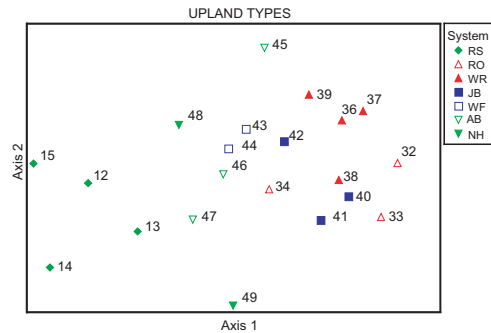


**A48 White Cedar - Yellow Birch Forest***Thuja occidentalis* - *Betula alleghaniensis* Forest**Description**

This community is dominated by a canopy of white-cedar, with lesser amounts of trembling aspen (yellow birch is rare in the Park), balsam fir, and bigtooth aspen. The shrub and herb layers vary with tree canopy closure, more dense as tree canopy opens up. Shrubs include white-cedar, balsam fir, red maple, and *Acer spicatum* (mountain maple). Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Aster macrophyllus* (large-leaved aster), *Clintonia borealis* (bluebead lily), *Linnaea borealis* (twinflower), *Lycopodium annotinum* (bristly clubmoss), and *Lycopodium clavatum* (running clubmoss). The most abundant moss species is *Rhytidiadelphus triquetrus*.

Stands occur on flat or gently sloping terrain with variable aspects. They frequently occupy toeslopes located just above wetland communities. There is often very little surficial bedrock. Soils contain a shallow (1–5 cm) organic layer over 5–15 cm of loam or silt loam over dense lacustrine clay. In some cases, a shallow buildup of well decomposed peat may be present. Microtopography is typically flat.

**NORTHERN HARDWOODS – (CONIFER) FOREST****CHARACTERISTIC SPECIES** (n = 4, 21)**Tree**

*Abies balsamea* (balsam fir) IV.15, *Betula papyrifera* (paper birch) IV.15, *Picea glauca* (white spruce) IV.15, *Thuja occidentalis* (white-cedar) IV.25

**Shrub**

*Abies balsamea* (balsam fir) V.25, *Acer rubrum* (red maple) V.7, *A. spicatum* (mountain maple) III.15, *Amelanchier* spp. (serviceberry) IV.1, *Betula papyrifera* (paper birch) V.7, *Corylus cornuta* (beaked hazelnut) IV.1, *Picea glauca* (white spruce) IV.1, *Pinus strobus* (white pine) IV.1, *Populus tremuloides* (trembling aspen) IV.2, *Thuja occidentalis* (white-cedar) IV.35

**Dwarf-shrub**

*Lonicera canadensis* (fly honeysuckle) V.4, *Vaccinium angustifolium* (lowbush blueberry) V.2

**Forb**

*Aralia nudicaulis* (wild sarsaparilla) V.7, *Aster macrophyllus* (large-leaved aster) IV.7, *Clintonia borealis* (bluebead lily) V.4, *Cornus canadensis* (bunchberry) V.2, *Galium triflorum* (three-flowered bedstraw) IV.1, *Linnaea borealis* (twinflower) V.4, *Lycopodium annotinum* (bristly clubmoss) IV.7, *Lycopodium clavatum* (running clubmoss) IV.7, *Lycopodium obscurum* (and others) (princess-pine) IV.1, *Maianthemum canadense* (Canada mayflower) IV.2, *Mitella nuda* (naked miterwort) IV.1, *Streptopus roseus* (rosey twisted-stalk) IV.1, *Trientalis borealis* (starflower) V.4

**Graminoid**

*Carex gracillima* (graceful sedge) III.4, *Oryzopsis asperifolia* (mountain rice-grass) IV.1

**RANGE***Voyageurs National Park*

This type is most commonly found in the environs south and southwest of the Park, but also occurs less commonly in the southern part of the Park on flat terrain. For distribution of how this plant community was mapped, refer to the location map in Appendix 5 entitled Plant Community Types, Northern Hardwoods - (Conifer) Forest System.

*Global*

This community is found in the northern Great Lakes region of the United States and adjacent regions in Canada.

**COMMENTS**

Diagnostic features of the type include dominance by white-cedar, with trembling aspen and paper birch as co-associates, with a rich diversity of moist indicator species, but few wetland species. Yellow birch is more common in examples outside the Park. Stands are closely related to the White Cedar - Boreal Conifer Mesic Forest (A12). Though uncommon, some stands that are more well drained may be more closely related to the mesic versions of the Spruce - Fir / Mountain Maple Forest (A43). The A48 type is most similar to Ontario's V21 (Sims and others, 1997).

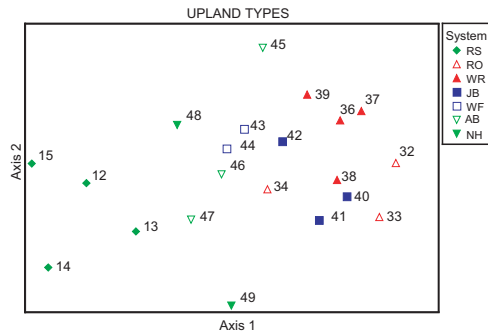
The predominance of trembling aspen in the canopy and emergent layers of this community may reflect a disturbed (post-logging) phase of the White Cedar - Yellow Birch Forest.

**MAP UNITS**

The White Cedar-Yellow Birch Forest (WCA) map unit represents this association.

**MINNESOTA STATE TYPE 2003**

Upland White Cedar Forest (FDn43c)

**A49 Northern Bur Oak Mesic Forest***Quercus macrocarpa* / (*Amelanchier alnifolia*, *Cornus drummondii*) / *Aralia nudicaulis* Forest**Description**

The canopy of this forest community is typically dominated by bur oak, with green ash or basswood as common co-dominants. Trembling aspen, paper birch, and red maple may be present in the canopy at low cover. A shrub layer of 20–80% cover is almost always present and may consist of the following species: red maple, *Amelanchier* spp. (serviceberry), *Cornus drummondii* (= *rugosa*) (round-leaved dogwood), *Corylus cornuta* (beaked hazelnut), *Ostrya virginiana* (ironwood), *Quercus macrocarpa* (bur oak), *Tilia americana* (basswood), *Ulmus americana* (American elm), and *Viburnum rafinesquianum* (downy arrow-wood). The herb layer is usually well developed and comprises 80–90% cover. Common species include *Aralia nudicaulis* (wild sarsaparilla), *Aster macrophyllus* (large-leaved aster), *Circaea lutetiana* (Canada enchanter's nightshade), and *Osmorhiza claytonii* (Clayton's sweet cicely).

Stands occur on level to gently sloping terrain with variable aspects. They are most common on dry-mesic to mesic sites on islands or peninsulas. Soils are loams or sandy loams and can be shallow (3–7 cm) or relatively deep (20–35+ cm). In stands with shallower soils, patches of exposed bedrock may exist.

**CONSERVATION RANK****DATABASE CODE** CEGLO02072

**NORTHERN HARDWOODS – (CONIFER) FOREST****CHARACTERISTIC SPECIES** (n = 4, 29)**Tree**

*Acer rubrum* (red maple) III.4, *Betula papyrifera* (paper birch) III.4, *Fraxinus pennsylvanica* (green ash) III.15, *Quercus macrocarpa* (bur oak) V.25, *Tilia americana* (basswood) V.35

**Shrub**

*Abies balsamea* (balsam fir) III.4, *Acer rubrum* (red maple) V.7, *A. spicatum* (mountain maple) III.4, *Amelanchier* spp. (serviceberry) V.25, *Cornus rugosa* (round-leaved dogwood) IV.25, *Corylus cornuta* (beaked hazelnut) V.15, *Fraxinus nigra* (black ash) III.15, *F. pennsylvanica* (green ash) III.7, *Ostrya virginiana* (ironwood) IV.25, *Populus grandidentata* (big-tooth aspen) III.4, *Quercus macrocarpa* (bur oak) V.7, *Tilia americana* (basswood) V.25, *Ulmus americana* (American elm) IV.15, *Viburnum lentago* (nannyberry) III.7, *V. rafinesquianum* (downy arrow-wood) IV.25

**Dwarf-shrub**

*Lonicera canadensis* (fly honeysuckle) IV.1, *Parthenocissus* (virginia creeper; woodbine) IV.1, *Prunus virginiana* (chokecherry) IV.1, *Rhus radicans* (poison ivy) III.7, *Rubus strigosus* (red raspberry) IV.7, *Symphoricarpos occidentalis* (and others) (wolfberry) IV.2

**Forb**

*Actaea rubra* (red baneberry) IV.1, *Aralia nudicaulis* (wild sarsaparilla) IV.7, *Aster macrophyllus* (large-leaved aster) V.15, *Circaea lutetiana* (Canada enchanter's nightshade) III.15, *Fragaria virginiana* (common strawberry) V.2, *Galium triflorum* (three-flowered bedstraw) IV.1, *Lathyrus ochroleucus* (pale vetchling) IV.1, *Maianthemum canadense* (Canada mayflower) V.4, *Osmorhiza claytonii* (clayton's sweet cicely) III.15, *Rubus pubescens* (dwarf raspberry) IV.1, *Trientalis borealis* (starflower) IV.1, *Uvularia grandiflora* (yellow bellwort) IV.2

**Graminoid**

*Oryzopsis asperifolia* (mountain rice-grass) III.7

**RANGE***Voyageurs National Park*

This type is most common on islands or peninsulas on Lake Kabetogama. For distribution of how this plant community was mapped, refer to the location map in Appendix 5 entitled Plant Community Types, Northern Hardwoods - (Conifer) Forest System.

*Global*

This community occurs in the the northern tallgrass prairie and woodland region of the United States.

**COMMENTS**

Diagnostic features of the type include the canopy of bur oak, with green ash or basswood as common co-dominants. Species more characteristic of the northern hardwoods rather than the boreal region are also more common, including *Cornus rugosa* (round-leaved dogwood), *Ostrya virginiana* (ironwood), and *Ulmus americana* (American elm). Stands of this type have diverse herb layers and may contain species that are found in few other communities in the Park, including *Uvularia grandiflora* (yellow bellwort), *U. sessiliflora* (pale bellwort), *Trillium* spp. (trillium), and *Smilax herbacea* (tendriled carrion-flower). Overall, these stands are very unique in the boreal-dominated landscape at Voyageurs, and the placement of these bur oak stands into this association is tentative. See also the Minnesota description for MHn46. The A49 type is similar to Ontario's V3.2 (Sims and others, 1997).

Evidence of logging and past human habitation are frequently present in these stands, especially those on islands in Lake Kabetogama.

(Continued on page 124)

## Additional Community Types

The following community types were initially described as possibly being present at Voyageurs National Park, but are not treated in the mapping project as distinct associations.

**CT1. Balsam Fir - Paper Birch Forest** (*Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest) (n = 0, 0).

This evergreen type was not described separately at Voyageurs National Park. See global description for the fir-birch type using Database Code CEGl002474. Stands are typically mapped as part of the Spruce - Fir / Mountain Maple Forest (A43, CEGl002446) or the Spruce - Fir - Aspen Forest (A44, CEGl002475).

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**CT2. Black Spruce - Aspen Forest** (*Picea mariana* - *Populus tremuloides* / Mixed Herbs Forest) (n = 0, 5)

This type was not described separately at Voyageurs National Park. See global description for this type using Database Code CEGl002516. Stands were typically mapped as part of the Spruce - Fir - Aspen Forest (A44, CEGl002475).

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**CT3. Bog Birch - Leatherleaf Poor Fen** (*Betula pumila* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland).

This type was initially listed as possibly being present at Voyageurs National Park, but upon review was subsequently removed. It closely resembles the Tamarack Scrub Poor Fen (A5) and the Leatherleaf Poor Fen (A6). See global description for this type using Database Code CEGl002494.

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(Continued from page 49 - Type A13)

**MAP UNITS**

The Trembling Aspen-Balsam Poplar Lowland Forest (AL) map unit represents this association.

**MINNESOTA STATE TYPE 2003**

Black Ash - Aspen - Balsam Poplar Swamp (Northeast) (WFn55a)

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(Continued from page 57 - Type A17)

**COMMENTS**

Diagnostic features of the type are canopy of white-cedar with *Alnus incana* (speckled alder) shrubs and *Sphagnum* spp. moss. This is one of the most floristically diverse types in the Park. In wetter and more minerotrophic conditions, the white-cedar in the canopy is often mixed with black ash and can grade into the White Cedar - Black Ash Swamp (A15). That type, however, has at least 25% of both white-cedar and ash in the canopy or a canopy of black ash with a subcanopy of white-cedar. That type also tends to have much less *Sphagnum* spp. In cases where tamarack and or black spruce are present in the canopy or in the emergent layer, this type can grade into a map phase described as the White Cedar-Tamarack Peat Swamp (WCT). At Voyageurs, the phase was not recognized as a separate association because it is very similar to stands without tamarack as a dominant. Globally that phase is still recognized as a distinct association (CEGL005225), based on patterns outside of Voyageurs. This type is similar to Ontario's W31 and W32 (Harris and others, 1996).

**MAP UNITS**

Two map units represent two structural phases of this one association: the White Cedar-(Mixed Conifer)/Alder Swamp (rich soil phase) (WCS) and the White Cedar-(Mixed Conifer)/Alder Swamp (peatland phase) (WCT).

**MINNESOTA STATE TYPE 2003**

White Cedar Swamp (NorthCentral) (FPn63b)

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(Continued from page 59 - Type A18)

**MAP UNITS**

The Northern Tamarack Rich Swamp (TA) map unit represents this association.

**MINNESOTA STATE TYPE 2003**

Extremely Rich Tamarack Swamp (FPn82b)

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(Continued from page 97 - Type A37)

**MINNESOTA STATE TYPE 2003**

Red Pine - White Pine Woodland (Canadian Shield) (FDn32a)

## 124 Field Guide to the Plant Community Types of Voyageurs National Park

(Continued from page 103 - Type A40)

### MAP UNITS

The Jack Pine/Balsam Fir Forest (JPF) represents this association. This association is also mapped with the Jack Pine-Aspen Forest Mosaic (JPAX) when jack pine stands are in tight mosaic pattern with aspen stands.

### MINNESOTA STATE TYPE 2003

Black Spruce - Jack Pine Woodland, Jack Pine - Balsam Fir Subtype (FDn32c1)

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(Continued from page 115 - Type A46)

### MAP UNITS

The Quaking Aspen-Paper Birch Forest (AB) map unit represents this association and the Aspen - Birch - Red Maple Forest association (A47). This association is also mapped with the Jack Pine-Aspen Forest Mosaic (JPAX) map unit and the White Pine-Red Pine-Quaking Aspen-Birch Forest (WRPA) map unit when aspen stands are in tight mosaic pattern with pine stands.

### MINNESOTA STATE TYPE 2003

Aspen - Birch Forest Balsam Fir Subtype (FDn43b1)

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(Continued from page 121 - Type A49)

### MAP UNITS

The Northern Bur Oak Mesic Forest (BO) map unit represents this association.

### MINNESOTA STATE TYPE 2003

Aspen - Ash Forest (MHn46a)

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## **Appendix 1. Analytical Methods Used To Define Plant Community Types**

### **Preliminary Classification List and Map Units**

A preliminary list of vegetation types (associations and alliances) from Faber-Langendoen and others (1996; Midwest portion of U.S. National Vegetation Classification [USNVC]) was generated for the Park in May 1996 based on a variety of sources, including information from the Minnesota County Biological Survey and the Natural Heritage Program (1993), Sims and others (1989), and Harris and others (1996). The preliminary classification was field tested during summer and fall 1996 and 1997 by a team of aerial photointerpreters and ecologists who collected detailed vegetation plots and observation point data on the plant communities encountered in the field. The data helped clarify the nature of the classification units and their diagnostic aerial photo signatures.

Map units compatible with the vegetation types found within the project area were developed jointly between the photointerpretation and ecologist teams. Map units were made to match vegetation units on a one-to-one basis as often as possible. For several reasons, including complexity of the vegetation and lack of distinctive features between similar associations, some map units represent combinations of associations. In other instances, structural details within a single association could be mapped and were of potential interest to wildlife habitat models, so they were given their own map unit (see Appendix 4). Additional map units were derived from map land use and land cover features not described by the USNVC, such as populated areas, roads, agricultural lands, quarries, and large open water bodies that are <10% vegetated. To map these features, a land use and land cover classification system developed by Anderson and others (1976) was used (to Level II). A few more map units were developed to map park-specific situations such as small islands less than the minimum mapping unit of 0.5 ha, and small natural ponds (open water <10% vegetated). Additional information on the map unit process is described in Hop and others (2001). Maps of associations and ecological systems are provided in Appendix 5.

### **Vegetation Sampling and Analysis for Classification Development**

Voyageurs National Park covers 88,244 ha, of which 54,336 ha is land and the remainder open water (lakes and ponds). The mapping project also included the environs around the Park, making the total area mapped about 156,886 ha. Most of the Park and environs fall in one ecological subsection (Border Lakes: 212La) as reported by the ECOMAP ecological

land classification (Keys and others, 1995). The Park was stratified into three areas: the western peatland area (Rat Root River Peatland), which falls mostly outside the Park boundaries but within the project area; the northern unit where the bedrock is primarily biotite schist (metasedimentary rocks) with local areas of greenstone; and a southern unit where the bedrock is primarily granite (the Vermillion granitic complex, Okajangas and Matsch, 1982). In 1996, the first year of reconnaissance and sampling, the first two areas were emphasized. In the second and third years (1997 and 1998), the third area was emphasized.

Plot sampling was generally limited to an average of three plots per type based on USGS-NPS Vegetation Mapping Program specifications, but less well-understood types were sampled more extensively. These plots were spread across the Park as much as possible. One hundred and ninety-one plots were collected for the project, and an additional 68 were added from surveys by Kurmis and others (1986) and the Minnesota Natural Heritage Program (MN NHP).

Plot sizes were 20 x 20 m for forests and woodlands and 10 x 10 m for shrublands, herbaceous, and nonvascular vegetation. Plots were selected to cover the distribution of types across the three stratified areas and placed subjectively in the most representative part of a selected stand. The vegetation was visually divided into strata and height and cover abundance of each stratum was estimated. Cover of dominant life forms was also estimated to match methods used by the MN NHP survey methods. All species found in each stratum were listed (including mosses and lichens) and percent cover was estimated for vascular plants using the Braun-Blanquet cover scale. Additional species within the vegetation unit or polygon occurring outside of sampled plots (generally within 2 m of the plot border) were listed separately. Species that were not identifiable in the field were collected for later identification. In addition to floristic information, the following environmental information was recorded on field forms: surficial geology, hydrologic (flooding) regime, soil drainage regime, soil texture, slope, aspect, topographic position, and evidence of disturbance. The X-Y coordinates of each plot were recorded in Universal Transverse Mercator (UTM) projection (Zone 15) using a Rockwell Precision Lightweight GPS Receiver (PLGR) and, on occasion, a Trimble GPS unit. Typical positional accuracy of GPS coordinates was approximately  $\pm 9.0$  m. Other location information was also recorded. A provisional name for the vegetation type was assigned to the plot.

Vegetation plot data were entered into the MN NHP plot database. Species were assigned standardized codes and names based on Ownbey and Morley (1991). These data were transferred to the PLOTS database developed by The Nature Conservancy (1997), where species nomenclature and codes were

standardized to the PLANTS database (USDA, NRCS 1999). Plots were then uploaded to VegBank, a publicly viewable Vegetation Plots archive that will maintain the primary plot data for the U.S. National Vegetation Classification (USNVC) <[www.vegbank.org](http://www.vegbank.org)>.

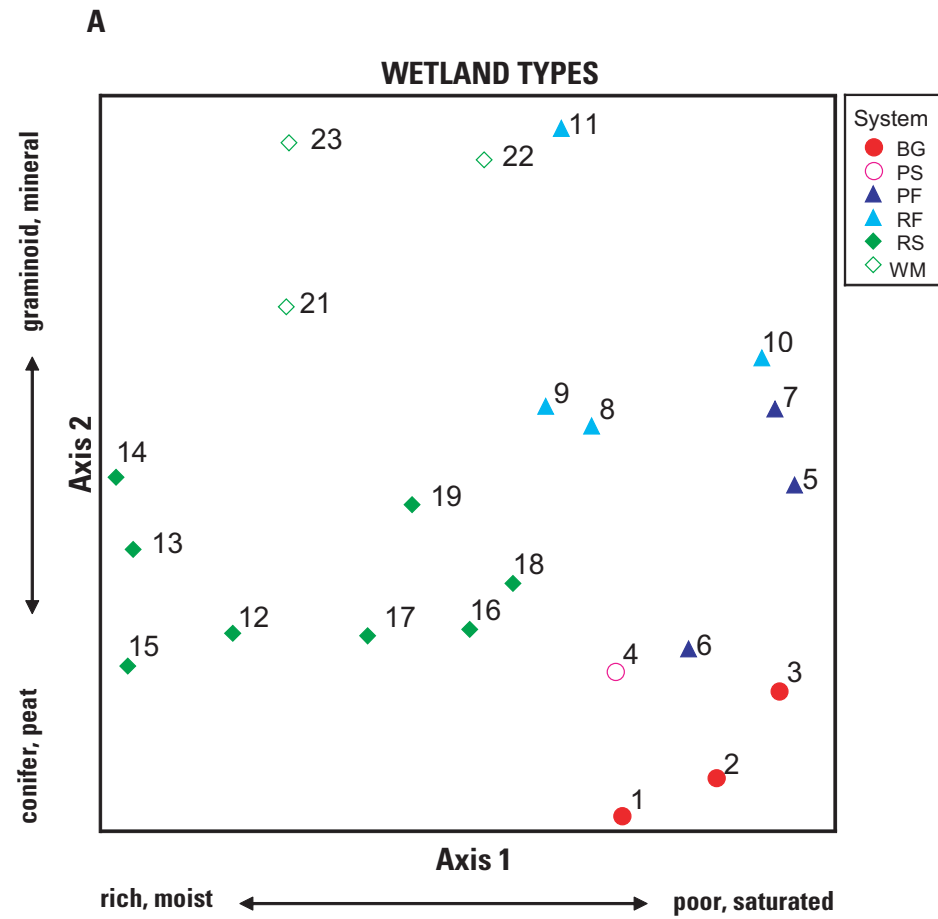
Vegetation data were analyzed using both ordination and cluster methods, including Non-metric Multidimensional Scaling (NMS), Detrended Correspondence Analysis (DCA) and Flexible Beta Cluster Analysis, as implemented in the PC-ORD software (McCune and Mefford, 1999). For the ordination methods, cover midpoint data were first relativized by species maxima, then transformed using arcsine-square root. This transformation places greater emphasis on the less abundant species in the data set. For NMS, analyses were run using a random starting configuration, with 15 runs of real data and 30 runs of randomized data (autopilot mode). Data were run using Sorenson Index. For the final upland and wetland datasets, iterations were 55, final stability was 0.00010. For DCA, the default settings were used (downweighting of rare species, segments = 26). For all data sets, species in <3% of the dataset were removed to reduce potential noise.

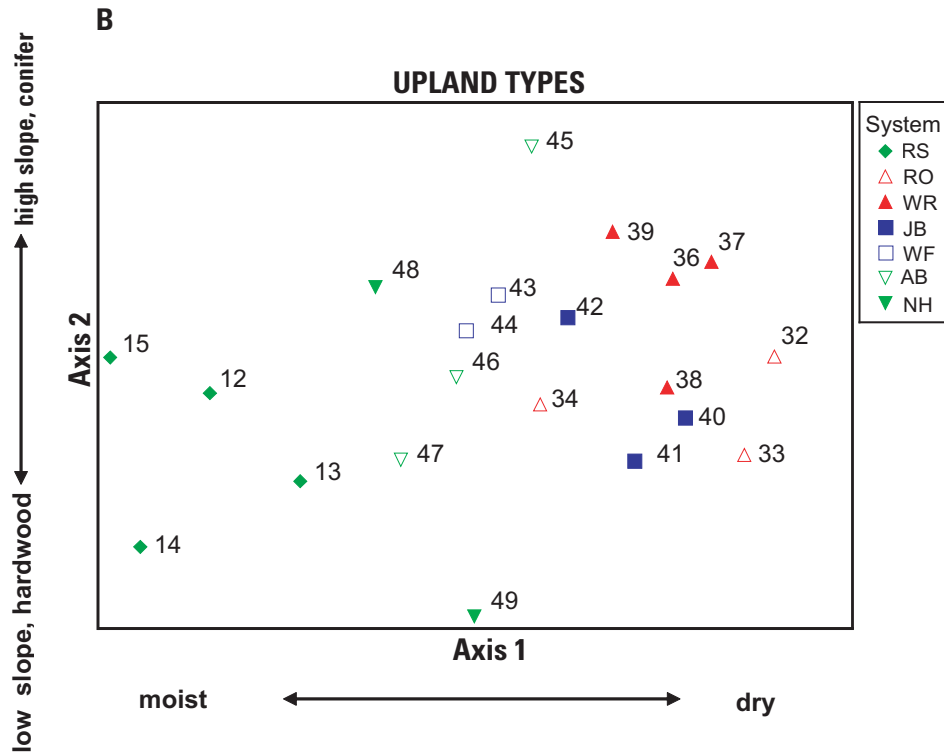
Given the complexity of the data sets, we sought to partition the plots into meaningful subsets. The overall ordinations of 259 plots were strongly skewed by the 26 marsh plots. After removal of the marsh plots, the subsequent analyses further suggested a distinction between primarily upland plots and primarily wetland plots. Outlier analysis based on ordination and cluster analysis suggested that a single rocky outcrop plot be removed, as well as three successional shrubby rock outcrop plots. Wet mineral forests occupied the center of the ordinations, and we chose to leave the 21 plots of these wet forests in both upland and wetland datasets. The upland dataset consisted of 138 plots x 219 species and the wetland dataset of 112 plots x 223 species. Assignment of plots to USNVC associations and Minnesota state types was made by visual inspection of the ordinations and cluster analyses, relying on NVC descriptions in Faber-Langendoen (2001) and state type descriptions in MN NHP (2003). This was done because of limitations of plot sampling size and restricted geographic area of sampling, compared to the availability of information for state and national classification units. The analyses also suggested several refinements to the USNVC associations, and these possible refinements are under review.

Plot patterns were then reviewed and assessed for perceived environmental gradients (e.g., moisture gradients, peat depth, and soil depth) for both wetland and upland stands.

Plots for each association were then summarized into a type summary (the fact sheets). Cover was averaged (based on midpoint of cover scales). All species present in  $\geq 20\%$  of the plots were retained (all species were

retained for plots with fewer than five plots per type [18 of 39 types]). We then re-submitted the types as “plots” in an ordination analysis — a common technique for summarizing vegetation patterns (Curtis, 1959; Harris and others, 1996; Sims and others, 1997). These type ordinations were run separately for uplands and wetlands. We used NMS, following the same approach as outlined above. The two ordinations shown in the fact sheets provide a key demonstration of the ability of the types themselves to summarize the vegetation and environmental relationship. These ordinations display the relative similarity among the types and locate the position of the types along major vegetation/environmental gradients. A summary of these environmental gradients for both the wetland and upland ordinations are shown in fig. 1.1.





**Figure 1.1.** Summary ordinations for wetland (A) and upland (B) types. The ordinations are based on non-metric multi-dimensional scaling, and each point represents an association type, with the dot color-coded by System. The arrows and text on each axis provide a summary of the environmental gradients influencing the types. Types belonging to the Rich Swamp system are included in both the upland and wetland ordination, as they are wetlands with transitional characteristics to uplands. For a complete list of the codes and names of systems and associations, see Fact Sheets: List Of Plant Communities.





## Appendix 2. Ecological Systems

Patterns among the plant communities (associations) can be portrayed using ecological systems; that is, groups of types that share similar ecological processes (Faber-Langendoen 2001; Comer and others, 2003). A more formal definition can be stated as follows: “Ecological Systems are dynamic assemblages or complexes of plant and/or animal communities that (1) occur together on the landscape; (2) are tied together by similar ecological processes, underlying abiotic environmental factors or gradients; and (3) form a readily identifiable unit on the ground.” The use of ecological systems is a way of emphasizing some of the ecological, in addition to the floristic or physiognomic similarities among the types. The Systems presented here are ecosystems that were used to organize the plant communities at Voyageurs National Park and its environs; seven wetland systems and six upland systems (see <[www.natureserve/explorer.org](http://www.natureserve/explorer.org)> for the most recent version). The criteria used to define them include hydrology, peat, acidity, vegetation structure and major dominants, and moisture. These groups help to highlight the ecological diversity found at and near Voyageurs National Park.

We used local, shorthand names for the system types, but their full name is shown in Table 2.1

**Table 2.1.** Local system name and standard System name used by NatureServe.

<b>Number</b>	<b>Local System Name</b>	<b>Standard NatureServe System Code and Name</b>
1	Bog	CES103.581 Boreal-Laurentian Bog
2	Poor Swamp	CES201.574 Laurentian-Acadian Acid Swamp
3	Poor Fen	CES201.583 Boreal-Laurentian-Acadian Acidic Basin Fen
4	Rich Fen	CES201.585 Laurentian-Acadian Alkaline Fen
5	Rich Swamp	CES201.575 Laurentian-Acadian Alkaline Swamp
6	Wet Meadow - Shrub Swamp	CES201.582 Laurentian-Acadian Wet Meadow-Shrub Swamp
7	Freshwater Marsh	CES201.594 Laurentian-Acadian Freshwater Marsh
8	Rocky Outcrop / Woodland	CES201.571 Laurentian-Acadian Acid Rocky Outcrop
9	Northern Pine - (Oak) Forest	CES201.719 Laurentian-Acadian Northern Pine-(Oak) Forest
10	Jack Pine - Black Spruce Forest	CES103.022 Boreal Jack Pine-Black Spruce Forest
11	White Spruce - Fir Forest	CES103.021 Boreal White Spruce-Fir-Hardwood Forest
12	Aspen - Birch Forest	CES103.020 Boreal Aspen-Birch Forest
13	Northern Hardwoods - (Conifer) Forest	CES201.564 Laurentian-Acadian Northern Hardwoods Forest

## Appendix 3. Tree Names

Common and scientific names of tree species as used in the fact sheets.

**Table 3.1.** List of tree species used in the fact sheets.

<b>Common name</b>	<b>Scientific name</b>
Balsam fir	<i>Abies balsamea</i>
Basswood	<i>Tilia americana</i>
Big-tooth aspen	<i>Populus grandidentata</i>
Black ash	<i>Fraxinus nigra</i>
Black spruce	<i>Picea mariana</i>
Bur oak	<i>Quercus macrocarpa</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Jack pine	<i>Pinus banksiana</i>
Northern pin oak	<i>Quercus ellipsoidalis</i>
Paper birch	<i>Betula papyrifera</i>
Red maple	<i>Acer rubrum</i>
Red pine	<i>Pinus resinosa</i>
Tamarack	<i>Larix laricina</i>
Trembling aspen	<i>Populus tremuloides</i>
White pine	<i>Pinus strobus</i>
White spruce	<i>Picea glauca</i>
White-cedar	<i>Thuja occidentalis</i>



## Appendix 4. Relation Between Associations and Map Units For Voyageurs National Park Vegetation Mapping Project

Associations found in Voyageurs National Park, organized by ecological systems, are listed in Table 4.1. Associations are shown with the standard common names and abbreviated Community Element Global (CEGL) codes used in the U.S. National Vegetation Classification (e.g., full code would be CEGLO02485). System names are local versions of formal ecological system types (Comer and others, 2003). The final column provides the map unit link to each association. The CEGL codes with an asterisk (\*) indicate associations that were both uniquely mapped and are part of complexes. Codes with a double asterisk (\*\*\*) indicate associations that were mapped only as part of a mosaic or complex. And, codes with a plus sign (+) indicate associations mapped at the alliance level. All other associations were mapped directly, sometimes with two or more map units (as phases) based on structural or floristic variability. Map unit codes designated with a superscript t (t) are map units that have been adjusted from the original vegetation map (Hop and others, 2001) due to results of subsequent vegetation analysis from this project. Adjustments to these map unit codes are listed in Table 4.2.

**Table 4.1.** List of associations found in Voyageurs National Park, organized by ecological system and their relation to map units.

System	A-type	Association (plant community type)	CEGL Code	Map Unit Link
BOG	A1	Black Spruce Bog	2485	BSB
	A2	Black Spruce / Leatherleaf Semi-treed Bog	5218+	LBC <sup>t</sup> (shares)
	A3	Leatherleaf Bog	5278+	LBC <sup>t</sup> (shares)
POOR SWAMP	A4	Black Spruce / Labrador Tea Poor Swamp	2454	BSL (evergreen), BST (mixed, with tamarack), and BSO <sup>t</sup> (open, BBX when mosaic/complex)
POOR FEN	A5	Tamarack Scrub Poor Fen	5226	TF
	A6	Leatherleaf Poor Fen	5277*	LPP <sup>t</sup> (BBX when beaver mosaic/complex)
	A7	Northern Sedge Poor Fen	2265+	SFF (shares)

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RICH FEN	A8	Bog Birch - Willow Shore Fen	5227	BBSF
	A9	Leatherleaf - Sweet Gale Shore Fen	5228*	LSF (BBX when mosaic/complex)
	A10	Boreal Sedge Rich Fen	2500+	SFF† (shares)
	A11	Wiregrass Sedge Shore Fen	5229**	SMX (shares)
RICH SWAMP	A12	White Cedar - Boreal Conifer Mesic Forest	2449	WCU
	A13	Trembling Aspen - Balsam Poplar Lowland Forest	5036	AL
	A14	Black Ash - Mixed Hardwood Swamp	2105	BA
	A15	White Cedar - Black Ash Swamp	5165	WCBA
	A16	Black Spruce / Alder Rich Swamp	2452	BSAS
	A17	White Cedar - (Mixed Conifer) / Alder Swamp	2456	WCS (swamp) and WCT (peat, with tamarack)
	A18	Northern Tamarack Rich Swamp	2471	TA
	A19	Speckled Alder Swamp	2381	AS
WET MEADOW -	A21	Dogwood - Pussy Willow Swamp	2186	DS
SHRUB SWAMP	A22	Northern Sedge Wet Meadow	2257**	SMX (shares)
	A23	Canada Bluejoint Eastern Meadow	5174*	BI (SMX when mosaic/complex)

FRESHWATER MARSH	A24	Midwest Cattail Deep Marsh	2233*	CM (DMX & SMX when mosaic/complex)
	A25	Eastern Reed Marsh	4141*	PM (DMX & SMX when mosaic/complex)
	A26	Freshwater Bulrush Marsh	2225*	BM (DMX when mosaic/complex)
	A27	Water Horsetail - Spikerush Marsh	5258**	DMX (shares)
	A28	Wild Rice Marsh	2382*	WRM (DMX when mosaic/complex)
	A29	Midwest Pondweed Submerged Aquatic Wetland	2282*	PW (DMX and BBX when mosaic/complex)
	A30	Northern Water Lily Aquatic Wetland	2562*	WL (DMX and BBX when mosaic/complex)
ROCKY OUTCROP /	A31	Jack Pine / Lichen Rocky Barrens	2491	JPL
WOODLAND	A32	Boreal Pine Rocky Woodland	2483	JPW (jack pine) & JPM (mixed pine)
	A33	Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland	5246	OW (deciduous), JPOM (jack pine-oak), and MPHW (mixed pine-oak)
	A34	Mixed Aspen Rocky Woodland	2487	ABW
	A35	Boreal Hazelnut - Serviceberry Rocky Shrubland	5197	UBS
	A35a	Poverty Grass Granite Barrens	5157	MGF
NORTHERN PINE -	A36	Red Pine / Blueberry Dry Forest	2443*	RP (WRPA when mosaic with AB)
(OAK) FOREST	A37	Red Pine - Aspen - Birch Forest	2520**+	WRPA (shares)
	A38	White Pine - Aspen - Birch Forest	2479**+	WRPA (shares)
	A39	White Pine / Mountain Maple Mesic Forest	2445*	WP (WRPA when mosaic with AB)



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JACK PINE - BLACK SPRUCE FOREST	A40 A41 A42	Jack Pine / Balsam Fir Forest Jack Pine - Aspen / Bush Honeysuckle Forest Black Spruce / Feathermoss Forest	2437* 2518** 2447	JPF (JPAX when mosaic with AB) JPAX (shares) BSF
WHITE SPRUCE - FIR FOREST	A43 A44	Spruce - Fir / Mountain Maple Forest Spruce - Fir - Aspen Forest	2446 2475	SF SFA
ASPEN - BIRCH FOREST	A45 A46 A47	Paper Birch / Fir Forest Aspen - Birch / Boreal Conifer Forest Aspen - Birch - Red Maple Forest	2463 2466*+ 2467*+	PB AB (shares, JPAX and WRPA when mosaic) AB (shares, JPAX and WRPA when mosaic)
NORTHERN HARDWOODS (CONIFER) FOREST	A48 A49	White Cedar - Yellow Birch Forest Northern Bur Oak Mesic Forest	2450 2072	WCA BO

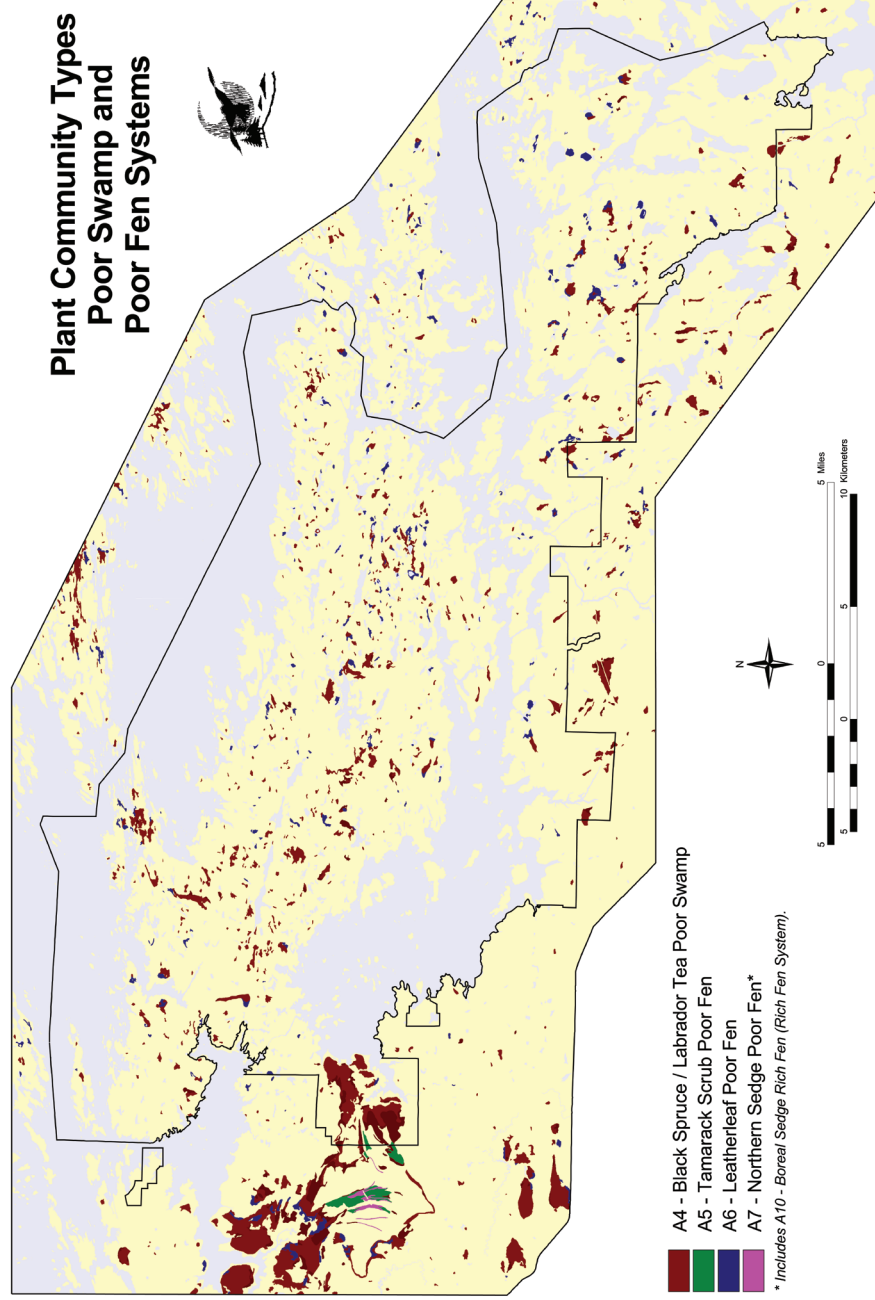
**Table 4.2.** Adjustments necessary to the original vegetation map to match this field guide and the revised plant community descriptions.

A-type	Association	CEGL Code	Field Guide Map Code	Vegetation Map Code (2001)	Explanation and adjustment necessary to the vegetation map
A2	Black Spruce / Leatherleaf Semi-treed Bog	5218*+ LBC <sup>1</sup>	LBC <sup>1</sup>	LBC	At the time of mapping, this association (A2) and the open version of the Black Spruce / Labrador Tea Poor Swamp association (A4), which is now acknowledged in this guide, were not recognized as distinct, so the LBC map unit was based on a broader concept. Under the revised concept, <u>all</u> LBC map unit polygons of the original vegetation map that are <u>within</u> the Rat Root River Peatland bog complex (five polygons) and the small bog complex between Black Bay and Cranberry Bay (one polygon) now represent the A2 association. In this guide, we link this association to the Black Spruce / Leatherleaf Semi-treed Bog (LBC) map unit. In contrast, <u>all</u> LBC polygons <u>external</u> and along the <u>margins</u> of these bog complexes are now the open version of the Black Spruce / Labrador Tea Poor Swamp (A4). See A4 below for map unit link.
A3	Leatherleaf Bog	5278*+ LBC <sup>1</sup>	LBC <sup>1</sup>	LB	At the time of mapping, this association and the Leatherleaf Poor Fen (A6), which is now acknowledged in this guide, were not recognized as distinct, so the LB map unit was based on a broader concept. Under the revised concept, the Leatherleaf Bog association (A3) only occurs within the bog portions of the Rat Root River Peatland bog complex and possibly within the small bog complex between Black Bay and Cranberry Bay. The A3 association is likely mapped along with A2 in the revised LBC map unit. No map unit polygons for A3 were originally mapped within the Rat Root River Peatland bog complex or the small bog complex between Black Bay and Cranberry Bay. Thus, there are <u>no</u> LB polygons of the original vegetation map that represent the A3 association. Rather, LB now represent the A6 association (which occurs outside of the Rat Root River Peatland). See A6 below for map unit link.

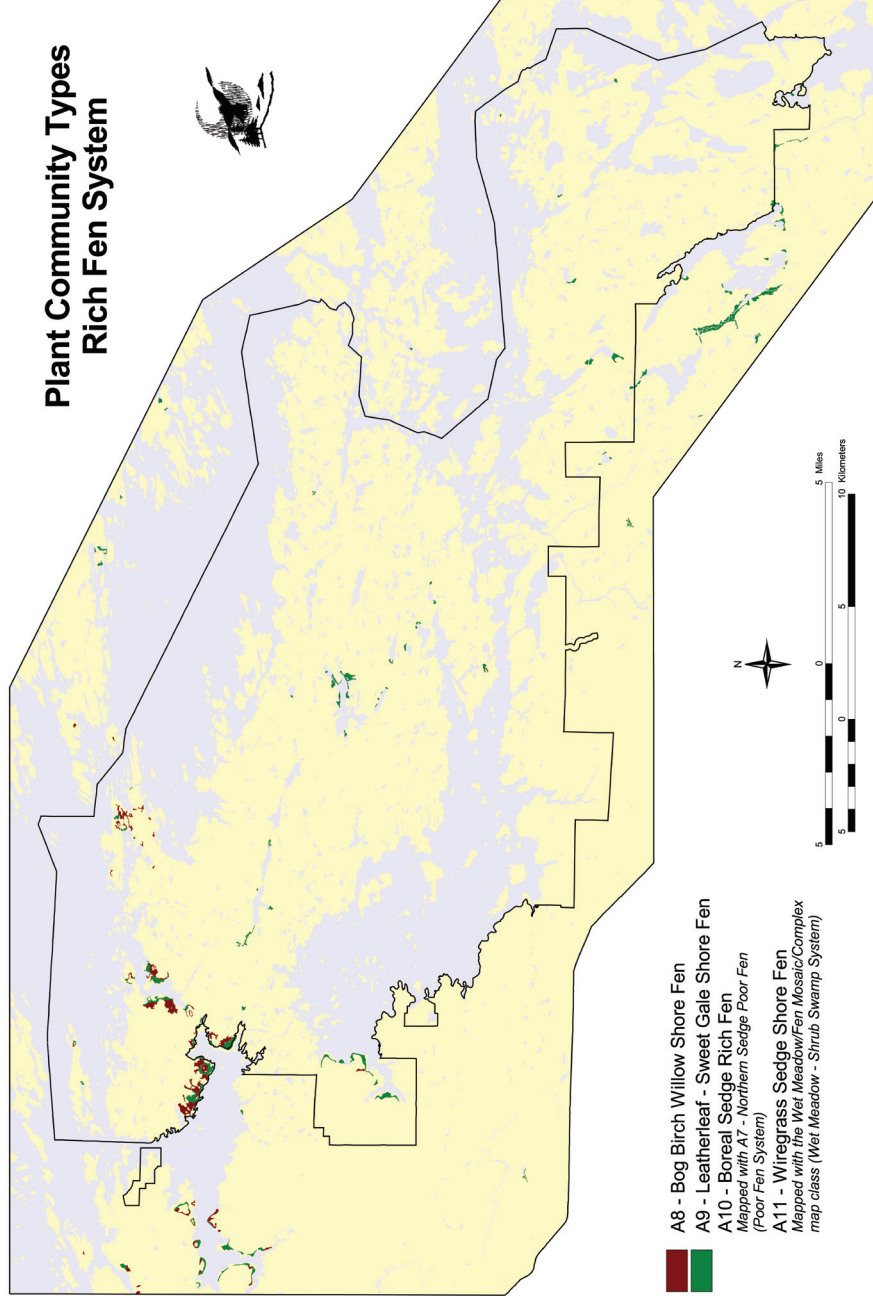
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A4	Black Spruce / Labrador Tea Poor Swamp	2454	BSO <sup>1</sup>	LBC	<p>At the time of mapping, the open version of this association (A4), which is now acknowledged in this guide, and the Black Spruce / Leatherleaf Semi-treed Bog association (A2), were not recognized as distinct, so the LBC map unit was based on a broader concept.</p> <p>Under the revised concept, <u>all</u> LBC map unit polygons of the original vegetation map, except those found within the Rat Root River Peatland bog complex and the small bog complex between Black Bay and Cranberry Bay, now represent the open version of the A4 association. In this guide, we link the open version of this association to a new map unit phase, the Black Spruce / Labrador Tea Open Swamp (open canopy phase, BSO) joining two other map unit phases of the A4 association (the evergreen phase, BSL and the mixed phase, BST).</p> <p>In contrast, <u>all</u> LBC polygons within these bog complexes are now the Black Spruce / Leatherleaf Semi-treed Bog association (A2). See A2 above for map unit link.</p>
A6	Leatherleaf Poor Fen	5277*	LPF <sup>1</sup>	LB	<p>At the time of mapping, this association (A6), which is now acknowledged in this guide, and the Leatherleaf Bog (A3), were not recognized as distinct, so the LB map unit was based on a broader concept that included both A3 and A6.</p> <p>Under the revised concept, <u>all</u> LB (A3) map unit polygons of the original vegetation map now represent the Leatherleaf Poor Fen association (A6). In this guide, we link A6 to the Leatherleaf Poor Fen (LPF). We eliminated the use of the LB map unit code altogether. There were no LB polygons mapped within the Rat Root River Peatland bog complex or the small bog complex between Black Bay and Cranberry Bay to consider any as being Leatherleaf Bog association (A3). See A2 above for map unit link.</p>
A10	Boreal Sedge Rich Fen	2500	SPF <sup>1</sup>	None	<p>This association was not initially recognized at the time of mapping, and thus was not assigned a map unit. It is considered a very localized type at or near Voyageurs National Park. It is presumably mapped within the Northern Sedge Poor Fen (SPF) map unit, a map unit originally designed to map locations of the Northern Sedge Poor Fen association (A7) in the Rat Root River Peatland bog complex. In this guide, we link the SPF map unit to both the A7 and A10 associations.</p>

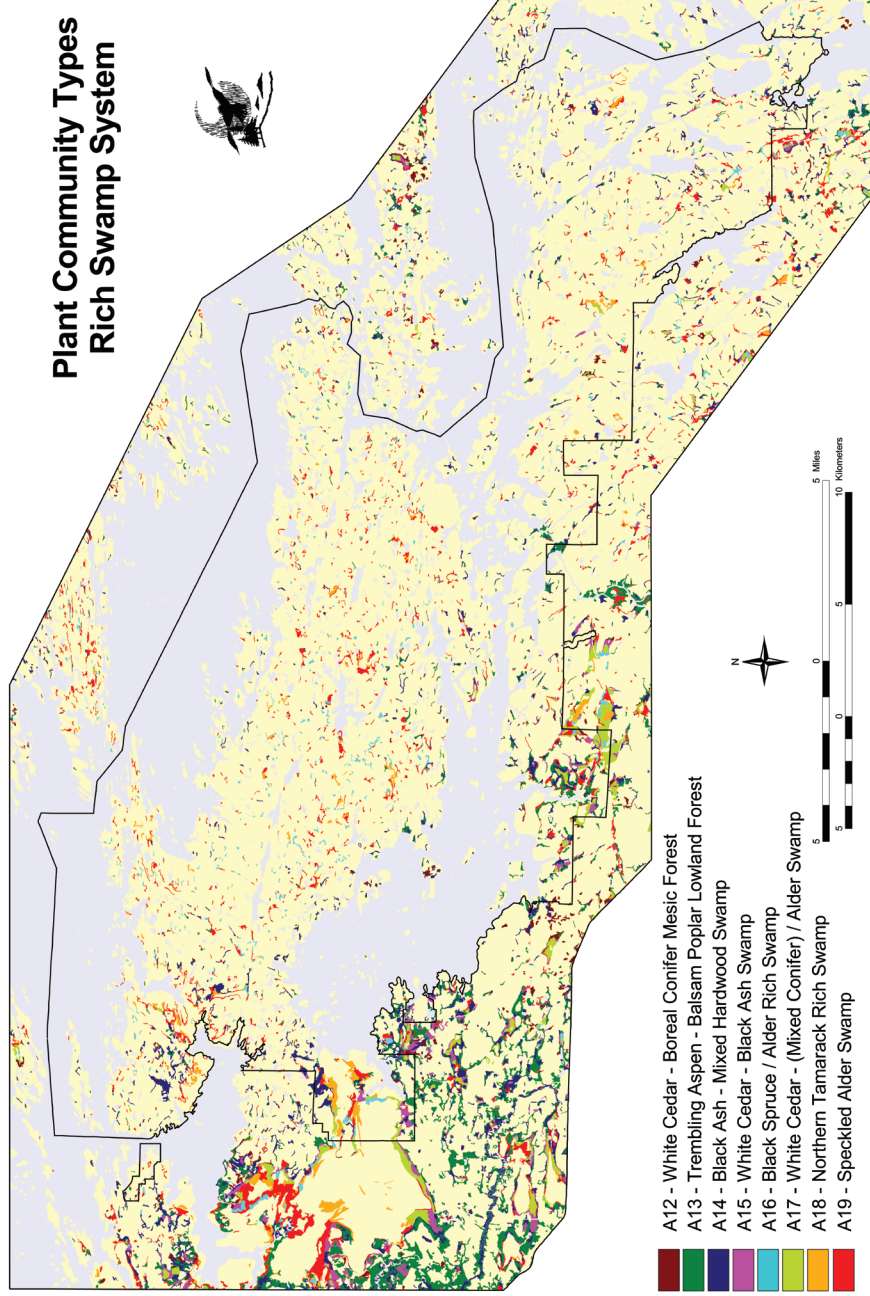




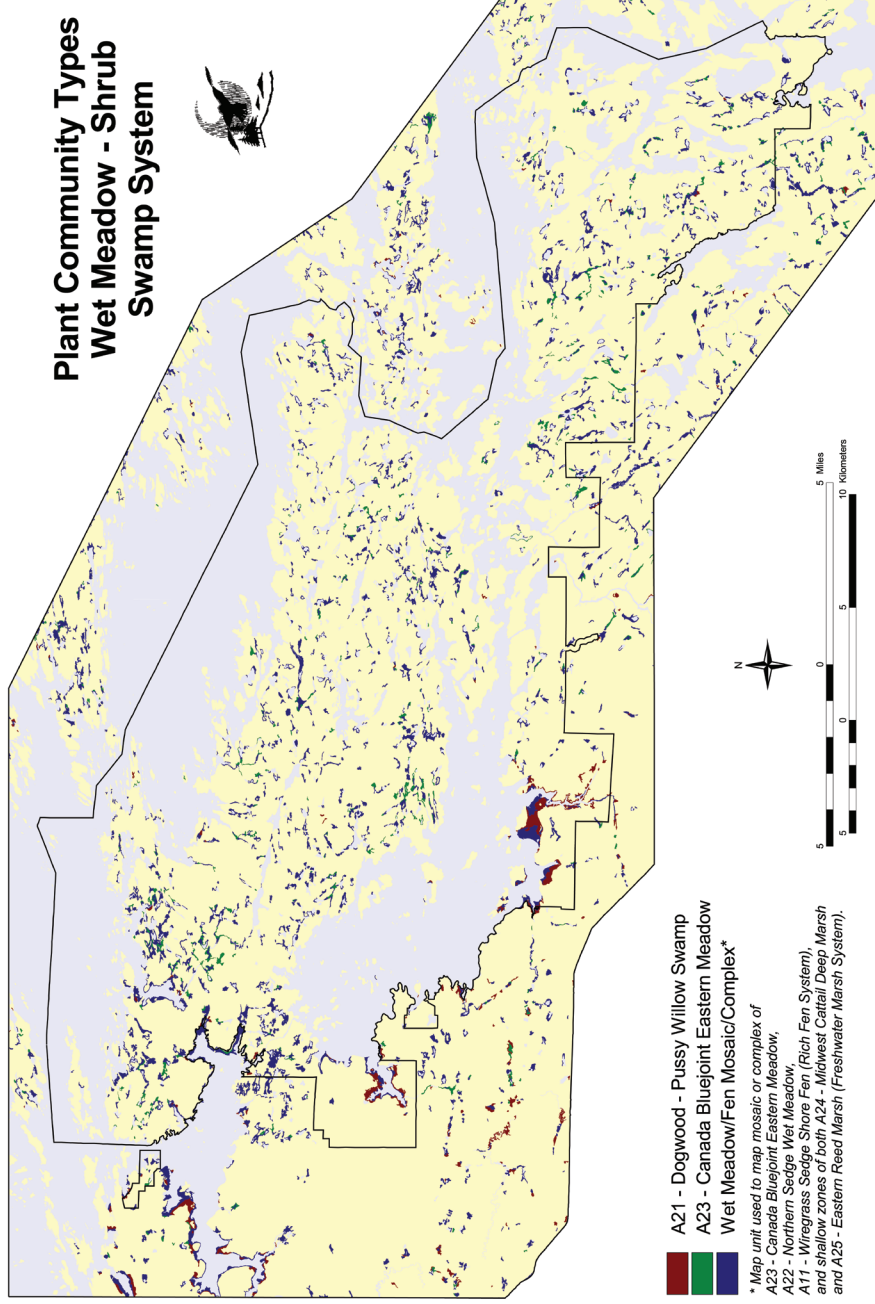
# Plant Community Types Rich Fen System



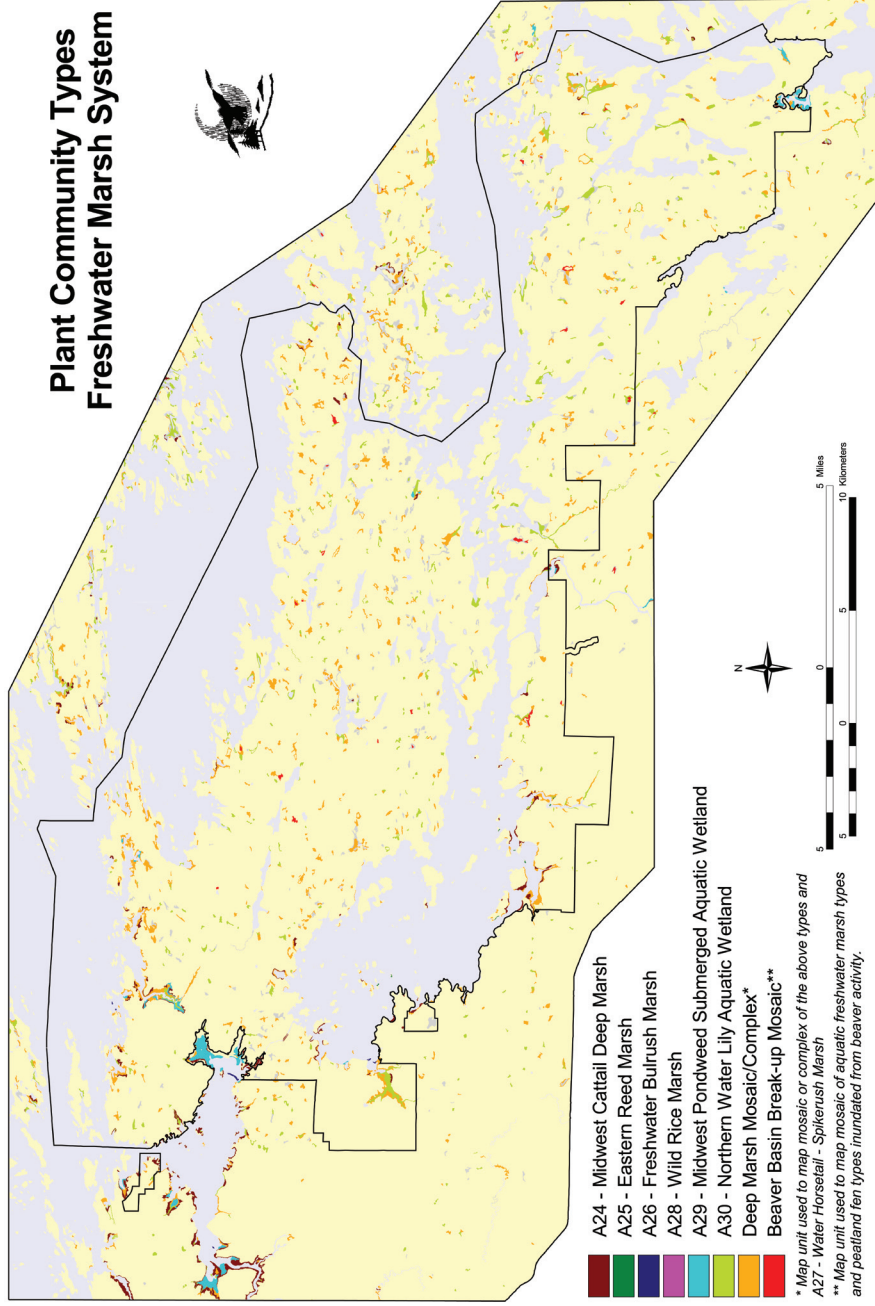
- A8 - Bog Birch Willow Shore Fen
- A9 - Leatherleaf - Sweet Gale Shore Fen
- A10 - Boreal Sedge Rich Fen  
*Mapped with A7 - Northern Sedge Poor Fen  
(Poor Fen System)*
- A11 - Wiregrass Sedge Shore Fen  
*Mapped with the Wet Meadow/Fen Mosaic/Complex  
map class (Wet Meadow - Shrub Swamp System)*



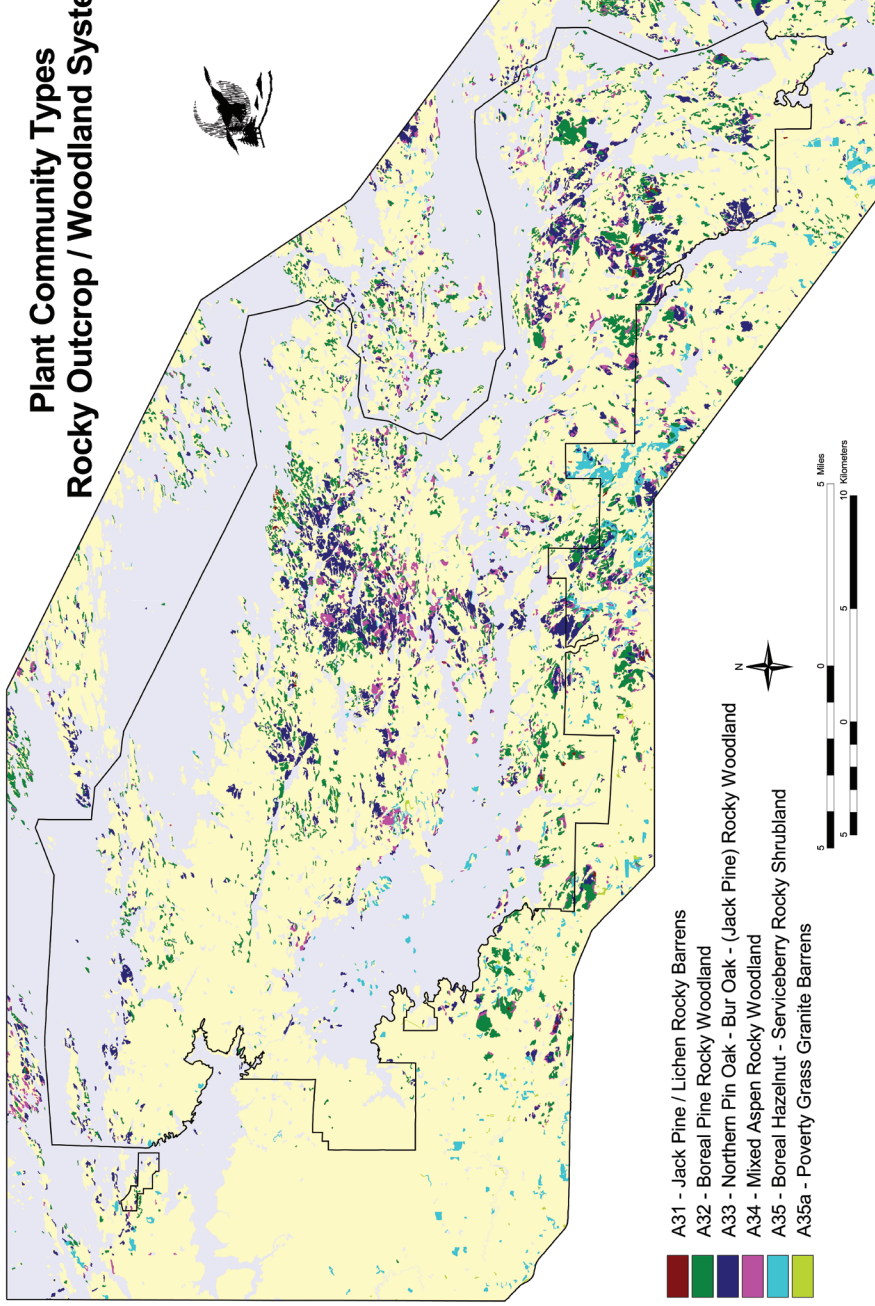
# Plant Community Types Wet Meadow - Shrub Swamp System



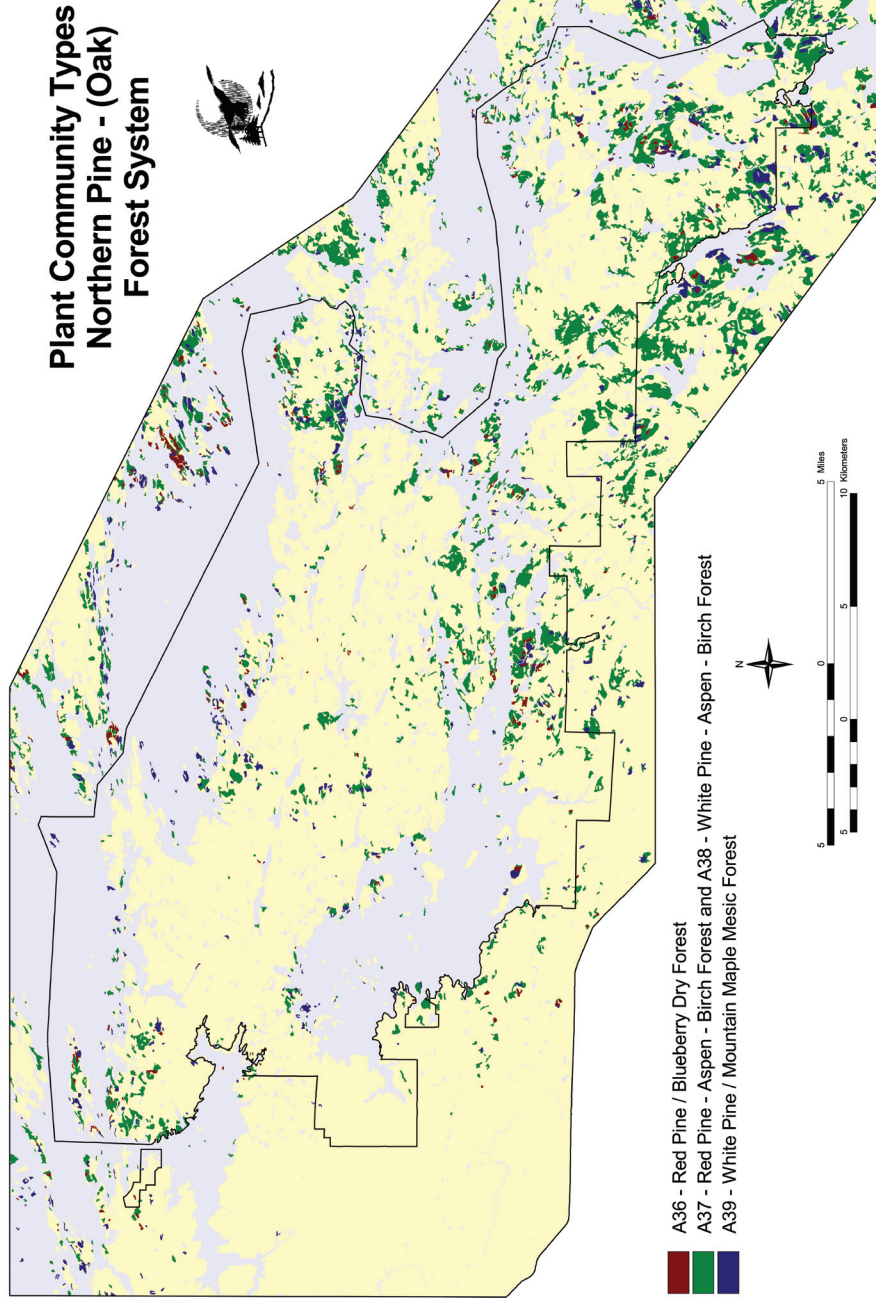




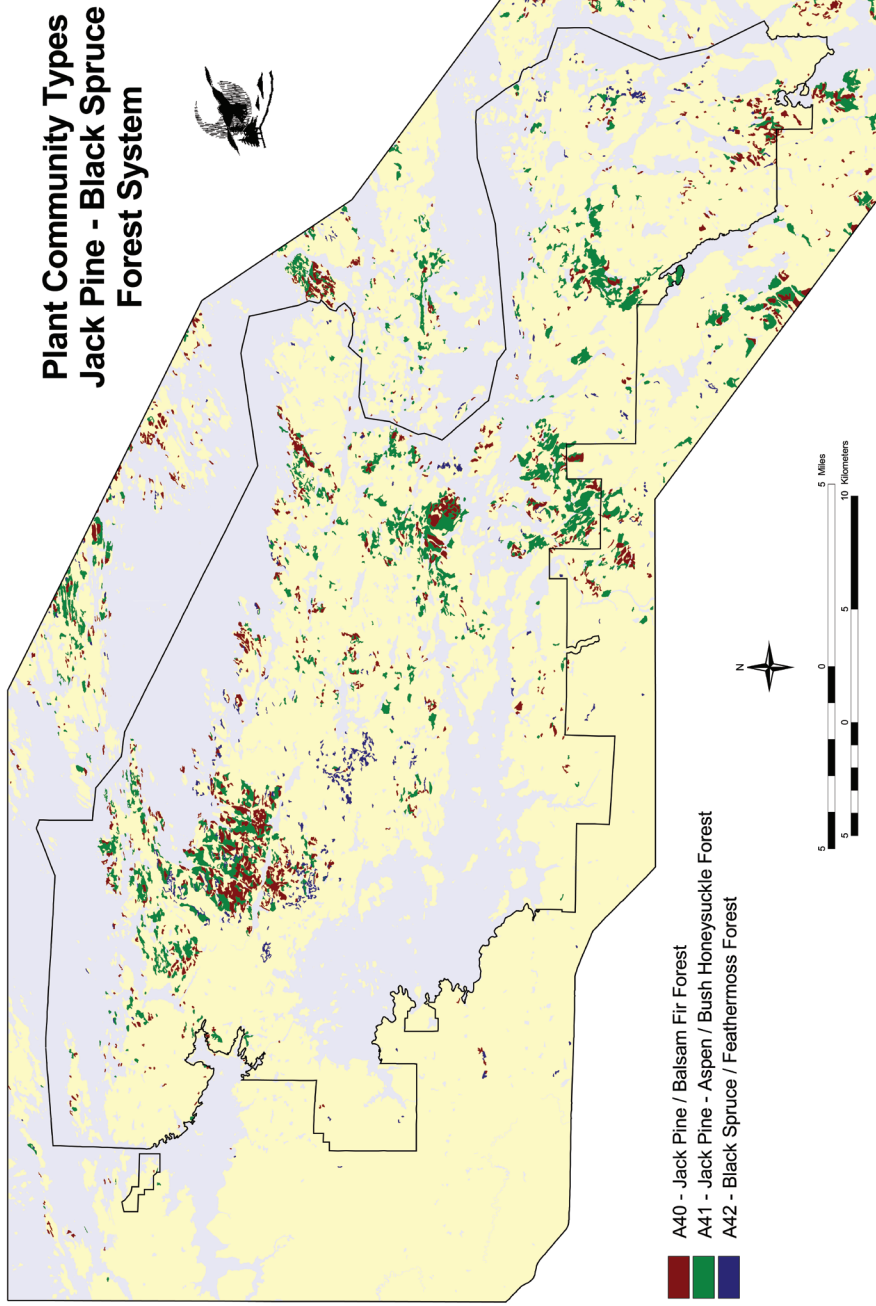
# Plant Community Types Rocky Outcrop / Woodland System



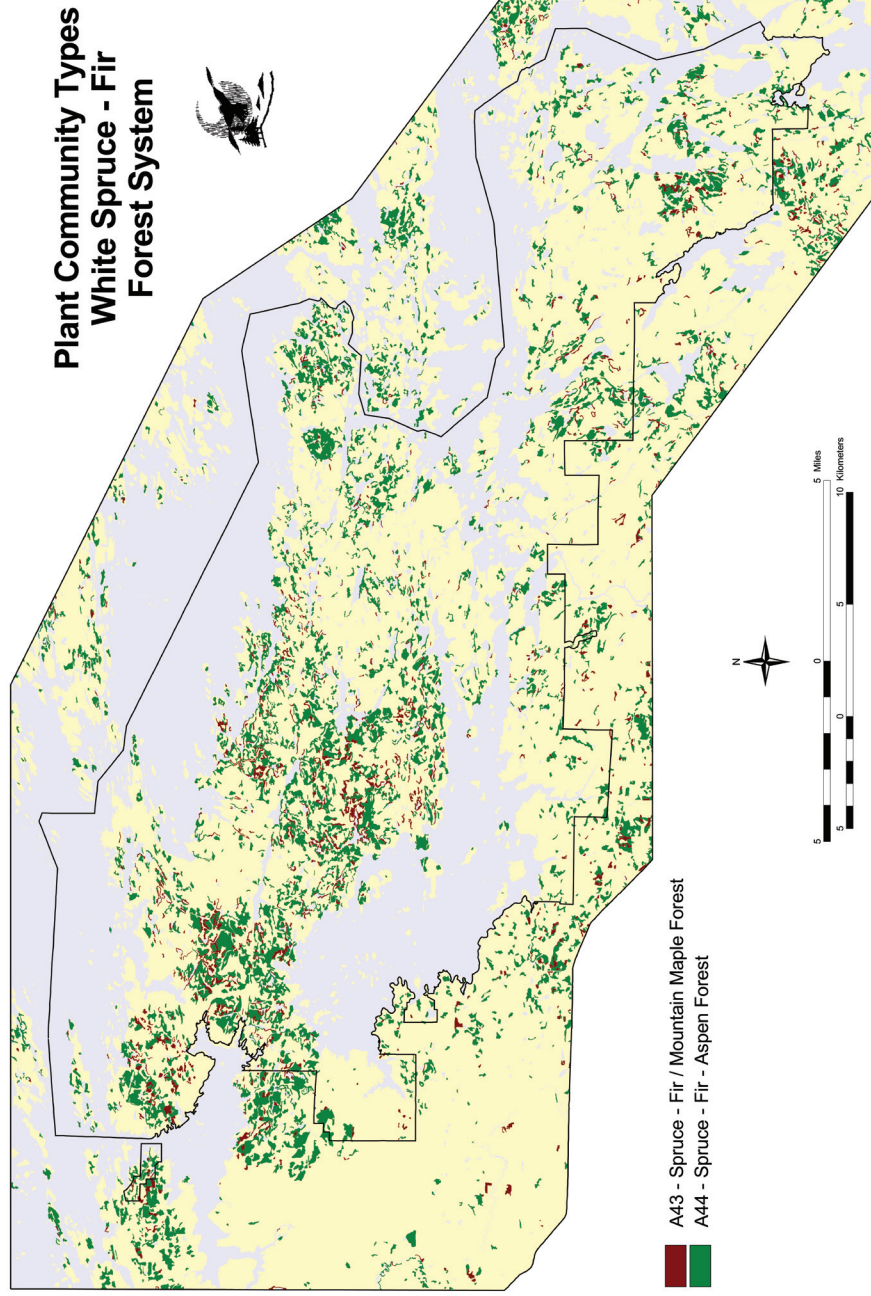
- A31 - Jack Pine / Lichen Rocky Barrens
- A32 - Boreal Pine Rocky Woodland
- A33 - Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland
- A34 - Mixed Aspen Rocky Woodland
- A35 - Boreal Hazelnut - Serviceberry Rocky Shrubland
- A35a - Poverty Grass Granite Barrens



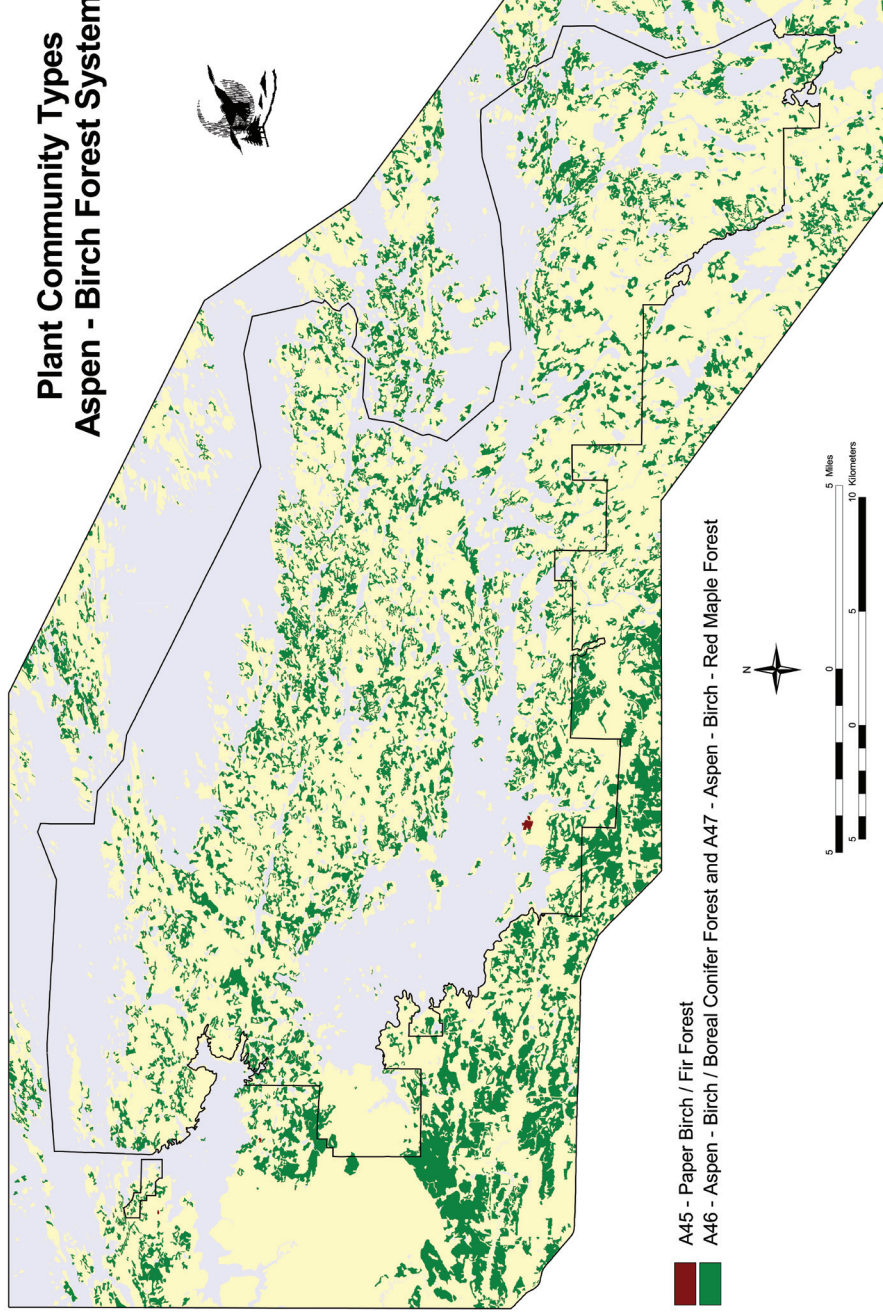
# Plant Community Types Jack Pine - Black Spruce Forest System



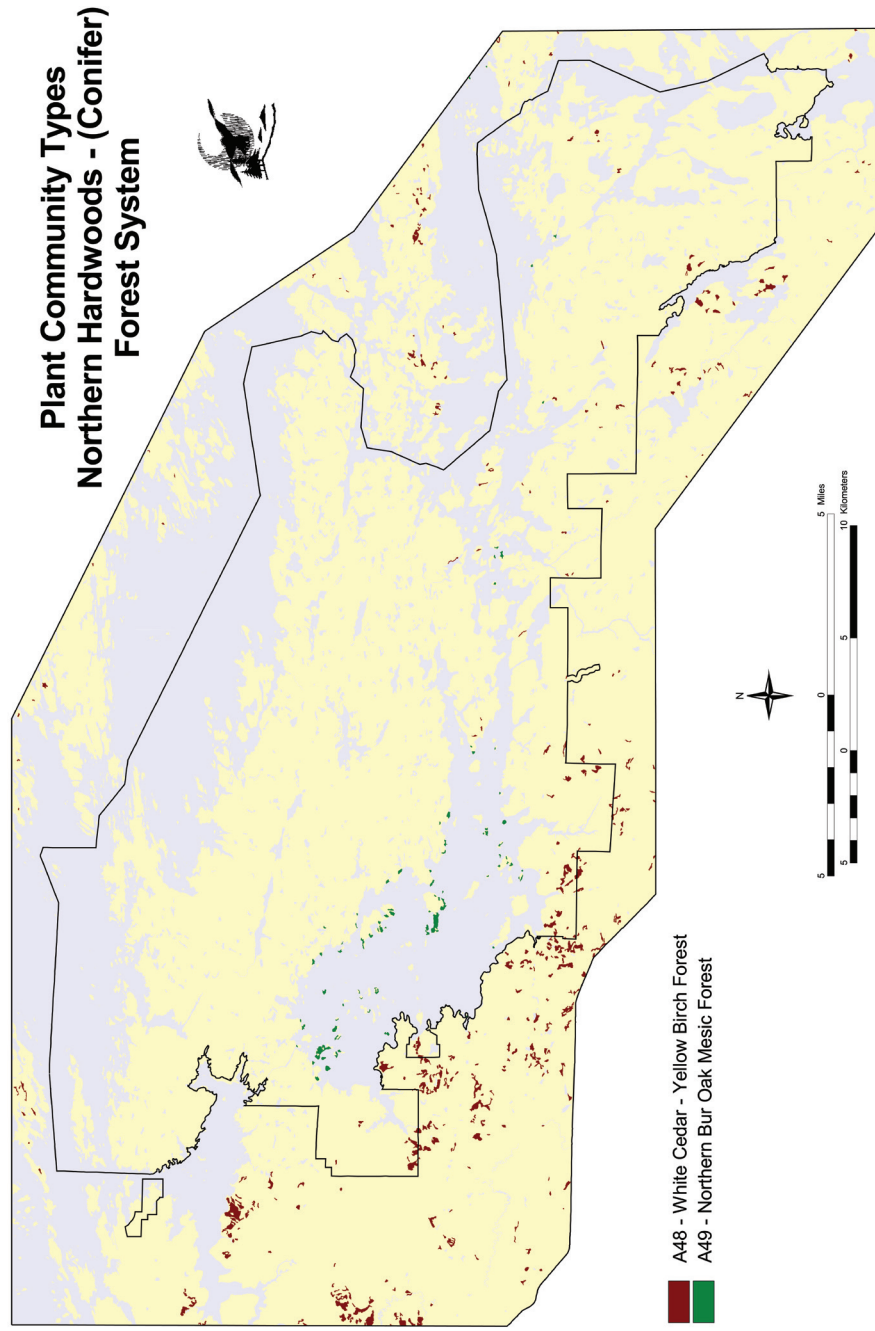
- A40 - Jack Pine / Balsam Fir Forest
- A41 - Jack Pine - Aspen / Bush Honeysuckle Forest
- A42 - Black Spruce / Feathermoss Forest



# Plant Community Types Aspen - Birch Forest System



- A45 - Paper Birch / Fir Forest
- A46 - Aspen - Birch / Boreal Conifer Forest and A47 - Aspen - Birch - Red Maple Forest









Faber-Langendoen and others—**Field Guide to the Plant Community Types of Voyageurs NP**—Techniques and Methods 2-A4