vaccinium	N.D.	N.D.	N.D.	—	N.D.	—	90-110	(60-85)	N.D.	N.D.	—	—	—
Tsuga-Maianthemum-Vaccinium	(20-32)	(55-118)	N.D.	—	N.D.	—	110-145	(70-90)	N.D.	N.D.	—	—	—
Tsuga-Maianthemum	28-42	(55-118)	N.D.	—	(55-80)	—	155-180	(80-110)	N.D.	N.D.	—	—	—
Acer-Quercus-Viburnum	(45-55)	(55-118)	—	N.D.	(64-70)	N.D.	(130-155)	N.D.	N.D.	(35-45)	—	—	—
Acer-Tsuga-Dryopteris	35-48	(70-118)	N.D.	—	N.D.	N.D.	155-180	—	—	—	—	—	—
Acer-Viola-Osmorhiza	(40-53)	(70-120)	—	N.D.	N.D.	N.D.	155-180	—	—	—	—	—	—
Acer-Osmorhiza-Caulophyllum	(45-55)	N.D.	-	N.D.	N.D.	N.D.	—	—	—	—	—	—	—
Tsuga-Acer-Mitchella	(20-35)	(35-60)	N.D.	N.D.	N.D.	N.D.	—	—	N.D.	N.D.	N.D.	N.D.	—
Tsuga-Thuja-Lonicera	(15-30)	(65-80)	N.D.	N.D.	N.D.	N.D.	—	—	N.D.	N.D.	N.D.	N.D.	—
Tsuga-Thuja-Petasites	N.D.	N.D.	—	N.D.	—	—	—	—	N.D.	N.D.	—	—	—
Tsuga-Maianthemum-Coptis	N.D.	N.D.	—	N.D.	—	—	—	—	N.D.	N.D.	N.D.	N.D.	(30-45)
Fraxinus-Impatiens	—	—	—	N.D.	—	—	—	—	N.D.	N.D.	—	—	—
Tsuga-Thuja-Sphagnum	—	—	—	N.D.	—	—	—	—	N.D.	N.D.	N.D.	N.D.	(20-30)
Picea-Fraxinus-Osmunda	—	—	—	N.D.	—	—	—	—	—	N.D.	N.D.	N.D.	N.D.

[1]Dashed line indicates the species is not part of the successional pattern for the habitat type.
[2]Data in parenthesis are based on only a few stands and may change after future sampling.
[3]N.D. No or insufficient information is available to make an estimate.

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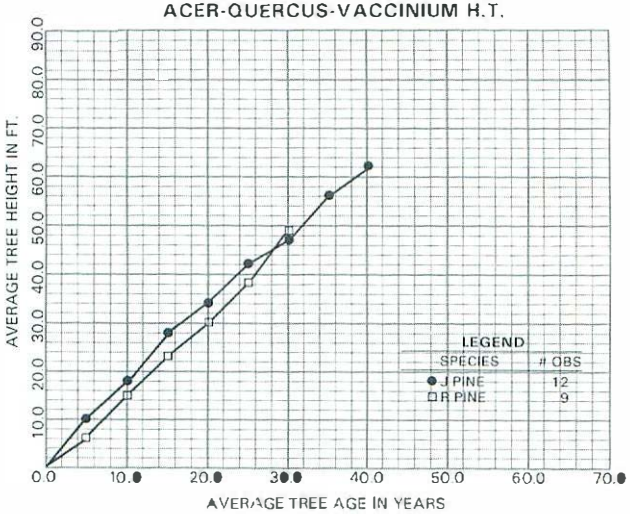

FIGURE 5.1 Height/age relationships for jack pine and red pine on the Acer-Quercus Vaccinium habitat type. (Courtesy of Champion International)

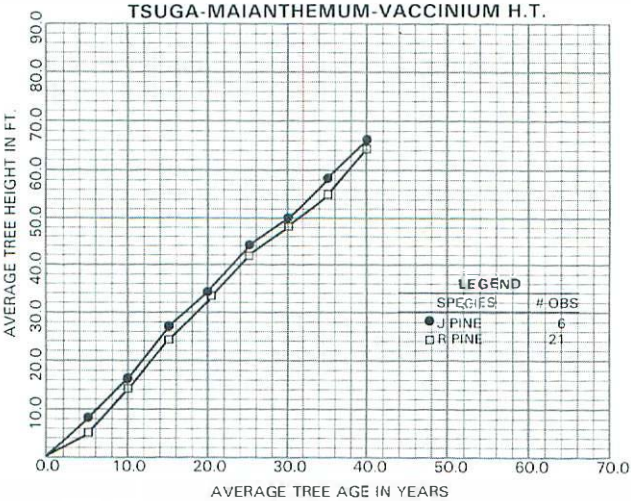

FIGURE 5.2 Height/age relationships for jack pine and red pine on the Tsuga-Maianthemum-Vaccinium habitat type. (Courtesy of Champion International)

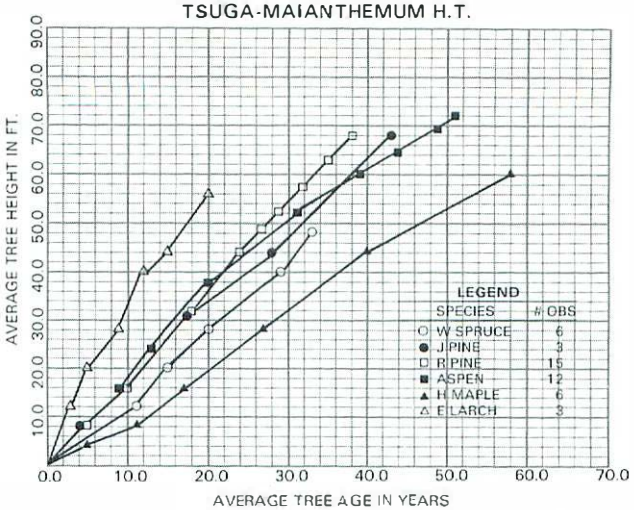

FIGURE 5.3 Height/age relationships for various species on the Tsuga-Maianthemum habitat type. (Courtesy of Champion International)

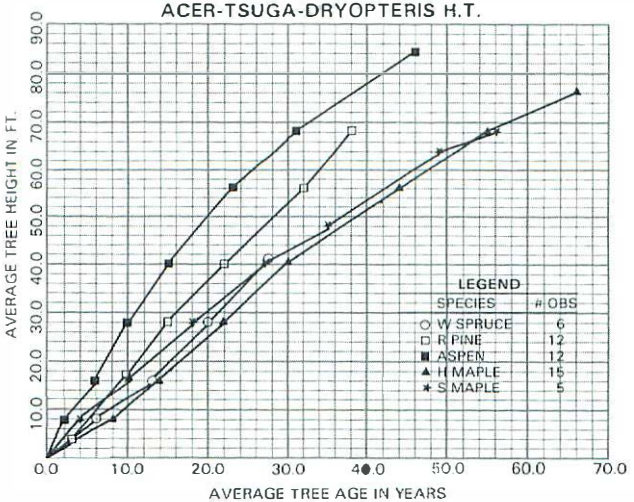

FIGURE 5.4 Height/age relationships for various species on the Acer-Tsuga-Dryopteris habitat type. (Courtesy of Champion International)

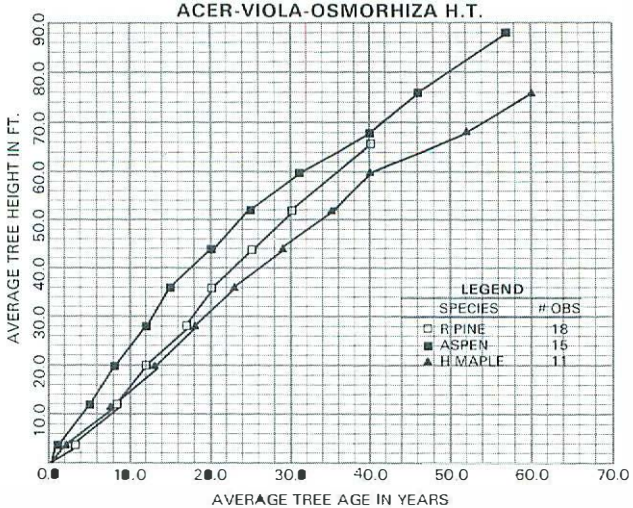

FIGURE 5 5 Height/age relationships for various species on the Acer-Viola-Osmorhiza habitat type. (Courtesy of Champion International)

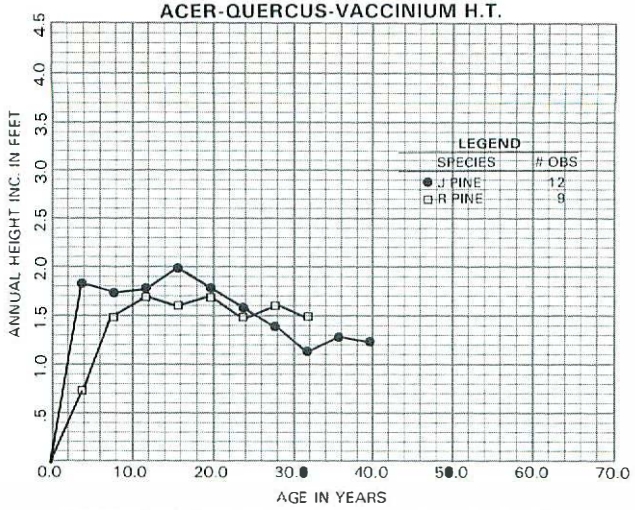

FIGURE 5.6 Periodic height growth of various species on the Acer-Quercus-Vaccinium habitat type. (Courtesy of Champion International)

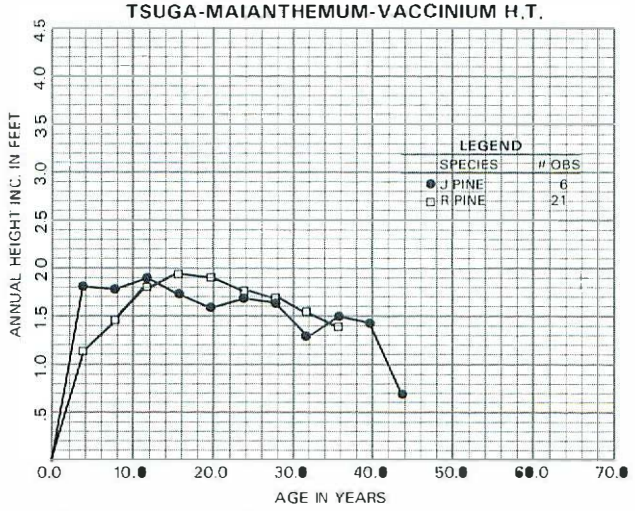

FIGURE 5.7 Periodic height growth of various species on the Tsuga-Maianthemum-Vaccinium habitat type. (Courtesy of Champion International)

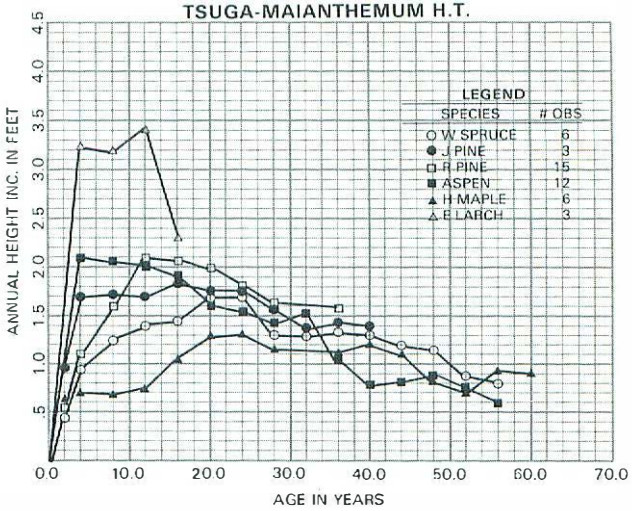

FIGURE 5.8 Periodic height growth of various species on the Tsuga-Maianthemum habitat type. (Courtesy of Champion International)

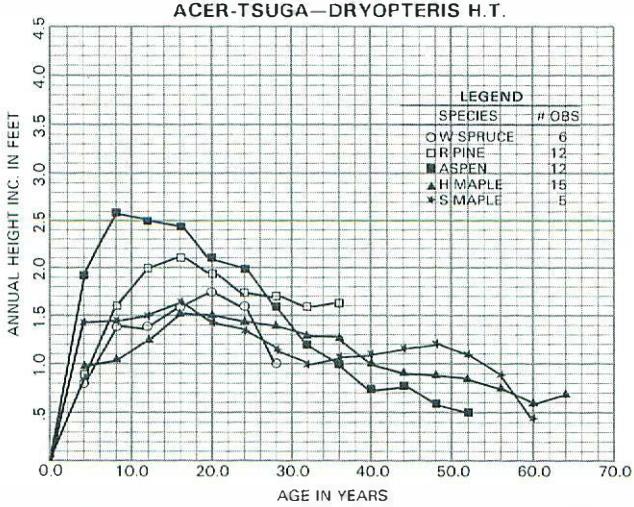

FIGURE 5.9 Periodic height growth of various species on the Acer-Tsuga-Dryopteris habitat type. (Courtesy of Champion International)

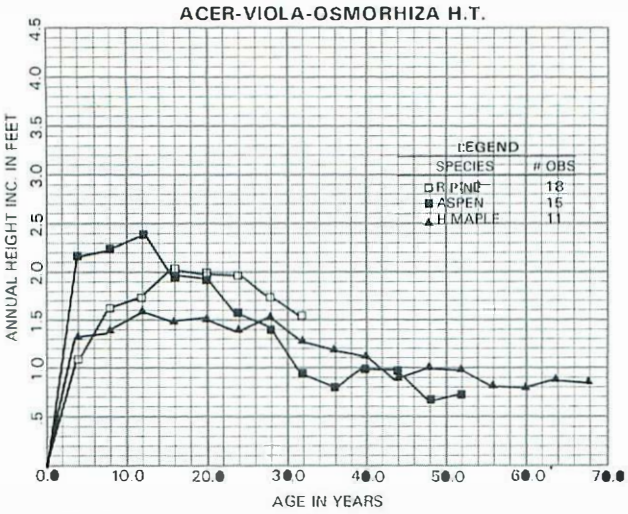

FIGURE 5.10 Periodic height growth of various species on the Acer-Viola-Osmorhiza habitat type. (Courtesy of Champion International)

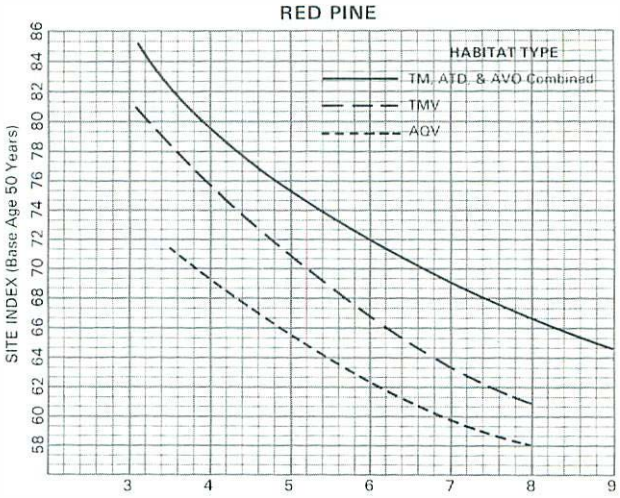

FIGURE 5.11 The relationship between site index of red pine and habitat type as affected by the number of years it takes approximately twenty-one dominant seedlings per acre to reach breast height (4.5 feet). (Courtesy of Champion International)

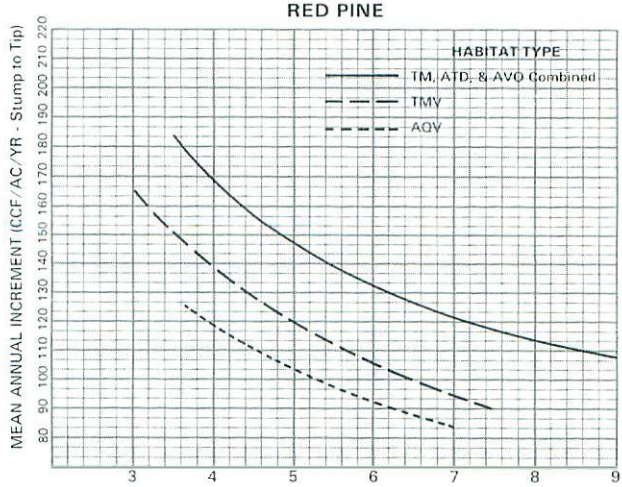

FIGURE 5.12 The relationship between total mean annual increment of red pine and habitat type as affected by the number of years it takes twenty-one dominant seedlings per acre to reach breast height (4.5 feet). (Courtesy of Champion International)

INDEX

NOTES

HABITAT TYPE DESCRIPTIONS

The following descriptions of habitat types provide the user with an abbreviated discussion of species, soils, present cover types, and general silviculture information and recommendations for each cover type. Unfortunately, silvicultural data and information are missing or limited on many of the newer or less important habitat types. As additional research provides this information it will be included in future printings.

CLIMAX

Climax overstory/understory species were obtained from studies done within the climax associations, with the exception of the sand dominated habitat types. As noted in the section on succession, the sand and clay or clay loam dominated habitat types have been so disturbed by natural fires and man-caused activities that no climax communities have been found to evaluate. Therefore, information included in these descriptions were obtained by evaluating successional direction in seral stands.

UNDERSTORY SPECIES

Common and important understory species that occur on a given habitat type are listed by decreasing constancy (i.e. how often it is found on a habitat type). Coverage is also given to enable the user to form a mental picture of what a habitat type looks like vegetatively. This data is derived from over 2500 sample plots and is very reliable for the more common upland habitat types. The user should refer to the discussion of Table 5.1 (Groundflora Distribution) for a further explanation of the limitations of this data.

SOILS

Although considerable information has been collected on soil/habitat type correlations, analysis of these correlations is not final. Therefore, only broad soil types are described in this section. Further, it is anticipated that any discussion of soils will be at least as comprehensive as that for habitat types, thereby necessitating a separate field guide for soils.

SUCCESSION AFTER ORIGINAL LOGGING

These descriptions allow the user to identify the general nature of the cover types that have resulted from the three most common types of past logging of our forest lands; logging in original old growth climax stands, logging in second growth virgin stands; and logging followed by burning. Although generalized, these descriptions provide a framework for understanding the complex mosaic of cover types that are typically found in the western U.P. and N.E. Wisconsin today.

These descriptions are not intended to imply that the resulting cover types for a given activity within a habitat type are inclusive. Other possibilities also exist. Actual response to an activity not only depends on the type of activity (i.e. disturbance) but also in its severity, available seed, and climatic conditions at the time of disturbance (see section on succession for further discussion).

GENERAL SILVICULTURE INFORMATION

Pertainent information such as site index, volume growth, rotation ages, yields, and successional stability are presented for each species typically dominating a successional stage within a habitat type. The information presented in this table also assumes that stands are intensively managed and are in a regulated condition. Therefore, mean annual growth, rotation length, and yield at the end of rotation provide information of the species *POTENTIAL* on a given habitat type rather than what is being produced with today's practices. 'Potential' productivity rather than 'actual' is used as it is a better measure of site capability. It is easier to apply a reasonable reduction factor to a species potential productivity when circumstances warrant than to guess the site might be capable of producing.

SPECIFIC INFORMATION ON SITE INDEX AND VOLUME GROWTH HAVE BEEN DEVELOPED FROM LIMITED DATA AND SHOULD BE USED WITH

CAUTION. A detailed discussion of the use and limitations of this data is given in the section on summary tables.

Rotation ages are suggestions based on growth and on projected yields. These will be revised as better data on growth, costs, and returns are available for management intensities. Until then users may want to vary rotation lengths based on better information or to suit their individual circumstances.

Yields at rotation are based on Lake States yield tables for site classes comparable to that for the individual habitat types, or where data or specific research have provided tentative data. However, use of yield tables assumes a good correlation between the site index employed by the yield tables and true site potential for the habitat type. This correlation is not known, but is the best available at the present time.

Preliminary data on mean annual and periodic annual volume growth is available for some species/habitat type combinations. For instance yields of uneven-aged sugar maple on the *Acer-Tsuga-Dryopteris* habitat type have been determined based on cutting studies in well managed, regulated stands in the Ford Forestry Center. Additionally, volume information is available for varying ages up to 50 years of age for red pine on the *Tsuga-Maianthemum, Tsuga-Maianthemum-Vaccinium, Acer-Tsuga-Dryopteris,* and *Acer-Viola-Osmorhiza* habitat types that provide mean annual and periodic annual volume growth, yield, and other data. This type of information is limited, however, and in general yield data is incomplete and additional research should be planned to strengthen these estimates.

SUGGESTED SILVICULTURE SYSTEMS

An abbreviated listing of a silviculture system that could be used is presented for each species within a habitat type. The user should be aware that other systems will work on a given species/habitat type combination and the suggested system represents a typical one that would be widely adapted for a variety of objectives.

As noted previously, the systems outlined assume stands are already in a regulated condition. Procedures and systems utilized in bringing unregulated stands into regulation have not yet been developed. However, generalized guides are available for some species and it should be possible to adapt these guides to specific habitat conditions within a short period of time. These could provide interim guides until research needed for specific guides is completed.

The systems suggested in the following descriptions are tentative. Additional literature review and discussions with research foresters specifically involved with the species/site conditions described is needed. Habitat types also need to be mapped in areas where past research has already been conducted in order to tie those research results directly to these habitat type descriptions.

Herbicide recommendations are based on dozens of trials and studies established by various agencies and companies. On-site investigation by the authors, and personal communications with foresters have been evaluated and synthesized to develop the recommended herbicides and application rates. Sufficient information is now available to indicate that these herbicides will generally provide the level of control needed to allow near maximum growth of the conifers. However, each herbicide provides a different spectrum of control and no single one will be satisfactory for all conditions the user will find within his or her ownership. Nothing replaces experience in deciding specific prescriptions, and these recommendations merely provide guidelines for the user to get started. Nor are the chemicals listed the only ones that may be suitable. Others may be equally or even better suited, but are not listed because the authors are not familiar with them. Also, new herbicides will be coming on the market after this printing that are not included. The user is advised to check with Mr. Robert Sajdak in the Department of Forestry at Michigan Technological University for the latest recommendations and dosages.

DEFINITIONS USED

Constancy - a measure of the frequency of occurrence of a species across a given habitat type.

Eolian or Loess - transported or deposited by wind. (There is some disagreement among soil scientists as to whether these are fine eolian or loess deposits or are ablation till).

Podzol (Podzolized) - a sandy or loamy sand soil having a leached A_2 (E) horizon that is often grayish in color, with an accumulation of clay, organics, and minerals (primarily iron with some aluminum) in the B horizon. In highly podzolized soils this accumulation of clays, organics, and iron often cements into an ortstein layer of discontinuous dark reddish brown plates in the B horizon. (Where used in this field guide the term podzol or podzolized refers to this process rather than to meeting the exact criteria for a spodosol).

Lacustrine - soils formed from former lake bed deposits.

Moraine - a hummocky deposit of glacial till formed at the terminal end, sides or under a receding glacier.

Drumlin - whale-back shaped glacial feature composed of unsorted till whose axis is parallel to the direction of ice flow.

Coverage - see definitions of coverage terminology in Section 2 - Classification Key.

PINUS-VACCINIUM-DESCHAMPSIA HABITAT TYPE
(PVD)

IDENTIFICATION

From key: The sum of hairgrass, sedge, reindeer moss and bearberry > the sum of wild lily-of-the-valley and bracken fern. And hair grass > sedge, spinulose shield fern usually absent.

Additional Habitat Characteristics:

1. This is an extremely droughty type and often poorly stocked with jack pine.
2. The bracken fern is normally very sparse on this type and is usually less than 1 foot tall.
3. This type is common on "sand or pine plains".

CLIMAX OVERSTORY

Dominant: Jack Pine
Associate: Red Pine
Minor: White Pine

SUCCESSIONAL OVERSTORY

See successional diagram as well a detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin jack pine with scattered red pine, usually poorly stocked. White pine uncommon.
2. Logged Successional Stands: Jack pine and scattered red pine, with poor aspen, red maple or oak uncommon depending on seed source.
3. Logged and Burned: Jack pine occassional red pine.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Hairgrass				**
	Sedge			+	
	Sweetfern		+		
	Lowsweet blueberry			+	
	Flaindeer mosses		*		
	Trailing arbutus	+			
	Bracken fern			+	
	Canada blueberry	+			
	Pin cherry	+			
	Cowwheat	+			
75-50%	Sand Cherry		+		
	Bearberry		+		
	Juneberry	+			
	Wild lily-of-the-valley	+			

SOILS

This habitat type is only found on sandy soils with little or no horizon development. The landform is usually a droughty outwash plain.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 Yrs.)	Mean Annual Growth[2] Pulpwood (Cu. Ft./Ac.)	Rotation Age (Pulpwood)	Yield at Rotation (CCF/Ac.)	Successional Stability
Jack Pine	50-56	(30-40)[1]	50-55	17-21	High
Red Pine	(40-46)[1]	?	50	?	Low

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Cf/Ac/Yr.

SUGGESTED SILVICULTURAL SYSTEM

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	*Disk or *Patch Scarify	*Direct Seeding or *Direct Seed 2-3 seed per patch	None

*Silvicultural prescriptions are not well known.

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PINUS-VACCINIUM-CAREX HABITAT TYPE
(PVC)

IDENTIFICATION

From key: The sum of hairgrass, sedge, reindeer moss and bearberry > the sum of wild lily-of-the-valley and bracken fern. And sedge > hairgrass, spinulose shield fern often present.

Additional Habitat Characteristics:

1. This is a very droughty type with jack pine the only species capable of occurring in well stocked stands.
2. The bracken fern is often very sparse on this type, and is usually less than 1½ feet tall.
3. This type is common on "sand or pine plains".

CLIMAX OVERSTORY

Dominant: Jack Pine
Associate: Red Pine
Minor: Black spruce, white pine

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession after original logging:

1. Logged climax stands: jack pine with some red pine, black spruce, often poorly stocked. White pine uncommon.
2. Logged successional stands: Jack pine and scattered red pine with poor aspen, red maple or red oak depending on seed source.
3. Logged & burned: Jack pine, red pine.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Sedge				**
	Low sweet blueberry				+
	Sweet fern	+			
	Sand cherry	+			
	Juneberry	+			
	Wild lily-of-the-valley	+			
	Bracken fern			+	
	Trailing arbutus		+		
	Reindeer moss		+		
	Hairgrass		+		
	Wintergreen		+		
	Cow wheat	+			
	Canada blueberry	+			
75-50%	Spinulose shield fern	*			

SOILS

This habitat type is only found on sandy soils with little or no horizon development. The landform is usually a droughty outwash plain.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 Yrs.)	Mean Annual Growth[2] Pulpwood (Cu. Ft./Ac.)	Rotation Age (Pulpwood)	Yield at Rotation (CCF/Ac.)	Successional Stability
Jack Pine	55-60	(40-50)[1]	50	20-25	High
Red Pine	(45-53)	?			Low

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Cf./Ac./Yr.

SUGGESTED SILVICULTURAL SYSTEM

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	*Disk or *Patch Scarify	*Direct Seed (½ lb. ac.) *Direct Seed 2-3 seed Per spot	None
		*Patch Scarify or Disk Trench	*Plant 900-1000 trees/ac.	

*Silviculture operations are not adequately known, therefore the suggested guide is an estimate based on extrapolated knowledge.

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QUERCUS-ACER-EPIGAEA HABITAT TYPE

(QAE)

IDENTIFICATION

From key: The sum of bracken fern and wild lily-of-the-valley > the sum of hairgrass, sedge, reindeer moss and bearberry. And trailing arbutus at least twice as much coverage as the sum of beaked hazelnut, wild sarsaparilla, and barren strawberry.

Additional Habitat Characteristics:

1. The bracken fern on this type is often nearly continuous except under heavy plantation overstories.
2. The bracken fern is generally around two feet tall or less.
3. Trailing arbutus, while it is the key indicator, may not be in high abundance and may occur in patches only.
4. Beaked hazelnut, wild sarsaparilla, and barren strawberry are usually absent or extremely rare on this type. If these species occur in fair abundance you may be on the Acer-Quercus-Vaccinium habitat type.

CLIMAX OVERSTORY

Dominant: Red oak, Red Maple
Associate: None
Minor: White Spruce, white pine

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: seed and sprout origin red oak and red maple with black/white spruce, white pine, and some balsam fir.
2. Logged Successional Stands: white pine, white spruce, jack pine and/or red pine, depending on seed source.
3. Logged and Burned: jack pine, red pine, and/or aspen depending on seed source.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Bracken fern				*
	Wintergreen		+		
	Low sweet blueberry			+	
	Trailing arbutus	**			
	Juneberry	+			
	Grasses			+	
	Mosses			+	
	Canada blueberry		+		
50-75%	Cow wheat	+			
	Sweet fern		+		
	Sedges	+			
	Blue bladonia	+			
	Wild lily-of-the-valley	*			

SOILS

The Quercus-Acer-Epigaea habitat type is almost always found on sandy soils with poor horizon development. The landform is often a nearly level outwash or lacustrine deposit with hilly or dissected areas less common. In limited areas this type will occur on heavier soils which are very shallow to bedrock.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[2] Pulp (Ft.³/Ac.)	Saw (BF/Ac)	Rotation Age Pulp	Saw	Yield at Rotation Pulp (CCF/ac.)	Saw (MBF/ac.)	Successional Stability
Jack Pine	56-64	50-70[1]	-	50	-	(20-30)	-	Mod. Low
Red Pine	50-59	65-85	(450-600)	50	80	(25-35)	(20-28)	Moderate
White Pine	?	?	?	?	?	?	?	Moderate
Aspen	(50-65)	-	-	-	-	-	-	Very Low
White Spruce	?	?	-	?	-	?	-	Mod. High?
Black Spruce	?	?	-	?	-	?	-	Mod. High?
Red Oak	(40-50)	-	-	-	-	-	-	High
Red Maple	?	-	-	-	-	-	-	High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Growth is per acre per year.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	*Disk or disk trench to expose mineral soil and reduce competition.	Plant 800 tree/ac. or *direct seed using ½ lb./ac.	*Thin once at age 25-30 removing 4-5 CCF and leaving 60 ft.²B.A./Ac.
Red Pine	Clearcut	*Disk or disk trench to reduce competition. If brush competition warrants, spray with 1 gal./ac. Tordon 101, 2 qts.ac. Roundup, or 1 gal./ac. Velpar L.	Plant 900 trees/ac.	*Thin once at 25-30, 45-50, & 65-70 to 90, 100 ft²ac. respectively. Remove 5 to 8 CCF for thinnings.
Aspen	Clearcut Parent stand must have 50 trees or 20 ft.²/Ac.	Leave residual of no more than 50 trees or 10ft.² B.A./Ac. Preferably remove all overstory.	Sucker	None
W. Spruce	Clearcut	*Disk to reduce competition.	Plant 900 trees/ac.	?
Balsam Fir	Not a desireable species on this site.			
Red Maple	Not a desirenble species on this site.			
Red Oak	Not a desirenble species on this site (except for wildlife).			

[1] Aspen is not a productive species on this site and conversion to a softwood is advised.
* Silviculture operations are not adequately known, therefore the suggested guide is an estimate based on extrapolated knowlerlge.

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ACER-QUERCUS-VACCINIUM HABITAT TYPE
(AQVac)

IDENTIFICATION

From key: Trailing arbutus < twice as much coverage as the sum of beaked hazelnut, wild sarsaparilla and barren strawberry. And low sweet blueberry > the sum of wild sarsaparilla, wood betony, twisted stalk, yellow beadlily, false solomon's seal, and spinulose shield fern, with wood betony less than 5% coverage.

Additional Habitat Characteristics:

1. Bracken fern coverage is often greater than 50% on this type and, though variable, averages about 2½ feet and is usually taller than on the Quercus-Acer-Epigaea type.
2. Beaked hazelnut is usually common, often occuring in clumps.
3. Wood betony, twisted stalk, yellow beadlily, false solomon's seal, and spinulose shield fern are often absent or extremely rare on this type. If any of these species are common you may be on the Tsuga-Mainanthemum-Vaccinium type.
4. Low sweet blueberry is usually well represented but may be hidden under a cover of bracken fern.
5. Although not as abundant as on the Tsuga-Maianthemum-Vaccinium h.t., white pine commonly occurred on this type before the white pine cuts at the turn of the century, and scattered stumps are still evident today.

CLIMAX OVERSTORY

Dominant: Red Maple, Red Oak
Associate: E. Hemlock, white pine
Minor: Balsam fir, white spruce

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin red maple, red oak, balsam fir, and occassional white pine and white spruce.
2. Logged Successional Stands: sprout red maple, red oak and/or balsam fir, white spruce, white pine, with occassional red pine, jack pine, aspen, or white birch (or clumps of these species).
3. Logged and Burned: aspen/white birch, red pine, jack pine, depending on seed source. Balsam fir and white spruce may be mixed with any of the above species.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Low sweet blueberry		**		
	Bracken fern				+
	Canada blueberry		+		
	Wintergreen		+		
	Large leaved aster		+		
	Beaked hazelnut		**		
	Grasses			+	
75-50%	Pincherry	+			
	Wood anemone	+			
	Juneberry	+			
<50%	Barren strawberry		*		
	Starflower	+			
	Cow wheat	+			
	Wild sarsaparilla	*			
	Sweet fern	+			

SOILS

The AQV habitat type is most common on sandy soils with moderate horizon development. The landform is usually an outwash (lacustrine less common) and may be hilly or dissected. In limited areas this type will occur on heavier soils which are very shallow to bedrock or occur as a shallow cap over sand and gravel.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[2] Pulp (Ft.³/Ac.)	Saw (BF/Ac)	Rotation Age Pulp	Saw	Yield at Rotation Pulp (CCF/ac.)	Saw (MBF/ac.)	Successional Stability
Jack Pine	67-75	60-85	-	45	-	25-33	-	Low
Red Pine	64-68	90-110	550-700	45	70-80	(28-38)	(23-33)	Mod. Low
White Pine	?	?	?	?	?	?	?	Moderate
Aspen	(55-75)[1]	?	-	(60)	-	?	-	Very Low
White Birch	?	?	?	?	?	?	?	Very Low
White Spruce	(40-55)	?	-	?	-	?	-	Moderate
Balsam Fir	?	?	-	?	-	?	-	Mod. High
Red Oak	(50-60)	?	-	-	(100)	-	?	High
Red Maple	(40-50)	?	-	?	-	?	-	High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Growth is per acre per year

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	Remove any hardwood and spray herbicide to control brush if necessary.[1,2]	Plant 800 trees/ac.	*Thin once at age 25-30 removing 5-6 CCF/ac. and leaving 60ft²/ac. basal area.[3]
Red Pine	Clearcut	Remove any hardwood and spray herbicide to control brush if necessary.[1]	Plant 800-900 trees/ac.	*Thin at age 25-30, 40-45, 55-60 to 90, 100 and 110, ft.²/ac. basal area.[3] Remove 6-9 CCF/ac. for each thinning.
W. Pine	Clearcut	Remove any hardwood and spray herbicide.[1,2]	Plant 800-900 trees/ac.	?
Aspen[4]	Clearcut Parent Stand must have 50 trees or 20ft.²	Leave residual of no more than 50 trees or 10ft.² B.A./ac. Preferably removal all overstory.	Sucker	None
W. Birch	*Shelterwood	?	Natural	?
W. Spruce	Clearcut	Remove any hardwood and spray herbicide to control brush if necessary.[1]	Plant 900 trees/ac.	?
Balsam Fir	*Shelterwood: Prep cut to 70ft² /ac. Five years later seed cut to 50ft²/ac. removing as much maple fir, and spruce as possible. Four to 7 yrs. later removal cutting.	*During seed cut disperse skidding. During removal cutting concentrate skidding, avoiding areas of advanced oak regeneration.		
Red Maple	Not a desirable species on this site.			

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimate based on extrapolated knowledge.

[1] Suggested herbicides are Tordon 101, 4 qts./ac., Roundup, 2 qts./ac. (up to 2.5qts. for hard to kill red maple and oak); Velpar L, 4 qts./ac.; and when named and labeled Dupont DPX-T6376, 2-4 oz/ac. (6-8 oz. for r. oak and s. maple). Tordon 101, and DPX-T6376 will not kill grass competition. Failure to reduce grass competition will reduce red pine volume growth by up to 30%. Double disking also controls aspen suckering without herbicides.

[2] Do not spray Velpar directly on jack pine, or Roundup directly on white pine.

[3] Do not allow basal area per acre to exceed 125 ft² or 180 ft² for jack pine or red pine respectively before thinning.

[4] Aspen is not a productive species on this site and conversion to a softwood is advised.

2nd Printing, 1983

TSUGA-MAIANTHEMUM-VACCINIUM HABITAT TYPE (TMV)

IDENTIFICATION

From key: Canada blueberry, low sweet blueberry and/or wood betony present. And low sweet blueberry < the sum of the coverage of wild sarsaparilla, wood betony, twisted stalk, yellow beadlily, false solomon's seal, and spinulose shield fern.

Additional Habitat Characteristics:

1. Canada blueberry usually occurs in greater coverage than low sweet blueberry.
2. Under conifer plantations or well stocked hardwood stands the blueberries may have very low coverage.
3. Bracken fern coverage is often greater than 40% of this type and may be waist high (3-3½ ft.).
4. If wood betony is present it is likely that you are on this type.
5. Wild sarsaparilla is often common on this type and usually occurs in groups.
6. White pine dominated this type prior to the heavy white pine cuts in the turn of the century. Therefore, white pine stumps and/or residual white pine often are prevalent in stands of this type.

CLIMAX OVERSTORY

Dominant: Eastern hemlock, red maple
Associate: Sugar maple, white pine, balsam fir, white spruce
Minor: Red oak

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin red/sugar maple, and balsam fir/white spruce.
2. Logged Successional Stands: sprout red/sugar maple and/or balsam fir/white spruce, with occassional red oak (or clumps of red oak), and/or white pine.
3. Logged and Burned: aspen/birch and/or balsam fir/white spruce. Where seed source available stands of white, jack, or red pine can develop.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Bracken fern				+
	Wild lily-of-the-valley		+		
	Large leaved aster				+
	Canada blueberry	**			
	Wild sarsaparilla		**		
	Beaked hazelnut		+		
75-50%	Grasses		+		
	Wintergreen		+		
	Juneberry	+			
	Starflower		+		
	Low sweet blueberry	*			
	Sedges	+			
<50%	Yellow beadlily	*			
	False solomon's seal	*			
	Twisted stalk	*			
	Wood betony		**		
	Spinulose shield fern	*			

SOILS

The Tsuga-Maianthemum-Vaccinium habitat type is primarily found on sandy soils with moderate horizon development or shallow sandy loam soils. The landform is usually outwash or lacustrine in origin, or where shallow eolian deposits cover course sand and gravel. It is less common on moraines where it may occur in areas shallow to bedrock.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[2] Pulp (Cu. Ft.)	Mean Annual Growth[2] Saw (Bf/Ft)	Rotation Age Pulp	Rotation Age Saw	Yield at Rotation Pulp (CCF/ac.)	Yield at Rotation Saw (MBF/ac.)	Successional Stability
Jack Pine	(73-78)	(70-90)	-	40	-	(24-30)	-	Very Low
Red Pine	72-78	110-145	650-800	40	60-80	31-40	(29-38)	Low
White Pine	?	?	?	?	?	?	?	Moderate
Aspen	(65-80)[3]	(55-118)	-	45-55	-	(30-53)	-	Very Low
White Birch	?	?	?	?	?	?	?	Very Low
White Spruce	50-62	?	?	?	?	?	?	Mod. High
Balsam Fir	?	?	?	?	?	?	?	High
Red Oak	(63-68)	?	?	-	?			Mod. High
Red Maple	(50-56)	(20-32)						High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Growth is per acre per year.
[3] Site index is highly variable for aspen because of its sensitivity to stand treatment when it was regenerated and because of its very high genetic variability.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	Remove any hardwood and spray herbicide to control brush if necessary.[1,2]	Plant 700-800 trees/ac.	*Thin once at age 25-30 removing 6-8 CCF/ac. and leaving 60ft²/ac. basal area.[3]
Red Pine	Clearcut	Remove any hardwood and spray herbicide to control brush and grass if necessary.[1]	Plant 700-900 trees/ac.	Thin at age 20-22, 28-30, 42-47, and 55-65 to 90, 100, 110, 120 ft²/ac. respectively. Remove 6-10 CCF/ac. for each thinning.[3]
W. Pine	Clearcut	Remove any hardwood and spray herbicide to control brush, if necessary.[1,2]	Plant 700-900 trees/ac.	?
Aspen	Clearcut Parent stand must have 50 trees or 20ft²/ac.	Leave residual of no more than 50 trees or 10ft² B.A./Ac. Preferably remove all overstory	Sucker	None
W. Birch	*Shelterwood	?	Natural	?
W. Spruce	Clearcut	Remove any hardwood and spray herbicide to control brush, if necessary.[1]	Plant 700-900 trees/ac.	?
Balsam Fu	*Shelterwood	?	Natural	?
Red Oak	*Shelterwood Prep. cut to 80ft²/ac. Five years later seed cut to 60ft²/ac. removing as much maple and lir as possible. Four to 7 years later removal cutting.	*During seed cut disperse skidding. During removal cutting concentrate skidding, avoiding areas of advanced oak generation.		
Red Maple	Not a desireable species on this site.			

* Silvicultrue operations are not adequately known, therefore, the suggested guide is an estimate based on extrapolated knowledge.
[1] Suggested herbicides are Tordon 101, 4 qts./ac.; Roundup, 2 qts./ac. (up to 2.5 qts. for hard to kill red maple); Velpar L, 4 qts./ac.; and when named and labeled Dupont DPX-T6376, (2-4 oz/ac.) (4-6 oz. for r. maple). Tordon 101, and DPX-T6376 will not kill grass competition. For this tank mix Oust, Dowco 453 ME, (Experimental number, Dow Corp) or any other compatible grass killer. Failure to control grass will reduce volume growth of red pine by up to 30%. Double disking also controls aspen suckering without herbicides.
[2] Do not spray Velpar directly on jack pine, or Roundup directly on white pine.
[3] Do not allow basal area per acre of jack pine and red pine to exceed 125 ft² and 180 ft² respectively before thinning.
[4] Aspen is not a productive species on this site and conversion to a softwood is advised.

TSUGA-MAIANTHEMUM HABITAT TYPE
(TM)

IDENTIFICATION

From key: Canada blueberry, low sweet blueberry, and wood betony absent or extremely rare. And wild-lily-of-the-valley > the sum of the coverage of spinulose shield fern, sweet cicely, elderberry, and yellow, canada or downy violet.

Additional Habitat Characteristics:

1. Wild lily-of-the-valley is often very abundant and scattered throughout the stand.
2. Elderberry, yellow violet, jack in-the-pulpit, bloodroot, rattlesnake fern, and lady fern are very rare on this type. If any of these species are common you may be on the Acer-Tsuga-Dryopteris or Acer-Viola-Osmorhiza habitat type.
3. Wood betony, cow wheat, sweet fern, and trailing arbutus are extremely rare on this type. If any of these are common you may be on the Tsuga-Maianthemum-Vaccinium habitat type.

Phases:

1. **The Deschampsia phase** is limited to moderate to highly podzolized sands, usually in areas with a history of frequent fires, haying, farming, or deeply furrowed plantations.

CLIMAX OVERSTORY

Dominant:	Eastern hemlock, sugar maple, red maple
Associate:	Yellow birch
Minor:	White spruce, balsam fir, white pine, red oak, N. white cedar, basswood

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin-sugar/red maple with mixed yellow birch.
2. Logged Successional Stands: Seed and sprout origin red/sugar maple with mixed yellow birch, and minor components of red oak, basswood, white cedar, white spruce and balsam fir.
3. Logged and burned: aspen/birch and/or spruce/fir with mixed red/sugar maple; occasionally red and jack pine.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Wild lily-of-the-valley		**		
	Grasses			+	
	Sedges		+		
	Bracken fern				+
	Starflower	+			
	Bedstraw	+			
	Wild sarsaparilla	+			
75-50%	Beaked hazelnut			+	
	Pin cherry		+		
	Choke cherry		+		
	Ground pine	+			
	Large leaved aster		+		
	Juneberry	+			
	Spinulose shield fern	+			
<50%	Hairgrass	Δ			

SOILS

The Tsuga-Maianthemum habitat type is characteristically found on sandy to sandy loam texture soils. If the soils are sand they must be well developed fine sand or very fine sand, or podzolized to support this type. The landform is generally moraine or outwash covered moraine, with lacustrine deposits or areas shallow to bedrock less common.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[1] Pulp (Cu./Ac.)	Saw (Bd./Ft.)	Rotation Age Pulp	Saw	Yield at Rotation[2] Pulp (CCF)	Saw (MBF)	Successional Stability
Jack Pine	75-80[3]	(80-110)	-	40	70	(25-35)	-	Very Low
Red Pine	78-82	155-180	750-900	40	60-80	40-48	(30-40)	Low
Aspen	(65-80)[4]	(55-118)	-	50	-	124361	-	Very Low
Spruce	(55-66)	?	?	?	?	?	?	Med. High
Red Oak	68-73	(55-80)	(200-300)	-	70	-	(14-20)	Med. High
Sugar Maple	54-61	(28-42)	(75-100)	-	95	-	(5-7)	High
(Uneven-age)[2]			(100-200)		15		2-3	High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Data given assumes uneven-aged management using the selection system.
[3] Growth data is per acre per year. Yield data is per acre.
[4] Site index is highly variable for aspen because of its sensitivity to stand treatment when it was regenerated and because of its very high genetic variability.

Phase Productivity. Productivity of red maple and red pine on the Deschampsia Phase is significantly lower than on the Tsuga-Maianthemum habitat type.

SITE INDEX AND VOLUME GROWTH ON THE DESCHAMPSIA PHASE

Species	Site Index (ft)	Mean Annual Volume Growth (CF/Ac./Yr)
Red Maple	50-55	(20-32)
Red Pine	68-71	(95-120)

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Jack Pine	Clearcut	Remove hardwood. Allow 1 year growth. Spray herbicides to control brush, if necessary.[1,2]	Plant 700-900 trees/ac.	*Thin at age 25-30 to 60ft²/ac. remove 8-10 CCF/ac.[3]
Red Pine	Clearcut	Remove hardwood. Allow 1 year growth. Spray herbicides to control brush, if necessary.[1]	Plant 700-900 trees/ac.	Thin at ages 18-20, 26-28, 40-45, and 55-65 to 90, 100, 110, and 120 ft²/ac for each thinning.[3] Remove 8-12 CCF/ac. for each thinning.
Aspen	Clearcut. Parent stand must have 50 trees or 20ft²/ac.	Leave maximum 50 trees or 10 ft²/ac. Preferably remove all trees.	Sucker	None
Spruce	Clearcut	Remove hardwood. Allow 1 year growth. Spray herbicides to control brush, if necessary.[1]	Plant 800-900 trees/ac.	Unknown
Red Oak	*Shelterwood Prep. cut to 80ft²/ac. Five years later seed cut to 60ft²/ac., removing as much maple as possible. Four to seven years later removal cut.	*During seed cut disperse skidding. During removal cut concentrate skidding, avoiding areas of advanced oak regeneration.		*Precommercial cleaning at age 15 to 20, leave 1000 stems (or spot thin around 150 crop trees). Liberation cutting at age 30-35 to 90-70ft²/ac. Commercial thinnings thereafter @15 year intervals to 70ft²/ac. In all cases maple should be removed in favor oak.
Sugar Maple	*Selection cut on a 15 to 20 year cutting cycle removing 2-3 or 3.0 M.BF./ac. and leaving 70ft²/ac. or 80ft²/ac.	*Locate skid roads around areas of advanced regeneration and through areas of inadequate regeneration to disturb the site.		Poor quality trees down to 9" dbh should be removed with the marked sawtimber while keeping within basal area guidelines.

* Silvicultural operations are not known or not adequately known. Therefore, the suggested guide is an estimate based on extrapolated knowledge.
[1] Suggested herbicides are Tordon 101, 4 qts./ac., Roundup, 2.5 qts./ac. (up to 3 qts. if heavy to S. maple); Velpar L 4-5 qts./ac. (5-6 qts. if heavy to s. maple; and when named and labeled Dupont's DPX-T6376, 2-4 oz./ac. (6-8 oz if heavy to s. maple). Tordon 101 and DPX-T6376 will not kill grass competition. For this tank mix Oust, Oxaco 45:1 ME, (Experimental number, Dow Corp) or any other compatible grass killer. Failure to control grass may reduce red pine volume growth by 30%. Double disking also controls aspen suckering without herbicides.
[2] Do not spray Velpar L directly on jack pine, or Roundup directly on white pine.
[3] Do not allow basal area of jack pine and red pine to exceed 125ft² and 180ft²/ac. respectively before thinning.

ACER-QUERCUS-VIBURNUM HABITAT TYPE

(AQVib)

IDENTIFICATION

From key: Mapleleaf viburnum, witch-hazel, and/or pointed leaved tick trefoil common and > the sum of low sweet and canada blueberry; spinulose shield fern, sweet cicely, and smooth yellow violet or canada white violet.

Additional Habitat Characteristics:

1. This habitat only occurs in Northern Wisconsin or in Michigan near the Wisconsin border.
2. The Mapleleaf viburnum, witch-hazel, and pointed leaved tick trefoil are very abundant on this type and will often be well over the common coverage level.
3. Northern red oak and white ash commonly occur together on this type, along with very scattered bitternut hickory.

CLIMAX OVERSTORY

Dominant: Red Maple, Red Oak
Associate: American beech, sugar maple, white ash, basswood
Minor: White pine

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin red maple, red oak with some of the associate species like sugar maple and beech with occassional white ash.
2. Logged Successional Stands: Seed and sprout origin red maple, red oak, with mixed sugar maple, white ash, ironwood, beech and basswood.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, + common associate).

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Mapleleaf viburnum		**		
	Hairy solomon's seal	+			
	Wood anemone	+			
	False solomon's seal	+			
	Bracken fern		+		
	Choke cherry	+			
	Grasses				+
	Beaked hazelnut		+		
	Trilliums	+			
	Wild sarsaparilla		+		
	Witch-hazel		**		
	Larged leaved aster		+		
50-75%	Wild lily-of-the-valley	+			
	Pointed leaved tick trefoil		**		
<50%	Spinulose shield fern	+			

SOILS

This habitat type is associated with end - moraine topography. The soils consist of two to three feet of fine sandy loam or sandy loam over loamy sand till. They are well drained and lack inhibiting layers in the profile. They are commonly stoney both on and in the profile. Sarona and Keweenaw appear to be the dominant soil series from the information available to date.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)[1]	Mean Annual Growth Pulp (Ft.³/Ac.)[1]	Mean Annual Growth Saw (BF/Ac)	Rotation Age Pulp	Rotation Age Saw	Yield at Rotation Pulp (CCF/ac.)	Yield at Rotation Saw (MBF/ac.)	Successional Stability
Aspen	(73-82)[2]	(55-118)	-	45-50	-	43-48	-	Very Low
Sugar Maple/ W. Ash/R. Oak/R. Maple	(61-73)	(45-55)	?	-	85-95	?	?	Very High
Red Oak	(64-70)	(60-68)	?	?	?	?	?	
Red Maple/ B. Ash	(52-58)	(40-49)	?	?	?	?	?	Med. High
Balsam Fir	(60-68)	(35-45)	?	?	?	?	?	Moderate
Red Pine	(74-79)	(130-155)	(700-850)	40	60-80	(35-45)	(30-39)	Low

[1] Data for this table supplied by the Nicolet National Forest from their TMIS data base. Red pine data provided by Champion International and is based on limited sampling.

[2] Data given in parenthesis is based on preliminary or sketchy information.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut Parent Stand Must have 50 trees or 20ft²/ac.	Leave maximum 50 trees or 10ft²/ac. Preferably remove all trees.	Sucker	None
Sugar Maple/Red Oak/White Ash complex	*Shelterwood: Prep. cut should remove maple & undesireable species or trees leaving as much ash and oak as possible. Cut to 80ft²/ac. Five years later seed cut to 60ft² removing as much maple as possible. Four to seven years later removal cut.	*During seed cut disperse skidding, avoiding regeneration of red oak and white ash. During removal cut plan to concentrate skidding to avoid oak and ash regeneration.		*Precommercial cleaning at age 15 to 20, leave 1000 stems (or spot thin around 150 crop trees) favoring oak and ash. Liberation cutting at age 30-35 to 60-70ft²/ac. Commercial thinnings thereafter @15 yr. intervals to 70ft²/ac. In all cases maple should be removed to favor oak and ash.
Red Pine	Clearcut	Remove hardwood. Allow one year to grow spray herbicides to control brush if necessary.[1]	Plant 700-900 trees/ac.	Thin at ages 20-22, 28-30, 42-47, and 55-65 to 90, 100, 110, 120 ft²/ac. respectively. Remove 7-11 CCF/ac. for each thinning.[2]

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimate based on extrapolated knowledge.

[1] Suggested herbicides are Tordon 101, 4-6 qts./ac.; Roundup, 2.5 qts./ac.; Velpar L, 4-6 qts./ac.; and when named and labeled Dupont's DPX-T6376; 4-6 oz/ac. Tordon 101 will not kill white ash. Tordon 101 and DPX-T6376 will not kill grass competition. For this mix DOWCO-453 ME (Experimental number, Dow Corp.), Oust or any other compatible grass killer.

[2] Do not allow basal area for red pine to exceed 180 ft²/ac. before thinning.

Second Printing, 1983

ACER-TSUGA-DRYOPTERIS HABITAT TYPE
(ATD)

IDENTIFICATION

From key: Wild lily-of-the-valley < the sum of the coverage of spinulose shield fern, sweet cicely, ehlerberry, and yellow, canadian, or downy violet. And spinulose shield fern at least twice as much coverage as the sum of sweet cicely, blue cohosh, and yellow, canadian, or downy violet.

Additional Habitat Characteristics:

1. The groundflora diversity is often low on this type, giving the understory a sparse appearance.
2. Eastern hemlock often occurs in hardwood stands in small groups rather than as individuals on this type.
3. This habitat type is a very common northern hardwood site and occurs on a variety of soil-landform combinations.

Phases:

1. **The Deschampsia Phase** is limited to highly podzolized sands, or sands having a well developed B_2 usually in areas with a history of frequent fires, haying, farming, or deeply furrowed plantations.
2. **The Dryopteris Phase** is identified by the absence or near absence of several nutrient demanding species (lady fern, yellow, canada, or downy violet, jack-in-the-pulpit, and rattlesnake fern). This phase is limited, therefore, to areas where the soil is not heavy enough to support these species. It normally occurs on podzolized sands or very fine loamy sands with a well developed B horizon or other compensating factor which improves the site.
3. The Circaea-Impatiens Phase is usually limited to rivulet drainway systems, on sirle slopes or upland drainways within this type.

CLIMAX OVERSTORY

Dominant:	Sugar maple
Associate:	E. Hemlock, basswood, american beech
Minor:	Yellow birch, red maple, american elm

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin sugar maple with some basswood and/or ironwood.
2. Logged Successional Stands: seed and sprout origin sugar maple, with mixed basswood and/or ironwood and minor components of yellow birch, red maple, and american elm.
3. Logged and Burned: aspen/birch and/or mixed red/sugar maple, basswood, or ironwood. Sprouting common.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δphase indicator, + common associate).

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Spinulose shield fern		**		
	Sugar maple seedlings				+
	Twisted stalk	+			
	Hairy solomon's seal	+			
	Sedges		+		
75-50%	Wild lily-of-the-valley	+			
	Elderberry	*			
	Starflower	+			
	Lady fern	Δ			
<50%	Yellow, canadian, downy violet	Δ			
	Jack in-the-pulpit	Δ			
	Rattlesnake fern	Δ			
	Enchanter's nightshade	Δ			
	Jewelweed	Δ			
	Hair grass	Δ			

SOILS

The Acer-Tsuga-Dryopteris habitat type is characteristically found on podzolized or well developed sands to loam textured soils. The landform is generally morainic in origin, but may be covered by an eolian deposit. Deep eolian deposits over outwash sands can also occur. Areas shallow to fractured bedrock or lacustrine are less common.

Phases:

The Deschampsia and Dryopteris Phases are limited to well developed podzolized sands.

The Circaea Impatiens Phase is generally limited to heavier soils, often enriched by a loess cap, and is usually found on rivulet drainway systems or upland drainway systems.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50yrs)	Mean Annual Growth[4] Pulp (Cu. Ft.)	Mean Annual Growth[4] Saw (Bd./Ft.)	Rotation Age Pulp	Rotation Age Saw	Yield at Rotation[4] Pulp (CCF)	Yield at Rotation[4] Saw (MBF)	Successional Stability
Aspen	(70-80)[1]	(65-110)		50	60	(38-53)	(0-10)	Very Low
Basswood	(64-68)	?	?	?	?	?	?	Low
Sugar Maple (Uneven-aged)[2]	60-65	35-48	(85-120) 170-225	-	85 15	-	(79) 3.0	Very High Very High
Red Pine[3,5]	*78-82*	*155-180*	*750-900*	*40*	*60-80*	*40-48*	*(30-41)*	*Very Low*

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Data given assumes uneven-aged management using the selection system.
[3] Data in italics represent plantation possibilities and are not part of natural succession.
[4] Growth data is per acre per year. Yield data is per acre.
[5] Future work may reveal that red pine potential is somewhat higher using intensive management than this data presents.

Phases:
1 **Deschampsia Phase.** Productivity of the **Deschampsia Phase** is much lower than on the Acer-Tsuga-Dryopteris habitat type. To date the only productivity data for this phase is on red pine.
2 **Dryopteris Phase.** Productivity of the Dryopteris phase is the same as the Acer-Tsuga-Dryopteris h.t. However, it dries more rapidly in the spring and remains drier during wet summers, which changes operability restrictions. Also, it is much more "fragile" than the ATD h.t. and frequent fires, intensive farming, or other severe treatment could reduce it to the Deschampsia phase.

SITE INDEX AND VOLUME GROWTH ON THE DESCHAMPSIA PHASE

Species	Site Index (50 Yr.)	Mean Annual Volume Growth (Cf/Ac./Yr.)
Red Pine	60-67	80-115

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut. Whole tree harvesting preferred; parent stand must have 50 trees or have 50 trees in 20ft²/ac.	Leave no more than 50 trees or 10 ft²/ac. especially if maple saplings are numerous. Preferably remove all trees.	Sucker	*Thin at age 30 when stand exceeds 120 ft²/ac. Leave 60 to 70 ft²/ac., removing as much sprout maple and inferior clones as possible.
Basswood	?	?	?	*Crown release thin 75 trees/ac at age 20 to 25. Thin to 70 75 ft²/ac. on 15 year cycles thereafter removing undesireable maple and ironwood, & eliminating all but 1 or 2 sprouts per basswood clump.
S. Maple	Selection cut on a 15 year cutting cycle removing 3.0 MBF/ac. & leaving 70 to 80 ft²/ac.	*Locate skid roads around areas of advanced regeneration and through areas of inadequate regeneration so as to disturb the site.		Poor quality trees down to 9" dbh should be removed with the marked sawtimber while keeping within basal area guidelines.
Red Pine[1]	*Clearcut*	*Remove hardwood overstory. Allow 1 year to sprout or sucker then spray herbicide.*[2]	*Plant 800-900 trees/ac.*	*Thin at ages 18-20, 26-28, 40-45, and 55-65 to 90, 100, 110, and 120 ft²/ac. respectively. Remove 8-12 CCF/ac. for each thinning.*

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimated based on extrapolated knowledge.
[1] Suggestions made in italics represent plantation opportunities and are not part of natural succession.
[2] Suggested herbicides are Tordon 101, 4-6 qts./ac; Tordon 101, 4 qts./ac. plus Garlon 4, 2-3 qts. ac.; Roundup, 2.5 - 3.0 qts./ac; Vetpar L, 5-8 qts./ac.; and when named and labeled Dupont's DPX-T6376, 2-4 oz./ac. aspen and 6-8 oz./ac. sugar maple. Tordon 101 and DPX T6376 will not kill grass competition. For this tankmix Oust, Dowco 453 ME, (Experimental number, Dow Corp) or any other compatible grass killer. Grass must be controlled. Failure to do so will decrease survival and will decrease volume growth by up to 35%.
[3] Do not allow basal area per acre for red pine to exceed 180 ft² before thinning.

2nd Printing, 1983

ACER-VIOLA-OSMORHIZA HABITAT TYPE
(AVO)

IDENTIFICATION

From key: Spinulose shield fern < twice the sum of the coverage of sweet cicely, yellow, canadian or downy violet, and blue cohosh. And blue cohosh must have less than 5% coverage.

Additional Habitat Characteristics:

1. The diversity of understory species is much higher than on the relatively sparse ATD habitat type.
2. The vertical development of the understory is often much greater than on the ATD habitat type.
3. Sedges may form a continuous carpet on this type, especially where grazing or recurrent fires once occurred.

Phases:

1. The **Circaea-Impatiens Phase** is usually limited to rivulet drainway systems on side slopes or upland drainways within this type.
2. The **Adiantum Phase** is identified by the commonness of wild leek and maidenhair fern.

CLIMAX OVERSTORY

Dominant:	Sugar Maple
Associate:	Basswood
Minor:	White ash, yellow birch, ironwood, eastern hemlock, american elm

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: seed origin sugar maple with small amounts of basswood and/or ironwood.
2. Logged Successional Stands: seed and sprout origin sugar maple with some basswood, american elm and/or ironwood.
3. Logged and Burned: mixed aspen/sugar maple with some areas of heavy ironwood and/or basswood. Sprouting of sugar maple can be prolific and site can be set back to an understocked pucker-brush cover type with sedge understory.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δphase indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Sweet cicely		**		
	Sedges		+		
	Spinulose shield fern		+		
	Yellow, canadian, downy violet	**			
	Hairy solomon's seal	+			
	Twisted stalk	+			
	Bedstraw	+			
	Lady fern		+		
	Wild lily-of-the-valley	+			
	Elderberry	+			
50-75%	False solomon's seal	+			
	Jack-in-the-pulpit	*			
	Trilliums	+			
<50%	Rattlesnake fern	*			
	Blue cohosh	*			
	Bloodroot	*			
	Jewelweed	Δ			
	Bellworts	*			
	Enchanter's nightshade	Δ			
	Wild leek	Δ			
	Maidenhair fern	Δ			

SOILS

The Acer-Viola-Osmorhiza habitat type commonly occurs on loam to silt loam texture soils. The landform is usually moranic in origin, rolling, and often loess capped. Lacustrine deposits and areas shallow to fractured bedrock may support this type, but are less common.

Phases:

The **Circaea-Impatiens Phase** occurs where the soils are wetter, usually within a rivulet or major drainway system.

The **Adiantum Phase** occurs on silt loam to loam soils, is always on moraines, and is frequently associated with drumlins.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[5] Pulp (Cu./Ac.)	Saw (Bd. Ft)	Rotation Age Pulp	Saw	Yield at Rotation[5] Pulp (CCF)	Saw (MBF)	Successional Stability
Aspen	(75-85)[1]	(70-120)	?	50	70[2]	(45-59)	(0-10)	Very Low
Basswood	67-70	?	?	?	?	?	?	Mod. Low
Ironwood	-	-	-	-	-	-	-	Mod. High
Sugar Maple	64-69	40-53	(100-140)	-	85	-	(8-11)	Very High
(Uneven-aged)[3]			(200-275)	-	15	-	(3.6)	
Red Pine[5,6]	*78-82*	*155-180*	*750-900*	*40*	*60-80*	*40-48*	*(30-41)*	*Very Low*

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] The 70 year rotation assumes veneer product. Extreme caution must be taken with these lengthy rotations and stands must be monitored for heart rots.
[3] Data given assumes uneven-aged management using the selection system.
[4] Data in italics represent plantation possibilities and are not part of natural succession.
[5] Growth data is per acre per year. Yield data per acre.
[6] Future work may reveal that red pine potential is much higher when using intensive management than this data presents.

Phases:

1. **Circaea-Impatiens Phase.** Productivity of maple, ash, and other species on this phase is quite variable depending on the relative wetness and richness.
2. **Adiantum Phase.** Equipment operability usually better than on main AVO h.t. because of better moisture drainage. Also, soils are often richer than AVO and site index of sugar maple tends to be on the high end of the AVO h.t.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut (Whole tree harvesting preferred). Parent stand must have 50 trees or 20ft²/ac.	Leave no more than 50 trees or 10ft²/ac. especially in sugar maple sapling(s). Preferably remove all trees.	Sucker	*If veneer desired: 1 pre-commercial thinning at age 10, leaving 550 trees/ac. Thin commercially at 30 leaving 80 to 90 ft.²/ac. and removing sugar maple and poor clones.
Basswood	?	?	?	*Crown release thin 70 to 100 trees per acre at age 20-25. Again at age 35-40. Commercial thinning leaving 70 ft²/ac. at 15 year intervals thereafter, removing undesireable maple and ironwood, and eliminating all but 1 or 2 sprouts per basswood clump.
Sugar Maple	Selection: Cut on a 15 year cutting cycle removing 3.6 MBF/Ac. and leaving 70 to 80 ft.²/ac.	*Locate skid roads around areas of advanced regeneration and through areas of inadequate regeneration so as to disturb the site.		Poor quality trees down to 9" dbh should be removed with the marked sawtimber while keeping within basal area guidelines.
Red Pine[1]	*Clearcut*	*Remove hardwood overstory. Allow 1 year to sprout or sucker and spray herbicide/*[2]	*Plant 800-900 trees/ac.*	*Thin at ages 18-20, 26-28, 40-45, and 55-65 to 90, 100, 110, and 120 ft²/ac. respectively. Remove 8-12 CCF/ac. for each thinning.*[3]

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimated based on extrapolated knowledge.
[1] Suggestions made in italics represent plantation opportunities and are not part of natural succession.
[2] Suggested herbicides are Tordon 101, 6-8 qts/ac.; Tordon 101, 4 qts/ac. plus Garlon 4, 2-3 qts./ac.; Roundup 3.0-3.5 qts. ac/., Velpar L. > 2 gal./ac.; and when named and labeled Dupont's OPX-T6376, 6-8 oz./ac. Tordon 101 and OPC-T6376 will not kill grass competition. For this tank mix Oust; Oxyco 453 ME, or any other compatable labeled grass killer. Grass must be controlled. Failure to do so may results in poor survival and will reduce volume growth up to 40%.
[3] Do not allow the basal area per acre for red pine to exceed 180ft² before thinning.

ACER-OSMORHIZA-CAULOPHYLLUM HABITAT TYPE (AOC)

IDENTIFICATION

From key: Blue cohosh more than 5% coverage. And spinulose shield fern < twice the sum of the coverage of sweet cicely, yellow, canadian, or downy violet, and blue cohosh.

Additional Habitat Characteristics:

1. This type often occurs on a lower landform position resulting in a moisture and nutrient enriched site. Or on an extremely rich soil.
2. The understory diversity is usually high with many nutrient demanding species present.
3. Even though this is a very productive type for hardwoods the stand condition is often very poor with many branchy trees.

CLIMAX OVERSTORY

Dominant: Sugar maple
Associate: Eastern Hemlock, basswood
Minor: American elm, white ash, ironwood

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin sugar maple with small to moderate amounts of basswood and occassional eastern hemlock.
2. Logged Successional Stands: Seed and sprout origin sugar maple, with moderate amounts of basswood and some white ash, american elm, and/or ironwood. Stem quality is often very poor in even-aged stands.
3. Logged and Burned: not common.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Spinulose shield fern		+		
	Blue cohosh		**		
	Yellow, canadian, or downy violet		*		
	Sweet cicely		*		
	Elderberry	+			
	Hairy solomon's seal	+			
	Lady fern		+		
	Jack-in-the-pulpit	*			
	Twisted stalk	+			
75-50%	Trilliums	+			
	False solomon's seal	+			
	Choke cherry	+			
	Bloodroot	*			
<50%	Ostrich fern		*		
	Rattlesnake fern	*			
	Maidenhair fern	*			
	Wild leek	*			

SOILS

This habitat is limited to extremely rich soils, usually silt loam in texture. The landform is often morainic in origin, rolling, with a silt loam cap. The AOC type occurs within this landscape on the lower slopes and enriched bottoms.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[4] Pulp (Cu. Ft.)	Mean Annual Growth[4] Saw (Bd./Ft.)	Rotation Age Pulp	Rotation Age Saw	Yield at Rotation[4] Pulp (CCF)	Yield at Rotation[4] Saw (MBF)	Successional Stability
Aspen	?	?	?	?	?	?	?	Very Low
White Ash	(77-82)[1]	?	?	?	?	?	?	Low
American Elm	(77-82)	?	?	?	?	?	?	Low
Basswood	(70-75)	?	?	?	?	?	?	Moderate
Sugar Maple[2]	(68-73)	(45-55)	(100-150)	-	(75)	-	(9.3)	Very High
(Uneven-Aged)[3]			?		15	?	?	Very High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Site index and productivity for maple on this habitat type may be significantly reduced on some of the wetter landform positions with this type. Also, stem quality appears to be often very poor when using the even-aged system.
[3] Data given assumes uneven-aged management using the selection system.
[4] Growth data is per acre per year. Yield data is per acre.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut Whole tree harvesting preferred; parent stand must have 50 trees or 20ft²/ac.	Leave no more than 50 trees or 10 ft.²/ac. especially in sugar maple saplings. Preferably remove all trees	Sucker	*If veneer desired: 1 precommercial thinning at age 10, leaving 550 trees/ac. Thin commercially at age 30 leaving 80 to 90 ft²/ac. and removing sugar maple and poor clones.
Basswood	?	?	?	*Crown release thin 75 to 100 trees/ac. at age 20 to 25. Again at age 35 to 40. Commercial thinning thereafter at 15 year intervals leaving 70ft²/ac. Remove undesireable maple & ironwood, and eliminate all but 1 or 2 sprouts per basswood clump.
White Ash/ S. Maple	*Shelterwood (exact prescription is unkown).	*During seed cut disturb as much of the site as possible using skidding equipment.		*Crown release thin 75 to 100 trees/ac. at age 15 to 20 and again at age 30 to 35. Commercial thinning thereafter at 15 year intervals leaving 70ft²/ac. alter each thinning. Remove undesireable maple, ironwood, and basswood sprouts.
S. Maple	Selection: cut on a 15 year cutting cycle removing ? MBF/ ac. and leaving 70 to 80 ft²/ac.[1]	*Locate skid roads around areas of advanced regeneration and through areas of moderate regeneration so as to disturb the site.		Poor quality trees down to 9" dbh should be removed with the marked sawtimber while keeping within basal area guidelines.

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimate based on extrapolated knowledge.
[1] Heavy cutting leaving less than 70ft² may result in quality reduction in the residual trees.

Second Printing, 1983

TSUGA-ACER-MITCHELLA HABITAT TYPE (TAM)

IDENTIFICATION

From key: the sum of the coverage of partridge berry and wild sarsaparilla > american fly honeysuckle; palmate-leaf sweet coltsfoot, black snake root, joe-pye weed and jewelweed must be absent or extremely rare. And the sum of american fly honeysuckle and partridgeberry > the sum of spinulose shield fern, sweet cicely and yellow, canada, or downy violet.

Additional Habitat Characteristics:

1. An important step in identifying this type is the determination that soils are clay or clay loam in texture.
2. This type is common in the clay loam till in and around the Porcupine Mountains.
3. Wild sarsaparilla will usually have a coverage greater than 5% on this type.

Phases:

1. **The Equisetum Phase** is identified by a wetter site with horsetails common. An elm and black ash overstory usually is present.

CLIMAX OVERSTORY

Dominant:	Sugar maple, E. hemlock
Associate:	Red maple, basswood, white ash, yellow birch
Minor:	Ironwood

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin sugar maple, red oak with limited numbers of associates. Heavy logging on this type may raise the water table setting this type back to a lowland brush/sedge overstory.
2. Logged Successional Stands: Seed & sprout sugar maple - red maple with associates very limited. Or aspen if that was type cut.
3. Logged and Burned: Mixed aspen and red/sugar maple. Balsam fir and white/black spruce will often be present under an aspen overstory.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Sedges			+	
	Wild sarsaparilla		**		
	Wild lily-of-the-valley	+			
	Lady fern	+			
	Spinulose shield fern	+			
	American fly honeysuckle	+			
	Large leaved aster		+		
	Twisted stalk	+			
	Dewberry	+			
	Bedstraw	+			
	Yellow beadlily	+			
	Partridge berry	**			
75-50%	Yellow, canada, or downy violet	+			
	Sweet cicely	+			
	Bracken fern		+		
<50%	Horsetails	Δ			

SOILS

The Tsuga-Acer-Mitchella habitat type is found only on clay loam to clay texture soils. The land form is clay loam till (moraine) or a lacustrine clay deposit.

Phases:

The Equisetum Phase occurs in the wetter soils of the Tsuga-Acer-Mitchella type.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[2] Pulp (Cu. Ft.)	Saw (Bd./Ft.)	Rotation Age Pulp	Saw	Yield at Rotation[3] Pulp (CCF)	Saw (MBF)	Successional Stability
Aspen	(58-68)[1]	(35-60)	-	50		(18-31)	-	Low
Red Maple	(44-53)	(20-35)	?	-	110	-	?	High
Sugar Maple	(45-53)	(20-35)	?	-	110	-	?	High
(Uneven-aged)[2]		-	?	-	20	-	(1.7-2.3)	

[1] Data in parenthesis are based on preliminary or sketchy information.

[2] Data given assumes uneven-aged management using the selection system.

[3] Volume data is per acre. Annual growth is per acre per year.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut Parent stand must have 50 trees or 20ft²/ac.	Leave maximum 50 trees or 10ft²/ac. Preferably remove all trees.	Sucker	None
Maple	*Selection: cut on a 20 year cutting cycle removing ≅ 2 MBF/ac. and leaving 70-80 ft²/ac.	Locate skid roads around areas of advanced regeneration and through areas of inadequate regeneration to disturb the site.		Poor quality trees down to 9" dbh should be removed with the sawtimber while keeping within the basal area guidelines.

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimated based on extrapolated knowledge.

Second Printing, 1983

TSUGA-THUJA-LONICERA HABITAT TYPE
(TTL)

IDENTIFICATION

From key: Habitat must be on clay texture soil with good surface drainage. American fly honeysuckle > the sum of partridge berry and wild sarsaparilla. And palmate-leaf sweet coltsfoot and black snakeroot absent.

Additional Habitat Characteristics:

1. An important step in identifying this type is the determination that the soil is clay in texture.
2. This type is the driest of the three clay habitat types. The Tsuga-Thuja-Petasites type is moderately wetter with the Fraxinus-Eupatorium type showing excessive soil moisture.
3. American fly honeysuckle will usually have a coverage greater than 5% on this type.

CLIMAX OVERSTORY

Dominant:	Eastern hemlock, northern white cedar
Associate:	Red maple, sugar maple
Minor:	Balsam fir, white pine

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin sugar and red maple with considerable amounts of white pine if seed source is available. Scattered hemlock and cedar will be common.
2. Logged Successional Stands: Seed origin sugar maple and red maple with scattered white pine, hemlock and/or cedar. White pine may dominate if seed source is available.
3. Logged and Burned: Aspen, white birch and/or white pine with some red and sugar maple, or spruce-fir with mixed aspen, birch, and red maple. Tag alder can occur as an upland brush species on this type.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Grasses		+		
	Sedges		+		
	American fly honeysuckle		**		
	Wild lily-of-the-valley	+			
	Large leaved aster		+		
	Spinulose shield fern	+			
	St. Johns wort	+			
	Yellow beadlily	+			
	Choke cherry		+		
	Yellow, canada, or downy violet	+			
	Bracken fern		+		
75-50%	Lady fern	+			
	Buttercups	+			
	Beaked hazelnut	+			
	Twisted stalk	+			

SOILS

This type is limited almost exclusively to lacustrine clay soils with good surface drainage.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[3] Pulp (Cu. Ft.)	Saw (Bd./Ft.)	Rotation or cycle Age	Yield at Rotation[3] Pulp (CCF)	Saw (MBF)	Successional Stability
Aspen	(70-80)[1]	(65-80)	-	45	(30-36)	-	Low
White Birch	(70-75)	?	-	?	?	-	Low
White Spruce	(60-65)	?	-	?	?	-	Moderate
Balsam Fir	(50-55)	?	-	?	?	-	Mod. High
Sugar Maple	(45-50)	(15-30)	?	120	-	?	High
(Uneven-aged)[2]		-	?	20	-	?	

[1] Data given in parenthesis are based on preliminary or sketchy information.

[2] Data given assumes uneven-aged management using the selection system.

[3] Growth data is per acre per year. Yield data is per acre.

SUGGESTED SILVICULTURAL SYSTEM FOR EACH SUCCESSIONAL STAGE

Species	Harvest	Site Preparation	Regeneration	Thinnings
Aspen	Clearcut Parent stand Must have 50 trees or 20ft²/ac.	Leave maximum 50 trees or 10ft²/ac. Preferably remove all trees.	Sucker	If sawtimber possible thin when stands exceed 120 ft²/ac. Leave 60 to 70 ft²/ac., removing as much sprout maple and inferior cloues as possible.
W. Spruce	Clearcut	Remove any hardwood overstory. Spray herbicide to control grass (this is manditory) and brush.	Plant 800-900 trees/ac.	?
Balsam Fir	*Shelterwood	?	Natural	?
S. Maple	*Selection: cut on a 20 year cutting cycle removing ≅ 1.8 MBF/ac. and leaving 70-80ft².	Locate skid roads around areas of advanced regeneration and through areas of inadequate regeneration to disturb the site.		Poor quality trees down to 9" dbh should be removed with the sawtimber while keeping with the basal area guidelines.

* Silviculture operations are not adequately known, therefore, the suggested guide is an estimate based on extrapolated knowledge.

Second Printing, 1983

TSUGA-THUJA-PETASITES HABITAT TYPE (TTP)

IDENTIFICATION

From key: Habitat on clay texture soil which may have localized impeded drainage. And palmate-leaved sweet coltsfoot and/or black snakeroot present.

Additional Habitat Characteristics:

1. An important step in identifying this type is determining that the soil is clay in texture.
2. This type is wetter than the Tsuga-Thuja-Lonicera type and drier than the Fraxinus-Eupatorium type.
3. Large-leaved aster or wild sarsaparilla are often very abundant on this type and may cover the palmate-leaved sweet coltsfoot.

CLIMAX OVERSTORY

Dominant: Eastern hemlock, northern white cedar
Associate: Balsam fir, red maple
Minor: Sugar maple

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Poor stocking seed origin red/sugar maple with balsam fir. Heavy logging on this type may raise the water table setting this type back to a lowland/upland brush overstory.
2. Logged Successional Stands: Seed and sprout red/sugar maple or aspen/birch with some scattered balsam fir.
3. Logged and Burned: Mixed aspen/birch or balsam poplar depending on previous overstory. Balsam fir will often be present under the aspen/birch/poplar.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Grasses/sedges			+	
	Dewberry		+		
	Large-leaved aster				+
	Barren strawberry			+	
	Bunchberry		+		
	Horsetails	+			
	Palmate-leaved sweet coltsfoot		**		
	Wild sarsaparilla			+	
	Bracken fern		+		
50-75%	Spinulose shield fern	+			
	Wild lily-of-the-valley	+			
	Beaked hazelnut		+		
	American fly honeysuckle	+			
	Tag alder	+			
<50%	Black snakeroot	**			
	Tall rattlesnake root	*			

SOILS

This type is limited almost exclusively to lacustrine clay soils with moderate surface drainage.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 Yrs.)	Pulpwood Mean Annual Growth (Cu./Ft.)	Rotation Age	Yield at Rotation (CCF)	Successional Stability
Aspen	(48-60)	?	50	?	Low
White Spruce	(44-54)	?	50	?	Mod. High
Balsam Fir	(42-49)	?	50	?	High
White Pine	(45-53)	?	?	?	Mod. High

FRAXINUS-EUPATORIUM HABITAT TYPE
(FE)

IDENTIFICATION

From key: Habitat on clay texture soil with impeded drainage. And spotted joy-pye weed, boneset, and/or water hemlock common.

Additional Habitat Characteristics:

1. An important step in identifying this type is the determination that the soil is clay in texture.
2. This type is the wettest of the three clay types.
3. This type usually occurs as broad low areas or drainways within the Tsuga-Thuja-Lonicera and Petasites types.
4. Tag alder is often present with coverage over 20% on this type.

CLIMAX OVERSTORY

Dominant: Black ash, american elm
Associate: Red maple
Minor: Balsam fir, white ash

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Poor stocking seed origin black ash and american elm.
2. Logged Successional Stands: Tag alder or aspen/balsam poplar.
3. Logged and Burned: Unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Mints	+			
	Tag Alder			+	
	Sedges				+
	Dewberry		+		
	Wild Strawberry	+			
	Spinulose shield fern	+			
75-50%	Large leaved aster		+		
	Barren Strawberry		+		
	Jewelweed		+		
	Spotted joe-pye weed		**		
	Horsetails	+			
	Tall Rattlesnake root	+			
	Water Hemlock	**			
	Boneset	**			

SOILS

This type is limited almost exclusively to lacustrine clay soils with impeded surface drainage.

TSUGA-MAIANTHEMUM COPTIS HABITAT TYPE (TMC)

IDENTIFICATION

From key: Habitat type must have evidence of impeded drainage. The sum of goldthread, wood sorrel, and bunchberry at least one half the sum of sphagnum moss, horsetails, cinnamon fern, marsh marigold, naked miterwort, and twinflower.

Additional Habitat Characteristics:

1. This habitat often occurs as low-lying areas within many of the other types.
2. This type is one of the driest of the GroupIII, non-clay habitats and may occur on slight slopes which show evidence of impeded drainage.
3. A pit and mound mini-topography is common on this type. The leaves matted down in the pits normally show evidence of surface water.

Phases:

1. The **Vaccinium Phase** is identified by the commonness of blueberries in the habitat.
2. the **Dryopteris Phase** is identified by spinulose shield fern > wild lily-of-the-valley; long beech fern, oak fern and/or hairy solomon's seal common. This phase usually occurs within the Acer-Tsuga-Dryopteris habitat type.

CLIMAX OVERSTORY

Dominant:	Eastern hemlock, red maple
Associate:	Sugar maple, yellow birch
Minor:	Balsam Fir, white spruce, northern white cedar

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Balsam fir/white or black spruce with moderate amounts of yellow birch/red maple, and low amounts of northern white cedar and /or eastern hemlock. Scattered white or black ash.
2. Logged successional Stand: Balsam fir/white or black spruce with moderate amounts of yellow birch and some red maple. Scattered eastern hemlock, northern white cedar and white or black ash.
3. Logged and Burned: Aspen/birch/balsam poplar overstory with balsam fir/white or black spruce understory. Scattered yellow birch/red maple sprouts, ash, and eastern hemlock. Overstory will often be broken (discontinuous) with a dense understory of various grasses, sedges, and herbaceous material.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Wild lily-of-the-valley		*		
	Goldthread		**		
	Yellow beadlily	+			
	Bunchberry		**		
	Starflower	+			
	Sedges		+		
	Spinulose shield fern		Δ		
	Bracken fern			+	
75-50%	Wild sarsaparilla	+			
	Twisted stalk	+			
	Canada blueberry		Δ		
	Shining clubmoss	+			
	American fly honeysuckle	+			
	Wintergreen	+			
	Wood sorrel	**			
>50%	Long beech fern	Δ			
	Oak fern	Δ			
	Hairy solomon's seal*	Δ			

SOILS

This type occurs on soils of various textures with impeded soil drainage. Soils may be mineral or shallow (<6") organic over mineral. This type can occur within any landform.

Phases:

1. The **Vaccinium** Phase occurs primarily on lacustrine sands, usually within the Quercus-Acer-Epigaea, Acer-Quercus-Vaccinium or Tsuga-Maianthemum-Vaccinium habitat types.
2. The Dryopteris Phase usually occurs on loamy soils where the Acer-Tsuga-Dryopteris habitat type occurs.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 yrs)	Mean Annual Growth[2] Pulp (Cu. Ft.)	Saw (Bd./Ft.)	Rotation Age Pulp	Saw	Yield at Rotation Pulp (CCF)	Saw (MBF)	Successional Stability
Aspen	(57-76)[1]	?	-	50	?	?	-	Very Low
White spruce	(55-65)	?	?	50-60	?	?	?	Moderate
Balsam Fir	(42-60)	?	-	?	?	?	-	Mod. High
Black Spruce	(45-56)	?	-	50-60	-	?	-	Mod. High
Tamarack	(56-64)	(30-45)	-	50-60	-	(15-27)	-	Low
Yellow Birch	?	?	?	?	?	?	?	High
White Ash	(50-54)	?	?	?	?	?	?	Low
Basswood	(47-54)	?	?	?	?	?	?	Mod.
Red Maple	(46-55)	?	?	?	?	?	?	High
Sugar Maple	45-57	?	?	?	?	?	?	Very High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Volume data is per acre. Growth is per acre/yr.

TSUGA-THUJA-SPHAGNUM HABITAT TYPE
(TTS)

IDENTIFICATION

From key: More than twice as much sphagnum moss and horsetails than the sum of goldthread, bunchberry, and wood sorrel. And the sum of goldthread, bunchberry, and wood sorrel > the sum of naked miterwort, twinflower, and fringed polygala.

Additional Habitat Characteristics:

1. This type occurs only on areas with excessive soil moisture.
2. The sphagnum moss usually forms a nearly complete mat on the type.
3. This type may occur within any of the Group I or II types as a low area and is often limited in size.

CLIMAX OVERSTORY

Dominant: Eastern hemlock, northern white cedar
Associate: Balsam fir, black spruce
Minor: Red maple

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Heavy logging usually reduces this type to a lowland brush - sphagnum moss cover.
2. Logged Successional Stands: Balsam fir, black spruce and/or tamarack if conditions permit.
3. Logged and Burned: White birch, jack pine, cedar, black spruce, and/or tamarack.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Goldthread	*			
	Bunchberry	*			
	Wild lily-of-the-valley		+		
	Starflower	+			
	Sphagnum moss				**
	Sedges			+	
	Blueberries	+			
	Wood sorrel	*			
75-50%	Creeping snowberry	+			
	Dewberry	+			
	Tag alder			+	
	Spinulose shield fern		+		
	Yellow beadlily	+			
<50%	Horsetails		**		

SOILS

This type occurs on soils with excessive soil moisture. Usually the soil is organic (>6") over mineral, but the sphagnum may rarely occur directly on mineral soil. This type can occur within any landform.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 Yrs.)	Pulpwood Mean Annual Growth (Cu./Ft.)	Rotation Age	Yield at Rotation (CCF)[2]	Successional Stability
Jack Pine	(51-59)[1]	?	60-70	?	Very Low
Tamarack	(50-55)	(20-30)	60-70	?	Very Low
Black Spruce	(39-47)	?	60-70	?	Moderate
Balsam Fir	(55-66)	?	?	?	Moderate
Cedar	25-30	?	?	?	High

[1] Data given in parenthesis are based on preliminary or sketchy information.
[2] Growth data is per acre per year. Yield data is per acre.

FRAXINUS-MENTHA-CAREX HABITAT TYPE
(FMC)

IDENTIFICATION

From key: Habitat must have evidence of impeded drainage. The sum of sedge and mints > the sum of all understory species present.

Additional Habitat Characteristics:

1. This habitat type occurs as low areas within Group II or III habitat types.
2. Sedges and mints dominate this type with tag alder often occurring in coverage over 50%.

Phases:

1. **The Carex Phase** is limited to active floodplains where trees do not often grow.

CLIMAX OVERSTORY

Dominant: Black ash, american elm
Associate: Red Maple
Minor: Balsam fir

SUCCESSIDNAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Heavy logging on this type usually reduced the cover to lowland brush/swamp. Other unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Sedges				**Δ
	Mints			**	
	Tag Alder				+
	Sensitive fern	+			
	Dewberry		+		
	Jewelweed	+			
	Tufted loosestrife	+			
	Bedstraw	+			
75-50%	Lady Fern	+			
	Grasses			+	
	Raspberry		+		
	Flowering fern	+			

SOILS

This type occurs on soils with excessive soil moisture of various textures.

Phases: **The Carex Phase** occurs on organic over mineral soils deposited in active floodplains.

TSUGA-THUJA-MITELLA HABITAT TYPE (TTM)

IDENTIFICATION

From key: More than twice as much sphagnum moss, horsetails, naked miterwort, and twinflower than goldthread, hunchberry, and wood sorrel. And the sum of naked miterwort, and twinflower > the sum of cinnamon fern, marsh marigold, leatherleal, bog rosemary, and pale laurel. While at the same time the sum of naked miterwort and twinflower > the sum of goldthread, bunchberry and wood sorrel.

Additional Habitat Characteristics:

1. This type occurs only on areas with excessive soil moisture. However, if the stand being examined is heavily stocked, evidence of soil moisture may not be obvious.
2. Many of the heavily stocked cedar stands in the Eastern U.P. are this type.
3. Sphagnum moss is replaced by other mosses under heavy cedar stocking, but naked miterwort, twinflower, and fringed polygala will still he present.

CLIMAX OVERSTORY

Dominant: Northern White cedar, eastern hemlock
Associate: Balsam fir
Minor: Red Maple

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Heavy logging on this type usually reduced the cover to lowland brush/swamp.
   Other unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator. *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	General mosses				*
	Sedges			+	
	Wild lily-of-the-valley	+			
	Starflower	+			
	Naked miterwort		**		
	Twinflower	**			
75-50%	Bedstraw	+			
	Dewberry		+		
	Rattlesnake fern	+			
	Bunchberry		+		
	Sphagnum				*
	Pyrola	+			
	American fly honeysuckle	+			
	Fringed polygala	**			
<50%	Goldthread	+			

SOILS

This type occurs on soils with excessive moisture. A heavy sawtimber overstory can keep the water table low hut cutting that overstory olten causes the water table to rise making the site wetter. Soils are generally heavy in texture and may be shallow to bedrock. But this type also occurs on wet sands. This type can occur on many landforms.

FRAXINUS-IMPATIENS HABITAT TYPE
(FI)

IDENTIFICATION

From key: Habitattype must have evidence of impeded drainage. Jewelweed and Dwarf Enchanter's nightshade common with sphagnum moss < 25% coverage.

Additional Habitat Characteristics:

1. This type usually occurs as mineral soil in upland drainways within Group II habitat types.

Phases:

1. The **Caltha** Phase occurs within the Fraxinus-Impatiens type where there is flowing water and marsh marigold is common.

CLIMAX OVERSTORY

Dominant: White ash, red maple
Associate: Sugar maple, black ash
Minor: Balsam Fir

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Poor stocking seed origin white ash and red maple easily set back to lowland brush/sedge.
2. Logged Successional Stands: Aspen/balsam poplar or ash/maple depending on type cut.
3. Logged and Burned: Unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, Δ phase indicator, + common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Jewelweed		**		
	Spinulose shield fern		+		
	Lady fern		+		
	Elderberry		+		
	Sedges			+	
	Grasses			+	
	Enchanter's nightshade	**			
	Mints	+			
	Dewberry	+			
75-50%	Jack-in-the-pulpit	+			
	Gooseberries	+			
	Wild lily-of-the-valley	+			
	Raspberry	+			
<50%	Marsh marigold		Δ		
	Nettles	+			

SOILS

This type occurs on loam to clay texture soils with excessive soil moisture. The landform is usually morainic with this type present in the upland drainways occurring within that landform.

GENERAL SILVICULTURE INFORMATION FOR PRIMARY SPECIES IN EACH SUCCESSIONAL STAGE

Successional Stage	Site Index (50 Yrs.)	Pulpwood Mean Annual Growth (Cu./Ft.)	Rotation Age	Yield at Rotation (CCF)[2]	Successional Stability
Aspen	(58-74)	?	50	?	Very Low
Black Ash	?	?	?	?	High
Yellow Birch	(48-60)	?	?	?	High
Red Maple	(51-57)	?	?	?	High

PICEA-OSMUNDA HABITAT TYPE
(PO)

IDENTIFICATION

From key: Habitat must have evidence of impeded drainage. More than twice the coverage of the sum of sphagnum moss, cinnamon fern and marsh marigold as the sum of goldthread, bunchberry, and wood sorrel. And cinnamon fern > the sum of leatherleaf, bog rosemary, and pale laurel.

Additional Habitat Characteristics:

1. This type is a moderately productive bogland with cinnamon fern occurring in the understory.
2. This type is often small in acreage and occurs within other types or as a transition to the Picea-Chamadaphne-Sphagnum type.

CLIMAX OVERSTORY

Dominant: Black spruce, northern white cedar
Associate: Eastern hemlock
Minor: White pine

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin black spruce/lowland brush.
2. Logged Successional Stands: Poplar/birch/red maple depending on seed source and cover cut.
3. Logged and Burned: Unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Cinnamon fern			**	
	Sphagnum moss				*
	Sedges		+		
	Starflower	+			
	Creeping snowberry	+			
	Goldthread	+			
	Bunchberry	+			
	Yellow beadlily	+			
	Gooseberries	+			
75-50%	Blueberries	+			
	Wild raisin		+		
	Spinulose shield fern	+			
	Marsh marigold	*			

SOILS

This type occurs on organic (>6" depth) soils.

PICEA-CHAMADAPHNE-SPHAGNUM HABITAT TYPE (PCS)

IDENTIFICATION

From key: Vegetation dominated by sphagnum moss; leatherleaf, bog rosemary, and/or pale laurel well represented.

Additional Habitat Characteristics:

1. This type is the typical non-productive acid bog and may be very open.

CLIMAX OVERSTORY

Dominant: Black spruce
Associate: Tamarack
Minor: Northern white cedar

SUCCESSIONAL OVERSTORY

See successional diagram as well as detail below.

Succession After Original Logging

1. Logged Climax Stands: Seed origin black spruce/tamarack.
2. Logged Successional Stands: Unknown. Cutting is usually light due to low stocking present on this type.
3. Logged and Burned: Unknown.

UNDERSTORY SPECIES

Table of common and important species in order of decreasing constancy with expected coverage range (**primary indicator, *additional indicator, +common associate):

Constancy	Species	Average Coverage When Present <5%	5-15	15-25	>25%
>75%	Sphagnum moss				*
	Labrador tea			+	
	Leatherleaf			**	
	Sedges				+
	Canada blueberry		+		
	Creeping snowberry	+			
75-50%	Cranberry		*		
	Bog rosemary		**		
	Pale laurel		**		
	Gold thread	+			
	Three leaved solomon's seal	+			
	Pitcher plant	*			
<50%	Wild Iris	+			
	Sundew	*			

SOILS

This type occurs on deep organic soils.

SCIENTIFIC NAMES OF SPECIES USED IN HABITAT TYPE DESCRIPTIONS

TREES

American Beech	Fagus grandifolia
American Elm	Ulmus americana
Aspen	Populus grandidentata/tremuloides
Balsam Fir	Abies balsamea
Balsam Poplar	Populus balsamifera
Basswood	Tilia Americana
Black Ash	Fraxinus nigra
Black Spruce	Picea mariana
Eastern Hemlock	Tsuga canadensis
Ironwood	Ostrya virginiana
Jack Pine	Pinus banksiana
Northern Red Oak	Quercus rubra
Northern White Cedar	Thuja occidentalis
Red Maple	Acer rubrum
Red Pine	Pinus resinosa
Sugar Maple	Acer saccharum
Tamarack	Larix laricina
White Ash	Fraxinus americana
White Birch	Betula papyrifera
White Pine	Pinus strobus
White Spruce	Picea glauca
Yellow Birch	Betula alleghaniensis

SCIENTIFIC NAMES OF SPECIES USED IN HABITAT TYPE DESCRIPTIONS

FERNS, GROUNDFLORA, AND SHRUBS

COMMON NAME	SCIENTIFIC NAME	REF.
Barren Strawberry	Waldsteinia fragarioides	1-177
Beaked Hazelnut	Corylus cornuta	2-89
Bedstraw	Galium spp.	1-357
Bellwort, Large Flowered	Uvularia grandiflora	1-43
Bellwort, Sessile	Uvularia sessilifolia	1-45
Bloodroot	Sanguinaria canadensis	1-147
Blue Cladonia	Cladonia mitus	4-145
Blue Cohosh	Caulophyllum thalictroides	1-45
Blueberries	Vaccinium spp.	2
Blueberry, Canada	Vaccinium myrtilloides	2-266
Blueberry, Late Low	Vaccinium vacillans	2-268
Blueberry, Low Sweet	Vaccinium angustifolium	2-366
Boneset	Eupatorium perfoliatum	1-379
Bunchberry	Cornus canadensis	1-269
Buttercup	Ranunculis spp.	1-121
Cherry, Choke	Prunus virginiana	2-180
Cherry, Pin	Prunus pensylvanica	
Cherry, Sand	Prunus pumila	2-181
Cow Wheat	Melampyrum lineare	1-349
Cranberry	Vaccinium macrocarpon	2-275
Creeping Snowberry	Gaultheria hispida	1-281
Dewberry	Rubus flagellaris	6-330
Dwarf Enchanter's Nightshade	Circaea alpina	1-245
Elderberry, Red	Sambucus pubens	2-311
Fern, Bracken	Pteridum aquilinum	3-220
Fern, Cinnamon	Osmunda cinnamomea	3-139
Fern, Flowering	Osmunda regalis	3-135
Fern, Lady	Athyrium Felix-femina	3-191
Fern, Long Beech	Dryopteris phegopteris	3-165
Fern, Maiden Hair	Adiantum pedatum	3-219
Fern, Oak	Dryopteris disjuncta	3-161
Fern, Ostrich	Pteretis Pensylvanica	3-152
Fern, Rattlesnake	Botrychium virginiana	3-129
Fern, Sensitive	Onoclea sensibilis	3-155
Fern, Spinulose Shield	Dryopteris spinulosa	3-167
Goldthread	Coptis groenlandica	1-139
Gooseberry	Ribes spp.	6-306
Ground Pine	Lycopodium spp.	3
Hairgrass	Oeschampsia flexulosa	5-171
Honeysuckle, American Fly	Lonicera canadensis	2-287
Honeysuckle, Hairy	Lonicera hirsuta	2-291
Horsetail	Equisetum spp.	3-69
Jack-in-the-pulpit	Arisaemea atrorubens	1-33
Jewelweed	Impatiens capensis	1-233
Juneberry	Amelanchier spp.	2-124
Labrador Tea	Ledum groenlandicum	2-249
Larged Leaved Aster	Aster macrophyllus	1-394
Leatherwood	Dirca Palustris	2-229
Marsh Marigold	Caltha palustris	1-139
Nettles	Urtica spp.	6-438

FERNS, GROUNDFLORA, AND SHRUBS (Cont.)

COMMON NAME	SCIENTIFIC NAME	REF.
Partridge Berry	Mitchella repens	1-359
Pitcher Plant	Sarrecenia purpurea	1-163
Pyrola	Pyrola spp.	1-273
Raspberry	Rubus spp.	2-151
Rattlesnake Root, Tall	Prenanthes altissima	1-441
Rattlesnake Root, White	Prenanthes alba	1-441
Reindeer Moss	Cladonia rangiferina	4-143
Shining Clubmoss	Lycopodium lucidulum	3-95
Solomon's Seal, False	Smilacina racemosa	1-49
Solomon's Seal, Hairy	Polygonatum pubescens	1-53
Solomon's Seal, Three Leaved	Smilacina trifolia	1-52
St. John's Wort	Hypericum perforatum	1-226
Starflower	Trientalis borealis	1-287
Sundew	Drosera spp.	1-164
Sweet Cicely	Osmorhiza claytoni	1-253
Sweetfern	Comptonia peregrina	2-85
Tag Alder	Alnus rugosa	2-91
Trailing Arbutus	Epigaea repens	1-279
Trefoil, Pointed Leaved Tick	Desmodium glutinosum	6-102
Trillium	Trillium	1-55
Tufted Loosestrife	Lysimachia thyrsiflora	1-285
Twinflower	Linnaea borealis	1-361
Twisted Stalk	Streptopus roseus	1-53
Violet, American Dog	Viola conspersa	1-236
Violet, Canadian White	Viola canadensis	1-233
Violet, Downy Yellow	Viola pubescens	1-233
Violet, Smooth Yellow	Viola pensylvanica	1-235
Wild Iris	Iris versicolor	1-62
Wild Leek	Allium tricoccum	1-45
Wild Lily-of-the-Valley	Maianthemum canadense	1-52
Wild Raisin	Viburnum cassinoides	6-302
Wild Sarsaparilla	Aralia nudicaulis	1-247
Willow	Salix spp.	2-63
Wintergreen	Gaultheria procumbens	1-281
Wood Anemone	Anemone quinquefolia	1-135
Wood Betony	Pedicularis canadensis	1-349
Wood Sorrel	Oxalis montana	1-213
Yellow Beadlily	Clintonia borealis	1-48

This list prepared and revised by J. Ferris - March 1983.

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