



# National Park Service Vegetation Inventory Program

## *Grand Portage National Monument, Minnesota*

Natural Resource Report NPS/GLKN/NRR—2010/200



**ON THE COVER**

The Grand Portage crossing the Beaver Meadow, Grand Portage National Monument.  
Photograph by: Kevin Hop

---

# National Park Service Vegetation Inventory Program

## *Grand Portage National Monument, Minnesota*

Natural Resource Report NPS/GLKN/NRR—2010/200

Kevin Hop, Sara Lubinski, and Jennifer Dieck  
U.S. Geological Survey, Upper Midwest Environmental Sciences Center  
2630 Fanta Reed Road  
La Crosse, Wisconsin 54603

Shannon Menard, Ph.D. and Jim Drake  
NatureServe  
P.O. Box 9354  
St. Paul, Minnesota 55109

Don Faber-Langendoen  
NatureServe  
3467 Amber Road  
Syracuse, New York 13215



May 2010

U.S. Department of the Interior  
National Park Service  
Natural Resource Program Center  
Fort Collins, Colorado

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

---

The National Park Service, Natural Resource Program Center publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received formal peer review by subject-matter experts whose background and expertise put them on par technically and scientifically with the authors of the information. The peer review was conducted using the Fundamental Science Practices of the U.S. Geological Survey.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/NRPM/>).

Please cite this publication as:

Hop, K., S. Menard, J. Drake, S. Lubinski, D. Faber-Langendoen, and J. Dieck. 2010. National Park Service Vegetation Inventory Program: Grand Portage National Monument, Minnesota. Natural Resource Report NPS/GLKN/NRR—2010/200. National Park Service, Fort Collins, Colorado.

## Contents

Figures.....	v
Tables .....	vi
Executive Summary .....	vii
Acknowledgments.....	ix
Introduction.....	1
Grand Portage National Monument Vegetation Mapping Project .....	1
The National Park Service Vegetation Inventory Program.....	2
Natural Resource Inventory and Monitoring Program.....	2
Vegetation Inventory Program Standards .....	2
The National Vegetation Classification Standard .....	3
Content Standard for Digital Geospatial Metadata.....	4
Grand Portage National Monument .....	4
Location and Brief History .....	4
Landscape Setting.....	5
Project Overview .....	7
General Process.....	7
Scoping Meeting .....	7
Project Boundary Extent .....	8
Aerial Photography .....	9
Minimum Mapping Units.....	10
Classification Organization.....	10
Vegetation Classification .....	13
Methods.....	13
Preliminary Classification .....	13
Data Collection Preparation.....	13
Field Sampling.....	14
Data Analyses and Results .....	16
Discussion .....	19
Lakeshore Unit .....	19
Portage Corridor .....	20
Fort Charlotte Unit.....	21
Vegetation Mapping.....	23
Methods.....	23
Preliminary Map Classification .....	23
Field Reconnaissance .....	23
Map Classification.....	24
Photointerpretation .....	26
Digital Map Automation and Database Development.....	27
Results .....	28
Map Classes .....	28
Map Classes in the NVCS .....	28
Map Classes Not in the NVCS .....	29

Map Classification Link to Types in the NVCS.....	29
Map Classification Descriptions.....	34
Summary Report of the Map Layer.....	34
Brief Analysis and Discussion .....	38
Map Layer Presentation.....	38
Accuracy Assessment .....	41
Methods.....	41
Purpose .....	41
Sampling Design.....	41
Field Data Collection.....	42
Data Analyses .....	42
Results .....	44
References.....	47

### **List of Appendices**

- Appendix A: Plot Sampling Form
- Appendix B: Descriptions of Vegetation Types
- Appendix C: Field Key to Vegetation Types
- Appendix D: List of Plant Species
- Appendix E: Descriptions of Map Classes
- Appendix F: Accuracy Assessment Form
- Appendix G: Accuracy Assessment Contingency Table

## Figures

<b>Figure 1.</b> Grand Portage National Monument, Minnesota (courtesy nps.gov).....	5
<b>Figure 2.</b> Stockade and Great Hall at the Grand Portage National Monument.....	5
<b>Figure 3.</b> Monument at the Site of Fort Charlotte at the Grand Portage National Monument. ....	5
<b>Figure 4.</b> Aspen-birch-spruce-fir forest, which is the matrix forest of the Grand Portage National Monument. ....	6
<b>Figure 5.</b> Relic eastern white pine along the shores of the Pigeon River at the Grand Portage National Monument. ....	6
<b>Figure 6.</b> Northern white-cedar forest near the Site of Fort Charlotte at the Grand Portage National Monument. ....	6
<b>Figure 7.</b> Basalt outcrops on Mount Rose, overlooking Lake Superior at the Grand Portage National Monument. ....	6
<b>Figure 8.</b> Participants of the scoping meeting viewing, firsthand, vegetation types at the Grand Portage National Monument. ....	8
<b>Figure 9.</b> Project boundary for the Grand Portage National Monument vegetation mapping project. ....	8
<b>Figure 10.</b> Centers of color-infrared aerial photographs (1:12,000-scale) obtained in October 2006 for the Grand Portage National Monument vegetation mapping project.....	10
<b>Figure 11.</b> Example of a vegetation plot for the Grand Portage National Monument vegetation mapping project. ....	15
<b>Figure 12.</b> Locations of the 23 vegetation plots sampled for the Grand Portage National Monument vegetation mapping project. ....	16
<b>Figure 13.</b> General vegetation groups as defined by cluster and ordination analyses for the vegetation classification of the Grand Portage National Monument. ....	17
<b>Figure 14.</b> Shrub wetland of Grand Portage Creek with black hawthorn, gray alder, and willows. ....	19
<b>Figure 15.</b> A typical spruce-fir-aspen-paper birch mesic boreal forest in the Grand Portage National Monument. ....	20
<b>Figure 16.</b> Sedge-dominated beaver meadow complex, known as the Beaver Meadow, at the Grand Portage National Monument. ....	21
<b>Figure 17.</b> Narrow band of arrowhead vegetation along the water margins of the Pigeon River at the Grand Portage National Monument. ....	22
<b>Figure 18.</b> Field reconnaissance to promote correct assignment during photointerpretative mapping of the Grand Portage National Monument. ....	24
<b>Figure 19.</b> Vegetation of the Grand Portage National Monument, presented at the natural/semi-natural group and the cultural class levels of the National Vegetation Classification Standard (Version 2). ....	40
<b>Figure 20.</b> Locations of accuracy assessment sites used to validate the vegetation map layer for the Grand Portage National Monument. ....	43

## Tables

<b>Table 1.</b> Timeline of the vegetation mapping initiative for the Great Lakes Network. ....	1
<b>Table 2.</b> Hierarchy for natural/semi-natural vegetation (with examples) in the National Vegetation Classification Standard (Version 2). ....	3
<b>Table 3.</b> Hierarchy for cultural vegetation (with examples) in the National Vegetation Classification Standard. ....	4
<b>Table 4.</b> Aerial photography sets for the Grand Portage National Monument vegetation mapping project. ....	9
<b>Table 5.</b> Plot sizes used for vegetation plot sampling for the Grand Portage National Monument vegetation mapping project. ....	14
<b>Table 6.</b> Cover classes and vegetation strata used during vegetation plot sampling for the Grand Portage National Monument vegetation mapping project. ....	15
<b>Table 7.</b> List of vegetation communities of Grand Portage National Monument, with number of field observations. ....	18
<b>Table 8.</b> Physiognomic modifiers assigned to polygons during photointerpretation for the Grand Portage National Monument vegetation mapping project. ....	26
<b>Table 9.</b> White pine density and stratum modifiers assigned to polygons during photointerpretation for the Grand Portage National Monument vegetation mapping project. ....	26
<b>Table 10.</b> Map-class distribution within the National Vegetation Classification Standard for the Grand Portage National Monument vegetation mapping project. ....	28
<b>Table 11.</b> Map classification with crosswalk to the National Vegetation Classification Standard (Version 2) for the Grand Portage National Monument vegetation mapping project. ....	30
<b>Table 12.</b> Frequencies and areas of map classes (organized via the National Vegetation Classification Standard) represented in the vegetation map layer for the Grand Portage National Monument vegetation mapping project. ....	35
<b>Table 13.</b> Frequencies and areas of map classes (compiled at the group level in the National Vegetation Classification Standard) represented in the vegetation map layer for the Grand Portage National Monument vegetation mapping project. ....	37

## Executive Summary

The National Park Service (NPS) Vegetation Inventory Program (VIP) is an effort to classify, describe, and map existing vegetation of national park units for the NPS Natural Resource Inventory and Monitoring Program. The NPS VIP is managed by the NPS Biological Resources Management Division and provides baseline vegetation information to the NPS Natural Resource Inventory and Monitoring Program. The U.S. Geological Survey (USGS) Vegetation Characterization Program lends a cooperative role in the NPS VIP. Scientists at the USGS Upper Midwest Environmental Sciences Center, NatureServe, and NPS Grand Portage National Monument have completed vegetation classification and mapping of the Grand Portage National Monument (GRPO).

Photointerpreters, ecologists, and botanists collaborated to identify and describe vegetation types within the National Vegetation Classification Standard (NVCS) and to determine how best to map them by using aerial photographs. The team collected 23 vegetation sampling plots within the GRPO project extent. Furthermore, data from 147 accuracy assessment (AA) sites were collected (of which all were used to test accuracy of the vegetation map layer). These data sets led to the identification of 20 vegetation associations in the NVCS at the GRPO. Additional vegetation types are recognized at the group level in the NVCS.

A total of 35 map classes were developed to map the vegetation and general land cover of GRPO and environs, including the following: 31 map classes representing natural/semi-natural vegetation types at various levels in the NVCS, one map class representing cultural vegetation (e.g., developed) in the NVCS, and three map classes representing non-vegetated units (e.g., open water bodies). Features were interpreted by using high-quality stereoscopes over light tables and 1:12,000-scale, color-infrared aerial photographs dated October 2006 (during fall leaf change). Polygon units were mapped to a 0.25-ha minimum mapping unit. An ancillary set of 1:8,000-scale, true-color aerial photos dated May 2003 (during leaf-off conditions) covering the entire GRPO lands were used for additional reference during mapping. The interpreted data were digitally and spatially referenced, making the spatial database layers usable in a geographic information system.

A geodatabase containing various feature class layers and tables show the locations of vegetation types and general land cover (vegetation map), vegetation plot samples, AA sites, project boundary extent, and aerial photographic centers. The feature class layer for the GRPO vegetation map provides 423 polygons of detailed attribute data covering 291.8 ha, with an average polygon size of 0.7 ha. Of the area mapped, 413 polygons (97.6%) represent natural/semi-natural types in the NVCS, encompassing 279.2 ha (690 acres; 95.7%) of the total map extent.

Summary reports generated from the vegetation map layer indicate that forest types dominate the vegetation landscape (types from the NVCS), populating 93.7% of the polygons and covering 96.5% of the area, and are largely dominated by Spruce - Fir - Aspen Forest and Aspen - Birch / Boreal Conifer Forest associations. Although not common throughout the GRPO, the White-cedar - Boreal Conifer Mesic Forest association was mapped more frequently on the westward end. The White Pine / Mountain Maple Mesic Forest association was mapped intermittently throughout the GRPO. Some associations were mapped only to the Lake Superior area around

the village of Grand Portage, including Jack Pine / Balsam Fir Forest, Boreal Pine Rocky Woodland, and Boreal Hazelnut - Serviceberry Rocky Shrubland. Several other ruderal vegetation types growing in response to the human history of this area were also mapped. An herbaceous wetland association—Water Horsetail - Spikerush Marsh—was mapped only to the Pigeon River at the opposite end of the GRPO.

A thematic AA study was conducted of map classes representing floristic types within the NVCS. Results present an overall accuracy of 91.8% (Kappa index of 90.7%) based on data from 147 AA sites. Most individual map-class themes exceed the NPS VIP standard of 80%, with a 90% confidence interval.

The GRPO vegetation mapping project delivers many geospatial and vegetation data products in hardcopy and digital formats. These products consist of an in-depth project report discussing methods and results, which include descriptions and a dichotomous key to vegetation types, map classification and map class descriptions, and a contingency table showing AA results. They also include ground photos of vegetation types; a database of vegetation plots and AA sites; field data sheets; aerial photographic prints and images; hardcopy maps; and a geodatabase of vegetation types (map layer), fieldwork locations (vegetation plots and AA sites), aerial photographic indexes, and a project boundary. All geospatial products are projected in Universal Transverse Mercator, Zone 16, using the North American Datum of 1983. More NPS VIP information and products of completed park mapping projects are on the Internet at <http://biology.usgs.gov/npsveg/>.

## Acknowledgments

The success of this complex project was dependent on the collaborative efforts of several individuals from various organizations. The dedicated folks who worked on this project collectively have a wide array of skills and expertise, essential in moving the National Park Service (NPS) Grand Portage National Monument (GRPO) vegetation mapping project to its completion. We wish to acknowledge those individuals who have been essential in making this project a success.

We respectfully thank the NPS Vegetation Inventory Program (VIP) and the U.S. Geological Survey (USGS) Vegetation Characterization Program (VCP) staff for entrusting this project to us, including Karl Brown (NPS VIP Coordinator) for funding the GRPO vegetation mapping project, Mike Mulligan (USGS VCP Coordinator) for providing additional funding support for the vegetation mapping effort, and Chris Lea and Tammy Cook (NPS VIP) for giving us guidance when we needed it.

We also thank Bill Route and Ulf Gafvert of the NPS Great Lakes Network for supporting and coordinating a cluster approach to classify and map the remaining six national park units within the network. Further thanks are given to Ulf for managing the acquisition of fall, color-infrared aerial photography for the project.

Thanks are also in order to the NPS GRPO staff—particularly Brandon Seitz and David Cooper—for hosting this project with meetings and subsequent field efforts. The staff provided the project with valuable local knowledge of the GRPO landscape, as well as insight into local management and research needs. We also appreciate the use of a set of spring, leaf-off, true-color aerial photographs belonging to GRPO; these greatly assisted us in our mapping.

We also acknowledge and thank those who put forth their effort in classification and data collection, which formed the basis of so much of this project. We give thanks to Chel Anderson of the Minnesota Department of Natural Resources who provided us a state perspective on plant communities, consulted with us during our mapping field reconnaissance, and provided us some plant identification from our various fieldwork efforts. We also recognize our lead ecologist, Janet Marr, and her loyal field assistant, Matt Smith, for vegetation-plot data collection. Furthermore, we are grateful to Brandon Seitz of GRPO for co-laboring with us in data collection at accuracy assessment sites.

We finally thank our colleagues from within our own offices—the USGS Upper Midwest Environmental Sciences Center and NatureServe. Of the USGS, we acknowledge Janis Ruhser for orthorectification and map automation, and JC Nelson and the student geographic information system lab for quality control of map automation. In addition we recognize JC's assistance with random site selection for AA, building the geodatabase, and writing the metadata. Of NatureServe, we acknowledge Mary Russo for getting classification data into and out of the central database with such ease and speed.

This project required the cooperation and assistance of many individuals. Their diligence in working on this multifarious project is highly regarded and appreciated because their labors went toward so many aspects of this project—from developing the vegetation classification to creating the spatial geodatabase.

## Introduction

### Grand Portage National Monument Vegetation Mapping Project

The Grand Portage National Monument (GRPO) vegetation mapping project is an initiative of the National Park Service (NPS) Vegetation Inventory Program (VIP), with cooperative support from the U.S. Geological Survey (USGS) Vegetation Characterization Program (VCP), to classify and map plant communities of GRPO. The goals of the project are to adequately describe and map plant communities of GRPO and to provide the NPS Natural Resource Inventory and Monitoring (I&M) Program, resource managers, and biological researchers with useful baseline vegetation information.

The GRPO vegetation mapping project is also part of a cluster approach to classify and map plant communities of the remaining park units within the Great Lakes Network (GLKN) of the I&M Program. A cluster approach provided an avenue for advancing consistency of the vegetation classification throughout the network as well as the mapping thereof. With Voyageurs National Park and Isle Royale National Park already completed (mid-1990s), six GLKN park units needing vegetation inventory remained, including Apostle Islands National Lakeshore, Grand Portage National Monument, Indiana Dunes National Lakeshore, Pictured Rocks National Lakeshore, Saint Croix National Scenic Riverway, and Sleeping Bear Dunes National Lakeshore. With this cluster of six park units, an approach was taken to classify and map the vegetation of these park units in a somewhat staggered timeline (Table 1), providing some opportunity to share results and experiences from park units of the same regional locale.

**Table 1.** Timeline of the vegetation mapping initiative for the Great Lakes Network.

[AA, Accuracy Assessment; Clsf, Classification; Mtg, Meeting; Veg, Vegetation]

National Park	2004	2005	2006	2007	2008	2009	2010	2011
Indiana Dunes National Lakeshore	Air Photos	Scope Mtg Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Product Updates		
Apostle Islands National Lakeshore	Air Photos	Scope Mtg Veg Plots	Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Wrap-up	
Pictured Rocks National Lakeshore		Air Photos	Scope Mtg Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Wrap-up	
Grand Portage National Monument			Air Photos	Scope Mtg Veg Plots	Mapping	Field AA AA Analysis	Wrap-up	
Sleeping Bear Dunes National Lakeshore				Scope Mtg Veg Plots Air Photos	Veg Clsf Mapping	Mapping Field AA	AA Analysis	Wrap-up
Saint Croix National Scenic Riverway		Air Photos	Scope Mtg Veg Plots	Veg Plots Veg Clsf Mapping	Veg Clsf Mapping	Mapping Field AA	Field AA AA Analysis	AA Analysis Wrap-up

We officially inaugurated the GRPO vegetation mapping project May 31–June1, 2006, with a scoping meeting wherein partners discussed project objectives, goals, and methods. Major collaborators at this meeting included staff from NPS VIP, NPS GLKN, NPS GRPO, NatureServe, and the USGS. Common to all NPS VIP projects, the three major components of the GRPO vegetation mapping project are (1) vegetation classification, (2) vegetation mapping,

and (3) map accuracy assessment. In this report, we discuss each of these fundamental components in detail.

### **The National Park Service Vegetation Inventory Program**

The NPS VIP is an effort to classify, describe, and map existing vegetation of national park units. Managed by the NPS Biological Resources Management Division, the NPS VIP provides baseline vegetation information for the NPS Natural Resource I&M Program. The USGS VCP lends a cooperative role in the NPS VIP. Vegetation layers and associated information support a wide variety of resource assessment, park management, and planning needs. They also provide structure for framing and answering critical scientific questions about vegetation communities and their relation to environmental processes across the landscape.

Program scientists developed procedures for classification, mapping, and accuracy assessment (The Nature Conservancy [TNC] and Environmental Systems Research Institute 1994a, 1994b, TNC et al. 1994, NatureServe 2004). Ecology and mapping teams worked together to share knowledge and data and to resolve issues regarding classification and mapping procedures. The NPS VIP products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata and meet national standards for spatial accuracy and data transfer. Mapping standards include a minimum mapping unit (MMU) of 0.5 ha (1.2 acres) and classification accuracy meeting or exceeding 80% (with a 90% confidence level) for map classes representing plant communities. All geospatial products are projected in Universal Transverse Mercator (UTM) and use the North American Datum of 1983 (NAD83).

The NPS VIP provides an array of data products. Spatial products include aerial photographs; spatial databases of vegetation, including metadata; map classification description or key; hard-copy maps of vegetation; and accuracy assessment of the vegetation map. Vegetation products include vegetation classification, dichotomous field key to the vegetation classes, formal descriptions and ground photos of the vegetation types, and field data in database format. More NPS VIP information and products of completed park mapping projects are on the Internet at <http://science.nature.nps.gov/im/inventory/veg/> and <http://biology.usgs.gov/npsveg/>.

### **Natural Resource Inventory and Monitoring Program**

The NPS Natural Resource I&M Program is a long-term effort to acquire information needed to help maintain ecosystem integrity for all NPS units with significant natural resources. One of the long-term goals of the I&M Program is to produce baseline inventories of basic biological and geophysical natural resources. The NPS VIP provides detailed vegetation maps based on aerial photographs and meets specified thematic accuracy standards (80%) set by the I&M Program. In producing vegetation maps, the NPS VIP also provides a listing of plant species derived from its mapping projects, contributing yet another baseline inventory product for the I&M Program. More information on the I&M Program is on the Internet at <http://science.nature.nps.gov/im/index.cfm>.

### **Vegetation Inventory Program Standards**

The NPS VIP uses nationally defined standards, some of which are maintained by the FGDC. These include the following:

- National Vegetation Classification Standard (FGDC 2008),
- Content Standard for Digital Geospatial Metadata (FGDC 1998a),
- Spatial Data Transfer Standard (FGDC 1998b),
- United States National Map Accuracy Standards (U.S. Geological Survey 1999), and
- Integrated Taxonomic Information System (U.S. Department of Agriculture).

Descriptions and links to websites for these standards can be accessed at <http://biology.usgs.gov/npsveg/standards.html>.

**The National Vegetation Classification Standard**

In 1997, the FGDC adopted the Vegetation Classification Standard: FGDC-STD-005-1997 (FGDC 1997). Since then, the FGDC Vegetation Subcommittee has derived a major revision, which is the National Vegetation Classification Standard (NVCS), Version 2: FGDC-STD-005-2008 (Version 2) (FGDC 2008). This revision was an effort to foster a cohesive view between federal agencies in their approach to classifying vegetation, thus reducing duplicative efforts among multiple agencies. Version 2 replaced the original and addressed several issues known with the first version and includes a substantial reorganization to the classification hierarchical structure. The purpose of the classification standard is to promote consistent classification of vegetation resources across regions. The use of a national standard aids effective resource stewardship by augmenting compatibility and widespread use of the information throughout the NPS and other Federal and State agencies.

The NVCS classifies existing vegetation. In brief, the classification is separated into two overriding categories, including natural vegetation (including semi-natural) and cultural vegetation. From there, each category is further divided into three main sections, including the following: (1) Upper (where physiognomy plays a predominant role), (2) Middle (where both floristics and physiognomy play a significant role), and (3) Lower, where Floristics plays a predominant role. Within each section, additional levels are subset. Separate hierarchies are developed for cultural and natural vegetation types. Definitions to these various Levels are detailed within Section 2 of the NVCS (FGDC 2008). Tables 2 and 3 show hierarchical structures for both natural and cultural vegetation.

**Table 2.** Hierarchy for natural/semi-natural vegetation (with examples) in the National Vegetation Classification Standard (Version 2).

Level	Example
<b>Upper:</b> Physiognomy plays a predominant role.	
Formation Class	Forest & Woodland Class (1.)
Formation Subclass	Temperate Forest (1.C.)
Formation	Temperate Flooded & Swamp Forest (1.C.3.)
<b>Middle:</b> Both floristics and physiognomy play a significant role.	
Division	Northeastern & Central North American Flooded & Swamp Forest (1.C.3.a.)
Macrogroup	Northern & Central Swamp Forest (MG030.)
Group	Northern & Central Alkaline Conifer & Hardwood Swamp (G046.)
<b>Lower:</b> Floristics plays a predominant role.	
Alliance	<i>Fraxinus nigra</i> - <i>Acer rubrum</i> Saturated Forest (A.347)
Association	<i>Fraxinus nigra</i> -Mixed Hardwoods-Conifers / <i>Cornus sericea</i> / <i>Carex</i> spp. Forest (CEGL002105)

**Table 3.** Hierarchy for cultural vegetation (with examples) in the National Vegetation Classification Standard.

Level	Example
<b>Upper:</b> Physiognomy plays a predominant role.	
Cultural Class	Agricultural Vegetation
Cultural Subclass	Herbaceous Agricultural Vegetation
Cultural Formation	Pasture / Hay
Cultural Subformation	Permanent Pasture & Hayland
<b>Middle:</b> Both floristics and physiognomy play a significant role.	
Cultural Group <i>[optional]</i>	Temperate and Tropical Permanent Pasture & Hayland
Cultural Subgroup	Grass
<b>Lower:</b> Floristics plays a predominant role.	
Cultural Type	Co-dominance of tall fescue & perennial ryegrass
Cultural Subtype <i>[optional]</i>	

### **Content Standard for Digital Geospatial Metadata**

Metadata are data that describe the content, quality, condition, and other characteristics of other data. As a standard product, the NPS VIP employs FGDC-compliant metadata files for each spatial data set it produces. In 1998, the FGDC approved the Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998 (FGDC 1998a). This metadata standard uses a common set of terminology and definitions to document digital geospatial data. For spatial data sets involving biological components, the NPS VIP uses the FGDC-endorsed Biological Data Profile (a profile is a set of information specific to a discipline, in this instance the biological sciences discipline), which is a biological metadata standard developed by the National Biological Information Infrastructure. This is known as the Biological Data Profile of the Content Standard for Digital Geospatial Metadata, FGDC-STD-001.1-1999 (FGDC 1999).

## **Grand Portage National Monument**

### **Location and Brief History**

The GRPO (Figure 1) is located in northeast Minnesota in Cook County and near the Canada border. The Grand Portage (portage trail) stretches 13.7 km (8.5 miles) between the shores of Lake Superior and the Pigeon River, which borders Canada. The GRPO is located in an area of 287.3 ha (710 acres), with 91.5 m (300 feet) on each side of the majority of the portage trail. At each end of the portage trail are historic sites. At the village of Grand Portage, the Stockade and Great Hall nestles below Mount Rose on the shores of Lake Superior (Figure 2). Near the Pigeon River is the Site of Fort Charlotte (Figure 3). The Grand Portage bridges Lake Superior with the Pigeon River, which was an important fur trading venue most active during the late 18<sup>th</sup> century. The Grand Portage became the most direct route from the Great Lakes region to the Canadian interior lands, bypassing numerous waterfalls of the Pigeon River. The GRPO was authorized in 1958 by the U.S. Congress to preserve and interpret fur trade and Ojibwe history and culture of the 18<sup>th</sup> century.

National Park Service Vegetation Inventory Program  
Grand Portage National Monument



Figure 1. Grand Portage National Monument, Minnesota (courtesy nps.gov).

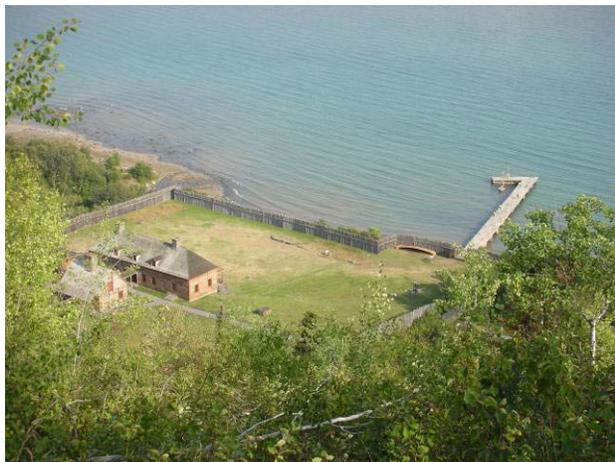


Figure 2. Stockade and Great Hall at the Grand Portage National Monument.



Figure 3. Monument at the Site of Fort Charlotte at the Grand Portage National Monument.

**Landscape Setting**

Significant to traders and voyageurs choosing the portage route, The Grand Portage treks its way through the landscape by avoiding several steep hills, some over 90-m high. According to Marschner (1974) and his study of Government Land Office Survey records of Minnesota (interpretation of Public Land Survey bearing tree data), the forests of the region during the late 19th century were primarily of eastern white pine (*Pinus strobus*), mixed with red pine (*Pinus resinosa*) on the western half of the portage (toward the Pigeon River), and aspens (*Populus* spp.), paper birch (*Betula papyrifera*), and conifers—most commonly white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*)—on the eastern half (toward Lake Superior). Then, at the turn of the century, logging events, white pine blister rust, and fire suppression significantly reduced the pine population throughout the landscape, and a major shift toward aspen-birch-spruce-fir forests flourished as the matrix forest throughout the entire area of GRPO (Figure 4), with relic white pine stands scattered throughout the western half (Figure 5). Northern white-

cedar (*Thuja plicata*) is more common on the western third of GRPO than on the eastern two-thirds (Figure 6). Nearer Lake Superior, the soil is thin and basalt bedrock manifests itself for only a brief distance inland from the lakeshore, just beyond (west of) U.S. Highway 61. Most known of the basalt formation at the GRPO is Mount Rose, which abruptly rises 105 m (345 feet) above the waters of Lake Superior (Figure 7).



**Figure 4.** Aspen-birch-spruce-fir forest, which is the matrix forest of the Grand Portage National Monument.



**Figure 5.** Relic eastern white pine along the shores of the Pigeon River at the Grand Portage National Monument.



**Figure 6.** Northern white-cedar forest near the Site of Fort Charlotte at the Grand Portage National Monument.



**Figure 7.** Basalt outcrops on Mount Rose, overlooking Lake Superior at the Grand Portage National Monument.

## Project Overview

### General Process

The three main components of the Grand Portage National Monument (GRPO) vegetation mapping project are as follows: (1) vegetation classification, (2) vegetation mapping, and (3) map accuracy assessment (AA). Our objectives were to identify and map existing vegetation communities of GRPO.

Color-infrared (CIR) aerial photographs of the study area were collected during fall 2006, providing aerial photos for fieldwork and mapping. True-color (TC) aerial photographs had also been collected during spring 2003 (before the inception of this project). The scoping meeting for the GRPO vegetation mapping project was held May 30–31, 2007, at Grand Portage, Minnesota. At this meeting, primary partners met to discuss and plan the vegetation mapping project.

During the summer of 2007, botanists collected vegetation samples for plant community characterization. We entered the sampling data into the National Park Service (NPS) PLOTS Database (NatureServe 2005) and performed analyses, which provided detailed ecological information to affirm plant communities at the GRPO and document them with local descriptors. The vegetation classification was later modified with additional field reconnaissance and data from AA sites.

Before mapping, we performed field reconnaissance during the summer of 2008 to correlate vegetation types to their appearances on aerial photographs. This resulted in the development of a map classification. An understanding of vegetation types is essential for mapping them. As vegetation concepts became known from either field or lab, we applied them to our photointerpretative mapping.

We completed a draft version of the vegetation map—a spatial database layer—for AA. During the summer of 2009, a field crew collected data of stratified and randomly selected sites for evaluating the accuracy of the vegetation map layer. Results were tabulated into a contingency matrix.

Ultimately, we developed a geodatabase containing four feature classes: vegetation points (containing vegetation sample points and AA sites), vegetation and land use polygons (showing locations of vegetation types and general land features), 1:12,000-scale CIR aerial photograph centers, and project boundary extent. Included in the geodatabase are several tables providing a suite of supporting information, from classification crosswalks to detailed sampling data. All geospatial products are projected in the Universal Transverse Mercator (UTM), Zone 16, using the North American Datum of 1983 (NAD83).

### Scoping Meeting

We officially launched the mapping project with a scoping meeting held at Grand Portage, Minnesota, on May 30–31, 2007. Various cooperators joined together to discuss the GRPO vegetation mapping project objectives and methods, receive assignments, and view firsthand the landscape and vegetation at the GRPO (Figure 8). Individuals from NPS GRPO, NPS GLKN, USGS Upper Midwest Environmental Sciences Center, and NatureServe met to achieve the following objectives:

## National Park Service Vegetation Inventory Program Grand Portage National Monument

- Inform the GRPO staff of the classification and mapping project,
- Learn about management and science issues and concerns at the GRPO,
- Learn about existing data,
- Explore possible cooperation with neighbors and partners,
- Develop an action plan for vegetation classification and mapping, and
- Define project boundary.



**Figure 8.** Participants of the scoping meeting viewing, firsthand, vegetation types at the Grand Portage National Monument.

### Project Boundary Extent

The GRPO vegetation mapping project boundary extent consists of the entire GRPO lands, plus 20 m into Lake Superior from the shoreline, and across the Pigeon River to its shoreline just into Canada (Figure 9). The total map extent is 291.8 ha, including all the GRPO lands and the small environs. The GRPO comprises 287.2 ha (98.5%) of the total map area, with the remaining 4.6 ha (1.5%) being environs. We produced a feature-class layer showing the extent of the project boundary and incorporated it into the GRPO vegetation mapping project geodatabase.



**Figure 9.** Project boundary for the Grand Portage National Monument vegetation mapping project.

## Aerial Photography

Aerial photographs provide the baseline imagery data for mapping plant communities and other feature units. Vertical photographs (photographs taken with the aerial camera pointed straight down at the ground) collected with proper overlapping within each flight line permit an interpreter to study the photographs three-dimensionally with a stereoscope (Avery 1978). Because ecologic settings are taken into account in mapping plant communities, the ability to view aerial photographs in this way is fundamental.

A variety of film emulsions are available from which to choose, and Avery (1978) concludes that no single film emulsion serves all purposes. Our aim with collecting aerial photography for the GRPO vegetation mapping project was to capture peak leaf-color change, aiding mapping in viewing distinctions between various deciduous forest types.

A set of CIR aerial photographs was collected on October 4, 2006. This photo mission was funded by the NPS VIP, and supervised by GLKN staff. This set of photography covered the entire GRPO vegetation mapping project extent at 1:12,000-scale and was the primary imagery used in photointerpretative mapping.

In support of mapping from the CIR photos, we used a set of TC aerial photographs (1:8,000-scale) that was collected May 2, 2003, providing deciduous leaf-off viewing of the entire extent. This photo mission was funded by GRPO and supervised by GLKN staff. Having the TC photos gave interpreters a definite advantage in determining evergreen tree and shrub components within forest communities otherwise obscured by deciduous tree canopy on the fall-season CIR photos, thus giving credence to Avery's statement regarding lack of a single all-purpose film emulsion.

To assure stereo viewing and full aerial coverage, aerial photo missions were planned with a 60% forward-lap and 30% side-lap. Contact prints of both CIR and TC photo sets were produced for fieldwork use by mappers and vegetation crews. Diapositives of the CIR photo set were produced for photointerpretative mapping.

Table 4 gives details to the aerial photography acquired for the GRPO vegetation mapping project.

**Table 4.** Aerial photography sets for the Grand Portage National Monument vegetation mapping project.

[CIR, color-infrared; TC, true-color; GRPO, Grand Portage National Monument]

Photography date	Film type	Scale	Photos	Products	Company
October 4, 2006	CIR Transparency (Positive)	1:12,000	67*	Contact Print Diapositive Orthophotograph	Pinnacle Mapping Technologies, Inc.
May 2, 2003	TC Transparency (Positive)	1:8,000	55*	Contact Print Orthophotograph	Great Lakes Aerial Survey, Inc. for Ayers Associates

\*The CIR and TC photography missions included an extended area surrounding GRPO. Twelve CIR aerial photographs, plus any necessary additional stereo pairs, and complementary TC photographs were used to map GRPO.

We produced a feature-class layer locating the centers of CIR aerial photographs (1:12,000-scale) obtained in October 2006 (Figure 10). This feature class is incorporated into the GRPO vegetation mapping project geodatabase. In addition, a digital orthophotographic mosaic of the CIR aerial photographs from October 2006 has been produced by the aerial photo contractor.



**Figure 10.** Centers of color-infrared aerial photographs (1:12,000-scale) obtained in October 2006 for the Grand Portage National Monument vegetation mapping project.

### Minimum Mapping Units

Because much of the GRPO boundary is narrow and linear in shape, we applied a minimum mapping unit (MMU) of 0.25 ha for mapping vegetation types and land features. This is half the size of a standard MMU in the NPS VIP. For vegetation types unique to their immediate surroundings (e.g., emergent wetland within an upland forest setting), we allowed for mapping down to half the MMU standard set for the GRPO vegetation mapping project<sup>1</sup>. In addition, we applied a secondary MMU standard of 1.0 ha for physiognomic feature changes within a particular map class (e.g., open versus closed forest). We used MMU templates to help us determine minimum polygon size on the photographs during mapping. Because of angle distortions inherent to nonrectified aerial photos, and slight scale changes from high ridges to valley bottoms, we applied our MMU standards liberally.

### Classification Organization

Throughout this project report and the final products related to the GRPO vegetation mapping project (e.g., the geodatabase), we have organized the vegetation classification with the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008). In the NVCS, separate

---

<sup>1</sup> Note that several polygons along the project boundary are smaller than the MMU standards for the GRPO vegetation mapping project because the vegetation map layer is clipped to the project boundary. We allowed clipped polygons as small as 0.05 ha along the project boundary.

categories are provided for natural and cultural vegetation. Typically, areas having 1% or more of their surface area covered with live vegetation are classified within the NVCS. The NVCS excludes non-vegetated natural lands (e.g., rock) and waters (e.g., lakes, rivers). For these, we employed classifications as provided by the 2001 National Land Cover Database (Homer et al. 2004).

Throughout this report, the term “vegetation type” is used to name vegetation classification units, in general, at any level of the hierarchy within the NVCS. For example, the Northern Hardwood - Hemlock - White Pine Forest Group and the *Alnus incana* Swamp Shrubland Association are both treated as vegetation types.



## Vegetation Classification

### Methods

#### *Preliminary Classification*

The first step in classifying the vegetation of Grand Portage National Monument (GRPO) was to prepare a preliminary classification report prior to the May 2007 scoping meeting. This report for the GRPO area was generated by reviewing all associations and alliances in the National Vegetation Classification Standard (NVCS) that are attributed to Minnesota or Ontario in the Great Lakes Ecoregion (ECO48). This list was derived by The Nature Conservancy (TNC), and covered a much broader area than the GRPO project area, included many types that were very unlikely to occur there. The initial list of possible associations and alliances was reviewed by NatureServe and GRPO staff to remove vegetation types thought unlikely to occur at the GRPO. The resulting, preliminary classification report included 49 associations and served as a rough guide to the number and kind of vegetation types the field crew might encounter during vegetation plot sampling and helped us to determine how much data field crews would need to collect to adequately survey the project area.

#### *Data Collection Preparation*

The protocols for the National Park Service (NPS) Vegetation Inventory Program (VIP) allowed for the collection of approximately three plots per estimated vegetation type (from the preliminary classification report), on average. The preliminary classification listed 49 possible associations in the project area. Several of those were similar to each other, though, and we expected only one or two of those to actually be present in the project area. For example, we suspected there would be sparsely vegetated cliffs and talus slopes in the project area. There were five sparsely vegetated cliff and talus slope associations listed in the preliminary classification. We did not know which of those would best fit the data we would gather from the project area, but we suspected that the data would best fit one, two, or, at most, three of those five. So, although we had five sparsely vegetated cliffs and talus slopes in the preliminary classification, we estimated that we would need only six plots to adequately characterize those areas. We did this kind of analysis for all associations in the preliminary classification and estimated there would be approximately 11 unique vegetation associations at the GRPO. Thus, our initial plan was to sample at least 33 plots.

Some vegetation types in the preliminary classification (e.g., wetlands Populus-dominated forests, rocky shrublands) were less well described or were expected to have variable composition from stand to stand, so we targeted 3–5 plots for them, whereas others (e.g., upland aspen forests, water-lily marshes) were well-described and/or compositionally simpler. For those, we only targeted 1–3 plots. We looked into using existing data to supplement our plots or reduce our data collection needs but did not find any suitable data.

The project boundary was essentially limited to the GRPO boundary. Thus, all vegetation sampling occurred on NPS-owned land. Our field team faced the problem of finding every vegetation type at the GRPO without knowing where they all were or even exactly what they all were. Our approach to this problem was to attempt to get the field team to all habitat types with the assumption this would allow the field crew to find as many different vegetation types as possible. The field crew had three primary resources to help with this, including the following: (1) aerial photographs (1:12,000-scale, color infrared) of the project area, (2) local NPS staff, and

(3) the field crew’s own knowledge of the project area gained from prior experience and reconnaissance during this project.

**Field Sampling**

Field sampling methodology was adapted from program standards (NatureServe 2004). Details are provided therein, with a general summary here.

Plots were placed to represent the character of an entire stand of vegetation as well as possible. Plots were usually located at least 15 m from the boundary of another vegetation type to reduce the variability associated with the transition from one vegetation type to another. This was not always possible in the case of small or linear vegetation stands. It was sometimes difficult to determine what constituted the boundary of a unique vegetation type because two adjacent stands may be floristically very similar but are separated based on physiognomic criteria (e.g., amount of shrub cover, which may be determined by one or two species) in the NVCS.

Plots were square or rectangular and were either 100 or 400 m<sup>2</sup>, depending on the dominant physiognomy (Table 5). Boundaries of the plots were marked with flagging or with measuring tapes.

**Table 5.** Plot sizes used for vegetation plot sampling for the Grand Portage National Monument vegetation mapping project.

<b>Dominant physiognomy</b>	<b>Plot size</b>	<b>Plot area</b>
<b>Forest:</b> trees have their crowns overlapping, usually forming 60-100% cover.	20 x 20 m or 40 x 10 m	400 m <sup>2</sup>
<b>Woodland:</b> open stands of trees with crowns usually not touching. Canopy tree cover 25-60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	20 x 20 m or 40 x 10 m	400 m <sup>2</sup>
<b>Shrubland:</b> shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m <sup>2</sup>
<b>Dwarf-shrubland</b> (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m <sup>2</sup>
<b>Herbaceous</b> (e.g., grassland, meadow, marsh): Herbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m <sup>2</sup>
<b>Nonvascular</b> (e.g., fen, bog, cliff): nonvascular cover dominant, usually forming more than 25% cover.	10 x 10 m or 20 x 5 m	100 m <sup>2</sup>
<b>Sparse vegetation</b> (e.g., blowout, beach): less than 10% total vegetation cover.	10 x 10 m or 20 x 5 m	100 m <sup>2</sup>

Within each plot, the vegetation was visually separated into strata. The canopy cover and average height of each stratum was estimated. Within each stratum, all taxa within the plot area were identified, and the foliar cover of each taxon was estimated by using cover classes. (See Table 6 for cover classes and strata.) The diameter at breast height (DBH) of trees greater than 10 cm was recorded as well.

National Park Service Vegetation Inventory Program  
 Grand Portage National Monument

**Table 6.** Cover classes and vegetation strata used during vegetation plot sampling for the Grand Portage National Monument vegetation mapping project.

Cover scales	Vegetation strata
T 0–1%	T1 Emergent Canopy
P >1–5%	T2 Main Canopy
1 >5–15%	T3 Subcanopy
2 >15–25%	S1 Tall Shrubs
3 >25–35%	S2 Short Shrubs
4 >35–45%	S3 Dwarf-shrubs
5 >45–55%	H Herbaceous (field layer, including tree seedlings)
6 >55–65%	A1 Floating-leaved aquatics
7 >65–75%	A2 Submerged-leaved aquatics
8 >75–85%	
9 >85–95%	
10 >95%	

Environmental information, such as slope, aspect, soil texture, and evidence of disturbance, were recorded. Locational information, including spatial coordinates, was obtained by using global positioning system (GPS), and written directions to the plot were provided. Digital photographs were taken of the plot to provide additional information and assist in classifying the plot. Finally, the field crew gave the plot a provisional classification name. Figure 11 shows an example of a vegetation plot. For an example of a plot form, see Appendix A: Plot Sampling Form.



**Figure 11.** Example of a vegetation plot for the Grand Portage National Monument vegetation mapping project.

## Data Analyses and Results

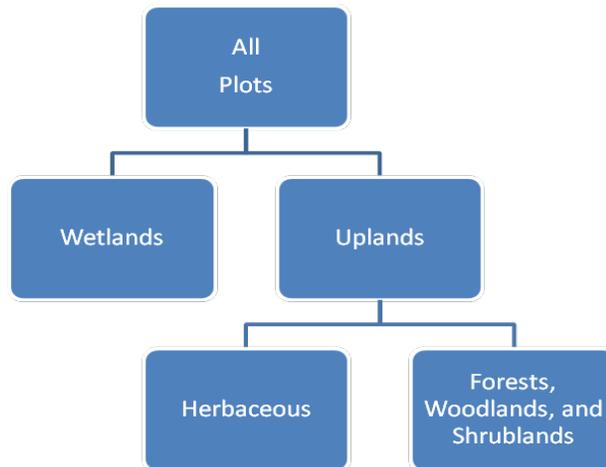
Field teams collected plot information in late August and early September 2007, sampling 22 plots. One additional plot was sampled in August 2009 during the accuracy assessment (AA) field effort. In total, 23 vegetation samples were collected for analysis. We did not create a sampling strategy before the field crew began work. With GRPO being a small-sized park unit and linear in shape, the field crew could view the majority of GRPO simply by traversing the length of it via the portage trail.

Plots were placed as the field crew encountered undersampled vegetation types along the length of GRPO (Figure 12). All field data were entered into the NPS PLOTS Database Version 2.0, a Microsoft Access database designed for the NPS VIP (NatureServe 2005). The plot data were then analyzed by using ordination (non-metric multidimensional scaling or NMS) and clustering techniques (Flexible Beta) with PC-Ord 5.0 (McCune and Mefford 1999).



**Figure 12.** Locations of the 23 vegetation plots sampled for the Grand Portage National Monument vegetation mapping project.

The limited number of plots collected at the GRPO presented some difficulties for our standard methods of analyses and classification. Our quantitative analytical strategy was to do iterative runs of the ordination and clustering analyses, removing groups of plots that were identified as most different from the rest in each run. We performed these standard analyses, and the initial groups reflected the distinction between wetlands and uplands (Figure 13). Subsequent groups were based on presence of significant woody canopy (forests, woodlands, and shrublands) versus herbaceous communities.



**Figure 13.** General vegetation groups as defined by cluster and ordination analyses for the vegetation classification of the Grand Portage National Monument.

The small number of vegetation plots limited the effectiveness of mere quantitative analyses, however, so we relied more heavily on qualitative classification methods. Our qualitative comparison of GRPO plots with existing vegetation associations in the NVCS was greatly aided by other NPS VIP classification and mapping projects at two nearby and ecologically similar park units. Both Voyageurs National Park and Isle Royale National Park have had vegetation-plot data collected and analyzed for VIP projects within the past 10 years. These two park units have a great deal of overlap in vegetation types with GRPO. This allowed us to compare the GRPO plot data with vegetation summaries derived from hundreds of plots within those two larger park units. After the plots were classified, we had some plots assigned to associations in the NVCS with somewhat limited confidence. Data collected from the AA field effort was used to solidify some of these less certain assignments. In addition, we received guidance in classification matters from a local regional ecologist with the Minnesota Department of Natural Resources.

Through the analyses of our summer 2007 sampling plots, we identified 15 plant communities (associations in the NVCS). During our summer 2008 field reconnaissance for the mapping effort and during our summer 2009 AA in the field, we discovered five additional plant communities that had not been characterized by the original plot data. Most of these communities were fairly well described from a regional perspective, so assigning them to vegetation associations was fairly straightforward, even without full vegetation plots. One community (discovered during the AA field effort) was not as well known—a sparsely vegetated talus of the northern toeslope of Mount Rose. Thus, a vegetation plot sample was collected of the site.

Three of the five plant communities were added from mapping field reconnaissance and consisted of two permanently flooded aquatic associations and one sparsely vegetated lakeshore association. The other two plant communities discovered during AA consisted of a well described (although unique to GRPO) jack pine-aspen forest and the sparsely vegetated talus, for which an additional vegetation plot was sampled.

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

---

In all, a total of 20 natural/semi-natural plant associations in the NVCS were identified for GRPO. Table 7 lists these associations and includes the number of times each was sampled with a vegetation plot or an AA site. It is worth noting there were over six times as many AA sites sampled as vegetation plots (147 versus 23), so most of the field observations were from AA sites. Data from AA sites provide information on distribution and dominant species, but they do not provide the detail of a full vegetation plot.

**Table 7.** List of vegetation communities of Grand Portage National Monument, with number of field observations.

[NVCS, National Vegetation Classification Standard; C EGL, Community Element Global]

Group	Association Name	NVCS Code	Observations
<b>Forest and Woodland</b>			
Northern Hardwood - Hemlock - White Pine Forest Group	White-cedar - Boreal Conifer Mesic Forest	CEGL002449	15
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	White Pine / Mountain Maple Mesic Forest	CEGL002445	14
Northern & Central Alkaline Conifer & Hardwood Swamp Group	Black Ash - Mixed Hardwood Swamp	CEGL002105	8
	Aspen - Balsam Poplar Lowland Forest	CEGL005036	10
Northern & Central Shrub Swamp Group	Gray Alder Swamp	CEGL002381	16
Jack Pine - Black Spruce Forest Group	Jack Pine - Aspen / Bush-honeysuckle Forest	CEGL002518	1
	Jack Pine / Balsam Fir Forest	CEGL002437	6
Jack Pine - Northern Pin Oak Rocky Woodland Group	Boreal Pine Rocky Woodland	CEGL002483	4
White Spruce - Balsam Fir Forest Group	Spruce - Fir - Aspen Forest	CEGL002475	36
	Spruce - Fir / Mountain Maple Forest	CEGL002446	11
	Aspen - Birch / Boreal Conifer Forest	CEGL002466	27
<b>Shrubland and Grassland</b>			
Eastern North American Boreal Shrubland Group	Boreal Hazelnut - Serviceberry Rocky Shrubland	CEGL005197	5
Eastern North American Freshwater Marsh Group	Water Horsetail - Spikerush Marsh	CEGL005258	3
Eastern North American Wet Meadow Group	Bluejoint Wet Meadow	CEGL005174	4
	Northern Sedge Wet Meadow	CEGL002257	5
<b>Aquatic Vegetation</b>			
Eastern North American Freshwater Aquatic Vegetation Group [Placeholder]	Northern Water-lily Aquatic Wetland	CEGL002562	0
	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	0
<b>Nonvascular and Sparse Vascular Rock Vegetation</b>			
Great Lakes Cliff & Shore Group [Placeholder]	Great Lakes Basalt - Diabase Cobble - Gravel Shore	CEGL005250	1
	Northern Non-Carbonate Dry Talus Vegetation	CEGL005247	2
	Northern Non-Carbonate Moist Talus Vegetation	CEGL002409	1

For types above the association level (e.g., group) in the NVCS, we relied on general observations via field and aerial photo study to determine classification placement. These types characterize anthropogenic or natural disturbance regimes (e.g., ruderal herbaceous field, dynamic beaver meadow).

All associations within the NVCS that we identified at the GRPO are described in Appendix B: Descriptions of Vegetation Types. A key to vegetation types is provided in Appendix C: Field Key to Vegetation Types, which can be used in concert with the vegetation descriptions. A listing of plant species identified from the vegetation plot samples and AA sites are provided in Appendix D: List of Plant Species.

## Discussion

The following are general observations regarding the vegetation of GRPO. We provide these general descriptions of vegetation at three locations at the GRPO, including the Lakeshore Unit, the Portage Corridor, and the Fort Charlotte Unit.

### **Lakeshore Unit**

The vegetation in and around the Lakeshore Unit is distinctive because of the Lake Superior shoreline and hills. Along the shore is found Great Lakes cobble beach. As the Grand Portage creek reaches Lake Superior, it widens and is terraced by speckled alder (*Alnus incana*), black hawthorn (*Crataegus douglasii*), and willow (*Salix* spp.) thickets (Figure 14). The Mount Rose Trail, which ascends 100 m, includes not only spectacular views of Lake Superior, but also forests consisting of white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), and jack pine (*Pinus banksiana*). Steep areas contain open talus slopes, both mesic and dry, depending on aspect, whereas somewhat more level, dry midslopes contain rocky shrublands and woodlands.



**Figure 14.** Shrub wetland of Grand Portage Creek with black hawthorn, gray alder, and willows.

### **Portage Corridor**

The Grand Portage makes its way through a gap in the hills north and west of Lake Superior. The gap was formed by more rapid weathering along bedrock that was shattered through movement along a crack named by geologists as the Grand Portage-Poplar Creek fault. The glacially-scoured, moderately level portage corridor contains rather shallow soils over bedrock. It courses through a matrix of mesic boreal forests dominated by quaking aspen (*Populus tremuloides*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), and paper birch (*Betula papyrifera*) (Figure 15). Less common are stands of northern white cedar (*Thuja occidentalis*), although they are more frequent to the western third of the portage corridor. Somewhat shallower mesic soils contain stands of eastern white pine (*Pinus strobus*), with occasional red pine (*Pinus resinosa*). Occurrences of jack pine (*Pinus banksiana*) are rare along the portage corridor. Together, the mesic forests contain understory shrubs of mountain maple (*Acer spicatum*), bush honeysuckle (*Diervilla lonicera*), alders (*Alnus incana*, *Alnus viridis*), and beaked hazel (*Corylus cornuta*). Common herbs include large-leaved aster (*Eurybia macrophylla*), wild sarsaparilla (*Aralia nudicaulis*), and bluebead (*Clintonia borealis*). Also, all the mesic forests show persistent effects of logging, lacking the typical range in tree sizes and ages for these forests, but natural processes, such as wind storms and fires, can restore these over time.



**Figure 15.** A typical spruce-fir-aspen-paper birch mesic boreal forest in the Grand Portage National Monument.

Lower flat, poorly drained areas contain lowland hardwood wet swamp forests and are dominated by balsam poplar (*Populus balsamifera*), black ash (*Fraxinus nigra*), quaking aspen (*Populus tremuloides*), and scattered conifers of northern white cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), and, rarely, black spruce (*Picea mariana*). The common shrub in

the understory is gray alder (*Alnus incana*). Depending on beaver activity within some of the small streams, open wet meadows and marshes may form. The larger, more prominent wet meadow is the extensive beaver meadow located midway between old U.S. Highway 61 and the Site of Fort Charlotte (Figure 16). Hairy sedge (*Carex lacustris*) dominates this herbaceous wet meadow along with other common species including harlequin blueflag (*Iris versicolor*), bluejoint (*Calamagrostis canadensis*), woolgrass (*Scirpus cyperinus*), upright sedge (*Carex stricta*), and cattail (*Typha* spp.).



**Figure 16.** Sedge-dominated beaver meadow complex, known as the Beaver Meadow, at the Grand Portage National Monument.

### **Fort Charlotte Unit**

The vegetation of GRPO changes once again along the Pigeon River near the Site of Fort Charlotte. This river is bordered by floodplain forests dominated by black ash (*Fraxinus nigra*), like the wet swamp forests more interior, but are here joined by green ash (*Fraxinus pennsylvanica*) and American elm (*Ulmus americana*), along with other boreal conifers and hardwoods. A thin band of herbaceous emergents, consisting mostly of sessilefruit arrowhead (*Sagittaria rigida*) and/or water horsetail (*Equisetum fluviatile*), with some single-vein sweetflag (*Acorus calamus*), dominate the water margins of the Pigeon River (Figure 17). In addition, the rocky landscape surrounding the campsite location contains a striking dry-mesic white pine-red pine (*Pinus strobus*-*Pinus resinosa*) forest with a very open understory dominated by rocky outcrops and blueberries (*Vaccinium angustifolium*, *V. myrtilloides*).



**Figure 17.** Narrow band of arrowhead vegetation along the water margins of the Pigeon River at the Grand Portage National Monument.

## Vegetation Mapping

### Methods

Mapping vegetation of Grand Portage National Monument (GRPO) involved four primary steps, including the following: (1) field reconnaissance, (2) map classification, (3) photointerpretation, and (4) digital map automation and database development. Although these steps occurred sequentially, they overlap to some degree.

### *Preliminary Map Classification*

Prior to field reconnaissance, it is advantageous for photointerpreters to become familiar with any known vegetation types to be mapped. Having a map classification in hand with initial mapping conventions, as preliminary as they might be, promotes continuity from the classifier to the mapper at the onset of the vegetation mapping process. As well, this preliminary step puts in the hands of the photointerpreters the foundations of a working map classification (one that will undoubtedly go through many updates and revisions throughout the vegetation mapping process).

The vegetation classification for GRPO had been developed via analyses of the vegetation sampling data collected the prior year. Thus, we met as classifiers and mappers in Redwing, Minnesota, during May 2008 to discuss the vegetation classification and how vegetation types might best be represented in a workable map classification. Pertinent details about the vegetation types that might aid in making interpretive decisions were assembled into mapping conventions.

### *Field Reconnaissance*

In preparation to map vegetation types, photointerpreters (with aerial photographs in hand) invested several days in the field investigating ground conditions. This process is necessary, as Hershey and Befort (1995) explain, because color-infrared (CIR) photography is not consistent enough between photo sets to allow a species or type to be described precisely. Film batch, printing process, sun angle, light intensity, shadow, and exposure can all affect the appearance of the contents of the photos. Hence, even as experienced photointerpreters, we engaged in formal ground verification of the aerial photographs. Ultimately, field reconnaissance helped us correlate photo signatures of the vegetation (appearances of vegetation on the aerial photographs) to vegetation on the ground. Field reconnaissance also allowed photointerpreters to become more familiar with the local ecology of plant communities, important when applying ecologic concepts to mapping.

Although the majority of field reconnaissance for mapping was conducted during the 2008 field season, a preliminary field visit to GRPO occurred during the 2007 field season to assist the vegetation sampling crew in locating some vegetation types. This effort was coupled with some mapping reconnaissance as a vanguard to the 2008 effort.

Much of the field reconnaissance effort was accomplished by using a team of mappers and ecologists to ensure correct assessment of vegetation types in the field and, subsequently, to promote correct assignment during photointerpretative mapping (Figure 18). We became familiar with the vegetation and local ecology as we discussed the structural, floristic, and habitat characteristics of the vegetation encountered in the field and compared them to their appearance

on the photos. Through this process, we built an understanding of how to map the vegetation types and established a working map classification with mapping protocols.



**Figure 18.** Field reconnaissance to promote correct assignment during photointerpretative mapping of the Grand Portage National Monument.

We took the photo contact prints into the field, recording notes onto photo jackets. These field notes included map-class assignment, if known, as well as noting significant species to promote proper perspective of species composition for photointerpretation (e.g., heterogeneous versus monotypic forest stand). In essence, we built a photo signature and environmental model to base our decisions on during photointerpretative mapping. In addition, estimated tree heights were occasionally recorded to give a perspective for applying the physiognomic height modifier during mapping.

### **Map Classification**

The map classification and protocols are based on existing classification systems. A map class represents a definable feature (e.g., a vegetation type) that can be distinguished on an aerial photograph and/or by use of an environmental model. We linked map classes representing natural/semi-natural plant communities to association in the National Vegetation Classification Standard (NVCS) as identified by NatureServe. Some vegetation types could not be assigned to an association because of disturbance (e.g., human or beaver). For those map classes, we assigned the appropriate type further up the hierarchy (e.g., group) within the NVCS. Cultural vegetation (e.g., roads, building grounds) are linked to the upper echelon of the NVCS and then further described with special modifiers by using the classification from the National Land Cover Database (NLCD) 2001 (Homer et al. 2004)<sup>2</sup>. For non-vegetated features (e.g., open water bodies), we derived map classes corresponding closely with the classification from NLCD 2001.

For those map classes representing associations in the NVCS, we used the synonym names as established in the classification database of NatureServe (e.g., Aspen - Birch / Boreal Conifer

---

<sup>2</sup> The NLCD 2001 is a land cover database produced by the Multi-Resolution Land Characterization 2001 Consortium.

Forest). For map classes with phases, we used the synonym names, followed by, and in parenthesis, the phase name we derived, such as White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase). We developed map-class phases when a variation of the plant community was recognizable on the aerial photographs and had importance for either management or ecologic interests. For map classes representing types above the floristic level in the NVCS and for non-vegetated features, we derived generic names.

We continually updated the map classification throughout the mapping effort. During the field reconnaissance, new information would be revealed, prompting us to modify map classes and their definitions. We also made revisions as the vegetation classification developed to completeness, as concepts were better understood. Furthermore, as aerial photos were interpreted, new issues arose, which forced us to redefine, expand, or polish map-class definitions. Even from the accuracy assessment, it was discovered that certain map classes originally thought to describe separate vegetation types were actually mere mapping phases of the same vegetation type. Throughout the project, we adjusted the map classification as needed to best reflect the vegetation classification we knew at the time.

We derived a map-class code for each map class merely for ease of assigning information to map polygons and as a short-hand language amongst team members. For each polygon, a map-attribute code is assigned, which is a code constructed of three sections, including the following: (1) a single map-class code, (2) a set of physiognomic modifier codes, and (3) a set of park-special, eastern white pine density and stratum codes<sup>3</sup>. A hyphen separates each section of the three-code systems (e.g., [map class code]-[set of physiognomic modifier codes]-[set of white pine density and stratum codes]).

A map-class code is made up of three alpha characters and represents an independent map class. Each vegetation map-class code begins with the first alpha representing the major physiognomic characteristic of the vegetation type, as follows:

- F = Forest,
- W = Woodland,
- S = Shrubland,
- H = Herbaceous Vegetation, and
- V = Sparse Vegetation.

For developed cultural vegetation and non-vegetated features, map class codes begin with an N. The subsequent two alpha characters for each map class loosely represent the map-class name (e.g., AS for alder swamp, WM for wet meadow, DV for developed).

The physiognomic modifier codes are strings of alpha and numeric characters and, when applicable, follow the map-class codes. These physiognomic modifiers provide additional information describing the physiognomic characteristics of the vegetation within each mapped polygon. Table 8 lists the physiognomic modifiers we used for mapping GRPO. Table 9 lists the white pine density and stratum modifiers.

---

<sup>3</sup> The eastern white pine density and stratum modifiers were added to support a white pine-regeneration strategy at the GRPO.

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

**Table 8.** Physiognomic modifiers assigned to polygons during photointerpretation for the Grand Portage National Monument vegetation mapping project.

Category	Modifier	Meaning
Coverage density (Applied to all vegetation map classes)	1	Closed Canopy/Continuous (60–100% cover)
	2	Open Canopy/Discontinuous (25–60% cover)
	3	Dispersed-Sparse Canopy (10–25% cover)
Coverage pattern (Applied to all vegetation map classes)	A	Evenly Dispersed
	B	Clumped/Bunched
	C	Gradational/Transitional
	D	Regularly Alternating
Height (Applied to woody terrestrial vegetation map classes only)	2	15–30 m
	3	5–15 m
	4	0.5–5 m

**Table 9.** White pine density and stratum modifiers assigned to polygons during photointerpretation for the Grand Portage National Monument vegetation mapping project.

Category	Modifier	Meaning
White Pine Density (Applied to map classes when any amount of white pine present)	S	Sparse (1–0% relative density)
	M	Moderate (10–25% relative density)
	D	Dense (25–100% relative density)
White Pine Stratum (Applied to map classes when any amount of white pine present)	1	Only Mature
	2	Both Mature & Mid-successional
	3	Only Mid-successional

An example of a map-attribute code is “FCM-1A3-M2.” This code describes given map polygons as the conifer - hardwood phase (FCM) of the White-cedar - Boreal Conifer Mesic Forest map class, which represents the *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449) in the NVCS. This code also indicates that the vegetation has a coverage density of 60–100%, a coverage pattern that is evenly distributed, and an average tree height of 5–15 m (16–50 ft) throughout the mapped polygon. Furthermore, the relative density of the white pine to other trees is 10–25%, with both mature and mid-successional white pine present. Presenting this series of map classification and physiognomic information can greatly enhance the interpretation of the map layer for managers and researchers, particularly when introducing other geospatial data sets.

### **Photointerpretation**

Preparation of the aerial photographs for interpretation generally followed procedures of Owens and Hop (1995). We placed clear acetate overlays on each aerial photograph diapositive used for mapping. Using the diapositive photos for photointerpretative mapping provided us with the highest resolution possible. The diapositive photos are also dimensionally stable and virtually not affected by temperature and humidity changes. The paper contact prints are less desirable because they are grainier, and the paper base can expand and contract slightly with changes in temperature and humidity.

We registered the mapping overlays to the CIR aerial photos (1:12,000-scale) from October 2006 by using the fiducials (standard reference points) and photo-identification information. The CIR

aerial photos were viewed for interpretation by using Richards MIM light tables and Bausch & Lomb Zoom 240 stereoscopes with variable zoom capabilities. Features within the entire project extent were mapped to a minimum mapping unit (MMU) of 0.25 ha between map classes and a MMU of 1.0 ha between physiognomic modifiers within a map-class unit. Exceptions for mapping below the MMU (to half of the MMU) were allowed for map-class units with vegetation unique to the immediate surroundings (e.g., herbaceous wetland within an upland forest)<sup>4</sup>. Interpreted data—map polygons and attributes—were applied to photo overlays covering the CIR photos. True-color aerial photos (1:8,000-scale) from May 2003 were viewed digitally on computer and/or using a Topcon (MS-3) mirror stereoscope with 3x binocular stereoscopes to aid the interpretation of the CIR photos.

We paired each diapositive photo with the adjacent photo (stereo pair) so we could view the images three-dimensionally. Features were delineated and scribed to their corresponding map-attribute codes onto the acetate overlays by using Rapidograph ink pens (4x0-size, 0.18 mm) and Rapidraw black India ink (3084; waterproof, fast drying for film). Standard photo signature characteristics were applied during the photointerpretation, including texture, color, pattern, and position in the landscape to guide placement of polygons. In addition to photo signature characteristics, understanding the environmental distribution of the vegetation types helped us not only identify types, but also to properly place polygon boundaries. For each polygon, the appropriate map-class code and physiognomic modifier codes (collectively, the map-attribute code) were applied to each map polygon unit.

#### ***Digital Map Automation and Database Development***

We converted the photointerpreted data into a format usable in a geographic information system (GIS) by employing three fundamental processes: (1) orthorectify, (2) digitize, and (3) develop the geodatabase. All digital map automation was projected in Universal Transverse Mercator (UTM) projection, Zone 16, using the North American Datum of 1983 (NAD83).

**Orthorectify:** We orthorectified the interpreted overlays by using OrthoMapper, a softcopy photogrammetric software for GIS. One function of OrthoMapper is to create orthorectified imagery from scanned and unrectified imagery (Image Processing Software, Inc. 2002). The software features a method of visual orientation involving a point-and-click operation that uses existing orthorectified horizontal and vertical base maps. Of primary importance to us, OrthoMapper also has the capability to orthorectify the photointerpreted overlays of each photograph based on the reference information provided.

**Digitize:** To produce a polygon vector layer for use in ArcGIS (Environmental Systems Research Institute [ESRI], Redlands, California), we converted each raster-based image mosaic of orthorectified overlays containing the photointerpreted data into a grid format by using ArcGIS. In ArcGIS, we used the ArcScan extension to trace the raster data and produce ESRI shapefiles. We digitally assigned map-attribute codes (both map-class codes and physiognomic modifier codes) to the polygons and checked the digital data against the photointerpreted overlays for line and attribute consistency. Ultimately, we merged the individual layers into a seamless layer.

**Geodatabase:** At this stage, the map layer has only map-attribute code assigned to each polygon. To assign meaningful information to each polygon (e.g., map-class names, physiognomic

---

<sup>4</sup> It should also be noted that we allowed polygons as low as 0.05 ha once clipped by the project boundary.

definitions, link to NVCS types), we produced a feature-class table, along with other supportive tables, and subsequently related them together via an ArcGIS Geodatabase. This geodatabase also links the map to other feature-class layers produced from this project, including vegetation sample plots, accuracy assessment (AA) sites, aerial photo locations, and the project boundary extent. A geodatabase provides access to a variety of interlocking data sets, is expandable, and equips resource managers and researchers with a powerful GIS tool.

## Results

### Map Classes

We developed 35 map classes (including map-class phases) to map GRPO. Of these 35 map classes, 31 represent natural/semi-natural vegetation types within the NVCS, one represents a cultural vegetation type (developed) within the NVCS, and three represent non-vegetated units (open water). Table 10 provides a breakdown of these map classes in regards to the finer levels of the NVCS: floristic (association), group, and macrogroup. The one unit not included in the NVCS is listed as well. Explanations to each are provided after the table.

**Table 10.** Map-class distribution within the National Vegetation Classification Standard for the Grand Portage National Monument vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database]

NVCS Classes	Map Class	Floristic	Group	Macrogroup
FOREST & WOODLAND	19	11	9	5
SHRUBLAND & GRASSLAND	7	4	4	3
AQUATIC VEGETATION	2	2	1	1
NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION	3	3	1	1
DEVELOPED VEGETATION CULTURAL	1	n/a	n/a	n/a
<b>NVCS Total</b>	<b>32</b>	<b>20</b>	<b>15</b>	<b>10</b>

Non-NVCS Units (NLCD 2001)	Map Class
Open Water	3
<b>Non-NVCS Total</b>	<b>3</b>
<b>Map Class Grand Total</b>	<b>35</b>

### Map Classes in the NVCS

Thirty-one map classes represent natural/semi-natural types in the NVCS and one represents a cultural type in the NVCS (developed area, which is modified into further detail using NLCD 2001 classes). Five map classes rest at the group level in the NVCS. Twenty-six map classes represent 20 association types in the NVCS, of which 10 of these classes are phases to four association types. The following is a breakdown of map classes and their relation to the NVCS, organized by NVCS class.

**Forest & Woodland:** Nineteen map classes represent 13 natural/semi-natural vegetation types. Two map classes rest at two group types, one being a ruderal forest group and the other being a plantation group. Seventeen map classes represent 11 association types; 10 of these map classes are phases within four of the associations.

Shrubland & Grassland: Seven map classes represent six natural/semi-natural vegetation types. Three map classes rest at two group types, two being ruderal and one being wet meadow. The remaining four map classes represent four associations.

Aquatic Vegetation: Two map classes represent two natural/semi-natural vegetation types, both being associations within the same group.

Nonvascular & Sparse Vascular Rock Vegetation: Three map classes represent three natural/semi-natural vegetation types, all three being associations within the same group.

Developed Vegetation Cultural: One map class—developed areas—represents a cultural vegetation type at the formation level. It was modified further by using the classification in the NLCD 2001.

***Map Classes Not in the NVCS***

Three map classes represent non-vegetation features not described in the NVCS. This unit correlates to the NLCD 2001 classification. We have categorized these map classes into the following group: Non-vegetated Water.

***Map Classification Link to Types in the NVCS***

Table 11 lists the map classes (map-class phases included) as they relate to the NVCS. It is organized first by class, then division, macrogroup, group, and finally floristic association. Map classes rest in the finest level of the NVCS possible.

**Table 11.** Map classification with crosswalk to the National Vegetation Classification Standard (Version 2) for the Grand Portage National Monument vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database]

Map-class Code	Map-class Name
<b>1. FOREST &amp; WOODLAND CLASS</b>	
1.C.2.a. Eastern North American Cool Temperate Forest Division	
MG014. Northern Hardwood & Conifer Forest Macrogroup	
G163. Northern Hardwood - Hemlock - White Pine Forest Group	
<i>Thuja occidentalis</i> / <i>Abies balsamea</i> - <i>Acer spicatum</i> Forest Association (CEGL002449)	
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	
<i>Pinus strobus</i> / <i>Acer spicatum</i> - <i>Corylus cornuta</i> Forest Association (CEGL002445)	
FWM	White Pine / Mountain Maple Mesic Forest (conifer mesic phase)
FWA	White Pine / Mountain Maple Mesic Forest (conifer - hardwood mesic phase)
FWD	White Pine / Mountain Maple Mesic Forest (dry-mesic phase)
MG013. Eastern North American Ruderal Forest & Plantation Macrogroup	
G030. Northern & Central Hardwood & Conifer Ruderal Forest Group	
FMX	Conifer - Hardwood Ruderal Forest
G032. Northern & Central Conifer & Hardwood Plantation Group	
FPE	Conifer Plantation
1.C.3.a. Northeastern & Central North American Flooded & Swamp Forest Division	
MG030. Northern & Central Swamp Forest Macrogroup	
G046. Northern & Central Alkaline Conifer & Hardwood Swamp Group	
<i>Fraxinus nigra</i> - Mixed Hardwoods - Conifers / <i>Cornus sericea</i> / <i>Carex</i> spp. Forest Association (CEGL002105)	
FBA	Black Ash - Mixed Hardwood Swamp (black ash phase)
FGA	Black Ash - Mixed Hardwood Swamp (green ash - elm phase)
<i>Populus tremuloides</i> - <i>Populus balsamifera</i> - Mixed Hardwoods Lowland Forest Association (CEGL005036)	
FAP	Aspen - Balsam Poplar Lowland Forest

---

**Map-class Code    Map-class Name**


---

MG160. Northern & Central Tall Shrub Wetland Macrogroup

G167. Northern & Central Shrub Swamp Group

*Alnus incana* Swamp Shrubland Association (CEGL002381)

SAS    Gray Alder Swamp Shrubland (classic alder phase)

SAH    Gray Alder Swamp Shrubland (hawthorn mix phase)

SAW    Gray Alder Swamp Shrubland (willow mix phase)

1.D.1.a. North American Lowland Boreal Forest Division

MG037. Eastern & Central North American Boreal Conifer & Hardwood Forest Macrogroup

G047. Jack Pine - Black Spruce Forest Group

*Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518)

FJM    Jack Pine - Aspen / Bush-honeysuckle Forest

*Pinus banksiana* / *Abies balsamea* Forest Association (CEGL002437)

FJF    Jack Pine / Balsam Fir Forest

G347. Jack Pine - Northern Pin Oak Rocky Woodland Group

*Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland Association (CEGL002483)

WPR    Boreal Pine Rocky Woodland

G048. White Spruce - Balsam Fir Forest Group

*Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475)

FCP    Spruce - Fir - Aspen Forest

*Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest Association (CEGL002446)

FSF    Spruce - Fir / Mountain Maple Forest

*Populus tremuloides* - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest Association (CEGL002466)

FAC    Aspen - Birch / Boreal Conifer Forest

## 2. SHRUBLAND & GRASSLAND CLASS

2.C.1.c. Eastern North American Grassland, Meadow & Shrubland Division

MG123. Eastern Ruderal Shrubland & Grassland Macrogroup

G059. Eastern Ruderal Shrubland & Grassland Group [Placeholder]

SDX    Deciduous Ruderal Shrubland

HMX    Ruderal Grassland

---

**Map-class Code    Map-class Name**


---

## 2.C.2.a. North American Boreal Grassland, Meadow &amp; Shrubland Division

## MG069. North American Boreal Shrubland &amp; Grassland Macrogroup

## G339. Eastern North American Boreal Shrubland &amp; Grassland Group

*Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland Association (CEGL005197)

SHS    Boreal Hazelnut - Serviceberry Rocky Shrubland

## 2.C.5.a. Eastern North America Freshwater Wet Meadow, Riparian &amp; Marsh Division

## MG069. Eastern &amp; North-Central North American Marsh &amp; Wet Meadow Macrogroup

## G125. Eastern North American Freshwater Marsh Group

*Equisetum fluviatile* - (*Eleocharis palustris*) Herbaceous Vegetation Association (CEGL005258)

HHS    Water Horsetail - Spikerush Marsh

## G112. Eastern North American Wet Meadow Group

HWM    Wet Meadow Mixed Herbaceous

*Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174)

HCC    Bluejoint Wet Meadow

*Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation Association (CEGL002257)

HSG    Northern Sedge Wet Meadow

**5. AQUATIC VEGETATION CLASS**

## 5.B.1.a. North American Freshwater Aquatic Vegetation Division

## MG108. Eastern North American Freshwater Aquatic Vegetation Macrogroup

## G114. Eastern North American Freshwater Aquatic Vegetation Group [Placeholder]

*Nymphaea odorata* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation Association (CEGL002562)

HFA    Northern Water-lily Aquatic Wetland

*Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282)

HSV    Midwest Pondweed Submerged Aquatic Wetland

---

**Map-class Code    Map-class Name**


---

**6. NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION CLASS**

6.B.2.a. Eastern North American Temperate Cliff, Scree &amp; Rock Vegetation Division

MG111. Eastern North American Cliff &amp; Rock Vegetation Macrogroup

G341. Great Lakes Cliff &amp; Shore Group [Placeholder]

Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation Association (CEGL005250)

VCB    Great Lakes Basalt - Diabase Cobble - Gravel Shore

Basalt - Diabase Northern Open Talus Sparse Vegetation Association (CEGL005247)

VDT    Northern Non-Carbonate Dry Talus Vegetation

Granite - Metamorphic Talus Northern Sparse Vegetation Association (CEGL002409)

VMT    Northern Non-Carbonate Moist Talus Vegetation

**8. DEVELOPED VEGETATION CULTURAL CLASS**

Herbaceous &amp; Woody Developed Vegetation Cultural Subclass (L2)

Other Developed Urban / Built Up Vegetation Formation (L3)

Developed Area (NLCD 2001; 21-24)

NDV    Developed Area

**NON-NVCS UNITS**

Non-Vegetated Water &amp; Land

Non-Vegetated Water

Open Water (NLCD 2001; 11)

NSR    Stream &amp; River

NWP    Open Water Pond

NWL    Open Water Lake

***Map Classification Descriptions***

We provide descriptions of map classes (and their phases) representing those vegetation types in the NVCS, as well as of non-vegetated units. These descriptions are provided in Appendix E: Descriptions of Map Classes. These descriptions point out the link between map classes and the types/units they represent. In addition, a succinct explanation is given of how map classes were employed during the AA analysis. Representative ground photos are provided as well.

***Summary Report of the Map Layer***

Table 12 provides a summary report of the spatial-data layer (map) of GRPO and summarizes frequency, area, and average polygon size for each map class (including phases). Table 13 provides a compilation of the map classes to the group level in the NVCS. The summary reports organize the map classes by hierarchy in the NVCS and represent all lands within the established project boundary extent, including the environs.

Following the tables are some general observations and inferences we made from a quick study of the summary reports. Although many more inferences can be made, these are provided as an example of how one might begin to analyze the map layer and garner information from it.

**Table 12.** Frequencies and areas of map classes (organized via the National Vegetation Classification Standard) represented in the vegetation map layer for the Grand Portage National Monument vegetation mapping project.

[Freq, Frequency; Ha, Hectare; Ave, Average; NVCS, National Vegetation Classification Standard]

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
<b>FOREST &amp; WOODLAND CLASS</b>						
<b>Northern Hardwood - Hemlock - White Pine Forest Group</b>						
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)	13	4.7	0.4	11.7	0.9
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)	19	14.7	0.8	36.3	1.9
<b>White Pine - Red Pine - Jack Pine - Oak Forest &amp; Woodland Group</b>						
FWM	White Pine / Mountain Maple Mesic Forest (conifer mesic phase)	6	2.7	0.4	6.6	1.1
FWA	White Pine / Mountain Maple Mesic Forest (conifer - hardwood mesic phase)	19	12.5	0.7	30.8	1.6
FWD	White Pine / Mountain Maple Mesic Forest (dry-mesic phase)	1	0.1	0.1	0.3	0.3
<b>Northern &amp; Central Hardwood &amp; Conifer Ruderal Forest Group</b>						
FMX	Conifer - Hardwood Ruderal Forest	1	0.2	0.2	0.4	0.4
<b>Northern &amp; Central Conifer &amp; Hardwood Plantation Group</b>						
FPE	Conifer Plantation	4	1.0	0.3	2.5	0.6
<b>Northern &amp; Central Alkaline Conifer &amp; Hardwood Swamp Group</b>						
FBA	Black Ash - Mixed Hardwood Swamp (black ash phase)	16	4.6	0.3	11.4	0.7
FGA	Black Ash - Mixed Hardwood Swamp (green ash - elm phase)	1	0.3	0.3	0.8	0.8
FAP	Aspen - Balsam Poplar Lowland Forest	40	18.3	0.5	45.1	1.1
<b>Northern &amp; Central Shrub Swamp Group</b>						
SAS	Gray Alder Swamp Shrubland (classic alder phase)	17	5.3	0.3	13.2	0.8
SAH	Gray Alder Swamp Shrubland (hawthorn mix phase)	2	1.1	0.6	2.8	1.4
SAW	Gray Alder Swamp Shrubland (willow mix phase)	1	0.2	0.2	0.5	0.5
<b>Jack Pine - Black Spruce Forest Group</b>						
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest	1	0.3	0.3	0.7	0.7
FJF	Jack Pine / Balsam Fir Forest	2	1.8	0.9	4.5	2.3
<b>Jack Pine - Northern Pin Oak Rocky Woodland Group</b>						
WPR	Boreal Pine Rocky Woodland	3	0.9	0.3	2.3	0.8
<b>White Spruce - Balsam Fir Forest Group</b>						
FCP	Spruce - Fir - Aspen Forest	97	76.7	0.8	189.6	2.0
FSF	Spruce - Fir / Mountain Maple Forest	38	17.0	0.4	42.1	1.1
FAC	Aspen - Birch / Boreal Conifer Forest	106	106.8	1.0	263.8	2.5

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
<b>SHRUBLAND &amp; GRASSLAND CLASS</b>						
<b>Eastern Ruderal Shrubland &amp; Grassland Group</b>						
SDX	Deciduous Ruderal Shrubland	2	0.4	0.2	1.0	0.5
HMX	Ruderal Grassland	2	1.9	1.0	4.7	2.3
<b>Eastern North American Boreal Shrubland &amp; Grassland Group</b>						
SHS	Boreal Hazelnut - Serviceberry Rocky Shrubland	3	0.7	0.2	1.7	0.6
<b>Eastern North American Freshwater Marsh Group</b>						
HHS	Water Horsetail - Spikerush Marsh	3	1.0	0.3	2.4	0.8
<b>Eastern North American Wet Meadow Group</b>						
HWM	Wet Meadow Mixed Herbaceous	1	0.3	0.3	0.7	0.7
HCC	Bluejoint Wet Meadow	3	0.6	0.2	1.6	0.5
HSG	Northern Sedge Wet Meadow	5	2.9	0.6	7.2	1.4
<b>AQUATIC VEGETATION CLASS</b>						
<b>Eastern North American Freshwater Aquatic Vegetation Group</b>						
HFA	Northern Water-lily Aquatic Wetland	2	0.5	0.3	1.3	0.6
HSV	Midwest Pondweed Submerged Aquatic Wetland	2	0.5	0.3	1.2	0.6
<b>NONVASCULAR &amp; SPARSE VASCULAR ROCK VEGETATION CLASS</b>						
<b>Great Lakes Cliff &amp; Shore Group</b>						
VCB	Great Lakes Basalt - Diabase Cobble - Gravel Shore	1	0.4	0.4	0.9	0.9
VDT	Northern Non-Carbonate Dry Talus Vegetation	1	0.1	0.1	0.3	0.3
VMT	Northern Non-Carbonate Moist Talus Vegetation	1	0.6	0.6	1.4	1.4
<b>DEVELOPED VEGETATION CULTURAL CLASS</b>						
<b>Developed Area</b>						
NDV	Developed Area	7	7.4	1.1	18.3	2.6
<b>NON-NVCS UNITS</b>						
<b>Open Water</b>						
NSR	Stream & River	1	2.8	2.8	6.9	6.9
NWP	Open Water Pond	1	0.5	0.5	1.1	1.1
NWL	Open Water Lake	1	2.0	2.0	4.8	4.8

**Table 13.** Frequencies and areas of map classes (compiled at the group level in the National Vegetation Classification Standard) represented in the vegetation map layer for the Grand Portage National Monument vegetation mapping project.

[Freq, Frequency; Ha, Hectare; Ave, Average; NVCS, National Vegetation Classification Standard]

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
<b>FOREST &amp; WOODLAND CLASS</b>		<b>387</b>	<b>269.4</b>	<b>0.7</b>	<b>665.7</b>	<b>1.7</b>
	Northern Hardwood - Hemlock - White Pine Forest Group	32	19.4	0.6	48.0	1.5
	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	26	15.3	0.6	37.8	1.5
	Northern & Central Hardwood & Conifer Ruderal Forest Group	1	0.2	0.2	0.4	0.4
	Northern & Central Conifer & Hardwood Plantation Group	4	1.0	0.3	2.5	0.6
	Northern & Central Alkaline Conifer & Hardwood Swamp Group	57	23.2	0.4	57.4	1.0
	Northern & Central Shrub Swamp Group	20	6.7	0.3	16.5	0.8
	Jack Pine - Black Spruce Forest Group	3	2.1	0.7	5.2	1.7
	Jack Pine - Northern Pin Oak Rocky Woodland Group	3	0.9	0.3	2.3	0.8
	White Spruce - Balsam Fir Forest Group	241	200.5	0.8	495.6	2.1
<b>SHRUBLAND &amp; GRASSLAND CLASS</b>		<b>19</b>	<b>7.8</b>	<b>0.4</b>	<b>19.2</b>	<b>1.0</b>
	Eastern Ruderal Shrubland & Grassland Group	4	2.3	0.6	5.7	1.4
	Eastern North American Boreal Shrubland & Grassland Group	3	0.7	0.2	1.7	0.6
	Eastern North American Freshwater Marsh Group	3	1.0	0.3	2.4	0.8
	Eastern North American Wet Meadow Group	9	3.8	0.4	9.5	1.1
<b>AQUATIC VEGETATION CLASS</b>		<b>4</b>	<b>1.0</b>	<b>0.3</b>	<b>2.5</b>	<b>0.6</b>
	Eastern North American Freshwater Aquatic Vegetation Group	4	1.0	0.3	2.5	0.6
<b>NONVASCULAR &amp; SPARSE VASCULAR ROCK VEGETATION CLASS</b>		<b>3</b>	<b>1.1</b>	<b>0.4</b>	<b>2.6</b>	<b>0.9</b>
	Great Lakes Cliff & Shore Group	3	1.1	0.4	2.6	0.9
	<b>NVCS Subtotal</b>	<b>413</b>	<b>279.2</b>	<b>0.7</b>	<b>690.0</b>	<b>1.7</b>
<b>DEVELOPED VEGETATION CULTURAL CLASS</b>						
	Developed Area	7	7.4	1.1	18.3	2.6
	<b>NVCS Cultural Subtotal</b>	<b>7</b>	<b>7.4</b>	<b>1.1</b>	<b>18.3</b>	<b>2.6</b>
<b>NON-NVCS UNITS</b>						
	Open Water	3	5.2	1.7	12.8	4.3
	<b>Non-NVCS Subtotal</b>	<b>3</b>	<b>5.2</b>	<b>1.7</b>	<b>12.8</b>	<b>4.3</b>
	<b>Grand Total</b>	<b>423</b>	<b>291.8</b>	<b>0.7</b>	<b>721.1</b>	<b>1.7</b>

### **Brief Analysis and Discussion**

Collectively, the GRPO spatial database layer is composed of 423 polygons covering 291.8 ha, with an average polygon size of 0.7 ha. Map classes representing natural/semi-natural types in the NVCS apply to 413 polygons (97.6% of all polygons, with an average polygon size of 0.7 ha) and cover 279.2 ha (95.7% of the entire area). The Forest & Woodland Class in the NVCS applies to the majority of polygons and area covered by types in the NVCS, with 387 polygons (93.7% of natural/semi-natural polygons, with an average polygon size of 0.7 ha) and covering 269.4 ha (96.5% of area covered by the NVCS).

The Forest & Woodland Class is largely dominated by the White Spruce - Balsam Fir Forest Group (G048), both in polygon frequency (241 polygons, with an average polygon size of 0.8 ha, or 62.3%) and in area (200.5 ha or 74.4%). This dominance by G048 is largely because of two matrix forest map classes, including the Spruce - Fir - Aspen Forest (FCP, with 97 polygons covering 76.7 ha) and the Aspen - Birch / Boreal Conifer Forest (FAC, with 106 polygons covering 106.8 ha). From this quick analysis, we begin to see that GRPO is largely covered by hardwood mesic boreal forests.

The average polygon size for all natural/semi-natural map classes in the NVCS tends to be smaller at the GRPO than at other national park units within the Great Lakes Network (GLKN). Every natural/semi-natural map class for GRPO has an average polygon size of 1.0 ha or less, with an overall average of 0.7 ha, whereas the overall average polygon size at the Apostle Islands National Lakeshore (also within the GLKN) is 3.7 ha (Hop et al. 2010). The standard MMU for GRPO is 0.25 ha, whereas the MMU for other national park units within the GLKN is 0.5 ha. The smaller polygon sizes at the GRPO are largely due to the narrow (<200-m wide) corridor surrounding The Grand Portage. This narrow corridor limits polygon sizes, as many would continue beyond the GRPO boundary.

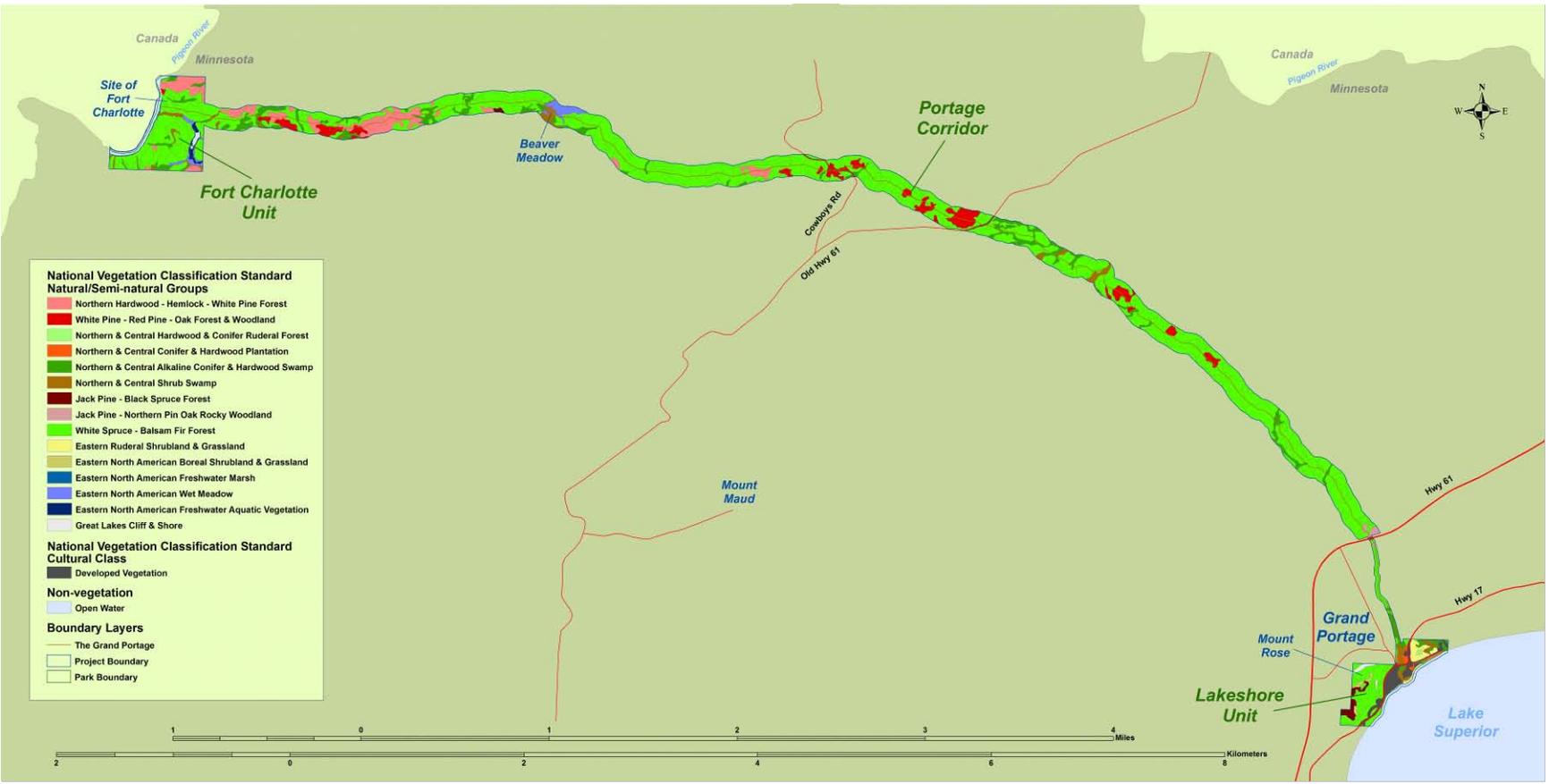
Cultural types in the NVCS and non-vegetated classes make up a nominal portion of the map layer, consisting of only 10 polygons (2.4% of all polygons) that cover just 12.6 ha (4.3% of the entire area). The sole map class capturing the cultural landscape is Developed Area (NDV), having 7 polygons covering 7.4 ha. The non-vegetated classes capture open water bodies of the Pigeon River, the deeper zone of a beaver pond in the Site of Fort Charlotte area, and Lake Superior.

Considerably more analyses and deductions can be attained even from these simple summary reports. Other summary tables can be derived from the map layer of localized areas (e.g., comparison of east and west sections of the portage trail) by clipping the map layer to its desired location and running new summaries. Also, more complex summary reports can be derived either from the map layer alone (e.g., employing physiognomic or park-special modifiers, such as coverage, pattern, height, white pine density, and stratum) or from introducing other spatial-data layers (e.g., invasive species, animal distribution, historical land use). By performing various exercises to the vegetation map layer, one can make further deductions regarding vegetation and its ecology.

### **Map Layer Presentation**

Figure 19 presents the map layer produced for the GRPO vegetation mapping project. The finest level of the map (the map-attribute codes consisting of map classes and physiognomic modifiers)

is too detailed to present; therefore, the map in Figure 19 is generalized, collapsing map classes at the group level within the NVCS. The light gray polygon boundaries are shown within to illustrate the finest level of the map.



**Figure 19.** Vegetation of the Grand Portage National Monument, presented at the natural/semi-natural group and the cultural class levels of the National Vegetation Classification Standard (Version 2).

## Accuracy Assessment

### Methods

#### *Purpose*

The objective of an accuracy assessment (AA) is to measure the probability that a particular location has been assigned its correct vegetation class. An AA estimates thematic errors in the data, giving users information needed to determine data suitability for a particular application. At the same time, data producers are able to learn more about the nature of errors in the data. Thus, the two views of an AA are “producers’ accuracy,” which is the probability that an AA point has been mapped correctly (also referred to as an error of omission), and “users’ accuracy,” which is the probability that the map actually represents what was found on the ground (also referred to as error of commission). Both producers’ and users’ accuracies can be obtained from the same set of data by using different analyses. Errors occur when map classes are not the same as the classes observed in the field. A major assumption of AA is that the process of mapping and the process of the assessment (e.g., the application of the classification system) are identical, so that a “false error” is not detected because of procedural differences. In actuality, the process of AA is based on field observance and the process of mapping is based on aerial photointerpretation with different perspectives of scale and observation.

#### *Sampling Design*

We used a stratified, random sampling approach to select AA sites. We included all primary map classes representing natural/semi-natural floristic vegetation types<sup>5</sup> in the National Vegetation Classification Standard (NVCS) as the individual themes to randomly select sites. Map-class phases were collapsed into the primary map class they belonged to. (Recall that a map-class phase is a version of a vegetation type recognizable in mapping and is important for either management or ecological interests.) The entire Grand Portage National Monument (GRPO) was included in the sampling design.

To determine the number of samples needed for each map class (theme), we divided the number of hectares for each map class by 1.67 and then rounded up to the nearest whole number. This formula, per guidance from National Park Service (NPS) Vegetation Inventory Program (VIP) staff, apportions sites per map class at near the same ratio as the standard scenarios (TNC et al. 1994) established for the Program; however, it improves the representation of map classes that are less common or rare (in area and frequency). If the resulting number was greater than 30, it was reduced to 30, and if less than five, it was increased to five or to the maximum number the map-class area could accommodate based on a minimum mapping unit (MMU)<sup>6</sup>.

---

<sup>5</sup> Map classes representing ruderal vegetation were classified at the group level in the NVCS and were not included in the AA sampling design (because of the inherent variability in vegetation), with one exception—the Wet Meadow Mixed Herbaceous (HWM) map class (which was classified as the Eastern North American Wet Meadow Group (G112) in the NVCS).

<sup>6</sup> The accuracy estimate associated with rare classes cannot be stated with the same level of confidence as with more abundant classes. For example, with a sample size of five, the level of error in the estimate is closer to 25% at a 90% confidence level, as opposed to 10% with a sample size of 27. This has implications for our ability to accept a given point estimate as meeting accuracy requirements. Whether or not a given accuracy estimate is accepted as one that meets accuracy requirements depends on the width of the confidence interval associated with the point estimate and the outcome of a hypothesis test that determines if a given point estimate is equivalent to or exceeds requirements.

We used the above guidelines in selecting the appropriate number of sites for each map class. For map classes receiving a MMU of 0.25ha, a 5-m buffer was applied interior to the polygon boundaries to promote global positioning system (GPS) navigation into the correct polygon. For map classes receiving a MMU of 0.10 ha, a 2-m buffer was applied. Random AA points (coordinates) were generated for each map class by using Hawth's Tools for ArcGIS (Beyer, H.L. 2004). The AA points were then assigned a random number used to identify each AA site location.

We equipped the field team with several tools to maximize their ability to accurately locate each AA site. We printed hard-copy maps showing locations of the AA sites, the unlabelled polygon boundaries of the vegetation map, the project boundary with the color-infrared aerial photomosaic displayed as a background. The AA site coordinates were uploaded into Trimble Recon units with Pathfinder XC GPS receivers, projected in Universal Transverse Mercator (UTM), Zone 16, using the North American Datum of 1983 (NAD83). ArcPad was used to display AA sites, polygon boundaries, the project boundary, and the aerial photomosaic to aid the field crew in correctly assessing an MMU area within the proper polygon in which an AA site was located.

### ***Field Data Collection***

Once the AA site was reached by using the tools described above, an area equal to MMU size was evaluated. Using ArcPad in the Trimble Recon GPS unit, one crew member would determine the MMU size within the polygon boundary, thus promoting assessment within the intended polygon. A field GPS coordinate was collected and recorded. Other crew members recorded AA data, including dominant species, environmental data, and pertinent comments. Then, using the field key, the appropriate vegetation type would be determined and recorded. If the area was not homogeneous (containing more than one vegetation type), the other appropriate vegetation types were also listed on the data sheet.

“Quick” assessments were performed at AA sites that were clearly typical of a particular vegetation type—common of matrix vegetation types where data collection becomes mere repetitive. For quick assessments, notation was recorded regarding the typical vegetation characteristics of the site. This allowed for an efficient field effort because the quick assessments did not include specific height and scale information regarding the strata and dominant species. For a sample data sheet, refer to Appendix F: Accuracy Assessment Form.

### ***Data Analyses***

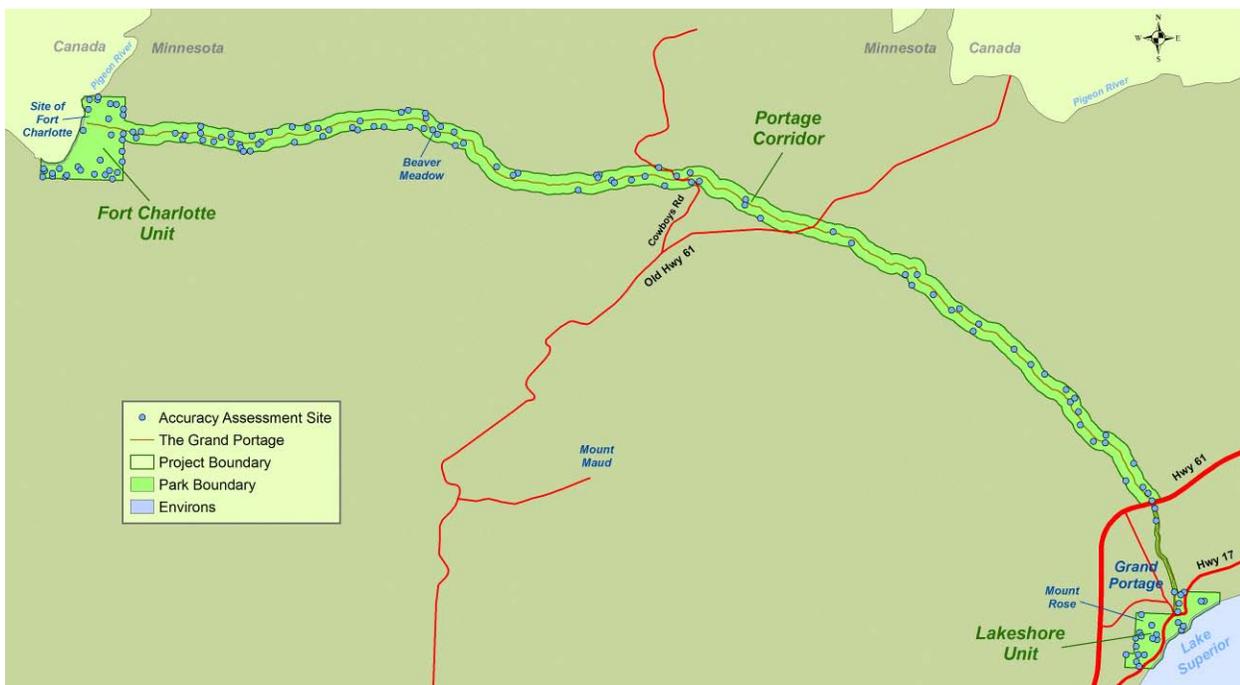
Field data for 147 AA sites were collected and entered into the NPS PLOTS Database Version 2 (TNC 2005b). The database was subsequently reviewed for data entry errors. The analyses of the map accuracy included the following steps:

- Initial comparative analysis of the field and map data,
- Review of all disagreements and correcting for false errors as necessary,
- Final comparative analysis of the field and map data,
- Individual map class analysis,
- Final output of results into a contingency matrix, and
- Final output of the analyses and results into a spatial database for use in GIS.

**Initial Comparative Analysis:** We completed a spatial join of the AA field-site data and the map polygon data. This allowed us to compare each AA field-site call (vegetation type) to the corresponding map-polygon call (map class representing vegetation type). We used Microsoft Excel 2007 (Microsoft Corporation) to compare and tabulate the field-site call to the map-polygon call. Our comparison accounted for alternate field-site calls indicated on the field data sheets, accepting map-polygon calls as correct when matching these alternate calls.

**Review of Disagreements:** All mismatches (disagreements) were subsequently reviewed for false errors. A false error is defined as a mismatch between the AA field-site call and the map-polygon call if caused by an accuracy error in the GPS field coordinates, a missing or misapplied field call, or a field site assessment of an area smaller than a MMU (an inclusion). This review process involved looking at the AA sites and their corresponding polygons by using ArcGIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California) to locate them and by then viewing them on aerial photographs with a Topcon (MS-3) mirror stereoscope with 3x binoculars. We also reviewed the field data sheet to gain fuller context of the ground data. From this process, we determined whether an initial disagreement was either a true error or indeed a match.

**Final Comparison:** We used all 147 AA field sites for the final comparative analysis of the vegetation map layer (Figure 20).



**Figure 20.** Locations of accuracy assessment sites used to validate the vegetation map layer for the Grand Portage National Monument.

**Individual Map-class Analysis:** For individual map-class accuracies falling below standards of the NPS VIP, we compared map classes to determine which were in confusion. If a repetitive confusion was evident, we then determined whether to merge the map classes for accuracy purposes or to leave the map classes as they were, even if doing so resulted in lower accuracy. If

confusion between map classes would occur, these determinations would be made with NPS staff involvement.

Final Output: The results of the final analyses were transferred into a contingency table (matrix) where we calculated percentages of users' and producers' accuracy for each map class. The matrix shows both the frequency of agreement and placement of disagreements.

AA Spatial Database: For use in GIS, we produced a feature-class layer of the AA site locations, along with supporting tables, and incorporated them into the GRPO vegetation mapping project geodatabase. The field data are also included in the PLOTS Database for this project.

## Results

There were initially 16 mismatches between the AA field-site calls and the map-polygon calls. Results from our review of those disagreements are as follows: one was found to be an inclusion, one was a correctable GPS error, one was classified as a wetland type that appeared to have changed to annual vegetation because of an environmental event, and one was assessed from an adjoining polygon having the GPS coordinates displaced. Once these four mismatches were reconciled, the remaining 12 mismatches were identified as actual errors.

There were no major issues with confusion between individual map classes. The accuracy of only one map class (at the 90% confidence interval) fell below the NPS VIP accuracy standard (as a producers' error) simply because it was a vegetation type discovered during the AA field effort, thus was deemed an error of omission (discussed further below). All other map classes, at the 90% confidence interval, met the accuracy standard of 80%.

The overall accuracy was 91.8% for primary map classes representing natural/semi-natural floristic types in the NVCS, exceeding the NPS VIP accuracy requirement of 80%. A kappa adjustment for chance agreements resulted in a final overall accuracy of 90.7%. The contingency matrix for AA is provided in Appendix G: Accuracy Assessment Contingency Table. The matrix shows the accuracy of each map class, along with 90% confidence intervals, with the users' accuracy reflecting errors of inclusion (commission errors) and producers' accuracy reflecting errors of exclusion (omission errors). The width of each confidence interval was affected by the sample size used to derive the point estimate. Most individual map classes met the 80% requirement, with many at 100% (both users' [11 of 17 map classes] and producers' accuracy [11 of 18 map classes]).

The one map class not meeting the 90% confidence interval accuracy requirement was with the producers' accuracy (-50–50%) for the Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) map class, which describes the *Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518) in the NVCS. This vegetation type was discovered during the AA field effort, residing at that time within the conifer - hardwood mesic (FWA) phase of the White Pine / Mountain Maple Mesic Forest map class, which describes a mixed conifer-hardwood version of the *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest Association (CEGL002445) in the NVCS. This particular vegetation type was not identified for GRPO at the time of mapping; therefore, no map class was derived for it, let alone did we attempt to map the vegetation type (thus, the users' accuracy for FJM is null). Although the location of the AA site (GRPO.AA085) where FJM was discovered is believed to be the only location of this vegetation

type at the GRPO, we decided to show it as an omission error in the contingency table for the benefit that if more of this vegetation type does exist, coverage may likely occur in polygons mapped as FWA. For the benefit of the map user, the appropriate map polygon has been changed to the FJM map class to show the location of the CEG002518 vegetation type (the polygon is 0.29 ha in size, just exceeding the size of a MMU).

Of the map classes meeting the 90% confidence intervals accuracy requirement, the following map classes fell below the base accuracy of 80%: (1) for the Boreal Hazelnut - Serviceberry Rocky Shrubland (SHS) map class, which represents the *Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland Association (CEGL005197) in the NVCS, the producers' accuracy was only 75% and (2) for the Boreal Pine Rocky Woodland (WPR) map class, which represents the *Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland Association (CEGL002441) in the NVCS, the users' accuracy was only 67%. These two results are actually from the same AA site, as the SHS and WPR map classes were confused for each other in the mapping. With only three polygons mapped for each of these map classes, one occurrence of misclassifying to each other diminishes the accuracy for each, one with the producers' and the other with the users'. Upon post-review of the polygon in confusion, it is evident that this area gives credence to the case where an aerial perspective and a ground perspective can pose different interpretations. Upon re-interpretation, the photointerpretive call would remain as originally interpreted, which was of coverage by WPR.



## References

- Avery, T. E. 1978. Forester's guide to aerial photo interpretation. Agriculture Handbook 308. U.S. Forest Service, Washington, D.C., USA. (Revised and enlarged version of Occasional Paper 156, Southern Forest Experiment Station, New Orleans, January 1957.)
- Beyer, H. L. 2004. Hawth's Analysis Tools for ArcGIS. Available from (<http://www.spataleecology.com/htools>.) Accessed 30 March 2010.
- Federal Geographic Data Committee (FGDC). 1997. Vegetation classification standard, FGDC-STD-005-1997. Online. (<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/vegclass.pdf>). Accessed 23 April 2010.
- Federal Geographic Data Committee (FGDC). 1998a. Content standard for digital geospatial metadata, FGDC-STD-001-1998. Online. ([http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/v2\\_0698.pdf](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/v2_0698.pdf)). Accessed 23 April 2010.
- Federal Geographic Data Committee (FGDC). 1998b. Spatial data transfer standard, FGDC-STD-002 (modified version ANSI NCITS 20:1998). Online. ([http://www.fgdc.gov/standards/standards\\_publications/index.html](http://www.fgdc.gov/standards/standards_publications/index.html)). Accessed 23 April 2010.
- Federal Geographic Data Committee (FGDC). 1999. Content standard for digital geospatial metadata, Part 1: Biological Data Profile, FGDC-STD-001.1-1999. Online. (<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/biometadata/biodatap.pdf>). Accessed 23 April 2010.
- Federal Geographic Data Committee (FGDC). 2008. National vegetation classification standard, Version 2, FGDC-STD-005-2008 (Version 2). Online. ([http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS\\_V2\\_FINAL\\_2008-02.pdf](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf)). Accessed 23 April 2010.
- Hershey, R. R., and W. A. Befort. 1995. Aerial photo guide to New England forest cover types. General Technical Report NE-195. U.S. Forest Service, Radnor, Pennsylvania, USA.
- Homer, C., C. Huang, L. Yang, B. Wylie, and M. Coan. 2004. [Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing](#) 70:829–840. ([http://www.mrlc.gov/pdf/July\\_PERS.pdf](http://www.mrlc.gov/pdf/July_PERS.pdf)). Accessed 23 April 2010.
- Hop, K., S. Menard, J. Drake, S. Lubinski, and J. Dieck. 2010. National Park Service Vegetation Inventory Program: Apostle Islands National Lakeshore, Wisconsin. Natural Resource Report NPS/GLKN/NRR—2010/199. National Park Service, Fort Collins, Colorado.
- Image Processing Software, Inc. 2002. OrthoMapper: softcopy Photogrammetric software for the GIS and natural resources professional. Madison, Wisconsin, USA.

- Marschner, F.J. 1974. The original vegetation of Minnesota, a map compiled in 1930 by F.J. Marschner under the direction of M.L. Heinselman of the U.S. Forest Service. Map at 1:500,000 scale. Cartography Laboratory of the Department of Geography, University of Minnesota, St. Paul, USA.
- McCune, B., and M.J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, Version 4.0. MjM Software Design, Gleneden Beach, Oregon.
- NatureServe. 2004. Field methods for vegetation mapping. Prepared for the U.S. Geological Survey and National Park Service. Washington, D.C., USA.
- NatureServe. 2005. NPS PLOTS Database Version 2.0. NatureServe, Arlington, Virginia, USA.
- Owens, T., and K. D. Hop. 1995. Long Term Resource Monitoring Program standard operating procedures: Field station photointerpretation. Long Term Resource Monitoring Program 95-P008-2. National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, USA.
- The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994a. NBS/NPS vegetation mapping program: Standardized national vegetation classification system. Prepared for the National Biological Survey and National Park Service. Washington, D.C., USA.
- The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994b. NBS/NPS vegetation mapping program: Field methods for vegetation mapping. Prepared for the National Biological Survey and National Park Service. Washington, D.C.
- The Nature Conservancy (TNC), Environmental Systems Research Institute, and National Center of Geographic Information and Analysis. 1994. NBS/NPS vegetation mapping program: accuracy assessment procedures. Prepared for the U.S. Department of the Interior, National Biological Survey and National Park Service. Washington, D.C.
- U.S. Geological Survey. 1999. Map accuracy standards. U.S. Geological Survey. Fact sheet 171-99. Online. (<http://egsc.usgs.gov/isb/pubs/factsheets/fs17199.pdf>). Accessed 23 April 2010.

## **Appendix A: Plot Sampling Form**





Environmental Comments:	Soil Taxon/Description
	Unvegetated Surface: <i>(percent – total should equal 100%)</i> <input type="checkbox"/> Bedrock <input type="checkbox"/> Litter, duff <input type="checkbox"/> Wood (> 1 cm) <input type="checkbox"/> Large rocks (cobbles, boulders > 10 cm) <input type="checkbox"/> Small rocks (gravel, 0.2-10 cm) <input type="checkbox"/> Sand (0.1-2 mm) <input type="checkbox"/> Bare soil <input type="checkbox"/> Other: _____
Soil Texture <input type="checkbox"/> sand <input type="checkbox"/> loamy sand <input type="checkbox"/> sandy loam <input type="checkbox"/> loam <input type="checkbox"/> silt loam <input type="checkbox"/> silt <input type="checkbox"/> clay loam <input type="checkbox"/> silty clay <input type="checkbox"/> silty clay loam <input type="checkbox"/> clay <input type="checkbox"/> peat <input type="checkbox"/> muck	Soil Drainage <input type="checkbox"/> Rapidly drained <input type="checkbox"/> Well drained <input type="checkbox"/> Moderately well drained <input type="checkbox"/> Somewhat poorly drained <input type="checkbox"/> Poorly drained <input type="checkbox"/> Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata		Height Scale for Strata	
<u>Trees and Shrubs</u>		<input type="checkbox"/> Forest	P	5%		
<input type="checkbox"/> Evergreen	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Woodland	01	10%	01	<0.5 m
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Needle-leaved	<input type="checkbox"/> Shrubland	02	20%	02	0.5-1m
<input type="checkbox"/> Drought-deciduous	<input type="checkbox"/> Mixed Needle-	<input type="checkbox"/> Dwarf Shrubland	03	30%	03	1-2 m
<input type="checkbox"/> Mixed evergreen -	leaved - Broad-leaved	<input type="checkbox"/> Herbaceous	04	40%	04	2-5 m
<input type="checkbox"/> cold-deciduous	<input type="checkbox"/> Microphyllous	<input type="checkbox"/> Nonvascular	05	50%	05	5-10 m
<input type="checkbox"/> Mixed evergreen -	<input type="checkbox"/> Graminoid	<input type="checkbox"/> Sparsely Vegetated	06	60%	06	10-15 m
<input type="checkbox"/> drought-deciduous	<input type="checkbox"/> Forb		07	70%	07	15-20 m
<u>Herbs</u>	<input type="checkbox"/> Pteridophyte		08	80%	08	20-35 m
<input type="checkbox"/> Annual			09	90%	09	35-50 m
<input type="checkbox"/> Perennial			10	100%	10	>50 m

Strata	Height Class	Cover Class	Diagnostic species (if known)
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short Shrub	_____	_____	_____
S3 Dwarf-Shrub	_____	_____	_____
H Herbaceous	_____	_____	_____
A1 FltngLvdAquatic	_____	_____	_____
A2 Submerged Aquatic	_____	_____	_____
N Non-vascular	_____	_____	_____
V Vine/liana	_____	_____	_____
E Epiphyte	_____	_____	_____

*please see above table for height and cover scales*

Animal Use Evidence

Natural and Anthropogenic Disturbance Comments:

Overall Qualitative Assessment:





## **Appendix B: Descriptions of Vegetation Types**



# U.S. NATIONAL VEGETATION CLASSIFICATION

## GRAND PORTAGE NATIONAL MONUMENT

11 November 2009

by

NatureServe

1101 Wilson Blvd., 15<sup>th</sup> floor  
Arlington, VA 22209

P.O. Box 9354  
St. Paul, MN 55109

This subset of the International Ecological Classification Standard covers the associations attributed to Grand Portage National Monument. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary\_russo@natureserve.org> and Shannon Menard, Senior Regional Ecologist, Minneapolis, MN <shannon\_menard@natureserve.org>.



National Park Service Vegetation Inventory Program  
Grand Portage National Monument

---

Copyright © 2009 NatureServe, 1101 Wilson Blvd, 15<sup>th</sup> floor  
Arlington, VA 22209, U.S.A. All Rights Reserved.

**Citations:**

*The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:*

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 11 November 2009.

**Restrictions on Use:** Permission to use, copy and distribute these data is hereby granted under the following conditions:

1. The above copyright notice must appear in all documents and reports;
2. Any use must be for informational purposes only and in no instance for commercial purposes;
3. Some data may be altered in format for analytical purposes, however the data should still be referenced using the citation above.

Any rights not expressly granted herein are reserved by NatureServe. Except as expressly provided above, nothing contained herein shall be construed as conferring any license or right under any NatureServe copyright.

**Information Warranty Disclaimer:** All data are provided as is without warranty as to the currentness, completeness, or accuracy of any specific data. The absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. NatureServe hereby disclaims all warranties and conditions with regard to these data, including but not limited to all implied warranties and conditions of merchantability, fitness for a particular purpose, and non-infringement. In no event shall NatureServe be liable for any special, indirect, incidental, consequential damages, or for damages of any kind arising out of or in connection with the use of these data. Because the data in the NatureServe Central Databases are continually being updated, it is advisable to refresh data at least once a year after receipt.

NatureServe  
1101 Wilson Blvd, 15<sup>th</sup> floor  
Arlington, VA 22209

---

These data are extracted from:

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 11 November 2009.

---

This document may be generally cited as follows:

NatureServe<sup>1</sup>. 2009. U.S. National Vegetation Classification: Associations of Grand Portage National Monument. NatureServe Central Databases. Arlington, VA. Data current as of 11 November 2009.

# National Park Service Vegetation Inventory Program

## Grand Portage National Monument

---

<sup>1</sup> NatureServe is an international organization including NatureServe regional offices, a NatureServe central office, U.S. State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ecological systems classification:

### United States

Central NatureServe Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque, NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

### Canada

Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre, Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

### Latin American and Caribbean

Centro de Datos para la Conservacion de Bolivia, La Paz, Bolivia; Centro de Datos para la Conservacion de Colombia, Cali, Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala, Guatemala; Centro de Datos para la Conservacion de Panama, Quarry Heights, Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo, Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora, Mexico; Netherlands Antilles Natural Heritage Program, Curacao, Netherlands Antilles; Puerto Rico-Departamento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

NatureServe also has partnered with many International and United States Federal and State organizations, which have also contributed significantly to the development of the International Classification. Partners include the following The Nature Conservancy; Provincial Forest Ecosystem Classification Groups in Canada; Canadian Forest Service; Parks Canada; United States Forest Service; National GAP Analysis Program; United States National Park Service; United States Fish and Wildlife Service; United States Geological Survey; United States Department of Defense; Ecological Society of America; Environmental Protection Agency; Natural Resource Conservation Services; United States Department of Energy; and the Tennessee Valley Authority. Many individual state organizations and people from academic institutions have also contributed to the development of this classification.



**TABLE OF CONTENTS**

<b>1. FOREST &amp; WOODLAND.....</b>	<b>9</b>
<b>1.C.2. Cool Temperate Forest .....</b>	<b>9</b>
1.C.2.a. Eastern North American Cool Temperate Forest.....	9
MG014. Northern Hardwood & Conifer Forest.....	9
G163. Northern Hardwood - Hemlock - White Pine Forest.....	9
White-cedar - Boreal Conifer Mesic Forest .....	9
G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland .....	11
White Pine / Mountain Maple Mesic Forest .....	11
<b>1.C.3. Temperate Flooded &amp; Swamp Forest.....</b>	<b>13</b>
1.C.3.a. Northeastern & Central North American Flooded & Swamp Forest .....	13
MG030. Northern & Central Swamp Forest .....	13
G046. Northern & Central Alkaline Conifer & Hardwood Swamp .....	13
Black Ash - Mixed Hardwood Swamp.....	13
Aspen - Balsam Poplar Lowland Forest.....	16
MG160. Northern & Central Tall Shrub Wetland.....	18
G167. Northern & Central Shrub Swamp .....	18
Gray Alder Swamp.....	18
<b>1.D.1. Lowland &amp; Montane Boreal Forest.....</b>	<b>20</b>
1.D.1.a. North American Lowland Boreal Forest .....	20
MG037. Eastern & Central North American Boreal Conifer & Hardwood Forest .....	20
G047. Jack Pine - Black Spruce Forest .....	20
Jack Pine - Aspen / Bush-honeysuckle Forest.....	20
Jack Pine / Balsam Fir Forest.....	22
G347. Jack Pine - Northern Pin Oak Rocky Woodland .....	23
Boreal Pine Rocky Woodland .....	23
G048. White Spruce - Balsam Fir Forest .....	25
Spruce - Fir - Aspen Forest .....	25
Spruce - Fir / Mountain Maple Forest.....	27
Aspen - Birch / Boreal Conifer Forest.....	29
<b>2. SHRUBLAND &amp; GRASSLAND .....</b>	<b>31</b>
<b>2.C.2. Boreal Grassland, Meadow &amp; Shrubland.....</b>	<b>31</b>
2.C.2.a. North American Boreal Grassland, Meadow & Shrubland .....	31
MG055. North American Boreal Shrubland & Grassland .....	31
G339. Eastern North American Boreal Shrubland & Grassland .....	31
Boreal Hazelnut - Serviceberry Rocky Shrubland .....	31
<b>2.C.5. Temperate &amp; Boreal Freshwater Wet Meadow &amp; Marsh.....</b>	<b>33</b>
2.C.5.a. Eastern North America Freshwater Wet Meadow, Riparian & Marsh .....	33
MG069. Eastern & North-Central North American Marsh & Wet Meadow .....	33
G125. Eastern North American Freshwater Marsh .....	33
Water Horsetail - Spikerush Marsh.....	33
G112. Eastern North American Wet Meadow .....	34
Bluejoint Wet Meadow .....	34
Northern Sedge Wet Meadow .....	36
<b>5. AQUATIC VEGETATION .....</b>	<b>39</b>
<b>5.B.1. Freshwater Aquatic Vegetation.....</b>	<b>39</b>
5.B.1.a. North American Freshwater Aquatic Vegetation.....	39
MG108. Eastern North American Freshwater Aquatic Vegetation.....	39
G114. Eastern North American Freshwater Aquatic Vegetation [Placeholder].....	39
Northern Water-lily Aquatic Wetland.....	39
Midwest Pondweed Submerged Aquatic Wetland .....	40

<b>6. NONVASCULAR &amp; SPARSE VASCULAR ROCK VEGETATION .....</b>	<b>42</b>
<b>6.B.2. Temperate &amp; Boreal Cliff, Scree &amp; Rock Vegetation .....</b>	<b>42</b>
6.B.2.a. Eastern North American Temperate Cliff, Scree & Rock Vegetation .....	42
MG111. Eastern North American Cliff & Rock Vegetation .....	42
G341. Great Lakes Cliff & Shore [Placeholder] .....	42
Great Lakes Basalt - Diabase Cobble - Gravel Shore .....	42
Northern Non-Carbonate Dry Talus Vegetation .....	43
Northern Non-Carbonate Moist Talus Vegetation .....	44

**1. Forest & Woodland****1.C.2. Cool Temperate Forest****1.C.2.a. Eastern North American Cool Temperate Forest****MG014. Northern Hardwood & Conifer Forest****G163. Northern Hardwood - Hemlock - White Pine Forest****White-cedar - Boreal Conifer Mesic Forest***Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest

Northern White-cedar / Balsam Fir - Mountain Maple Forest

Identifier: CEG002449

**NVC CLASSIFICATION**

Division	Eastern North American Cool Temperate Forest (1.C.2.a)
Macrogroup	Northern Hardwood & Conifer Forest (MG014)
Group	Northern Hardwood - Hemlock - White Pine Forest (G163)
Association (Common name)	White-cedar - Boreal Conifer Mesic Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

**ELEMENT CONCEPT**

**Global Summary:** This sub-boreal upland white-cedar forest occurs in the northern Great Lakes region of the United States and Canada, and occasionally eastward into northern New England. Stands are found on gentle wet-mesic slopes to very steep well-drained slopes, or in the eastern portion of the range on moderately well-drained flats. The predominant aspect is north to northeast. Soils are fine to moderately coarse-textured, usually calcareous, moderately deep to deep (50-100 cm), and often contain boulders at the surface. The overstory is dominated by coniferous trees, with or without a substantial deciduous component. *Thuja occidentalis* (northern white-cedar) is the most abundant tree and may occur in pure stands. Other canopy species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Populus tremuloides* (quaking aspen), and *Pinus strobus* (eastern white pine). There is usually an abundant shrub/sapling layer with saplings of *Thuja occidentalis* (northern white-cedar) and *Abies balsamea* (balsam fir) along with *Acer pensylvanicum* (striped maple) and the shrubs *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), and *Sorbus decora* (northern mountain-ash). *Vaccinium angustifolium* (lowbush blueberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) may be present on more acidic sites. The ground layer is typically diverse on mesic to wet-mesic stands and less so on drier stands. Wet-mesic stands can contain a hummock-and-hollow topography, with a seasonally saturated hydrology. Typical species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trillium undulatum* (painted trillium), and *Trientalis borealis* (starflower). Mosses include *Sanionia uncinata* (sanionia moss), *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss) and, in wetter phases of the type, *Sphagnum* (sphagnum) spp.

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This upland white-cedar forest was sampled once in the park. The site is a gentle south-facing slope with moderately well-drained clay soil. The surface is dominated by leaf litter (91% cover) with some wood (4%) and plant stems (5%). No evidence of disturbance was reported.

**Global Environment:** This community is found on gentle wet-mesic slopes to very steep well-drained slopes (MNNHP 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).

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderately dense (70% cover) tree canopy, 20-35 m tall, is dominated by *Thuja occidentalis* (northern white-cedar); small amounts of *Betula papyrifera* (paper birch) and *Populus tremuloides* (quaking aspen) also occur. *Abies balsamea* (balsam fir) forms a sparse (20%) subcanopy (10-15 m). The moderate (50%) tall-shrub layer (2-5 m) is dominated by *Abies balsamea* (balsam fir) and includes *Acer spicatum* (mountain maple) and *Picea mariana* (black spruce). The sparse (30%) short-shrub layer (0.5-1 m) is dominated by *Corylus cornuta* (beaked hazelnut) along with *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Lonicera hirsuta* (hairy honeysuckle), *Rosa* (rose) sp., *Rubus* (blackberry) sp., and *Vaccinium myrtilloides* (velvetleaf huckleberry). The sparse (30%) herbaceous layer includes *Athyrium filix-femina* (common ladyfern), *Carex pedunculata* (longstalk sedge), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Eurybia macrophylla* (bigleaf aster), *Galium* (bedstraw) sp., *Linnaea borealis* (twinflower), *Mitella nuda* (naked

miterwort), and others. Nonvascular species (mosses) cover 30% of the ground surface and include *Hylocomium splendens* (splendid feather moss) and *Pleurozium schreberi* (Schreber's big red stem moss).

**Global Vegetation:** The overstory is dominated by coniferous trees, with or without a substantial deciduous component. *Thuja occidentalis* (northern white-cedar) is the most abundant tree and may occur in pure stands. Usually there are other canopy species, especially *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Populus tremuloides* (quaking aspen), and *Pinus strobus* (eastern white pine). There is usually an abundant shrub/sapling layer with saplings of *Thuja occidentalis* (northern white-cedar) and *Abies balsamea* (balsam fir) along with the shrubs *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinline), *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), and *Sorbus decora* (northern mountain-ash). 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* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower). Mosses include *Sanionia uncinata* (sanionia moss), *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss) and, in wetter phases of the type, *Sphagnum* (sphagnum) spp. (Ohmann and Ream 1971, Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Thuja occidentalis</i> (northern white-cedar)
Tall shrub/sapling	Needle-leaved shrub	<i>Abies balsamea</i> (balsam fir)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Athyrium filix-femina* (common ladyfern), *Clintonia borealis* (bluebead), *Corylus cornuta* (beaked hazelnut), *Eurybia macrophylla* (bigleaf aster), *Hylocomium splendens* (splendid feather moss), *Linnaea borealis* (twinline), *Pleurozium schreberi* (Schreber's big red stem moss), *Thuja occidentalis* (northern white-cedar)

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4 (3-Oct-1996).

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 1 - Strong

**Global Comments:** This type has a wet-mesic phase that can be difficult to distinguish from cedar swamps, such as *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456). [See also Harris et al. (1996) who consider W32, a white-cedar swamp, to be equivalent to V21, a white-cedar upland type, of Sims et al. (1989).] Type is equivalent in concept to V21 of Sims et al. (1989) and V21 Chambers et al. (1997). In Wisconsin, stands of this type are best developed near the Great Lakes shore, but the type concept is still not clear. Those stands may still best go with either *Thuja occidentalis* - *Betula alleghaniensis* Forest (CEGL002450) or *Thuja occidentalis* - (*Betula alleghaniensis*, *Tsuga canadensis*) Forest (CEGL002595).

#### Global Similar Associations:

- *Thuja occidentalis* - (*Betula alleghaniensis*, *Tsuga canadensis*) Forest (CEGL002595)
- *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456)
- *Thuja occidentalis* - *Betula alleghaniensis* Forest (CEGL002450)--This is the mixed conifer-hardwood equivalent

#### Global Related Concepts:

- Boreal Forest (Chapman et al. 1989) B
- Cedar (inc. Mixedwood) / Mountain Maple Forest (V21) (Sims et al. 1989) =
- Lowland lakeshore northern white cedar forest (NAP pers. comm. 1998) ?
- White Cedar Type (Grigal and Ohmann 1975) =
- White Cedar-Trembling Aspen-White Spruce-Twinline (V21) (Chambers et al. 1997) =

### ELEMENT DISTRIBUTION

**Global Range:** This sub-boreal upland white-cedar forest type occurs in the northern Great Lakes region of the United States and Canada, east to upstate New York and northern New England.

**Nations:** CA, US

**States/Provinces:** MI, MN, NH:S1, NY, ON, QC?, WI

**TNC Ecoregions:** 35:C, 47:C, 48:C, 63:C, 64:C

**USFS Ecoregions (1994/95):** 212He:CCC, 212Hi:CCC, 212Hj:CCP, 212Hi:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212La:CCC, 212Lb:CCC,

212Lc:CCC, 212Ld:CC?, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CC?, 212Oa:CCC, 212Ob:CCC, 212Pa:CCC, 222Na:CCC, M212Ae:CCC

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior)

**Federal Lands:** Information not available.

#### ELEMENT SOURCES

**Grand Portage National Monument Plots:** GRPO.4.

**Grand Portage National Monument Map Code:** FCC, FCM

**Local Description Authors:** M.J. Russo

**Global Description Authors:** J. Drake

**References:** Chambers et al. 1997, Chapman et al. 1989, Edinger et al. 2002, Grigal and Ohmann 1975, MNNHP 1993, Midwestern Ecology Working Group n.d., NAP pers. comm. 1998, Ohmann and Ream 1971, Sims et al. 1989, Sperduto 2000a, WNHP unpubl. data

### G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland

#### White Pine / Mountain Maple Mesic Forest

*Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest

Eastern White Pine / Mountain Maple - Beaked Hazelnut Forest

**Identifier:** CEGL002445

#### NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.a)
Macrogroup	Northern Hardwood & Conifer Forest (MG014)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland (G025)
Association (Common name)	White Pine / Mountain Maple Mesic Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719) Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

#### ELEMENT CONCEPT

**Global Summary:** This white pine forest type is found in the northern parts of the midwestern United States and in adjacent parts of Canada. Stands occur on moderately deep to deep (>60 cm) sandy or gravelly loam soil. The canopy is dominated by *Pinus strobus* (eastern white pine), often mixed with *Pinus resinosa* (red pine). The lower layer of the canopy consists mainly of *Abies balsamea* (balsam fir) trees and saplings. Other trees that may be found in this layer include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Picea glauca* (white spruce), and *Thuja occidentalis* (northern white-cedar). The tall-shrub/sapling layer is moderately to well-developed and consists of *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), and, less frequently, *Amelanchier* (serviceberry) spp. The low-shrub layer is not well-developed and is dominated by *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Vaccinium myrtilloides* (velvetleaf huckleberry) and *Vaccinium angustifolium* (lowbush blueberry). The herb stratum is often sparse. Prevalent herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Polypodium virginianum* (rock polypody), and *Pteridium aquilinum* (western brackenfern). Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss). The forest floor is generally characterized by a deep layer of pine needle litter. Diagnostic features include dominance by *Pinus strobus* (eastern white pine), a well-developed tall-shrub layer with *Acer spicatum* (mountain maple) and *Corylus cornuta* (beaked hazelnut), and a sparse herb layer.

#### ENVIRONMENTAL DESCRIPTION

**Grand Portage National Monument Environment:** This white pine forest was sampled once in the park. The site is a gentle, south-facing slope with moderately well-drained clay soil. The surface is dominated by leaf litter (89% cover) with some wood (7%) and plant stems (4%). No evidence of disturbance was reported.

**Global Environment:** This community is found on Precambrian Shield bedrock, overlaid with sandy loam soils that are moderately well-drained and deep (>60 cm). In northeastern Minnesota it occurs on northeast- and south-facing slopes, that are moderate to steep (slope ranges between 4-45%) (Ohmann and Ream 1971). The climate is highly variable, with temperature extremes between -46.7 degrees C and 38.7 degrees C and 58-91 cm precipitation.

#### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** The moderate (50% cover) tree canopy, 15-20 m tall, is dominated by *Pinus strobus* (eastern white pine) and includes lesser amounts of *Picea glauca* (white spruce) and *Populus tremuloides* (quaking aspen). *Abies balsamea* (balsam fir) dominates the very sparse (10%) subcanopy (10-15 m) along with some *Betula papyrifera* (paper birch). The sparse (30%) tall-shrub layer (2-5 m) includes *Acer spicatum* (mountain maple), *Alnus incana* ssp. *rugosa* (speckled alder), *Corylus cornuta* (beaked hazelnut), *Populus tremuloides* (quaking aspen), and *Prunus virginiana* (chokecherry). The very sparse (10%) short-shrub layer (1-2 m) is composed of *Cornus sericea* (red-osier dogwood), *Lonicera canadensis* (American fly

honeysuckle), *Lonicera hirsuta* (hairy honeysuckle), *Rosa* (rose) sp., and *Rubus* (blackberry) sp. The dense (80%) herbaceous layer is dominated by *Eurybia macrophylla* (bigleaf aster) and *Aralia nudicaulis* (wild sarsaparilla) and includes small amounts of *Calamagrostis canadensis* (bluejoint), *Carex pedunculata* (longstalk sedge), *Cornus canadensis* (bunchberry dogwood), *Fragaria virginiana* (Virginia strawberry), *Lathyrus ochroleucus* (cream pea), *Linnaea borealis* (twinline), *Lycopodium clavatum* (running clubmoss), *Mitella nuda* (naked miterwort), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Nonvascular species (mosses), including *Pleurozium schreberi* (Schreber's big red stem moss), cover 10% of the ground surface.

**Global Vegetation:** This community is dominated by *Pinus strobus* (eastern white pine). It is often distinguished by a supercanopy of large, old *Pinus strobus* (eastern white pine) and scattered *Pinus resinosa* (red pine). The lower layer of the canopy consists mainly of *Abies balsamea* (balsam fir) trees and saplings (Ohmann and Ream 1971). Other trees that may be found in this layer include *Betula alleghaniensis* (yellow birch), *Picea glauca* (white spruce), *Thuja occidentalis* (northern white-cedar), *Acer rubrum* (red maple), *Acer spicatum* (mountain maple), and other trees common to boreal forest landscapes. The tall-shrub layer is moderately to well-developed and consists of *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), and, less frequently, *Amelanchier* (serviceberry) spp. (Ohmann and Ream 1971, Sims et al. 1989). The low-shrub layer is not well-developed and dominated by *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinline), *Vaccinium myrtilloides* (velvetleaf huckleberry), and *Vaccinium angustifolium* (lowbush blueberry). 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 1959a). Prevalent herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Polypodium virginianum* (rock polypody), and *Pteridium aquilinum* (western brackenfern). Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss).

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)
Herb (field)	Forb	<i>Aralia nudicaulis</i> (wild sarsaparilla), <i>Eurybia macrophylla</i> (bigleaf aster)

#### Global

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Abies balsamea</i> (balsam fir), <i>Pinus strobus</i> (eastern white pine)
Tree subcanopy	Needle-leaved tree	<i>Abies balsamea</i> (balsam fir), <i>Pinus strobus</i> (eastern white pine)
Tall shrub/sapling	Broad-leaved deciduous tree	<i>Acer spicatum</i> (mountain maple)
Tall shrub/sapling	Broad-leaved evergreen tree	<i>Corylus cornuta</i> (beaked hazelnut)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Diervilla lonicera</i> (northern bush honeysuckle)
Short shrub/sapling	Dwarf-shrub	<i>Vaccinium angustifolium</i> (lowbush blueberry), <i>Vaccinium myrtilloides</i> (velvetleaf huckleberry)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen)

**Global:** *Abies balsamea* (balsam fir), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Pinus strobus* (eastern white pine)

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G3G4 (22-Jun-1998). 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. Many, perhaps, most sites have been degraded by logging. Some sites may be disturbed by fire suppression, and they may be succeeding to other forest types.

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 1 - Strong

**Global Comments:** The type allows for *Pinus strobus* (eastern white pine)-dominated stands or mixed *Pinus strobus* (eastern white pine)-conifers, including *Pinus resinosa* (red pine). The type concept is not well-developed in Wisconsin, where it complexes with *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest (CEGL002480). The limits of the type farther eastward, where it overlaps with *Pinus strobus* - *Pinus resinosa* / *Cornus canadensis* Forest (CEGL006253), are also not clear. In some stands *Juniperus communis* (common juniper) may be present.

**Global Similar Associations:**

- *Pinus resinosa* / *Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest (CEGL002480)
- *Pinus strobus* - *Pinus resinosa* / *Cornus canadensis* Forest (CEGL006253)--northeastern U.S. version?
- *Pinus strobus* - *Populus tremuloides* / *Corylus cornuta* Forest (CEGL002479)
- *Pinus strobus* / *Vaccinium* spp. Forest (CEGL002444)

**Global Related Concepts:**

- White Pine (Ohmann and Ream 1971) =
- White Pine Conifer (V26) (Sims et al. 1989) =
- White Pine-Red Pine-Beaked Hazel-Bracken Fern-Bush Honeysuckle (V29) (Chambers et al. 1997) =

**ELEMENT DISTRIBUTION**

**Global Range:** This white pine forest type is found in the northern parts of the midwestern United States and in adjacent parts of Canada, ranging from Minnesota and Ontario east to Wisconsin and Michigan. Its range extent is between 100,000 and 200,000 square km.

**Nations:** CA, US

**States/Provinces:** MI?, MN:S3, ON, QC, WI

**TNC Ecoregions:** 47:C, 48:C, 64:C

**USFS Ecoregions (1994/95):** 212Ea:CCP, 212Eb:CCP, 212Ec:CCC, 212Ha:CCC, 212Ia:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCC, 212Je:CCC, 212Jl:CCC, 212Jm:CCC, 212Ka:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Ld:CC?, 212Ma:CCC, 212Mb:CCC, 212Nb:CCC

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Saint Croix, Voyageurs); USFS (Chequamegon-Nicolet, Chequamegon?, Nicolet, Superior)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.3.

**Grand Portage National Monument Map Code:** FWM, FWA, FWD

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Chambers et al. 1997, Frelich 1992, Grigal and Ohmann 1975, Heinselman 1973, Judziewicz and Koch 1993, MNNHP 1993, Martin 1959a, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, WNHIP unpubl. data

**1.C.3. Temperate Flooded & Swamp Forest****1.C.3.a. Northeastern & Central North American Flooded & Swamp Forest****MG030. Northern & Central Swamp Forest****G046. Northern & Central Alkaline Conifer & Hardwood Swamp****Black Ash - Mixed Hardwood Swamp**

*Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest

**Black Ash - Mixed Hardwoods - Conifers / Red-osier Dogwood / Sedge species Forest**

**Identifier:** CEGL002105

**NVC CLASSIFICATION**

Division	Northeastern & Central North American Flooded & Swamp Forest (1.C.3.a)
Macrogroup	Northern & Central Swamp Forest (MG030)
Group	Northern & Central Alkaline Conifer & Hardwood Swamp (G046)
Association (Common name)	Black Ash - Mixed Hardwood Swamp
<b>Ecological System(s):</b>	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575) Eastern Boreal Floodplain (CES103.588)

**ELEMENT CONCEPT**

**Global Summary:** This black ash - hardwood swamp forest is found widely in the northern midwestern region of the United States and into the boreal region of central Canada. Sites are found on well-decomposed woody peat or fine mineral soil. The type is found where perched wet pockets occur on fine sandy, clay loamy to fine loamy soils in valleys with impeded drainage or near shores. Hydrology can vary from seasonally flooded to saturated. Conditions are often transitional to uplands. Canopy structure is variable, ranging from 30-90% cover. The canopy is dominated by *Fraxinus nigra* (black ash) (at least 50% cover), with a diverse mix of hardwoods and conifers in the main and subcanopies, including *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica* (green ash), *Picea glauca* (white spruce), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), *Thuja occidentalis* (northern white-cedar), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). Shrub and sapling species include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis*

**Appendix B: Descriptions of Vegetation Types**

(American fly honeysuckle), *Prunus virginiana* (chokecherry), *Ribes triste* (red currant), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Athyrium filix-femina* (common ladyfern), *Carex gracillima* (graceful sedge), *Carex intumescens* (greater bladder sedge), *Cinna latifolia* (drooping woodreed), *Circaea alpina* (small enchanter's nightshade), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum sylvaticum* (woodland horsetail), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* var. *longipes* (twistedstalk), *Thalictrum pubescens* (king-of-the-meadow), and *Trientalis borealis* (starflower). Mosses include *Climacium dendroides* (tree climacium moss), *Plagiomnium* (plagiomnium moss) spp. A floodplain variant may also occur, with more hardwood dominance, with wetter species present, such as *Alnus incana* (gray alder), *Calamagrostis canadensis* (bluejoint), and *Caltha palustris* (yellow marsh-marigold). Diagnostic features include the dominance by *Fraxinus nigra* (black ash).

### ENVIRONMENTAL DESCRIPTION

**Grand Portage National Monument Environment:** This black ash - hardwood swamp forest was sampled at two locations in the park. One site is described as a moderate southwest-facing depression. Soils are somewhat poorly drained clay and clay loam. The surface is dominated by leaf litter (81-93% cover) with some large rocks (0-1%), wood (3-8%) and plant stems (5-10%). Evidence of disturbance includes trails and a boardwalk.

**Global Environment:** Sites are found on well-decomposed woody peat or fine mineral soil. The type is found where perched wet pockets occur on fine sandy, clay loamy to fine loamy soils in valleys with impeded drainage or near shores. Hydrology can vary from seasonally flooded to saturated. Conditions are often transitional to uplands (Sims et al. 1989, MNNHP 1993, Cleland et al. 1994, Chambers et al. 1997).

### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** The moderate (50-60% cover) tree canopy, 15-35 m tall, is dominated by *Fraxinus nigra* (black ash) and may include *Abies balsamea* (balsam fir) and *Picea glauca* (white spruce). The sparse (20%) subcanopy (10-15 m) includes *Populus balsamifera* (balsam poplar) and *Populus tremuloides* (quaking aspen). The moderately sparse (30-40%) tall-shrub layer (2-5 m) may include *Abies balsamea* (balsam fir), *Alnus incana* ssp. *rugosa* (speckled alder), *Corylus cornuta* (beaked hazelnut), *Fraxinus nigra* (black ash), and *Ulmus americana* (American elm). The sparse (30%) short-shrub layer (0.5-1 m) is dominated by *Cornus sericea* (red-osier dogwood) and may include *Prunus virginiana* (chokecherry), *Sorbus decora* (northern mountain-ash), and *Viburnum opulus* var. *americanum* (American cranberrybush). *Rubus* (blackberry) sp. and *Ribes* (currant) may form a sparse (30%) dwarf-shrub layer. The sparse to dense (30-80%) herbaceous layer includes *Anemone canadensis* (Canadian anemone), *Asarum canadense* (Canadian wildginger), *Athyrium filix-femina* (common ladyfern), *Carex gynandra* (nodding sedge), *Carex pedunculata* (longstalk sedge), *Equisetum arvense* (field horsetail), *Eurybia macrophylla* (bigleaf aster), *Glyceria striata* (fowl mannagrass), *Heracleum maximum* (common cowparsnip), *Matteuccia struthiopteris* (ostrich fern), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), and *Thalictrum dasycarpum* (purple meadowrue). Nonvascular species (mosses) cover 5-20% of the ground surface.

**Global Vegetation:** Canopy structure is variable, ranging from 30-90% cover. The canopy is dominated by *Fraxinus nigra* (black ash) (at least 50% cover), with a diverse mix of hardwoods and conifers in the main and sub canopies, including *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica* (green ash), *Picea glauca* (white spruce), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), *Thuja occidentalis* (northern white-cedar), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). Shrub and sapling species include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), *Ribes triste* (red currant), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Athyrium filix-femina* (common ladyfern), *Carex gracillima* (graceful sedge), *Carex intumescens* (greater bladder sedge), *Cinna latifolia* (drooping woodreed), *Circaea alpina* (small enchanter's nightshade), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum sylvaticum* (woodland horsetail), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* (twistedstalk), *Thalictrum pubescens* (king-of-the-meadow), and *Trientalis borealis* (starflower). Mosses include *Climacium dendroides* (tree climacium moss), *Plagiomnium* (plagiomnium moss) spp. (Sims et al. 1989, MNNHP 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* (gray alder), *Calamagrostis canadensis* (bluejoint), and *Caltha palustris* (yellow marsh-marigold) (Harris et al. 1996). Diagnostic features include the dominance by *Fraxinus nigra* (black ash).

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Abies balsamea</i> (balsam fir)
Tree canopy	Broad-leaved deciduous tree	<i>Fraxinus nigra</i> (black ash)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer spicatum</i> (mountain maple), <i>Fraxinus nigra</i> (black ash)
Herb (field)	Forb	<i>Mitella nuda</i> (naked miterwort)
Herb (field)	Fern or fern ally	<i>Athyrium filix-femina</i> (common ladyfern)

**CHARACTERISTIC SPECIES**

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Athyrium filix-femina* (common ladyfern), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Fraxinus nigra* (black ash), *Heracleum maximum* (common cowparsnip), *Mitella nuda* (naked miterwort), *Prunus virginiana* (chokecherry), *Thalictrum dasycarpum* (purple meadowrue)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G4 (3-Oct-1996).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** This type description is essentially boreal to sub-boreal in content, emphasizing the northern/western part of the range. Southern/eastern stands may differ and may warrant a separate type. For examples, see the description in Michigan provided by the Manistee National Forest FEC, ELTP 74 (Cleland et al. 1994), which lists *Hamamelis virginiana* (American witch-hazel), *Salix* (willow) spp. *Viburnum acerifolium* (mapleleaf viburnum), and *Viburnum nudum* var. *cassinoides* (withe-rod) in the shrub layer; and descriptions from central Minnesota (MNNHP 1993, Wovcha et al. 1995), which include virtually no conifers, lack a number of boreal species, and include others, such as the shrubs *Ilex verticillata* (common winterberry) and *Toxicodendron vernix* (poison-sumac), and the herbs *Arisaema triphyllum* (Jack in the pulpit), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), and *Onoclea sensibilis* (sensitive fern). A seepage variant has also been described in Minnesota, containing *Carex bromoides* (bromelike sedge) and *Symplocarpus foetidus* (skunk-cabbage). This seepage variant may resemble the riparian variant described in northern Ontario (MNNHP 1993, Harris et al. 1996 -W34). Finally, in Wisconsin stands have been described with a tree layer of *Fraxinus nigra* (black ash), *Tilia americana* (American basswood), *Picea glauca* (white spruce), a ground layer dominated by *Matteuccia struthiopteris* (ostrich fern) and *Laportea canadensis* (Canadian woodnettle), and a diverse mix of spring ephemerals that are more typical of southern Wisconsin (E. Epstein pers. comm. 1999).

**Global Similar Associations:**

- *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest (CEGL002071)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385)

**Global Related Concepts:**

- Black Ash Hardwood and Mixedwood (V2) (Sims et al. 1989) =
- Black Ash-Hardwoods-Herb Rich (V7) (Chambers et al. 1997) =
- ELTP 74 - Black ash-basswood-Viola plant association (Cleland et al. 1994) =
- Hardwood swamp: black ash (other hardwood): riparian (W34) (Harris et al. 1996) F
- Hardwood swamp: black ash (other hardwood): upland transition (W33) (Harris et al. 1996) F
- Northern Swamp (Chapman et al. 1989) B

**ELEMENT DISTRIBUTION**

**Global Range:** This black ash - hardwood swamp forest type is found widely in the northern midwestern region of the United States and into the boreal region of central Canada, ranging from northern Indiana and northern Illinois northward to Ontario and Manitoba.

**Nations:** CA, US

**States/Provinces:** IL, IN, MB:S2, MI, MN, ND:S3, ON, QC:S4?, WI:S3, WY

**TNC Ecoregions:** 35:C, 36:C, 46:C, 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Ha:CCP, 212Hb:CCP, 212Hd:CCC, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hy:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCC, 212Jd:CCC, 212Je:CCP, 212Jf:CCP, 212Jg:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212Oa:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Lc:CCC, 222Ld:CCC, 222Lf:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC, 251Aa:CCC, 251Dc:CCC

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.6, GRPO.14.

**Grand Portage National Monument Map Code:** FBA, FGA

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Chambers et al. 1997, Chapman et al. 1989, Cleland et al. 1994, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, Sims et al. 1989, WNHP unpubl. data, Wovcha et al. 1995

**Aspen - Balsam Poplar Lowland Forest***Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest**Quaking Aspen - Balsam Poplar - Mixed Hardwoods Lowland Forest****Identifier:** CEGL005036**NVC CLASSIFICATION**

Division	Northeastern & Central North American Flooded & Swamp Forest (I.C.3.a)
Macrogroup	Northern & Central Swamp Forest (MG030)
Group	Northern & Central Alkaline Conifer & Hardwood Swamp (G046)
Association (Common name)	Aspen - Balsam Poplar Lowland Forest
<b>Ecological System(s):</b>	Boreal Aspen-Birch Forest (CES103.020) Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

**ELEMENT CONCEPT**

**Global Summary:** This lowland aspen forest is found in the boreal/sub-boreal regions of the Great Lakes region of the United States and adjacent Canada. 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. Stands are dominated by deciduous trees, but can contain a mix of evergreen species. Dominants include *Populus tremuloides* (quaking aspen) and *Populus balsamifera* (balsam poplar). Other associates include *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), and *Picea glauca* (white spruce). The shrub and herb layer are often fairly rich. Typical shrubs/saplings include *Abies balsamea* (balsam fir), *Alnus incana* (gray alder), *Amelanchier* (serviceberry) spp., *Cornus sericea* (red-osier dogwood), *Cornus canadensis* (bunchberry dogwood), *Ribes* (currant) spp., *Rosa acicularis* (prickly rose), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). The herb layer contains *Aralia nudicaulis* (wild sarsaparilla), *Symphytotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Anemone quinquefolia* (nightcaps), *Calamagrostis canadensis* (bluejoint), *Carex* (sedge) spp., *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum* (horsetail) spp. (including *Equisetum sylvaticum* (woodland horsetail)), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mertensia paniculata* (tall bluebells), *Mitella nuda* (naked miterwort), *Petasites frigidus* var. *palmatus* (arctic sweet coltsfoot), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Viola renifolia* (white violet). *Calamagrostis canadensis* (bluejoint) can be abundant in the herb layer.

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This lowland aspen forest was sampled once in the park. The site is a moderate southwest-facing, seasonally flooded floodplain with well-drained clay loam soil. The surface is dominated by leaf litter (90% cover) with some large rocks (1%), wood (1%) and plant stems (8%). Evidence of disturbance includes the presence of human trash, a paved road and dead plants due to recent drought conditions.

**Global Environment:** 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).

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderate (60% cover) tree canopy, 15-20 m tall, is codominated by *Populus balsamifera* (balsam poplar) and *Populus tremuloides* (quaking aspen). Small amounts of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), and *Sorbus decora* (northern mountain-ash) form a sparse (30%) subcanopy (10-15 m). The moderate (50%) tall-shrub layer (2-5 m) is dominated by *Acer spicatum* (mountain maple) and includes *Alnus incana* ssp. *rugosa* (speckled alder), *Alnus viridis* (green alder), and *Sorbus decora* (northern mountain-ash). The sparse (20%) short-shrub layer (0.5-1 m) includes *Cornus sericea* (red-osier dogwood), *Diervilla lonicera* (northern bush honeysuckle), *Spiraea alba* (white meadowsweet), *Viburnum opulus* var. *americanum* (American cranberrybush), and trace amounts of others. The moderate (60%) herbaceous layer is dominated by *Eurybia macrophylla* (bigleaf aster) and includes *Athyrium filix-femina* (common ladyfern), *Calamagrostis canadensis* (bluejoint), *Carex intumescens* (greater bladder sedge), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Fragaria virginiana* (Virginia strawberry), *Mertensia paniculata* (tall bluebells), and *Symphytotrichum ciliolatum* (Lindley's aster). Nonvascular species (mosses) cover 10% of the ground surface.

**Global Vegetation:** Stands are dominated by deciduous trees, but can contain a mix of evergreen species. Dominants include *Populus tremuloides* (quaking aspen) and *Populus balsamifera* (balsam poplar). Other associates include *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), and *Picea glauca* (white spruce). The shrub and herb layer are often fairly rich. Typical shrubs/saplings include *Abies balsamea* (balsam fir), *Alnus incana* (gray alder), *Amelanchier* (serviceberry) spp., *Cornus sericea* (red-osier dogwood), *Cornus canadensis* (bunchberry dogwood), *Ribes* (currant) spp., *Rosa acicularis* (prickly rose), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). The herb layer contains *Aralia nudicaulis* (wild sarsaparilla), *Symphytotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Anemone quinquefolia* (nightcaps), *Calamagrostis canadensis* (bluejoint), *Carex* (sedge) spp., *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum* (horsetail) spp. (including *Equisetum sylvaticum* (woodland horsetail)), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mertensia paniculata* (tall bluebells), *Mitella nuda* (naked miterwort), *Petasites frigidus* var. *palmatus* (arctic sweet coltsfoot), *Streptopus lanceolatus* (twistedstalk), and *Viola renifolia* (white violet). *Calamagrostis canadensis* (bluejoint) can be abundant in the herb layer (Sims et al. 1989, McCarthy et al. 1994).

**MOST ABUNDANT SPECIES****Grand Portage National Monument**

<b>Stratum</b>	<b>Lifeform</b>	<b>Species</b>
Tree canopy	Broad-leaved deciduous tree	<i>Populus balsamifera</i> (balsam poplar), <i>Populus tremuloides</i> (quaking aspen)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer spicatum</i> (mountain maple)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

**CHARACTERISTIC SPECIES**

**Grand Portage National Monument:** *Acer spicatum* (mountain maple), *Alnus incana* ssp. *rugosa* (speckled alder), *Calamagrostis canadensis* (bluejoint), *Eurybia macrophylla* (bigleaf aster), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G5 (3-Oct-1996).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** This type may arise from clearcut sites on moist spruce-fir or spruce-fir aspen sites. In Wisconsin, this type may arise from widespread logging of spruce-fir stands followed by catastrophic fires that burn the humus out of the soil and prevent spruce-fir regeneration (E. Epstein pers. comm. 1999). It appears that, as result of the cut, soils become very wet because the trees are no longer "pulling" moisture out of the soil horizons. *Alnus incana* (gray alder) can be common in these situations. In fact the ground layer of spruce-fir types such as *Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest (CEGL002446), at its moistest end, can resemble this type [see, e.g., Sims et al. (1989) V24, which can contain *Alnus incana* (gray alder)]. The hydrology of this type may be close to saturated.

**Global Similar Associations:**

- *Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest (CEGL002475)--Although this is a spruce-fir-aspen type, and its moistest end, the ground layer can resemble this type.
- *Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest (CEGL002446)--Although this is a spruce-fir type, and its moistest end, the ground layer can resemble this type [see, e.g., Sims et al. (1989)].
- *Populus tremuloides* - *Populus balsamifera* / *Calamagrostis canadensis* Forest (CEGL002097)
- *Populus tremuloides* - *Populus balsamifera* / *Rubus pubescens* Forest (CEGL002511)

**Global Related Concepts:**

- Balsam Poplar Hardwood and Mixedwood Forest (V1) (Sims et al. 1989) =
- Northern Swamp (Chapman et al. 1989) ?

**ELEMENT DISTRIBUTION**

**Global Range:** This lowland aspen forest is found in the boreal/sub-boreal regions of the Great Lakes region of the United States and adjacent Canada., ranging from Minnesota east to Michigan and Ontario, and perhaps elsewhere in central Canada.

**Nations:** CA, US

**States/Provinces:** MI, MN, ON, QC, WI

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Hi:CCC, 212Ib:CCC, 212Ja:CPP, 212La:CCC, 212Lb:CCC

**Federal Lands:** NPS (Grand Portage, Isle Royale, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet?, Ottawa?, Superior?)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.21.

**Grand Portage National Monument Map Code:** FAP

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, McCarthy et al. 1994, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data

**MG160. Northern & Central Tall Shrub Wetland****G167. Northern & Central Shrub Swamp****Gray Alder Swamp***Alnus incana* Swamp Shrubland

Gray Alder Swamp Shrubland

Identifier: C EGL002381

**NVC CLASSIFICATION**

Division	Northeastern & Central North American Flooded & Swamp Forest (1.C.3.a)
Macrogroup	Northern & Central Tall Shrub Wetland (MG160)
Group	Northern & Central Shrub Swamp (G167)
Association (Common name)	Gray Alder Swamp
<b>Ecological System(s):</b>	Western Great Plains Open Freshwater Depression Wetland (CES303.675) Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582) High Allegheny Wetland (CES202.069)

**ELEMENT CONCEPT**

**Global Summary:** This alder swamp community is widespread in the midwestern and northeastern United States and southern Canada. Stands occur on shores, edges of beaver meadows in stream floodplains, swales associated with small streams in peatlands, or upland forests. Soils are well-decomposed peat, muck or mineral soils. The hydrology is typically seasonally flooded, with most sites remaining saturated. The vegetation is dominated by tall shrubs, 2-8 m in height, 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* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs, such as *Cornus sericea* (red-osier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* (willow) spp., *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Viburnum* (viburnum) spp., can be found. At the southern range limit of this type in West Virginia, shrub layers may be dominated or codominated by the Central Appalachian endemic *Ilex collina* (longstalk holly). The herbaceous layer contains species such as *Symphotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphotrichum puniceum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairiea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joeypyeweed), *Glyceria melicaria* (melic mannagrass), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk-cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* (cattail) spp., and *Viola* (violet) spp. Mosses include *Climacium dendroides* (tree climacium moss) and *Sphagnum* (sphagnum) spp. Where the tall-shrub canopy is open, graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white-cedar).

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This alder swamp community was sampled at three locations in the park. The sites are flat to gently sloping, seasonally flooded floodplains which were dry at the time of sampling. Soils range from poorly drained to moderately well-drained clay and clay loam. The surface is dominated by leaf litter (87-93% cover) with some large rocks (0-1%), wood (2-3%), bare soil (0-1%) and plant stems (5-15%). Evidence of disturbance includes animal and human paths and signs of beaver activity.

**Global Environment:** Sites are typically 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 seasonally flooded, or even saturated, but are typically seasonally flooded/saturated. The water ranges from non-stagnant, nutrient-rich, and often slightly calcareous (Curtis 1959) to rather stagnant and nutrient-poor where over acidic bedrock or till. Soils are wet, often mucks or peats (Anderson 1982, Chapman et al. 1989). In the upper Midwest, this community is found on Precambrian Shield bedrock that is overlaid with sandy loam soils, which are moderately well-drained and deep (>60 cm). In northeastern Minnesota stands can 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 and 38 degrees C and 58-91 cm precipitation.

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderately to very dense (70-90% cover) tall-shrub layer (2-5 m tall) is dominated by *Alnus incana* ssp. *rugosa* (speckled alder) along with lesser amounts of state-imperiled *Crataegus douglasii* (black hawthorn), as well as *Fraxinus nigra* (black ash), *Salix* (willow) sp., and *Viburnum opulus* var. *americanum* (American cranberrybush). The short-shrub layer (0.5-1 m) may be absent or moderate (0-50%) and may include *Alnus incana* ssp. *rugosa* (speckled alder), *Amelanchier* (serviceberry) sp., *Cornus sericea* (red-osier dogwood), *Ribes* (currant) spp., *Rubus* (blackberry) sp., and *Spiraea alba* (white meadowsweet). The sparse to moderately dense (30-70%) herbaceous layer may include *Asarum canadense*

**Appendix B: Descriptions of Vegetation Types**

(Canadian wildginger), *Calamagrostis canadensis* (bluejoint), *Equisetum arvense* (field horsetail), *Equisetum sylvaticum* (woodland horsetail), *Eupatorium maculatum* (spotted joeypeweed), *Heracleum maximum* (common cowparsnip), *Impatiens capensis* (jewelweed), *Impatiens capensis* (jewelweed), *Mertensia paniculata* (tall bluebells), *Onoclea sensibilis* (sensitive fern), and *Thalictrum dasycarpum* (purple meadowrue). Nonvascular species cover 5-10% of the ground surface.

**Global Vegetation:** The vegetation is dominated by tall shrubs, 2-8 m in height, 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* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs, such as *Cornus sericea* (red-osier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* (willow) spp., *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steplebush), and *Viburnum* (viburnum) spp., can be found. The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum purpureum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairiea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joeypeweed), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk-cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* (cattail) spp., and *Viola* (violet) spp. Mosses include *Climacium dendroides* (tree climacium moss) and *Sphagnum* (sphagnum) spp. Where the tall-shrub canopy is open, the graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white-cedar) (Curtis 1959, Anderson 1982, MNNHP 1993, Harris et al. 1996, Spreduto 2000b, Thompson and Sorenson 2000, Gawler 2002). Where stands border on saturated conditions with peaty soils, peatland species such as *Chamaedaphne calyculata* (leatherleaf), *Rhododendron canadense* (rhodora), and *Sphagnum* (sphagnum) spp. may be present.

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Alnus incana</i> ssp. <i>rugosa</i> (speckled alder)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Spiraea alba</i> (white meadowsweet)
Herb (field)	Forb	<i>Heracleum maximum</i> (common cowparsnip), <i>Impatiens capensis</i> (jewelweed)

#### Global

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Alnus incana</i> (gray alder)

### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Alnus incana* ssp. *rugosa* (speckled alder), *Asarum canadense* (Canadian wildginger), *Carex lacustris* (hairy sedge), *Cornus sericea* (red-osier dogwood), *Equisetum arvense* (field horsetail), *Heracleum maximum* (common cowparsnip), *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Spiraea alba* (white meadowsweet), *Thalictrum dasycarpum* (purple meadowrue)

**Global:** *Alnus incana* (gray alder)

### OTHER NOTEWORTHY SPECIES

**Grand Portage National Monument: Vulnerable:** *Crataegus douglasii* (black hawthorn, state-imperiled, G5)

**Global: Vulnerable:** *Ilex collina* (longstalk holly, vulnerable, G3)

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G5 (23-Jun-2006). This association is widely distributed and considered secure in many states.

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** Type has a very broad distribution, and there may be a need to separate a northern (more boreal) type from a southern (more temperate) type, or perhaps an enriched versus lower-nutrient type, based on floristic differences. Hydrology may be quite variable, ranging from temporarily flooded to semipermanently flooded. In Ohio, this association sometimes merges with *Alnus serrulata* (hazel alder) stands in *Alnus serrulata* Swamp Shrubland (CEGL005082); that association is distinguished by somewhat more southern associates, including *Rhododendron viscosum* (swamp azalea), *Lindera benzoin* (northern spicebush), *Peltandra virginica* (green arrow-arum), etc.. With increasing tree canopy cover, this association can be similar to *Larix laricina* (tamarack) forest types, *Thuja occidentalis* (northern white-cedar) saturated forest types, and *Fraxinus nigra* - *Acer rubrum* saturated forest types.

#### Global Similar Associations:

- *Alnus incana* - *Cornus* (*amomum*, *sericea*) / *Clematis virginiana* Shrubland (CEGL006062)
- *Alnus incana* ssp. *rugosa* - *Nemopanthus mucronatus* / *Sphagnum* spp. Shrubland (CEGL006158)
- *Alnus serrulata* Swamp Shrubland (CEGL005082)

#### Global Related Concepts:

- *Alnus incana* - *Sambucus canadensis* shrub community (Darlington 1943) F

## Appendix B: Descriptions of Vegetation Types

- *Alnus incana* - *Viburnum cassinoides* shrub community (Darlington 1943) F
- *Alnus incana* ssp. *rugosa* tall shrub thicket (Fortney et al. 2005) =
- *Alnus incana* ssp. *rugosa* shrubland (Byers et al. 2007) =
- *Alnus rugosa* shrub (Walbridge and Lang 1982) =
- *Alnus rugosa* tall shrub community (Walbridge 1982) =
- *Alnus rugosa* tall shrub community (Robinette 1966) =
- *Alnus rugosa* thicket community (Fortney 1975) =
- Alder Shrub Swamp (Anderson and Schwegman 1991) =
- Alder Thicket (Curtis 1959) =
- Thicket Swamp: Speckled Alder / Bluejoint Grass type , W35 (Harris et al. 1996) =

#### ELEMENT DISTRIBUTION

**Global Range:** This alder swamp shrubland is widespread in the midwestern and northeastern United States and southern Canada, ranging from Maine west to Manitoba, south to Iowa, and east to New York and perhaps northern New Jersey.

**Nations:** CA, US

**States/Provinces:** IA:S3?, IL, IN?, MA, MB?, ME, MI:S5, MN:S5, ND:S2?, NH:S3S4, NJ?:S2S4, NY, OH, ON, PA, QC:S4S5, VT, WI:S4, WV:S3, WY

**TNC Ecoregions:** 34:C, 35:C, 46:C, 47:C, 48:C, 60:C, 61:C, 62:C, 63:C, 64:C

**USFS Ecoregions (1994/95):** 212Cb:CCC, 212Da:CCC, 212Db:CCC, 212Dc:CCC, 212Fc:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Ht:CCC, 212Hv:CCP, 212Hw:CCC, 212Hy:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCC, 212Jg:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CCP, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 221Ae:CCC, 221Ak:CCP, 221Al:CCP, 221Bc:CCC, 222Je:CCC, 222Lb:CCC, 222Lc:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC, 251Aa:CCC, 251Ab:CCC, M212Aa:CCC, M212Ac:CCC, M212Ae:CCC, M212Af:CCC, M212B:CC, M212C:CC, M212D:CP

**Federal Lands:** NPS (Acadia, Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior); USFWS (Aroostook, Assabet River, Carlton Pond, Moosehorn?, Nulhegan Basin)

**Federal Lands:** Information not available.

#### ELEMENT SOURCES

**Grand Portage National Monument Plots:** GRPO.9, GRPO.12, GRPO.15.

**Grand Portage National Monument Map Code:** SAS, SAH, SAW

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen, mod. S.C. Gawler

**References:** Anderson 1982, Anderson and Schwegman 1991, Breden et al. 2001, Byers et al. 2007, Chapman et al. 1989, Curtis 1959, Darlington 1943, DeMeo et al. 1998, Fortney 1975, Fortney et al. 2005, Gawler 2002, Greenall 1996, Harris et al. 1996, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, NRCS 2004, Ohmann and Ream 1971, Rentch unpubl. data 2003, Robinette 1966, Sperduto 2000b, Swain and Kearsley 2001, Thompson and Sorenson 2000, WNHIP unpubl. data, Walbridge 1982, Walbridge and Lang 1982

### 1.D.1. Lowland & Montane Boreal Forest

#### 1.D.1.a. North American Lowland Boreal Forest

#### MG037. Eastern & Central North American Boreal Conifer & Hardwood Forest

#### G047. Jack Pine - Black Spruce Forest

#### Jack Pine - Aspen / Bush-honeysuckle Forest

*Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest

Jack Pine - Quaking Aspen / Northern Bush-honeysuckle Forest

Identifier: CEGL002518

#### NVC CLASSIFICATION

Division	North American Lowland Boreal Forest (1.D.1.a)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)
Group	Jack Pine - Black Spruce Forest (G047)
Association (Common name)	Jack Pine - Aspen / Bush-honeysuckle Forest
Ecological System(s):	Boreal Jack Pine-Black Spruce Forest (CES103.022)

#### ELEMENT CONCEPT

**Global Summary:** This jack pine - aspen forest is found in the northern parts of the midwestern United States and into central Canada. Stands occur on generally level sandy outwash plains or moderately sloping moraines. The soils are fresh to dry, deep, sandy

loams, loams, and fine sands. In Manitoba, the soils tend to be somewhat more moist and fine. The canopy layer is a mix of coniferous and deciduous trees, with the conifers tending to be more abundant in the north. The canopy is typically dominated by *Pinus banksiana* (jack pine) and *Populus tremuloides* (quaking aspen) with lesser amounts of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), and *Picea mariana* (black spruce). 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 m tall. The most common among these are *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinline), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium* (blueberry) spp. The herbaceous layer is also typically quite rich with species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Clintonia borealis* (bluebead), *Streptopus lanceolatus* var. *longipes* (twistedstalk), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

#### ENVIRONMENTAL DESCRIPTION

**Global Environment:** This community is found on generally level sandy outwash plains or moderately sloping moraines (Sims et al. 1989, MNNHP 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).

#### VEGETATION DESCRIPTION

**Global Vegetation:** 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* (jack pine) and *Populus tremuloides* (quaking aspen) with lesser amounts of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), and *Picea mariana* (black spruce). 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 m tall. The most common among these are *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinline), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium* (blueberry) spp. The herbaceous layer is also typically quite rich with species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Clintonia borealis* (bluebead), *Streptopus lanceolatus* (twistedstalk), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

#### OTHER NOTEWORTHY SPECIES

**Global: Vulnerable:** *Cypripedium arietinum* (ram's head lady's slipper, G3)

#### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4G5 (1-Oct-1996).

#### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 3 - Weak

**Global Comments:** In Voyageurs National Park, this type is on thin soil, rocky substrate, but on the scale of 1-10 hectares, it tends to be a mosaic of pure *Pinus banksiana* (jack pine) and pure *Populus tremuloides* (quaking aspen) stands. Type needs rangewide review.

#### Global Similar Associations:

- *Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland (CEGL002483)
- *Pinus banksiana* / (*Quercus rubra*, *Quercus ellipsoidalis*) Forest (CEGL002440)

#### Global Related Concepts:

- Jack Pine Mixedwood / Shrub Rich (V15) (Zoladeski et al. 1995) =
- Jack Pine Mixedwood / Shrub Rich (V17) (Sims et al. 1989) =

#### ELEMENT DISTRIBUTION

**Global Range:** This jack pine - aspen forest community type is found in the northern parts of the midwestern United States and into central Canada, ranging from northeastern Minnesota to Manitoba and Ontario.

**Nations:** CA, US

**States/Provinces:** MB?, MI, MN, ON, QC, WI

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Hi:CCC, 212Ia:CCC, 212La:CCC

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Pictured Rocks, Voyageurs); USFS (Superior?)

**Federal Lands:** Information not available.

#### ELEMENT SOURCES

**Grand Portage National Monument Map Code:** FJM

**Local Description Authors:**

**Global Description Authors:** J. Drake

**References:** Greenall 1996, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, Zoladeski et al. 1995

**Jack Pine / Balsam Fir Forest***Pinus banksiana* / *Abies balsamea* Forest**Jack Pine / Balsam Fir Forest**

Identifier: CEGL002437

**NVC CLASSIFICATION**

Division North American Lowland Boreal Forest (1.D.1.a)  
 Macrogroup Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)  
 Group Jack Pine - Black Spruce Forest (G047)  
 Association (Common name) Jack Pine / Balsam Fir Forest  
 Ecological System(s) Boreal Jack Pine-Black Spruce Forest (CES103.022)

**ELEMENT CONCEPT**

**Global Summary:** This jack pine / fir forest is found in the northern parts of the midwestern United States and in central Canada. Stands occur on moderately deep (50-100 cm), usually sandy soils. The sites are often on north- to northeast-facing slopes. The tree layer of this community is dominated by *Pinus banksiana* (jack pine), often to the exclusion of other species. *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), and *Populus tremuloides* (quaking aspen) 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* (mountain maple), *Amelanchier alnifolia* (Saskatoon serviceberry), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium* (blueberry) spp. The herbaceous layer is dominated by dry-mesic forest species, including *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), and *Galium boreale* (northern bedstraw). Mosses and lichens are common on the forest floor.

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This jack pine / balsam fir forest was sampled at one location near Mount Rose. The site is a somewhat steep, south-facing slope with rapidly drained loamy sand soil. The surface is dominated by leaf litter (88% cover) with some large rocks (1%), wood (2%) and plant stems (9%). Evidence of disturbance includes many standing dead jack pine, many broken off at the top.

**Global Environment:** This community is found on moderately deep (50-100 cm), usually sandy soils (Grigal and Ohmann 1975). The sites are often on north- to northeast-facing slopes.

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderate (60% cover) tree canopy, 15-20 m tall, is dominated by *Pinus banksiana* (jack pine) and includes lesser amounts of *Abies balsamea* (balsam fir) and *Populus tremuloides* (quaking aspen). The sparse (10%) subcanopy (10-15 m) and sparse (20%) tall-shrub layer (2-5 m) includes *Abies balsamea* (balsam fir). The sparse (20%) short-shrub layer (0.5-1 m) is dominated by *Diervilla lonicera* (northern bush honeysuckle) and includes *Amelanchier* (serviceberry) sp., *Lonicera canadensis* (American fly honeysuckle), *Rosa* (rose) sp., *Sorbus decora* (northern mountain-ash), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Arctostaphylos uva-ursi* (kinnikinnick) forms a very sparse (5%) dwarf-shrub layer. The moderate (60%) herbaceous layer is dominated by *Eurybia macrophylla* (bigleaf aster) and *Linnaea borealis* (twinflower) and includes lesser amounts of *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), and *Oryzopsis asperifolia* (roughleaf ricegrass). Nonvascular species (mosses) cover 70% of the ground surface and include *Dicranum* (dicranum moss) sp. and *Pleurozium schreberi* (Schreber's big red stem moss).

**Global Vegetation:** The tree layer of this community is dominated by *Pinus banksiana* (jack pine), often to the exclusion of other species. *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), and *Populus tremuloides* (quaking aspen) 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* (mountain maple), *Amelanchier alnifolia* (Saskatoon serviceberry), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium* (blueberry) spp. The herbaceous layer is dominated by dry-mesic forest species including *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), and *Galium boreale* (northern bedstraw). Mosses and lichens are common on the forest floor (Grigal and Ohmann 1975, Sims et al. 1989).

**MOST ABUNDANT SPECIES****Grand Portage National Monument**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus banksiana</i> (jack pine)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)
Nonvascular	Moss	<i>Pleurozium schreberi</i> (Schreber's big red stem moss)

**CHARACTERISTIC SPECIES**

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Linnaea borealis* (twinflower), *Pinus banksiana* (jack pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Populus tremuloides* (quaking aspen)

**OTHER NOTEWORTHY SPECIES**

**Global:** **Vulnerable:** *Cypripedium arietinum* (ram's head lady's slipper, G3)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G5 (3-Oct-1996).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** This type represents a relatively more moist jack pine type in areas of the Canadian Shield, whereas *Pinus banksiana* / (*Quercus rubra*, *Quercus ellipsoidalis*) Forest (CEGL002440) is the drier type.

**Global Similar Associations:**

- *Pinus banksiana* / (*Quercus rubra*, *Quercus ellipsoidalis*) Forest (CEGL002440)

**Global Related Concepts:**

- Jack Pine (Fir) (Ohmann and Ream 1971) =
- Jack Pine / Low Shrub (V28) (Sims et al. 1989) B
- Jack Pine-Fir (Grigal and Ohmann 1975) =

**ELEMENT DISTRIBUTION**

**Global Range:** This jack pine / fir forest type is found in the northern parts of the midwestern United States and in central Canada, ranging from northeastern Minnesota to northwestern Ontario and probably elsewhere.

**Nations:** CA, US

**States/Provinces:** MI, MN:S4, ON, QC

**TNC Ecoregions:** 47:C, 48:C, 64:C

**USFS Ecoregions (1994/95):** 212Ea:CCC, 212Hi:CCC, 212La:CCC, 212Lb:CCC, 212Nc:C??

**Federal Lands:** NPS (Grand Portage, Pictured Rocks, Voyageurs); USFS (Superior)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.17.

**Grand Portage National Monument Map Code:** FJF

**Local Description Authors:** M.J. Russo

**Global Description Authors:** J. Drake

**References:** Farrand and Bell 1982, Grigal and Ohmann 1975, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989

**G347. Jack Pine - Northern Pin Oak Rocky Woodland****Boreal Pine Rocky Woodland**

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

Jack Pine - (Black Spruce, Eastern White Pine) / Blueberry species Rocky Woodland

Identifier: CEGL002483

**NVC CLASSIFICATION**

Division	North American Lowland Boreal Forest (1.D.1.a)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)
Group	Jack Pine - Northern Pin Oak Rocky Woodland (G347)
Association (Common name)	Boreal Pine Rocky Woodland
<b>Ecological System(s):</b>	Laurentian Acidic Rocky Outcrop (CES201.019)

**ELEMENT CONCEPT**

**Global Summary:** This jack pine - black spruce rocky woodland is found in central Canada and adjacent boreal forests of the Great Lakes in the United States. 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. The tree canopy is open, with scattered *Pinus banksiana* (jack pine) and *Picea mariana* (black spruce). The understory is quite open, with scattered clumps of shrubby *Picea mariana* (black spruce). The dwarf-shrub layer contains *Vaccinium angustifolium* (lowbush blueberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer is sparse, containing *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), and *Melampyrum lineare* (narrowleaf cowwheat). The moss layer contains *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss). Lichens include *Cladina rangiferina* (greygreen reindeer lichen), *Cladina mitis* (reindeer lichen), and *Cladina stellaris* (star reindeer lichen).

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This jack pine - black spruce woodland was sampled at one location in the park. The site is a somewhat steep, southwest-facing rocky ridge with well-drained sandy loam soil. The surface is dominated by plant

stems (88% cover) with some exposed bedrock (5%), large rocks (8%), small rocks (2%), leaf litter (10%), wood (1%) and bare soil (1%). Evidence of disturbance includes the presence of exotic plants.

**Global Environment:** 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).

### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** The sparse (30% cover) tree canopy, 15-20 m tall, is dominated by *Pinus banksiana* (jack pine) and *Pinus strobus* (eastern white pine). The sparse (30%) subcanopy (5-10 m) includes *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Populus tremuloides* (quaking aspen), and *Thuja occidentalis* (northern white-cedar). The sparse (20%) tall-shrub layer (2-5 m) is comprised of sapling trees from the upper layers. The sparse (20%) short-shrub layer (0.5-1 m) includes *Alnus viridis* (green alder), *Amelanchier* (serviceberry) sp., *Diervilla lonicera* (northern bush honeysuckle), *Prunus pensylvanica* (pin cherry), *Rosa* (rose) sp., *Sorbus decora* (northern mountain-ash), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), and *Juniperus horizontalis* (creeping juniper) (state-vulnerable) form a moderately dense (60%) dwarf-shrub layer. The sparse (30%) herbaceous layer includes *Antennaria neglecta* (field pussytoes), *Apocynum androsaemifolium* (spreading dogbane), *Danthonia spicata* (poverty oatgrass), *Eurybia macrophylla* (bigleaf aster), *Oryzopsis asperifolia* (roughleaf ricegrass), and *Sibbaldiopsis tridentata* (shrubby fivefingers). Nonvascular species, including *Cladina* (reindeer lichen) sp., *Dicranum* (dicranum moss) sp., and *Pleurozium schreberi* (Schreber's big red stem moss), cover 70% of the ground surface.

**Global Vegetation:** The tree canopy is open, with scattered *Pinus banksiana* (jack pine) and *Picea mariana* (black spruce). The understory is quite open, with scattered clumps of shrubby *Picea mariana* (black spruce). The dwarf-shrub layer contains *Vaccinium angustifolium* (lowbush blueberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer is sparse, containing *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), and *Melampyrum lineare* (narrowleaf cowwheat). The moss layer contains *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss). Lichens include *Cladina rangiferina* (greygreen reindeer lichen), *Cladina mitis* (reindeer lichen), and *Cladina stellaris* (star reindeer lichen) (Sims et al. 1989, McCarthy et al. 1994).

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Diervilla lonicera</i> (northern bush honeysuckle)
Herb (field)	Dwarf-shrub	<i>Juniperus communis</i> (common juniper), <i>Juniperus horizontalis</i> (creeping juniper)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Arctostaphylos uva-ursi* (kinnikinnick), *Danthonia spicata* (poverty oatgrass), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper), *Picea glauca* (white spruce), *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), *Pleurozium schreberi* (Schreber's big red stem moss)

### OTHER NOTEWORTHY SPECIES

**Grand Portage National Monument: Vulnerable:** *Juniperus horizontalis* (creeping juniper, state-vulnerable, G5); **Exotic/Invasive:** *Poa compressa* (Canada bluegrass, exotic/invasive, High/Low)

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4? (3-Oct-1996).

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** In Michigan, this type is possible on Isle Royale and elsewhere in the Upper Peninsula, and in Minnesota this type is expected primarily in the Border Lakes region (212La), though it may occur elsewhere. The description in the MNNHP (1993) report has a richer shrub layer than is described in Ontario, and probably also includes the tall-shrub phase of *Pinus banksiana* - *Picea mariana* / *Vaccinium* spp. / *Pleurozium schreberi* (Schreber's big red stem moss) Forest (CEGL002448).

In Minnesota, especially at Voyageurs National Park, this type may essentially be synonymous with *Pinus banksiana* / (*Quercus rubra*, *Quercus ellipsoidalis*) Forest (CEGL002440) in more open rocky stands, and that type could be characterized as the typical subassociation within this type where *Picea mariana* (black spruce) is minor and *Quercus ellipsoidalis* (northern pin oak) is more common. Farther north in Ontario, *Picea mariana* (black spruce) is more common.

#### Global Similar Associations:

- *Pinus banksiana* - *Picea mariana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002448)
- *Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest (CEGL002518)--This type contains more deciduous trees, but poor sites may resemble CEGL002483.

## Appendix B: Descriptions of Vegetation Types

- *Pinus banksiana* / (*Quercus rubra*, *Quercus ellipsoidalis*) Forest (CEGL002440)
- *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002441)
- *Quercus ellipsoidalis* - *Quercus macrocarpa* - (*Pinus banksiana*) Rocky Woodland (CEGL005246)

**Global Related Concepts:**

- Jack Pine - Black Spruce / Blueberry / Lichen (V30) (Sims et al. 1989) =
- Jack Pine - Black Spruce / Feathermoss (V16) (McCarthy et al. 1994) =

**ELEMENT DISTRIBUTION**

**Global Range:** This jack pine - black spruce rocky woodland type is found in central Canada and adjacent boreal forests of the Great Lakes in the United States.

**Nations:** CA, US

**States/Provinces:** MB:S4?, MI, MN, ON, QC, WI

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Hb:CPP, 212Ib:CCC, 212Ja:CPP, 212Jj:CPP, 212Jm:CPP, 212Ka:CPP, 212La:CCP, 212Lb:CCC, 212Lc:CCC

**Federal Lands:** NPS (Grand Portage, Isle Royale, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet, Superior)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.19.

**Grand Portage National Monument Map Code:** WPR

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Greenall 1996, MNNHP 1993, McCarthy et al. 1994, Midwestern Ecology Working Group n.d., Sims et al. 1989

**G048. White Spruce - Balsam Fir Forest****Spruce - Fir - Aspen Forest**

*Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest

White Spruce - Balsam Fir - Quaking Aspen / Mixed Herbs Forest

**Identifier:** CEGL002475

**NVC CLASSIFICATION**

Division	North American Lowland Boreal Forest (1.D.1.a)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)
Group	White Spruce - Balsam Fir Forest (G048)
Association (Common name)	Spruce - Fir - Aspen Forest
<b>Ecological System(s):</b>	Boreal White Spruce-Fir-Hardwood Forest (CES103.021)

**ELEMENT CONCEPT**

**Global Summary:** This spruce - fir - aspen forest is found in the western Great Lakes area of the United States and Canada and elsewhere in parts of central Canada. Stands occur on deep, well-drained to rapidly drained, moist, fine-textured mineral soils. Loams are the most common, but silts and clays are also possible. The overstory is a mixture of coniferous and deciduous trees. Species composition is varied. The most abundant tree species are *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). The sapling/shrub layer is usually moderately well-developed. *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and saplings of *Abies balsamea* (balsam fir) are the most commonly encountered in this stratum. Herb diversity is usually high. *Aralia nudicaulis* (wild sarsaparilla), *Symphotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower) are typical of this community. A Lake Superior clayplain variant may occur in northern Wisconsin.

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This spruce - fir - aspen forest was sampled at two locations in the park. One site is a flat with moderately well-drained clay soil, the other a somewhat steep, southwest-facing midslope with well-drained clay loam soil. The surface is dominated by leaf litter (79-87% cover) with some large rocks (0-1%), wood (3-5%) and plant stems (10-15%). Evidence of disturbance includes past fire and the presence of trails and human trash.

**Global Environment:** 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).

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** Vegetation heights and percent cover were only recorded for one of the sampled plots. The moderate (60% cover) tree canopy, 20-35 m tall, is dominated by *Populus tremuloides* (quaking aspen) and may include lesser amounts of *Picea glauca* (white spruce). The sparse (30%) subcanopy (10-15 m) includes *Abies balsamea* (balsam fir), *Betula*

**Appendix B: Descriptions of Vegetation Types**

*papyrifera* (paper birch), and *Picea glauca* (white spruce). The moderate (40%) tall-shrub layer (2-5 m) and moderate (40%) short-shrub layer (0.5-1 m) are dominated by *Acer spicatum* (mountain maple); additional short shrubs include *Alnus viridis* (green alder), *Amelanchier* (serviceberry) sp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), and *Rubus* (blackberry) sp. The moderately dense (70%) herbaceous layer is dominated by *Eurybia macrophylla* (bigleaf aster) and may include *Aralia nudicaulis* (wild sarsaparilla), *Carex pedunculata* (longstalk sedge), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), and others. Nonvascular species (mosses) cover 10% of the ground surface.

**Global Vegetation:** The overstory composition is varied. The most abundant tree species typically are *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). The sapling/shrub layer is usually moderately well-developed. *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and saplings of *Abies balsamea* (balsam fir) are the most commonly encountered in this stratum. Herb diversity is usually high. *Aralia nudicaulis* (wild sarsaparilla), *Symphotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower) are typical of this community (Sims et al. 1989, MNNHP 1993). A Lake Superior clayplain variant may occur in northern Wisconsin. Leading canopy dominants include *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), and *Betula papyrifera* (paper birch). Common associates include *Abies balsamea* (balsam fir), *Populus tremuloides* (quaking aspen), *Populus balsamifera* (balsam poplar), *Thuja occidentalis* (northern white-cedar), and *Acer rubrum* (red maple). Shrubs include *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera hirsuta* (hairy honeysuckle), *Rubus parviflorus* (thimbleberry), *Rubus pubescens* (dwarf red blackberry), *Sorbus decora* (northern mountain-ash), and *Viburnum opulus* var. *americanum* (American cranberrybush). Typical herbaceous species include *Anemone quinquefolia* (nightcaps), *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Calamagrostis canadensis* (bluejoint), *Carex arctata* (drooping woodland sedge), *Fragaria virginiana* (Virginia strawberry), *Luzula acuminata* (hairy woodrush), *Maianthemum canadense* (Canada mayflower), *Petasites frigidus* (arctic sweet coltsfoot), and *Pteridium aquilinum* (western brackenfern) (E. Epstein pers. comm. 1999).

#### MOST ABUNDANT SPECIES

##### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus tremuloides</i> (quaking aspen)
Tree subcanopy	Needle-leaved tree	<i>Abies balsamea</i> (balsam fir)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer spicatum</i> (mountain maple)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Diervilla lonicera</i> (northern bush honeysuckle)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

#### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula papyrifera* (paper birch), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Picea glauca* (white spruce), *Populus tremuloides* (quaking aspen), *Pteridium aquilinum* (western brackenfern)

#### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G5 (3-Oct-1996). No old-growth stands are known for the Lake Superior clayplain variant.

#### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** This type overlaps in concept with *Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest (CEGL002474). A red maple variant may occur in the Great Lake states (Michigan, Minnesota, Wisconsin). The Lake Superior clayplain variant should be reviewed range-wide to see if it may represent a distinct association.

##### Global Similar Associations:

- *Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest (CEGL002474)
- *Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest (CEGL002446)
- *Populus tremuloides* - (*Populus grandidentata*) Rocky Woodland (CEGL002487)
- *Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036)

##### Global Related Concepts:

- White Spruce Mixedwood (V13) (Zoladeski et al. 1995) =
- White Spruce Mixedwood (V15) (Sims et al. 1989) =

#### ELEMENT DISTRIBUTION

**Global Range:** This spruce - fir - aspen forest type is found in the western Great Lakes area of the United States and Canada and elsewhere in parts of central Canada, ranging from northern Minnesota and Manitoba east to Michigan and possibly Quebec.

**Nations:** CA, US**States/Provinces:** MB:S4S5, MI, MN, ON, QC, WI:S2**TNC Ecoregions:** 35:C, 46:C, 47:C, 48:C**USFS Ecoregions (1994/95):** 212He:CC?, 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Hv:CCP, 212Hw:CCP, 212Ia:CCP, 212Ib:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Mb:CCC, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212Ob:C??, 222Ma:CCC, 222Na:CCC**Federal Lands:** NPS (Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Ottawa, Superior)**Federal Lands:** Information not available.**ELEMENT SOURCES****Grand Portage National Monument Plots:** GRPO.5, GRPO.22.**Grand Portage National Monument Map Code:** FCP**Local Description Authors:** M.J. Russo**Global Description Authors:** J. Drake**References:** Epstein pers. comm., Greenall 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data, Zoladeski et al. 1995**Spruce - Fir / Mountain Maple Forest***Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest**White Spruce - Balsam Fir / Mountain Maple / Dwarf Red Raspberry Forest****Identifier:** CEG002446**NVC CLASSIFICATION**

Division	North American Lowland Boreal Forest (1.D.1.a)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)
Group	White Spruce - Balsam Fir Forest (G048)
Association (Common name)	Spruce - Fir / Mountain Maple Forest
<b>Ecological System(s):</b>	Boreal White Spruce-Fir-Hardwood Forest (CES103.021)

**ELEMENT CONCEPT**

**Global Summary:** This white spruce - balsam fir conifer forest is found in the southern boreal region of the Great Lakes in the United States and elsewhere in central Canada. Stands are found primarily on dry-mesic to mesic sites with well-drained, deep (>60 cm), loam, sand, or silt soils. Less commonly, it may be found on wetter sites. The soils have little organic content, and the topography is flat to gently sloping. This community is a closed-canopy forest dominated by a combination of *Picea glauca* (white spruce) and *Abies balsamea* (balsam fir). Common associates include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus banksiana* (jack pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). There is usually a prominent shrub/sapling layer containing *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Picea glauca* (white spruce), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), *Sorbus americana* (American mountain-ash), *Vaccinium myrtilloides* (velvetleaf huckleberry), and (eastward) *Viburnum nudum* var. *cassinoides* (withe-rod). The herbaceous layer is often moderately sparse, with species such as *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower). Mosses include *Dicranum polysetum* (dicranum moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss).

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This white spruce - balsam fir forest was sampled once in the park. The site is a gentle southeast-facing slope with moderately well-drained clay soil. The surface is dominated by leaf litter (75% cover) with some wood (20%) and plant stems (5%). Evidence of disturbance includes many downed trees, possibly due to wind damage, shallow soil and/or drought.

**Global Environment:** This community is found primarily on dry-mesic to mesic sites with well-drained, deep (>60 cm) loam, sand, or silt 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.

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderate (60% cover) tree canopy, 20-35 m tall, is dominated by *Abies balsamea* (balsam fir) with lesser amounts of *Picea glauca* (white spruce) and *Betula papyrifera* (paper birch). In addition, there is a sparse (20%) emergent tree layer (35-50 m) of *Pinus strobus* (eastern white pine). *Acer spicatum* (mountain maple) forms a sparse (20%) subcanopy (10-15 m) and moderate (40%) tall-shrub layer (2-5 m). Additional tall shrubs include *Abies balsamea* (balsam fir)

and *Sorbus decora* (northern mountain-ash). The moderate (50%) short-shrub layer (0.5-1 m) is dominated by *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), and *Rubus* (blackberry) sp. and includes small amounts of *Amelanchier* (serviceberry) sp., *Cornus sericea* (red-osier dogwood), *Lonicera hispidula* (pink honeysuckle), *Prunus virginiana* (chokecherry), and *Taxus canadensis* (Canada yew). The moderately dense (70%) herbaceous layer is dominated by *Carex pedunculata* (longstalk sedge), *Cornus canadensis* (bunchberry dogwood), *Equisetum sylvaticum* (woodland horsetail), *Eurybia macrophylla* (bigleaf aster), and *Mitella nuda* (naked miterwort); additional herbs include *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Linnaea borealis* (twinline), *Lycopodium annotinum* (stiff clubmoss), *Symphotrichum ciliolatum* (Lindley's aster), and others. Nonvascular species (mosses) cover 30% of the ground surface.

**Global Vegetation:** This community is a closed-canopy forest dominated by a combination of *Picea glauca* (white spruce) and *Abies balsamea* (balsam fir). Some stands have a preponderance of one of these species and the other may then be an important associate. In these situations it is typically *Picea glauca* (white spruce) that is the most abundant (Maycock and Curtis 1960, MNNHP 1993). Common associates include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus banksiana* (jack pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). There is usually a prominent shrub/sapling layer containing *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Picea glauca* (white spruce), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), *Sorbus americana* (American mountain-ash), *Vaccinium myrtilloides* (velvetleaf huckleberry), and (eastward) *Viburnum nudum* var. *cassinoides* (withe-rod). The herbaceous layer is often moderately sparse, with species such as *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort) and *Trientalis borealis* (starflower). Mosses include *Dicranum polysetum* (dicranum moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss) (Sims et al. 1989, Chambers et al. 1997).

#### MOST ABUNDANT SPECIES

##### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Abies balsamea</i> (balsam fir)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer spicatum</i> (mountain maple)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)

#### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Carex pedunculata* (longstalk sedge), *Cornus canadensis* (bunchberry dogwood), *Corylus cornuta* (beaked hazelnut), *Equisetum sylvaticum* (woodland horsetail), *Eurybia macrophylla* (bigleaf aster), *Lonicera canadensis* (American fly honeysuckle), *Mitella nuda* (naked miterwort), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine)

#### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4G5 (3-Oct-1996).

#### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 1 - Strong

**Global Comments:** This type occurs in a variety of sites, including sites that are fairly wet, and occurs both after disturbances and as a late-successional type. It is difficult to separate from the mixed spruce-fir-hardwood types, *Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest (CEGL002475), from which it may only differ in the degree of conifer dominance. Treefalls in this type can create a very open canopy. Inclusions of Spruce-Fir/Feathermoss, *Picea glauca* - *Abies balsamea* / *Pleurozium schreberi* Forest (CEGL002509), may occur in this type in the Great Lake states. Conversely, CEGL002509 appears to be the common type in Manitoba, and this type is not expected (J. Greenall pers. comm. 1999). In northern Wisconsin this type has been documented only in ravines or on stable clay bluffs and is not known from the extensive Lake Superior clayplains [see *Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest (CEGL002475)].

##### Global Similar Associations:

- *Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest (CEGL002474)
- *Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest (CEGL002475)--This is the mixed hardwood-conifer equivalent.
- *Picea glauca* - *Abies balsamea* / *Pleurozium schreberi* Forest (CEGL002509)
- *Pinus strobus* - *Populus tremuloides* / *Corylus cornuta* Forest (CEGL002479)
- *Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036)

##### Global Related Concepts:

- *Abies*-*Populus*/*Rosa*/*Mertensia*, *Corylus*/*Diervilla*/*Aster*-*Anemone* Group (La Roi 1967) =
- Aetna Creek Stand (Maycock 1961) =
- Delaware Stand (Maycock 1961) =
- Dry-mesic Stands (Maycock and Curtis 1960) =

- White Spruce - Balsam Fir / Shrub Forest (Zoladeski et al. 1995) =
- White Spruce - Balsam Fir / Shrub Rich Forest (Sims et al. 1989) =

### ELEMENT DISTRIBUTION

**Global Range:** This white spruce - balsam fir conifer forest is found in the southern boreal region of the Great Lakes of the United States and elsewhere in central Canada.

**Nations:** CA, US

**States/Provinces:** MB:S4, MI, MN:S3, ON, QC, WI:S2

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Hr:CCP, 212Hs:CC?, 212Hv:CC?, 212Hw:CCP, 212Ib:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Jk:CCP, 212Jl:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Ma:CCC, 212Mb:CCP, 212Na:CCP, 212Nb:CCP, 212Nc:CCP, 212Oa:CCC

**Federal Lands:** NPS (Grand Portage, Pictured Rocks, Saint Croix, Voyageurs); USFS (Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Ottawa, Superior)

**Federal Lands:** Information not available.

### ELEMENT SOURCES

**Grand Portage National Monument Plots:** GRPO.11.

**Grand Portage National Monument Map Code:** FSF

**Local Description Authors:** M.J. Russo

**Global Description Authors:** J. Drake

**References:** Chambers et al. 1997, Greenall 1996, La Roi 1967, MNNHP 1993, Maycock 1961, Maycock and Curtis 1960, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data, Zoladeski et al. 1995

## Aspen - Birch / Boreal Conifer Forest

*Populus tremuloides* - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest

Quaking Aspen - Paper Birch / (Balsam Fir, White Spruce) Forest

Identifier: CEGL002466

### NVC CLASSIFICATION

Division	North American Lowland Boreal Forest (1.D.1.a)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (MG037)
Group	White Spruce - Balsam Fir Forest (G048)
Association (Common name)	Aspen - Birch / Boreal Conifer Forest
<b>Ecological System(s):</b>	Boreal Aspen-Birch Forest (CES103.020)

### ELEMENT CONCEPT

**Global Summary:** This aspen - birch boreal hardwoods forest type is found in the boreal regions of the midwestern United States and in central Canada. Sites occupy a variety of topographic positions, including ridgetops and gentle to moderate upper, mid, and lower slopes. The soils are deep, well-drained to rapidly drained mineral soils (dry to mesic soils). Soil textures are usually clay loamy but can be silt or fine sand. This community is dominated by deciduous trees, with a moderate amount of conifers (<25%). The canopy is dominated by *Betula papyrifera* (paper birch) and *Populus tremuloides* (quaking aspen), and occasionally *Populus grandidentata* (bigtooth aspen). Conifer associates include *Abies balsamea* (balsam fir) and *Picea glauca* (white spruce), either in the canopy or, more characteristically, in the subcanopy. *Abies balsamea* (balsam fir) and *Picea glauca* (white spruce) are abundant in the sapling layer. Common shrubs include *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), *Sorbus decora* (northern mountain-ash), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous stratum is sometimes dominated by *Eurybia macrophylla* (bigleaf aster), but can include a diversity of forbs, such as *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *longipes* (twistedstalk), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). Mosses include *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss). Diagnostic features of this type are the dominance by the combination of *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch), boreal conifer associates (but very little *Picea mariana* (black spruce) or *Pinus banksiana* (jack pine)), and lack of more southern hardwoods (such as *Acer saccharum* (sugar maple)).

### ENVIRONMENTAL DESCRIPTION

**Grand Portage National Monument Environment:** This aspen - birch forest was sampled once in the park. The site is a moderate north-facing upper slope with moderately well-drained clay soil. The surface is dominated by leaf litter (87% cover) with some wood (3%), bare soil (5%) and plant stems (5%). No evidence of disturbance was reported.

**Global Environment:** This community is found on a variety of topographic positions. Ohmann 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 (including lacustrine clays or clayier tills), silt, or sand.

### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** The moderate (50% cover) tree canopy, 20-35 m tall, is dominated by *Populus tremuloides* (quaking aspen) along with *Abies balsamea* (balsam fir) and *Betula papyrifera* (paper birch). The sparse (20%) tall-shrub layer (2-5 m) includes canopy species as well as *Acer spicatum* (mountain maple) and *Fraxinus nigra* (black ash). The moderate (30%) short-shrub layer (0.5-1 m) is dominated by *Cornus sericea* (red-osier dogwood) and *Corylus cornuta* (beaked hazelnut) and includes *Alnus incana* ssp. *rugosa* (speckled alder), *Alnus viridis* (green alder), *Amelanchier* (serviceberry) sp., *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Lonicera hirsuta* (hairy honeysuckle), and *Prunus virginiana* (chokecherry). The very dense (90%) herbaceous layer is dominated by *Eurybia macrophylla* (bigleaf aster) and *Pteridium aquilinum* (western brackenfern) and includes *Apocynum androsaemifolium* (spreading dogbane), *Aralia nudicaulis* (wild sarsaparilla), *Calamagrostis canadensis* (bluejoint), *Fragaria virginiana* (Virginia strawberry), *Heracleum maximum* (common cowparsnip), *Lathyrus ochroleucus* (cream pea), and *Pteridium aquilinum* (western brackenfern). Nonvascular species (mosses), including *Brachythecium* (brachythecium moss) sp., cover 5% of the ground surface.

**Global Vegetation:** 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* (paper birch) and *Populus tremuloides* (quaking aspen), and occasionally *Populus grandidentata* (bigtooth aspen). Conifer associates include *Abies balsamea* (balsam fir) and *Picea glauca* (white spruce), either in the canopy or, more characteristically, in the subcanopy. *Abies balsamea* (balsam fir) and *Picea glauca* (white spruce) are abundant in the sapling layer. Common shrubs include *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), *Sorbus decora* (northern mountain-ash), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous stratum is sometimes dominated by *Eurybia macrophylla* (bigleaf aster), but can include a diversity of forbs, such as *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* (twistedstalk), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). Mosses include *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough goose neck moss) (Sims et al. 1989, Chambers et al. 1997).

### MOST ABUNDANT SPECIES

#### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus tremuloides</i> (quaking aspen)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer spicatum</i> (mountain maple), <i>Populus tremuloides</i> (quaking aspen)
Short shrub/sapling	Broad-leaved evergreen shrub	<i>Cornus sericea</i> (red-osier dogwood), <i>Corylus cornuta</i> (beaked hazelnut)
Herb (field)	Forb	<i>Eurybia macrophylla</i> (bigleaf aster)
Herb (field)	Fern or fern ally	<i>Pteridium aquilinum</i> (western brackenfern)

### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula papyrifera* (paper birch), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Eurybia macrophylla* (bigleaf aster), *Populus tremuloides* (quaking aspen), *Pteridium aquilinum* (western brackenfern)

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G5 (3-Oct-1996).

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 1 - Strong

**Global Comments:** Further north in Ontario, a *Populus tremuloides* - *Betula papyrifera* type, *Populus* (*tremuloides*, *balsamifera*) - (*Betula papyrifera*) - *Picea mariana* / *Alnus viridis* Forest (CEGL002514), occurs that contains greater proportions of *Picea mariana* (black spruce) and *Pinus banksiana* (jack pine). *Acer spicatum* (mountain maple) drops out of this type in the more western part of the type's range in Ontario and Minnesota. This type is often an early successional type following fire or logging, and occupies a wide variety of site types.

#### Global Similar Associations:

- *Betula papyrifera* / *Diervilla lonicera* - (*Abies balsamea*) Forest (CEGL002463)
- *Populus* (*tremuloides*, *balsamifera*) - (*Betula papyrifera*) - *Picea mariana* / *Alnus viridis* Forest (CEGL002514)
- *Populus tremuloides* - (*Populus grandidentata*) Rocky Woodland (CEGL002487)

- *Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest (CEGL002467)--This type contains neither a northern hardwoods understory nor a boreal conifer understory.
- *Populus tremuloides* - *Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest (CEGL002468)--This type contains a mixed northern hardwoods understory.

**Global Related Concepts:**

- Aspen - Birch (Ohmann and Ream 1971) =
- Boreal Forest (Chapman et al. 1989) B
- Paper Birch - Aspen - Balsam Fir - White Spruce (Hansen et al. 1973) =
- Trembling Aspen (White Birch) - Balsam Fir / Mountain Maple (V6) (Sims et al. 1989) F
- Trembling Aspen - Balsam Fir / Balsam Fir Shrub (V7) (Sims et al. 1989) F
- Trembling Aspen-White Birch-White Spruce-Dwarf Raspberry (V22) (Chambers et al. 1997) =

**ELEMENT DISTRIBUTION**

**Global Range:** This aspen - birch boreal hardwoods forest type is found in the boreal regions of the midwestern United States and in central Canada, ranging from Minnesota and Manitoba east to Michigan, Ontario and possibly Quebec.

**Nations:** CA, US

**States/Provinces:** MB:S4S5, MI, MN:S4?, ON, QC:S4, WI:S5

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Ha:CPP, 212Hb:CPP, 212He:CPP, 212Hh:CPP, 212Hi:CPP, 212Hj:CPP, 212Hk:CPP, 212Ia:CCC, 212Ib:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CP?, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212La:CCP, 212Lb:CCC, 212Lc:CCC, 212Ld:CCC, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Saint Croix, Voyageurs); USFS (Chippewa, Ottawa, Superior)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.1.

**Grand Portage National Monument Map Code:** FAC

**Local Description Authors:** M.J. Russo

**Global Description Authors:** J. Drake

**References:** Chambers et al. 1997, Chapman et al. 1989, Greenall 1996, Hansen et al. 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, WNHIP unpubl. data

**2. Shrubland & Grassland****2.C.2. Boreal Grassland, Meadow & Shrubland****2.C.2.a. North American Boreal Grassland, Meadow & Shrubland****MG055. North American Boreal Shrubland & Grassland****G339. Eastern North American Boreal Shrubland & Grassland****Boreal Hazelnut - Serviceberry Rocky Shrubland**

*Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland

Beaked Hazelnut - Serviceberry species - Chokecherry Rocky Shrubland

**Identifier:** CEGL005197

**NVC CLASSIFICATION**

Division	North American Boreal Grassland, Meadow & Shrubland (2.C.2.a)
Macrogroup	North American Boreal Shrubland & Grassland (MG055)
Group	Eastern North American Boreal Shrubland & Grassland (G339)
Association (Common name)	Boreal Hazelnut - Serviceberry Rocky Shrubland
<b>Ecological System(s):</b>	Great Lakes Acidic Rocky Shore and Cliff (CES201.025) Laurentian Acidic Rocky Outcrop (CES201.019)

**ELEMENT CONCEPT**

**Global Summary:** This rocky shrubland is found in the northern Great Lakes region of the United States and Canada. Stands occur on rocky ridges, with thin, acidic soils. The vegetation is dominated by shrubs, with a strong graminoid layer. Dominant shrubs include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), and *Prunus virginiana* (chokecherry). Other shrubs include *Juniperus communis* (common juniper), *Rosa acicularis* (prickly rose), and *Rhus typhina* (staghorn sumac). Associated herbs include *Danthonia spicata* (poverty oatgrass), *Hieracium* (hawkweed) spp., and *Poa compressa* (Canada bluegrass).

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This serviceberry short shrubland was sampled once in the park near Mount Rose. The site is a steep, southeast-facing ridge with rapidly drained sandy loam soil. The surface is dominated by leaf litter (76% cover) with some small rocks (4%), bare soil (4%) and plant stems (20%). Evidence of disturbance includes trails, dead and brown vegetation due to drought conditions, and the presence of exotic plants.

**Global Environment:** Stands occur on rocky ridges, with thin, acidic soils (C. Reschke pers. comm. 1999).

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderately sparse (40%) short-shrub layer (0.5-1 m) is dominated by *Amelanchier* (serviceberry) sp. and includes *Diervilla lonicera* (northern bush honeysuckle) and *Prunus pensylvanica* (pin cherry). *Arctostaphylos uva-ursi* (kinnikinnick) forms a very sparse (5%) dwarf-shrub layer. The moderately sparse (40%) herbaceous layer is dominated by *Danthonia spicata* (poverty oatgrass) and includes small amounts of *Antennaria neglecta* (field pussytoes), *Fragaria virginiana* (Virginia strawberry), *Solidago* (goldenrod) sp., and several exotic species. Nonvascular species (mosses and lichens) cover 30% of the ground surface and are dominated by *Cladina* (reindeer lichen) spp.

**Global Vegetation:** The vegetation is dominated by shrubs, with a strong graminoid layer. Dominant shrubs include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), and *Prunus virginiana* (chokecherry). Other shrubs include *Juniperus communis* (common juniper), *Rosa acicularis* (prickly rose), and *Rhus typhina* (staghorn sumac). Associated herbs include *Danthonia spicata* (poverty oatgrass), *Hieracium* (hawkweed) spp., and *Poa compressa* (Canada bluegrass) (C. Reschke pers. comm. 1999).

**MOST ABUNDANT SPECIES****Grand Portage National Monument****Stratum**

Herb (field)

**Lifeform**

Graminoid

**Species***Danthonia spicata* (poverty oatgrass)**CHARACTERISTIC SPECIES**

**Grand Portage National Monument:** *Danthonia spicata* (poverty oatgrass)

**OTHER NOTEWORTHY SPECIES**

**Grand Portage National Monument: Exotic/Invasive:** *Leucanthemum vulgare* (oxeye daisy, exotic/invasive, Medium/Low), *Poa compressa* (Canada bluegrass, exotic/invasive, High/Low)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** GNR (3-Oct-1996).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 3 - Weak

**Global Comments:** Type concept is taken from studies on Isle Royale and needs rangewide review. The associated herbaceous type is *Danthonia spicata* - *Poa compressa* Granite Herbaceous Vegetation (CEGL005157), which is dominated by *Danthonia spicata* (poverty oatgrass) and *Poa compressa* (Canada bluegrass).

**Global Similar Associations:**

- *Juniperus communis* - (*Quercus rubra*) / *Juniperus horizontalis* - *Arctostaphylos uva-ursi* Shrubland (CEGL005065)
- *Picea glauca* - (*Betula papyrifera*) / *Danthonia spicata* Woodland (CEGL005196)

**Global Related Concepts:**

- Boreal Shrubland (Chapman et al. 1989) ?

**ELEMENT DISTRIBUTION**

**Global Range:** This rocky shrubland type is found in the northern Great Lakes region of the United States and Canada.

**Nations:** CA, US

**States/Provinces:** MI, MN, ON, QC

**TNC Ecoregions:** 48:C

**USFS Ecoregions (1994/95):** 212Ib:CCC, 212Lb:CCC

**Federal Lands:** NPS (Grand Portage, Isle Royale, Voyageurs)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.16.

**Grand Portage National Monument Map Code:** SHS

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Midwestern Ecology Working Group n.d., Reschke pers. comm.

**2.C.5. Temperate & Boreal Freshwater Wet Meadow & Marsh****2.C.5.a. Eastern North America Freshwater Wet Meadow, Riparian & Marsh****MG069. Eastern & North-Central North American Marsh & Wet Meadow****G125. Eastern North American Freshwater Marsh****Water Horsetail - Spikerush Marsh***Equisetum fluviatile* - (*Eleocharis palustris*) Herbaceous Vegetation

Water Horsetail - (Common Spikerush) Herbaceous Vegetation

Identifier: CEGLO05258

**NVC CLASSIFICATION**

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.a)
Macrogroup	Eastern & North-Central North American Marsh & Wet Meadow (MG069)
Group	Eastern North American Freshwater Marsh (G125)
Association (Common name)	Water Horsetail - Spikerush Marsh
<b>Ecological System(s):</b>	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582) Laurentian-Acadian Freshwater Marsh (CES201.594)

**ELEMENT CONCEPT**

**Global Summary:** This low graminoid marsh community is found in the boreal regions of the Great Lakes and perhaps more widely in Canada. 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. A layer of partially decomposed stalks may be present. Emergent cover is greater than 25%, and floating-leaved and submergent cover is low. Emergent graminoids <1 m dominate the stands, including *Equisetum fluviatile* (water horsetail) and/or *Eleocharis palustris* (common spikerush). Associated species of low constancy include *Glyceria borealis* (small floating mannagrass), *Isoetes tenella* (spiny-spore quillwort), *Potamogeton gramineus* (variableleaf pondweed), and *Utricularia macrorhiza* (common bladderwort).

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This low graminoid marsh community was sampled once in the park near Fort Charlotte. The site is a gently sloping, permanently flooded floodplain of Pigeon River with poorly drained muck soil. The surface is made up of leaf litter (38% cover), large rocks (1%), wood (1%), standing water (35%), bare soil (20%) and plant stems (5%). Evidence of disturbance includes a nearby canoe portage.

**Global Environment:** 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).

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** The moderate (50%) herbaceous layer is dominated by nearly equal amounts of *Acorus calamus* (calamus), *Carex vesicaria* (blister sedge), *Equisetum fluviatile* (water horsetail), *Lysimachia terrestris* (earth loosestrife), and *Sagittaria* (arrowhead) sp. Additional species include *Bidens cernua* (nodding beggarticks), *Eleocharis* (spikerush) sp., *Lycopus uniflorus* (northern bugleweed), *Megalodonta beckii* (Beck's watermarigold), *Scirpus cyperinus* (woolgrass), and *Triadenum fraseri* (Fraser's marsh St. Johnswort).

**Global Vegetation:** Emergent cover is greater than 25%, and floating-leaved and submergent cover is low. Emergent graminoids <1 m dominate the stands, including *Equisetum fluviatile* (water horsetail) and/or *Eleocharis palustris* (common spikerush). Associated species of low constancy include *Glyceria borealis* (small floating mannagrass), *Isoetes tenella* (spiny-spore quillwort), *Potamogeton gramineus* (variableleaf pondweed), and *Utricularia macrorhiza* (common bladderwort) (Harris et al. 1996).

**MOST ABUNDANT SPECIES****Grand Portage National Monument**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Acorus calamus</i> (calamus), <i>Lysimachia terrestris</i> (earth loosestrife)
Herb (field)	Graminoid	<i>Carex vesicaria</i> (blister sedge)
Herb (field)	Fern or fern ally	<i>Equisetum fluviatile</i> (water horsetail)

**CHARACTERISTIC SPECIES**

**Grand Portage National Monument:** *Acorus calamus* (calamus), *Carex vesicaria* (blister sedge), *Equisetum fluviatile* (water horsetail), *Lysimachia terrestris* (earth loosestrife)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G4 (1-Feb-1996).

**CLASSIFICATION****Status:** Standard**Classification Confidence:** 2 - Moderate**Global Comments:** This type can occur as reed swamp communities. It can grade into bulrush-dominated communities, or occur in conjunction with wild rice marshes. The range limit westward for this type (CEGL005258) remains to be worked out. The Northern Great Lakes Emergent Marsh type, *Schoenoplectus acutus* - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation (CEGL005274), may resemble this type to some degree.**Global Similar Associations:**

- *Equisetum fluviatile* Herbaceous Vegetation (CEGL002746)--is a western type. The range limit westward for CEGL005258 and eastward for CEGL001960 remains to be worked out.
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386)
- *Nymphaea tetragona* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation (CEGL002563)
- *Schoenoplectus acutus* - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation (CEGL005274)

**Global Related Concepts:**

- Marsh: spikerush-water horsetail: mineral substrate (W6) (Harris et al. 1996) =

**ELEMENT DISTRIBUTION****Global Range:** This low graminoid marsh community is found in the boreal regions of the Great Lakes and perhaps more widely in Canada.**Nations:** CA, US**States/Provinces:** MB:S4, MI, MN, ON, QC**TNC Ecoregions:** 47:C, 48:C**USFS Ecoregions (1994/95):** 212Hi:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC**Federal Lands:** NPS (Grand Portage, Isle Royale, Pictured Rocks, Voyageurs)**Federal Lands:** Information not available.**ELEMENT SOURCES****Grand Portage National Monument Plots:** GRPO.7.**Grand Portage National Monument Map Code:** HHS**Local Description Authors:** M.J. Russo**Global Description Authors:** D. Faber-Langendoen**References:** Harris et al. 1996, Midwestern Ecology Working Group n.d.**G112. Eastern North American Wet Meadow****Bluejoint Wet Meadow*****Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation****Bluejoint - Spotted Joe-pyeweed Herbaceous Vegetation****Identifier:** CEGL005174**NVC CLASSIFICATION**

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.a)
Macrogroup	Eastern & North-Central North American Marsh & Wet Meadow (MG069)
Group	Eastern North American Wet Meadow (G112)
Association (Common name)	Bluejoint Wet Meadow
<b>Ecological System(s):</b>	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
<b>Ecological System(s):</b>	Eastern Boreal Floodplain (CES103.588)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	Central Appalachian River Floodplain (CES202.608)
	High Allegheny Wetland (CES202.069)

**ELEMENT CONCEPT****Global Summary:** This wet meadow vegetation is widespread in the northeastern and midwestern United States and central and eastern Canada. Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat. Water regime varies between temporarily and seasonally flooded. Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex utriculata* (Northwest Territory sedge), and *Carex stricta* (upright sedge). In fen transitions, *Carex lasiocarpa* (woollyfruit sedge) can be present. *Agrostis gigantea* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb),**Appendix B: Descriptions of Vegetation Types**

*Eupatorium maculatum* (spotted joepeyweed), *Eupatorium perfoliatum* (common boneset), *Impatiens capensis* (jewelweed), *Iris versicolor* (harlequin blueflag), *Polygonum amphibium* (water knotweed), and *Comarum palustre* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrow-wood), *Spiraea alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Alnus incana* (gray alder), or *Alnus serrulata* (hazel alder), may be present. *Phalaris arundinacea* (reed canarygrass) and/or *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

#### ENVIRONMENTAL DESCRIPTION

**Grand Portage National Monument Environment:** This reed canarygrass herbaceous vegetation was sampled once in the park near Poplar Creek. The site is a flat, intermittently flooded floodplain with moderately well-drained clay soil. The surface is dominated by leaf litter (88% cover) with some wood (1%), standing water (5%) and plant stems (6%). Evidence of disturbance includes animal and human paths and signs of beaver activity.

**Global Environment:** Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat or peat silt loam with a thick root mat. Water regime varies between temporarily and seasonally flooded.

#### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** *Cornus sericea* (red-osier dogwood) and *Spiraea alba* (white meadowsweet) form a very sparse (10% cover) short-shrub layer (1-2 m tall) over the dominant herbaceous layer (90%). *Phalaris arundinacea* (reed canarygrass) clearly dominates; additional herbs include small amounts of Asteraceae sp., *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Eupatorium maculatum* (spotted joepeyweed), *Heracleum maximum* (common cowparsnip), *Lycopus uniflorus* (northern bugleweed), and *Scirpus cyperinus* (woolgrass).

**Global Vegetation:** Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex rostrata* (beaked sedge), and *Carex stricta* (upright sedge). In fen transitions, *Carex lasiocarpa* (woollyfruit sedge) can be present. *Agrostis gigantea* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepeyweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Polygonum amphibium* (water knotweed), and *Comarum palustre* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrow-wood), *Spiraea alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Alnus incana* (gray alder), or *Alnus serrulata* (hazel alder), may be present. *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

#### MOST ABUNDANT SPECIES

##### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Phalaris arundinacea</i> (reed canarygrass)

##### Global

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Calamagrostis canadensis</i> (bluejoint)

#### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Phalaris arundinacea* (reed canarygrass)

**Global:** *Calamagrostis canadensis* (bluejoint)

#### OTHER NOTEWORTHY SPECIES

**Global: Vulnerable:** *Polemonium vanbruntiae* (Vanbrunt's polemonium, G3G4)

#### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4G5 (31-Mar-2000). This type is widespread throughout the northeastern and upper midwestern United States and central/southern Canada.

#### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** This type can grade into sedge meadows. A guideline of <50% sedges may be suggested as a criterion for the definition of this type compared to sedge meadow types. Harris et al. (1996) suggest that the bluejoint meadow type is drier than sedge meadows and less peaty than shore fens.

##### Global Similar Associations:

- *Calamagrostis canadensis* - *Doellingeria umbellata* - *Spartina pectinata* Herbaceous Vegetation (CEGL006427)
- *Calamagrostis canadensis* - *Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258)--Dominance of sedges versus grasses is much higher.
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044)

- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474)
- *Phleum pratense* - (*Calamagrostis canadensis*) Semi-natural Herbaceous Vegetation (CEGL005249)

**Global Related Concepts:**

- *Calamagrostis canadensis* herbaceous community (Walbridge and Lang 1982) =
- *Calamagrostis canadensis* meadow (Walbridge 1982) =
- *Calamagrostis canadensis* wet meadow (Fortney 1975) =
- *Calamagrostis canadensis* wet meadow (Byers et al. 2007) =
- Canada bluejoint-tussock sedge meadow (CAP pers. comm. 1998) ?
- Meadow marsh: bluejoint grass (W13) (Harris et al. 1996) =
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) ?
- SNE low-energy riverbank community (Rawinski 1984) ?
- Shallow Emergent Marsh (Thompson 1996) ?

**ELEMENT DISTRIBUTION**

**Global Range:** This wet meadow vegetation is widely distributed in the northeastern and midwestern United States and south-central and southeastern Canada. It ranges from Maine south to West Virginia and possibly Virginia and west to Minnesota.

**Nations:** CA, US

**States/Provinces:** CT, DE, MA, MD, ME, MI, MN, NH, NJ, NY, ON, PA, QC:S4?, RI, VA?, VT, WI, WV:S2

**TNC Ecoregions:** 35:C, 45:C, 47:C, 48:C, 51:P, 59:C, 60:C, 61:C, 63:C, 64:C

**USFS Ecoregions (1994/95):** 212Cb:CCC, 212Fa:CCC, 212Fb:CCC, 212Fc:CCC, 212Fd:CCC, 212Ga:CCC, 212Gb:CCC, 212Hi:CCC, 212Hj:CCC, 212Ho:CCC, 212Hs:CCC, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ib:CCC, 212La:CCP, 212Lb:CCC, 212Na:CPP, 221Ae:CCP, 221Af:CCC, 221Ag:CCC, 221Ah:CCC, 221Ai:CCC, 221Al:CCC, 221Ba:CCP, 221Bb:CCC, 221Bc:CCP, 221Bd:CCC, 221D:CC, 222Jg:CCC, 222Na:CCC, 251Aa:CCC, M212Bb:CCC, M212Bc:CCC, M212Bd:CCC, M212Cb:CCC, M212Ea:CCC, M212Eb:CCC, M221Ba:CCC, M221Bb:CCC, M221Db:C??, M221Dc:C??, M221Dd:C??

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Minute Man, Pictured Rocks, Saint Croix, Saint-Gaudens, Sleeping Bear Dunes, Valley Forge, Voyageurs); USFS (Monongahela); USFWS (Assabet River?, Canaan Valley, Great Meadows?)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.13.

**Grand Portage National Monument Map Code:** HCC

**Local Description Authors:** M.J. Russo

**Global Description Authors:** S.C. Gawler

**References:** Breden et al. 2001, Browning 1859, Byers et al. 2007, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Fike 1999, Fortney 1975, Francl et al. 2004, Gawler 2002, Harris et al. 1996, Harrison 2004, NAP pers. comm. 1998, Rawinski 1984, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data, Walbridge 1982, Walbridge and Lang 1982

**Northern Sedge Wet Meadow**

*Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria) Herbaceous Vegetation*

**(Beaked Sedge, Northwest Territory Sedge) - Lake Sedge - (Inflated Sedge) Herbaceous Vegetation**

**Identifier:** CEGL002257

**NVC CLASSIFICATION**

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.a)
Macrogroup	Eastern & North-Central North American Marsh & Wet Meadow (MG069)
Group	Eastern North American Wet Meadow (G112)
Association (Common name)	Northern Sedge Wet Meadow
<b>Ecological System(s):</b>	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Northern Great Lakes Coastal Marsh (CES201.722)
	Western Great Plains Open Freshwater Depression Wetland (CES303.675)
	North-Central Interior Floodplain (CES202.694)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	High Allegheny Wetland (CES202.069)

**ELEMENT CONCEPT**

**Global Summary:** This northern tall sedge community is found in the mixed conifer - hardwood zone of the Great Lakes region and north into Canada, with outliers in the Allegheny Mountains region of West Virginia and Maryland. 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. 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* (water sedge), *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), *Carex utriculata* (Northwest Territory sedge), *Carex vesicaria* (blister sedge), and locally *Carex stricta* (upright sedge). Other graminoids include *Calamagrostis canadensis* (bluejoint), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), and in wetter areas, *Eleocharis palustris* (common spikerush) and *Equisetum fluviatile* (water horsetail). Forbs include *Acorus calamus* (calamus), *Symphotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepeeweed), *Iris virginica* var. *shrevei* (Shreve's iris), *Lycopus uniflorus* (northern bugleweed), *Poa palustris* (fowl bluegrass), *Polygonum amphibium* (water knotweed), *Comarum palustre* (purple marshlocks), and others. Diagnostic features include the general dominance by coarse-leaved sedges, wet, somewhat peaty soil conditions, and the mix of sub-boreal herbs with more temperate herbs.

#### ENVIRONMENTAL DESCRIPTION

**Grand Portage National Monument Environment:** This northern tall sedge community was sampled at two locations in the park. The sites are flat, seasonally flooded floodplains with poorly drained peat soil and hummock-and-hollow microtopography. The surface is dominated by leaf litter (55-60% cover) with some wood (0-1%), standing water (10-20%), bare soil (5-9%) and plant stems (15-20%). Evidence of disturbance includes animal and human paths and signs of beaver activity.

**Global Environment:** 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).

#### VEGETATION DESCRIPTION

**Grand Portage National Monument Vegetation:** *Alnus incana* ssp. *rugosa* (speckled alder) and *Salix* (willow) sp. form a very sparse (<5% cover) short-shrub layer (1-2 m tall) over the dominant herbaceous layer (70%). *Carex lacustris* (hairy sedge) dominates; additional herbs include *Bidens cernua* (nodding beggarticks), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex stricta* (upright sedge), *Comarum palustre* (purple marshlocks), *Equisetum fluviatile* (water horsetail), *Glyceria canadensis* (rattlesnake mannagrass), *Iris versicolor* (harlequin blueflag), *Scirpus cyperinus* (woolgrass), *Sparganium natans* (small bur-reed), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Typha* (cattail) sp., and *Utricularia intermedia* (flatleaf bladderwort). Nonvascular species (sphagnum and other mosses) cover 10% of the ground surface.

**Global Vegetation:** 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* (water sedge), *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), *Carex vesicaria* (blister sedge), and locally *Carex stricta* (upright sedge). Other graminoids include *Calamagrostis canadensis* (bluejoint), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), and in wetter areas, *Eleocharis palustris* (common spikerush) and *Equisetum fluviatile* (water horsetail). Forbs include *Acorus calamus* (calamus), *Symphotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepeeweed), *Iris virginica* var. *shrevei* (Shreve's iris), *Lycopus uniflorus* (northern bugleweed), *Poa palustris* (fowl bluegrass), *Polygonum amphibium* (water knotweed), *Comarum palustre* (purple marshlocks), and others (Curtis 1959, Harris et al. 1996).

#### MOST ABUNDANT SPECIES

##### Grand Portage National Monument

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Iris versicolor</i> (harlequin blueflag)
Herb (field)	Graminoid	<i>Carex lacustris</i> (hairy sedge)

#### CHARACTERISTIC SPECIES

**Grand Portage National Monument:** *Calla palustris* (water arum), *Carex lacustris* (hairy sedge), *Carex stricta* (upright sedge), *Comarum palustre* (purple marshlocks), *Iris versicolor* (harlequin blueflag)

#### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G4G5 (17-Jun-1999).

#### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** Expansion of the range of this type eastward to Massachusetts and West Virginia is based on the ambiguous application of *Carex utriculata* (Northwest Territory sedge) in past studies. Taxonomy and distribution of *Carex utriculata* (Northwest Territory sedge) versus *Carex rostrata* (beaked sedge) needs to be resolved. In Gleason and Cronquist (1991), *Carex rostrata* (beaked sedge) is circumboreal and only occurs in northern Michigan and northern Minnesota, whereas *Carex utriculata* (Northwest Territory sedge) is boreal but extends south to Delaware, Indiana, Nebraska, New Mexico and California. (*Carex vesicaria* (blister sedge) has a similar distribution to *Carex utriculata* (Northwest Territory sedge).) *Carex rostrata* (beaked sedge) has also been reported from extreme northern Wisconsin, e.g., on the Apostle Islands (E. Judziewicz pers. comm. 1999). However, all of the atlases and floras in the Midwest (Voss 1972, Mohlenbrock and Ladd 1978, Ownbey and Morley 1991) do not make such a distinction, so the species are essentially treated as synonymous in this type. Curtis (1959) suggested that differential species for northern sedge meadows in Wisconsin may be *Symphotrichum puniceum* (purplestem aster), *Campanula aparinoides* (marsh bellflower), *Glyceria canadensis*

(rattlesnake mannagrass), *Scirpus atrovirens* (green bulrush), and *Solidago uliginosa* (bog goldenrod), among others, but this list needs further study.

**Global Similar Associations:**

- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174)--This type is more heavily grass- and forb-dominated, sedges <25%?
- *Carex aquatilis* - *Carex utriculata* Herbaceous Vegetation (CEGL001803)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258)
- *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Dwarf-shrubland (CEGL005091)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187)
- *Eriophorum virginicum* - (*Carex folliculata*) / *Sphagnum* spp. - *Polytrichum* spp. Herbaceous Vegetation (CEGL006570)
- *Myrica gale* - *Chamaedaphne calyculata* / *Carex* (*lasiocarpa*, *utriculata*) - *Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302)

**Global Related Concepts:**

- *Carex rostrata* - *Rubus hispidus* - *Pyrus melanocarpa* community (Edens 1973) =
- *Carex rostrata* - *Sphagnum* spp. community (Darlington 1943) =
- *Carex rostrata* sedge-meadow community (Robinette 1966) =
- *Carex utriculata* / *Sphagnum* spp. fen (Byers et al. 2007) =
- *Polytrichum* - *Carex* (*rostrata*, *stricta*) hummock bog (Fortney 1975) =
- Meadow marsh: tall sedge (W12) (Harris et al. 1996) =
- Northern Sedge Meadow (Curtis 1959) =

**ELEMENT DISTRIBUTION**

**Global Range:** This northern tall sedge community is found in the mixed conifer - hardwood zone of the Great Lakes and northeastern region of the United States and north into Canada, extending from Maine to Manitoba, south to Michigan and Iowa.

**Nations:** CA, US

**States/Provinces:** IA, MB:SU, ME, MI, MN, ND:S2S3, ON, QC:S4?, SD, WI:S3, WV:S2, WY

**TNC Ecoregions:** 26:C, 34:C, 35:C, 46:C, 47:C, 48:C, 59:C

**USFS Ecoregions (1994/95):** 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hn:CCP, 212Ho:CCC, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jd:CCC, 212Je:CC?, 212Jf:CCP, 212Jg:CCP, 212Jh:CCP, 212Ji:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212La:CCP, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Mb:CCP, 212Na:CCP, 212Nb:CCP, 212Nc:CCP, 222Lb:CCC, 251Ab:CCC, 251B:CC, 332:?

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Monongahela, Nicolet, Ottawa?, Superior?); USFWS (Canaan Valley)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.8, GRPO.10.

**Grand Portage National Monument Map Code:** HSG

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen, mod. E.A. Byers

**References:** Byers et al. 2007, Curtis 1959, Damman and French 1987, Darlington 1943, Edens 1973, Fortney 1975, Fortney and Rentch 2003, Francl et al. 2004, Gawler 2002, Gleason and Cronquist 1991, Greenall 1996, Harris et al. 1996, INAI unpubl. data, Midwestern Ecology Working Group n.d., Mohlenbrock and Ladd 1978, NDNHI unpubl. data, Ownbey and Morley 1991, Robinette 1966, Voss 1972, WNHIP unpubl. data

**5. Aquatic Vegetation****5.B.1. Freshwater Aquatic Vegetation****5.B.1.a. North American Freshwater Aquatic Vegetation****MG108. Eastern North American Freshwater Aquatic Vegetation****G114. Eastern North American Freshwater Aquatic Vegetation [Placeholder]****Northern Water-lily Aquatic Wetland***Nymphaea odorata* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation

American White Water-lily - (Yellow Pond-lily, Variegated Yellow Pond-lily) Herbaceous Vegetation

Identifier: CEG002562

**NVC CLASSIFICATION**

Division	North American Freshwater Aquatic Vegetation (5.B.1.a)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (MG108)
Group	Eastern North American Freshwater Aquatic Vegetation [Placeholder] (G114)
Association (Common name)	Northern Water-lily Aquatic Wetland
<b>Ecological System(s):</b>	Laurentian-Acadian Freshwater Marsh (CES201.594)

**ELEMENT CONCEPT**

**Global Summary:** This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada. 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. 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* (American white waterlily), *Nuphar microphylla*, and *Nuphar variegata*. Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur in this community.

**ENVIRONMENTAL DESCRIPTION**

**Global Environment:** 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)

**VEGETATION DESCRIPTION**

**Global Vegetation:** 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* (American white waterlily), *Nuphar microphylla*, and *Nuphar variegata*. Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur within this type (Harris et al. 1996).

**MOST ABUNDANT SPECIES****Global****Stratum**

Floating aquatic

**Lifeform**

Aquatic herb (floating &amp; submergent)

**Species**

*Nuphar lutea* ssp. *pumila* (yellow pond-lily), *Nuphar lutea* ssp. *variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

**CHARACTERISTIC SPECIES**

**Global:** *Nuphar lutea* ssp. *pumila* (yellow pond-lily), *Nuphar lutea* ssp. *variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G5 (3-Oct-1996).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 3 - Weak

**Global Comments:** This type is not well-characterized across its range. Further review is needed in the United States. Depending on spatial scale, it conceptually overlaps both submergent and emergent aquatic types.

**Global Related Concepts:**

- Inland Emergent Marsh (Chapman et al. 1989) B
- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) =

**ELEMENT DISTRIBUTION**

**Global Range:** This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada.

**Nations:** CA, US

**States/Provinces:** MB:S2, MI, MN, NY, ON, QC:S5?, WI

**TNC Ecoregions:** 47:C, 48:C

**USFS Ecoregions (1994/95):** 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jl:CCP, 212Jn:CCP, 212Jo:CCP, 212La:CCP, 212Mb:CCP, 212Na:CCP, 212Nb:CCP, 212Nc:CCP, 221B:CC, 222Jb:CCC, 222Je:CCC, M212:C

**Federal Lands:** NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Local Description Authors:**

**Grand Portage National Monument Map Code:** HFA

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Edinger et al. 2002, Greenall 1996, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

**Midwest Pondweed Submerged Aquatic Wetland**

**Potamogeton spp. - Ceratophyllum spp. Midwest Herbaceous Vegetation**

**Pondweed species - Hornwort species Midwest Herbaceous Vegetation**

**Identifier:** CEGL002282

**NVC CLASSIFICATION**

Division	North American Freshwater Aquatic Vegetation (5.B.1.a)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (MG108)
Group	Eastern North American Freshwater Aquatic Vegetation [Placeholder] (G114)
Association (Common name)	Midwest Pondweed Submerged Aquatic Wetland
<b>Ecological System(s):</b>	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687) North-Central Interior Floodplain (CES202.694) Laurentian-Acadian Freshwater Marsh (CES201.594) North-Central Interior Freshwater Marsh (CES202.899)

**ELEMENT CONCEPT**

**Global Summary:** This broadly defined submerged aquatic or open marsh type is found throughout the midwestern region of the United States and adjacent Canada. 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* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella* (spiny-spore quillwort), *Isoetes lacustris* (lake quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower). 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* (needle spikerush), *Myriophyllum* (watermilfoil) spp., *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitstem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza* (common bladderwort). 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 that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's-tail), *Elodea canadensis* (Canadian waterweed), *Lemna* (duckweed) spp., *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (whitewater crowfoot), *Utricularia macrorhiza* (common bladderwort), and *Vallisneria americana* (American eel-grass).

**ENVIRONMENTAL DESCRIPTION**

**Global Environment:** Curtis (1959) [see also Swindale and Curtis (1957)] noted that the major environmental controls on submerged aquatic vegetation 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, which depends 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.

### VEGETATION DESCRIPTION

**Global Vegetation:** 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* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella* (spiny-spore quillwort), *Isoetes lacustris* (lake quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower) (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* (needle spikerush), *Myriophyllum* (watermilfoil) spp., *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza* (common bladderwort). 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 that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's-tail), *Elodea canadensis* (Canadian waterweed), *Lemna* (duckweed) spp., *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (whitewater crowfoot), *Utricularia macrorhiza* (common bladderwort), and *Vallisneria americana* (American eel-grass) (Curtis 1959, Harris et al. 1996).

### CONSERVATION STATUS RANK

**Global Rank & Reasons:** G5 (3-Oct-1996).

### CLASSIFICATION

**Status:** Standard

**Classification Confidence:** 3 - Weak

**Global Comments:** This type is based on information in the more northern parts of the range. However, it may need to be split into a boreal/sub-boreal type (subgroup A above) and a Midwestern type (subgroups B and C), and even within the Midwest there may be substantial differences between western and eastern stands (Robert Dana pers. comm. 1999). In Wisconsin, Subgroup A is considered distinctive, and could be ranked an S3 type. It is locally common there in deep, hard-bottomed seepage lakes of the Northern Highlands Pitted Outwash subsection (212Jm of Keys et al. 1995) (E. Epstein pers. comm. 1999).

**Global Similar Associations:**

- *Stuckenia pectinata* - *Ruppia maritima* Herbaceous Vegetation (CEGL002004)--Prairie pothole type.

**Global Related Concepts:**

- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) I

### ELEMENT DISTRIBUTION

**Global Range:** This pondweed submerged aquatic type is found widely throughout the midwestern United States and adjacent Canada, ranging from Ohio and Ontario west to North Dakota and south to Iowa.

**Nations:** CA, US

**States/Provinces:** IA:SU, IL, IN, MI:S4, MN, ND, OH, ON, SD, WI, WY

**TNC Ecoregions:** 35:C, 36:C, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C, 50:C

**USFS Ecoregions (1994/95):** 212Hb:CCP, 212Hi:CCC, 212Ho:CCC, 212Hs:CCC, 212Hv:CCC, 212Hw:CCC, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 212La:CPP, 212Mb:C??, 221Ef:CCC, 221Fc:CCC, 221He:CCC, 222Ao:CPP, 222Ch:CPP, 222Gc:CPP, 222Ha:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222L:CC, 251Aa:???, 251Ba:???

**Federal Lands:** NPS (Apostle Islands, Effigy Mounds, Grand Portage, Indiana Dunes, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet, Shawnee, Superior?)

**Federal Lands:** Information not available.

### ELEMENT SOURCES

**Grand Portage National Monument Map Code:** HSV

**Local Description Authors:**

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Curtis 1959, Harris et al. 1996, INAI unpubl. data, Keys et al. 1995, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, Swindale and Curtis 1957

**6. Nonvascular & Sparse Vascular Rock Vegetation****6.B.2. Temperate & Boreal Cliff, Scree & Rock Vegetation****6.B.2.a. Eastern North American Temperate Cliff, Scree & Rock Vegetation****MG111. Eastern North American Cliff & Rock Vegetation****G341. Great Lakes Cliff & Shore [Placeholder]****Great Lakes Basalt - Diabase Cobble - Gravel Shore****Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation****Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation****Identifier: CEG005250****NVC CLASSIFICATION**

Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (6.B.2.a)
Macrogroup	Eastern North American Cliff & Rock Vegetation (MG111)
Group	Great Lakes Cliff & Shore [Placeholder] (G341)
Association (Common name)	Great Lakes Basalt - Diabase Cobble - Gravel Shore
<b>Ecological System(s):</b>	Great Lakes Alkaline Rocky Shore and Cliff (CES201.995)

**ELEMENT CONCEPT**

**Global Summary:** The basalt cobble - gravel Great Lakes shore type is commonly found along the northern Great Lakes shores of the United States and Canada. Stands occur between volcanic bedrock exposures comprised of both basalt and Copper Harbor conglomerates. Size of the gravel and cobble vary from less than 2 cm to over 20 cm. Size range varies depending on the wave energy acting on the shoreline and the nature of the bedrock being eroded. These steep shores are typically devoid of vegetation. At Isle Royale National Park, this cobble - gravel lakeshore is a sparsely vegetated community on cobble or gravel beaches. This community occurs as a mosaic of sparse grassland with over 25% cover, and sparsely vegetated areas with less than 25% cover. The most abundant herbs are grasses, mostly *Elymus trachycaulus* (slender wheatgrass) (average 29% cover); other characteristic herbs are *Lathyrus palustris* (marsh pea) and *Oenothera biennis* (common evening-primrose); characteristic shrubs are *Rubus idaeus* (American red raspberry), *Cornus sericea* (red-osier dogwood), and *Alnus viridis* (green alder) (each with <5% cover). The shrub zone is dominated by low shrubs, which vary from 20-60% cover. The most abundant shrubs are *Rosa acicularis* (prickly rose), *Rubus idaeus* (American red raspberry), *Diervilla lonicera* (northern bush honeysuckle), *Physocarpus opulifolius* (common ninebark), *Ribes oxycanthoides* (Canadian gooseberry), *Alnus incana* (gray alder), and *Sorbus decora* (northern mountain-ash). There may be scattered trees (0-5% cover) including *Picea glauca* (white spruce), *Abies balsamea* (balsam fir), *Thuja occidentalis* (northern white-cedar), and *Betula papyrifera* (paper birch). Cover of herbs varies from 10-40%; the most common herbs are *Lathyrus palustris* (marsh pea), *Oenothera biennis* (common evening-primrose), *Cornus canadensis* (bunchberry dogwood), *Calamagrostis canadensis* (bluejoint), and *Equisetum hyemale* (scouringrush horsetail). *Carex atratifomis* (scrabrous black sedge), *Polygonum viviparum* (alpine bistort), and *Trisetum spicatum* (spike trisetum) have been reported at the inner margin of the island's cobble lakeshore, near the tree edge. Elsewhere, in Minnesota, *Lathyrus japonicus* (beach pea) is characteristic.

**ENVIRONMENTAL DESCRIPTION**

**Global Environment:** This community occupies cobble or gravel shores of Lake Superior. These shores occur in coves and gently curving bays between rocky points. These mostly non-vegetated shores may contain a shrub zone that occurs on the highest beach ridge, which is usually nearly level. There may be little or no soil; the plants are rooted in the cobble or gravel (C. Reschke pers. comm. 1999).

**VEGETATION DESCRIPTION**

**Global Vegetation:** At Isle Royale National Park, this cobble-gravel lakeshore is a sparsely vegetated community on cobble or gravel beaches. This community occurs as a mosaic of sparse grassland with over 25% cover, and sparsely vegetated areas with less than 25% cover. The most abundant herbs are grasses, mostly *Elymus trachycaulus* (slender wheatgrass) (average 29% cover); other characteristic herbs are *Lathyrus palustris* (marsh pea) and *Oenothera biennis* (common evening-primrose); characteristic shrubs are *Rubus idaeus* (American red raspberry), *Cornus sericea* (red-osier dogwood), and *Alnus viridis* (green alder) (each with <5% cover). The shrub zone is dominated by low shrubs, which vary from 20-60% cover. The most abundant shrubs are *Rosa acicularis* (prickly rose), *Rubus idaeus* (American red raspberry), *Diervilla lonicera* (northern bush honeysuckle), *Physocarpus opulifolius* (common ninebark), *Ribes oxycanthoides* (Canadian gooseberry), *Alnus incana* (gray alder), and *Sorbus decora* (northern mountain-ash). There may be scattered trees (0-5% cover) including *Picea glauca* (white spruce), *Abies balsamea* (balsam fir), *Thuja occidentalis* (northern white-cedar), and *Betula papyrifera* (paper birch). Cover of herbs varies from 10-40%; the most common herbs are *Lathyrus palustris* (marsh pea), *Oenothera biennis* (common evening-primrose), *Cornus canadensis* (bunchberry dogwood), *Calamagrostis canadensis* (bluejoint), and *Equisetum hyemale* (scouringrush horsetail) (C. Reschke pers. comm. 1999). *Carex atratifomis* (scrabrous black sedge), *Polygonum viviparum* (alpine bistort), and *Trisetum spicatum* (spike trisetum) have been reported at the inner margin of the island's cobble lakeshore, near the tree edge. Elsewhere, in Minnesota, *Lathyrus japonicus* (beach pea) is characteristic.

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G4G5 (7-Apr-2000). Type may be relatively localized, but threats are uncommon.

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** The alkaline cobble - gravel shorelines are split into two types, basalt /diabase (this type) and Limestone Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005169).

**Global Similar Associations:**

- Basalt - Conglomerate Bedrock Great Lakes Shore Sparse Vegetation (CEGL005215)
- Igneous - Metamorphic Cobble - Gravel Inland Lake Shore Sparse Vegetation (CEGL002303)
- Limestone Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005169)
- Non-alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL002508)

**Global Related Concepts:**

- Cobble Beach (Chapman et al. 1989) B

**ELEMENT DISTRIBUTION**

**Global Range:** The basalt cobble-gravel Great Lakes shore type is commonly found in the northern Great Lakes region of the United States and Canada, ranging from Michigan to Minnesota and Ontario.

**Nations:** CA?, US

**States/Provinces:** MI, MN, ON?

**TNC Ecoregions:** 48:C

**USFS Ecoregions (1994/95):** 212Ib:CCC, 212J:CC, 212Lb:CCC

**Federal Lands:** NPS (Grand Portage, Isle Royale)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Map Code:** VCB

**Local Description Authors:**

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Midwestern Ecology Working Group n.d., Reschke pers. comm.

**Northern Non-Carbonate Dry Talus Vegetation**

**Basalt - Diabase Northern Open Talus Sparse Vegetation**

**Basalt - Diabase Northern Open Talus Sparse Vegetation**

**Identifier:** CEGL005247

**NVC CLASSIFICATION**

Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (6.B.2.a)
Macrogroup	Eastern North American Cliff & Rock Vegetation (MG111)
Group	Great Lakes Cliff & Shore [Placeholder] (G341)
Association (Common name)	Northern Non-Carbonate Dry Talus Vegetation
<b>Ecological System(s):</b>	Laurentian-Acadian Acidic Cliff and Talus (CES201.569)

**ELEMENT CONCEPT**

**Global Summary:** This open basalt - diabase talus type occurs in the northern parts of the midwestern United States and into Canada. The type is in need of further characterization.

**ENVIRONMENTAL DESCRIPTION**

**Grand Portage National Monument Environment:** This sparsely vegetated community was sampled at one location in the park near Mount Rose. The site is a very steep, east-facing talus slope with rapidly drained soil. The surface is dominated by large rocks (96% cover) with some small rocks (2%), wood (1%) and plant stems (1%). These slopes are unstable and subject to rocks falling from cliffs located above and to downslope slippage.

**VEGETATION DESCRIPTION**

**Grand Portage National Monument Vegetation:** Lichens dominate this community with 80% cover. In addition, in this example, *Betula papyrifera* (paper birch) forms a very sparse (5% cover) tree canopy 5-10 m tall. *Polypodium* (polypody) sp. is the only recorded herbaceous species.

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** GNR (1-Dec-1997).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** In Wisconsin, basalt talus occurs along the St. Croix River.

**Global Similar Associations:**

- *Betula papyrifera* - *Picea glauca* / *Acer spicatum* - *Alnus viridis* / *Polypodium virginianum* Talus Shrubland [Provisional] (CEGL005252)
- Granite - Metamorphic Talus Northern Sparse Vegetation (CEGL002409)
- *Sorbus decora* - *Acer spicatum* / *Dryopteris carthusiana* Shrubland (CEGL005253)

**Global Related Concepts:**

- Moist Non-Acid Cliff (Chapman et al. 1989) B

**ELEMENT DISTRIBUTION**

**Global Range:** This open basalt/diabase talus type occurs in the northern parts of the midwestern United States and into Canada, ranging from Wisconsin and Ontario to possibly Minnesota and Michigan.

**Nations:** CA, US

**States/Provinces:** MI, MN, ON, WI

**TNC Ecoregions:** 48:C

**USFS Ecoregions (1994/95):** 212J:CC, 212Lb:CCC

**Federal Lands:** NPS (Grand Portage)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Plots:** GRPO.18.

**Grand Portage National Monument Map Code:** VDT

**Local Description Authors:** M.J. Russo

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

---

**Northern Non-Carbonate Moist Talus Vegetation**

**Granite - Metamorphic Talus Northern Sparse Vegetation**

**Granite - Metamorphic Talus Northern Sparse Vegetation**

**Identifier:** CEGL002409

---

**NVC CLASSIFICATION**

Association (Common name) Northern Non-Carbonate Moist Talus Vegetation

**Ecological System(s):** Laurentian-Acadian Acidic Cliff and Talus (CES201.569)

**ELEMENT CONCEPT**

**Global Summary:** This granite - metamorphic talus type is found in the northern parts of the Great Lakes region in both the United States and Canada. Stands occur as unconsolidated rocks at the base of steep slopes or cliffs. Soils are absent. The parent material is either granite or metamorphic, and rock fragments are often angular and large. The vegetation on these talus slopes varies from very sparse to pockets of shrubs and trees. Species composition needs to be described.

**ENVIRONMENTAL DESCRIPTION**

**Global Environment:** Stands occur as unconsolidated rocks at the base of steep slopes or cliffs. Soils are absent. The parent material is either granite or metamorphic, and rock fragments are often angular and large.

**VEGETATION DESCRIPTION**

**Global Vegetation:** The vegetation on these talus slopes varies from very sparse to pockets of shrubs and trees. Species composition needs to be described.

**CONSERVATION STATUS RANK**

**Global Rank & Reasons:** G4G5 (8-Jul-1997).

**CLASSIFICATION**

**Status:** Standard

**Classification Confidence:** 2 - Moderate

**Global Comments:** Type may need to be split into open versus wooded types. In Wisconsin, this type may possibly occur in the Penoque Range (granite). Stands along the St. Croix River are basalt/diabase and are treated with Basalt - Diabase Northern Open Talus Sparse Vegetation (CEGL005247). Devil's Lake has a quartzite, metamorphic talus which is included here for now.

**Global Similar Associations:**

- Basalt - Diabase Northern Open Talus Sparse Vegetation (CEGL005247)
- *Betula papyrifera* - *Picea glauca* / *Acer spicatum* - *Alnus viridis* / *Polypodium virginianum* Talus Shrubland [Provisional] (CEGL005252)
- *Polypodium (virginianum, appalachianum)* / Lichens Nonvascular Vegetation (CEGL006534)
- Sandstone Talus Northern Sparse Vegetation (CEGL005202)

**Global Related Concepts:**

- Dry Acid Cliff (Chapman et al. 1989) B

**ELEMENT DISTRIBUTION**

**Global Range:** This granite/metamorphic talus type is found in the northern parts of the Great Lakes region in both the United States and Canada, ranging from Minnesota and Ontario east to Wisconsin and Michigan.

**Nations:** CA, US

**States/Provinces:** MI, MN, ON:S3S4, QC, WI

**TNC Ecoregions:** 47:C, 48:C, 64:C

**USFS Ecoregions (1994/95):** 212Ja:CPP, 212Jb:CPP, 212Jf:CP?, 212Jj:CPP, 212Jn:CP?, 222:C

**Federal Lands:** NPS (Grand Portage); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet)

**Federal Lands:** Information not available.

**ELEMENT SOURCES**

**Grand Portage National Monument Map Code:** VMT

**Local Description Authors:**

**Global Description Authors:** D. Faber-Langendoen

**References:** Chapman et al. 1989, Midwestern Ecology Working Group n.d., WNHIP unpubl. Data



**Bibliography for Grand Portage National Monument**

- Albert, D. A., P. J. Comer, R. A. Corner, D. Cuthrell, M. Penskar, and M. Rabe. 1995. Bedrock shoreline survey of the Niagaran Escarpment in Michigan's Upper Peninsula: Mackinac County to Delta County. Michigan Natural Features Inventory for Land and Water Management Division (grant # CD-0.02).
- Anderson, D. M. 1982. Plant communities of Ohio: A preliminary classification and description. Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Columbus, OH. 182 pp.
- Anderson, R. D., and J. E. Schwegman. 1991. Twenty years of vegetational change on a Southern Illinois Barren. *Natural Areas Journal* 11(2):100-107.
- Breden, T. F., Y. R. Alger, K. S. Walz, and A. G. Windisch. 2001. Classification of vegetation communities of New Jersey: Second iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, New Jersey Department of Environmental Protection, Trenton.
- Browning, M. 1859. Forty-four years of the life of a hunter; being reminiscences of Meshach Browning, a Maryland hunter, roughly written down by himself. Ill. E. Stabler. J. B. Lippincott Company, Philadelphia. Reprinted in 2003 by Appalachian Background, Oakland. 400 pp.
- Byers, E. A., J. P. Vanderhorst, and B. P. Streets. 2007. Classification and conservation assessment of high elevation wetland communities in the Allegheny Mountains of West Virginia. West Virginia Natural Heritage Program, West Virginia Division of Natural Resources, Elkins.
- CAP [Central Appalachian Forest Working Group]. 1998. Central Appalachian Working group discussions. The Nature Conservancy, Boston, MA.
- Chambers, B. A., B. J. Naylor, J. Nieppola, B. Merchant, and P. Uhlig. 1997. 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.
- Chapman, K. A., D. A. Albert, and G. A. Reese. 1989. Draft descriptions of Michigan's natural community types. Michigan Department of Natural Resources, Lansing, MI. 35 pp.
- Cleland, D. T., J. B. Hart, G. E. Host, K. S. Pregitzer, and C. W. Ramm. 1994. Field guide to the ecological classification and inventory system of the Huron-Manistee National Forest. USDA Forest Service, North Central Forest Experiment Station.
- Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.
- Curtis, J. T. 1959. The vegetation of Wisconsin: An ordination of plant communities. University of Wisconsin Press, Madison. 657 pp. [reprinted in 1987]
- Damman, A. W. H., and T. W. French. 1987. The ecology of peat bogs of the glaciated northeastern United States: A community profile. USDI Fish & Wildlife Service Biological Report 85(7.16). 100 pp.
- Darlington, H. C. 1943. Vegetation and substrate of Cranberry Glades, West Virginia. *Botanical Gazette* 104:371-393.
- DeMeo, T., D. McCay, D. Walton, and J. Concannon. 1998. Terrestrial ecological classification of the Monogahela National Forest. USDA Forest Service, Elkins, WV.
- Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boston, MA.
- Edens, D. L. 1973. The ecology and succession of Cranberry Glades, WV. Ph.D. dissertation, North Carolina State University, Raleigh.
- Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, editors. 2002. Ecological communities of New York state. Second edition. A revised and expanded edition of Carol Reschke's ecological communities of New York state. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.
- Epstein, Eric. Personal communication. Community Ecologist, Wisconsin Natural Heritage Program, Madison, WI.
- Farrand, W. R., and D. L. Bell. 1982. Quaternary geology of northern Michigan. University of Michigan, Lansing.
- Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.
- Fortney, R. H. 1975. The vegetation of Canaan Valley, West Virginia: A taxonomic and ecological study. Ph.D. dissertation, University of West Virginia, Morgantown.
- Fortney, R. H., S. L. Stephenson, and J. S. Rentch. 2005. Rare plant communities of Canaan Valley, West Virginia, USA. Unpublished manuscript.
- Fortney, R. H., and J. S. Rentch. 2003. Post logging era plant successional trends and geospatial vegetation patterns in Canaan Valley, West Virginia, 1945 to 2000. *Castanea* 68(4):317-334.

- Francl, K. E., W. M. Ford, and S. B. Castleberry. 2004. Characterization of high elevation central Appalachian wetlands. Research Paper NE-725. USDA Forest Service, Northeastern Research Station, Newtown Square, PA. 26 pp.
- Frelich, L. E. 1992. The relationship of natural disturbances to white pine stand development. Presented at the White Pine Symposium: History, Ecology, Policy and Management, Duluth, Minn., Sept. 16-18, 1992.
- Gawler, S. C. 2002. Natural landscapes of Maine: A guide to vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta, ME.
- Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. New York Botanical Garden, Bronx, NY. 910 pp.
- Greenall, J. A. 1996. Manitoba's terrestrial plant communities. MS Report 96-02, Manitoba Conservation Data Centre, Winnipeg.
- Grigal, D. F., and L. F. Ohmann. 1975. Classification, description, and dynamics of upland plant communities within a Minnesota wilderness area. *Ecological Monographs* 45:389-407.
- Hansen, H. L., L. W. Krefting, and V. Kurmis. 1973. The forest of Isle Royale in relation to fire history and wildlife. University of Minnesota, Agricultural Experiment Station, Technical Bulletin 294, Forestry Series 13.
- 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 pp. plus appendix.
- Harrison, J. W., compiler. 2004. Classification of vegetation communities of Maryland: First iteration. A subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States, NatureServe. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis. 243 pp.
- Heinselman, M. 1996. The Boundary Waters Wilderness Ecosystem. University of Minnesota Press, Minneapolis, MN. 334 pp.
- Heinselman, M. L. 1973. Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota. *Journal of Quaternary Research* 3:329-382.
- INAI [Iowa Natural Areas Inventory]. No date. Vegetation classification of Iowa. Iowa Natural Areas Inventory, Iowa Department of Natural Resources, Des Moines.
- Judziwicz, E. J., and R. G. Koch. 1993. Flora and vegetation of the Apostle Islands National Lakeshore and Madeline Island, Ashland and Bayfield counties, Wisconsin. *Michigan Botanist* 32:43-189.
- La Roi, G. H. 1967. Ecological studies in the boreal spruce-fir forests of the North American taiga. I. Analysis of the vascular flora. *Ecological Monographs* 37(3):229-253.
- MNNHP [Minnesota Natural Heritage Program]. 1993. Minnesota's native vegetation: A key to natural communities. Version 1.5. Minnesota Department of Natural Resources, Natural Heritage Program, St. Paul, MN. 110 pp.
- Martin, N. D. 1959a. An analysis of forest succession in Algonquin Park, Ontario. *Ecological Monographs* 29(3):187-218.
- Maycock, P. F. 1961. The spruce-fir forest of the Keweenaw Peninsula, northern Michigan. *Ecology* 42(2):357-365.
- Maycock, P. F., and J. T. Curtis. 1960. The phytosociology of boreal conifer-hardwood forests of the Great Lakes Region. *Ecological Monographs* 30(1):1-35.
- 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.
- Midwestern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Minneapolis, MN.
- Mohlenbrock, R. H., and D. M. Ladd. 1978. Distribution of Illinois vascular plants. Southern Illinois University Press, Carbondale. 282 pp.
- NAP [Northern Appalachian-Boreal Forest Working Group]. 1998. Northern Appalachian-Boreal Working group discussions. The Nature Conservancy, Boston, MA.
- NDNHI [North Dakota Natural Heritage Inventory]. No date. Unpublished data. Vegetation classification of North Dakota. North Dakota Natural Heritage Inventory, North Dakota Parks & Recreation Department, Bismarck.
- NRCS [Natural Resources Conservation Service]. 2004. Soil survey of Saratoga County, New York. USDA Natural Resources Conservation Service. 590 pp.
- Ohmann, L. F., and P. R. Ream. 1971. Wilderness ecology: Virgin plant communities of the Boundary Waters Canoe Area. Research Paper NC-63. USDA Forest Service, North Central Forest Experiment Station, St. Paul, MN. 35 pp.
- Ownbey, G. B., and T. Morley. 1991. Vascular plants of Minnesota: A checklist and atlas. University of Minnesota Press, Minneapolis.
- Rawinski, T. 1984. Natural community description abstract - southern New England calcareous seepage swamp. Unpublished report. The Nature Conservancy, Boston, MA. 6 pp.
- Rentch, J. S. 2003. *Alnus incana* shrubland, unpublished plot data. West Virginia University, Morgantown.

---

Reschke, Carol. Personal communication. Ecologist, New York Natural Heritage Program. New York State Department of Environmental Conservation, Latham, NY.

Robinette, S. L. 1966. Major plant communities of Cranesville Swamp, West Virginia. *Arboretum Newsletter* 16(1): 1-7.

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.

Sperduto, D. D. 2000a. Natural communities of New Hampshire: A guide and classification. Near final unformatted draft without pictures and illustrations; includes upland classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 127 pp.

Sperduto, D. D. 2000b. A classification of wetland natural communities in New Hampshire. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Division of Forests and Lands. Concord, NH. 156 pp.

Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

Thompson, E. 1996. Natural communities of Vermont uplands and wetland. Nongame and Natural Heritage Program, Department of Fish and Wildlife in cooperation with The Nature Conservancy, Vermont chapter. 34 pp.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, woodland, wildland: A guide to the natural communities of Vermont. The Nature Conservancy and the Vermont Department of Fish and Wildlife. University Press of New England, Hanover, NH. 456 pp.

Voss, E. G. 1972. Michigan flora: A guide to the identification and occurrence of the native and naturalized seed-plants of the state. Part I. Gymnosperms and Monocots. Cranbrook Institute of Science. 488 pp.

WNIHIP [Wisconsin Natural Heritage Inventory Program]. No date. Vegetation classification of Wisconsin and published data. Wisconsin Natural Heritage Program, Wisconsin Department of Natural Resources, Madison.

Walbridge, M. R. 1982. Vegetation patterning and community distribution in four high-elevation headwater wetlands in West Virginia. M.S. thesis, West Virginia University, Morgantown.

Walbridge, M. R., and G. E. Lang. 1982. Major plant communities and patterns of community distribution in four wetlands of the unglaciated Appalachian region. In: R. B. MacDonald, editor. *Proceedings of the Symposium on Wetlands of the Unglaciated Appalachian Region*. West Virginia University, Morgantown.

Wovcha, D. S., B. C. Delaney, and G. Nordquist. 1995. Minnesota's St. Croix Valley and Anoka Sandplain: A guide to native habitats. University of Minnesota Press, Minneapolis. 234 pp.

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.



## **Appendix C: Field Key to Vegetation Types**



### **Explanation and Use of the Key**

This is a field key to natural vegetation types of Grand Portage National Monument (GRPO). Forest plantations, lawns, gardens, and roadside vegetation are excluded. The vegetation types are based on the National Vegetation Classification Standard (NVCS) and were derived from field data collected during the GRPO vegetation mapping project. This key depicts vegetation types at the association (plant community) level, the lowest level of the NVCS, unless otherwise specified. For association types, the common association name is given, followed by the Community Global Element code in parenthesis. A few associations have an additional name listed in brackets, which correlate to map-class phases.

For best results, assessments of vegetation types in the field should be done on an area of ~2000 m<sup>2</sup> (i.e., 25 m radius around point) and within a single vegetation type. Given the complexity and variability of vegetation, no key is infallible. Appendix B: Descriptions to Vegetation Types is recommended to complement this key to ascertain correct assessment of types.

### **Key Terms**

The term dominance means a species has greater than 25% cover. Strongly dominant means greater than 60% cover. When the term “total canopy cover” is used, it is in reference to the absolute canopy cover. All other cover values refer to relative canopy cover, e.g., if total cover of the tree canopy is 40%, then a notation of >25% cover of jack pine refers to 25% of the 40% total cover.

**Cover:** This is the percent of the ground covered by an outline of the species foliage, when viewed from above or below. For trees and tall shrubs, percent cover is estimated by viewing the outline of the canopy of each crown from below. For short shrubs, herbs, and non-vascular plants, percent cover is estimated by viewing the foliage from above. Cover classes are used (e.g., 5–15%), since an exact measure is not needed to classify the vegetation. There are some important breakpoints for cover that require greater care:

- **>25% cover**—Essentially, this translates to more than a quarter of the plot or area being estimated. Species are considered dominant if they exceed 25% cover. A particular stratum (e.g., tree canopy, tall shrub, herbaceous) is considered dominant if it exceeds 25% cover.
- **>5% cover**—Five percent is the minimum value used to define “important” species in the stand. Thus a species may be considered important to a type if it typically exceeds 5% cover.
- **Canopy Cover**—In the key for Forests and Woodlands, the term “canopy” is used as short hand for both canopy and subcanopy trees, that is, the “canopy” includes percent cover of all trees >5 m).

**Relative Cover:** This is the percent cover of a particular species relative to the total cover of all species in that strata. For example, if species A has 25% cover, and species B has 15% cover, then the relative cover of species A=63%, and the relative cover of Species B=37%.

**Constant species:** These are species that are typically found in a stand (e.g., at least 60% of all stands contain the species). They may or may not be dominant or important.

**Stratum (strata):** A combination of growth forms (or life form) and height. For example the tall shrub stratum is comprised of shrubs (perennial, multi-stemmed woody plants) that typically attain >2 m in height. Strata used in this key include:

- ***Tree stratum***—Dominated by single-stemmed woody plants that exceed 5 m in height. Includes all tree layers (emergent, main, and subcanopy).
- ***Tall shrub stratum***—Dominated by multi-stemmed woody plants that exceed 2 m in height (e.g., have fairly sturdy stems). Includes tree saplings between 2–5 m.
- ***Short shrub stratum***—Dominated by short (<2 m) multi-stemmed woody plants that often lack sturdy stems, or have many small, thin stems, or have creeping stems. Dwarf-shrubs are included, as are tree seedlings (tree stems <2 m).
- ***Herb stratum***—Dominated by non-woody plants, including graminoids (e.g., grasses), forbs (wildflowers), and ferns.
- ***Non-vascular stratum***—Dominated by mosses, lichen, liverworts and macro-algae.

## GENERAL KEY

1. **FOREST & WOODLAND.** Total canopy cover of trees typically >25%. This is an initial starting point. Also consider shrub and herb strata. If the canopy is between 10 and 25%, but typical forest or woodland herbs are common in those strata, and tree regeneration is strong, the site may still qualify as a forest or woodland. This situation may happen on sites where tree canopy cover has been reduced by recent disturbances such as timber harvesting, windstorms, or fire.
  - A. **UPLAND FOREST & WOODLAND.** Sites very rarely have standing water and/or peat (organic) soil. Soils are typically saturated only briefly in the spring or following heavy rains, though some sites may show some saturation into the growing season.
  - B. **WETLAND FOREST & WOODLAND.** Sites often have standing water and/or peat or muck (organic) soil. Soils are typically saturated well into or throughout the growing season or following heavy rains, or may flood annually by streams, rivers, or lakes for more than a week.
- 1'. **SHRUBLAND, GRASSLAND, or NON-VASCULAR VEGETATION.** Tree canopy cover typically <25%, and some combination of shrub, herb, or non-vascular vegetation are dominant. This is a first starting point. If canopy is between 10 and 25%, typical forest or woodland herbs are common, and tree regeneration is strong, the site may still qualify as a forest or woodland. This situation may happen on sites where tree canopy cover has been reduced by recent disturbances such as timber harvesting, windstorms, or fire.
  - C. **UPLAND SHRUBLAND, GRASSLAND, or NON-VASCULAR VEGETATION.** Sites very rarely have standing water and/or peat (organic) soil. Soils are typically saturated only briefly in the spring or following heavy rains, though some sites may show some saturation into the growing season.
  - D. **WETLAND SHRUBLAND, GRASSLAND, or NON-VASCULAR VEGETATION.** Sites often have standing water and/or peat or muck (organic) soil. Soils are typically saturated well into or throughout the growing season or following heavy rains, or may flood annually by streams, rivers, or lakes for more than a week.

### **A. UPLAND FOREST & WOODLAND**

Total canopy cover of trees >25% (or if <25%, dominated by forest and woodland shrubs and herbs, and tree regeneration in seedling and sapling layers exceeds 25%. Canopy dominated by one or more of the following conifers or hardwoods: pine (*Pinus* spp.), spruce (*Picea* spp.), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*). If dominated by trembling aspen, then combined percent cover of balsam poplar (*Populus balsamifera*), cedar (*Thuja occidentalis*), or black ash (*Fraxinus nigra*) in canopy is <10% cover, and alder is uncommon in the shrub layer.

1. Relative cover (RC) of conifers in canopy >25%. Canopy may be dominated by conifer trees or be a mixture of conifers and hardwoods.

2. Canopy contains >25% RC pine species (*Pinus* spp.), and RC of pine species exceeds that of spruce, fir or cedar.

3. Jack pine (*Pinus banksiana*) >25% RC, or, if multiple pine species are present *Pinus banksiana* is the most common pine.

4. Woodland. Total tree canopy cover <60% and canopy closure prevented by the presence of exposed bedrock or large rocks. Lichen and grasses common. Known from occurrences along the trail near Highway 61.

#### **Boreal Pine Rocky Woodland (CEGL02483, jack pine variant)**

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

5. Jack Pine forms a mostly closed canopy, with some balsam fir, or occasionally with aspen (which may exceed 25% RC of canopy). Groundlayer dominated by bush honeysuckle, along with occasional dry-mesic species (blueberries, kinnikinick) but more mesic (moist) species such as mountain maple or dwarf raspberry are absent. Some blueberries may be present. At GRPO, found only on Mount Rose.

#### **Jack Pine / Balsam Fir Forest (CEGL002437)**

5'. Jack Pine forms an open to closed canopy, often with trembling aspen or birch. Ground layer contains many mesic species, such as mountain maple or dwarf raspberry, along with bush honeysuckle, but dry-mesic species, such as blueberries and kinnikinick absent. Known from a single occurrence on the trail, west of Cowboy Road.

#### **Jack Pine - Aspen / Bush Honeysuckle Forest (CEGL2518)**

3'. *Pinus strobus*, sometimes in combination with *Pinus resinosa*, >25% RC, and these together exceed the cover of *Pinus banksiana*. Hardwoods may be absent or up to 75% RC.

6. Woodland. Total tree canopy cover <60% and canopy closure prevented by the presence of exposed bedrock or large rocks. Lichen and grasses common. *Pinus strobus* and *Pinus resinosa* common, *Picea* spp. uncommon. Known from occurrences along the trail near Highway 61.

**Boreal Pine Rocky Woodland (CEGL02483, mixed pine variant)**

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

7. Shrub and herb layers mostly continuous (>50% cover) and dominated by mesic species, such as mountain maple or dwarf raspberry. Exposed rocks uncommon or absent.

**White Pine / Mountain Maple Mesic Forest (CEGL02445)  
[conifer mesic phase or conifer - hardwood mesic phase]**

7.' Shrub and herb layers often discontinuous (10–50% cover) and containing some dry-mesic species, such as blueberries. Exposed bedrock may be common. Known from a single site at Ft Charlotte.

**White Pine / Mountain Maple Mesic Forest (CEGL02445)  
[dry-mesic phase]**

2'. Canopy contains >25% RC white or black spruce (*Picea glauca*, *Picea mariana*), balsam fir (*Abies balsamea*) and/or cedar (*Thuja occidentalis*) species, and percent of these species exceeds that of pine species.

8. *Picea glauca* or *Abies balsamea* >25% RC, either as pure conifer stands or a mixture of those species with *Populus* spp. and/or *Betula papyrifera*, and *Picea glauca* and *Abies balsamea* together more abundance than cedar.

9. Canopy dominated solely by *Picea glauca* (*P. mariana* may be present). Sites range from moist to wet near beaver ponds, with alder and Canada bluejoint common, or to somewhat dry-mesic, as on Mt Rose.

**Spruce - Fir / Mountain Maple Forest (CEGL02446)**

9.' Canopy a mixture of *Picea glauca*, *Abies balsamea*, and *Populus* spp. and/or *Betula papyrifera*, with at least 25% RC of the hardwoods. *Picea mariana* may be present.

**Spruce - Fir - Aspen Forest (CEGL02475)**

8'. *Thuja occidentalis* >25% RC, either as pure conifer or or a mixture of *Thuja occidentalis* with *Populus* spp. and/or *Betula* spp, and proportion of cedar greater than spruce or fir.

**White-cedar - Boreal Conifer Mesic Forest (CEGL002449)  
[conifer phase or conifer - hardwood phase]**

1.' Canopy dominated by deciduous trees *Populus* spp. and/or *Betula papyrifera*. Percent cover of evergreen trees in canopy <25% RC. Tree and groundlayer lacks wet-mesic or wet species. Note, if *Populus balsamifera* and or *Fraxinus nigra* are >10% RC of tree layer, then consider wetland forest key.

**Aspen - Birch / Boreal Conifer Forest (CEGL02466)**

## **B. WETLAND FOREST & WOODLAND**

Poorly drained soils, with canopy >25% cover. Species with >25% RC include *Populus balsamifera*, *Fraxinus nigra*, or *Thuja occidentalis*. Or, if dominated by *Populus tremuloides*, then *Populus balsamifera*, *Thuja occidentalis*, or *Fraxinus nigra* have >10% RC in either the canopy or sapling layer, and alder typically common in the shrub layer.

1. Canopy dominated by deciduous species (>75% RC). *Thuja occidentalis* absent or, if present, <25% RC.

2. Canopy with >25% RC of *Fraxinus nigra*.

3. Canopy does not contain *Fraxinus pensylvanica* and/or *American elm* at >10% RC.

**Black Ash - Mixed Hardwood Swamp (CEGL02105)**  
[black ash phase]

3.' Canopy contains *Fraxinus pensylvanica* and/or *American elm* at >10% RC.

**Black Ash - Mixed Hardwood Swamp (CEGL02105)**  
[green ash - elm phase]

2'. *Populus tremuloides* and/or *P. balsamifera* dominate (>25%). Alder is common in the shrub layer. *Fraxinus nigra* with less than 25% RC.

**Trembling Aspen - Balsam Poplar Lowland Forest (CEGL05036)**

1.' Canopy dominated (>25% RC) by conifer species. *Thuja occidentalis* >25% RC and *Fraxinus nigra* <25% RC. No sites larger than 0.25 ha are known to fit a white cedar wet or swamp forest, but small inclusions may occur near the boundary of GRPO. See also [CEGL02449] White Cedar - Boreal Conifer Mesic Forest, which occasionally occupies wettish sites.

## **C. UPLAND SHRUBLAND, GRASSLAND, or NON-VASCULAR VEGETATION**

N.B. Some open pine woodlands with 25- 60% total tree cover may key out to this part, if area of assessment is very small. These should be treated with Upland Forest and Woodland.

1. Sparsely vegetated (<25% total vascular plant vegetation cover), but overhanging trees can shade the site.

2. Substrate cobble or talus below or associated with cliffs, not lake or river shorelines.

3. Talus is moist, with very large boulders (>12 inches diameter) with mosses, ferns, and scattered herbs, shrubs, and short trees. Found on Mt Rose on northerly aspects.

**Northern Non-Carbonate Moist Talus Vegetation (CEGL002409)**

3'. Talus is dry, with smaller rocks (<12 inches), with little to no vegetation, and lichens common. Found on Mt Rose, on southerly aspects.

**Northern Non-Carbonate Dry Talus Vegetation (CEGL005247)**

2'. Cobble - gravel shore.

**Great Lakes Basalt - Diabase Cobble - Gravel Shore (CEGL05250)**

1.' Shrub and herb cover >25%, and tree canopy cover <25%. Sites on thin, sometimes rocky, soil; if on talus slope, see 2 above.

**Boreal Hazelnut - Serviceberry Rocky Shrubland (CEGL05197)**

**D. WETLAND SHRUBLAND, GRASSLAND, or NON-VASCULAR VEGETATION**

Presence of standing water, saturated mineral soil or peat (organic) soil. Herb or shrub dominated.

1. Not permanently flooded. Or, if permanently flooded, then standing water  $\leq$  0.5 meters deep, and rooted aquatics <25% total cover.

2. Shrubs dominant (>25% total cover of shrubs), alder typically present.

3. Dominant shrub *Alnus incana*, typically >75% RC.

**Speckled Alder Swamp (CEGL02381)**

**[classic alder phase]**

3.' Dominant shrub either *Crataegus* spp. or tall willows (up to 75% RC).

4. Dominated by *Crataegus* spp (>25% RC). Found near the Heritage Center.

**Speckled Alder Swamp (CEGL02381)**

**[hawthorn mix phase]**

4.' Dominated by tall (>2 m) *Salix* spp. (>25% RC) Found near the Heritage Center.

**Speckled Alder Swamp (CEGL02381)**

**[willow mix phase]**

2.' Graminoid or herb strongly dominant (>60% total herb cover), and shrub total cover <25%.

5. Community strongly dominated by *Calamagrostis Canadensis*, *Carex* spp, or *Phalaris arundinacea*.

6. RC of *Carex* spp. <50%.

7.' Community dominated by *Calamagrostis canadensis* or *Phalaris arundinacea*.

**Canada Bluejoint Eastern Meadow (CEGL05174)**

6.' *Carex* spp. 50% RC or greater.

**Northern Sedge Wet Meadow (CEGL02257)**

5.' No clear dominant emergent, graminoid or herbaceous species. Obvious indication of beaver or anthropogenic disturbance. Typically consists of early successional grass and forb beaver meadows found near Ft. Charlotte, but not described to the association level.

**Wet Meadow Mixed Herbaceous (Map Class; Macrogroup G112)**

1.' Permanently flooded. Standing water  $\geq 0.5$  m deep (rarely less than 0.5 m) and rooted aquatics dominant (>25% total cover), and emergents not dominant (<25% total cover).

8. Dominated ( $\geq 50\%$  RC) by emergent aquatics.

9.' Community strongly dominated by *Equisetum fluviatile* or *Sparganium* spp.

**Water Horsetail - Spikerush Marsh (CEGL05258)**

8'. Dominated (>50% RC) by rooted floating leaved aquatics (*Nymphaea odorata*, *Nuphar lutea*), or rooted submergent-leaved aquatics (*Ceratophyllum demersum*, *Potamogeton* spp., *Myriophyllum* spp.) vegetation.

10. Dominated ( $\geq 50\%$  RC) by rooted floating-leaved aquatics such as *Nymphaea odorata* and *Nuphar lutea* with little to no rooted submergent-leaved aquatic vegetation (<50% RC).

**Northern Water-lily Aquatic Wetland (CEGL002562)**

10.' Dominated (>50% cover) by rooted submergent-leaved vegetation (*Ceratophyllum demersum*, *Potamogeton* spp., *Myriophyllum* spp.) with little to no rooted floating-leaved aquatic species present.

**Midwest Pondweed Submerged Aquatic Wetland (CEGL002282)**

8.'' No clear dominant emergent, graminoid or herbaceous species. Obvious indication of beaver or anthropogenic disturbance. Typically consists of early successional grass and forb beaver meadows found near Ft. Charlotte, but not described to the association level.

**Wet Meadow Mixed Herbaceous (Map Class; Macrogroup G112)**

## **Appendix D: List of Plant Species**



### Explanation of the Species List

Plant species were identified and documented from vegetation sample plots and accuracy assessment sites collected for the Grand Portage National Monument (GRPO) vegetation mapping project. Plant species, along with other sample data, were entered into the National Park Service PLOTS Database Version 2 (NatureServe 2005b) for subsequent analyses (plant community descriptions and map assessment). Table D-1 is an export of all plant species generated from the PLOTS Database for this project. This list is not intended to be comprehensive of every species at the GRPO. The plant species list is organized alphabetically, first by family name and then by scientific name. Nomenclature follows the PLANTS database (U.S. Department of Agriculture 2004).

**Table D-1.** Plant species list of Grand Portage National Monument.

Scientific Name	Common Name	Family
<i>Acer saccharum</i>	sugar maple	Aceraceae
<i>Acer spicatum</i>	mountain maple	Aceraceae
<i>Acorus calamus</i>	single-vein sweetflag	Acoraceae
<i>Sagittaria</i>	arrowhead	Alismataceae
<i>Sagittaria latifolia</i>	broadleaf arrowhead	Alismataceae
<i>Sagittaria rigida</i>	sessilefruit arrowhead	Alismataceae
<i>Calliargon</i>	calliargon moss	Amblystegiaceae
<i>Rhus glabra</i>	smooth sumac	Anacardiaceae
<i>Cicuta bulbifera</i>	bulblet-bearing water hemlock	Apiaceae
<i>Heracleum maximum</i>	common cowparsnip	Apiaceae
<i>Sanicula marilandica</i>	Maryland sanicle	Apiaceae
<i>Apocynum</i>	dogbane	Apocynaceae
<i>Apocynum androsaemifolium</i>	spreading dogbane	Apocynaceae
<i>Calla palustris</i>	water arum	Araceae
<i>Aralia nudicaulis</i>	wild sarsaparilla	Araliaceae
<i>Asarum canadense</i>	Canadian wildginger	Aristolochiaceae
<i>Achillea millefolium</i>	common yarrow	Asteraceae
<i>Antennaria neglecta</i>	field pussytoes	Asteraceae
<i>Aster</i>	aster	Asteraceae
<i>Bidens cernua</i>	nodding beggartick	Asteraceae
<i>Cirsium</i>	thistle	Asteraceae
<i>Cirsium muticum</i>	swamp thistle	Asteraceae
<i>Doellingeria umbellata</i>	parasol whitetop	Asteraceae
<i>Eupatorium maculatum</i>	spotted joeypyweed	Asteraceae
<i>Eurybia macrophylla</i>	bigleaf aster	Asteraceae
<i>Hieracium</i>	hawkweed	Asteraceae
<i>Lactuca biennis</i>	tall blue lettuce	Asteraceae
<i>Leucanthemum vulgare</i>	oxeye daisy	Asteraceae
<i>Megalodonta beckii</i>	Beck's watermarigold	Asteraceae
<i>Petasites frigidus</i>	arctic sweet coltsfoot	Asteraceae
<i>Petasites frigidus</i> var. <i>palmatus</i>	arctic sweet coltsfoot	Asteraceae
<i>Petasites sagittatus</i>	arrowleaf sweet coltsfoot	Asteraceae
<i>Prenanthes alba</i>	white rattlesnakeroot	Asteraceae
<i>Solidago</i>	goldenrod	Asteraceae
<i>Solidago canadensis</i>	Canada goldenrod	Asteraceae

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

Scientific Name	Common Name	Family
<i>Solidago gigantea</i>	giant goldenrod	Asteraceae
<i>Solidago juncea</i>	early goldenrod	Asteraceae
<i>Solidago nemoralis</i>	gray goldenrod	Asteraceae
<i>Symphyotrichum ciliolatum</i>	Lindley's aster	Asteraceae
<i>Symphyotrichum cordifolium</i>	common blue wood aster	Asteraceae
<i>Symphyotrichum puniceum</i>	purplestem aster	Asteraceae
<i>Impatiens</i>	touch-me-not	Balsaminaceae
<i>Impatiens capensis</i>	jewelweed	Balsaminaceae
<i>Alnus</i>	alder	Betulaceae
<i>Alnus incana</i>	gray alder	Betulaceae
<i>Alnus incana</i> ssp. <i>rugosa</i>	speckled alder	Betulaceae
<i>Alnus viridis</i>	green alder	Betulaceae
<i>Betula</i>	birch	Betulaceae
<i>Betula papyrifera</i>	paper birch	Betulaceae
<i>Corylus cornuta</i>	beaked hazelnut	Betulaceae
<i>Mertensia paniculata</i>	tall bluebells	Boraginaceae
<i>Brachythecium</i>	brachythecium moss	Brachytheciaceae
<i>Diervilla lonicera</i>	northern bush honeysuckle	Caprifoliaceae
<i>Linnaea borealis</i>	twinflower	Caprifoliaceae
<i>Lonicera canadensis</i>	American fly honeysuckle	Caprifoliaceae
<i>Lonicera hirsuta</i>	hairy honeysuckle	Caprifoliaceae
<i>Lonicera hispidula</i>	pink honeysuckle	Caprifoliaceae
<i>Sambucus canadensis</i>	elderberry	Caprifoliaceae
<i>Sambucus racemosa</i>	red elderberry	Caprifoliaceae
<i>Symphoricarpos</i>	snowberry	Caprifoliaceae
<i>Viburnum opulus</i>	European cranberrybush	Caprifoliaceae
<i>Viburnum opulus</i> var. <i>americanum</i>	American cranberrybush	Caprifoliaceae
<i>Cladina</i>	reindeer lichen	Cladoniaceae
<i>Triadenum fraseri</i>	Fraser's marsh St. Johnswort	Clusiaceae
<i>Cornus</i>	dogwood	Cornaceae
<i>Cornus canadensis</i>	bunchberry dogwood	Cornaceae
<i>Cornus rugosa</i>	roundleaf dogwood	Cornaceae
<i>Cornus sericea</i>	redosier dogwood	Cornaceae
<i>Sedum</i>	stonecrop	Crassulaceae
<i>Juniperus communis</i>	common juniper	Cupressaceae
<i>Juniperus horizontalis</i>	creeping juniper	Cupressaceae
<i>Thuja occidentalis</i>	arborvitae	Cupressaceae
<i>Carex</i>	sedge	Cyperaceae
<i>Carex gracillima</i>	graceful sedge	Cyperaceae
<i>Carex gynandra</i>	nodding sedge	Cyperaceae
<i>Carex intumescens</i>	greater bladder sedge	Cyperaceae
<i>Carex lacustris</i>	hairy sedge	Cyperaceae
<i>Carex laxiculmis</i>	spreading sedge	Cyperaceae
<i>Carex pedunculata</i>	longstalk sedge	Cyperaceae
<i>Carex retrorsa</i>	knotsheath sedge	Cyperaceae
<i>Carex stricta</i>	upright sedge	Cyperaceae
<i>Carex vesicaria</i>	blister sedge	Cyperaceae
<i>Eleocharis</i>	spikerush	Cyperaceae

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

Scientific Name	Common Name	Family
<i>Scirpus cyperinus</i>	woolgrass	Cyperaceae
<i>Pteridium aquilinum</i>	western brackenfern	Dennstaedtiaceae
<i>Dicranum</i>	dicranum moss	Dicranaceae
<i>Athyrium filix-femina</i>	common ladyfern	Dryopteridaceae
<i>Cystopteris fragilis</i>	brittle bladderfern	Dryopteridaceae
<i>Dryopteris carthusiana</i>	spinulose woodfern	Dryopteridaceae
<i>Dryopteris intermedia</i>	intermediate woodfern	Dryopteridaceae
<i>Gymnocarpium dryopteris</i>	western oakfern	Dryopteridaceae
<i>Matteuccia struthiopteris</i>	ostrich fern	Dryopteridaceae
<i>Onoclea sensibilis</i>	sensitive fern	Dryopteridaceae
<i>Woodsia ilvensis</i>	rusty woodsia	Dryopteridaceae
<i>Equisetum arvense</i>	field horsetail	Equisetaceae
<i>Equisetum fluviatile</i>	water horsetail	Equisetaceae
<i>Equisetum sylvaticum</i>	woodland horsetail	Equisetaceae
<i>Arctostaphylos uva-ursi</i>	kinnikinnick	Ericaceae
<i>Vaccinium angustifolium</i>	lowbush blueberry	Ericaceae
<i>Vaccinium myrtilloides</i>	velvetleaf huckleberry	Ericaceae
<i>Lathyrus ochroleucus</i>	cream pea	Fabaceae
<i>Lotus corniculatus</i>	birdfoot deervetch	Fabaceae
<i>Melilotus alba</i>	white sweetclover	Fabaceae
<i>Trifolium pratense</i>	red clover	Fabaceae
<i>Ribes</i>	currant	Grossulariaceae
<i>Hylocomium splendens</i>	splendid feather moss	Hylocomiaceae
<i>Pleurozium schreberi</i>	Schreber's big red stem moss	Hylocomiaceae
<i>Rhytidiadelphus triquetrus</i>	rough goose neck moss	Hylocomiaceae
<i>Iris versicolor</i>	harlequin blueflag	Iridaceae
<i>Lycopus uniflorus</i>	northern bugleweed	Lamiaceae
<i>Mentha arvensis</i>	wild mint	Lamiaceae
<i>Scutellaria lateriflora</i>	blue skullcap	Lamiaceae
<i>Stachys tenuifolia</i>	smooth hedgenettle	Lamiaceae
<i>Utricularia intermedia</i>	flatleaf bladderwort	Lentibulariaceae
<i>Utricularia macrorhiza</i>	common bladderwort	Lentibulariaceae
<i>Clintonia borealis</i>	bluebead	Liliaceae
<i>Maianthemum canadense</i>	Canada mayflower	Liliaceae
<i>Streptopus lanceolatus</i>	twistedstalk	Liliaceae
<i>Streptopus lanceolatus</i> var. <i>roseus</i>	twistedstalk	Liliaceae
<i>Trillium cernuum</i>	whip-poor-will flower	Liliaceae
<i>Lycopodium</i>	clubmoss	Lycopodiaceae
<i>Lycopodium annotinum</i>	stiff clubmoss	Lycopodiaceae
<i>Lycopodium clavatum</i>	running clubmoss	Lycopodiaceae
<i>Lycopodium obscurum</i>	rare clubmoss	Lycopodiaceae
<i>Fraxinus nigra</i>	black ash	Oleaceae
<i>Fraxinus pennsylvanica</i>	green ash	Oleaceae
<i>Chamerion angustifolium</i>	fireweed	Onagraceae
<i>Epilobium</i>	willowherb	Onagraceae
<i>Epilobium ciliatum</i>	fringed willowherb	Onagraceae
<i>Oenothera biennis</i>	common evening-primrose	Onagraceae
<i>Corallorrhiza maculata</i>	summer coralroot	Orchidaceae

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

Scientific Name	Common Name	Family
<i>Osmunda claytoniana</i>	interrupted fern	Osmundaceae
<i>Abies balsamea</i>	balsam fir	Pinaceae
<i>Picea glauca</i>	white spruce	Pinaceae
<i>Picea mariana</i>	black spruce	Pinaceae
<i>Pinus banksiana</i>	jack pine	Pinaceae
<i>Pinus resinosa</i>	red pine	Pinaceae
<i>Pinus strobus</i>	eastern white pine	Pinaceae
<i>Agropyron</i>	wheatgrass	Poaceae
<i>Bromus inermis</i>	smooth brome	Poaceae
<i>Calamagrostis canadensis</i>	bluejoint	Poaceae
<i>Cinna latifolia</i>	drooping woodreed	Poaceae
<i>Danthonia spicata</i>	poverty oatgrass	Poaceae
<i>Deschampsia caespitosa</i>	tufted hairgrass	Poaceae
<i>Deschampsia flexuosa</i>	wavy hairgrass	Poaceae
<i>Elymus</i>	wildrye	Poaceae
<i>Elymus canadensis</i>	Canada wildrye	Poaceae
<i>Glyceria canadensis</i>	rattlesnake mannagrass	Poaceae
<i>Glyceria striata</i>	fowl mannagrass	Poaceae
<i>Oryzopsis</i>	ricegrass	Poaceae
<i>Oryzopsis asperifolia</i>	roughleaf ricegrass	Poaceae
<i>Phalaris arundinacea</i>	reed canarygrass	Poaceae
<i>Phleum pratense</i>	timothy	Poaceae
<i>Poa compressa</i>	Canada bluegrass	Poaceae
<i>Poa pratensis</i>	Kentucky bluegrass	Poaceae
<i>Polypodium</i>	polypody	Polypodiaceae
<i>Polypodium virginianum</i>	rock polypody	Polypodiaceae
<i>Polytrichum</i>	polytrichum moss	Polytrichaceae
<i>Lysimachia</i>	yellow loosestrife	Primulaceae
<i>Lysimachia terrestris</i>	earth loosestrife	Primulaceae
<i>Trientalis borealis</i>	starflower	Primulaceae
<i>Chimaphila umbellata</i>	pipsissewa	Pyrolaceae
<i>Orthilia secunda</i>	sidebells wintergreen	Pyrolaceae
<i>Pyrola</i>	wintergreen	Pyrolaceae
<i>Pyrola americana</i>	American wintergreen	Pyrolaceae
<i>Pyrola elliptica</i>	waxflower shinleaf	Pyrolaceae
<i>Actaea</i>	baneberry	Ranunculaceae
<i>Actaea pachypoda</i>	white baneberry	Ranunculaceae
<i>Actaea rubra</i>	red baneberry	Ranunculaceae
<i>Anemone canadensis</i>	Canadian anemone	Ranunculaceae
<i>Aquilegia</i>	columbine	Ranunculaceae
<i>Caltha palustris</i>	yellow marsh marigold	Ranunculaceae
<i>Coptis trifolia</i>	threeleaf goldthread	Ranunculaceae
<i>Thalictrum</i>	meadow-rue	Ranunculaceae
<i>Thalictrum dasycarpum</i>	purple meadow-rue	Ranunculaceae
<i>Thalictrum pubescens</i>	king of the meadow	Ranunculaceae
<i>Rhamnus alnifolia</i>	alderleaf buckthorn	Rhamnaceae
<i>Amelanchier</i>	serviceberry	Rosaceae
<i>Comarum palustre</i>	purple marshlocks	Rosaceae

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

Scientific Name	Common Name	Family
<i>Crataegus</i>	hawthorn	Rosaceae
<i>Crataegus douglasii</i>	black hawthorn	Rosaceae
<i>Fragaria virginiana</i>	Virginia strawberry	Rosaceae
<i>Geum</i>	avens	Rosaceae
<i>Potentilla norvegica</i>	Norwegian cinquefoil	Rosaceae
<i>Prunus pensylvanica</i>	pin cherry	Rosaceae
<i>Prunus virginiana</i>	chokecherry	Rosaceae
<i>Rosa</i>	rose	Rosaceae
<i>Rosa acicularis</i>	prickly rose	Rosaceae
<i>Rubus</i>	blackberry	Rosaceae
<i>Rubus allegheniensis</i>	Allegheny blackberry	Rosaceae
<i>Rubus idaeus</i>	American red raspberry	Rosaceae
<i>Rubus parviflorus</i>	thimbleberry	Rosaceae
<i>Rubus pubescens</i>	dwarf red blackberry	Rosaceae
<i>Sibbaldiopsis tridentata</i>	shrubby fivefingers	Rosaceae
<i>Sorbus decora</i>	northern mountain ash	Rosaceae
<i>Spiraea alba</i>	white meadowsweet	Rosaceae
<i>Galium</i>	bedstraw	Rubiaceae
<i>Populus balsamifera</i>	balsam poplar	Salicaceae
<i>Populus tremuloides</i>	quaking aspen	Salicaceae
<i>Salix</i>	willow	Salicaceae
<i>Salix bebbiana</i>	Bebb willow	Salicaceae
<i>Salix humilis</i>	prairie willow	Salicaceae
<i>Salix planifolia</i>	diamondleaf willow	Salicaceae
<i>Mitella nuda</i>	naked miterwort	Saxifragaceae
<i>Saxifraga virginiana</i>	early saxifrage	Saxifragaceae
<i>Chelone glabra</i>	white turtlehead	Scrophulariaceae
<i>Sparganium natans</i>	small bur-reed	Sparganiaceae
<i>Sphagnum</i>	sphagnum	Sphagnaceae
<i>Taxus canadensis</i>	Canada yew	Taxaceae
<i>Phegopteris</i>	beechnern	Thelypteridaceae
<i>Typha</i>	cattail	Typhaceae
<i>Ulmus americana</i>	American elm	Ulmaceae
<i>Viola</i>	violet	Violaceae



## **Appendix E: Descriptions of Map Classes**



## Explanation of Map-class Descriptions

This appendix to the Main Report of the Grand Portage National Monument (GRPO) vegetation mapping project provides descriptions to the 35 map classes we used to map GRPO for the National Park Service (NPS) Vegetation Inventory Program (VIP). Of these 35 map classes, 32 represent vegetation types within the National Vegetation Classification Standard (NVCS) (FGDC 2008), where another three represent non-vegetated units (open water). For those map classes representing associations in the NVCS, we recommend using Appendix B: Descriptions of Vegetation Types and Appendix C: Field Key to Vegetation Types to complement these map-class descriptions.

Each map-class description provides the formal map-class name and code we used for mapping. Names for map classes representing associations in the NVCS are the synonym names as provided by NatureServe. (For map-class phases, the phase portion of the name is not part of the synonym name.) For map classes representing vegetation types above the floristic level in the NVCS and for non-vegetated features, we derived succinct names to describe the feature.

Commencing each map-class description, we provide the official classification name and code that the map class represents, whether to the NVCS or, if non-vegetated, to the classification in the National Land Cover Database (NLCD) 2001 (Homer et al. 2004). The map class is described with a focus to GRPO and not necessarily to the region beyond.

Also, descriptions are from a mapping perspective more than from an ecologic perspective; however, some ecologic concepts are inherent to the descriptions, as one would expect when describing the mapping of types in the NVCS. We also discuss how map classes relate to other map classes, because many vegetation types transition into each other. Furthermore, we discuss briefly the distribution of how a particular map class was mapped throughout GRPO. (Several local names are used; Figure E-1 is provided to show their locations at the GRPO.) We finally provide a brief explanation of how map classes were analyzed by the accuracy assessment.

Throughout the map-class descriptions, “RD” refers to relative density and “AA” refers to accuracy assessment. Also, when speaking of tree species (e.g., balsam fir, quaking aspen, northern white-cedar), it is assumed these are of heights >5 m unless otherwise specified (e.g., shrub-height trees). This includes general references to trees as conifers and hardwoods.

Along with describing the map classes via text, representative ground pictures are also provided to give a visual concept of what the map classes represent. It is worth noting that the representative pictures are a partial representation; to capture all variations within a map class would become daunting.

We organized map classes representing vegetation types by the hierarchy within the NVCS (FGDC 2008). We organized map classes representing non-vegetated features (open water) with the classification in the NLCD. Map classification codes, names, and their crosswalk to the NVCS and NLCD are listed in Table E-1. The map classification is listed alphabetically by map-class code in Table E-2 at the end of this appendix.

**Minimum Mapping Units**

Because much of the GRPO boundary is narrow and linear in shape, we applied a minimum mapping unit (MMU) of 0.25 ha for mapping vegetation types and land features. This is half the size of the normal standard for a MMU within the NPS VIP. For vegetation types unique to the immediate surroundings (e.g., emergent wetland within an upland forest setting), we allowed for mapping down to half the MMU standard set for the GRPO vegetation mapping project<sup>1</sup>. In addition, we applied a secondary MMU of 1.0 ha for physiognomic-feature changes within a particular map class (e.g., open versus closed forest). We used MMU templates to help us determine minimum polygon size on the photographs during mapping. Because of angle distortions inherent to nonrectified aerial photos, and slight scale changes from high ridges to valley bottoms, we applied our MMU standards liberally.

**Page Reference to Map-classification Descriptions**

White-cedar - Boreal Conifer Mesic Forest (FCC and FCM) .....	11
White-cedar - Boreal Conifer Mesic Forest (conifer phase)–FCC .....	12
White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)–FCM .....	13
White Pine / Mountain Maple Mesic Forest (FWM, FWA, and FWD) .....	14
White Pine / Mountain Maple Mesic Forest (conifer mesic phase)–FWM .....	15
White Pine / Mountain Maple Mesic Forest (conifer - hardwood phase)–FWA .....	16
White Pine / Mountain Maple Mesic Forest (dry-mesic phase)–FWD.....	17
Conifer - Hardwood Ruderal Forest (FMX) .....	18
Conifer Plantation (FPE).....	19
Black Ash - Mixed Hardwood Swamp (FBA and FGA) .....	20
Black Ash - Mixed Hardwood Swamp (black ash phase)–FBA .....	21
Black Ash - Mixed Hardwood Swamp (green ash - elm phase)–FGA .....	22
Aspen - Balsam Poplar Lowland Forest (FAP) .....	23
Gray Alder Swamp Shrubland (SAS, SAH, and SAW) .....	24
Gray Alder Swamp Shrubland (classic alder phase)–SAS.....	25
Gray Alder Swamp Shrubland (hawthorn mix phase)–SAH .....	26
Gray Alder Swamp Shrubland (willow mix phase)–SAW .....	27
Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) .....	28
Jack Pine / Balsam Fir Forest (FJF) .....	29
Boreal Pine Rocky Woodland (WPR) .....	30
Spruce - Fir - Aspen Forest (FCP) .....	31
Spruce - Fir / Mountain Maple Forest (FSF) .....	34
Aspen - Birch / Boreal Conifer Forest (FAC).....	37
Deciduous Ruderal Shrubland (SDX).....	40

---

<sup>1</sup>Note that several polygons along the project boundary are smaller than the MMU standards of the VIP because the vegetation map layer is clipped to the project boundary. We allowed clipped polygons as small as 0.05 ha along the project boundary.

National Park Service Vegetation Inventory Program  
Grand Portage National Monument

---

Ruderal Grassland (HMX).....	41
Boreal Hazelnut - Serviceberry Rocky Shrubland (SHS).....	42
Water Horsetail - Spikerush Marsh (HHS).....	43
Wet Meadow Mixed Herbaceous (HWM).....	44
Bluejoint Wet Meadow (HCC).....	45
Northern Sedge Wet Meadow (HSG).....	46
Northern Water-lily Aquatic Wetland (HFA).....	47
Midwest Pondweed Submerged Aquatic Wetland (HSV).....	48
Great Lakes Basalt - Diabase Cobble - Gravel Shore (VCB).....	49
Northern Non-Carbonate Dry Talus Vegetation (VDT).....	50
Northern Non-Carbonate Moist Talus Vegetation (VMT).....	51
Developed Area (NDV).....	52
Open Space–21 (O).....	52
Low Intensity–22 (L).....	53
Medium Intensity–23 (M).....	53
High Intensity–24 (H).....	53
Stream & River (NSR).....	54
Open Water Pond (NWP).....	55
Open Water Lake (NWL).....	56



Figure E-1. Local geographic names in connection to the Grand Portage National Monument vegetation mapping project.

Table E-1. Map classification with crosswalk to the National Vegetation Classification Standard (Version 2) for the Grand Portage National Monument vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database; MMU, minimum mapping unit]

Map-class Code	Map-class Name
<b>1. FOREST &amp; WOODLAND CLASS</b>	
1.C.2.a. Eastern North American Cool Temperate Forest Division	
MG014. Northern Hardwood & Conifer Forest Macrogroup	
G163. Northern Hardwood - Hemlock - White Pine Forest Group	
<i>Thuja occidentalis</i> / <i>Abies balsamea</i> - <i>Acer spicatum</i> Forest Association (CEGL002449)	
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	
<i>Pinus strobus</i> / <i>Acer spicatum</i> - <i>Corylus cornuta</i> Forest Association (CEGL002445)	
FWM	White Pine / Mountain Maple Mesic Forest (conifer mesic phase)
FWA	White Pine / Mountain Maple Mesic Forest (conifer - hardwood mesic phase)
FWD	White Pine / Mountain Maple Mesic Forest (dry-mesic phase)
MG013. Eastern North American Ruderal Forest & Plantation Macrogroup	
G030. Northern & Central Hardwood & Conifer Ruderal Forest Group	
FMX	Conifer - Hardwood Ruderal Forest
G032. Northern & Central Conifer & Hardwood Plantation Group	
FPE	Conifer Plantation
1.C.3.a. Northeastern & Central North American Flooded & Swamp Forest Division	
MG030. Northern & Central Swamp Forest Macrogroup	
G046. Northern & Central Alkaline Conifer & Hardwood Swamp Group	
<i>Fraxinus nigra</i> - Mixed Hardwoods - Conifers / <i>Cornus sericea</i> / <i>Carex</i> spp. Forest Association (CEGL002105)	
FBA	Black Ash - Mixed Hardwood Swamp (black ash phase)
FGA	Black Ash - Mixed Hardwood Swamp (green ash - elm phase)
<i>Populus tremuloides</i> - <i>Populus balsamifera</i> - Mixed Hardwoods Lowland Forest Association (CEGL005036)	
FAP	Aspen - Balsam Poplar Lowland Forest

Map-class Code	Map-class Name
----------------	----------------

MG160. Northern & Central Tall Shrub Wetland Macrogroup

G167. Northern & Central Shrub Swamp Group

*Alnus incana* Swamp Shrubland Association (CEGL002381)

SAS Gray Alder Swamp Shrubland (classic alder phase)

SAH Gray Alder Swamp Shrubland (hawthorn mix phase)

SAW Gray Alder Swamp Shrubland (willow mix phase)

1.D.1.a. North American Lowland Boreal Forest Division

MG037. Eastern & Central North American Boreal Conifer & Hardwood Forest Macrogroup

G047. Jack Pine - Black Spruce Forest Group

*Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518)

FJM Jack Pine - Aspen / Bush-honeysuckle Forest

*Pinus banksiana* / *Abies balsamea* Forest Association (CEGL002437)

FJF Jack Pine / Balsam Fir Forest

G347. Jack Pine - Northern Pin Oak Rocky Woodland Group

*Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland Association (CEGL002483)

WPR Boreal Pine Rocky Woodland

G048. White Spruce - Balsam Fir Forest Group

*Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475)

FCP Spruce - Fir - Aspen Forest

*Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest Association (CEGL002446)

FSF Spruce - Fir / Mountain Maple Forest

*Populus tremuloides* - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest Association (CEGL002466)

FAC Aspen - Birch / Boreal Conifer Forest

**2. SHRUBLAND & GRASSLAND CLASS**

2.C.1.c. Eastern North American Grassland, Meadow & Shrubland Division

MG123. Eastern Ruderal Shrubland & Grassland Macrogroup

G059. Eastern Ruderal Shrubland & Grassland Group [Placeholder]

SDX Deciduous Ruderal Shrubland

HMX Ruderal Grassland

Map-class Code	Map-class Name
2.C.2.a.	North American Boreal Grassland, Meadow & Shrubland Division
MG069.	North American Boreal Shrubland & Grassland Macrogroup
G339.	Eastern North American Boreal Shrubland & Grassland Group
	<i>Corylus cornuta</i> - <i>Amelanchier</i> spp. - <i>Prunus virginiana</i> Rocky Shrubland Association (CEGL005197)
SHS	Boreal Hazelnut - Serviceberry Rocky Shrubland
2.C.5.a.	Eastern North America Freshwater Wet Meadow, Riparian & Marsh Division
MG069.	Eastern & North-Central North American Marsh & Wet Meadow Macrogroup
G125.	Eastern North American Freshwater Marsh Group
	<i>Equisetum fluviatile</i> - ( <i>Eleocharis palustris</i> ) Herbaceous Vegetation Association (CEGL005258)
HHS	Water Horsetail - Spikerush Marsh
G112.	Eastern North American Wet Meadow Group
HWM	Wet Meadow Mixed Herbaceous
	<i>Calamagrostis canadensis</i> - <i>Eupatorium maculatum</i> Herbaceous Vegetation Association (CEGL005174)
HCC	Bluejoint Wet Meadow
	<i>Carex (rostrata, utriculata)</i> - <i>Carex lacustris</i> - ( <i>Carex vesicaria</i> ) Herbaceous Vegetation Association (CEGL002257)
HSG	Northern Sedge Wet Meadow
 <b>5. AQUATIC VEGETATION CLASS</b>	
5.B.1.a.	North American Freshwater Aquatic Vegetation Division
MG108.	Eastern North American Freshwater Aquatic Vegetation Macrogroup
G114.	Eastern North American Freshwater Aquatic Vegetation Group [Placeholder]
	<i>Nymphaea odorata</i> - <i>Nuphar (microphylla, variegata)</i> Herbaceous Vegetation Association (CEGL002562)
HFA	Northern Water-lily Aquatic Wetland
	<i>Potamogeton</i> spp. - <i>Ceratophyllum</i> spp. Midwest Herbaceous Vegetation Association (CEGL002282)
HSV	Midwest Pondweed Submerged Aquatic Wetland

Map-class Code	Map-class Name
----------------	----------------

**6. NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION CLASS**

6.B.2.a. Eastern North American Temperate Cliff, Scree & Rock Vegetation Division

MG111. Eastern North American Cliff & Rock Vegetation Macrogroup

G341. Great Lakes Cliff & Shore Group [Placeholder]

Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation Association (CEGL005250)

VCB Great Lakes Basalt - Diabase Cobble - Gravel Shore

Basalt - Diabase Northern Open Talus Sparse Vegetation Association (CEGL005247)

VDT Northern Non-Carbonate Dry Talus Vegetation

Granite - Metamorphic Talus Northern Sparse Vegetation Association (CEGL002409)

VMT Northern Non-Carbonate Moist Talus Vegetation

**8. DEVELOPED VEGETATION CULTURAL CLASS**

Herbaceous & Woody Developed Vegetation Cultural Subclass (L2)

Other Developed Urban / Built Up Vegetation Formation (L3)

Developed Area (NLCD 2001; 21-24)

NDV Developed Area

**NON-NVCS UNITS**

Non-Vegetated Water & Land

Non-Vegetated Water

Open Water (NLCD 2001; 11)

NSR Stream & River

NWP Open Water Pond

NWL Open Water Lake

### **White-cedar - Boreal Conifer Mesic Forest (FCC and FCM)**

The White-cedar - Boreal Conifer Mesic Forest map class represents the *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449) in the NVCS. This map class consists of two phases, including the conifer (FCC) and conifer - hardwood (FCM). The White-cedar - Boreal Conifer Mesic Forest map class captures mesic to wet-mesic forests wherein the RD of northern white-cedar and mixed conifers to hardwoods is  $>25\%$ . The RD of white-cedar to white spruce and balsam fir is  $>25\%$ . Balsam fir is often a primary component, and some eastern white pine can be present, although their RD to conifers should be  $<25\%$ . Hardwoods typically consist of quaking aspen and paper birch, although some balsam poplar and black ash can be present in more wet-mesic locations. Eastern white pine can be scattered, but its RD to all conifers should be  $<25\%$ .

When the RD of white pine to conifers was  $>25\%$ , either the conifer mesic (FWM) phase or the conifer - hardwood mesic (FWA) phase of the White Pine / Mountain Maple Mesic Forest map class was considered, depending on the RD of hardwoods to conifers. Likewise, when the RD of white spruce and balsam fir to all conifers was  $>75\%$ , the Spruce - Fir - Aspen Forest (FCP) map class was considered. Furthermore, when the RD of conifers to hardwoods was  $<25\%$ , the Aspen - Birch / Boreal Conifer Forest (FAC) map class was considered.

The conifer (FCC) phase captures mesic white-cedar forests wherein the RD of conifers to hardwoods is  $>75\%$ . The conifer - hardwood (FCM) phase captures forests wherein the mutual RD of conifers and hardwoods is  $>25\%$ .

For AA, the two map-class phases (FCC and FCM) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

***White-cedar - Boreal Conifer Mesic Forest (conifer phase)–FCC***

The conifer (FCC) map-class phase represents the White-cedar - Boreal Conifer Mesic Forest map class (as described above) when the RD of the conifer component to hardwoods is >75%. When the RD of hardwoods to conifers was >25%, the conifer - hardwood (FCM) phase of this same map class was considered. A significant amount of balsam fir may be present, but its RD to northern white-cedar should be <75%. These forests are often dense, with a shaded understory and a lack of diversity in vegetation at the ground layer. The few hardwoods present include quaking aspen and paper birch, yet may also include balsam poplar and even some black ash when in more wet-mesic locations.

Mapping of the FCC map-class phase was uncommon throughout GRPO—mapped with just over a dozen units and only at the western half of GRPO. The majority of units were mapped at the far western end of the Portage Corridor and at the Fort Charlotte Unit; furthermore, FCC was usually mapped in close proximity to FCM.



***White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)–FCM***

The conifer - hardwood (FCM) map-class phase represents the White-cedar - Boreal Conifer Mesic Forest map class (as described above) when the mutual RD of conifers and hardwoods is >25%. When the RD of hardwoods to conifers was <25%, the conifer (FCC) phase of this same map class was considered. These forests are often less dense and more open than those mapped as FCC and, thus, have richer understory vegetation. Hardwood trees consist primarily of quaking aspen and paper birch, yet also of balsam poplar and even some black ash when in more wet-mesic locations. Because the hardwood canopy is often above the conifers (such that the conifers are obscured from an aerial viewpoint), it was essential to refer to spring, leaf-off aerial photographs during the mapping of FCM. Using this practice, not merely the RD of conifers to hardwoods could be determined, but also the RDs among conifer species (e.g., northern white-cedar RD to balsam fir) in order to identify the correct forest type.

Mapping of the FCM map-class phase was somewhat uncommon throughout GRPO—mapped with almost twenty units and only at the western half of GRPO. The majority of units were mapped at the far western end of the Portage Corridor and at the Fort Charlotte Unit; furthermore, FCM was often mapped in close proximity to FCC (yet was mapped independently as well).



### **White Pine / Mountain Maple Mesic Forest (FWM, FWA, and FWD)**

The White Pine / Mountain Maple Mesic Forest map class represents the *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest Association (CEGL002445) in the NVCS. This map class consists of three phases, including conifer mesic (FWM), conifer - hardwood mesic (FWA), and dry-mesic (FWD). The White Pine / Mountain Maple Mesic Forest map class captures mesic forests of eastern white pine wherein the RD of white pine to other conifers is >25% and the RD of hardwoods to conifers is <25%. Balsam fir and a significant tall-shrub layer are characteristic of the White Pine / Mountain Maple Mesic Forest, where northern white-cedar is a common component throughout the western third of GRPO. Red pine is often present, but often only a scattered few.

When the RD of white pine to all other trees was <25%, other map classes were considered (depending on RDs of conifer and hardwood components), including the conifer (FCC) and conifer - hardwood (FCM) phases of the White-cedar - Boreal Conifer Mesic Forest, the Spruce - Fir - Aspen Forest (FCP), and the Aspen - Birch / Boreal Conifer Forest (FAC).

The conifer mesic (FWM) phase captures mesic forests wherein the RD of conifers to hardwoods is >75%. The conifer - hardwood mesic (FWA) phase captures mesic forests wherein the mutual RD of conifers and hardwoods is >25%. The dry-mesic (FWD) phase captures the dry-mesic forests.

For AA, the three map-class phases (FWM, FWA, and FWD) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

***White Pine / Mountain Maple Mesic Forest (conifer mesic phase)–FWM***

The conifer mesic (FWM) map-class phase of the White Pine / Mountain Maple Mesic Forest map class (as described above) represents mesic forests wherein the RD of conifers to hardwoods is >75%. The few hardwoods present mostly include quaking aspen and paper birch. When the RD of hardwoods to conifers was >25%, the conifer - hardwood (FWA) phase of this same map class was considered. When the forest was in dry-mesic settings, the dry-mesic (FWD) phase of this same map class was considered.

Mapping of the FWM map-class phase was uncommon throughout GRPO, mapped with a half dozen units that were scattered throughout the Portage Corridor. The mapping of FWM was less extensive than of FWA, and it was often mapped in close proximity to FWA. It is noteworthy that the sole unit of FWD, which was mapped near the Site of Fort Charlotte within the Fort Charlotte Unit, is more than 800 m in distance from any mapped units of FWM or FWA.



***White Pine / Mountain Maple Mesic Forest (conifer - hardwood phase)–FWA***

The conifer - hardwood mesic (FWA) map-class phase of the White Pine / Mountain Maple Mesic Forest map class (as described above) represents mesic forests wherein the mutual RD of conifers and hardwoods is >25%. Hardwoods mostly include quaking aspen and paper birch. When the RD of hardwoods to conifers was <25% RD, the conifer mesic (FWM) phase of this same map class was considered. When the forest was in dry-mesic settings, the dry-mesic (FWD) phase of this same map class was considered.

Mapping of the FWA map-class phase was uncommon throughout GRPO—mapped with almost twenty units that were scattered throughout the Portage Corridor. Mapping of FWA was more extensive than of FWM, and FWA was often mapped in close proximity to FWM (yet it was mapped independently as well). It is noteworthy that the sole unit of FWD, which was mapped near the Site of Fort Charlotte within the Fort Charlotte Unit, is more than 800 m in distance from any mapped units of FWM or FWA.



***White Pine / Mountain Maple Mesic Forest (dry-mesic phase)–FWD***

The dry-mesic (FWD) map-class phase of the White-cedar - Boreal Conifer Mesic Forest map class (as described above) represents forests in a dry-mesic setting. The understory vegetation layer is sparse, with low diversity and a significant needle duff layer. The few hardwoods present are mostly quaking aspen and paper birch. When in mesic settings, either the conifer mesic (FWM) phase or the conifer - hardwood (FWA) phase of this same map class was considered, depending on the RD of hardwoods.

Mapping of the FWD map-class phase was rare to GRPO—mapped with one unit encompassing the campsite along the Pigeon River in close proximity to the Site of Fort Charlotte. Noteworthy is that this sole unit of FWD is more than 800 m in distance from any mapped units of FWM or FWA.



### **Conifer - Hardwood Ruderal Forest (FMX)**

The Conifer - Hardwood Ruderal Forest (FMX) map class represents the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Because of disturbance from anthropogenic activity and the inherent variability of floristic vegetation of these early successional forests, an association type was not determined. This map class captures open-canopy ruderal forests, with trees contributing >25% cover. Trees consist of any mixture of conifers and hardwoods, whether native or exotic to the GRPO area.

When trees contributed <25% cover, the Deciduous Ruderal Shrubland (SDX) map class was considered. Furthermore, when trees and shrubs both contributed <25% cover, the Ruderal Grassland (HMX) map class was considered.

Mapping of FMX was rare to GRPO—mapped with one unit in the Village Meadow of the Lakeshore Unit. FMX was mapped in close proximity to both SDX and HMX, both of which were also mapped only to the Lakeshore Unit.

Because of the disturbance regime inherent to ruderal forests, the FMX map class was not assessed for accuracy.

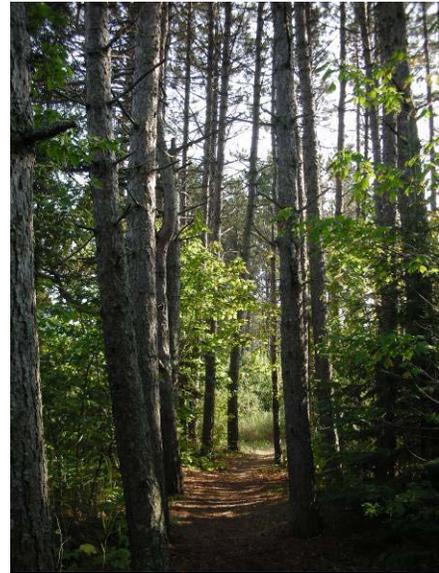


### **Conifer Plantation (FPE)**

The Conifer Plantation (FPE) map class represents the Northern & Central Conifer & Hardwood Plantation Group (G032) in the NVCS. The FPE map class captures conifer evergreen plantations of the Lakeshore Unit, consisting of jack pine, red pine, and/or spruce.

Mapping of FPE was rare to GRPO—mapped with four units in the northern half of the Lakeshore Unit. One of the mapped units of FPE is of the trailhead to The Grand Portage.

Because of the cultivated disposition of being a plantation, the FPP map class was not assessed for accuracy.



### **Black Ash - Mixed Hardwood Swamp (FBA and FGA)**

The Black Ash - Mixed Hardwood Swamp map class represents the *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105) in the NVCS. This map class consists of two phases, including black ash (FBA) and green ash - elm (FGA). The Black Ash - Mixed Hardwood Swamp map class captures wetland forests in basins and drainages wherein the RD of black ash to other hardwoods is >25%. Other hardwoods may include balsam poplar and quaking aspen, with paper birch less commonly included. Conifers may include northern white-cedar and balsam fir, with white spruce less commonly included. The RD of conifers (often short-stature trees) to hardwoods is <25%. The hardwood forest canopy can be open with a significant speckled alder shrub understory. Typical settings range from wet drainages to swamp margins of beaver meadow complexes.

When in wet lowland settings wherein the RD of black ash to other hardwoods was <25%, the Aspen - Balsam Poplar Lowland Forest (FAP) map class was considered, particularly when balsam poplar and/or quaking aspen were dominant; however, when hardwoods altogether contributed <25% canopy cover, with alder shrubs contributing >25% cover, the Gray Alder Swamp Shrubland (SAS) map class was considered.

The black ash (FBA) phase captures hardwood wetland forests wherein black ash is either monotypic or is present with elements of balsam poplar, quaking aspen, and paper birch. The green ash - elm (FGA) phase captures the hardwood wetland forest as black ash, with a fair component of green ash and American elm present. The FBA phase is wide-ranging throughout GRPO, where the FGA phase is found within the Pigeon River floodplain of the Fort Charlotte Unit.

For AA, the two map-class phases (FBA and FGA) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

***Black Ash - Mixed Hardwood Swamp (black ash phase)–FBA***

The black ash (FBA) map-class phase of the Black Ash - Mixed Hardwood Swamp map class (as described above) represents wetland forests wherein the RD of black ash to other hardwoods (balsam poplar, quaking aspen, and paper birch) is >25%. Often, however, these swamps are located near monotypic black ash. Tree canopy is often open in swamp-like settings and closed in wet to wet-mesic basin-like drainage sites. A significant amount of speckled alder shrub can be present, particularly in swamp-like settings with an open hardwood canopy.

The Black Ash - Mixed Hardwood Swamp within the Pigeon River floodplain of the Fort Charlotte Unit has a significant component of green ash and/or American elm present, with black ash remaining the primary hardwood. When in these settings, the green ash - elm (FGA) phase of the same map class was considered.

Mapping of the FBA map-class phase was somewhat uncommon throughout GRPO—mapped with just over fifteen units. By far, the majority of units were mapped at the western half of the Portage Corridor and at the Fort Charlotte Unit. No units of FBA were mapped at the Lakeshore Unit. It is noteworthy that mapping of FBA was often in close proximity to mapping of Aspen - Balsam Poplar Lowland Forest (FAP).



***Black Ash - Mixed Hardwood Swamp (green ash - elm phase)–FGA***

The green ash - elm (FGA) map-class phase of the Black Ash - Mixed Hardwood Swamp map class (as described above) represents riparian floodplain sites wherein black ash is the primary hardwood, yet there is also a significant presence of green ash and/or American elm. Some balsam poplar and quaking aspen may also be present. At the GRPO, these riparian versions of the Black Ash - Mixed Hardwood Swamp are known only to exist along the Pigeon River, north of the Site of Fort Charlotte.

The more typical version of the Black Ash - Mixed Hardwood Swamp map class does not have elements of green ash and/or American elm, but is either monotypically black ash or black ash mixed with a significant presence of balsam poplar and few quaking aspen and paper birch. For black ash hardwood forests throughout GRPO, other than along the Pigeon River, the black ash (FBA) phase of this same map class was considered.

Mapping of the FGA map-class phase was rare to GRPO—mapped with one unit along the Pigeon River at the far northwest corner of the Fort Charlotte Unit.



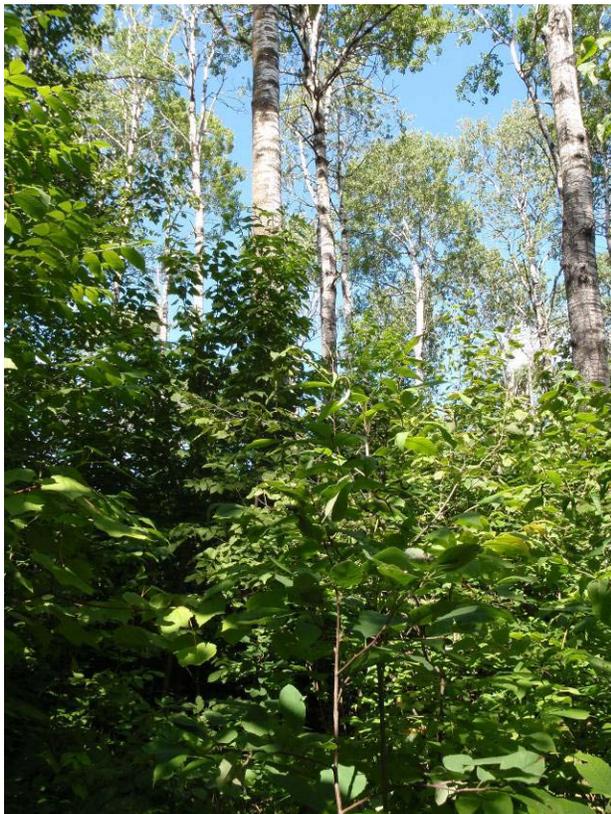
### **Aspen - Balsam Poplar Lowland Forest (FAP)**

The Aspen - Balsam Poplar Lowland Forest (FAP) map class represents the *Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest Association (CEGL005036) in the NVCS. This map class captures wet lowland hardwood forests wherein quaking aspen and balsam poplar are the primary canopy trees, with lesser amounts of paper birch. The RD of black ash to other hardwoods is <25%. Conifers may include northern white-cedar and balsam fir, with white spruce less commonly included. The RD of conifers (often short-stature trees) to hardwoods is <25%. Speckled alder may be scattered throughout, only occasionally in high density.

When in wetland settings wherein the RD of black ash to other hardwoods is >25%, the Black Ash - Mixed Hardwood Swamp map class (two phases, FBA and FGA) was considered (most commonly the black ash [FBA] phase). The green ash - elm (FGA) phase was limited to specific site along the Pigeon River at the Fort Charlotte Unit; however, when hardwoods contributed <25% canopy cover, with alder shrubs contributing >25% cover, the Gray Alder Swamp Shrubland map class (three phases, SAS, SAH, and SAW) was considered.

Mapping of the FAP map class was common throughout GRPO, with units mapped somewhat regularly from the shores of Lake Superior to the shores of the Pigeon River. Only a few stretches of the Portage Corridor are void of mapped FAP units.

For AA, the FAP map class was assessed independently of all other map classes.



### **Gray Alder Swamp Shrubland (SAS, SAH, and SAW)**

The Gray Alder Swamp Shrubland map class represents the *Alnus incana* Swamp Shrubland Association (CEGL002381) of the NVCS. It is worth pointing out that although a shrubland, this association is located within the Forest & Woodland Class hierarchy of the NVCS. This map class consists of three phases, including the classic alder (SAS), hawthorn mix (SAH), and willow mix (SAW). The Gray Alder Swamp Shrubland map class captures wetlands having >25% shrub cover, with the RD of speckled alder (variant of gray alder) to all shrubs typically >25%. These alder shrub wetlands are common to saturated drainages and beaver pond complexes.

The common expression of these shrub wetlands is characterized by tall, dense stands wherein alder is nearly monotypic, with few other shrub species (such as willows, redosier dogwood, and even some mountain maple) present. At the Lakeshore Unit, willows and black hawthorn are significantly present because of the unique history of anthropogenic use in that area. Hardwoods, such as black ash and balsam poplar, can be present; however, when hardwoods contributed >25% cover, even as short-statured trees, either the Aspen - Balsam Poplar Lowland Forest (FAP) map class or the black ash (FBA) phase of the Black Ash - Mixed Hardwood Swamp map class was considered, depending on the RDs of hardwood components. On the contrary, when shrubs and trees together contributed <25% cover, the Bluejoint Wet Meadow (HCC) or the Northern Sedge Wet Meadow (HSG) map classes were considered.

The classic alder (SAS) phase is the most typical form of these shrub wetlands, wherein stands of alder are nearly monotypic. The hawthorn mix (SAH) phase captures these shrub wetlands when there is a significant component of black hawthorn. The willow mix (SAW) phase captures these shrub wetlands when there is a significant component of tall willows, particularly prairie willow. The latter two phases are known only to the Lakeshore Unit, whereas the SAS phase is found throughout the entire GRPO.

For AA, the three map-class phases (SAS, SAH, and SAW) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

***Gray Alder Swamp Shrubland (classic alder phase)–SAS***

The classic alder (SAS) map-class phase of the Gray Alder Swamp Shrubland map class (as described above) represents shrub wetlands wherein speckled alder are nearly monotypic, with some willows, redosier dogwood, and mountain maple in low densities. Likewise, short statured trees, including black ash, balsam poplar, and balsam fir, are also common in low densities. These alder-dominant shrub wetlands are common to fast running streambeds, gentle flowing drainages, and beaver meadows.

When the RD of black hawthorn and/or willows to alder and other shrubs was >25%, particularly at the Lakeshore Unit, either the hawthorn mix (SAH) phase or the willow mix (SAW) phase of the same map class was considered, depending on the shrub components present.

Mapping of the SAS map-class phase was somewhat uncommon and spotty throughout GRPO. The majority of units were mapped at the far western end of the Portage Corridor and at the Fort Charlotte Unit. Units of SAS were also mapped at the Beaver Meadow and at the Poplar Creek drainages. Only one unit was mapped at the Lakeshore Unit, because most shrub wetlands of this area were mapped with the SAH and SAW map-class phases of the same class.



***Gray Alder Swamp Shrubland (hawthorn mix phase)–SAH***

The willow mix (SAH) map-class phase of the Gray Alder Swamp Shrubland map class (as described above) represents shrub wetlands consisting of speckled alder and a significant component of black hawthorn. Some redosier dogwood, mountain maple, and willows may also be present. This map-class phase was derived to capture the unique anthropogenic history that undoubtedly affected the shrub wetlands of the Lakeshore Unit.

At the Lakeshore Unit, when tall willows were more prominent than black hawthorn, the willow mix (SAW) phase of the same map class was considered. Throughout GRPO, including the Lakeshore Unit, when black hawthorn, as well as tall willows, was only a minor shrub component or non-existent, the classic alder (SAS) phase of the same map class was considered.

Mapping of the SAH map-class phase was rare to GRPO—mapped as two units within the Grand Portage Creek of the Lakeshore Unit.



***Gray Alder Swamp Shrubland (willow mix phase)–SAW***

The willow mix (SAW) map-class phase of the Gray Alder Swamp Shrubland map class (as described above) represent shrub wetlands consisting of speckled alder and a significant component (even exceedingly dominant) of tall willows that mostly include prairie willow and lesser amounts of diamondleaf willow. Some redosier dogwood and mountain maple may also be present. This map-class phase was derived to capture the unique anthropogenic history that undoubtedly affected the shrub wetlands of the Lakeshore Unit.

At the Lakeshore Unit, when black hawthorn was more prominent than tall willows, the hawthorn mix (SAH) phase of the same map class was considered. Throughout GRPO, including at the Lakeshore Unit, when tall willows and black hawthorn were only minor shrub components or non-existent, the classic alder (SAS) phase of the same map class was considered.

Mapping of the SAW map-class phase was rare to GRPO—mapped as one unit within the Village Meadow of the Lakeshore Unit. This single unit of SAW adjoins with another unit mapped as the SAS phase of the same map class.

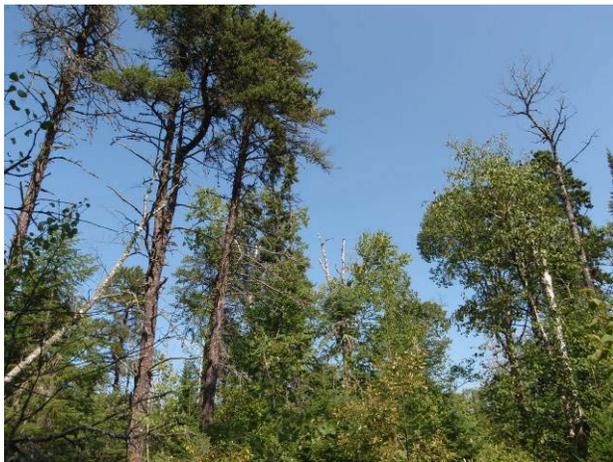


### **Jack Pine - Aspen / Bush-honeysuckle Forest (FJM)**

The Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) map class represents the *Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518) in the NVCS. This map class captures mesic forests wherein jack pine is dominant but mixed with quaking aspen. Only one location of FJM is known to GRPO, within the Portage Corridor, about 400 m west of the Beaver Meadow. The forest canopy is open, with short-statured balsam fir, white spruce, northern white-cedar, and paper birch. The northern bush honeysuckle is a primary shrub component.

This only known site of FJM was discovered during the AA field effort (GRPO.AA085) while assessing a site originally mapped as the conifer - hardwood mesic (FWA) phase of the White Pine / Mountain Maple Mesic Forest map class. For the benefit of the map user, this one unit (polygon) was updated to the FJM map class, reflected as such in the vegetation map layer. The jack-pine dominant forests on Mount Rose of the Lakeshore Unit are drier sites than FJM—mesic to dry-mesic—and have less diverse understory vegetation. These forest sites were mapped with the Jack Pine / Balsam Fir Forest (FJF) map class, even when quaking aspen and paper birch were present.

During AA, the FJM map class was not included with field-site selection because it was not part of the map classification; however, it was included with the AA results, shown as an error of omission (producers' accuracy) in the contingency table. The purpose in handling FJM this way in the AA results was to show that if more FJM exists at the GRPO, it might occur within units mapped as the White Pine / Mountain Maple Mesic Forest map class, and more specifically, the FWA map-class phase. It is noteworthy that, since the FJM map class did not exist at the time of site selection, the users' accuracy for FJM is null.



### **Jack Pine / Balsam Fir Forest (FJF)**

The Jack Pine / Balsam Fir Forest (FJF) map class represents the *Pinus banksiana* / *Abies balsamea* Forest Association (CEGL002437) in the NVCS. This map class captures jack-pine dominant, mesic to dry-mesic forests on Mount Rose at the Lakeshore Unit. The understory vegetation is less diverse than the more mesic sites of Jack Pine - Aspen / Bush-honeysuckle Forest (FJM). The only known site of FJM at the GRPO is about 9 km northwest of Mount Rose within the Portage Corridor, about 400 m west of the Beaver Pond Complex (discovered during field AA).

When the RD of jack pine to white spruce and balsam fir was <25%, either the Spruce - Fir / Mountain Maple Forest (FSF) map class or the Spruce - Fir - Aspen Forest (FCP) map class was considered, depending on the RD of quaking aspen and paper birch to conifers.

Mapping of the FJF map class was rare to GRPO—mapped as two units on Mount Rose at the Lakeshore Unit.

For AA, the FJF map class was assessed independently of all other map classes.



### **Boreal Pine Rocky Woodland (WPR)**

The Boreal Pine Rocky Woodland (WPR) map class represents the *Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland Association (CEGL002483) in the NVCS. This map class captures dry woodlands of mixed pine, with thin soil development and bedrock exposures covered with lichens. These woodlands are located on the basalt exposures somewhat anterior to Lake Superior where Highway 61 intersects the Portage Corridor. Trees contribute >25% cover and consist of jack pine and white pine, along with white spruce, balsam fir, and northern white-cedar. A sparse amount of quaking aspen can be present.

When the RD of tree cover was <25%, the Boreal Hazelnut - Serviceberry Rocky Shrubland (SHS) map class was considered. When the RD of tree cover was >25% and located on deeper soils and the forest canopy was not restricted by bedrock exposures and when the RD of pines to conifers was <25%, either the Spruce - Fir / Mountain Maple Forest (FSF) map class or the Spruce - Fir - Aspen Forest (FCP) map class was considered, depending on the RD of quaking aspen and paper birch to conifers. Interestingly, surrounding each unit of WPR are mapped units of FCP.

Mapping of the WPR map class was rare to GRPO—mapped with three units near where Highway 61 intersects with the Portage Corridor. It is noteworthy that one of these three units was determined to be SHS during field AA. Nevertheless, upon further review of the unit in question, it became evident this was a case where an aerial perspective and a ground perspective posed different interpretations. Refer to the Accuracy Assessment Results section of the main report for further discussion of this particular scenario when WPR and SHS were confused.

For AA, the WPR map class was assessed independently of all other map classes.



### **Spruce - Fir - Aspen Forest (FCP)**

The Spruce - Fir - Aspen Forest (FCP) map class represents the *Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475) in the NVCS. This map class captures conifer - hardwood forests primarily consisting of white spruce and balsam fir that co-dominate with quaking aspen and paper birch. The conifer component is often of short stature, below the taller canopy of hardwoods; however, the RD of conifers >5 m height to hardwoods of all tree-height strata is >25%. The exception is when both hardwoods and conifers are of a shrub-height stratum (e.g., early successional response from windthrows), in which case the forest amounts to a short-height stand of FCP.

Within the portage corridor, eastern white pine and northern white-cedar may be present, but the RD of each to other conifers is <25%. In the Mount Rose area, jack pine may be present, but its RD to other conifers is <25%. Although the FCP is most common to mesic sites of the Portage Corridor and the Fort Charlotte Unit, it is also commonplace to the dry-mesic slopes of Mount Rose.

Because the hardwood canopy is often above the conifers (such that the conifers are obscured from an aerial viewpoint), it was essential to refer to spring, leaf-off aerial photographs during the mapping of FCP. This practice was necessary to determine not merely the RD of conifers to hardwoods, but also the RDs among conifer species (e.g., the RD of northern white-cedar to balsam fir) to determine the correct forest type.

Normally the physiognomic coverage and height modifiers applied to the mapping of forests capture the total coverage of all trees and the average height of those trees throughout the unit mapped. An exception to this rule was, however, made to promote a better understanding of the canopy structure of FCP forests that have undergone intense disturbance, such as windthrow. Often, FCP at the GRPO has an open (e.g., 25–30% cover) supracanopy of tall (e.g., 25 m) quaking aspen over a dense (e.g., 70–80% cover) canopy of short (e.g., 10 m) white spruce, balsam fir, quaking aspen, and paper birch. Normally, all trees present (short and tall) are considered to determine this scenario as “Closed Canopy/Continuous (60-100% coverage),” with an average tree height of “5–15 meters (16–50 feet).” From this convention, one cannot determine any difference from forest stands of FCP, where canopy height and density are more uniform throughout the forest strata; however, adjusting the modifiers to reflect the sparse supracanopy of quaking aspen relays to the user that the supracanopy is “Open Canopy/Discontinuous (25–60% coverage),” with a height of “15–30 meters (50–98 feet).” From this description, one can assume to know the typical forest structure below the supracanopy; e.g., an early successional forest mix of spruce, fir, aspen, and birch.

When the RD of white pine to conifers was >25%, the conifer - hardwood mesic (FWA) phase of the White Pine / Mountain Maple Mesic Forest map class was considered. Likewise, when the RD of white-cedar to conifers was >25% (RD of white pine <25%), the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. Also, on Mount Rose of the Lakeshore Unit, when the RD of jack pine to conifers (white spruce and balsam fir) was >25%, the Jack Pine / Balsam Fir Forest (FJF) map class was considered. Throughout GRPO, however, when the RD of hardwoods to conifers was <25%, the Spruce - Fir / Mountain Maple Forest (FSF) map class was considered. Likewise, when the RD of conifers to

hardwoods was <25%, the Aspen - Birch / Boreal Conifer Forest (FAC) map class was likely considered.

Being one of the matrix forests of GRPO, mapping of the FCP map class was abundant throughout, from the shores of Lake Superior to the shores of the Pigeon River. It was mapped regularly at a variety of environments as described above, from the dry slopes on Mount Rose of the Lakeshore Unit to the wet-mesic flats of the Fort Charlotte Unit. A few noticeable areas were not mapped with FCP, including the low-elevation flats in the northern portion of the Lakeshore Unit (e.g., the Village Meadow), which has received intense anthropogenic use since the days of fur trading during the late 18<sup>th</sup> century. Another area was a 2-km stretch eastward from the Fort Charlotte Unit within the Portage Corridor, which is where white-cedar and white pine are more prominent. These areas were mapped more frequently with the White-cedar - Boreal Conifer Mesic Forest and the White Pine / Mountain Maple Mesic Forest map classes (with various map-class phases).

Some short-statured (shrub-height) FCP units, responsive to harsh environment and/or intense windthrow events, were mapped throughout GRPO. Two notable areas are the steep northwest slope on Mount Rose of the Lakeshore Unit and an area within the Portage Corridor, midway between Grand Portage Creek and Poplar Creek. These units of short-statured FCP were designated with the 0.5–5-m physiognomic height modifier to distinguish them from more typical forest structures of FCP.

For AA, the FCP map class was assessed independently of all other map classes.





### **Spruce - Fir / Mountain Maple Forest (FSF)**

The Spruce - Fir / Mountain Maple Forest (FSF) map class represents the *Picea glauca* - *Abies balsamea* / *Acer spicatum* / *Rubus pubescens* Forest Association (CEGL002446) in the NVCS. This map class captures conifer forests strongly dominated by white spruce and balsam fir. Within the portage corridor, eastern white pine and northern white-cedar may be present, but the RD of each to other conifers should be <25%. On Mount Rose of the Lakeshore Unit, jack pine might be present, but its RD to conifers should be <25%. Some hardwoods can be present, but their RD to conifers should be <25%. Hardwoods should consist of quaking aspen and paper birch in mesic to dry-mesic locations (typic) and balsam poplar and black ash in wet-mesic locations (unique). Although the FSF is most common to the mesic sites of the Portage Corridor and the Fort Charlotte Unit, it is also commonplace to the dry-mesic slopes on Mount Rose.

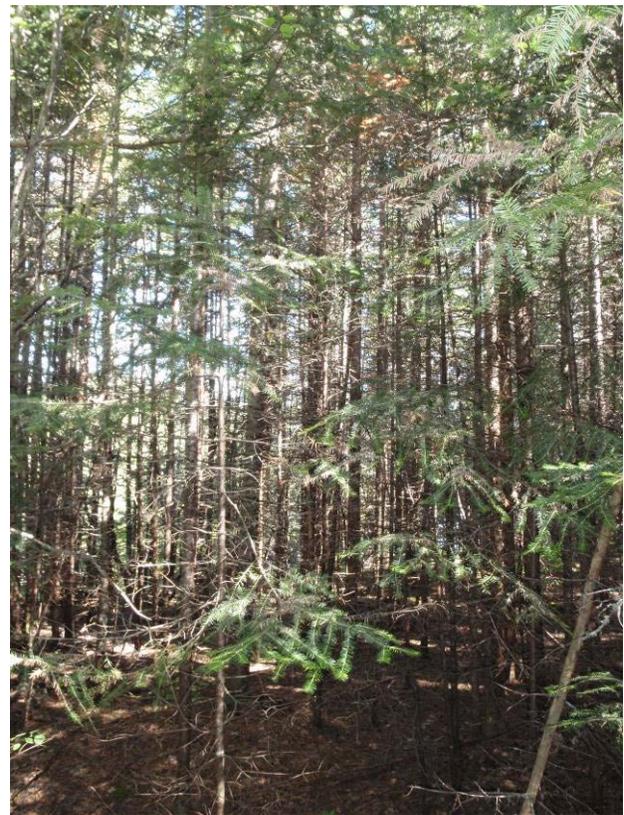
Classic mesic sites of FSF are located on uplands surrounding beaver meadow complexes where hardwoods have been removed. These forests have transitioned from a once shaded understory of white spruce and balsam fir shrub and tree layer to a semi-open forest of thriving mature trees. This classic representation of FSF is common to the margins along the Beaver Meadow and the large beaver meadow complex within Snow Creek at the Fort Charlotte Unit. Noteworthy are the dense (doghair) moderately short-height stands of FSF located in the southwest corner of the Fort Charlotte Unit along the Pigeon River. These stands are so dense in places that they become difficult to walk through. Some of these dense FSF stands have a component of jack pine. Although it is apparent that beaver have altered these forests, it also seems implicit that past anthropogenic activity may have spurred these forests into such dense tree cover.

Rarely is FSF recognized within a wetland margin of a beaver meadow complex. One is recognized, however, known to the Beaver Meadow (south of the boardwalk, east side). Here the forest is in transition, but it was once, perhaps, a classic representation of FSF. After years of saturation from the beaver pond, the site has changed from mesic toward wet, and it now supports balsam poplar, black ash, black spruce, speckled alder, and other wetland understory vegetation such as bluejoint. Again, this is a unique scenario, and perhaps the site at the Beaver Meadow is the only occurrence within a wetland margin at the GRPO.

When the RD of white pine to conifers was >25%, the conifer mesic (FWM) phase of the White Pine / Mountain Maple Mesic Forest map class was considered. Likewise, when the RD of white-cedar to conifers (RD of white pine <25%) was >25%, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. Also, on Mount Rose of the Lakeshore Unit, when the RD of jack pine to conifers (white spruce and balsam fir) was >25%, the Jack Pine / Balsam Fir Forest (FJF) map class was considered. Throughout GRPO, when the RD of hardwoods to conifers was >25%, the Spruce - Fir - Aspen Forest (FCP) map class was considered.

Being somewhat of a matrix forest to GRPO, mapping of the FSF map class was common, yet scattered throughout, from the shores of Lake Superior to the shores of the Pigeon River. It was mapped regularly to a variety of environments as described above, from the dry slopes on Mount Rose of the Lakeshore Unit to the wet-mesic flats of the Fort Charlotte Unit.

For AA, the FSF map class was assessed independently of all other map classes.





### **Aspen - Birch / Boreal Conifer Forest (FAC)**

The Aspen - Birch / Boreal Conifer Forest (FAC) map class represents the *Populus tremuloides* - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest Association (CEGL002466) in the NVCS. This map class captures hardwood mesic forests dominated by quaking aspen and paper birch. Shrub-height conifers consisting of white spruce, balsam fir, and northern white-cedar are abundant in the understory, along with mountain maple, northern bush honeysuckle, and beaked hazelnut; however, the RD of conifers that are >5 m in height to hardwoods should not exceed 25%. Within the Portage Corridor, eastern white pine may be scattered.

Because the hardwood canopy is often above the conifers (such that the conifers are obscured from an aerial viewpoint), it was essential to refer to spring, leaf-off aerial photographs during the mapping of FAC in order to determine the height conifer component for the correct forest classification. When the RD of conifers >5 m height to hardwoods of all tree-height strata was >25%, either the Spruce - Fir - Aspen Forest (FCP) map class or the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered, depending on dominance within the conifer component. However, when the upper canopy was of shrub-height (e.g., early successional response from windthrows), the FCP or FCM map classes were considered but modified for short-statured forests.

Normally, the physiognomic coverage modifier for forests does not go below 25% cover. In such instances, the stand no longer functions as forest, but rather as understory vegetation layers, whether shrubland or herbaceous. An exception to this rule was made, however, to capture stands of FAC having canopy <25%. This was particularly true of some forests far west within the Portage Corridor and extensively of forests in the southern half of the Fort Charlotte Unit. These forests have undergone extensive windthrow, yet from field observations, these stands with their understory layer, are functioning as forests. Much of the understory is of young shrub-height quaking aspen in regeneration. The application of the coverage and height physiognomic modifiers, in relation to younger trees below the supracanopy of quaking aspen, was applied similarly to how it was applied for the Spruce - Fir - Aspen Forest (FCP) map class (refer to the FCP map-class description for further explanation).

When the RD of conifers to hardwoods was >25%, and the RD of white pine to conifers was >25%, the conifer - hardwood mesic (FWA) phase of the White Pine / Mountain Maple Mesic Forest map class was considered. Likewise, when the RD of white-cedar to conifers (RD of white pine <25%) was >25%, the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. Furthermore, when the RD of white spruce and balsam fir to all conifers was >75%, the Spruce - Fir - Aspen Forest (FCP) map class was considered. On a different note, when sites of quaking aspen were in wet-mesic to wet locations, especially with balsam poplar present, the Aspen - Balsam Poplar Lowland Forest (FAP) map class was considered.

Being one of the matrix forests to GRPO, mapping of FAC was abundant throughout the Portage Corridor and the Fort Charlotte Unit; however, only a few units of FAC were mapped at the Lakeshore Unit.

For AA, the FAC map class was assessed independently of all other map classes.





### **Deciduous Ruderal Shrubland (SDX)**

The Deciduous Ruderal Shrubland (SDX) map class represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) of the NVCS. Because of disturbance from anthropogenic activity and the inherent variability of floristic vegetation of these shrublands, an association type was not determined. This map class captures ruderal upland shrublands of the Lakeshore Unit. Although shrub cover is open, it contributes >25% cover. Shrubs consist of deciduous species that may be either native or exotic to the GRPO area.

When trees contributed >25% cover, the Conifer - Hardwood Ruderal Forest (FMX) map class was considered. To the contrary, when trees and shrubs together contributed <25% cover, the Ruderal Grassland (HMX) map class was considered, which also represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS.

Mapping of the SDX map class was rare to GRPO—mapped as two units within the northeast portion of the Lakeshore Unit, one unit within the Village Meadow, and the other unit between the Lake Superior shore and some picnic grounds. The SDX was mapped in close proximity to FMX and HMX (both of which were mapped only at the Lakeshore Unit) and to Developed Area (NDV).

Because of the disturbance regime inherent to ruderal shrublands, the SDX map class was not assessed for accuracy.



### **Ruderal Grassland (HMX)**

The Ruderal Grassland (HMX) map class represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) of the NVCS. Because of disturbance from anthropogenic activity and the inherent variability of floristic vegetation of these shrublands, an association type was not determined. This map class captures a mosaic of mesic to wet-mesic, ruderal herbaceous meadows located within the Village Meadow of the Lakeshore Unit. Shrubs and trees each contribute <25% cover. Herbaceous vegetation consists of various graminoids and forbs that may be either native or exotic to GRPO. From an informal transect of the herbaceous meadow just east of Highway 17, the following description provides a snapshot of the vegetation (informal transect collected September 2007). It is noteworthy that the ruderal herbaceous meadow as a whole is more characteristic of mesic than of wet-mesic environments.

- Dryer meadow vegetation (mesic): timothy, smooth brome, Kentucky bluegrass, Canada thistle, bird's-foot trefoil, goldenrod, agrimony, Lindley's aster, raspberry, rose, and saplings of hawthorn.
- Wetter meadow vegetation (wet-mesic): giant mountain aster, purplestem aster, Lindley's aster, rush, bluejoint, whitetop, and saplings of redosier dogwood, willow, and black ash.

When shrubs contributed >25% cover, the Deciduous Ruderal Shrubland (SDX) map class was considered, which also represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS; however, when trees contributed >25% cover, the Conifer - Hardwood Ruderal Forest (FMX) map class was considered.

Mapping of HMX map class was rare to GRPO—mapped with two units within the Village Meadow of the Lakeshore Unit. The HMX was mapped in close proximity to FMX and SDX (both of which were mapped only at the Lakeshore Unit) and to Developed Area (NDV).

Because of the disturbance regime inherent to ruderal herbaceous fields, the HMX map class was not assessed for accuracy.



### **Boreal Hazelnut - Serviceberry Rocky Shrubland (SHS)**

The Boreal Hazelnut - Serviceberry Rocky Shrubland (SHS) map class represents the *Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland Association (CEGL005197) in the NVCS. This map class captures dry, open shrublands on thin soils, often with rocky outcrops and exposed bedrock. Shrubs contribute >25% cover, with tree canopy contributing <25% cover.

Shrub density and vegetation diversity tend to be lower on steeper sites than on more level sites. Level sites have a somewhat sparse layer of short-shrubs, mostly of serviceberry and northern bush honeysuckle, along with pin cherry, lowbush blueberry, kinnikinnick, and common juniper. The herbaceous layer is a broad cover of poverty oatgrass, with smooth brome and Canada bluegrass commonly included, along with a significant layer of reindeer lichen. Steeper sites, on the other hand, have a denser—yet still open—coverage of shrubs consisting of a diverse mixture of short shrubs, tall shrubs, and shrub-height trees, including serviceberry, beaked hazelnut, currant, pin cherry, snowberry, dogwood, hawthorn, mountain maple, northern mountain ash, quaking aspen, paper birch, and balsam fir. The herbaceous layer may be of low density, although of high diversity. Regardless of level or steep position, the ecotonal edges toward neighboring forests often have higher densities of short-statured quaking aspen and paper birch.

When the RD of tree cover (consisting of quaking aspen, paper birch, white spruce, and balsam fir) was >25%, either the Aspen - Birch / Boreal Conifer Forest (FAC) map class or the Spruce - Fir / Mountain Maple Forest (FSF) map class was considered.

Mapping of the SHS map class was rare to GRPO—mapped with three units on Mount Rose at the Lakeshore Unit. It is noteworthy that a unit mapped as WPR just south of where Highway 61 intersects with the Portage Corridor was determined as SHS during field AA. Nevertheless, upon post-review of the polygon unit in question, it became evident that this was a case where the aerial perspective and the ground perspective posed different interpretations. Refer to the Accuracy Assessment Results section of the main report for further discussion of this particular scenario SHS and WPR were confused.

For AA, the SHS map class was assessed independently of all other map classes.



### **Water Horsetail - Spikerush Marsh (HHS)**

The Water Horsetail - Spikerush Marsh (HHS) map class represents the *Equisetum fluviatile* - (*Eleocharis palustris*) Herbaceous Vegetation Association (CEGL005258) in the NVCS. This map class captures narrow wetland margins of the Pigeon River that are dominant with water horsetail and/or sessilefruit arrowhead. Spikerush, broadleaf arrowhead, single-vein sweetflag, sedges, and other wetland herbaceous forbs often complement these emergent wetlands. The RD of sedges and/or bluejoint to horsetail, arrowhead, and Spikerush is <50%. Otherwise, the Northern Sedge Wet Meadow (HSG) or the Bluejoint Wet Meadow (HCC) map classes were considered.

Mapping of the HHS map class was rare to GRPO—mapped with three units along the shores of the Pigeon River within the Fort Charlotte Unit.

For AA, the HHS map class was assessed independently of all other map classes.



### **Wet Meadow Mixed Herbaceous (HWM)**

The Wet Meadow Mixed Herbaceous (HWM) map class represents mixed herbaceous wetlands within the Eastern North American Wet Meadow Group (G112) in the NVCS. This map class captures wetland meadows with a diverse mix of emergent herbaceous vegetation—pioneering and persistent—receiving disturbance from dynamic hydrology changes caused by beaver activity. The disturbance is such that the community of vegetation is non-distinct to any one established herbaceous vegetation type, particularly Bluejoint Wet Meadow (HCC) and Northern Sedge Wet Meadow (HSG). Although bluejoint and sedges are common to HWM, the RD of each to the mix of herbaceous vegetation is <25%. Woolgrass can be a primary component of these disrupted beaver meadows, along with various amounts of asters, jewelweed, and other pioneering herbaceous vegetation.

It is noteworthy that herbaceous beaver meadows can be HWM, HCC, or HSG, depending on beaver activity and subsequent vegetation response. A beaver meadow that received a sudden change (e.g., dam breach) just prior to the aerial photography collection (August 2006) was in good position to receive the HWM map class during mapping.

Trees and shrubs are often present, each contributing <25% cover. When shrubs of predominantly speckled alder contributed >25% cover, the Gray Alder Swamp Shrubland (SAS) map class was considered. When tree canopy contributed >25% cover, with balsam poplar and quaking aspen most prominent, the Aspen - Balsam Poplar Lowland Forest (FAP) map class was considered.

Mapping of the HWM map class was rare to GRPO—mapped with one unit of a small beaver meadow located within the southern portion of the Fort Charlotte Unit.

For AA, the HWM map class was assessed independently of all other map classes.



### **Bluejoint Wet Meadow (HCC)**

The Bluejoint Wet Meadow (HCC) map class represents the *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174) in the NVCS. This map class captures herbaceous wetland meadows dominated by bluejoint and that are receptive to beaver activity. Sedges are often present, but their RD to all herbaceous vegetation is <25%. Barring sedges, the RD of bluejoint to all other emergent herbaceous vegetation is >25%. When the RD of sedges to bluejoint was >25%, the Northern Sedge Wet Meadow (HSG) map class was considered. Also, when the amount of bluejoint component relative to sedges could not be determined from aerial photographs, the HSG was typically the default map class. When herbaceous vegetation consisted of a diverse mix wherein the RD of bluejoint and sedges to herbaceous vegetation was each <25%, the Wet Meadow Mixed Herbaceous (HWM) map class was considered.

Mapping of the HCC map class was rare to GRPO—mapped with two units within the beaver meadow complex along Snow Creek in the Fort Charlotte Unit and with one unit along the boardwalk of the Beaver Meadow.

For AA, the HCC map class was assessed independently of all other map classes.



### **Northern Sedge Wet Meadow (HSG)**

The Northern Sedge Wet Meadow (HSG) map class represents the *Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation Association (CEGL002257) in the NVCS. This map class captures wetland meadows that are receptive to beaver activity and include emergent herbaceous coverage, wherein the RD of sedges to herbaceous vegetation (including bluejoint) is >25%. When RD of sedges to herbaceous vegetation was <25%, either the Bluejoint Wet Meadow (HCC) map class or the Wet Meadow Mixed Herbaceous (HWM) map class was considered, depending on density of herbaceous components. It is noteworthy that when the amount of bluejoint component relative to sedges could not be determined from the aerial photographs, HSG was typically the default map class.

Mapping of the HSG map class was somewhat rare to GRPO—mapped with three units within the beaver meadow complex along Snow Creek at the Fort Charlotte Unit and with two units within the Beaver Meadow.

For AA, the HSG map class was assessed independently of all other map classes.



### **Northern Water-lily Aquatic Wetland (HFA)**

The Northern Water-lily Aquatic Wetland (HFA) map class represents the *Nymphaea odorata* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation Association (CEGL002562) in the NVCS. This map class captures deep water marshes with floating-leaved aquatic vegetation (e.g., American white waterlily, watershield) contributing >10% cover and emergent herbaceous vegetation contributing <25% cover; submergent aquatic vegetation (e.g., pondweeds) may be of high density. When floating-leaved aquatics contributed <10% cover, yet with submergent aquatics contributing >10% cover, the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class was considered. If vegetation contributed <10% cover over open water, the Open Water Pond (NWP) map class was considered, which is a non-NVCS map class.

Only one location at the GRPO was classified with mappable HFA—the large beaver meadow complex within Snow Creek at the Fort Charlotte Unit. During spring of 2008, about one and a half years after the project’s aerial photography was collected (August 2006), a series of beaver dams had breached, resulting in a dramatic shift in vegetation. Much of the meadow reverted to annual herbaceous vegetation (e.g., smartweed) during the summer of 2008. By the summer of 2009, persistent emergent vegetation (e.g., fowl mannagrass) had taken root and some deep water pools had reestablished with submergent and floating-leaved aquatic vegetation, as the beaver began rebuilding the dams. Based on the appearances of floating aquatic vegetation in the August 2006 aerial photographs, and viewing firsthand the onset of floating aquatic vegetation being reestablished within the beaver ponds, the HFA map class was applied to portions of this beaver pond complex.

Mapping of the HFA map class was rare to GRPO—mapped with two units within the beaver meadow complex along Snow Creek at the Fort Charlotte Unit, as described above.

For AA, the HFA map class was not assessed. Since HFA was mapped only at the large beaver meadow complex that had breached prior to the AA field season, no AA sites were selected for a field visit because the vegetation had changed considerably.

No representative pictures were available.

### **Midwest Pondweed Submerged Aquatic Wetland (HSV)**

The Midwest Pondweed Submerged Aquatic Wetland (HSV) map class represents the *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282) in the NVCS. This map class captures deep water marshes wherein submergent aquatic vegetation (e.g., pondweeds) contributes >10% cover, with floating-leaved aquatic vegetation (e.g., American white waterlily, watershield) and persistent emergent vegetation (e.g., sedges, bluejoint) contributing <25% cover. When open water bodies in beaver ponds were determined too deep for submergent and floating-leaved aquatic vegetation to grow, the Open Water Pond (NWP) map class was considered, which is a non-NVCS map class.

Only one location at the GRPO was classified with mappable HSV—the large beaver meadow complex within Snow Creek of the Fort Charlotte Unit. During the spring of 2008, about one and a half years after the aerial photography was collected (August 2006), a series of beaver dams within this beaver complex had breached, resulting in a dramatic shift in vegetation. Much of the meadow reverted to annual herbaceous vegetation (e.g., smartweed) during the summer of 2008, and during the summer of 2009, persistent emergent vegetation (e.g., fowl mannagrass) had taken root and some deep water pools had reestablished with submergent and floating-leaved aquatic vegetation, as the beaver began rebuilding the dams. Based on the appearances of submergent aquatic vegetation in the August 2006 aerial photographs, and viewing firsthand the onset of submergent aquatic vegetation being reestablished within the beaver ponds, the HSV map class was applied to portions of this beaver pond complex.

Mapping of the HSV map class was rare to GRPO—mapped with two units within the beaver meadow complex along Snow Creek at the Fort Charlotte Unit, as described above.

For AA, the HSV map class was not assessed. Since HSV was mapped only of the large beaver meadow complex that had breached prior to the AA field season, no AA sites were selected for field visit because the vegetation had changed considerably.

No representative pictures were available.

**Great Lakes Basalt - Diabase Cobble - Gravel Shore (VCB)**

The Great Lakes Basalt - Diabase Cobble - Gravel Shore (VCB) map class represents the Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation Association (CEGL005250) in the NVCS. This map class captures narrow cobble or gravel beaches along the Lake Superior shoreline that are sparsely vegetated with a variety of vegetation, from shrubs to herbaceous species, including redosier dogwood, pin cherry, willow, speckled alder, Canada goldenrod, American red raspberry, common yarrow, oxeye daisy, common evening-primrose, birdfoot, deervetch, aster, willowherb, Norwegian cinquefoil, and white sweetclover. The shrubs occur on the less dynamic areas of the upper beach ridge. The more dynamic areas closest to the water edge is mostly void of vegetation because of wave action.

Mapping of the VCB map class was rare to GRPO—mapped with one unit along the Lake Superior shoreline of the Lakeshore Unit.

For AA, the VCB map class was assessed independently of all other map classes.



### **Northern Non-Carbonate Dry Talus Vegetation (VDT)**

The Northern Non-Carbonate Dry Talus Vegetation (VDT) map class represents the Basalt - Diabase Northern Open Talus Sparse Vegetation Association (CEGL005247) of the NVCS. This map class captures the sparsely vegetated, steep, east-facing talus slope on Mount Rose at the Lakeshore Unit. The sites are dry, rapidly drained, and unstable (subject to talus rock slippage). Talus rocks are in high density, covering almost the entire ground. Lichens are dominant on the talus rocks, with only a slight presence of polypody, essentially the only herbaceous plant known to exist on these talus slopes. An occasional paper birch may take root amongst the talus rock, yet individuals tend to remain short in stature.

Mapping of the VDT map class was rare to GRPO—mapped with one small (0.1 ha) unit on the east-facing slope of Mount Rose at the Lakeshore Unit; however, more sites of VDT might exist along the eastern slope of Mount Rose. If so, these sites would be mapped as inclusions to the surrounding forest encompassing them, because they would be much too small for mapping (well below the size of a MMU). Much of the eastern slope of Mount Rose was mapped with the Spruce - Fir - Aspen Forest (FCP) map class.

For AA, the VDT map class was assessed independently of all other map classes.



### **Northern Non-Carbonate Moist Talus Vegetation (VMT)**

The Northern Non-Carbonate Moist Talus Vegetation (VMT) map class represents the Granite - Metamorphic Talus Northern Sparse Vegetation Association (CEGL002409) of the NVCS. This map class captures the sparsely vegetated, boulder talus sites on the steep, northwest-facing slopes of Mount Rose at the Lakeshore Unit. Talus rock boulders are rather large and irregularly shaped, and they cover most of the ground layer. A semi-sparse layer of shrubs and trees (consisting of paper birch, northern mountain ash, balsam fir, redosier dogwood, American cranberrybush, and currant) take root amongst the boulder field. The herbaceous component is mostly rock polypody, with non-vascular vegetation (including lichens and some feathermoss) fairly widespread.

The inception of the VMT map class into the GRPO vegetation mapping project was unique. The vegetation type that is represented by VMT was discovered in route to an AA field site. The field crew stopped to collect a vegetation sample to document this type at GRPO. After AA, the VMT from the northwest slope of Mount Rose was added to the vegetation map layer. Because of the unique location where VMT can exist, the northwest talus slope on Mount Rose is believed to be the only occurrence of VMT at the GRPO.

Mapping of the VMT map class was rare to GRPO—mapped with one unit on the northwest-facing slope of Mount Rose at the Lakeshore Unit.

For AA, the VMT map class was not assessed, because the map class was derived after AA.



### **Developed Area (NDV)**

The Developed Area (NDV) map class falls under the Developed Vegetation Cultural Class (8) in the NVCS and is defined in the NVCS down to Level 3—Other Developed Urban / Built Up Vegetation Formation. From there, finer break outs are defined with the use of modifiers to depict the amount of impervious surface of developed areas. These modifiers represent classes 21–24 of the National Land Cover Database (NLCD) 2001. The NDV map class captures areas having regular human use. Examples at the GRPO include roads and their right-of-ways, parking lots, GRPO buildings and grounds (such as headquarters and the stockade complex), and open lawns of multi-purpose use, including picnic areas.

Mapping of the NDV map class was uncommon throughout GRPO. Of those mapped, most units were at the Lakeshore Unit. The only units of NDV mapped outside the Lakeshore Unit were at roads crossing the Portage Corridor, including Highway 61, Old Highway 61, and Cowboys Road.

Because NDV is a cultural vegetation map class, it was not assessed for accuracy.

The following sections describe NLCD classes 21–24, which were used to further attribute (using a special modifier) the NDV map class. The Low Intensity (22) and High Intensity (24) classes were not used for the mapping of GRPO, yet remains included here for completeness and comparison purposes. Definitions are taken from the NLCD.

### ***Open Space–21 (O)***

This class includes areas with a mixture of some constructed materials but mostly includes vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot, single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.





***Low Intensity–22 (L)***

This class includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49% of total cover. These areas most commonly include single-family housing units.

No representative pictures were available.

***Medium Intensity–23 (M)***

This class includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50–79% of total cover. These areas most commonly include single-family housing units.



***High Intensity–24 (H)***

This class includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial facilities. Impervious surfaces account for 80–100% of the total cover.

No representative pictures were available.

### **Stream & River (NSR)**

The Stream & River (NSR) map class represents, in part, the NLCD 2001 Open Water (11) class. This map class captures open water portions within the Pigeon River at the Fort Charlotte Unit, where vegetation contributes <10% cover. Herbaceous vegetation consisting of water horsetail and/or sessilefruit arrowhead is common along the shore margins; however, when these margins were vegetated with >10% cover and were of mappable width and size, the Water Horsetail - Spikerush Marsh (HHS) map class was considered.

Mapping of the NSR map class was rare to GRPO—mapped with one unit for the open water portions within Pigeon River at the Fort Charlotte Unit.

Because NSR is a non-vegetation map class, it was not assessed for accuracy.



### **Open Water Pond (NWP)**

The Open Water Pond (NWP) map class represents in part the NLCD 2001 Open Water (11) class. This map class captures open water bodies that are <8 ha in area. These ponds are usually deep enough that vegetation is unable to take root. Wetland vegetation—emergent and/or aquatic—may be present but should contribute <10% cover and is usually in shallower waters close to shorelines. When aquatic vegetation contributed >10% cover, either the Northern Water-lily Aquatic Wetland (HFA) map class or the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class was considered, depending on vegetation composition. It is noteworthy that in areas >8 ha, the Open Water Lake (NWL) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. In essence, the NWL map class captures the Lake Superior waters along the shores of the Lakeshore Unit.

Only one location at the GRPO was classified with mappable NWP—the large beaver meadow complex within Snow Creek at the Fort Charlotte Unit. During the spring of 2008, about one and a half years after the aerial photography was collected (August 2006) for the project, a series of beaver dams within this beaver complex had breached, resulting in a dramatic shift in vegetation. With careful study of the August 2006 aerial photographs, it was determined, however, that the deepest portion of this beaver pond complex was void of vegetation; thus, the NWP map class was applied.

Mapping of the NWP map class was rare to GRPO—mapped with one unit within the beaver meadow complex along Snow Creek at the Fort Charlotte Unit.

Because NWP is a non-vegetation map class, it was not assessed for accuracy.

No representative pictures were available.

### **Open Water Lake (NWL)**

The Open Water Lake (NWL) map class represents, in part, the NLCD 2001 Open Water (11) class. This map class captures open water bodies that are >8 ha in area and have <10% vegetation present. In essence, NWL covers the Lake Superior waters of the Lakeshore Unit. It is noteworthy that when open water bodies were <8 ha, the Open Water Pond (NWP) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. In essence, the NWP map class captures the deep, open water portions within beaver pond complexes, as found within the large beaver meadow complex along Snow Creek at the Fort Charlotte Unit.

Mapping of the NWL map class was rare to GRPO—mapped with one unit for the Lake Superior waters within the Lakeshore Unit. Although the map unit itself is <8 ha because of the project boundary limits, the context of Lake Superior constituted mapping this unit as NWL.

Because NWL is a non-vegetation map class, it was not assessed for accuracy.



National Park Service Vegetation Inventory Program  
Grand Portage National Monument

**Table E-2.** Map classification listing, sorted alphabetically by map-class code, used for the Grand Portage National Monument vegetation mapping project.

<b>Map-class Code</b>	<b>Map-class Name</b>
FAC	Aspen - Birch / Boreal Conifer Forest
FAP	Aspen - Balsam Poplar Lowland Forest
FBA	Black Ash - Mixed Hardwood Swamp (black ash phase)
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
FCP	Spruce - Fir - Aspen Forest
FGA	Black Ash - Mixed Hardwood Swamp (green ash - elm phase)
FJF	Jack Pine / Balsam Fir Forest
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest
FMX	Conifer - Hardwood Ruderal Forest
FPE	Conifer Plantation
FSF	Spruce - Fir / Mountain Maple Forest
FWA	White Pine / Mountain Maple Mesic Forest (conifer - hardwood mesic phase)
FWD	White Pine / Mountain Maple Mesic Forest (dry-mesic phase)
FWM	White Pine / Mountain Maple Mesic Forest (conifer mesic phase)
HCC	Bluejoint Wet Meadow
HFA	Northern Water-lily Aquatic Wetland
HHS	Water Horsetail - Spikerush Marsh
HMX	Ruderal Grassland
HSG	Northern Sedge Wet Meadow
HSV	Midwest Pondweed Submerged Aquatic Wetland
HWM	Wet Meadow Mixed Herbaceous
NDV	Developed Area
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond
SAH	Gray Alder Swamp Shrubland (hawthorn mix phase)
SAS	Gray Alder Swamp Shrubland (classic alder phase)
SAW	Gray Alder Swamp Shrubland (willow mix phase)
SDX	Deciduous Ruderal Shrubland
SHS	Boreal Hazelnut - Serviceberry Rocky Shrubland
VCB	Great Lakes Basalt - Diabase Cobble - Gravel Shore
VDT	Northern Non-Carbonate Dry Talus Vegetation
VMT	Northern Non-Carbonate Moist Talus Vegetation
WPR	Boreal Pine Rocky Woodland



## **Appendix F: Accuracy Assessment Form**



National Park Service Vegetation Inventory Program  
 Grand Portage National Monument

**NATIONAL PARK SERVICE VEGETATION INVENTORY PROJECT: ACCURACY ASSESSMENT FORM  
 CLASSIFICATION, LOCATION, AND ENVIRONMENT**

AA Observation Code: GRPO.AA Survey Date: \_\_\_/\_\_\_/2009 Survey Time: \_\_\_\_\_ No Access: \_\_\_\_\_

State: Minnesota NPS Park Name: Grand Portage National Monument Park Location: \_\_\_\_\_

Surveyors:  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_

1<sup>st</sup> Veg Type Name: \_\_\_\_\_ New?  Veg Type Code: \_\_\_\_\_

2<sup>nd</sup> Veg Type Name: \_\_\_\_\_ New?  Veg Type Code: \_\_\_\_\_

Other Veg Type Name within 25 m: \_\_\_\_\_ New?  Veg Type Code: \_\_\_\_\_

---

Field Coordinate (UTM Zone 16, NAD83): X \_\_\_\_\_ m Easting Y \_\_\_\_\_ m Northing

GPS Unit:  Trimble Recon / Pathfinder XC (PDOP: \_\_\_\_\_ HDOP: \_\_\_\_\_)  Garmin \_\_\_\_\_ (DOP: \_\_\_\_\_ EPE: \_\_\_\_\_)

Elevation: \_\_\_\_\_ Slope: \_\_\_\_\_ Aspect: \_\_\_\_\_ Topographic Position: \_\_\_\_\_

Pictures (N – E – S – W – Best): \_\_\_\_\_

---

Representativeness of site within polygon:  Good  Fair  Poor  Unknown

---

Comments (other types nearby, complications at site, uncertainty with type, etc.):

**VEGETATION DESCRIPTION**

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class
<u>Trees and Shrubs</u> ___ Evergreen ___ Cold-deciduous ___ Mixed evergreen - cold-deciduous	___ Broad-leaf ___ Needle-leaf ___ Mixed broad-leaf/Needle leaf ___ Micro-phyllous ___ Graminoid ___ Forb ___ Pteridophyte	___ Forest ___ Woodland ___ Shrubland ___ Dwarf Shrubland ___ Herbaceous ___ Nonvascular ___ Sparsely Vegetated
<u>Herbs</u> ___ Annual      ___ Perennial		

National Park Service Vegetation Inventory Program  
 Grand Portage National Monument

**NATIONAL PARK SERVICE VEGETATION INVENTORY PROJECT: ACCURACY ASSESSMENT FORM**  
**VEGETATION DESCRIPTION (Continued)**

Strata	Height Class	Cover Class	Dominant species (mark <i>Diagnostic</i> 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	_____	_____	_____	_____

**Comments:**

**\*\*\* All Cover Estimates Are Absolute!\*\*\***

Height Scale		Cover Scale	
		T	0-1%
01	<0.5 m	P	>1-5%
02	0.5-1m	1	>5-15%
03	1-2 m	2	>15-25%
04	2-5 m	3	>25-35%
05	5-10 m	4	>35-45%
06	10-15 m	5	>45-55%
07	15-20 m	6	>55-65%
08	20-35 m	7	>65-75%
09	35-50 m	8	>75-85%
10	>50 m	9	>85-95%
		10	> 95%

## **Appendix G: Accuracy Assessment Contingency Table**



### **Explanation of the Contingency Matrix**

The accuracy assessment contingency matrix for the Grand Portage National Monument vegetation map layer is an array of numbers set out in rows and columns to compare results of vegetation types represented on the map layer to vegetation types as verified on the ground. Map-class codes are used to identify vegetation types for ease of comparison during the analysis. (A crosswalk between map classes and vegetation types is provided in the main report and in Appendix E: Descriptions of Map Classes. The crosswalk reveals the various vegetation types assigned to the map-class codes that are used to label vegetation types in this contingency table.)

The columns represent vegetation types in the National Vegetation Classification Standard (NVCS). These columns tabulate the producer's accuracy by showing errors of exclusion (omission errors) present in the map. The rows represent the map classes listed by their respective map-class codes. (Again, refer to the crosswalk for map-class names and links to vegetation types.) These rows tabulate the users' accuracy by showing errors of inclusion (commission errors) present in the map.

		FIELD SAMPLES - REFERENCE DATA																	COMISSION				
MAP CODES	FWM, FWA, FWD	FCC, FCM	FBA, FGA	FAP	SAS, SAH, SAW	FJF	FJM	FSF	FAC	FCP	WPR	SHS	HWM	HSG	HCC	HHS	VDT	VCB	TOTAL	USERS' ACCURACY	90% Confidence Intervals		
																					-	+	
MAP DATA - PREDICTION DATA	FWM, FWA, FWD	11					1			1									13	85%	64%	105%	
	FCC, FCM		13							1									14	93%	78%	108%	
	FBA, FGA			6															6	100%	92%	108%	
	FAP			1	9	1													11	82%	58%	105%	
	SAS, SAH, SAW					10													10	100%	95%	105%	
	FJF						5												5	100%	90%	110%	
	FJM							0											0	x	x	x	
	FSF								11										11	100%	95%	105%	
	FAC	1			1					25	3								30	83%	70%	96%	
	FCP				1						28								29	97%	89%	104%	
	WPR											2	1						3	67%	5%	128%	
	SHS												3						3	100%	83%	117%	
	HWM													1					1	100%	50%	150%	
	HSG														5				5	100%	90%	110%	
	HCC															2			2	100%	75%	125%	
	HHS																2		2	100%	75%	125%	
	VDT																	1	1	100%	50%	150%	
VCB																		1	100%	50%	150%		
OMISSION	Total	12	13	7	11	11	5	1	11	25	33	2	4	1	5	2	2	1	1	147			
	PRODUCERS' ACCURACY	92%	100%	86%	82%	91%	100%	0%	100%	100%	85%	100%	75%	100%	100%	100%	100%	100%	100%	135			
	90% Confidence Interval -	74%	96%	57%	58%	72%	90%	-50%	95%	98%	73%	75%	27%	50%	90%	75%	75%	50%	50%	Total Samples = 147			
	90% Confidence Interval +	109%	104%	115%	105%	110%	110%	50%	105%	102%	97%	125%	123%	150%	110%	125%	125%	150%	150%	Total Correct = 135			
OVERALL ACCURACY = 91.8%      KAPPA INDEX = 90.7%      KAPPA INDEX LOWER 90% CONFIDENCE LEVEL = 86.4%      KAPPA INDEX UPPER 90% CONFIDENCE LEVEL = 95.0%																							
HSV, HFA, VMT were not assessed for accuracy and thus, are not shown in this matrix.																							

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 398/102527, May 2010

**National Park Service**  
**U.S. Department of the Interior**



---

**Natural Resource Program Center**  
1201 Oakridge Drive, Suite 150  
Fort Collins, CO 80525

[www.nature.nps.gov](http://www.nature.nps.gov)

**EXPERIENCE YOUR AMERICA™**