USGS-NPS VEGETATION MAPPING PROGRAM

Voyageurs National Park, Minnesota

Kevin Hop
U.S. Geological Survey
Upper Midwest Environmental Sciences Center

Don Faber-Langendoen
Association for Biodiversity Information

Michael Lew-Smith
Northeast Ecological Resources

Norman Aaseng
Minnesota County Biological Survey
Minnesota Department of Natural Resources

Sara Lubinski
U.S. Geological Survey
Upper Midwest Environmental Sciences Center

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U.S. Department of the Interior
U.S. Geological Survey
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54602-0818

Program Managed by:
U.S. Geological Survey
Center for Biological Informatics
Denver Federal Center, Building 810
Room 8000, MS 302
Denver, Colorado 80225-0046

In cooperation with:

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LIST OF CONTACTS

U. S. Department of the Interior
United States Geological Survey - Biological Resources Division

Thomas Owens
Program Coordinator - USGS-NPS Vegetation Mapping Program
U.S. Geological Survey
Center for Biological Informatics
P.O. Box 25046
Denver, Colorado 80225-0046
Phone (303) 202-4259
E-Mail: tom_owens@usgs.gov
Website: http://biology.usgs.gov/cbi

Kevin Hop
Project Team Leader
U.S. Geological Survey
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603
Phone (608) 783-7550 Extension 46
E-Mail: kevin_hop@usgs.gov
Website: http://www.umesc.er.usgs.gov

U. S. Department of the Interior
National Park Service

Mike Story
NPS Vegetation Mapping Program Liaison
NPS Natural Resources Information Division
Phone: 303-969-2746
E-Mail: mike_story@nps.gov

National Park Service
Voyageurs National Park
3131 Highway 53
International Falls, Minnesota 56649-8904
Website: http://www.nps.gov/voya

Jim Schaberl
Ecologist
Phone: (218) 283-9821
E-Mail: jim_schaberl@nps.gov

Wayne Wold
GIS Coordinator
Phone: (218) 283-9821
E-Mail: wayne_wold@nps.gov

The Nature Conservancy
Midwest Regional Office
1313 Fifth Street, S.E. # 314
Minneapolis, MN 55414
Website: http://www.tnc.org

Association for Biodiversity Information
Midwest Regional Office
1313 Fifth Street, S.E. # 314
Minneapolis, MN 55414
Website: http://www.abi.org

Jim Drake[1]
Project Manager
Phone: (612) 331-0729
E-Mail: jdrake@tnc.org

Don Faber-Langendoen[2]
Regional Ecologist
Phone: (518) 673-0921
E-Mail: dfaber-lang@tnc.org

[1]current address: Project Manager, Association for Biodiversity Information, Midwest Resource Office, 1313 Fifth St. SE, #314, Minneapolis, MN 55414. Phone (612) 331-0729, Email: jim_drake@abi.org

[2]current address: Senior Ecologist, Association for Biodiversity Information, 3467 Amber Rd, Syracuse, NY 13215. Phone: (315) 673-0921, Email: don_faber-langendoen@abi.org

Minnesota Department of Natural Resources
Norman Aaseng
Plant Ecologist
Minnesota County Biological Survey
Division of Ecological Services
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, MN 55155
Phone: 651-297-7267
E-Mail: norman.aaseng@dnr.state.mn.us
Website: http://www.dnr.state.mn.us/ecological_services

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EXECUTIVE SUMMARY

The Biological Resources Division of the U.S. Geological Survey (USGS) is cooperating with the Inventory and Monitoring Program of the National Park Service to classify, describe, and map vegetation for 250 National Parks. The Upper Midwest Environmental Sciences Center (UMESC) in La Crosse, Wisconsin, the Midwest Regional Office of The Nature Conservancy (TNC), and the Association for Biodiversity Information have completed mapping and classifying the existing vegetation in Voyageurs National Park and environs. The UMESC provided project coordination, photo interpretation of the aerial photographs and subsequent automation, accuracy assessment analysis, and final product compilation. Staff at the Midwest Resource Office of TNC and the Minnesota County Biological Survey of the Minnesota Department of Natural Resources conducted vegetation classification, including collection of data in the field and subsequent analysis. The Center for Biological Informatics provided oversight to the project. Staff at Voyageurs National Park organized the acquisition of the aerial photographs, provided logistical and equipment support, and provided housing and personnel for field work. This report presents the work conducted at Voyageurs National Park in northern Minnesota between 1996 and 1998.

Voyageurs National Park contains a high diversity of vegetation types typical of the southern boreal and Laurentain mixed conifer-hardwood regions. The U.S. National Vegetation Classification (USNVC) provided the standards for describing the vegetation types. The USNVC is a vegetation-based system that emphasizes natural and existing vegetation. 191 plots were collected throughout the project area, resulting in 50 community types (associations of the USNVC). The types were linked to map units, which are representations of the types to the extent that can be discerned on the aerial photographs. Sixty-seven map units, including land use/land cover and park specific categories, were used to map 156,886 hectares (387,674 acres) of Voyageurs National Park and environs, including a portion of Canada. Color infrared film at a scale of 1:15,840 provided the imagery. The interpreted photos were manually transferred to orthophoto quadrangle maps (1:12,000-scale), and subsequently automated using ArcInfo. 32,841 polygons were delineated; nearly 53% of the polygons were forest types. The greatest number of hectares (h) mapped was the Quaking Aspen-Paper Birch Forest (>21,500 h) and the largest polygons mapped (average size 30 h) were Black Spruce Bogs. The Natural Heritage Network and TNC consider a number of vegetation types at Voyageurs National Park to be globally rare. Two types are listed as Vulnerable or Apparently Secure (G3G4), the Northern Sedge Poor Fen and the White Pine / Mountain Maple Mesic Forest. The potentially rarest type, White Cedar - Yellow Birch Forest, is present in the park, but its global taxonomic status is unresolved (G2Q). 1,251 field data points were used to test the thematic accuracy of the map. Overall thematic map accuracy was assessed at 82.4%.

Products developed for the Voyageurs National Park Vegetation Mapping Project include the following:

- This final report, including methodologies, descriptions of vegetation types, vegetation key, map accuracy assessment results and contingency table, and mapping convention report and photo interpretation visual key;
- Spatial database coverages of the vegetation map, observation points, vegetation field plots, accuracy assessment sites, flight line index, and other supportive GIS data;
- Digital data files and hard copy data sheets of field work including observation points, vegetation field plots, and accuracy assessment sites;
- Aerial photographs of the project area (1 transparency set and 2 contact print sets) and their corresponding interpreted overlays;
- Representative ground photos for each vegetation type;
- Graphics of all spatial database coverages, and map composition of the vegetation map;

- Federal Geographic Data Committee compliant metadata for all vegetation spatial database coverages and field work data, and;
- CD-ROM containing reports, metadata, keys, classification lists, fieldwork data, spatial data, map composition, graphics, and ground photos.

1. INTRODUCTION

1.1 Background

The objective of the U.S. Geological Survey - National Park Service Vegetation Mapping Program is to classify, describe, and map vegetation communities for most of the park units within the National Park Service (NPS). The program was created in response to the NPS Natural Resources Inventory and Monitoring Guidelines issued in 1992. Products to each park include digital files of the vegetation map and field data, keys and descriptions to the vegetation communities (associations), reports, metadata, map accuracy verification summaries, and aerial photographs. Inter-agency teams work in each park following standardized mapping and field sampling protocols. The teams develop products and vegetation classification standards documenting the various vegetation types found in a given park.

The use of a standard national vegetation classification system and mapping protocol facilitate effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs, and provide a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental processes across the landscape.

The U.S. National Vegetation Classification (USNVC) is used for park mapping. The classification:

- Is vegetation based;
- Uses a systematic approach to classify a continuum;
- Emphasizes natural and existing vegetation;
- Uses a combined physiognomic-floristic hierarchy;
- Identifies vegetation units based on both qualitative and quantitative data;
- Is appropriate for mapping at multiple scales.

The USNVC has primarily been developed and implemented by The Nature Conservancy (TNC) and the network of Natural Heritage Programs over the past twenty years (Grossman et al. 1998). Additional support has come from federal agencies, the Federal Geographic Data Committee (FGDC), and the Ecological Society of America. Refinements to the classification occur in the process of application, leading to ongoing proposed revisions that are reviewed both locally and nationally. TNC has made available a 2-volume publication presenting the standardized classification, providing a thorough introduction to the classification, its structure, and the list of vegetation types found across the United States as of April 1997 (Grossman et al. 1998). This publication can be found on the Internet at: http://consci.tnc.org/library/pubs/class/index.html. The Association for Biodiversity Information (ABI) has since superceded Volume II of the publication (the classification listing), providing regular updates to ecological communities in the United States and Canada. This online database server, NatureServe®, can be found on the Internet at: http://www.natureserve.org.

Further information about the USGS-NPS Vegetation Mapping Program, including examples of completed parks, may be viewed at the Program's web site: http://biology.usgs.gov/npsveg.

1.2 Voyageurs National Park

Voyageurs National Park was authorized in 1971 and established in 1975. The park extends for over 50 km along the Canadian - United States international border, from 29 km east of International Falls to the western edge of the Boundary Waters Canoe Area (BWCA) in the Superior National Forest (Figure 1). It covers 88,244 h (218,055 acres), of which 61.6% (54,336 h, 134,266 acres) is land, the rest open

lakes and ponds. Four large lakes comprise the majority of the water area. The climate is mid-continental, with a mean annual temperature of 1.4 °C, extremes of -40 and 36 °C and a mean annual precipitation of 63 cm per year (Kurmis et al. 1986). The landscape is rugged Canadian Shield terrain, consisting of Early Precambrian granite (more common in the southern part of the park), biotite schist (more common in the north), and migmatite (interlayered granite and biotite). A greenstone belt outcrop occurs in a limited region of the northwestern part of the park. Mafic dikes occur in localized areas. Prolonged erosion and glacial scouring during the Pleistocene have produced the current surficial geology features, which include sandy loam tills, lacustrine deposits (particularly on the western edge from glacial Lake Agassiz, but also in localized lowlands and bedrock depressions), and localized outwash deposits of sand and gravel (Okajangas and Matsch 1982).

Figure 1. Location of Voyageurs National Park in Northern Minnesota

Soils formed in the glacial deposits range from thin, loamy, and well drained, often in raised areas with bedrock outcrops, to thick, clayey, and poorly drained low-lying areas (Kurmis *et al.* 1986). The topography of the area is a complex pattern of low ridges and valleys, with a maximum relief of 90 m (Johnston and Naiman 1990), but more typically 20 to 30 m. All of Voyageurs National Park falls in one ecological land unit at the subsection level, the Border Lakes subsection (212La of Keys et al. 1995).

Prior to settlement and logging, which began around 1875 and ended in the early 1970s (cutting almost all of the park forests in the process), the vegetation consisted of jack pine forests with rocky outcrops, white and red pine forests, spruce-fir and aspen forests, black spruce-tamarack bogs and swamps, fens, wet meadows, marshes, and aquatics (Marschner 1974, Kurmis et al. 1986). Periodic fires both before and after settlement favored the fire-dependent pines, as well as the aspen-birch forests. Based on analyses from the adjacent BWCA (Heinselman 1996), fires could sweep through thousands of acres at a time. Heinselman's work indicated that jack pine stands in the BWCA had high-intensity catastrophic burns every 50-100 years, whereas red pine and white pine generally had more frequent low-intensity burns every 30-40 years, but less frequent high-intensity burns every 200 years or so. Windstorms, spruce-budworm disease, herbivores, and beaver activity are other disturbance factors acting in the park (Johnston and Naiman 1990, Crowley 1995).

2. METHODS

2.1 Planning

In May 1996, personnel from Voyageurs National Park, U.S. Geological Survey (USGS) Center for Biological Informatics (CBI), USGS Upper Midwest Environmental Sciences Center (UMESC), The Nature Conservancy (TNC, Midwest Office), and Minnesota Department of Natural Resources (Ecological Services) held a planning meeting at Voyageurs National Park headquarters in International Falls, Minnesota to organize the mapping project. Specific goals of the meeting were to review existing data, determine boundaries for the project, discuss logistics and protocols, and assign tasks. Among the topics and tasks discussed were use of existing data, development of the classification and sampling strategy, data analysis, photo interpretation and cartography, and accuracy assessment. Specific responsibilities and final products were assigned.

UMESC responsibilities and products:

- Facilitate project activities;
- Perform field reconnaissance to develop map unit and vegetation classifications, and to verify vegetation and land use/land cover appearances on the aerial photographs;
- Develop map units that link to the USNVC and other classification systems;
- Assist TNC with information regarding the distribution and occurrence of vegetation types within the park;
- Interpret and delineate vegetation and land use types using aerial photographs;
- Transfer and automate interpreted information to produce a digital spatial database (in various formats) and hard copy vegetation maps;
- Produce spatial coverages of observation point, vegetation field plot, and accuracy assessment site locations;
- Provide accuracy assessment analysis and report results;
- Provide a final report describing all aspects of the project;
- Provide a photo interpretation mapping convention report and visual key;
- Document FGDC compliant metadata for all vegetation data, and;
- Provide a CD-ROM containing reports, metadata, keys, classification lists, fieldwork data, spatial data, map composition, graphics, and ground photos.

TNC responsibilities and products:

- Develop a preliminary and final vegetation classification for the study area based on the USNVC;
- Provide guidance to the photo interpreters regarding the ecology and floristic compositions of the vegetation types;
- Design a sampling strategy to collect vegetation data;
- Sample representative stands for all vegetation communities;
- Provide vegetation descriptions and keys to vegetation communities;
- Field test final classification, descriptions, and keys during accuracy assessment;
- Collect accuracy assessment data;
- Provide a PLOTS database of vegetation field plot and accuracy assessment data, and;
- Provide documentation on field and analyses methodology and results.

Voyageurs National Park was one of the pilot/prototype parks, so extended vegetation work was conducted to apply, test, and refine the methods. Staff at the UMESC in La Crosse, Wisconsin performed photo interpretation of the aerial photographs and subsequent automation. (Staff at the USGS Mid-continent Ecological Science Center in Ft. Collins, Colorado provided automation on a small northern

section of the vegetation spatial database.) Staff at the Midwest Regional Office of TNC and its affiliate, the Minnesota County Biological Survey of the Minnesota Department of Natural Resources conducted vegetation classification, including collection of data in the field and subsequent analyses. CBI provided oversight to the project. This report presents the work conducted at Voyageurs National Park between 1996 and 1998.

2.2 Aerial Photograph Acquisition

Voyageurs National Park staff contracted KBM, INC (1604 S. Washington St., Grand Forks, ND 58201-6334) to collect aerial photographs of the park and environs (Figure 2). A portion of the northern one-third of project was collected on September 27, 1995. The remaining area was collected in 1996 (September 13, 14, and October 3). The photos were taken at a flight altitude of 7,920 feet above sea level with a Jena Link 15/2323 camera using Kodak Aerochrome Infrared 2443 film. The photo mission was designed to take photos with about 30% side lap (between each flight line) and 60% overlap (along each flight line). The scale of the color infrared (CIR) 9 x 9-inch transparencies is 1:15840 (approximately 4 inches to one mile). A total of 782 photos along 20 flight lines were collected. The photo mission covered the entire project area, which includes the entire park and environs (Figures 3 and 4). Only 509 of these photos were necessary to map the defined project area. An existing set of CIR photo prints, taken in the fall of 1988 at a scale of 1:12,000, were used as collateral information (see section 2.7 Photo Interpretation).

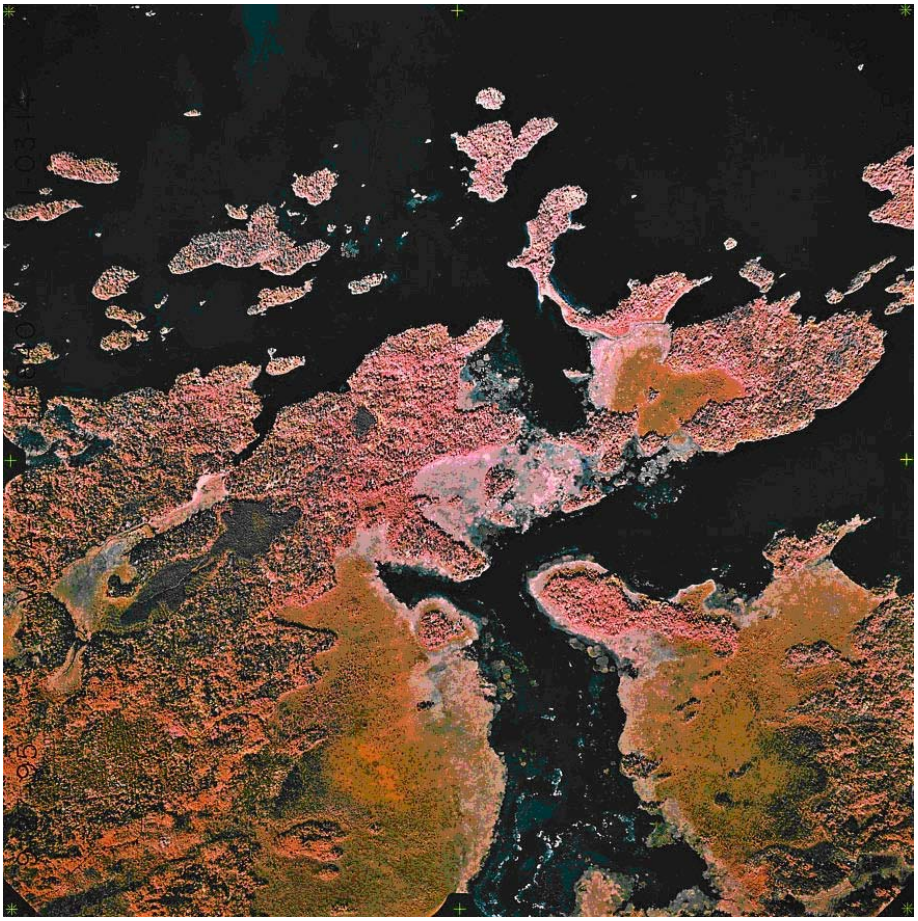

Figure 2. Example of an aerial photograph for the Voyageurs National Park Vegetation Mapping Project (example is not to scale)

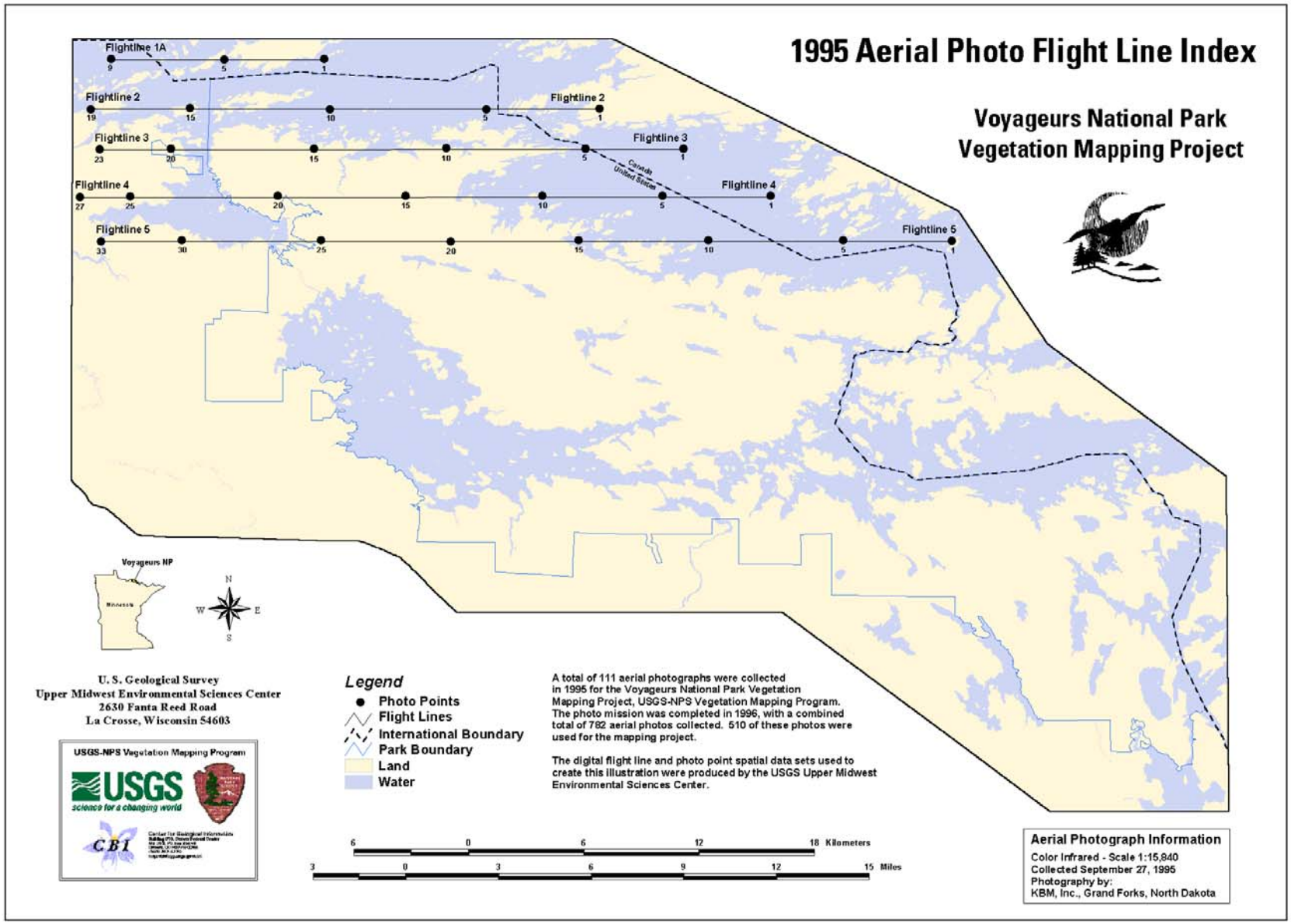

Figure 3. 1995 Aerial Photo Flight Line Index.

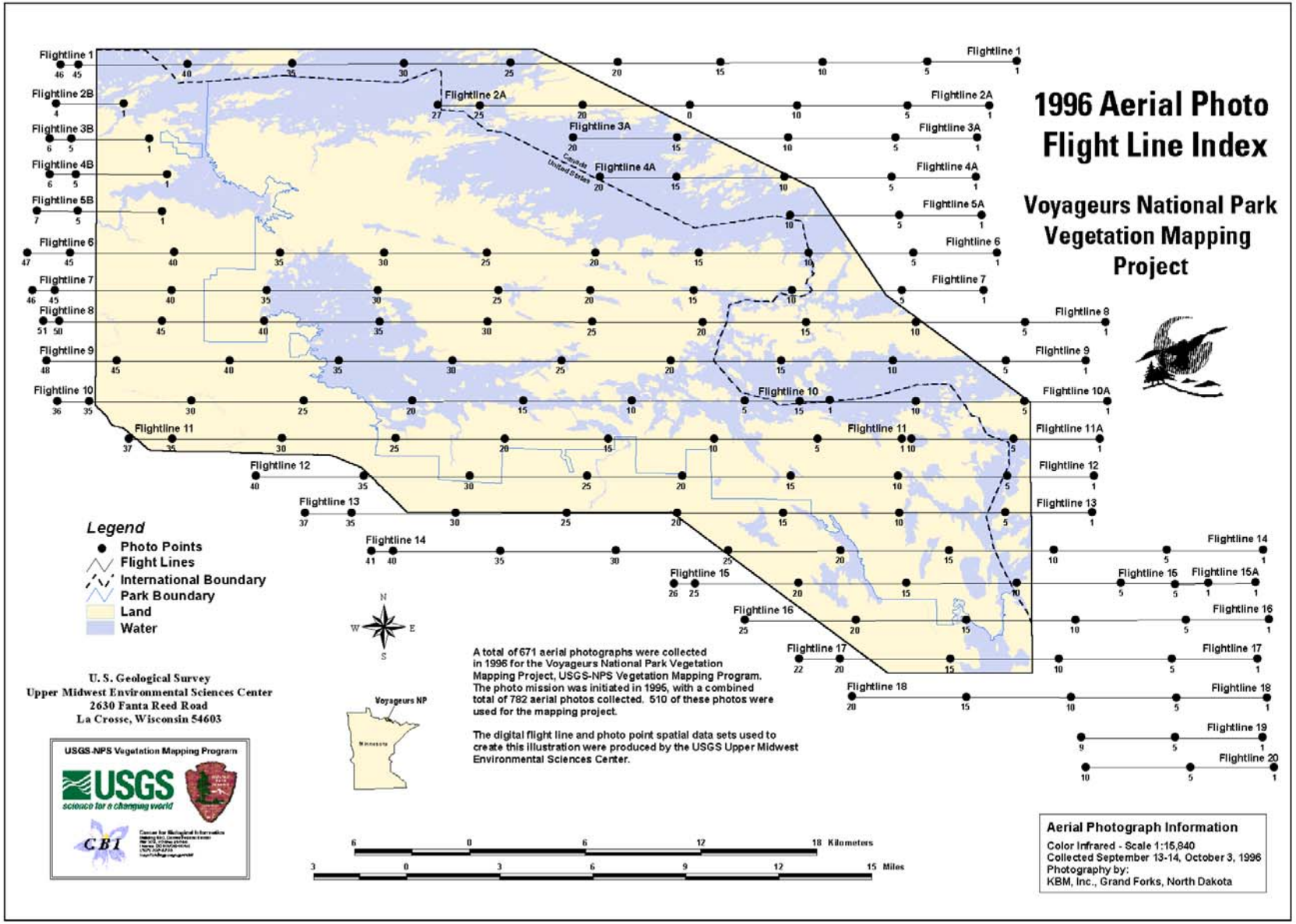

Figure 4. 1996 Aerial Photo Flight Line Index

2.3 Vegetation Classification and Preliminary Classification List

The USNVC, developed by TNC and the network of state Natural Heritage Programs, was used for classifying the vegetation for the Voyageurs National Park Vegetation Mapping Project. The classification is a hierarchical system with physiognomic features at the highest levels of the hierarchy and floristic features at the lower levels. The physiognomic units have a broad geographic perspective and the floristic units have local and site-specific perspective (Grossman et al. 1994, 1998).

The national classification includes most existing vegetation, whether natural or cultural, but TNC has focused attention on natural vegetation types. "Natural vegetation" as defined in Grossman et al. (1994) includes types that "occur spontaneously without regular management, maintenance, or planting and have a strong component of native species". "Cultural" vegetation includes planted/cultivated vegetation types such as orchards, pastures, and vineyards.

The physiognomic-floristic classification includes all upland terrestrial vegetation and all wetland vegetation with rooted vascular plants. The hierarchy has seven levels, with five physiognomic levels and two floristic levels (Table 1). The basic unit of the physiognomic portion of the classification is the "formation", a type defined by dominance of a given growth form in the uppermost stratum and characteristics of the environment (e.g., cold-deciduous alluvial forests). The physiognomic portion of the classification is based upon the UNESCO world physiognomic classification of vegetation, which was modified to provide greater consistency at all hierarchical levels and to include additional types (Drake and Faber-Langendoen 1997).

The floristic levels include alliances and associations. The alliance is a physiognomically uniform group of plant associations that share dominant or diagnostic species, usually found in the uppermost strata of the vegetation. For forested types, the alliance is roughly equivalent to the "cover type" of the Society of American Foresters. Alliances also include non-forested types.

The association is the lowest level in the national classification. The association is defined as "a plant community of definite floristic composition, uniform habitat conditions, and uniform physiognomy" (see Flahault and Schroter 1910 in Moravec 1993). Most schools of floristic classification have used this concept.

Table 1. The USNVC's Physiognomic-floristic Hierarchy for Terrestrial Vegetation (from Grossman et al. 1998).

Level	Primary Basis For Classification	Example
Class	Growth form and structure of vegetation	Woodland
Subclass	Growth form characteristics, e.g., leaf phenology	Deciduous Woodland
Group	Leaf types, corresponding to climate	Cold-deciduous Woodland
Subgroup	Relative human impact (natural/semi-natural or cultural)	Natural/Semi-natural
Formation	Additional physiognomic and environmental factors, including hydrology	Temporarily Flooded Cold-deciduous Woodland
Alliance	Dominant/diagnostic species of uppermost or dominant stratum	Populus deltoides Temporarily Flooded Woodland Alliance
Association	Additional dominant/diagnostic species from any strata	*Populus deltoides – (Salix amygdaloides) / Salix exigua* Woodland

A preliminary list of vegetation types (associations and alliances) from Faber-Langendoen et al. (1996, Midwest portion of USNVC) was generated for the park in May of 1996, based on a variety of sources. This list was part of early drafts of the USNVC (Grossman et al. 1998). These drafts were reviewed by many ecologists, including those of the Minnesota County Biological Survey and the Natural Heritage Program. In addition, recent publications on vegetation types in northwestern Ontario, such as those by

Sims et al. (1989) and Harris et al. (1996), were also consulted and used to refine the list. This early USNVC list served as a starting point for plot sampling and field reconnaissance. The USNVC database contains a crosswalk to the Minnesota state classification to ensure compatibility between the two systems.

2.4 Reconnaissance and Verification for Mapping and Classification

The preliminary classification was field tested during the summer and fall of 1996. A combined team of aerial photo interpreters and ecologists collected observation point data on the vegetation communities they encountered while in the field (Figure 5**,** Appendix A). The data helped clarify the nature of the classification units and their diagnostic aerial photo signatures.

Additional aerial photo "ground truth" fieldwork was performed throughout the 1996 field season by the photo interpretation team to learn, test, and verify photo signatures. Efforts were concentrated in the northern one-third of the project area for which a set of photographs had already been acquired. Ecologists intermittently assisted to assure correct field calls and to verify additional vegetation types as they were encountered.

By the end of the 1996 field season, mapping protocols were sufficiently stabilized to permit the aerial photo interpretation team to begin delineating polygons for the northern one-third of the project area. During the 1997 field season, "ground truth" field activities continued, focusing on the southern two-thirds of the project area with an emphasis on photo signatures not commonly observed the previous year. Throughout this field process, map unit classes were developed, and a fuller understanding of their linkage to vegetation types was strengthened.

Figure 5. Reconnaisance through a Black Spruce / Leatherleaf Semi-treed Bog

2.5 Creation of Map Units

The relationship between vegetation mapping and classification of vegetation types is extremely complex. Timing of the photo mission, type of film (e.g. true color or color infrared), scale, and resolution all contribute to how accurately vegetation can be mapped. Having two sets of aerial photographs (fall 1995/1996 set and fall 1988 set) was helpful in developing vegetation map units as each set supplied different information regarding the appearance of USNVC vegetation types (alliances and associations). However, even with two sets of photographs, not every vegetation type verified in the field could be clearly discerned on the aerial photographs.

Developing map units compatible with the vegetation types found within the project area was developed jointly between the photo interpretation and ecologist teams during the reconnaissance and subsequent "ground-truth" field trips, with further refinement following fieldwork. Field days were spent discussing structural, floristic, and habitat characteristics of the vegetation types encountered and comparing the types to their appearances on the photos. Through this process, decisions were made as to how to map the vegetation types. When vegetation communities were difficult to discern on the photographs, it became necessary to aggregate vegetation communities into single map units. For example, map unit Aspen-Birch Forest (AB) is compatible to the USNVC Aspen - Birch Forest Alliance as it contains two associations within that alliance: Aspen - Birch Boreal Conifer Forest and Aspen - Birch - Red Maple Forest. These 2 associations appear similar on the aerial photographs, with no discriminating features to allow for mapping separately. Further, the Aspen - Birch - Red Maple Forest is not common in the project area. Other map unit aggregates are explained in section 3.4 Map Units.

Subsequent to fieldwork, a list of map units representing vegetation types was developed with careful attention to each map unit's relationship to the classification. Once the photo interpretation began, new questions surfaced regarding the map units, so discussions were continued between the two teams to insure a clear understanding of the relationships between map units and the vegetation types. Once the relationships stabilized, a classification matrix was developed that illustrates the relationship between the map units and the vegetation associations (Appendix B).

Additional map units were derived to 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 et al. (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 .5 h, and small natural ponds (open water <10% vegetated).

Map units were reviewed by resource management staff at Voyageurs National Park and offered additional mapping criteria based on resource management needs.

In addition to map units, a set of modifiers was derived to provide additional information (when applicable) about the physiognomic structure of the vegetation type being mapped.

2.6 Vegetation Sampling and Analysis for Classification Development

In general, the vegetation field sampling methods used for developing the classification followed the methodology outlined by the USGS-BRD/NPS Vegetation Mapping Program (Grossman et al. 1994). Voyageurs National Park is a large-sized park (100 - 2,500 km^2) based on land area (543 km^2). In addition, the mapping project included the environs around the park, making the total area mapped about 1,569 km^2. However, the landscape is not too complex, and most of the park and environs fall in one ecological subsection (Border Lakes: 212La), as reported by the ECOMAP ecological land classification

(Keys et al. 1995). Thus, although a gradsect sampling approach is recommended based on size, it was used in a modified form. The park was stratified into three areas: the western peatland area (Rat Root River peatland), which falls mostly outside the park boundaries, 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 the first year of reconnaissance and sampling (1996), 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 3 plots per type. Less well-understood types were sampled more extensively (Figure 6). These plots were spread across the park as much as possible. Some types were restricted to the Rat Root River peatland complex. All plots for those types were located there. For the rest, 1-2 plots were taken in both the northern and southern units. Special emphasis was given to the greenstone outcrop areas. 191 plots were collected as part of this project (Figure 7). Additional plots were available from a study by Kurmis et al. (1986) and Minnesota Natural Heritage Program surveys in the area.

Plot sizes ranged from 20 x 20 m for forests and woodlands to 10 x 10 m for shrublands, herbaceous, and nonvascular vegetation. Plots were placed subjectively in the most representative part of each stand of vegetation. 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 Minnesota Natural Heritage Program survey methods (e.g. total cover of evergreen trees or shrubs was recorded separately from cover of deciduous trees or shrubs (Norm Aaseng, personal communication, 1996). All the species of each stratum were listed (including mosses and lichens) and percent cover estimated using the Braun-Blanquet cover scale. Additional species within the vegetation unit or polygon that occurred 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. 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). Other locational information was also recorded. A provisional name for the vegetation type was assigned to the plot.

Figure 6. Conducting a vegetation plot within a rocky woodland.

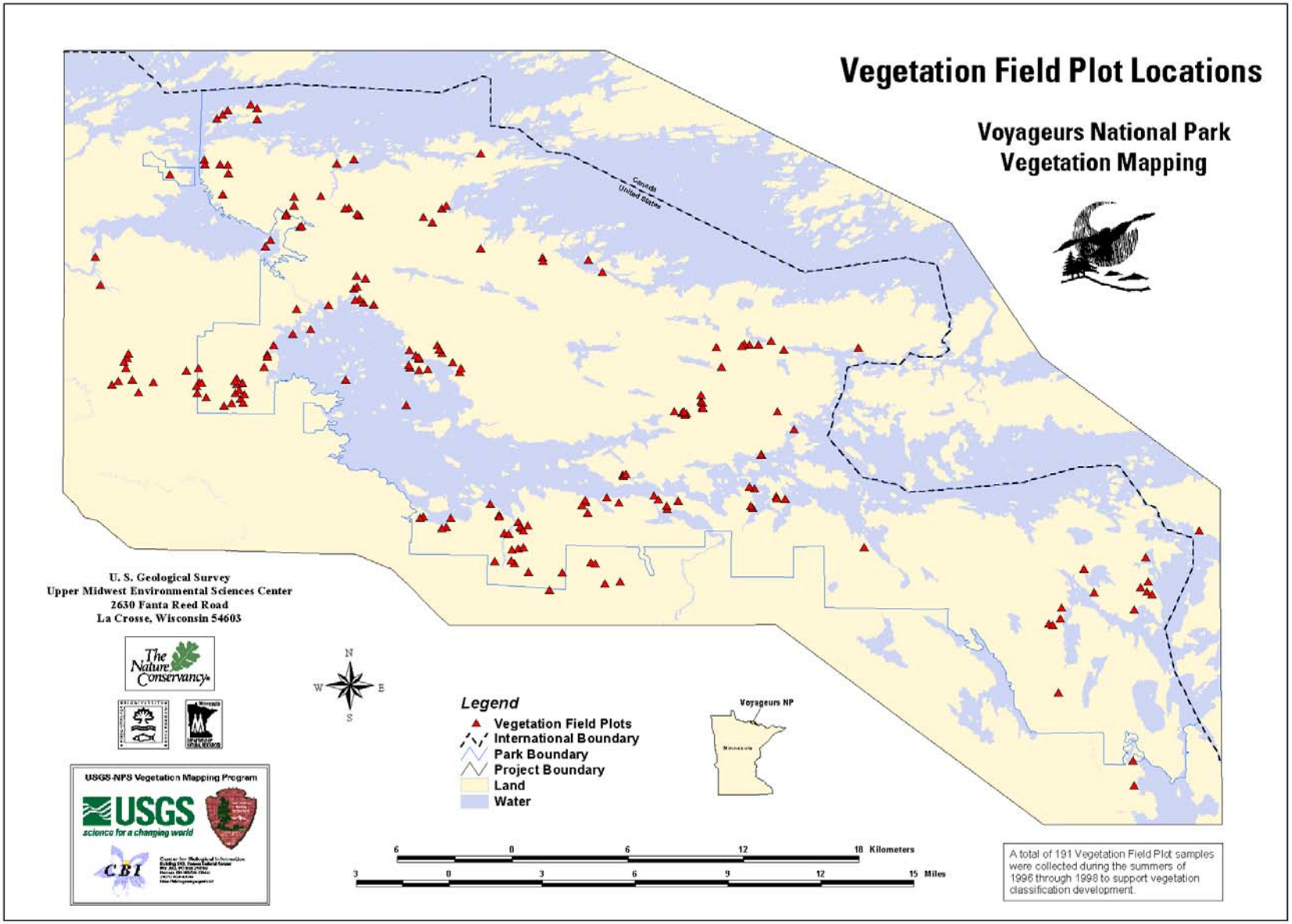

Figure 7. Location of vegetation plots collected for the Voyageurs National Park Vegetation Mapping Project

Vegetation plot data were entered into the Minnesota Natural Heritage Program's plot database. Species were assigned standardized codes and names based on the PLANTS database (USDA, NRCS 1999). These data were transferred to the PLOTS database developed by the Nature Conservancy (TNC 1997) for final inclusion in this report. For the vegetation analysis, the data were analyzed using the PC-ORD Multivariate Analysis package (McCune and Mefford 1997). The data were analyzed in a series of runs, partitioning the data into smaller sets based on clusters found in the larger data sets, until sufficient resolution was achieved. Multivariate analysis was done using both Non-metric Multidimensional Scaling or NMS (Clarke 1993) and Cluster Analysis. A Bray-Curtis ordination was used as a starting point for the NMS and Ward's Method was used in the Cluster Analysis. These were then reviewed and assessed for perceived environmental gradients (e.g. moisture gradients, peat depth, soil depth, etc.). Indicator Species Analysis (Dufrene and Legendre 1997) was used to identify indicator species and to assess the reassignment of plots into different cluster analysis groups.

These groups were compared with the USNVC (Faber-Langendoen et al. 1996, Grossman et al. 1998), as well as to northwestern Ontario types (Sims et al. 1989 and 1997, Harris et al. 1996). Care was taken not to over-emphasize local variations found at Voyageurs compared to more extensive information compiled at the state or regional level. Nevertheless, several types in the USNVC were revised based on these analyses. Plot summaries were produced for each type.

2.7 Photo Interpretation

Preparation of the aerial photographs for interpretation follows procedures of Owens and Hop (1995). The 1995 and 1996 CIR film transparencies were cut from rolls and covered with clear acetate overlays. The overlays were registered to the transparency photos and subsequently labeled with flight line and photo numbers.

Field reconnaissance was performed to learn, test, and verify photo signatures of vegetation types and other non-vegetated features (land use/land cover) and to establish a map classification. Once mapping protocols were established, photo interpretation and mapping proceeded.

Photo interpretation was performed using the 1995 and 1996 photo transparencies. Ground features were interpreted, and subsequently were delineated and labeled with map unit codes onto the photo overlays using a Bausch and Lomb Zoom 240 stereoscope over a light table. Each transparency photo was viewed with its matching stereo pair (adjacent photo) so images could be seen in 3-dimensions. To minimize edge distortion, interpretation was focused towards the center of each aerial photograph. Texture, height, color, pattern, life form, and position in the landscape were all used in the decision making process of delineating polygons and assigning map unit codes. In addition to photo signature characteristics, the photo interpreter's knowledge of the environmental distribution of the types was used to help confirm the identity of the signatures. A standard minimum mapping unit of 0.5 h was applied. Small upland islands were mapped to 0.1 h. 509 aerial photographs of the 1995/1996 set were interpreted for the project.

With mapping vegetation types, a polygon is delineated to define a particular vegetation type. The polygon is attributed with a map unit code that represents the vegetation type. Conventionally, a polygon is not sub-divided because of physiognomic structural changes with the vegetation (e.g. density, height). However, extensive structural changes (e.g. large blowdown areas) within a map unit polygon were delineated separately. To attribute the physiognomic structure of the vegetation, a systematic string of modifier codes (see Appendix F for conventions) were added to map unit code (Table 2, e.g. DMX-2B, BA-1A4, WRPA-1A2M). Physiognomic modifiers are added (when applicable) to all vegetation map units.

During the onset of mapping, other maps were used to gain familiarity with vegetation characteristics. A map of Kabetogama Lake [*1988 Vegetation of the Kabetogama Peninsula, Minnesota. Unpublished map (1:24,000), Natural Resources Research Institute, Duluth, Minnesota. Funded by National Science Foundation Grant DEB-9119614]* and National Wetlands Inventory 7.5-minute quadrangle maps (U.S. Fish and Wildlife Service, St. Petersburg, Florida) were especially useful during the initial stages of photo interpretation.

Throughout the entire interpretation process, October 1988 CIR photographs were also viewed to better determine vegetation types. The 1988 photos, because they effectively captured fall colors in leaf canopies, were very helpful in revealing various distinctions not apparent on the 1995 and 1996 photographs. The primary characteristic that differed was that of color. Where changes in the vegetation occurred between the two sets of photographs, only characteristics on the recent set were used to determine the types.

For more details on photo interpretation and how each map unit was interpreted, see Appendix F.

Table 2. Physiognomic modifiers assigned to polygons during photo interpretation.

COVERAGE DENSITY	1 2 3	Closed Canopy/Continuous (60-100% cover) Open Canopy/Discontinuous (25-60% cover) Dispersed-Sparse Canopy (10-25% cover)
COVERAGE PATTERN	A B C D	Evenly Dispersed Clumped/Bunched Gradational/Transitional Regularly Alternating
HEIGHT	1 2 3 4 5 6	30-50 meters (98-162 feet) 20-30 meters (65-98 feet) 12-20 meters (40-65 feet) 5-12 meters (16-40 feet) 0.5-5 meters (1.5-16 feet) <0.5 meters (<1.5 feet)
DOMINANCE/CO-DOMINANCE	D E M	Deciduous 60-75% dominance of existing tree coverage; evergreen 25-40% Evergreen 60-75% dominance of existing tree coverage, deciduous 25-40% Deciduous/Evergreen 40-60- % co-dominance of existing tree coverage

2.8 Transfer and Automation of Photo Interpreted Data

To geo-reference the photo interpreted data, zoom transfer scopes were used to manually transfer the interpreted polygons onto drafting film over base maps. The transfer process removes much of the aerial photograph's inherent distortion and ties the interpreted data to real-world coordinates so it can be digitally automated. Fifty-one USGS 3.75-minute digital orthophoto quadrangles (DOQ) were used to plot hard copy (film acetate) orthophoto base maps at a scale of 1:12,000 (Figure 8). For portions of Canada not covered by DOQ maps, Ontario Basic Mapping Series (OBM, Ontario Ministry of Natural Resources) topographic paper maps at a scale of 1:20,000 were used (Figure 9). About 92% of the project area was produced with the DOQ-based maps, covering the Voyageurs National Park, all the environs within the USA, and portions of the environs within Canada.

The interpreted polygons were manually transferred to overlays that were registered to the base maps. Map unit attributes and appropriate physiognomic modifier codes were added to a second overlay. The overlays were subsequently rechecked for accuracy. Each overlay of transferred data was scanned using a large format sheet fed scanner at a resolution of 400 dots per inch. The resulting Tagged Image File Format (TIFF) images were then converted to a grid using ArcInfo (Version 7.2.1 Patch 2, Environmental Systems Research Institute, Redlands, California). For data produced with the DOQ base maps, the converted grid was projected to UTM Zone 15 using North American Datum of 1983 (NAD83). For data

produced with OBM base maps, the converted grid was projected to UTM Zone 15 using North American Datum of 1927 (NAD27) and later converted to NAD83 once all OBM-based digital coverages were produced and joined. Each individual grid was transformed to a geo-referenced boundary coverage to digitally reference the data to real-world coordinates. In ArcTools, the ArcScan utility was used to trace the referenced polygon data creating ArcInfo coverage. Each intermediate coverage was edited for errors, assigned attributes to polygons, checked against the hand-transferred overlays for line and attribute errors, and finally joined to produce a seamless spatial database coverage of the vegetation map.

The Look Up Table (LUT) was produced in spreadsheet format (dBASE IV), and then converted to an ArcInfo table using ArcInfo (Version 8.0.2). The table was merge with the spatial database coverage using a common attribute item (CODE_MOD). The LUT contains numerous items that, when linked to the coverage, offers a set of information for each polygon. The LUT includes items as follows:

(*NOTE - citations to classification systems are not necessarily complete*)

CODE_MOD	Map Unit Code with all applicable physiognomic feature modifiers
MAP_CODE	Map Unit Code - UMESC derived, project specific
MAP_DESC	Map Unit Description Name - UMESC derived, project specific
DENS_MOD	Coverage Density Modifier - numeric code-description - applies to all vegetation map units
PTRN_MOD	Coverage Pattern Modifier - alpha code-description - applies to all vegetation map units
HT_MOD	Height Modifier - numeric code-description - applies to woody terrestrial vegetation map units
DOM_MOD	Dominance/Co-dominance Modifier - alpha code-description - applies to mixed conifer/deciduous woody terrestrial vegetation map units
ASSN_NAME	Project Global Community Name - USNVC Association
ASSN_CNAME	Project Global Common Community Name - synonym name of Association
ASSN_CEGL	Community Element Global Code - Elcode link to USNVC Association
ALL_NAME	USNVC Alliance Name
ALL_CNAME	Common Alliance Name - translated common name of USNVC Alliance
ALL_KEY	Alliance Key -Code representing USNVC Alliance
NVCS_CODE	USNVC Code - to USNVC Formation level
CLASS	USNVC Formation Class - Class name (code)
SUBCLASS	USNVC Formation Subclass - Subclass name (code)
GROUP	USNVC Formation Group - Group name (code)
SUBGROUP	USNVC Formation Subgroup - Subgroup name (code)
FORMATION	USNVC Formation - Formation name (code)
ECO_GROUP	Ecological Group - groups of vegetation types sharing ecological processes (TNC Midwest Conservation Science Department, Faber-Langendoen 2000)
ECO_SUBGRP	Ecological Subgroup - subgroups of vegetation types sharing eco processes (TNC Midwest Conservation Science Department, Faber-Langendoen 2000)
MNCC	Minnesota Natural Community Classification (MN Department of Natural Resources Natural Heritage Program 1993)
NWON_FEC	NW Ontario Forest Ecosystem Classification (Ontario Ministry of Natural Resources, Sims et al. 1997)
NWON_WET	NW Ontario Wetland Ecosystem Classification (Ontario Ministry of Natural Resources, Harris et al. 1996)
LUC_II	Land Use and Land Cover Classification System (USGS, Anderson et al. 1976)
COMMENT1	General description about the map unit
COMMENT2	General comment of how the map unit relates to other map units.

In addition to LUT Items listed above, ArcInfo default items are also included (e.g. perimeter, area, and polygon identification numbers).

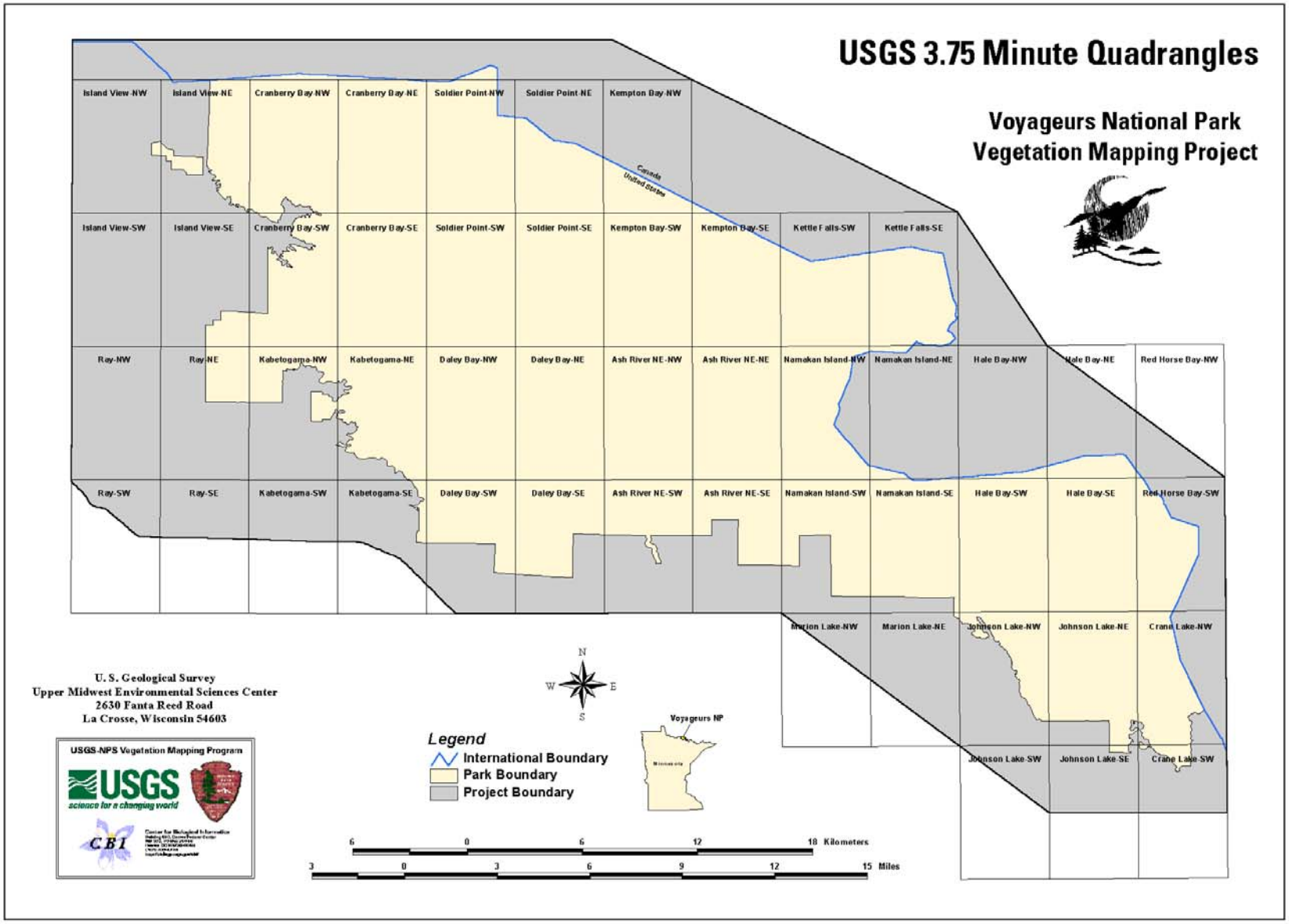

Figure 8. USGS 3.75-minute quadrangles of Voyageurs National Park and environs

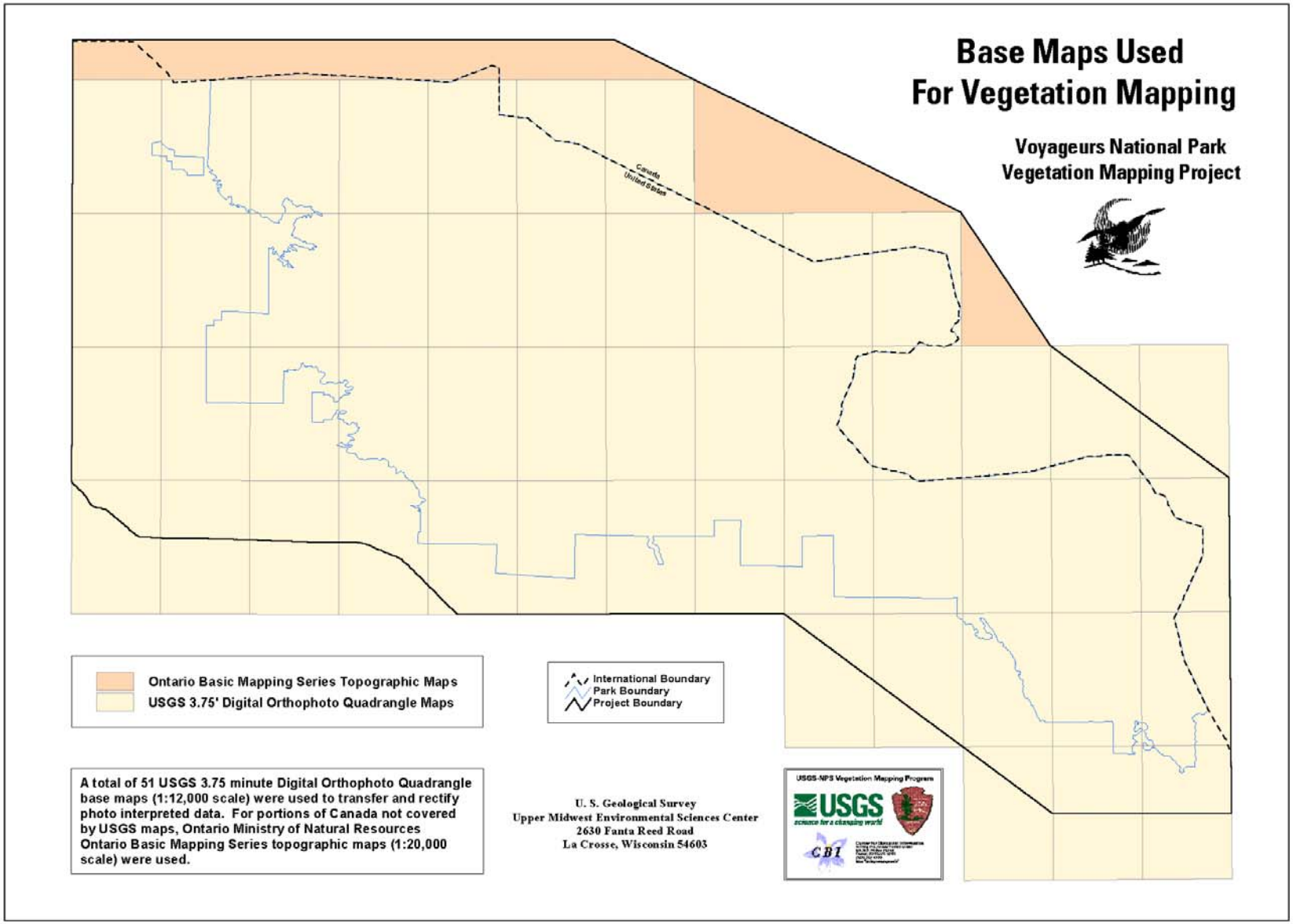

Figure 9. Distirbution of base maps used for mapping Voyageurs National Park and environs

2.9 Accuracy assessment

Once the aerial photo interpretation team had delineated polygons, an assessment of the thematic accuracy was conducted. Accuracy requirements for the USGS-NPS Vegetation Mapping Program specify 80% accuracy for each map unit. The number of sites visited per map unit depended on how common the map unit was, from 30 polygons for widespread map units to 5 for rare map units. Points were stratified as much as possible by the 3 major areas. Accuracy assessment data were collected in the field during the 1997 and 1998 field seasons.

During 1997 and early 1998 field seasons, the focus was in the northern one-third of the project area. A digital form of the polygon database was not yet available, so the accuracy assessment teams relied on copies of interpreted overlays and the aerial photos to select sites. Data for 552 accuracy assessment sites were collected using this procedure (Figure 10). The accuracy assessment team chose polygons and then hiked to the polygons to determine the community type present. The points were also distributed as evenly as possible across the northern one-third of the project area; e.g. not all of the Aspen-Birch points were taken from the same locale. Teams recorded locational information and briefly described the vegetation, noting canopy structure, dominant species by strata, and environmental features, including topographic position, slope, and aspect. The nearest vegetation communities, if known, within 50 m of the point were also recorded. Rationale for the classification type chosen was explained (Appendix C).

By the second year, much of the polygon data had been digitized, enabling the accuracy assessment team to have a computer-generated selection of sampling points. The majority of the accuracy assessment sites were selected in the bottom two-thirds of the project area. Three times the number of sites needed were generated so that points that were inaccessible or falling near polygon lines could be deleted from the selection. It was recognized that points falling on or near polygon lines could create positional errors in the field because of inherent error in the coordinate readings; PLGR units often have 10 m or more error associated with the readings. Thus, UTM coordinates selected within 10 m of a polygon boundary could actually fall within a neighboring polygon. To help avoid this potential problem, points near polygon lines were eliminated from the sampling scheme. However, some points within 10 m of polygon lines were kept so that narrow polygons would be sampled.

Hard copy 1:12,000-scale orthophoto quadrangle maps, produced from USGS 3.75-minute DOQ's, were plotted with the polygons and final accuracy assessment points overlaying the maps. Each point had a corresponding UTM coordinate that was uploaded into a PLGR GPS unit. The PLGR was used to navigate to each point. The orthophoto maps were used with the GPS unit to help navigate across the terrain. Once the sampling site was reached, the accuracy assessment team assessed the plant community within a 0.5 h radius (the minimum mapping unit) and assigned a provisional community name. Dominant species, environmental data, and rationale for classification were recorded for each site (Appendix C). Data for 736 sites were collected using this method (Figure 9).

The accuracy assessment data (1,288 points) were entered into the PLOTS database and subsequently reviewed for data entry and false errors. Incomplete data on the field sheets, including missing GPS coordinates, resulted in dropping 37 sites from further analysis. Five of these 37 sites were time factor errors. Time factor errors were due to changes in the vegetation community between the time the polygon was mapped and the accuracy assessment was conducted (i.e. exposed mud flats due to lake drawdown, or a recent beaver flooding)

The remaining 1251 points were plotted by their UTM coordinates over the spatial coverage so that all points could be viewed in relation to the vegetation map coverage. USNVC Community Element Global database codes (CEGL) for each accuracy assessment point were compared to corresponding

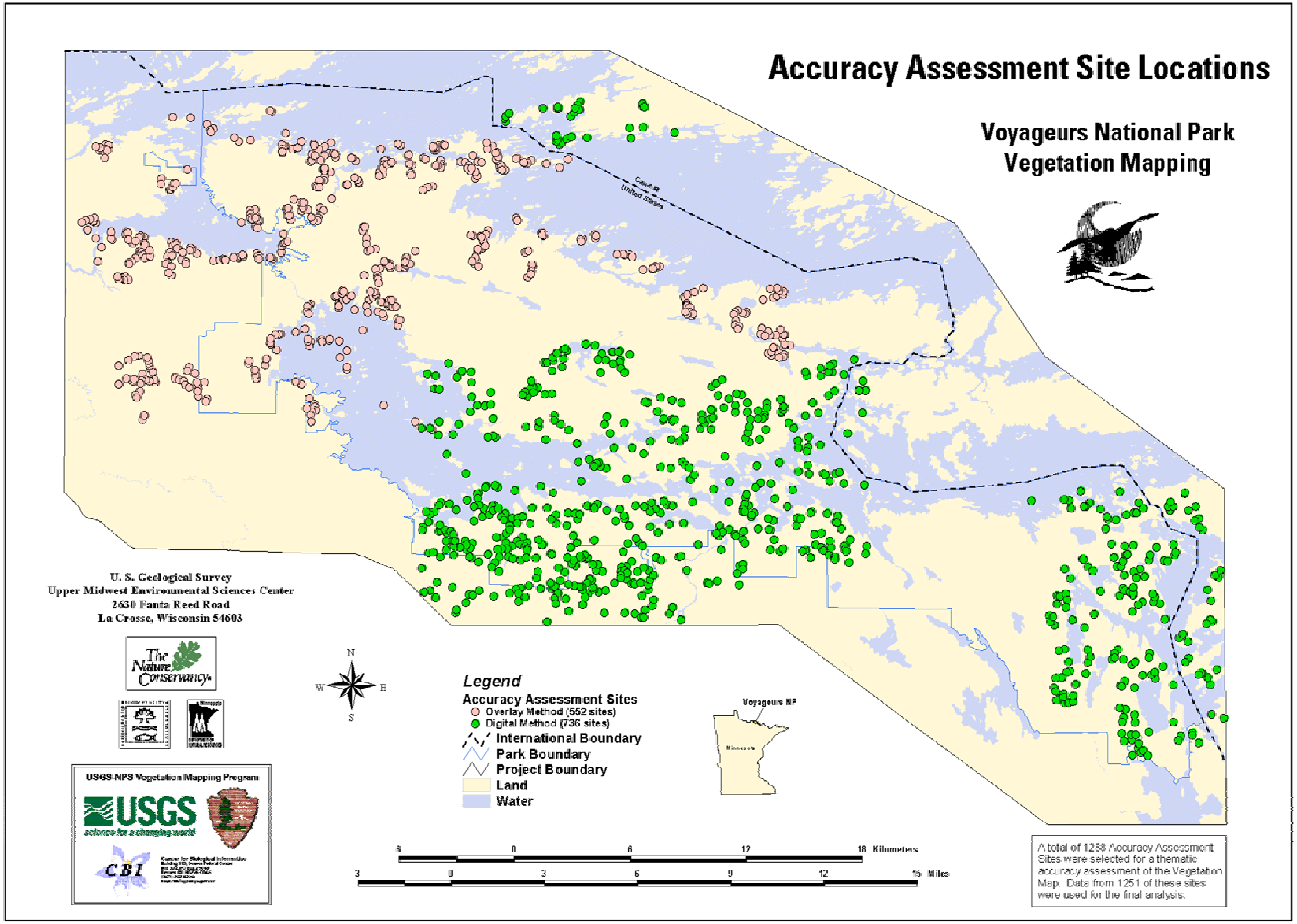

Figure 10. Locations of accuracy assessment points sampled for the Voyageurs National Park Vegetation Mapping Project

polygon map unit codes. An output file was created that listed all the accuracy assessment points and their corresponding map codes from the coverage and subsequently run through a SAS routine (SAS Institute 1996) that reported all the matches and mismatches. All mismatches were reviewed to see if there were any "false errors." Mismatches that were deemed "false errors" were corrected, resulting in either a match or a true error.

A false error is defined as a mismatch between a polygon and an accuracy assessment call if the disagreement was caused by one of the following problems:

- A GPS error;
- An accuracy assessment point occurring in a zone of transition between two types (an ecotone);
- An accuracy assessment point that was classified differently than the polygon but was clearly too small to map (an inclusion)

GPS errors occurred when the recorded coordinates were inaccurate and placed points in the wrong polygons. For example, accuracy assessment point VOYA.275, when plotted on the spatial coverage, fell within a Black Ash Forest polygon. However, the data sheet claimed the point fell within a Black Spruce / Alder Rich Swamp. Also, the point fell 2 m from a Black Spruce / Alder Rich Swamp polygon, well within the reported GPS error for this site of plus or minus 7.9 m. Thus, it was revealed that the cause of the error was inaccuracy inherent in the GPS reading (Figure 11). GPS errors were corrected after comparisons between the data sheet, the point's location, and the spatial coverage. Some GPS errors, once corrected, still resulted in a true error.

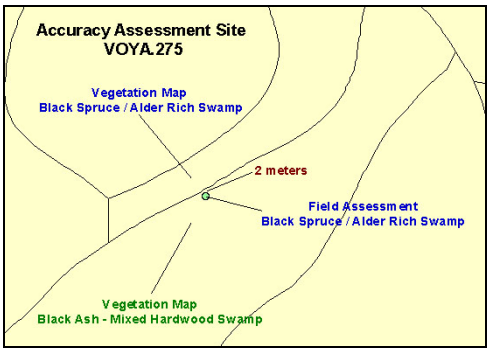

Figure 11. Example of a GPS location error

Ecotone errors occurred when sites fell in transition zones (typically near a polygon boundary) between 2 associations and the accuracy assessment crew acknowledged the presence or mixture of more than one association. When the field crew was uncertain of the correct vegetation type and one of their calls matched the polygon, the mismatch was corrected so that the polygon and accuracy assessment call matched one another.

Inclusion errors were sites where the vegetation associations recorded on the data sheets were different than the associations represented by the mapped polygons AND the accuracy assessment call was determined to represent a small area (< the minimum mapping unit) within the polygon. If it was easily determined as an area too small to map, accuracy assessment site was considered an inclusion and it was assumed that the polygon call was correct.

Map units that represented a single association were assessed together. Map units JPOM, MPHW, and OW were all considered a single association according to the classification: Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland Association. The 3 map units represent different phases of this association.

Three other map unit phase situations were also combined together for the assessment: JPW and JPM map units, representing evergreen and mixed phases of the Boreal Pine Rocky Woodland Association, BSL and BST map units, representing evergreen and mixed phases of Black Spruce / Labrador Tea Poor Swamp Association, and WCS and WCT map units, representing the White Cedar - (Mixed Conifer) / Alder Swamp Association.

PROC FREQ (SAS Institute 1996) was used to compare the final accuracy assessment database with the corresponding polygons. The SAS output was transferred into a contingency table, or error matrix (Appendix D). The error matrix is an array of numbers set in rows and columns which express the number of sample units (polygons) assigned to a particular category relative to the actual category as verified on the ground. The columns represent the accuracy assessment data while the rows represent the mapped polygons. Map accuracy of each category is expressed as a percentage of correctly classified polygons compared to the accuracy assessment results.

3. RESULTS AND DISCUSSION

3.1 Vegetation Classification

Voyageurs National Park contains a high diversity of vegetation communities (associations) typical of the southern boreal or Laurentain mixed conifer-hardwood region, including both upland and wetland types. The analysis of the plot data in large part corroborated the preliminary classification produced from other sources, based on sampling work at Voyageurs (Kurmis et al. 1986), from adjacent Ontario (Sims et al. 1989, Harris et al. 1996), and the Midwest classification (Faber-Langendoen et al. 1996). It also suggested some important refinements, particularly in the open bedrock and the conifer swamp types. All changes to types were integrated into the USNVC (Faber-Langendoen 2000)

A total of 50 community types are reported for Voyageurs National Park (Table 3). 191 plots were used to characterize these types. The plot data were first partitioned using ordination methods, TWINSPAN, and cluster analysis into 2 main sets, those that were primarily herbaceous wetlands (including submerged aquatics, wet meadows, and fens), and all other types (Figure 12). Within the first set, the herbaceous wetland types separated into two subsets, the deep marsh and submerged aquatic types, and the wet meadow-fen types. Within the deep marsh and submerged aquatic subsets, subsequent ordinations and cluster analysis (not shown) separated the open water types (including pondweed, open water bulrush, and wild rice marsh types), from the inland lakes water lily type and the shoreline cattail marsh type. Within the wet meadow and fen subset, the analyses separated the reed marsh from the bluejoint, sedge meadow, and dogwood-willow shrub types, and separated the sedge wet meadow from the graminoid shore fen, supporting the association distinctions made by the existing classification.

Analysis of the second category using ordinations, TWINSPAN, and cluster analysis led to 4 major subsets, from wet, low nutrient systems (bogs and fens) to primarily peatland swamps, to wet-mesic/mesic forests and dry (fire-dependent) forests (Figure 13). Each of these subsets was analyzed in turn. The first subset, the bogs and fens, ranged from more nutrient-rich shore fens (tall shrub (bog birch) shore fens, and dwarf-shrub (leatherleaf) shore fens) to nutrient-poor black spruce bogs and swamps. The black spruce bogs (and swamps) cluster together in the ordination, with only the black spruce/labrador tea type clearly distinguishable. However, a subsequent analysis (not shown) separated the raised black spruce bog in the large peatland complex (both forest and woodland physiognomy) from black spruce/labrador tea in confined basins. Intermediate between the shore fens and the black spruce bogs are the dwarf-shrub/graminoid poor fens, the tamarack scrub fens, and the leatherleaf bogs (with and without a sparse conifer layer).

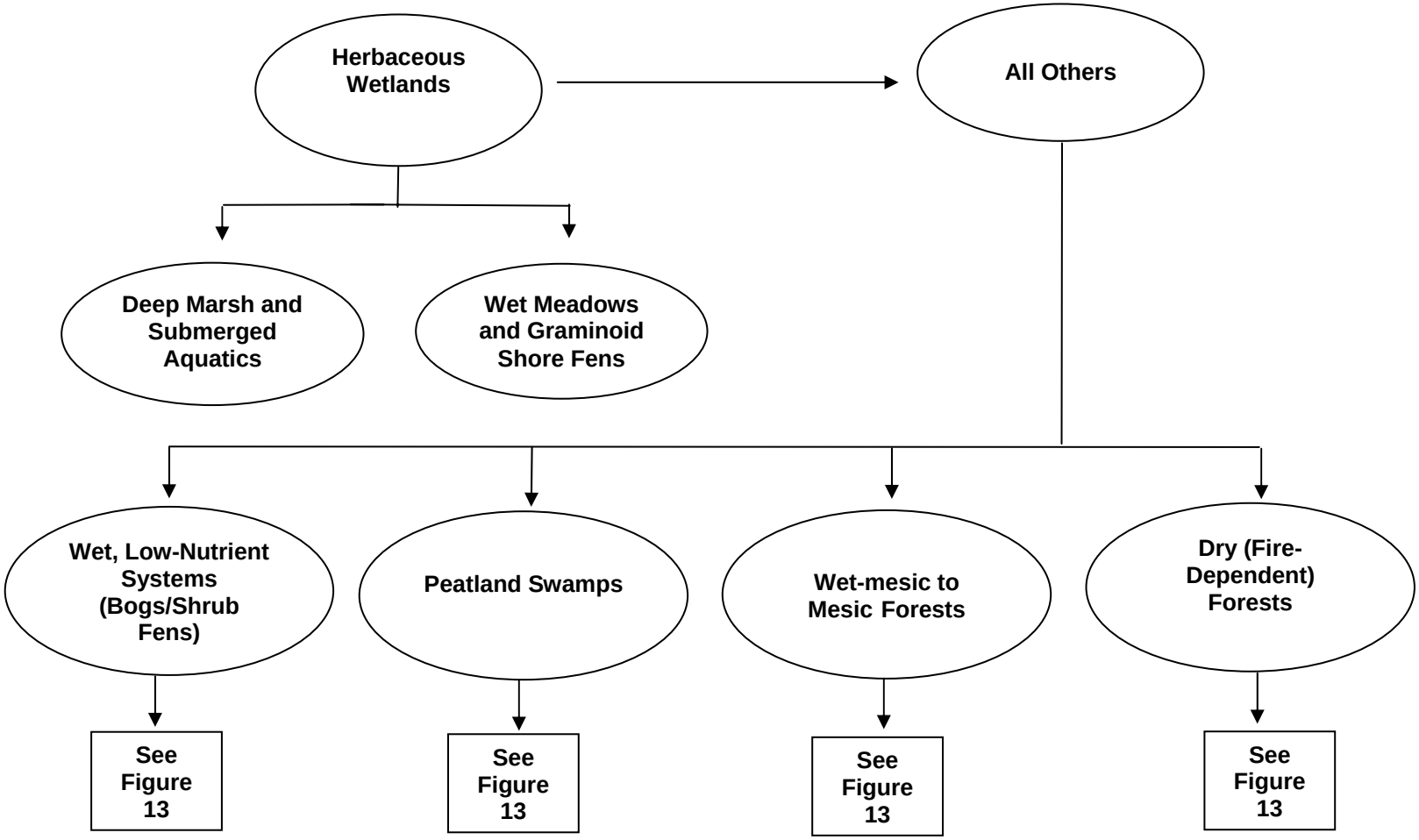

Figure 12. Flow chart of ordination subsets used to analyze the vegetation plot data
Each circled group indicates a subset of plots that were analyzed further to refine the types and assign them to specific associations.
See Figure 11 for rest of diagram.

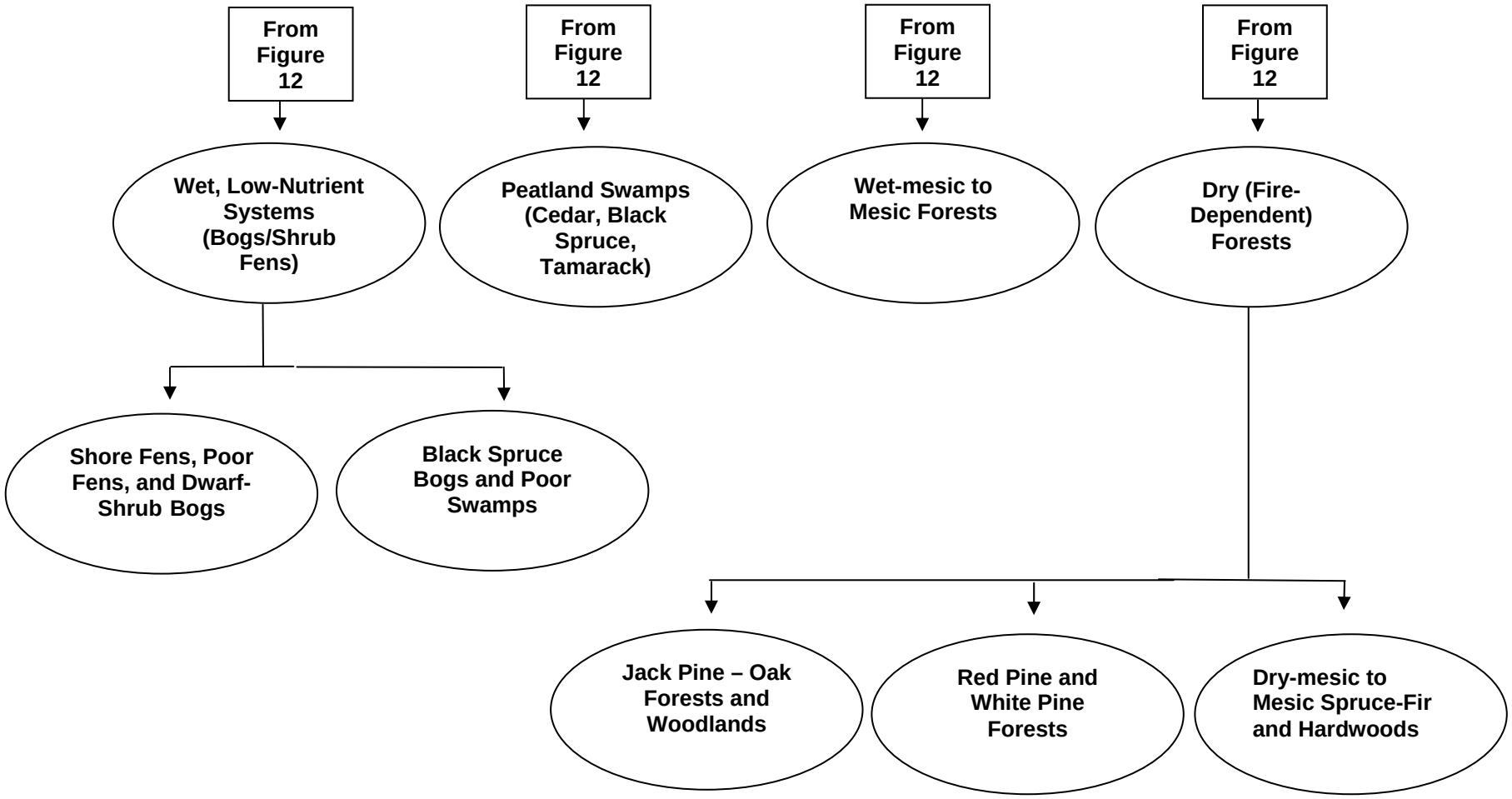

Figure 13. Flow chart of ordination subsets used to analyze the vegetation plot data
Each circled group indicates a subset of plots that were analyzed further to refine the types and assign them to specific associations.

The second subset, the conifer and alder swamps (which are primarily peatland swamps) include nutrient-rich white cedar swamps, white cedar-tamarack swamps, and alder swamps, and more moderately minerotrophic black spruce/alder and tamarack-(black spruce)/alder swamps. A scrub cedar-spruce-tamarack type is placed with the white cedar-tamarack swamp type, though it appears to be as related to the tamarack/alder type.

The third subset includes primarily the wet-mesic hardwood or mixed hardwood-conifer swamps and forests, though it also shows the split between that subset and the more fire-dependent upland spruce-fir and aspen types. Types include the black ash swamp, with some white cedar-black ash and wet-mesic white cedar upland forest, the aspen lowland forest, and the more mesic white cedar upland and white cedar-aspen-birch forests. The white cedar upland types grade from mesic upland to wet-mesic upland or lowland, where they overlap with white cedar-black ash swamps.

Finally, the fourth subset included all of the dry to dry-mesic pine and hardwood types. The analysis separated the drier jack pine and oak types from the red pine, white pine, and black spruce feathermoss types, and these in turn from the spruce-fir -aspen–birch types . These three sub-subsets were individually analyzed using ordination, TWINSPAN, and cluster analysis to further clarify their patterns. The jack pine and oak types were further refined into an open jack pine/lichen nonvascular type, a jack pine/fir type, and a heterogeneous set of jack pine or mixed pine-hardwood and pin oak-bur oak woodlands on bedrock (with a Dryweed Island subtype). The pin oak-bur oak woodland type overlapped considerably with a proposed jack pine-oak type. These were lumped together into a pin oak-bur oak-(jack pine) rocky woodland type that ranged from an overstory of pure oak to oak with jack pine. The Dryweed Island stands, which are on greenstone rather than biotite schist bedrock, are considered part of this type contingent on a wider review of the influence of the bedrock. In addition, the mixed pine-hardwood woodland also overlapped with the pin oak-bur oak- (jack pine) rocky woodland type, so the type was broadened to include mixtures of oak with red pine, white pine, and white spruce. The jack pine woodland, transitional between jack pine/fir forest and pin oak-bur oak-(jack pine) rocky woodland, was restricted in scope to be an evergreen jack pine rocky woodland type that ranged from pure jack pine to mixed pines.

The analysis of the second sub-subset (red and white pine types), using ordination and TWINSPAN separated the white pine types (both pure evergreen white pine and white pine-aspen) from the red pine types (both red pine and red pine-aspen types). Another cluster appeared to be a mixture of pine or oak types that had recently been burned. Although these appear to have some shared understory characteristics of their own, stands are placed with the types that contain similar overstory dominants.

Analysis of the third sub-subset (the dry-mesic to mesic spruce-fir and hardwood types) indicated a distinctive mesic bur oak forest type, a rocky aspen-birch woodland type, an aspen-birch type that has both dry and mesic phases, a mix of spruce fir and spruce-fir aspen types, and the black spruce/feathermoss type. The black spruce/feathermoss type overlaps with two moist jack pine/fir stands. The spruce-fir and spruce-fir-aspen types are only distinguishable based on an arbitrary canopy cover distinction between pure evergreen (> 75% conifers) and mixed evergreen-deciduous (25-75% conifer).

3.2 Ecological groups

Patterns among the vegetation communities (associations) can be portrayed through ecological groups; that is, groups of types that share similar ecological processes (Faber-Langendoen 2000, in press). 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 groups is a way of emphasizing

some of the ecological, rather than floristic or physiognomic, similarities among the types. Twelve ecological groups were used to organize the vegetation communities at Voyageurs National Park and its environs; 6 wetland groups and 6 upland groups (Table 3). These 12 groups were based on discussions with Minnesota state ecologists. 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.

Table 3. Vegetation communities (associations) recognized at Voyageurs National Park and environs for the Voyageurs National Park Vegetation Mapping Project.

Community Name (Association)	Common Name (Synonym)	Elcode*	Formation Code*
WETLANDS			
Bogs			
Treed Bogs			
Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum spp. Forest	Black Spruce Bog	CEGL002485	I.A.8.N.g.
Shrub Bogs			
Picea mariana / Chamaedaphne calyculata / Sphagnum spp. Dwarf-Shrubland	Black Spruce / Leatherleaf Semi-treed Bog	CEGL005218	IV.A.1.N.g.
(Chamaedaphne calyculata) - Ledum groenlandicum - Kalmia polifolia Bog Dwarf-shrubland	Leatherleaf Bog	CEGL002498	IV.A.1.N.g.
Northern Shrub and Graminoid Fens			
Shrub Fens			
Alnus incana - Salix spp. - Betula pumila / Chamaedaphne calyculata Shrubland	Bog Birch - Willow Shore Fen	CEGL005227	III.B.2.N.g.
Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa Dwarf-shrubland	Leatherleaf - Sweet Gale Shore Fen	CEGL005228	IV.A.1.N.g.
Larix laricina - Betula pumila / Chamaedaphne calyculata Shrubland	Tamarack Scrub Poor Fen	CEGL005226	III.B.2.N.g.
Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa Shrubland	Bog Birch - Leatherleaf Poor Fen	CEGL002494	III.B.2.N.g.
Graminoid Fens			
Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile Herbaceous Vegetation	Wiregrass Sedge Shore Fen	CEGL005229	V.A.5.N.m.
Carex lasiocarpa - Carex oligosperma / Sphagnum spp. - Polytrichum spp. Herbaceous Vegetation	Northern Sedge Poor Fen	CEGL002265	V.A.5.N.m.
Wet Meadows			
Calamagrostis canadensis Eastern Herbaceous Vegetation [Provisional]	Canada Bluejoint Eastern Meadow	CEGL005174	V.A.5.N.k.
Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria) Herbaceous Vegetation	Northern Sedge Wet Meadow	CEGL002257	V.A.5.N.k.
Marshes			
Emergent Marshes			
Phragmites australis Semipermanently Flooded Ruderal Herbaceous Vegetation	Eastern Reed Marsh	CEGL004141	V.A.5.N.l.
Scirpus acutus - (Scirpus fluviatilis) Freshwater Herbaceous Vegetation	Freshwater Bulrush Marsh	CEGL002225	V.A.5.N.l.
Typha spp. Midwest Herbaceous Vegetation	Midwest Cattail Deep Marsh	CEGL002233	V.A.5.N.l.
Equisetum fluviatile - (Eleocharis smallii) Herbaceous Vegetation	Water Horsetail - Spikerush Marsh	CEGL005258	V.B.2.N.e.
Zizania (aquatica, palustris) Herbaceous Vegetation [Provisional]	Wild Rice Marsh	CEGL002382	V.A.5.N.l.
Rooted and Floating Aquatic Marshes			
Potamogeton spp. - Ceratophyllum spp. Midwest Herbaceous Vegetation	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	V.C.2.N.a.
Nymphaea odorata - Nuphar lutea (ssp. pumila, variegata) Herbaceous Vegetation	Northern Water Lily Aquatic Wetland	CEGL002562	V.C.2.N.a.

Community Name (Association)	Common Name (Synonym)	Elcode*	Formation Code*
Northern Conifer and Hardwood Swamps			
Rich Hardwood Swamps			
Fraxinus nigra - Mixed Hardwoods-Conifers / Cornus sericea / Carex spp. Forest	Black Ash - Mixed Hardwood Swamp	CEGL002105	I.B.2.N.g.
Thuja occidentalis - Fraxinus nigra Forest	White Cedar - Black Ash Swamp	CEGL005165	I.C.3.N.d.
Rich Conifer Swamps			
Picea mariana / Alnus incana / Sphagnum spp. Forest	Black Spruce / Alder Rich Swamp	CEGL002452	I.A.8.N.g.
Larix laricina / Alnus incana Forest	Northern Tamarack Rich Swamp	CEGL002471	I.B.2.N.g.
Thuja occidentalis - (Picea mariana - Abies balsamea) / Alnus incana Forest	White Cedar - (Mixed Conifer) / Alder Swamp	CEGL002456	I.A.8.N.g.
Poor Conifer Swamps			
Picea mariana / Ledum groenlandicum / Sphagnum spp. Forest	Black Spruce / Labrador Tea Poor Swamp	CEGL002454	I.A.8.N.g.
Northern Shrub Swamps			
Cornus spp. - Salix discolor - (Rosa palustris) Shrubland	Dogwood - Pussy Willow Swamp	CEGL002186	III.B.2.N.e.
Alnus incana Swamp Shrubland [Provisional]	Speckled Alder Swamp	CEGL002381	III.B.2.N.e.
UPLANDS			
Rock Barrens			
Treed Rock Barrens			
Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium spp. / Rocky Woodland	Boreal Pine Rocky Woodland	CEGL002483	II.A.4.N.a.
Pinus banksiana - Mixed Conifer / Cladonia spp. Nonvascular Vegetation	Jack Pine / Lichen Rocky Barrens	CEGL002491	VI.B.1.N.c.
Populus tremuloides - (Populus grandidentata) Rocky Woodland	Mixed Aspen Rocky Woodland	CEGL002487	II.B.2.N.a.
Quercus ellipsoidalis - Quercus macrocarpa - (Pinus banksiana) Rocky Woodland	Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland	CEGL005246	II.B.2.N.a.
Shrub and Herb Rock Barrens			
Corylus cornuta - Amelanchier spp. - Prunus virginiana Rocky Shrubland	Boreal Hazelnut - Serviceberry Rocky Shrubland	CEGL005197	III.B.2.N.a.
Danthonia spicata - Poa compressa Granite Herbaceous Vegetation	Poverty Grass Granite Barrens	CEGL005157	V.A.5.N.c.
Northern White Cedar-(Hardwood) Forests			
Thuja occidentalis / Abies balsamea - Acer spicatum Forest	White Cedar - Boreal Conifer Mesic Forest	CEGL002449	I.A.8.N.c.
Thuja occidentalis - Betula alleghaniensis Forest	White Cedar - Yellow Birch Forest	CEGL002450	I.C.3.N.a.
Northern Pine-(Hardwood) Forests			
Pinus banksiana - Populus tremuloides / Diervilla lonicera Forest	Jack Pine - Aspen / Bush Honeysuckle Forest	CEGL002518	I.C.3.N.a
Pinus banksiana / Abies balsamea Forest	Jack Pine / Balsam Fir Forest	CEGL002437	I.A.8.N.b.
Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium spp. Forest	Red Pine - Aspen - Birch Forest	CEGL002520	I.C.3.N.a.
Pinus resinosa / Vaccinium spp. Forest	Red Pine / Blueberry Dry Forest	CEGL002443	I.A.8.N.b.
Pinus strobus - Populus tremuloides / Corylus cornuta Forest	White Pine - Aspen - Birch Forest	CEGL002479	I.C.3.N.a.
Pinus strobus / Acer spicatum - Corylus cornuta Forest	White Pine / Mountain Maple Mesic Forest	CEGL002445	I.A.8.N.b.
Northern Spruce-Fir-(Hardwood) Forests			
Abies balsamea - Betula papyrifera / Diervilla lonicera Forest	Balsam Fir - Paper Birch Forest	CEGL002474	I.A.8.N.c.
Picea mariana - Populus tremuloides / Mixed Herbs Forest	Black Spruce - Aspen Forest	CEGL002516	I.C.3.N.a.

Community Name (Association)	Common Name (Synonym)	Elcode*	Formation Code*
Picea mariana / Pleurozium schreberi Forest	Black Spruce / Feathermoss Forest	CEGL002447	I.A.8.N.c.
Picea glauca - Abies balsamea - Populus tremuloides / Mixed Herbs Forest	Spruce - Fir - Aspen Forest	CEGL002475	I.C.3.N.a.
Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens Forest	Spruce-Fir / Mountain Maple Forest	CEGL002446	I.A.8.N.c.
Boreal Hardwood Forests			
Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca) Forest	Aspen - Birch / Boreal Conifer Forest	CEGL002466	I.B.2.N.b.
Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata) Forest	Aspen - Birch - Red Maple Forest	CEGL002467	I.B.2.N.b.
Betula papyrifera / Diervilla lonicera - (Abies balsamea) Forest	Paper Birch / Fir Forest	CEGL002463	I.B.2.N.b.
Populus tremuloides - Populus balsamifera - Mixed Hardwoods Lowland Forest	Trembling Aspen - Balsam Poplar Lowland Forest	CEGL005036	I.B.2.N.d.
Northern Hardwood Forests			
Quercus macrocarpa / Amelanchier alnifolia / Aralia nudicaulis - Carex assiniboinensis Forest	Northern Bur Oak Mesic Forest	CEGL002072	I.B.2.N.a.

* Elcode is the USNVC database code (CEGL) for each vegetation association. The Formation code for each association is also listed. This code refers to the Formation level name in the USNVC.

3.3 Global rarity

TNC and the Natural Heritage Network assess plant communities as to rarity and degree of imperilment. Ranks indicating the range wide (global) conservation status have been developed for nearly all of the identified communities occurring in the United States. The communities are ranked on a global (G) scale of 1 to 5, with 1 indicating critical imperilment due to rarity, endemism, and/or threats, and 5 indicating little or no risk of extirpation or elimination. For example, a rank of G1 indicates critical imperilment on a range wide basis, i.e., a great risk of "extinction" of the type worldwide. A few plant communities (associations) at and near Voyageurs National Park are globally imperiled. Two associations are listed as Vulnerable or Apparently Secure (G3G4): the Northern Sedge Poor Fen and the White Pine / Mountain Maple Mesic Forest (Figure 14). The Red Pine / Blueberry Dry Forest Association is listed as a G3. The potentially most imperiled community, White Cedar - Yellow Birch Forest Association, is a G2Q, meaning that it is Imperiled. However, until the taxonomic uncertainty around this association is resolved, the rank is still in doubt. One association that has not yet been ranked, but may prove to be rare is the Northern Bur Oak Mesic Forest. It is worth noting that the more imperiled plant communities found within and around the park are primarily upland types.

Figure 14. Northern Sedge Poor Fen: Global Rarity of G3G4

3.4 Map Units

Sixty-seven map units were used to map Voyageurs National Park and environs (Table 4). Fifty-three of these map units represent vegetation types that belong to the USNVC (Appendix B). The map units relate to the USNVC hierarchy at different levels. Forty-three of the 53 map units represent associations (or phases of associations), the finest level of the USNVC hierarchy. Three map units represent the USNVC at the alliance level. Three map units represent the USNVC at the formation level. These map units represent evergreen plantations and perennial grass crops. Last, 4 map units represent more than one formation. These 4 map units were created to handle vegetation patterns that were too complicated or intricate to map at finer levels of the USNVC.

Eight map units represent categories of developed land use such as urban, agricultural lands, commercial services, and transportation areas, or unvegetated water such as lakes and streams (Anderson et al. 1976). Six additional park-specific map units were developed to capture small upland islands (0.1 - 0.5 h) and small natural ponds (<16 h in size and <10% vegetated).

Table 4. Map units and related levels within the US National Vegetation Classification (USNVC) or Anderson et al. (1976) for Voyageurs National Park.
Map units are organized by Ecological Groups.

MAP UNIT CODE	MAP UNIT NAME	LEVEL
Natural/Semi-natural Vegetation Map Units		
Bogs		
Treed Bogs		
BSB	Black Spruce Bog	Association
Shrub Bogs		
LBC	Black Spruce/Leatherleaf Semi-treed Bog	Association
LB	Leatherleaf Bog	Association
BBX	Beaver Basin Break-up Mosaic	Map Unit
Northern Shrub and Graminoid Fens		
Shrub Fens		
BBSF	Bog Birch-Willow Shore Fen	Association
LSF	Leatherleaf-Sweet Gale Shore Fen	Association
TF	Tamarack Scrub Poor Fen	Association
Graminoid Fens		
SPF	Northern Sedge Poor Fen	Association
Wet Meadows		
BJ	Canada Bluejoint Eastern Meadow	Association
SMX	Wet Meadow/Fen Mosaic/Complex	Map Unit
Marshes		
Emergent Marshes		
PM	Eastern Reed Marsh	Association
BM	Freshwater Bulrush Marsh	Association
CM	Midwest Cattail Deep Marsh	Association
WRM	Wild Rice Marsh	Association
DMX	Deep Marsh Mosaic/Complex	Map Unit
Rooted and Floating Aquatic Marshes		
PW	Midwest Pondweed Submerged Aquatic Wetland	Association
WL	Northern Water Lily Aquatic Wetland	Association

MAP UNIT CODE	MAP UNIT NAME	LEVEL
Northern Conifer and Hardwood Swamps		
Rich Hardwood Swamps		
BA	Black Ash-Mixed Hardwood Swamp	Association
WCBA	White Cedar-Black Ash Swamp	Association
Rich Conifer Swamps		
BSAS	Black Spruce/Alder Rich Swamp	Association
TA	Northern Tamarack Rich Swamp	Association
WCS	White Cedar-(Mixed Conifer)/Alder Swamp (rich soil phase)	Association
WCT	White Cedar-(Mixed Conifer)/Alder Swamp (peatland phase)	Association
Poor Conifer Swamps		
BSL	Black Spruce/Labrador Tea Poor Swamp (evergreen phase)	Association
BST	Black Spruce/Labrador Tea Poor Swamp (mixed phase)	Association
Northern Shrub Swamps		
DS	Dogwood-Pussy Willow Swamp	Association
AS	Speckled Alder Swamp	Association
Rock Barrens		
Treed Rock Barrens		
JPW	Boreal Pine Rocky Woodland (jack pine phase)	Association
JPM	Boreal Pine Rocky Woodland (mixed pine phase)	Association
JPL	Jack Pine/Lichen Rocky Barrens	Association
ABW	Mixed Aspen Rocky Woodland	Association
OW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (deciduous phase)	Association
JPOM	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (jack pine-oak phase)	Association
MPHW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (mixed pine-oak phase)	Association
Shrub and Herb Rock Barrens		
UBS	Boreal Hazelnut-Serviceberry Rocky Shrubland	Association
MGF	Poverty Grass Granite Barrens	Association
Northern White Cedar-(Hardwood) Forests		
WCU	White Cedar-Boreal Conifer Mesic Forest	Association
WCA	White Cedar-Yellow Birch Forest	Association
Northern Pine-(Hardwood) Forests		
JPAX	Jack Pine-Aspen Forest Mosaic	Map Unit
JPF	Jack Pine/Balsam Fir Forest	Association
WRPA	White Pine-Red Pine-Quaking Aspen-Birch Forest	Alliance
RP	Red Pine/Blueberry Dry Forest	Association
WP	White Pine/Mountain Maple Mesic Forest	Association
Northern Spruce-Fir-(Hardwood) Forests		
SFA	Spruce-Fir-Aspen Forest	Alliance
BSF	Black Spruce/Feathermoss Forest	Association
SF	Spruce-Fir/Mountain Maple Forest	Association
Boreal Hardwood Forests		
AB	Quaking Aspen-Paper Birch Forest	Alliance
PB	Paper Birch/Fir Forest	Association
AL	Trembling Aspen-Balsam Poplar Lowland Forest	Association
Northern Hardwood Forests		
BO	Northern Bur Oak Mesic Forest	Association

MAP UNIT CODE	MAP UNIT NAME	LEVEL
Planted/Cultivated, Land Use/Land Cover, and Park Specific Map Units		
Planted/Cultivated Vegetation (USNVC)		
EP	Evergreen Plantation	Formation
PGCH	Perennial Grass Crops (hay, pastureland)	Formation
PGCS	Perennial Grass Crops with Sparse Shrubs (hay, pastureland)	Formation
Land Use/Land Cover (USGS - Anderson Level II)		
Developed Lands		
ACP	Cropland and Pasture	LUC II
ARB	Other Agricultural Land	LUC II
BLQ	Strip Mines, Quarries, and Gravel Pits	LUC II
UC	Commercial and Services	LUC II
UR	Residential	LUC II
UT	Transportation, Communications, and Utilities	LUC II
Lakes and Streams		
WLK	Lakes (>16 ha)	LUC II
WS	Streams and Canals	LUC II
Small Islands and Natural Ponds (Park Specific)		
Small Islands (0.1 - .05 h)		
SIG	Small Island with Grass	Park
SIR	Small Island with Rock	Park
SIS	Small Island with Shrubs	Park
SIT	Small Island with Trees	Park
Small Natural Ponds (<10% vegetated)		
WBP	Water-Beaver Pond	Park
WNP	Water-Natural Pond (<16 h)	Park

Association Level Map Units

Forty-three map units represent associations, the finest level of the USNVC hierarchy. Twenty-one of these map units share a one-to-one relationship with a vegetation association. For example, Jack Pine/Lichen Rocky Barrens Map Unit (JPL) represents only one vegetation association, Jack Pine / Lichen Rocky Barrens Association. Nine of the remaining 22 map units represent association phases (see below). Phases can be distinguished on the photographs because canopy dominance is different (e.g. jack pine phase versus a mixed pine-oak phase) but the phases are floristically similar. Map unit phases were initially thought to be associations until late in the mapping process, after analysis of the vegetation plot data was completed. The remaining 13 map units represent either a single association, or they are represented within an aggregate map unit because of mapping complexity and photo limitations. Four aggregate map units were made to handle these situations.

Map Units Representing Association Phases

The Black Spruce / Labrador Tea Poor Swamp Association has 2 map unit phases: an evergreen phase dominated by black spruce (Black Spruce/Labrador Tea Poor Swamp (evergreen phase); BSL, Figure 15), and a mixed phase with black spruce and tamarack sharing dominance (Black Spruce/Labrador Tea Poor Swamp (mixed phase); BST). BSL was applied to polygons where black spruce dominates, and BST was applied to the mixed phase. The phases are recognizable from each other on the aerial photographs, and were initially thought to be 2 different associations.

Figure 15. A Black Spruce / Labrador Tea Poor Swamp Association
This stand was mapped as the evergreen phase, BSL.

The Boreal Pine Rocky Woodland Association has 2 map unit phases: a jack pine phase, (Boreal Pine Rocky Woodland (jack pine phase); JPW), and a mixed pine phase, (Boreal Pine Rocky Woodland (mixed pine phase); JPM). JPW was applied to polygons where jack pine dominated the canopy, and JPM was applied to polygons where the evergreen component was of mixed pine species. The phases are recognizable from each other on the aerial photographs, and were initially thought to be 2 different associations.

The Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland Association has 3 map unit phases depending on relative canopy dominance: a deciduous phase, (Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (deciduous phase); OW), a jack pine and pin oak phase, (Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (jack pine-oak phase); JPOM), and a mixed pine and oak phase (Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (mixed pine-oak phase); MPHW). The phases are recognizable from each other on the aerial photographs, and were initially thought to be 3 different associations.

The White Cedar- (Mixed Conifer)/Alder Swamp Association has 2 map unit phases: a phase with tamarack present in the canopy or in the emergent layer (White Cedar-(Mixed Conifer)/Alder Swamp Map Unit (peatland phase); WCT) and a phase lacking tamarack (White Cedar-(Mixed Conifer)/Alder Swamp (rich soil phase); WCS). The phases are recognizable from each other on the aerial photographs, and were initially thought to be 2 different associations.

Map Units Representing Alliances

Three map units reflect alliance levels of the USNVC. These map units include more than one association within the same alliance. Alliance level map units were necessary for mapping because the individual associations within the alliance do not have unique photo signatures.

The Quaking Aspen-Paper Birch Forest Map Unit (AB) includes two associations in the Quaking Aspen - Birch Forest Alliance: the Aspen - Birch / Boreal Conifer Forest and the Aspen - Birch - Red Maple Forest. The differences between the 2 associations were not visible on the aerial photographs

because closed canopy situations disguised the sub-canopy floristics. In addition, the Aspen - Birch - Red Maple Forest Association is the less common of the 2, and where red maple occurs in the sub-canopy with balsam fir, the stand is considered an Aspen - Birch / Boreal Conifer Forest Association. Although the map unit represents two associations, any one polygon mapped as AB could represent either or both associations.

The White Pine-Red Pine-Quaking Aspen-Birch Forest Map Unit (WRPA) includes 2 associations from the White Pine - (Red Pine) - Quaking Aspen Forest Alliance: the White Pine - Aspen - Birch Forest and the Red Pine Aspen Birch Forest. The two associations were mapped as one map unit because they were not easily distinguished from one another on the aerial photographs. WRPA is also an aggregate map unit, containing other associations that occur together in a mosaic pattern (e.g. WP and AB, see below). Although the map unit represents two associations or an aggregate of other map units, any one polygon mapped as WRPA could represent either or both associations, or an aggregate of map units.

The Spruce-Fir-Aspen Forest Map Unit (SFA) includes two associations from two different alliances. SFA is not Formation level mapping because other alliances within the same formation were mapped separately (e.g. JPAX, WRPA, WCA). The Spruce - Fir - Aspen Forest Association is from the White Spruce - Balsam Fir - Aspen Alliance and the Black Spruce - Aspen Forest Association is from the Black Spruce - Quaking Aspen Forest Alliance. These two associations could not be distinguished from one another on the aerial photographs because their signatures are similar. Although the map unit represents two associations, any one polygon mapped as SFA could represent either or both associations.

The Tamarack Scrub Poor Fen Map Unit (TF) includes 2 associations: the Tamarack Scrub Poor Fen and the Bog Birch - Leatherleaf Poor Fen. However, the Bog Birch - Leatherleaf Poor Fen is considered an inclusion to TF because it generally occurs in small stands and is considered a minor type. The TF map unit is considered an association level map unit, but is mentioned here for clarification. In addition, the Bog Birch - Leatherleaf Poor Fen Association could not be clearly distinguished on the aerial photographs from the Tamarack Scrub Poor Fen Association. Notice in Table 5 that Bog Birch - Leatherleaf Poor Fen is listed as an inclusion to the TF Map Unit.

The Spruce-Fir/Mountain Maple Forest Map Unit (SF) includes 2 associations: the Spruce - Fir / Mountain Maple Forest and the Balsam Fir - Paper Birch Forest. The latter is a very minor type and could not be clearly distinguished on the aerial photographs from the Spruce - Fir / Mountain Maple Forest Association. Thus, it was mapped as part of the Spruce - Fir / Mountain Maple Forest Association. Like TF, the SF map unit is considered is an association level map unit.

Map Units Representing Formations

Three map units represent the classification hierarchy at the formation level and are the Evergreen Plantation Map Unit (EP), the Perennial Grass Crops Map Unit (PGCH) and the Perennial Grass Crops with Sparse Shrubs (PGCS). The 3 formations represented by these map units fall under the Planted/Cultivated Subgroup of the USNVC.

Map Units that are Aggregates (more than one Formation)

Five map units are aggregates of vegetation associations. Each unit combines ecologically linked associations that consistently occur together in the landscape. The aggregates were created because sometimes the individual vegetation associations occurring together could not be distinguished from one another on the aerial photographs because they look alike, or the pattern of several associations occurring together is too intricate to map. There are photo interpretation terms for both these situations.
COMPLEX: The individual communities are not recognizable on the aerial photographs but repeatedly occur together in the landscape**.** Complexes typically are composed of communities with similar

physiognomies, thus, are more difficult to tell apart on the photo. **MOSAIC:** The individual communities are recognizable on the aerial photographs but occur in an intermixed pattern too intricate to map as separate polygons. Mosaics are typically composed of communities with different physiognomies - that is why they are visibly different appearing on the photo. **COMPLEX/MOSAIC**: In many situations, these map unit concepts overlap with one another; we might be able to see individual communities that are too small to map, but other communities exist within the same polygon that have similar signatures.

The Wet Meadow/Fen Mosaic/Complex Map Unit (SMX) includes 5 associations: Canada Bluejoint Eastern Meadow, Northern Sedge Wet Meadow, Wiregrass Sedge Shore Fen, Eastern Reed Marsh, and Midwest Cattail Deep Marsh. In any given polygon designated as SMX, one or more of these communities might occur. Midwest Cattail Deep Marsh and Eastern Reed Marsh were included in this map unit only when found in relatively shallow water. They were mapped with the Deep Marsh Mosaic/Complex Map Unit (DMX) when occurring in deeper water. Three of the 5 associations may be mapped individually if they reach at least the minimum mapping unit of 0.5 h in size and are recognizable on the aerial photograph. The Wiregrass Sedge Shore Fen and the Northern Sedge Wet Meadow were never mapped as individual map units. The Northern Sedge Wet Meadow can also be part of Beaver Basin Break-up Mosaic Map Unit.

Figure 16. One example of vegetation mapped using the SMX Map Unit

The Deep Marsh Mosaic/Complex Map Unit (DMX) includes 7 associations: Eastern Reed Marsh, Freshwater Bulrush Marsh, Midwest Cattail Deep Marsh, Wild Rice Marsh, Water Horsetail-Spikerush Marsh, Northern Water Lily Aquatic Wetland, and Midwest Pondweed Submerged Aquatic Wetland. Midwest Cattail Deep Marsh and Eastern Reed Marsh associations also occur as part of SMX when in shallower water. Horsetail-Spikerush Marsh does not exist as an individual map unit. The Midwest Pondweed Submerged Aquatic Wetland, and the Northern Water Lily Aquatic Wetland associations were each mapped individually if occurring singularly (at least 0.5 h), and could be recognized on the aerial photograph. They were also mapped within the BBX Map Unit under.

The Beaver Basin Break-up Mosaic Map Unit (BBX), includes 6 associations: Leatherleaf Bog, Black Spruce / Leatherleaf Semi-treed Bog, Leatherleaf - Sweet Gale Shore Fen, Northern Sedge Wet Meadow, Northern Water Lily Aquatic Wetland, and Midwest Pondweed Submerged Aquatic Wetland. The associations often occur in a spatial pattern too intricate to map individually, occurring where beaver activity has caused ericaceous mats to break up. The mats become partly flooded, creating pockets of wet sedges or in deeper zones, water lilies and pondweeds. A polygon mapped as BBX includes at least one

dwarf shrub and one herbaceous association. Any association included in BBX was mapped individually if occurring singularly, visible on the aerial photograph, and at least 0.5 h.

The White Pine-Red Pine-Quaking Aspen-Birch Forest Map Unit (WRPA) includes 6 associations when mapped as a mosaic: White Pine - Aspen - Birch Forest, Red Pine Aspen Birch Forest, Red Pine / Blueberry Dry Forest, White Pine / Mountain Maple Mesic Forest, Aspen - Birch / Boreal Conifer Forest, and the Aspen Birch / Red Maple Forest. When WRPA was used to map a combination of pine and aspen forest types, it was mapped as such because the forests occurred in a mosaic pattern with each other. Another way to describe WRPA when mapped as a mosaic is by the combinations of Map Units RP and/or WP with Map Unit AB. WRPA also represents an Alliance level map unit with 2 pine-aspen associations, as discussed previously.

The Jack Pine-Aspen Forest Mosaic Map Unit (JPAX) represents 4 associations: Jack Pine / Balsam Fir Forest, Aspen-Birch / Boreal Conifer Forest, Aspen-Birch-Red Maple Forest, and Jack Pine-Aspen / Bush Honeysuckle Forest (Figure 15). When JPAX was used to map a combination of jack pine and aspen forest types, it was mapped as such because forests occurred in a mosaic pattern with each other. Another way to describe JPAX when mapped as a mosaic is by the combinations of Map Unit JPF with Map Unit AB. Occasionally, the map unit represents the true mixed forest association of Jack Pine-Aspen / Bush Honeysuckle Forest.

Figure 17. A Jack Pine / Balsam Fir Forest
One of the associations included in the Jack Pine-Aspen Mosaic Map Unit (JPAX)

Table 5 shows the relationship of each vegetation association to the map unit or map units. The first 2 columns present the USNVC associations and their common names. The third column gives the USNVC Community Element Global database codes for each association, and the fourth column presents the USNVC codes to the formation level from Grossman et al. (1998). The last column shows the map unit codes that link to each association. As explained in previous paragraphs, some associations are mapped by more than one map unit. The map unit codes under the Map Unit Link column that are followed by the word “shares” or another map unit code in parentheses means the association is also part of another

map unit. For example, the Leatherleaf Bog Association is mapped as LB when it occurs alone, but it is also mapped as BBX when the association occurs as a mosaic with other associations within certain beaver floodings. Some map units, such as SFA, include more than one association. These map units have the word "shares" in parentheses. Still others, such as AB, include 2 associations (shares), yet these associations are also part of mosaic/complex map units (JPAX & WRPA). Map units that are phases of the same association, such as BSL and BST, are listed together in the same cell. See text below for a complete discussion of these relationships. Appendix B also shows the relationships between associations and map units.

For specific details about each map unit, how they were used in mapping, and their relationship to vegetation communities, see Appendix F, *Photo Interpretation Mapping Conventions and Visual Key*.

Table 5. Crosswalk of vegetation associations to map units.

COMMUNITY NAME (ASSOCIATION)	COMMON NAME (SYNONYM)	ELCODE	FORMATION	MAP UNIT LINK
Bogs				
Treed Bogs				
Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum spp. Forest	Black Spruce Bog	CEGL002485	I.A.8.N.g.	BSB
Shrub Bogs				
Picea mariana / Chamaedaphne calyculata / Sphagnum spp. Dwarf-shrubland	Black Spruce / Leatherleaf Semi-treed Bog	CEGL005218	IV.A.1.N.g.	LBC (BBX when mosaic/complex)
(Chamaedaphne calyculata) - Ledum groenlandicum - Kalmia polifolia Bog Dwarf-shrubland	Leatherleaf Bog	CEGL002498	IV.A.1.N.g.	LB (BBX when mosaic/complex)
Northern Shrub and Graminoid Fens				
Shrub Fens				
Alnus incana - Salix spp. - Betula pumila / Chamaedaphne calyculata Shrubland	Bog Birch - Willow Shore Fen	CEGL005227	III.B.2.N.g.	BBSF
Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa Dwarf-Shrubland	Leatherleaf - Sweet Gale Shore Fen	CEGL005228	IV.A.1.N.g.	LSF (BBX when mosaic/complex)
Larix laricina - Betula pumila / Chamaedaphne calyculata Shrubland	Tamarack Scrub Poor Fen	CEGL005226	III.B.2.N.g.	TF
Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa Shrubland	Bog Birch - Leatherleaf Poor Fen	CEGL002494	III.B.2.N.g.	inclusion within TF
Graminoid Fens				
Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile Herbaceous Vegetation	Wiregrass Sedge Shore Fen	CEGL005229	V.A.5.N.m.	SMX (shares)
Carex lasiocarpa - Carex oligosperma / Sphagnum spp. - Polytrichum spp. Herbaceous Vegetation	Northern Sedge Poor Fen	CEGL002265	V.A.5.N.m.	SPF
Wet Meadows				
Calamagrostis canadensis Eastern Herbaceous Vegetation [Provisional]	Canada Bluejoint Eastern Meadow	CEGL005174	V.A.5.N.k.	BJ (SMX when mosaic/complex)
Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria) Herbaceous Vegetation	Northern Sedge Wet Meadow	CEGL002257	V.A.5.N.k.	SMX (shares)
Marshes				
Emergent Marshes				
Phragmites australis Semipermanently Flooded Ruderal Herbaceous Vegetation	Eastern Reed Marsh	CEGL004141	V.A.5.N.l.	PM (DMX & SMX when mosaic/complex)
Scirpus acutus - (Scirpus fluviatilis) Freshwater Herbaceous Vegetation	Freshwater Bulrush Marsh	CEGL002225	V.A.5.N.l.	BM (DMX when mosaic/complex)
Typha spp. Midwest Herbaceous Vegetation	Midwest Cattail Deep Marsh	CEGL002233	V.A.5.N.l.	CM (DMX & SMX when mosaic/complex)
Equisetum fluviatile - (Eleocharis smallii) Herbaceous Vegetation	Water Horsetail - Spikerush Marsh	CEGL005258	V.B.2.N.e.	DMX (shares)

COMMUNITY NAME (ASSOCIATION)	COMMON NAME (SYNONYM)	ELCODE	FORMATION	MAP UNIT LINK
Zizania (aquatica, palustris) Herbaceous Vegetation [Provisional]	Wild Rice Marsh	CEGL002382	V.A.5.N.l.	WRM (DMX when mosaic/complex)
Rooted and Floating Aquatic Marshes				
Potamogeton spp. - Ceratophyllum spp. Midwest Herbaceous Vegetation	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	V.C.2.N.a.	PW (DMX & BBX when mosaic/complex)
Nymphaea odorata - Nuphar lutea (ssp. pumila, variegata) Herbaceous Vegetation	Northern Water Lily Aquatic Wetland	CEGL002562	V.C.2.N.a.	WL (DMX & BBX when mosaic/complex)
Northern Conifer and Hardwood Swamps				
Rich Hardwood Swamps				
Fraxinus nigra - Mixed Hardwoods-Conifers / Cornus sericea / Carex spp. Forest	Black Ash - Mixed Hardwood Swamp	CEGL002105	I.B.2.N.g.	BA
Thuja occidentalis - Fraxinus nigra Forest	White Cedar - Black Ash Swamp	CEGL005165	I.C.3.N.d.	WCBA
Rich Conifer Swamps				
Picea mariana / Alnus incana / Sphagnum spp. Forest	Black Spruce / Alder Rich Swamp	CEGL002452	I.A.8.N.g.	BSAS
Larix laricina / Alnus incana Forest	Northern Tamarack Rich Swamp	CEGL002471	I.B.2.N.g.	TA
Thuja occidentalis - (Picea mariana - Abies balsamea) / Alnus incana Forest	White Cedar - (Mixed Conifer) / Alder Swamp	CEGL002456	I.A.8.N.g.	WCS & WCT
Poor Conifer Swamps				
Picea mariana / Ledum groenlandicum / Sphagnum spp. Forest	Black Spruce / Labrador Tea Poor Swamp	CEGL002454	I.A.8.N.g.	BSL (evergreen) & BST (mixed)
Northern Shrub Swamps				
Cornus spp. - Salix discolor - (Rosa palustris) Shrubland	Dogwood - Pussy Willow Swamp	CEGL002186	III.B.2.N.e.	DS
Alnus incana Swamp Shrubland [Provisional]	Speckled Alder Swamp	CEGL002381	III.B.2.N.e.	AS
Rock Barrens				
Treed Rock Barrens				
Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium spp. Rocky Woodland	Boreal Pine Rocky Woodland	CEGL002483	II.A.4.N.a.	JPW (jack pine) & JPM (mixed pine)
Pinus banksiana - Mixed Conifer / Cladonia spp. Nonvascular Vegetation	Jack Pine / Lichen Rocky Barrens	CEGL002491	VI.B.1.N.c.	JPL
Populus tremuloides - (Populus grandidentata) Rocky Woodland	Mixed Aspen Rocky Woodland	CEGL002487	II.B.2.N.a.	ABW
Quercus ellipsoidalis - Quercus macrocarpa - (Pinus banksiana) Rocky Woodland	Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland	CEGL005246	II.B.2.N.a.	OW (deciduous), JPOM (jack pine-oak), & MPHW (mixed pine-oak)
Shrub and Herb Rock Barrens				
Corylus cornuta - Amelanchier spp. - Prunus virginiana Rocky Shrubland	Boreal Hazelnut - Serviceberry Rocky Shrubland	CEGL005197	III.B.2.N.a.	UBS
Danthonia spicata - Poa compressa Granite Herbaceous Vegetation	Poverty Grass Granite Barrens	CEGL005157	V.A.5.N.c.	MGF
Northern White Cedar-(Hardwood) Forests				
Thuja occidentalis / Abies balsamea - Acer spicatum Forest	White Cedar - Boreal Conifer Mesic Forest	CEGL002449	I.A.8.N.c.	WCU
Thuja occidentalis - Betula alleghaniensis Forest	White Cedar - Yellow Birch Forest	CEGL002450	I.C.3.N.a.	WCA
Northern Pine-(Hardwood) Forests				
Pinus banksiana - Populus tremuloides / Diervilla lonicera Forest	Jack Pine - Aspen / Bush Honeysuckle Forest	CEGL002518	I.C.3.N.a	JPAX (shares)
Pinus banksiana / Abies balsamea Forest	Jack Pine / Balsam Fir Forest	CEGL002437	I.A.8.N.b.	JPF (JPAX when mosaic with AB)

COMMUNITY NAME (ASSOCIATION)	COMMON NAME (SYNONYM)	ELCODE	FORMATION	MAP UNIT LINK
Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium spp. Forest	Red Pine - Aspen - Birch Forest	CEGL002520	I.C.3.N.a.	WRPA (shares)
Pinus resinosa / Vaccinium spp. Forest	Red Pine / Blueberry Dry Forest	CEGL002443	I.A.8.N.b.	RP (WRPA when mosaic with AB)
Pinus strobus - Populus tremuloides / Corylus cornuta Forest	White Pine - Aspen - Birch Forest	CEGL002479	I.C.3.N.a.	WRPA (shares)
Pinus strobus / Acer spicatum - Corylus cornuta Forest	White Pine / Mountain Maple Mesic Forest	CEGL002445	I.A.8.N.b.	WP (WRPA when mosaic with AB)
Northern Spruce-Fir-(Hardwood) Forests				
Abies balsamea - Betula papyrifera / Diervilla lonicera Forest	Balsam Fir - Paper Birch Forest	CEGL002474	I.A.8.N.c.	minor within SF
Picea mariana - Populus tremuloides / Mixed Herbs Forest	Black Spruce - Aspen Forest	CEGL002516	I.C.3.N.a.	SFA (shares)
Picea mariana / Pleurozium schreberi Forest	Black Spruce / Feathermoss Forest	CEGL002447	I.A.8.N.c.	BSF
Picea glauca - Abies balsamea - Populus tremuloides / Mixed Herbs Forest	Spruce - Fir - Aspen Forest	CEGL002475	I.C.3.N.a.	SFA (shares)
Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens Forest	Spruce-Fir / Mountain Maple Forest	CEGL002446	I.A.8.N.c.	SF
Boreal Hardwood Forests				
Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca) Forest	Aspen - Birch / Boreal Conifer Forest	CEGL002466	I.B.2.N.b.	AB (shares, JPAX & WRPA when mosaic)
Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata) Forest	Aspen - Birch - Red Maple Forest	CEGL002467	I.B.2.N.b.	AB (shares, JPAX & WRPA when mosaic)
Betula papyrifera / Diervilla lonicera - (Abies balsamea) Forest	Paper Birch / Fir Forest	CEGL002463	I.B.2.N.b.	PB
Populus tremuloides - Populus balsamifera - Mixed Hardwoods Lowland Forest	Trembling Aspen - Balsam Poplar Lowland Forest	CEGL005036	I.B.2.N.d.	AL
Northern Hardwood Forests				
Quercus macrocarpa / Amelanchier alnifolia / Aralia nudicaulis - Carex assiniboinensis Forest	Northern Bur Oak Mesic Forest	CEGL002072	I.B.2.N.a.	BO

3.5 Vegetation Map

A total area of 156,886 h was mapped of Voyageurs National Park and environs, including a portion of Canada (Table 6). Of this total, vegetated map units represent >100,000 h. The remaining map units are land use and land cover (Anderson et al. 1976) and park specific map units. The map unit for lakes is by far the largest in area (>53,000 h), which is one of the land cover map units.

The greatest number of hectares mapped for vegetated map units is the Quaking Aspen-Paper Birch Forest (>21,000 h, AB), the Spruce Fir-Aspen Forest (>12,000 h, SFA), and the White Pine-Red Pine-Quaking Aspen-Paper Birch Forest (>9500 h, WRPA). These map units are each mapped at the alliance level within the USNVC, each with more than one association. WRPA, to reiterate, is also mapped as an aggregate of other map units (the AB map unit being one of them). The map units fall within 3 forested ecological groups: Boreal Hardwood Forests, Northern Spruce - Fir (Hardwood) Forests, and Northern Pine (Hardwood) Forests. The high numbers of hectares reflect the influence of natural events such as periodic forest fires and human impacts of logging on the forest ecosystem, especially the Quaking Aspen-Paper Birch Forest, which occurs as fairly young forest stands outside the park.

The map units with the largest polygon areas are in the Rat Root River Peatland: Black Spruce Bog (BSB) and Tamarack Scrub Poor Fen (TS). Although few in number (25 and 9 polygons respectively) these polygons range from an average of >30 h for BSB to 19 h for TF. Average polygon size drops sharply, to 9 h or less for all other vegetated map units.

Although each polygon is small in area (2.1 h average), the highest of number of polygons (> 5,500) are map units within the Treed Rock Barrens ecological group. Map units Boreal Pine Rocky Woodland (2 phases; JPW and JPM), Jack Pine/Lichen Rocky Barrens (JPL), Mixed Aspen Rocky Woodland (ABW), and Northern Pin Oak-Bur Oak- (Jack Pine) Rocky Woodland (3 phases; OW, JPOM, MPHW) make up the majority of this group. The associations recognized by these map units are confined to ridge tops and slopes where there is exposed bedrock.

Relatively rare in both number of polygons and in area are the map units Paper Birch/Fir Forest (PB) and Northern Bur Oak Mesic Forest (BO). PB occurs only near Deer Point Islands in the park. BO is most common on islands and peninsulas of Kabetogama Lake.

Table 6. Area Report for the Voyageurs National Park Vegetation Map.

Map Unit Code	Map Unit Name	Polygons	Hectares	Ave (h)	Acres	Ave (a)
Natural/Semi-natural Vegetation Map Units						
Bogs		563	3,427	6	8,468	15
Treed Bogs		25	761	30	1,879	75
BSB	Black Spruce Bog	25	761	30	1,879	75
Shrub Bogs		538	2,666	5	6,589	12
LBC	Black Spruce/Leatherleaf Semi-treed Bog	212	1,703	8	4,208	20
LB	Leatherleaf Bog	297	892	3	2,205	7
BBX	Beaver Basin Break-up Mosaic	29	71	2	176	6
Northern Shrub and Graminoid Fens		202	939	5	2,320	11
Shrub Fens		194	874	5	2,159	11
BBSF	Bog Birch-Willow Shore Fen	51	238	5	588	12
LSF	Leatherleaf-Sweet Gale Shore Fen	134	464	3	1,146	9
TF	Tamarack Scrub Poor Fen	9	172	19	425	47
Graminoid Fens		8	65	8	161	20
SPF	Northern Sedge Poor Fen	8	65	8	161	20
Wet Meadows		2,487	5,236	2	12,938	5
BJ	Canada Bluejoint Eastern Meadow	475	752	2	1,858	4
SMX	Wet Meadow/Fen Mosaic/Complex	2,012	4,484	2	11,080	6
Marshes		2,342	4,807	2	11,877	5
Emergent Marshes		1,223	2,605	2	6,436	5
PM	Eastern Reed Marsh	8	4	0	9	1
BM	Freshwater Bulrush Marsh	6	7	1	18	3
CM	Midwest Cattail Deep Marsh	212	475	2	1,173	6
WRM	Wild Rice Marsh	38	267	7	661	17
DMX	Deep Marsh Mosaic/Complex	959	1,852	2	4,575	5
Rooted and Floating Aquatic Marshes		1,119	2,202	2	5,441	5
PW	Midwest Pondweed Submerged Aquatic Wetland	669	1,223	2	3,023	5
WL	Northern Water Lily Aquatic Wetland	450	979	2	2,418	5
Northern Conifer and Hardwood Swamps		3,815	9,869	3	24,388	6
Rich Hardwood Swamps		1,858	3,507	2	8,665	5
BA	Black Ash-Mixed Hardwood Swamp	1,586	2,677	2	6,616	4
WCBA	White Cedar-Black Ash Swamp	272	829	3	2,049	8
Rich Conifer Swamps		1,029	2,488	2	6,148	6
BSAS	Black Spruce/Alder Rich Swamp	536	707	1	1,748	3
TA	Northern Tamarack Rich Swamp	255	705	3	1,743	7

Map Unit Code	Map Unit Name	Polygons	Hectares	Ave (h)	Acres	Ave (a)
WCS	White Cedar-(Mixed Conifer)/Alder Swamp (rich soil phase)	214	1,011	5	2,499	12
WCT	White Cedar-(Mixed Conifer)/Alder Swamp (peatland phase)	24	64	3	158	7
Poor Conifer Swamps		928	3,875	4	9,575	10
BSL	Black Spruce/Labrador Tea Poor Swamp (evergreen phase)	704	2,937	4	7,257	10
BST	Black Spruce/Labrador Tea Poor Swamp (mixed phase)	224	938	4	2,318	10
Northern Shrub Swamps		1,857	3,412	2	8,431	5
DS	Dogwood-Pussy Willow Swamp	262	587	2	1,450	6
AS	Speckled Alder Swamp	1,595	2,825	2	6,981	4
Rock Barrens		6,294	13,462	2	33,266	5
Treed Rock Barrens		5,583	11,829	2	29,230	5
JPW	Boreal Pine Rocky Woodland (jack pine phase)	1,087	2,118	2	5,233	5
JPM	Boreal Pine Rocky Woodland (mixed pine phase)	1,774	3,351	2	8,280	5
JPL	Jack Pine/Lichen Rocky Barrens	57	84	1	208	4
ABW	Mixed Aspen Rocky Woodland	856	1,659	2	4,099	5
OW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (deciduous phase)	303	827	3	2,044	7
JPOM	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (jack pine-oak phase)	34	77	2	190	6
MPHW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (mixed pine-oak phase)	1,472	3,713	3	9,176	6
Shrub and Herb Rock Barrens		711	1,633	2	4,036	6
UBS	Boreal Hazelnut-Serviceberry Rocky Shrubland	598	1,518	3	3,750	6
MGF	Poverty Grass Granite Barrens	113	116	1	286	3
Northern White Cedar-(Hardwood) Forests		708	1,498	2	3,702	5
WCU	White Cedar-Boreal Conifer Mesic Forest	324	488	2	1,207	4
WCA	White Cedar-Yellow Birch Forest	384	1,010	3	2,496	6
Northern Pine-(Hardwood) Forests		4,044	19,240	5	47,544	12
JPAX	Jack Pine-Aspen Forest Mosaic	715	4,592	6	11,348	16
JPF	Jack Pine/Balsam Fir Forest	909	2,502	3	6,183	7
WRPA	White Pine-Red Pine-Quaking Aspen-Paper Birch Forest	1,486	9,823	7	24,274	16
RP	Red Pine/Blueberry Dry Forest	289	594	2	1,468	5
WP	White Pine/Mountain Maple Mesic Forest	645	1,728	3	4,271	7
Northern Spruce-Fir-(Hardwood) Forests		4,222	14,734	3	36,408	9
SFA	Spruce-Fir-Aspen Forest	2,649	12,225	5	30,209	11
BSF	Black Spruce/Feathermoss Forest	406	551	1	1,360	3
SF	Spruce-Fir/Mountain Maple Forest	1,167	1,958	2	4,838	4
Boreal Hardwood Forests		4,626	24,873	5	61,462	13
AB	Quaking Aspen-Paper Birch Forest	3,361	21,696	6	53,613	16
PB	Paper Birch/Fir Forest	4	21	5	52	13
AL	Trembling Aspen-Balsam Poplar Lowland Forest	1,261	3,155	3	7,797	6
Northern Hardwood Forests		83	156	2	384	5
BO	Northern Bur Oak Mesic Forest	83	156	2	384	5

Map Unit Code	Map Unit Name	Polygons	Hectares	Ave (h)	Acres	Ave (a)
Planted/Cultivated, Land Use/Land Cover, and Park Specific Map Units						
Planted/Cultivated Vegetation (USNVC)		88	318	4	786	9
EP	Evergreen Plantation	4	4	1	10	2
PGCH	Perennial Grass Crops (hay, pastureland)	39	164	4	406	10
PGCS	Perennial Grass Crops with Sparse Shrubs (hay, pastureland)	45	150	3	370	8
Land Use/Land Cover (USGS - Anderson Level II)		385	54,559	142	134,819	350
Developed Lands		335	1,115	3	2,755	8
ACP	Cropland and Pasture	31	200	6	494	16
ARB	Other Agricultural Land	58	78	1	192	3
BLQ	Strip Mines, Quarries, and Gravel Pits	16	74	5	184	11
UC	Commercial and Services	47	210	4	519	11
UR	Residential	179	269	2	664	4
UT	Transportation, Communications, and Utilities	4	284	71	702	175
Lakes and Streams		50	53,445	1,069	132,064	2,641
WLK	Lakes (>16 h)	40	53,347	1,334	131,824	3,296
WS	Streams and Canals	10	97	10	240	24
Small Islands and Natural Ponds (Park Specific)		1,125	357	0	882	1
Small Islands (.01 - .05 h)		1,052	174	0	431	0
SIG	Small Island with Grass	11	1	0	3	0
SIR	Small Island with Rock	58	6	0	14	0
SIS	Small Island with Shrubs	128	16	0	39	0
SIT	Small Island with Trees	855	152	0	375	0
Small Natural Ponds (<10% vegetated)		73	183	3	451	6
WBP*	Water-Beaver Pond	52	70	1	173	3
WNP	Water-Natural Pond (<16 h)	21	113	5	279	13
Totals		**Polygons**	**Hectares**	**Ave (h)**	**Acres**	**Ave (a)**
All Map Units		**32,841**	**156,886**	**5**	**387,674**	**12**
Natural/Semi-natural Vegetation Map Units		**31,243**	**101,652**	**3**	**251,187**	**8**
Planted/Cultivated, Land Use/Land Cover, and Park Specific Map Units		**1,598**	**55,234**	**35**	**136,487**	**85**

***** The Water-Beaver Pond Map Unit (WBP) does not include all beaver ponds present, but only those that appeared on the aerial photographs to have <10% of the surface area covered with vegetation. Many other beaver ponds were mapped under various vegetated map units, such as BBX, BJ, DMX, SMX, PW, WL, etc.

More than 1200 h of the Midwest Pondweed Submerged Aquatic Wetland Map Unit (PW) were mapped. However, some polygons of the Water-Beaver Pond Map Unit (WBP) and the Water-Natural Pond Map Unit (WNP), because of limitations in seeing submergent vegetation on CIR aerial photographs, may indeed have >10% vegetation. In such cases, these polygons would best be described within the Midwest Pondweed Submerged Aquatic Wetland Association of the USNVC (see Appendix F).

3.6 Accuracy Assessment

Forty-one map units and 4 map unit groups were assessed for accuracy. The 4 map unit groups were map units representing phases of individual vegetation associations. For example, BSL and BST represent the evergreen and mixed phases of the Black Spruce / Labrador Tea Poor Swamp Association and were assessed together because they represent a single association.

The overall thematic accuracy is 82.4% (Appendix D). For producers' accuracy, 29 of the 45 units (64%) reached at least 80% accuracy. Another 13 units fell below 80% accuracy. However, 80% is included within the confidence interval. Thus, 42 of the 45 units (93%) reached 80% accuracy when the confidence interval is taken into account. Three map units did not meet the Program's goal for producers' accuracy: the Quaking Aspen-Paper Birch Forest (AB, 65% with confidence interval 52-77%), the Spruce-Fir-Aspen Forest (SFA, 67% with confidence interval 54-79%), and the Northern Water Lily Aquatic Wetland (WL, 46% with confidence interval 31-61%).

For users' accuracy, 30 of the 45 units (67%) also reached at least 80% accuracy. Another 14 units fell below 80% accuracy. However, 80%is included within the confidence interval. Thus, 44 of 45 units (98%) reached 80% when the confidence interval is taken into account. One map unit did not meet the Program's goal for users' accuracy: Midwest Pondweed Submerged Aquatic Wetland (PW, 44% with confidence interval 27-62%).

Consideration was given to combining map units that did not meet 80% accuracy. However, it seems more useful to keep the map units separate and explain the errors rather than combine map units together. For example, producers' and users' accuracy for the Trembling Aspen-Balsam Poplar Lowland Forest Map Unit (AL) fell below 80% because it was more difficult to map than expected. This map unit grades into the Quaking Aspen-Paper Birch Forest Map Unit (AB) and other upland forest map units with similar signatures. More than 3,000 h and >1,000 polygons of AL have been mapped. Collapsing AL into AB would improve the accuracy assessment result, but the user would not know of the existence of AL, albeit with a lower degree of confidence.

Table 7 presents results of the accuracy assessment for the map units. The comments column reports the percent of polygons mapped in agreement with the accuracy assessment calls, and reports the types of errors. Nearly all errors occurred when a polygon was mapped as an association very similar to the accuracy assessment call. Many of these errors were related to different estimates of percent cover between the photo interpreter and ground crew (see Comments column in Table 7). The photo interpreter sees canopy crowns at a relatively small scale but over a relatively large area, and the field crew sees the canopy over a relatively small area. These different perspectives frequently lead to different estimates of percent cover, which in turn leads to differing conclusions on determining the vegetation type. When judging canopy cover, it is difficult to say which perspective provides the most accurate cover estimates. This is particularly true for conical crowned species, whose canopy is often widest near the ground. Problems with cover classes are also magnified by the overall structure of the classification system, which depends on percent cover to break forest from woodland. In addition, the finest levels of the classification depend on percent cover of individual species in the lower strata to separate associations from one another. The ability to discriminate vegetation types from aerial photographs using these kinds of criteria can be challenging.

Table 7. Summary of accuracy assessment results of the vegetation spatial database coverage for Voyageurs National Park and environs.

MAP UNIT CODE	MAP UNIT NAME	CONFIDENCE INTERVAL PRODUCER'S/ USERS	COMMENTS Producers' accuracy (errors of omission) is the probability that the map actually represents what was found on the ground. Users' accuracy (errors of commission) is the probability that an accuracy assessment point has been mapped correctly. Producers or users' accuracy is considered acceptable when 80% falls within the confidence interval. Errors are explained in the Comment Section.
Bogs			
Treed Bogs			
BSB	Black Spruce Bog	85-105% 98-103%	95% of the polygons identified by the accuracy assessment (aa) team as Black Spruce Bog (2485) were mapped correctly as BSB (producers' accuracy). An errors occurred when a polygon was mapped as BSL / BST. 100% of the polygons mapped as BSB were identified as Black Spruce Bog (2485) by the aa team (users' accuracy).
Shrub Bogs			
LBC	Black Spruce/Leatherleaf Semi-treed Bog	74-101% 60-90%	88% of the polygons identified by the aa team as Black Spruce / Leatherleaf Semi-treed Bog (5218) were mapped correctly as LBC (producers' accuracy). Errors occurred when polygons were mapped as LSF (2 errors) and BSAS (1 error). 75% of the polygons mapped as LBC were identified as Black Spruce / Leatherleaf Semi-treed Bog (5218) by the aa team (users' accuracy). Errors occurred when a polygon was mapped as BSL / BST (3 errors) or LB (4 errors).
LB	Leatherleaf Bog	58-88% 71-98%	73% of the polygons identified by the aa team as Leatherleaf Bog (2498) were mapped correctly as LB (producers' accuracy). Errors occurred when a polygon was mapped as LBC (4 errors), BBSF (2 errors), AS (1 error), and SMX (1 error). 85% of the polygons mapped as LB were identified as Leatherleaf Bog (2498) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AS (1error), BSAS (1 error), or when identified as Northern Sedge Wet Meadow (2257) by the aa team. Northern Sedge Wet Meadow should have been mapped as BBX or SMX.
BBX	Beaver Basin Break-up Mosaic	75-125% 75-125%	100% of the polygons identified by the aa team as Northern Sedge Wet Meadow (2257) were mapped correctly as BBX (producers' accuracy). 100% of the polygons mapped as BBX were identified as Northern Sedge Wet Meadow (2257) by the aa team (users accuracy).

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Northern Shrub and Graminoid Fens			
Shrub Fens			
BBSF	Bog Birch-Willow Shore Fen	84-106% 67-98%	95% of the polygons identified by the aa team as Bog Birch - Willow Shore Fen (5227) were mapped correctly as BBSF (producers' accuracy). An error occurred when a polygon was mapped as DS (1 error). 83% of the polygons mapped as BBSF were identified as Bob Birch - Willow Shore Fen (5227) by the aa team (users' accuracy). Errors occurred when polygons were mapped as LB (2 errors), BSL / BST (1 error), and AS (1error).
LSF	Leatherleaf-Sweet Gale Shore Fen	78 – 103% 78 – 103%	90% of the polygons identified by the aa team as Leatherleaf - Sweet Gale Shore Fen (5228) were mapped correctly as LSF (producers' accuracy). Errors occurred when polygons were mapped as SMX (2 errors). 90% of the polygons mapped as LSF were identified as Leatherleaf - Sweet Gale Shore Fen (5228) by the aa team (users' accuracy). Errors occurred when polygons were mapped as LBC (2 errors).
TF	Tamarack Scrub Poor Fen	95-105% 61-105%	100% of the polygons identified by the aa team as Tamarack Scrub Poor Fen (5226) were mapped correctly as TF (producers ' accuracy). 83% of the polygons mapped as TF were identified as Tamarack Scrub Poor Fen (5226) by the aa team (users' accuracy). Errors occurred when polygons were mapped as WCS / WCT (2 errors).
Graminoid Fens			
SPF	Northern Sedge Poor Fen	94-106% 94-106%	100% of the polygons identified by the aa team as Northern Sedge Poor Fen (2265) were mapped correctly as SPF (producers' accuracy). 100% of the polygons mapped as SPF were identified as Northern Sedge Poor Fen (2265) by the aa team (users' accuracy).
Wet Meadows			
BJ	Canada Bluejoint Eastern Meadow	86-105% 56-86%	96% of the polygons identified by the aa team as Canada Bluejoint Eastern Meadow (5174) were mapped correctly as BJ (producers' accuracy). Error occurred when a polygon was mapped as DS (1 error). 71% of the polygons mapped as BJ were identified as Canada Bluejoint Eastern Meadow (5174) by the aa team (users accuracy). Errors occurred when polygons were mapped as BJ but identified by the aa team as Northern Sedge Wet Meadow (2257; 7 errors), as Wiregrass Shore Fen (5229; 1 error), and when mapped as WL (1 error).

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SMX	Wet Meadow/Fen Mosaic/Complex	55-80% 64-89%	67% of the polygons identified by the aa team as one of the associations of SMX (5174, 2257, 4141, 2233, 5229) were mapped correctly as SMX (producers' accuracy). Errors occurred when polygons were mapped as BJ (8 errors), CM (1 error), DS (1 error), LB (2 errors), PW (1 error), and WL (2 errors). 76% of the polygons mapped as SMX were identified as one of the associations of SMX by the aa team (users' accuracy). Errors occurred when polygons were mapped as DS (1 error), LB (1 error), LSF (1 error), and WL (5 errors).
Marshes			
Emergent Marshes			
PM	Eastern Reed Marsh	27-107% 88-113%	67% of the polygons identified by the aa team as Eastern Reed Marsh (4141) were mapped correctly as PM (producers' accuracy). Errors occurred when polygons were mapped as BJ (2 errors). 100% of the polygons mapped as PM were identified as Eastern Reed Marsh (4141) by the aa team (users' accuracy).
BM	Freshwater Bulrush Marsh	-28-95% -28-95%	33% of the polygons identified by the aa team as Freshwater Bulrush Marsh (2225) were mapped correctly as BM (producers' accuracy). Errors occurred when polygons were mapped as WRM (2 errors). 33% of the polygons mapped as BM were identified as Freshwater Bulrush Marsh (2225) by the aa team (users' accuracy). Errors occurred when polygons were mapped as PM (2 errors).
CM	Midwest Cattail Deep Marsh	98-102% 86-105%	100% of the polygons identified by the aa team as Midwest Cattail Deep Marsh (2233) were mapped correctly as CM (producers' accuracy). 95% if the polygons mapped as CM were identified as Midwest Cattail Deep Marsh (2233) by the aa team (users' accuracy). Error occurred when a polygon was mapped as LSF (1 error).
WRM	Wild Rice Marsh	72-104% 50-87%	88% of the polygons identified by the aa team as Wild Rice Marsh (2382) were mapped correctly as WRM (producers' accuracy). Errors occurred when polygons were mapped as WL (1error) and PW (1 error). 68% of the polygons mapped as WRM were identified as Wild Rice Marsh (2382) by the aa team (users' accuracy). Errors occurred when polygons were mapped as BM (2 errors), PW (4 errors), and WL (1 error).

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DMX	Deep Marsh Mosaic/Complex	90-103% 98-102%	97% of the polygons identified by the aa team as one of the associations of DMX (4141, 2225, 3344, 2382, 5258, 2562, 2282) were mapped correctly as DMX (producers' accuracy). An error occurred when a polygon was mapped as CM. 100% of the polygons mapped as DMX were identified as one of the associations within DMX by the aa team (users accuracy).
Rooted and Floating Aquatic Marshes			
PW	Midwest Pondweed Submerged Aquatic Wetland	49-92% 27-62%	71% of the polygons identified by the aa team as Midwest Pondweed Submerged Aquatic Wetland (2282) were mapped correctly as PW (producers' accuracy). Errors occurred when polygons were mapped as WRM (4 errors), and WL (1 error). 44% of the polygons mapped as PW were identified as Midwest Pondweed Submerged Aquatic Wetland (2282) by the aa team (users accuracy). Errors occurred when polygons were mapped as WL (13 errors) and WRM (1 error). 1 error occurred when a polygon was mapped as PW but was identified by the aa team as Northern Sedge Wet Meadow (2257).
WL	Northern Water Lily Aquatic Wetland	31-61% 64-97%	46% of the polygons identified by the aa team as Northern Water Lily Aquatic Wetland (2562) were mapped correctly as WL (producers' accuracy). Errors occurred when polygons were mapped as PW (13 errors), SMX (5 errors), WRM (1 error), and BJ (1error). 81% of the polygons mapped as WL were identified as Northern Water Lily Aquatic Wetland (2562) by the aa team (users' accuracy). Errors occurred when polygons were mapped as PW (1 error) and WRM (1 error). 2 polygons were mapped as WL but were identified by the aa team as Northern Sedge Wet Meadow (2257).
Northern Conifer and Hardwood Swamps			
Rich Hardwood Swamps			
BA	Black Ash-Mixed Hardwood Swamp	56-86% 75-101%	71% of the polygons identified by the aa team as Black Ash - Mixed Hardwood Swamp (2105) were mapped correctly as BA (producers' accuracy). Errors occurred when polygons were mapped as AB (1 error), AL (1error), BO (1error), SFA (1 error), and WCBA (5 errors). 88% of the polygons mapped as BA were identified as Black Ash - Mixed Hardwood Swamp (2105) by the aa team. Errors occurred when polygons were mapped as AL (1 error), BO (1error), and WCBA (1 error).

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WCBA	White Cedar-Black Ash Swamp	67-96% 64-93%	81% of the polygons identified by the aa team as White Cedar - Black Ash Swamp (5165) were mapped correctly as WCBA (producers' accuracy). Errors occurred when polygons were mapped as BA (1 error), WCA (1 error), and WCS / WCT (3 errors). 79% of the polygons mapped as WCBA were identified as White Cedar - Black Ash Swamp (5165) by the aa team (users' accuracy). Errors occurred when polygons were mapped as BA (5 errors), and AS (1 error).
Rich Conifer Swamps			
BSAS	Black Spruce/Alder Rich Swamp	59-94% 46-82%	76% of the polygons identified by the aa team as Black Spruce / Alder Rich Swamp (2452) were mapped correctly as BSAS (producers' accuracy). Errors occurred when polygons were mapped as BSL / BST (3 errors), LB (1 error), TA (1 error). 64% of the polygons mapped as BSAS were identified as Black Spruce / Alder Rich Swamp (2452) by the aa team (users' accuracy). Errors occurred when polygons were mapped as BSL / BST (4 errors), LBC (1 error), and WCS / WCT (4 errors).
TA	Northern Tamarack Rich Swamp	94-102% 72-90%	98% of the polygons identified by the aa team as Northern Tamarack Rich Swamp (2471) were mapped correctly as TA (producers' accuracy). Error occurred when a polygon was mapped a WCS / WCT (1 error). 81% of the polygons mapped as TA were identified as Northern Tamarack Rich Swamp (2471) by the aa team (users' accuracy). Errors occurred when polygons were mapped as BSL / BST (10 errors), BSAS (1 error), and AS (1 error).
WCS / WCT	White Cedar-(Mixed Conifer)/Alder Swamp (rich soil phase and peatland phase)	55-82% 71-96%	68% of the polygons identified by the aa team as White Cedar - (Mixed Conifer)/ Alder Swamp (2456) were mapped correctly as WCS or WCT (producers accuracy). Errors occurred when polygons were mapped as BSAS (4 errors), BSL / BST (4 errors), TF (2 errors), and WCU (2 errors). 84% of the polygons mapped as WCS / WCT were identified as White Cedar - (Mixed Conifer)/Alder Swamp (2456) by the aa team (users' accuracy). Errors occurred when polygons were mapped as WCU (1 error), WCS / WCT (3 errors), TA (1 error).

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Poor Conifer Swamps			
BSL / BST	Black Spruce/Labrador Tea Poor Swamp (evergreen phase & mixed phase)	69-85%	77% of the polygons identified by the aa team as Black Spruce /Labrador Tea Poor Swamp (2454) were mapped correctly as BSL or BST (producers' accuracy). Errors occurred when polygons were mapped as BBSF (1 error), BSAS (4 errors), BSF (1 error), LBC (3 errors), and TA (10 errors).
		82-96%	89% of the polygons mapped as BSL / BST were identified as Black Spruce /Labrador Tea Poor Swamp (2454) by the aa team (users' accuracy). Errors occurred when polygons were mapped as BSAS (3 errors), BSB (1 error), and WCS / WCT (4 errors).
Northern Shrub Swamps			
DS	Dogwood-Pussy Willow Swamp	72-98%	85% of the polygons identified by the aa team as Dogwood - Pussy Willow Swamp (2186) were mapped correctly as DS (producers' accuracy). Errors occurred when polygons were mapped as AS (2 errors), SMX (1 error), and UBS (1 error).
		68-96%	82% of the polygons mapped as DS were identified as Dogwood - Pussy Willow Swamp (2186) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AS (2 errors), BBSF (1 error), and BJ (1 error), and when 1 polygon was mapped as DS but was identified by the aa team as Northern Sedge Wet Meadow (2257).
AS	Speckled Alder Swamp	67-92%	79% of the polygons identified by the aa team as Speckled Alder Swamp (2381) were mapped correctly as AS (producers' accuracy). Errors occurred when polygons were mapped as AL (1 error), BBSF (1 error), DS (2 errors), LB (1 error), TA (1 error), WCBA (1 error).
		76-99%	87% of the polygons mapped as AS were identified as Speckled Alder Swamp (2381) by the aa team (users' accuracy). Errors occurred when polygons were mapped as DS (2 errors), LB (1 error), and UBS (1 error).

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Rock Barrens			
Treed Rock Barrens			
JPW / JPM	Boreal Pine Rocky Woodland (jack pine phase and mixed pine phase)	61-83% 99-101%	72% of the polygons identified by the aa team as Boreal Pine Rocky Woodland (2483) were mapped correctly as JPW or JPM (producers' accuracy). Errors occurred when polygons were mapped as BSF (1 error), JPL (1error), JPAX (1 error), MPHW (9 errors), and SFA (2 errors). 100% of the polygons mapped as JPW / JPM were identified as Boreal Pine Rocky Woodland (2483) by the aa team (users' accuracy).
JPL	Jack Pine/Lichen Rocky Barrens	97-103% 68-101%	100% of the polygons identified by the aa team as Jack Pine / Lichen Rocky Barrens (2491) were mapped correctly as JPL (producers' accuracy). 84% of the polygons mapped as JPL were identified as Jack Pine / Lichen Rocky Barrens (2483) by the aa team (users' accuracy). Errors occurred when polygons were mapped as ABW (2 errors), and JPW / JPM (1 error).
ABW	Mixed Aspen Rocky Woodland	61-101% 51-85%	85% of the polygons identified by the aa team as Mixed Aspen Rocky Woodland (2487) were mapped correctly as ABW (producers' accuracy). Errors occurred when polygons were mapped as JPL (2 errors), and MPHW (1 error). 68% of the polygons mapped as ABW were identified as Mixed Aspen Rocky Woodland (2487) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AB (5 errors), MPHW (1 error), and SFA (2 errors).
JPOM / MPHW / OW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (jack pine-oak phase, mixed pine-oak phase, and deciduous phase)	96-102% 79-92%	99% of the polygons identified by the aa team as Northern Pin Oak-Bur Oak - (Jack Pine) Rocky Woodland (5246) were mapped correctly as JPOM, MPHW, or OW (producers' accuracy). Error occurred when a polygon was mapped as ABW (1 error). 86% of the polygons mapped as JPOM, MPHW, or OW were identified as Northern Pin Oak-Bur Oak - (Jack Pine) Rocky Woodland (5246) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AB (1 error), ABW (1error), and JPW / JPM (9 errors).

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Shrub and Herb Rock Barrens			
UBS	Boreal Hazelnut-Serviceberry Rocky Shrubland	80-101% 76-99%	90% of the polygons identified by the aa team as Boreal Hazelnut - Serviceberry Rocky Shrubland (5197) were mapped correctly as UBS (producers' accuracy). Errors occurred when polygons were mapped as AS (1 error), AL (1 error), and SFA (1 error). 88% of the polygons mapped as UBS were identified as Boreal Hazelnut - Serviceberry Rocky Shrubland (5197) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AB (1 error), AL (1 error), BO (1 error), and DS (1 error).
MGF	Poverty Grass Granite Barrens	83-117% 83-117%	100% of the polygons identified by the aa team as Poverty Grass Granite Barrens (5157) were mapped correctly as MGF (producers' accuracy). 100% of the polygons mapped as MGF were identified as Poverty Grass Granite Barrens (5157) by the aa team (users' accuracy).
Northern White Cedar-(Hardwood) Forests			
WCU	White Cedar-Boreal Conifer Mesic Forest	75-101% 76-101%	88% of the polygons identified by the aa team as White Cedar - Boreal Conifer Mesic Forest (2449) were mapped correctly as WCU (producers' accuracy). Errors occurred when polygons were mapped as WCS, WCT (1 error), and WCA (2 errors). 88% of the polygons mapped as WCU were identified as White Cedar - Boreal Conifer Mesic Forest (2449) by the aa team (users' accuracy). Errors occurred when polygons were mapped as WCS / WCT (2 errors), and WRM (1 error).
WCA	White Cedar-Yellow Birch Forest	84-103% 67-92%	93% of the polygons identified by the aa team as White Cedar – Yellow Birch Forest (5165) were mapped correctly as WCA (producers' accuracy). Errors occurred when polygons were mapped as AL (1 error), and WP (1 error). 79% of the polygons mapped as WCA were identified as White Cedar – Yellow Birch Forest (5165) by the aa team (users' accuracy). Errors occurred when polygons were mapped as AB (1 error), AL (1 error), SFA (2 errors), WCT / WCS (1 error), and WCU (2 errors).

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Northern Pine-(Hardwood) Forests			
JPAX	Jack Pine-Aspen Forest Mosaic	66-94% 66-94%	83% of the polygons identified by the aa team as associations included in JPAX (2437, 2467, 2466, 2518) were mapped correctly as JPAX (producers' accuracy). Errors occurred when polygons were mapped as BSF (1 error), JPF (3 errors), and WRPA (1 error). 80% of the polygons mapped as JPAX were identified by the aa team as associations included in JPAX. Errors occurred when polygons were mapped as JPW / JPM (1 error), and SFA (5 errors).
JPF	Jack Pine/Balsam Fir Forest	82-103% 65-92%	93% of the polygons identified by the aa team as Jack Pine / Balsam Fir Forest (2437) were mapped correctly as JPF (producers' accuracy). Errors occurred when polygons were mapped as RP (1 error), and AB (1 error). 78% of the polygons mapped as JPF were identified by the aa team as Jack Pine / Balsam Fir Forest (2437). Errors occurred when polygons were mapped as BSF (3 errors), WP (3 errors) and when polygons were mapped as JPF but were identified by aa team as Jack Pine - Aspen / Bush Honeysuckle Forest (2518, 3 errors).
WRPA	White Pine-Red Pine-Quaking Aspen-Paper Birch Forest	74-96% 87-102%	85% of the polygons identified by the aa team as associations included in WRPA (2443, 2445, 2467, 2466, 2520, 2479) were mapped correctly as WRPA (producers' accuracy). Errors occurred when polygons were mapped as WP (2 errors), AB (2 errors), RP (1 error), and WCU (1 error). 94% of the polygons mapped as WRPA were identified by the aa team as associations included in WRPA. Errors occurred when polygons were mapped as JPW/JPM (1 error) and JPAX (1error).
RP	Red Pine/Blueberry Dry Forest	72-98% 76-101%	85% of the polygons identified by the aa team as Red Pine / Blueberry Dry Forest (2443) were mapped correctly as RP (producers' accuracy). Errors occurred when polygons were mapped as AB (1 error), and WP (3 errors). 88% of the polygons mapped as RP were identified by the aa team as Red Pine / Blueberry Dry Forest (2443). Errors occurred when polygons were mapped as JPF (1 error), WP (1 error) and WRPA (1 error).

MAP UNIT CODE	MAP UNIT NAME	CONFIDENCE INTERVAL PRODUCER'S/ USERS	COMMENTS Producers' accuracy (errors of omission) is the probability that the map actually represents what was found on the ground. Users' accuracy (errors of commission) is the probability that an accuracy assessment point has been mapped correctly. Producers or users' accuracy is considered acceptable when 80% falls within the confidence interval. Errors are explained in the Comment Section.
WP	White Pine/Mountain Maple Mesic Forest	77-101% 63-91%	89% of the polygons identified by the aa team as White Pine / Mountain Maple Mesic Forest (2445) were mapped correctly as WP (producers' accuracy). Errors occurred when polygons were mapped as JPF (1 error), SFA (1 error), and RP (1 error). 77% of the polygons mapped as WP were identified by the aa team as White Pine / Mountain Maple Mesic Forest (2445). Errors occurred when polygons were mapped as RP (3 errors), SFA (1 error), WCA (1 error), and WRPA when polygons were identified by aa team as pine-aspen mixed forest types (2479/2520, 2 errors).
Northern Spruce-Fir-(Hardwood) Forests			
SFA	Spruce-Fir-Aspen Forest	54-79% 59-83%	67% of the polygons identified by the aa team as Spruce - Fir - Aspen Forest (2475) or as Black Spruce - Aspen Forest (5116) were mapped correctly as SFA (producers' accuracy). Errors occurred when polygons were mapped as ABW (2 errors), AL (1 error), JPAX (5 errors), MPHW (1 error), SF (4 errors), WCA (2 errors) and WP (1 error). 71% of the polygons mapped as SFA were identified by the aa team as Spruce - Fir - Aspen Forest (2475) or as Black Spruce - Aspen Forest (5116). Errors occurred when polygons were mapped as AB (5 errors), AL (1 error), BA (1 error), BSF (1 error), JPW / JPM (2 errors), SF (1 error), UBS (1 error), WP (1error).
BSF	Black Spruce/Feathermoss Forest	65-93% 72-98%	79% of the polygons identified by the aa team as Black Spruce / Feathermoss Forest (2447) were mapped correctly as BSF (producers' accuracy). Errors occurred when polygons were mapped as JPF (3 errors), SF (2 errors), and SFA (1 error). 85% of the polygons mapped as BSF were identified by the aa team as Black Spruce / Feathermoss Forest (2447). Errors occurred when polygons were mapped as BSL / BST (1error), JPAX (1error), JPW / JPM (1 error), and SF (1 error).
SF	Spruce-Fir/Mountain Maple Forest	80-103% 64-93%	92% of the polygons identified by the aa team as Spruce Fir - Mountain Maple Forest (2446) or Balsam Fir - Paper Birch Forest (2474) were mapped correctly as SF (producers' accuracy). Errors occurred when polygons were mapped as BSF (1 error), and SFA (1 error). 79% of the polygons mapped as SF were identified by the aa team as Spruce Fir - Mountain Maple Forest (2446) or Balsam Fir - Paper Birch Forest (2474). Errors occurred when polygons were mapped as BSF (2 errors), and SFA (4 errors).

MAP UNIT CODE	MAP UNIT NAME	CONFIDENCE INTERVAL PRODUCER'S/ USERS	COMMENTS Producers' accuracy (errors of omission) is the probability that the map actually represents what was found on the ground. Users' accuracy (errors of commission) is the probability that an accuracy assessment point has been mapped correctly. Producers or users' accuracy is considered acceptable when 80% falls within the confidence interval. Errors are explained in the Comment Section.
Boreal Hardwood Forests			
AB	Quaking Aspen-Paper Birch Forest	52-77% 72-95%	65% of the polygons identified by the aa team as Aspen - Birch / Boreal Conifer Forest (2466) or Aspen - Birch - Red maple Forest (2467) were mapped correctly as AB (producers' accuracy). Errors occurred when polygons were mapped as ABW (5 errors), AL (3 errors), BO (1 error), MPHW (1 error), SFA (5 errors), UBS (1 error), and WCA (1 error). 84% of the polygons mapped as JPF were identified by the aa team as Jack Pine / Balsam Fir Forest (2437). Errors occurred when polygons were mapped AL (1 error), BA (1 error), JPF (1 error), and RP (1 error). One polygon mapped as AB was identified by the aa team as White Pine - Aspen - Birch Forest (2479).
PB	Paper Birch/Fir Forest	41-119% 88-113%	80% of the polygons identified by the aa team as Paper Birch / Fir Forest (2463) were mapped correctly as JPF (producers' accuracy). An errors occurred when a polygon was mapped as AL (1 error). 100% of the polygons mapped as PB were identified by the aa team as Paper Birch / Fir Forest (2463
AL	Trembling Aspen-Balsam Poplar Lowland Forest	57-93% 44-81%	75% of the polygons identified by the aa team as were mapped correctly as AL (producers' accuracy). Errors occurred when polygons were mapped as AB (1 error), BA (1error), SFA (1 error), UBS (1 error), and WCA (1 error). 63% of the polygons mapped as AL were identified by the aa team as Trembling Aspen - Balsam Poplar Lowland Forest (5036). Errors occurred when polygons were mapped as AB (3 errors), AS (1 error) BA (1 error), WCBA (1 error).
Northern Hardwood Forests			
BO	Northern Bur Oak Mesic Forest	84-102% 84-102%	93% of the polygons identified by the aa team as Northern Bur Oak Mesic Forest (2072) were mapped correctly as BO (producers' accuracy). Errors occurred when polygons were mapped as BA (1 error), and UBS (1 error). 93% of the polygons mapped as BO were identified by the aa team as Northern Bur Oak Mesic Forest (2072). Errors occurred when polygons were mapped as AB (1 error), and BA (1 error).

3.7 Recommendations for Future Projects

Several ideas for improving the mapping process have surfaced as a result of the Voyageurs project. Improving the mapping process in ways suggested herein would save time and money, and provide for more accurate mapping.

Aerial Photographs

Having two sets of aerial photographs (fall 1995/1996 and fall 1988) for this mapping project provided invaluable information in distinguishing between several vegetation types and maximized the interpretation effort. Differences in phenological stages of the vegetation between the 2 photo sets allowed interpretation that would not have been possible if only one set was used. It is recommended that whenever possible, two sets of aerial photographs should be acquired.

Classification Development

It is highly recommended that a completed (or nearly completed) classification be in place before the actual interpretation begins. Ideally, mappers and ecologists should do field reconnaissance together so that a strong connection between mapping and classification is created from the beginning of the project. Plot sampling should begin early in the project, followed by analysis of the vegetation data before the mappers begin ground-truthing and interpretation of the aerial photographs. It is important that the mappers have written descriptions of the associations and a vegetation key during ground-truthing so that their understanding of the vegetation types can be related to the photo signatures. It is not only frustrating and time consuming to ground truth aerial photos and build map unit classifications when the types are not known or well-understood, but it also leads to incorrect mapping. Further, unnecessary time is spent mapping polygons that, in the end, turn out to be phases of associations. The Voyageurs project has 9 map units that fall into this phase category, which in turn represent 4 plant communities. What has not been discussed in this report is the 5 or 6 situations where map units have been collapsed together (performed globally in GIS), decisions made after the vegetation classification was better understood. It cannot be emphasized enough the extensive amount time that goes into map unit development, mapping convention, interpretive decisions, and even the map production when a good grasp of the vegetation communities is not well understood. Most importantly, lengthy explanations are needed to describe disparities between map units and associations because the two systems (classification and map unit) have used different approaches to describe the vegetation. No matter how clearly the linkages are described, the potential for confusion remains. The purpose for using the USNVC is to promote increased sharing, exchanging, and comparing of vegetation-related data among federal government agencies and other partners. This is greatly hindered when map units deviate from the USNVC.

Accuracy Assessment

Accuracy assessment forms need to be standardized throughout the mapping program. The data sheets need to include finer resolution of cover scales for species and for strata. Vegetation types are typically separated from one another based on percent cover, and the right information needs to be recorded so that the data sheets can be re-evaluated if necessary during the accuracy assessment analysis. For the Voyageurs project, several errors were discovered when cover estimates were incorrect for the vegetation types listed. However, for several other data sheets, the cover scales used were often too broad to evaluate whether the correct vegetation type had been selected.

Front-loading accuracy assessment is *not* recommended if at all possible. For Voyageurs, this led to two different approaches for fieldwork and caused confusion, controversy, and extra effort of everyone involved. The digital data is important to complete before the accuracy assessment teams work in the field so that a digital map of the polygons can be provided.

Better methodologies for selecting accuracy assessment points need to be developed. While stratified random selection may continue as the preferred approach, many other considerations need to be built into an automated program that is beyond the expertise of the mapping team. A statistician who understands logistical and spatial issues in addition to proper application of statistical methodologies should be available to every park. Further, a statistician could build the proper statistical programs for running analysis of the accuracy assessment data.

Reports and Formating

A standard format for reports is needed. The standard format should include tables, graphics, and appendices that are consistent throughout the program and are designed to present the information in a user-friendly way. In addition, the standard should include introductory material, a glossary, and a reference section so that all reports provide some of the basic information about the program.

GPS Data Collection

It is vital that all GPS reference data be collected in the same datum, North American Datum of 1983.

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5. DICHOTOMOUS KEY TO THE PLANT COMMUNITIES AT VOYAGEURS NATIONAL PARK

Version 3.6

- This is a key to the community types identified in the park. All assessments of plant communities in the field must be done on an area of 625 m2 (50m diameter around point).
- The term dominance in the context of woodland communities means greater than 25% cover. In the context of forest, shrub and herbaceous communities, dominance means greater than 60% cover.
- Species listed after "*" are indicator species for that community type and are often (but not always) present.
- When the term "total tree canopy cover" is used, this refers to the absolute canopy cover. All other cover values refer to relative canopy cover e.g. if total canopy cover is 40%, >25% cover of tamarack refers to 25% of the 40% total cover. The linkages between community types and map units are presented in Table 5, page 37.

1. UPLANDS. Absence of standing water and/or peat soil. Mineral soil that is not saturated throughout the growing season.

2. Well drained soils. Canopy dominated by one or more of the following: *Pinus* spp., *Quercus* spp., *Picea* spp., *Betula* spp., *Populus tremuloides, P. grandidentata.* If dominated by *Populus tremuloides* or *P. grandidentata* then *P. balsamifera, Thuja occidentalis,* or *Fraxinus nigra* present in canopy or shrub layers at <10% cover. ** Clintonia borealis, Corylus cornuta, Prunus virginiana, Viburnum rafinesquianum.*

3. Dominated by shrubs or herbaceous vegetation. Total tree canopy < 25%.
4. Dominated by herbaceous vegetation (shrub cover < 25%). **Poverty Grass Granite Barrens (5157)**
4. Dominated by shrubs (shrubs > 25% cover). **Boreal Hazelnut-Serviceberry Rocky Shrubland (5197)**

3. Forest or Woodland. Total tree canopy > 25% (or if <25%, dominated by bedrock and lichens, not shrubs).
5. Canopy dominated by evergreen trees or a mixture evergreen and deciduous trees. Percent cover of evergreen trees in canopy > 25%.
6. Canopy dominated by *Pinus banksiana* with or without *Quercus ellipsoidalis* or *Populus* spp.
7. Canopy consisting primarily of *Pinus banksiana. Quercus ellipsoidalis* or *Populus* spp. absent or present < 25%.
8. Woodland. Total tree canopy cover < 60% and canopy closure prevented by the presence of exposed bedrock.
9. Sparsely vegetated, total tree canopy cover < 25%. Dominated by bedrock and lichens. **Jack Pine / Lichen Rocky Barrens (2491)**
9. Total tree canopy cover 25-60%. **Boreal Pine Rocky Woodland (jack pine phase) (2483)**
8. Forest. Total tree canopy cover > 60%. Or, if <60%, then canopy closure not prevented by the presence of exposed bedrock. **Jack Pine / Balsam Fir Forest (2437)**
7. Canopy consisting of a mix of *Pinus banksiana* and *Populus* spp. or *Pinus banksiana* and *Quercus* spp. Deciduous trees comprising > 25% cover.
10. Canopy consisting of a mix of *Pinus banksiana* and *Populus* spp. each with > 25% cover. **Jack Pine - Aspen / Bush Honeysuckle Forest (2518**). This type is uncommon
10. Canopy consisting of *Pinus banksiana* and *Quercus ellipsoidalis* each with > 25% cover. *Populus* spp. absent in canopy or present at < 25% cover. **Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland** (jack pine-oak phase) **(5246)**
6. Canopy dominated *by Pinus strobus, Pinus resinosa, Picea* spp., *Populus* spp., and/or *Betula papyrifera.*
11. Canopy dominated by *Pinus resinosa* and/or *Pinus strobus*. Or canopy a mix of *Pinus resinosa* and *Pinus strobus* with *Populus* spp. and/or *Betula papyrifera*.
12. Forest. Total tree canopy cover > 60%. Or, if <60%, then canopy closure not prevented by the presence of exposed bedrock.
13. Dominant conifer *Pinus strobus*. *Pinus resinosa* in canopy < 60%. ** Rubus pubescens, Clintonia borealis.*

14. < 25% hardwoods (*Populus* spp. and/*or Betula papyrifera*) in canopy. **White Pine / Mountain Maple Mesic Forest Community (2445)**

14. > 25% hardwoods (*Populus* spp. and/or *Betula papyrifera*) in canopy. **White Pine - Aspen - Birch Forest (2479)**

13. Dominant conifer *Pinus resinosa* (may contain < 25% *P. strobus* in canopy). * *Pleurozium schreberii, Dicranum* spp., *Picea mariana, Abies balsamea*.

15. < 25% hardwoods (*Populus* spp. and/or *Betula papyrifera*) in canopy. **Red Pine / Blueberry Dry Forest Community (2443)**

15. > 25% hardwoods (*Populus* spp. and/or *Betula papyrifera*) in canopy. **Red Pine - Aspen - Birch Forest Community (2520)**

12. Woodland. Total tree canopy cover < 60% and canopy closure prevented by the presence of exposed bedrock. *Pinus strobus* and *Pinus resinosa* common, *Picea* spp. uncommon, with or without a mixture of hardwoods, typically *Populus* spp. and/or *Betula papyrifera*.

15a. < 25 hardwoods (typically *Populus* spp. and/*or Betula papyrifera*) in canopy. **Boreal Pine Rocky Woodland** (mixed pine phase) **(2483)**

15a. > 25% hardwoods (*Populus* spp. and/or *Betula papyrifera*) in canopy. **Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland** (mixed pine-oak phase) **(5246)**

11. Canopy dominated solely by *Picea* spp. or a mixture of *Picea* spp. with *Populus* spp. and/or *Betula papyrifera*.

16. Woodland. Total tree canopy cover < 60%, evergreen dominated, and canopy closure prevented by the presence of exposed bedrock. **Boreal Pine Rocky Woodland** (mixed pine phase) **(2483).** This is an uncommon variant of the mixed pine phase. Rare cases of mixed evergreen-deciduous stand of *Picea* spp. mixed with hardwoods should be placed in the **Northern Pin Oak - Bur Oak (Jack Pine) Rocky Woodland (mixed pine-oak phase; 5246)**

16. Forest. Total tree canopy cover > 60%. Or, if <60%, then canopy closure not prevented by the presence of exposed bedrock.

17. Canopy dominated solely by *Picea* spp. Percent cover of *Populus* spp. and/or *Betula papyrifera* < 25%.

18. Canopy dominated exclusively *by Picea mariana.* * *Picea mariana, Sphagnum* spp., *Gaultheria procumbens, Pleurozium schreberii*. **Black Spruce / Feathermoss Forest (2447)**

18. Canopy dominated by *Picea glauca* (*P. mariana* may be present). * *Lycopodium obscurum, L. complanatum*. **Spruce - Fir / Mountain Maple Forest Community (2446)**

17. Canopy a mixture of *Picea* spp., *Abies balsamea* and *Populus* spp. and/or *Betula papyrifera.* Percent canopy cover of these hardwoods > 25%.

19. Canopy a mixture of *Picea glauca* and *Populus* spp. and/or *Betula papyrifera*, with occasional dominance by *Abies balsamea*. **Spruce - Fir - Aspen Forest (2475);** rarely **Balsam Fir - Paper Birch Forest (SFA; 2474),** a very minor type.

19. Canopy a mixture of *Picea mariana* and *Populus* spp. and/or *Betula papyrifera.* **Black Spruce Aspen Forest (2516)** a very minor type

5. Canopy dominated by deciduous trees. Percent cover of evergreen trees in canopy < 25%.

20. Canopy dominated by *Quercus macrocarpa, Q. ellipsoidalis, Tilia americana* or *Fraxinus pensylvanica*.

21. Forest or woodland canopy dominated by *Q. ellipsoidalis*. Or woodland dominated by *Q. macrocarpa* with < 60% cover and canopy closure prevented by the presence of exposed bedrock. **Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland** (deciduous phase) **(5246)**

21. Canopy dominated by *Quercus macrocarpa, Fraxinus pensylvanica*, and/or *Tilia americana*. Forest. Total tree canopy cover >60% and canopy closure not prevented by the presence of exposed bedrock. **Northern Bur Oak Mesic Forest (2072)**

20. Canopy dominated by *Populus* spp. and/or *Betula papyrifera*.

22. Forest. Total tree canopy cover >60%. Or, if <60%, then canopy closure not prevented by the presence of exposed bedrock.

23. Canopy dominated by *Populus* spp. **Aspen - Birch / Boreal Conifer Forest (2466),** rarely **Aspen - Birch - Red Maple Forest (2467),** a very minor type.

23. Canopy dominated *by Betula papyrifera*. *Populus* spp. < 10 %. **Paper Birch / Fir Forest (2463)**

22. Woodland. Total tree canopy cover < 60% and canopy closure prevented by the presence of exposed bedrock. * Cladonia spp. Canopy cover <60%. **Mixed Aspen Rocky Woodland (2487)**

2. Poorly drained soils, canopy dominated by *Populus* spp., *Fraxinus nigra, Thuja occidentalis*. If dominated by *Populus* spp. then *P. balsamifera*, *Thuja occidentalis*, or *Fraxinus nigra* present in canopy or shrub layers at >10% cover.

24. Canopy dominated by *Populus tremuloides, P. grandidentata*, and/or *P. balsamifera*. Or a mix of *Populus* spp. and *Thuja occidentalis.*

25. Thuja occidentalis absent or present < 25% cover. **Trembling Aspen - Balsam Poplar Lowland Forest (5036)**

25. Thuja occidentalis present in the canopy or subcanopy > 25% cover. **White Cedar - Yellow Birch Forest (2450)**

24. Canopy dominated by *Fraxinus nigra* and/or *Thuja occidentalis*.

26. Canopy consists solely of *Fraxinus nigra* (*T. occidentalis* may be present in the sub-canopy).

27. Canopy of *F. nigra* with > 25% *T. occidentalis* in subcanopy. **White Cedar - Black Ash Swamp (5165)**

27. Canopy of *F. nigra* with < 25% *T. occidentali*s in the subcanopy. **Black Ash - Mixed Hardwood Swamp (2105)**

26. Canopy consists solely of *T. occidentalis* (F. nigra <25%) or consists of a mix *of T. occidentalis* and *F. nigra* each comprising at least 25% cover. * *Thelypteris phegopteris, Lonicera canadensis, Actaea* spp., *Streptopus roseus*.

28. Canopy dominated by *T. occidentalis* with < 25% *F. nigra*. **White Cedar - Boreal Conifer Mesic Forest (2449)**

28. Canopy mixed *T. occidentalis* and *F. nigra* with at least 25% cover of each. **White Cedar - Black Ash Swamp (5165)**

1. WETLANDS. Presence of standing water, saturated mineral soil, or peat soil.

29. Non-peatland wetlands, *Sphagnum* spp. absent or present < 25% cover.
30. Permanently flooded. Standing water ≥ 0.5 meters deep.
31. Dominated by *Typha* spp., *Carex lasiocarpa, Equisetum fluviatile* or *Phragmites australis*.
32. Dominated by *Typha* spp. **Midwest Cattail Deep Marsh (2233)**
32. Dominated by *Carex lasiocarpa, Equisetum fluviatile,* or *Phragmites australis*.
33. Dominated by *Carex lasiocarpa*. **Wiregrass Sedge Shore Fen (5229)**
33. Dominated by *Equisetum fluviatile* or *Phragmites australis.*
34. Dominated by *Phragmites australis.* **Eastern Reed Marsh (4141)**
34. Dominated by *Equisetum fluviatile*. **Water Horsetail - Spikerush Marsh (5258)**
31. Dominated by one or more of the following: *Potamogeton* spp., *Scirpus* spp., *Zizania palustris, Brasenia schreberii, Nymphaea odorata.*
35. Dominated by floating water aquatics especially *Brasenia schreberii* or *Nymphaea odorata* (> 10% cover). **Northern Water Lily Aquatic Wetland (2562)**
35. Dominated by emergent or submerged aquatics. *Potamogeton* spp., *Scirpus* spp. or *Zizania palustris.* Usually located on large, open lakes or bays.
36. Dominated by submerged aquatics *(Ceratophyllum demersum, Potamogeton* spp., *Myriophyllum* spp.). Emergent and floating aquatics < 10% cover. **Midwest Pondweed Submerged Aquatic Wetland (2282)**
36. Dominated by emergent aquatics (submerged aquatics may be present).
37. Dominated by *Zizania palustris*. **Wild Rice Marsh (2382)**
37. Dominated by *Scirpus* spp. **Freshwater Bulrush Marsh (2225)**
30. Not permanently flooded. Or, if permanently flooded, then standing water ≤ 0.5 meters deep.
38. Dominated by trees (*Populus* spp., *Fraxinus nigra, Thuja occidentalis*.) Go to couplet 26
38. Dominated by shrubs, graminoids, or herbs.
39. Shrub dominated.
40. Dominant shrub *Alnus incana*. **Speckled Alder Swamp (2381)**
40. Dominant shrubs *Salix* spp. and/or *Cornus* spp. **Dogwood - Pussy Willow Swamp (2186)**
39. Graminoid or herb dominated.
41. Community dominated by *Calamagrostis canadensis*. **Canada Bluejoint Eastern Meadow (5174)**
41. Community not dominated by *Calamagrostis canadensis.* Community dominated by *Equisetum fluviatile, Carex* spp. or *Typha* spp.
42. Dominated by *Equisetum fluviatile* **Water Horsetail - Spikerush Marsh (5258)**
42. Not dominated by *Equisetum fluviatile*. Dominated by *Carex* spp. and/or *Typha* spp.
43. Percent cover of *Carex* spp. 50% or greater. **Northern Sedge Wet Meadow (2257)**
43. Percent cover of *Carex* spp. < 50%. Community dominated by *Typha* spp. **Midwest Cattail Deep Marsh (2233)**

29. Peatlands. *Sphagnum* spp. present > 25% cover.
    44. Dominated by shrubs or graminoids, trees < 25% cover.
        45. Dominated by graminoids.
            46. Dominated by *Carex lasiocarpa*. Community restricted to water tracts of Rat Root peatland **Northern Sedge Poor Fen (2265)**
            46. Not dominated by *Carex lasiocarpa.* Community found outside Rat Root Peatland. Dominated by *Carex* spp. (commonly *C. lacustris, C. rostrata, C. vesicaria,* and/or *C. stricta*). **Northern Sedge Wet Meadow (2257)**
        45. Dominated by shrubs.
            47. Dominated by *Salix* spp. and/or *Cornus* spp. **Dogwood - Pussy Willow Swamp (2186)**
            47. Dominated by *Alnus incana, Chamadaphne calyculata,* or *Betula glandulifera.*
                48. Dominated by *Alnus incana*. **Speckled Alder Swamp (2381)**
                48. Dominated by *Chamadaphne calyculata* and/or *Betula glandulifera*.
                49. Minerotrophic indicators present e.g. *Salix* spp., *Betula glandulifera, Alnus incana, Equisetum fluviatile, Calamagrostis canadensis, Spirea alba, Campanula aparanoides, Myrica gale*. Commonly shoreline situations.
                50. > 25% *Betula glandulifera* (*Chamadaphne calyculata* and *Salix* spp. may also be present)
                51. Restricted to the Rat Root River Peatland, except along shoreline to Lake Kabetogama. **Bog Birch - Leatherleaf Poor Fen (2494)**
                51. Found outside the Rat Root River Peatland and along Rat Root River Peatland shoreline to Lake Kabetogama. Common in shoreline situations. **Bog Birch - Willow Shore Fen (5227)**
                50. < 25% *Betula glandulifera*. Community dominated by *Chamadaphne calyculata*. Other shrubs present but cover < 25%. **Leatherleaf - Sweet gale Shore Fen (5228)**
                49. Minerotrophic indicators absent. Not (or rarely) shoreline situations.
                52. Dominated by *Chamadaphne calyculata*. Conifers (usually *Picea mariana* and *Larix laricina*) < 10 % cover. **Leatherleaf Bog (2498)**
                52. Dominated by *Chamadaphne calyculata*. Conifers (usually *Picea mariana* and *Larix laricina*) 10-25% cover. **Black Spruce / Leatherleaf Semi-treed Bog (5218)**
    44. Dominated by trees, total tree canopy cover > 25%. Woodland or forest physiognomy.
        53. *Larix laricina* present > 25% cover.
            54. Dominated by *Larix laricina*. Other conifers absent or present < 25%.
                55. Graminoid layer dominated by *Carex lasiocarpa*. Restricted to Rat Root Peatland. **Tamarack Scrub Poor Fen (5226),** a very minor type
                55. Graminoid layer not dominated by *Carex lasiocarpa*. Not restricted to Rat Root Peatland. **Northern Tamarack Rich Swamp (2471)**
            54. Dominated by mixture of *Larix laricina* and other conifers (*Picea mariana, Thuja occidentalis*). Other conifers present > 25% cover.
                56. Dominated by mixture of *Larix laricina* and *Black Spruce*. Woodland or forest physiognomy. **Black Spruce / Labrador Tea Poor Swamp (mixed phase) (2454)**
                56. Dominated by mixture of *Larix laricina and Thuja occidentalis*. Woodland or forest physiognomy. **White Cedar - (Mixed Conifer) /Alder Rich Swamp** (tamarack phase) **(2456)**
        53. *Larix laricina* absent or present < 25% cover. Dominated by *Picea mariana* or *Thuja occidentalis*.
            57. Dominated by *Thuja occidentalis*. **White Cedar - (Mixed Conifer) / Alder Swamp (2456)**
            57. Dominated by *Picea mariana*.
                58. *Alnus incana* dominant in shrub layer. Other minerotrophic species present, including *Carex lacustris, Dryopteris carthusiana* and *Calamagrostis canadensis.* **Black Spruce / Alder Rich Swamp (2452)**
                58. *Alnus incana* not dominant in shrub layer. Minerotrophic species absent.
                59. Present in confined basins. * *Pleurozium schreberii, Vaccinium angustifolium*. **Black Spruce / Labrador Tea Poor Swamp** (evergreen phase) **(2454)**
                59. Present within large peatlands. Restricted to the Rat Root Peatland and large peatland in Cranberry Bay. **Black Spruce Forested Bog (2485)**

6. VEGETATION COMMUNITY DESCRIPTIONS OF VOYAGEURS NATIONAL PARK

6.1 Bogs

Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum spp. Forest (Black Spruce Bog)

COMMON NAME	Black Spruce / Labrador-tea / Three-fruit Sedge / Peatmoss species Forest
SYNONYM	Black Spruce Bog
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g)
ALLIANCE	PICEA MARIANA SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is found in the Rat Root River peatland area and in the peatland complex between Black Bay and Cranberry Bay.

Globally

This association is found in Maine, Michigan, Minnesota, Manitoba, Ontario, and probably Wisconsin.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Black Spruce Bog is found in situations removed from ground and surface water inputs and only in the interior of large peatlands. It may occur at the crests of raised bogs and adjacent to water tracks. The substrate is deep, acidic Sphagnum peat which is mineral poor. Hummock and hollow microtopography is moderately to well developed. The water regime is saturated.

Globally

Stands are found most typically on the crests of raised bog landforms in large peatland complexes, as well as in basin bogs, where the peat mat surface is removed from contact with ground and surface water inputs. Sites are poorly drained, with wet, saturated organic substrates. Hummock and hollow microtopography is moderately to well developed. (Sims *et al.* 1989, Minnesota DNR 1993, McCarthy *et al.* 1994, Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea mariana*
Tall shrub	*Picea mariana*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex trisperma*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Tree canopy	*Picea mariana*
Tall shrub	*Picea mariana*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*

Graminoid	*Carex trisperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea mariana, Ledum groenlandicum, Chamaedaphne calyculata, Carex trisperma

Globally

Picea mariana, Ledum groenlandicum, Chamaedaphne calyculata, Carex trisperma

VEGETATION DESCRIPTION

Voyageurs National Park

This community includes both a woodland and a forested phase, so canopy cover is widely variable. *Picea mariana* trees dominate this type and are typically 10-15 m tall in the forested phase and 5-10 m tall in the woodland phase. Scattered *Larix laricina* trees are occasionally present. The canopy, especially in the woodland phase, tends to be uneven aged. Shrub strata are usually absent, though *Picea mariana* saplings may be present at low cover. The dwarf-shrubs *Ledum groenlandicum* and *Chamaedaphne calyculata* are nearly always present, but cover is highly variable, ranging from 20-90%. Other ericaceous shrubs such as *Kalmia polifolia, Andromeda polifolia,* and *Vaccinium oxycoccos* can also be present at low cover. The herbaceous strata is species poor and present at low density, usually less than 40% cover. The most widespread species are *Carex trisperma* and *Maianthemum trifolium*. In some cases, *Carex chordorhiza* or *Carex pauciflora* may take the place of *Carex trisperma*. The herbs *Eriophorum vaginatum, Cornus canadensis, Drosera rotundifolia,* and *Sarracenia purpurea* may also be present at low cover. Sphagnum moss typically covers nearly 100% of the forest floor. The most abundant species are *Sphagnum magellanicum, Sphagnum recurvum sensu lato,* and *Sphagnum fuscum.*

Globally

Trees cover at least 25% of the canopy, varying in height from 3 m to over 10 m. *Picea mariana* is often the sole species in the canopy. *Larix laricina* may occasionally occur. The dwarf-shrub layer is dominated by *Ledum groenlandicum* and other ericaceous shrubs, such as *Chamaedaphne calyculata, Vaccinium myrtilloides, Vaccinium oxycoccos, Kalmia polifolia, Gaultheria hispidula,* and *Andromeda polifolia*. *Picea mariana* may also be found in scrub form in this layer. The ground cover consists of a species-poor herb layer, with *Carix trisperma, Eriophorum vaginatum,* and *Maianthemum trifolium* most prevalent. In northern Minnesota, *Carex chordorhiza* or *Carex pauciflora* may take the place of *Carex trisperma* in some stands, and the herbs *Eriophorum vaginatum, Cornus canadensis, Drosera rotundifolia,* and *Sarracenia purpurea* may also be present at low cover (M. Smith personal communication 1999). Moss cover is a *Sphagnum* carpet with patches of feathermoss (especially *Pleurozium schreberi*) and conifer litter beneath the trees. Dominant sphagnum species include *Sphagnum magellanicum, Sphagnum fuscum,* and *Sphagnum angustifolium*, and less commonly, *Sphagnum capillifolium, Sphagnum nemoreum,* and *Sphagnum girgensohnii*. Minerotrophic indicators, such as *Betula pumila, Carex stricta,* and *Carex aquatilis,* are absent (Sims *et al.* 1989, Minnesota NHP 1993, McCarthy *et al.* 1994, Harris *et al.* 1996).

CONSERVATION RANK G5.

DATABASE CODE CEGL002485

COMMENTS

Voyageurs National Park

Diagnostic features of the type are forested or woodland canopy of *Picea mariana* within a large peatland, often with a raised bog, and a species-poor understory. The woodland (25-60%) and forested (60-100%) phases can be distinguished through mapping, but appear to be the same type floristically. The type is analogous to Ontario's W26, which includes all treed bog stands with tree cover > 25% (Harris *et al.* 1996). In some cases, this community closely resembles more nutrient poor examples of the Black Spruce/Labrador Tea Poor Swamp. The Black Spruce/Labrador Tea Poor Swamp will generally contain more minerotrophic indicators than the Black Spruce Bog. Position on the landscape, however, is the best way to distinguish these types. The Black Spruce Bog is found only in the interior of large peatlands whereas the Black Spruce/Labrador Tea Poor Swamp is found in confined basins, shores, and the margins of large peatlands.

In the park and environs this community has been mapped only in the Rat Root Peatland and in a large peatland between Cranberry and Black Bays.

REFERENCES

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field guide FG-01. 74 p.

Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.

Sims, R. A., W. D. Towill, K. A. Baldwin, and G. M. Wickware. 1989. Field guide to the forest ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources.

Picea mariana / Chamaedaphne calyculata / Sphagnum spp. Dwarf-shrubland (Black Spruce / Leatherleaf Semi-treed Bog)

COMMON NAME	Black Spruce / Leatherleaf / Peatmoss species Dwarf-shrubland
SYNONYM	Black Spruce / Leatherleaf Semi-treed Bog
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A)
PHYSIOGNOMIC GROUP	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (IV.A.1.N)
FORMATION	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g)
ALLIANCE	CHAMAEDAPHNE CALYCULATA SATURATED DWARF-SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type occurs throughout the park and is extensive in the Rat Root Peatland.

Globally

This association is found in northern Minnesota, northern Michigan, northern Wisconsin, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs in confined basins, as part of large peatlands and as part of peatland shores. In the latter case, this type usually occurs away from the water's edge, often separated from it by a shrub bog. The substrate is deep fibric Sphagnum peat, which is mineral poor. High hummocks are often well developed while hollows are poorly developed. The water regime is saturated.

Globally

Sites are on the crests of raised bogs in large peatland complexes, in basin bogs, and occasionally on shores isolated from ground water influence (Sims *et al.* 1989, Harris *et al.* 1996). The substrate is deep fibric Sphagnum peat, which is mineral poor. High hummocks are often well developed while hollows are poorly developed. The water regime is saturated.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Picea mariana, Larix laricina*
Short shrub	*Chamaedaphne calyculata,*
Forb	*Maianthemum trifolium, Sarracenia purpurea*
Graminoid	*Eriophorum vaginatum*
Nonvascular	*Sphagnum magellanicum, Sphagnum fuscum, Sphagnum angustifolium*

Globally

Stratum	Species
Tall shrub	*Picea mariana, Larix laricina*
Short shrub	*Chamaedaphne calyculata,*
Forb	*Maianthemum trifolium, Sarracenia purpurea*
Graminoid	*Eriophorum vaginatum*
Nonvascular	*Sphagnum magellanicum, Sphagnum fuscum, Sphagnum angustifolium*

CHARACTERISTIC SPECIES

Voyageurs National Park

Chamaedaphne calyculata,Picea mariana, Larix laricina, Eriophorum vaginatum, *Sphagnum* spp.

Globally

Chamaedaphne calyculata,Picea mariana, Larix laricina, Eriophorum spp., *Carex oligosperma, Carex pauciflora, Sarracenia purpurea, Sphagnum* spp.

VEGETATION DESCRIPTION

Voyageurs National Park

Picea mariana and/or *Larix laricina* are the dominate conifers in this community, though in some cases, *Pinus strobus* may be locally abundant. These conifers are present at 10-25% cover and are usually 2-10 m tall. The dwarf-shrub layer consists mainly of *Chamaedaphne calyculata* and usually comprises 90-100% cover. Other dwarf ericaceous shrubs such as *Andromeda polifolia, Kalmia polifolia, Vaccinium oxycoccos* and *Ledum groenlandicum* are often present but rarely make up a significant cover. The herbaceous strata is poorly developed with low species diversity and very sparse cover, typically less than 10%. The most abundant species are *Maianthemum trifolium, Eriophorum vaginatum, Sarracenia purpurea, Carex oligosperma* and *Drosera rotundifolia*. Minerotrophic indicators are absent. *Sphagnum magellanicum, Sphagnum fuscum,* and *Sphagnum angustifolium* form a continuous carpet of peat moss. Typically, *Sphagnum fuscum* dominates the high hummocks, *Sphagnum magellanicum* dominates the lower and developing hummocks and *Sphagnum angustifolium* colonizes the hollows. Other mosses such as *Aulacomnium palustre* and *Polytrichum strictum* may also be present.

Globally

Vegetation structure is complex with a dominant layer of dwarf-shrubs, stunted trees and hummock-hollow microtopography, sometimes referred to as muskeg. Ericaceous dwarf-shrubs dominante the stand, with over 40% cover. Dominant species include *Andromeda polifolia, Chamaedaphne calyculata, Kalmia polifolia,* and *Ledum groenlandicum*. Creeping dwarf-shrubs include *Gaultheria hispidula* and *Vaccinium oxycoccos*. Trees average about 10 - 25% cover, may be stunted (3 m tall), and are often clumped on higher hummocks with intervening, weakly-developed hollows. Typical species include *Picea mariana* and *Larix laricina*. The herbaceous layer contains graminoids such as *Carex oligosperma, Carex pauciflora,* and *Eriophorum vaginatum,* and forbs such as *Maianthemum stellatum* and *Sarracenia purpurea*. The nonvascular layer contains a carpet of *Sphagnum* (including *Sphagnum fuscum* and *Sphagnum magellanicum*), with patches of *Pleurozium schreberi* (Sims *et al.* 1989, Harris *et al.* 1996).

CONSERVATION RANK G?

DATABASE CODE CEGL005218

COMMENTS

Voyageurs National Park

Diagnostic features of the type are the dwarf-shrub layer dominated by *Chamaedaphne calyculata* with 10-25% cover of conifers (typically *Picea mariana* and/or *Larix laricina*). This type differs from the Leatherleaf Bog (CEGL002498) primarily in the density of conifers. That type has less than 10% tree cover. This type is analogous to Ontario's W25 (Harris *et al.* 1996). In large peatlands (like Rat Root Peatland) this community can grade into the woodland phase of the Black Spruce Bog (CEGL002485).

REFERENCES

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field guide FG-01. 74 p.

Sims, R. A., W. D. Towill, K. A. Baldwin, and G. M. Wickware. 1989. Field guide to the forest ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources.

Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia Bog Dwarf-shrubland (Leatherleaf Bog)

COMMON NAME	Leatherleaf - Labrador-tea - Bog Laurel Bog Dwarf-shrubland
SYNONYM	Leatherleaf Bog
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A)
PHYSIOGNOMIC GROUP	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (IV.A.1.N)
FORMATION	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g)
ALLIANCE	CHAMAEDAPHNE CALYCULATA SATURATED DWARF-SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE
Voyageurs National Park
This type occurs throughout the park.

Globally
This association is found in Michigan, Minnesota, Wisconsin, Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
This type occurs in confined basins, as part of large peatlands, and as part of shoreline complexes. In the later case, the Leatherleaf bog can occur right up to the water's edge or spatially removed from the influence of the water. Stands that occur right up to the water's edge do so only because the lakes are oligotrophic (with granite bedrock basins). The substrate is deep fibric Sphagnum peat which is mineral poor. High hummocks are often well developed while hollows are poorly developed. The water regime is saturated.

Globally
Sites are found on raised bog landforms in large peatland complexes, basin bogs, and occasionally on shores (but still isolated from groundwater influence). Stands have a saturated hydrology with a fibric *Sphagnum* spp. peat soil and a pH usually < 4.3 (Harris *et al.* 1996, Minnesota NHP 1993).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Tall shrub	*Picea mariana, Larix laricina*
Short shrub	*Chamaedaphne calyculata*
Forb	*Maianthemum trifolium, Sarracenia purpurea*
Graminoid	*Eriophorum vaginatum*
Nonvascular	*Sphagnum magellanicum, Sphagnum fuscum, Sphagnum angustifolium*

Globally

Stratum	Species
Tree canopy	*Picea mariana, Larix laricina*
Short shrub	*Chamaedaphne calyculata, Ledum groenlandicum*
Graminoid	*Carex oligosperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES
Voyageurs National Park
Chamaedaphne calyculata, Maianthemum trifolium, Sarracenia purpurea, Eriophorum vaginuatum, Sphagnum spp.

Globally

Chamaedaphne calyculata, Ledum groenlandicum, Carex oligosperma, Sphagnum spp.

VEGETATION DESCRIPTION

Voyageurs National Park

This community is dominated by an ericaceous dwarf-shrub layer consisting mainly of *Chamaedaphne calyculata.* Other dwarf ericaceous shrubs such as *Andromeda polifolia, Kalmia polifolia, Vaccinium oxycoccos,* and *Ledum groenlandicum* are often present but rarely make up a significant cover. Total cover of the dwarf-shrubs is usually 90-100%. A scattered tall shrub layer of *Picea mariana, Larix laricina* or, rarely, *Pinus strobus* can exist at <10% cover. The herbaceous strata is poorly developed with low species diversity and very sparse cover, typically less than 10%. The most abundant species are *Maianthemum trifolium, Eriophorum vaginatum, Sarracenia purpurea, Carex oligosperma,* and *Drosera rotundifolia*. *Sphagnum magellanicum, Sphagnum fuscum,* and *Sphagnum angustifolium* form a continuous carpet of peat moss. Typically, *Sphagnum fuscum* dominates the high hummocks, *Sphagnum magellanicum* dominates the lower and developing hummocks and *Sphagnum angustifolium* colonizes the hollows. Other mosses, such as *Aulacomnium palustre, Polytrichum strictum,* and *Sphagnum recurvum sensu stricta* may also be present.

Minerotrophic indicator species are nearly always absent in this type, though in a few circumstances may be present at low cover. These circumstances include (but are not limited to) a stand that has experienced the impacts of recent beaver flooding or a stand that is adjacent to a lake shore. The most common minerotrophic species found in these situations are *Carex lacustris, Carex lasiocarpa, Eriophorum viridi-carinatum,* and *Betula pumila*.

Globally

Vegetation is dominated by an open dwarf-shrub/scrub conifer layer with very scattered trees (<10% cover). Microtopography is high hummocks with weakly developing hollows. Ericaceous dwarf-shrubs are dominant, including *Andromeda polifolia, Chamaedaphne calyculata, Kalmia polifolia,* and *Ledum groenlandicum,* and the creeping dwarf-shrub *Vaccinium oxycoccos*. Scrub conifers include *Larix laricina* and *Picea mariana*. They also occur as scattered trees (> 3m). The herb layer is species poor, containing *Carex oligosperma, Carex pauciflora, Eriophorum vaginatum,* and *Sarracenia purpurea*. The moss layer forms a continuous hummocky mat dominated by *Sphagnum angustifolium, Sphagnum fuscum,* and *Sphagnum magellanicum* (Minnesota 1993, Harris *et al.* 1996). Diagnostic features of this type include the dominance of a dwarf-shrub ericaceous layer, absence of a tree layer (<10%), species-poor herbaceous layer, and almost complete lack of minerotrophic indicators, such as *Betula pumila, Carex aquatilis,* and *Carex stricta*. A possible subtype may occur in which pools form near the bogs crests, and contain maritime species such as *Scheucherzia palustris, Rhynchospora alba, Sphagnum cuspidatum,* and *Utricularia cornata*.

CONSERVATION RANK G5.

DATABASE CODE CEGL002498

COMMENTS

Voyageurs National Park

Diagnostic features of the type include the dwarf-shrub layer dominated by *Chamaedaphne calyculata* with <10% cover of conifers. This type differs from the Black Spruce/Leatherleaf Semi-Treed Bog (CEGL005218) in the density of conifers, which for that type contain 10-25% cover. This type is analogous to Ontario's W24 (Harris *et al.* 1996). In cases with minerotrophic species present, stands are more analogous to W21, a Leatherleaf poor fen type. When scattered minerotrophic species are present, the Leatherleaf Bog can also grade into the Leatherleaf-Sweet Gale Shore Fen (CEGL005228). That type, however, has a greater consistent coverage of minerotrophic indicators (see VEGETATION DESCRIPTION) and is typically located near the lakeshore.

REFERENCES

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field guide FG-01. 74 p.

Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.

6.2 Northern Shrub and Graminoid Fens

Alnus incana - Salix spp. - Betula pumila / Chamaedaphne calyculata Shrubland (Bog Birch - Willow Shore Fen)

COMMON NAME	Speckled Alder - Willow species - Bog Birch / Leatherleaf Shrubland
SYNONYM	Bog Birch - Willow Shore Fen
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Saturated cold-deciduous shrubland (III.B.2.N.g)
ALLIANCE	BETULA PUMILA - (SALIX SPP.) SATURATED SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type is found primarily in the northern part in association with peatland areas.

Globally

This association is found in northern Minnesota and Ontario and may be in Wisconsin and Michigan.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type is most commonly found along the minerotrophic margins of confined basin peatlands, associated with peatland lake shore complexes or as part of large peatlands. The substrate is deep fibric, Sphagnum peat. The water regime is saturated or, rarely, seasonally flooded. Hummock and hollow microtopography is well developed.

Globally

This type is most commonly found along the minerotrophic margins of confined basin peatlands, associated with peatland lakeshore complexes or on "lagg" zones at edges of peatlands where periodic exposure to flooding occurs from groundwater runoff. The substrate is deep fibric to mesic peat. The water regime is saturated to seasonally flooded. Hummock and hollow microtopography is well developed (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Betula pumila, Alnus incana, Salix* spp.
Short shrub	*Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex lacustris, Carex trisperma*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Tall shrub	*Betula pumila, Alnus incana, Salix* spp.
Short shrub	*Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex lacustris, Carex trisperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Betula pumila, Alnus incana, Salix spp.

Globally
Betula pumila, Alnus incana, Salix spp.

VEGETATION DESCRIPTION
Voyageurs National Park
The shrub layer of this type is dominated by *Betula pumila*; however, *Alnus incana, Salix pyrifolia, Salix pedicellaris,* and *Salix petiolaris* are also commonly present, usually at lower cover. Shrubs are usually under 2m tall and coverage ranges from 30-90%. *Chamaedaphne calyculata* dominates the dwarf-shrub layer, with lesser amounts of *Ledum groenlandicum, Andromeda polifolia,* and *Kalmia polifolia* present at low cover or absent. Cover of these dwarf-shrubs is typically 70-90%. Often being shaded out by this dense dwarf-shrub layer, the cover of herbaceous plants is generally low (5-30%). The most abundant species are *Carex lacustris, Carex trisperma,* and *Maianthemum trifolium*. *Potentilla palustris, Calamagrostis canadensis, Carex chordorrhiza,* and *Eriophorum vaginatum* are also common at low density. The nonvascular strata is dominated by *Sphagnum magellanicum, Sphagnum angustifolium, Sphagnum centrale, Sphagnum girgensohnii,* and *Sphagnum fallax*. These species typically comprise 90-100% cover.

Globally
The shrub layer of this type is dominated by *Betula pumila,* with *Alnus incana* and *Salix* spp codominants (including *Salix pyrifolia, Salix planifolia, Salix pedicellaris,* and *Salix petiolaris*). Other less constant tall shrubs include *Cornus stolonifera* and *Rhamnus alnifolia*. Shrubs are typically 1.5 to 3 m tall and coverage ranges from 30-80%. *Chamaedaphne calyculata* dominates the dwarf-shrub layer, with lesser amounts of *Ledum groenlandicum, Andromeda polifolia, Kalmia polifolia, Rubus acaulis, Rubus idaeus* and *Rubus pubescens*. Cover of these dwarf-shrubs is typically 60-90%. The herbaceous layer is often shaded out by the dense dwarf-shrubs, and their cover is variable (20-60%). The most abundant species are *Carex lacustris, Carex leptalea, Carex rostrata, Carex trisperma, Maianthemum trilolium* and *Potentilla palustris*. Common, but less abundant, species include *Calamagrostis canadensis, Carex chordorrhiza, Carex lasiocarpa, Eriophorum vaginatum* and *Viola* spp. The nonvascular strata in northern Minnesota is dominated by *Sphagnum magellanicum, Sphagnum angustifolium, Sphagnum centrale, Sphagnum girgensohnii,* and *Sphagnum fallax*. These species typically comprise 90-100% cover (Harris *et al.* 1996, M. Smith personal communication 1999).

CONSERVATION RANK G?

DATABASE CODE CEGL005227

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the shrubland dominated by *Betula pumila,* with *Alnus incana* and *Salix* spp. consistent at low cover. An ericaceous dwarf-shrub mix is usually present. When *Alnus incana* or *Salix* spp. increase in cover, this community can grade into the Speckled Alder Swamp (CEGL002381) and the Dogwood-Pussy Willow Swamp (CEGL002186). This occurs most commonly in shoreline situations. When alder, willow and bog birch all are present with equal cover, the stand is still considered a Bog Birch-Willow Shore Fen since mixed dominance is typical for this community. When alder or willow reach dominance (perhaps greater than 60% relative cover) the stand should be classified into either of those types. This type is analogous to Ontario's W16 (Harris *et al.* 1996).

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour. Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa Dwarf-shrubland (Leatherleaf - Sweetgale Shore Fen)

COMMON NAME	Leatherleaf - Sweet Gale / Wiregrass Sedge Dwarf-shrubland
SYNONYM	Leatherleaf - Sweetgale Shore Fen
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A)
PHYSIOGNOMIC GROUP	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (IV.A.1.N)
FORMATION	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g)
ALLIANCE	CHAMAEDAPHNE CALYCULATA SATURATED DWARF-SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type is localized in areas around the larger lakes in the park.

Globally

This association is found in northern Minnesota, and may be in northern Michigan, northern Wisconsin, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occupies peatland sites that receive minerotrophic influence from lake water. They can occur right up to the water's edge or be separated from the water by another community, typically a shallow marsh. When they exist up to the water's edge, the peat may be floating. The mat usually becomes grounded as it approaches the shore. Hummock and hollow microtopography is usually well developed. Standing water may or may not be present in the hollows. This community can occasionally occur independent of lake water influence if another source of mineral rich water is available. Substrate is deep, fibric, Sphagnum peat. The water regime is seasonally flooded to saturated.

Globally

This community is typically found on floating mats on the edges of lakes and streams, with localized shallow surface pools that may persist throughout the growing season. Stands occur where there is low wave and current energy with seasonal flooding. The water regime is otherwise saturated (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Betula pumila, Alnus incana, Salix* spp.
Short shrub	*Myrica gale, Chamaedaphne calyculata,*
Graminoid	*Carex lacustris, Carex lasiocarpa, Eriophorum vaginatum,* Typha spp.
Nonvascular	*Sphagnum magellanicum, Sphagnum fuscum, Sphagnum angustifolium, Sphagnum recurvum sensu stricta*

Globally

Stratum	Species
Short shrub	*Chamaedaphne calyculata, Myrica gale*
Graminoid	*Carex lasiocarpa*

CHARACTERISTIC SPECIES

Voyageurs National Park

Myrica gale, Betula pumila, Alnus incana, Salix spp., *Chamaedaphne calyculata,Carex lacustris, Carex lasiocarpa, Eriophorum vaginatum*

Globally
Myrica gale, Chamaedaphne calyculata, Carex lasiocarpa

VEGETATION DESCRIPTION
Voyageurs National Park
A short shrub layer with low to moderate cover is often present, with *Myrica gale, Betula pumila, Alnus incana, Salix petiolaris,* and *Salix pedicellaris* the most abundant shrubs. *Chamaedaphne calyculata* is usually present at 80-100% cover but may be mixed with lesser amounts of the dwarf-shrubs *Andromeda polifolia* and *Vaccinium oxycoccos*. In addition to bog plants such as *Eriophorum vaginatum* and *Drosera rotundifolia*, other minerotrophic indicators are also present at 10-40% cover. These include *Carex lacustris, Carex lasiocarpa, Typha latifolia, Calamagrostis canadensis,* and *Iris versicolor.* Occasionally, herbaceous cover may reach 90%. A continuous carpet of peat moss includes species such as *Sphagnum magellanicum, Sphagnum recurvum sensu stricta, Sphagnum angustifolium,* and *Sphagnum subsecundum sensu lato*.

Globally
Low shrubs dominate the stands, generally over 60%. Dominant species include *Chamaedaphne calyculata* and *Myrica gale*. *Salix pedicillaris* is often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis, Carex aquatilis, Carex lasiocarpa, Carex rostrata*, and *Potentilla palustris* (Harris *et al.* 1996). In northern Minnesota a short shrub layer with low to moderate cover is often present, with *Myrica gale, Betula pumila, Alnus incana, Salix petiolaris*, and *Salix pedicellaris* the most abundant shrubs. In the dwarf-shrub layer *Chamaedaphne calyculata* is usually present at 80-100% cover but may be mixed with lesser amounts of *Andromeda polifolia* and *Vaccinium oxycoccos*. In addition to bog plants such as *Eriophorum vaginatum* and *Drosera rotundifolia*, other minerotrophic indicators are also present at 10-40% cover. These include *Carex lacustris, Carex lasiocarpa, Typha latifolia, Calamagrostis canadensis,* and *Iris versicolor.* Occasionally, herbaceous cover may reach 90%. A continuous carpet of peat moss includes species such as *Sphagnum magellanicum, Sphagnum recurvum sensu stricta, Sphagnum angustifolium,* and *Sphagnum subsecundum sensu lato* (M. Smith personal communication 1999).

CONSERVATION RANK G?.

DATABASE CODE CEGL005228

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the high cover of *Chamaedaphne calyculata* with one or more of the following minerotrophic species present: *Myrica gale, Betula pumila, Salix* spp., *Carex lacustris, Carex lasiocarpa Typha latifolia, Calamagrostis canadensis,* and *Iris versicolor.* Depending on the site, this community includes poor, intermediate and rich fens. This type is analogous to Ontario's W15 (Harris *et al.* 1996). This type differs from the Leatherleaf Bog (CEGL002498) in that it harbors minerotrophic indicator species that the Leatherleaf Bog lacks. When cover of *Betula pumila* and *Salix* spp. increases, this community can grade into a Bog Birch-Willow Shore Fen (CEGL005227) or a Dogwood-Pussy Willow swamp (CEGL002186). Greater than 25% cover of short (not dwarf) shrubs would warrant placing the stand into one of these other communities.

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Larix laricina - Betula pumila / Chamaedaphne calyculata Shrubland (Tamarack Scrub Poor Fen)

COMMON NAME	Tamarack - Bog Birch / Leatherleaf Shrubland
SYNONYM	Tamarack Scrub Poor Fen
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Saturated cold-deciduous shrubland (III.B.2.N.g)
ALLIANCE	BETULA PUMILA - (SALIX SPP.) SATURATED SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE
Voyageurs National Park
It is not know for sure whether this type occurs in the park. It may occur in the Rat Root River peatlands.

Globally
This association is found in Minnesota and probably Ontario.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park

Globally
Stands that occur on the margins of water tracks, generally being less mineral rich and having greater cover of tamarack, are most likely to contain the habitat for this type.

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally

VEGETATION DESCRIPTION
Voyageurs National Park

Globally
The type concept is that of a scrub poor fen, where tree height does not exceed 2 m. The type has been defined by the Minnesota Natural Heritage Program type as the "poor fen, scrub tamarack subtype" (MN HP 1993). Range-wide review is still needed, and type does not clearly match any type in Harris *et al.* (1996), but comes closest to the poor fen: ericaceous shrub/ wire sedge / Sphagnum type (W20).

CONSERVATION RANK

DATABASE CODE CEGL005226

COMMENTS
Voyageurs National Park
This type may or may not occur in the Rat Root River Peatlands in and near Voyageurs. Stands that occur in the water tracks of the large peatland have been labelled as Northern Sedge Poor Fen (CEGL002265). They are

analagous to Ontario's W19 and W20 (Harris *et al.* 1996). Those that occur on the margins of water tracks, generally being less mineral rich and having greater cover of tamarack, are floristically most similar to the Tamarack Scrub Poor Fen type, which is somewhat analagous to Ontario's W20. Part of the difficulty is resolving how much of the tamarack is scrub (< 3m tall) vs tree (> 3 m tall) from an aerial vs ground perspective. The wetter phase of this type occurs in the water tracks, is more clearly graminoid-dominated, and often contains standing water in the hollows.

REFERENCES

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

COMMON NAME	Bog Birch / Leatherleaf / Wiregrass Sedge Poor Fen Shrubland
SYNONYM	Bog Birch - Leatherleaf Poor Fen
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Saturated cold-deciduous shrubland (III.B.2.N.g)
ALLIANCE	BETULA PUMILA - (SALIX SPP.) SATURATED SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type is only mapped in the Rat Root River peatland..

Globally

This association is found in Minnesota, Michigan, Wisconsin, Manitoba, Ontario, and possibly Maine.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

Stands are found on the margins of water tracks of large peatlands (Harris *et al.* 1996).

Globally

Stands are found on the margins of water tracks of large peatlands, or in the interior of small basins that are relatively isolated from run-off (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Betula pumila, Alnus incana*, Salix spp.
Short shrub	*Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex lacustris, Carex trisperma*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Tall shrub	*Betula pumila, Alnus incana, Salix* spp.
Short shrub	*Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex lacustris, Carex trisperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Betula pumila, Alnus incana, Salix spp.

Globally

Betula pumila, Alnus incana, Salix spp.

VEGETATION DESCRIPTION

Voyageurs National Park

This type was not visited at Voyaguers NP. The following description is based on information from northwesern

Ontaro. The shrub cover is at least 25%, dominated by a combination of *Betula pumila* and ericaceous shrubs, including *Andromeda polifolia, Chamaedaphne calyculata, Ledum groenlandicum*, and *Vaccinium oxycoccos*. Other minerotrophic shrubs include *Lonicera villosa, Rhamnus alnifolia, Rubus acaulis, Rubus pubescens*, and *Salix pedicellaris*. Scattered, small (2-10 m) tree stems of *Larix laricina, Picea mariana*, and *Thuja occidentalis* are present at low cover. There is a diverse forb, graminoid, and moss cover, at least in the richer examples of this type. The graminoids include *Carex chordorrhiza, Carex lasiocarpa, Carex leptalea*, and *Eriophorum viridi-carinatum*. Forbs include *Drosera rotundifolia, Equisetum fluviatile, Maianthemum trifolium, Menyanthes trifoliata, Potentilla palustris, Sarracenia purpurea*, and *Solidago uliginosa*. The moss layer contains *Aulacomnium palustre, Pleurozium schreberi, Sphagnum angustifolium*, and *Sphagnum capillifolium*. Less frequent are *Campylium stellatum, Sphagnum fuscum*, and *Tomenthypnum nitens* (Harris *et al.* 1996).

Globally
The shrub cover is at least 25%, dominated by a combination of *Betula pumila* and ericaceous shrubs, including *Andromeda polifolia, Chamaedaphne calyculata, Ledum groenlandicum*, and *Vaccinium oxycoccos*. Other minerotrophic shrubs include *Lonicera villosa, Rhamnus alnifolia, Rubus acaulis, Rubus pubescens*, and *Salix pedicellaris*. Scattered, small (2-10 m) tree stems of *Larix laricina, Picea mariana*, and *Thuja occidentalis* are present at low cover. There is a diverse forb, graminoid, and moss cover, at least in the richer examples of this type. The graminoids include *Carex chordorrhiza, Carex lasiocarpa, Carex leptalea*, and *Eriophorum viridi-carinatum*. Forbs include *Drosera rotundifolia, Equisetum fluviatile, Maianthemum trifolium, Menyanthes trifoliata, Potentilla palustris, Sarracenia purpurea*, and *Solidago uliginosa*. The moss layer contains *Aulacomnium palustre, Pleurozium schreberi, Sphagnum angustifolium*, and *Sphagnum capillifolium*. Less frequent are *Campylium stellatum, Sphagnum fuscum*, and *Tomenthypnum nitens* (Harris *et al.* 1996).

CONSERVATION RANK G4G5.

DATABASE CODE CEGL002494

COMMENTS
Voyageurs National Park
Stands in the Rat Root River peatland were mapped as this type, but not visited. Further field checks are necessary to determine how well they correspond to the expected composition of this type.

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.
Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.

Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile Herbaceous Vegetation (Wiregrass Sedge Shore Fen)

COMMON NAME	Wiregrass Sedge - (Beaked Sedge) - Water Horsetail Herbaceous Vegetation
SYNONYM	Wiregrass Sedge Shore Fen
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Saturated temperate or subpolar grassland (V.A.5.N.m)
ALLIANCE	CAREX LASIOCARPA SATURATED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type typically occurs inland from shores around the large lakes.

Globally

This association is found in northern Michigan, northern Minnesota, northern Wisconsin, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community occurs on floating or grounded mats of peat near the shores of the large lakes. Typically, the peat mat near the edge of open water is floating and can be thin. The mat becomes grounded as it gets closer to the shore. The peat is commonly a fibric sedge peat, though fibric *Sphagnum* peat can occasionally be found in layers below the sedge peat. Standing water 20-50 cm deep is usually present throughout the year in these stands. Most of these stands are located in areas sheltered from extreme wave action and have very little microtopography. The water regime is permanently flooded to intermittently exposed.

Globally

This community occurs on floating or grounded mats of peat near the shores of the large lakes. Typically, the peat mat near the edge of open water is floating and can be thin. The mat becomes grounded as it gets closer to the shore. The peat is commonly a fibric sedge peat, though fibric *Sphagnum* peat can occasionally be found in layers below the sedge peat. Standing water 20-50 cm deep seasonally floods these stands. Most of these stands are located in areas sheltered from extreme wave action and have very little microtopography. The water regime is seasonally flooded to saturated (Harris *et al.* 1996, M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Fern	*Equisetum fluviatile*
Graminoid	*Carex lasiocarpa*

Globally

Stratum	Species
Fern	*Equisetum fluviatile*
Graminoid	*Carex lasiocarpa*

CHARACTERISTIC SPECIES

Voyageurs National Park

Carex lasiocarpa, Equisetum fluviatile

Globally

Carex lasiocarpa, Carex rostrata, Equisetum fluviatile

VEGETATION DESCRIPTION

Voyageurs National Park

The Wiregrass Sedge Shore Fen is characterized by a continuous cover of *Carex lasiocarpa*. This community is typically species poor, with some stands harboring as few as four species. Along with *Carex lasiocarpa*, *Equisetum fluviatile* is often found at high density. The following herbs are also common, but usually exist at low cover: *Acorus calamus, Polygonum hydropiper, Cicuta bulbifera, Lysimachia terrestris, Calamagrostis canadensis,* and *Carex rostrata*. Few, scattered shrubs of *Chamaedaphne calyculata* may be present. In stands that have standing water, submerged aquatic plants may also be found, including *Utricularia intermedia* and *Potamogeton natans*. The moss, *Warnstorfia exannulata* is also frequent in standing water in this community, though at low density.

Globally

Graminoids dominate the stand, with shrub cover typically much less than 25%. *Carex lasiocarpa* can form extensive "lawns". Other species present include *Carex rostrata, Equisetum fluviatile, Potentilla palustris, Triadenum fraseri, Utricularia intermedia*, and *Utricularia vulgaris*. *Menyanthes trifoliata* can occur at high cover, especially at the outer edge of the floating mat. Permanent surface pools and small hummocks with *Sphagnum* spp. and ericaceous shrubs may be present. The substrate is a mat of fibric to mesic peat held together by roots and rhizomes (Harris *et al.* 1996).

CONSERVATION RANK G?.

DATABASE CODE CEGL005229

COMMENTS

Voyageurs National Park

Diagnostic features of the type include an herbaceous layery with greater than 70% cover of *Carex lasiocarpa.* Overall, this community is most similar to the Northern Sedge Wet Meadow (CEGL002257) but can easily be distinguished by its dominance of *Carex lasiocarpa* and its restriction to the shores of the large lakes. This type is analogous to Ontario's W14 (Harris *et al.* 1996). Spatially, this community is often located near the Midwest Cattail Marsh (CEGL002233), the Northern Sedge Wet Meadow (CEGL002257), and/or the Water Horsetail Marsh (CEGL005258) and, compositionally, may grade into any of them. Typically, as the peat mat gets closer to shore, it becomes more dominated by *Sphagnum* spp. and more well developed. At this point, other species, especially shrubs, colonize it and the community may grade into a Leatherleaf-Sweetgale Shore Fen (CEGL005228), a Dogwood-Pussy Willow Swamp (CEGL002186) or a Bog Birch-Willow Shore Fen (CEGL005227). Floristically, this community is also similar to the Northern Sedge Poor Fen (CEGL00265) in that both are dominated by *Carex lasiocarpa.* The Northern Sedge Poor Fen, however, usually has a significant cover of *Sphagnum* spp. and *Chamaedaphne calyculata* and is found only in the Rat Root Peatland.

REFERENCES

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Carex lasiocarpa - Carex oligosperma / Sphagnum spp. - Polytrichum spp. Herbaceous Vegetation (Northern Sedge Poor Fen)

COMMON NAME	Wiregrass Sedge - Few-seed Sedge / Peatmoss species Herbaceous Vegetation
SYNONYM	Northern Sedge Poor Fen
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Saturated temperate or subpolar grassland (V.A.5.N.m)
ALLIANCE	CAREX OLIGOSPERMA - CAREX LASIOCARPA SATURATED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type occurs in and around water tracks of the Rat Root Peatland.

Globally

Isolated stands can occur in central/southern Minnesota, Wisconsin, Michigan, and even northern Iowa and Illinois. This community also is found in Manitoba, Ontario, and possible North Dakota.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Northern Poor Fen occurs in and around water tracks of large peatlands. In the wetter, more minerotrophic phase, microtopography consists of wet hollows with scattered hummocks. In the drier phase, hummock and hollow microtopography is more well developed. The substrate is deep, fibric Sphagnum peat. The water regime is saturated.

Globally

Stands are found in peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding and larger peatlands. Water hydrology is saturated (Harris *et al.* 1996). The surface water is slightly acidic (pH 4.1-5.9) and nutrient poor [calcium < 13 mg/l) (MN NHP 1993).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Larix laricina*
Short shrub	*Chamaedaphne calyculata, Andromeda polifolia*
Graminoid	*Carex lasiocarpa*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Short shrub	*Chamaedaphne calyculata, Andromeda polifolia*
Graminoid	*Carex lasiocarpa, Carex oligosperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Carex lasiocarpa

Globally

Carex lasiocarpa

VEGETATION DESCRIPTION

Voyageurs National Park
The Northern Poor Fen is dominated by 80-100% cover of *Carex lasiocarpa*. Short, stunted *Larix laricina* trees, usually under 2 m tall, are present above the herbaceous layer at less than 10% cover. Dwarf-shrubs, most commonly *Chamaedaphne calyculata* and *Andromeda polifolia*, may be present at less than 40% cover and, in wetter stands, occupy only the drier hummocks. The dwarf-shrubs *Kalmia polifolia, Betula pumila,* and *Vaccinium oxyccocus* may also be present at low density. In addition to *Carex lasiocarpa*, common herbs include *Maianthemum trifolium, Menyanthes trifolia, Equisetum fluviatile, Drosera rotundifolia,* and *Sarricenia purpurea*. Stands of this type that occur in water tracks tend to be more mineral rich and may also contain *Pogonia ophioglosoides, Carex livida,* and *Utricularia intermedia*. Sphagnum moss typically forms a continuous carpet, though in wetter stands may be intermixed with brown mosses. The most abundant species are *Sphagnum magellanicum, Sphagnum angustifolium, Sphagnum subsecundum sensu lato,* and *Warnstorfii exanulata*.

Globally
The vegetation is dominated by graminoids, with up to 25% shrub cover, and scattered trees. The dominant graminoid is *Carex lasiocarpa*, and typical associates include *Carex chordorrhiza, Carex limosa, Carex oligosperma, Rhynchospora alba, Scirpus cespitosus*, and *Scheuchzeria palustris*. Forbs include *Sarracenia purpurea*. The low shrub layer contains *Andromeda polifolia, Betula pumila, Chamaedaphne calyculata, Larix laricina, Salix discolor, Salix pedicillaris*, and *Vaccinium oxycoccos*. The moss layer is virtually continuous, and is dominated by *Sphagnum capillifolium, Sphagnum fuscum*, and *Sphagnum magellanicum* (Chapman *et al.* 1989, MN NHP 1993, Harris *et al.* 1996).

CONSERVATION RANK G3G4.

DATABASE CODE CEGL002265

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the continuous cover of *Carex lasiocarpa* and low coverage of *Larix laricina* (less than 25%). Stands that occur in the water tracks are most similar to Ontario's W19 (Harris *et al.* 1996). Those that occur on the margins of water tracks, generally being less mineral rich and having greater cover of tamarack, are floristically most similar to W20.

The wetter phase of this type occurs in the water tracks and often contains standing water in the hollows. The drier phase usually lacks standing water, has greater cover of *Larix laricina* and has a more well developed shrub layer. When cover of *Larix laricina* increases, this community can grade into the Northern Tamarack Poor Swamp. The Northern Tamarack Poor Swamp, however, generally contains a greater cover of *Betula pumila*, is less mineral rich and is drier.

The Wiregrass Sedge Shore Fen is also dominated by *Carex lasiocarpa* but is not found in the Rat Root Peatland and typically lacks *Larix laricina*.

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.

6.3 Wet Meadows

Calamagrostis canadensis Eastern Herbaceous Vegetation [Provisional] (Canada Bluejoint Eastern Meadow)

COMMON NAME	Canada Reedgrass Eastern Herbaceous Vegetation
SYNONYM	Canada Bluejoint Eastern Meadow
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE
Voyageurs National Park
This type occurs predominately in old beaver meadows or along slow moving streams throughout the park.

Globally
This association is widespread throughout the eastern United States and adjacent southern Canada.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
This type occurs predominately in old beaver meadows or along slow moving streams. In beaver meadows, this community is found on relatively dry sites and often occurs on the upland edge of more recent beaver floodings or completely colonizing older, drier beaver meadows. Soils usually contain deep, dense clay which prevents or slows drainage. A shallow layer of mineral soil or well decomposed peat may occur over the clay. In wetter conditions of this type, standing water may be present in low areas. In these situations, tussocky microtopography is often present. Water channels and standing or fallen dead trees are frequently present. The water regime is temporarily to seasonally flooded.

Globally
Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat (Harris *et al.* 1996). In northern Minnesota, the water regime varies between temporarily and seasonally flooded (M. Smith personal communication 1999).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Graminoid	*Calamagrostis canadensis*

Globally

Stratum	Species
Short shrub	*Alnus incana*
Graminoid	*Calamagrostis canadensis, Scirpus cyperinus, Carex rostrata, Carex stricta*
Forb	*Eupatorium maculatum*

CHARACTERISTIC SPECIES
Voyageurs National Park
Calamagrostis canadensis

Globally
Calamagrostis canadensis, Scirpus cyperinus, Carex rostrata, Carex stricta, Eupatorium maculatum

VEGETATION DESCRIPTION

Voyageurs National Park

This community is characterized by a continuous herbaceous cover of *Calamagrostis canadensis*. *Alnus incana*, *Betula pumila,* or *Salix* spp. infrequently colonize these sites at <25% cover. Other herbaceous species are usually present but typically make up very little cover. These often include *Scirpus cyperinus, Carex lacustris, Eupatorium maculatum, Typha latifolia,* and *Campanula aparinoides*. Some stands are very species poor and contain as few as three species. This occurs when *Calamagrostis canadensis* cover is very dense and a thick thatch layer accumulates. Water channels occasionally occur within these stands and can contain species typical of wetter conditions, including *Calla palustris, Cicuta bulbifera,* and *Sagittaria* spp.

Globally

Graminoid cover is typically dense, and can form hummocky microtopography. *Calamagrostis canadensis* dominates, often in almost pure stands or with tall sedges, such as *Carex aquatilis, Carex lacustris, Carex rostrata*, and *Carex stricta*. In fen transitions, *Carex lasiocarpa* can be present. *Glyceria grandis, Poa palustris, Scirpus cyperinus*, and *Typha latifolia* are sometimes abundant. Forbs include *Campanula aparinoides, Epilobium leptophyllum, Eupatorium maculatum, Iris versicolor, Polygonum amphibium*, and *Potentilla palustris* (Harris *et al.* 1996).

CONSERVATION RANK G?.

DATABASE CODE CEGL005174

COMMENTS

Voyageurs National Park

Diagnostic features of the type include a herbaceous layer with continuous cover of *Calamagrostis canadensis*. This type is analogous to Ontario's W13 (Harris *et al.* 1996). This community often occurs adjacent to, and readily grades into the Northern Sedge Wet Meadow (CEGL002257). The Northern Sedge Wet Meadow usually occurs in the wetter areas of beaver meadows. The Bluejoint Eastern Meadow can also, though more rarely, grade into the Midwest Cattail Marsh (CEGL002233). The Speckled Alder Swamp (CEGL002381) and the Dogwood-Pussy Willow Swamp (CEGL002186) can occasionally invade a Bluejoint Eastern Meadow site. In these circumstances, a shrub layer of > 25% cover distinguish these shrub communities from the Bluejoint Eastern Meadow.

The Bluejoint Eastern Meadow most commonly occurs in beaver meadows. Constant beaver activity can alter local hydrology and, over time, cause this community to grade into other communities.

Globally

In northern Minnesota, this type commonly occurs in beaver meadows. Constant beaver activity can alter local hydrology and, over time, cause this community to grade into other communities (M. Smith personal communication 1999).

REFERENCES

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria) Herbaceous Vegetation (Northern Sedge Wet Meadow)

COMMON NAME	Swollen-beak Sedge - Hairy Sedge - (Inflated Sedge) Herbaceous Vegetation
SYNONYM	Northern Sedge Wet Meadow
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type occurs in beaver meadows, along lake shores and slow moving streams, and in isolated basins throughout the park.

Globally

This association is found in Iowa, Michigan, Minnesota, Wisconsin, Manitoba, Ontario, and possibly North and South Dakota.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community type occurs in beaver meadows, along lake shores, along slow moving streams and in isolated basins. Substrate is most often deep sedge peat under various stages of decomposition, or shallow (5-10 cm) peat over clay. A thick thatch layer over the peat may be present. The peat mat may occasionally be floating. Standing dead trees, especially in beaver meadows, are common. Hummock and hollow microtopography is usually well developed. Standing water is common in the hollows. The water regime is highly variable, ranging from saturated to permanently flooded.

Globally

Sites are found on floodplains, shallow bays of lakes and streams, beaver meadows, ditches, and occasionally in isolated basins, or on semi-floating mats. Hydrology is seasonally to semipermanently flooded. Substrate is mineral soil or well-decomposed peat (Curtis 1959, Harris *et al.* 1996). Standing dead trees, especially in beaver meadows, are common. Hummock and hollow microtopography is usually well developed, with standing water often in the hollows. The water regime is highly variable, ranging from saturated to permanently flooded (M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Graminoid	*Carex lacustris, Carex vesicaria, Carex rostrata*

Globally

Stratum	Species
Graminoid	*Carex rostrata, Carex lacustris, Calamagrostis canadensis*
Forb	*Eupatorium maculatum*

CHARACTERISTIC SPECIES

Voyageurs National Park

Carex rostrata, Carex lacustris, Carex vesicaria

Globally

Carex rostrata, Carex lacustris, Carex vesicaria, Eupatorium maculatum

VEGETATION DESCRIPTION

Voyageurs National Park

Northern Sedge Wet Meadow is most commonly dominated by *Carex lacustris* with *Carex rostrata, Carex vesicaria, Calamagrostis canadensis, Typha* spp., *Calla palustris* and/or *Scirpus cyperinus* often present at low cover. In some circumstances, *Carex rostrata* and/or *Carex vesicaria* may share dominance with *Carex lacustris* or obtain complete dominance. Cover of this herbaceous layer is usually 90-100%. Shrubs of *Alnus incana, Chamaedaphne calyculata,* or *Salix* spp. may be found at low cover (<25%). Stands with standing water or water channels running through them may contain species typical of wetter conditions like *Brasenia schreberi* or *Potamogeton* spp. In most circumstances, the moss layer is virtually absent. In the uncommon cases where sedges are colonizing a peatland, however, the moss strata can be 20-90% cover of *Sphagnum* spp.

Globally

Tall coarse-leaved sedges dominate the vegetation layer, often creating a tussocky hummock microtopography. Shrubs can cover up to 25% of the area. Pools with submergents may also be present. Dominant graminoids include a number of Carices, including *Carex aquatilis, Carex lacustris, Carex lasiocarpa, Carex rostrata, Carex vesicaria,* and locally *Carex stricta*. Other graminoids include *Calamagrostis canadensis, Scirpus atrovirens, Scirpus cyperinus*, and, in wetter areas, *Eleocharis smallii* and *Equisetum fluviatile*. Forbs include *Acorus calamus, Aster simplex, Campanula aparinoides, Eupatorium maculatum, Iris shrevei, Lycopus uniflorus, Poa palustris, Polygonum amphibium, Potentilla palustris*, and others (Curtis 1959, Harris *et al.* 1996). Stands with standing water or water channels running through them may contain species typical of wetter conditions like *Brasenia schreberi* or *Potamogeton* spp. In most circumstances, the moss layer is virtually absent. In the uncommon cases where sedges are colonizing a peatland, however, the moss strata can be 20-90% cover of *Sphagnum* spp. (M. Smith personal communication 1999).

CONSERVATION RANK G4G5Q.

DATABASE CODE CEGL002257

COMMENTS

Voyageurs National Park

Diagnostic features of the type are greater than 40% cover of *Carex lacustris, Carex rostrata*, and/or *Carex vesicaria*. It is analogous to Ontario's W12 (Harris *et al.* 1996). The sedges in this community can occasionally occur mixed with *Typha* spp. and *Calamagrostis canadensis*, grading into the Midwest Cattail Marsh and the Eastern Bluejoint Marsh respectively. When *Carex* spp. occurs mixed with *Typha* spp., there must be >60% cover of cattails for the stand to be considered a Midwest Cattail Marsh. Up to this point, the stands usually retain more characteristics of a Northern Sedge Wet Meadow than of a Midwest Cattail Marsh. When *Carex* spp. are mixed with *Calamagrostis canadensis*, the dominant species (or genera) will determine the appropriate community. Occasionally, a Speckled Alder Swamp or other shrub type may invade over a Northern Sedge Wet Meadow. In these circumstances, the shrubs must obtain greater than 25% cover for the stand to be considered a shrub type.

Stands dominated by *Carex lasiocarpa* are not included here. See Wiregrass Sedge Shore Fen or Northern Poor Fen

This community is subject to disturbance by beaver activity. In recently flooded beaver ponds, small patches of Northern Sedge Wet Meadow may occur interspersed with small patches of Northern Water Lily Aquatic Wetland. The Northern Sedge Wet Meadow tends to be intermediate in moisture tolerance between the wetter Midwest Cattail Marsh and the drier Eastern Bluejoint Marsh.

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6.4 Marshes

Phragmites australis Semipermanently Flooded Ruderal Herbaceous Vegetation (Eastern Reed Marsh)

COMMON NAME	Common Reed Semipermanently Flooded Ruderal Herbaceous Vegetation
SYNONYM	*Eastern* ***Reed Marsh***
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	PHRAGMITES AUSTRALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL

USFWS WETLAND SYSTEM PALUSTRINE

RANGE
Voyageurs National Park
This type is restricted to shorelines of the large lakes and islands in the park.

Globally
This association is widespread throughout the eastern United States.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
Stands occur on large lakes, most often on fairly wave exposed sites on sand bars or shallow areas adjacent to islands. The substrate is typically sand or, in some cases, clay or peat over clay. The density of *Phragmites australis* tends to be inversely related to water depth with the deeper stands having as much as 60% open water. Most sites contain 0.25 - 1 m standing water. The water regime is permanently flooded to intermittently exposed.

Globally
Stands are found in semipermanently flooded marshes, ditches, impoundments, and other disturbed aquatic systems, as well as lake shorelines.

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Graminoid	*Phragmites australis*

Globally

Stratum	Species
Graminoid	*Phragmites australis*

CHARACTERISTIC SPECIES
Voyageurs National Park
Phragmites australis

Globally
Phragmites australis

VEGETATION DESCRIPTION
Voyageurs National Park
The Reed Marsh community is composed primarily, and sometimes solely, by one species: *Phragmites australis*. The density of *Phragmites australis* in the Reed Marsh is highly variable. In deep water (1-1.5 m deep), it can be as low as 40% whereas in shallow water (0-1 m) it is commonly 100%. The Reed Marsh Community typically consists of very few species. In most cases one or more of the following species may be present at low (0-15%) cover:

Polygonum lapathifolium, Polygonum punctatum, Typha spp., *Acorus calamus, Calamagrostis canadensis, Carex rostrata, Scirpus acutus,* and/or *Scirpus tabernaemontani*. In addition, a wide variety of submerged aquatic plants (see Midwest Pondweed Submerged Aquatic Wetland) may be found if the site has standing water. These submerged aquatics often float in from other areas but are rarely found rooted within the Reed Marsh community because of the high wave energy.

Globally
This community is composed primarily, and sometimes solely, by one species: *Phragmites australis*. The density of *Phragmites australis* is highly variable: in deep water (1-1.5 m deep), it can be as low as 40% whereas in shallow water (0-1 m) it is commonly 100%. Typically, few other species are present. In Northern Minnesota, one or more of the following species may be present at low (0-15%) cover: *Polygonum lapathifolium, Polygonum punctatum, Typha* spp., *Acorus calamus, Calamagrostis canadensis, Carex rostrata, Scirpus acutus,* and/or *Scirpus tabernaemontani*. In addition, a wide variety of submerged aquatic plants may be found if the site has standing water. These submerged aquatics often float in from other areas but are rarely found rooted within this community (M. Smith personal communication 1999).

CONSERVATION RANK GW.

DATABASE CODE CEGL004141

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the herbaceous community dominated solely by *Phragmites australis*. This type is analogous to Ontario's W8 (Harris *et al.*1996).

Phragmites australis is a cryptogenic species which has become somewhat invasive in wetlands further south. Its presence in Voyageurs seems to be limited to relatively small stands in flooded areas of the large lakes.

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.
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Scirpus acutus - (Scirpus fluviatilis) Freshwater Herbaceous Vegetation (Freshwater Bulrush Marsh)

COMMON NAME	Hardstem Bulrush - (River Bulrush) Freshwater Herbaceous Vegetation
SYNONYM	Freshwater Bulrush Marsh
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	SCIRPUS ACUTUS - (SCIRPUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type occurs on sheltered to moderately wave exposed sites, primarily on the large lakes.

Globally

This community is found in Iowa, Minnesota, South Dakota, North Dakota, southern Manitoba, and northwestern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Freshwater Bulrush Marsh occurs on sheltered to moderately wave exposed sites, primarily on the large lakes. Water depth is typically 0.5-1.5 meters and substrate is clay, muck or sand. The water regime is permanently flooded.

Globally

This community is found on wetland sites that are flooded for most or all of the growing season. Weaver (1960) found abundant *Scirpus acutus* in water 0.3-1.6 m deep. Soils are usually mostly mineral but can contain significant organic matter (Harris *et al.* 1996). Dix and Smeins (1967) found the soils to be humic gleys and mucks in North Dakota, while in northwestern Ontario this community is favored on sandy substrates (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Graminoid	*Scirpus tabernaemontani, Scirpus acutus, Scirpus fluviatilis*

Globally

Stratum	Species
Graminoid	*Scirpus tabernaemontani, Scirpus acutus, Scirpus fluviatilis*

CHARACTERISTIC SPECIES

Voyageurs National Park

Scirpus tabernaemontani, Scirpus acutus, Scirpus fluviatilis

Globally

Scirpus tabernaemontani, Scirpus acutus, Scirpus fluviatilis

VEGETATION DESCRIPTION

Voyageurs National Park

This community is dominated by *Scirpus tabernaemontani, Scirpus acutus* and, to a lesser extent, *Scirpus fluviatilis*. Cover of these dominants is typically 50-90%, though in rare cases may be much lower. Floating leaf aquatics may be present at low cover, especially *Nuphar variegatum, Nymphaea odorata, Lemna minor,* and *Lemna trisulca*. Submerged aquatics may also be present at low cover and include *Potamogeton zosteriformis, Potamogeton*

richardsonii, *Potamogeton friesii*, *Myriophyllum sibiricum*, and *Utricularia vulgaris*.

Globally
Tall hydrophytic graminoids, particularly *Scirpus acutus* and *Scirpus fluviatilis*, dominate the vegetation. These two species may grow taller that 2-m (Weaver 1960) and sometimes nearly exclude other species. Other species that can be present to common include *Carex atherodes* (especially in the shallower parts of the community), *Lemna* spp., *Scirpus tabernaemontani*, *Typha latifolia*, and *Utricularia macrorhiza*. *Scirpus tabernaemontani* can be a co-dominant in places. Floating leaved and submergent plants have low cover (Harris *et al.* 1996). This community often occurs as dense stands with interspersed channels or pools of open water.

CONSERVATION RANK G4G5.

DATABASE CODE CEGL002225

COMMENTS
Voyageurs National Park
Diagnostic features of the type are *Scirpus validus*, *Sciipus acutus*, and *Scirpus fluviatilis*. It is analogous to Ontario's W7 (Harris *et al.* 1996).

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Typha spp. Midwest Herbaceous Vegetation (Midwest Cattail Deep Marsh)

COMMON NAME	Cattail species Midwest Herbaceous Vegetation
SYNONYM	Midwest Cattail Deep Marsh
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCIRPUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type is found in 0.25 - 1 m of water along the shores of lakes.

Globally

This association is found in Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin. It is likely in southern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Midwest Cattail Marsh most commonly occurs from 0.25 - 1 m of water along the shores of lakes. Wave exposure is low to moderate and substrate is clay, sand or muck. In more isolated sites, a floating mat may develop. This community can also occur in beaver floodings and low areas surrounded by upland. In these cases, substrate is usually well decomposed peat and the water regime is permanently to temporarily flooded. Open water is common in both circumstances.

Globally

Stands commonly occur in water depths of 0.5 - 2 m of water along the shores of lakes, ponds, and rivers. Wave exposure is low to moderate and substrate is clay, sand or muck. In more isolated sites, a floating mat may develop. This community can also occur in beaver floodings and low areas surrounded by upland. In these cases, substrate is usually well decomposed peat and the water regime is permanently to temporarily flooded. Open water is common in both circumstances.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Graminoid	*Typha latifolia, Typha angustifolia*

Globally

Stratum	Species
Graminoid	*Typha latifolia, Typha angustifolia*

CHARACTERISTIC SPECIES

Voyageurs National Park

Typha latifolia, Typha angustifolia

Globally

Typha latifolia, Typha angustifolia

VEGETATION DESCRIPTION

Voyageurs National Park

This herbaceous community can be colonized almost exclusively by *Typha angustifolia* and *Typha latifolia* or, less frequently, by a mix of *Typha* spp. and other graminoids. Near monocultures with coverage of 80-100% of *Typha*

spp. are common. Other species that may be present (usually at low cover) include: *Phragmites australis, Scirpus acutus, Scirpus tabernaemontani, Calamagrostis canadensis, Sium suave, Polygonum lapathifolium, Sagittaria cuneata,* and *Sagittaria latifolia*. In cattail stands located on the shores of a lake, it is common to find one or more of the following aquatic species at low density: *Ceratophyllum demersum, Lemna minor, Lemna trisulca, Myriophyllum sibiricum, Utricularia vulgaris*, and *Potamogeton* spp.

Globally
The vegetation is dominated by relatively pure stands of *Typha* spp., either *Typha latifolia* or *Typha angustifolia* or both. Many associates could occur. Less frequently, stands contain a mix of *Typha* spp. and other graminoids. Other species that may be present (usually at low cover) include: *Phragmites australis, Scirpus acutus, Scirpus tabernaemontani, Calamagrostis canadensis, Sium suave, Polygonum lapathifolium, Sagittaria cuneata,* and *Sagittaria latifolia*. In cattail stands located on the shores of a lake, it is common to find one or more of the following aquatic species at low density: *Ceratophyllum demersum, Lemna minor, Lemna trisulca, Myriophyllum sibiricum, Utricularia vulgaris*, and *Potamogeton* spp.

CONSERVATION RANK G5.

DATABASE CODE CEGL002233

COMMENTS
Voyageurs National Park
The diagnostic feature of this herbaceous community is a continuous cover of *Typha latifolia, Typha angustifolia* or *Typha X glauca*. Temporarily flooded or saturated cattail marshes found in shallow basins are floristically quite different from those along the shores of lakes and may represent a sub-type. Insufficient data exist to determine the relationship between these two situations. This association is analogous to Ontario's W11 (Harris *et al.* 1996). Cattail stands along the shores of the lakes often contain little else other than cattail and are therefore difficult to confuse with any other type. When they exist in drier situations, especially inland, *Typha* spp. can share dominance with other graminoids, particularly sedges. Cattails may invade Northern Sedge Wet Meadow stands. When this occurs, there must be >60% cover of cattails for the stand to be considered a Midwest Cattail Marsh. Up to this point, the stands usually retain more characteristics of a Northern Sedge Wet Meadow than of a Midwest Cattail Marsh.

Globally
This type may simply be a less diverse variation of *Typha* spp. - *Scirpus* spp. Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229).

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Equisetum fluviatile - (Eleocharis smallii) Herbaceous Vegetation (Water Horsetail - Spikerush Marsh)

COMMON NAME	Water Horsetail - (Marsh Spikerush) Herbaceous Vegetation
SYNONYM	Water Horsetail - Spikerush Marsh
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial forb vegetation (V.B)
PHYSIOGNOMIC GROUP	Temperate or subpolar perennial forb vegetation (V.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.B.2.N)
FORMATION	Semipermanently flooded temperate perennial forb vegetation (V.B.2.N.e)
ALLIANCE	EQUISETUM FLUVIATILE SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community is fairly uncommon in the park. It is most abundant in the larger bays like Daley and Tom Cod, though some stands may also be found in the many smaller bays throughout the park.

Globally

This association is found in Minnesota, Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs in sheltered bays and shores and along slow moving streams throughout the park. Wave exposure is typically low. Standing water is typically present up to 0.5 m deep. Substrate is clay or shallow peat over clay. The water regime is permanently flooded to intermittently exposed. This community is fairly uncommon in the park. It is most abundant in the larger bays like Daley and Tom Cod, though some stands may be found in the many smaller bays as well. Stands may be ephemeral due to fluctuating water levels in the large lakes.

Globally

Stands occur in wave-washed shores, sandbars, and stream channels. Substrate is mineral soil (often sand), sometimes held together by root mats. The water regime is permanently flooded to intermittently exposed, and water depth is generally less than 1 m (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Forb	*Acorus calamus, Sagittaria rigida, Sparganium chlorocarpum*
Fern	*Equisetum fluviatile*

Globally

Stratum	Species
Fern	*Equisetum fluviatile*
Graminoid	*Eleocharis smallii*

CHARACTERISTIC SPECIES

Voyageurs National Park

Equisetum fluviatile, Acorus calamus, Sagittaria rigida, Sparganium chlorocarpum

Globally

Eleocharis smallii, Equisetum fluviatile, Sparganium fluctuans

VEGETATION DESCRIPTION

Voyageurs National Park

This herbaceous comunity is dominated by *Equisetum fluviatile, Acorus calamus, Sagittaria rigida,* and/or *Sparganium chlorocarpum*. Stands may be dominated by just one of these species or they may occur mixed. Most

commonly, *Equisetum fluviatile* may mix with *Acorus calamus*. *Acorus calamus* may also mix with *Sagittaria rigida* and, less commonly, *Sparganium chlorocarpum*. Other herbs that may be present but do not reach dominance include *Sium suave, Cicuta bulbifera,* and *Polygonum lapathifolium*. Aquatic species may also be present at low density and include *Potamogeton* spp., *Utricularia intermedia,* and *Najas flexilis*.

Globally
Emergent cover is greater than 25%, and floating-leaved and submergent cover is low. Emergent graminoids < 1 m dominate the stands, including *Equisetum fluviatile* and/or *Eleocharis smallii*. Associated species of low constancy include *Glyceria borealis, Isoetes echinospora, Potamogeton gramineus,* and *Utricularia vulgaris* (Harris *et al.* 1996). In northern Minnesota, stands most commonly have a mix of *Equisetum fluviatile* and *Acorus calamus*. *Acorus calamus* may also mix with *Sagittaria rigida* and, less commonly, *Sparganium chlorocarpum*. Other herbs that may be present but do not reach dominance include *Sium suave, Cicuta bulbifera,* and *Polygonum lapathifolium*. Aquatic species may also be present at low density and include *Potamogeton* spp., *Utricularia intermedia,* and *Najas flexilis* (M. Smith personal commuication 1999).

CONSERVATION RANK G4.

DATABASE CODE CEGL005258

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the herbaceous layer dominated by *Equisetum fluviatile, Acorus calamus, Sagittaria rigida,* and/or *Sparganium chlorocarpum.* Most analogous to Ontario's W5 (Harris *et al.* 1996), though more broadly defined to include W6 as well. When dominated solely by *Equisetum fluviatile*, this type can grade into the Wiregrass Sedge Shore Fen (CEGL005229).

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Zizania (aquatica, palustris) Herbaceous Vegetation [Provisional] (Wild Rice Marsh)

COMMON NAME	(Annual Wild-rice, Northern Wild-rice) Herbaceous Vegetation
SYNONYM	Wild Rice Marsh
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	ZIZANIA (AQUATICA, PALUSTRIS) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This type is typically found in sheltered and isolated bays along the shores of the large lakes in the park.

Globally

This association is found in Iowa, Indiana, Michigan, New York, Vermont, Wisconsin, Ontario, and possibly Minnesota and Manitoba.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Wild Rice Marsh is typically found in sheltered and isolated bays along the shores of large lakes. These sites are permanently flooded with water 0.5-2 meters deep. Substrate is deep muck or clay or a thin layer of muck over clay.

Globally

Stands are found in deeper, sheltered waters of slow-moving streams, protected bays, and flowage lakes, particularly at stream mouths. Water depths generally exceed 0.5 m. Substrate is rich sedimentary peat, or mucky, silty soils. A thick mat of rice stalks often covers the bottom (Harris *et al.* 1996, Voss 1972).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Floating-leaved	*Zizania palustris, Potamogeton* spp.

Globally

Stratum	Species
Floating-leaved	*Zizania palustris,Zizania aquatica*

CHARACTERISTIC SPECIES

Voyageurs National Park

Zizania palustris, Potamogeton spp.

Globally

Zizania palustris, Zizania aquatica

VEGETATION DESCRIPTION

Voyageurs National Park

Cover of *Zizania palustris* in this community is highly variable, ranging from 20-100%. Other emergent species such as *Scirpus acutus* and *Scirpus tabernaemontani* may be present at low cover. Submerged and floating aquatic plants are also often present at low cover. *Nymphaea odorata* and *Nuphar variegatum* are the most abundant floating aquatic plants. Depending on the site, any of the plant species present in the Midwest Pondweed Marsh may be present in the Wild Rice Marsh. This most commonly includes *Vallisneria americana, Sparganium*

fluctuans, Najas flexilis, Potamogeton gramineus, Potamogeton zosteriformis, and *Potamogeton friesii*.

Globally
The marsh is dominated almost entirely by the tall emergent graminoids *Zizania aquatica* or *Zizania palustris*. Floating-leaved and submerged aquatic cover can be high, but species composition is variable. Species include *Ceratophyllum demersum, Nymphaea odorata, Nuphar variegatum, Potamogeton natans, Potamogeton zosteriformis, Spirodela polyrhiza, Utricularia vulgaris,* and others (Harris *et al.* 1996).

CONSERVATION RANK G?.

DATABASE CODE CEGL002382

COMMENTS
Voyageurs National Park
Diagnostic features of the type are open water and dominance by *Zizania palustris*. This type is analogous to Ontario's W9 (Harris *et al.* 1996).

The natural and human caused fluctuation in water levels in the large lakes of Voyageurs National Park can have a significant impact on the presence of this community. Because the Wild Rice Marsh is dependent on a specific range of water levels, extreme wet or dry years may have an effect on the presence of this community in a particular area and throughout the park. For this reason, the location of this community is constantly in flux, appearing in one place where in previous years it was absent and disappearing from where it may have been the previous year.

Globally
The natural and human caused fluctuation in water levels in lakes and rivers can have a significant impact on the presence of this community. Because the Wild Rice Marsh is dependent on a specific range of water levels, extreme wet or dry years may have an effect on the presence of this community in a particular area and throughout the park. For this reason, the location of this community is constantly in flux, appearing in one place where in previous years it was absent and disappearing from where it may have been the previous year (M. Smith personal communication 1999).

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.
Voss, E.G. 1972. Michigan Flora, Part I. Gymnosperms and Monocots. Cranbrook Institute of Science, Bloomfield Hills Bull., No. 55.

Potamogeton spp. - Ceratophyllum spp. Midwest Herbaceous Vegetation (Midwest Pondweed Submerged Aquatic Wetland)

COMMON NAME	Pondweed species - Coontail species Midwest Herbaceous Vegetation
SYNONYM	Midwest Pondweed Submerged Aquatic Wetland
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Hydromorphic rooted vegetation (V.C)
PHYSIOGNOMIC GROUP	Temperate or subpolar hydromorphic rooted vegetation (V.C.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.C.2.N)
FORMATION	Permanently flooded temperate or subpolar hydromorphic rooted vegetation (V.C.2.N.a)
ALLIANCE	POTAMOGETON SPP. - CERATOPHYLLUM SPP. - ELODEA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type is found throughout the park area, typically in fairly sheltered bays of the large lakes, in interior lakes or, rarely, in recent beaver floodings. It can also occur in more wave exposed sites on the large lakes.

Globally

This community is found in Iowa, Illinois, Indiana, Michigan, Minnesota, Ohio, North Dakota, South Dakota, Wisconsin, and possible Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community type typically occurs in fairly sheltered bays of the large lakes, in interior lakes or, rarely, in recent beaver floodings. It can also occur in more wave exposed sites on the large lakes where water depth is not limiting. Water depth is typically 0.5-2 m. The substrate is most commonly clay, though occasionally sand or, in less exposed sites, muck over clay.

Globally

The major environmental controls on submerged aquatic vegetation, as noted by Curtis (1959), are water depth (as it relates to light intensity), water chemistry, water movement, and nature of the substrate. Various combinations of these factors can interact in a variety of ways to influence the local composition of the community. As a result, a single lake may contain a number of relatively homogeneous stands, each with a different species makeup, depending on depth, nature of adjoining shoreline, degree of protection from waves, etc. Water chemistry may be one of the few constants. Assessment of water conductivity and alkalinity are two measured parameters that can provide some understanding of the influence of water chemistry on species composition. Curtis (1959) also summarizes a study by Swindale and Curtis (1959).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Floating-leaved	*Potamogeton* spp., *Nymphaea odorata*
Submersed	*Valesneria americana, Myriophyllum sibiricum, Najas flexilis*

Globally

Stratum	Species
Submersed	*Potamogeton* spp., *Ceratophyllum* spp., *Myriophyllum* spp., *Utricularia* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Potamogeton spp., *Nymphaea odorata, Valesneria americana, Myriophyllum sibiricum, Najas flexilis*

Globally

Potamogeton spp., *Ceratophyllum* spp., *Myriophyllum* spp., *Chara* spp., *Utricularia* spp.

VEGETATION DESCRIPTION

Voyageurs National Park

The Midwest Pondweed Submerged Aquatic Wetland consists primarily of submerged aquatic plants but can contain <10% cover of floating aquatics. Percent cover of submerged aquatic vegetation is highly variable and ranges from 10-90%. Species composition and diversity are, likewise, highly variable. The most common species are: *Valesneria americana, Potamogeton richardsonii, Potamogeton epihydrus, Potamogeton zosteriformis, Potamogeton friesii, Potamogeton gramineus, Ceratophyllum demersum, Potamogeton vaseyi, Sparganium fluctuans, Myriophyllum sibiricum, Najas flexilis, Nymphaea odorata,* and *Nuphar variegatum*. Examples of this type may be relatively species rich and contain nearly all of the above listed species or be species poor and contain only two or three species. *Valesneria americana*, in particular, can occasionally be found in nearly monotypic stands. Emergent species such as *Scirpus tabernaemontani, Scirpus acutus,* and *Zizania palustris* may be present at low cover, especially in the large lakes. In the infrequent case of this community existing in a recent beaver flooding, species composition is relatively low and commonly includes *Utricularia vulgaris* and *Brasenia schreberi.*

Globally

Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima, Eriocaulon aquaticum, Gratiola aurea, Isoetes echinospora, Isoetes macrospora, Juncus pelocarpus,* and *Lobelia dortmanna* (Curtis 1959, Harris *et al.* 1996). Subgroup B is a shallow (<50 cm) open water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis, Myriophyllum* spp., *Potamogeton amplifolius, Potamogeton gramineus, Potamogeton praelongus, Potamogeton robbinsii, Sparganium fluctuans,* and *Utricularia vulgaris*. Subgroup C includes open water marsh with emergent cover < 25% and floating leaved aquatics >25%. Substrate is sedimentary peat and stands are often found in sheltered bays of lakes and streams which do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum, Lemna* spp., *Myriophyllum sibiricum, Myriophyllum verticillatum, Potamogeton natans, Potamogeton pectinatus, Potamogeton richardsonii, Potamogeton zosteriformis, Ranunculus aquatilis, Utricularia vulgaris,* and *Vallisneria americana* (Curtis 1959, Harris *et al.* 1996).

CONSERVATION RANK G5Q.

DATABASE CODE CEGL002282

COMMENTS

Voyageurs National Park

Diagnostic features of the type are floating leaf aquatics <10% cover, and dominance by submerged aquatics, mainly *Vallissneria americana, Potamogeton* spp., and *Myriophyllum sibiricum*. The type is analogous to Ontario's W1 and W3 (Harris *et al.* 1996). Where floating aquatics, especially *Nymphaea odorata* and *Nuphar variegatum*, increase in cover this community grades into the Northern Water Lily Aquatic Wetland. Beaver floodings most commonly have >10% cover of floating aquatics and are therefore usually colonized by the Northern Water Lily Aquatic Wetland. The stands at Voyageurs are most like subgroup C of the global description.

The natural and human caused fluctuation in water levels in the large lake of Voyageurs National Park can have a significant impact on the structure, composition and presence of this community. See Wilcox and Meeker (1991) for a discussion on the effects of annual water level fluctuations. Extreme wet or dry years may have an effect on the presence of the Midwest Pondweed Submerged Aquatic Wetland community by changing the dominance of floating, emergent and submerged vegetation.

REFERENCES

Curtis, J. T. 1959. The vegetation of Wisconsin: An ordination of plant communities. Univ. of Wisconsin Press, Madison. 657 p.

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Swindale, Delle N. and Curtis, J. T. 1957. Phytosociology of the larger submergered plants in Wisconsin lakes. Ecology 38:397-407.

Wilcox,D.A. and J.E. Meeker. 1991. Disturbance effects on aquatic vegetation in regulated and unregulated lakes in northern Minnesota. Canadian Journal of Botany. 69:1542-1551.

Nymphaea odorata - Nuphar lutea (ssp. pumila, variegata) Herbaceous Vegetation (Northern Water Lily Aquatic Wetland)

COMMON NAME	White Water Lily - Yellow Water Lily Herbaceous Vegetation
SYNONYM	Northern Water Lily Aquatic Wetland
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Hydromorphic rooted vegetation (V.C)
PHYSIOGNOMIC GROUP	Temperate or subpolar hydromorphic rooted vegetation (V.C.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.C.2.N)
FORMATION	Permanently flooded temperate or subpolar hydromorphic rooted vegetation (V.C.2.N.a)
ALLIANCE	NUPHAR LUTEA - NYMPHAEA ODORATA PERMANENTLY FLOODED HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type is found throughout the park area, typically in fairly sheltered bays of the large lakes, in interior lakes or, rarely, in recent beaver floodings.

Globally

This association is found in Michigan, Minnesota, New York, Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs in sheltered bays of lakes and beaver impoundments. In confined basins, this community may also occur as an open water lag around emergent marshcommunities. Wave exposure is low. Water depth is 0.25 - 2 meters and substrate is typically muck, clay, or muck over clay. In stands that occur in beaver impoundments, standing dead trees and patches of emergent vegetation are common. The water regime is permanently flooded.

Globally

Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat (Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Floating-leaved	*Nymphaea odorata, Nuphar lutea* ssp. *variegata, Brasenia schreberi, Potamogeton* spp.

Globally

Stratum	Species
Floating-leaved	*Nuphar lutea* ssp. *variegata, Nuphar lutea* ssp. *pumila, Nymphaea odorata, Potamogeton* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Nymphaea odorata, Nuphar lutea ssp. *variegata, Brasenia schreberi, Potamogeton* spp.

Globally

Nuphar lutea ssp. *variegata, Nuphar lutea* ssp. *pumila, Nymphaea odorata, Potamogeton* spp.

VEGETATION DESCRIPTION

Voyageurs National Park

This community is dominated by floating aquatics, mainly *Nymphaea odorata, Nuphar lutea* ssp. *variegata,* and *Brasenia schreberi*. Cover of these floating aquatics is highly variable, ranging from 10-90%. *Nymphaea odorata*

and *Nuphar lutea* ssp. *variegata* tend to dominate stands which occur in sheltered bays of lakes while *Brasenia schreberi* dominates beaver impoundments. A low amount of emergent vegetation may occur and is more common in beaver impoundments. Submerged aquatic plants often occur with the floating aquatics at 10-80% cover. The most abundant submerged aquatics in the lakes are *Potamogeton richardsonii, Potamogeton natans, Potamogeton epihydrus, Myriophyllum sibiricum, Vallisneria americana,* and *Najas flexilis*. In stands that occur in beaver impoundments, the most abundant submerged aquatic is *Utricularia vulgaris.*

Globally
Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand, but include *Nymphaea odorata*, *Nuphar lutea* ssp. *pumila,* and *Nuphar lutea* ssp. *variegata*. Other dominants may include *Brasenia schreberi* and *Potamogeton amplifolius*. A variety of emergent species can occur with this type (Harris *et al.* 1996).

CONSERVATION RANK G5.

DATABASE CODE CEGL002562

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the greater than 10% cover of *Nymphaea odorata, Nuphar lutea* ssp. *variegata* and/or *Brasenia schreberi*. Stands that occur in sheltered bays of the large lakes closely related to the Midwest Pondweed Submerged Aquatic Wetland (CEGL002282) but that type has less than 10% cover of floating aquatics. Many stands that are intermediate between these two types exist. When found in beaver impoundments, the Northern Water Lily Aquatic Wetland many occur with patches of Northern Sedge Wet Meadow (CEGL002257) or Leatherleaf-Sweet Gale Shore Fen (CEGL005228), which together may be mapped as Deep Marsh Complex (DMX). Ths type is analogous to Ontario's W4 (Harris *et al.* 1996).

This community is subject to disturbance by beaver activity.

REFERENCES
Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

6.5 Northern Conifer and Hardwood Swamps

Fraxinus nigra - Mixed Hardwoods-Conifers / Cornus sericea / Carex spp. Forest (Black Ash - Mixed Hardwood Swamp)

COMMON NAME	Black Ash - Mixed Hardwoods - Conifers / Red-osier Dogwood / Sedge species Forest
SYNONYM	Black Ash - Mixed Hardwood Swamp
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Saturated cold-deciduous forest (I.B.2.N.g)
ALLIANCE	FRAXINUS NIGRA - ACER RUBRUM SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This community type occurs throughout the park in shallow depressions and low areas or adjacent to peatlands.

Globally

This black ash - hardwood swamp forest type is found widely in the northern Midwest region of the United States and into the boreal region of Central Canada. This association is found in Illinois, Michigan, Minnesota, western North Dakota, Wisconsin, Manitoba, and Ontario. It may be in Indiana, too.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Black Ash-Mixed Hardwood Swamp occurs throughout the park in shallow depressions and low areas or adjacent to peatlands. In some cases, soils may be fairly deep peats reaching depths of >30 cm. More commonly, however, the soils of this type consist of 4-10 cm mineral soils (often with high organic matter content) or peat over dense clay. Under wetter conditions, the soils are typically peats, with hummock and hollow microtopography well developed. In these situations, standing water is usually present throughout the season in the hollows. Under relatively drier conditions (though still poorly drained), the soils are mineral soils and there is minimal microtopographic relief. Standing water is usually absent in these circumstances. Depending on topographic position and substrate, the water regime in these communities can be temporarily to seasonally flooded or saturated.

Globally

Stands occur on poorly drained wetland depressions on flat, gentle, or moderate slopes in valleys with impeded drainages or near lake shores. These wet pockets contain fine sandy clay loams, fine loams, mucks or soils with well-decomposed peat. Hydrology can vary from seasonally flooded to saturated. Conditions are often transitional to uplands (Sims *et al.* 1989, Minnesota NHP 1993, Cleland *et al.* 1994, Chambers *et al.* 1997).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Fraxinus nigra*
Tree sub-canopy	*Fraxinus nigra*
Tall shrub	*Alnus incana, Fraxinus nigra*
Short shrub	*Rubus pubescens*
Fern	*Equisetum sylvaticum, Dryopteris carthusiana, Athyrium angustum*
Graminoid	*Calamagrostis canadensis, Carex* spp.
Nonvascular	*Rhytidiadelphus triquetrus, Calliergon cordifolium, Mniaceae, Drepanocladus* spp.

Globally

Stratum	Species

Tree canopy	*Fraxinus nigra, Abies balsamea, Acer rubrum*
Tall shrub	*Alnus incana*

CHARACTERISTIC SPECIES
Voyageurs National Park
Fraxinus nigra, Alnus incana

Globally
Fraxinus nigra, Alnus incana

VEGETATION DESCRIPTION
Voyageurs National Park
The canopy and sub canopy (if present) of the Black Ash-Mixed Hardwood Swamp most commonly consists solely of *Fraxinus nigra*. In some situations, *Thuja occidentalis* may be mixed in these strata at low cover (< 25%). Canopy cover is typically 70-90% but may be as low as 40%. Canopy height is generally 10-20 meters. The subcanopy is either absent or present at low (20-30%) cover. In most stands, *Fraxinus nigra* saplings are present in the shrub strata around 20%. In wetter stands, *Alnus incana* shrubs may be present, typically around 20-30% cover. *Abies balsamea* and *Acer spicatum* can also occasionally be found in the shrub layers. The herbaceous layer is very diverse and usually reaches 80-100% cover. The most abundant species are *Calamagrostis canadensis, Equisetum sylvaticum, Rubus pubescens, Dryopteris carthusiana,* and *Athyrium angustum*. In addition to these, the following species are also common: *Iris versicolor, Carex lacustris, Carex intumescens, Carex gracillima, Platanthera psycodes, Mitella nuda,* and *Aster macrophyllus*. The nonvascular component of this community tends to be more prevalent in the wetter stands and consists of *Rhytidiadelphus triquetrus, Calliergon cordifolium, Mniaceae,* and *Drepanocladus* spp. In these wetter stands, bryophytes typically colonize the hollows, low hummocks and fallen logs at 20-40% cover.

Globally
Canopy structure is variable, ranging from 30 to 90% cover. The canopy is dominated by *Fraxinus nigra* (at least 50% cover), with a diverse mix of hardwoods and conifers in the main and sub canopies, including *Abies balsamea, Acer rubrum, Acer saccharum, Betula papyrifera, Betula alleghaniensis, Fraxinus pennsylvanica, Picea glauca, Populus balsamifera, Populus tremuloides, Thuja occidentalis, Tilia americana,* and *Ulmus americana*. Shrub and sapling species include *Abies balsamea, Acer spicatum, Alnus incana, Cornus sericea, Corylus cornuta, Lonicera canadensis, Prunus virginiana, Ribes triste, Rubus idaeus,* and *Rubus pubescens*. Herbaceous species include *Aralia nudicaulis, Aster macrophyllus, Athyrium felix-femina, Carex gracillima, Carex intumescens, Cinna latifolia, Circaea alpina, Clintonia borealis, Dryopteris carthusiana, Equisetum sylvaticum, Fragaria virginiana, Maianthemum canadense, Mitella nuda, Streptopus roseus, Thalictrum pubescens,* and *Trientalis borealis*. Mosses include *Climacium dendroides* and *Plagiomnium* spp. (Sims *et al.* 1989, Minnesota DNR 1993, Cleland *et al.* 1994, Harris *et al.* 1996, Chambers *et al.* 1997). A floodplain variant may also occur, with more hardwood dominance, with wetter species present, such as *Alnus incana, Calamagrostis canadensis,* and *Caltha palustris* (Harris *et al.* 1996). Diagnostic features include the dominance by *Fraxinus nigra*.

CONSERVATION RANK G4.

DATABASE CODE CEGL002105

COMMENTS
Voyageurs National Park
Diagnostic features of the type are canopy of *Fraxinus nigra*. Analogous to Ontario's W33 and W34 (Harris *et al.* 1996). As cedar becomes more common in the canopy and subcanopy, this type grades into the White Cedar-Black Ash Swamp. The Black Ash-Mixed Hardwood Swamp differs from the White Cedar-Black Ash Swamp in that it contains less than 25% cover of cedar in the canopy or subcanopy. Stands intermediate between these two types are common.

Many Black Ash-Mixed Hardwood Swamps occur in drainages and are therefore occasionally influenced by beaver activity. Since Black ash trees cannot survive prolonged periods of inundation, these communities are frequently flooded out by beaver activity.

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Thuja occidentalis - Fraxinus nigra Forest (White Cedar - Black Ash Swamp)

COMMON NAME	Northern White-cedar - Black Ash Forest
SYNONYM	White Cedar - Black Ash Swamp
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Saturated mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.d)
ALLIANCE	THUJA OCCIDENTALIS - ACER RUBRUM SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is found in pockets throughout the park, but also occurs as large stands in the environs west of park, and in the Rat Root peatlands.

Globally

This association is found in northern Minnesota, Michigan, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type is found in confined basins surrounded by upland or as part of large wetland complexes. If associated with peatlands, it is usually found on the upland border where wetter, more minerotrophic conditions exist. Soils are either deep, well decomposed peats or shallow, well decomposed peats over clay. Microtopography of hummocks and hollows may be well developed or absent. Standing water is often present. The water regime is seasonally flooded to saturated.

Globally

This type is found in confined basins surrounded by upland or as part of large wetland complexes. If associated with peatlands, it is usually found on the upland border where wetter, more minerotrophic conditions exist. Soils are either deep, well decomposed peats or shallow, well decomposed peats over clay. Microtopography of hummocks and hollows may be well developed or absent. Standing water is often present. The water regime is seasonally flooded to saturated (M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Thuja occidentalis, Fraxinus nigra*
Tree sub-canopy	*Thuja occidentalis*
Tall shrub	*Acer spicatum, Alnus incana, Abies balsamea*
Short shrub	*Rubus pubescens*
Forb	*Coptis groenlandica*
Fern	*Equisetum sylvaticum*
Graminoid	*Carex intumescens, Carex* spp., *Calamagrostis canadensis*
Nonvascular	*Rhytidiadelphus triquetrus, Calliergon* spp., *Mniaceae*

Globally

Stratum	Species
Tree canopy	*Thuja occidentalis, Fraxinus nigra*
Tall shrub	*Alnus incana*

CHARACTERISTIC SPECIES

Voyageurs National Park

Thuja occidentalis, Fraxinus nigra, Alnus incana

Globally
Thuja occidentalis, Fraxinus nigra, Alnus incana

VEGETATION DESCRIPTION
Voyageurs National Park
The White Cedar-Black Ash Swamp consists of a mixed canopy of *Fraxinus nigra* and *Thuja occidentalis* each comprising at least 25% relative cover. It is also found with a canopy solely of *Fraxinus nigra* (usually 80-100% cover) and a sub-canopy of *Thuja occidentalis* (40- 90% cover). The shrub layer, with 20-40% cover, is dominated by *Acer spicatum, Alnus incana, Abies balsamea, Fraxinus nigra, Rubus pubescens*, with some *Acer rubrum*. *Alnus incana* alone may occasionally occupy the shrub layer at 70-90% cover. The herbaceous layer usually covers 80-100% of the forest floor and is very diverse. The most common herbs are *Equisetum sylvaticum, Carex intumescens, Carex gracillima, Calamagrostis canadensis,* and *Coptis groenlandica*. Moss cover is highly variable ranging from 30-90%. *Rhytidiadelphus triquetrus, Calliergon cordifolium, Calliergon giganteum, Mniaceae, Thuidium* spp., *Sphagnum warnstorfii,* and *Sphagnum squarrosum* are the most abundant mosses.

Globally
Canopy cover is variable, sometimes fairly open. *Thuja occidentalis* and *Fraxinus nigra* dominate the canopy, but some stands may have *Fraxinus nigra* in the upper canopy and *Thuja occidentalis* in the lower canopy. *Thuja occidentalis* also tends to occur on the hummocks and *Fraxinus nigra* in the hollows. *Populus tremuloides* can be a major component, but this may be caused by logging of *Thuja occidentalis*. *Acer rubrum, Betula alleghaniensis,* and *Picea glauca* may also be present. Shrubs include *Acer spicatum, Alnus incana, Cornus alternifolia, Lonicera canadensis, Ribes* spp., and *Rubus pubescens*. The herb rich layer includes *Aralia nudicaulis, Arisaema triphyllum, Carex gracillima, Carex intumescens, Clintonia borealis, Cornus canadensis, Dryopteris carthusiana, Galium triflorum, Maianthemum canadense, Tiarella cordifolia* and *Trientalis borealis* (Chambers *et al.* 1997). In northern Minnesota, moss cover is highly variable, ranging from 30-90%. The most abundant mosses are *Rhytidiadelphus triquetrus, Calliergon cordifolium, Calliergon giganteum, Mniaceae, Thuidium* spp., *Sphagnum warnstorfii,* and *Sphagnum squarrosum* (M. Smith personal communication 1999).

CONSERVATION RANK G?

DATABASE CODE CEGL005165

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Thuja occidentalis* and *Fraxinus nigra*, both comprising at least 25% cover. Stands may also have a canopy of *Fraxinus nigra* with at least 25% cover of *Thuja occidentalis* in the subcanopy. This type can be similar to the White Cedar-Boreal Conifer Forest (CEGL002449), though it is usually wetter and more minerotrophic. It is perhaps intermediate between that type and the Black Ash-Mixed Hardwood Swamp (CEGL002105) in terms of moisture and mineral status. When the cover of *Fraxinus nigra* in the canopy is less than 25%, the stand becomes a White Cedar-Boreal Conifer Forest.

This type, like the Black Ash-Mixed Hardwood Swamp, is occasionally subject to beaver floodings.

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Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ont. Minist. Nat. Resour., Northwest Sci. Tech. Field Guide FG-01.Thunder Bay, Ont. 74 p.

Picea mariana / Alnus incana / Sphagnum spp. Forest (Black Spruce / Alder Rich Swamp)

COMMON NAME	Black Spruce / Speckled Alder / Peatmoss species Forest
SYNONYM	Black Spruce / Alder Rich Swamp
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g)
ALLIANCE	PICEA MARIANA SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is most common in the northern parts of the park, where peatlands are more extensive, but can be found throughout the park in small confined basins.

Globally

This community is found in northern Minnesota, northern Michigan, northwestern Ontario, and southeastern Manitoba.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs as part of large peatlands, in confined basins and along the upland margins of less minerotrophic peatlands. The substrate is deep, fibric Sphagnum peat or peat over clay. Hummock and hollow microtopography is moderately to well developed with standing water occasionally occurring in the hollows. The water regime is saturated.

Globally

This type occurs as part of large peatlands, in confined basins and along the upland margins of less minerotrophic peatlands (M. Smith personal communication 1999). Stands occur on level, wet, poorly drained organic soils (Zoladeski 1995). The substrate is deep, fibric Sphagnum peat or shallow peat over clay. Hummock and hollow microtopography is moderately to well developed with standing water occasionally occurring in the hollows. The water regime is saturated.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea mariana*
Tall shrub	*Alnus incana*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Calamagrostis canadensis, Carex lacustris*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Tree canopy	*Picea mariana, Picea glauca*
Tall shrub	*Alnus incana*
Graminoid	*Carex rostrata, Calamagrostis canadensis*
Nonvascular	*Sphagnum* spp., *Calliergon* sp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea mariana, Alnus incana

Globally
Picea mariana, Alnus incana

VEGETATION DESCRIPTION
Voyageurs National Park
The canopy of *Picea mariana* in this community is typically uneven aged and fairly open, ranging from 20-40%. In rare cases, canopy coverage may be as high as 90%. *Larix laricina* and *Thuja occidentalis* can also be found in the canopy at low cover. A shrub layer of *Alnus incana* and *Picea mariana* ranges from 30-90% but is most commonly found in the upper part of that range. The dwarf-shrub strata is dominated by *Ledum groenlandicum* and, to a lesser extent, *Chamaedaphne calyculata*. Coverage of dwarf-shrubs is highly variable (10-80%). The herbaceous layer is typically moderately rich and dominated by *Calamagrostis canadensis, Maianthemum trifolium,* and/or *Carex lacustris*. *Carex trisperma, Osmunda cinnamomea, Equisetum sylvaticum, Cornus canadensis*, and *Dryopteris carthusiana* are also common. The cover of herbaceous species is highly variable, ranging from 20-90%. Sphagnum moss typically occupies 90-100% of the forest floor. The most abundant species are *Sphagnum magellanicum, Sphagnum girgensohnii, Sphagnum centrale, Sphagnum wulfianum,* and *Sphagnum recurvum sensu lato*.

Globally
The overstory is composed almost exclusively of conifers. *Picea mariana* is the most abundant tree and may occur in pure stands. *Abies balsamea, Larix laricina,* and *Thuja occidentalis* vary from minor to codominant. There is a moderately well developed tall shrub/sapling layer, consisting of *Alnus incana* and saplings of the canopy trees. Several shrubs, many of them ericaceous, make up a low shrub layer. These include *Andromeda polifolia, Chamaedaphne calyculata, Gaultheria hispidula, Ledum groenlandicum, Linnaea borealis, Rubus pubescens*, and *Vaccinium angustifolium*. The herbaceous layer is frequently species rich, containing species such as *Calamagrostis canadensis, Carex leptalea, Carex trisperma, Clintonia borealis, Coptis trifolia, Cornus canadensis, Dryopteris cristata, Eriophorum* spp., *Mitella nuda*, and *Trientalis borealis*. Mosses include *Dicranum flagellare, Dicranum polysetum, Pleurozium schreberi, Ptilium crista-castrensis, Sphagnum girgensohnii, Sphagnum magellanicum*, and *Sphagnum nemoreum* (Sims *et al.* 1989, Harris *et al.* 1996, Chambers *et al.* 1997).

CONSERVATION RANK G5.

DATABASE CODE CEGL002452

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Picea mariana* with less than 25% cover of other conifers and a shrub layer of *Alnus incana*. Analogous to Ontario's W29 and W30 (Harris *et al.* 1996). The Black Spruce-Tamarack Poor Swamp is very similar to the Black Spruce/Alder Rich Swamp but contains greater than 25% relative cover of Larix laricina. In cases where spruce cover is low, this type can grade into the Speckled Alder Swamp.

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Larix laricina / Alnus incana Forest (Northern Tamarack Rich Swamp)

COMMON NAME	Tamarack / Speckled Alder Forest
SYNONYM	Northern Tamarack Rich Swamp
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Saturated cold-deciduous forest (I.B.2.N.g)
ALLIANCE	LARIX LARICINA SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type occurs as part of large peatlands, in confined basins and along the upland margins of less minerotrophic peatlands throughout the park.

Globally

This community is found in the United States in northern and central parts of Minnesota, Wisconsin, and Michigan; and in Canada in Ontario, Manitoba, and probably elsewhere.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs as part of large peatlands, in confined basins and along the upland margins of less minerotrophic peatlands. The substrate is deep, fibric Sphagnum peat or shallow peat over clay. Hummock and hollow microtopography is moderately to well developed, with standing water occasionally occurring in the hollows. The water regime is saturated.

Globally

Stands are found on the shores of lakes and rivers above the flooding level, as well as margins of flowage areas of peatland complexes. The substrate is primarily a well-decomposed woody peat in wet, saturated soils, but can also be a moist mineral soil. Hummock and hollow microtopography is moderately to well developed, with standing water occasionally occurring in the hollows. (Sims *et al.* 1989, MN NHP 1993, Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Larix laricina*
Tall shrub	*Alnus incana*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata*
Forb	*Maianthemum trifolium, Sarracenea purpurea*
Graminoid	*Calamagrostis canadensis, Carex lacustris*
Nonvascular	*Sphagnum* spp.(*Sphagnum magellanicum, Sphagnum recurvum sensu lato, Sphagnum russowii*)

Globally

Stratum	Species
Tree canopy	*Larix laricina*
Tall shrub	*Alnus incana, Betula pumila, Thuja occidentalis*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata, Gaultheria hispidula*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Larix laricina, Alnus incana, Chamaedaphne calyculata, Betula pumila, Sphagnum spp.

Globally
Larix laricina,Chamaedaphne calyculata, Betula pumila, Sphagnum spp.

VEGETATION DESCRIPTION
Voyageurs National Park
The canopy of *Larix laricina* in this community is typically uneven-aged and fairly open, ranging from 20-50%. *Thuja occidentalis* and *Picea mariana* may also occur in the canopy at low densities (<25% relative cover). A shrub layer of *Alnus incana* is typically present at 40-90% cover. The shrub layer may also include *Betula pumila* and *Salix* spp. (typically *Salix pyrifolia, Salix discolor,* and/or *Salix pedicellaris*). A dwarf-shrub layer of *Ledum groenlandicum* and *Chamaedaphne calyculata* is typically present at 70-90% cover, though it may be as low as 10% cover in some stands. The herbaceous layer is moderately species rich and highly variable in cover, ranging from very low to continuous. The most abundant species are *Calamagrostis canadensis, Maianthemum trifolium,* and *Carex lacustris. Equisetum sylvaticum, Rubus pubescens, Carex trisperma,* and *Potentilla palustris* are also commonly present. Sphagnum moss typically occupies 90-100% of the forest floor. The most abundant species are *Sphagnum magellanicum, Sphagnum recurvum sensu lato,* and *Sphagnum russowii. Calliergon cordifolium* and/or *Calliergon giganteum* infrequently colonize the wet hollows.

Globally
The canopy layer varies from closed (60-100% cover) to open (25-60% cover), and may also range from 3-10 m in height. *Larix laricina* is the dominant tree species, with associates of *Picea mariana* and *Thuja occidentalis.* The shrub, herb, and moss layers can be very rich. The shrub layer typically contains *Alnus incana,* along with *Abies balsamea, Cornus sericea, Salix* spp., and *Picea mariana*. The dwarf-shrub layer is strongly ericaceous, including *Ledum groenlandicum* and *Gaultheria hispidula*. Other dwarf-shrubs include *Chamaedaphne calyculata, Linnaea borealis, Lonicera villosa, Ribes triste, Rosa acicularis,* and *Rubus pubescens*. Herbaceous cover is variable; species include *Carex disperma, Carex lacustris, Carex trisperma, Coptis trifolia, Cornus canadensis, Equisetum sylvaticum, Galium triflorum, Maianthemum canadense, Maianthemum trifolium, Mitella nuda, Trientalis borealis,* and *Viola renifolia*. The moss layer, which is sometimes patchy, includes *Dicranum polysetum, Hylocomnium spendens, Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquestrus, Sphagnum capillifolium, Spaghnum girgensohnii,* and *Sphagnum nemoreum*. (Sims *et al.* 1989, Minnesota NHP 1993, Harris *et al.* 1996).

CONSERVATION RANK G4.

DATABASE CODE CEGL002471

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy consisting solely of *Larix laricina,* with *Alnus incana* in the shrub layer. This type, Northern Tamarack Rich Swamp, is usually wetter than the Black Spruce/Alder Rich Swamp (CEGL002452) or the Black Spruce/Labrador Tea Poor Swamp (CEGL002454), but the *Sphagnum* spp. layer can range from patchy to more continuous. The type differs from those communities by having a canopy consisting solely of *Larix laricina. Picea mariana* and/or *Thuja occidentalis* may be present in the canopy at less than 25% relative cover. The type is also very similar to the Speckled Alder Swamp (CEGL002381) but has a canopy of *Larix laricina* with at least 20% cover over the alder shrub layer. This type is somewhat analogous to Ontario's W31 (Harris *et al.* 1996).

Globally
Fires may move through this community in dry years.

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Thuja occidentalis - (Picea mariana - Abies balsamea) / Alnus incana Forest [White Cedar - (Mixed Conifer) / Alder Swamp]

COMMON NAME	Northern White-cedar - (Black Spruce, Balsam Fir) / Speckled Alder Forest
SYNONYM	White Cedar - (Mixed Conifer) / Alder Swamp
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g)
ALLIANCE	THUJA OCCIDENTALIS SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type occurs in localized areas throughout the park.

Globally

This community is found in northern Minnesota, northern Wisconsin, Upper and Lower Michigan, southeastern Manitoba, and northwestern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs in moderately minerotrophic conditions over deep peat. Hummock and hollow microtopography is usually well developed. In wetter stands, there is often standing water present in the hollows. Coarse woody debris can be significant. The water regime is saturated.

Globally

This community is found on level to gently sloping ground with wet, organic (Sims *et al.* 1989) or mineral soil (MN NHP 1993). Stands typically occur along the margins of peatlands, in drainage courses, or shallow depressions. The substrate has moderately minerotrophic conditions over deep peat. Hummock and hollow microtopography is usually well developed. In wetter stands, there is often standing water present in the hollows. Coarse woody debris can be significant. The water regime is saturated.

Schwintzer and Tomberlin (1982) reported detailed results on the chemical characteristics of the ground water of several wetland types in Lower Michigan. They found that it was difficult to differentiate swamps dominated by conifers from those dominated by other vegetation on the basis of ground water. The swamps were moderately to strongly minerotrophic and had circumneutral pH.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Emergent tree	*Picea mariana*
Tree canopy	*Thuja occidentalis, Larix laricina*
Tall shrub	*Alnus incana, Abies balsamea, Betula pumila*
Short shrub	*Ledum groenlandicum, Rubus pubescens*
Forb	*Cornus canadensis, Mitella nuda, Maianthemum trifolium*
Graminoid	*Carex* spp., *Calamagrostis canadensis*
Nonvascular	*Sphagnum* spp., *Calliergon* spp., *Rhytidiadelphus triquetrus, Drepanocladus* spp.

Globally

Stratum	Species
Tree canopy	*Thuja occidentalis*
Tall shrub	*Alnus incana*

Forb	*Coptis trifolia, Maianthemum canadense*
Graminoid	*Calamagrostis canadensis, Carex disperma, Carex leptalea*
Nonvascular	*Hylocomium splendens, Rhytidiadelphus triquestrus, Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Thuja occidentalis, Alnus incana, Sphagnum spp.

Globally

Thuja occidentalis, Alnus incana, Coptis trifolia, Carex disperma, Hylocomium splendens, Sphagnum spp.

VEGETATION DESCRIPTION

Voyageurs National Park

Thuja occidentalis typically forms a fairly closed canopy in this community with covers ranging from 70-100%. In larger peatlands, however, the canopy may be as low a 30%. It is in these larger peatlands that an emergent layer of *Picea mariana* becomes common with low (10-20%) cover. A shrub layer of *Alnus incana* and/or *Abies balsamea* is nearly always present but cover is highly variable, ranging from 20-90%. Other species common in the shrub layer include *Thuja occidentalis, Betula pumila,* and *Fraxinus nigra*. A dwarf-shrub strata, if present, exists at low (10-25%) cover but can be quite species diverse. Most abundant species include *Ledum groenlandicum, Cornus rugosa, Fraxinus nigra, Lonicera oblongifolia,* and *Ribes* spp. Cover in the herbaceous strata is highly variable and ranges from 30-90%. Species diversity in the herbaceous strata is very high. The most abundant species are *Rubus pubescens, Carex trisperma, Carex disperma, Carex leptalea, Calamagrostis canadensis, Cornus canadensis, Mitella nuda, Equisetum sylvaticum, Iris versicolor,* and *Gymnocarpium dryopteris*. Like the herbaceous layer, the nonvascular strata can be very diverse. In some circumstances, *Sphagnum* spp. dominate the nonvascular strata with 90-100% cover, leaving other species like *Rhytidiadelphus triquetrus* and *Calliergon cordifolium* to colonize the wet hollows. In other cases, though, *Sphagnum* spp. is found sharing dominance with a mix of *Rhytidiadelphus triquetrus, Calliergon cordifolium, Calliergon giganteum, Rhizomnium magnifolium, Rhizomnium pseudopunctatum* and *Climacium dendroides*. In both cases, the dominant Sphagnum species found in this community are *Sphagnum warnstorfii, Sphagnum wulfianum, Sphagnum centrale,* and *Sphagnum recurvum sensu lato.*

The White Cedar Tamarack Peat Swamp phase is a mixed evergreen-deciduous forest domined by conifers, especially *Thuja occidentalis* and *Larix laricina.* In some cases, *Larix laricina,* along with lesser amounts of *Picea mariana,* may form an emergent layer over a canopy of *Thuja occidentalis*. Canopy coverage is typically 30-60% and is commonly composed of uneven aged trees. Though typically 10-15 m tall, in some cases trees may be 5-10 m tall. A shrub/scrub layer of *Alnus incana, Betula pumila,* and/or *Thuja occidentalis* is usually present at 40-70% cover. A dwarf-shrub layer of *Rubus pubescens, Cornus canadensis, Ledum groenlandicum* and/or *Chamaedaphne calyculata* is typically present at low cover. The herbaceous strata is fairly diverse and exists at a wide range of densities. The most abundant species are, *Carex leptalea* and *Maianthemum trifolium*. Sphagnum moss normally forms a continuous carpet on the forest floor. This strata is dominated by *Sphagnum warnstorfii, Sphagnum capillifolium, Sphagnum magellanicum, and Sphagnum russowii*. Wet hollows may be colonized by *Calliergon cordifolium, Calliergon giganteum, Mniaceae,* and/or *Drepanocladus* spp.

Globally

The canopy is often moderately dense to dense (MN NHP 1993). Basal areas of 42.2-62.2 m2/ha and densities of 2457-7565 stems/ha have been reported in four stands in Lower Michigan, using a tree definition of woody stems greater than 2.5 cm dbh (Schwintzer 1981). The understory structure consists of high hummocks and deep, water-filled hollows, with fallen, moss-covered logs common. *Thuja occidentalis* is usually moderately to strongly dominant in the canopy, but occasionally *Picea mariana* may overtop the subdominant *Thuja occidentalis*. Other species include *Abies balsamea, Acer rubrum, Betula papyrifera, Fraxinus nigra, Larix laricina* and, more rarely, *Picea glauca* (in northern Minnesota and northwestern Ontario), or *Tsuga canadensis* (eastward). The shrub layer in this community is sparse to dense, in inverse proportion to the tree canopy. Species present in this stratum include *Alnus incana, Chamaedaphne calyculata, Cornus sericea, Gaultheria hispidula, Ledum groenlandicum, Linnaea borealis, Rosa acicularis, Rubus pubescens,* and *Vaccinium myrtilloides*. *Nemopanthus mucronatum* and *Viburnum cassinoides* are more common eastward. Species diversity in the herbaceous layer can be very high. The most common species are *Carex* spp. (including *Carex disperma, Carex leptalea*), *Coptis trifolia, Cornus canadensis, Clintonia borealis, Dryopteris carthusiana, Galium triflorum, Maianthemum canadense, Mitella nuda, Trientalis borealis,* and *Viola renifolia*. Mosses include *Hylocomium splendens, Pleurozium schreberi, Ptilium crista-*

castrensis, Rhytidiadelphus triquetrus, Sphagnum capillifolium, Sphagnum girgensohnii, and *Sphagnum magellanicum*. Moss cover may be thin where the canopy is very dense. Diagnostic species include *Thuja occidentalis* as a dominant/co-dominant species, with a combination of acidic and minerotrophic understory species, such as *Alnus incana* and *Cornus sericea* (Sims *et al.* 1989, Harris *et al.* 1996, Chambers *et al.* 1997).

CONSERVATION RANK G4.

DATABASE CODE CEGL002456

COMMENTS

Voyageurs National Park

Diagnostic features of the type are canopy of *Thuja occidentalis* with *Alnus incana* shrubs and *Sphagnum* spp moss. This type is somewhat analogous to Ontario's W31 (Harris *et al.* 1996). In wetter and more minerotrophic conditions, the cedar in the canopy is often mixed with black ash and can grade into the White Cedar-Black Ash Swamp. The White Cedar-Black Ash Swamp, however, must have at least 25% of both cedar and ash in the canopy or a canopy of black ash with a subcanopy of cedar. The White Cedar-Black Ash Swamp also tends to have much less *Sphagnum* spp. than does the White Cedar-Mixed Conifer/Alder Swamp.

In the cases where *Larix laricina* is present in the canopy or in the emergent layer, the White Cedar-Mixed Conifer/Alder Swamp can grade into the White Cedar-Tamarack Peat Swamp. Tamarack must be present with at least 25% of the relative cover for a stand to be considered a White Cedar-Tamarack Peat Swamp.

In the cases where *Larix laricina* (Tamarack) is present in the canopy or in the emergent layer, the White Cedar-Mixed Conifer/Alder Swamp (WCS) can grade into a phase described as the White Cedar-Tamarack Peat Swamp (WCT). At Voyageurs, this phase was not recognized as a separate association because the phase is very similar to stands without Tamarack as a dominant So both WCS and WCT are placed into the one association. (CEGL002456). Tamarack must be present with at least 25% of the relative cover for a stand to be considered part of the White Cedar-Tamarack Peat Swamp phase. Globally this phase is recognized as a distinct type (CEGL005225), based on patterns outside of Voyageurs.

This is one of the most floristically diverse types in the park. The richer stands of this type often contain many orchids including the state flower, *Cypripedium reginae*.

Globally

See Harris *et al.* (1996) type W31 for further descriptions of Ontario examples of this type. Tipup mounds caused by blowdowns are common, in part because the very wet soils permit only shallow rooting by *Thuja occidentalis*.

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Picea mariana / Ledum groenlandicum / Sphagnum spp. Forest (Black Spruce / Labrador Tea Poor Swamp)

COMMON NAME	Black Spruce / Labrador-tea / Peatmoss species Forest
SYNONYM	***Black Spruce / Labrador Tea Poor Swamp***
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g)
ALLIANCE	PICEA MARIANA SATURATED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is most common in the northern parts of the park, where peatlands are more extensive, but can be found throughout the park.

Globally

This community is found in northern Michigan, northwestern Ontario, northern Minnesota, northern Wisconsin, and southeastern Manitoba. This community is rare in Michigan.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type is found in confined peatland basins, on the upland margins of large peatlands, in poorly drained depressions in bedrock, and removed from the water's edge on peatland shorelines. The substrate is deep, acidic Sphagnum peat that is mineral poor. Hummock and hollow microtopography is moderately to well developed. The water regime is saturated.

Globally

This type is found in confined peatland basins, on the upland margins of large peatlands, in poorly drained depressions in bedrock, and removed from the water's edge on peatland shorelines. Stands occur on level, wet sites with organic soils (Zoladeski *et al.* 1995). The substrate is deep, acidic Sphagnum peat that is mineral poor (M. Smith personal communication). Hummock and hollow microtopography is moderately to well developed. Water regime is saturated.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea mariana, Larix laricina*
Tall shrub	*Picea mariana, Alnus incana, Betula pumila*
Short shrub	*Ledum groenlandicum, Chamaedaphne calyculata*
Forb	*Maianthemum trifolium*
Graminoid	*Carex trisperma*
Nonvascular	*Sphagnum* spp.

Globally

Stratum	Species
Tree canopy	*Picea mariana*
Short shrub	*Ledum groenlandicum*
Graminoid	*Carex trisperma*
Nonvascular	*Sphagnum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea mariana, Larix laricina, Alnus incana, Ledum groenlandicum, Carex trisperma, Sphagnum spp.

Globally
Picea mariana, Ledum groenlandicum, Carex trisperma, Sphagnum spp.

VEGETATION DESCRIPTION
Voyageurs National Park
This community includes both woodland and forested examples, so canopy cover is widely variable. *Picea mariana* trees dominate this type and are typically 10-20 m tall in the forested stands and 5-10 m tall in the woodland stands. Scattered *Larix laricina* trees are occasionally present, and it may occur as a co-dominant (25-75% cover) in some stands. The canopy, especially in the woodland phase, tends to be uneven aged. Shrub strata are usually absent, though *Picea mariana* saplings may be present at low cover, as can *Alnus incana* or *Betula pumila*. The dwarf-shrubs *Ledum groenlandicum* and *Chamaedaphne calyculata* are nearly always present, but cover is highly variable, ranging from 20-90%. Cover of dwarf-shrubs tends to be higher in the more open stands. Other ericaceous shrubs such as *Kalmia polifolia, Andromeda polifolia,* and *Vaccinium oxycoccos* can also be present at low cover. The herbaceous strata is species poor and present at low density, usually less than 40% cover. The most widespread species are *Carex trisperma* and *Maianthemum trifolium*. Scattered minerotrophic species may also be present, most commonly *Carex lacustris, Iris versicolor* and *Monotropa uniflora*. Sphagnum moss typically covers nearly 100% of the forest floor. The most abundant species are *Sphagnum magellanicum, Sphagnum recurvum sensu lato, Sphagnum capillifolium,* and *Sphagnum russowii.* In the more mixed *Picea mariana-Larix laricina* stands, nutrient levels may be higher. The herbaceous layer is moderately species rich and usually comprises 10-40% cover. *Maianthemum trifolium* and *Carex trisperma* are the most widespread herbaceous species. Other common species include *Menyanthes trifolia, Carex paupercula, Calamagrostis canadensis, Carex leptalea, Rubus pubescens,* and *Potentilla palustris*. Sphagnum moss typically occupies 90-100% of the forest floor. The most abundant species are *Sphagnum magellanicum, Sphagnum recurvum sensu lato, Sphagnum warnstorfii,* and *Sphagnum fuscum. Calliergon cordifolium* and/or *Calliergon giganteum* may colonize the wet hollows.

Globally
The overstory of this community is made up of conifers. The tree canopy is broken to closed over a moderately well developed low shrub layer, sparse herbaceous layer, and a carpet of mosses (Kurmis *et al.* 1986). The canopy is often pure *Picea mariana*, but *Larix laricina* may be a codominat. *Abies balsamea* can be present to codominant, and the occasional *Pinus banksiana* may occur (Sims *et al.* 1989). The shrubs are primarily ericaceous and include *Chamaedaphne calyculata, Gaultheria hispidula, Kalmia polifolia, Ledum groenlandicum,* and *Vaccinium* spp, but mixed spruce-tamarack stands can contain *Alnus incana* or *Betula pumila*. The few herbaceous species found in this community include *Carex lasiocarpa, Carex trisperma, Clintonia borealis, Coptis trifolia, Cornus canadensis,* and *Maianthemum trifolium*. Occasional minerotrophic indicators found in northern Minnesota include *Carex lacustris, Iris versicolor,* and *Monotropa uniflora* (M. Smith personal communication 1999). Mosses, particularly *Sphagnum* spp. typically cover nearly 100% of the forest floor. *Dicranum polysetum, Sphagnum* spp. (including *Sphagnum magellanicum, Sphagnum recurvum sensu lato, Sphagnum capillifolium, Sphagnum russowii*), and *Pleurozium schreberi* are among the species found in this abundant moss layer (Sims *et al.* 1989, Harris *et al.* 1996).

CONSERVATION RANK G5.

DATABASE CODE CEGL002454

COMMENTS
Voyageurs National Park
Diagnostic features of the type are a forested or woodland canopy of *Picea mariana* with or without *Larix laricina.* This community is found in confined peatland basins, on the upland margins of large peatlands, in poorly drained depressions in bedrock, and removed from the water's edge on peatland shorelines. Minerotrophic species may be present. This type is analogous to Ontario's W27 and W28 (Harris *et al.* 1996). In some cases, this community closely resembles more nutrient poor examples of the the Black Spruce Bog (CEGL002485). The Black Spruce/Labrador Tea Poor Swamp will generally contain more minerotrophic indicators than the Black Spruce Bog. Position on the landscape, however, is the best way to distinguish these types. The Black Spruce Bog is found only in the interior of large peatlands whereas the Black Spruce/Labrador Tea Poor Swamp is found in confined basins, shores, and the margins of large peatlands. Where *Larix laricina* exceeds 75%, stands should be placed in the Northern Tamarack Rich Swamp type (CEGL002471).

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6.6 Northern Shrub Swamps

Cornus spp. - Salix discolor - (Rosa palustris) Shrubland (Dogwood - Pussy Willow Swamp)

COMMON NAME	Red-osier Dogwood - Willow species - (Swamp Rose) Shrubland
SYNONYM	***Dogwood - Pussy Willow Swamp***
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e)
ALLIANCE	CORNUS SERICEA - SALIX SPP. SEASONALLY FLOODED SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type commonly occupies beaver meadows and the shorelines of the large lakes in sheltered bays throughout the park.

Globally

This dogwood-willow shrub swamp community type is found in the upper Midwestern region of the United States in New York, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, and southern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Dogwood-Pussy Willow Swamp commonly occupies beaver meadows and the shorelines of the large lakes in sheltered bays. It infrequently occurs up to the waters edge but is often found between the upland and a shallow marsh such as the Midwest Cattail Marsh, Wiregrass Sedge Shore Fen, or the Northern Sedge Wet Meadow. A thick (2-5 cm) thatch layer of undecomposed organic matter is common. Soils are either deep peats or shallow peats over dense lacustrine clay. Hummock and hollow microtopography may be present. The water regime is temporarily to seasonally flooded or saturated.

Globally

Stands are found along streams and lakes, or in upland depressions. Hydrology is variable, but is typically seasonally flooded. Soils are wet, organic, and minerotrophic, with either highly decomposed peat or fine mineral soils (Curtis 1959, Harris *et al.* 1996).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Salix discolor, Salix petiolaris*
Graminoid	*Calamagrostis canadensis, Carex lacustris, Typha latifolia*
Nonvascular	*Aulacomnium palustre, Campylium stellatum, Hypnum lindbergii, Sphagnum* spp., *Drepanocladus* spp., *Calliergon* spp.

Globally

Tall shrub	*Cornus sericea, Salix discolor, Salix petiolaris*
Graminoid	*Calamagrostis canadensis, Carex lacustris, Typha latifolia*

CHARACTERISTIC SPECIES

Voyageurs National Park

Salix discolor, Salix petiolaris, Salix planifolia, Salix serissima, Salix pedicellaris, Salix candida, Salix humilis.

Globally

Salix discolor, Salix petiolaris, Cornus sericea, Rosa palustris

VEGETATION DESCRIPTION

Voyageurs National Park

The Dogwood-Pussy Willow Swamp contains a shrub layer mainly of willows 1-5 meters tall and usually 40-70% cover. The most abundant willow species are *Salix discolor* and *Salix petiolaris*. The following willow species are also common though usually present at low cover*: Salix planifolia, Salix serissima, Salix pedicellaris, Salix candida,* and *Salix humilis*. Shrubs typically absent include *Cornus* spp., *Spiraea alba,* and *Alnus incana,* though they may be present at low cover. Herbaceous cover is typically high (90-100%) and is made up primarily of graminoids, especially *Calamagrostis canadensis* and *Carex lacustris. Typha latifolia, Scirpus cyperinus, Potentilla palustris, Equisetum fluviatile, Iris versicolor, Carex stricta,* and *Acorus calamus* are also common in the herbaceous layer. Mosses may be absent or present around 10-30% cover. Most common species include: *Aulacomnium palustre, Campylium stellatum, Hypnum lindbergii, Sphagnum* spp., *Drepanocladus* spp., *Calliergon cordifolium, Calliergon giganteum,* and *Climacium dendroides.* In some cases, *Sphagnum* spp. may have nearly 100% cover and form a continuous carpet. This occurs primarily when the Dogwood-Pussy Willow Swamp is adjacent to a peatland.

Globally

The vegetation is dominated by tall shrubs between 1 and 3 m tall, with at least 25% cover, and often very dense. More open stands may have high graminoid cover. Trees may be scattered, but cover less than 25%. Composition of the shrub layer is quite diverse, primarily due to the diversity of willow or *Salix* spp., which collectively share dominance with *Cornus sericea*. Willow species include *Salix bebbiana, Salix discolor, Salix eriocephala, Salix exigua (=interior), Salix fragilis,* and *Salix petiolaris*. Other shrubs associates include *Cephalanthus occidentalis* (southeastward), *Cornus amomum, Ribes americanum, Rosa palustris* (more common eastward), *Rubus pubescens* (northward), *Rubus strigosus, Sambucus canadensis, Spirea alba,* and *Viburnum lentago*. Woody vines present include *Clematis virginiana, Parthenocissus quinquifolia,* and *Toxicodendron radicans*. Characteristic herbs include *Asclepias incarnata, Aster simplex, Calamagrostis canadensis, Eupatorium maculatum, Glyceria nervata, Impatiens biflora, Impatiens capensis, Lycopus americanus, Lycopus uniflorus, Phalaris arundinacea, Solidago gigantea,* and *Thalictrum dasycarpum*. A variety of sedges may dominate more open stands, including *Carex lacustris* and *Carex stricta*. Tree species include *Acer rubrum, Fraxinus pennsylvanica,* and *Ulmus americana* (Curtis 1959, White and Madany 1978, Chapman *et al.* 1989, Reschke 1990, Minnesota NHP 1993, Harris *et al.* 1996).

CONSERVATION RANK G5.

DATABASE CODE CEGL002186

COMMENTS

Voyageurs National Park

Diagnostic features of the type are *Salix discolor, Salix petiolaris, Salix planifolia, Salix serissima, Salix pedicellaris, Salix candida,* and *Salix humilis*. The Dogwood-Pussy Willow Swamp is closely related to the Bluejoint Eastern Meadow, the Northern Sedge Wet Meadow, and the Speckled Alder Swamp. Analogous to Ontario's W36 (Harris *et al.* 1996). The willow in the Dogwood-Pussy Willow Swamp can occasionally be mixed with equal amounts of *Alnus incana* or *Betula pumila*. When this occurs, the community grades into the Speckled Alder Swamp or Bog Birch-Leatherleaf Poor Fen. Willows can occasionally invade a Bluejoint Eastern Meadow or a Northern Sedge Wet Meadow. In these circumstances, a shrub layer of < 25% cover distinguish these herbaceous communities from the Dogwood-Pussy Willow Swamp.

Globally

Shrub swamps may naturally succeed herbaceous wet meadows as part of successional series in lakes and ponds. They may also originate from clearing of forested swamps (Curtis 1959), or draining of wet meadows (Minnesota NHP 1993). Infrequent fires may have maintained shrub swamps in the western part of the range, preventing tree canopy closure (Minnesota NHP 1993).

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Alnus incana Swamp Shrubland [Provisional] (Speckled Alder Swamp)

COMMON NAME	Speckled Alder Swamp Shrubland
SYNONYM	Speckled Alder Swamp
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e)
ALLIANCE	ALNUS INCANA SEASONALLY FLOODED SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM PALUSTRINE

RANGE

Voyageurs National Park

This community type occurs throughout the park in isolated low areas surrounded by uplands or as a ring around the edge of less minerotrophic peatlands.

Globally

This alliance is widespread in the Midwest and Northeast United States.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Speckled Alder Swamp occurs in isolated low areas surrounded by upland or as a ring around the edge of less minerotrophic peatlands. Stands can occur on deep peats, shallow peats, or mineral soils where drainage is impeded by clay or dense glacial till. Depending on substrate and topographic placement, they can be temporarily or seasonally flooded or remain saturated throughout the growing season.

Globally

Sites are typically located along streams, lakeshores, edges of beaver meadows, swales associated with small streams in peatlands or upland forests, or near seeps. Most have little to no slope, but some sites are on moderate slopes. Hydrologic conditions can range from temporarily flooded to semipermanently flooded. The water that affects this alliance is non-stagnant, nutrient rich, and often slightly calcareous (Curtis 1959). Soils are wet, often mucks or peats (Anderson 1982, Chapman *et al.* 1989).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Alnus incana*
Short shrub	*Rubus pubescens*
Graminoid	*Carex lacustris, Calamagrostis canadensis, Typha* spp.
Nonvascular	*Sphagnum centrale, Sphagnum girgensohnii, Sphagnum magellanicum, Mnium* spp., *Drepanocladus* spp., *Climacium dendroides*

Globally

Stratum	Species
Tall shrub	*Alnus incana*
Graminoid	*Calamagrostis canadensis*

CHARACTERISTIC SPECIES

Voyageurs National Park

Alnus incana

Globally

Alnus incana, Calamagrostis canadensis

VEGETATION DESCRIPTION

Voyageurs National Park
Alnus incana shrubs, usually around 2 m tall, usually form a dense canopy in this community. *Salix* spp. and *Betula pumila* may also occur at low cover in the shrub layer with *Alnus incana*. The is a wide variation in the composition of the herbaceous and nonvascular strata largely as a result of the wide range of environmental conditions where this community can exist. In most circumstances, the herbaceous layer ranges from 30-90% and is dominated by *Calamagrostis canadensis, Carex lacustris, Rubus pubescens, Typha* spp., *Potentilla palustris,* and *Calla palustris*. Some examples of this type contain a nearly continuous carpet of *Sphagnum* spp. moss. In these situations, *Chamaedaphne calyculata* may be found as a dwarf-shrub, and the herbaceous layer may also contain species associated with *Sphagnum* spp. (e.g. *Carex trisperma, Carex disperma, Maianthemum trifolium*). In situations lacking *Sphagnum* spp., the associated species are lacking as well and the nonvascular stratum is minor and consists of *Mnium* spp., *Drepanocladus* spp., and *Climacium dendroides*.

Globally
The vegetation is dominated by tall shrubs, 2-8 meters tall, with a moderately open to dense shrub canopy. There is an understory of shorter shrubs and herbaceous species. The density of the understory varies inversely with the tall shrub canopy. The overstory is usually overwhelmingly dominated by *Alnus incana*, but where it is not as dominant, other shrubs, such as *Cornus sericea, Rubus idaeus, Salix* spp., *Spiraea alba*, and *Viburnum* spp., can be found. The herbaceous layer contains species such as *Aster simplex, Calamagrostis canadensis, Caltha palustris, Carex lacustris, Carex prairea, Eupatorium maculatum, Impatiens capensis, Lycopus uniflorus, Scirpus atrovirens, Symplocarpus foetidus, Thelypteris palustris,* and *Typha* spp. Mosses include *Climacium dendroides*. Where the tall shrub canopy is open, the graminoids can become dense. Trees are found in many stands, including *Acer rubrum, Fraxinus nigra*, and *Thuja occidentalis* (Anderson 1982, Curtis 1959, Harris *et al.* 1996, Minnesota NHP 1993).

CONSERVATION RANK G5?.

DATABASE CODE CEGL002381

COMMENTS
Voyageurs National Park
The diagnostic feature of the type is a tall shrubland dominated by *Alnus incana*. The type is analogous to Ontario's W35 (Harris *et al.* 1996). In situations where willow or bog birch become more dominant, this community grades into the Dogwood-Pussy Willow Swamp or the Bog Birch-Leatherleaf Poor Fen. In non-peatland situations, the Speckled Alder Swamp can have <25% *Fraxinus nigra* canopy over the alder shrub layer. The Black Spruce/Alder Rich Swamp, the Black Spruce-Tamarack Poor Swamp and the Tamarack/Speckled Alder Forest all can resemble the Speckled Alder Swamp but differ in that they contain greater than 25% cover of conifers in the canopy. Likewise, the cedar types (White Cedar-Mixed Conifer/Alder Swamp and White Cedar-Tamarack Peat Swamp) may contain a shrub layer of alder but must have at least 25% cover of conifers in the canopy.

Basins with water levels controlled by beavers can experience fluctuating water levels. Alder often persists after trees such as black spruce or cedar have died from the rising water levels. Outside the park, the Speckled Alder Swamp can be found in wetlands (including peatlands) that have been recently logged.

REFERENCES

6.7 Rock Barrens

Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium spp. Rocky Woodland (Boreal Pine Rocky Woodland)

COMMON NAME	Jack Pine - (Black Spruce, White Pine) / Blueberry species Rocky Woodland
SYNONYM	Boreal Pine Rocky Woodland
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (II.A.4.N)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a)
ALLIANCE	PINUS (BANKSIANA, RESINOSA) WOODLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type occurs throughout the park.

Globally
This association is found in northern Minnesota and Manitoba and possible in Ontario and northern Michigan.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
This community occurs on ridge tops and slopes with 5-50% exposed bedrock. Slopes are highly variable and range from flat to very steep with variable aspects. Vegetation usually occurs on patches where soil has collected over bedrock. The soil in these patches are typically shallow (1-4 cm deep) sandy loams with surficial rocks. These sites are rapidly drained.

Globally
Stands typically occur on shallow, sandy or rocky sites. Soils vary from talus slopes and bare bedrock to deep mineral soils of coarse to fine sand (Sims *et al.* 1989, McCarthy *et al.* 1994).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus banksiana*
Tall shrub	*Abies balsamea, Pinus strobus, Quercus ellipsoidalis*
Short shrub	*Vaccinium angustifolium, Juniperus communis*
Forb	*Aster macrophyllus*
Graminoid	*Danthonia spicata, Agrostis scabra*
Nonvascular	*Pleurozium schreberi, Cladina* spp.

Globally

Stratum	Species
Tree canopy	*Pinus banksiana, Pinus strobus, Pinus resinosa*
Short shrub	*Juniperus communis, Quercus ellipsoidalis, Vaccinium angustfolium*
Nonvascular	*Cladina* spp.

CHARACTERISTIC SPECIES
Voyageurs National Park
Pinus banksiana, Pinus strobus, Pinus resinosa, Quercus ellipsoidalis, Juniperus communis, Vaccinium angustifolium, Cladina spp.

Globally

Pinus banksiana, Pinus strobus, Pinus resinosa, Juniperus communis, Vaccinium angustifolium, Cladina spp.

VEGETATION DESCRIPTION

Voyageurs National Park

The tree canopy is variable, typically open, with stands often being dominated by a single pine species, typically *Pinus banksiana*, but also either *Pinus resinsa* or *Pinus strobus*, or all three. Occasionally, *Picea mariana* is present. Canopy cover ranges from 30-60% with exposed bedrock preventing the complete closure of the canopy. *Abies balsamea, Pinus strobus*, and *Quercus ellipsoidalis* constitute the shrub layer which, when present, comprises 20-30% cover. Dwarf-shrubs are commonly present at 10-50% cover. In addition to *Vaccinium angustifolium* and *Juniperus communis*, lesser amounts of *Diervilla lonicera, Amelanchier* spp., *Rubus* spp., and *Arctostaphylos uva-ursi* may also be present. The herb layer may be virtually absent or may reach 30% cover and consist of *Aster macrophyllus, Danthonia spicata*, and *Agrostis scabra*. Moss and lichen cover is highly variable, ranging from 20-90%, though most commonly is around 30%. The most abundant moss is *Pleurozium schreberi* while the most abundant lichens are *Cladina rangiferina, Cladina mitis* and *Cladina stellaris.*

Globally

The tree canopy is variable, typically open, with stands often being dominated by a single pine species, but the pines could be *Pinus banksiana, Pinus resinsa*, or *Pinus strobus*. Occasionally *Picea mariana* is present. The understory is quite open, with scattered clumps of shrubby *Picea mariana*. *Abies balsamea, Pinus strobus*, and *Quercus ellipsoidalis* constitute the shrub layer which, when present, comprises 20-30% cover. The dwarf-shrub layer contains *Vaccinium angustifolium* and *Vaccinium myrtilloides* with occasional *Juniperus communis*, *Cornus canadensis, Diervilla lonicera, Amelanchier* spp, *Rubus* spp., and *Arctostaphylos uva-ursi*. The herbaceous layer is sparse, containing *Agrostis scabra, Danthonia spicata, Maianthemum canadense*, and *Melampyrum lineare*. Moss and lichen cover is highly variable, ranging from 20-90%, though most commonly around 30%. Moss species include *Dicranum polysetum* and *Pleurozium schreberi*. Lichens include *Cladina rangiferina, Cladina mitis*, and *Cladina stellaris* (Sims *et al.* 1989, McCarthy *et al.* 1994, M. Smith personal communication 1999).

CONSERVATION RANK G4?.

DATABASE CODE CEGL002483

COMMENTS

Voyageurs National Park

Diagnostic features of the type are canopy of *Pinus banksiana*, *Pinus resinosa, Pinus strobus*, in pure or mixed combinations, with less than 60% cover and canopy closure prevented by the presence of bedrock. Stands on Dryweed Island (on greenstone bedrock) are distinct from the stands that occur in the rest of the park, presumably because of the differences in underlying bedrock, but a wider survey is needed to verify these patterns. This type is similar to Jack Pine/Lichen Rocky Barrens Community but with greater than 25% cover of trees, especially *Pinus banksiana*. When deciduous trees, especially *Quercus ellipsoidalis*, are co-dominant with *Pinus banksiana*, the community grades into the Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland (CEGL005246).

REFERENCES

McCarthy, T.G., R.W. Arnup, J. Nieppola, B.G. Merchant, K.C. Taylor, and W.J. Parton. 1994. Field Guide to Forest Ecosystems of Northeastern Ontario. NEST Field Guide FG-001, Ontario Ministry of Natural Resources, Northeast Science and Technology, Timmins ON.

Sims, R. A., W. D. Towill, K. A. Baldwin, and G. M. Wickware. 1989. Field guide to the forest ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources.

Pinus banksiana - Mixed Conifer / Cladina spp. Nonvascular Vegetation (Jack Pine / Lichen Rocky Barrens)

COMMON NAME	Jack Pine - Mixed Conifer / Reindeer Lichen species Nonvascular Vegetation
SYNONYM	Jack Pine / Lichen Rocky Barrens
PHYSIOGNOMIC CLASS	Nonvascular Vegetation (VI)
PHYSIOGNOMIC SUBCLASS	Lichen vegetation (VI.B)
PHYSIOGNOMIC GROUP	Temperate or subpolar lichen vegetation (VI.B.1)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (VI.B.1.N)
FORMATION	Lichen vegetation with a sparse tree layer (VI.B.1.N.c)
ALLIANCE	PINUS BANKSIANA / CLADINA SPP. NONVASCULAR ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This community is common to some areas of the park. In the northern part of the park, it can be found in Anderson Bay and, less abundantly, in Daley Bay.

Globally

This association is found in northern Minnesota, Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs on ridge tops and high slopes with 40-80% exposed bedrock. Slopes are highly variable and range from gentle to very steep with variable aspects. Vegetation usually occurs on patches where soil has collected over bedrock. The soil in these patches are typically shallow (1-3 cm deep) loams. These sites are rapidly drained.

Globally

This type occurs on ridge tops and high slopes with 40-80% exposed bedrock. Stands are typically comprised of granite or metamorphic rock, and possibly basalt. Slopes are highly variable and range from gentle to very steep with variable aspects. These sites are rapidly drained. Vegetation usually occurs on patches where soil has collected over bedrock. The soil in these patches are typically shallow (1-3 cm deep) loams, soil development is minimal, and pH is typically acid (Ohmann and Ream 1971, Grigal and Ohmann 1975, Minnesota NHP 1993, M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus banksiana*
Tall shrub	*Quercus ellipsoidalis*
Short shrub	*Vaccinium angustifolium, Juniperus communis*
Graminoid	*Danthonia spicata, Agrostis scabra*
Nonvascular	*Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi*

Globally

Stratum	Species
Tree canopy	*Pinus banksiana*
Tall shrub	*Quercus ellipsoidalis*
Short shrub	*Vaccinium angustifolium, Juniperus communis*
Graminoid	*Danthonia spicata, Agrostis scabra*
Nonvascular	*Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi*

CHARACTERISTIC SPECIES

Voyageurs National Park

Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi, Pinus banksiana, Quercus ellipsoidalis,

Vaccinium angustifolium, Juniperus communis, Danthonia spicata, Agrostis scabra

Globally
Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi, Pinus banksiana, Quercus ellipsoidalis, Vaccinium angustifolium, Juniperus communis, Danthonia spicata, Agrostis scabra

VEGETATION DESCRIPTION
Voyageurs National Park
In this community, *Pinus banksiana* is the only tree dominant in the canopy. These trees are usually 10-15 meters tall and are present at less than 25% cover. Vascular vegetation is usually present in clumps underneath the canopy of *Pinus banksiana* trees. The short scrub or shrubs *Quercus ellipsoidalis, Abies balsamea,* and/or *Amelanchier* spp. may be absent or present at low cover. A dwarf-shrub layer is nearly always present, usually at 10-30% cover. The most abundant dwarf-shrubs are *Vaccinium angustifolium, Juniperus communis* var. *depressa*, and *Prunus pumila*. The herbaceous layer is poorly developed and may be absent. When present, it comprises 5-10% cover and primarily consists of *Danthonia spicata, Agrostis scabra, Corydalis sempervirens*, and *Woodsia ilvensis.* The nonvascular strata in this community typically comprises 30-50% cover, not including crustose lichens. Depending on substrate and slope, nonvascular cover can be as low as 10%. Dominant species are the lichens *Cladina rangiferina, Cladina mitis, Cladina stellaris, Stereocaulon* spp., and the mosses *Pleurozium schreberi, Polytrichum juniperinum, Polytrichum piliferum, Hedwigia ciliata,* and *Orthotrichum* spp.

Globally
Occurrences are typically a mosaic of exposed bedrock with patches of low vegetation dominated by fructicose lichens and mosses, which cover about 40% of the area. Bare rock covers about 30% of the area. Lichen species include *Cladina rangiferina, Cladina stellaris,* and *Cladina mitis*. Mosses include *Dicranum* spp., *Hedwigia ciliata, Orthotrichum* spp., *Pleurozium schreberi, Polytrichum juniperinum, Polytrichum piliferum,* and *Stereocaulon* spp. The vascular vegetation is typically sparse. Scattered trees and tall shrubs include *Abies balsamea, Amelanchier* spp., *Pinus banksiana, Prunus pensylvanica,* and *Salix bebbiana*. A dwarf-shrub layer is nearly always present usually at 10-30% cover. The most abundant dwarf-shrubs are *Diervilla lonicera, Vaccinium angustifolium, Juniperus communis* and *Prunus pumila*. The sparse herbaceous layer includes *Aralia hispidus, Corydalis sempervirens, Danthonia spicata, Sibbaldiopsis (=Potentilla) tridentata,* and *Woodsia ilvensis* (Ohmann and Ream 1971, Grigal and Ohmann 1975, Minnesota NHP 1993, M. Smith personal communication 1999).

CONSERVATION RANK G3G5.

DATABASE CODE CEGL002491

COMMENTS
Voyageurs National Park
Diagnostic features of the type are the dominance of nonvascular vegetation, with <25% cover of trees or shrubs and only scattered herbaceous vegetation. When trees are present, *Pinus banksiana* is most typical. When canopy cover of *Pinus banksiana* reaches 25%, this community grades into the Boreal Pine Rocky Woodland (CEGL002483).

REFERENCES

Grigal, D. F. and L. F. Ohmann. 1975. Classification, description, and dynamics of upland plant communities within a Minnesota wilderness area. Ecol. Monogr. 45:389-407.
Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.
Ohmann, L. F. and R. R. Ream. 1971. Wilderness ecology: virgin plant communities of the Boundary Waters Canoe Area. Res. Pap. NC-63. St. Paul, MN. U. S. Dept. of Agr., For. Service, North Central Exper. Sta. 55 pp.

Populus tremuloides - (Populus grandidentata) Rocky Woodland (Mixed Aspen Rocky Woodland)

COMMON NAME	Trembling Aspen - (Bigtooth Aspen) Rocky Woodland
SYNONYM	Mixed Aspen Rocky Woodland
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (II.B.2.N)
FORMATION	Cold-deciduous woodland (II.B.2.N.a)
ALLIANCE	POPULUS TREMULOIDES WOODLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type occurs in localized upland areas throughout the park.

Globally

This association is found in northern Michigan, northern Minnesota, Manitoba, and probably Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community occurs on bedrock ridges with shallow soils. Soils range from non-existent on bedrock openings to 8-12 cm loams or sandy loams in low areas where soil has developed. Slopes are generally gentle (1-10%) with variable aspects. Exposed bedrock ranges from 5-20%. These sites are rapidly drained.

Globally

This community occurs on bedrock ridges with shallow soils. Soils range from non-existent on bedrock openings to 8-12 cm loams or sandy loams in low areas where soil has developed. Slopes are generally gentle (1-10%) with variable aspects. Exposed bedrock ranges from 5-20%. These sites are rapidly drained (M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Populus tremuloides, Betula papyrifera Populus grandidentata*
Tree sub-canopy	*Abies balsamea, Betula papyrifera*
Tall shrub	*Corylus cornuta, Acer rubrum, Populus tremuloides*
Short shrub	*Vaccinium* spp.
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Graminoid	*Schizachne purpurascens*
Nonvascular	*Pleurozium schreberi, Cladina* spp.

Globally

Stratum	Species
Tree canopy	*Populus tremuloides, Betula papyrifera Populus grandidentata*
Tree sub-canopy	*Abies balsamea, Betula papyrifera*
Tall shrub	*Corylus cornuta, Acer rubrum, Populus tremuloides*
Short shrub	*Vaccinium* spp.
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Graminoid	*Schizachne purpurascens*
Nonvascular	*Pleurozium schreberi, Cladina* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Populus tremuloides, Populus grandidentata, Betula papyrifera, Vaccinium spp., *Schizachne purpurascens, Pleurozium schreberi, Cladina* spp.

Globally

Populus tremuloides, Populus grandidentata, Betula papyrifera, Vaccinium spp., *Schizachne purpurascens, Pleurozium schreberi, Cladina* spp.

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy of this type usually consists of a mix *of Populus tremuloides, Betula papyrifera* and, occasionally, *Populus grandidentata*. Percent cover ranges from 20-60%. There is often a subcanopy (usually about 30% cover) containing the species in the canopy as well as *Abies balsamea, Acer rubrum* and, less commonly, *Quercus ellipsoidalis*. In the patches of soil that exist between the bedrock outcrops, vegetation can be more forest-like. These areas contain a short shrub layer of *Corylus cornuta* and *Populus* spp., with cover ranging from 20-90%. The herb layer in these patches consists of *Aralia nudicaulis, Pteridium aquilinum,* and *Aster macrophyllus* with cover typically in the 60-70% range. The bedrock outcrops often contain a low cover of *Vaccinium* spp. The herb layer associated with bedrock typically contains *Woodsia ilvensis, Schizachne purpurascens,* and *Agropyron trachycaulum*, with cover usually low (less than 25%). These bedrock areas may also contain a low cover of *Pleurozium schreberi, Cladina rangiferina, Cladina mitis,* and *Cladina stellaris*.

Globally

The canopy of this type usually consists of a mix *of Populus tremuloides, Betula papyrifera,* and, occasionally, *Populus grandidentata*. Percent cover ranges from 20-60%. There is often a subcanopy (usually about 30% cover) containing the species in the canopy as well as *Abies balsamea, Acer rubrum,* and, less commonly, *Quercus ellipsoidalis*. In the patches of soil that exist between the bedrock outcrops, vegetation can be more forest-like. These areas contain a short shrub layer of *Corylus cornuta* and *Populus* spp. with cover ranging from 20-90%. The herb layer in these patches consists of *Aralia nudicaulis, Pteridium aquilinum,* and *Aster macrophyllus* with cover typically in the 60-70% range. The bedrock outcrops often contain a low cover of *Vaccinium* spp. The herb layer associated with bedrock typically contains *Woodsia ilvensis, Schizachne purpurascens,* and *Agropyron trachycaulum*, with cover usually low (less than 25%). These bedrock areas may also contain a low cover *of Pleurozium schreberi* and *Cladina rangiferina, Cladina mitis* and *Cladina stellaris* (M. Smith personal communication 1999).

CONSERVATION RANK G?.

DATABASE CODE CEGL002487

COMMENTS

Voyageurs National Park

Diagnostic features of the type are the canopy of *Populus tremuloides, Populus grandidentata,* and/or *Betula papyrifera*, with less than 60% cover and canopy closure prevented by the presence of exposed bedrock. When canopy cover is greater than 60% and canopy closure is not prevented by the presence of exposed bedrock, the community is considered an Aspen-Birch/Boreal Conifer Forest (CEGL002466). Some stands intermediate between these two communities exist. Vegetation indicative of exposed bedrock conditions should be present for the stand to be considered a Mixed Aspen Rocky Woodland. If woodland physiognomy is evident and the canopy is a mixture of aspen/birch and other conifers, this type can grade into Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (CEGL005246), but that type has at least 20% oaks in the canopy.

Globally

This type may originate after fires or logging, and many stands may not have a natural origin.

REFERENCES

Quercus ellipsoidalis - Quercus macrocarpa - (Pinus banksiana) Rocky Woodland [Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland]

COMMON NAME	Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland
SYNONYM	Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (II.B.2.N)
FORMATION	Cold-deciduous woodland (II.B.2.N.a)
ALLIANCE	QUERCUS MACROCARPA - QUERCUS (ALBA, ELLIPSOIDALIS, VELUTINA) WOODLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type occurs on ridge tops and high slopes throughout the park.

Globally

This association is found in northern Minnesota, Ontario, and Manitoba.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs on ridge tops and high slopes, and some dry, flat, rocky areas. Slopes range from 0-20% with variable aspects. These sites are generally dry, well drained sites with exposed bedrock typical in the more open stands and commonly covering 10-30% of the ground. In stands with more closed canopies exposed bedrock may be absent. In both cases, soils are fairly rocky, shallow loams, averaging 3-5 cm deep. Occasional cracks in the underlying bedrock results in pockets of relatively deep (15-20 cm) soil.

Globally

This type occurs on ridge tops and high slopes, and some dry, flat, rocky areas. Slopes range from 0-20% with variable aspects. These sites are generally dry, well drained sites with exposed bedrock typical in the more open stands and commonly covering 10-30% of the ground. In stands with more closed canopies exposed bedrock may be absent. In both cases, soils are fairly rocky, shallow loams, averaging 3-5 cm deep. Occasional cracks in the underlying bedrock results in pockets of relatively deep (15-20 cm) soil.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus banksiana, Pinus resinosa, Pinus strobus, Quercus ellipsoidalis, Populus tremuloides*
Tall shrub	*Corylus cornuta, Viburnum rafinesquianum, Quercus ellipsoidalis, Amelanchier* spp., *Abies balsamea*
Short shrub	*Vaccinium angustifolium, Juniperus communis*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Graminoid	*Danthonia spicata*
Nonvascular	*Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi*

Globally

Stratum	Species
Tree canopy	*Pinus banksiana, Quercus ellipsoidalis*
Tall shrub	*Corylus cornuta, Viburnum rafinesquianum, Quercus ellipsoidalis, Amelanchier* spp.
Short shrub	*Vaccinium angustifolium, Juniperus communis*

Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Graminoid	*Danthonia spicata*
Nonvascular	*Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi*

CHARACTERISTIC SPECIES

Voyageurs National Park

Pinus banksiana, Quercus ellipsoidalis, Corylus cornuta, Viburnum rafinesquianum, Quercus ellipsoidalis, Amelanchier spp., *Vaccinium angustifolium, Juniperus communis Aster macrophyllus, Aralia nudicaulis, Pteridium aquilinum, Danthonia spicata, Cladina rangiferina, Cladina mitis, Cladina stellaris, Pleurozium schreberi*

Globally

Information not available.

VEGETATION DESCRIPTION

Voyageurs National Park

This type is characterized by either a canopy dominated by *Quercus ellipsoidalis*, with occasional *Quercus macrocarpa* or *Pinus banksiana* or with large *Pinus banksiana, Pinus resinosa*, or *Pinus strobus* either forming an emergent canopy over the oak trees, or mixed with the oaks. These evergreen trees may have 25-75% cover. Thus the canopy of this type varies from pure deciduous to mixed evergreen-deciduous. Stands may also vary in canopy cover from 30% ("woodland" physiognomy) to 90% ("forest" physiognomy). It is common for open bedrock ridges with oak to be found in a mosaic with more closed oak stands. In both circumstances, *Corylus cornuta, Viburnum rafinesquianum, Quercus ellipsoidalis,* and *Amelanchier* spp. are the most abundant species in the shrub layers and usually cover 20-40% of the forest floor. *Vaccinium angustifolium* is the most common dwarf-shrub and is present at low (<25%) cover. In stands with much exposed bedrock, the dwarf-shrubs *Juniperus communis, Prunus pumila, Arctostaphylos uva-ursi,* and *Comptonia peregrina* may also be present. Cover of the herbaceous layer is highly variable, ranging from 20-80%, with the most abundant herbs being *Pteridium aquilinum, Aster macrophyllus,* and *Aralia nudicaulis*. Species typical of bedrock outcrops and shallow soils can also be found and include *Danthonia spicata, Poa alsodes, Agropyron trachycaulum, Maianthemum canadense, Schizachne purpurascens,* and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas this layer consists mainly of the lichens *Cladina rangiferina, Cladina mitis, Cladina stellaris,* and, to a lesser degree, the mosses *Polytrichum juniperinum, Polytrichum piliferum, Hedwigia ciliata,* and *Orthotrichum* spp. Under the canopy of oaks, the nonvascular strata consist primarily of *Pleurozium schreberi* and *Dicranum* spp.

Globally

This type is characterized by either a canopy dominated by *Quercus ellipsoidalis*, with occasional *Quercus macrocarpa* or *Pinus banksiana*, or with large *Pinus banksiana, Pinus resinosa*, or *Pinus strobus* either forming an emergent canopy over the oak trees, or mixed with the oaks. These evergreen trees may have 25-75% cover. Thus, the canopy of this type varies from pure deciduous to mixed evergreen-deciduous. Stands may also vary in canopy cover from 30% (woodland physiognomy) to 90% (forest physiognomy). It is common for open bedrock ridges with oak to be found in a mosaic with more closed oak stands. In both circumstances, *Corylus cornuta, Viburnum rafinesquianum, Quercus ellipsoidalis,* and *Amelanchier* spp. are the most abundant species in the shrub layers and usually cover 20-40% of the forest floor. *Vaccinium angustifolium* is the most common dwarf-shrub and is present at low (<25%) cover. In stands with much exposed bedrock, the dwarf-shrubs *Juniperus communis, Prunus pumila, Arctostaphylos uva-ursi,* and *Comptonia peregrina* may be present. Cover of the herbaceous layer is highly variable, ranging from 20-80%, with the most abundant herbs being *Pteridium aquilinum, Aster macrophyllus,* and *Aralia nudicaulis*. Species typical of bedrock outcrops and shallow soils can also be found and include *Danthonia spicata, Poa alsodes, Agropyron trachycaulum, Maianthemum canadense, Schizachne purpurascens,* and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas this layer consists mainly of the lichens *Cladina rangiferina, Cladina mitis, Cladina stellaris,* and, to a lesser degree, the mosses *Polytrichum juniperinum, Polytrichum piliferum, Hedwigia ciliata,* and *Orthotrichum* spp. Under the canopy of oaks, the nonvascular strata consist primarily of *Pleurozium schreberi* and *Dicranum* spp.

CONSERVATION RANK G?

DATABASE CODE CEGL005246

COMMENTS

Voyageurs National Park

Diagnostic features of the type include the forest or woodland canopy consisting primarily of *Quercus ellipsoidalis*, with varying amounts of *Quercus macrocarpa*, *Pinus banksiana*, *Pinus resinosa*, and *Pinus strobus*, and a rocky substrate, with dry herbaceous, moss, and lichen species. Though there are some differences, community analysis indicates that the floristic similarities between the oak woodland and the oak forest warrant including them as open and closed version of the same type. This type lacks *Abies balsamea*, whereas the Boreal Pine Rocky Woodland (CEGL002483) usually contains it. Stands of this type on Dryweed Island appear to be distinct from the stands that occur in the rest of the park, presumably because of the differences in underlying greenstone bedrock. In the case of *Quercus macrocarpa* being dominant in the canopy, this type includes only those stands with exposed bedrock and woodland physiognomy. Forested mesic situations with *Quercus macrocarpa* are included in the Northern Bur Oak Mesic Forest.

REFERENCES

Kurmis, V., S. L. Webb, and L. C. Merriam. 1986. Plant communities of Voyageurs National Park, Minnesota, U.S.A. Can. J. Bot. 64:531-540.

Sims, R. A., W. D. Towill, K. A. Baldwin, P. Uhlig, and G. M. Wickware. 1997. Field guide to the forest ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, North West Science and Technology, Thunder Bay, ON. Field Guide FG-03. 176 p.

Corylus cornuta - Amelanchier spp. - Prunus virginiana Rocky Shrubland (Boreal Hazelnut - Serviceberry Rocky Shrubland)

COMMON NAME	Beaked Hazelnut - Serviceberry species - Choke Cherry Rocky Shrubland
SYNONYM	Boreal Hazelnut - Serviceberry Rocky Shrubland
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (III.B.2.N)
FORMATION	Temperate cold-deciduous shrubland (III.B.2.N.a)
ALLIANCE	CORYLUS CORNUTA - AMELANCHIER SPP. SHRUBLAND ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type occurs widely in small pockets throughout the park.

Globally

This association is found in northern Minnesota, northern Michigan, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Boreal Hazelnut-Serviceberry Rocky Shrubland occurs on a wide variety of slopes, soils, topographic positions and moisture regimes. This community typically arises because of natural or human disturbance, most commonly beavers, fire, logging and blowdowns. (See Natural Disturbance). This community can also occur without disturbance, usually on ridgetops. These sites, however, are usually so small that they are often included within other communities.

Globally

This type occurs on a wide variety of slopes, soils, topographic positions and moisture regimes. It typically arises because of natural or human disturbance, most commonly beavers, fire, logging and blowdowns. This community can also occur without disturbance, usually on dry rock ridgetops that have thin, acidic soils. These sites, however, are usually so small that they are often included within other communities (C. Reschke personal communication 1999, M. Smith personal communication 1999).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tall shrub	*Acer spicatum, Populus tremuloides, Corylus cornuta, Abies balsamea*
Short shrub	*Rubus strigosus*
Forb	*Aster macrophyllus, Polygonum cilinode*
Fern	*Pteridium aquilinum*

Globally

Stratum	Species
Tall shrub	*Corylus cornuta,*
Short shrub	*Diervilla lonicera, Amelanchier* spp.
Forb	*Aster macrophyllus, Hieracium piloselloides*

CHARACTERISTIC SPECIES

Voyageurs National Park

Acer spicatum, Corylus cornuta, Abies balsamea, Rubus strigosus, Polygonum cilinode

Globally

Corylus cornuta, Diervilla lonicera, Amelanchier spp., *Hieracium piloselloides*

VEGETATION DESCRIPTION

Voyageurs National Park

This shrub community usually contains a dense (70-90% cover) shrub canopy of *Acer spicatum, Populus tremuloides, Corylus cornuta* and/or *Abies balsamea*. Trees may be absent or present with less than 25% cover over the shrub layer. Trees species varies depending on the site. Where the canopy of tall shrubs is more open, short shrubs such as *Rubus strigosus, Taxus canadensis, Rubus pubescens,* and *Juniperus communis* exist at low to moderate cover. Density and composition of the herbaceous strata is highly variable. The most common species include *Aster macrophyllus, Pteridium aquilinum* and *Polygonum cilinode*. On wetter sites, herbaceous species such as *Calamagrostis canadensis* and *Scirpus cyperinus* may dominate.

Globally

The vegetation is dominated by shrubs, with a strong graminoid layer. Dominant shrubs include *Amelanchier* spp., *Corylus cornuta*, and *Prunus virginiana*. Other shrubs include *Acer spicatum, Juniperus communis, Rosa acicularis*, and *Rhus typhina*. Associated herbs include *Danthonia spicata, Hieracium* spp., and *Poa compressa*. At Isle Royale NP, this boreal rocky shrubland is a deciduous shrubland with variable physiognomy and composition. This community often has a sparse tree layer, with about 5 to 20% cover of trees over 5 m tall. The speceis are quite variable, but the most common trees are *Picea glauca* and *Populus tremuloides*. The tall shrub layer varies from 0 to 70% cover. On Isle Royale, the most abundant tall shrubs are *Corylus cornuta, Crataegus douglasii, Picea glauca, Prunus pensylvanica*, and *Sorbus decora*; the short shrub layer (including dwarf-shrubs) varies from about 10 to 80% cover, with the most abundant short shrubs being *Diervilla lonicera, Amelanchier* sp., *Rubus parviflorus, Juniperus communis, Rubus idaeus, Rosa acicularis*, and *Arctostaphylos uva-ursi*. At Voyageurs NP the tall shrub layer contains *Acer spicatum, Populus tremuloides, Corylus cornuta* and/or *Abies balsamea*; where the canopy of tall shrubs is more open, short shrubs such as *Rubus strigosus, Rubus pubescens, Taxus canadensis* and *Juniperus communis* exist at low to moderate cover. On Isle Royale the herb layer varies from 5 to 80% cover; the most abundant herbs are *Aster macrophyllus, Hieracium piloselloides, Clinopodium vulgare, Poa compressa, Danthonia spicata*, and *Pteridium aquilinum*. The cover of nonvascular plants varies from about 5 to 60% cover, with lichens (including *Cladina* spp.), and mosses. At Voyaguers, the density and composition of the herbaceous strata is highly variable. The most common species include *Aster macrophyllus, Pteridium aquilinum* and *Polygonum cilinode*. On wetter sites, herbaceous species such as *Calamagrostis canadensis and Scirpus cyperinus* may dominate. (C. Reschke personal communication 1999, M. Smith personal communication 1999).

CONSERVATION RANK G?.

DATABASE CODE CEGL005197

COMMENTS

Voyageurs National Park

Diagnostic features of the type are the upland deciduous shrubs with over 25% cover and trees with less than 25% cover. These stands generally classify best with the types that match the previous tree canopy that existed on the site. When trees approach 25% cover, the Boreal Hazelnut-Serviceberry Rocky Shrubland can grade into whatever community is appropriate for the tree canopy. This type can have patches of exposed bedrock but tree canopy closure is not prevented by it.

This community typically arises because of a wide variety of disturbances. Outside the park (and in some locations within the park) this shrub community arises after logging has removed the tree canopy. In these circumstances, the shrubs are typically dense *Populus tremuloides* saplings. This community is also common on slopes above beaver ponds where beaver have removed all or most of the tree canopy. In these situations, the shrubs are usually dense *Corylus cornuta* and *Acer spicatum*. The Boreal Hazelnut-Serviceberry Rocky Shrubland can also occur on ridge tops, high slopes and other places where high winds have blown down the trees in the canopy. Finally, this community also arises after fire has killed the trees in the canopy.

Globally

This community often has evidence of past fires; it can be a successional stage following a severe burn. It seems to be an intermediate successional stage after Poverty grass barrens that may gradually develop into a woodland. Soils are often very shallow, and successional development is very slow on the exposed rocky summits where this community is found; so the community may be a fairly long-lived and stable successional stage (C. Reschke personal communication 1999). This type can also arise after logging has removed the tree canopy. In these circumstances, the shrubs are typically dense *Populus tremuloides* saplings. This community is also common on slopes above beaver ponds where beaver have removed all or most of the tree canopy. In these situations, the shrubs

are usually dense *Corylus cornuta* and *Acer spicatum*. Finally this type can also occur on ridge tops, high slopes and other places where high winds have blown down the trees in the canopy (M. Smith personal communication 1999).

REFERENCES

Danthonia spicata - Poa compressa Granite Herbaceous Vegetation (Poverty Grass Granite Barrens)

COMMON NAME	Poverty Grass - Canada Bluegrass Granite Herbaceous Vegetation
SYNONYM	***Poverty Grass Granite Barrens***
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c)
ALLIANCE	DANTHONIA SPICATA HERBACEOUS ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type primarily represents localized disturbed sites around abandoned cottages in and around the park.

Globally
This association is found in Minnesota, Michigan, and Ontario.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
Sites are typically disturbed, shallow soil sites.

Globally
Stands occur on granite or metamorphic rocks. Soils are thin and acidic. Conditions at Isle Royale National Park, where this community is restricted to rocky summits and rocky slopes of ridges where a lot of bedrock is exposed, may be typical of the type (C. Reschke 1999). It may also occur on disturbed sites, following clearing of the natural vegetation (M. Smith personal communication).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

Stratum	Species
Short shrub	*Juniperus communis, Amelanchier bartramiana, Diervilla lonicera*
Forb	*Hieracium piloselloides*
Graminoid	*Danthonia spicata*
Nonvascular	*Cladina* spp., *Xanthoparmelia* spp.

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Danthonia spicata, Hieracium piloselloides, Cladina spp., *Xanthoparmelia* spp.

VEGETATION DESCRIPTION
Voyageurs National Park
This type was not described in the park proper but is thought to occur on nearby private land. See the global description for some characteristics of the type.

Globally
The vegetation is open and dominated by graminoids. Characteristic dominants include *Danthonia spicata* and *Poa compressa*. Features at Isle Royale NP may be typical of the type. There, a sparse cover of trees over 5 m tall (from

0 to 20% cover) is found. The most common trees are *Picea glauca* and *Populus tremuloides*. Cover of tall shrubs may be present (from 0 to 10% cover); the most common tall shrubs are *Picea glauca*, *Amelanchier bartramiana*, and *Crataegus douglasii*. Cover of low shrubs (under 1 m tall, including dwarf-shrubs) varies from 5 to 20% cover; the most common low shrubs are *Juniperus communis, Amelanchier bartramiana, Diervilla lonicera, Rosa acicularis*, *Juniperus horizontalis*, and *Arctostaphylos uva-ursi*. Cover of herbs varies from 30 to 80% cover; *Danthonia spicata* is the dominant herb (15 to 40% cover), other characteristic herbs are *Hieracium piloselloides, Agrostis hyemalis, Clinopodium vulgare, Elymus trachycaulus*, and *Poa* spp. Cover of nonvascular plants varies from 10 to 60% cover; the most abundant lichens are *Cladina* spp. (reindeer lichens, 5 to 25% cover) and *Xanthoparmelia* spp. (1 to 5% cover) (C. Reschke personal communication 1999).

CONSERVATION RANK G?.

DATABASE CODE CEGL005157

COMMENTS

Voyageurs National Park

This type, which primarily represents localized disturbed sites around abandoned cottages, was not described. A variety of native and exotic species can be found on these sites. It occurs mainly on private lands so sampling was not possible.

Globally

This type may arise after clearing or burning of conifer-dominated stands on rocky sites.

REFERENCES

6.8 Northern White Cedar-(Hardwood) Forests

Thuja occidentalis / Abies balsamea - Acer spicatum Forest (White Cedar - Boreal Conifer Mesic Forest)

COMMON NAME	Northern White-cedar / Balsam Fir - Mountain Maple Forest
SYNONYM	White Cedar - Boreal Conifer Mesic Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c)
ALLIANCE	THUJA OCCIDENTALIS FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This community occurs in small patches in localized areas throughout the park, typically on moderate slopes. In the southwestern park of the park it occurs on more flat terrain.

Globally

This community is found in northern Minnesota, northern Wisconsin, northern Michigan, and northwestern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

In the southwest part of the park, this type usually occurs on flat terrain over deep, poorly drained silt clay loams. In the rest of the park, this community is commonly found on gently sloping terrain, often on toeslopes, located just above wetland communities. There is usually very little surficial bedrock. The soils are typically 7-10 cm loams over dense lacustrine clay. In some cases, a shallow build up of well decomposed peat may be present. Hummocks and hollows formed from fallen trees and build up of organic debris may be absent or well developed.

Globally

This community is found on gentle wet-mesic slopes to very steep well-drained slopes (MN NHP 1993). The predominant aspect is north to northeast. Soils are moderately deep to deep (50-100 cm), calcareous, coarse to fine textured, and often contain boulders at the surface (Ohmann and Ream 1971, Sims *et al.* 1989).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Thuja occidentalis*
Tall shrub	*Abies balsamea, Acer spicatum*
Short shrub	*Rubus pubescens*
Forb	*Mitella nuda, Aralia nudicaulis*
Fern	*Dryopteris carthusiana, Equisetum sylvaticum*
Nonvascular	*Rhytidiadelphus triquetrus, Calliergon* spp., *Mniaceae*

Globally

Stratum	Species
Tree canopy	*Thuja occidentalis*
Tree subcanopy	*Abies balsamea*

CHARACTERISTIC SPECIES

Voyageurs National Park

Thuja occidentalis, Abies balsamea, Acer spicatum, Rubus pubescens

Globally
Thuja occidentalis, Abies balsamea, Acer spicatum, Coptis trifolia

VEGETATION DESCRIPTION
Voyageurs National Park
The White Cedar-Boreal Conifer Forest generally exhibits a completely closed canopy of *Thuja occidentalis* (90-100% cover). In rare cases, canopy cover may be as low as 60%. *Fraxinus nigra* and, less commonly, *Populus balsamifera* and *Populus tremuloides* can also occur in the canopy or emergent layers at less than 25% cover. There is no sub-canopy, but occasionally a tall shrub layer occurs with about 25% cover of *Abies balsamea*. *Acer spicatum* can also occur in canopy openings. The cover of herbaceous species is highly variable, ranging from 10-90%. *Rubus pubescens, Dryopteris carthusiana, Mitella nuda, Equisetum sylvaticum,* and *Aralia nudicaulis* are the most abundant. The dominant bryophytes are *Rhytidiadelphus triquetrus, Climacium dendroides, Calliergon cordifolium, Calliergon giganteum,* and mosses in the *Mniaceae* (the *Mnium* family). The cover of this nonvascular strata can range from virtually non-existent to about 40% cover.

Globally
The overstory is dominated by coniferous trees, with or without a substantial deciduous component. *Thuja occidentalis* is the most abundant tree and may occur in pure stands. Usually there are other canopy species, especially *Abies balsamea, Betula papyrifera, Picea glauca, Picea mariana, Populus tremuloides,* and *Pinus strobus*. There is usually an abundant shrub/sapling layer with saplings of *Thuja occidentalis* and *Abies balsamea* along with the shrubs *Acer spicatum, Corylus cornuta, Linnaea borealis, Lonicera canadensis, Rubus pubescens,* and *Sorbus decora*. The ground layer is typically diverse on mesic to wet-mesic stands and less so on steep drier stands. Wet-mesic stands can contain a hummock and hollow topography, with a seasonally saturated hydrology. Typical species include *Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Coptis trifolia, Cornus canadensis, Dryopteris carthusiana, Galium triflorum, Maianthemum canadense, Mitella nuda,* and *Trientalis borealis*. Mosses include *Drepanocladus uncinatus, Hylocomium splendens, Plagiomnium cuspidatum, Pleurozium schreberi, Ptilium crista-castrensis,* and *Rhytidiadelphus triquestrus* and, in wetter phases of the type, *Sphagnum* spp (Ohmann and Ream 1971, Sims *et al.* 1989, Chambers *et al.* 1997).

CONSERVATION RANK G4.

DATABASE CODE CEGL002449

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Thuja occidentalis* without *Alnus incana* shrubs or *Sphagnum* spp. moss. In contrast to the White Cedar/Alder Swamp community, the White-Cedar Boreal Conifer Forest generally does not contain *Alnus incana* in the shrub layer or significant cover of *Sphagnum* spp. moss. Intermediate stands, however, do exist. When *Populus* spp. are present in the emergent layer or canopy approaching 25% relative cover, this community can grade into the White Cedar-Yellow Birch Forest.

Fraxinus nigra is commonly found mixed in the canopy with *Thuja occidentalis*. When cover of *Fraxinus nigra* in the canopy is greater than 25%, the stand becomes a White Cedar-Black Ash Swamp. The White Cedar-Black Ash Swamp is typically wetter than the White Cedar Boreal Forest, often containing standing water in the hollows and *Alnus incana* shrubs. Many stands intermediate between the two types exist.

Globally
Browsing by deer can be a serious hindrance to *Thuja occidentalis* reproduction (MN NHP 1993).

REFERENCES
Chambers, B.A., B.J. Naylor, J. Nieppola, B. Merchant, P. Uhlig. Field Guide to Forest Ecosystems of Central Ontario. Southcentral Science Section (SCSS) Field Guide FG-01, Ontario Ministry of Natural Resources, North Bay, Ontario, Canada. 200 pp.

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Thuja occidentalis - Betula alleghaniensis Forest (White Cedar - Yellow Birch Forest)

COMMON NAME	White-cedar - Yellow Birch Forest
SYNONYM	White Cedar - Yellow Birch Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	THUJA OCCIDENTALIS - BETULA ALLEGHANIENSIS FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

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.

Globally

This community is found in northern Minnesota, northern Wisconsin, northern Michigan, and Ontario. It is reported from two ecoregion subsections in the western Lake Superior basin.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type occurs on flat or gently sloping terrain with variable aspects. It frequently occupies toeslopes located just above wetland communities. There is usually 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 build up of well decomposed peat may be present. Microtopography is typically flat. Coarse woody debris is often abundant.

Globally

This community is found on both poorly drained lowland soils, occasionally bordering on wet, organic soils (Beals and Cottam 1960, Chambers *et al.* 1997), and gentle to somewhat steep northerly slopes (C. Reschke personal communication 1999). The soil is typically moderately acidic sandy clay with a thin litter layer.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Emergent tree	*Populus tremuloides, Populus balsamifera*
Tree canopy	*Thuja occidentalis, Abies balsamea*
Tall shrub	*Abies balsamea, Acer spicatum, Corylus cornuta*
Short shrub	*Rubus pubescens*
Forb	*Mitella nuda, Aralia nudicaulis*
Fern	*Lycopodium* spp.
Nonvascular	*Rhytidiadelphus triquetrus*

Globally

Stratum	Species
Tree canopy	*Thuja occidentalis, Betula alleghaniensis*
Short shrub	*Cornus canadensis*
Forb	*Clintonia borealis*

CHARACTERISTIC SPECIES

Voyageurs National Park

Thuja occidentalis, Populus tremuloides

Globally
Thuja occidentalis, Betula alleghaniensis

VEGETATION DESCRIPTION
Voyageurs National Park
This community is dominated by a canopy of *Thuja occidentalis* with lesser amounts of *Abies balsamea*. Canopy coverage is typically 80-100%. *Populus tremuloides* and/or *Populus balsamifera* can occur as an emergent strata with 30-60% cover or as part of the canopy of *Thuja occidentalis*. In stands with a dense canopy, the shrub layer is usually absent. In more open canopies, the shrub layer is present at low cover and consists of *Abies balsamea, Acer spicatum,* and/or *Corylus cornuta*. Cover of the herbaceous stratum is, likewise, dependent on canopy closure. Stands with dense canopy may virtually lack an herbaceous stratum. Even in more open stands, cover of the herbaceous layer is typically less than 40%. The most abundant species are *Rubus pubescens, Mitella nuda, Aralia nudicaulis, Lycopodium clavatum,* and *Lycopodium dendroideum*. The nonvascular strata may be absent or present at low cover. The most abundant species is *Rhytidiadelphus triquetrus.*

Globally
The canopy of this community is dominated by *Thuja occidentalis* and a variety of hardwoods, most typically *Betula alleghaniensis, Betula papyrifera*, and *Populus tremuloides*, but occasionally *Acer rubrum, Acer saccharum,* and *Fraxinus nigra*. Associated conifers include *Abies balsamea, Picea glauca*, and, rarely, *Tsuga canadensis*. The understory usually contains a well developed shrub/sapling layer, including *Abies balsamea, Acer spicatum, Corylus cornuta, Diervilla lonicera, Linnaea borealis, Ribes triste, Rubus pubescens,* and *Taxus canadensis.* Herbaceous species include *Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Coptis trifolia, Cornus canadensis, Dryopteris carthusiana, Galium triflorum, Gymnocarpium dryopteris, Lycopodium* spp., *Maianthemum canadense, Mitella nuda, Onoclea sensibilis,* and *Trientalis borealis*. Moss species include *Hylocomium splendens, Pleurozium schreberi, Rhytidiadelphus triquestrus*, and others (Minnesota NHP 1993, Chambers *et al.* 1997). Diagnostic features include the mixed dominance of *Thuja occidentalis* and hardwoods, particularly *Betula alleghaniensis,* in an essentially upland site type.

CONSERVATION RANK G2Q. There are probably fewer than 100 occurrences of this community rangewide. It is reported from Minnesota (where it is ranked S2), Wisconsin (S?), Michigan (S?), and Ontario (S?). Currently there is only one occurrence documented from Minnesota, but stands at Voyageurs have recently been reported. Minimal data on current acreage are available; the one occurrence documented from Minnesota has 14 acres. It is likely that many stands have been degraded by logging. This community is reported from two ecoregion subsections in the western Lake Superior basin.

DATABASE CODE CEGL002450

COMMENTS
Voyageurs National Park
Most stands are closely related to the White Cedar-Boreal Conifer Forest. 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. The understory of this community can resemble that of the White Cedar-Boreal Conifer Forest. The Eastern White Cedar-Yellow Birch Forest differs in having at least 25% *Populus tremuloides* and/or *Populus balsamifera* in the canopy or emergent strata.

Given the predominance of *Populus tremuloides* in the canopy and emergent layers of this community, stands of this type in the park may represent a disturbed (post-logging) phase of the Eastern White Cedar-Yellow Birch Forest.

REFERENCES
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6.9 Northern Pine-(Hardwood) Forests

Pinus banksiana - Populus tremuloides / Diervilla lonicera Forest (Jack Pine - Aspen / Bush Honeysuckle Forest)

COMMON NAME	Jack Pine - Trembling Aspen / Bush-honeysuckle Forest
SYNONYM	Jack Pine - Aspen / Bush Honeysuckle Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	PINUS BANKSIANA - POPULUS TREMULOIDES FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
Type was not described at Voyageurs, as many examples are actually mosaics of Jack Pine/Balsam Fir Forest (CEGL002437) and Aspen-Birch/Boreal Conifer Forest (CEGL002466). Both of those types are widespread throughout the park.

Globally
This community is found in northern Minnesota, northwestern Ontario, and Manitoba. It may be more widespread in Canada's boreal region.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park

Globally
This community is found on generally level sandy outwash plains or moderately sloping moraines (Sims *et al.* 1989, MN NHP 1993). The soils are fresh to dry, deep, sandy loams, loams, and fine sands (Sims *et al.* 1989). In Manitoba, the soils tend to be somewhat more moist and fine (Zoladeski *et al.* 1995).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

Stratum	Species
Tree canopy	*Pinus banksiana, Populus tremuloides*
Tall shrub	*Corylus cornuta*
Forb	*Aralia nudicaulis, Aster macrophyllus, Clintonia borealis*

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Pinus banksiana, Populus tremuloides, Corylus cornuta

VEGETATION DESCRIPTION
Voyageurs National Park
This type was not described at Voyageurs National Park. See the global description for some characteristics of the type.

Globally
The canopy layer is a mix of coniferous and deciduous trees, with the conifers tending to be more abundant in the

north (Sims *et al.* 1989, Zoladeski *et al.* 1995). The canopy is typically dominated by *Pinus banksiana* and *Populus tremuloides* with lesser amounts of *Abies balsamea, Betula papyrifera, Picea glauca*, and *Picea mariana*. Tree density and crown spacing may be moderately dense to dense, but sufficient light penetrates to permit the growth of a vigorous shrub layer. Most shrubs are less than 1 meter tall. The most common among these are *Corylus cornuta, Diervilla lonicera, Linnaea borealis, Rosa acicularis, Rubus pubescens*, and *Vaccinium* spp. The herbaceous layer is also typically quite rich with species such as *Aralia nudicaulis, Aster macrophyllus, Cornus canadensis, Clintonia borealis, Streptopus roseus, Trientalis borealis*, and *Viola* spp.

CONSERVATION RANK G4G5.

DATABASE CODE CEGL002518

COMMENTS

Voyageurs National Park

Type was not described at Voyageurs, as many examples are actually mosaics of Jack Pine/Balsam Fir Forest (CEGL002437) and Aspen-Birch/Boreal Conifer Forest (CEGL002466).

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Zoladeski, C. A., G. M. Wickware, R. J. Delorme, R. A. Sims, and I. G. W. Corns. 1995. Forest ecosystem classification for Manitoba: field guide. Natural Resources Canada, Canadian Forest Service, Northwest Region, Northern Forestry Center, Edmonton, Alberta. Special Report 2.

Pinus banksiana / Abies balsamea Forest (Jack Pine / Balsam Fir Forest)

COMMON NAME	Jack Pine / Balsam Fir Forest
SYNONYM	Jack Pine / Balsam Fir Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b)
ALLIANCE	PINUS BANKSIANA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This community type occurs throughout the park on well-drained, somewhat rocky upland sites.

Globally

This community is found in northeastern Minnesota and northwestern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community type occurs on flat or slightly sloping terrain with variable aspects. Soils are typically fairly well drained loams or sandy loams ranging from 5-30 cm in depth. Surficial rocks and bedrock outcrops are common. In some stands, coarse woody debris is abundant.

Globally

This community is found on moderately deep (50-100 cm), usually sandy soils (Grigal and Ohmann 1975). Surficial rocks and bedrock outcrops are common. The sites are often on north- to northeast-facing slopes.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus banksiana*
Tree sub-canopy	*Abies balsamea, Picea mariana*
Tall shrub	*Abies balsamea, Viburnum rafinesquianum, Corylus cornuta*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Nonvascular	*Pleurozium schreberi, Dicranum* spp.

Globally

Stratum	Species
Tree canopy	*Pinus banksiana*
Tall shrub	*Abies balsamea, Viburnum rafinesquianum, Corylus cornuta*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Nonvascular	*Pleurozium schreberi, Dicranum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Pinus banksiana, Abies balsamea, Viburnum rafinesquianum

Globally

Pinus banksiana, Abies balsamea

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy of this community usually consists solely of *Pinus banksiana* and ranges from 60-80% cover. The sub-canopy is most often absent, but in some cases may be a 20-30% cover of *Abies balsamea, Betula papyrifera,* or *Picea mariana*. In some cases, these species may also reach the canopy. Like the sub-canopy, the tall shrub layer may be absent or present at 20-30% cover and consist of *Abies balsamea, Viburnum rafinesquianum,* and *Corylus cornuta*. A dwarf-shrub layer dominated by *Vaccinium angustifolium* is usually present at 20-40% cover but in some cases may be as low as 5%. Herbaceous cover is highly variable, ranging from 30-80%, and consists mainly of *Aster macrophyllus, Aralia nudicaulis,* and *Pteridium aquilinum,* with lesser amounts of *Cornus canadensis, Maianthemum canadensis, Lycopodium dendroideum,* and *Oryzopsis asperifolia.* The abundance of the nonvascular strata, which usually consists mainly of *Pleurozium schreberi,* is highly variable. Stands with 90% cover of *Pleurozium schreberi,* as well as stands lacking this moss, are both common.

Globally

The tree layer of this community is dominated by *Pinus banksiana*, often to the exclusion of other species. *Abies balsamea*, *Betula papyrifera*, *Picea mariana*, and *Populus tremuloides* dominate the sapling and seedling layers and sometimes occur in the canopy. There is a well developed shrub layer containing species such as *Acer spicatum, Amelanchier alnifolia*, *Corylus cornuta*, *Lonicera canadensis*, and *Vaccinium* spp. The herbaceous layer is dominated by dry-mesic forest species including *Aralia nudicaulis*, *Aster macropyllus*, *Clintonia borealis*, *Coptis trifolia*, and *Galium boreale*. Mosses and lichens are common on the forest floor.

CONSERVATION RANK G5.

DATABASE CODE CEGL002437

COMMENTS

Voyageurs National Park

Diagnostic features of the type include the canopy consisting solely of *Pinus banksiana* and canopy closure not prevented by the presence of exposed bedrock. This type is more similar to the Jack Pine Rocky Woodland than to the Jack Pine-Northern Pin Oak Forest. Some stands in the park may represent a Jack Pine/Feathermoss type similar to the Black Spruce/Feathermoss type. *Populus* spp. may rarely be found mixed in the canopy with *Pinus banksiana*. These circumstances represent the Jack Pine-Aspen/Bush Honeysuckle Forest type, which is rare in the park. More commonly, the Jack Pine/Balsam Fir Forest is found in a mosaic pattern with Aspen-Birch/Boreal Conifer Forest.

This community often originates after and may be maintained by fire.

Globally

This community often originates following fires.

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Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium spp. Forest (Red Pine - Aspen - Birch Forest)

COMMON NAME	Red Pine - Trembling Aspen / Bush-honeysuckle - Blueberry species Forest
SYNONYM	Red Pine - Aspen - Birch Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	PINUS STROBUS - (PINUS RESINOSA) - POPULUS TREMULOIDES FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type is found throughout the park, typically as a mix or as part of a mosaic of pure red or white pine and pure aspen-birch types.

Globally
This association is found in Minnesota, Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy, and shallow to deep.

Globally
Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy, and shallow to deep (Sims *et al.* 1989, McCarthy *et al.* 1994).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

Stratum	Species
Tree canopy	*Pinus resinosa, Populus tremuloides*
Short shrub	*Diervilla lonicera, Vaccinium* spp.

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Pinus resinosa, Populus tremuloides, Diervilla lonicera, Vaccinium spp.

VEGETATION DESCRIPTION
Voyageurs National Park
This type was not described separately at Voyageurs National Park. See global description for characteristics of this type.

Globally
Stands contain a mix of deciduous and evergreen trees, comprising mainly *Pinus resinosa* as the conifer, with some *Pinus banksiana, Pinus strobus,* and *Abies balsamea*. Less frequent associates include *Picea glauca* and *Picea*

mariana. Hardwoods include *Betula papyrifera, Populus grandidentata,* and *Populus tremuloides*. The shrub and herb layer varies from dense to open. Tall and dwarf-shrubs include *Abies balsamea, Acer spicatum, Amelanchier* spp., *Corylus cornuta, Diervilla lonicera, Linnaea borealis, Lonicera canadensis, Vaccinium angustifolium,* and *Vaccinium myrtilloides*. Herbs *include Aster macrophyllus, Aralia nudicaulis, Clintonia borealis, Cornus canadensis,* and *Maianthemum canadense*. Large patches of feathermoss can develop on the forest floor. Moss species include *Dicranum polysetum* and *Pleurozium schreberi* (Sims *et al.* 1989, McCarthy *et al.* 1994).

CONSERVATION RANK G?.

DATABASE CODE CEGL002520

COMMENTS

Voyageurs National Park

The Red Pine-Aspen-Birch Forest is rarely found as a distinct type; it more commonly is found as a mosiac of the Red Pine/Blueberry Dry Forest (CEGL002443) and the Aspen-Birch/Boreal Conifer Forest (CEGL002466). Where hardwoods, especially *Populus tremuloides* and *Betula papyrifera*, are present in the canopy with *Pinus resinosa* at > 25% cover, stands belong with this type, the Red Pine-Aspen-Birch Forest.

REFERENCES

Pinus resinosa / Vaccinium spp. Forest (Red Pine / Blueberry Dry Forest)

COMMON NAME	Red Pine / Blueberry species Forest
SYNONYM	Red Pine / Blueberry Dry Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b)
ALLIANCE	PINUS RESINOSA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is found througout the park on dry, rocky sites with gentle to moderate (5-20%) slopes and variable aspects.

Globally

This community is found in northern Michigan, northern Wisconsin, northern Minnesota, and northwestern Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

Though occurring occasionally on flat terrain, the Red Pine/Blueberry Dry Forest more often occurs on gentle to moderate (5-20%) slopes with variable aspects. The substrate is typically dry to dry-mesic and very rocky. Soils are loams or sandy loams and range from 3-20 cm in depth underlain by bedrock or coarse loose rock. Typical soil development includes 1-3 cm "O" layer composed of undecomposed needle duff, 3-5 cm "A" sandy loam, 5+ cm "B" sandy loam. A low chroma "E" horizon 3-5 cm thick below the "A" horizon may or may not be present. The duff layer composed of pine needles commonly cover 60-90% of the forest floor. Smaller stands of this type typically exist on small islands within the park.

Globally

This community occurs on a variety of substrates, but typically has sandy upper horizons. Sites may be on bedrock, overlaid with shallow to medium deep (> 60 cm), coarse sand or coarse loam soils. Moisture varies from dry to dry-mesic, and stands are on mid to upper gentle slopes. The climate is highly variable, with temperature extremes between -46 C and 38 C, and anywhere from 58-91 cm of precipitation.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus resinosa, Pinus strobus*
Tall shrub	*Abies balsamea, Corylus cornuta, Acer rubrum*
Short shrub	*Vaccinium angustifolium, Vaccinium myrtilloides, Pinus strobus, Amelanchier* spp.
Forb	*Maianthemum canadense, Aster macrophyllus*
Fern	*Pteridium aquilinum, Polypodium virginianum*
Graminoid	*Oryzopsis asperifolia*
Nonvascular	*Pleurozium schreberi, Dicranum polysetum, Dicranum scoparium, Dicranum ontariense*

Globally

Stratum	Species
Tree canopy	*Pinus resinosa*
Tall shrub	*Corylus cornuta*
Short shrub	*Vaccinium angustifolium, Vaccinium myrtilloides*
Nonvascular	*Pleurozium schreberi*

CHARACTERISTIC SPECIES
Voyageurs National Park
Pinus resinosa, Vaccinium angustifolium

Globally
Corylus cornuta, Pinus resinosa, Vaccinium angustifolium, Vaccinium myrtilloides

VEGETATION DESCRIPTION
Voyageurs National Park
Canopy coverage in the Red Pine/Blueberry Dry Forest is typically 70-90% and can consist either solely of *Pinus resinosa* or of a mixture of *Pinus resinosa* and *Pinus strobus*. *Pinus resinosa* is often the only conifer in the canopy on sites with rockier, more shallow soils. On dry-mesic sites, however, *Pinus strobus* can comprise up to 60% of the canopy. *Populus tremuloides* and *Betula papyrifera* may also exist in the canopy at <25% relative cover. Canopy height is 10-15 meters in younger stands and up to 20-35 meters in more mature stands. In stands with more complete canopy cover, understory vegetation can be sparse. A shrub layer, if present, comprises low (20%) cover and consists of *Abies balsamea, Corylus cornuta, Acer rubrum, Pinus strobus*, and *Amelanchier* spp. *Vaccinium angustifolium* and *Vaccinium myrtilloides* are common dwarf-shrubs, but rarely reach greater than 40% cover. In more open stands with exposed bedrock, *Juniperus communis* may dominate the dwarf-shrub strata with 20-30% cover. Presence of herbaceous species is highly variable ranging from virtually absent to 90% cover. Younger stands with closed canopies typically contain less herbaceous cover than more mature stands. In both cases, the herbaceous class is relatively species poor. The most abundant species are: *Maianthemum canadense, Aster macrophyllus, Pteridium aquilinum, Oryzopsis asperifolia*, and *Polypodium virginianum*. Though the cover of moss can occasionally reach 70-80%, 10-20% is more common. Important moss species include *Pleurozium schreberi, Dicranum polysetum, Dicranum scoparium*, and *Dicranum ontariense*.

Globally
This community is characterized by a pine overstory and a poorly developed understory. *Pinus resinosa* is present in the canopy at a higher cover and basal area than other conifers (typically 80% or more). *Pinus strobus* can be common in the canopy. Mesic sites tend to include *Pinus resinosa, Picea mariana, Picea glauca*, and *Abies balsamea* in the canopy, whereas on dry sites, *Pinus resinosa* and *Pinus banksiana* are found (MN NHP 1993). Beneath the canopy, northern hardwoods, such as *Acer rubrum* and *Betula papyrifera*, sometimes form a subcanopy. The understory ranges from moderately herb and shrub rich to extremely poor. In the tall shrub class, the important species are *Amelanchier* spp. and *Corylus cornuta*. The short shrub layer includes *Gaultheria procumbens, Linnaea borealis, Vaccinium angustifolium*, and *Vaccinium myrtilloides*, particularly where gaps in the canopy occur (Ohmann and Ream 1971). The herb layer is very poorly represented in most parts of this community's range and includes *Aralia nudicaulis, Aster macrophyllus, Cornus canadensis, Maianthemum canadense, Pteridium aquilinum*, and *Trientalis borealis*. Mosses can have very high cover, and typically include *Dicranum* spp. (e.g., *Dicranum polysetum, Dicranum scoparium*) and *Pleurozium schreberi*. The average coverage of feathermoss was greater in the northwest region of Ontario than in the northcentral region (Sims *et al.* 1989).

CONSERVATION RANK G3. There are probably over 100 occurrences of this community rangewide. Currently there are 77 occurrences documented from Michigan (where it is ranked S3), Minnesota (S3), and Wisconsin (S3); it is also reported from Manitoba (S3) and Ontario (S?). There are probably over 10,000 acres of this community rangewide. Currently 5545 acres have been documented from 45 occurrences in Michigan, Minnesota, and Wisconsin. Some sites have been degraded by logging, but there are also many mature to old-growth stands remaining.

DATABASE CODE CEGL002443

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Pinus resinosa* with less than 40% *Pinus strobus* in the canopy. The Red Pine/Blueberry Dry Forest is very similar to the Red Pine-Aspen-Birch Forest and can be distinguished only by the differences in canopy dominants. On dry-mesic sites, the Red Pine/Blueberry Dry Forest can grade into the White Pine/Mountain Maple Mesic Forest where *Pinus strobus* in the canopy reaches > 60% cover. Where hardwoods (especially *Populus tremuloides* and *Betula papyrifera*) are also present in the canopy at > 25% cover, this type grades into the Red Pine-Aspen-Birch Forest. The Red Pine-Aspen-Birch Forest is rarely found as a distinct type; it more commonly is found as a mosiac of the Red Pine/Blueberry Dry Forest and the Aspen-Birch-Boreal Conifer Forest.

See comments on fire in Global description.

Globally
Sims *et al.* (1989) found that in the Quetico region of northwest Ontario, a rich understory of *Acer spicatum, Corylus cornuta, Alnus crispa, Diervilla lonicera,* and *Aralia nudicaulis* was established. Further north and west, however the understory was open, and dominated by low ericaceous species.

Fire is an important natural disturbance in this community. *Pinus resinosa* has adaptations that make it well suited to frequent ground fires and occasional crown fires. Reconstructions of the fire regime (Heinselman 1973, Frelich 1992) in red and white pine stands indicate that a combination of ground fires every 20 to 30 years, and severe crown fires every 100-150 years maintained presettlement *Pinus resinosa* communities. The thick, corky bark of older *Pinus resinosa* stems make them more resistant to fire than any other type of pine. These older stems are more likely to survive than those of *Pinus strobus* or *Pinus banksiana* when no crown damage results (Ahlgren 1974). In addition *Pinus resinosa* seedling establishment is favored by exposed mineral soils and high sunlight. Therefore relatively frequent fires make the continued regeneration of *Pinus resinosa* possible, as they are only moderately shade tolerant. Fire suppression over much of its range appears to be leading towards the gradual succession from *Pinus resinosa* forests to forests of mesic hardwoods or *Pinus strobus*, which under a frequent fire regime are confined to the understory (MN NHP 1993).

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Pinus strobus - Populus tremuloides / Corylus cornuta Forest (White Pine - Aspen - Birch Forest)

COMMON NAME	White Pine - Trembling Aspen / Beaked Hazelnut Forest
SYNONYM	White Pine - Aspen - Birch Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	PINUS STROBUS - (PINUS RESINOSA) - POPULUS TREMULOIDES FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is found throughout the park, typically as part of a mix or as a mosaic of pure red or white pine and pure aspen-birch types.

Globally

This association is found in Michigan, Minnesota, Wisconsin, and probably Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

Stands are found on a variety of slope positions on shallow to deep (> 60 cm), dry-mesic to mesic, rapidly drained soils.

Globally

Stands are found on a variety of slope positions on shallow to deep (> 60 cm), dry-mesic to mesic, rapidly drained soils, with fine sandy to loamy soil textures (Sims *et al.* 1989, Minnesota DNR 1993, Chambers *et al.* 1997).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus strobus, Betula papyrifera, Populus tremuloides*

Globally

Stratum	Species
Tree canopy	*Pinus strobus, Betula papyrifera, Populus tremuloides*

CHARACTERISTIC SPECIES

Voyageurs National Park

Pinus strobus, Betula papyrifera, Populus tremuloides

Globally

Pinus strobus, Betula papyrifera, Populus tremuloides

VEGETATION DESCRIPTION

Voyageurs National Park

This type was not described separately at Voyageurs National Park. See global description for characteristics of this type.

Globally

The tree canopy is mixed evergreen-deciduous. *Pinus strobus* may form a supercanopy over a mixture of other species, including *Betula papyrifera, Populus tremuloides, Picea glauca*, and *Abies balsamea*. Less frequent are *Pinus resinosa, Populus grandidentata,* and *Thuja occidentalis*. The subcanopy can include *Acer rubrum* and *Acer saccharum*, as well as a mixture of canopy species. Tall shrubs and saplings include *Abies balsamea, Acer*

spicatum, Amelanchier spp., and *Corylus cornuta*. Short shrubs include *Diervilla lonicera, Linnaea borealis, Lonicera canadensis*, and *Vaccinium myrtilloides. Viburnum cassinoides* may be present in the eastern part of the range. Herbs include *Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Cornus canadensis, Maianthemum canadense, Oryzopsis asperifolia, Pteridium aquilinum, Streptopus roseus*, and *Trientalis borealis*. Typical mosses include *Pleurozium schreberi, Dicranum polysetum* and *Dicranum flagellare* (Sims *et al.* 1989, Minnesota DNR 1993, Chambers *et al.* 1997).

CONSERVATION RANK G4?.

DATABASE CODE CEGL002479

COMMENTS

Voyageurs National Park

The White Pine-Aspen-Birch Forest is rarely found as a distinct type; it more commonly is found as a mosiac of the White Pine/Mountain Maple Mesic Forest (CEGL002445) and the Aspen-Birch/Boreal Conifer Forest (CEGL002466). Where hardwoods, particularly *Populus tremuloides* and *Betula papyrifera*, are present in the canopy with *Pinus strobus* at > 25% cover, stands are classified as the White Pine-Aspen-Birch Forest.

Globally

This community may arise as a successional stage after fire, but may also originate after logging.

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Pinus strobus / Acer spicatum - Corylus cornuta Forest (White Pine / Mountain Maple Mesic Forest)

COMMON NAME	White Pine / Mountain Maple - Beaked Hazelnut Forest
SYNONYM	White Pine / Mountain Maple Mesic Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b)
ALLIANCE	PINUS STROBUS FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This community occurs on dry mesic sites throughout the park.

Globally

This community is found in Ontario, northern Wisconsin, northern Michigan, and northern Minnesota.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The White Pine/Mountain Maple Mesic Forest generally occurs on gentle slopes with variable aspects. Surficial rocks and small patches of exposed bedrock are occasionally present. Soils are somewhat shallow (3-10 cm deep) loams or sandy loams. A duff layer of pine needles is common. These sites are well to moderately well drained.

Globally

This community is found on Precambrian Shield bedrock that is overlaid with sandy loam soils, which are moderately well-drained and shallow to deep (> 60 cm). In northeastern Minnesota stands occur on northeast and south facing slopes that are moderate to steep, with slopes ranging from 4 to 45% (Ohmann and Ream 1971). The climate is highly variable, with temperature extremes between -46 C and 38 C and 58-91 cm precipitation.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Pinus strobus, Pinus resinosa*
Tall shrub	*Abies balsamea, Corylus cornuta, Acer rubrum, Amelanchier* spp.
Short shrub	*Vaccinium angustifolium, Vaccinium myrtilloides*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*
Nonvascular	*Pleurozium schreberi, Dicranum* spp.

Globally

Emergent tree	*Pinus strobus*
Tree canopy	*Pinus strobus, Abies balsamea*
Tall shrub	*Acer spicatum, Corylus cornuta, Diervilla lonicera*
Short shrub	*Vaccinium angustifolium, Vaccinium myrtilloides*
Forb	*Aster macrophyllus*
Nonvascular	*Pleurozium schreberi, Dicranum* spp.

CHARACTERISTIC SPECIES

Voyageurs National Park

Pinus strobus, Abies balsamea, Corylus cornuta, Amelanchier spp., *Vaccinium angustifolium*

Globally

Abies balsamea, Aster macrophyllus, Diervilla lonicera, Pinus strobus

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy of the White Pine/Mountain Maple Mesic Forest commonly consists of a mix of *Pinus strobus* and *Pinus resinosa*, with *Pinus strobus* comprising at least 40% of the relative cover. Total canopy cover is 60-90% with canopy tree height typically 15-20 meters. A shrub layer composed of *Abies balsamea, Corylus cornuta, Acer rubrum*, and/or *Amelanchier* spp. is usually present with 20-50% cover. The dwarf blueberries, *Vaccinium angustifolium* and *Vaccinium myrtilloides* may also be present at low cover. The herbaceous strata is typically sparse with low to moderate cover and low species diversity. The most common species are *Aster macrophyllus, Pteridium aquilinum, Aralia nudicaulis, Maianthemum canadense*, and *Oryzopsis asperifolia*. The cover of mosses is highly variable ranging from nearly absent to 90%. The most common species are *Pleurozium schreberi, Dicranum scoparium, Dicranum polysetum*, and *Dicranum ontariense*.

Globally

This community is dominated by *Pinus strobus*. It is often distinguished by a supercanopy of large, old *Pinus strobus* and scattered *Pinus resinosa*. The lower layer of the canopy consists mainly of *Abies balsamea* trees and saplings (Ohmann and Ream 1971). Other trees that may be found in this layer include *Betula alleghaniensis, Picea glauca, Thuja occidentalis, Acer rubrum, Acer spicatum*, and other trees common to boreal forest landscapes. The tall shrub layer is moderately to well developed and consists of *Abies balsamea, Acer spicatum, Corylus cornuta*, and, less frequently, *Amelanchier* spp. (Ohmann and Ream 1971, Sims *et al.* 1989). The low shrub layer is not well developed. Characteristic species include *Diervilla lonicera, Linnaea borealis, Vaccinium myrtilloides*, and *Vaccinium angustifolium*. The herb stratum is also not well developed. The deep layer of undecomposed needles that formed the mor humus are not conducive to herb growth (Martin 1959). Prevalent herbs include *Aralia nudicaulis, Aster macrophyllus, Cornus canadensis, Maianthemum canadense, Polypodium vulgare*, and *Pteridium aquilinum*. Moss species include *Dicranum polysetum* and *Pleurozium schreberi*.

CONSERVATION RANK G3G4. There are fewer than 100 occurrences of this community rangewide, but Ontario ranks are unknown. Currently there are 45 occurrences documented from Minnesota (where it is ranked S3), Michigan (S?), and Wisconsin (S?); it is also reported from Ontario (S?). There are probably fewer than 10,000 acres of this community rangewide. Currently 2075 acres have been documented from 32 occurrences in Minnesota, Michigan, and Wisconsin. Many stands are reported to be of post-fire origin; infrequent catastrophic fires may be important for maintenance of this community. Some sites have been degraded by logging. Some sites may be disturbed by fire suppression, and they may be succeeding to other forest types.

DATABASE CODE CEGL002445

COMMENTS

Voyageurs National Park

Diagnostic features of the type are forest canopy consisting of greater than 40% *Pinus strobus*. May not be distinct from the White Pine-Aspen-Birch Forest. Both the White Pine/Mountain Maple Mesic Forest and the Red Pine/Blueberry Dry Forest may contain *Pinus strobus* and *Pinus resinosa* in the canopy. The White Pine/Mountain Maple Mesic Forest, however, may contain up to 60% *Pinus resinosa*. This community also generally occupies more mesic sites than the Red Pine/Blueberry Dry Forest. Where hardwoods (especially *Populus tremuloides* and *Betula papyrifera*) are also present in the canopy at > 25% cover, this type grades into the White Pine-Aspen-Birch Forest. The White Pine-Aspen-Birch Forest is rarely found as a distinct type, it more commonly is found as a mosiac of the White Pine/Mountain Maple Mesic Forest and the Aspen-Birch-Boreal Conifer Forest.

Globally

There appear to be two variants of this community. Both are dominated by a supercanopy of white pines. In the first variant of this in northeastern Minnesota and northwestern Ontario, the understory is dominated by *Abies balsamea*, and, with no fire regime, the forest appears to succeed to a fir-(birch?) forest (Ohmann and Ream 1970). This type of stand was also found in northeastern Ontario by Martin (1959), in a 25 acre stand estimated to be 100 years old. There were also a few spindly *Betula papyrifera* trees in the understory. A second variant may be a late successional stage white pine forest, thought to be 300 years old in the same region, where the understory was dominated by *Betula lutea* and *Tsuga canadensis*. All of the *Abies balsamea* over 5 cm d.b.h. were dead, although there were many smaller *A. balsamea*.

Fire is an important natural disturbance in this community. Although *Pinus strobus* does not have the more

sophisticated adaptations to fire that *Pinus resinosa* and *Pinus banksiana* do, *Pinus strobus* seedling establishment is favored by post-fire conditions, such as exposed mineral soil and high sunlight. Once established, mature *Pinus strobus* are able to survive surface fires and have moderate tolerance to shade. Frelich (1992), in an overview of research done on various *Pinus strobus* communities, found that white pine is most abundant in forests with a catastrophic fire rotation period of 150-300 years. This coincides with the fire rotation cycle found in the BWCA in northeastern Minnesota, where Heinselman found that *Pinus strobus* stands remained largely intact for 150-350 years.

Fire plays an important part in the longevity of the stand. Where there are frequent ground fires, understory shrubs and herbs are reduced, and the exposed mineral soil is favorable for pine regeneration (Ohmann and Ream 1971). Ohmann and Ream (1971) also suggested that fire suppression in the BWCA had allowed an extremely well-developed *Abies balsamea* undercanopy to become established, thus hastening the successional trend towards an *Abies balsamea* forest.

REFERENCES

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6.10 Northern Spruce-Fir-(Hardwood) Forests

Abies balsamea - Betula papyrifera / Diervilla lonicera Forest (Balsam Fir - Paper Birch Forest)

COMMON NAME	Balsam Fir - Paper Birch / Bush-honeysuckle Forest
SYNONYM	Balsam Fir - Paper Birch Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c)
ALLIANCE	PICEA GLAUCA - ABIES BALSAMEA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park1
This type was not tracked separately at Voyageurs, so its range is not clear.

Globally
This community is found in northern Minnesota, northwestern Ontario, and southeastern Manitoba.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park

Globally
This community is found on deep, moist to mesic, mineral soils, usually loams (Sims *et al.* 1989). It can be on flat to moderate slopes (5-30%) and, in northern Minnesota, tends to be near water (Ohmann and Ream 1971).

MOST ABUNDANT SPECIES
Voyageurs National Park

Globally

Stratum	Species
Tree canopy	*Abies balsamea, Betula papyrifera*

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Abies balsamea, Betula papyrifera

VEGETATION DESCRIPTION
Voyageurs National Park
This type was not described separately at Voyageurs National Park.

Globally
Canopy is either pure evergreen or mixed evergreen-deciduous. The overstory is usually dominated by *Abies balsamea* and *Betula papyrifera* but some stands may have large amounts of *Populus tremuloides*. Other common trees include *Picea glauca, Picea mariana, Pinus strobus,* and *Thuja occidentalis*. Canopy trees may typically be 15-25 m tall (Hansen *et al.* 1973). *Abies balsamea* is also abundant in the sapling/shrub stratum, along with *Acer spicatum, Betula papyrifera, Diervilla lonicera, Corylus cornuta, Linnaea borealis, Rubus pubescens, Sorbus americana,* and *Taxus canadensis* (especially on Isle Royale and in northern Wisconsin). Herbaceous species found in this community include *Anemone quinquefolia, Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Coptis*

trifolia, Cornus canadensis, Maianthemum canadense, Mitella nuda, Streptopus roseus, and *Trientalis borealis*. Mosses include *Hylocomium splendens, Plagiomnium cuspidatum, Pleurozium schreberi,* and *Ptilium crista-castrensis* (Sims *et al.* 1989).

CONSERVATION RANK G5.

DATABASE CODE CEGL002474

COMMENTS

Voyageurs National Park

This evergreen type was not described separately at Voyageurs National Park. See global description for the Fir-birch type (CEGL002474). Stands are typically mapped as part of the Spruce-Fir/Mountain Maple type (CEGL002446) or the Spruce-Fir-Aspen type (CEGL002475).

Globally

Diervilla lonicera may not be abundant in all stands. Hansen *et al.* (1973) found very little on their stands on Isle Royale in Lake Superior.

Stands may often have high tree mortality of *Abies balsamea* because of spruce budworm outbreaks. These stands are described by Ohmann and Ream (1971) as a separate "budworm-disturbed" type, but Grigal and Ohmann (1975) found that floristically these stands belong with the "Fir-birch" type.

REFERENCES

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Picea mariana - Populus tremuloides / Mixed Herbs Forest (Black Spruce - Aspen Forest)

COMMON NAME	Black Spruce - Trembling Aspen / Mixed Herbs Forest
SYNONYM	Black Spruce - Aspen Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	PICEA MARIANA - POPULUS TREMULOIDES FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type is uncommon and localized at Voyaguers National Park, and stands were not identified for description.

Globally
This community is found in northern Minnesota, northwestern Ontario, and Manitoba, but may occur elsewhere in Canada's boreal region.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park

Globally
This community is found on flat to gently sloping sites with fresh to moist mineral soils (Sims *et al.* 1989, Zoladeski *et al.* 1995). Soil texture is most often coarse loam, but can be clay, silt, or sand. Fine textured soils tend to be on lacustrine substrates while coarse textured soils result from morainal or glaciofluvial substrates. In Ontario, this community often occurs on calcareous soil (Sims *et al.* 1989).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

Stratum	Species
Tree canopy	*Picea mariana, Populus tremuloides*
Short shrub	*Linnaea borealis, Abies balsamea, Rubus pubescens, Vaccinium angustifolium, Vaccinium myrtilloides*.

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Picea mariana, Populus tremuloides, Linnaea borealis, Abies balsamea, Rubus pubescens, Vaccinium angustifolium, Vaccinium myrtilloides.

VEGETATION DESCRIPTION
Voyageurs National Park
Not described at Voyageurs National Park. See description for Spruce-Fir-Aspen type (CEGL002475).

Globally
The tree layer is dominated by a moderately closed to closed canopy of mixed coniferous and deciduous species. *Populus tremuloides* is the only common deciduous tree, but scattered *Betula papyrifera* and *Populus balsamifera* are also found. *Picea mariana* is the most abundant coniferous species, and often the most abundant canopy species. *Abies balsamea*, *Picea glauca*, and *Pinus banksiana* are typical associated conifers. The shrub layer ranges from

open to dense. Species found in this layer include *Diervilla lonicera*, *Ledum groenlandicum*, *Linnaea borealis*, *Rosa acicularis*, *Rubus pubescens*, *Vaccinium angustifolium*, and *Vaccinium myrtilloides*. The herbaceous layer has great diversity. *Aralia nudicaulis*, *Aster macrophyllus*, *Cornus canadensis*, *Coptis trifolia*, *Maianthemum canadense*, *Petasites frigidus*, *Trientalis borealis*, and *Viola renifolia* are common herbaceous species. Mosses also cover a substantial portion of the forest floor.

CONSERVATION RANK G4G5.

DATABASE CODE CEGL002516

COMMENTS
Voyageurs National Park
This type was not described separately at Voyageurs National Park. See global description for this type under CEGL002516. Stands were mapped under the Spruce-Fir-Aspen Forest alliance, where the common type was the Spruce-Fir-Aspen Forest (CEGL002475).

Many of the *Abies balsamea* trees and shrubs in these communities are dying from Spruce Budworm infestations. In stands that border beaver ponds, selective beaver cutting of aspen and birch may occur.

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Picea mariana / Pleurozium schreberi Forest (Black Spruce / Feathermoss Forest)

COMMON NAME	Black Spruce / Feathermoss Forest
SYNONYM	Black Spruce / Feathermoss Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c)
ALLIANCE	PICEA MARIANA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is relatively restricted in the park, commonly occurring on moist, north-facing slopes.

Globally

This community is found in northeastern Minnesota, northwestern Ontario, and southeastern Manitoba. It may be found in other parts of Manitoba.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

The Black Spruce/Feathermoss community occurs on flat to very steep (35% slope) terrain often with a northerly aspect. It can also occur on ridge tops where shallow soils have developed down slope from open bedrock. The terrain is usually very rocky, the rocks often covered by feathermoss. Patches of exposed bedrock are common. The soils are shallow sandy or silt loams averaging 2-10 cm deep over bedrock or loose rock. An undecomposed "O" horizon 2-5 cm thick is nearly always present and in shallow soils may constitute the only soil. In more well developed soils, "A", "B" and "E" horizons may also be present with varying degrees of thickness.

Globally

This community is found on level to gently sloping ground. Soils are typically moderately well drained, coarse loams, sands, and silts (Sims *et al.* 1989).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea mariana*
Tree sub-canopy	*Abies balsamea*
Tall shrub	*Picea mariana, Abies balsamea*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Cornus canadensis, Clintonia borealis*
Fern	*Lycopodium* spp.
Nonvascular	*Pleurozium schreberi*

Globally

Stratum	Species
Tree canopy	*Picea mariana*
Nonvascular	*Pleurozium schreberi*

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea mariana, Pleurozium schreberi

Globally

Picea mariana, Pleurozium schreberi

VEGETATION DESCRIPTION

Voyageurs National Park

Canopy cover of *Picea mariana* in this community ranges from 40-100% but is commonly in the 80-90% range. *Betula papyrifera* and *Populus tremuloides* can also occur in the canopy at low cover. The sub-canopy is non-existent or consists of a low cover of *Abies balsamea*. Shrub layers are typically absent or present with low cover and consist of *Picea mariana* and *Abies balsamea*. In the stands that have a more open canopy, the herbaceous strata can reach 80% and is dominated by *Aster macrophyllus, Lycopodium clavatum, Lycopodium dendroideum, Cornus canadensis, Clintonia borealis*, and *Maianthemum canadense*. In the stands with a more closed canopy, the herbaceous strata can be as low as 5%. The dwarf-shrub *Vaccinium angustifolium* may be absent or present up to 20% cover. Feathermoss, mainly *Pleurozium schreberi*, usually covers 80-100% of the forest floor, though in closed canopy situations may be virtually absent.

Globally

The canopy of this community is closed and strongly dominated by *Picea mariana* with small amounts of *Abies balsamea*, *Betula papyrifera*, *Picea glauca*, *Pinus banksiana*, and *Populus tremuloides*. The shrub and herb layer are poorly developed (Grigal and Ohmann 1975). Species that are most abundant in these layers include the shrubs *Corylus cornuta*, *Gaultheria procumbens*, *Ledum groenlandicum*, *Rosa acicularis*, *Vaccinium angustifolium*, and *Vaccinium myrtilloides*, and the herbs *Aster macrophyllus*, *Cornus canadensis*, *Equisetum arvense*, and *Maianthemum canadense*. Feathermosses, particularly *Pleurozium schreberi*, are very abundant. Mosses may cover from 23 % (Grigal and Ohmann 1975) to over 85% (Sims *et al.* 1989) of the forest floor.

CONSERVATION RANK G5.

DATABASE CODE CEGL002447

COMMENTS

Voyageurs National Park

Diagnostic features of the type include the *Picea mariana* canopy with *Pleurozium schreberi, Ptilium crista-castrensis,* and *Hylocomnium splendens* feathermosses. Sphagnum moss is generally absent, but may be present on lower slopes adjacent to swamps, where this community can occur mixed with the Black Spruce/Labrador Tea Poor Swamp. When *Populus* spp. becomes more dominant in the canopy, this type can grade into the Black Spruce-Aspen Forest. *Pinus banksiana* can occur mixed in the canopy.

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Picea glauca - Abies balsamea - Populus tremuloides / Mixed Herbs Forest (Spruce - Fir - Aspen Forest)

COMMON NAME	White Spruce - Balsam Fir - Trembling Aspen / Mixed Herbs Forest
SYNONYM	Spruce - Fir - Aspen Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.C.3.N)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a)
ALLIANCE	PICEA GLAUCA - ABIES BALSAMEA - POPULUS SPP. FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is common throughout the park.

Globally

This community is found in northern Michigan, northern Wisconsin, northern Minnesota, northwestern Ontario, and southeastern Manitoba.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This community almost always occurs on gentle slopes (0 - 10%) with variable aspects. Bedrock and coarse surficial rocks are common. A large amount of coarse woody debris is common. Soils are usually rocky, shallow sandy loams or silt loams. Typical depth is 5-8 cm though there may be areas with soils up to 20- 30 cm deep.

Globally

This upland community is found on deep, well drained to rapidly drained, moist, fine-textured, mineral soils. Loams are the most common, but silts and clays are not rare (Sims *et al.* 1989, Zoladeski *et al.* 1995).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea glauca, Abies balsamea, Populus tremuloides, Betula papyrifera*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*

Globally

Stratum	Species
Tree canopy	*Picea glauca, Populus tremuloides, Betula papyrifera*
Forb	*Aster macrophyllus, Aralia nudicaulis*

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea glauca, Abies balsamea, Populus tremuloides, Betula papyrifera, Diervilla lonicera, Aster macrophyllus, Aralia nudicaulis, Pteridium aquilinum, Cornus canadensis, Calamagrostis canadensis

Globally

Picea glauca, Abies balsamea, Populus tremuloides, Betula papyrifera, Diervilla lonicera, Aster macrophyllus, Aralia nudicaulis, Pteridium aquilinum, Cornus canadensis, Calamagrostis canadensis

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy in this type is a dominated by a mix of *Populus tremuloides, Betula papyrifera, Picea glauca*, and *Abies*

balsamea. Both the deciduous and evergreen components comprise at least 25% of the canopy. Though much variation exists, there tends to be a ratio of 60:40 deciduous : evergreen trees in the canopy. Canopy cover in this community is usually 70-90% with canopy trees ranging from 10-20 m tall. The subcanopy is usually absent, but if present consists of a low (20%) cover of *Abies balsamea* or *Acer rubrum.* This community characteristically contains large gaps in the canopy allowing for a significant shrub layers. Though these layers can reach 90%, they most commonly are in the 40-70% cover range and consist of *Abies balsamea, Acer rubrum,* and *Corylus cornuta.* The short shrubs *Vaccinium angustifolium* and *Vaccinium myrtilloides* can be absent or present with less than 20% cover. There is generally a fairly low species diversity in the herbaceous strata and cover is typically from 70-80% but can be as low as 30%. The most abundant species are *Pteridium aquilinum, Aster macrophyllus, Aralia nudicaulis,* and *Cornus canadensis.*

Globally
The canopy in this type is a dominated by a mix of *Populus tremuloides, Betula papyrifera, Picea glauca,* and *Abies balsamea.* Both the deciduous and evergreen components comprise at least 25% of the canopy. Canopy cover in this community is usually 70-90% with canopy trees ranging from 10-20 m tall. The overstory composition is varied. The most abundant tree species typically *are Abies balsamea, Acer rubrum, Picea glauca, Pinus strobus, Populus tremuloides,* and *Populus balsamifera*. The subcanopy is usually absent, but if present consists of a low (20%) cover of *Abies balsamea*. The sapling/shrub layer is usually moderately well developed. *Acer spicatum, Corylus cornuta, Rosa acicularis, Rubus pubescens,* and saplings of *Abies balsamea* are the most commonly encountered in this stratum. Herb diversity is usually high. *Aralia nudicaulis, Aster ciliolatus, Aster macrophyllus, Clintonia borealis, Cornus canadensis, Galium triflorum, Maianthemum canadense, Mitella nuda,* and *Trientalis borealis* are typical of this community.

CONSERVATION RANK G5.

DATABASE CODE CEGL002475

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the mixed canopy of *Populus tremuloides, Betula papyrifera, Picea glauca,* and *Abies balsamea.* Both evergreen and deciduous components comprising at least 25% relative cover. When canopy cover of the evergreen component of this type falls to near 25%, this type can grade into the Aspen-Birch-Boreal Conifer Forest. In stands where the dominant evergreen is *Picea mariana*, the stand is considered a Black Spruce-Aspen Forest (CEGL002516), but that type is rare in the park. In stands that border beaver ponds, selective beaver cutting of aspen and birch trees may cause these types to shift to Spruce-Fir/Mountain Maple Forests (CEGL002446) or Boreal Hazelnut-Serviceberry Rocky Shrubland (CEGL005197).

Many of the *Abies balsamea* trees and shrubs in these communities are dying from Spruce Budworm infestations.

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Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens Forest (Spruce - Fir / Mountain Maple Forest)

COMMON NAME	White Spruce - Balsam Fir / Mountain Maple / Dwarf Blackberry Forest
SYNONYM	Spruce - Fir / Mountain Maple Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.A.8.N)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c)
ALLIANCE	PICEA GLAUCA - ABIES BALSAMEA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 1

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type most commonly occurs on gentle to moderate slopes above wetlands and lake shores throughout the park.

Globally

This community is found in northern Michigan, northern Wisconsin, northern Minnesota, northwestern Ontario, and Manitoba. It may be found elsewhere in Canada.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type most commonly occurs on gentle to moderate slopes above beaver ponds and lake shores. Aspects are variable. Coarse woody debris is often abundant. Soils are generally rocky, 3-15 cm deep sandy loams. These sites are well to moderately well drained.

Globally

This community is found primarily on dry-mesic to mesic sites with well-drained, deep (>60 cm) loamy, sandy, or silty soils (Sims *et al.* 1989, Zoladeski *et al.* 1995). Less commonly, it may be found on wetter sites that may approach seasonally saturated conditions (Maycock 1961). The soils have little organic content and the topography is flat to gently sloping.

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Picea glauca, Abies balsamea*
Tall shrub	*Abies balsamea, Corylus cornuta, Populus tremuloides*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Aralia nudicaulis, Cornus canadensis*
Fern	*Pteridium aquilinum*
Nonvascular	*Pleurozium schreberi*

Globally

Stratum	Species
Tree canopy	*Picea glauca, Abies balsamea*
Tall shrub	*Abies balsamea, Corylus cornuta, Populus tremuloides*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Aralia nudicaulis, Cornus canadensis*
Fern	*Pteridium aquilinum*
Nonvascular	*Pleurozium schreberi*

CHARACTERISTIC SPECIES

Voyageurs National Park

Picea glauca, Abies balsamea, Corylus cornuta, Aster macrophyllus

Globally
Picea glauca, Abies balsamea, Acer spicatum, Rubus pubescens

VEGETATION DESCRIPTION
Voyageurs National Park
The canopy of this community is typically fairly open (40-70%) and composed predominantly of *Picea glauca* and *Abies balsamea* with lesser amounts of *Picea mariana* occasionally present. Deciduous trees, especially *Betula papyrifera* and *Populus tremuloides* may be present in the canopy with less than 25% relative cover. A shrub layer of *Abies balsamea, Corylus cornuta,* and/or *Populus tremuloides* is almost always present. Cover of the shrub layer is highly variable and inversely proportional to canopy cover. A dwarf-shrub layer of *Vaccinium angustifolium* may be absent or present at low cover. Like the shrub strata, density of the herbaceous layer is highly variable, ranging from 10-80%. The most abundant species are *Aster macrophyllus, Pteridium aquilinum, Aralia nudicaulis,* and *Cornus canadensis*. A moss layer of *Pleurozium schreberi* may be absent or present up to 40% cover.

Globally
This community is a closed canopy forest dominated by a combination of *Picea glauca* and/or *Abies balsamea*. Some stands have a preponderance of one of these species, with the other an important associate. Typically *Picea glauca* is the more abundant (Maycock and Curtis 1960, MN NHP 1993). Common associates include *Acer rubrum, Betula papyrifera, Picea mariana, Pinus banksiana, Populus tremuloides,* and *Populus balsamifera*. There is usually a prominent shrub/sapling layer containing *Abies balsamea, Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Picea glauca, Rosa acicularis, Rubus pubescens,* and *Sorbus americana*. The herbaceous layer is often moderately sparse, with species such as *Anemone quinquefolia, Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Coptis trifolia, Cornus canadensis, Dryopteris carthusiana, Maianthemum canadense, Mitella nuda, Trientalis borealis, Vaccinium myrtilloides,* and (eastward) *Viburnum cassinoides*. Mosses include *Dicranum polystem, Pleurozium schreberi, Ptilium crista-castrensis,* and *Rhytidiadelphus triquetrus* (Sims *et al.* 1989, Chambers *et al.* 1997).

CONSERVATION RANK G4G5.

DATABASE CODE CEGL002446

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Picea glauca* and *Picea mariana* or *Abies balsamea*, with less than 25% cover of deciduous trees. When deciduous trees, especially *Betula papyrifera* and *Populus* spp., are present in the canopy with about 25% cover, this type grades into the Spruce-Fir-Aspen Forest. In stands where beaver and spruce budworm have taken most of the trees, this type can grade into the Boreal Hazelnut-Serviceberry Rocky Shrubland. This shrubland, however, must have less than 25% cover of trees. If open bedrock is present in the stand, there must be less than 60% cover of spruce-fir and canopy closure must be prevented by the exposed bedrock for the stand to be considered a Boreal Pine Rocky Woodland type.

Stands of this type are often located above beaver ponds and adjacent to lakes and, therefore, subject to beaver feeding. In many circumstances, the open canopy of these stands is the result of beavers removing the deciduous trees (in what may have been, for example, a Spruce-Fir-Aspen Forest). *Abies balsamea* is also subject to defoliation by the Spruce Budworm.

Globally
In Northern Minnesota, stands of this type are often located above beaver ponds and adjacent to lakes and, therefore, subject to beaver feeding. In many circumstances, the open canopy of these stands is the result of beavers removing the deciduous trees (in what may have been, for example, a Spruce-Fir-Aspen Forest). *Abies balsamea* is also subject to defoliation by the Spruce Budworm (M. Smith personal communication 1999).

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6.11 Boreal Hardwood Forests

Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca) Forest (Aspen - Birch / Boreal Conifer Forest)

COMMON NAME	Trembling Aspen - Paper Birch / (Balsam Fir, White Spruce) Forest
SYNONYM	*Aspen - Birch / Boreal Conifer Forest*
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b)
ALLIANCE	POPULUS TREMULOIDES - BETULA PAPYRIFERA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This is one of the most abundant and widespread types in the Park and environs.

Globally
This community is found in Manitoba, Ontario, northern Minnesota, northern Wisconsin, and Michigan.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
This type occurs in a wide variety of positions on the landscape from well drained ridges with shallow soils to moderately drained lower areas. Though they can occupy moderate (6-14 degree) slopes, they generally occur on flat to gently sloping terrain with variable aspects. Soils are very rocky loams or fine sandy loams ranging from 2-10 cm deep. The more mesic example of this type may occur over a clay subsoil. An abundance of coarse woody debris is common.

Globally
This community is found on a variety of topographic positions. Omann and Ream (1971) found it on ridgetops, upper, mid, and lower slopes. These slopes are gentle to moderate. The soils are deep, well drained to rapidly drained mineral soils (Sims *et al.* 1989). The soils are usually loam but can be clay, silt, or sand.

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Tree canopy	*Populus tremuloides, Betula papyrifera, Populus grandidentata*
Tree sub-canopy	*Abies balsamea, Acer rubrum*
Tall shrub	*Abies balsamea, Acer rubrum, Corylus cornuta*
Short shrub	*Corylus cornuta, Populus tremuloides*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides, Betula papyrifera*
Short shrub	*Abies balsamea, Picea glauca*
Forb	*Aster macrophyllus, Aralia nudicaulis*

CHARACTERISTIC SPECIES
Voyageurs National Park
Populus tremuloides, Betula papyrifera, Abies balsamea, Populus grandidentata

Globally
Populus tremuloides, Betula papyrifera, Abies balsamea

VEGETATION DESCRIPTION
Voyageurs National Park
This is one of the most variable types in the Park and environs. It includes fairly young forests, mostly outside the park, where the canopy is 5-10m tall, to the more mature stands, mostly within the park, where the canopy is 20-35m tall. Typically, the canopy is dominated by *Populus tremuloides, Betula papyrifera*, and/or *Populus grandidentata*, is 10-20m tall, and has a cover of 70-80%. The sub-canopy is usually absent, but if present, contains low cover (20-30%) and *Abies balsamea* or *Acer rubrum*. The tall shrub stratum, on the other hand, is nearly always present at around 30-40% cover. *Abies balsamea* is the most common species in the sub-canopy and tall shrub layers, though in rare situations *Acer rubrum* may be more abundant. The short shrub stratum very often contains *Corylus cornuta*, commonly around 30% cover, but reaching 90-100% cover in some circumstances. The cover of the herbaceous stratum is usually 70-90% and can in some circumstances be composed almost entirely of *Pteridium aquilinum, Aster macrophyllus*, and *Aralia nudicaulis*. In addition to these, the herbs *Cornus canadensis, Rubus pubescens, Clintonia borealis*, and *Maianthemum canadense* may also be present.

Globally
This community is dominated by deciduous trees, with a moderate amount of conifers (<25%). The dominant tree species do not have dense leaf layers and allow a significant amount of light to pass through. This promotes the establishment of prominent sapling and shrub layers and a moderately dense herbaceous stratum. The canopy is dominated by *Betula papyrifera* and *Populus tremuloides*, and occasionally *Populus grandidentata*. Conifer associates include *Abies balsamea* and *Picea glauca*, either in the canopy or, more characteristically, in the subcanopy. *Abies balsamea* and *Picea glauca* are abundant in the sapling layer. Common shrubs include *Acer spicatum, Corylus cornuta, Diervilla lonicera, Linnaea borealis, Lonicera canadensis, Rosa acicularis, Rubus pubescens, Sorbus decora*, and *Vaccinium myrtilloides*. The herbaceous stratum is sometimes dominated by *Aster macrophyllus*, but can include a diversity of forbs, such as *Anemone quinquifolia, Aralia nudicaulis, Clintonia borealis, Cornus canadensis, Galium triflorum, Maianthemum canadense, Mitella nuda, Pteridium aquilinum, Streptopus roseus, Trientalis borealis*, and *Viola renifolia*. Mosses include *Plagiomnium cuspidatum, Pleurozium schreberi, Ptilium crista-castrensis*, and *Rhytidiadelphus triquestris* (Sims *et al*. 1989, Chambers *et al*. 1997). Diagnostic features of this type are the dominance by both *Populus tremuloides* and *Betula papyrifera*, boreal conifer associates (but very little *Picea mariana* or *Pinus banksiana*), and lack of more southern hardwoods (such as *Acer saccharum*).

CONSERVATION RANK G5.

DATABASE CODE CEGL002466

COMMENTS
Voyageurs National Park
Diagnostic features of the type include the canopy of *Populus tremuloides, Betula papyrifera*, and/or *Populus grandidentata* with less than 25% cover by conifers. *Abies balsamea* present in the sub-canopy or shrub strata. Both dry and mesic versions of this type are common in the park. This type can resemble the Spruce-Fir-Aspen Forest but has < 25% spruce or fir in the canopy. The richer versions of this type, which generally occur on deeper soils, can grade into the Trembling Aspen-Balsam Poplar Lowland Forest. This occurs commonly in areas where there is less topographic relief and lacustrine clay is more common in the subsoil. Bedrock outcrops can also occur within stands of the Aspen-Birch-Boreal Conifer Forest. When the canopy is < 60% cover and canopy closure is prevented by the presence of bedrock outcrops, this type becomes the Mixed Aspen Rocky Woodland.

The Aspen-Birch-Red Maple Forest contains *Acer rubrum* in place of *Abies balsamea* in the sub canopy and shrub layers. The Aspen-Birch-Red Maple Forest, however, is very rare in the park. Where *Acer rubrum* and *Abies balsamea* occur mixed in the sub canopy and shrub layers, the stand is considered an Aspen-Birch-Boreal Conifer Forest.

Where the Aspen-Birch-Boreal Conifer Forest occurs adjacent to beaver ponds, beaver may cut many trees resulting in a very open canopy and, eventually, a Boreal Hazelnut-Serviceberry Rocky Shrubland community.

Globally
Historically, this type originated after catastrophic fires in boreal systems. Aspen can form suckers from the roots of

fire-killed trees, up to 30 m from the main stem, and has tiny, light seeds that can travel thousands of meters (Heinselman 1996). This type can cover extensive areas because of logging and repeated post-logging fires, which eliminated most of the local pine seed sources (MN NHP 1993). Locally, where this type occurs adjacent to beaver ponds, beaver may cut many trees resulting in a very open canopy and, eventually, a Boreal Hazelnut-Serviceberry Rocky Shrubland (CEGL005197) community (M. Smith personal communication 1999).

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Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata) Forest (Aspen - Birch - Red Maple Forest)

COMMON NAME	Trembling Aspen - Paper Birch - (Red Maple, Bigtooth Aspen) Forest
SYNONYM	Aspen - Birch - Red Maple Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b)
ALLIANCE	POPULUS TREMULOIDES - BETULA PAPYRIFERA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type is very localized in the park and is not treated separately from other aspen-birch types.

Globally
This community is found in Ontario, northern Minnesota, northern Wisconsin, and Michigan.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park

Globally
This community is mostly found on level to rolling topography. It can occur on upper slopes or plateaus or in valley bottoms (Ohmann and Ream 1971). The soil is typically deep, sandy loam or loamy sand (Alban *et al.* 1991). The sites are on glacial outwash, lacustrine deposits, or moraines (Ohmann and Ream 1971, Sims *et al.* 1989). Most are well drained; however, this community can be found on somewhat poorly drained sites.

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species

Globally

Stratum	Species
Tree canopy	*Populus tremuloides, Betula papyrifera, Acer rubrum*
Tall shrub	*Corylus cornuta*
Forb	*Aster macrophyllus, Aralia nudicaulis*

CHARACTERISTIC SPECIES
Voyageurs National Park

Globally
Populus tremuloides, Betula papyrifera, Acer rubrum, Corylus cornuta

VEGETATION DESCRIPTION
Voyageurs National Park
This type was not described separately at Voyageurs National Park.

Globally
This deciduous forest community has a moderately closed canopy usually dominated by *Populus tremuloides* and *Betula papyrifera*. *Acer rubrum* and *Populus grandidentata* may be absent to dominant. Other minor components of the overstory may include *Abies balsamea*, *Pinus resinosa*, *Pinus strobus*, *Picea glauca*, and *Quercus rubra*. The shrub layer is approximately 2 meters tall and often well developed (MN NHP 1993). The most abundant species are *Acer spicataum*, *Amelanchier* spp., *Corylus cornuta*, *Diervilla lonicera*, and *Rosa acicularis*. Other shrubs

present include *Lonicera canadensis*, *Rubus pubescens*, *Vaccinium angustifolium*, and *Vaccinium myrtilloides*. The herbaceous layer tends to contain many species. Common species include *Aralia nudicaulis*, *Aster macrophyllus*, *Clintonia borealis*, *Maianthemum canadense*, *Trientalis borealis*, and *Viola* spp.

CONSERVATION RANK G5.

DATABASE CODE CEGL002467

COMMENTS
Voyageurs National Park
The Aspen-Birch-Red Maple Forest contains *Acer rubrum* in place of *Abies balsamea* in the subcanopy and shrub layers. The Aspen-Birch-Red Maple Forest, however, is very rare in the park, and where *Acer rubrum* and *Acer balsamea* occur mixed in the subcanopy and shrub layers, the stand is considered an Aspen-Birch/Boreal Conifer Forest.

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Betula papyrifera / Diervilla lonicera - (Abies balsamea) Forest (Paper Birch / Fir Forest)

COMMON NAME	Paper Birch / Bush-honeysuckle - (Balsam Fir) Forest
SYNONYM	Paper Birch / Fir Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b)
ALLIANCE	BETULA PAPYRIFERA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

Large stands of this type are known from only one location in Voyageurs National Park - Deer Island. Smaller, isolated patches of this forest, however, can be found scattered throughout the park.

Globally

This community is found in northern Michigan, northern Minnesota, southern Manitoba, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type usually occurs on flat terrain or gentle slopes with variable aspects. Soils of this community are shallow sandy loams usually 3-10 cm deep over bedrock.

Globally

This community is found on fresh to moist soils (Hansen *et al.* 1971, Sims *et al.* 1989). In Ontario, stands occur on coarse textured, non-calcareous mineral soils, at times very shallow (<15 cm). The soil texture is typically coarse loam or sandy loam (Sims *et al.* 1989).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Betula papyrifera*
Tall shrub	*Corylus cornuta*
Short shrub	*Vaccinium angustifolium*
Forb	*Aster macrophyllus, Aralia nudicaulis*
Fern	*Pteridium aquilinum*

Globally

Stratum	Species
Tree canopy	*Betula papyrifera*
Short shrub	*Diervilla lonicera*
Forb	*Aster macrophyllus, Aralia nudicaulis*

CHARACTERISTIC SPECIES

Voyageurs National Park

Betula papyrifera, Corylus cornuta, Aster macrophyllus, Aralia nudicaulis, Pteridium aquilinum

Globally

Betula papyrifera, Diervilla lonicera, Aster macrophyllus, Aralia nudicaulis

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy is dominated by deciduous trees. *Betula papyrifera* is frequently the only tree species in the canopy. Lesser amounts of *Populus tremuloides* or *Abies balsamea* may be present or absent. The canopy is moderately open (60-80% cover) and usually composed of trees 10-15 meters tall. *Corylus cornuta* is the dominant shrub and almost always present either in dense colonies (60-80% cover) or in scattered patches (5-25% cover). Other shrubs that may be present at low cover include *Amelanchier* spp., *Acer rubrum, Abies balsamea, Vaccinium angustifolium,* and *Populus tremuloides*. The herbaceous layer is typically 70-90% cover and consists mainly of *Aster macrophyllus, Pteridium aquilinum,* and *Aralia nudicaulis*. The following herbs may also be found at low cover: *Lycopodium dendroideum, Maianthemum canadense, Trientalis borealis,* and *Clintonia borealis*.

Globally
The canopy of this forested community is closed to moderately open. *Betula papyrifera* is the dominant canopy tree and can form nearly pure stands. *Populus tremuloides*, *Abies balsamea*, *Picea glauca*, and, especially in Canada, *Pinus banksiana* can be found in minor amounts, as well. Tree density can be high, but the growth form and size of the canopy dominants allows significant light to pass through. *Abies balsamea* is common to dense in the understory (Hansen *et al.* 1971) and shrubs such as *Corylus cornuta*, *Diervilla lonicera*, *Rosa acicularis*, and *Taxus canadensis*. The herbaceous layer is similar to other dry-mesic to mesic northern communities. Species found in this layer include *Aralia nudicaulis*, *Aster macrophyllus*, *Clintonia borealis*, *Cornus canadensis*, *Maianthemum canadense*, and *Trientalis borealis*.

CONSERVATION RANK G4?.

DATABASE CODE CEGL002463

COMMENTS
Voyageurs National Park
Diagnostic feature of the type is a canopy comprised almost entirely of *Betula papyerifera*. The Paper Birch/Fir Forest is very similar to the Aspen-Birch/Boreal Conifer Forest but its canopy is composed primarily of *Betula papyrifera*. If the canopy cover of *Betula papyrifera* is less than 90%, the stand is considered an Aspen-Birch/Boreal Conifer Forest. Shrub and herbaceous layers of the two communities are very similar.

Globally
This type often originates after fires. In the absence of disturbance the community may succeed to *Picea glauca* - *Abies balsamea* evergreen or mixed evergreen-deciduous community types (MN NHP 1993). Further north in Canada, it may succeed to *Pinus banksiana* and *Picea mariana* upland forests (Sims et al. 1989). Paper birch has tiny, light-winged seeds, easily blown long distances by wind. Its bark is very flammable, and even ground fires may kill a mature stem. Birch can resprout from the root collar at the base of the trunk, but not from roots further away from the tree (Heinselman 1996).

REFERENCES
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Heinselman, M.L. 1996. The Boundary Waters wilderness ecosystem. University of Minnesota Press, Minneapolis, MN. 334 p.
Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.
Sims, R. A., W. D. Towill, K. A. Baldwin, and G. M. Wickware. 1989. Field guide to the forest ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources.

Populus tremuloides - Populus balsamifera - Mixed Hardwoods Lowland Forest (Trembling Aspen - Balsam Poplar Lowland Forest)

COMMON NAME	Trembling Aspen - Balsam Poplar - Mixed Hardwoods Lowland Forest
SYNONYM	Trembling Aspen - Balsam Poplar Lowland Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d)
ALLIANCE	POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 2

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE

Voyageurs National Park

This type is most common in the west and southwest part of the park and in park environs, where the terrain is relatively flat and poorly drained soils are more common, but also occurs locally elsewhere in the park in areas surrounded by upland or in drainage areas adjacent to lakes.

Globally

This association is found in northern Michigan, northern Wisconsin, and Ontario.

ENVIRONMENTAL DESCRIPTION

Voyageurs National Park

This type generally occurs on very flat to slightly sloping (<5%) terrain. It can be extensive where the terrain is relatively flat and where poorly drained soils are more common, but it can also be found in low areas surrounded by upland or in drainage areas adjacent to lakes. The soils are generally poorly drained and relatively deep, reaching depths greater than 35 cm. The "A" horizons are usually 4-10 cm loams or silt loams with a high amount of organic matter. The "B" horizons, if present, are 1-5 cm clay loams and the "C" horizons are consistently deep, heavy, lacustrine clays or sandy clays.

Globally

Stands are found on lower slopes and draws, occasionally under seepage conditions. Soils are deep, fresh to moist, poorly drained, and often fine-textured and of lacustrine origin (Sims *et al.* 1989).

MOST ABUNDANT SPECIES

Voyageurs National Park

Stratum	Species
Tree canopy	*Populus tremuloides, Populus balsamifera*
Tree sub-canopy	*Fraxinus nigra*
Tall shrub	*Fraxinus nigra, Abies balsamea, Alnus incana*
Short shrub	*Rubus pubescens*
Fern	*Dryopteris carthusiana, Equisetum sylvaticum*
Graminoid	*Carex* spp.

Globally

Stratum	Species
Tree canopy	*Populus tremuloides, Populus balsamifera, Betula papyrifera*

CHARACTERISTIC SPECIES

Voyageurs National Park

Populus tremuloides, Populus balsamifera

Globally
Populus balsamifera, Populus tremuloides, Alnus incana, Calamagrostis canadensis

VEGETATION DESCRIPTION
Voyageurs National Park
The canopy of the Trembling Aspen-Balsam Poplar Lowland Forest is commonly 15-20m tall and consists of *Populus tremuloides* and *Populus balsamifera*. *Fraxinus nigra* can occasionally reach the canopy as well, though is usually found only in the sub canopy at 20-30% cover. The shrub layer is highly variable, ranging from 20-90% cover. It commonly consists of *Fraxinus nigra, Abies balsamea* and *Alnus incana*. The herbaceous layer is typically very diverse and covers 80-90% of the forest floor. The most abundant herbaceous species are *Rubus pubescens, Dryopteris carthusiana,* and *Equisetum sylvaticum. Carex intumescens, Carex gracillima, Bromus ciliatus, Iris versicolor, Calamagrostis canadensis,* and *Asarum canadense* are also common.

Globally
Stands are dominated by deciduous trees, but can contain a mix of evergreen species. Dominants include *Populus tremuloides* and *Populus balsamifera*. Other associates include *Abies balsamea, Betula papyrifera,* and *Picea glauca*. The shrub and herb layer are often fairly rich. Typical shrubs/saplings include *Abies balsamea, Alnus incana, Amelanchier* spp., *Cornus sericea, Ribes* spp., *Rosa acicularis, Rubus idaeus,* and *Rubus pubescens*. The herb layer contains *Aralia nudicaulis, Aster ciliolatus, Aster macrophyllus, Anemone quinquifolia, Calamagrostis canadensis, Carex* spp. (including *Carex intumescens, Carex gracillima*), *Clintonia borealis, Cornus canadensis, Dryopteris carthusiana, Equisetum* spp. (including *Equisetum sylvaticum*), *Galium triflorum, Maianthemum canadense, Mertensia paniculatus, Mitella nuda, Petasites frigidus* var. *palmatus, Streptopus roseus,* and *Viola renifolia*. *Calamagrostis canadensis* can be abundant in the herb layer (Sims *et al.* 1989, McCarthy *et al.* 1994).

CONSERVATION RANK G5.

DATABASE CODE CEGL005036

COMMENTS
Voyageurs National Park
Diagnostic features of the type include a canopy of *Populus tremuloides* and/or *Populus balsamifera* with *Fraxinus nigra, Alnus incana,* or *Populus balsamifera* present in the sub canopy or shrub layers. Though the canopy can be very similar to the Aspen Birch/Boreal Conifer Forest (CEGL002466), that type does not contain *Fraxinus nigra, Populus balsamifera* or *Alnus incana* in the canopy, subcanopy or shrub layers. That type also has lower diversity of herbaceous plants than this type. That type also has well-drained soils compared to the poorly drained, and relatively deep soils of this type. Very often, stands are found adjacent to (and slightly drier than) the Black Ash-Mixed Hardwood Swamp (CEGL002105) or as inclusions within the Aspen Birch/Boreal Conifer Forest (CEGL002466).

REFERENCES
McCarthy, T.G., R.W. Arnup, J. Nieppola, B.G. Merchant, K.C. Taylor, and W.J. Parton. 1994. Field Guide to Forest Ecosystems of Northeastern Ontario. NEST Field Guide FG-001, Ontario Ministry of Natural Resources, Northeast Science and Technology, Timmins ON.

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6.12 Northern Hardwood Forests

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

COMMON NAME	Bur Oak / (Saskatoon Serviceberry, Roughleaf Dogwood) / Wild Sarsaparilla Forest
SYNONYM	Northern Bur Oak Mesic Forest
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural (I.B.2.N)
FORMATION	Lowland or submontane cold-deciduous forest (I.B.2.N.a)
ALLIANCE	QUERCUS MACROCARPA FOREST ALLIANCE

CLASSIFICATION CONFIDENCE LEVEL 3

USFWS WETLAND SYSTEM TERRESTRIAL

RANGE
Voyageurs National Park
This type is most common on islands or peninsulas on Lake Kabetogama.

Globally
This community occurs in the northern tallgrass region of western Minnesota (with isolated stands in the western Border Lakes region in Voyageurs National Park), eastern Dakotas, western Iowa, and northeastern Nebraska.

ENVIRONMENTAL DESCRIPTION
Voyageurs National Park
This community type occurs on level to gently sloping terrain with variable aspects. It is 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.

Globally
Stands This community typically occur on gentle to steep slopes of draws and bluffs, historically where fire breaks occurred. Soils in the northern part of the range include well-drained sandy loams to loams formed in glacial till, and in the southern part include silty to sand loams formed primarily in loess and glacial till (Minnesota NHP 1993, Rosburg and Glenn-Lewin 1996, Steinauer and Rolfsmeier 1997).

MOST ABUNDANT SPECIES
Voyageurs National Park

Stratum	Species
Tree canopy	*Quercus macrocarpa, Fraxinus pennsylvanica, Tilia americana*
Tall shrub	*Amelanchier* spp., *Corylus cornuta, Fraxinus pennsylvanica, Tilia americana*
Forb	*Aster macrophyllus, Aralia nudicaulis, Osmorhiza longistylis*

Globally

Stratum	Species
Tree canopy	*Quercus macrocarpa, Fraxinus pennsylvanica, Tilia americana, Celtis occidentalis*
Tall shrub	*Amelanchier* spp., *Corylus cornuta, Cornus drummondii*
Forb	*Aralia nudicaulis*

CHARACTERISTIC SPECIES
Voyageurs National Park
Quercus macrocarpa, Fraxinus pennsylvanica, Tilia americana

Globally
Quercus macrocarpa, Fraxinus pennsylvanica, Celtis occidentalis, Corylus cornuta, Cornus drummondii, Aralia nudicaulis

VEGETATION DESCRIPTION

Voyageurs National Park

The canopy in this community is typically dominated by *Quercus macrocarpa* with *Fraxinus pennsylvanica* or *Tilia americana* present at low cover or absent. In some circumstances, *Fraxinus pennsylvanica* or *Tilia americana* may dominate the canopy to the near exclusion of *Quercus macrocarpa*. *Populus tremuloides* and *Acer saccharinum* may also 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: *Fraxinus pennsylvanica, Tilia americana, Amelanchier* spp., *Corylus cornuta, Ostrya virginiana*, and/or *Viburnum rafinesquianum*. The herbaceous strata is usually well developed and comprises 80-90% cover. *Aster macrophyllus, Aralia nudicaulis, Osmorhiza longistylis*, and *Pteridium aquilinum* usually comprise the majority of the cover in this community. The herbs *Circaea lutetiana, Carex arctata, Carex gracillima*, and *Impatiens capensis* are also common.

Globally

The tree layer is a closed canopy dominated by *Quercus macrocarpa* with a mixture of shade-tolerant trees, such as *Celtis occidentalis, Fraxinus pennsylvanica, Ulmus americana*, and *Ulmus rubra*, and further north *Populus tremuloides*. Occasionally *Ostrya virginiana, Tilia americana*, or *Quercus rubra* are present. The shrub layer is often prominent, dominated by *Amelanchier alnifolia* and *Corylus cornuta* in the north and *Cornus drummondii* in the south. Other species shared across the range include *Prunus virginiana, Ribes missouriense, Rubus occidentalis, Symphoricarpos occidentalis, Symphoricarpos orbiculatus*, and *Zanthoxylum americanum*. Vines include *Celastrus scandens, Parthenocissus quinquifolia*, and *Toxicodendron radicans*. The herbaceous layer can be quite sparse. Common species include *Aralia nudicaulis, Carex assiniboinensis, Carex blanda, Elymus villosus, Galium boreale, Geum canadense, Maianthemum stellatum, Osmorhiza longistylis, Poa pratensis, Polygonatum biflorum*, and *Viola sororia*. At Voyageurs NP, the understory is dominated by *Aster macrophyllus, Aralia nudicaulis, Osmorhiza longistylis*, and *Pteridium aquilinum* (Minnesota NHP 1993, Rosburg and Glenn-Lewin 1996, Steinauer and Rolfsmeier 1997).

CONSERVATION RANK G4.

DATABASE CODE CEGL002072

COMMENTS

Voyageurs National Park

Diagnostic features of the type include the canopy of *Quercus macrocarpa, Fraxinus pennsylvanica*, or *Tilia americana*. In sites with shallow soils and exposed bedrock, some sites may approach woodland physiognomy and grade into the Northern Pin Oak-Bur Oak Rocky Woodland. If the total canopy cover is <60% and canopy closure is prevented by the presence of exposed bedrock, the site is considered a Northern Pin Oak-Bur Oak Rocky Woodland.

The more mesic versions of this type have fairly diverse herbaceous stratas and can contain species that are found in few other communities in the park. Some of these species are *Uvularia grandiflora, Uvularia sessiliflora, Trillium* spp., and *Smilax herbacea*.

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

Globally

There may be a shift in composition between the Iowa -Nebraska stands and the stands to the north. The more characteristic set of northern U.S. species include *Amelanchier alnifolia, Carex assiniboinensis*, and *Aralia nudicaulis*, and the more central U.S. species include *Cornus drummondii*. *Poa pratensis*, generally considered an exotic, can dominate the ground layer across the range of the type.

REFERENCES

Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Ver. 1.5. Minn. Dep. Nat. Resour., Nat. Heritage Prog. St. Paul, Minn. 110 p.

Rosburg, T. R. and D. C. Glenn-Lewin. 1996. Species composition and environmental characteristics of grassland and ecotonal plant communities in the Loess Hills of western Iowa (USA). Natural Areas Journal 16:318-334.

Steinauer, G. and S. Rolfsmeier. 1997. Terrestrial natural communities of Nebraska. Draft - October 28, 1997. Nebraska Game and Parks Commission, Lincoln, NE. 117 p.

Appendix A

Observation Points for the Voyageurs National Park Vegetation Mapping Project

(Location Map and Condensed Listing)

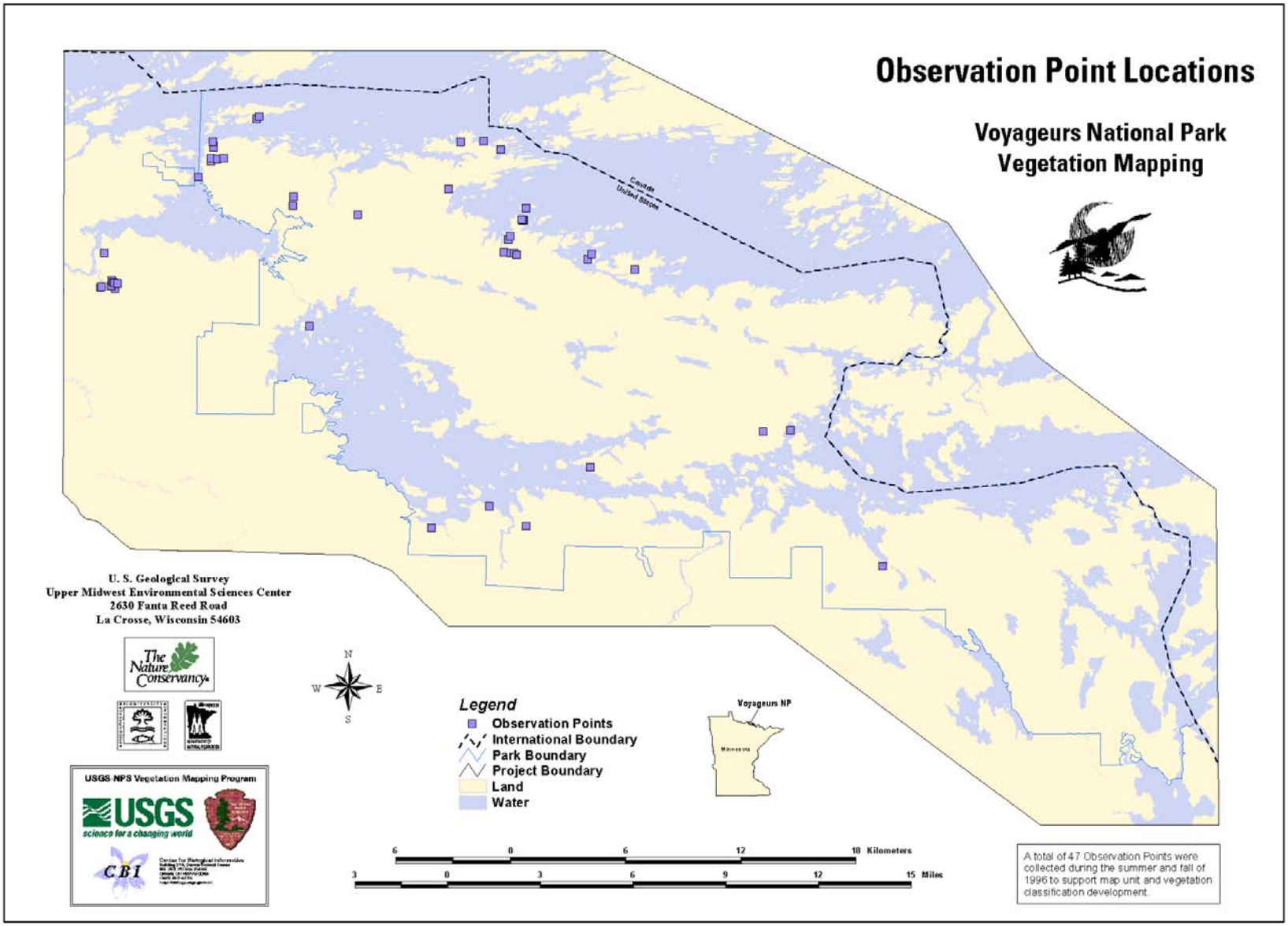

Figure 18. Locations of observations points collected by ecologist and mapping teams during 1996 field reconnaissance

Observation	Map Unit Code	Map Unit Description Name	TNC/ABI Elcode
1	WP	White Pine/Mountain Maple Mesic Forest	CEGL002445
2	AS	Speckled Alder Swamp	CEGL002381
3	BSL	Black Spruce/Labrador Tea Poor Swamp (evergreen phase)	CEGL002454
4	BST	Black Spruce/Labrador Tea Poor Swamp (mixed phase)	CEGL002454
5	TA	Northern Tamarack Rich Swamp	CEGL002471
6	AS	Speckled Alder Swamp	CEGL002381
7	AL	Trembling Aspen-Balsam Poplar Lowland Forest	CEGL005036
8	SMX	Wet Meadow/Fen Mosaic/Complex	CEGL002257
9	LBC	Black Spruce/Leatherleaf Semi-treed Bog	CEGL005218
10	UBS	Boreal Hazelnut-Serviceberry Rocky Shrubland	CEGL005197
11	MPHW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (mixed pine-oak phase)	CEGL005246
12	AL	Trembling Aspen-Balsam Poplar Lowland Forest	CEGL005036
13	WRPA	White Pine-Red Pine-Quaking Aspen-Birch Forest	CEGL002479
14	TA	Northern Tamarack Rich Swamp	CEGL002471
15	AB	Quaking Aspen-Paper Birch Forest	CEGL002467
16	BA	Black Ash-Mixed Hardwood Swamp	CEGL002105
17	OW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (deciduous phase)	CEGL005246
18	JPAX	Jack Pine-Aspen Forest Mosaic	CEGL002518
19	JPF	Jack Pine/Balsam Fir Forest	CEGL002437
20	WP	White Pine/Mountain Maple Mesic Forest	CEGL002445
21	BSF	Black Spruce/Feathermoss Forest	CEGL002447
22	BSL	Black Spruce/Labrador Tea Poor Swamp (evergreen phase)	CEGL002454
23	JPF	Jack Pine/Balsam Fir Forest	CEGL002437
24	AB	Quaking Aspen-Paper Birch Forest	CEGL002466
25	SF	Spruce-Fire/Mountain Maple Forest	CEGL002446
26	JPOM	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (jack pine-oak phase)	CEGL005246
27	BSL	Black Spruce/Labrador Tea Poor Swamp (evergreen phase)	CEGL002454
28	BSAS	Black Spruce/Alder Rich Swamp	CEGL002452
29	WP	White Pine/Mountain Maple Mesic Forest	CEGL002445
30	OW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (deciduous phase)	CEGL005246
31	RP	Red Pine/Blueberry Dry Forest	CEGL002443
32	BSF	Black Spruce/Feathermoss Forest	CEGL002447
33	BJ	Canada Bluejoint Eastern Marsh	CEGL005174
34	JPW	Boreal Pine Rocky Woodland (jack pine phase)	CEGL002483
35	WCU	White Cedar-Boreal Conifer Mesic Forest	CEGL002449
36	WCS	White Cedar-(mixed conifer)/Alder Swamp (rich soil phase)	CEGL002456
37	TA	Northern Tamarack Rich Swamp	CEGL002471
38	MPHW	Northern Pin Oak-Bur Oak-(Jack Pine) Rocky Woodland (mixed pine-oak phase)	CEGL005246
39	JPW	Boreal Pine Rocky Woodland (jack pine phase)	CEGL002483
40	ABW	Mixed Aspen Rocky Woodland	CEGL002487
41	JPW	Boreal Pine Rocky Woodland (jack pine phase)	CEGL002483
42	WCBA	White Cedar-Black Ash Swamp	CEGL005165
43	PB	Paper Birch/Fir Forest	CEGL002463
44	JPL	Jack Pine/Lichen Rocky Barrens	CEGL002491
45	DS	Dogwood-Pussy Willow Swamp	CEGL002186
46	BO	Northern Bur Oak Mesic Forest	CEGL002072
47	WCU	White Cedar-Boreal Conifer Mesic Forest	CEGL002449

Appendix B

Classification Matrix

(USNVC Vegetation Communities and Map Units)

How to use the classification matrix

The classification matrix is a separate spreadsheet. The matrix is designed to show the relationships between the USNVC vegetation associations and the map units used in the Voyageurs National Park mapping project. The associations are listed in rows and the map unit codes are listed in columns. Blue squares indicate a match or link between the associations and map units. In most instances, there is one blue square where a map unit links to an association. Thus, one blue square represents a one-to-one relationship between a given map unit and its corresponding vegetation association.

Some map units have more than one blue square in their columns. This means that map units sometimes include more than one association. For example, SF includes both the Balsam Fir-Paper Birch Forest and the Spruce-Fir/Mountain Maple Forest.

Some associations have more than one blue square in their rows. This means that some associations are mapped in more than one map unit. For example, the Black Spruce/Labrador Tea Poor Swamp was mapped using either BSL or BST. In this case, BSL and BST are phases of the association and were used to indicate either an evergreen or a mixed phase of the association.

Appendix C
Accuracy Assessment Forms
(1997 and 1998)

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM (1997)

IDENTIFIERS/LOCATORS

Plot Code_____ Polygon Code_____

Provisional Community Name_____

State ___ Park Name _____ Park Site Name _____

Quad Name_____ Quad Code_____

GPS file name_____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N

please do not complete the following information when in the field
Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____

Survey Date_____ Surveyors_____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____

Topographic Position

Landform

Cowardian System	Hydrologic Regime		Salinity Modifiers
___Upland	Non-Tidal		___Saltwater
___Riverine	___Permanently Flooded	___Saturated	___Brackish
___Palustrine	___Semipermanetly Flooded	___Temporarily Flooded/Saturated	___Freshwater
___Lacustrine	___Seasonally Flooded	___Intermittently Flooded	

Environmental Comments:	Unvegetated Surface: (please use the cover scale below)
	___ Bedrock ___ Litter, duff ___ Wood (> 1 cm)
	___ Large rocks (cobbles, boulders > 10 cm)
	___ Small rocks (gravel, 0.2-10 cm)
	___ Sand (0.1-2 mm) ___ Bare soil
	___ Other:_____

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata & Unvegetated Surface		Height Scale for Strata	
Trees and Shrubs		___Forest				
___Evergreen	___Broad-leaved	___Woodland	01	5%	01	<0.5 m
___Cold-deciduous	___Needle-leaved	___Shrubland	02	10%	02	0.5-1m
___Drought-deciduous	___Mixed broad-leaved/Needle leaved	___Dwarf Shrubland	03	20%	03	1-2 m
___Mixed evergreen - cold-deciduous	___Microphyllous	___Herbaceous	04	30%	04	2-5 m
___Mixed evergreen - drought-deciduous	___Graminoid	___Nonvascular	05	40%	05	5-10 m
	___Forb	___Sparsely Vegetated	06	50%	06	10-15 m
Herbs	___Pteridophyte		07	60%	07	15-20 m
___Annual			08	70%	08	20-35 m
___Perennial			09	80%	09	35 - 50 m
			10	90%	10	>50 m
			11	100%		

Strata	Height	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	_____	_____	_____	
T2 Canopy	_____	_____	_____	
T3 Sub-canopy	_____	_____	_____	
S1 Tall shrub	_____	_____	_____	
S2 Short Shrub	_____	_____	_____	
S3 Dwarf-shrub H Herbaceous	_____	_____	_____	
N Non-vascular	_____	_____	_____	
V Vine/liana	_____	_____	_____	
E Epiphyte	_____	_____	_____	

please see the table on the previous page for height and cover scales for strata

Other Comments

Cover Scale for Species
01 <1%
02 1-5%
03 5-25%
04 25-50%
05 50-75%
06 75-100%

Accuracy assessment Form (1998)
USGS-NPS Vegetation Mapping Program

1. Plot Number _____ 2. Park Code _____ 3. Date _____

4. Observer(s)_____5. Datum _____ 6. Accuracy _____

7. UTM Coordinates: Easting __ __ __, __ __ __ Northing __, __ __ __, __ __ __

8. UTM Zone _____ 9. Offset from Point: Easting _____m Northing _____m

10. Topographic Description _____

11. Elevation _____m 12. Aspect _____

13. Veg Assoc. at Site _____

14. Veg Assoc 2 within 50m of Site _____

15. Veg Assoc 3 within 50m of Site _____

16. Major Species Present (by strata)_____

_____

_____

17. Canopy Closure of Top Layer _____

18. Rationale for Classification_____

_____

_____

_____

19. Comments _____

_____

_____

Appendix D
Accuracy Assessment Contingency Matrix

Using the Accuracy Assessment Contingency Matrix

The accuracy assessment contigency matrix is a separate spreadsheet. The matrix is an array of numbers set out in rows and columns which reveal the number of polygons assigned to a particular vegetation association(s) relative to the actual vegetation type as verified on the ground. The columns represent the vegetation associations and the rows represent the map unit codes. The accuracies of each map unit are described along with both the errors of inclusion (commission errors) and errors of exclusion (omission errors) present in the mapping.

Appendix E

A List of Species found during the Vegetation Mapping Project for Voyageurs National Park

Summarized by Plant Family
Nomenclature follows the PLANTS database

The following list of species includes those found during the Vegetation Mapping Project for Voyageurs National Park. It is not intended to be a comprehensive list of every species that occurs in the Voyageurs National Park Mapping project area. The species are presented alphabetically by family. Lichens and bryophte Families are shaded in gray.

Family	Scientific Name	Common Name
Aceraceae	Acer rubrum L.	red maple
	Acer spicatum Lam.	mountain maple
Acoraceae	Acorus calamus L.	calamus
Alismataceae	Sagittaria cristata Engelm.	crested arrowhead
	Sagittaria latifolia Willd.	broadleaf arrowhead
	Sagittaria rigida Pursh	sessilefruit arrowhead
Amblystegiaceae	Calliergon (Sull.) Kindb.	calliergon moss
	Calliergon cordifolium (Hedw.) Kindb.	calliergon moss
	Calliergon giganteum (Schimp.) Kindb.	giant calliergon moss
	Drepanocladus (C.M.ll.) G. Roth	drepanocladus moss
	Drepanocladus aduncus (Hedw.) Warnst.	drepanocladus moss
	Warnstorfia exannulata (Schimp. in B.S.G.) Loeske	warnstorfia moss
Anacardiaceae	Rhus glabra L.	smooth sumac
	Rhus hirta (L.) Sudworth	staghorn sumac
	Toxicodendron radicans ssp. radicans (L.) Kuntze	eastern poison ivy
Aneuraceae	Riccardia multifida	
Apiaceae	Cicuta bulbifera L.	bulblet bearing water hemlock
	Cicuta L.	water hemlock
	Osmorhiza claytonii (Michx.) C.B. Clarke	Clayton's sweetroot
	Osmorhiza longistylis (Torr.) DC.	longstyle sweetroot
	Sanicula marilandica L.	Maryland sanicle
	Sium suave Walt.	hemlock waterparsnip
Apocynaceae	Apocynum androsaemifolium L.	spreading dogbane
Araceae	Arisaema triphyllum (L.) Schott	Jack in the pulpit
	Calla palustris L.	water arum
Araliaceae	Aralia hispida Vent.	bristly sarsaparilla
	Aralia nudicaulis L.	wild sarsaparilla
	Aralia racemosa L.	American spikenard
Aristolochiaceae	Asarum canadense L.	Canadian wildginger
Asteraceae	Achillea millefolium L.	common yarrow
	Anaphalis margaritacea (L.) Benth. & Hook. f.	western pearlyeverlasting
	Antennaria neglecta Greene	field pussytoes
Asteraceae	Aster ciliolatus Lindl.	Lindley's aster
	Aster L.	aster
	Aster lateriflorus (L.) Britt.	calico aster
	Aster macrophyllus L.	bigleaf aster
	Aster puniceus L.	purplestem aster
	Cirsium arvense (L.) Scop.	Canadian thistle
	Cirsium muticum Michx.	swamp thistle
	Cirsium P. Mill.	thistle
	Doellingeria umbellata (P. Mill.) Nees	
	Erigeron strigosus Muhl. ex Willd.	prairie fleabane
	Eupatorium maculatum L.	spotted joepyeweed
	Hieracium kalmii L.	Kalm's hawkweed
	Hieracium scabrum Michx.	rough hawkweed
	Hieracium umbellatum L.	narrowleaf hawkweed
	Lactuca biennis (Moench) Fern.	tall blue lettuce
	Lactuca canadensis L.	Canada lettuce
	Lactuca L.	lettuce
	Megalodonta beckii (Torr. ex Spreng.) Greene	aquatic beggartick

Family	Scientific Name	Common Name
	Petasites frigidus var. palmatus (Ait.) Cronq.	Arctic sweet coltsfoot
	Petasites sagittatus (Banks ex Pursh) Gray	arrowleaf sweet coltsfoot
	Solidago canadensis L.	Canada goldenrod
	Solidago gigantea Ait.	giant goldenrod
	Solidago hispida Muhl. ex Willd.	hairy goldenrod
	Solidago L.	goldenrod
	Solidago nemoralis Ait.	Dyersweed goldenrod
	Solidago uliginosa Nutt.	bog goldenrod
	Taraxacum G.H. Weber ex Wiggers	dandelion
Aulacomniaceae	Aulacomnium palustre (Hedw.) Schwaegr.	aulacomnium moss
Balsaminaceae	Impatiens capensis Meerb.	jewelweed
Betulaceae	Alnus incana ssp. rugosa (Du Roi) Clausen	speckled alder
	Alnus viridis ssp. crispa (Ait.) Turrill	American green alder
	Betula papyrifera Marsh.	paper birch
	Betula pumila var. glandulifera Regel	glandulose birch
	Betula X sandbergii Britt.	Sandberg's birch
	Corylus americana Walt.	American hazelnut
	Corylus cornuta Marsh.	beaked hazelnut
	Ostrya virginiana (P. Mill.) K. Koch	eastern hophornbeam
Brassicaceae	Rorippa Scop.	yellowcress
Bryaceae	Brachymenium erectum (Hook.) Marg.	erect brachymenium moss
Cabombaceae	Brasenia schreberi J.F. Gmel.	watershield
Campanulaceae	Campanula aparinoides Pursh	marsh bellflower
	Campanula rotundifolia L.	bluebell bellflower
Caprifoliaceae	Diervilla lonicera P. Mill.	northern bush honeysuckle
	Linnaea borealis ssp. americana (Forbes) Hulten ex Clausen	
	Lonicera canadensis Bartr. ex Marsh.	American fly honeysuckle
	Lonicera dioica L.	limber honeysuckle
	Lonicera hirsuta Eat.	hairy honeysuckle
	Lonicera oblongifolia (Goldie) Hook.	swamp fly honeysuckle
	Lonicera villosa (Michx.) J.A. Schultes	mountain fly honeysuckle
	Sambucus racemosa var. racemosa L.	
	Symphoricarpos albus (L.) Blake	common snowberry
	Viburnum lentago L.	nannyberry
	Viburnum opulus var. americanum Ait.	American cranberry viburnum
	Viburnum rafinesquianum J.A. Schultes	downy arrowwood
Caryophyllaceae	Stellaria longifolia Muhl. ex Willd.	longleaf starwort
Celastraceae	Celastrus scandens L.	American bittersweet
Ceratophyllaceae	Ceratophyllum demersum L.	coon's tail
Cladoniaceae	Cladina (Nyl.) Nyl.	reindeer lichen
	Cladina mitis (Sandst.) Hustich	reindeer lichen
	Cladina rangiferina (L.) Nyl.	greygreen reindeer lichen
	Cladina stellaris (Opiz) Brodo	star reindeer lichen
	Cladonia P. Browne	cup lichen
Climaciaceae	Climacium dendroides (Hedw.) Web. & Mohr	tree climacium moss
Clusiaceae	Triadenum fraseri (Spach) Gleason	Fraser's marsh St. Johnswort
Conocephalaceae	Conocephalum conicum	
Cornaceae	Cornus alternifolia L. f.	alternateleaf dogwood
	Cornus canadensis L.	bunchberry dogwood
	Cornus racemosa Lam.	gray dogwood

Family	Scientific Name	Common Name
	Cornus rugosa Lam.	roundleaf dogwood
	Cornus sericea ssp. sericea L.	redosier dogwood
Cupressaceae	Juniperus communis var. depressa Pursh	common juniper
	Thuja occidentalis L.	eastern arborvitae
Cyperaceae	Carex aquatilis Wahlenb.	water sedge
	Carex arcta Boott	bear sedge
	Carex bebbii Olney ex Fern.	Bebb's sedge
	Carex brunnescens ssp. sphaerostachya (Tuckerman) Kalela	brownish sedge
	Carex canescens L.	silvery sedge
	Carex chordorrhiza Ehrh. ex L. f.	creeping sedge
	Carex cristatella Britt.	crested sedge
	Carex diandra Schrank	lesser panicled sedge
	Carex disperma Dewey	softleaf sedge
	Carex echinata ssp. echinata Murr.	prickly sedge
	Carex gracillima Schwein.	graceful sedge
	Carex interior Bailey	inland sedge
	Carex intumescens Rudge	greater bladder sedge
	Carex L.	sedge
	Carex lacustris Willd.	hairy sedge
	Carex lasiocarpa var. americana Fern.	American woollyfruit sedge
	Carex leptalea Wahlenb.	bristlystalked sedge
	Carex limosa L.	mud sedge
	Carex livida var. radicaulis Paine	livid sedge
	Carex magellanica ssp. magellanica Lam.	little sedge
	Carex oligosperma Michx.	fewseed sedge
	Carex pauciflora Lightf.	star sedge
	Carex peckii Howe	Peck's sedge
	Carex pensylvanica Lam.	Pennsylvania sedge
	Carex projecta Mackenzie	necklace sedge
	Carex retrorsa Schwein.	knotsheath sedge
	Carex rostrata var. utriculata (Boott) Bailey	= Carex utriculata
	Carex scoparia Schkuhr ex Willd.	broom sedge
	Carex stipata Muhl. ex Willd.	owlfruit sedge
	Carex stricta Lam.	uptight sedge
	Carex tenuiflora Wahlenb.	sparseflower sedge
	Carex trisperma Dewey	threeseeded sedge
	Carex vesicaria L.	blister sedge
	Cladium P. Br.	sawgrass
	Dulichium arundinaceum (L.) Britt.	threeway sedge
	Eriophorum angustifolium Honckeny	tall cottongrass
	Eriophorum chamissonis C.A. Mey.	Chamisso's cottongrass
	Eriophorum gracile W.D.J. Koch	slender cottongrass
	Eriophorum L.	cottongrass
	Eriophorum tenellum Nutt.	fewnerved cottongrass
	Eriophorum vaginatum var. spissum (Fern.) Boivin	tussock cottongrass
	Eriophorum virginicum L.	tawny cottongrass
	Eriophorum viridicarinatum (Engelm.) Fern.	thinleaf cottonsedge
	Scirpus acutus Muhl. ex Bigelow	= Schoenoplectus acutus var. acutus
	Scirpus cyperinus (L.) Kunth	woolgrass
	Scirpus validus var. creber Fern.	= Schoenoplectus tabernaemontani
Dennstaedtiaceae	Pteridium aquilinum var. latiusculum (Desv.) Underwood ex Heller	western brackenfern
Dicranaceae	Dicranum flagellare Hedw.	dicranum moss
	Dicranum Hedw.	dicranum moss
	Dicranum montanum Hedw.	montane dicranum moss
	Dicranum ontariense Peters.	Ontario dicranum moss
	Dicranum polysetum Sw.	dicranum moss
	Dicranum scoparium Hedw.	dicranum moss

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Droseraceae	Drosera rotundifolia L.	roundleaf sundew
Dryopteridaceae	Athyrium filix-femina ssp. angustum (Willd.) Clausen	subarctic ladyfern
	Dryopteris Adans.	woodfern
	Dryopteris carthusiana (Vill.) H.P. Fuchs	spinulose woodfern
	Dryopteris cristata (L.) Gray	crested woodfern
	Gymnocarpium dryopteris (L.) Newman	western oakfern
	Onoclea sensibilis L.	sensitive fern
	Woodsia ilvensis (L.) R. Br.	rusty woodsia
Equisetaceae	Equisetum arvense L.	field horsetail
	Equisetum fluviatile L.	water horsetail
	Equisetum L.	horsetail
	Equisetum pratense Ehrh.	meadow horsetail
	Equisetum scirpoides Michx.	dwarf scouringrush
	Equisetum sylvaticum L.	woodland horsetail
Ericaceae	Andromeda polifolia var. glaucophylla (Link) DC.	bog rosemary
	Arctostaphylos uva-ursi (L.) Spreng.	kinnikinnick
	Chamaedaphne calyculata var. angustifolia (Ait.) Rehd.	leatherleaf
	Gaultheria hispidula (L.) Muhl. ex Bigelow	creeping snowberry
	Gaultheria procumbens L.	eastern teaberry
	Kalmia polifolia Wangenh.	bog laurel
	Ledum groenlandicum Oeder	bog Labradortea
	Vaccinium angustifolium Ait.	lowbush blueberry
	Vaccinium macrocarpon Ait.	cranberry
	Vaccinium myrtilloides Michx.	velvetleaf huckleberry
	Vaccinium oxycoccos L.	small cranberry
	Vaccinium vitis-idaea ssp. minus (Lodd.) Hulten	northern mountain cranberry
Fabaceae	Amphicarpaea bracteata (L.) Fern.	American hogpeanut
	Lathyrus ochroleucus Hook.	cream peavine
	Lathyrus venosus Muhl. ex Willd.	veiny peavine
	Trifolium pratense L.	red clover
	Vicia americana Muhl. ex Willd.	American vetch
Fagaceae	Quercus ellipsoidalis E.J. Hill	northern pin oak
	Quercus L.	oak
	Quercus macrocarpa Michx.	bur oak
	Quercus rubra L.	northern red oak
Fumariaceae	Corydalis DC.	corydalis
	Corydalis sempervirens (L.) Pers.	rock harlequin
Gentianaceae	Halenia deflexa (Sm.) Griseb.	American spurredgentian
Grossulariaceae	Ribes americanum P. Mill.	American black currant
	Ribes aureum var. villosum DC.	golden currant
	Ribes glandulosum Grauer	skunk currant
	Ribes hirtellum Michx.	hairystem gooseberry
	Ribes hudsonianum Richards.	northern black currant
	Ribes L.	currant
	Ribes lacustre (Pers.) Poir.	prickly currant
	Ribes oxyacanthoides L.	Canadian gooseberry
	Ribes triste Pallas	red currant
Haloragaceae	Myriophyllum L.	watermilfoil
	Myriophyllum sibiricum Komarov	shortspike watermilfoil
	Myriophyllum verticillatum L.	whorlleaf watermilfoil
Hedwigiaceae	Hedwigia ciliata (Hedw.) P. Beauv.	ciliate hedwigia moss
Hydrocharitaceae	Elodea canadensis Michx.	Canadian waterweed
	Vallisneria americana Michx.	American eelgrass
Hylocomiaceae	Hylocomium splendens (Hedw.) Schimp. in B.S.G.	splendid feather moss
	Pleurozium Mitt.	big red stem moss
	Pleurozium schreberi (Brid.) Mitt.	Schreber's big red stem moss
Hylocomiaceae	Rhytidiadelphus triquetrus (Hedw.) Warnst.	rough goose neck moss

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Hypnaceae	Hypnum lindbergii Mitt.	Lindberg's hypnum moss
	Ptilium crista-castrensis (Hedw.) De Not.	knights plume moss
Iridaceae	Iris versicolor L.	harlequin blueflag
Juncaceae	Luzula acuminata Raf.	hairy woodrush
Lamiaceae	Agastache foeniculum (Pursh) Kuntze	blue giant hyssop
	Clinopodium vulgare L.	wild basil
	Lycopus americanus Muhl. ex W. Bart.	American waterhorehound
	Lycopus L.	waterhorehound
	Lycopus uniflorus Michx.	northern bugleweed
	Mentha canadensis L.	Canadian mint
	Mentha spicata L.	spearmint
	Prunella vulgaris L.	common selfheal
	Scutellaria galericulata L.	marsh skullcap
	Scutellaria L.	skullcap
	Scutellaria lateriflora L.	blue skullcap
Lemnaceae	Lemna minor L.	common duckweed
	Lemna trisulca L.	star duckweed
	Spirodela polyrrhiza (L.) Schleid.	common duckweed
Lentibulariaceae	Utricularia intermedia Hayne	flatleaf bladderwort
	Utricularia L.	bladderwort
	Utricularia macrorhiza Le Conte	common bladderwort
Liliaceae	Clintonia borealis (Ait.) Raf.	yellow bluebeadlily
	Maianthemum canadense Desf.	Canada beadruby
	Maianthemum trifolium (L.) Sloboda	threeleaf false Solomon's seal
	Polygonatum biflorum var. commutatum (J.A. & J.H. Schultes) Morong	king Solomon's seal
	Polygonatum pubescens (Willd.) Pursh	hairy Solomon's seal
	Streptopus lanceolatus var. longipes (Fern.) Reveal	
	Trillium cernuum L.	whippoorwill flower
	Uvularia grandiflora Sm.	largeflower bellwort
Lycopodiaceae	Huperzia lucidula (Michx.) Trevisan	shining clubmoss
	Lycopodium annotinum L.	stiff clubmoss
	Lycopodium clavatum L.	running clubmoss
	Lycopodium complanatum L.	groundcedar
	Lycopodium dendroideum Michx.	tree groundpine
	Lycopodium hickeyi W.H. Wagner, Beitel & Moran	Pennsylvania clubmoss
Lythraceae	Lythrum salicaria L.	purple loosestrife
Menyanthaceae	Menyanthes trifoliata L.	common buckbean
Mniaceae	Mnium Hedw.	mnium calcareous moss
	Plagiomnium T. Kop.	plagiomnium moss
	Rhizomnium magnifolium (Horik.) T. Kop.	grandleaf rhizomnium moss
	Rhizomnium pseudopunctatum (Bruch & Schimp.) T. Kop.	rhizomnium moss
Monotropaceae	Monotropa uniflora L.	Indianpipe
Myricaceae	Comptonia peregrina (L.) Coult.	sweet fern
	Myrica gale L.	sweetgale
Najadaceae	Najas flexilis (Willd.) Rostk. & Schmidt	nodding waternymph
Nymphaeaceae	Nuphar lutea ssp. variegata (Dur.) E.O. Beal	varigated yellow pondlily
	Nymphaea odorata Ait.	American white waterlily
Oleaceae	Fraxinus nigra Marsh.	black ash
	Fraxinus pennsylvanica Marsh.	green ash
Onagraceae	Circaea alpina L.	small enchanter's nightshade
	Circaea lutetiana ssp. canadensis (L.) Aschers. & Magnus	broadleaf enchanter's nightshade
	Epilobium coloratum Biehler	purpleleaf willowherb

Family	Scientific Name	Common Name
	Epilobium L.	willowweed
	Epilobium leptocarpum Hausskn.	slenderfruit willowherb
	Epilobium palustre L.	marsh willowherb
Ophioglossaceae	Botrychium Sw.	grapefern
	Botrychium virginianum (L.) Sw.	rattlesnake fern
Orchidaceae	Arethusa bulbosa L.	dragon's mouth
	Corallorrhiza maculata (Raf.) Raf.	summer coralroot
	Corallorrhiza striata Lindl.	hooded coralroot
	Cypripedium acaule Ait.	pink lady's slipper
Orchidaceae	Cypripedium reginae Walt.	showy lady's slipper
	Goodyera repens (L.) R. Br. ex Ait. f.	lesser rattlesnake plantain
	Goodyera tesselata Lodd.	checkered rattlesnake plantain
	Malaxis brachypoda (Gray) Fern.	white addersmouth orchid
	Platanthera hyperborea (L.) Lindl.	northern green orchid
	Platanthera orbiculata (Pursh) Lindl.	large roundleaved orchid
Osmundaceae	Osmunda cinnamomea L.	cinnamon fern
	Osmunda claytoniana L.	interrupted fern
Pinaceae	Abies balsamea (L.) P. Mill.	balsam fir
	Larix laricina (Du Roi) K. Koch	tamarack
	Picea glauca (Moench) Voss	white spruce
	Picea mariana (P. Mill.) B.S.P.	black spruce
	Pinus banksiana Lamb.	jack pine
	Pinus resinosa Soland.	red pine
	Pinus strobus L.	eastern white pine
Poaceae	Agropyron Gaertn.	wheatgrass
	Agrostis L.	bentgrass
	Agrostis scabra Willd.	rough bentgrass
	Agrostis stolonifera L.	creeping bentgrass
	Bromus ciliatus L.	fringed brome
	Calamagrostis canadensis (Michx.) Beauv.	bluejoint
	Cinna latifolia (Trev. ex Goepp.) Griseb.	drooping woodreed
	Danthonia spicata (L.) Beauv. ex Roemer & J.A. Schultes	poverty danthonia
	Dichanthelium scabriusculum (Ell.) Gould & C.A. Clark	woolly rosette grass
	Dichanthelium xanthophysum (Gray) Freckmann	slender rosette grass
	Elymus trachycaulus ssp. trachycaulus (Link) Gould ex Shinners	slender wheatgrass
	Elymus virginicus L.	Virginia wildrye
	Glyceria canadensis (Michx.) Trin.	rattlesnake mannagrass
	Glyceria grandis S. Wats.	American mannagrass
	Glyceria striata (Lam.) A.S. Hitchc.	fowl mannagrass
	Oryzopsis asperifolia Michx.	roughleaf ricegrass
	Oryzopsis pungens (Torr. ex Spreng.) A.S. Hitchc.	mountain ricegrass
	Panicum capillare L.	witchgrass
	Panicum L.	panicum
	Phleum pratense L.	timothy
	Phragmites australis (Cav.) Trin. ex Steud.	common reed
	Poa alsodes Gray	grove bluegrass
	Poa L.	bluegrass
	Schizachne purpurascens (Torr.) Swallen	false melic
	Torreyochloa pallida (Torr.) Church	pale false mannagrass
	Zizania palustris L.	northern wildrice
Polygonaceae	Polygonum amphibium var. stipulaceum Coleman	water smartweed
	Polygonum cilinode Michx.	fringed black bindweed
	Polygonum douglasii Greene	Douglas' knotweed
	Polygonum hydropiper L.	marshpepper knotweed
	Polygonum L.	knotweed
	Polygonum lapathifolium L.	curlytop knotweed
	Polygonum punctatum Ell.	dotted smartweed
	Polygonum sagittatum L.	arrowleaf tearthumb
	Polygonum virginianum L.	jumpseed

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	Rumex altissimus Wood	pale dock
	Rumex crispus L.	curly dock
	Rumex orbiculatus Gray	greater water dock
Polypodiaceae	Polypodium virginianum L.	rock polypody
Polytrichaceae	Polytrichum commune Hedw.	polytrichum moss
	Polytrichum Hedw.	polytrichum moss
	Polytrichum juniperinum Hedw.	juniper polytrichum moss
	Polytrichum piliferum Hedw.	polytrichum moss
	Polytrichum strictum Brid.	polytrichum moss
Potamogetonaceae	Potamogeton friesii Rupr.	Fries' pondweed
	Potamogeton gramineus L.	variableleaf pondweed
	Potamogeton L.	pondweed
	Potamogeton natans L.	floating pondweed
	Potamogeton richardsonii (Benn.) Rydb.	Richardson's pondweed
	Potamogeton spirillus Tuckerman	spiral pondweed
	Potamogeton zosteriformis Fern.	flatstem pondweed
Primulaceae	Lysimachia L.	loosestrife
	Lysimachia terrestris (L.) B.S.P.	earth loosestrife
	Lysimachia thyrsiflora L.	tufted loosestrife
	Trientalis borealis Raf.	American starflower
Pyrolaceae	Chimaphila umbellata ssp. cisatlantica (Blake) Hulten	pipsissewa
	Moneses uniflora (L.) Gray	single delight
	Orthilia secunda (L.) House	sidebells wintergreen
	Pyrola americana Sweet	American wintergreen
	Pyrola asarifolia Michx.	liverleaf wintergreen
Pyrolaceae	Pyrola chlorantha Sw.	greenflowered wintergreen
	Pyrola elliptica Nutt.	waxflower shinleaf
Pyrolaceae	Pyrola L.	pyrola
Ranunculaceae	Actaea L.	baneberry
	Actaea rubra (Ait.) Willd.	red baneberry
	Anemone quinquefolia var. bifolia Farw.	twoleaf anemone
	Aquilegia canadensis L.	red columbine
	Caltha palustris L.	yellow marshmarigold
	Coptis trifolia ssp. groenlandica (Oeder) Hulten	threeleaf goldthread
	Hepatica nobilis var. obtusa (Pursh) Steyermark	roundlobed hepatica
	Thalictrum dasycarpum Fisch. & Ave-Lall.	purple meadowrue
Rhamnaceae	Rhamnus alnifolia L'Her.	alderleaf buckthorn
Rosaceae	Agrimonia L.	agrimony
	Amelanchier Medik.	serviceberry
	Amelanchier sanguinea (Pursh) DC.	roundleaf serviceberry
	Aronia melanocarpa (Michx.) Ell.	black chokeberry
	Comarum palustre L.	purple marshlocks
Rosaceae	Crataegus chrysocarpa Ashe	fireberry hawthorn
	Crataegus L.	hawthorn
	Fragaria L.	strawberry
	Fragaria vesca ssp. americana (Porter) Staudt	woodland strawberry
	Fragaria virginiana Duchesne	Virginia strawberry
	Geum aleppicum Jacq.	yellow avens
	Geum macrophyllum var. perincisum (Rydb.) Raup	largeleaf avens
	Geum rivale L.	purple avens
	Potentilla norvegica L.	Norwegian cinquefoil
	Prunus pensylvanica L. f.	pin cherry
	Prunus pumila L.	sand cherry
	Prunus virginiana L.	common chokecherry
	Rosa acicularis ssp. sayi (Schwein.) W.H. Lewis	prickly rose
	Rubus arcticus ssp. acaulis (Michx.) Focke	dwarf raspberry
	Rubus idaeus ssp. strigosus (Michx.) Focke	grayleaf red raspberry
	Rubus occidentalis L.	black raspberry

Family	Scientific Name	Common Name
	Rubus pubescens Raf.	dwarf red blackberry
	Sorbus americana Marsh.	American mountainash
	Sorbus decora (Sarg.) Schneid.	northern mountainash
	Sorbus L.	mountainash
	Spiraea alba Du Roi	white meadowsweet
Rubiaceae	Galium asprellum Michx.	rough bedstraw
	Galium boreale L.	northern bedstraw
	Galium L.	bedstraw
	Galium labradoricum (Wieg.) Wieg.	northern bog bedstraw
	Galium obtusum Bigelow	bluntleaf bedstraw
	Galium trifidum L.	threepetal bedstraw
	Galium triflorum Michx.	fragrant bedstraw
Salicaceae	Populus balsamifera L.	balsam poplar
	Populus grandidentata Michx.	bigtooth aspen
	Populus tremuloides Michx.	quaking aspen
	Salix bebbiana Sarg.	Bebb willow
	Salix candida Fluegge ex Willd.	sageleaf willow
	Salix discolor Muhl.	pussy willow
	Salix eriocephala Michx.	Missouri River willow
	Salix humilis Marsh.	prairie willow
	Salix L.	willow
	Salix pedicellaris var. pedicellaris	bog willow
	Salix petiolaris Sm.	meadow willow
	Salix planifolia Pursh	diamondleaf willow
	Salix pyrifolia Anderss.	balsam willow
	Salix serissima (Bailey) Fern.	autumn willow
Santalaceae	Comandra umbellata (L.) Nutt.	bastard toadflax
Sarraceniaceae	Sarracenia purpurea L.	purple pitcherplant
Saxifragaceae	Heuchera richardsonii R. Br.	Richardson's alumroot
	Mitella nuda L.	naked miterwort
	Saxifraga pensylvanica L.	eastern swamp saxifrage
Scheuchzeriaceae	Scheuchzeria palustris ssp. americana (Fern.) Hulten	American scheuchzeria
Scrophulariaceae	Melampyrum lineare Desr.	narrowleaf cowwheat
Selaginellaceae	Selaginella rupestris (L.) Spring	northern selaginella
Sparganiaceae	Sparganium eurycarpum Engelm. ex Gray	broadfruit burreed
	Sparganium fluctuans (Morong) B.L. Robins.	floating burreed
Sphagnaceae	Sphagnum capillifolium (Ehrh.) Hedw.	sphagnum
	Sphagnum centrale C. Jens. in Arnell & C. Jens.	sphagnum
	Sphagnum contortum Schultz	contorted sphagnum
	Sphagnum fimbriatum Wils. in Wils. & Hook. f. in Hook. f.	sphagnum
	Sphagnum fuscum (Schimp.) Klinggr.	sphagnum
	Sphagnum girgensohnii Russ.	Girgensohn's sphagnum
	Sphagnum L.	sphagnum
	Sphagnum magellanicum Brid.	Magellan's sphagnum
	Sphagnum nitidum Warnst.	sphagnum
	Sphagnum papillosum Lindb.	papillose sphagnum
	Sphagnum recurvum P. Beauv.	recurved sphagnum
	Sphagnum russowii Warnst.	Russow's sphagnum
	Sphagnum squarrosum Crome	sphagnum
	Sphagnum subsecundum Nees in Sturm	sphagnum
	Sphagnum tenerum Sull. & Lesq. in Sull. in Gray	sphagnum
	Sphagnum teres (Schimp.) Angstr. in Hartm.	sphagnum
Sphagnaceae	Sphagnum warnstorfii Russ.	Warnstorf's sphagnum
	Sphagnum wulfianum Girg.	Wulf's sphagnum
Thelypteridaceae	Phegopteris connectilis (Michx.) Watt	long beechfern
	Thelypteris palustris Schott	eastern marsh fern

Family	Scientific Name	Common Name
	Thelypteris Schmidel	maiden fern
Thuidiaceae	Thuidium delicatulum (Hedw.) Schimp. in B.S.G.	delicate thuidium moss
	Thuidium recognitum (Hedw.) Lindb.	thuidium moss
	Thuidium Schimp. in B.S.G.	thuidium moss
Tiliaceae	Tilia americana L.	American basswood
Typhaceae	Typha angustifolia L.	narrowleaf cattail
	Typha L.	cattail
	Typha latifolia L.	broadleaf cattail
	Typha X glauca Godr. (pro sp.)	white cattail
Ulmaceae	Ulmus americana L.	American elm
Urticaceae	Urtica dioica ssp. gracilis (Ait.) Seland.	California nettle
Violaceae	Viola adunca Sm.	hookedspur violet
	Viola L.	violet
	Viola novae-angliae House	New England blue violet
Violaceae	Viola pubescens Ait.	downy yellow violet
	Viola renifolia Gray	white violet
Vitaceae	Parthenocissus quinquefolia var. quinquefolia (L.) Planch.	Virginia creeper